MULTIPHASE TRANSFER

- PROGRESSING CAVITY PUMPS

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PCM | keep it moving

ABOUT PCM

PCM is one of the world's leading manufacturers of positive displacement pumps and fluid-handling equipment. The company was co-founded in 1932 by the inventor of the Progressing Cavity Pump (PCP), René Moineau.

THE MULTIPHASE TRANSFER EXPERTS

PCM Oil & Gas provides cost-effective PCP-based pumping systems and integrated services for all upstream multiphase processes in the Oil & Gas industry.

Available for a wide range of onshore and offshore applications, PCM Troika™ multiphase transfer systems eliminate the need to separate crude, gas and water produced by the oil well. You don't have to build separate pipelines for the transportation of liquids and gases. Nor are compressors required for gas transportation.

When you work with PCM you are dealing with dedicated Progressing Cavity Pump specialists located around the world, close to your door. PCM Oil & Gas teams are ready to provide you with highly responsive, custom tailored services, including engineering and design, project management, field services and training.

CONTENTS

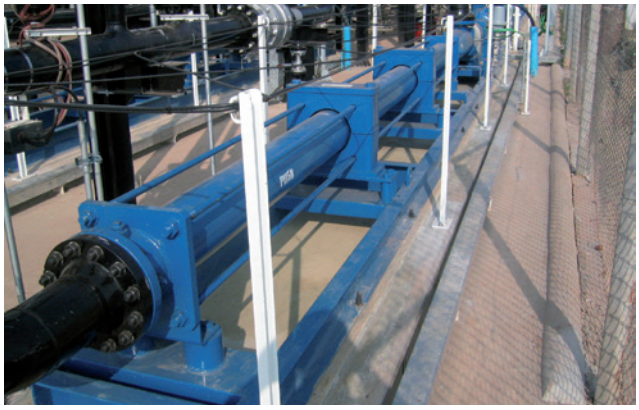
THE RELIABLE ALTERNATIVE TO UPSTREAM SEPARATION

PCM Troika™ pumps are used onshore around the world to deliver robust, efficient and cost-effective multiphase solutions.

MULTIPHASE BOOSTER

To ensure steady production delivery despite varying levels of viscosity and high sand cut, the customer replaced several existing twin-screw pumps with PCM Troika multiphase pumps featuring a specially designed hydraulic profile.

Country	Thailand
Field	Sirikit
Fluid	Oil + Water + Gas + Sand
Model	180THP30
Flow rate	75 m³/h - 330 gpm - 11 260 bpd
Pressure	20 bar - 290 psi
Key Points	New hydraulic profile/ Continuous operation

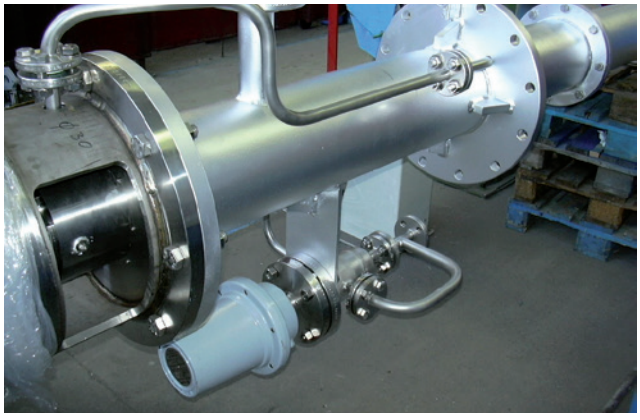


Multiphase booster, Thailand

CLOSED DRAIN

To handle volatile condensates from a closed Drain Tank, PCM developed a custom PCM Troika pump built from duplex steel that met the customer's high specifications in a highly corrosive environment. The pump was built to order for vertical operation.

Country	Algeria
Field	ROD
Fluid	Condensates
Model	50l30V
Flow rate	25 m³/h - 110 gpm - 3 750 bpd
Pressure	20 bar - 290 psi
Key Points	Vertical/High level specs

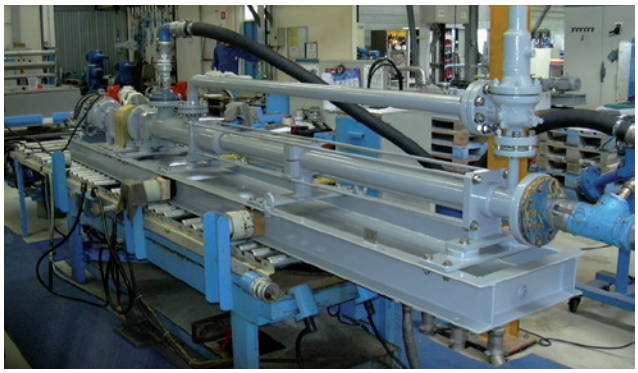


Closed drain, Algeria

RECOVERED OIL

In a gas field that produced residual oily water, the customer chose to install PCM Troika multiphase pumps capable of withstanding the high-pressure system for emulsion free transportation.

Country	Indonesia
Field	Betara
Fluid	Oily water
Model	3THP60
Flow rate	2.25 m³/h - 10 gpm - 340 bpd
Pressure	40 bar - 580 psi
Key Points	High pressure



Recovered oil, Indonesia

POLYMER MAKE-UP

To handle the extreme viscosity of the polymers used in Enhanced Oil Recovery, the customer selected a PCM low shear pump for integration into their polymer make-up unit.

Country	Oman
Field	Marmul
Fluid	Polymer
Model	90l5
Flow rate	60m³/h - 264 gpm - 9 000 bpd
Pressure	4.5 bar - 65 psi
Key Points	High viscosity

Polymer make-up, Sultanate of Oman

CRUDE OIL TRANSFER

PCM Troika pumps were able to operate outdoors, unprotected, at temperatures as low as -30°C.

Country	China
Field	Liaohe
Fluid	Crude oil
Model	35l20
Flow rate	20 m³/h - 88 gpm - 3 000 bpd
Pressure	14 bar - 200 psi
Key Points	Extreme winter temperature

ROBUST OPERATION WHERE YOU NEED IT MOST

When space is at a premium and you are hundreds of kilometers offshore, PCM Troika™ pumps deliver highly reliable performance with the most suitable footprint.

OPEN DRAIN

For use on an offshore platform where space is scarce, the customer selected high-pressure PCM Troika pumps for their low-NPSH performance, thereby eliminating the need for booster pumps.

Country	Qatar
Field	Al Khaleej
Fluid	Oily water + solids
Model	9THP80
Flow rate	5 m^3/h - 22 gpm - 750 bpd
Pressure	75 bar - 1 090 psi
Key Points	Low NPSH (0.36 m-1.1 ft)/ High pressure

Open drain, Qatar

PRODUCED WATER

To enable easy processing of the wash tanks filled with oil and water produced during production on a Floating Production Storage and Offloading Unit (FPSO), PCM engineered a new PCM Troika model to fit the application. To save space and enable easy top-side access for maintenance, the pumps were installed vertically.

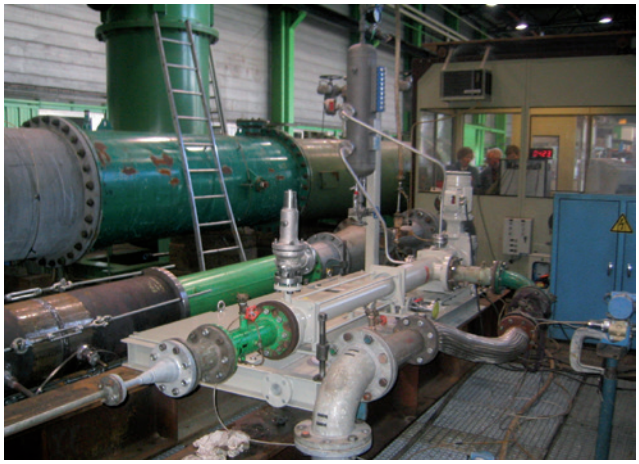
Country	Nigeria
Field	USAN
Fluid	Oily water
Model	390THP15V
Flow rate	120 m^3/h - 528 gpm - 18 000 bpd
Pressure	8 bar - 115 psi
Key Points	Vertical 30 m-100 ft long/ High level specs

Produced water, Nigeria

FLARE KNOCKOUT DRUM

To handle low NPSH and overcome the problems of cavitation due to high gas content, the customer opted for a PCM Troika pump built from duplex steel and featuring an API Plan 53 mechanical seal to avoid the leakage of toxic aromatics.

Country	Middle East
Field	Various
Fluid	Oil condensates
Model	50l15
Flow rate	20 m^3/h - 88 gpm - 3 000 bpd
Pressure	12.5 bar - 180 psi
Key Points	API Plan 53/Duplex



Flare knockout drum, Middle East

WELL TESTING DISPOSAL

Designed to provide easy installation on a rig and low-maintenance, reliable operations in harsh offshore conditions, PCM developed a heavy-duty mobile skid solution for pumping the oil mixed with water and gas produced during well testing.

Country	Abu Dhabi
Field	Zakum
Fluid	Oil + Water + Gas
Model	38THP100
Flow rate	26.5 m^3/h - 117 gpm - 4 000 bpd
Pressure	100 bar - 1 500 psi
Key Points	Heavy duty/Mobile skid

Well testing disposal, Abu Dhabi, UAE

SUMP CAISSON

PCM Troika pumps are capable of reliably handling the varying kinds of liquids and debris collected by an offshore platform's drainage system, while withstanding the harsh offshore conditions encountered in the North Sea.

Country	Norway
Field	Draugen
Fluid	Oily water + Residue
Model	13l5 V
Flow rate	9 m^3/h - 40 gpm - 1 350 bpd
Pressure	3.5 bar - 50 psi
Key Points	NORSOK Specifications

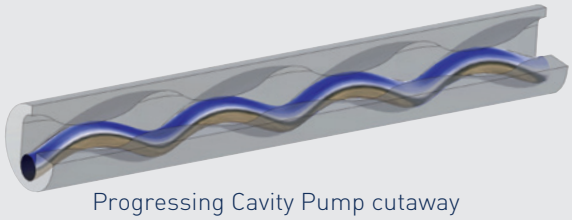
PROGRESSING CAVITY PUMP

With low Life Cycle Costs and operational simplicity, PCM Troika™ progressing cavity pumps are ideal for standard multiphase applications.

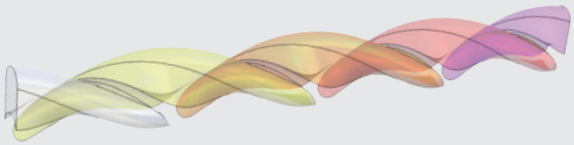
WORKING PRINCIPLE

Inserting a single helical rotor, precisely machined from high strength steel, in a double internal helical stator (molded in elastomer or steel), creates sealed lenticular cavities. As the rotor turns, the cavities progress along the rotor, gently carrying liquid, gas and/or solids. This makes the progressing cavity pump ideal for viscous and abrasive fluids.

As the PCP is a volumetric pump, the flow rate depends only on the rotor speed.



Progressing Cavity Pump cutaway



3D visualisation of sealed cavities

PCM TROIKA HIGHLIGHTS

Application requirement	PCM Troika advantage
Varying viscosity	Stable flow rate
Pressure fluctuations	Stable flow rate
Easy flow rate adjustment	Proportional pump speed adjustment using variable speed drive
Low NPSH	Low NPSH required (30 cm-1 ft)
No added emulsion	Low shear pumping action. Laminar flow
Gas surge	Ability to handle high gas content
Sand	Ability to handle high sand content

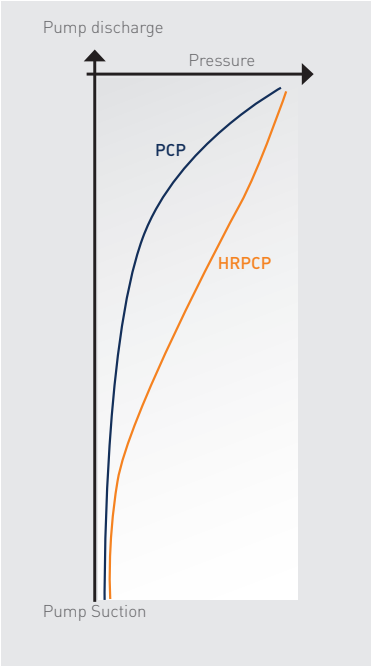
Produced water, Nigeria

HRPCP

The exclusive and patented PCM HRPCP (Hydraulically Regulated PCP) technology takes progressing cavity pumps to a new level, enabling you to handle the highest gas void fraction, while benefiting from all the existing advantages of PCP technology.

WORKING PRINCIPLE

PCM HRPCP technology consists of Hydraulic Regulators that re-circulate the fluid between the PCP's cavities to control the pump's thermo-hydraulic response. In doing so, the regulators avoid excessive heat build up, which might result in premature failure of the pump's stator.



Pressure distribution along the PCP with 90% GVF multiphase fluid

PERFORMANCE COMPARISON

Standard PCM Troika and PCM Troika HR pumps offer clear advantages over the two other technologies that are most commonly used for multiphase transfer. The choice between the two PCM technologies depends on GVF levels and efficiency objectives.

	PCM Troika HR	PCM Troika	Twin-screw pump	Centrifugal pump
Max gas void fraction (GVF)	99%	40-50%	99%	75%
Efficiency	**High**	**Good**	Poor	Fair
Ability to handle changes in viscosity	**High**	**High**	Poor	Poor
Ability to handle changes in flow rate	**High**	**High**	Poor	Poor
Ability to handle changes in pressure	**High**	**High**	Fair	Poor
Ability to handle sand content	**High**	**High**	Fair	Poor

Standard PCM Troika and Troika HR pumps offer clear cost savings over the two other technologies that are most commonly used for multiphase transfer.

	PCM Troika HR	PCM Troika	Twin-screw pump	Centrifugal pump
CAPEX	**Low**	**Low**	High	High
OPEX	**Low**	Medium	High	High
Energy consumption	**Low**	**Low**	High	High
Maintenance	**Low**	Medium	High	Medium

FROM SIMPLE TO SOPHISTICATED MULTIPHASE SOLUTIONS

We have developed a comprehensive offering of multiphase pumping solutions that covers all your needs, from "rough and ready" standard pumps to "high level specs" custom engineered pumping systems.

	STANDARD SYSTEMS *Easy to order and delivered fast, they are simple to operate and incredibly reliable.*	**CUSTOMIZED SYSTEMS** *When the answer to your challenges isn't available off the shelf, it's time to put the full breadth of our expertise to work.*	
DESIGN & CONSTRUCTION	PCM manufacturing standard API 676	- API 676, API 682 - Custom built - Fit-to-purpose sealing system	- Modular design - Custom painting - Materials: carbon steel, SS316L, duplex or super duplex
TESTING	Hydraulic performance	- Dye penetrant and x-ray (PMI) - Hardness - Performance and NPSH - All testing can be witnessed	- Positive Material Identification - Hydrostatic - Noise and vibration
DOCUMENTATION	Operating manual Maintenance manual	- Operating manual - Welding documents - Project reporting - Vendor data book	- Maintenance manual - Quality control plan - 3.1 certificates (traceability)
CERTIFICATIONS	Standard certification GOST	- ASME - NACE	- NORSOK - GOST
PROJECT MANAGEMENT	Order follow up Supply chain Logistics	Dedicated Oil & Gas project team leader for: - QHSE - Production - Logistics	 - Engineering - Supply chain

CUSTOMER SERVICES

Our engineering team delivers efficient and reliable technology, precise project follow-up for customer's peace of mind and additional cost savings.

Installation & Commissioning

PCM Troika™ pumps are one of the world's simplest and most efficient multiphase transfer systems, as long as they are installed and commissioned properly. Through pre-operational checks and close monitoring of all equipment, PCM field technicians implement stable and secure production.

Operation

To ensure maximum uptime of your PCM pump systems, we provide a wide range of operational support services. These include troubleshooting, maintenance contracts and pump upgrades.

Training

Intensive training sessions adapted to your specific needs are available for your engineers, technicians and operational staff. Sessions can be delivered on site, both in the classroom and in the field, or at the PCM Learning Center.

Spare parts

The availability and quality of spare parts impacts a pump's uptime, especially for remote sites and in regions with multiple fields. Our experts can help you implement the best way to manage your inventories to reduce costs, optimize stock levels and streamline operations.

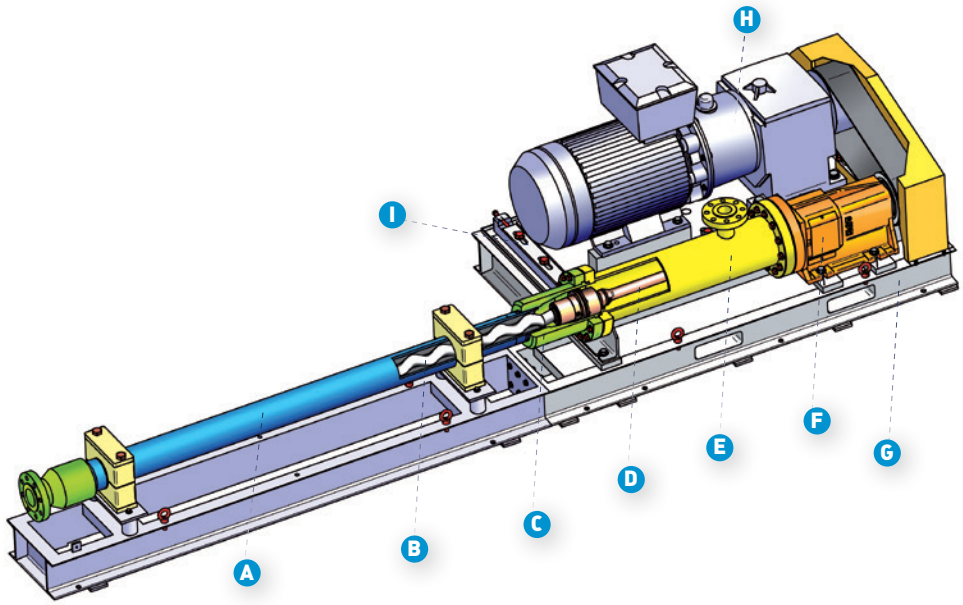
PCM TROIKA™

Featuring PCM PCP technology

- High quality, cost effective construction
- Easy to use in horizontal or vertical configuration
- Long lasting, proven design
- Large spare parts inventory

MODULAR BY DESIGN

PCM Troika pumps feature a modular design that is easily customizable. The modular design simplifies the selection and pricing process, and enables you to obtain a configuration that is perfectly adapted to your installation, operational and fluid-handling requirements.



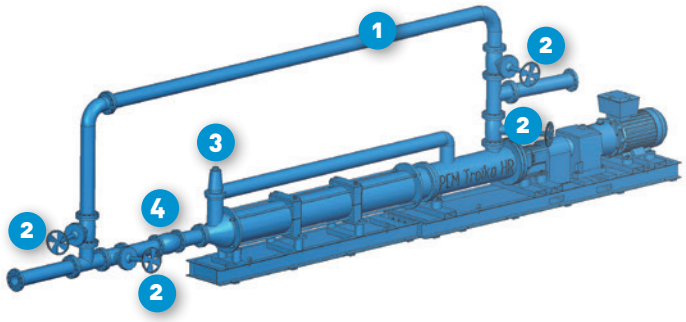
- **A Stator**: available in NBR, HNBR and FKM elastomer material
- **B Rotor**: hard chromed plated steel or high alloy steel
- **C Adaptor for quick assembly** and easy maintenance
- **D Torque transmission**: high pressure articulated connecting rod or flexible shaft
- **E Pump body & casing**: black steel, 316L stainless steel or high alloy steel
- **F Reinforced bearings**
- **G Base frame:** two skids with forklift slots & lifting eyes
- **H Electric drive:** gear reducer with safety motor
- **I Easy belt and pulley alignment**

PCM TROIKA™ HR

Featuring PCM HR PCP technology

- Lower stator temperature
- Less stator strain
- PCM Troika pumps can be upgraded to PCM Troika™ HR pumps
- Less maintenance

DESIGN



1. By-pass line
2. Gate valves
3. External safety relief valve
4. Check valve

ACCESSORIES (MULTIPHASE PACKAGE AS PER API 676)

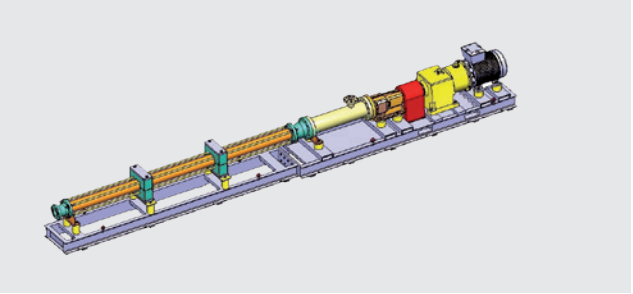
INSTRUMENTATION	CONTROL	PIPING
Pump Inlet : • Pressure transmitter and indicator • Temperature transmitter and indicator **Pump Outlet :** • Pressure transmitter and indicator • Temperature transmitter and indicator **Stator surveillance :** • Temperature transmitter and indicator	**Automated control system :** • Regulation based on Pressure transmitters and Temperature transmitters signal • Pump protection ensured against dry running and overpressure **Possibility to control several pumps in parallel** to increase flow rate capacity required by the applications **Human Machine Interface :** • User friendly • Easy to start	**API gate valves and check valves** come with pump internal spooler and piping as per API 676

TROIKA INTEGRATED SKIDS

PCM Troika and PCM Troika HR pumps are available in turnkey skids for easy installation and integration.

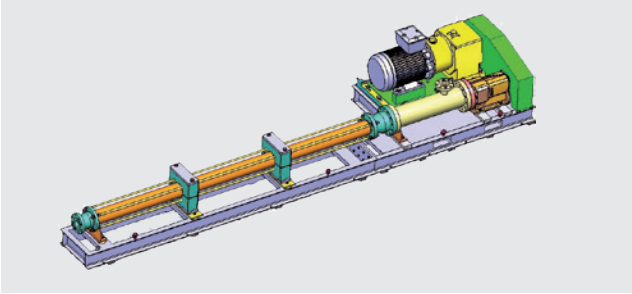
CONFIGURATIONS

In-line assembly



For vertical or horizontal installation

Pulley & Belt assembly



25% smaller footprint For horizontal installation only

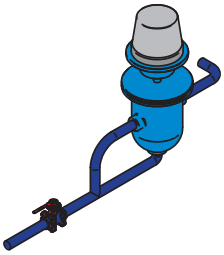
PCM TROIKA™ AND PCM TROIKA™ HR PERFORMANCES

	Pump model		Max. speed	Max. differential pressure		Capacity at Max. speed & 2/3rd of max differential pressure		
			rpm	bar	psi	m³/h	gpm	bpd
LOW PRESSURE RANGE	0.03ID	10	1 500	12	174	0,03	0,132	4,5
	0.4I	10	1 500	10	145	0,4	1,76	60
	1I	10	1 500	10	145	1	4,4	150
	1.6I	45	1 000	45	653	1,1	4,84	165
	2.6I	10	1 500	10	145	2,5	11	375
	6I	5/10/20	900	20	290	3	13,2	450
	4I	52	600	48	696	3	13,2	450
	13I	5/10/20	900	20	290	7	30,8	1 050
	25I	5/10	700	10	145	18	79,2	2 700
	20I	16/20/40	450	40	580	12	52,8	1 800
	40I	10	500	10	145	22	96,8	3 300
	35I	20/40	450	40	580	20	88	3 000
	45I	5	500	5	73	30	132	4 500
	62I	5	450	5	73	45	198	6 750
	60I	10	450	10	145	45	198	6 750
	60THP	20	400	20	290	40	176	6 000
	50I	15/30	300	30	435	40	176	6 000
	70THP	45	250	45	653	30	132	4 500
	90I	5	450	5	73	70	308	10 500
	100I	10/20	300	20	290	75	330	11 250
	135THP	20/30	250	30	435	60	264	9 000
	150I	10/20	300	20	290	100	440	15 000
	180I	5	250	5	73	100	440	15 000
	185THP	20/30	250	30	435	80	352	12 000
	240I	5/10	250	10	145	180	792	27 000
	390THP	15	200	15	218	140	616	21 000
	500I	5	200	5	73	300	1 320	45 000
	1THP	60/130/200	500	200	2 900	1	4,4	150
	3THP	60/130/200/260	500	260	3 770	2,6	11,44	390
HIGH PRESSURE RANGE	5THP	60/130/200/240	450	240	3 480	4,3	18,92	645
	9THP	80/160/220	450	220	3 190	8	35,2	1 200
	12THP	60/120/160	450	160	2 320	10,5	46,2	1 575
	18THP	60/130/200	450	200	2 900	13	57,2	1 950
	24THP	50/100/160	450	160	2 320	20	88	3 000
	32THP	80/120	450	120	1 740	26	114,4	3 900
	38THP	50/100/120	400	120	1 740	29	127,6	4 350
	44THP	60/90	450	90	1 305	36	158,4	5 400

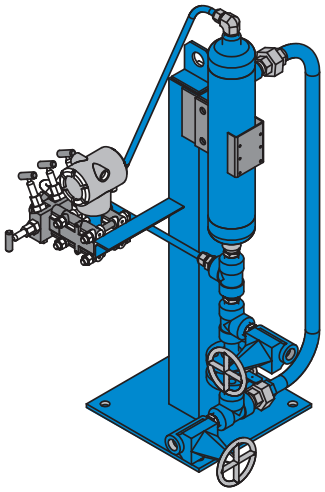
For high GVF (Gas Void Fraction) PCM Troika pumps can be upgraded to PCM Troika HR pumps.

SEALING SYSTEMS (API 682 PLANS)

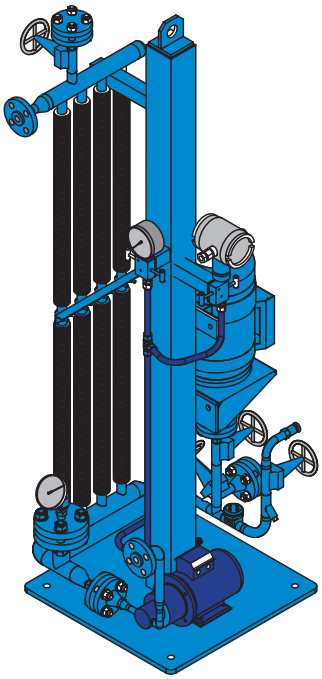
Large choice of shaft sealing systems (from basic to high-protection system)



API PLAN 65



API PLAN 65
with pressure tranmitters

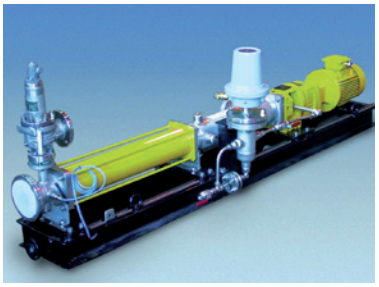


API PLAN 53B
for pressurized Mechanical seal

OTHER ACCESSORIES

Accessories are highly recommended to optimize pump process and safety.

Stator Security System
Protects the stator against dry running.



Safety relief valve
Protects the installation against overpressure.

Drive system controls
Simplifies process control and system safety.