CRUDE OIL TRANSPORT PUMPS

HIGHER PRODUCTIVITY. BETTER RELIABILITY. LOWER COST OF OWNERSHIP.

CIRCOR

ALLWEILER® HOUTTUIN™
IMO® TUSHACO®
WARREN® ZENITH®


OIL HANDLING
SOLUTIONS THAT
WORK FOR YOU.

EXCELLENCE IN FLOW CONTROL

WITH OUR EXPERTISE YOU'RE NOT ALONE

The difficult challenges you face day after day in the demanding world of crude oil transportation are best met by a company who provides diverse product offerings along with deep fluid-handling expertise. The extensive range of pumping system brands from CIRCOR assures you the right oil-handling solutions for your particular application in your specific process: 1) Production, both wellheads and platforms, 2) Transportation, in field processing or long-distance transport, 3) Storage, including tank loading and unloading, and 4) Refining and petrochemical manufacturing.

PRODUCTION

TAKING OIL PROCESSING TO THE EXTREME

Safety, uptime and efficiency: the key operating metrics that your performance is measured on for all onshore and offshore production facilities. Remote locations, a limited number of operators and extreme climates: the difficulties you face every day in meeting your goals and objectives. CIRCOR knows and relates to the needs of facility managers in the upstream sector and offers safe and reliable fluid-handling solutions that allow you to focus on running your operations.

CIRCOR has proven experience in these challenging Production applications, whether on the open water or on land.

	Progressing cavity	Twin-screw	Three-screw	Engineered systems
Field Gathering Pumps	X	X	X	
Heater Treater Charge Pumps	X	X	X	
Free Water Knockout Pumps	X	X		
Desalter Bottoms Pumps	X	X		
Multiphase Pumps	X	X		
Multiphase Systems				X
Gas Compression Systems				X
Water Injection Systems				X

TRANSPORTATION

FROM PIPELINE TO STORAGE TO EVERYTHING IN BETWEEN

Efficiently and dependably transporting crude oil from upstream production facilities to storage operations is a challenging round-the-clock exercise. Downstream production commitments must be met, and vessel and rail tank car schedules must be maintained, to satisfy the demand for crude oil. CIRCOR clearly understands these pressures and offers proven, reliable fluid-handling solutions that allow you to focus on running your operations.

The applications below demonstrate the proven experience CIRCOR has for each facet of this complex system, supporting crude oil pipelines, rail car loading and unloading facilities, marine barges and FPSO vessels.

	Progressing cavity	Twin-screw	Three-screw	Gear
Suction Booster Pumps	X	X	X	
Mainline Shipping Pumps		X	X	
Pipeline Re-injection Pumps		X	X	
Scraper Trap Pumps			X	X
Chemical Injection Pumps				X
Custody Transfer			X	

STORAGE

THE UPSIDE OF MIDSTREAM PROCESSING

Move fluids with speed and precision by having the right people and technology in place. Backed by a team of knowledgeable specialists, CIRCOR terminal station solutions ensure efficiency flows downstream, whether you're charged with loading and unloading fluids or storing, redistributing and consolidating them.

Daily conveying fluids into, around and out of storage terminals is another critical area where CIRCOR has proven experience. Our technologies are used extensively for applications such as:

	Progressing cavity	Twin-screw	Three-screw
Tank Loading & Unloading Pumps	X	X	X
Tank Blending Pumps	X	X	X
Tank Heater Circulation Pumps	X	X	
Bitumen & Asphalt Transfer Pumps		X	X

REFINING

SETTING THE STANDARD FOR ENERGY-SAVING AND ENVIRONMENTAL SAFETY

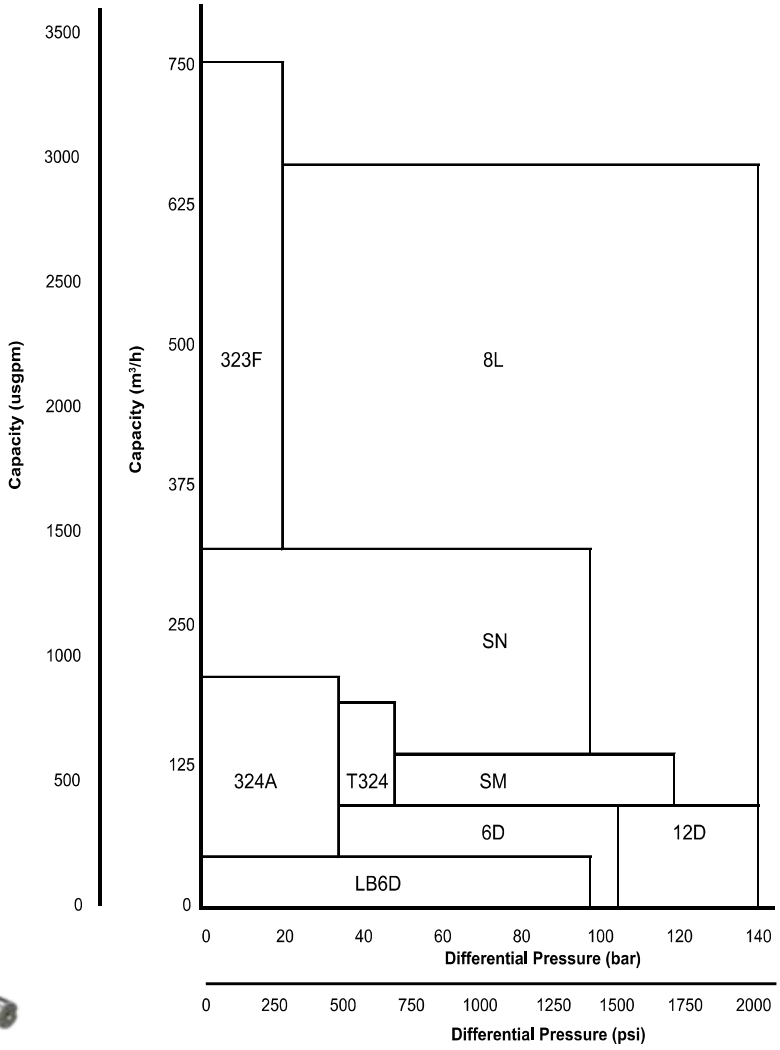
Refineries are the main delivery point for crude oil. Complex, energy demanding processes abound here in the downstream sector, with the associated challenges of high temperatures, high pressures and sour as well as corrosive process fluids. Facility managers contend with significant power costs in addition to ensuring that their facilities meet the ever-growing environmental regulations imposed by their regional and federal governments. With these immense pressures and constraints, delivering an operating profit is becoming increasingly difficult. CIRCOR understands the tremendous challenges that are present here and can provide proven fluid-handling solutions which allow you to concentrate on running your operations.

In all of the major oil Refining areas around the globe, CIRCOR provides proven fluid-handling solutions for applications such as these:

	Progressing cavity	Twin-screw	Three-screw	Engineered systems
Process Charge Pumps		X	X	
Residuum & Vacuum Bottoms Pumps		X		
De-asphalting Pumps		X	X	
Tank Loading Pumps		X	X	
Waste & Slop Oil Pumps	X	X		
API 614 Lubrication Systems				X
API 682/610 Seal Oil Systems				X

THE CIRCOR PRODUCT SOLUTION

AT-A-GLANCE SELECTION GUIDE: THREE-SCREW PUMPS

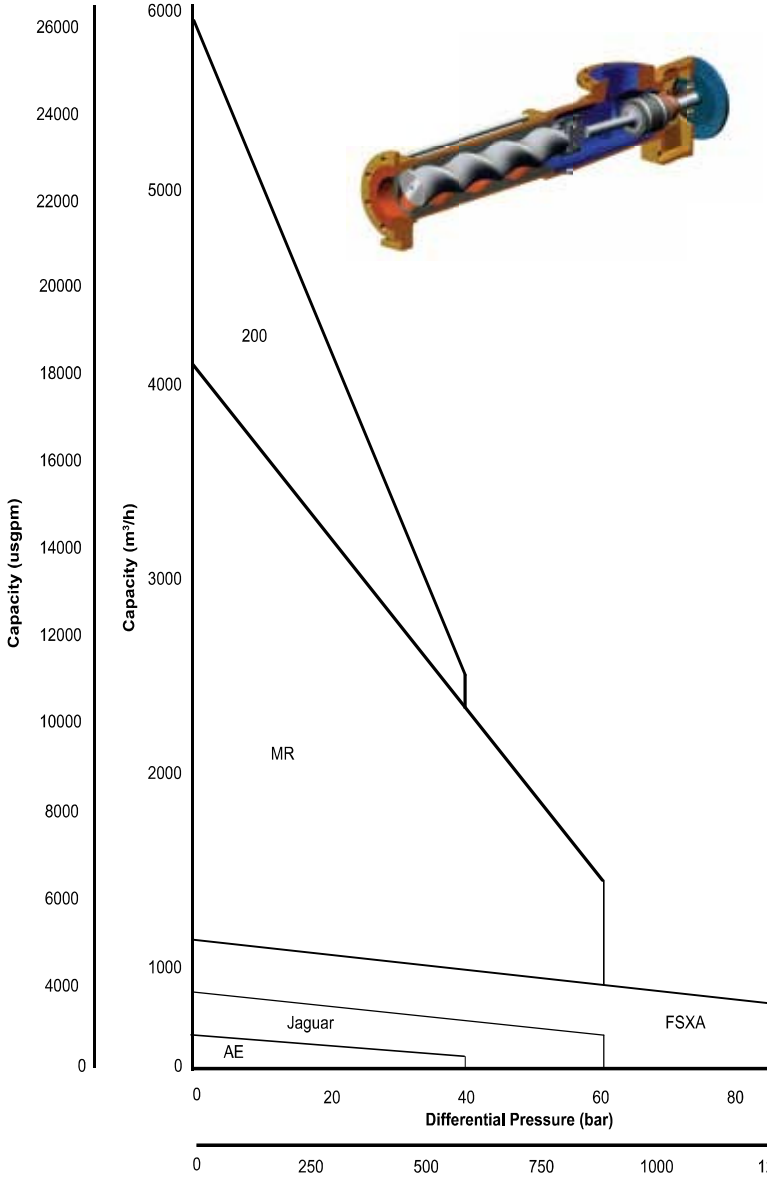


Three-Screw Pumps:

Maximum Flow Rate	Differential Pressure	Viscosity Range Min to Max	Max Fluid Temperature	Max Solids Content	Max Free Water Content	Max Gas Content	CIRCOR Brand & Series
34 m3/h 150 usgpm	100 bar 1450 psi	1 to 2000 cSt	80 deg C 175 deg F	0.5%	10%	5%	Imo LB6D series
90 m3/h 400 usgpm	103 bar 1500 psi	4 to 5400 cSt	107 deg C 225 deg F	0.5 %	10%	5%	Imo 6D series
90 m3/h 400 usgpm	138 bar 2000 psi	4 to 5400 cSt	107 deg C 225 deg F	0.5 %	10%	5%	Imo 12D series
660 m3/h 2900 usgpm	138 bar 2000 psi	10 to 5400 cSt	107 deg C 225 deg F	0.5%	10%	5%	Imo 8L series
318 m3/h 1400 usgpm	100 bar 1450 psi	4 to 5000 cSt	250 deg C 480 deg F	0.5%	10%	5%	Allweiler SN series
130 m3/h 570 usgpm	120 bar 1740 psi	4 to 5000 cSt	250 deg C 480 deg F	0.5%	10%	5%	Allweiler SM series
750 m3/h 3300 usgpm	21 bar 300 psi	10 to 5400 cSt	260 deg C 500 deg F	0.5%	10%	5%	Imo 323F series
204 m3/h 900 usgpm	34 bar 500 psi	10 to 5400 cSt	260 deg C 500 deg F	0.5%	10%	5%	Imo 324A series

THE CIRCOR PRODUCT SOLUTION

AT-A-GLANCE SELECTION GUIDE: PC AND TWIN-SCREW PUMPS



Progressing Cavity Pump:

Maximum Flow Rate	Differential Pressure	Viscosity Range Min to Max	Max Fluid Temperature	Max Solids Content	Max Free Water Content	Max Gas Content	CIRCOR Brand & Series
450 m3/h 1980 usgpm	40 bar 580 psi	1 to 270000 cSt	165 deg C 330 deg F	20%	100%	40%	Allweiler AE series

Twin-Screw Pumps:

Maximum Flow Rate	Differential Pressure	Viscosity Range Min to Max	Max Fluid Temperature	Max Solids Content	Max Free Water Content	Max Gas Content	CIRCOR Brand & Series
6000 m3/h 26,000 usgpm	16 bar 230 psi	0.5 to 5400 cSt	140 deg C 285 deg F	2%	100%	50%	Houttuin 200 series
3300 m3/h 14,500 usgpm	16 bar 232 psi	0.5 to 5,000 cSt	140 deg C 285 deg F	2%	100%	50%	Houttuin TT series
795 m3/h 3500 usgpm	40 bar 580 psi	0.5 to more than 1 million cSt	400 deg C 750 deg F	2%	100%	50%	Warren Jaguar series
4000 m3/h 17,500 usgpm	60 bar 870 psi	0.5 to 100000 cSt	400 deg C 750 deg F	2%	100%	100%	Houttuin MR series

SINGLE SUCTION PROGRESSING CAVITY PUMPS

HOW THEY CONVEY FLUIDS

The ALLWEILER® progressing cavity pump is a rotary, self-priming positive displacement pump. The pumping elements are the rotating eccentric screw (rotor) and the fixed, abrasion resistant, elastomeric lined casing (stator). In the cross-sectional plane, both are in contact with one another at two points, forming two sealing lines along the length of the conveying elements. The fluid entering the suction area of the casing (typically located adjacent to the bearing frame) enters a cavity which is being formed as the rotor turns. As the pump shaft continues to rotate, the cavity is sealed and the captured process fluid is displaced axially along the length of the casing to its ultimate exit point at the casing discharge (typically located at the extreme non-drive end of the pump). This smooth, continuous pumping action ensures an even, uninterrupted volumetric output from the pump and minimizes pressure pulsations at the pump discharge.

Allweiler AE Series

Standard materials of construction:

- Casing – carbon steel, stainless steel with an elastomer lined pumping chamber
- Screw shafts – carbon steel, stainless steel
- Shaft sealing – single and double mechanical seals with cartridge option

Engineered design advantages of the technology:

- Able to handle contaminated process fluids with large percentages of abrasives and entrained gas
- Simple and economical design requiring only one shaft seal
- Low NPSHr / NPIPr due to large internal cavities and low speed operation
- Gently handles shear sensitive fluids like emulsions
- Able to be mounted in horizontal and vertical orientations
- Sealed universal coupling joint for increase pump life
- Customized materials of construction for optimum compatibility with process fluid
- Optional NACE compliance for H_2S services
- Able to offer in accordance to the latest edition of API 676 as an option

Typical oil and gas process fluid-handling applications:

- Field Gathering Pumps
- Heater Treater Charge Pumps
- Free Water Knockout Pumps
- Desalter Bottoms Pumps
- Multiphase Pumps
- Suction Booster Pumps
- Tank Loading & Unloading Pumps
- Tank Blending Pumps
- Tank Heater Circulation Pumps
- Waste & Slop Oil Pumps

Operating parameters:

Progressing Cavity Pump:

Maximum Flow Rate	Differential Pressure	Viscosity Range Min to Max	Max Fluid Temperature	Max Solids Content	Max Free Water Content	Max Gas Content	CIRCOR Brand & Series
450 m3/h	40 bar	1 to 270000 cSt	165 deg C	20%	100%	40%	Allweiler AE

DOUBLE SUCTION TWIN-SCREW PUMPS

HOW THEY CONVEY FLUIDS

The HOUTTUIN™ and WARREN® two-screw pumps are rotary, self-priming positive displacement pumps. In both cases, the basic pump design is double ended or double suction to achieve higher flow rates. The two pumps' shafts are supported between bearings. The fluid entering the suction port is split into two equal portions, with half being diverted to the inlet area of each opposing screw set. As the rotating screws intermesh, transfer chambers are formed, trapping and conveying the fluid axially to the discharge location, which is typically located at the mid span of the pump casing. The drive relationship between the two pumps shafts is achieved through a set of timing gears. These mechanical components provide the drive transmission link between the longer shaft, which is connected to the input driver, and the shorter driven shaft. By means of this design arrangement a close clearance can be maintained between the four pumping rotors and the pump casing without the possibility of metal-to-metal contact during operation. To permit the handling of contaminated, corrosive process fluids and dry running, the bearings and timing gears are located outside of the process envelope and are independently lubricated.

Houttuin TT Series

Standard materials of construction:

- Casing – ductile iron, carbon & stainless steel
- Screw shafts – carbon steel, stainless steel
- Shaft sealing – single and double mechanical seals with cartridge option

Warren FSXA Series

Engineered design advantages of the technology:

- Able to handle contaminated and/or corrosive process fluids with large volumes of gas - run dry capability
- Extremely low NPSHr / NPIPr, ideal for stripping services
- Optional NACE compliance for H_2S services
- Able to offer in accordance to the latest edition of API 676 as an option
- Pair with patented SMART cavitation sensing package for high efficiency, cavitation free operation

Typical oil and gas process fluid-handling applications:

- Field Gathering Pumps
- Heater Treater Charge Pumps
- Free Water Knockout Pumps
- Multiphase Pumps
- Suction Booster Pumps
- Mainline Shipping Pumps
- Tank Loading & Unloading Pumps
- Tank Blending & Circulation Pumps

Operating parameters:

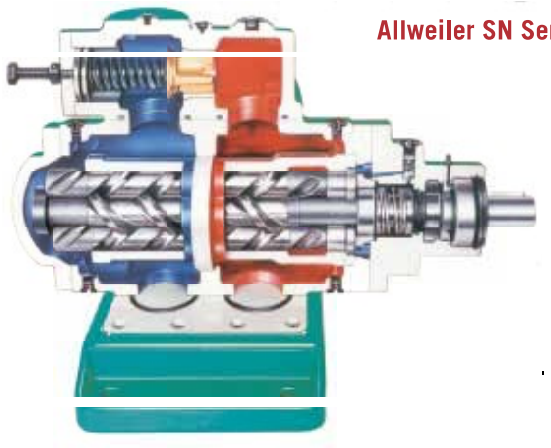
Maximum Flow Rate	Differential Pressure	Viscosity Range Min to Max	Max Fluid Temperature	Max Solids Content	Max Free Water Content	Max Gas Content	CIRCOR Brand & Series
6000 m3/h 26,000 usgpm	16 bar 230 psi	0.5 to 5400 cSt	140 deg C 285 deg F	2%	100%	50%	Houttuin 200 series
3300 m3/h 14,500 usgpm	16 bar 232 psi	0.5 to 5,000 cSt	140 deg C 285 deg F	2%	100%	50%	Houttuin TT series
795 m3/h 3500 usgpm	40 bar 580 psi	0.5 to more than 1 million cSt	400 deg C 750 deg F	2%	100%	50%	Warren Jaguar series
4000 m3/h 17,500 usgpm	60 bar 870 psi	0.5 to 100000 cSt	400 deg C 750 deg F	2%	100%	100%	Houttuin MR series
1300 m3/h 5700 usgpm	100 bar 1450 psi	0.5 to 100000 cSt	140 deg C 285 deg F	2%	100%	50%	Warren FSXA series

SINGLE SUCTION THREE-SCREW PUMPS

HOW THEY CONVEY FLUIDS

The ALLWEILER® and IMO® three-screw pumps are rotary, self-priming, single suction, positive displacement pumps. The pumping elements consist of three moving parts: the power rotor (main screw) and two symmetrically opposed idler rotors, all operating within close fitting housing bores. The incoming process fluid is conveyed by the rotating power rotor by means of the cavity formed with the intermeshing idler rotors. These two hydraulically driven shafts, which only make rolling contact with the power rotor, regulate the amount of internal slip. From the single entry suction port to the discharge connection, the fluid is transferred by means of a series of constantly forming and re-forming chambers until it reaches the casing outlet. Symmetrical pressure loading on the power rotor eliminates the need for radial bearings to absorb radial forces. The idler rotors generate a hydrodynamic film which provides radial support similar to journal bearings. Axial loads on the power rotor and idler rotors, created by differential pressure, are hydrostatically balanced. By this design arrangement high differential pressures can be managed.

Allweiler SN Series



Standard materials of construction:

- Casing – ductile iron, carbon steel
- Screw shafts – hardened steel
- Shaft sealing – single and double mechanical seals with cartridge option

Engineered design advantages of the technology:

- Tremendous pressure boost capabilities
- High overall efficiencies on low and high viscosity fluids
- Simple pump design with only one seal and one bearing
- Pulse-free flow with extremely low vibration and noise levels
- Able to offer in accordance to the latest edition of API 676 as an option

Imo 12D Series

Typical oil and gas process fluid-handling applications:

- Field Gathering Pumps
- Mainline Shipping Pumps
- Pipeline Re-injection Pumps

Operating parameters:

Maximum Flow Rate	Differential Pressure	Viscosity Range Min to Max	Max Fluid Temperature	Max Solids Content	Max Free Water Content	Max Gas Content	CIRCOR Brand & Series
34 m3/h 150 usgpm	100 bar 1450 psi	1 to 2000 cSt	80 deg C 175 deg F	0.5%	10%	5%	Imo LB6D series
90 m3/h 400 usgpm	103 bar 1500 psi	4 to 5400 cSt	107 deg C 225 deg F	0.5 %	10%	5%	Imo 6D series
90 m3/h 400 usgpm	138 bar 2000 psi	4 to 5400 cSt	107 deg C 225 deg F	0.5 %	10%	5%	Imo 12D series
660 m3/h 2900 usgpm	138 bar 2000 psi	10 to 5400 cSt	107 deg C 225 deg F	0.5%	10%	5%	Imo 8L series
318 m3/h 1400 usgpm	100 bar 1450 psi	4 to 5000 cSt	250 deg C 480 deg F	0.5%	10%	5%	Allweiler SN series
130 m3/h	120 bar	4 to 5000 cSt	250 deg C	0.5%	10%	5%	Allweiler SM

DOUBLE SUCTION THREE-SCREW PUMPS

HOW THEY CONVEY FLUIDS

The ALLWEILER® and IMO® three-screw pumps are rotary, self-priming, double suction, positive displacement pumps. The pumping elements consist of five moving parts: the power rotor (main screw) and two sets of symmetrically opposed idler rotors, all operating within close fitting housing bores. The power rotor shaft is supported at either end by journal bushings (similar to a between bearings arrangement) which are product lubricated. The incoming process fluid is conveyed by the rotating power rotor by means of the cavities formed with the intermeshing idler rotors. These four hydraulically driven shafts, which only make rolling contact with the power rotor, regulate the amount of internal slip. The fluid entering the suction port is split into two equal portions, with half being diverted to the inlet area of each opposing screw set. From suction to discharge the fluid is transferred by means of a series of constantly forming and re-forming chambers until it reaches the casing outlet. Symmetrical axial pressure loading on the power rotor eliminates the need for thrust bearings to absorb axial forces. The idler rotors generate a hydrodynamic film which provides radial support similar to journal bearings.

Imo 324A Series

Imo 323F Series

Engineered design advantages of the technology:

- High overall efficiencies on low and high viscosity fluids
- Pulse-free flow with extremely low vibration and noise levels
- Between bushings power rotor design with only one shaft seal
- Able to offer in accordance to the latest edition of API 676 as an option

Standard materials of construction:

- Casing – ductile iron, carbon steel
- Screw shafts – hardened steel
- Shaft sealing – single and double mechanical seals with cartridge option

Typical oil and gas process fluid-handling applications:

- Field Gathering Pumps
- Heater Treater Charge Pumps
- Suction Booster Pumps
- Tank Loading & Unloading Pumps
- Tank Blending & Circulation Pumps

Operating parameters:

Three-Screw Pumps:

Maximum Flow Rate	Differential Pressure	Viscosity Range Min to Max	Max Fluid Temperature	Max Solids Content	Max Free Water Content	Max Gas Content	CIRCOR Brand & Series
750 m3/h 3300 usgpm	21 bar 300 psi	10 to 5400 cSt	260 deg C 500 deg F	0.5%	10%	5%	Imo 323F series
204 m3/h 900 usgpm	34 bar 500 psi	10 to 5400 cSt	260 deg C 500 deg F	0.5%	10%	5%	Imo 324A series
182 m3/h	48 bar	10 to 5400 cSt	107 deg C	0.5%	10%	5%	Imo T324N

SINGLE SUCTION EXTERNAL GEAR PUMPS

HOW THEY CONVEY FLUIDS

The ZENITH® external gear pump is a rotary, positive displacement pump. The pumping elements consist of two precision ground, specially profiled spur style pumping gears rotating within close-clearance casing bores. At either end of these gears are tight fitting end plates to limit internal leakage from discharge to suction. The process fluid enters the side inlet connection; and as each tooth cavity opens, it is subsequently filled with fluid. As the drive shaft rotates with its fixed gear rotor, the spur gear on the driven shaft is mechanically propelled. This action advances the gear teeth to the point where the tooth cavity becomes enclosed by a portion of the semi-circumferential casing bore. As the two shafts continue to rotate, the captured fluid is borne around this arc length until the cavity opens to discharge pressure. The fluid is then discharged when the gear teeth re-mesh. By this means the surfaces of the pumping rotors cooperate to provide continuous sealing.

Zenith 9000MD Series

Standard materials of construction:

- Casing – tool steel, stainless steel
- Rotors & shafts – tool steel, stainless steel
- Shaft sealing – single and double mechanical seals with cartridge option

Engineered design advantages of the technology:

- Precision metering capabilities with excellent repeatability
- High pressure boost and temperature ranges
- Zero-leaked, sealless pump design using magnetically coupled drive, thereby eliminating the need for expensive double mechanical seals and the barrier fluid support system
- Compact, robust design that is bi-directional
- Hardened materials for increased resistance to abrasive wear of critical internal clearances
- Meets hazardous atmospheres equipment requirements stipulated by OSHA, EPA and CSA regulations
- Able to offer in accordance to the latest edition of API 676 as an option

Typical oil and gas process fluid-handling applications:

- Scraper Trap Pumps
- Chemical Injection Pumps

Operating parameters:

External Gear Pump:

Maximum Flow Rate	Differential Pressure	Viscosity Range Min to Max	Max Fluid Temperature	Max Solids Content	Max Free Water Content	Max Gas Content	CIRCOR Brand & Series
2 m3/h 9 usgpm	170 bar 2500 psi	0.5 to 50000 cSt	510 deg C 950 deg F	0.5%	100%	5%	Zenith 9000MD series

CIRCOR is a market-leading, global provider of integrated flow control solutions, specializing in the manufacture of highly engineered valves, instrumentation, pumps, pipeline products and services, and associated products, for critical and sever service applications in the oil and gas, power generation, industrial, process, maritime, aerospace, and defense industries.

Excellence in Flow Control

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