



Positive Displacement Pumps and Oil-Free Gas Compressors For Liquid CO₂ Applications



- Recirculation
- Processing
- Bulk Transfer
- Truck & Transport
- Railcar Unloading
- Vapor Recovery



Blackmer Liquid CO₂ Pumps & Compressors

Guide to Blackmer Liquid CO₂ Equipment

Product	Description / Application	Page
CRLR 1.25 CRL 1.25 CRL 1.5	Motor-speed pumps for cylinder filling, low volume motor fueling and small vaporizers. Capacities to 22 U.S. gpm (83 L/min.).	4
CRL 2 CRL 3 CRL 4	Fuel-mounted pumps for bulk transfer, recirculation and truck systems. Capacities to 300 U.S. gpm (1,135 L/min.).	5
HD162 HD362 HD602 HDL322 HDL342 HDL642	Oil-free gas compressors for liquid transfer and vapor recovery. Capacities to 63 cfm (107 m ³ /hr).	7
BV$\frac{1}{4}$ BV1 BV1.25 BV1.5 BV2	Bypass valves for in-line system protection. Capacities to 250 U.S. gpm (946 L/min.).	8

Liquefied gas pumps specially designed for liquid CO₂ service

In response to specific requests from major CO₂ marketers for a more durable pump, capable of handling higher working pressures on liquid CO₂ service, Blackmer accepted the challenge of designing a pump that would meet or exceed the marketers' specifications. Design criteria included the ability to easily handle dry, non-lubricating CO₂, at sub-zero temperatures, with differential pressures up to 100 psig (6.89 bar), while operating on a continuous 24-hour duty cycle with minimal maintenance and inspection requirements. After four years of intensive research and development, and 30,000 hours at combined laboratory and field testing, Blackmer introduced a new line of pumps that far exceeded the original expectations. Utilizing Blackmer's unique sliding-vane design, these rotary positive displacement pumps offer the best combined characteristics of sustained high level performance, energy efficiency, trouble-free operation and low maintenance cost.

A full line of transfer and recirculation pump models are available in 1.25, 1.5, 2, 3 and 4-inch port sizes for industrial and food processing systems, refrigeration, process plants and transport loading and unloading. Capacities range from 5 to 300 gpm (19-1,134 L/min). with working pressures up to 500 psig (34.47 bar) and operating temperatures down to -30°F (-34°C).

High Performance Design Features

Replaceable casing liner and end discs

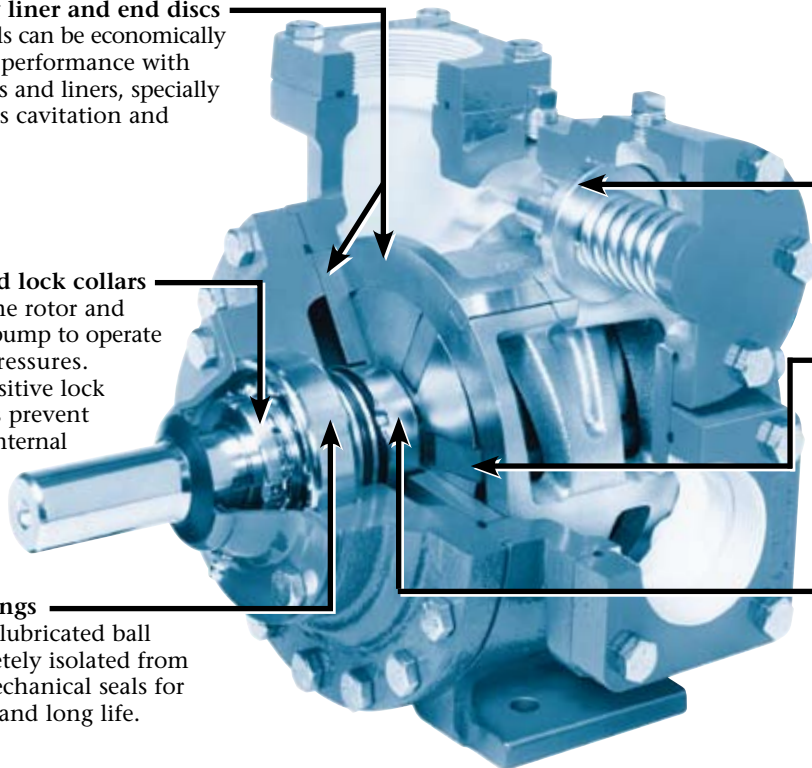
Blackmer CRL models can be economically rebuilt for like-new performance with replaceable end discs and liners, specially designed to suppress cavitation and reduce wear.

Two-piece threaded lock collars

Precisely position the rotor and shaft, allowing the pump to operate under high inlet pressures. In addition, this positive lock thrust control helps prevent premature wear to internal components.

External ball bearings

Low friction grease-lubricated ball bearings are completely isolated from the pumpage by mechanical seals for trouble-free service and long life.



Ductile iron construction

All pressure parts are of ductile iron for greater resistance to both thermal and mechanical shock

Internal relief valve

Protects the pump from excessive pressure buildup in the event of an obstructed or closed return line.

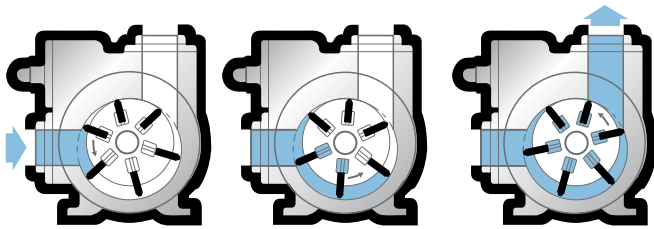
Self-adjusting vanes

Designed to resist wear under non-lubricating conditions. These chemically inert vanes are formulated of a tough laminate material for long life and quiet operation.

Blackmer mechanical seals

Specially developed for non-lubricating liquid CO₂ applications, Blackmer's exclusive component-type design is field proven to provide long life and reliable service.

FIGURE 1. How Blackmer's sliding vane action works



How Blackmer sliding vane pumps achieve high efficiency

As shown in Figure 1, Blackmer pumps use a rotor with sliding vanes that draw the liquid in behind each vane, through the inlet port and into the pumping chamber. As the rotor turns, the liquid is transferred between the vanes to the outlet where it is discharged as the pumping chamber is squeezed down. Each vane provides a positive mechanical push to the liquid before it.

Vane contact with the chamber wall is maintained by three forces: (1) centrifugal force from the rotor's rotation, (2) push rods moving between opposing pairs of vanes, and (3) liquid pressure entering through the vane grooves and acting on the rear of the vanes. Each revolution of a Blackmer pump displaces a constant volume of fluid. Variance in pressure has minimal effect. Energy-wasting turbulence and slippage are minimized and high volumetric efficiency is maintained.

Efficiency means energy savings

The high efficiency of Blackmer pumps means they require less horsepower than other positive displacement pumps. So you spend less on motors initially and less on electricity to operate the pumps after they are installed.

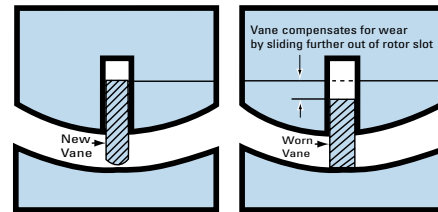
High capacity at lower speeds means reduced wear

The volumetric efficiency of Blackmer pumps saves more than energy. Their inherently low slippage allows them to operate at substantially lower rpms than other positive displacement pump types, while still delivering equivalent output. These lower operating speeds mean quieter operation, longer service life, and reduced maintenance requirements.

Self-adjusting vanes keep performance high

The performance of gear pumps will constantly diminish as wear increases clearances. To compensate for the reduced performance, you must increase the pump speed (which further accelerates pump wear) or put up with reduced capacity until performance drops to a totally unacceptable level. The vanes on a Blackmer pump automatically slide out of their rotor slots to continuously adjust for wear. No more speeding up to compensate and no more putting up with poor performance. Blackmer pumps maintain near-original efficiency and capacity throughout the life of the vanes.

FIGURE 2. How Blackmer's sliding vanes maintain efficiency



Vane replacement in minutes, easy inspection

Vane replacement is easy. Simply remove the outboard head assembly, slide out the old vanes, insert the new ones, and reinstall the head. In a matter of minutes, your pump is back in operation. Routine inspection is equally easy. In fact, most maintenance can be done without disconnecting the pump from its piping or drive shaft.



Simple vane replacement requires no special tools.

Replaceable liners economically restore efficiency

Blackmer CO₂ pumps are equipped with replaceable liners that protect the pump casing and provide the economy of simple replacement, restoring the pump to like-new efficiency. No special tools are required to remove a worn liner and install a new one, and the simple operation can be completed in a few minutes without taking the pump off line.



Easily replaceable liner restores efficiency.

All Products in this bulletin are manufactured to ISO 9001 quality standards.



CRLR1.25, CRL1.25 & CRL1.5 Pumps

Motor-Speed Recirculation Pumps



CRL(R) 1.25" /
CLR 1.5" cutaway

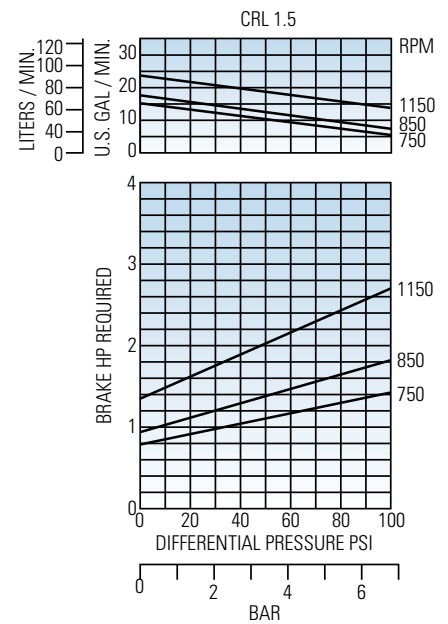
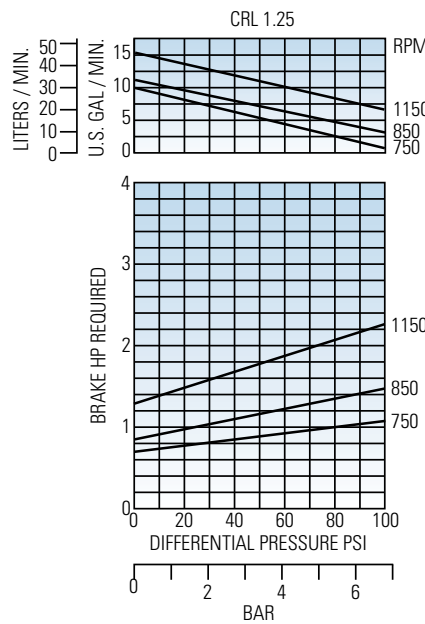
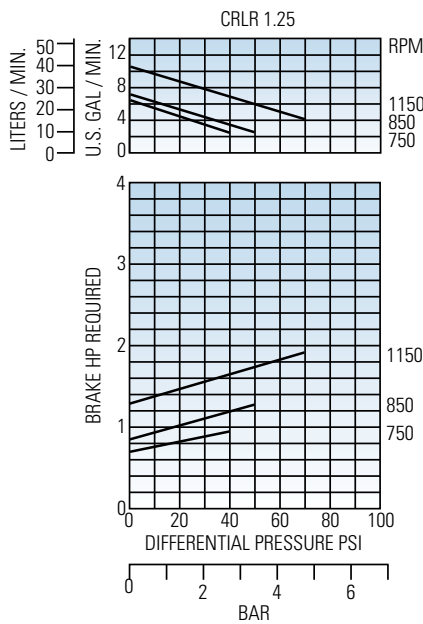
These durable motor-speed pumps offer capacities from 5 to 22 U.S. gpm (19-83 L/min.), and are ideal for loop systems and low-volume transfer applications. The CRL models are designed for foot-mounting to a common baseplate.

Available with 1.25 or 1.5-inch NPT tapped ports, all models are equipped with an internal relief valve, and a replaceable casing liner and end discs for easy rebuilding of the pumping chamber if ever necessary. The CRLR 1.25-inch model features a special liner which offers lower flow rates than the CRL 1.25-inch pump.

Standard construction materials for these pumps include silicon carbide mechanical seals and laminate vanes. Maximum differential pressure for the CRLR 1.25 is 70 psi (4.83 bar), and 100 psi (6.89 bar) for the CRL 1.25 and CRL1.5-inch models.

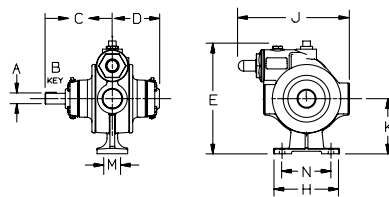
Assembled pump units are available from the factory, with or without motors. For dimensions of assembled pump units, refer to catalog dimension sheets.

Performance Curves



Foot Mounting - Direct Motor Drive

Base Pump Dimensions

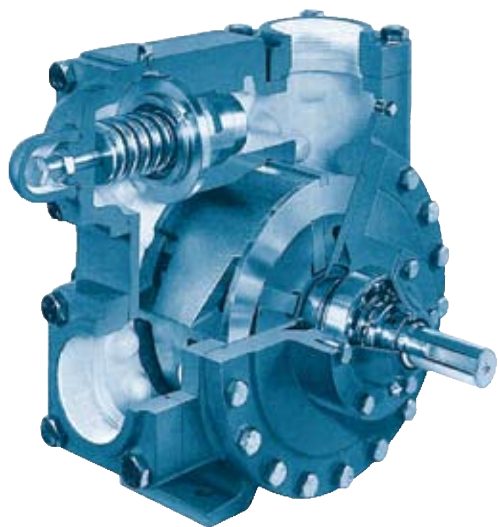


Pump Model	A	B	C	D	E	G	H	J	K	M	N	Approx. Weight Less Motor	
												lbs.	kg
CRLR 1.25	in	7/8	3/16	5 1/2	3 3/8	9 1/8	—	5 1/2	9 1/8	4 1/2	1 3/8	4	30
CRL 1.25	mm	—	—	140	98	232	—	140	232	114	35	102	14
CRL 1.5	mm	—	—	140	98	232	—	140	232	114	35	102	14



CLR2, CLR3 & CLR4 Pumps

Bulk-Transfer Recirculation Pumps



CRL4 cutaway

These rugged pumps are widely used for bulk-transfer and recirculation applications which include industrial and food-processing systems, refrigeration, process plants and transport loading and unloading.

Models are available in 2, 3 and 4-inch port sizes with capacities ranging from 25 to 300 U.S. gpm (95-1,134 L/min.). All models have a double-ended drive shaft arrangement, which allows the pump to be easily positioned for clockwise or counterclockwise shaft rotation. These pumps are equipped with an internal relief valve, and a replaceable casing liner and end discs for easy rebuilding of the pumping chamber if ever necessary.

Standard construction materials for these models include silicon carbide mechanical seals and laminate vanes. Ports are offered with NPT tapped companion flanges or weld flanges (see companion flange chart below). Maximum differential pressure is 100 psi (6.89 bar) for all models.

Standard base-mounted unit assemblies are available from the factory with helical gear reduction or V-belt drives. All assembled units are available with or without motors. For dimensions of assembled pump units, refer to catalog dimension sheets. Alternate drive arrangements include P.T.O., hydraulic motor or engine drivers.

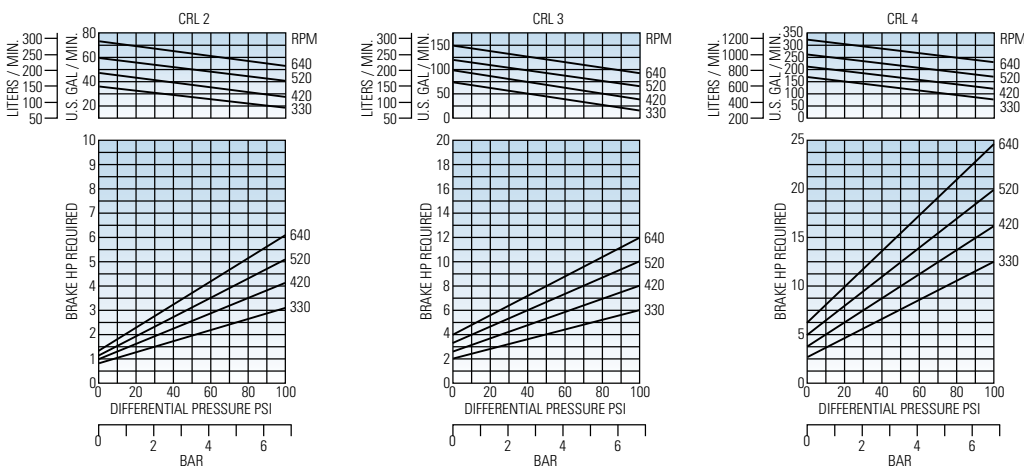
Performance Curves



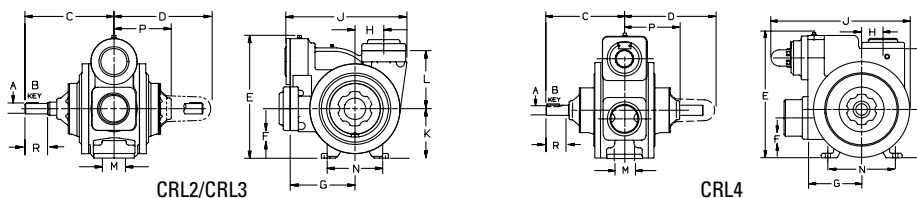
Helical Gear Reduction Drive



V-Belt Drive



Base Pump Dimensions



Product	Standard or Optional	Intake	Discharge
CRL2	Standard	2" NPT Flange	2" NPT Flange
	Optional	2" Weld Flange	2" Weld Flange
CRL3	Standard	3" NPT Flange	3" NPT Flange
	Optional	3" Weld Flange	3" Weld Flange
CRL4	Standard	4" Weld Flange	3" Weld Flange
	Optional	3" NPT Flange	3" NPT Flange
	Optional	3" Weld Flange	3" Weld Flange
	Optional	4" Weld Flange	4" Weld Flange

Pump Model	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	Approx. Weight Less Motor		
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	lbs.	kg	
CRL2	in	1 1/8	1/4	8	8 15/16	10	3 3/4	4 9/16	2 3/8	9 3/4	4	4 3/8	1 3/8	5	5 1/8	2 1/4	85	39
	mm	-	-	203	227	254	95	122	60	248	102	124	41	127	138	57		
CRL3	in	1 1/8	1/4	9 3/8	11 1/8	13 3/8	5 3/8	7	3 3/8	13 3/8	5 3/8	6 3/8	2 1/2	6	6 3/8	2 1/8	160	73
	mm	-	-	245	283	340	137	178	79	340	137	160	64	152	160	62		
CRL4	in	1 1/4	5/16	9 3/8	11 1/8	15 1/8	4 7/8	6 3/8	2 3/8	16 1/8	5 1/8	7 1/2	2 1/2	8 1/4	6 3/8	2 3/4	250	93
	mm	-	-	245	281	392	124	167	67	430	151	191	64	210	172	70		



HD162, HD362, HD602, HDL322, HDL342 & HDL642

Oil-Free Gas Compressors



Blackmer oil-free gas compressors are ideal for railcar unloading and vapor-recovery applications. These single-stage compressors are designed to give maximum performance and reliability under the most severe conditions.

The double-seal compressor models incorporate a vented or pressurized distance piece chamber which prevents piston rod over-travel, eliminating any contamination of compressed CO₂. Crankcase oil contamination and cylinder blow-by is further prevented in all compressor models with live-loaded, self-adjusting, filled PTFE seals which maintain a constant sealing pressure around the piston rods.

Models are available with capacities from 4 to 63 cfm (6.8-107 m³/hr), with working pressure up to 1,000 psia (69 bar). Blackmer offers a variety of mounting arrangements to fit most application requirements. Complete factory-assembled base-mounted units are available with liquid trap, four-way valve, strainer, relief valve, pressure gauges, interconnecting piping, and V-belt drive assembly including motor sheave and hub with adjustable motor slide base.

Compressors are available with or without motors or accessories. All models can be transport mounted, and can be adapted for either direct drive or V-belt drive. For more information and specifications for all Blackmer industrial compressors, request Bulletin 901-001.

Engineering Specifications

Double-Seal Models	HD162	HDL322	HDL342	HD362	HDL642	HD602
Number of Cylinders	2	2	2	2	2	2
Bore - in. (mm)	3.0 (76)	2.0 (51)	2.69 (68)	4.0 (102)	3.25 (83)	4.625 (117)
Stroke in. (mm)	2.5 (64)	3.0 (76)	3.0 (76)	3.0 (76)	4.0 (102)	4.0 (102)
Maximum Allowable Working Pressure - psia (bar)	350 (24.1)	1,000 (69)	750 (51.7)	350 (24.1)	750 (51.7)	350 (24.1)
Minimum/Maximum rpm	350 / 825	350 / 825	350 / 825	350 / 825	350 / 825	350 / 825
Piston Displacement						
@100 rpm - cfm (m ³ /hr)	2.05 (3.48)	1.09 (2.80)	1.97 (3.34)	4.36 (7.41)	3.84 (6.5)	7.78 (13.2)
@Min rpm - cfm (m ³ /hr)	7.16 (12.2)	3.81 (9.8)	6.89 (11.71)	15.3 (26.0)	13.4 (22.8)	27.2 (46.3)
@Max rpm - cfm (m ³ /hr)	16.9 (28.7)	9.00 (23.1)	16.25 (27.61)	36.0 (61.2)	31.7 (53.8)	64.2 (109.0)
Max. BHP (kw)	10 (7.5)	15 (11)	15 (11)	15 (11)	40 (30)	40 (30)
Wt. w/Flywheel - lb. (kg)	-225 (102)	~385 (175)	~375 (170)	~365 (166)	~705 (320)	~705 (320)
Inlet / Outlet Connections	0.75" NPT	1.5" 600# ANSI	1.5" 600# ANSI	1.5" 300# ANSI	2" 600# ANSI	2" 300# ANSI

Compression Ratios are normally limited by discharge temperature. High compression ratios and certain gases can cause excessive heat, i.e. over 350°F (177°C). The duty cycle must provide for adequate cooling time between periods of operation to prevent excessive operating temperature.

Compressor Selection Data: Carbon Dioxide (CO₂)

Model	Approximate Liquid Transfer Delivery ¹		Pipe Diameter ²			
			Vapor		Liquid	
	U.S. gpm	L/min.	in.	mm	in.	mm
HD162	50-100	190-375	1.25	32	2	50
HD362	125-200	475-750	2	50	3	80
HD602	250-340	945-1,285	2.5	65	4	100

1 Delivery will depend on proper system design, pipe sizing and valve capacity.

2 Use next larger pipe size if piping exceeds 100 feet (30 meters).



Bypass Valves Precise, On-Line Pressure Protection



BV $\frac{3}{4}$ /BV1

BV2



BV2 cutaway

FIGURE 3.
Bypass volume/pressure curve BV1.5 in.

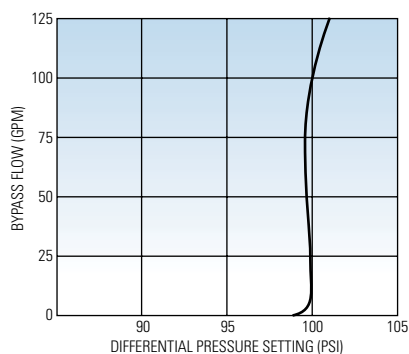
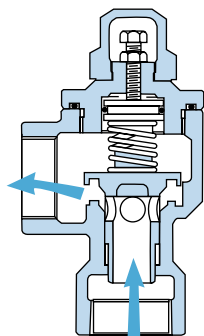


FIGURE 4.
Bypass valve operation



Dash-pot chamber cushions closing of valve

Blackmer differential bypass valves are designed to protect pumps and system components from excessive pressure damage, and no CO₂ pump installation is complete without one. Blackmer offers five different models that provide full-flow pressure control to 250 U.S. gpm (946 L/min.) at 120 psid (8.27 bar). Installation is easy with NPT tapped ports in sizes from 3/4 in. to 2 in.



In operation, Blackmer valves provide exceptionally close pressure control, even under widely varying bypass flow conditions. The performance curve in Figure 3 below shows how a Blackmer valve maintains a virtually constant pressure of 100 psi (6.89 bar) even as the volume being bypassed rises from 10 gpm to 100 gpm (38-378 L/min.). Although the curve is that of a BV1.5 in. valve, the precision it demonstrates is typical of any Blackmer valve.

Blackmer bypass valves have no small, easily plugged sensing passages; and with only two moving parts, their operation is simple and reliable. They open precisely at the preset spring pressure, and they close smoothly and quietly, thanks to a patented dash-pot design. As shown in Figure 4, a small chamber in the valve stem fills with liquid when the valve opens. This liquid then provides a hydraulic cushion preventing the valve from slamming shut if pressure is suddenly released. It also minimizes chatter and valve-seat wear when pressures hover around the critical limit.

Selection Guide

Model BV $\frac{3}{4}$ (ports are $\frac{3}{4}$ -inch NPT tapped)
Model BV1 (ports are 1-inch NPT tapped)

These models are commonly used for cylinder-filling system. Either valve can be used with 1.25 or 1.5-inch Blackmer pump models.

Model BV1.25 (ports are 1.25-inch NPT tapped)
Model BV1.5 (ports are 1.5-inch NPT tapped)

These models are normally used for bobtail trucks and smaller bulk plant systems. Either valve can be used with 2 or 3-inch Blackmer pump models.

Model BV2 (ports have 2-inch NPT companion flanges, 1.25-inch and 1.5-inch NPT and WELD bolt-on flanges are available)

The BV2 model is widely used for transports or larger bulk plant systems. It is recommended for use with 3 and 4-inch Blackmer pump models.

Maximum flow-through valve

Model	Maximum Rated Flow* - gpm (L/min.) @			
	20 psi (1.38 bar)	50 psi (3.45 bar)	80 psi (5.52 bar)	120 psi (8.27 bar)
BV$\frac{3}{4}$ BV1	25 (95)	40 (151)	50 (189)	60 (227)
BV1.25 BV1.5	60 (227)	80 (303)	100 (379)	125 (473)
BV2	150 (568)	180 (681)	220 (833)	250 (946)

*Normal maximum bypass flow rates without significantly exceeding the set pressure limit.



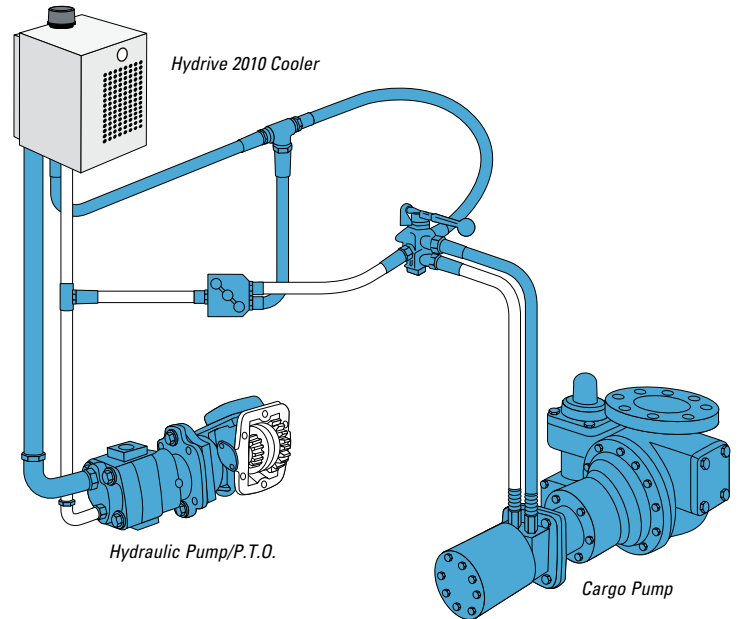
Hydraulic Drive Packages

Pump Solutions Group offers Mouvex Hydrive coolers for hydraulic drive systems. The Hydrive forms the heart of the hydraulic system and is designed for easy truck mounting.

The compact size allows for easy installation on tractors and trucks with minimal space on chassis rails. The compact and low noise centrifugal fan provides maximum performance and heat dissipation up to 13.5 hp (10kW) on 2010 models and 26 hp (20kW) on 2020 models. Both models are constructed from stainless-steel materials to withstand harsh environmental and operation conditions.

The light-weight cooler with a small hydraulic oil reservoir, reduces the concern and hazard of costly spills. The maintenance-friendly Hydrive provides an easy-to-read restriction gauge mounted on the front of the unit to indicate when the spin-on oil filter should be replaced. Normal hydraulic oil maintenance is made easy with the reservoir drain on the Hydrive tank.

Blackmer offers hydraulic motor adapters to fit CRL pumps for hydraulic drive operation.



Technical Assistance

In some applications, selecting the right pump or compressor may require more detailed information than can be presented in this bulletin. Your Blackmer representative can help you find the correct equipment to ensure the best performance possible for your specific application.

If you have a unique gas or fluid-handling problem, please contact Blackmer at the telephone or fax number listed below.



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