

LPG Equipment Training Manual



INDEX: Blackmer LPG Pumps and Compressors

- 4 Dover Resources / Dover Corp.
- 5 Blackmer – Over 100 years of history
- 6 Blackmer - Manufacturer with Total Responsibility
- 7 Engineering
- 8 Foundry
- 9 Manufacturing / Assembly
- 10 Sales / Marketing
- 11 Blackmer Markets
- 12 Worldwide Distribution
- 13 Selected Blackmer Customers
- 14 Blackmer Products

- 15 LPG Transfer with Liquid Pumps
- 16 What is LPG?
- 17 Typical LPG Pump System
- 18 How Rotary-Vane Pumps Work
- 19 How Sliding Vanes are Actuated
- 20 How Sliding Vane Self Adjust for Wear
- 21 Blackmer LPG Pump Design Features
- 22 Blackmer Mechanical Seals
- 23 Replaceable Liner & End Discs
- 24 Rugged Construction
- 25 UL Listed
- 26 Blackmer Sliding Vane Pump Advantages
- 27 Motor Speed Pumps
- 28 Stationary Transfer Pumps
- 29 Truck Pumps
- 30 ByPass Valves
- 31 Proper Pump Installation Benefits
- 32 Minimize Suction Line Losses
- 33 Don't Let Vapor Form
- 34 Stop Vapor Formation in Suction Line
- 35 Eliminate Suction Line Vapor Pockets
- 36 Use a Back-to-Tank ByPass Valve
- 37 Use a Vapor Return Line
- 38 Routine Maintenance
- 39 Easy Pump Maintenance
- 40 Pump Pictures

INDEX, continued....

- 41 LPG Transfer with Compressors
- 42 What is LPG?
- 43 Typical LPG Compressor Transfer System
- 44 Why Transfer LPG with a Compressor?
- 45 Liquid LPG transfer with a Compressor
- 46 Vapor Recovery with a Compressor
- 47 Inside the Compressor
- 48 Crankcase Details
- 49 Crosshead / Rod / Seal Details
- 50 Cylinder Details
- 51 Head / Valve Details
- 52 Typical Liquefied Gas Transfer Compressor Components
- 53 4-Way Valves
- 54 Liquid Traps
- 55 Standard Liquid Traps
- 56 ASME Code Liquid Traps
- 57 Relief Valves & Strainers
- 58 Low Oil Pressure & Hi T₂ Switches, Drivers
- 59 Models Available
- 60 Performance - English
- 61 Performance - Metric
- 62 Proper Compressor Installation Benefits
- 63 Minimize line losses
- 64 Minimize heat losses
- 65 Watch Out for Liquid
- 66 Install the compressor properly
- 67 Routine Service Schedule
- 68 Compressor Maintenance Repair
- 69 Compressor Pictures

- 70 Use a Pump or a Compressor?
- 71 When to use a Pump
- 72 When to use a Compressor
- 73 When to use a Pump & Compressor Together

- 74 End of Manual

Dover Resources / Dover Corp.

A multi-billion dollar corporation comprised of over 100 industrial manufacturing facilities.

Committed to being a leader in each market it serves via:

Product Quality

Innovation

Responsive Service

Long-term Orientation to the Market

blackmer - A Worldwide Supplier of Rotary Liquid Pumps and Gas Compressors

Over 100 years of experience:

- 1901 Robert Blackmer invents first rotary-vane pump.
- 1903 Company incorporates in Petoskey, Michigan as Blackmer Pump, Power and Manufacturing Co.
- 1914 Blackmer becomes supplier to U.S. military.
- 1915 Blackmer originates first truck-mounted pump.
- 1925 Blackmer relocates to Grand Rapids, Michigan; establishes foundry.
- 1950 Integral mechanical seal pump introduced.
- 1954 First liquefied gas pumps designed.
- 1964 Company is purchased by the Dover Corporation.
- 1968 Stainless steel non-galling pump introduced.
- 1980 First Blackmer compressor introduced.
- 1987 ML4 modular pump line introduced.
- 1990 'HD' industrial compressors introduced.
- 1991 Company name changed from 'Blackmer Pump' to 'Blackmer' to reflect growing product line.
- 1991 Seal-less technology pumps introduced.
- 1992 New compressor plant Opened.
- 1993 Grand Rapids plant received ISO-9001 certification.
- 1994 Acquired Tarby, a progressing cavity pump manufacturer.
- 1995 Oklahoma City plant received ISO-9001 certification.
- 1995 Acquired Hammond Engineering, England.
- 1997 Acquired Mouvex, a pump manufacturer in France.
- 2000 Acquired System One centrifugal pumps.

Blackmer is a manufacturer with total responsibility for the design, production and sales of its products.

Engineering - Design the Products

Foundry - Produce the Castings

Manufacturing / Assembly - Build the Products

Sales / Marketing - Determine the Markets.

Work with our distribution channels and end users to ensure that our products meet or exceed the needs of the marketplace.

Engineering - Design the Product

Professional Engineers

FEA - Finite Element Analysis

CAD - Computer Aided Design

Testing Laboratories

Foundry - Produce the Castings

Cast Iron

Ductile Iron

State of the art sand castings

State of the art Electric Furnaces

Heat Treating Facilities

Test Facilities

Quality Control

Manufacturing / Assembly - Build the Products

**Two Plants: Grand Rapids, MI - Vane Pumps,
Handpumps, System One Pumps,
Recip. Compressors, Gear Reducers
Auxerre, France - Mouvex Pumps,
Hydrive, Enterprise Compressors**

Computer Controlled Machining Centers

All finished products are tested before shipment

Quality Control, ISO-9001 Certified

Sales / Marketing

- Present the Product to the Customer

Market Managers -

Ensure that products match market needs.

Application Engineers -

Select the best solution for each application.

Customer Service -

Ensure that orders are processed smoothly.

Field Sales -

Train and Backup Distributors / Agents.

Strive for Complete End User Satisfaction.

Blackmer: Major Markets

Government

Contract Products

Mobile Transfer Equipment

Fuel Oil Truck Pumps and Accessories

Pumps for Bulk Liquid Transports & Trailers

Fluid Processing and Transfer Pumps

Pumps for Lube Oil, Asphalt, Solvents, Inks, Paints, Abrasives, Syrups, Caustics, Soaps, Latex, Molasses, etc.

Liquefied and Compressed Gas Equipment

LPG & NH₃ Transfer Pumps & Compressors

Transfer or Recovery of Carbon Dioxide, Refrigerants, other Liquefied Gasses, various Industrial gases.

International Marketing

A Global Network



Selected Blackmer Customers

General Motors

Shell

PPG

Dow

Union Oil

DuPont

Mobil

ICI

W.R. Grace

BASF

Nestle Foods

Petro Peru

Japanese Gas Co.

Techos Maalit

USAir

Sun Chemical

Lever Brothers

Hershey

Proctor & Gamble

Nippon Paint

Seven-Up

Century Oils

Owens-Illinois

FMC

B.F. Goodrich

Coca-Cola

Cargill

Federal-Mogul

General Foods

Exxon

Sun Chemical

R.J. Reynolds

GTE

China Petroleum

Croda Inks

Chevron

Fairchild Aircraft

Wal-Mart

Tadlagaz

Blackmer Products

Rotary-Vane Positive Displacement Pumps

1" to 10" Ports

Cast Iron, Ductile Iron, Steel, Stainless Steel

Packed, Mechanical Seals, Sealless

Hand Pumps

Pump Related Equipment

Relief Valves

Gear Reducers

Hydraulic Oil Cooling Systems

DMX Air Elimination Systems

Abaque Peristaltic Hose Pumps

System One Centrifugal Pumps

Enterprise Rotary Vane Compressors

Gas Compressors

2 to 50 HP (1.5 to 37 KW)

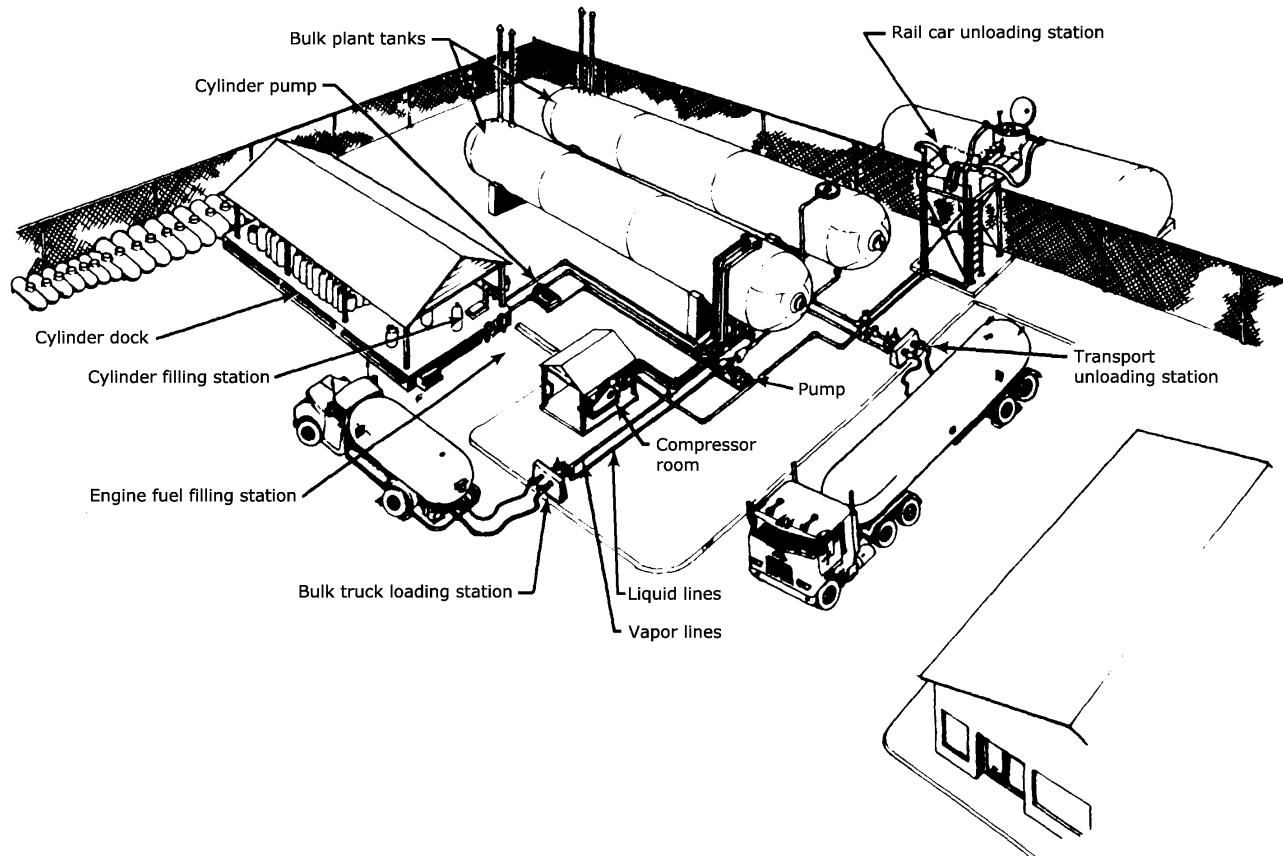
Ductile Iron Construction

Single-Stage / Two-Stage • Air-Cooled / Water-Cooled

Unit Packages

Per Customer Specification

Transfer of LPG with Blackmer Liquid Pumps



Transport to Storage
Bobtail to Storage
Storage to Cylinder

Storage to Rail
Storage to Bobtail
Storage to Vaporizer


What is LPG?

LPG: Liquefied Petroleum Gas

Usually refers to Propane, Butane or a mixture of Propane and Butane.

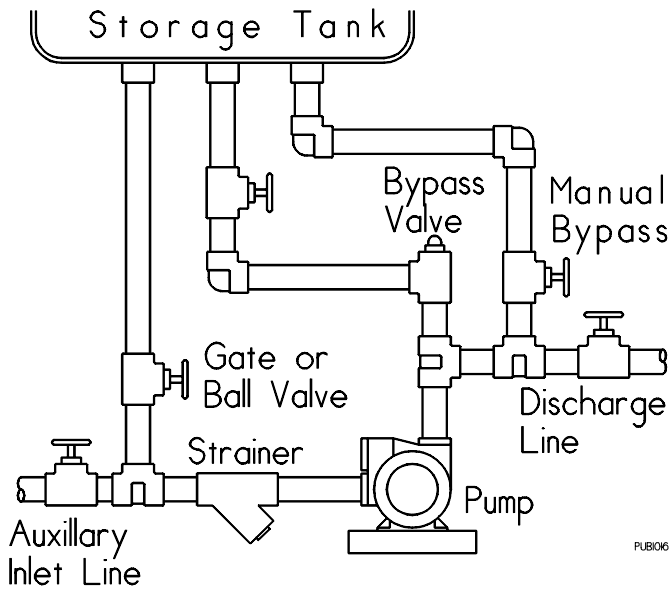
Used as a fuel in Homes, Business, and Industry.

Transported and Stored as a Liquid

Readily converted: Liquid  Gas

	Propane C ₃ H ₈		Butane C ₄ H ₁₀	
Molecular Weight	44.09		58.12	
Specific Gravity Liquid @ 60°F water = 1.0	0.51		0.58	
Vapor Pressure	psia	bar-a	psia	bar-a
at 32°F (0°C)	69.6	4.80	14.9	1.03
at 60°F (16°C)	105.5	7.28	26.1	1.80
at 100°F (38°C)	183.7	12.67	49.9	3.44

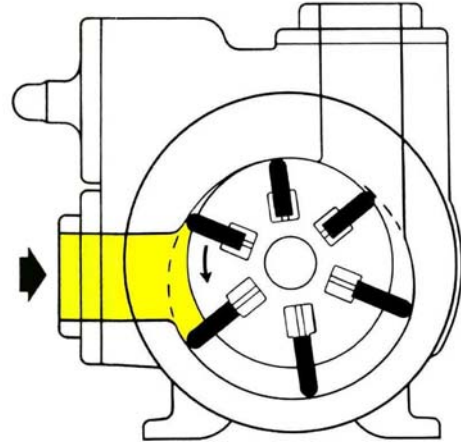
Typical LPG Pump Systems



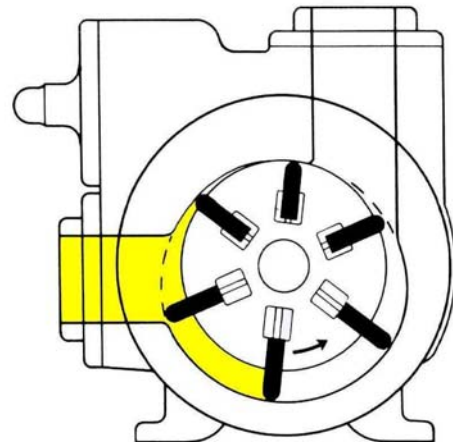
How Rotary-Vane Pumps Work

Each revolution displaces a constant volume of fluid.

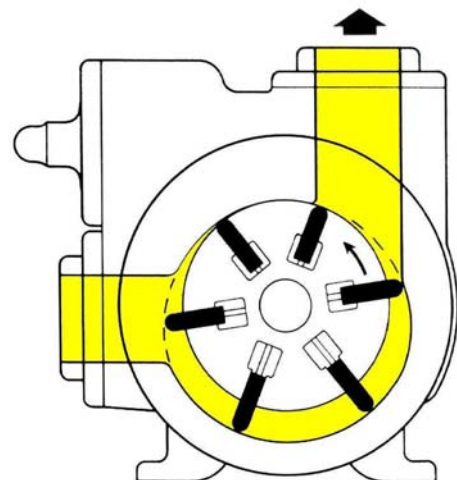
As the rotor turns, sliding vanes move outward at the intake port, expanding the pumping chamber and creating a void to draw fluid into the pump.



Fluid is transferred between the vanes from the inlet to the outlet port.

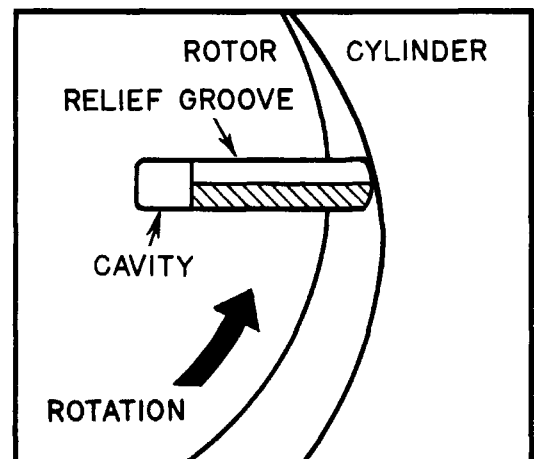
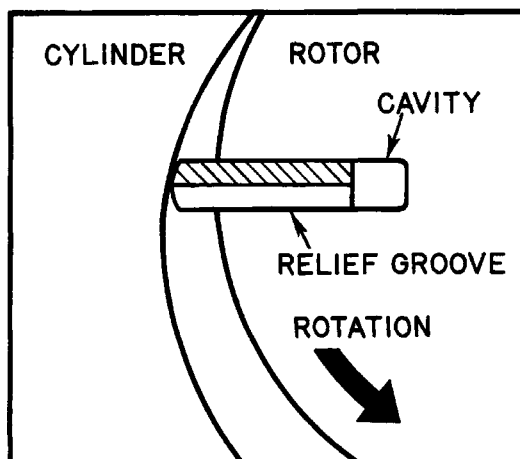
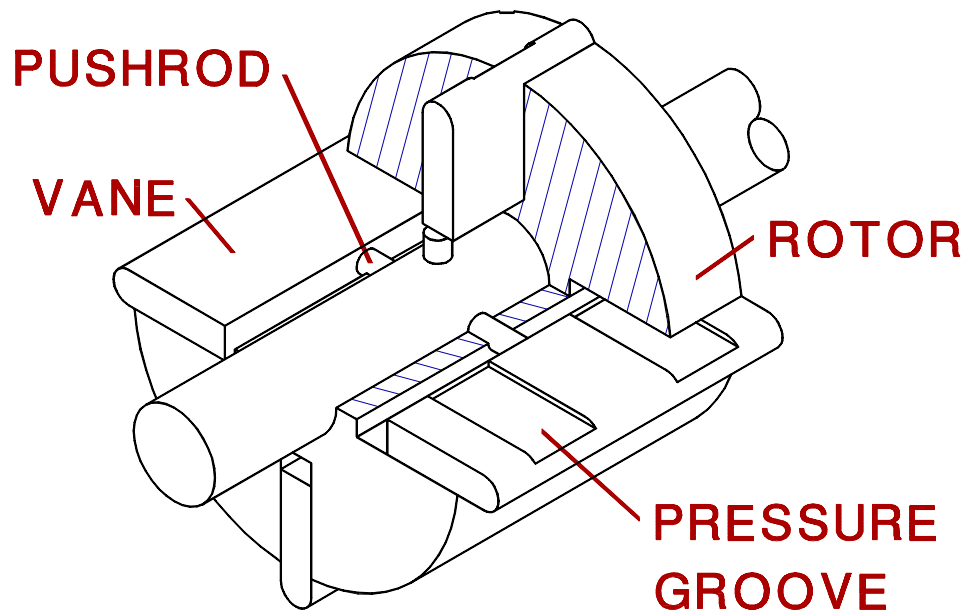


At the outlet, fluid is discharged as the pumping chamber is squeezed down and the vanes are forced back into their slots.

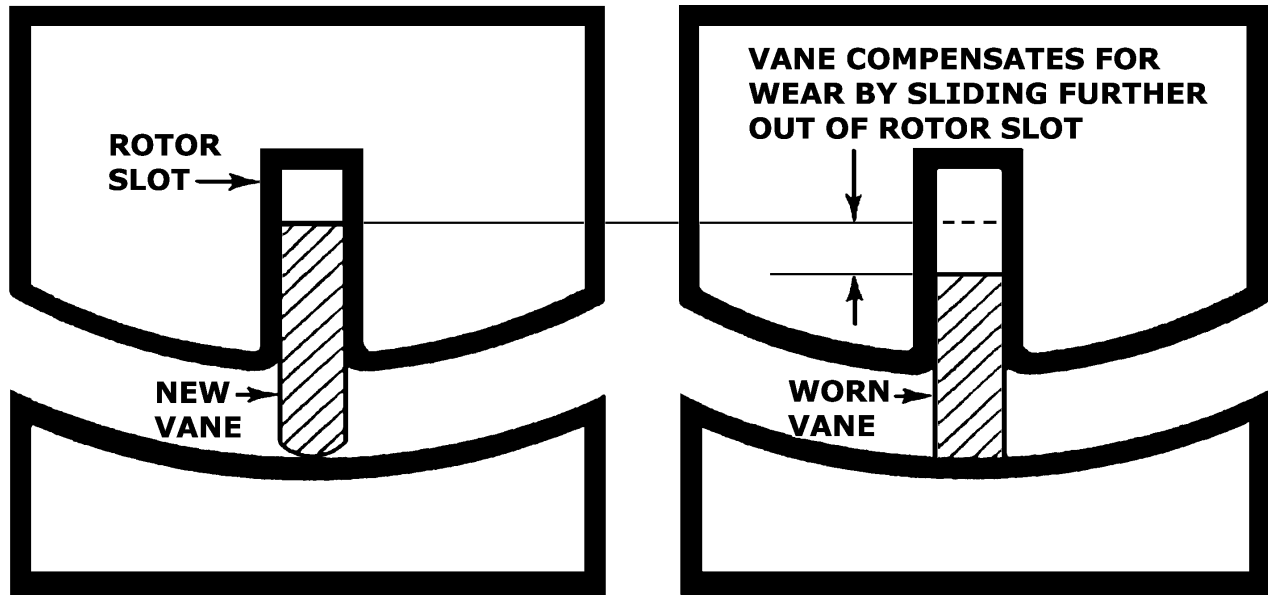


How Sliding-Vanes are Actuated

- Centrifugal force from the rotor's rotation.
- Push rods between opposing pairs of vanes.
- Liquid pressure entering through the vane grooves and acting on the bottom of the vanes.



How Sliding-Vanes Sustain High Level Performance

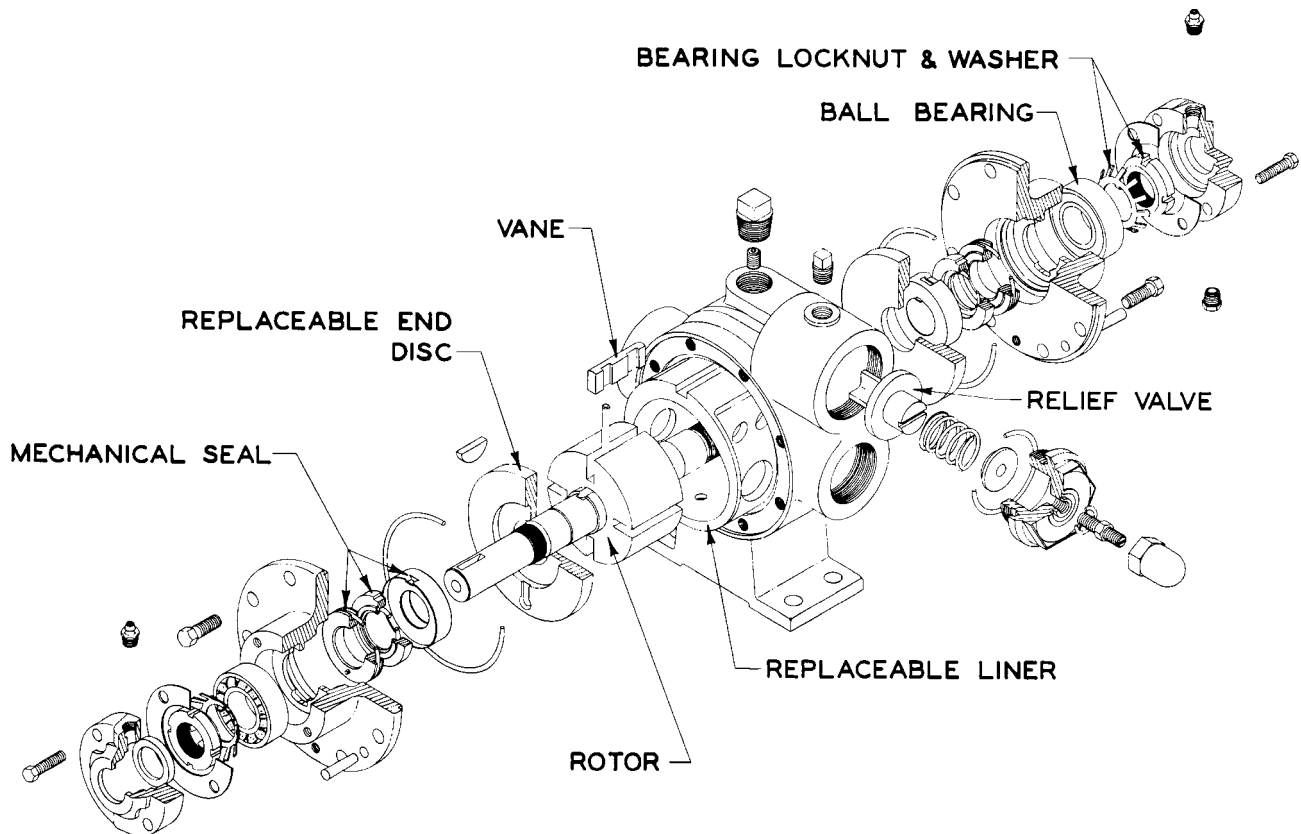


As Blackmer sliding-vanes wear, they simply move further out of the rotor slots. So the vanes self-compensate for wear to maintain high pump efficiency.

The result? Even after long use, Blackmer sliding-vane pumps maintain "like-new" levels of capacity, suction and volumetric efficiency.

Blackmer LPG Pump Design Features

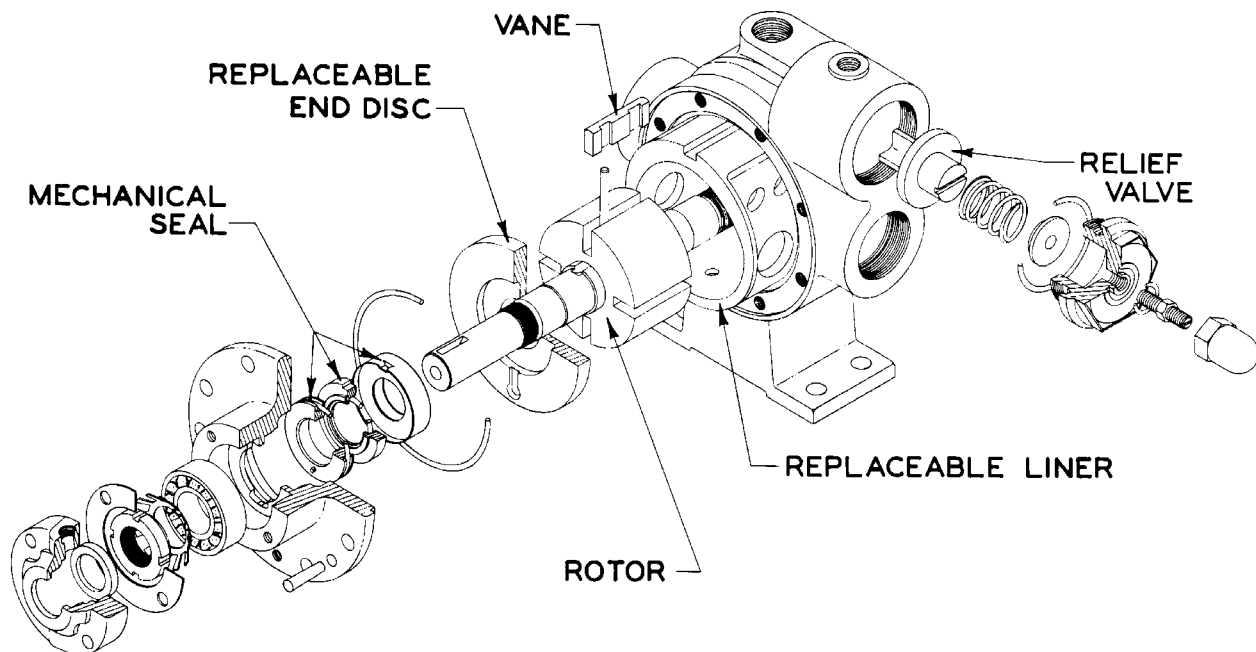
- Replaceable casing liner and end discs
- Two-Piece threaded lock collars
- External ball bearings
- Ductile iron construction
- Internal safety relief valve
- Nonmetallic Duravanes
- Blackmer mechanical seals



Blackmer Mechanical Seals

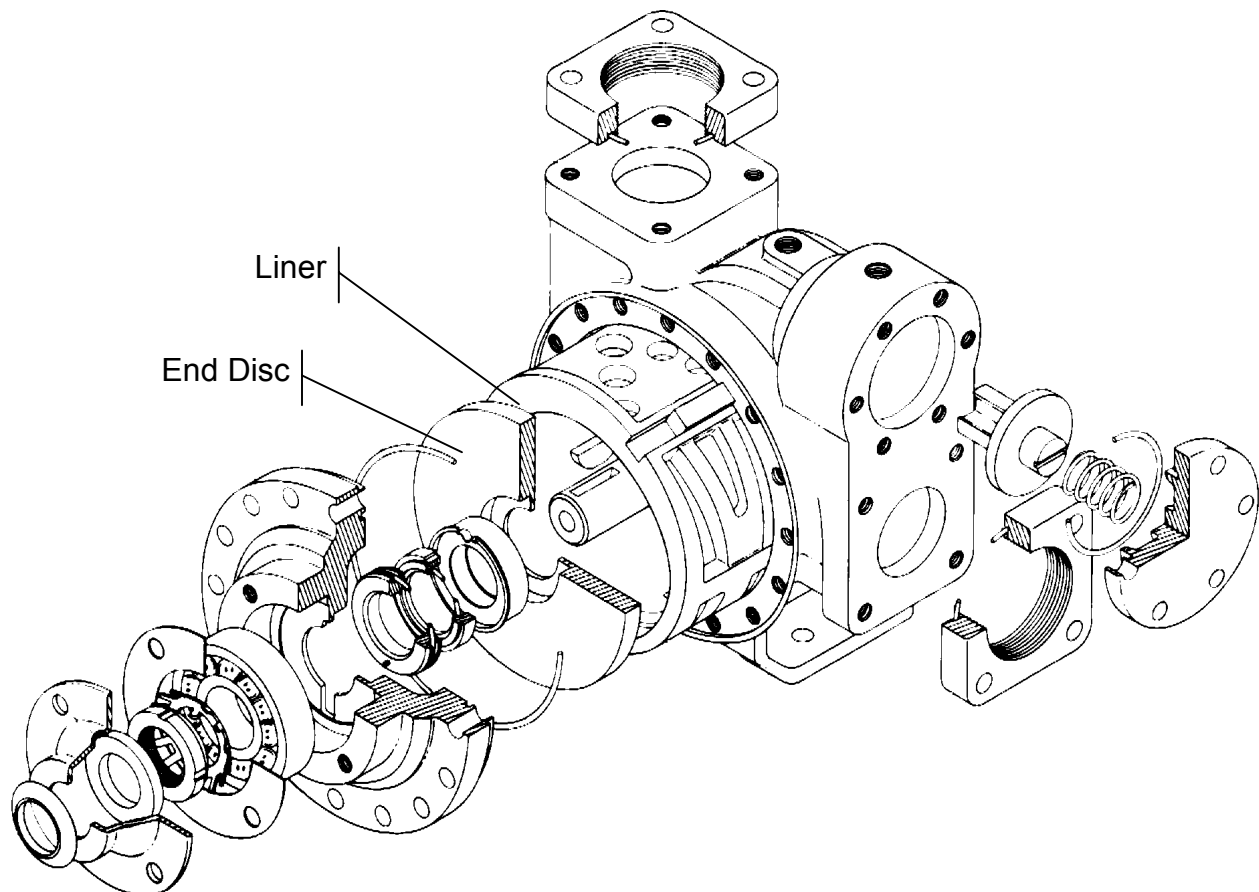
Designed And Built Exclusively for Blackmer Pumps

- Design minimizes axial and radial seal movement.
- As pump wears, seal face alignment is maintained.
- Mechanical Seal is located to maximize flush and cooling of the seal faces.
- Low PV (pressure and velocity) factors.
- No set screws or seal stack-up problems.
- Economical and easy to replace.



Replaceable Liner and End Discs

- **Featured on all LGL pumps.**
- **Protect the pump casing and head.**
- **Restores the pump to be to like-new efficiency.**
- **Simple, inexpensive replacement.**
- **Piping does not have to be disconnected.**



Rugged Construction

- **Ductile Iron Case**
 - High Strength**
 - Thermal and Mechanical Shock Resistant**
 - Working pressures of 350 psi (24.1 bar)**
- **Steel Shaft**
 - Oversized to allow operation at 150 psi (10.3 bar) differential pressures on many models.**
- **Ball Bearings**
 - External, isolated from the pumpage**
 - Grease lubricated**
 - Easy and inexpensive replacement**
- **Lock Collars**
 - Precisely position the rotor and shaft**
 - Allow higher differential pressures**
 - Prevent premature wear**

UL Listed

**All Blackmer LPG pumps are listed by
Underwriters Laboratories
for service on both
LP-gas and Anhydrous Ammonia**



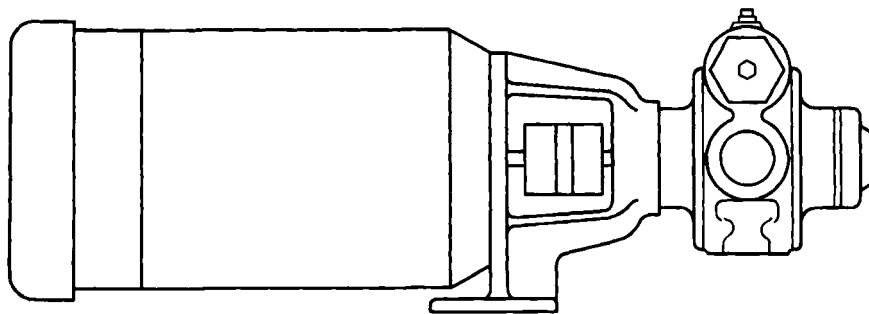
Blackmer Sliding Vane Pump Advantages

- **Vanes self adjust for wear**
Sustained high level performance
- **No metal-to-metal contact**
Quieter, less wear
- **Positive Displacement**
Moves product even under adverse conditions
- **High energy efficiency**
- **Easy and inexpensive maintenance**

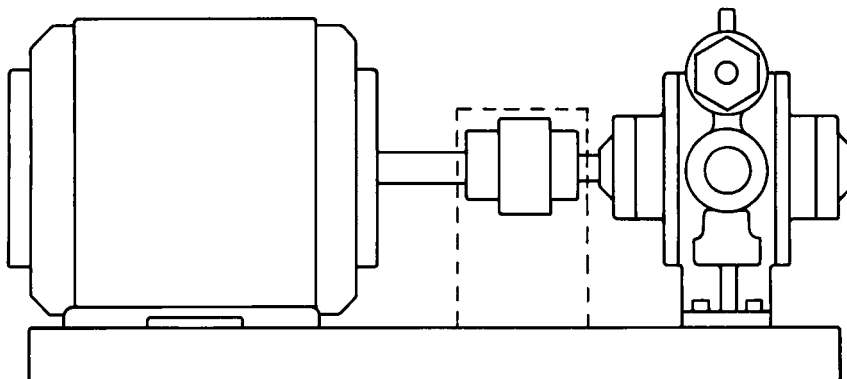
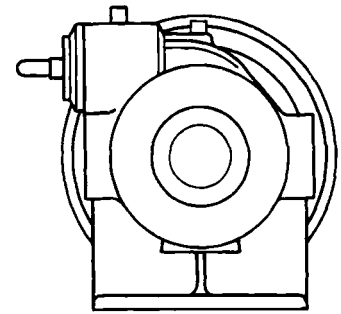
Motor Speed Pumps

Cylinder Filling	Motor Fueling	Vaporizers
LGB1C LGF1C LGB1PC LGF1PC LGL1.25	LGF1PC LGRLF1.25 LGLF1.25	LGLF1.25 LGL1.5

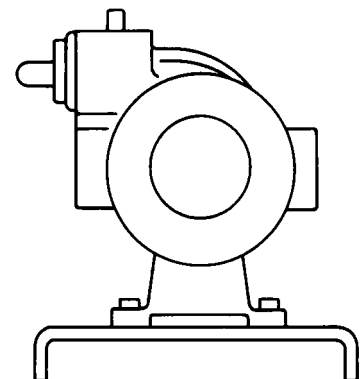
- 1750 or 1450 RPM Operation
- Combination ByPass/Safety-Relief Valve (1" Models)
- 3 to 35 GPM (11 to 130 lpm)



Flange Mounting



Base Mounting



Stationary Transfer Pumps

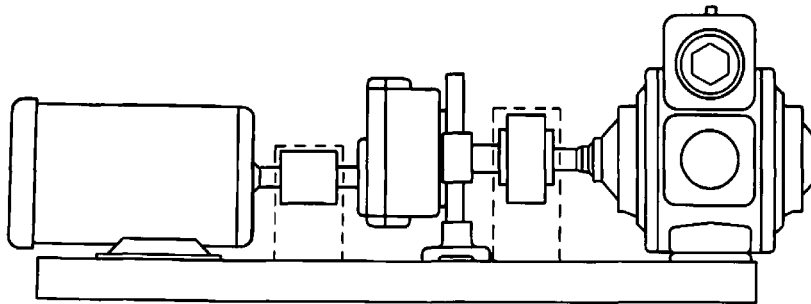
Bulk Plants Terminals Vaporizers
Large Scale Cylinder Filling

LGLD2E

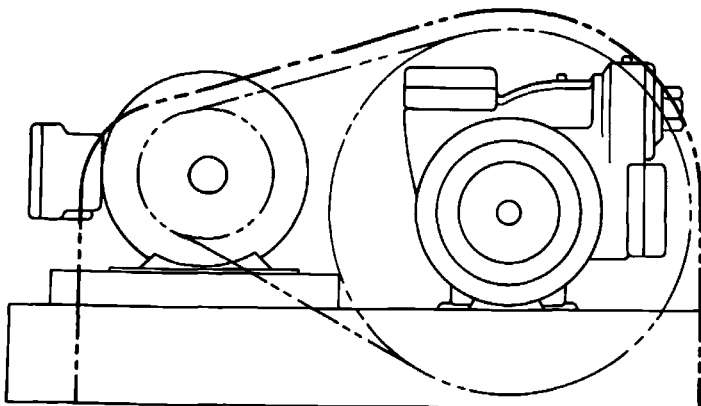
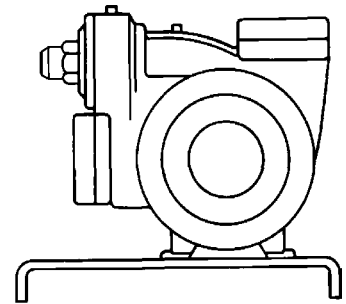
LGLD3E

LGLD4

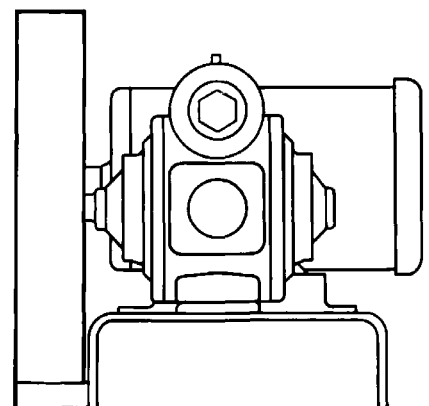
- **Built-in Relief Valves**
- **20 to 300 GPM**
- **(75 to 1,135 lpm)**
- **350 - 980 RPM**
- **2 to 28 HP**
- **(1.5 to 21 Kw)**



Gear Reduction Drive



V-Belt Drive



Truck Pumps

Bobtail Delivery Trucks

Transport Trucks

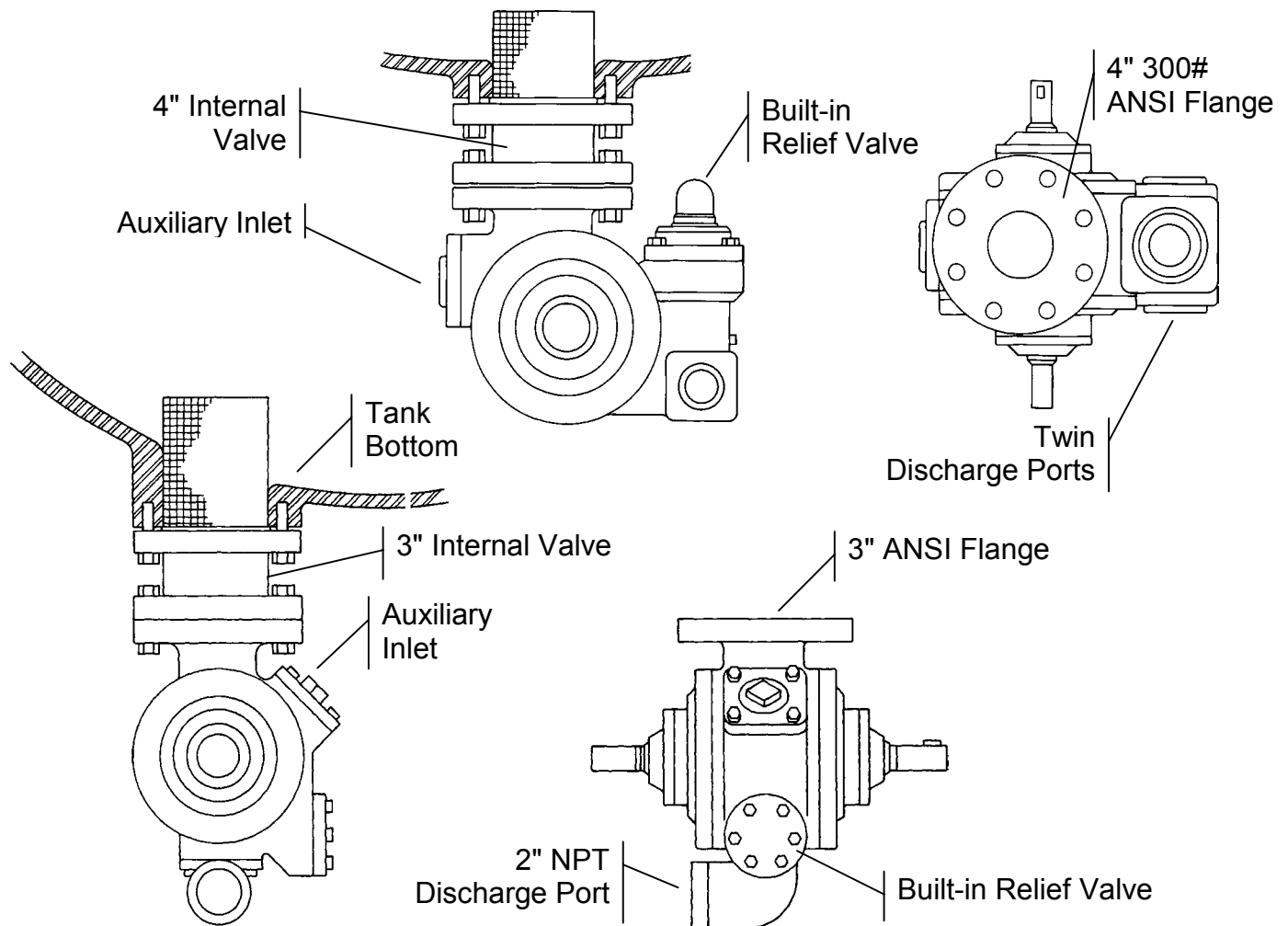
Chassis Mounted:
Flange Mounted:

LGLD2E
TLGLF3C

LGLD3E
TLGLF4A

- PTO Driven
- Double-ended Drive Shafts

- 350 - 980 RPM
- 20 to 300 GPM
- 75 to 1,135 lpm

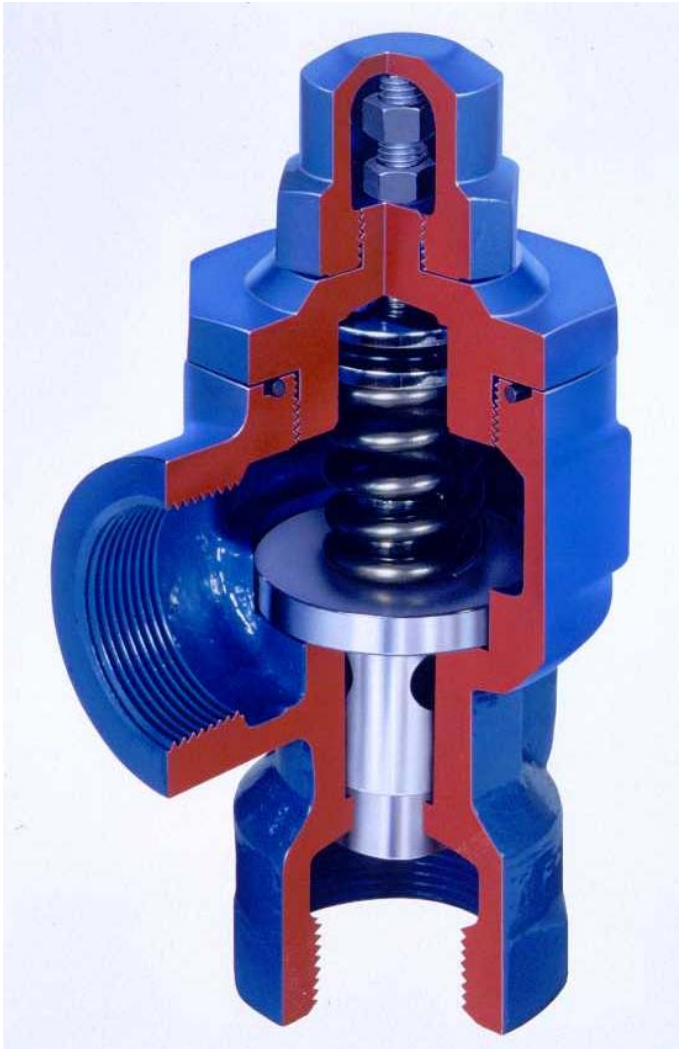


ByPass Valves

BV3/4 BV1 BV1-1/4 BV1-1/2 BV2

All Blackmer pumps should be installed with a Back-to-Tank ByPass Valve

- **Hydraulically Cushioned Closing Action**
- **Ductile Iron Body**
- **For Flows of 5 to 250 GPM (19 to 950 lpm)**



Dash-pot chamber cushions closing of valve.

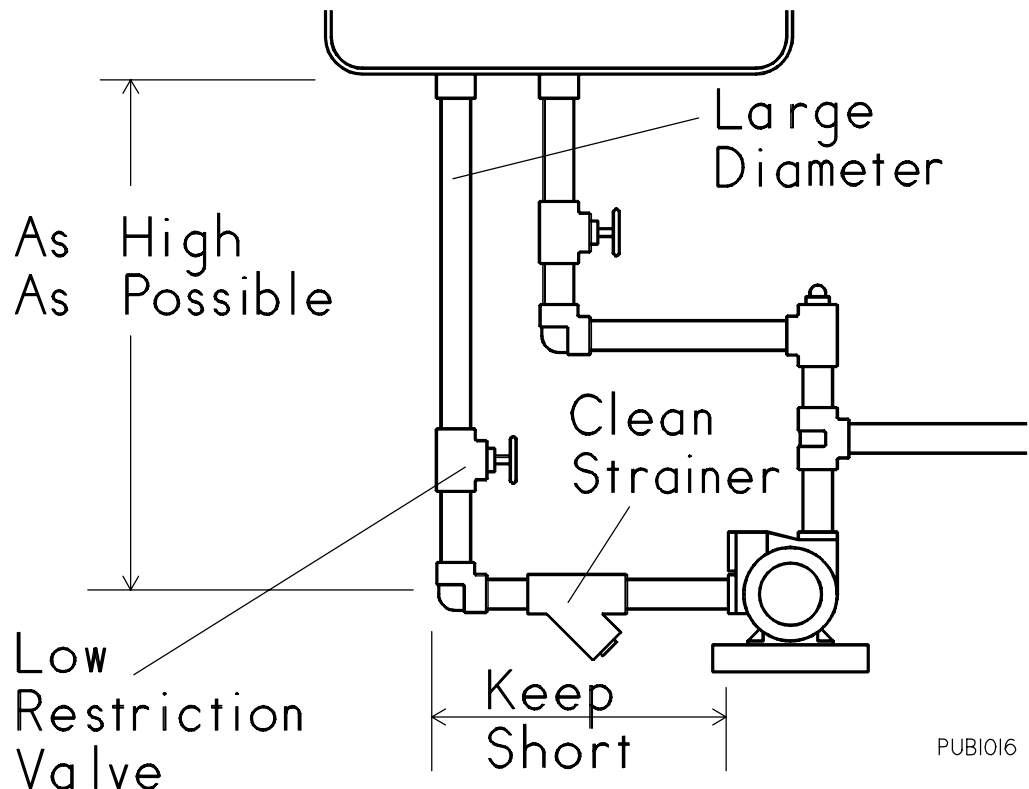
Proper Pump Installation

Benefits:

- **Trouble free, consistent transfer of product**
- **Less wear and tear on the pump**
- **Quieter operation**
- **Lower operating costs**
- **Faster transfer rates**
- **Safer operation**

Minimize losses in the Suction Line

- Use properly sized suction line
One size larger than the pump suction connection (if possible)
- Place the tank as high as possible above the pump
- Place the pump as close as possible to the tank
- Use low restriction valves and other fittings
- Keep the strainer clean

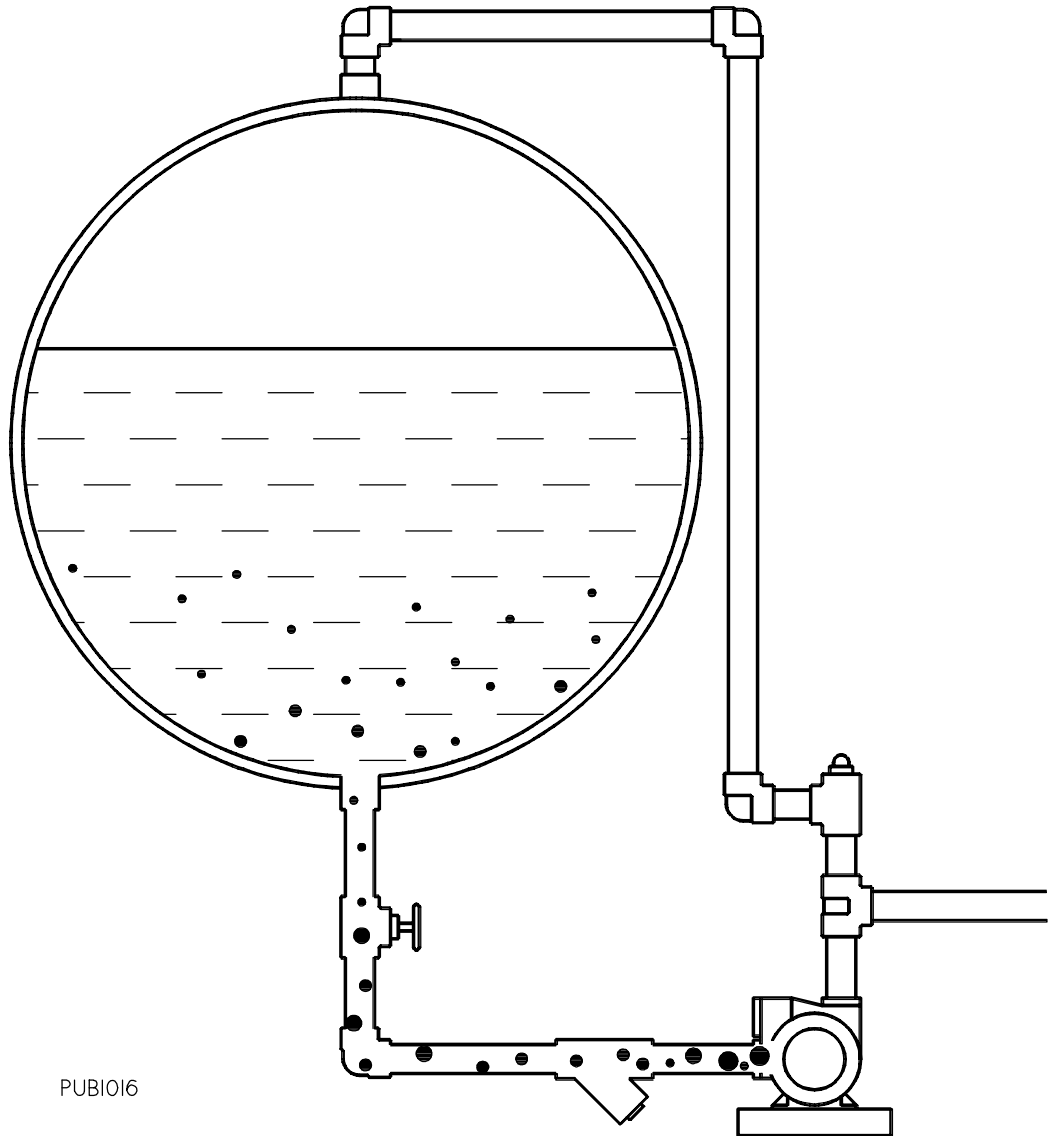


PUB1016

Don't Let Vapor Form!

Vapor –

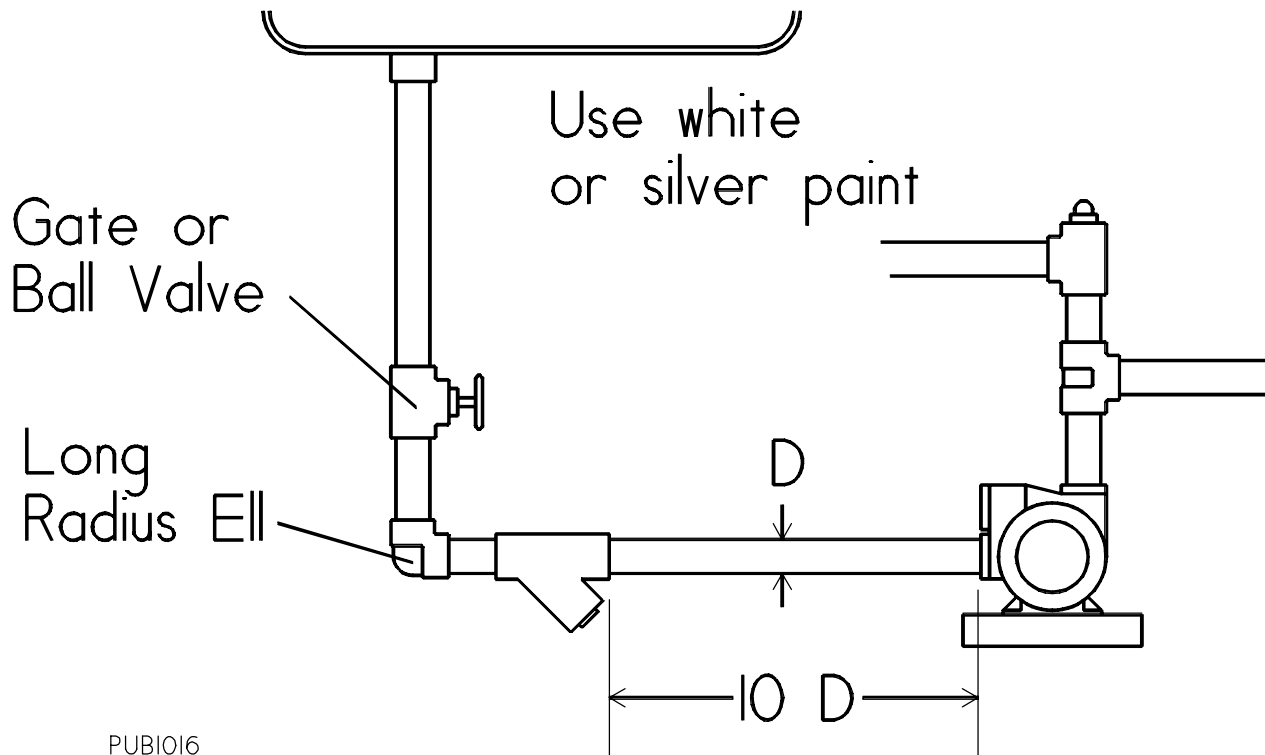
- Reduces pump capacity
- Reduces seal life
- Reduces vane life
- Reduces maximum differential pressure
- Increases noise



PUB1016

Stop Vapor Formation in the Suction Line

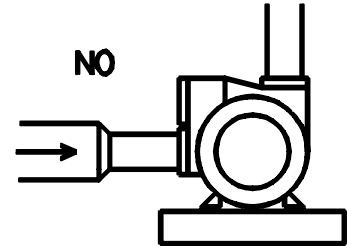
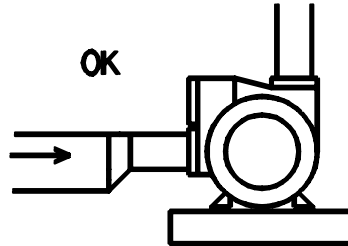
- Use low restriction valves and other fittings
- Use long radius ells
- Keep strainers and other fittings at least 10 pipe diameters from the pump
- Paint the lines white or silver
- Place suction lines in shade



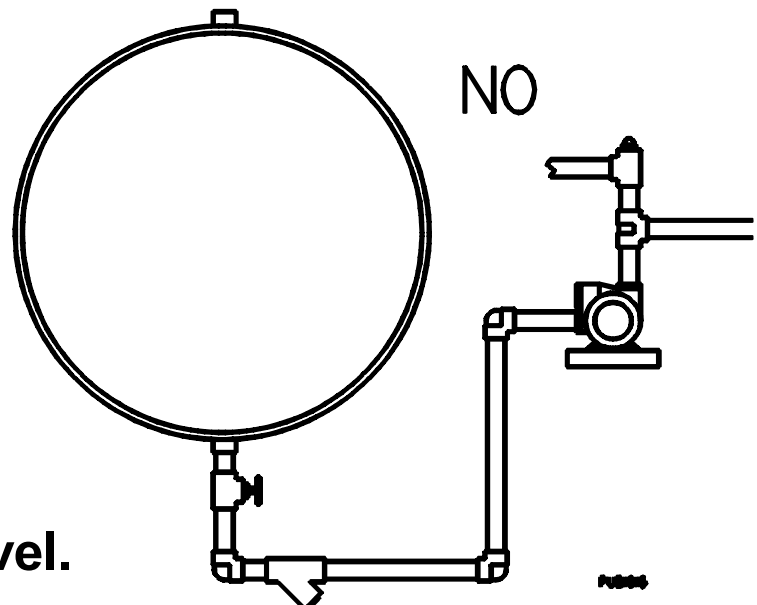
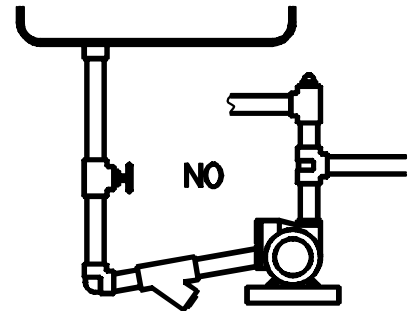
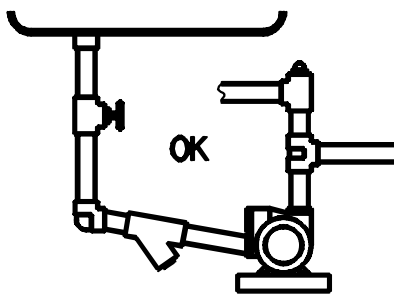
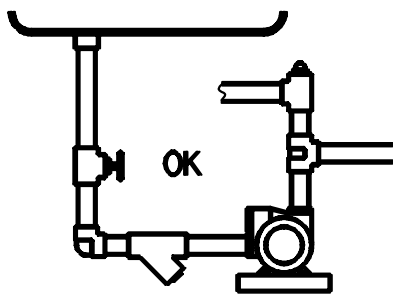
PUB1016

Eliminate Vapor Pockets in the Suction Line

**Use
eccentric reducers,
flat side up.**



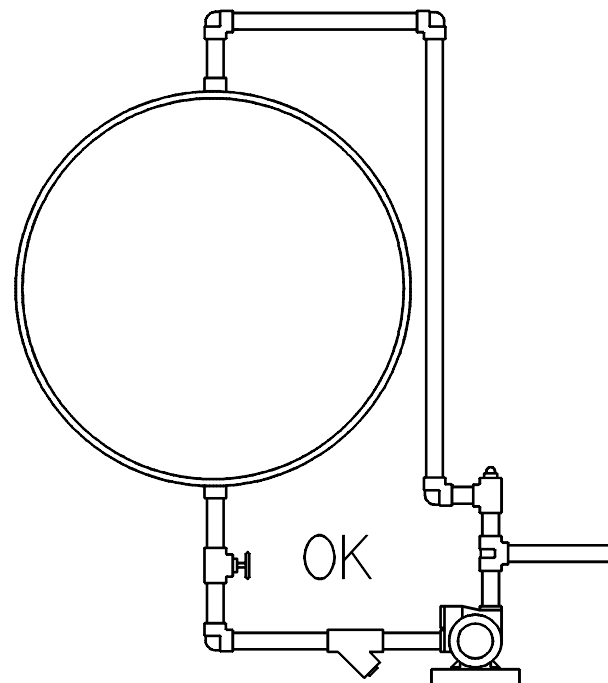
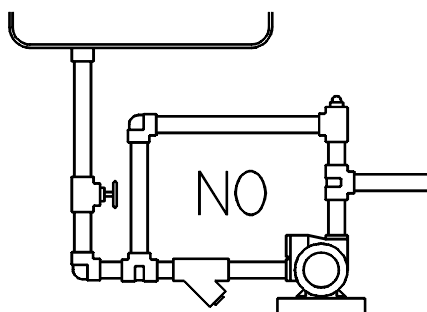
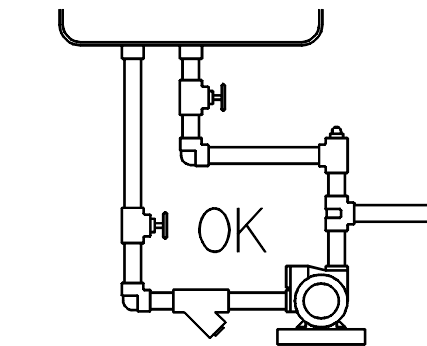
Make the suction line horizontal or slope downward.



**Don't set the pump
above the liquid level.**

Use a Back-to-Tank Bypass Valve

- The bypass line must return to the tank.
- The bypass must not return to the suction line. Recirculated liquid will quickly heat and turn to vapor. The pump will run dry, greatly increasing wear on the vanes and seals.
- The bypass line may return to either the vapor section or liquid section of the tank.
- Set pressure should be 25 psi (1.7 bar) lower than the pump's built-in relief valve.

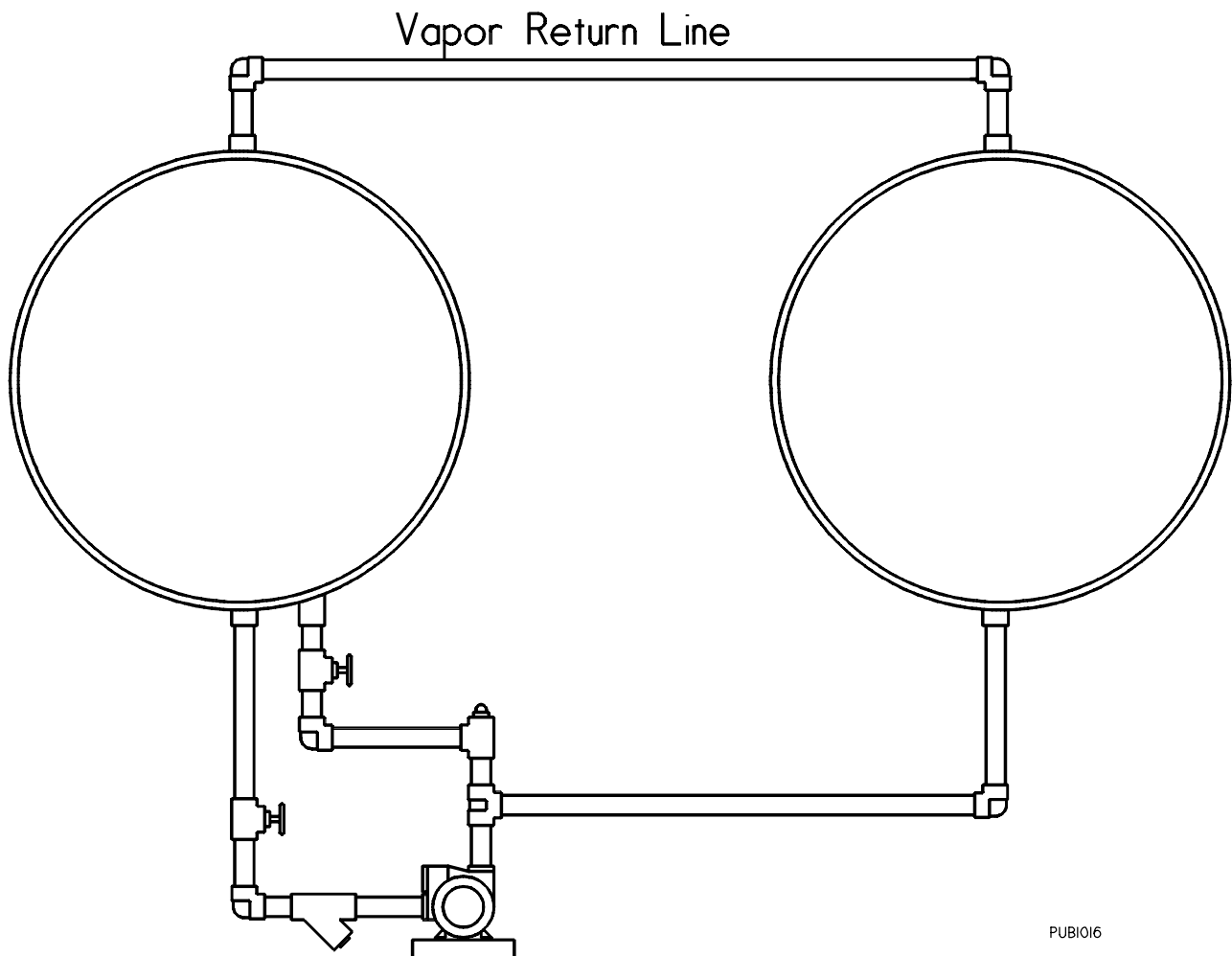


PUB1016

Use Vapor Return Lines (when possible)

Vapor Return Lines will:

- Reduce the pump differential pressure
- Decrease the power required
- Increase the flow rate



PUB1016

Routine Maintenance

- **Check the V-Belts
Alignment
Tension**

- **Check the Strainer
Keep the element clean**

- **Grease Pump Bearings**

- **Grease Motor Bearings**

Easy Pump Maintenance

- **Easy Vane Replacement & Inspection**
Vaness replace in minutes in a simple slide in - slide out procedure. Vane inspection is equally easy.
- **Replaceable Liners & End Discs (LGL series)**
If pump wears, a new liner and end discs will restore like-new efficiency - at a fraction of the cost of a new pump.
- **Repairs Made Without Disconnecting the Pump**
Bearings, seals, vanes, end discs and the liner can all be replaced without disconnecting the pump piping.
- **No special tools required.**

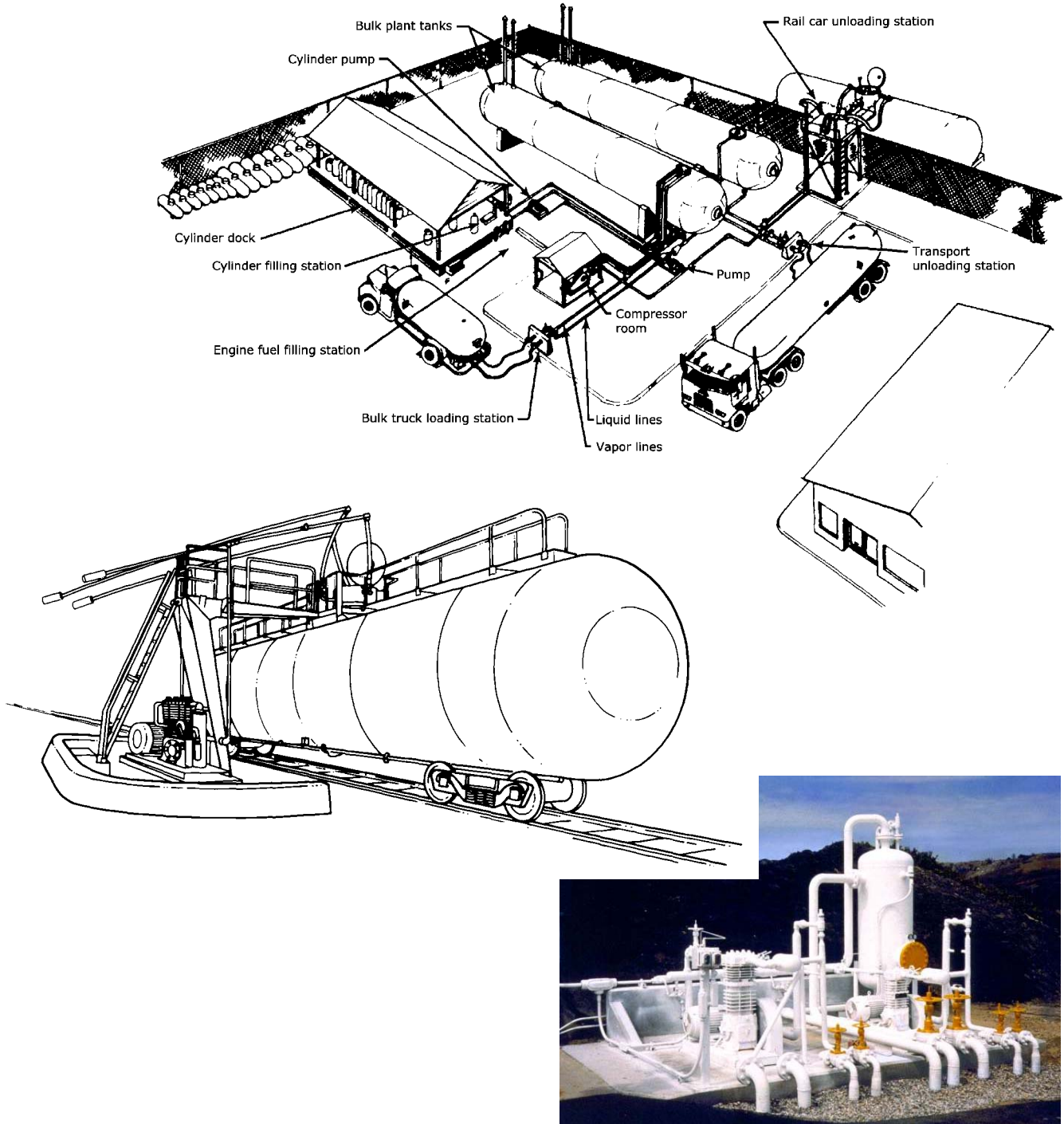


Pumps2 & pump5 pix

LPG Transfer with a Compressor

Liquid Transfer
Emergency Transfer

Vapor Recovery
Cylinder Evacuation



What is LPG?

LPG: Liquefied Petroleum Gas

Usually refers to Propane, Butane or a mixture of Propane and Butane.

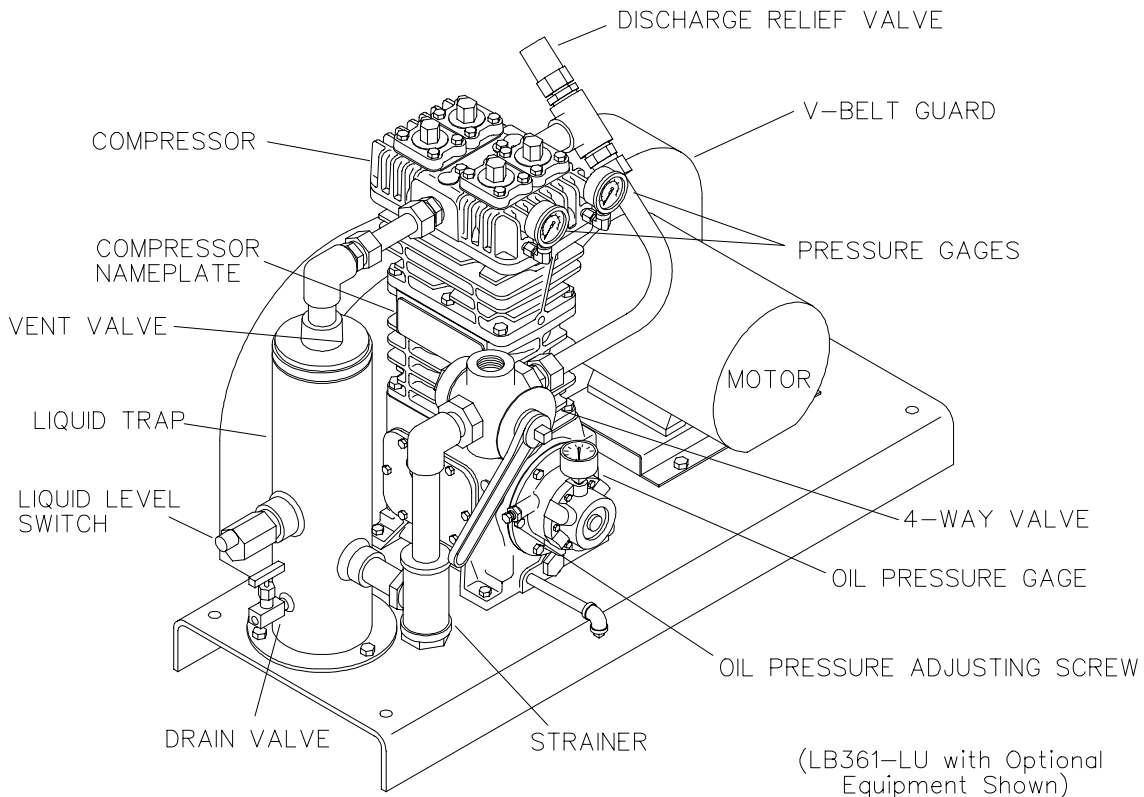
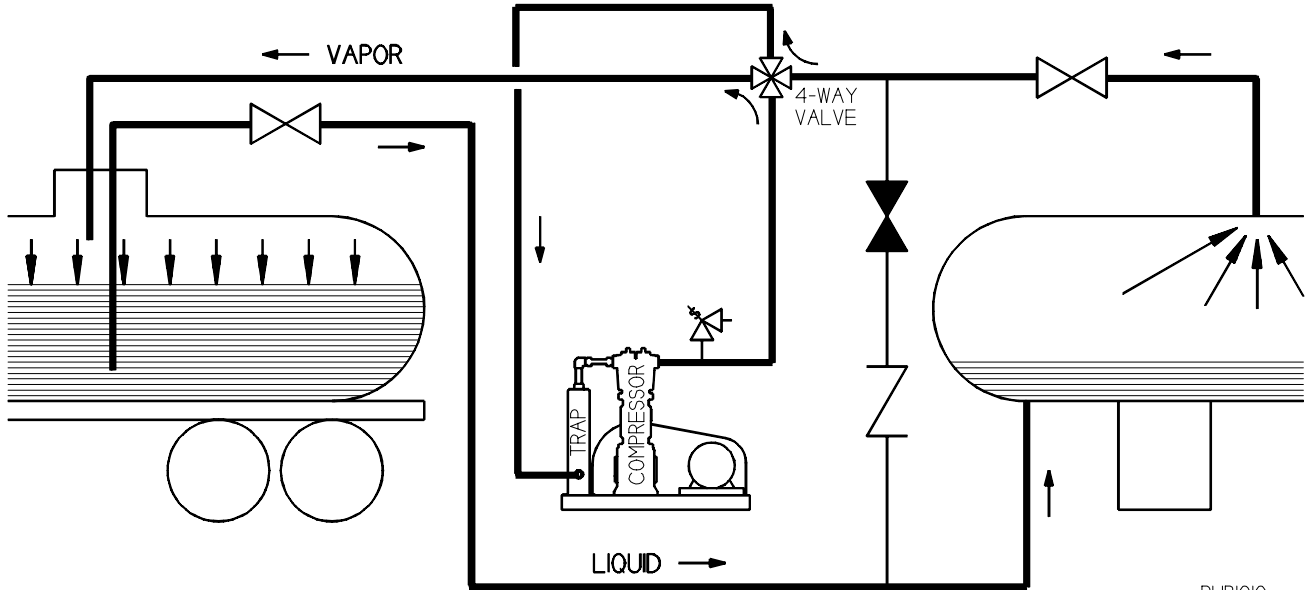
Used as a fuel in Homes, Business, and Industry.

Transported and Stored as a Liquid

Readily converted: Liquid  Gas

	Propane C ₃ H ₈		Butane C ₄ H ₁₀	
Molecular Weight	44.09		58.12	
Specific Gravity Liquid @ 60°F water = 1.0	0.51		0.58	
Vapor Pressure	psia	bar-a	psia	bar-a
at 32°F (0°C)	69.6	4.80	14.9	1.03
at 60°F (16°C)	105.5	7.28	26.1	1.80
at 100°F (38°C)	183.7	12.67	49.9	3.44

Typical LPG Compressor Transfer System



Why Transfer LPG with a Compressor?

- Pumps leave all tanks full of vapor - equals 3% of total tank capacity.
- Top opening tanks = poor pump suction conditions
 - Short vane and seal life
 - Noisy operation
 - Considerable liquid is left in the tank
- Vessel with no liquid openings
 - Home delivery tanks (under 500 gal., 2,000 l)
 - Cylinders
 - Trucks or Rail Cars involved in accidents

Compressors

- Can transfer all the product - both liquid & vapor
- Are not subject to poor pump suction problems
- Can empty all vessels

LPG Liquid Transfer with a Compressor

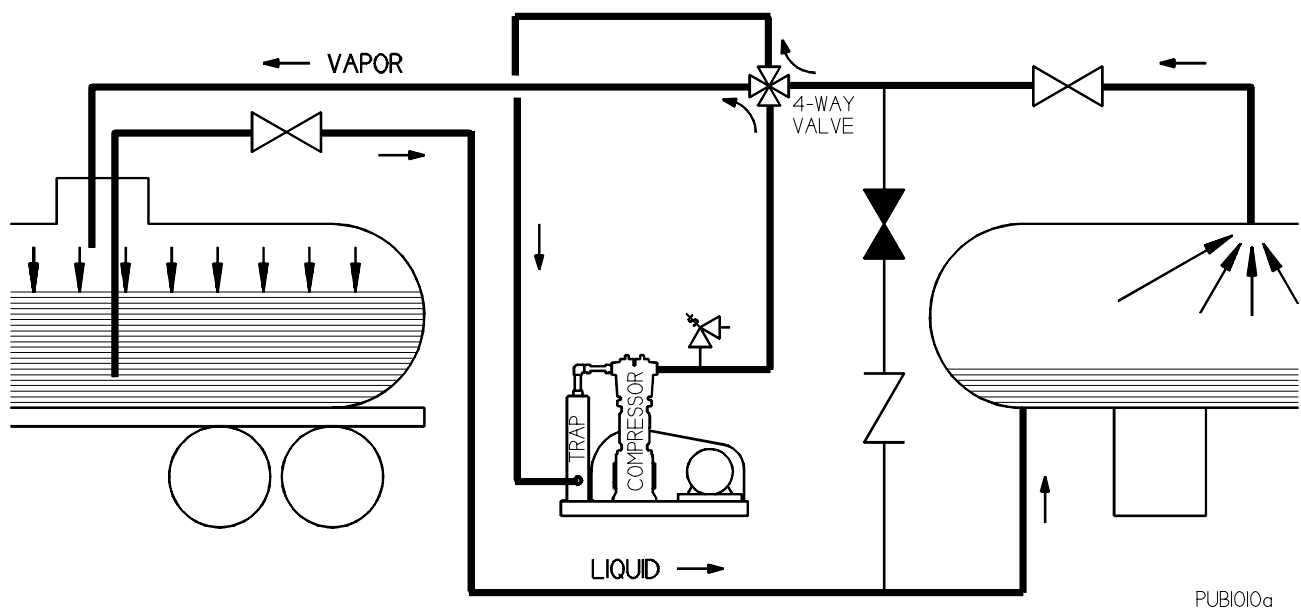
Vapors are:

- Drawn off the top of the tank being filled
- Compressed slightly
- Discharged into the top of the tank being emptied

Pressures are:

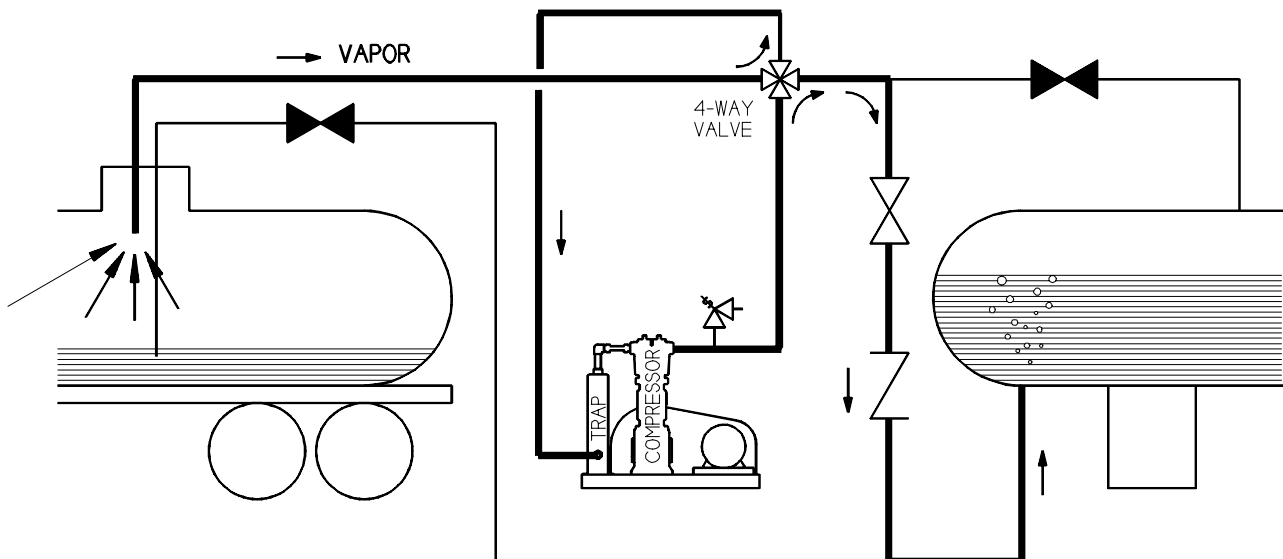
- Slightly reduced in the tank being filled
- Raised in the tank being emptied

The pressure difference will push the liquid from one tank to the other.



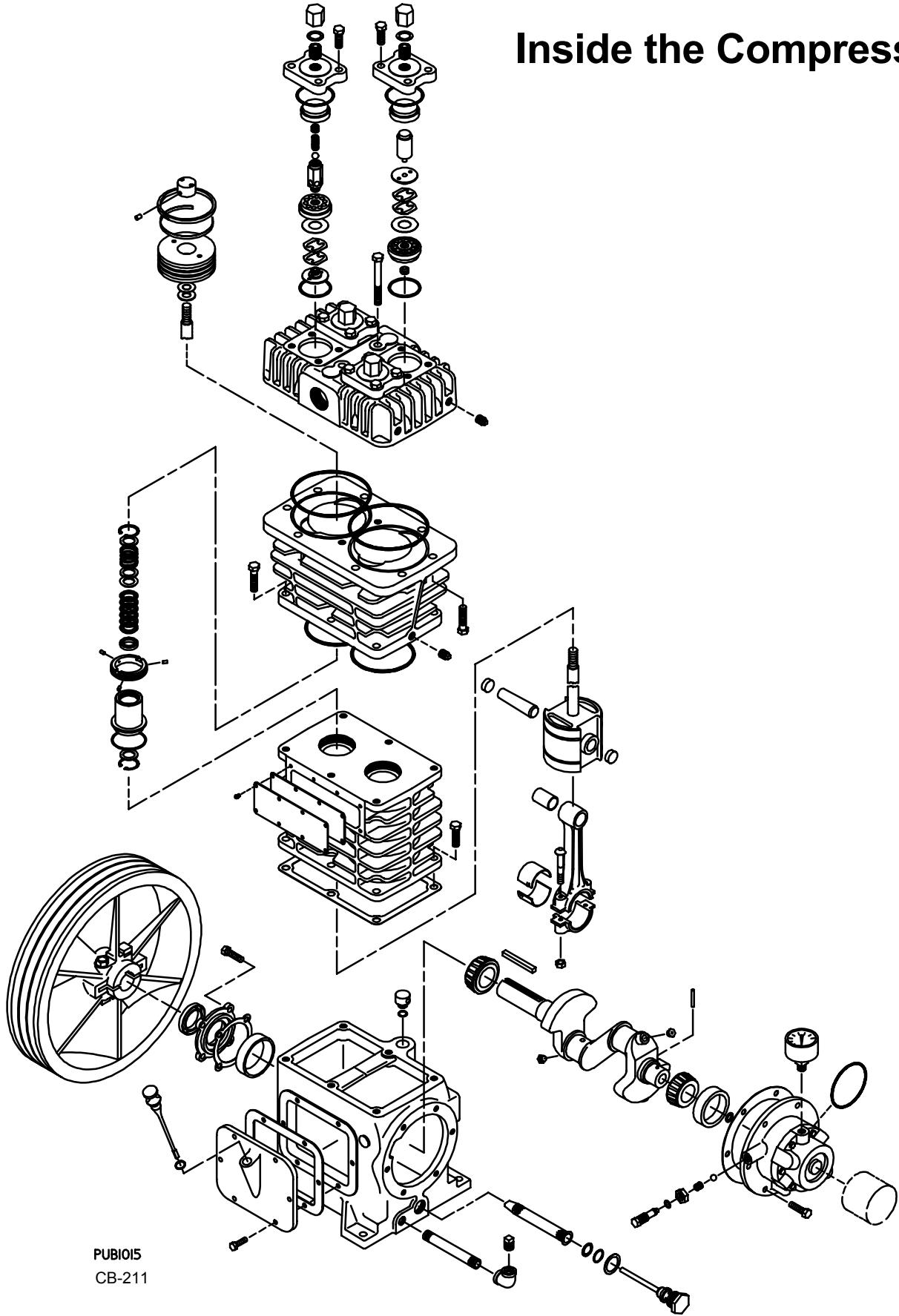
Vapor Recovery with a Compressor

- Rotate the 4-way valve handle 90°
- Reroute the discharge piping to the LIQUID section of the tank being filled to cool the vapors
- Close the liquid line
- Recovery stops at 25 - 30% of the original pressure



PUB1010b

Inside the Compressor



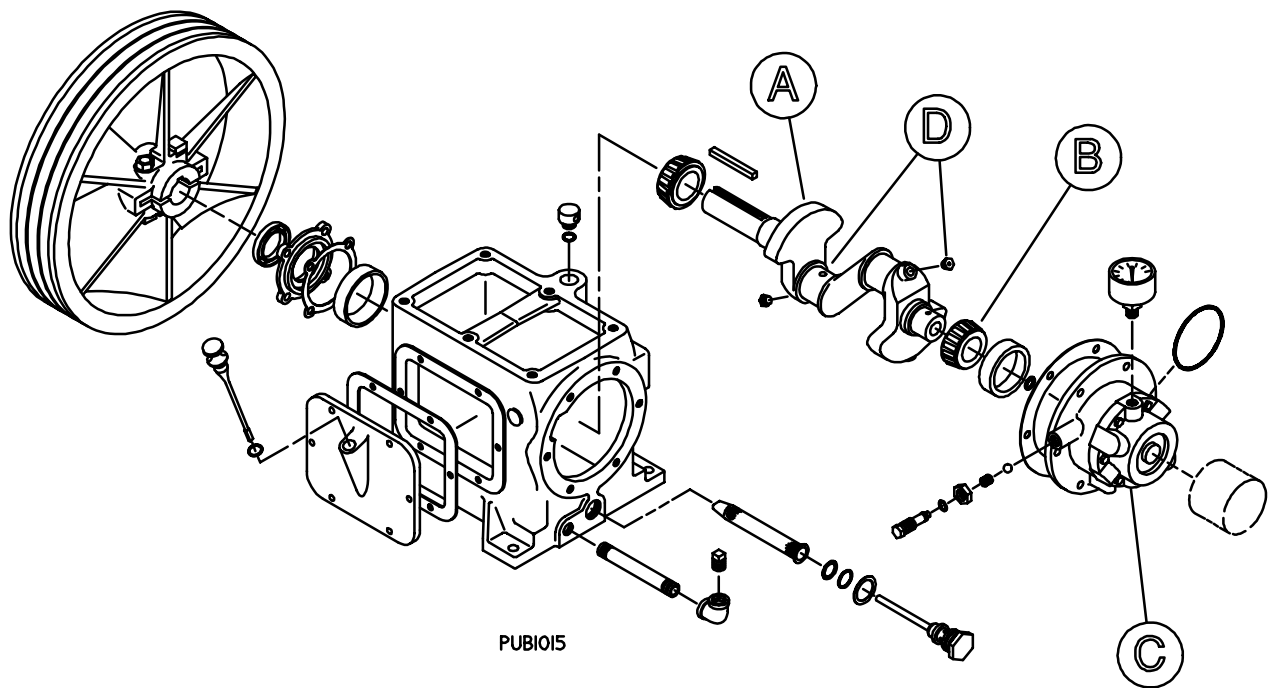
PUB1015
CB-211

A Ductile Iron Crankshaft

B Roller Bearings

C Oil Pump Driven by the Crankshaft

D Drilled Crankshaft with Oil Ports



A Seals

PTFE V-ring design
Self adjusting
Cartridge design

B Crosshead Guide

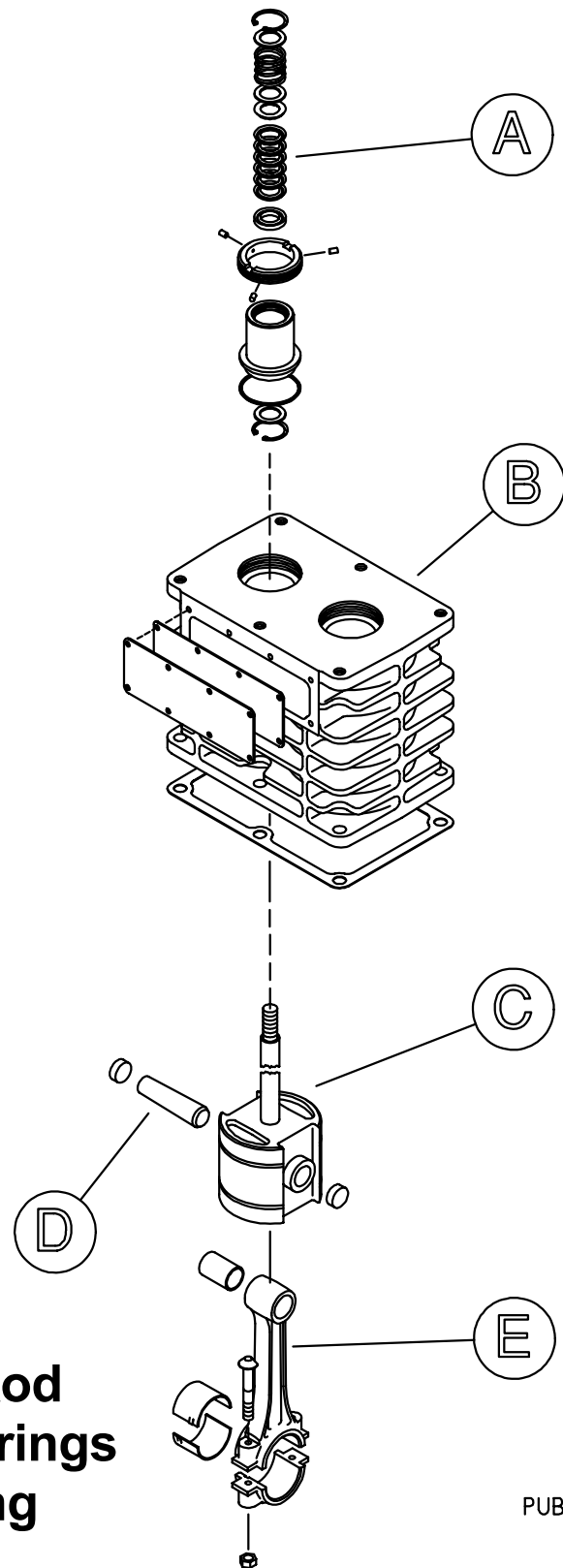
Maintain piston &
seal alignment

C Crosshead / Piston Rod

BSR steel rod
Oil lubrication grooves

D Steel Wrist Pin

E Ductile Iron Connecting Rod
Automotive babbitt bearings
Bronze wrist pin bushing
Rifle Drilled

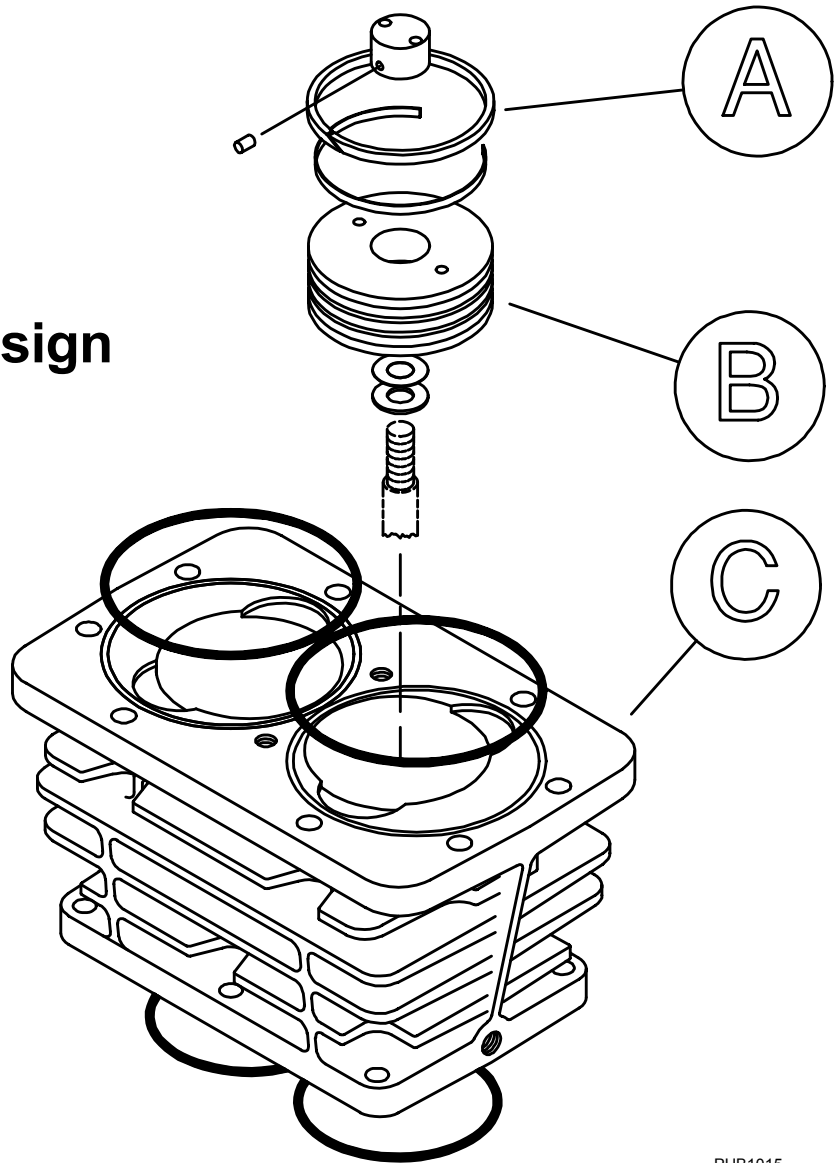


PUB1015

A Piston Rings
PTFE for nonlube service

B Pistons
One piece design
Ductile Iron

C Cylinder
Ductile Iron
O-ring seals



PUB1015

A Valves

Designed for nonlube service

Liquid relief on suction

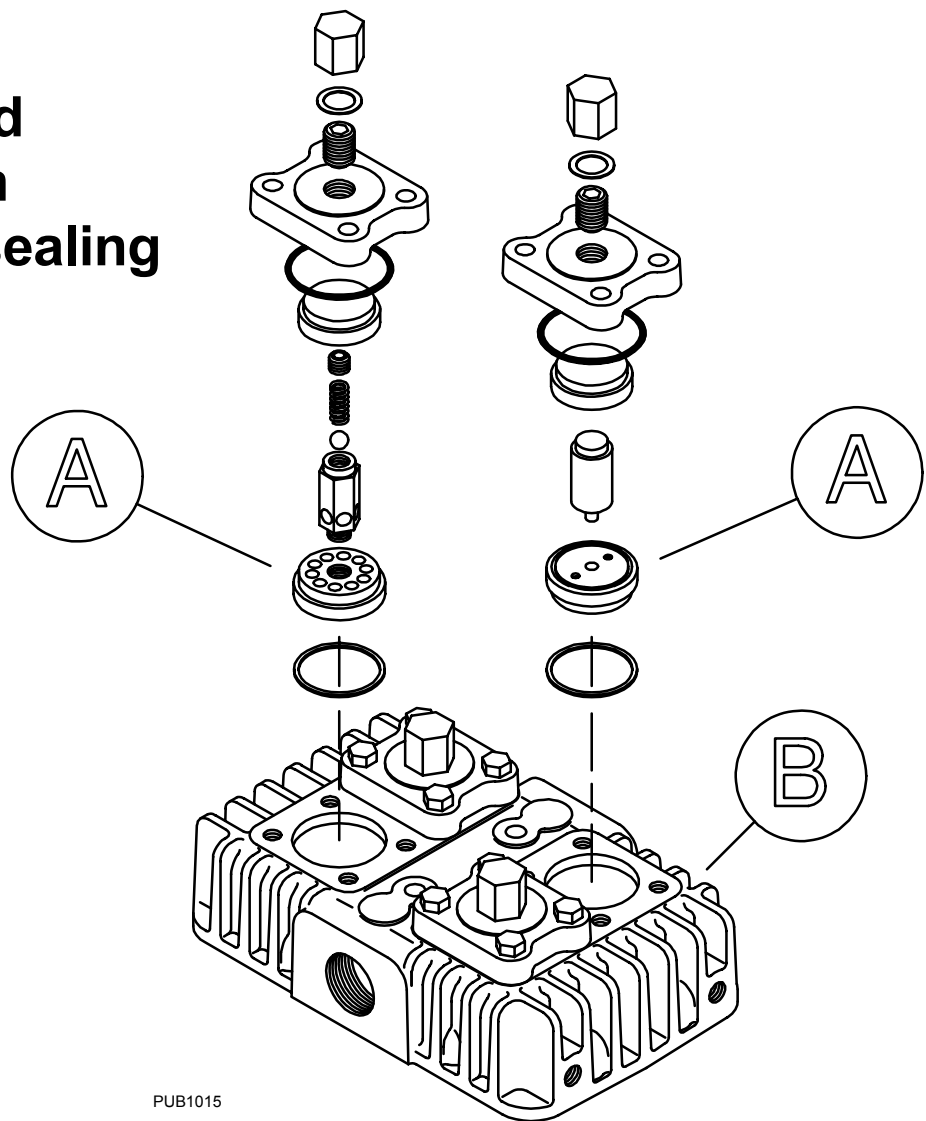
Rebuild as a suction or discharge valve

Easily inspected / replaced.

B Cylinder Head

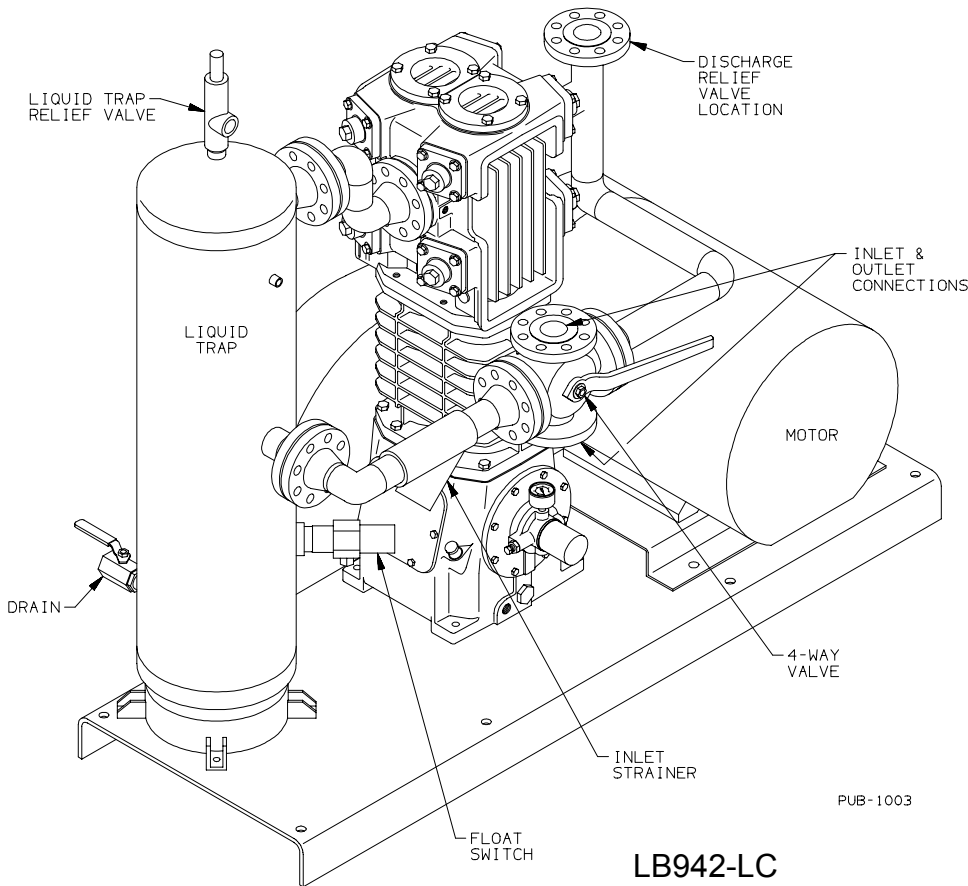
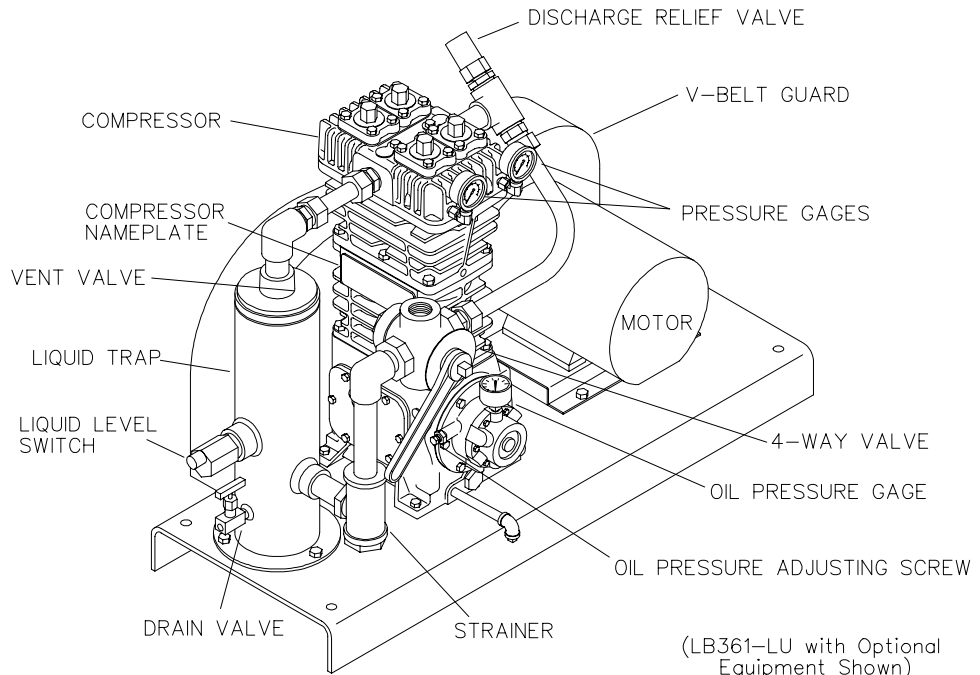
Ductile Iron

All O-ring sealing



PUB1015

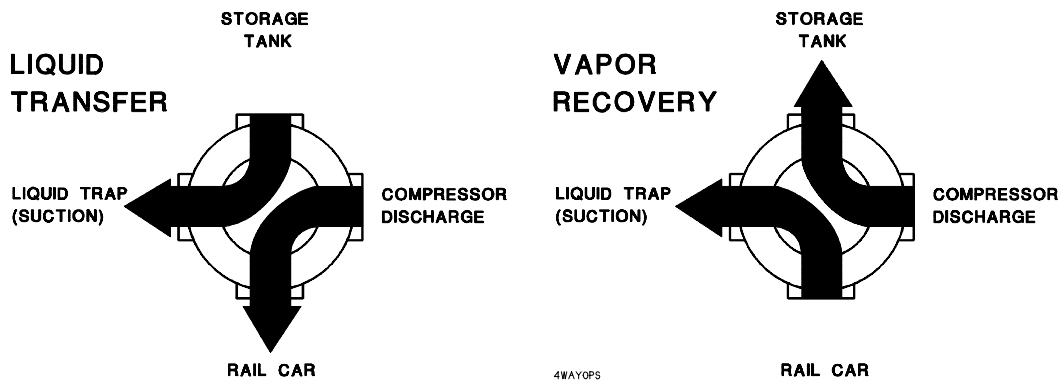
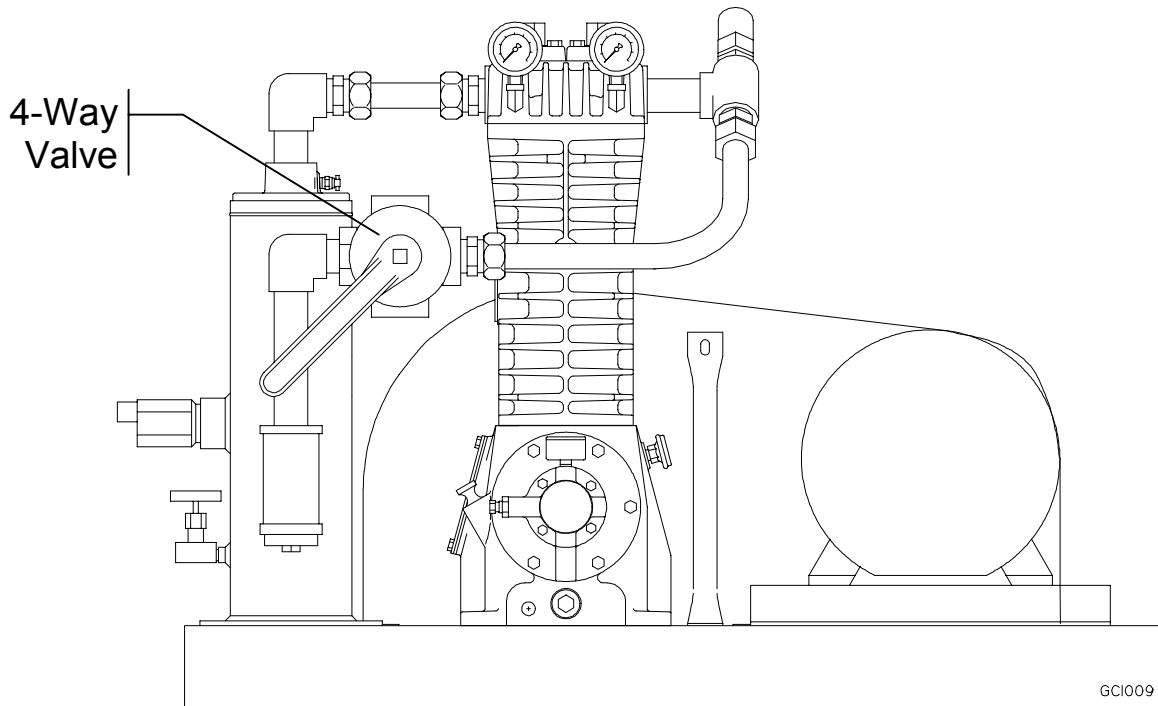
Typical Compressor Packages for Liquid Transfer and Vapor Recovery



4-Way Valve

CB-219

- Allows both Liquid Transfer and Vapor Recovery
- Reverses the flow direction



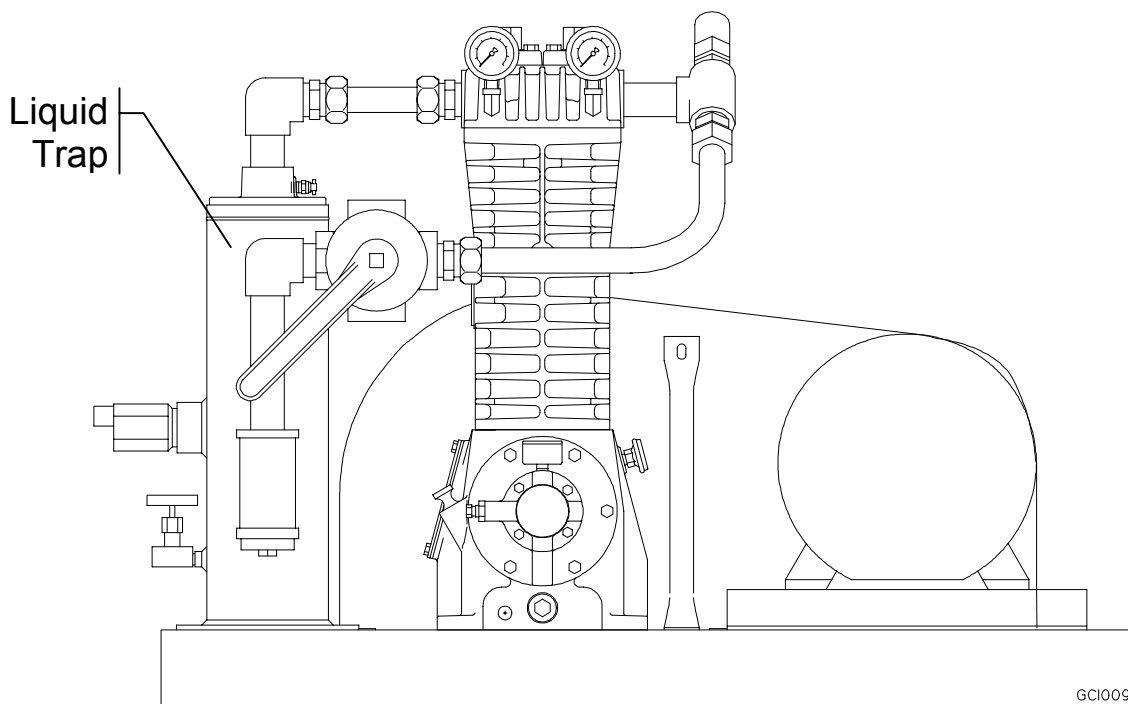
Liquid Traps

Traps liquid before it can enter the compressor

- Liquid that condenses in the suction line
- Liquid from a wrongly connected line

Liquid traps work by:

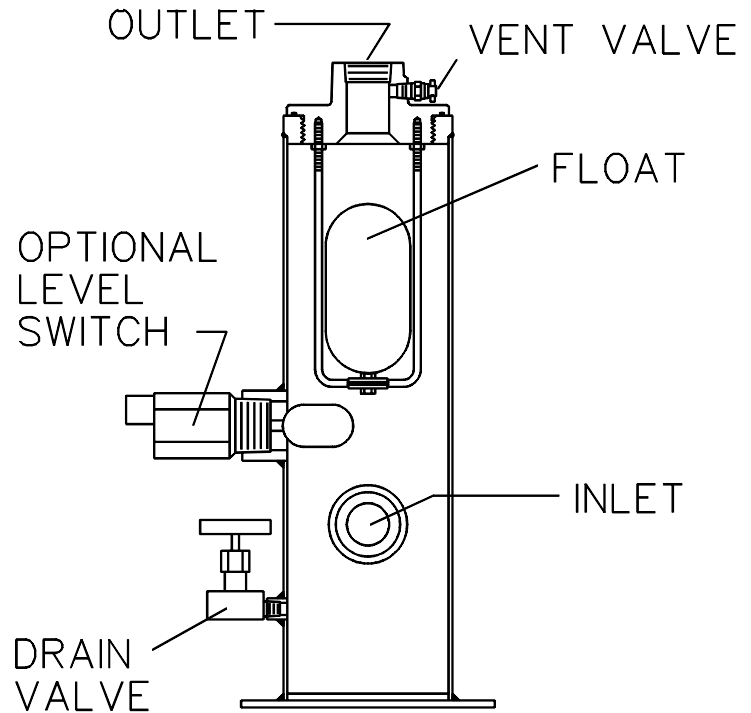
- Providing a volume for the liquid to collect
- Using a mechanical float to block the line
- Using an electrical float switch



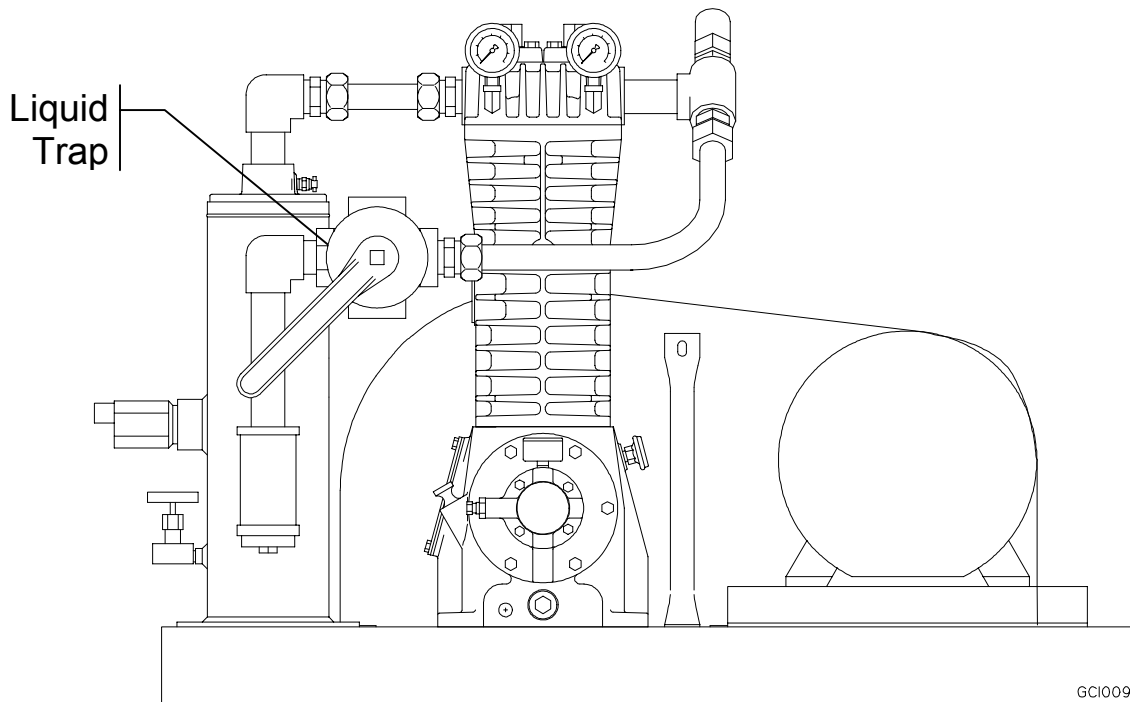
Standard Liquid Traps

cb-219

- Use a mechanical float to block the suction line
- Electrical float switches are available
- Non-code vessel
- Vent Valve
- 1/4" Drain



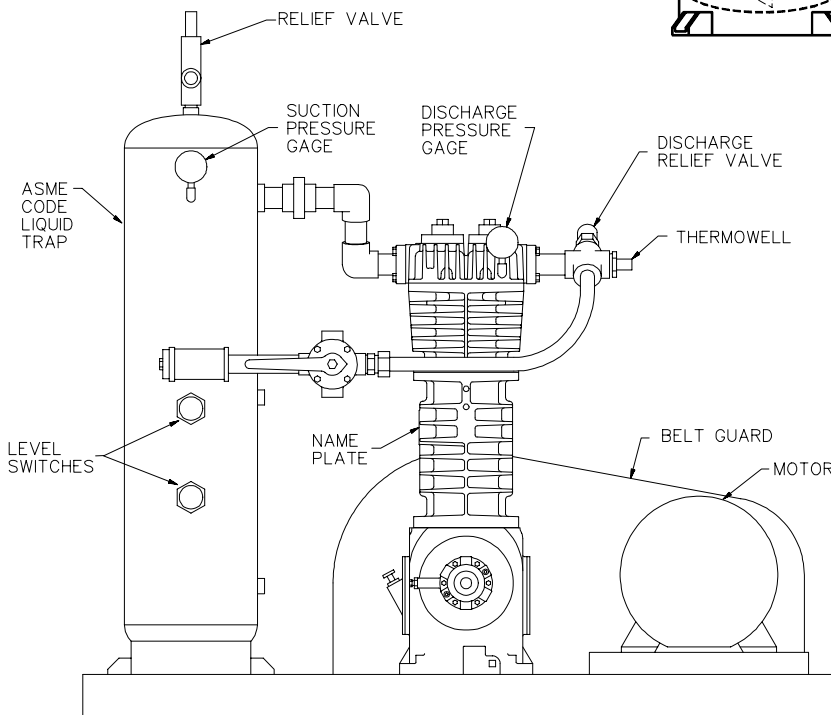
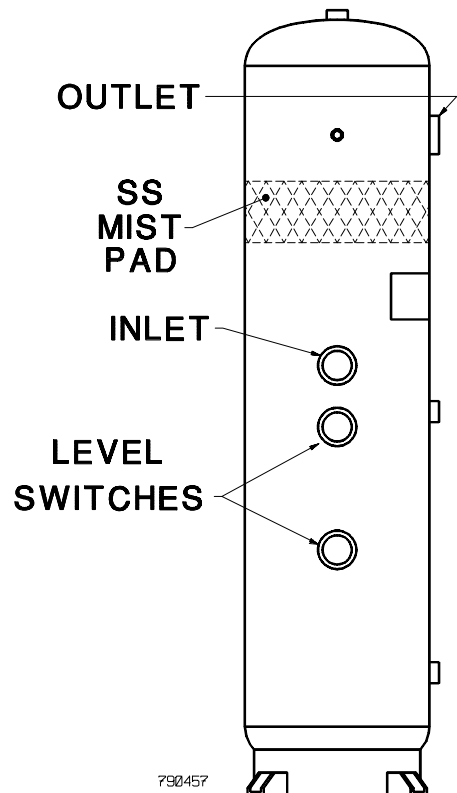
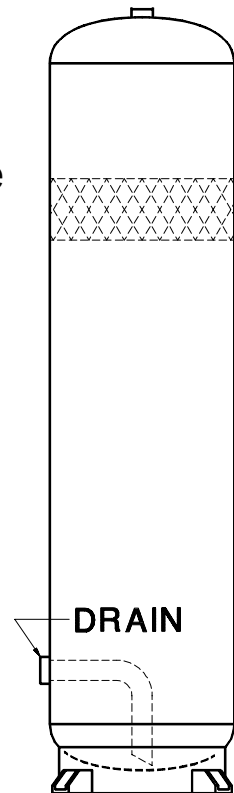
790119



ASME Code Liquid Traps

CB-218

- Larger volume to collect more liquid
- Two electric float switches may be fitted
- Complete with a relief valve
- ASME code vessel
- May be fitted with a level gauge
- 1" manual drain valve
- 4" SS mist pad



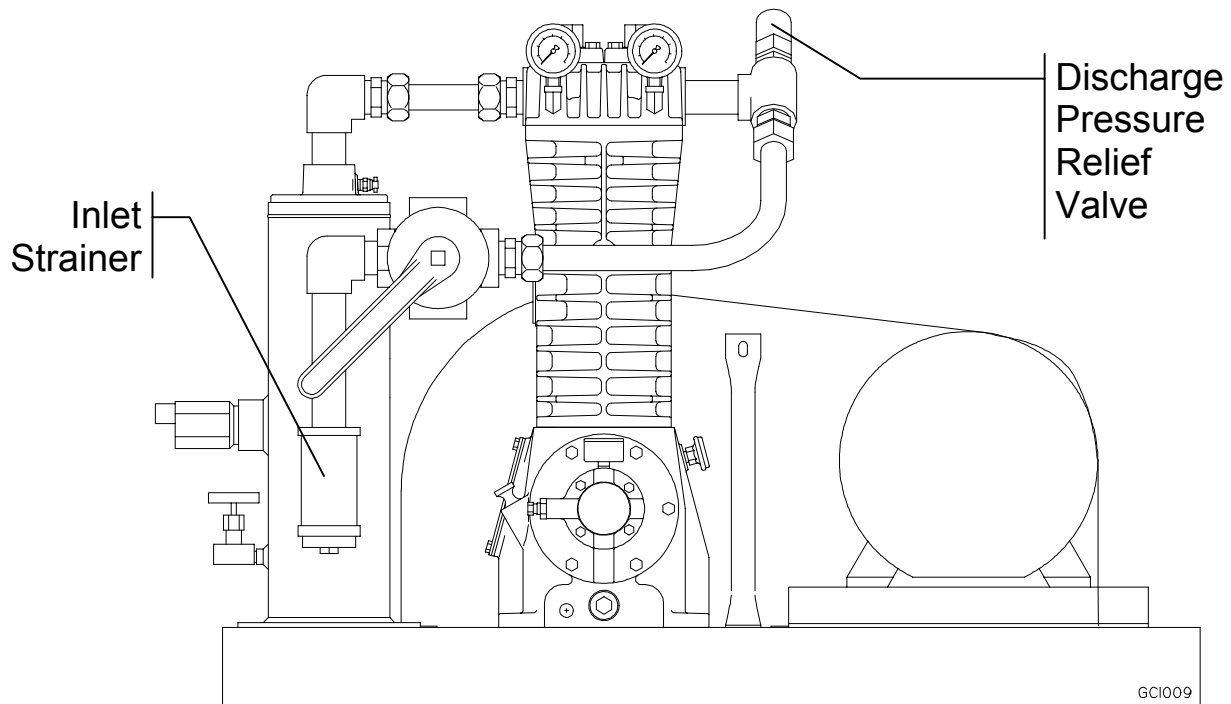
AE92-98844-1

Discharge Pressure Relief Valves

- **MUST** be installed
- **250 - 265 psig (17.2 - 18.3 bar-g) is typical**
- **Brass for LPG, Aluminum for NH₃**

Inlet Strainers

- **Standard on 'LU' and 'LC' Mountings**
- **Protect the compressor**
- **30 mesh screen**
- **Clean regularly**



Low Oil Pressure Switch

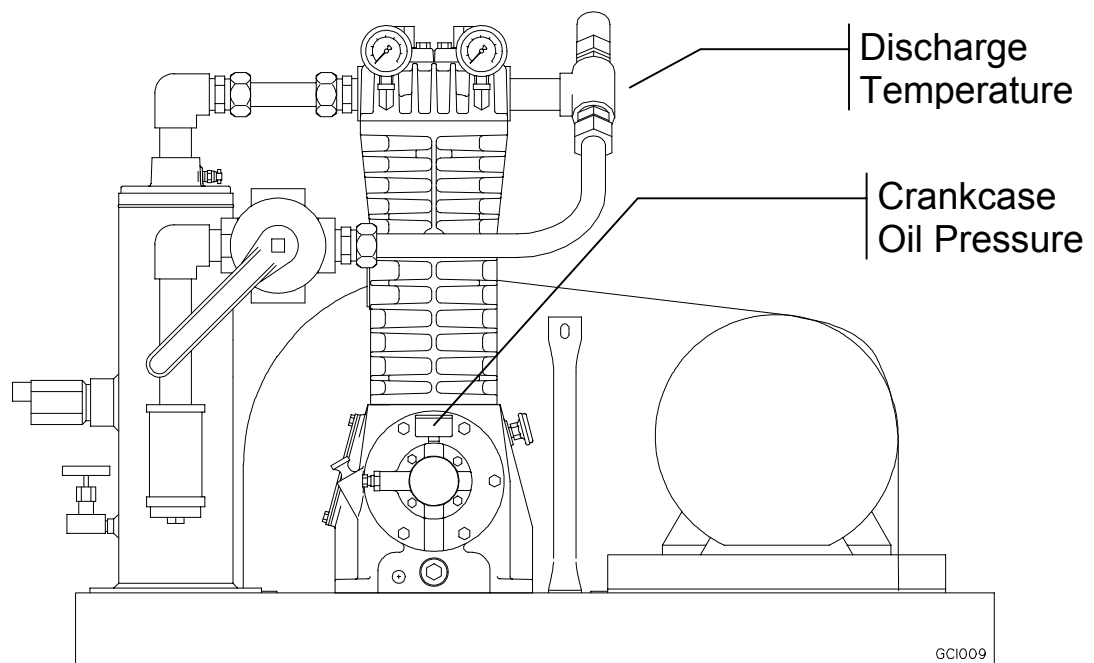
- Monitors crankcase oil pressure
- Prevent expensive damage
- 12 psig (0.83 bar-g) typical
- 10 second lockout at startup

Hi Discharge Temperature Switch

- Detects potential problems early
(Blocked line, worn parts, etc.)
- Set just above normal discharge temperature
- Use a thermowell

Drivers

- V-belt or gear reduction drive
- Electric motor
- Engine with clutch (Gasoline, Diesel or LPG)



Blackmer LPG Compressors

English Units	LB161	LB361	LB601	LB942
No. of Cylinders	2	2	2	2 Double Acting
Bore x Stroke, in.	3.0 x 2.5	4.0 x 3.0	4.625 x 4.0	4.625 x 4.0
MAWP, psia (kPa)	350	350	350	350
Speed, rpm	350 - 825	350 - 825	350 - 825	350 - 825
Piston Displacement, CFM				
@ 350 rpm	7.16	15.3	27.2	52.46
@ 825 rpm	16.9	36.0	64.2	125.2
Max. BHP	7.5	15	30	50
Weight, lb.	~225	~365	~705	~905
Inlet/Outlet Connections	0.75" NPT	1.25" NPT	*2.00", 1.50", 1.25"	2" 300# ANSI

Metric Units	LB161	LB361	LB601	LB942
No. of Cylinders	2	2	2	2 Double Acting
Bore x Stroke, mm	76.2 x 63.5	102 x 76	117 x 102	117 x 102
MAWP, psia (kPa)	2,413	2,413	2,413	2,413
Piston Displacement, m ³ /hr				
@ 350 rpm	12.2	26.0	46.3	89.1
@ 825 rpm	28.7	61.2	109.0	212
Max. kw	5.5	11	22	37
Weight, kg	~102	~166	~320	~410
Inlet/Outlet Connections	0.75" NPT	1.25" NPT	*2.00", 1.50", 1.25"	2" 300# ANSI

*NPT & Weld type flanges available

PERFORMANCE

English Units

Model	Approximate Liquid Transfer Rate at 70°F, GPM			Driver Size BHP
	Propane	Butane	Anhydrous Ammonia	
LB161	49 @ 425 rpm	46 @ 650 rpm	44 @ 380 rpm	3
	80 @ 695 rpm	62 @ 825 rpm	74 @ 630 rpm	5
	95 @ 825 rpm		93 @ 790 rpm	7½
LB361	83 @ 335 rpm	85 @ 560 rpm		5
	123 @ 495 rpm	125 @ 825 rpm	116 @ 470 rpm	7½
	161 @ 650 rpm		154 @ 605 rpm	10
	205 @ 825 rpm		190 @ 765 rpm	15
LB601	175 @ 405 rpm	160 @ 640 rpm		10
	245 @ 550 rpm	210 @ 825 rpm	230 @ 515 rpm	15
	300 @ 680 rpm		292 @ 650 rpm	20
	345 @ 790 rpm		330 @ 735 rpm	25
	360 @ 825 rpm		360 @ 825 rpm	30
LB942	360 @ 450 rpm	325 @ 760 rpm	325 @ 400 rpm	20
	435 @ 545 rpm	345 @ 805 rpm	390 @ 480 rpm	25
	490 @ 615 rpm		470 @ 580 rpm	30
	650 @ 805 rpm		625 @ 765 rpm	40
			650 @ 805 rpm	50

Actual transfer rate will depend on proper system design, pipe sizing, and valve capacity.

Horsepower is for liquid transfer and vapor recovery in moderate climates (80°F).

Blackmer can provide a detailed performance analysis on request.

PERFORMANCE

Metric Units

Model	Approximate Liquid Transfer Rate at 21°C, lpm			Driver Size KW
	Propane	Butane	Anhydrous Ammonia	
LB161	185 @ 425 rpm	174 @ 650 rpm	166 @ 380 rpm	2.2
	303 @ 695 rpm	235 @ 825 rpm	280 @ 630 rpm	3.7
	360 @ 825 rpm		352 @ 790 rpm	5.5
LB361	314 @ 335 rpm	322 @ 560 rpm		3.7
	466 @ 495 rpm	473 @ 825 rpm	439 @ 470 rpm	5.5
	609 @ 650 rpm		583 @ 605 rpm	7.5
	776 @ 825 rpm		719 @ 765 rpm	11
LB601	662 @ 405 rpm	606 @ 640 rpm		7.5
	927 @ 550 rpm	795 @ 825 rpm	871 @ 515 rpm	11
	1,136 @ 680 rpm		1,105 @ 650 rpm	15
	1,306 @ 790 rpm		1,249 @ 735 rpm	18.5
	1,362 @ 825 rpm		1,363 @ 825 rpm	22
LB942	1,363 @ 450 rpm	1,230 @ 760 rpm	1,230 @ 400 rpm	15
	1,646 @ 545 rpm	1,306 @ 805 rpm	1,476 @ 480 rpm	18.5
	1,855 @ 615 rpm		1,779 @ 580 rpm	22
	2,460 @ 805 rpm		2,366 @ 765 rpm	30
			2,460 @ 805 rpm	37

Actual transfer rate will depend on proper system design, pipe sizing, and valve capacity.

Horsepower is for liquid transfer and vapor recovery in moderate climates (27°C).

Blackmer can provide a detailed performance analysis on request.

Proper Compressor Installation

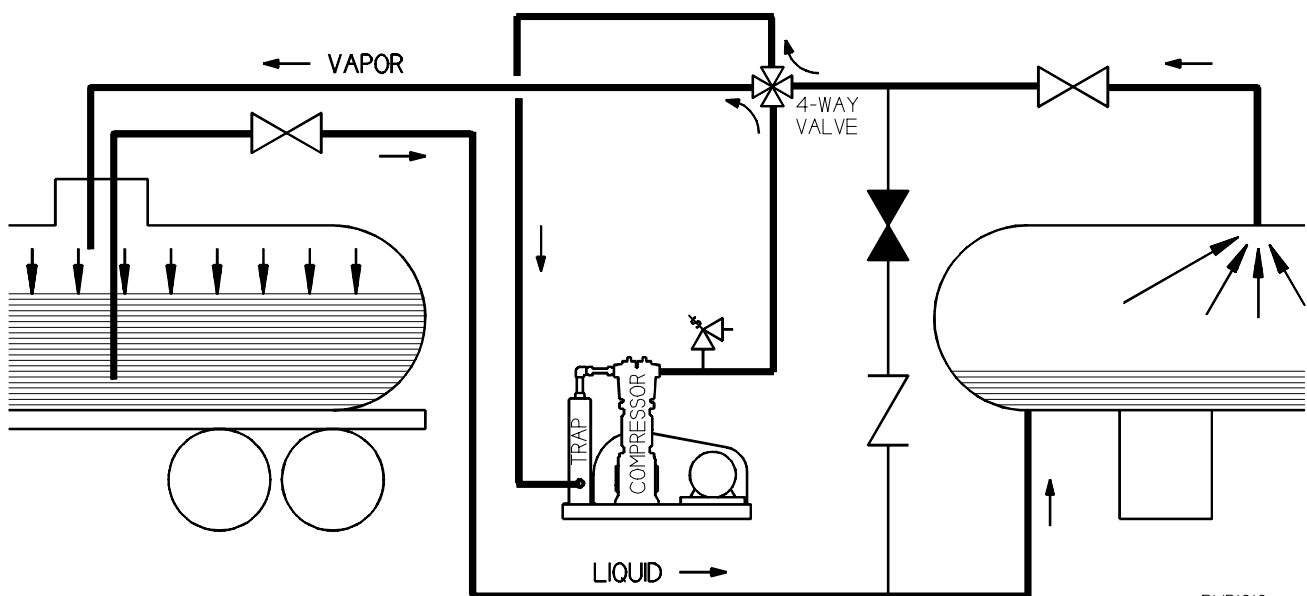
Benefits:

- **Trouble free, consistent transfer of product**
- **Less wear and tear on the compressor**
- **Lower operating costs**
- **Faster transfer rates**
- **Safer operation**

Minimize Line Losses

CB-221

- Lower pressure drops:
Less power required
Faster transfer
- Use larger line sizes
- Keep runs as short as possible
- Eliminate unneeded fittings,
Particularly on the liquid line
- Use low restriction fittings and valves
- Clean strainer elements



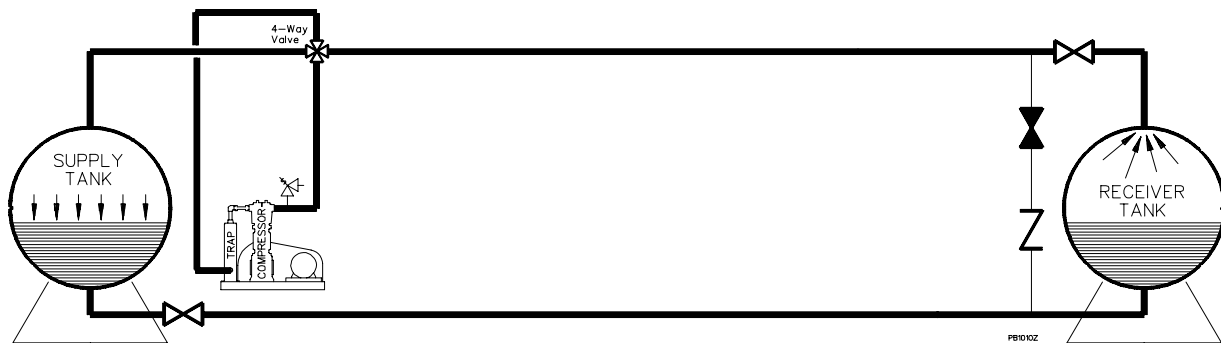
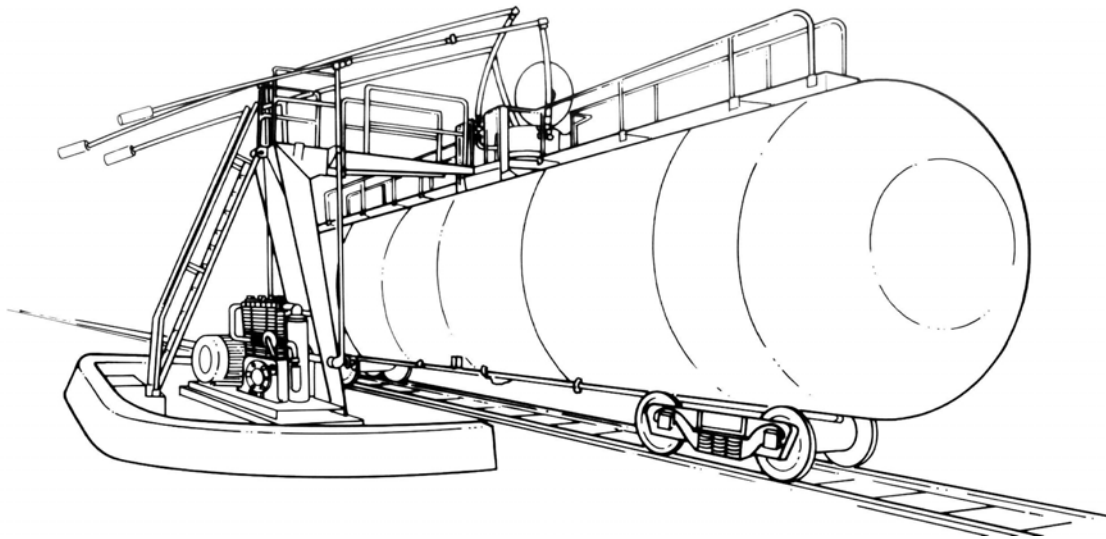
PUB1010a

Minimize Heat Losses

CB-222

- Place the compressor next to the vessel to be emptied.

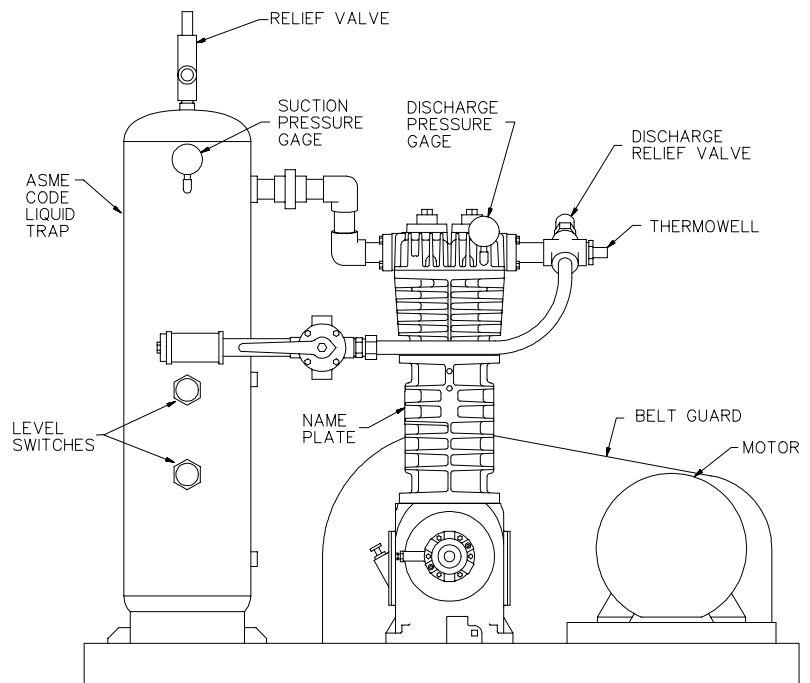
Long discharge lines = Heat loss
= Premature condensation
= Slow transfer rate



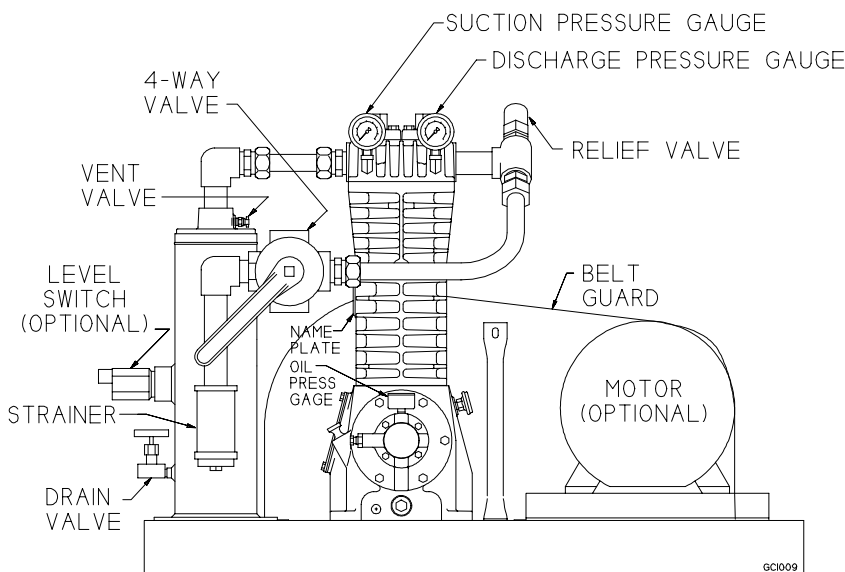
Watch Out For Liquid

CB-224

- Use a Liquid Trap
- Use a larger trap with long suction lines
- Don't put the compressor at a low point



AE92-98844-1

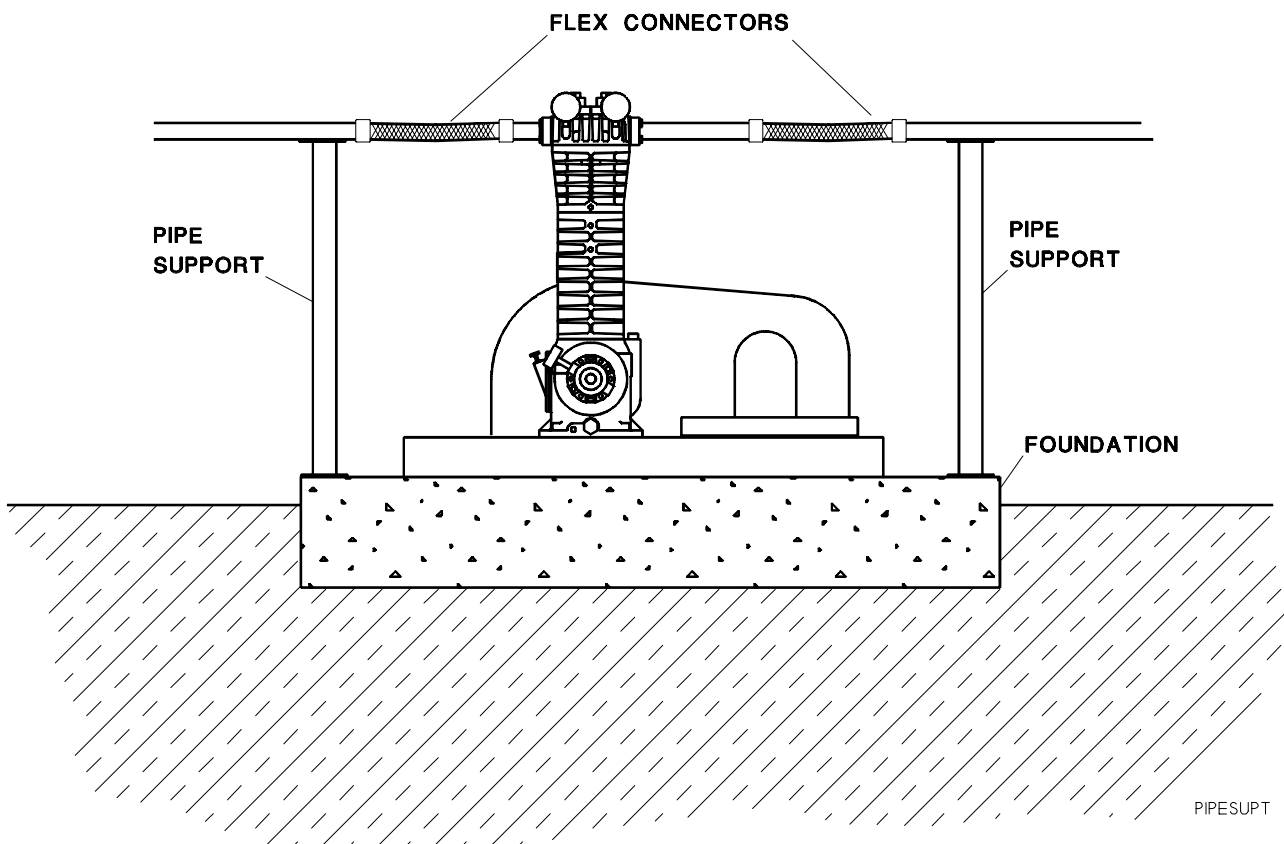


GC009

Install the Compressor Properly

Cb-220

- Compressors are a reciprocating device
- Provide a solid foundation
- Support the baseplate along its entire length
- Support the piping



ROUTINE SERVICE SCHEDULE

	Daily	Weekly	Monthly	6 Months
Overall Visual Check	X			
Check Crankcase Oil Pressure	X			
Check Suction Pressure	X			
Check Discharge Pressure	X			
Drain Liquid Trap		X		
Clean Compressor Cooling Fins		X		
Check Crankcase Oil Level *			X*	
Check V-Belt Tension			X	
Change Oil *				X*
Clean Inlet Strainer Element				X
Inspect Valves				X
Lubricate Motor Bearings per Manufacturers Suggestions				X

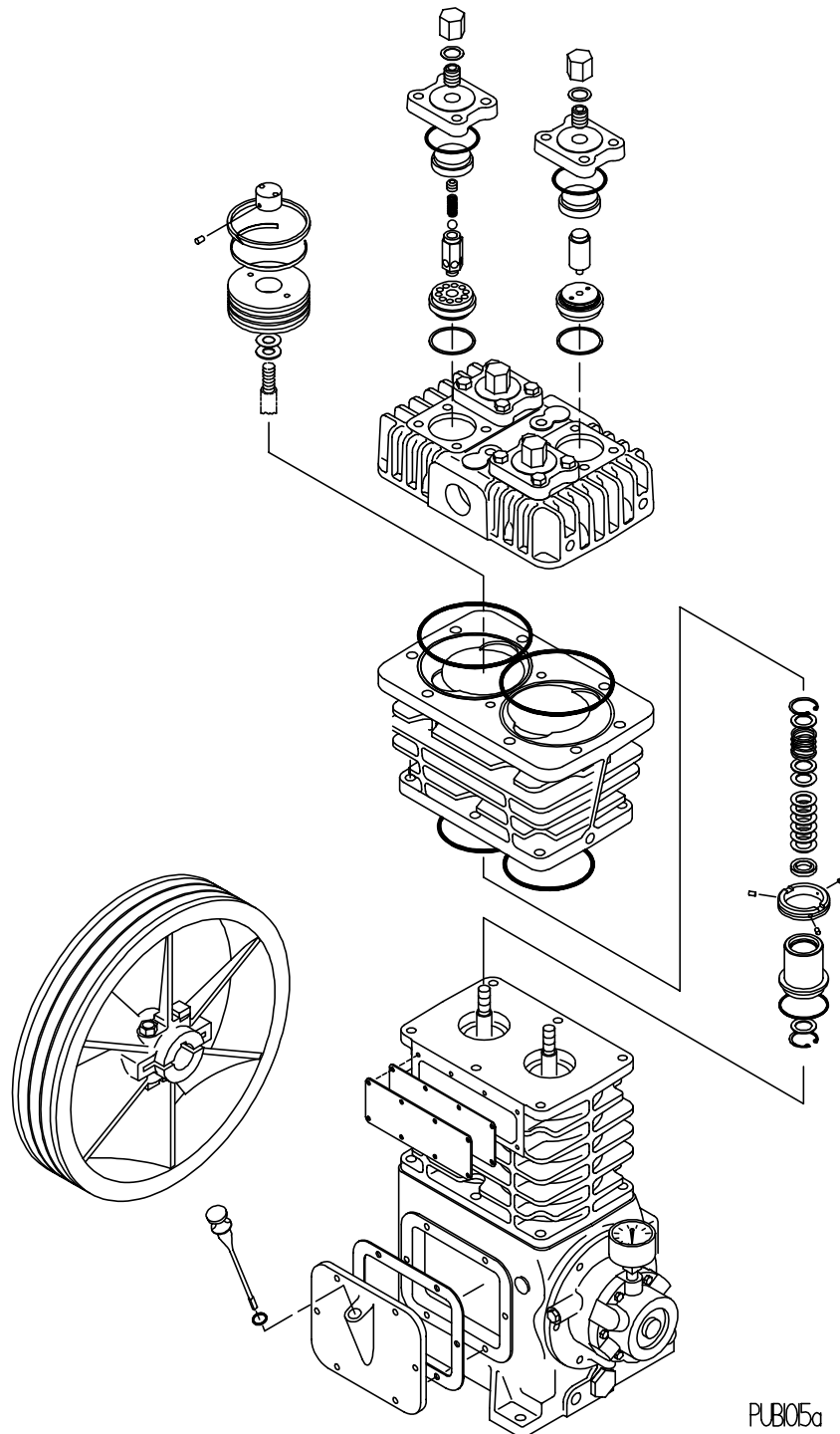
* Change oil every 1,000 hours of operation, or every 6 months which ever occurs first. If the oil becomes unusually dirty, change oil as often as needed to maintain clean oil.

Compressor Maintenance Repair

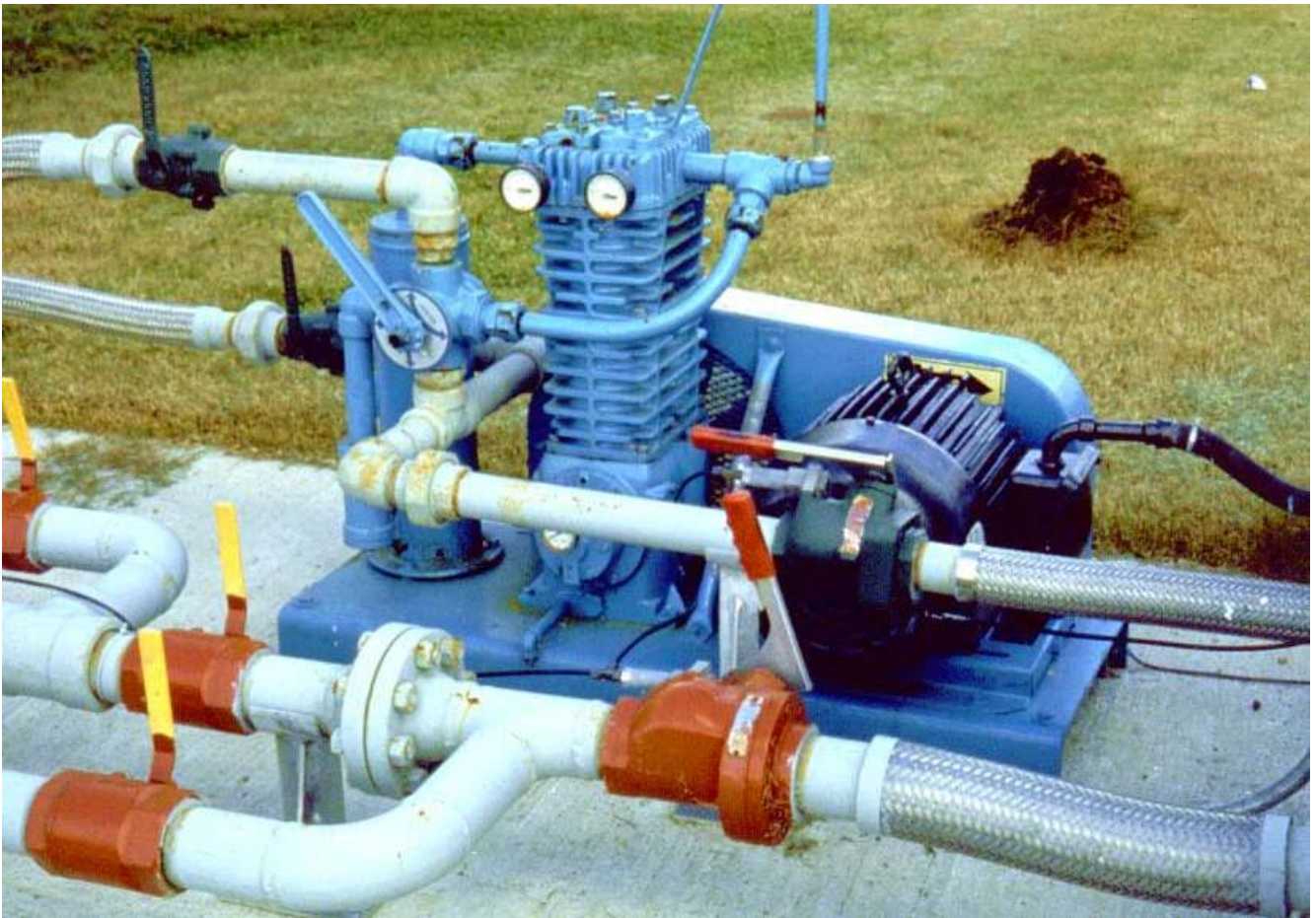
- Valves -
Inspect / replace without disturbing the piping

- Piston rings

- Seals



PUB105a



Use a Pump or a Compressor?

Pumps

+ + + + + + +	- - - - -
Vapor return line is not mandatory	Must have adequate NPSH available
Suitable for higher differential pressures	Requires careful suction piping design
Can use with meters	Will usually leave some liquid in the tank
Less expensive	Cannot recover vapors
Simpler	May be noisier

Compressors

+ + + + + + +	- - - - -
No NPSH problems	Must have both vapor and liquid lines
Transfers all the liquid	Best for moderate differential pressures
Can Recover Vapors	Cannot use with meters
Less critical piping design	More expensive
Quieter	More complex

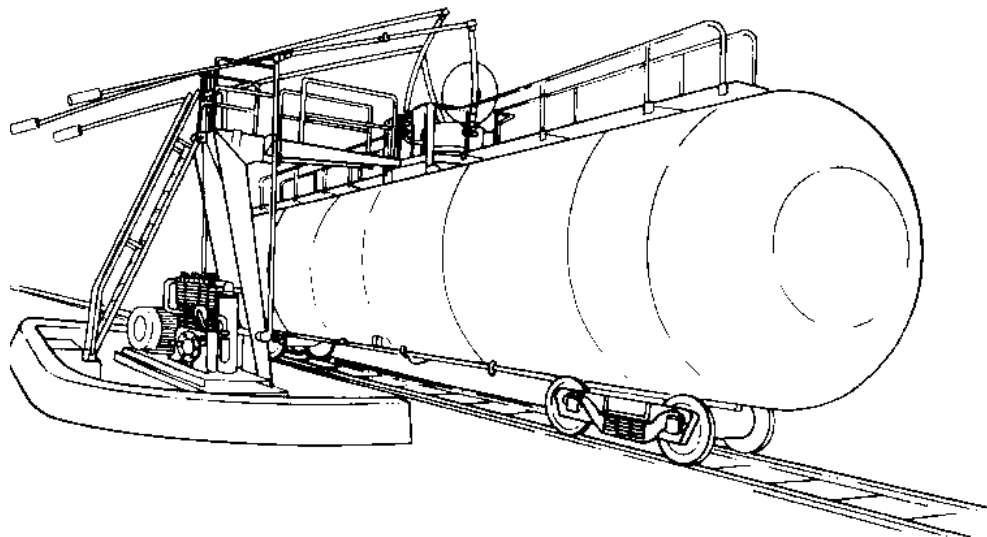
When to Use a Pump

- Product is to be metered
Home delivery
Motor fueling
- Adequate available NPSH
Bottom opening vessels
- High differential pressures
Truck pumps
Cylinder filling



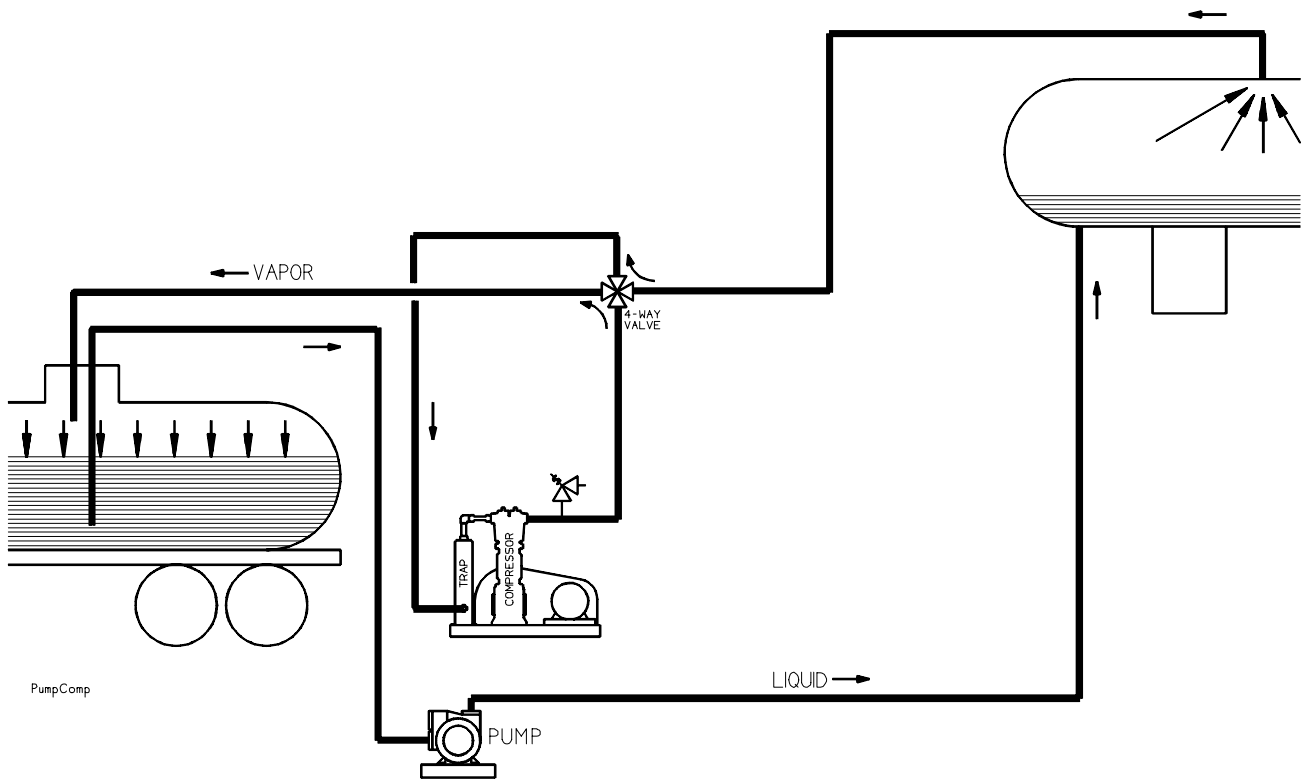
When to Use a Compressor

- **Low NPSH available**
Rail cars
Tank with top openings
Overturnd vessels
- **Vapor recovery desired**
Fewer loads for the same capacity
- **Vessel must be 'emptied'**
Inspection / repair
Environmental / safety



When to Use a Pump & Compressor Together

- Poor pump suction conditions +
high differential pressures
- Rail car and storage vessel separated by:
Distance
Elevation
Undersized piping





1809 Century Avenue, Grand Rapids, Michigan 49503 U.S.A.
(616) 241-1611 • Fax: (616) 241-3752 • www.blackmer.com