



# PumpLines

*Innovation...Technology...Leadership*

Welcome to the premier issue of *PumpLines*, our quarterly newsletter devoted to communicating technological developments by ITT Industrial Pump Group companies. Our brands; Goulds Pumps, A-C Pump, Richter, and Vogel enjoy outstanding reputations in the markets they serve. Through innovative engineering and problem solving application services, we strive to continuously improve our products and processes.



As the world's largest pump company, we have assumed a leadership role in the development of new technologies to increase your operating efficiencies while decreasing your costs. As our partners in fluid handling progress, I encourage you to give us your feedback and suggestions. Our *PumpLines* tagline says it all: *Innovation...Technology...Leadership*. Enjoy *PumpLines*.

**Robert Ayers**  
President & CEO, ITT Industrial Pump Group

## Tech Talk

**Barry Erickson**  
Vice President of Technology  
ITT Industrial Pump Group

One of the core competencies of the Industrial Pump Group is hydraulic design. A long standing tradition of leadership in designs that optimize efficiency, NPSH or operating range, stretches back to the 1930s. Goulds was one of the first companies to develop a program to estimate hydraulic performance by considering the energy input by the impeller, and the hydraulic losses within the impeller and casing. "Loss Analysis" programs have been continually developed and today ITT possesses leading edge technology in performance prediction.

More recent developments include an NPSH model that provides the ability to estimate the NPSH required between 50% and 130% of best efficiency flow. Both of these tools are used routinely in new product design to optimize operating characteristics. The most recent products to benefit from them are the process pump.

ITT Industries' Hydraulic Engineers participate in technical organizations sharing their knowledge with the industry. In 1998 the Hydraulic Institute released a standard on NPSH Margin which introduced a new concept, Suction Energy. This concept can be used to reliably predict where pumps may be subject to cavitation damage from Suction Recirculation and was developed in ITT Industries hydraulic laboratories. The Hydraulic Institute Committee was led by an ITT Industries Engineer.

Today most of the design tools are automated and tied directly to Pro Engineer CAD systems. This automation allows iterations to be run quickly resulting in optimized designs, with a high level of

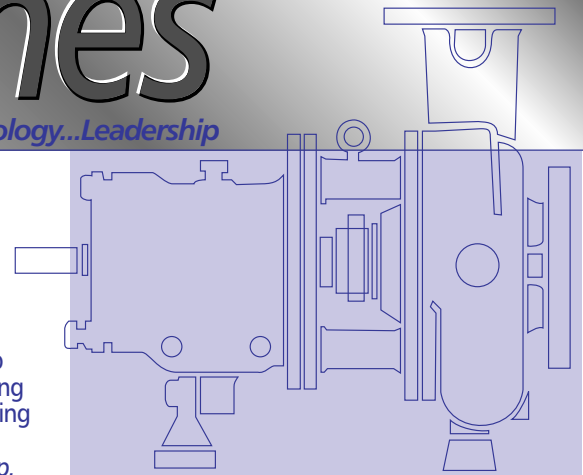


*Hydraulic Design Conference Attendees.*

confidence in field performance. Computational Fluid Dynamics is beginning to be used to more accurately model losses in casings and other hydraulic elements.

In May a Hydraulic Design Conference was held in Seneca Falls and was attended by 30 hydraulic designers from across ITT Industries' fluid businesses. The attendees discussed various design methods and shared best practices. An important outcome of the Conference was the formation of a Hydraulic Design Center of Excellence. This center is located in Stockholm, Sweden, and is overseen by a three person advisory group representing major business units. This Center is focused on advancing the state of the art in hydraulic design. Objectives are to improve the ability to design products that operate reliably over a wide range of flows and suction pressures.

We will be talking extensively about these and many other technical topics in future issues of *PumpLines*. I look forward to the exchange of ideas with you, our customers. ■



**JULY 1999**

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**Goulds Pumps**



**ITT Industries**  
*Engineered for life*

## New Technology

### Sealless Pump Family Expands

**Rich Nardone**  
Assistant Product Manager  
Goulds Pumps/ITT Industries

Teamwork by engineers from ITT Richter in Germany and Goulds Pumps in the U.S. has created two new magnetic drive process pumps—the Series MDK—for the ISO chemical process market in Europe, Asia and Africa and the Model 3298 for ANSI applications in North America and other world markets.

Both pumps are TEFLON®-lined and built to withstand highly corrosive liquids. The MDK is designed according to environmental specifications of ISO, the International Standards Organization. Chemical-process plants in Europe and Asia demand ISO-compliant products.

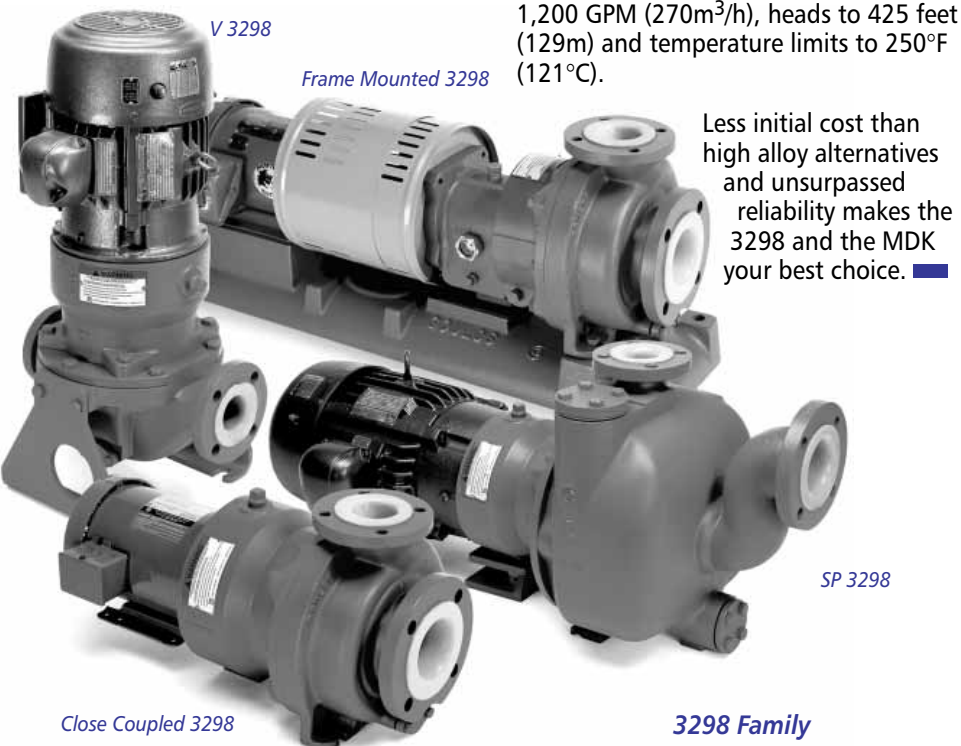
“Richter already produces a heavy-duty chemical-process pump, but many customers don't need that much capability,” says Manfred Kluge, manager of Marketing at Richter. “We knew that the Goulds 3298 pump development fit the needs of these customers, but it is made according to ANSI (American National Standards Institute) standards.”

So began a technology transfer from Goulds to its sister company that resulted in the MDK hitting the market this past January, “just one year after initiation—very fast,” says Kluge. “The MDK has no mechanical seals, which can be damaged by corrosive liquids, and its stationary-shaft design makes it simple to maintain,” says Richard Nardone, Goulds Assistant Product Manager for the 3298. “Its principal use is in the chemical-process industry, but it can be used in mining, pulp and paper, or wherever corrosive liquids are pumped,” says Nardone.

The Model 3298 is available in frame mounted, close-coupled, and the recently introduced vertical in-line and self priming configurations. It represents the most extensive lined pump product offering available.

Liquid-end parts are lined with a thick layer of TEFZEL® (ETFE) for universal corrosion resistance and an impenetrable barrier against leakage. Being sealless and magnetically driven, the 3298 has no expensive conventional mechanical seals to fail.

Operational safety is a prime consideration in the selection of process pumps today. The Model 3298 meets the strictest EPA regulations under the Clean Air Act. Zero emissions for a safe system and work environment.



Lower operating costs are a by-product of the 3298 design. Efficiencies are equal to conventionally sealed ANSI pumps and as high as 30% better than competitive metallic, sealless pumps.

The 3298 family offers capacities to 1,200 GPM (270m<sup>3</sup>/h), heads to 425 feet (129m) and temperature limits to 250°F (121°C).

Less initial cost than high alloy alternatives and unsurpassed reliability makes the 3298 and the MDK your best choice. ■

### Two New Pump Series Now Available From Vogel

**Johann Riefenthaler**  
Division Manager Industrial Pumps  
Vogel Pumpen/ITT Industries

Two new products were developed by Vogel Pumpen and will be marketed worldwide by Vogel and Goulds distribution. The two pumps introduced are a 40 bar and 55 bar pump. The 40 bar, Model CPR, is a process pump with capacities up to 8800 GPM (1800m<sup>3</sup>/h), heads to 850 feet (260 m), and speeds from 2950 to 3550 RPM. It is a horizontal, centerline, single stage pump with back pullout for easy maintenance. It is designed to handle process applications such as refineries and petrochemical plants, plus gas production, slop gas oil and hot water. Request bulletin number Liste 3504-1e.

The 55 bar pump, designated Type MP, is a multistage pump with a modular design to maximize component interchangeability. It has capacities up to 1500 GPM (340m<sup>3</sup>/h), heads to 1640 feet (500 m), and a maximum speed of 3600 RPM (3600 min<sup>-1</sup>). Its heavy duty design means long operating life in industrial applications such as: water supply, irrigation, fire fighting, snow making, boiler feed, condensate and more. It can handle pure liquid as well as slightly contaminated media. Request bulletin number Liste 5222-1e. ■



## New Technology

### Hydrovar™ Engineered System Solutions

**Stan Knecht**  
Product Manager  
Goulds Pumps/ITT Industries

As an extension to the already successful Hydrovar\Aquavar product family, ITT-Vogel Pumpen now announces the availability of the **Industrial Hydrovar**.

Beginning this month, ITT-Vogel Pumpen's **patented** variable speed pump control technology is now available in a panel mounted configuration suitable for industrial applications for motor ratings from 30kW – 45kW (40 HP- 60HP).

Hydrovar is a variable speed drive whose software has been pre-programmed for the sole purpose of centrifugal pump operation. It is this **dedicated software** which differentiates the Hydrovar from other Variable Frequency Drives (VFD) available in the market today as this single purpose programming results in **simplified installation and set-up** while at the same time provides **greater pump control capabilities resulting in improved pumping system reliability**.

#### Panel Mounted Industrial Hydrovar 30 – 45kW

The Industrial Hydrovar utilize the same logic and programming which has been proven over the past five years in thousands of applications with the smaller capacity, motor mounted Hydrovar units. The difference between the Industrial Hydrovar and the standard motor mounted Hydrovar available to date is:

#### Standard Hydrovar w\Opt. Wall Mounting 1.1 kW – 11kW

- 1. Higher Power Capabilities:**  
Industrial Hydrovars are suitable for motors ranging from 30kW to 45kW.
- 2. Standard Panel Mounting:**  
For industrial applications, mounting of the motor drive in a starter panel, versus on the motor frame, is preferred to allow this technology to be applied on explosive, hazardous and remote pump services. By mounting the Industrial Hydrovar in an area of the plant outside of the hazardous areas, it's program settings can be easily monitored\adjusted protecting both maintenance and operations personnel.

**Note: The Standard Hydrovar can also be supplied with a wall mounting kit as an option.**

#### Wall Mounted Industrial Hydrovar Arrangement for Explosion Proof Areas

**Here's how Hydrovar can help reduce costs:**

##### Reduced Energy Consumption

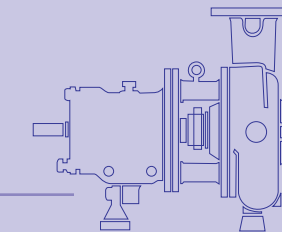
Most industrial pumping systems utilize either a manual or automatic (control) throttle valve located on the discharge side of the pump. The function of this valve is to throttle the output from fixed speed pumps to match variable system/process demands. The industrial Hydrovar eliminates the need for pump throttling by regulating pump speed and output to match demand thereby eliminating wasted energy traditionally lost across the control valve. Typically a **30 – 50% energy reduction** can be realized which, in many cases, the energy savings will pay for the cost of the Hydrovar unit in less than one year!

##### Reduced Installation Expense

As indicated above, typically a **discharge control valve can be eliminated**, reducing both cost and design expenses. Many industrial pumping systems also utilize bypass line to maintain minimum flow to protect the pump during period of low demand. Again the Industrial Hydrovar can automatically regulate pump performance to match system demand while protecting the pump making bypass lines unnecessary. This will result in **pipng savings** and sometimes **elimination of a costly Automatic Re-Circulation ARC valve**.

##### Increased Pump Reliability – Decreased Maintenance Cost

Because the Hydrovar software is designed solely for pump operation it can be setup to protect the pump from operating under unfavorable conditions. Hydrovar can be provided with Min and Max set points, which are used to maintain pump performance within the recommended operating range of the pump. If conditions prevail where demand requires pump operation outside these limits, Hydrovar will automatically shut down the pump and send an alarm. This capability **prevents the pump from “dead heading” or being run off the curve**; both conditions know to reduce seal and bearing life and sometime result in catastrophic failure.



Similarly if changes in suction conditions (e.g., draining of a vessel, etc) were to result in cavitation or dry running, again Hydrovar will shut down and alarm thereby protecting both the pump and its shaft seal from failure.

Unlike other VFD's on the market today the ability to shutdown the pump and **prevent dead-heading, dry running, cavitation or running the pumps “off the curve”** is unique only to *Hydrovar* and results in increased pump reliability and decreased maintenance cost for our customers.

##### Greater Pump Standardization – Inventory Reductions

One key benefit of variable speed technology is that the range of hydraulic coverage of a given pump size is significantly increased as compared to the same pump's fixed speed, single line performance. This broadened coverage will allow customers to **reduce the number of different pump sizes** that they need to meet all their pumping needs. In doing this, similar **reductions of spare parts inventories** will be attainable as a spare part for one size pumps will now be useable on a number of different pumping services. The result is **smaller MRO inventories and simplified repair parts ordering/inventory management** for the customer.

Another customer benefit of the broadened hydraulic coverage attainable with variable speed technology is the **elimination of the need to trim impellers**. In most cases for a given pump size customers will be able to purchase and stock factory balanced, max diameter impellers without having to trim and re-balance them when required for a given service. The result again is simplified inventory management and reduced maintenance cost.

##### Where can Hydrovar be installed?

Essentially anywhere there is an automatic control valve in the system may represent an opportunity to use Hydrovar. Also Batch Processes or processes with variable/seasonal demand will also represent areas where Hydrovar may be the ideal solution to your needs.

If you think your plant can benefit from Hydrovar technology, give your Goulds representative a call. ■

## New Technology

### New Magnetic Drive Pump Expands the Range of Corrosion-resistant Centrifugal Pumps

**Manfred Kluge**  
Marketing Manager  
ITT Richter Chemie-Technik GmbH

Magnetic drive chemical centrifugal pumps have long been accepted in the process industry. Not only that – the proportion of magnetic drive pumps in chemical installations overall is steadily growing. Higher safety standards and the need to cut operational costs play a role in this development just as much as the high operational reliability of these pumps.

This applies in particular to plastic-lined magnetic drive centrifugal pumps. Their major field of application is the conveyance of highly corrosive media and chemicals in the fine chemical and pharmaceutical industries.

One indication of the great acceptance of this design is that major chemical and pharmaceutical companies specify lined magnetic drive pumps as a standard.

The plastic-lined magnetic drive pump enjoyed a real boom when the MNK series from Richter Chemie-Technik, was launched in 1988. In the just over ten years, plastic-lined magnetic drive pumps have made inroads into fields of application which neither the pump manufacturer nor the pump operators had expected.

Magnetic pumps up until now had their limitations.

- Solids were taboo.
- There was a great fear of damage from dry-running.
- The eddy currents generated in metallic cans meant that heat was transferred to the medium, i.e. a risk of overheating at low flow rates.

ITT Richter has overcome many of these.

- Substantial numbers of the MNK series have been operating with solids contents of 10, 20 and more percent by volume.

■ Richter SAFEGLIDE® PLUS has since become synonymous with extremely effective dry-running protection of SiC plain bearings (1/2 hour and more!).

■ The non-metallic MNK cans made of CFRP/PTFE prevent eddy currents and thus permit the conveyance of very small volumes as well as media near their boiling points.

■ Operating temperatures of up to 180°C, in isolated cases even higher, do not present any problems.

■ Flow rates of up to 300 m<sup>3</sup>/h and delivery heads of up to 90 m.

■ Thanks to a host of accessories as well as safety and monitoring equipment, even extremely critical media and very difficult applications can be readily handled.

On the basis of the successful MNK pump, the product development of lined magnetic drive pumps was also continued for special pumping applications.

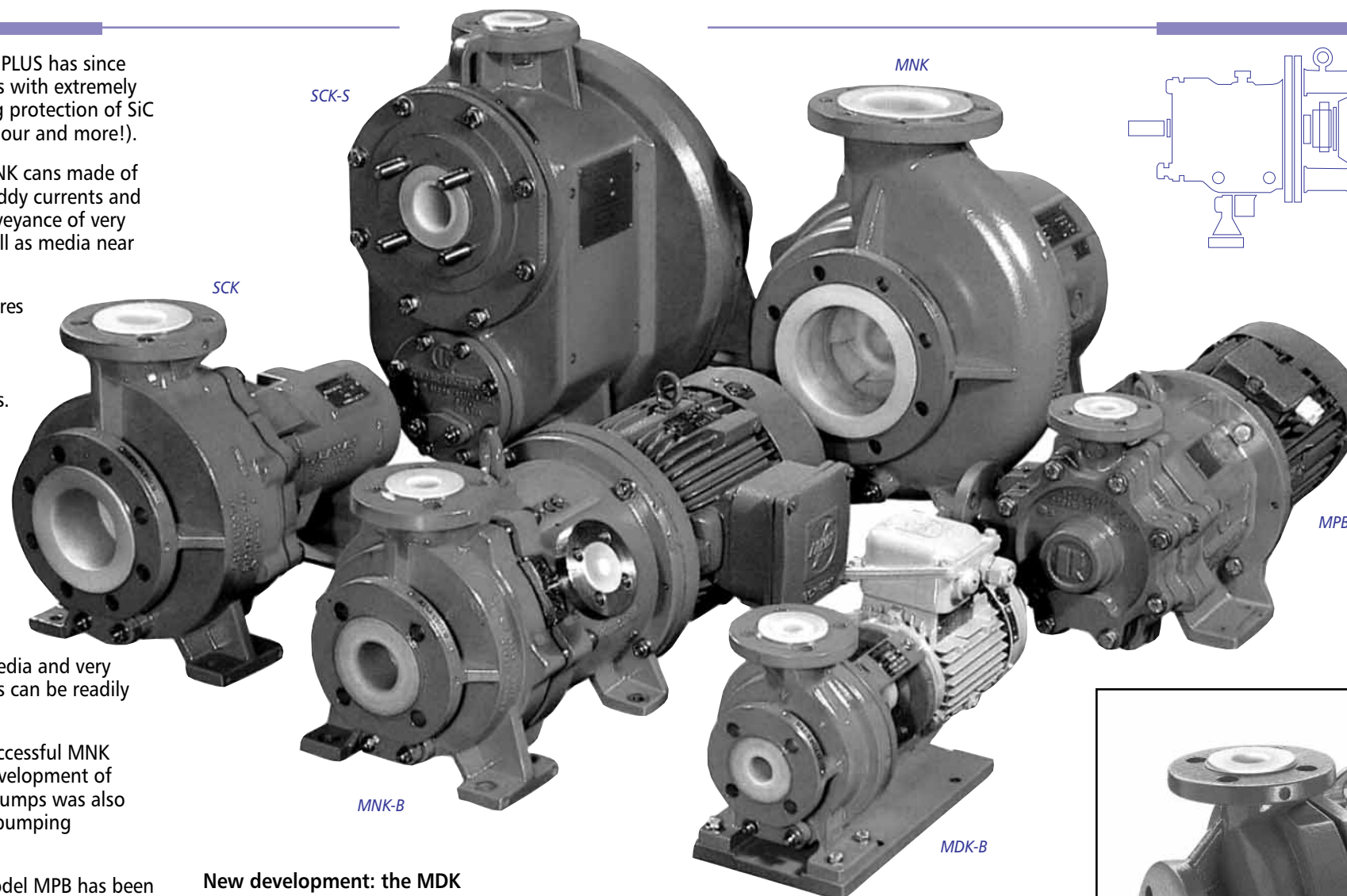
■ Peripheral pump model MPB has been designed with a novel flexible impeller ring channel gasket. Precise impeller ring channel adjustment is now possible.

■ Vortex pump model MNK-X with an extended housing compartment and special impeller geometry are designed to pump media containing very large or long-fibrous particles or with high solids contents.

Also ideal for very high gas contents of up to 5% by volume.

■ Self-priming pump model MNK-S are proven problem-solvers suction lift applications such as emptying chemical containers and wastewater basins from the top – even at high back pressures!

With its robust design, the MNK services the chemical and related process technology sectors – down to very difficult applications. The MNK is a universal process pump.



SCK

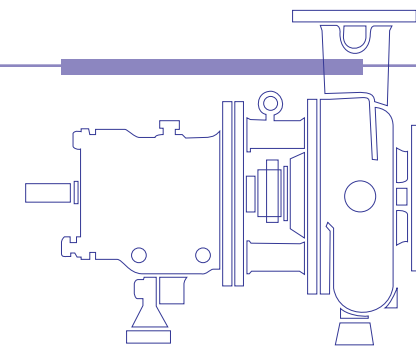
SCK-S

MNK

MNK-B

MDK-B

MPB



- as an alternative to
  - pumps made of expensive exotic metals (Hastelloy, monel, titanium etc.)
  - plastic-lined or all-plastic mechanical seal pumps
  - stainless steel pumps with a double mechanical seal
  - and stainless steel magnetic drive pumps (more universal resistance, prevention of eddy currents)

■ for pure media where good cleaning possibilities and anti-adhesive surfaces are important

■ for environmentally critical media

■ for media near their boiling points where even small rises in temperature could result in evaporation and thus to inadequate lubrication

■ for applications where there is a risk of brief dry-running, e.g. when containers are being emptied or where there is a risk of incorrect operation.

#### New development: the MDK

All of Richter's experience provided the momentum to develop a new supplementary plastic-lined magnetic drive pump, the MDK series:

Many plant operators tend to have applications/operating conditions of medium to lower difficulty for process pumps, especially in terms of corrosion resistance and operating temperature.

Instead of a universal process pump a magnetic drive pump with a technically more simple design and at a lower cost but with a more limited application range would certainly be an interesting alternative.

The elementary safety features, which have even been adopted now in the chemical engineering sector in the form of a standard for plastic-lined magnetic drive centrifugal pumps, must also be provided even with a lower-priced solution:

Free from eddy currents, resistant to dry-running and a robust, metal-reinforced overall design.

With its new magnetic drive pump, the MDK, ITT Richter now offers a technically and commercially attractive innovation for this market sector.

#### Fields of application of the MDK

The MDK can convey both corrosive as well as pure media. A host of applications are to be found in the chemical, pharmaceutical, petrochemical, pulp, metal, food processing and waste disposal/recycling sectors.

The MDK series is designed for an operating pressure of up to 16 bar and for operating temperatures of -60 to +120°C (FEP lining) or -30 to +80°C (PP lining).



Model MDK

8 sizes are available, from 25-25-125 up to 80-50-200 with flow rates of up to 80 m<sup>3</sup>/h and delivery head of up to 60 m LC (2900 rpm).

The MDK was developed:

- for conveying media where customary stainless steels are not sufficiently corrosion-resistant.

The design, flow rates and dimensions comply with EN 22858/ISO 2858. Flanges to DIN PN 16, alternatively bored to ANSI 150 lbs.

The MDK provides excellent performance and a cost effective solution to many of our process customers' problems. **Try one!**

## New Technology

### Extending Pump Life... The Cyclone Seal Chamber

**Stan Knecht**  
Product Manager  
Goulds Pumps/ITT Industries

Every Day on the Serengeti Plain the "King of the Wild," a lion, awakes knowing that if he is not the fastest, strongest and smartest hunter on this day, he will go hungry!

The lesson learned from this simple example is that even Market Leaders must seek to be better every single day. Goulds Pumps is a leader in the design and development of seal chambers which provide the optimum sealing environment for extended mechanical seal reliability. Recent developments include the patented TaperBore™ Plus which has been proven in thousands of installations to extend the life of mechanical seals on tough sealing applications containing solids, vapors or paper stock.

Even with the success of the TaperBore, ITT's engineers asked the question, "Can we do better?"

One of the benefits of the merger of Goulds Pumps to ITT Industries is synergy opportunities for exchange of technology. Leveraging this situation, discussions within the Fluid Technology Group revealed that recent development work had been completed on a patented, alternative seal chamber design for submersible pumps, which also had been shown to extend mechanical seal life. Like the TaperBore™ Plus, this design utilizes a conical shaped, tapered bore seal chamber design. However, at the heart of this design are two casted helical grooves



Figure 1 – Cyclone Seal Chamber, Patented by ITT Industries.

in the tapered walls of the seal chamber which serve to modify the flow pattern within the seal chamber to keep solids out of the seal environment. Additionally this design also offers improved ease of manufacture such that it can be manufactured in iron constructions.

#### Principle of Operation - How Does This Work?

Development research testing conducted by ITT Industries has shown that the flow pattern of solids within an un-enhanced conical/tapered bore seal chamber is such that:

Liquid containing solid particles will travel radially inward along the face of the seal chamber due to the differential pressure found at the OD of the impeller versus that near the shaft.

Solids are then shown to travel along the tapered walls until contacting the back wall of the seal chamber.

At the back wall of the seal chamber, momentum will tend to deflect the solids towards the shaft, yet centrifugal forces causes the solids to be shot back radially against the taper walls of the seal chamber. This action tends to capture and concentrate solids near the mechanical seal components resulting in accelerated erosion of the seal chamber and/or failure of the seal.

The Cyclone Seal Chamber has been proven to be the solution to eliminate this problem. In operation, the function of this design is as follows:

The casted helical grooves act as barriers, collecting inbound solid particles as they travel along the angled walls of the seal

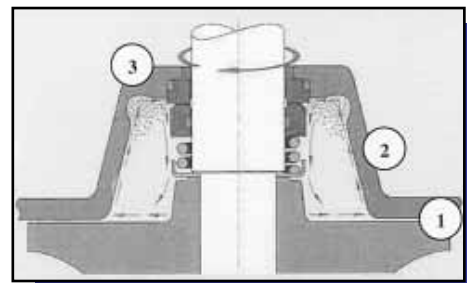


Figure 2 – Typical Flow Pattern of Solid Particles In an un-enhanced conical/tapered bore seal chamber.

chamber. Once caught in the grooves, the rotational velocity of the liquid within the seal chamber acts to rotate these solids along the helical path of the grooves until they are transported out of the seal chamber environment. The result is the maintenance of a seal chamber environment free of solids, preventing both seal chamber erosion and clogging/wear of the mechanical seal hardware.

#### Qualification Testing

A series of tests were conducted to evaluate the performance of the Cyclone Seal Chamber and it's potential for applications in process pumps. These tests were designed to evaluate the ability of this seal chamber design to maintain the optimum sealing environment in the presence of both vapor and solids, without the use of an auxiliary seal flush, in a process pump application.

#### Vapor Handling

Testing performed on a pump mounted in a vertical arrangement showed that the Cyclone Seal Chamber design does prevent vapors from collecting in the seal chamber for liquids containing up to 10% entrained gas. This is an important feature, as air vapors will compromise lubrication of the mechanical seal faces, which can result in premature seal failures.

#### Solids Handling

Similarly, a pump fitted with an aluminum Cyclone Seal Chamber was tested on solid laden liquids (diatomaceous earth), up to 10% by weight, at 3550 RPM. (Aluminum was

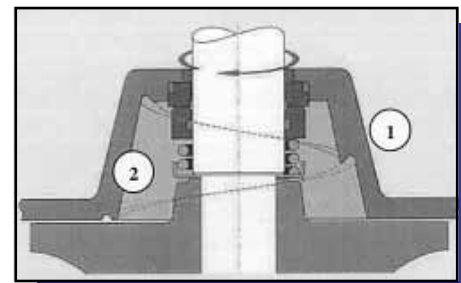


Figure 3 – Solids Transported Out of Seal Chamber Environment along Helical Groove in Cyclone Seal Chamber.

selected to accelerate wear and reduce the length of testing). After 80 hours of operation the impeller face of the seal chamber exhibited significant erosion, yet the seal chamber and the mechanical seal itself (John Crane Type 8-1T, SiC vs SiC), showed little or no signs of wear while continuing to operating perfectly.

#### Test Conclusions

Based on these tests results it was shown that the performance of the Cyclone Seal Chamber was similar to the TaperBore™ Plus in it's ability to maintain the optimum seal environment in the presence of either solids or vapors.

#### Customer Benefits

Mechanical seals failures are acknowledged as the number one cause of pump downtime. Most seal failures are typically not the result of a bad seal design, but the result of a poor sealing environment, one which lacks proper lubrication, cooling, and is free of solids.

The patented Cyclone Seal Chamber is the solution, increasing circulation and

volume of liquid near the seal faces, improving lubrication and cooling. The helical grooves act to maintain an environment which is free of solids.

The Cyclone Seal Chamber is also the optimum choice for most applications with less than 10% solids and will not require an auxiliary flush for the mechanical seal. The benefits of "flushless" operation are as follows:

- Reduced Operating Cost by eliminating the need to supply flush water.
- Operator Friendly - Eliminates Seal Failures at Start-up resulting from failure to open flush water valves.
- Product Contamination/Dilution by flush water is eliminated.
- Reduced Environmental Liability, as flush water will no longer need to be collected and treated.
- Reduced Installation Costs as auxiliary piping and connections to Flush Water System are eliminated.

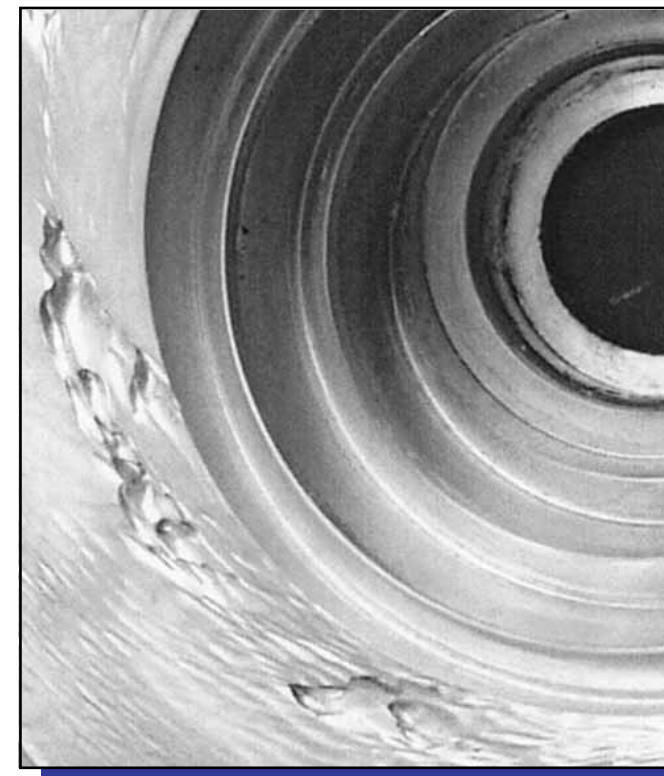


Figure 4 – Results after 80 hours, Significant wear on Impeller face, No Wear in Grooves or Seal Area. (Testing performed on Aluminium Cyclone Seal Chamber at 3550 rpm.)

- Simplifies Maintenance Activities due to increased accessibility to seal area and minimizes the number of secondary connection which need to be isolated prior to working on the pump.

The bottomline benefit is increased profits through increased seal and pump reliability and reduced expenses.

In the next issue of *Pumplines*, we will discuss specific applications for the Cyclone Seal Chamber in Process Pumps. ■

## Material Matters

### Ferrite in Cast Austenitic Stainless Steels

**Stephen J. Morrow**  
Global Manager of Materials Technology  
Goulds Pumps/ITT Industries

The topic of delta-ferrite, in cast austenitic stainless steels is extremely complex. The various and specific services in which these alloys are utilized require control of delta-ferrite for acceptable performance. The volume fraction of delta-ferrite present in these cast stainless alloys is related to the chemical composition balance and thermal processing history. The microstructures of cast austenitic stainless steels, are generally composed of islands of discontinuous ferrite pools in the austenitic matrix. This two-phase microstructure is in contrast to the single-phase microstructure characteristic of the wrought, fully austenitic stainless steels. In cast austenitic stainless steels, delta-ferrite can be both beneficial and detrimental.

Although the presence of some delta-ferrite in austenitic stainless steels provides some benefits, including reduction in some types of casting defects (e.g. shrinkage and hot tears); excessive ferrite levels may result in an overall reduction in corrosion resistance by selective dissolution in certain environments. Users are cautioned to bear this in mind when specifying cast austenitic stainless alloys. If the volume percentage of delta-ferrite is greater than 15% in the CF grades, or 18% in the CG grades, continuous delta-ferrite networks or stringers may form.

Cast stainless steels differ from their wrought counterparts in that they may contain ferrite contents more than 25% in the CF type alloys and up to 35% in the CG type alloys, which are well above the optimum maximums to prevent continuous ferrite networks, corrosion and cracking problems. Such high ferrite contents have resulted in "sweating" or "weeping" of pumpage through castings, corrosion, and cracking type failures in service. A high delta-ferrite content, resulting from an imbalance of ferrite-to-austenite stabilizers, fosters the formation of continuous ferrite stringers or

## Ferrite in Cast Austenitic Stainless Steels con'd

a ferrite network, providing a continuous path for corrosion, and produces an effect similar to intergranular corrosion (IGC) and stress-corrosion-cracking (SCC) grain boundary attack.

In high alloy Chromium-Nickel austenitic stainless steels, Molybdenum is often added to improve localized corrosion (i.e. pitting and crevice) resistance in chloride media. Note that the composition ranges for cast alloys are not identical to their nearest wrought counterparts: casting specifications generally allow for a greater percentage of Chromium and Silicon, two ferrite promoting elements, and lower percentages of Nickel and Manganese, two austenite stabilizers. The variations in chemistry provide for optimum fluidity, formability, and castability for the wrought and cast alloys, respectively.

In certain environments premature failure of stainless castings have been attributed to a high ferrite content. The volume fraction of ferrite is determined primarily by the composition balance between elements that tend to stabilize the ferrite, and austenite; and to a lesser extent, by the casting thermal history. Casting process parameters and subsequent thermal processing also has an effect on delta-ferrite morphology, making microstructure control more difficult than just chemical composition control.

By adjusting the ratio of ferrite stabilizers, to austenite stabilizers, within the specified ranges for the elements in a given alloy, the casting producer can somewhat control the ferrite content and physical properties. ASTM practice A800 provides the standard practice for estimating the ferrite content of stainless alloy castings that have compositions balanced to form ferrite as a second phase. The ASTM specifications have a wide chemical range that can result in delta-ferrite from between 5 to 35% or more unless chemical balance is established for each grade of alloy. While ferrite levels are not specified in ASTM specifications, they are generally expected to be in the 5-15% range for CF type alloys, and 8-18% for CG types.

Ferrite content control is not an obvious requirement under ASTM A743 or A744 for those unfamiliar with ASTM specifications.

Supplemental requirements, which must be specified in addition to the basic ASTM specification on the purchase order allows for additional testing. Unless one knows where to look, *Supplementary Requirements*, which are a part of the basic ASTM specifications, are often missed.

When ferrite content needs to be controlled, specify A781 supplementary S11.1 requirement as follows:

"The chemical composition of the heat shall be controlled such that the ferrite content, as determined by the chemical composition procedure of Practice A800 shall be in conformance with the specified ferrite content range."

Finally, the service conditions under which the castings are to be subjected dictates control of delta-ferrite to specific levels for

optimum performance and life. Serious considerations should be given to specifying a ferrite range of 5 - 15% maximum for CF type and 8 - 18% maximum for CG type alloys in procurement documents. Foundries can avoid high ferrite by keeping Nickel on the high end of the range (above 10% in the CF grades, and above 12% in the CG grades), and by adjusting the Chromium and Molybdenum levels accordingly to balance out the composition.

The point is that the chemical compositions must be balanced such that the ferrite contents are controlled within any specified range. The procurement documents should specify the ferrite range desired, and require the casting manufacturer to report the actual ferrite contents when determined to be necessary. ■

## Service Solutions

### Terry McMahon

Global Market Manager, PRO Services  
ITT Industrial Pump Group

### Are your repairs and maintenance program out of control? Call a PRO!

Our customers are process companies such as Chemical, Refineries, Pulp & Paper Mills, Mining and Utilities. They are telling us it is more important than ever to have an efficient equipment repair and maintenance program in place. These companies are machinery intensive and usually have a maintenance organization and a substantial investment in spare parts to keep the plant running.

Many are also faced with the following dilemma. They have to meet tighter production goals, quality goals and increasing customer requirements with a shrinking and declining skilled labor force. In addition there is pressure to improve return on assets, increase uptime and increase productivity. On top of this, they have to comply with regulatory issues for environmental and safety.

Our customers have been looking to Equipment Manufacturers to help provide support and solutions to address this dilemma. Goulds Pumps has been responding. We have been and are

continuing to invest in PRO services to develop leading parts supply and inventory management programs coupled with field service programs and repair shops. Goulds Pumps provides quality repairs of all pump types of rotating equipment, regardless of manufacture and pump upgrades for improved equipment reliability.

We have been working with our customers to develop varying maintenance choices ranging from equipment repair to integrated maintenance strategies. Below is a list of measures used to measure various maintenance strategies and some typical savings that may be realized. Of course, an integrated solution addressing, inventory, equipment repair, reliability upgrades and predictive maintenance will generate more savings than any single effort. Working with you, a service program can be tailored to your needs.

### ROI Measurements

- Increased Productivity (2 - 40%)
- Reduced Maintenance Expense (7 - 60%)
- Improved Repair Quality (Rework and Scrap reduced 5 - 90%)
- Extended Equipment Life
- Reduced Spares Inventory (10 - 60%)
- Increased Inventory Turns (to 75%)
- Reduced Energy Consumption
- Increased Safety and Environmental Protection ■

Send your comments or suggestions to:

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