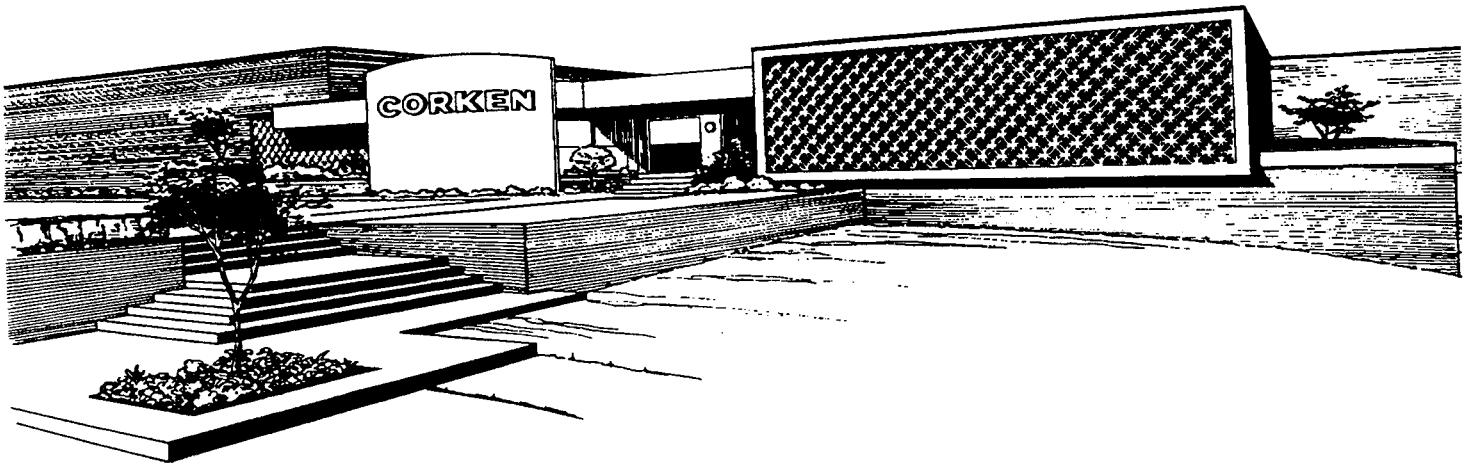
LPG
Training Manual



Solutions beyond products...

CORKEN®

IDEX

CP281

CORKEN TRAINING MANUAL
FOR
LPG PUMPS AND COMPRESSORS

FIRST EDITION MARCH 1993

TABLE OF CONTENTS

INTRODUCTION

This manual is to be used as a training tool at the LPG pump and compressor schools offered by Corken's technical staff. The information in this manual is for use only by Corken's staff when conducting a training and maintenance session on select Corken equipment. It is not to be used as a Service Manual for repairing Corken equipment.

This manual does not include all the instruction and service pages available for repairing and maintaining Corken equipment. Its purpose is to acquaint you with the sales, service and instruction pages on select Corken equipment. Please note the instruction and service pages may not be current. Before repairing equipment or ordering parts and units, contact your Corken distributor for current instruction and service manual pages.

ONE YEAR LIMITED WARRANTY

CORKEN, INC. warrants that its products will be free from defects in material and workmanship for a period of 12 months following date of purchase from CORKEN.

CORKEN products which fail within the warranty period due to defects in material or workmanship will be repaired or replaced at CORKEN's option, when returned, freight prepaid to CORKEN, INC., 3805 N.W. 36th St, Oklahoma City, Oklahoma 73112.

Parts subject to wear or abuse, such as mechanical seals, blades, piston rings, valves and packing, and other parts showing signs of abuse are not covered by this limited warranty. Also, equipment, parts and accessories not manufactured by CORKEN but furnished with CORKEN products are not covered by this limited warranty and the purchaser must look to the original manufacturer's warranty, if any. This limited warranty is void if the CORKEN product has been altered or repaired without the consent of CORKEN.

All implied warranties, including any implied warranty of merchantability or fitness for a particular purpose, are expressly negated to the extent permitted by law and shall in no event extend beyond the expressed warranty period.

CORKEN DISCLAIMS ANY LIABILITY FOR CONSEQUENTIAL DAMAGES DUE TO BREACH OF ANY WRITTEN OR IMPLIED WARRANTY ON CORKEN PRODUCTS. Transfer of toxic, dangerous, flammable or explosive substances using CORKEN PRODUCTS is at the user's risk. Such substances should be handled by experienced, trained personnel in compliance with governmental and industrial safety standards.

PRICES

All prices are f.o.b. factory at Oklahoma City U.S.A. Prices quoted are for acceptance within 30 days, but in the meantime may be changed upon proper notice. Prices of equipment for future delivery will be those in effect at time of shipment.

TERMS

Standard terms for all sales are net payment within thirty (30) days from the date of invoice unless it is the judgement of CORKEN that the financial condition of the purchaser warrants other terms. In the event the Purchaser fails to make payment in accordance with the conditions specified, the Purchaser shall pay interest on the amount due at the rate of 1 1/2% per month.

DESIGN

It is CORKEN's intention to continually improve the design and performance of its products as new ideas, new practices and new materials become available. Therefore, all published designs, specifications and prices are subject to minor modifications at the time of manufacture to coincide with this policy, without prior notice to the Purchaser. If the equipment purchased is to be used in an existing installation to match previously purchased equipment, material will be furnished to be interchangeable as near as may be feasible, but CORKEN reserves the right to substitute materials and designs.

SHIPMENTS

The prices shown include standard crating or packaging for normal rail or commercial truck shipments within the borders of the continental United States, Canada, and Mexico. Consult Factory for Export Crating charges. All promises of shipment are estimates contingent upon strikes, fires, elements beyond our control or manufacturing difficulties, including the scheduled shipping dates of materials from our suppliers.

CANCELLATION CHARGES

There will be a minimum cancellation charge of 15% of the net price for any order which is cancelled after having been accepted and officially acknowledged by CORKEN. In the event there is material involved that is manufactured by others, and is being purchased by CORKEN for the sole purpose of becoming part of this cancelled order, the cancellation charges assessed CORKEN by these other manufacturers shall be borne by the Purchaser.

If shipment has already been made before notice of cancellation, the Purchaser will be charged all the freight costs involved in the handling of the order, including the charges necessary to get the equipment back to the respective warehouses of CORKEN and its supplies, in addition to the cancellation charge described above.

RETURNED MATERIAL

Material may be returned to the factory ONLY if there is prior written authorization from CORKEN and accompanied by a Corken "Returned Goods" tag and the freight is paid by the shipper.

Material that is authorized for return will be inspected when received, and if it is of current design, unused, and in first-class resalable condition, credit will be allowed on the basis of the original invoice value less restocking charges. Returned material that is found to be worn, or in damaged condition, will not be accepted. The customer will be notified of this, and return shipping instructions, or permission to scrap such items will be requested. If no instructions are received within sixty (60) days after such notice, the material will be scrapped. Outside purchased materials and equipment may be returned for credit ONLY by CORKEN's prior written authorization, and must be in new and undamaged resalable condition, and of current design. Such returned materials are subject to a MINIMUM restocking charge of 25%.

LITERATURE

CORKEN will furnish, upon request and without charge to the Purchaser, four copies of paper prints of standard drawings, performance curves, and other current literature covering the pump or compressor and/or such other descriptive material that good judgement would consider necessary. Any additional material and/or special drawings will be charged for at appropriate rates determined by the CORKEN Engineering Department and are available upon request.

FACTORY INSPECTION AND TESTS

Each article of CORKEN's manufacture passes a standard factory inspection and operating test prior to shipment. Special factory inspections, tests and/or certified test reports are all subject to a factory charge available upon request.

LIABILITY FROM USE OF PRODUCT

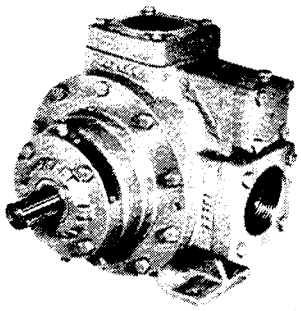
CORKEN has no control over the ultimate use of its products and specifically disclaims any liability damage, loss or fines which may arise from the use thereof. The user and purchaser shall hold CORKEN harmless from such damage, loss or fines. The user and purchaser shall determine the suitability of CORKEN products for the use intended and issue adequate safety instructions therefor.

Compliance with the Occupational Safety and Health Act and similar laws and regulations shall be the responsibility of the user of the product and not the responsibility of CORKEN.

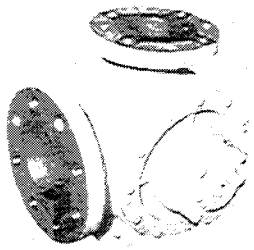
•••

CORO-VANE® PUMP

Stationary Pump Units



MODEL 521

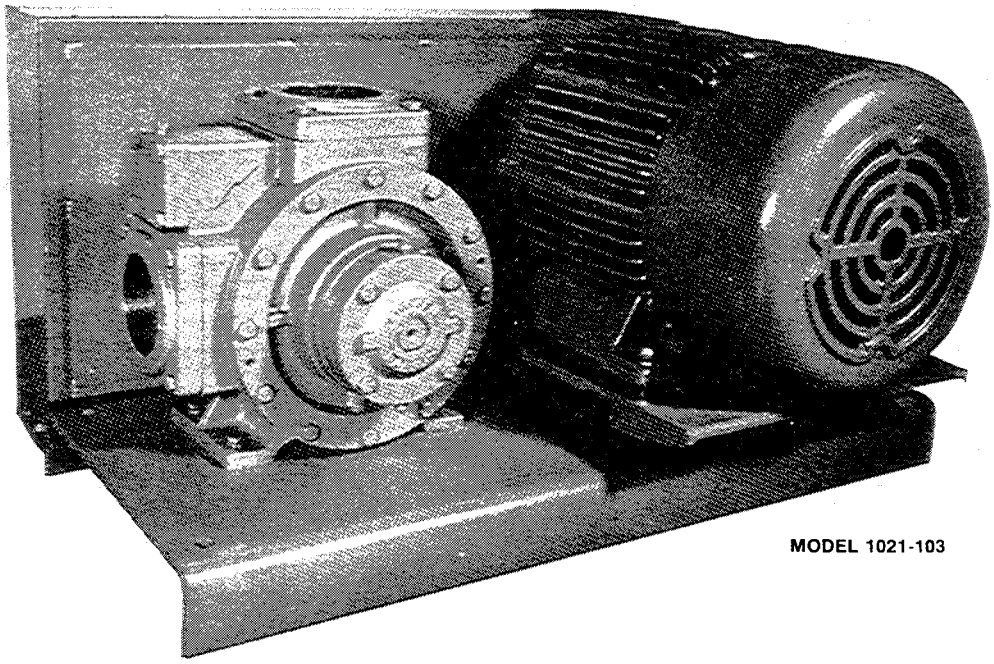


MODEL F1521

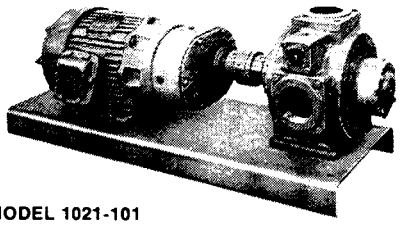
Three Sizes to Economically Handle Bulk Plant Pumping Applications

- **Model 521 — Capacities up to 90 GPM (341 Lit/Min) at 950 RPM**
- **Model 1021 & F1021 — Capacities up to 200 GPM (757 Lit/Min) at 950 RPM**
- **Model F1521 — Capacities up to 350 GPM (1325 Lit/Min at 860 RPM**

Listed by Underwriters' Laboratories, Inc. for use in LP-Gas and Anhydrous Ammonia.



MODEL 1021-103



MODEL 1021-101

CORKEN®
IDEX

MEMBER PEI

FOR FAST EFFICIENT TRANSFER OF HARD-TO-HANDLE LIQUIDS, ESPECIALLY LPG, NH_3, AEROSOL PROPELLANTS, FUELS AND MANY OTHER PETROLEUM AND NON-CORROSIVE FLUIDS.

ONLY
CORKEN CORO-VANE
STATIONARY PUMP UNITS
OFFER SO MUCH!

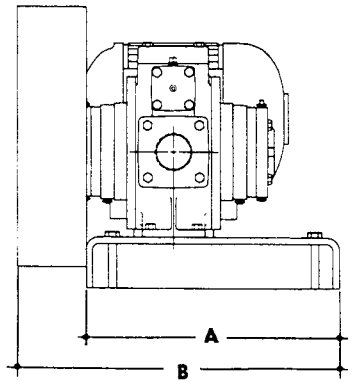
- CAPACITIES UP TO 350 GPM (1325 LIT/MIN)
- MINIMUM OF MOVING PARTS
- FLANGED INLET AND OUTLET CONNECTIONS
- HANDLE MOST ANY BULK PLANT APPLICATION ECONOMICALLY AND EFFICIENTLY
- "FLOATING" ROTOR REQUIRES NO ADJUSTING OR SHIMS
- F1021 AND F1521 OFFER 300 LB ASA FLANGES
- THREE BASIC SIZES
- EASY INSTALLATION
- SIMPLE REPLACEMENT OF PARTS
- NO TROUBLESOME PINS OR SPRINGS BEHIND BLADES
- HYDRAULICALLY ACTUATED BLADES
- UNIQUE AND SIMPLE DESIGN
- QUIET OPERATION
- OPTIONAL FLANGE SIZES ON SOME MODELS
- STURDY PUMP BODIES MADE OF DUCTILE IRON
- EACH PUMP CAREFULLY TESTED BEFORE SHIPMENT
- O-RING GASKET CONSTRUCTION
- COMPACT SIZE

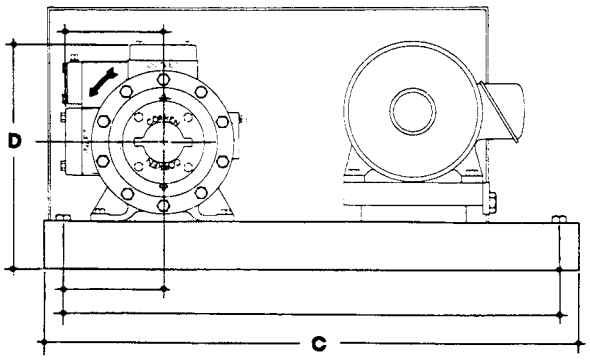
ALL CORO-VANE pumps, both the stationary models shown here, as well as the truck and transport models* from 2" to 4" sizes, use the same size mechanical seals and roller bearings to help CORKEN customers keep their spare parts inventories at a minimum — another cost saving CORKEN FEATURE!

*See Catalog Section VD.

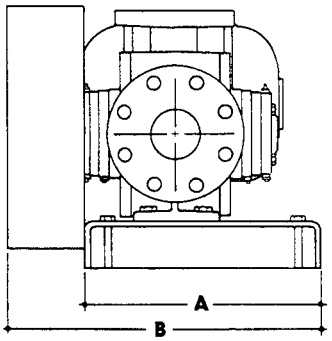
The equipment shown in this bulletin is covered in whole or in part by Patent Numbers 3,072,066 and 3,392,677.

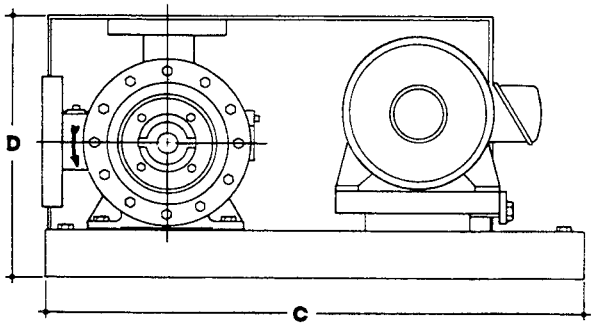
MODELS 521- AND 1021-103





MODELS F1021- AND F1521-103



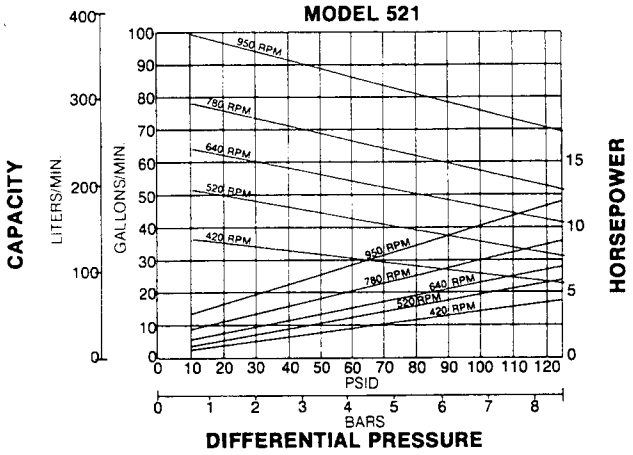


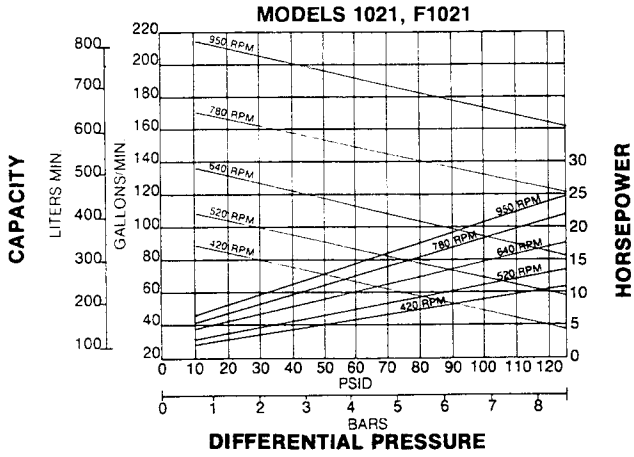
**MAXIMUM DIMENSIONS, In. (cm.)*

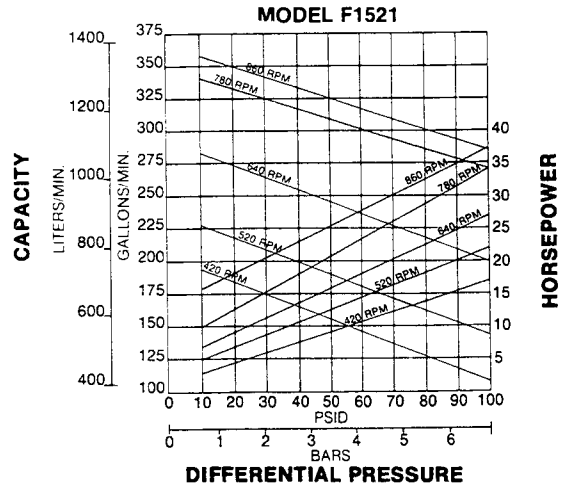
MODEL	A	B	C	D
521-103	15(38.1)	19¾(50.2)	42(106.7)	20(50.8)
1021-103	15(38.1)	19¾(50.2)	42(106.7)	20(50.8)
F1021-103	15(38.1)	19¾(50.2)	42(106.7)	20(50.8)
F1521-103	18(45.7)	22¾(57.8)	42(106.7)	20(50.8)

*Stationary CORO-VANE models are normally V-belt driven, but direct driven arrangements are available. For exact dimensions and more information consult your nearby Distributor or the Factory.

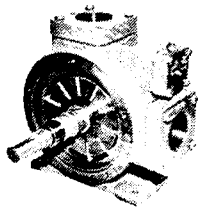
PERFORMANCE CURVES
FOR LPG, NH3 AND OTHER LIGHT LIQUIDS



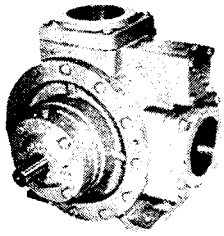




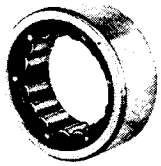
FEATURES



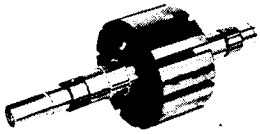
All parts, including the hydraulically actuated self adjusting blades are easily accessible for inspection or replacement without disturbing the piping.



Models 521 and 1021 have a built-in internal relief valve. Models F1021 and F1521 are furnished without a relief valve. All liquefied gas pumps should be installed with a separate back-to-tank bypass valve.



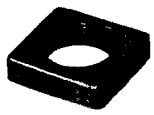
Only Corken Coro-Vane pumps have heavy-duty roller bearings for longer bearing life. These bearings are interchangeable in all sizes of Coro-Vane pumps.



Large diameter shaft gives greater strength and stability. No holes in this shaft to weaken it.

Special precision ground sideplates add years to pump life and saves money on repairs.

Replaceable precision ground cam (liner) with holes instead of slots for greater strength and higher capacity. Anti-cavitation design!



Ductile iron threaded flanges save money by eliminating pipe unions and make installation easier. Steel slip on welding flanges are available at slight extra cost. The F1021 and F1521 have 300 lb. ASA flanged openings on both suction and discharge.

Corken pumps have precision mechanical seals that are easy and inexpensive to replace. These seals are interchangeable in all sizes of Coro-Vane pumps.

SPECIFICATIONS

MECHANICAL SPECIFICATIONS

SPECIFICATION	521	1021	F1021	F1521
Suction Flange	2½"(2" Optional)[1]	3"(4" Optional)[1]	3" 300 LB ASA	4" 300 LB ASA
Discharge Flange	2"(2½" Optional)[1]	3"(4" Optional)[1]	2½" 300 LB ASA	3" 300 LB ASA
Maximum RPM	950	950	950	860
Minimum RPM	420	420	420	420
Minimum Temperature	−25°F(−32°C)	−25°F(−32°C)	−25°F(−32°C)	−25°F(−32°C)
Maximum Temperature	225°F(107°C)	225°F(107°C)	225°F(107°C)	225°F(107°C)
Maximum Working Pressure	400 PSIG(28.6 Bars)[3]	400 PSIG(28.6 Bars)[3]	400 PSIG(28.6 Bars)[3]	400 PSIG(28.6 Bars)[3]
Maximum Differential Pressure	125 PSID(8.6 Bars)[4]	125 PSID(8.6 Bars)[4]	125 PSID(8.6 Bars)[4]	100 PSID(6.9 Bars)

Coro-Vane Pumps should not be run with 'V' Belt Drive when a driver of greater than 20 Horsepower is required except in a few unusual conditions for Models 1021 and F1021. Consult the factory when in doubt.

MATERIAL SPECIFICATIONS

PART	STANDARD	OPTIONAL AT ADDITIONAL COST
Case, Heads, Rotor	A536 Ductile Iron	———
Cam, Sideplates, Bearing Cap	Gray Iron	———
Seal Seat	Gray Iron	Stainless Steel
Seal Rotor	Carbon	———
Seal Metal Parts	Steel	———

PART	STANDARD	OPTIONAL AT ADDITIONAL COST
Shaft	Steel	———
Vanes	Plastic	———
Relief Valve	Steel	———
Relief Valve Spring	Steel	———
'O' Rings	Buna N, Neoprene[2]	Viton[2],Teflon[2]
Bearings	Cylindrical Roller	———

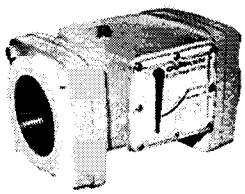
Notes:

1. Ductile Iron pipe threaded; Steel Slip-on Welding Flanges available at extra cost.
2. Neoprene, Viton and Teflon are registered trademarks of DuPont.
3. Maximum allowed by UL for LPG and NH_3 is 350 PSIG (25.2 Bars).
4. Maximum allowed by UL for LPG and NH_3 is 125 PSID (8.6 Bars).

ACCESSORIES

T166 Bypass Valve

B177 Bypass Valve



Flo-Chek Valve

PERFORMANCE — Backed by Worldwide Service

To assure greater satisfaction to Corken customers across the United States and in many foreign countries all Corken distributors maintain their own service departments with adequate stocks of repair parts.

CORKEN® IDEX

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Phone (405) 946-5576 • Telex 262513 Corkn Ur

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PRINTED IN U.S.A.
JANUARY 1993

MODEL NO. AND MOUNTING IDENTIFICATION CODE

OCTOBER 1988
SUPERSEDES VC150B

MODELS INVOLVED	DESCRIPTION	CODE	FEATURE
521, 1021	FOOT MOUNTED	NONE	GENERAL CONSTRUCTION
1021, 1521	FOOT MOUNTED WITH 300 LB. ASA INLET AND OUTLET FLANGES	F	
ALL	SLIDING VANE PUMP WITH FLOATING ROTOR AND ONE SHAFT EXTENSION	521 1021 1521	BASIC MODEL
521, 1021	10 SOLID BLADES	E	BLADE TYPE
1521	6 SOLID BLADES	F	
521,1021	GCB-33 (LPG)	F	BLADE MATERIAL
521, 1021	GCB-40 (NH_3)	G	
1521	GCB-40 (ALL SERVICES)		
ALL	BUNA N TEFLON* VITON* NEOPRENE* BUNA N/VITON* BUNA N/TEFLON*	NONE A B C L M	O-RING MATERIAL

ALL	BARE PUMP	NONE	MOUNTING
ALL	DIRECT DRIVE	-101	
ALL	V-BELT DRIVE FOR ENGINE	-102	
ALL	V-BELT DRIVE FOR ELECTRIC MOTOR	-103	

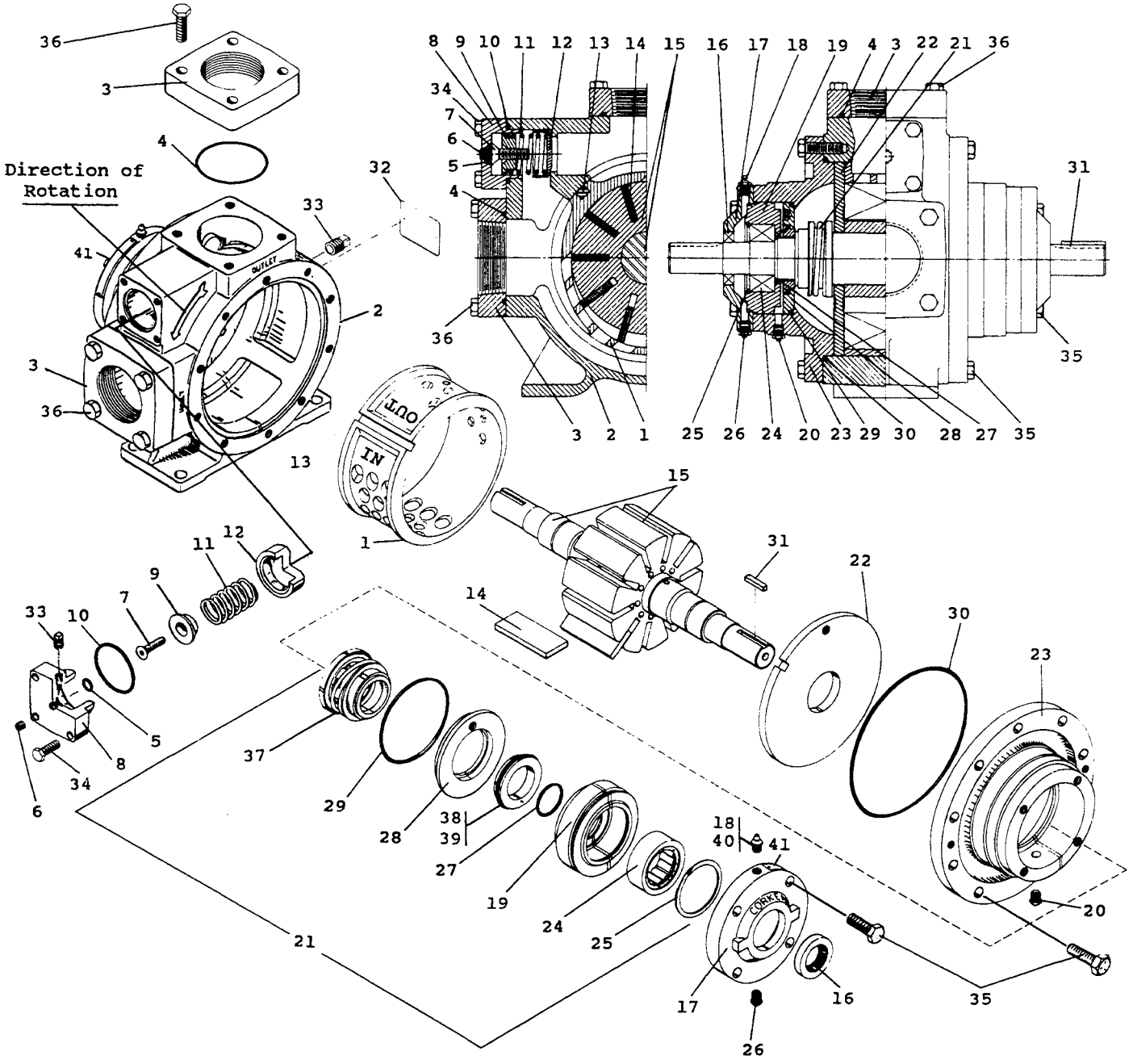
EXAMPLE

F 1521 F G A - 103

MODEL NUMBER — MOUNTING

A LETTER Z IS ADDED TO THE END OF THE MODEL NUMBER AND/OR THE MOUNTING NUMBER WHEN SPECIAL MATERIAL IS USED

*TEFLON, VITON AND NEOPRENE ARE REGISTERED TRADEMARKS OF DUPONT.


Direction of Rotation
OUTLET
OUT
IN

PARTS DETAILS
CORO-VANE PUMPS
MODELS 521,522,1021,1022, S/N CT115372 AND LATER
OBSOLETE MODELS 321,322

REF NO.	PART NO.	PART NAME	QTY.
1.	1465	Cam (321,322)	1
	1162-2	Cam (521,522)	1
	1201-2	Cam (1021,1022)	1
2.	2832	Case (321,322,521,522)	1
	2841	Case (1021,1022)	1
(c) 3.	1172-2.5	Flange - 2-1/2" NPT (321,521)	1
	1172-2	Flange - 2" NPT (322,522)	2
	1172-2	Flange - 2" NPT (321,521)	1
(d)	1206-3	Flange - 3" NPT (1021,1022)	2
(b) 4.	2-234	O-Ring, Flange (321,322,521,522)	2
	2-245	O-Ring, Flange - 3" (1021,1022)	2
	2-249	O-Ring, Flange - 4" (1021,1022)	2
(b) 5.	2-112	O-Ring, Adjusting Screw	1
6.	2590	Flush Seal Plug - 1/8" NPT	1
7.	2252	Relief Valve Adjusting Screw	1
8.	1174	Valve Cap (321,322,521,522)	1
	1207	Valve Cap (1021,1022)	1
9.	1242	Relief Valve Spring Guide (321,322,521,522)	1
	1227	Relief Valve Spring Guide (1021,1022)	1
(b) 10.	2-224	O-Ring, Relief Valve Cap (321,322,521,522)	1
	2-228	O-Ring, Relief Valve Cap (1021,1022)	1
11.	1240	Relief Valve Spring (321,322,521,522)	1
	1226	Relief Valve Spring (1021,1022)	1
12.	1241	Relief Valve (321,322,521,522)	1
	1224	Relief Valve (1021,1022)	1
13.	1170	Cam Key (321,322,521,522)	1
	1309	Cam Key (1021,1022)	1
14.	1168-6	Blade - LPG (321,322,521,522)	10
	1168-7	Blade - NH_3 (321,322,521,522)	10
	1308-8	Blade - LPG (1021,1022)	10
	1308-9	Blade - NH_3 (1021,1022)	10
15.	1166-1X1R	Rotor/Shaft Assy. w/2755 (321,521)	1
	1166-1X2R	Rotor/Shaft Assy. w/2755 (322,522)	1
	1208-1X1R	Rotor/Shaft Assy. w/2755 (1021)	1
	1208-1X2R	Rotor/Shaft Assy. w/2755 (1022)	1
16.	1358	Grease Seal	2
17.	1164-1	Bearing Cap	2
18.	2158	Grease Zerk (1/8" NPT)	2
19.	1769	Bearing Housing	2
20.	1343	Relief Fitting (Seal Vent)	2
a,b) 21.	1769-X	Seal Assembly	2
(e) 22.	1163-2	Sideplate (321,322,521,522)	2
	1209-1	Sideplate (1021,1022)	2
23.	1161-4	Head (321,322,521,522)	2
	1205-4	Head (1021,1022)	2
24.	2754-X	Roller Bearing - Complete	2
	2755	Bearing Inner Race	2
	2754	Bearing Outer Race	2
25.	2760-244	Retainer Ring	2
26.	1343	Relief Fitting (Grease)	2
(b) 27.	2-128	O-Ring, Shaft	2
28.	1822	Seat Adapter Plate	2
(b) 29.	2-240	O-Ring, Adapter Plate	2
(b) 30.	2-261	O-Ring, Case (321,322,521,522)	2
	2-268	O-Ring, Case (1021,1022)	2
31.	2270	1/4" Key	2
32.	2649	Nameplate	1
33.	3442	1/4" NPT Plug	1
34.	7001-031 NC125A	Bolt Hex Head 5/16 - 18 X 1-1/4	4
35.	7001-037 NC125A	Bolt Hex Head 3/8 - 16 X 1-1/4 (321,322,521,522)	28
	7001-037 NC125A	Bolt Hex Head 3/8 - 16 X 1-1/4 (1021,1022)	32
36.	7001-037 NC150A	Bolt Hex Head 3/8 - 16 X 1-1/2	8
37.	----	Retainer (Not available separately)	2
38.	----	Seal Seat (Not available separately)	2
39.	2-227	O-Ring, Seal Seat	2
40.	2159	Lubricap #2	2
41.	1359	Lubricated Instruction Tag	2

CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.

NOTES:

(a) Two Seal Assemblies are available (For Seal Details See Service Manual Page C224):

1769-X	Complete Seal Assembly (B) consisting of: Bearing Housing, Seat Adapter Plate, Bearings, Retainer Ring, Seal and O-Rings.
1769-XR	Field Replacement Seal Assembly (c) consisting of: Seal and O-Rings.

(b) For Seal and O-Ring Material Coding See Page A500.

(c) Optional:

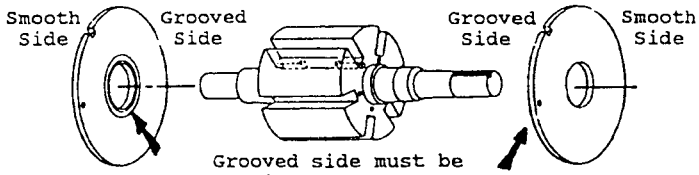
1172-1.5	Flange - 1-1/2" NPT
1172-1.5S	Flange - 1-1/2" Welded
1172-2	Flange - 2" NPT
1172-2S	Flange - 2" Welded
1172-2.5	Flange - 2-1/2" NPT
1172-2.5S	Flange - 2-1/2" Welded
1947-1.5	Flanged Ell - 1-1/2" NPT
2008-2	Flanged Ell - 2" NPT

(d) Optional:

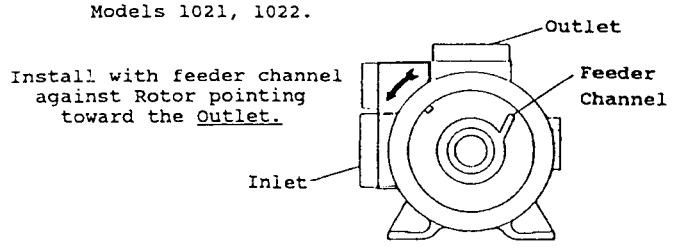
1206-3S	Flange - 3" Welded
1206-4	Flange - 4" NPT
1206-4S	Flange - 4" Welded

(e) Sideplate Replacement:

Models 521, 522.
Obsolete Models 321, 322.



Models 1021, 1022.



CORO-VANE SEAL REPLACEMENT INSTRUCTIONS

Simple as A, B, C . . . but **watch** alignments A, B and C or your new seal **will leak!**

CAUTION

Bleed all pressure from the pump and piping before starting to install your seal assembly.

CLEANLINESS

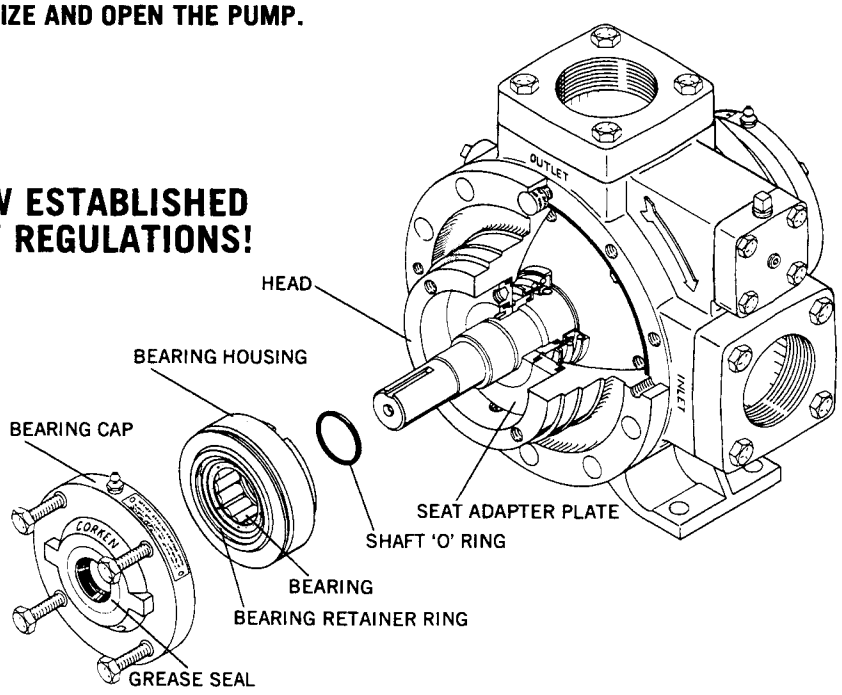
Even the smallest amount of dirt on your new seal can cause early failure.Keep all parts, tools and your hands clean while installing the seal. Never touch the smooth lapped faces of the carbon rotor or seal seat. For LP-gas, anhydrous ammonia and similar liquids, you are trying to seal a fluid that is 5 to 10 times thinner than water! Your new seal needs every chance it can get, so keep it clean.

WORKMANSHIP

Your Corken pump is a precision piece of equipment with very close clearances. Treat it as such. Never beat on it to get parts in or out.

STEP 1 — DEPRESSURIZE AND OPEN THE PUMP.

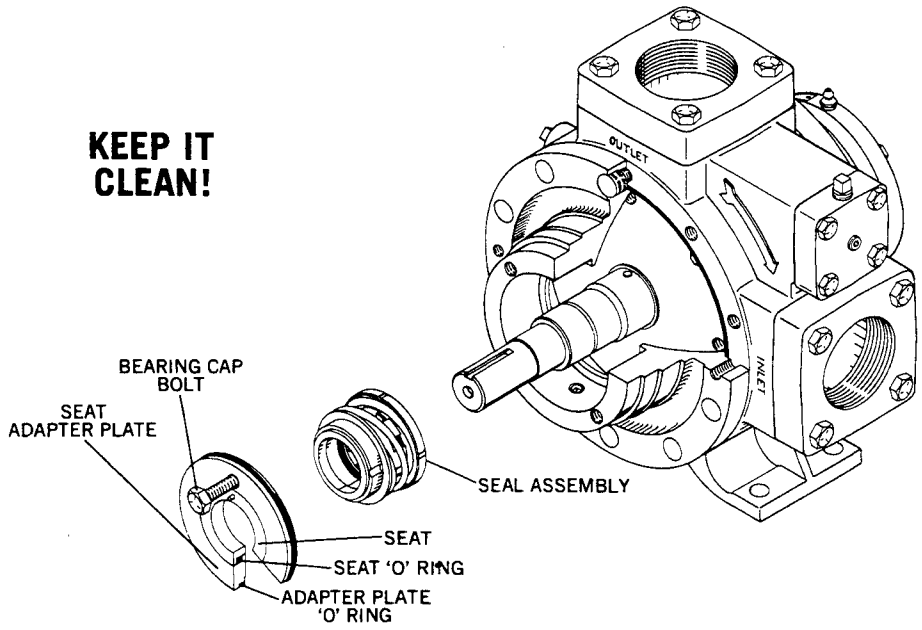
FOLLOW ESTABLISHED SAFETY REGULATIONS!



Remove the bearing cap and bearing housing. Should the bearing housing be rusted or frozen in place it may be necessary to remove the entire pump head. The housing can then be driven out **gently** with a block of wood. Remove the old shaft 'O' Ring and discard it. Never reuse an old 'O' Ring except in an emergency. If you are also installing a new bearing or grease seal, do so now.

STEP 2 — REMOVE THE OLD SEAL.

KEEP IT CLEAN!

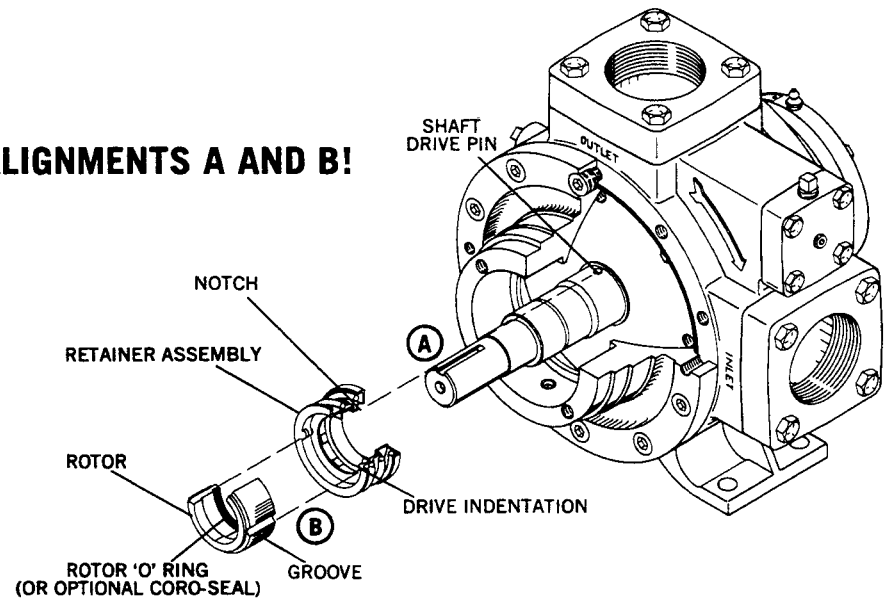


The seat adapter plate can be removed using a bearing cap bolt as a puller. Discard the old adapter plate 'O' Ring, seat and seat 'O' Ring. Remove and discard the rest of the old seal.

Thoroughly clean all surfaces which contact 'O' Rings. Use fine emery or crocus cloth. The shaft under the seal 'O' Ring should be shiny smooth. Lubricate all surfaces with a clean light engine oil. Do not let dirt settle on the parts.

STEP 3 — PROPER ALIGNMENT.

WATCH ALIGNMENTS A AND B!



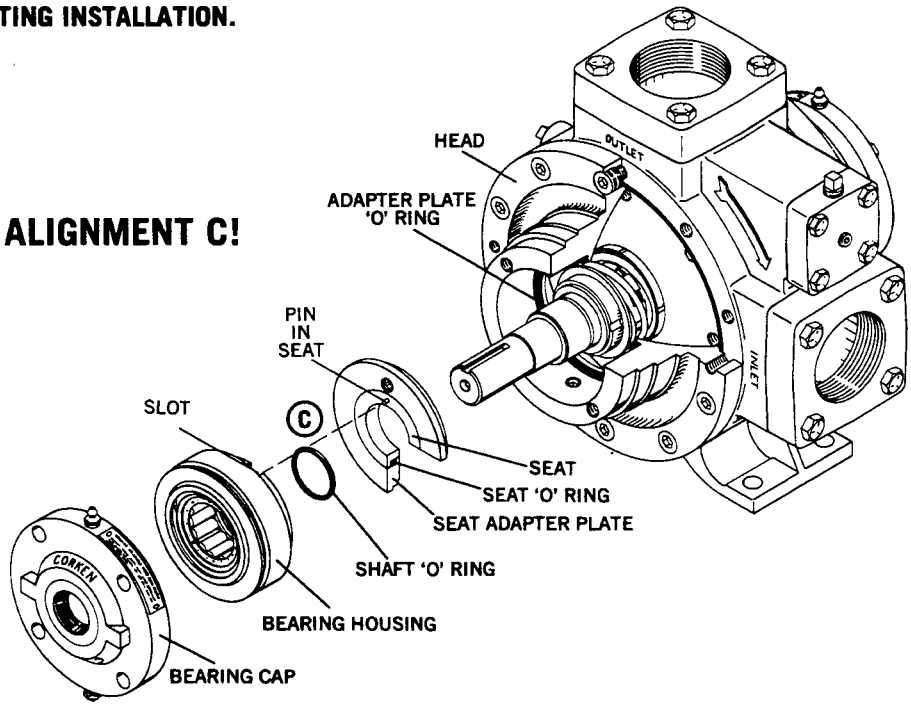
This is the most critical part of your seal installation.
Be sure your hands are clean. Unwrap your new seal and make certain do not touch the seal faces.
Ⓐ Install the retainer assembly, locating the notch over the shaft drive pin. If the pin is not in the notch, the seal will be improperly positioned and **will leak.** It should not require any force to install the retainer assembly.
Hold the carbon rotor without touching the lapped face, lubricate the rotor 'O' Ring with a light oil and install both on the pump shaft. (For optional Teflon Coro-Seal installation see paragraph below.)
Ⓑ The two grooves in the carbon rotor must line up with the drive indentations in the retainer assembly. If they do not, the seal will be improperly positioned and **will leak.** Do not allow the carbon rotor to cock or you may chip the lapped face.

OPTIONAL CORO-SEAL INSTALLATION

If you are using the optional Teflon Coro-Seal be sure that the shaft is very clean and smooth as the Teflon Seal is not as tolerant of surface blemishes as the rubber type 'O' Ring. After lubricating the Coro-Seal install in back of carbon rotor with the spring **toward** you, and then slide the carbon rotor in position as previously described.

STEP 4 — COMPLETING INSTALLATION.

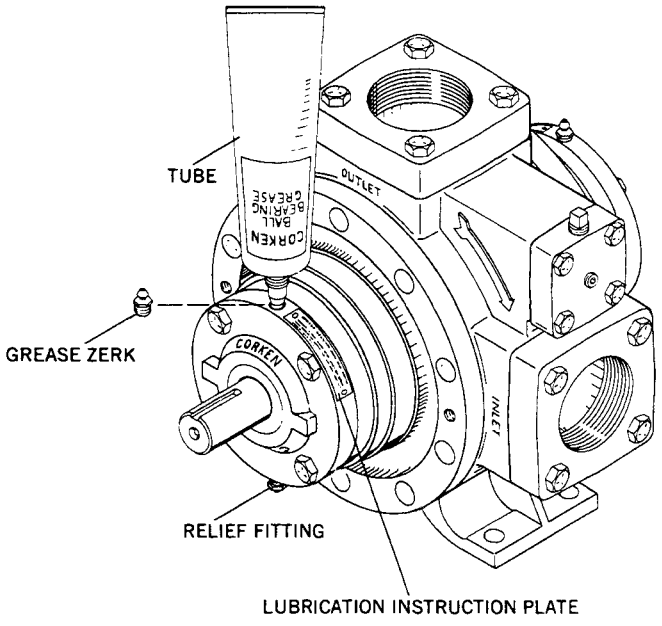
WATCH ALIGNMENT C!



Oil then place the new adapter plate 'O' Ring into the pump head.
Put the new seat and oiled seat 'O' Ring into the adapter plate without touching the lapped face.
Install the adapter plate in the pump head.
Put the shaft 'O' Ring on the shaft.
© Slide the bearing housing into the head locating the slot in the bearing housing over the pin in the back of the seat. If the pin is not in the slot, the seal will be improperly positioned and **will leak.**
Install the bearing cap using a criss-cross method on the bolts. Make sure the pump turns freely.

STEP 5 — LUBRICATION.

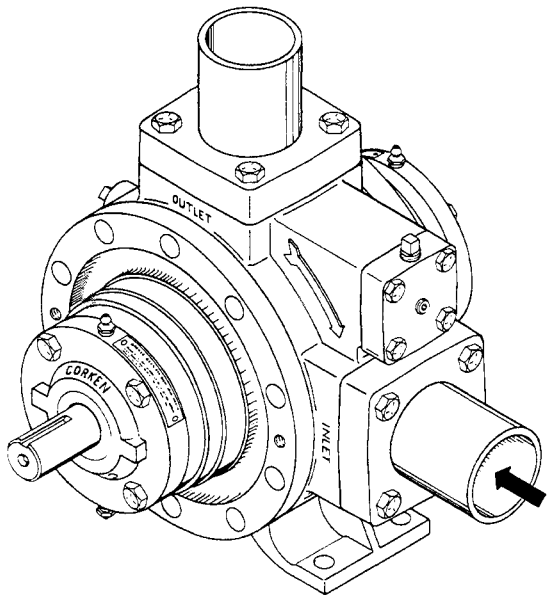
DON'T OVERGREASE!



Regrease the bearings after **thoroughly cleaning the grease openings** and fittings. If dirt is forced into the bearings, early failure will result.
Special relief fittings have been provided to prevent over-greasing the bearings. Excessive grease may drip out for several hours after lubrication. Over-greasing will damage the pump bearings.
Use only a recommended ball bearing grease. If you use the Corken ball bearing grease tube, remove the grease zerk and screw the tip of the tube into the hole. Squeeze the tube until grease comes out the relief fitting. If you use a hand grease gun, put the grease in as slowly as possible and stop as soon as the relief fitting opens.
For truck pumps: Grease the U-joints and the spline of the drive shaft when greasing the pump.

STEP 6 — REPRESSURIZE THE SYSTEM.

VAPOR FIRST, THEN LIQUID!



Best results are usually obtained by **quickly** pressurizing with vapor pressure. Liquid entering the pump even slowly can sometimes refrigerate enough that seal elastomers fail to be forced properly into their sealing positions; leakage is the result.

1450 RPM MOTOR			Motor Hp.	Nominal Pump RPM	1750 RPM MOTOR		
Belt No.	Sheave Pitch Dia.				Sheave Pitch Dia.		Belt No.
	Pump	Motor			Pump	Motor	
B64	B15.4	B7.4	2	420	1-3V14.0	1-3V3.35	3V600
B60	B13.6	B4.2		470	1-3V10.6	1-3V2.80	3V530
B60	B12.4	B4.2		520	1-3V10.6	1-3V3.15	3V530
B55	B11.0	B4.2		580	1-3V10.6	1-3V3.65	3V560
B56	B11.0	B4.8		640	1-3V8.0	1-3V3.00	3V500
B64	B15.4	B4.4	3	420	2-3V10.6	2-3V2.65	3V530
B64	B15.4	B4.8		470	2-3V10.6	2-3V2.80	3V530
A55	2A10.6	2A3.6		520	1-3V14.0	1-3V4.12	3V630
B55	2B11.0	2B4.2		580	1-3V14.0	1-3V4.75	3V630
B60	B12.4	B5.4		640	2-3V8.0	2-3V3.00	3V500
B56	B11.0	B5.2		710	2-3V6.9	2-3V2.80	3V475
B53	B9.4	B4.8		780	1-3V8.0	1-3V3.65	3V500
B53	B8.6	B5.0		860	2-3V5.3	2-3V2.65	3V450
B51	B7.4	B4.8		950	1-3V6.5	1-3V3.65	3V475
B64	2B15.4	2B4.4	5	420	3-A13.2	3-A3.2	A60
B60	2B13.6	2B4.2		470	2-A13.2	2-A3.6	A60
B60	2B12.4	2B4.2		520	2-A12.0	2-A3.6	A56
B55	2B11.0	2B4.2		580	2-3V10.6	2-3V3.65	3V560
B56	2B11.0	2B4.8		640	3-3V8.0	3-3V3.00	3V500
B56	2B11.0	2B5.2		710	2-3V8.0	2-3V3.35	3V500
B53	2B9.4	2B4.8		780	2-3V6.9	2-3V3.15	3V475
B53	2B8.6	2B5.0		860	2-3V6.5	2-3V3.15	3V475
B51	2B7.4	2B4.8		950	2-3V6.0	2-3V3.35	3V475
B64	3B15.4	3B4.4	7½	420	4-A13.2	4-A3.2	A60
B64	2B15.4	2B4.8		470	3-A13.2	3-A3.6	A60
B60	3B12.7	3B4.2		520	3-3V14.0	3-3V4.12	3V630
B55	3B11.0	3B4.2		580	2-3V14.0	2-3V4.75	3V630
B56	3B11.0	3B4.8		640	2-3V14.0	2-3V5.30	3V630
B56	3B11.0	3B5.2		710	2-3V10.6	2-3V4.50	3V560
B53	3B9.4	3B4.8		780	3-3V6.9	3-3V3.15	3V475
B53	3B8.6	3B5.0		860	3-3V6.5	3-3V3.15	3V475
B51	3B7.4	3B4.8		950	2-3V8.0	2-3V4.50	3V530
B71	3B18.4	3B5.2	10	420	3-3V19.0	3-3V4.50	3V710
B71	2B18.4	2B5.8		470	3-3V19.0	3-3V5.00	3V710
B60	4B12.4	4B4.2		520	3-3V14.0	3-3V4.12	3V630
B55	4B11.0	4B4.2		580	3-3V14.0	3-3V4.50	3V630
B56	4B11.0	4B4.8		640	2-3V14.0	2-3V5.30	3V630
B62	3B12.4	3B5.8		710	2-3V14.0	2-3V5.60	3V630
B56	3B11.0	3B5.8		780	2-B12.4	2-B5.6	B60
B62	3B12.4	3B7.0		860	2-3V10.6	2-3V5.30	3V560
B60	3B9.4	3B6.0		950	2-3V10.6	2-3V5.60	3V560
B71	4B18.4	4B5.2	15	420	4-3V19.0	4-3V4.75	3V710
B71	3B18.4	3B5.8		470	4-3V19.0	4-3V5.00	3V710
B62	5B13.6	5B4.8		520	3-3V19.0	3-3V5.60	3V750
B60	5B12.4	5B4.8		580	4-3V14.0	4-3V4.75	3V630
B56	5B11.0	5B4.8		640	3-3V14.0	3-3V5.30	3V630
B56	5B11.0	5B5.2		710	3-3V14.0	3-3V5.60	3V630
B53	5B9.4	5B4.8		780	3-B12.4	3-B5.6	B60
B53	5B8.6	5B5.0		860	2-B12.4	2-B6.0	B60
B51	5B7.4	5B4.8		950	2-B11.0	2-B6.0	B56
B75	4B18.4	4B6.6	20	520	4-3V19.0	4-3V5.60	3V750
B68	4B15.4	4B6.8		640	4-3V14.0	4-3V5.30	3V630
B64	4B12.4	4B6.6		780	3-B13.6	3-B6.0	B62
B68	3B13.6	3B8.0		860	4-3V10.6	4-3V5.30	3V560
B65	3B12.4	3B8.0		950	3-B11.0	3-B6.0	B56

NOTE: Coro-Vane Pumps should not be run with 'V' Belt Drive when a driver of greater than 25 Horsepower is required, except in a few unusual conditions for the Model 1000. Consult the Factory

TROUBLESHOOTERS GUIDE - FOR CORKEN CORO-VANE PUMPS
Stationary Pumps

In diagnosing pump and "system troubles, the following information is essential:

1. Pressure at pump suction.
2. Pressure at pump discharge.
3. Pressure in tank being evacuated.
4. Pressure in tank being filled.
5. Pipe size and length of suction and discharge lines.
6. Size and length of vapor equalizing line.

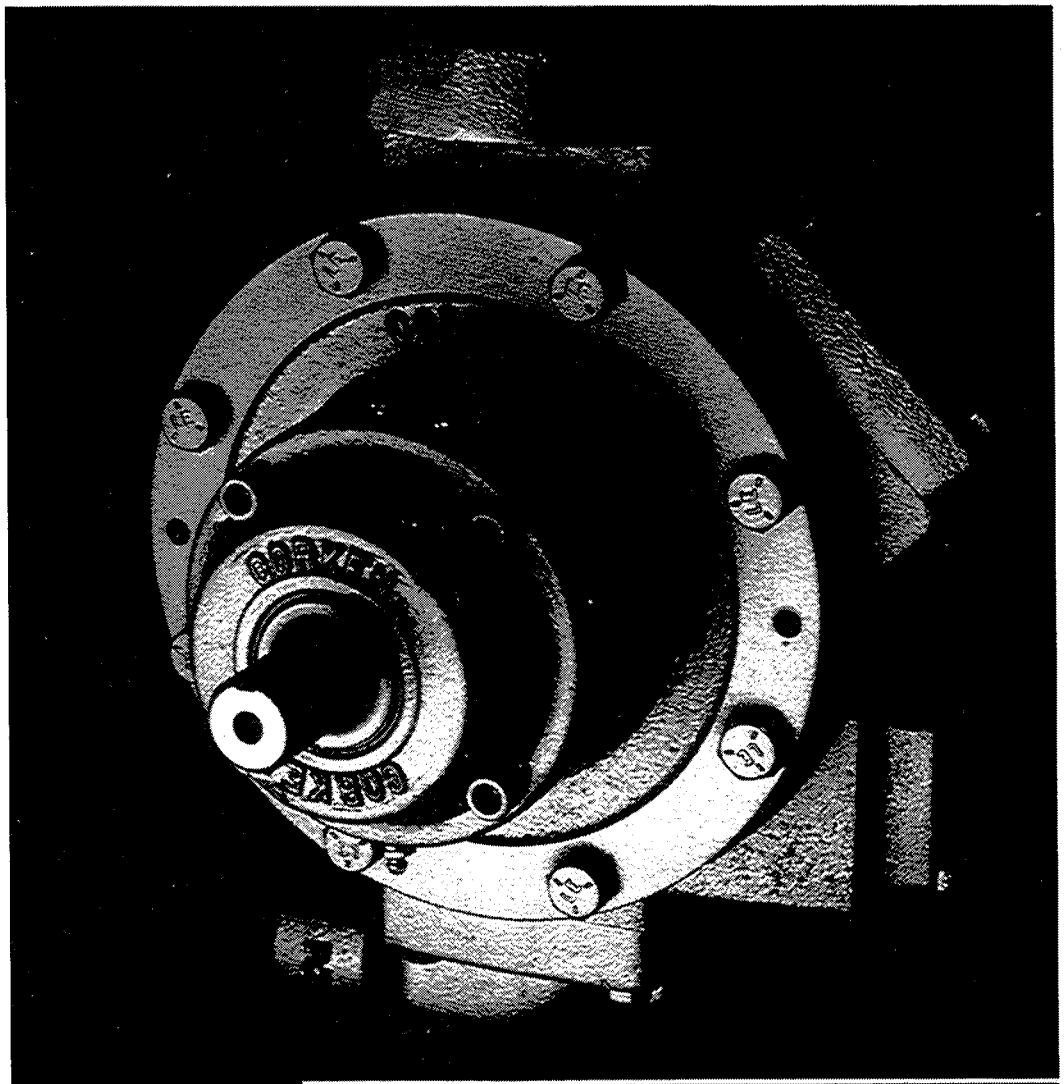
PROBLEM	CAUSE	WHAT TO DO
ɔw apacity	Pump speed too low	Check motor speed. Tighten belts if necessary. Consult pump performance curve. Use tachometer on pump if speed is questionable. Change belt sheaves if required.
	Low voltage	
	High differential pressure	Restriction in discharge piping or discharge piping hose too small. Vapor equalization lines too small or not used.
	Bypass valve stuck open or set too low	Check capacity with bypass line closed with manual valve. Use care! Readjust, repair or replace valve.
	Clogged strainer	Clean strainer.
	Suction pipe too small or restricted	Indicated by pump inlet pressure dropping several pounds when pump is started. Remove restriction or modify piping.
	Worn vanes	Replace or invert blades.

PROBLEM	CAUSE	WHAT TO DO
Low Capacity (cont'd)	Worn sideplates	Replace sideplates.
	Vanes sticking	Remove blades and clean out foreign matter. Grind down or replace blades if swollen.
Pump Runs But No Flow	Valve closed	Open valve.
	Excess flow valve slugged	Stop pump 'til valve opens. If problem continues, slow pump down by changing sheaves or install new or larger excess flow valve.
	Broken shaft	Disassemble and inspect pump. Repair if necessary.
Pump won't turn - locked	Foreign matter in pump	Clean out the pump - install strainer in suction line.
	Blades broken	Clean out pump carefully and replace blades.
	Bearing seized	Clean or replace pump bearings - grease regularly (see instructions)
	Moisture frozen in pump	Thaw and break loose carefully
Won't Build Pressure	Poor suction conditions	Increase pipe size - liquid and vapor. Clean inlet strainer.
	Bypass valve set too low	Set valve for higher pressure - (see instructions).
	Worn vanes, sideplates	Disassemble, inspect and repair if necessary.

PROBLEM	CAUSE	WHAT TO DO
Pump is Noisy	Cavitation from poor suction conditions	As above.
	Vanes sticking	As Above.
	Bearings bad	Replace if necessary - grease regularly.
	Very high differential pressure	Check for restriction in discharge line.
Pump Leaks Around Shaft	Seal or 'O'rings failed	Inspect seal assembly and replace if necessary. Keep new seal very clean, and oil 'O'rings.
Motor gets hot or Switch Overload Kicks Out	Motor overloaded	Check motor load with ammeter. Differential pressure too high. Set bypass lower. Check for low line voltage at motor while pump is operating. Be sure motor is wired for proper voltage. Consult motor name-plate and wiring diagram.
	Starter overload heaters too small	Check motor load with ammeter and confirm heater size with starter manufacturer's instructions.
	Motor shorted out	TEFC (totally enclosed) and explosion proof motors are subject to moisture condensation inside when used intermittently. To eliminate trouble, allow motor to operate at least once a week long enough for motor to get hot. This would not be necessary during off seasons when equipment is not normally operating.

CORO-VANE truck pump

For LPG, NH_3 and other light liquids.



Solutions beyond products...

IDEX

You can hear the superiority of the Z3000 pump.

The innovative cam design and large inlet port of the Z3000 CORO-VANE® pump control noisy cavitation that often occurs with highly volatile liquids pumped at low tank levels. The high-flow inlet and direct flow outlet minimize cavitation even more. Because cavitation is minimized, you'll find the Z3000 amazingly quiet as it pumps. And a quiet pump is a better pump, because quiet means there's less wear and tear on internal parts.

Why this pump lasts longer, needs service less often:

Besides its new cam design and longer-lasting advanced materials, the Z3000 CORO-VANE® pump has other features to extend pump life and reduce maintenance.

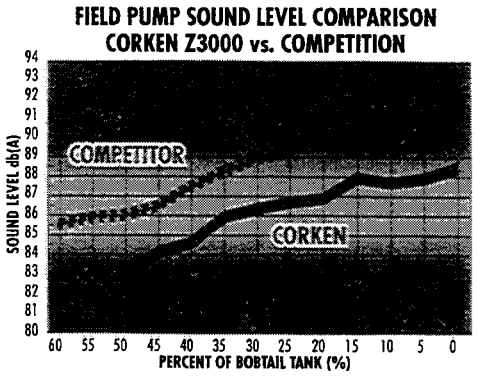
Unlike pumps with conventional steel blade drivers that will eventually penetrate the blade, the Z3000 pump has large diameter, light weight blade drivers that are extremely durable. They won't damage the blades, even at high RPMs.

Precision-machined sideplates are reversible to provide twice the service life.

A new heavy-duty PTO thrust eliminator isolates the pump shaft, rotor and sideplates from PTO thrusts that can cause premature failure. This extends the life of the pump by reducing wear on all moving parts.

Six reasons to choose the Z3000 CORO-VANE® pump.

1. New cam design and material control cavitation, minimizing wear on cam, blades and sideplates. You get extended wear life from these high wear parts.
2. New blade and blade driver design made of advanced materials improves pumping efficiency. Blade drivers are made of a lightweight, advanced material rather than steel.
3. New thrust eliminator isolates PTO thrust from the pump shaft, rotor and sideplates. Moving parts experience less wear, require replacement less often.
4. New internal relief valve requires no field adjustment. It's preset at the factory to save you hassles in the field.
5. Reversible sideplates give you twice the life.
6. Easy maintenance. Mechanical seals can be replaced without removing the head; simply remove the bearing cap. Overhaul can be done at a fraction of the cost of a new pump.



Switching to the Z3000 is easier than you think.

So that you can install it without re-piping inlet and outlet piping, the Z3000 is dimensionally interchangeable with commonly used truck pumps. You can adapt the pump to either right- or left-hand PTO rotation.

Another convenient innovation is the preset, no-adjust internal relief valve. It ends guessing and repeated field adjustments. The reliable, easy-to-replace mechanical seal for the Z3000 is compatible with propane and ammonia, so you can pump either without wasting time changing seals.

Z3000 is backed by the strongest warranty in the industry.

Because the Z3000 offers longer, reliable performance, we can offer the industry's strongest truck pump warranty. Ask your distributor for details.

And, as with every Corken product, you're supported by a world-wide network of Corken distributors ready to provide expert advice and service.

Solutions beyond products...

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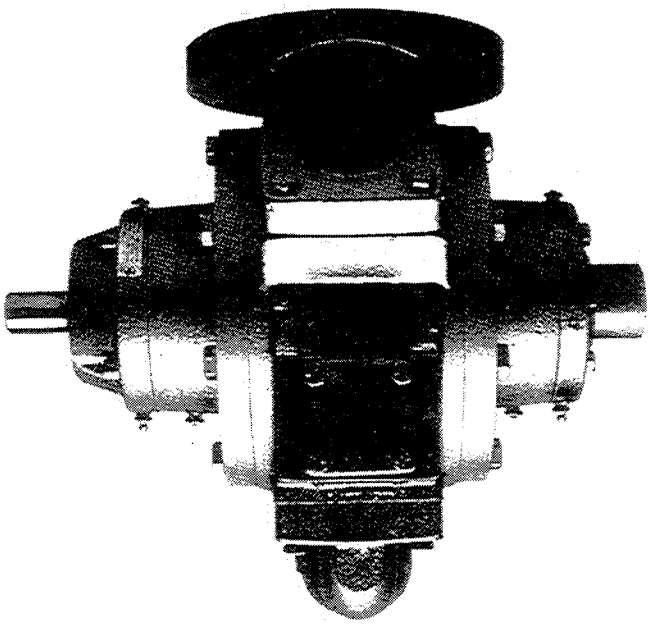
IDEX

Z3000

CORO-VANE® Specifications



PUMP SPEED	DIFFERENTIAL PRESSURE	APPROXIMATE DELIVERY ON PROPANE (•)	BRAKE HP REQUIRED	PUMP TORQUE REQUIRED
RPM	PSI (kPa)	GPM (LPM)	BHP (KW)	FT LBS. (KG/m)
750	50 (345)	114 (431)	6.2 (4.6)	43.4 (6.0)
750	100 (689)	104 (394)	9.9 (7.4)	69.3 (9.6)
650	50 (345)	98 (371)	5.2 (3.9)	42.0 (5.8)
650	100 (689)	88 (333)	8.2 (6.1)	66.3 (9.2)
600	50 (345)	90 (341)	4.7 (3.5)	41.1 (5.7)
600	100 (689)	80 (303)	7.4 (5.5)	64.7 (9.0)
500	50 (345)	73 (276)	3.8 (2.8)	39.9 (5.5)
500	100 (689)	63 (238)	5.8 (4.3)	60.9 (8.4)

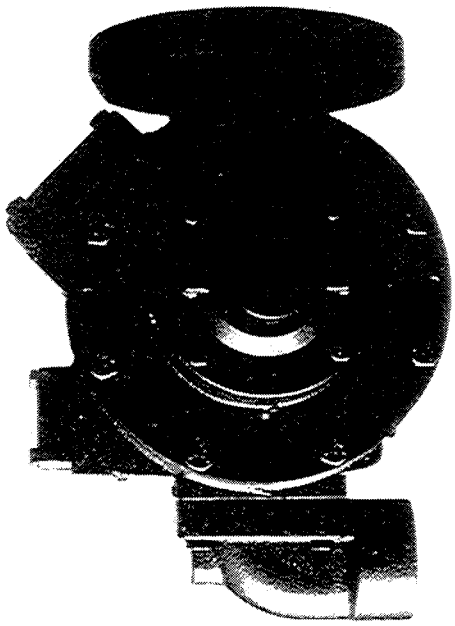
• The chart shows approximate delivery rates as seen in vapor equalized propane systems at 70°F/21°C with no pressure loss in pump suction piping.
The following will cause increased vaporization of the liquid in the pump suction, adversely affecting the delivery:

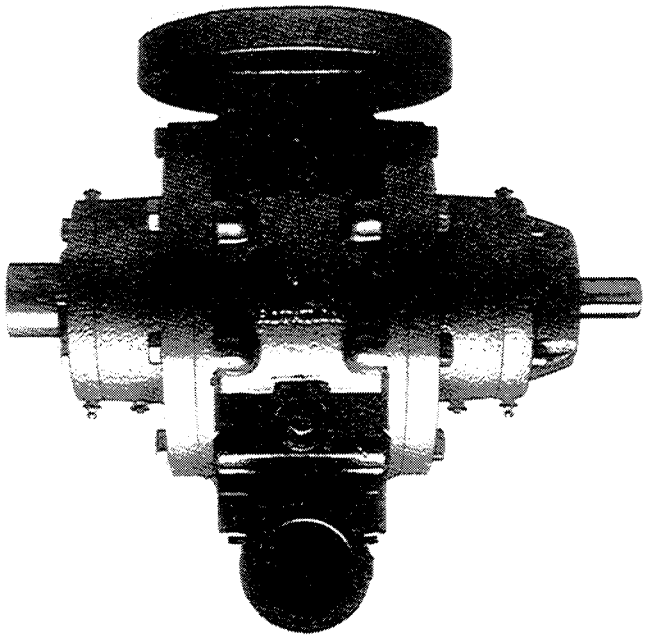
1. Restrictions in the suction piping such as internal valves, excess flow valves, elbows, etc..
2. Restriction or lack of a vapor return line.
3. Temperatures below 70°F/21°C.

This loss of delivery is not caused by the pump but is a result of the natural thermodynamic properties of liquified petroleum gases. See the GUIDE TO CORKEN LIQUIFIED GAS TRANSFER EQUIPMENT CP226 for additional information.

PORTS	COMPANION FLANGES	
	STANDARD	OPTIONAL
INLET	3" MOUNTING 300# ANSI	———
OUTLET	2" NPT EL	2" OR 1 1/2" NPT (1)
AUXIL INLET	2" NPT (1)	1 1/2" NPT 2" NPT EL OR BLIND (1)

(1) Steel slip on welding flanges available at extra cost.





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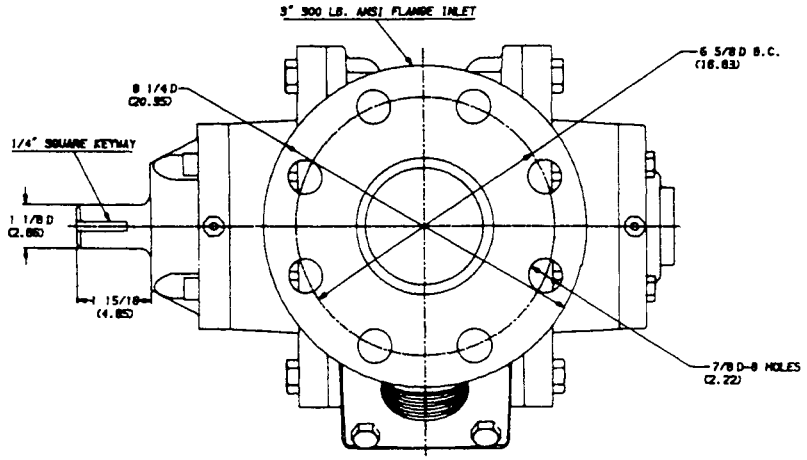
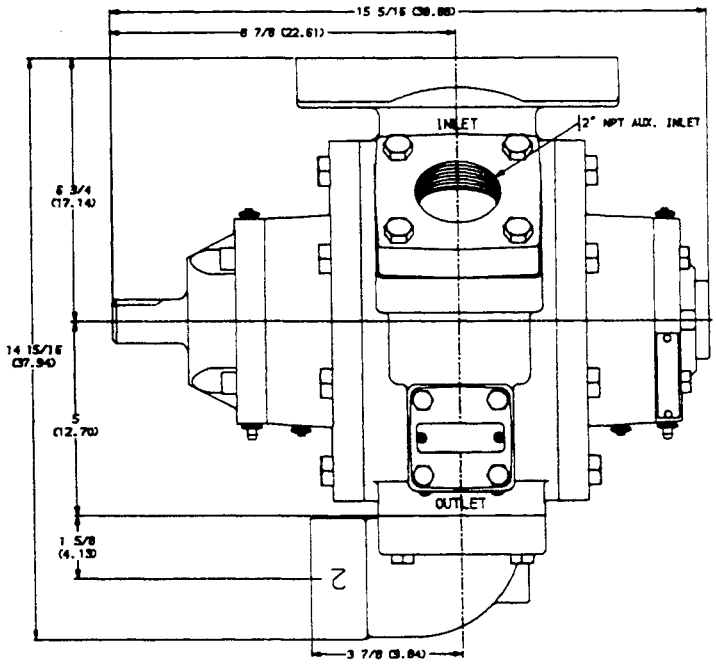
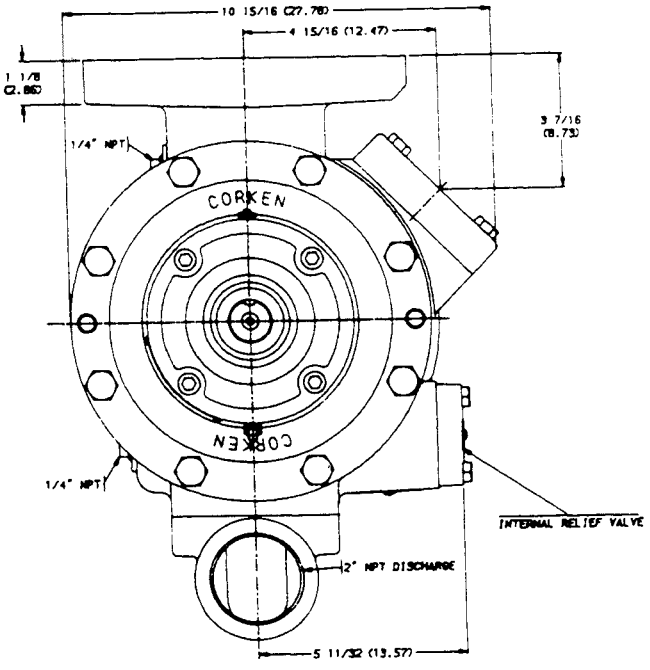
MODEL Z3000
OUTLINE DIMENSIONS

JANUARY 1993
FIRST ISSUE







DIMENSIONS IN INCHES / (CENTIMETERS)

GENERAL
TRUCK & TRANSPORT
PUMPS

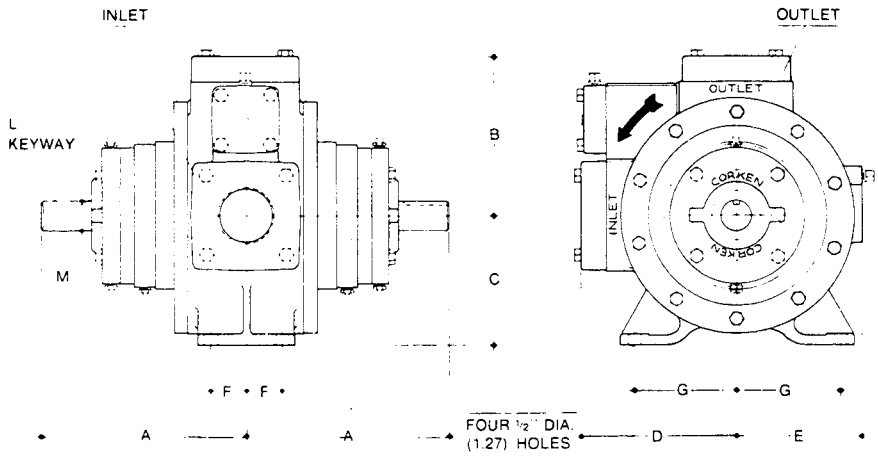
FOR DEPENDABLE LIQUID TRANSFER OF LPG & NH3

AND

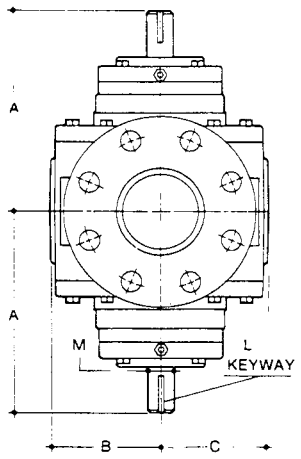
SIMILAR HARD TO HANDLE FLUIDS

OUTLINE DIMENSIONS

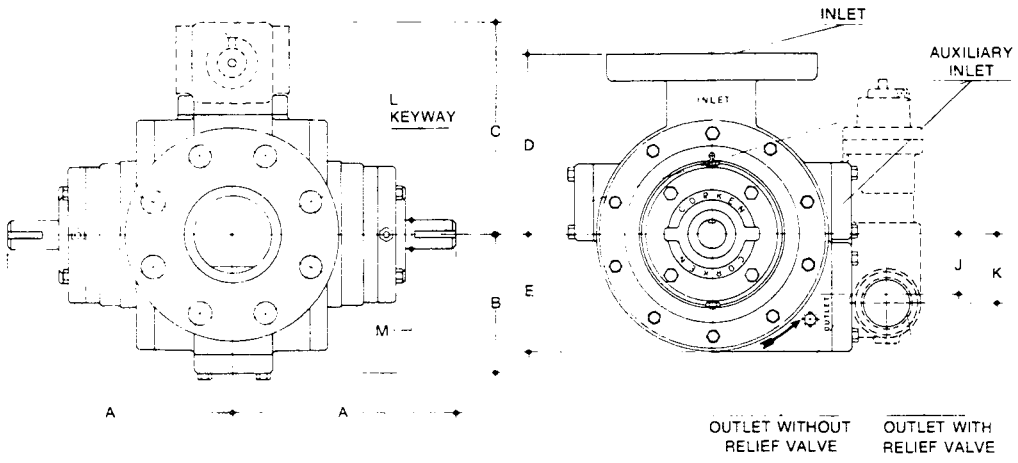
MODELS 522, 1022

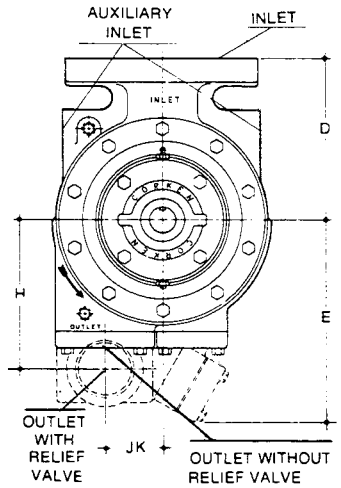


MODELS T522, TR522, T722, TR722



MODELS TS722, TSR722, T1522, TR1522





Dimensions in Inches (Centimeters)

MODEL	A WITHOUT THRUST ABSORBER	A WITH THRUST ABSORBER	B	C	D	E	F	G	H	J	K	L WITHOUT THRUST ABSORBER	L WITH THRUST ABSORBER	M WITHOUT THRUST ABSORBER	M WITH THRUST ABSORBER
522	7⅞ (20.0)	–	6⅛ (15.6)	5 (12.7)	6⅛ (15.6)	4 11/16 (11.9)	1⅜ (3.5)	4 (10.2)	–	–	–	¼ (0.64)	–	1⅛ (2.86)	–
T522	7⅞ (20.0)	–	4 7/16 (11.3)	4 13/16 (12.2)	7 (17.8)	5 13/16 (14.8)	–	–	–	2⅜ (6.0)	–	¼ (0.64)	–	1⅛ (2.86)	–
TR522	7⅞ (20.0)	–	4 7/16 (11.3)	4 13/16 (12.2)	7 (17.8)	8 11/16 (22.1)	–	–	6⅜ (16.2)	–	2⅜ (6.0)	¼ (0.64)	–	1⅛ (2.86)	–
T722	8 11/16 (22.1)	–	4¾ (12.1)	4¾ (12.1)	7 (17.8)	5 13/16 (14.8)	–	–	–	2 5/16 (5.9)	–	¼ (0.64)	–	1⅛ (2.86)	–
TR722	8 11/16 (22.1)	–	4¾ (12.1)	4¾ (12.1)	7 (17.8)	8 11/16 (22.1)	–	–	6⅜ (16.2)	–	2 5/16 (5.9)	¼ (0.64)	–	1⅛ (2.86)	–
TS722	8 11/16 (22.1)	–	5½ (14.0)	5⅝ (14.3)	7 (17.8)	4 9/16 (11.6)	–	–	–	2⅜ (6.0)	–	¼ (0.64)	–	1⅛ (2.86)	–
TSR722	8 11/16 (22.1)	–	5½ (14.0)	8½ (21.6)	7 (17.8)	4 9/16 (11.6)	–	–	–	–	2⅜ (6.0)	¼ (0.64)	–	1⅛ (2.86)	–
1022	8½ (21.6)	–	7 3/16 (18.3)	5½ (14.0)	7 3/16 (18.3)	5⅜ (13.6)	1¾ (4.4)	4⅛ (10.5)	–	–	–	¼ (0.64)	–	1⅛ (2.86)	–
T1522	10⅝ (27.0)	13¾ (34.9)	6 7/16 (16.4)	6⅞ (17.5)	7 27/32 (19.9)	5 9/16 (14.1)	–	–	–	2 9/16 (6.5)	–	¼ (0.64)	5/16 (0.79)	1⅛ (2.86)	1¼ (3.18)
TR1522	10⅝ (27.0)	13¾ (34.9)	6 7/16 (16.4)	11½ (29.2)	7 27/32 (19.9)	5 9/16 (14.1)	–	–	–	–	3 9/16 (9.0)	¼ (0.64)	5/16 (0.79)	1⅛ (2.86)	1¼ (3.18)

SPECIFICATIONS

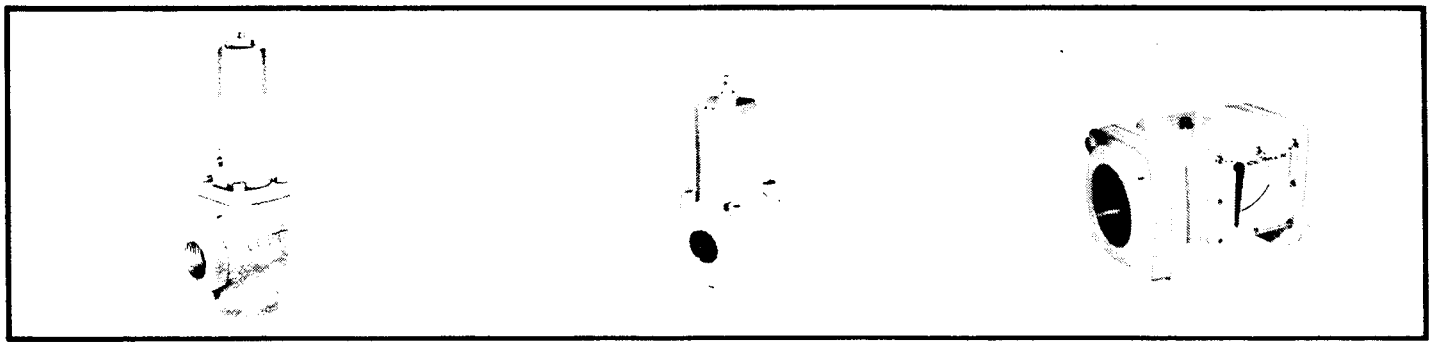
SPECIFICATION	522	T522	TR522	T722	TR722	TS722	TSR722	1022	T1522	TR1522
INLET FLANGES	2 (2½ OPTIONAL)[1]	3 300# ASA	3 300# ASA	3 300# ASA	3 300# ASA	3 300# ASA	3 300# ASA	3 (4 OPTIONAL)[1]	4 300# ASA	4 300# ASA
OUTLET FLANGES	2 (2½, 1½ OPTIONAL)[1]	2 (2½, 1½ OPTIONAL)[1]	DUAL 2[2]	2 (2½, 1½ OPTIONAL)[1]	DUAL 2[2]	2 (2½, 1½ OPTIONAL)[1]	DUAL 2[2]	3 (4 OPTIONAL)[1]	3 (4 OPTIONAL)[1]	DUAL 2 (2½ OPTIONAL)[1]
AUXILIARY INLET FLANGE	NONE	2 (1½, 1¼ OPTIONAL)[3]	2 (1½, 1¼ OPTIONAL)[5]	2[4]	2[2]	2 (1½, 1¼ OPTIONAL)[5]	2 (1½, 1¼ OPTIONAL)	NONE	2 (2½, 1½ OPTIONAL)[5]	2 (2½, 1½ OPTIONAL)
MAXIMUM DIFFERENTIAL PRESSURE	125 psid (8.6 Bars)[6]	125 psid (8.6 Bars)[6]	125 psid (8.6 Bars)[6]	125 psid (8.6 Bars)[6]	125 psid (8.6 Bars)[6]	125 psid (8.6 Bars)[6]	125 psid (8.6 Bars)[6]	125 psid (8.6 Bars)[6]	100 psid (6.9 Bars)	100 psid (6.9 Bars)

Maximum Speed	950 RPM
Minimum Speed	420 RPM
Maximum Temperature	225° F (107° C)
Minimum Temperature	−25° F (−32° C)
Maximum Working Pressure	400 psig (28.6 Bars)[7]

Notes:

1. Ductile iron pipe threaded; steel slip-on welding flanges available at extra cost.
2. Non-flanged pipe threaded nozzles.
3. Three ductile iron pipe threaded nozzles; two are normally blind flanged.
4. Two non-flanged 2" pipe threaded nozzles and one blind flanged nozzle with 2", 1½", 1¼" pipe threaded flange optional.
5. Two ductile iron pipe threaded nozzles; one is normally blind flanged.
6. Maximum allowed by UL for LPG and NH_3 is 125 psid (8.6 Bars).
7. Maximum allowed by UL for LPG and NH_3 is 350 psig (25.2 Bars)

ACCESSORIES



B177 BY PASS VALVE

B177 Differential By Pass Valve is a low pressure build up by pass valve designed for pumps displacing 40-350 GPM.

T166 BY PASS VALVE

T166 Pump By Pass Valve is specifically designed for by pass protection for pumps in the 30-100 GPM range such as used on delivery trucks.

CORKEN FLO-CHEK VALVE

Flow indicating and back check valve featuring all ductile iron construction. Available in 1¼" through 4" sizes — flanged.

PERFORMANCE — Backed by Worldwide Service

To assure greater satisfaction to Corken customers across the United States and in many foreign countries all Corken distributors maintain their own service departments with adequate stocks of repair parts.

WARNING: (1) Periodic inspection and maintenance of Corken products is essential. (2) Inspection, maintenance and installation of Corken products must be made only by experienced, trained and qualified personnel. (3) Maintenance, use and installation of Corken products must comply with Corken instructions, applicable laws and safety standards (such as NFPA Pamphlet 58 for LP-Gas and ANSI K61.1-1972 for Anhydrous Ammonia). (4) Transfer of toxic, dangerous, flammable or explosive substances using Corken products is at user's risk and equipment should be operated only by qualified personnel according to applicable laws and safety standards.

CORKEN®

PRINTED IN USA January 1989

MODEL NUMBER IDENTIFICATION CODE

MAY 1993
SUPERSEDES VD150B

MODELS INVOLVED	DESCRIPTION		CODE	FEATURE
522, 1022	FOOT MOUNTED		NONE	GENERAL CONSTRUCTION
Z3000	300 LB. INLET FLANGE FOR DIRECT MOUNTING TO TRUCK - OUTLET 180° FROM INLET		Z	
522, 722	300 LB. INLET FLANGE FOR DIRECT MOUNTING TO TRUCK - OUTLET 180° FROM INLET		T	
1522	300 LB. INLET FLANGE FOR DIRECT MOUNTING TO TRUCK- OUTLET 90° FROM INLET			
722	300 LB. INLET FLANGE FOR DIRECT MOUNTING TO TRUCK - OUTLET 90° FROM INLET		TS	
522, 722, 1522	APPLIES ONLY TO T OR TS CONSTRUCTION ABOVE	NO RELIEF VALVE MANIFOLD	NONE	RELIEF VALVE MANIFOLD
		RELIEF VALVE MANIFOLD	R	
ALL	SLIDING VANE PUMP WITH FLOATING ROTOR AND TWO SHAFT EXTENSIONS		522 722 Z3000 1022 1522	BASIC MODEL
522 (a), 1022	10 SOLID BLADES		E	BLADE TYPE
1522	6 SOLID BLADES		F	
522 (b), 722	6 HOLED BLADES		G	
Z3000	6 BLADES WITH BLADE DRIVES		H	
522 (a), 1022	GCB-34 (LPG ONLY)		F	BLADE MATERIAL
522 (b), 722, 1022, 1522	GCB-40		G	
Z3000	GCB-50			
ALL	BUNA N TEFLON* VITON* NEOPRENE*		NONE A B C	O-ring MATERIAL

EXAMPLE

MODEL NUMBER

T

R

1522

F

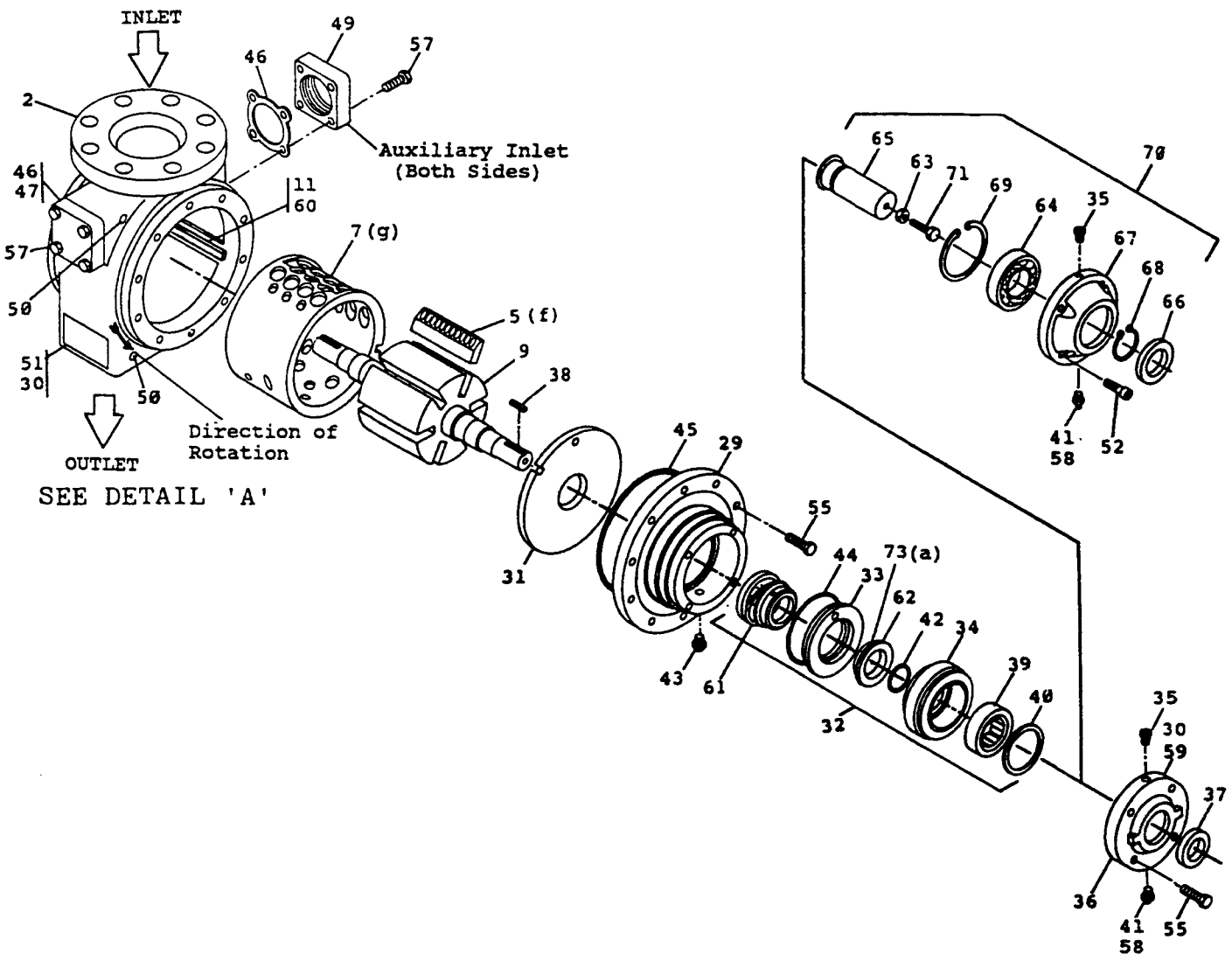
G

A

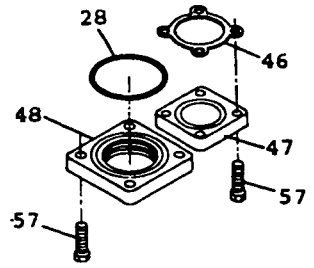
A LETTER Z IS ADDED TO THE END OF THE MODEL NUMBER WHEN SPECIAL MATERIAL IS USED.

*TEFLON, VITON AND NEOPRENE ARE REGISTERED TRADEMARKS OF DUPONT.

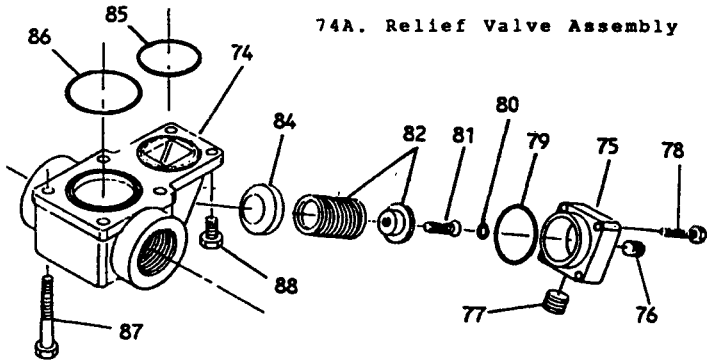
NOTES:
(a) Foot Mounted Model Only.
(b) Flange Mounted Model Only.



DETAIL A Models Without Relief Valve



74A. Relief Valve Assembly



CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.

PARTS DETAILS
CORO-VANE PUMPS
MODELS T522 AND TR522
SERIAL NO. LX156624 AND LATER

REF. NO.	PART NO.	DESCRIPTION
	1. —	Omitted
	2. 2209	Case
	3. —	Omitted
	4. —	Omitted
(f)	5. 4000	Blade
	6. —	Omitted
(g)	7. 1162-2	Cam
	8. —	Omitted
	9. 1166-1X8R	Rotor and Shaft
	10. —	Omitted
	11. 1170	Cam Key
	12. thru 27	Omitted
(a)	28. 2-234	O-Ring, Flange or Relief Valve Manifold
	29. 1161-4	Head
	30. 7003-004 DR019B	Drive Screw #4 X 3/16 Rd.Hd.
	31. 3932	Sideplate
(a,e)	32. 1769-X	Seal Assembly (Complete)
	1769-XR	Field Replacement Seal Assembly (Includes O-Rings)
	33. 1822	Seat Adapter Plate
	34. 1769	Bearing Housing
	35. 1343	Relief Fitting (Grease)
	36. 1164-1	Bearing Cap
	37. 1358	Grease Seal
	38. 2270	1/4" Key
	39. 2754-X	Roller Bearing - Complete
	2755	Bearing Inner Race
	2754	Bearing Outer Race
	40. 2760-244	Retainer Ring
	41. 2158	Grease Zerk (1/8" npt)
(a)	42. 2-128_	O-Ring, Shaft
	43. 1343	Relief Fitting (Seal Vent)
(a)	44. 2-240_	O-Ring, Adapter Plate
(a)	45. 2-261_	O-Ring, Case
	46. 2010	Flange Gasket
(c)	47. 1885	Blind Flange
(b)	48. 1172-2	Flango - 2" npt
(c)	49. 1951-2	Flange - 2" npt
	50. 3442	1/4" NPT Plug
	51. 2649	Nameplate
	52. 7002-037 NC125A	Bolt, Soc Hd 3/8-16 x 1-1/4"
	55. 7001-037 NC125A	Bolt, Hex Hd 3/8-16 X 1-1/4"
	56. 7002-037 NC100A	Bolt, Soc Hd 3/8-16 X 1
	57. 7001-037 NC150A	Bolt, Hex Hd 3/8-16 X 1-1/2"
	58. 2159	Lubricap
	59. 1359	Lubrication Instruction Plate
	60. 3253	Cam Key Pin
	61. —	Seal Retainer (Not Available Separately)
	62. —	Seat (Not Available Separately)
	63. 7101-037 NC01A	Nut, 3/8-16
	64. 3209	Ball Bearing
	65. 1958-X4	Shaft
	66. 2014	Grease Seal
	67. 1957	Bearing Cap
	68. 5102-177	Retainer Ring
	69. 5002-334	Retainer Ring
	70. 254-X4	Thrust Absorber Assembly
	71. 2911	Adjusting Screw
(a)	73. 2-227_	O-Ring, Seal Seat
	74. 4093	Relief Valve Manifold
	74A. 4093-X	Relief Valve Manifold Assy.
	75. 1174	Cap
	76. 2590	Pipe Plug
	77. 3442	Pipe Plug, 1/4" npt
	78. 7001-031 NC125A	Bolt, 5/15-18 x 1-1/4" Hex Hd.
(a)	79. 2-224_	O-Ring
(a)	80. 2-112_	O-Ring
	81. 2252	Relief Valve Adjusting Screw
	82. 1242-X	Spring Guide Assy.
	83. —	Omitted
	84. 1241	Relief Valve
(a)	85. 2-237_	O-Ring
(a)	86. 2-234_	O-Ring
	87. 7001-037 NC350A	Bolt
	88. 7001-037 NC100A	Bolt

NOTES:

(a) For Seal and O-Ring Material Coding See Page A500.

(b) Optional:

1172-1.5	Flange, 1-1/2" npt
1172-1.5S	Flange, 1-1/2" Welded
1172-2S	Flange, 2" Welded
1172-2.5	Flange, 2-1/2" npt
1172-2.5S	Flange, 2-1/2" Welded
1947-1.5	Flange E11, 1-1/2" npt
2008	Flange E11, 2" npt

(c) Optional:

1885	Blind Flange
1951-1.25	Flange - 1-1/4" npt
1951-1.5	Flange - 1-1/2" npt

(e) For Detailed Seal Information See Page C224.

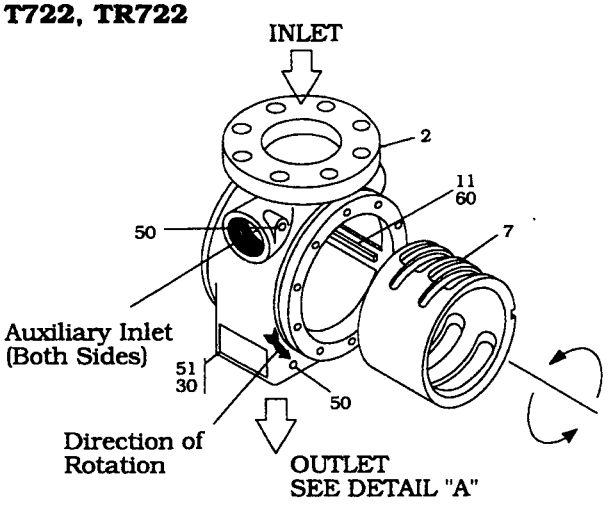
(f) Blade Holes MUST Face Direction of Rotation When Installed. (Patent Pending).

(g) Correct Installation of the Cam is with the Largest Group of Holes Toward the Inlet.

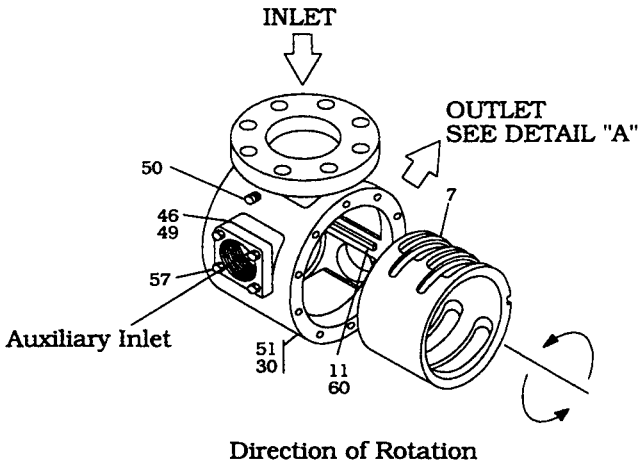
CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.

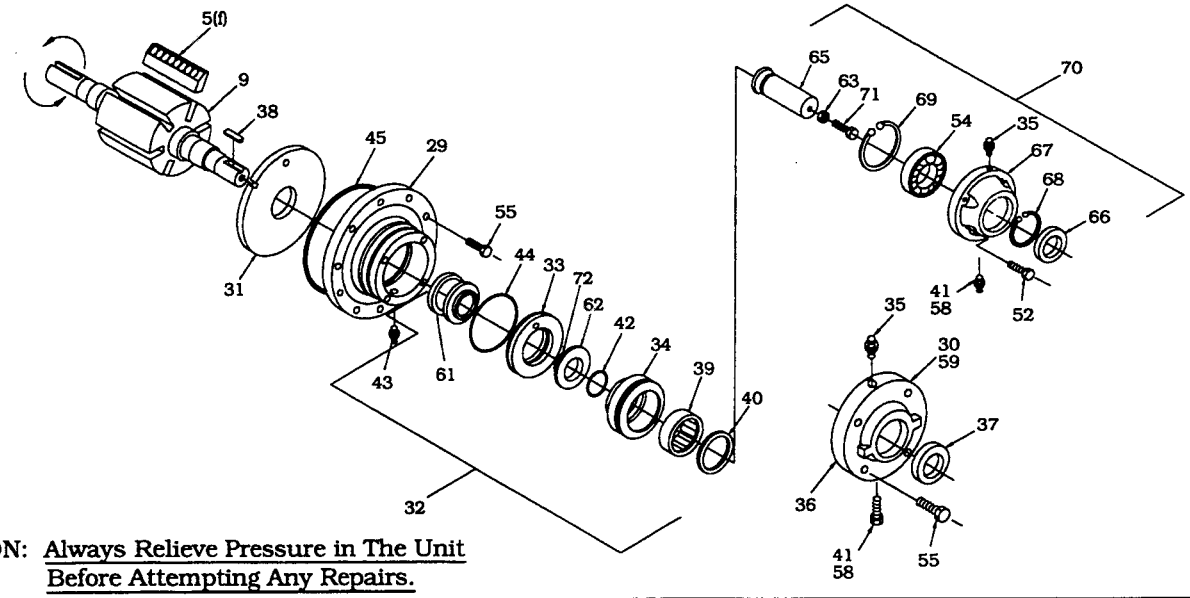
NOTES: When installing the cam, align with the key so that the large group of holes faces the INLET.

T722, TR722



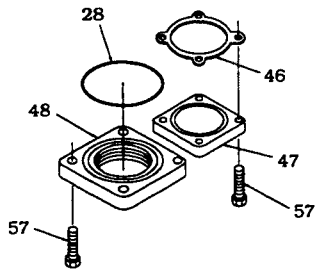
TS722, TSR722



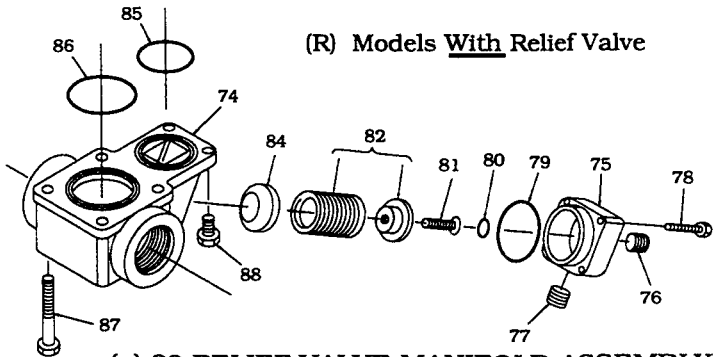


CAUTION: Always Relieve Pressure in The Unit Before Attempting Any Repairs.

DETAIL "A" Models Without Relief Valve



(R) Models With Relief Valve



(a) 89 RELIEF VALVE MANIFOLD ASSEMBLY

PARTS DETAILS
CORO-VANE PUMPS
MODELS T722, TR722, TS722, TSR722
SERIAL NO. LX156624 AND LATER

REF NO.	PART NO.	DESCRIPTION
1.	....	Omitted
2.	1921	Case (Models T722 & TR722).
3.	1847	Case (Models TS722 & TSR722)
4.	....	Omitted
(f)5.	3981	Blade
6.	....	Omitted
7.	4060	Cam
8.	....	Omitted
9.	3983-X2R	Rotor and Shaft
10.	....	Omitted
11.	1891	Cam Key
(a)12. thru 27.		Omitted
28.	2-234	O-Ring, Flange or Relief Valve Manifold
29.	1161-4	Head
30.	7003-004	
	DR019B	Drive Screw #4 x 3/16 Rd. Hd.
31.	3932	Sideplate
(e)32.	1769-X	Seal Assembly (Complete)
	1769-XR	Field Replacement Seal Assembly (includes O-rings)
33.	1822	Seat Adapter Plate
34.	1769	Bearing Housing
35.	1343	Relief Fitting (Grease)
36.	1164-1	Bearing Cap
37.	1358	Grease Seal
38.	2270	1/4" Key
39.	2754-X	Roller Bearing (Complete)
	2755	Bearing Inner Race
	2754	Bearing Outer Race
40.	2760-244	Retainer Ring
41.	2158	Grease Zerk (1/8" NPT)
(a)42.	2-128	0-Ring, Shaft
43.	1343	Relief Fitting (Seal Vent)
(a)44.	2-240	0-Ring Adapter Plate
(a)45.	2-261	0-Ring Case
46.	2010	Flange Gasket
(c)47.	1885	Blind Flange
(b)48.	1172-2	Flange - 2" NPT
(c)49.	1951-2	Flange - 2" NPT
50.	3442	1/4" NPT Plug
51.	2649	Nameplate
52.	7002-037	
	NC125A	Bolt, Soc Hd 3/8 - 16 x 1-1/4"
53.	2271	Jam Nut
54.	2017	Stud 3/8 x 1-7/8
55.	7001-037	
	NC125A	Bolt, Hex Hd 3/8 - 16 x 1-1/4"
56.	7002-037	
	NC100A	Bolt, Soc Hd 3/8 - 16 x 1
57.	7001-037	
	NC150A	Bolt, Hex Hd 3/8 - 16 x 1-1/2"
58.	2159	Lubricap
59.	1359	Lubrication Instruction Plate
60.	3253	Cam Key Pin
61.	....	Seal Retainer (Not Available Separately)
62.	....	Seat (Not Available Separately)
63.	7101-037	
	NC01A	Nut, 3/8 - 16
64.	3209	Ball Bearing
65.	1958-X2	Shaft
66.	2014	Grease Seal
67.	1957	Bearing Cap
68.	5102-177	Retainer Ring
69.	5002-334	Retainer Ring
70.	254-X4	Thrust Absorber Assembly
71.	2911	Adjusting Screw
(a)72.	2-227	0-Ring, Seal Seat
73.	....	Omitted
74.	4093	Relief Valve Manifold
75.	1174	Cap
76.	2590	Pipe Plug 1/8" NPT
77.	3442	Pipe Plug 1/4" NPT
78.	7001-037	
	NC125A	Bolt
79.	2-224	O-Ring
80.	2-112	O-Ring
81.	2252	Relief Valve Adjusting Screw
82.	1242-X	Spring Guide Assembly
83.	....	Omitted
84.	1241	Relief Valve
85.	2-227	O-Ring
86.	2-234	O-Ring
87.	7001-037	
	NC350A	Bolt
88.	7001-037	
	NC100A	Bolt
(a)89.	4093-X	Relief Valve Manifold Assembly

CAUTION: Always Relieve Pressure in The Unit Before Attempting Any Repairs.

NOTES:

(a) For Seal and O-Ring Material Coding See Page A500.

(b) Optional:

1172-1.5	Flange - 1-1/2" NPT
1172-1.5S	Flange - 1-1/2" Welded
1172-2S	Flange - 2" Welded
1172-2.5	Flange - 2-1/2" NPT
1172-2.5S	Flange - 2-1/2" Welded
1947-1.5	Flange E11 - 1-1/2" NPT
2008	Flange E11 - 2" NPT

(c) Optional:

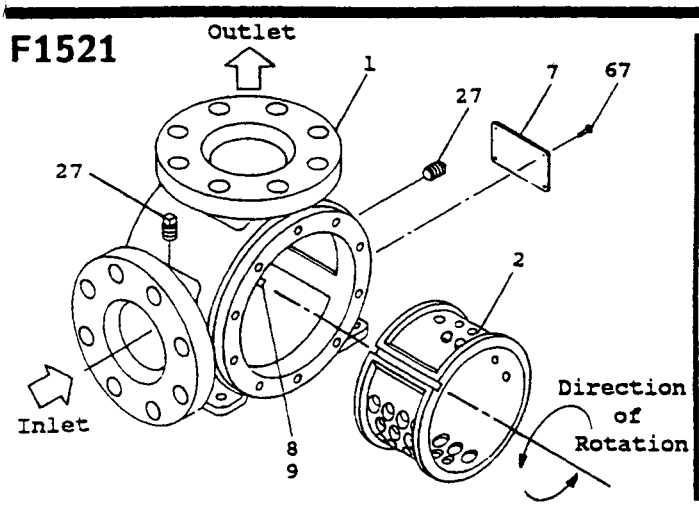
1885	Blind Flange
1951-1.25	Flange - 1-1/4" NPT
1951-1.5	Flange - 1-1/2" NPT

(e) For Detailed Seal Information See Page C224

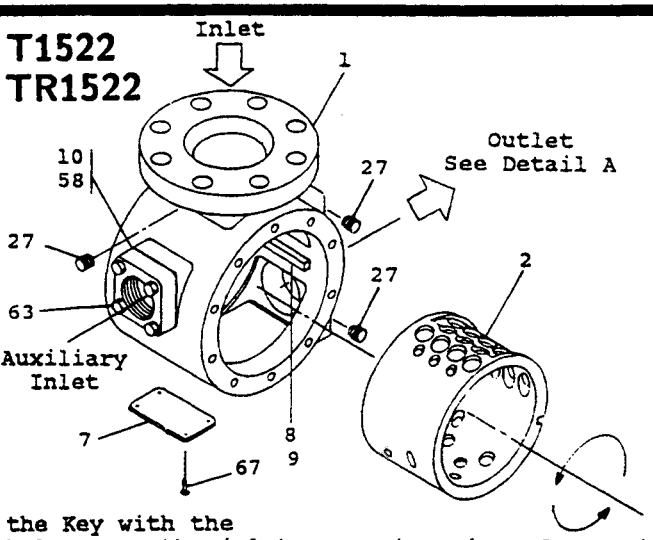
(f) Blade Holes MUST Face Direction of Rotation When Installed. (Patent Pending).

(g) 4093-XA XD
XB XE

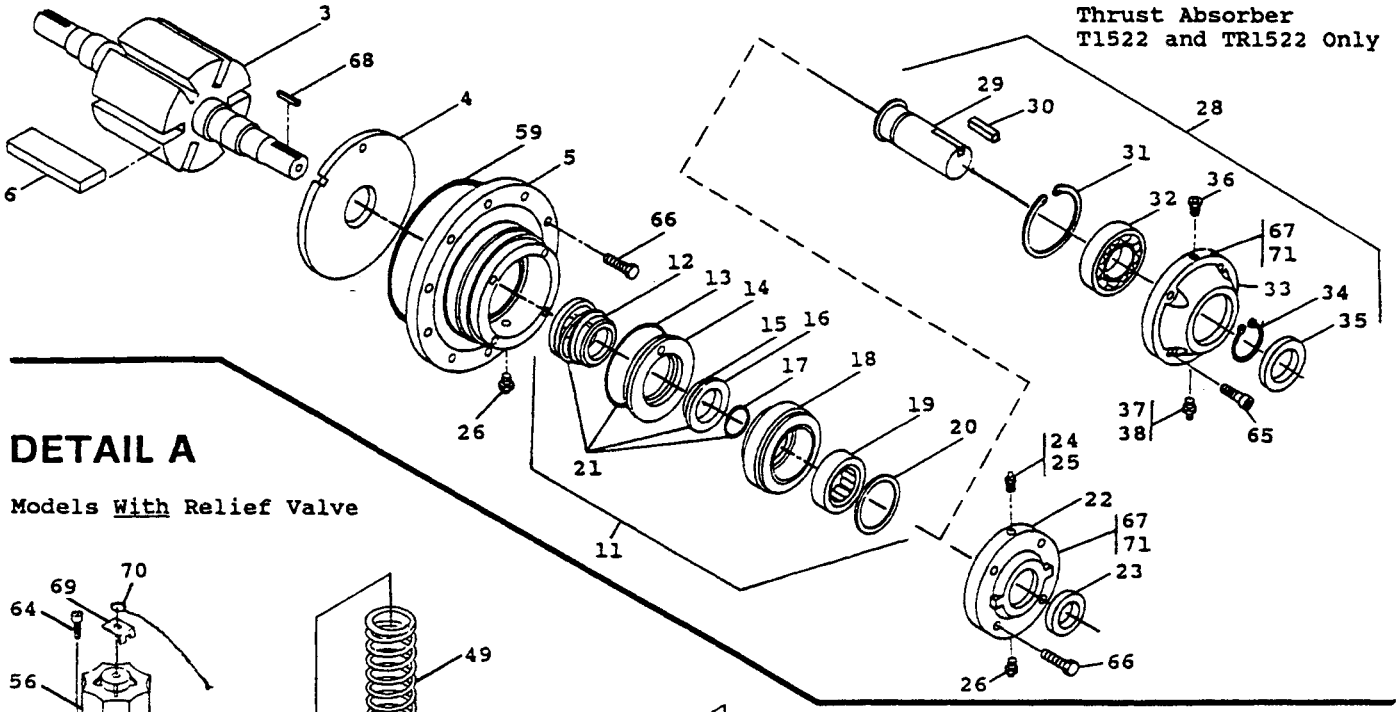
F1521



T1522 TR1522

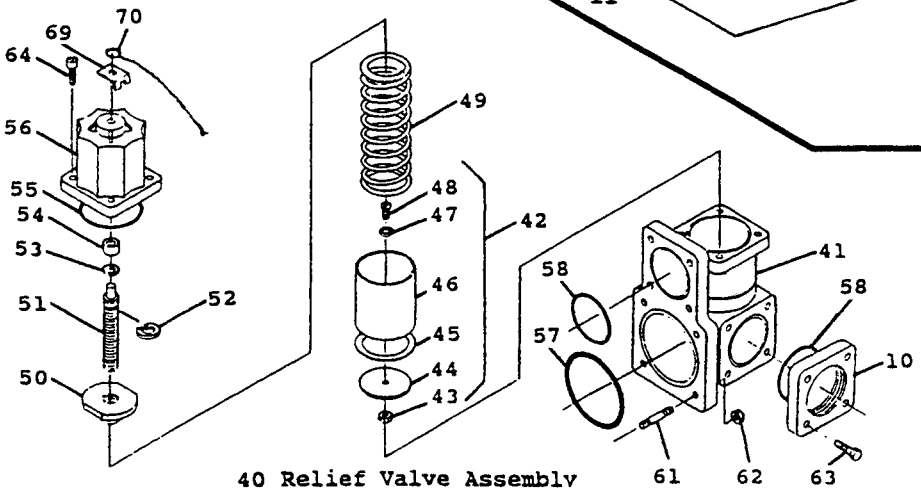


NOTE: Align the Cam on the Key with the largest group of holes near the inlet.



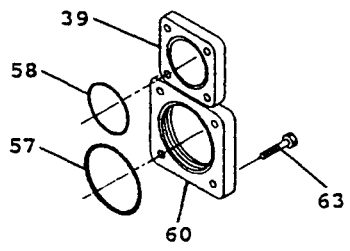
DETAIL A

Models With Relief Valve



40 Relief Valve Assembly

Models Without Relief Valve



PARTS DETAILS
CORO-VANE PUMPS
MODELS F1521,T1522,TR1522
S/N CT115372 AND LATER

REF NO.	PART NO.	DESCRIPTION
1.	1923	Case (Models T1522,TR1522)
	2437	Case (Model F1521)
2.	1792-1	Cam
3.	3350-X1R	Rotor-Shaft Assy (Model F1521)
	3350-X2R	Rotor-Shaft Assy (Models T1522,TR1522)
(f,g) 4.	3476-R	Sideplate
	3476-L	Sideplate
5.	1205-4	Head
6.	3477	Blade
7.	2649	Nameplate
8.	1880	Cam Key
9.	3253	Cam Key Pin
(c)10.	1172-2	Flange - 2" NPT (T1522,TR1522)
(a,b)11.	1769-X	Seal Assy
12.	----	Seal Retainer (Not Available Separately)
(b)13.	2-240	O-Ring (Adapter Plate)
14.	1822	Seat Adapter Plate
(b)15.	2-223	O-Ring (Seal Seat)
16.	----	Seat (Not Available Separately)
(b)17.	2-128	O-Ring (Shaft)
18.	1769	Bearing Housing
19.	2754-X	Bearing Assy
20.	2760-244	Retaining Ring
(a,b)21.	1769-XR	Field Replacement Seal Assy (Includes Seal,Seat,O-Rings)
22.	1164-1	Bearing Cap
23.	1358	Grease Seal
24.	2158	Grease Zerk (1/8" NPT)
25.	2159	Lubricap #2 (Not Shown)
26.	1343	Relief Fitting
27.	3442	1/4" NPT Plug
28.	254-X2	Thrust Absorber Assy
(e)29.	1958-X2	Shaft Keyway
30.	2623	5/16" Key
31.	5102-177	Retainer Ring
32.	3209	Ball Bearing
33.	1957	Bearing Cap
34.	5002-334	Retainer Ring
35.	2014	Grease Seal
36.	1343	Relief Fitting (Thrust Absorber)
37.	2158	Grease Zerk (1/8" NPT)
38.	2159	Lubricap #2 (Not Shown)
39.	1920	Blind Flange
(b)40.	1787-X	Relief Valve Assy
41.	1787	Relief Valve Manifold
42.	1699-X	Plunger Assy
43.	1873	Nut
44.	1703	Retainer Plate
45.	1700	Seat, Teflon
46.	1699	Plunger
47.	2723	Gasket, Aluminum
48.	1872	Plunger Bolt
49.	1839	Spring
50.	1701	Spring Seat
51.	1878	Adjusting Screw
52.	5133-87	Retainer Ring
53.	1789	Stem Washer
54.	1887	Stem Seal
(b)55.	2-238	O-Ring
56.	1796	Relief Valve Bonnet
(b)57.	2-245	O-Ring (For 3" Flange or Relief Valve Manifold)
	2-249	O-Ring (For 4" Flange)
(b)58.	2-234	O-Ring (For 2" Flange)
(b)59.	2-268	O-Ring (Case)
(d)60.	1206-3	Flange - 3" NPT
61.	2018	Stud 3/8 x 2-1/4 Relief Valve
62.	7101-037 NC01A	Nut, 3/8 - 16 Relief Valve
63.	7001-037 NC150A	Bolt, 3/8-16 x 1-1/2 Hex Hd.
64.	7002-037 NC100A	Bolt, 3/8-16 x 1 Soc Hd.
65.	7002-037 NC125A	Bolt, 3/8-16 x 1-1/4 Soc Hd.
66.	7001-037 NC125A	Bolt, 3/8-16 x 1-1/4 Hex Hd.
67.	7003-004 DR019B	Drive Screw #4 x 3/16 Rd Hd.
68.	2270	1/4" Key
69.	2080	Lock
70.	3546	Seal Wire
71.	1359	Lubrication Inst. Tag

NOTES:

(a) For Seal Details See Service Manual Page C224. Two Seal Assemblies are available: 1769-X Complete Seal Assy consisting of: Bearing Housing, Seat Adapter Plate, Bearings, Retainer Ring, Seal and O-Rings. 1769-XR Field Replacement Seal Assy consisting of: Seal and O-Rings.

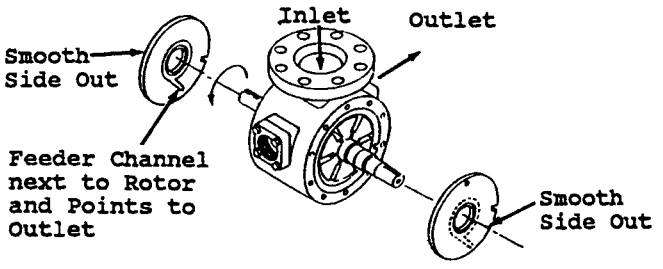
(b) For Seal and O-Ring Material Code See Page A500.

(c) Optional:
1172-1.5	Flange - 1-1/2" NPT
1172-1.5S	Flange - 1-1/2" Welded
1172-2S	Flange - 2" Welded
1172-2.5	Flange - 2-1/2" NPT
1172-2.5S	Flange - 2-1/2" Welded
1947	Flanged E11 - 1-1/2"NPT
2008	Flanged E11 - 2" NPT
1920	Blind Flange

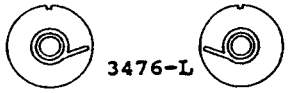
(d) Optional:
1206-3S	Flange - 3" Welded
1206-4	Flange - 4" NPT
1206-4S	Flange - 4" Welded

(e) Optional: 1958-X1 Shaft - 1-3/8"-6B Spline

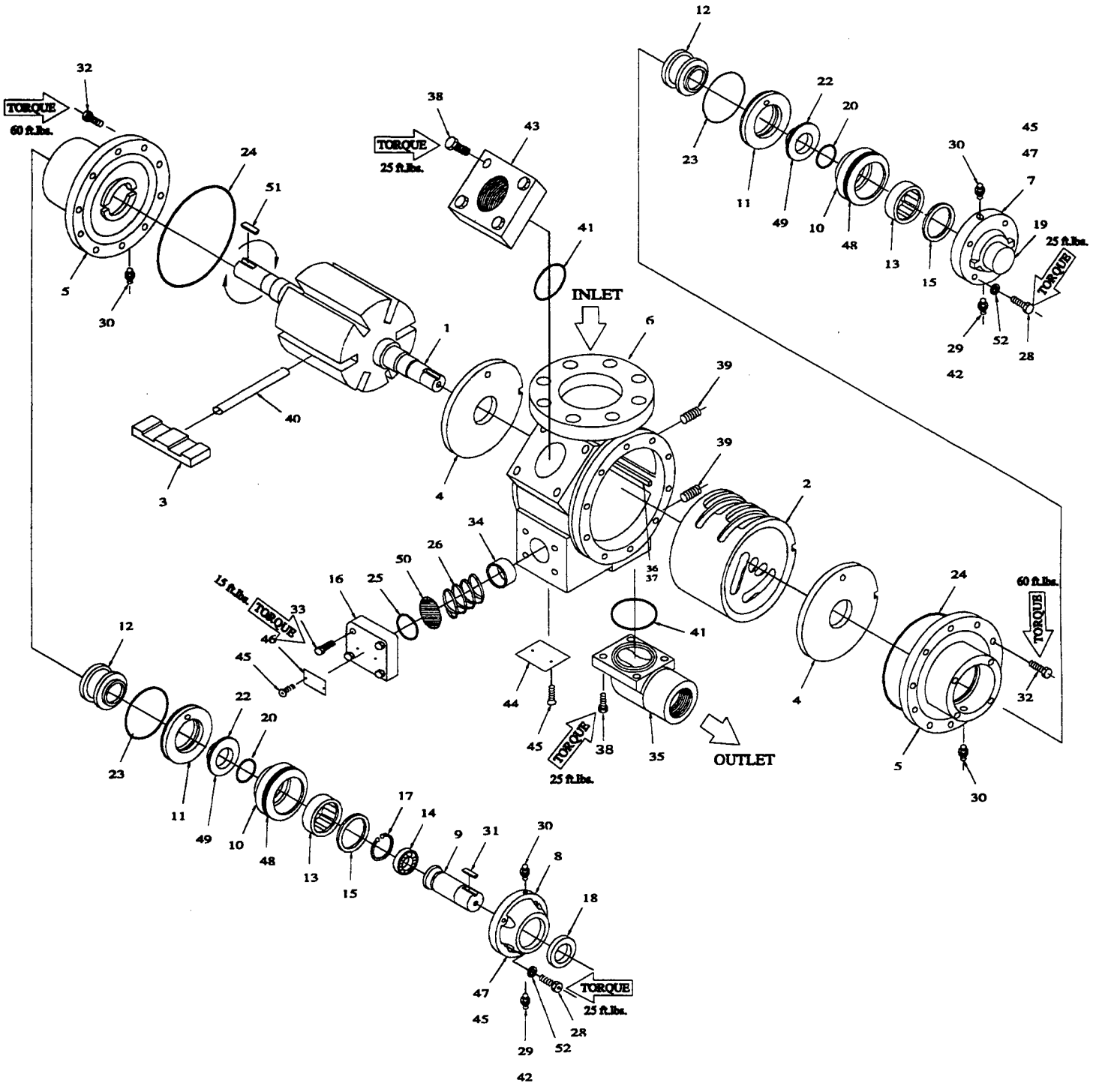
(f) Sideplate Replacement: Install with Feeder Channel toward Rotor positioned as shown below:



(g) Sideplate Identification:



CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.


TORQUE
60 ft.lbs.
TORQUE
25 ft.lbs.
INLET
OUTLET
TORQUE
15 ft.lbs.
TORQUE
25 ft.lbs.
TORQUE
60 ft.lbs.
TORQUE
25 ft.lbs.
TORQUE
25 ft.lbs.

PARTS DETAILS
CORO - VANE PUMP
MODEL Z3000

REF NO.	PART NO.	DESCRIPTION
1.	4234-X2	Rotor- Shaft Assembly
2.	4242	Cam
(d)3.	4232	Blade
4.	4231	Sideplate
5.	4240	Head
6.	4239	Case
7.	1164-1	Bearing Cap
8.	4237	Bearing Cap
9.	4233	Thrust Eliminator Shaft
10.	4238	Bearing Housing
11.	1822	Seat Adapter Plate
(a,b)12.	1769-XR	Field Replacement, Seal Assembly (Includes Seal, Seat, O-Rings)
13.	2754	Bearing Outer Race
14.	4236	Thrust Eliminator Bearing
15.	2760-244	Retainer Ring
16.	1174-2	Relief Valve Cap
17.	5102-177	Retainer Ring
18.	2014	Grease Seal
19.	4245	Shaft Cover
(b)20.	2-128	O-Ring - Shaft
(b)21.	2-223	O-Ring - Seal
(b)22.	2-227	O-Ring - Seal Seat
(b)23.	2-240	O-Ring - Adapter Plate
(b)24.	2-262	O-Ring - Case
(b)25.	2-224	O-Ring - Relief Valve Cap
26.	1240	Relief Valve Spring
27.		Omitted
* 28.	7001-037NC150A	Bolt - 3/8-16 x 1-1/2" Hex Head
29.	2158	1/8" NPT Grease Zerk
30.	1343	1/8" NPT Relief Fitting
31.	4244	Shaft Key
* 32.	7001-050NC150A	Bolt - 1/2-13 x 1-1/2" Hex Head
* 33.	7001-031NC125A	Bolt - 5/16-18 x 1-1/4" Hex Head
34.	1241	Relief Valve
(e)35.	4243	Flanged Elbow - 2"
36.	4241	Cam Key
37.	3253	Cam Key Pin
* 38.	7001-037NC150A	Bolt - 3/8-16 x 1-1/2" Hex Head
39.	3442	1/4" NPT Pipe Plug
40.	4262-X	Blade Driver (3 Required)

REF NO.	PART NO.	DESCRIPTION
(b)41.	2-234	O-Ring - Flange
42.	2159	Lubricap
(c)43.	1172-2	Flange - 2" NPT
44.	2649	Nameplate
45.	7003-004DR019B	Drive Screw
46.	4248	Relief Valve Nameplate
47.	1359	Lubrication Instruction Plate
(b)48.	2-154A	O-Ring - Bearing Cap
49.	....	Seal Seat (Not Available Separately)
50.	4282	Relief Valve Shim (As Required)
51.	4382	Shaft Key
52.	7206-037A	3/8" Lock Washer

NOTES:

(a) For Seal Details See Service Manual Page C224. Two Seal Assemblies are available: 1769-X Complete Seal Ass'y consisting of: Bearing Housing, Seat Adapter Plate, Bearings, Retainer Ring, Seal and O-Rings. 1769-XR Field Replacement Seal Assembly consisting of: Seal and O-Rings.

(b) For Seal and O-Ring Material Code See Page A500.

(c) Optional:

1172-1.5	Flange - 1-1/2" NPT
1172-1.5S	Flange - 1-1/2" Welded
1172-2S	Flange - 2" Welded
1920	Blind Flange
1947	Flanged Elbow - 1-1/2" NPT
4243	Flanged Elbow - 2" NPT

(d) Slots in Blades Must Face Towards the Direction of Rotation.

(e) Optional:

1172-1.5	Flange - 1-1/2" NPT
1172-1.5S	Flange - 1-1/2" Welded
1172-2	Flange - 2" NPT
1172-2S	Flange - 2" Welded
1947	Flanged Elbow - 1-1/2" NPT

* Note Torque Values on page C144B.

CAUTION: Always Relieve Pressure in The Unit Before Attempting Any Repairs.

SERVICE BULLETIN

#15
6-76

CORKEN

CORKEN, INC. • A Unit of IDEX Corporation

TROUBLESHOOTERS GUIDE - FOR CORKEN CORO-VANE TRUCK PUMPS

In diagnosing pump and "system" troubles, the following information is essential:

1. Pressure at pump suction.
2. Pressure at pump discharge.
3. Pressure in truck tank.
4. Pressure in tank being filled.
5. Pipe size and length of suction and discharge lines.
6. Size and length of vapor equalizing line.

PROBLEM	CAUSE	WHAT TO DO
Low capacity	Pump speed too low	Check engine speed and PTO ratio. Consult pump performance curve. Use tachometer on pump if speed is questionable.
	High differential pressure	Restriction in discharge piping or discharge piping or hose too small. Vapor equalization lines too small or not used.
	Bypass valve stuck open or set too low	Readjust, repair or replace valve.
	Clogged strainer	Clean strainer.
	Suction pipe too small or restricted	Indicated by pump inlet pressure dropping several pounds when pump is started. Remove restriction or modify piping.
	Worn vanes	Replace or invert blades.

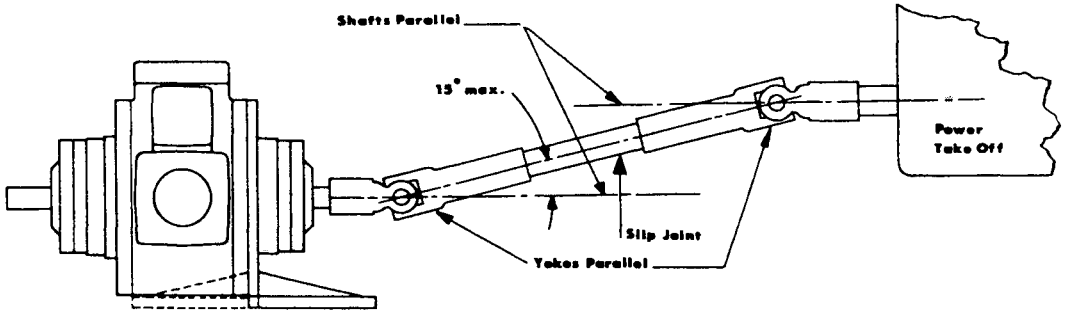
PROBLEM	CAUSE	WHAT TO DO
Low Capacity (cont'd)	Pumping without adequate vapor return	Without vapor equalization, a pump can remove only about 3% of the truck tank capacity per minute without severe cavitation and capacity loss.
	Worn sideplates	Replace sideplates. Check universal drive assembly to make sure angularity is within limits, yokes are parallel and slip-joint is greased.
	Vanes sticking	Remove blades and clean out foreign matter (check strainer). Grind down or replace blades if swollen.
Pump Runs But No Flow	Valve closed	Check valves. Make sure internal tank valve is open!
	Excess flow valve slugged	Stop pump 'til valve opens. If problem continues, slow pump down or install new or larger excess flow valve.
	Broken shaft	Disassemble and inspect pump. Repair if necessary.
Pump Won't Turn - Locked	Foreign matter in pump	Clean out the pump - install strainer in suction line.
	Blades broken	Clean out pump carefully and replace blades. Has pump been operated dry?
	Bearing seized	Replace pump bearings - grease monthly. Use ball bearing grease and don't use power gun.
	Moisture frozen in pump	Thaw and break loose carefully. Add alcohol to tank (on LP-gas). Check with product supplier about possibility of water in gas.

PROBLEM	CAUSE	WHAT TO DO
Won't Build Pressure	Poor suction conditions	Increase pipe size - clean inlet strainer.
	External bypass valve set too low	Set valve for higher pressure - (see instructions).
	Worn vanes, sideplates	Disassemble, inspect and repair as necessary. Don't run pump dry!
Pump is Noisy	Cavitation from poor suction conditions	As above.
	Vanes sticking	As above.
	Bearings bad	Replace if necessary - grease monthly.
	Very high differential pressure	Check for restriction in discharge line. Delivery hose too small and too long? Slow down pump!
		Check vapor release float assembly on meter and meter differential valve.
Pump Leaks Around Shaft	Seal or 'O'rings failed	Inspect seal assembly and replace if necessary. Keep new seal very clean, and oil 'O'rings. Don't run pump dry!

BOBTAIL TRUCKS

THE DRIVESHAFT connecting the Pump to the PTO should be of the "splined" variety. This type driveshaft permits the shaft to adjust for PTO movement and twisting of the truck frame. A stiff driveshaft throws these forces directly into the Pump and PTO, and will shorten the life of both considerably. The yokes of the driveshaft Universal Joints must be positioned as shown. Improper location of the U-joints will soon "whip" them out, along with the bearings in the Pump and PTO.

THE PTO SELECTION is important. The Model 522 Pump when used with a 1¼" meter requires a PTO with an average output speed of 500 to 700 rpm when the truck engine is operating at the proper speed to maintain oil pressure and water circulation. When operating with a 1½" meter, the Model 522 Pump requires a PTO with an average output speed of 700 to 1000 rpm. The Model 1022 requires a speed of 300 to 500 rpm for delivery trucks, and 700 or more rpm for transports.



TRANSPORT TRUCKS

THE DRIVE SYSTEM for the Transport Pump usually is either a hydraulic pump-motor circuit, or a direct connected drive shaft system between the PTO and the pump. A series of splined jack shafts and universal joints with a quick disconnect set up makes a good arrangement. Figure 1 illustrates in general detail a recommended drive system. The portion of the drive shaft between the Pump and the "fifth" wheel must be removed and stored on either the tractor or trailer during transit. This drive shaft section must not remain connected when the transport is in motion. The yokes of the drive shaft universal joints must be positioned as shown on Figure 1. Improper location of the U-joints soon will whip them out, along with the bearings in the Pump and the PTO.

THE PTO SELECTION and Drive System Design is extremely important. The PTO should have an average output speed of 500 to 1000 RPM when the tractor engine is operating at the recommended engine speed. The designer of the drive system must select a PTO and drive shaft capable of meeting the torque requirements of the pumping system. The Coro-Vane Transport Pump can not be harmed from high speed operation, or overspeeding; but the PTO must deliver approximately 220 ft-lbs of torque when the pump is discharging at a differential pressure of 100 psi. In most cases a PTO with a speed ratio to produce an output speed of 500 to 1000 RPM and a torque rating of 150 ft-lbs will be satisfactory, however. If the torque requirements of the system are higher than 150 ft-lbs as a result of high differential pressures, then the piping system is incorrect and should be redesigned.

Code Item Description

- **A** Power take-off
- **B** Flange type, slip movement drive shaft.
- **C** Pillow block bearings
- **D** 1¼" round (minimum) steel drive shaft Locate on center line of tractor.
- **E** 1⅜"—6B male spline X 1¼" bore coupler.
- **F** Quick disconnect end yoke to match Item E.
- **G** Telescoping propeller shaft.
- **H** CORKEN "Thrust Absorber."

Notes—1. Always use an even number of universal joints; that is, two, four as shown or six. An odd number of "U" joints will cause unbalanced pump shaft rotation.

2. The "U" joint yokes all must be in the same plane as shown.

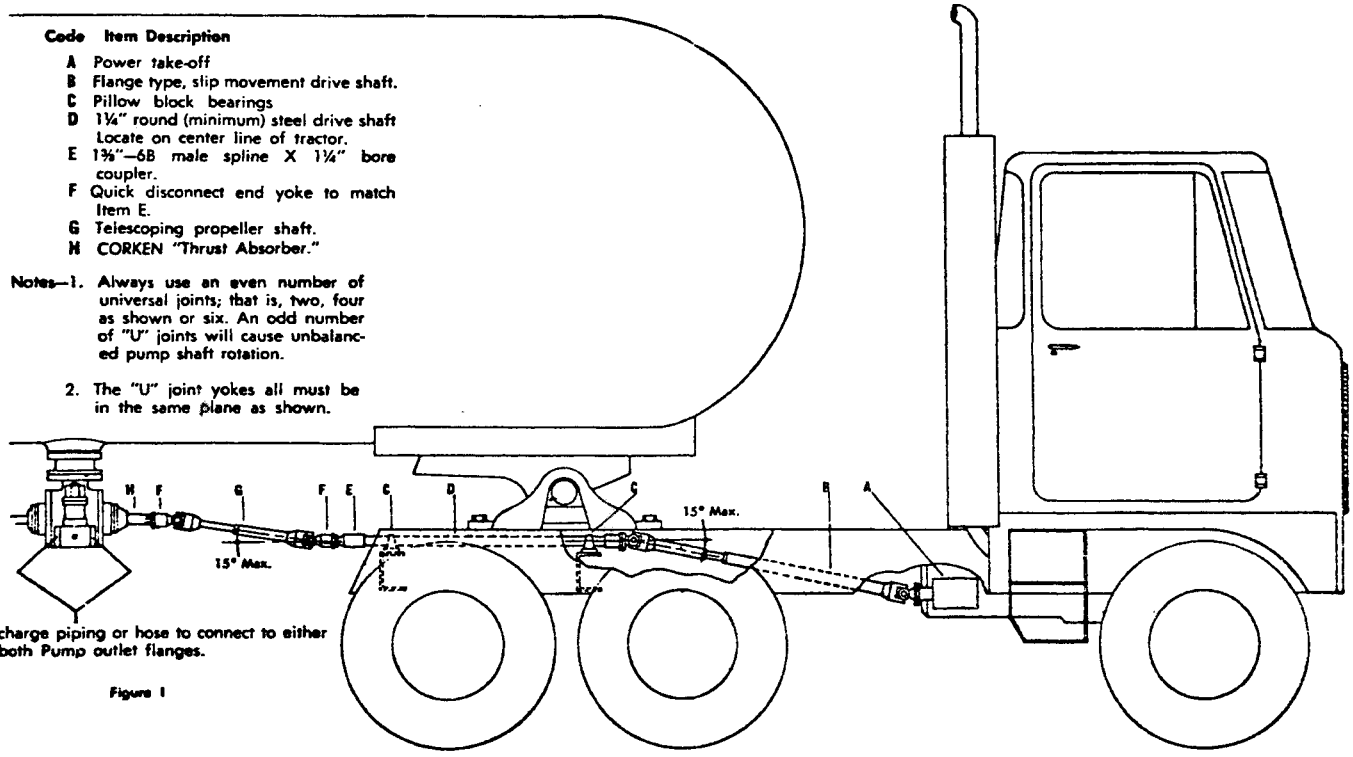
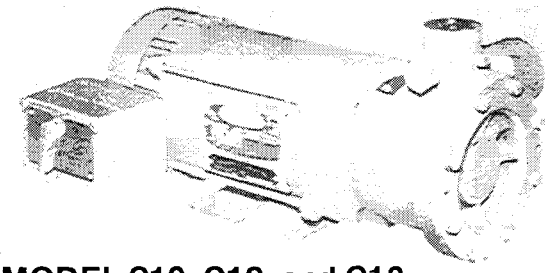


Figure 1

CORKEN

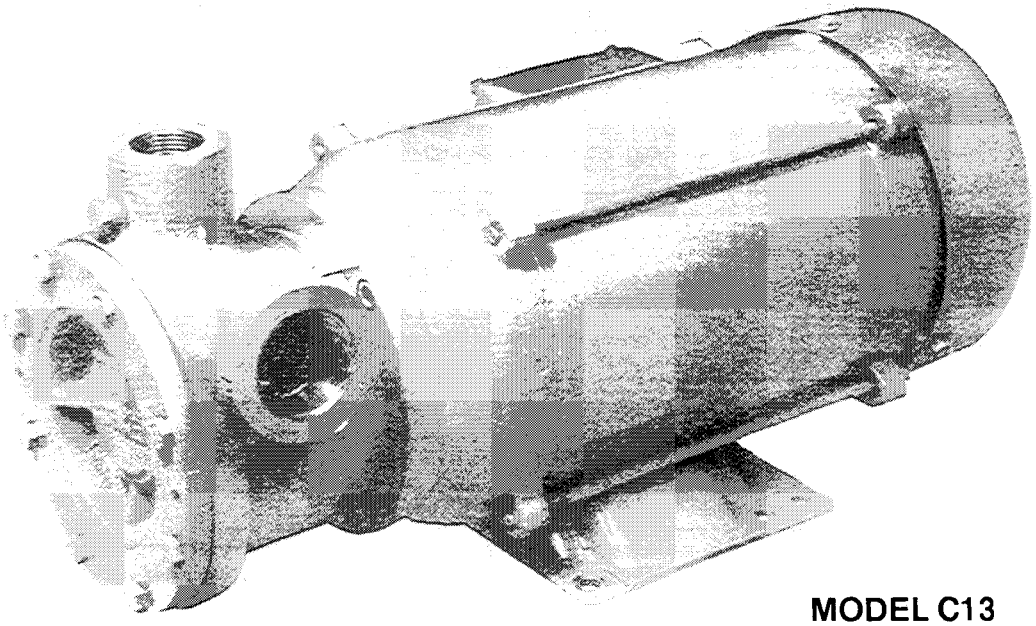
CORO-FLO PUMPS



MODEL C10, C12, and C13
Pump With Starter Mounted
On The Motor.
Separate Starter Available
For Remote Wall Mounting.

For Motor Fueling And Cylinder Filling

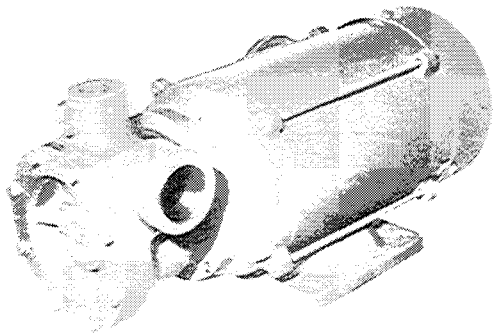
4 MODELS TO CHOOSE FROM!



MODEL C13

The Coro-Flo Lasts Longer...Pumps Better!

Listed by Underwriters' Laboratories, Inc. for use in LP-Gas.



MODEL C14

CORKEN®

CORKEN, INC. • A Unit of IDEX Corporation

MODEL NUMBER AND MOUNTING IDENTIFICATION CODE

NOVEMBER 1997
SUPERSEDES VF15[illegible]

MODELS INVOLVED	DESCRIPTION	CODE	FEATURE
C9-C15	CLOSE-COUPLED PUMP-MOTOR UNIT	C	PUMP TYPE
CF9-CF15	CLOSE-COUPLED PUMP-MOTOR WITH 300 LB. R.F. ANSI FLANGE INLET/OUTLET	CF	
	FLOW RATE**		
C9	1.5 - 7 GPM	9	PUMP SIZE
C10	2 - 12 GPM	10	
C12	7.5 - 19 GPM	12	SINGLE SEAL
C13	8 - 26 GPM	13	
C14	14 - 38 GPM	14	
C10	3/4 HP, 1 PHASE 50/60 HZ MOTOR	D	MOTOR
C10, C12	1 HP, 1 PHASE, 50/60 HZ MOTOR (RATED FOR 1.5 HP WITH 1.5 SERVICE FACTOR)	E	
C12, C13	2 HP, 1 PHASE, 50/60 HZ MOTOR	F	
C12, C13, C14	3 HP, 1 PHASE, 50/60 HZ MOTOR	G	
ALL	BRONZE IMPELLER ALUMINUM SEAL SLEEVE AND FOLLOWER STEEL SHAFT	D	IMPELLER, SEAL SLEEVE AND FOLLOWER, SHAFT MATERIAL
ALL	CAST IRON (STANDARD)	2	SEAL SEAT MATERIAL
ALL	BUNA N (STANDARD)	A	O-RING MATERIAL
	NEOPRENE*	B	
	VITON*	D	
	PTFE	E	

C9-C13, CF9-CF13	C-MODEL WITH A SEPARATE REMOTE WALL-MOUNTED STARTER	-S	MOUNTING
C9-C13, CF9-CF13	C-MODEL WITH STARTER MOUNTED AND WIRED TO MOTOR	-SM	

EXAMPLE

C 10 D D 2 A — MODEL NUMBER

SM — MOUNTING

A LETTER Z IS ADDED TO THE END OF THE MODEL NUMBER AND/OR THE MOUNTING NUMBER WHEN SPECIAL MATERIAL IS USED.

*VITON AND NEOPRENE ARE REGISTERED TRADEMARKS OF DUPONT.
**PERFORMANCE DATA FOR REFERENCE ONLY. CONSULT FACTORY FOR PRODUCT SELECTION.

STANDARD SELECTION TABLE
LIQUID L.P. GAS

JANUARY 1961
SUPERSEDES VF200

The CORO-FLO Pump line is manufactured in a Close-Coupled Motor Series identified as "C" models, and a ball bearing Frame Series identified as "F" Models. This class of pump is specifically designed for high pressure, small capacity pumping for such services as: cylinder filling, motor fueling, refrigeration charging, etc.

The "C" Series Pump close coupled to electric motors is available in standard production with fan cooled, continuous duty explosion proof motors only, but motors of any enclosure, rpm, phase, voltage, cycle or current can be furnished on special order with extended deliveries. Standard motors are 3600 rpm, dual voltage in sizes 3/4 hp, single phase; 1 hp, single phase; and 3 hp, three phase. Both the 3/4 hp and 1 hp motors are equipped with manual starters and overload relays. Separate starting equipment must be provided for the 3 hp motors. The close coupled type pump is extremely compact, lower in cost, requires no special foundation and is free of motor alignment problems.

The "F" Series Pump is a frame type and is manufactured with its own shaft and bearings supported in a cast iron frame. Heavy duty frames and shafts are available on special order to meet extremely high differential pressure, continuous duty operations. Consult the Factory for these applications. The Frame type pump can be driven by any desirable means: electric motor, internal combustion engine, flexible coupling or "V" belts. Standard baseplates and flexible couplings are furnished for the connection of the required driver to the pump unit.

The following Selection Table indicates the services and recommended models most commonly used in pumping LP Gas; however, the "F" Series Pumps lend themselves to a variety of applications. For unusual applications, refer to the Characteristic Curves on pages VF-202 and VF-203.

SERVICE: FILL SMALL I. C. C. CYLINDERS, FORK LIFT CYLINDERS, 20* "SELF-SERVICE CYLINDERS."

	"C" SERIES	"F" SERIES
Pump Model	C9	F9-101
Driver	3/4 hp, Continuous Duty Motor	3/4 hp, 3600 rpm Motor or B & S *80302 Engine at 3600 rpm
	Maximum Continuous Pressure	60 PSID *
	Maximum Intermittent Pressure	85 PSID
	Capacity at 20 PSID	7.0 GPM
	Capacity at 60 PSID	3.5 GPM
	Capacity at 85 PSID	1.5 GPM
	Minimum Piping Size, Inlet	1-1/4 In.
	Minimum Piping Size, Outlet	1/2 In.

STANDARD SELECTION TABLE
LIQUID L.P. GAS

JANUARY 1961
SUPERSEDES VF201

SERVICE: FILL 20* I. C. C. CYLINDERS IN 30 SECONDS - 100* I. C. C. CYLINDERS IN 2-1/2 MINUTES (WHEN EQUIPPED WITH STANDARD DOMESTIC CYLINDER VALVE) - MOTOR FUELING THROUGH METERS AT 7 GPM.

	"C" SERIES	"F" SERIES
Pump Model	C10	F10-101
Driver	3/4 hp, Continuous Duty Motor	3/4 or 1 hp, 3600 rpm Motor or B & S *80302 Engine at 3600 rpm
	Maximum Continuous Pressure, 3/4 hp	50 PSID *
	Maximum Intermittent Pressure, 3/4 hp	75 PSID
	Maximum Continuous Pressure, 1 hp	80 PSID
	Capacity at 20 PSID	12 GPM
	Capacity at 50 PSID	7 GPM
	Capacity at 75 PSID	3 GPM
	Capacity at 80 PSID	2 GPM
	Minimum Piping Size, Inlet	1-1/4 In.
	Minimum Piping Size, Outlet	1/2 In.

SERVICE: FILL 20* I. C. C. CYLINDERS IN 15 SECONDS - 100* I. C. C. CYLINDERS IN 2 MINUTES - MOTOR FUELING THROUGH METERS AT 15 GPM

	"C" SERIES	"F" SERIES
Pump Model	C12 Continuous	F12-101
Driver	1 hp, Continuous Duty Motor	1-1/2 or 2 hp, 3600 rpm Motor or B & S *80302 Engine at 3600 rpm
	Maximum Continuous Pressure, C12 , 1 hp	70 PSID *
	Maximum Intermittent Pressure, F12, 1-1/2 hp	85 PSID
	Maximum Continuous Pressure, F12, 2 hp	100 PSID
	Capacity at 20 PSID	19 GPM
	Capacity at 70 PSID	12.5 GPM
	Capacity at 85 PSID	10 GPM
	Capacity at 100 PSID	7-1/2 GPM
	Minimum Piping Size, Inlet	1-1/2 In.
	Minimum Piping Size, Outlet	3/4 In.

SERVICE: FILL 100* I. C. C. CYLINDERS AT 60 PER HOUR - MOTOR FUELING THROUGH METERS AT 30 GPM.

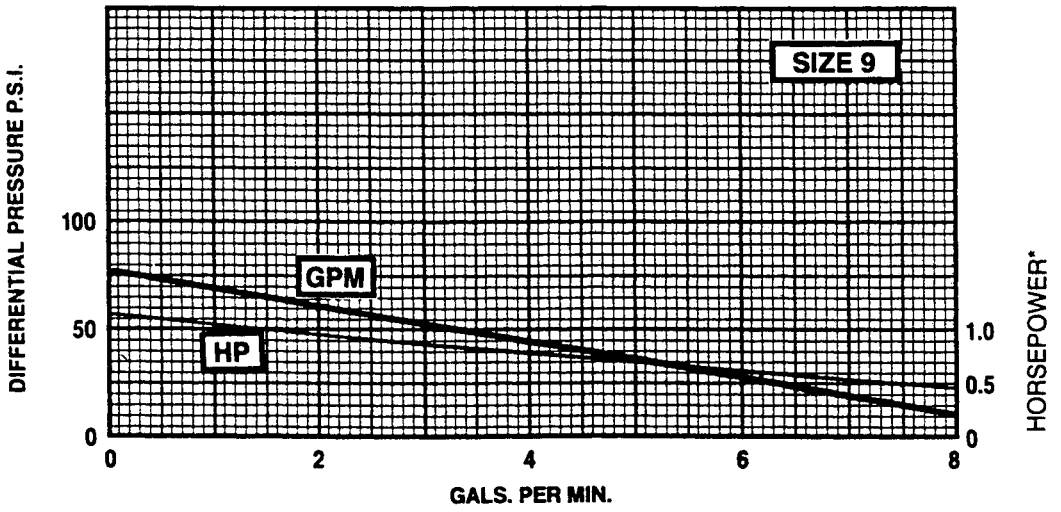
	"C" SERIES	"F" SERIES
Pump Model	C14	F14-101
Driver	3 hp, Continuous Duty Motor	3 or 5 hp, 3600 rpm Motor or B & S *143302 Engine at 3600 rpm
	Maximum Continuous Pressure, 3 hp	70 PSID*
	Maximum Continuous Pressure, 5 hp	125 PSID
	Maximum Intermittent Pressure, 3 hp	100 PSID
	Capacity at 20 PSID	38 GPM
	Capacity at 70 PSID	26 GPM
	Capacity at 100 PSID	20 GPM
	Capacity at 125 PSID	14 GPM
	Minimum Piping Size, Inlet	2 In.
	Minimum Piping Size, Outlet	1 In.

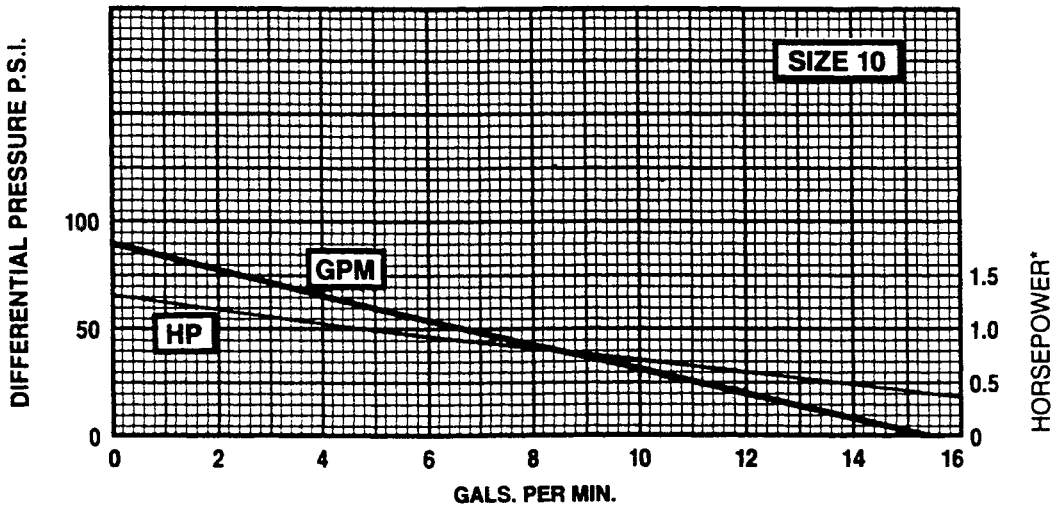
Notes: *PSID is the abbreviation for POUNDS PER SQUARE INCH PRESSURE DIFFERENTIAL.

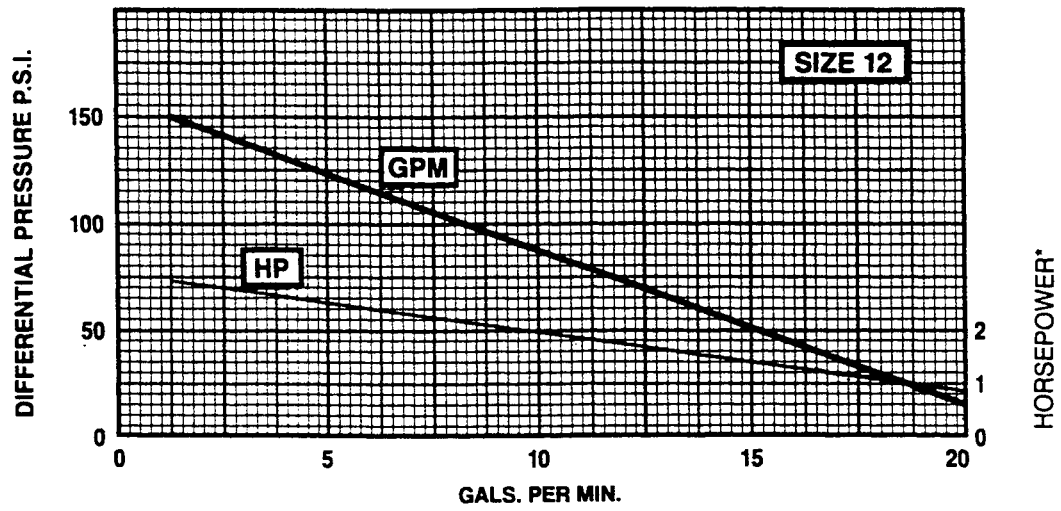
3450 RPM
CHARACTERISTIC CURVES

MAY 1995
SUPERSEDES VF202

Curves Based Upon LPG Ammonia and Similar Products





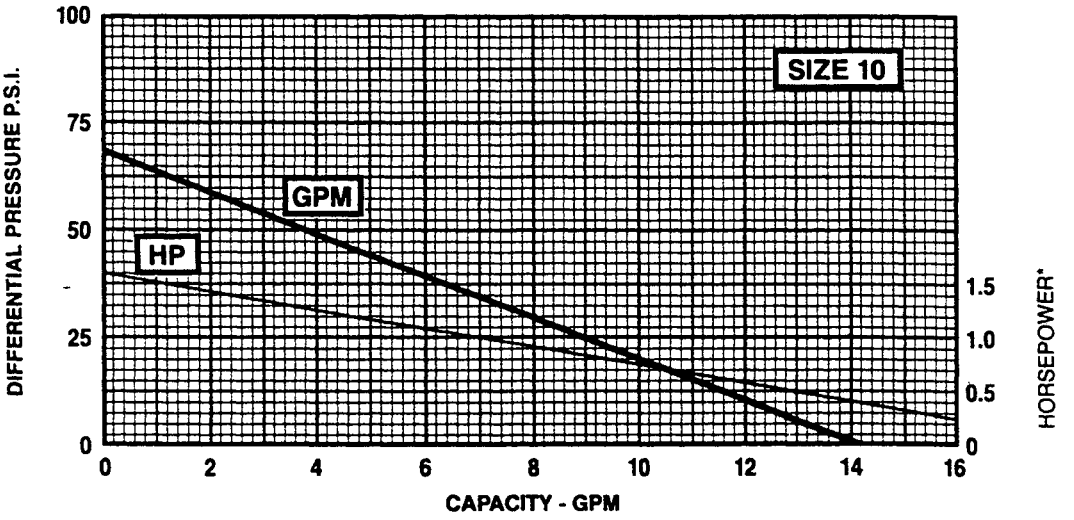


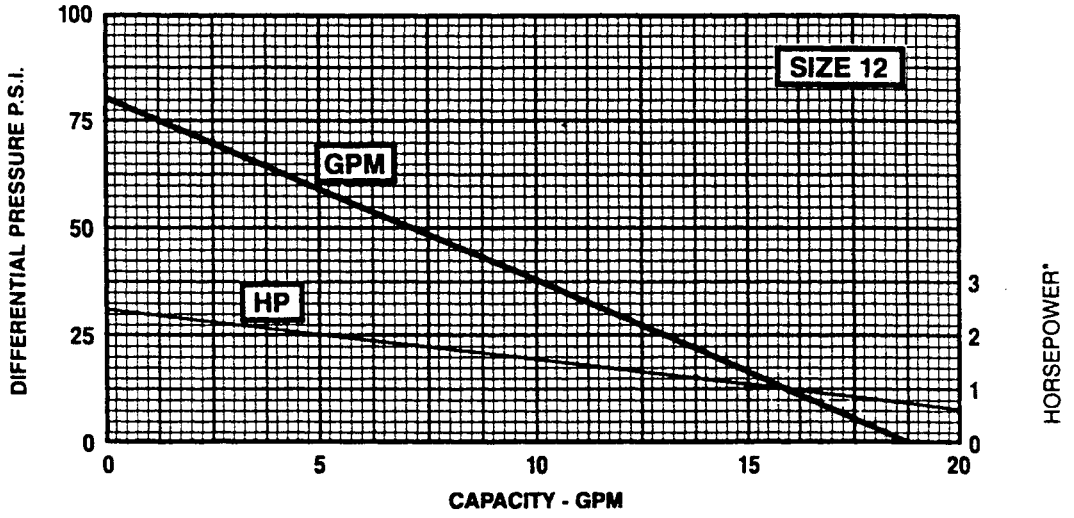
*TO DETERMINE HORSEPOWER WHEN PUMPING AMMONIA, MULTIPLY CURVE HORSEPOWER READING BY 1.2.

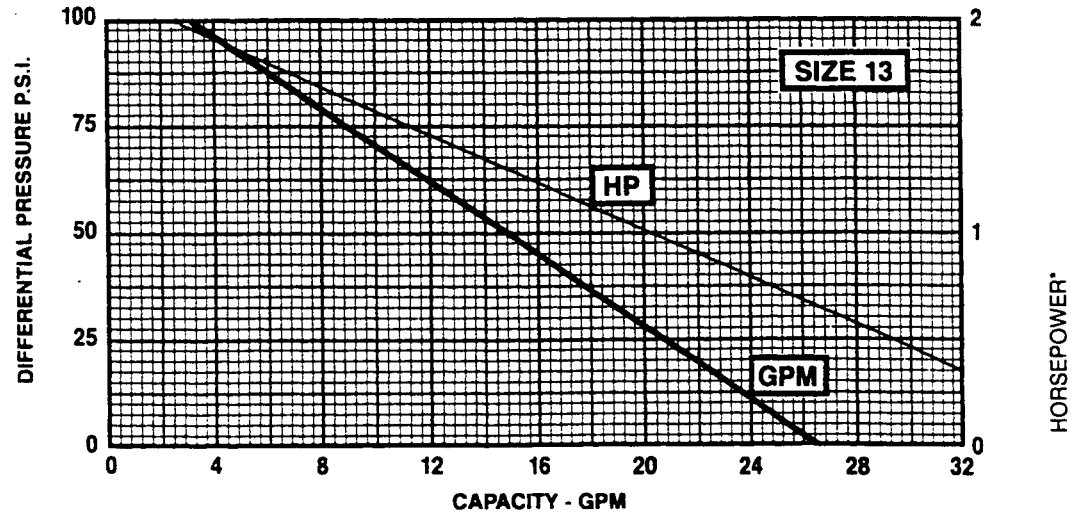
2880 RPM
CHARACTERISTIC CURVES

SEPTEMBER 1996
SUPERSEDES VF202-1A

Curves Based Upon LPG Ammonia and Similar Products



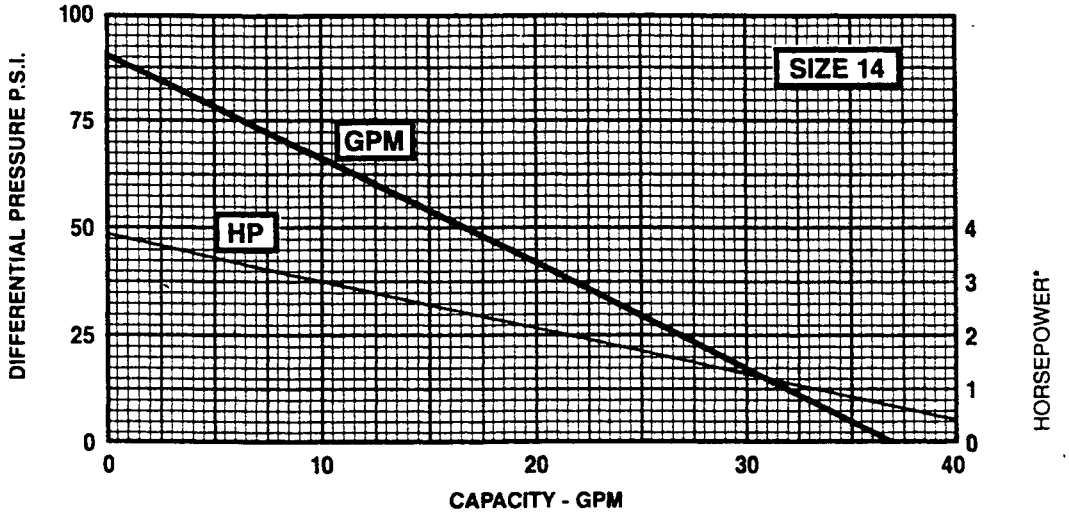


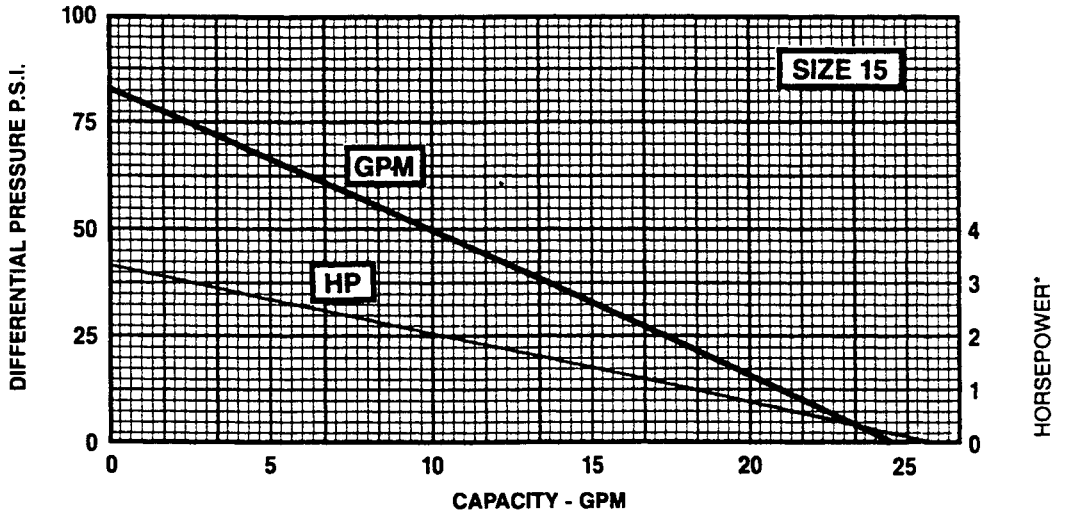


2880 RPM
CHARACTERISTIC CURVES

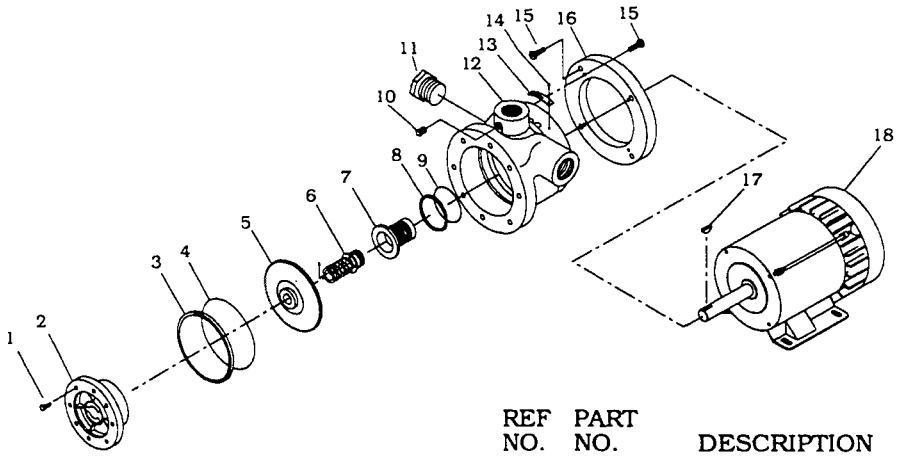
MAY 1995
SUPERSEDES VF203-1

Curves Based Upon LPG Ammonia and Similar Products





*TO DETERMINE HORSEPOWER WHEN PUMPING AMMONIA, MULTIPLY CURVE HORSEPOWER READING BY 1.2.

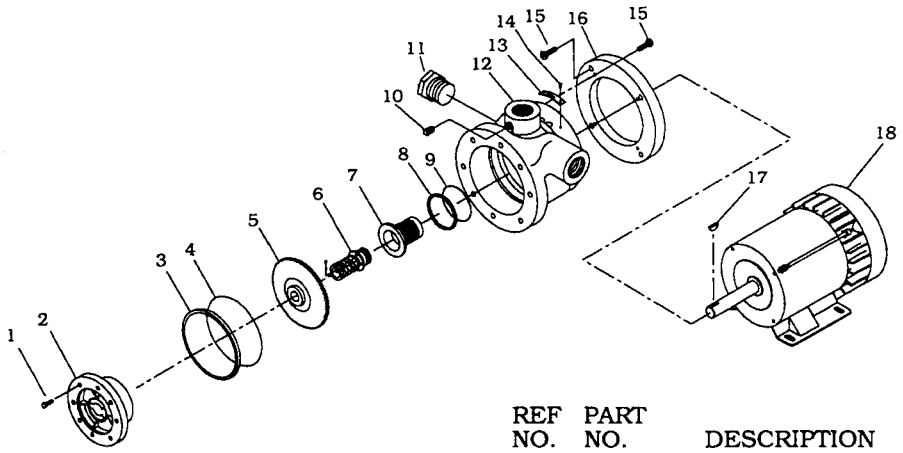


REF NO.	PART NO.	DESCRIPTION	QTY.
1.	7001-031 NC100A	Hex Hd. Cap Screw	8
2.	1001-09	Cover (Model 9)	1
	1001-0	Cover (Model 10)	1
	1001-2	Cover (Model 12)	1
	1001-3	Cover (Model 13)	1
	1001-4	Cover (Model 14)	1
	1001-5	Cover (Model 15)	1
(a)3.	1014	Case Clearance Shim (.002" Red)	As Req.
(a)	1014-1	Case Clearance Shim (.003" Green)	As Req.
(a,b)4.	2-246	O-ring, Case (Except TFE)	1
(a,b)	2-247E	O-ring, Case (TFE)	1
5.	1003-09	Impeller, Brass ┐	
	1003-091	Impeller, Iron ├ Model 9	1
	1003-092	Impeller, S.S. ┘	
	1003-0	Impeller, Brass ┐	
	1003-01	Impeller, Iron ├ Model 10	1
	1003-02	Impeller, S.S. ┘	
	1003-2	Impeller, Brass ┐	
	1003-21	Impeller, Iron ├ Model 12	1
	1003-22	Impeller, S.S. ┘	
	1003-3	Impeller, Brass ┐	
	1003-31	Impeller, Iron ├ Model 13	1
	1003-32	Impeller, S.S. ┘	
	1003-4	Impeller, Brass ┐	
	1003-41	Impeller, Iron ├ Model 14	1
	1003-42	Impeller, S.S. ┘	
	1003-5	Impeller, Brass ┐	
	1003-51	Impeller, Iron ├ Model 15	1
	1003-52	Impeller, S.S. ┘	
(b)6.	113-CX	Seal Assembly	1
7.	1004-1X	Seal Housing, Steel (Except TFE O-rings)	1
	1004-11X	Seal Housing, S.S. (Except TFE O-rings)	1
	1004-2X	Seal Housing, Steel (For TFE O-rings Only)	1
	1004-21X	Seal Housing, S.S. (For TFE O-rings Only)	1

REF NO.	PART NO.	DESCRIPTION	QTY.
8.	1013	Housing Adjustment Shim (.010")	As Req.
	1013-1	Housing Adjustment Shim (.020")	As Req.
(a,b)9.	2-224	O-ring, Housing	1
10.	3442	Pipe Plug, 1/4" NPT	1
11.	3444	Pipe Plug, 3/4" NPT	1
12.	1002-09	Case (Model 9)	1
	1002-0	Case (Model 10)	1
	1002-2	Case (Model 12)	1
	1002-3	Case (Model 13)	1
	1002-4	Case (Model 14)	1
	1002-5	Case (Model 15)	1
13.	1914-4	Nameplate	1
14.	7012-006 SF025E	Phillip Hd., 6-32 x 1/4" Type F, Plated	2
15.	7002-037 NC087A	Socket Hd. Cap Screw	8
16.	1015	Adapter Ring	1
(a)17.	2497	Woodruff Key, Steel	1
(a)	2497-1	Woodruff Key, S.S.	1
18.	2555	Motor - 3/4 Hp. (Models 9, 10)	1
	2556	Motor - 1 Hp. (Model 12)	1
(d)	2557	Motor - 3 Hp. (Models 14, 15)	1
	2895	Motor - 3/4 Hp., Obsolete (Models 9E, 10E)	1
	2896	Motor - 1-1/2 Hp., Obsolete (Model 12E)	1
(c)	4261	Motor - 2 Hp. (Model 13)	1

NOTES:
(a) Included with Seal Assembly 113-CX. See Page F202.
(b) For Seal and O-ring Material Coding, See Page A500.
(c) Prior to S.N. PR166727 Motor Part Number was 3760.
(d) Starting with S.N. PW168290 will be new Motor Frame Size.

CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.



REF NO.	PART NO.	DESCRIPTION	QTY.
1.	7001-031 NC100A	Hex Hd. Cap Screw	8
2.	1001-09	Cover (Model 9)	1
	1001-0	Cover (Model 10)	1
	1001-2	Cover (Model 12)	1
	1001-3	Cover (Model 13)	1
	1001-4	Cover (Model 14)	1
	1001-5	Cover (Model 15)	1
(a)3.	1014	Case Clearance Shim (.002" Red)	As Req.
(a)	1014-1	Case Clearance Shim (.003" Green)	As Req.
(a,b)4.	2-246	O-ring, Case (Except TFE)	1
(a,b)	2-247E	O-ring, Case (TFE)	1
5.	1003-09	Impeller, Brass	
	1003-091	Impeller, Iron — Model 9	1
	1003-092	Impeller, S.S.	
	1003-0	Impeller, Brass	
	1003-01	Impeller, Iron — Model 10	1
	1003-02	Impeller, S.S.	
	1003-2	Impeller, Brass	
	1003-21	Impeller, Iron — Model 12	1
	1003-22	Impeller, S.S.	
	1003-3	Impeller, Brass	
	1003-31	Impeller, Iron — Model 13	1
	1003-32	Impeller, S.S.	
	1003-4	Impeller, Brass	
	1003-41	Impeller, Iron — Model 14	1
	1003-42	Impeller, S.S.	
	1003-5	Impeller, Brass	
	1003-51	Impeller, Iron — Model 15	1
	1003-52	Impeller, S.S.	
(b)6.	113-CX	Seal Assembly	1
7.	1004-1X	Seal Housing, Steel (Except TFE O-rings)	1
	1004-11X	Seal Housing, S.S. (Except TFE O-rings)	1
	1004-2X	Seal Housing, Steel (For TFE O-rings Only)	1
	1004-21X	Seal Housing, S.S. (For TFE O-rings Only)	1
8.	1013	Housing Adjustment Shim (.010 ")	As Req.
	1013-1	Housing Adjustment Shim (.020")	As Req.
(a,b)9.	2-224	O-ring, Housing	1
10.	3442	Pipe Plug, 1/4" NPT	1
11.	3444	Pipe Plug, 3/4" NPT	1
12.	1002-09	Case (Model 9)	1
	1002-0	Case (Model 10)	1
	1002-2	Case (Model 12)	1
	1002-3	Case (Model 13)	1
	1002-4	Case (Model 14)	1
	1002-5	Case (Model 15)	1
13.	1914-4	Nameplate	1
14.	7012-006 SF025E	Phillip Hd., 6-32 x 1/4" Type F, Plated	2
15.	7002-037 NC087A	Socket Hd. Cap Screw	8
16.	1015	Adapter Ring	1
(a)17.	2497	Woodruff Key, Steel	1
(a)	2497-1	Woodruff Key, S.S.	1
18.	2555	Motor - 3/4 Hp. (Models 9, 10)	1
	2556	Motor - 1 Hp. (Model 12)	1
(d)	2557	Motor - 3 Hp. (Models 14, 15)	1
	2895	Motor - 3/4 Hp., Obsolete (Models 9E, 10E)	1
	2896	Motor - 1-1/2 Hp., Obsolete (Model 12E)	1
(c)	4261	Motor - 2 Hp. (Model 13)	1

NOTES:
(a) Included with Seal Assembly 113-CX, See Page F202.
(b) For Seal and O-ring Material Coding, See Page A500.
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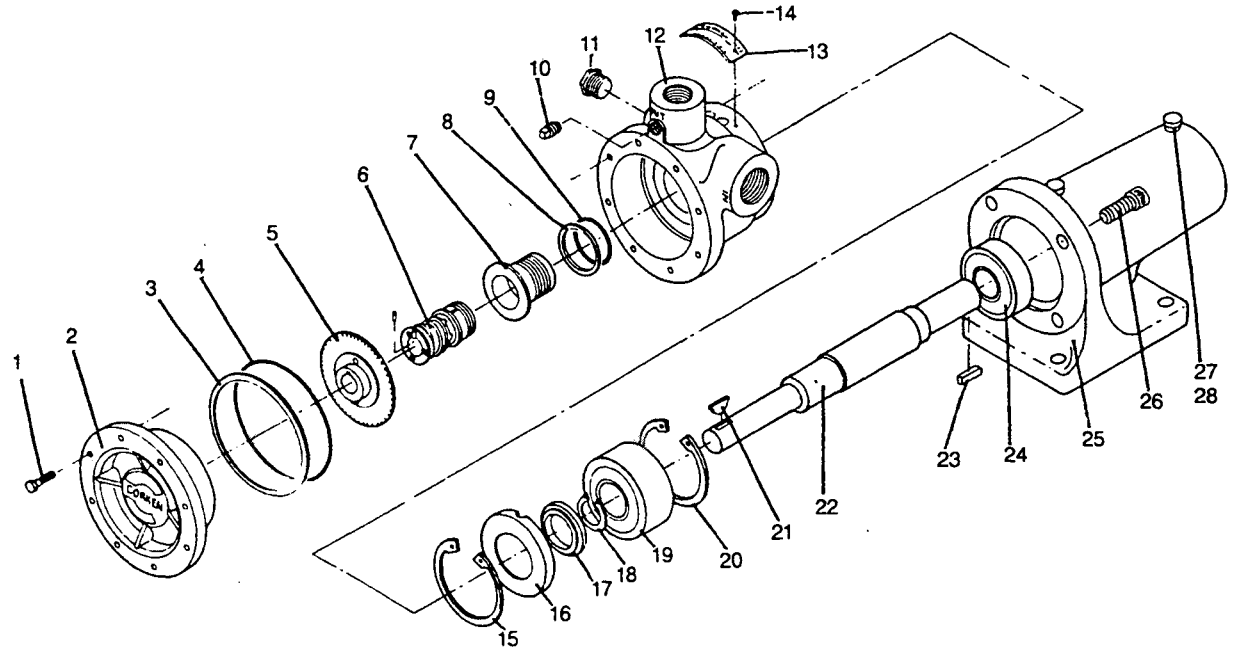
CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.

CAUTION: ALWAYS RELIEVE PRESSURE IN THE UNIT BEFORE ATTEMPTING ANY REPAIRS.



REF. NO.	PART NO.	PART NAME	QTY
1	7001-031NC100A 031NC100A	HEX HEAD CAP SCREW	8
2.	1001-09	COVER (MODEL 9)	1
	1001-0	COVER (MODEL 10)	1
	1001-2	COVER (MODEL 12)	1
	1001-3	COVER (MODEL 13)	1
	1001-4	COVER (MODEL 14)	1
	1001-5	COVER (MODEL 15)	1
(a) 3.	1014	CASE CLEARANCE SHIM (.002" RED)	As Req.
(a)	1014-1	CASE CLEARANCE SHIM (.003" GREEN)	As Req.
(a) 4	2-246	O-RING (CASE) (EXCEPT TFE)	1
(a)	2-247E	O-RING (CASE) (TFE)	1
5.	1003-09	IMPELLER BRASS	
	1003-091	IMPELLER IRON (MODEL 9)	1
	1003-092	IMPELLER STAINLESS STEEL	
	1003-0	IMPELLER BRASS	
	1003-01	IMPELLER IRON (MODEL 10)	1
	1003-02	IMPELLER STAINLESS STEEL	
	1003-2	IMPELLER BRASS	
	1003-21	IMPELLER IRON (MODEL 12)	1
	1003-22	IMPELLER STAINLESS STEEL	
	1003-3	IMPELLER BRASS	
	1003-31	IMPELLER IRON (MODEL 13)	1
	1003-32	IMPELLER STAINLESS STEEL	
	1003-4	IMPELLER BRASS	
	1003-41	IMPELLER IRON (MODEL 14)	1
	1003-42	IMPELLER STAINLESS STEEL	
	1003-5	IMPELLER BRASS	
	1003-51	IMPELLER IRON (MODEL 15)	1
	1003-52	IMPELLER STAINLESS STEEL	1
6.	113CX	SEAL ASSEMBLY	1
7.	1004-1X	SEAL HOUSING, STEEL (EXCEPT TFE O-RINGS)	1
	1004-11X	SEAL HOUSING, STAINLESS STEEL (EXCEPT TFE O-RINGS)	1
	1004-2X	SEAL HOUSING, STEEL (FOR TFE O-RINGS ONLY)	1
	1004-21X	SEAL HOUSING, STAINLESS STEEL (FOR TFE O-RINGS ONLY)	1
8.	1013	HOUSING ADJ. SHIM (.010)	As Req.
	1013-1	HOUSING ADJ. SHIM (.020)	As Req.

REF. NO.	PART NO.	PART NAME	QTY
(a) 9.	2-224	O-RING (HOUSING)	1
10.	3442	PIPE PLUG ¼" NPT	1
11.	3444	PIPE PLUG ¾" NPT	1
12.	1002-09	CASE (MODEL 9)	1
	1002-0	CASE (MODEL 10)	1
	1002-2	CASE (MODEL 12)	1
	1002-3	CASE (MODEL 13)	1
	1002-4	CASE (MODEL 14)	1
	1002-5	CASE (MODEL 15)	1
	4206-09	CASE ANSI FLANGED (MODEL 9)	1
	4206-0	CASE ANSI FLANGED (MODEL 10)	1
	4206-2	CASE ANSI FLANGED (MODEL 12)	1
	4206-3	CASE ANSI FLANGED (MODEL 13)	1
	4206-4	CASE ANSI FLANGED (MODEL 14)	1
	4206-5	CASE ANSI FLANGED (MODEL 15)	1
13.	1914-1	NAMEPLATE	1
14.	7012-006SF025E	PHILLIP HD. 6-32 X ¼"	2
15.	5002-281	BEARING RETAINER RING	1
16.	1238	BEARING CAP	1
17.	1006	GREASE SEAL	1
18.	5102-118	BEARING RETAINER RING	1
19.	2758	BALL BEARING (Was 55605)	1
20.	5000-281	BEARING RETAINER RING	1
21.	2497	#5 WOODRUFF KEY STEEL	1
	2497-1	#5 WOODRUFF KEY STAINLESS STEEL	1
22.	1234	SHAFT	1
	1234-1	SHAFT STAINLESS STEEL	1
23.	3226	KEY	1
24.	2759	BALL BEARING (Was 77506)	1
25.	1010-2	FRAME	1
26.	7002-037NC087A	SOC HEAD SCREW	4
27.	2158	GREASE ZERK	2
28.	2159	LUBRICAP	2

NOTE: (a) Included with Seal Assy 113-CX. See Page F202.
For Seal and O-Ring Material Coding See Page A500.

CORO-FLO SEAL REPLACEMENT INSTRUCTIONS

CAUTION

Bleed all pressure from the pump and piping before starting to install your seal assembly.

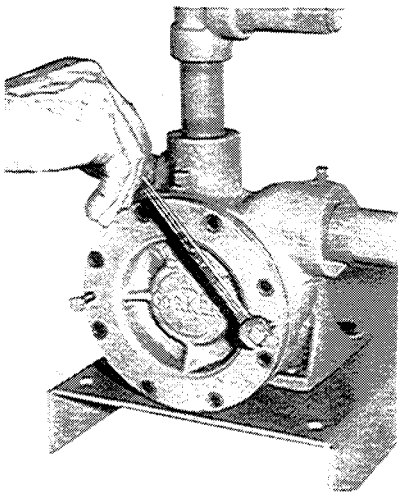
CLEANLINESS

Even the smallest amount of dirt on your new seal can cause early failure. Keep all parts, tools and your hands clean while installing the seal. Never touch the smooth lapped faces of the carbon rotor or seal seat. For LP-gas, anhydrous ammonia and similar liquids, you are trying to seal a fluid that is 5 to 10 times thinner than water! Your new seal needs every chance it can get, so keep it clean.

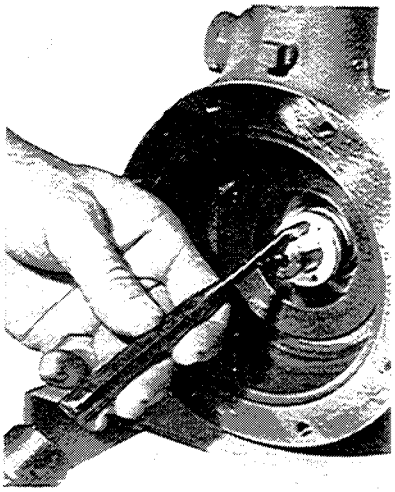
WORKMANSHIP

Your Corken pump is a precision piece of equipment with very close clearances. Treat it as such. Never beat on it to get parts in or out.

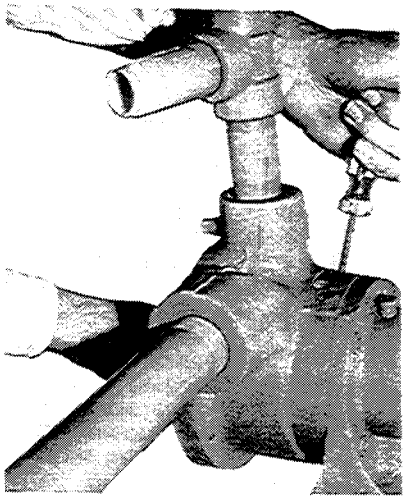
Refer to Figure 1 on back page for reference numbers.



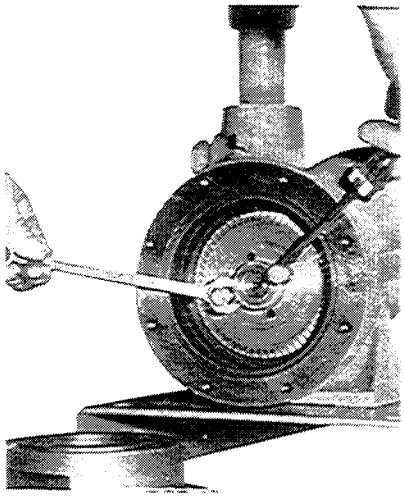
1. Remove the cover cap screws and remove the cover from the case. If the cover is stuck, use two cover screws in the threaded holes to loosen it.



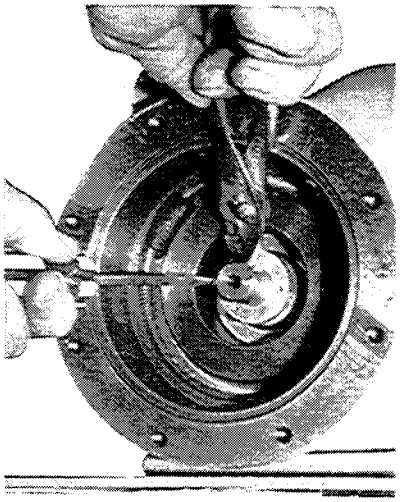
3. Remove the impeller key (No. 14; Figure 1) by tapping with a punch forcing the key up and out of it's slot. Take care not to damage the shaft.



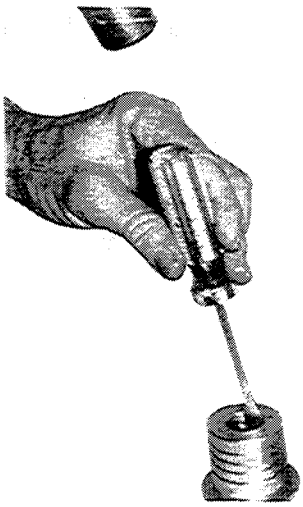
5. Remove the pump nameplate. Through the exposed holes in the case, engage a screw driver in the grooves on the seal housing (No.12) and pry the housing and seal sleeve from the pump chamber. Be sure to keep all of the shims (No.13) with the housing so they will not be bent or lost.



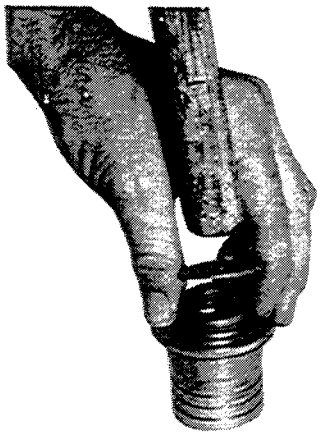
2. Remove the impeller. It should slide freely but if it is stuck use two cover cap screws in the threaded holes provided and pry off carefully. Care must be taken not to warp the impeller.



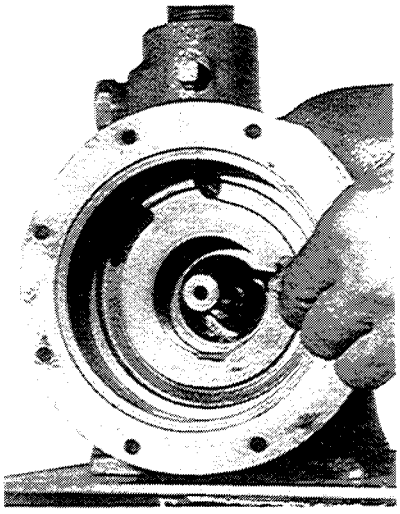
4. Remove the three seal clamp ring screws (No. 1) and remove the seal clamp ring (No. 2). Using a screw driver, press against the seal sleeve (No. 5) and remove the seal drive pin (No. 15).



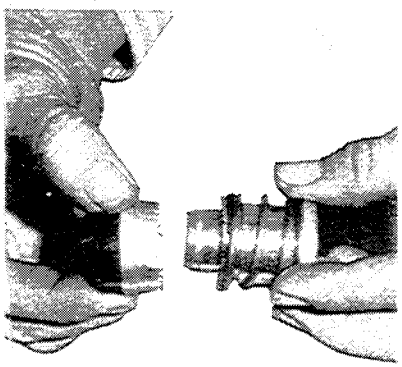
6. Carefully tap the old seal seat (No.10) out of the seal housing. Do not damage the interior of the housing.



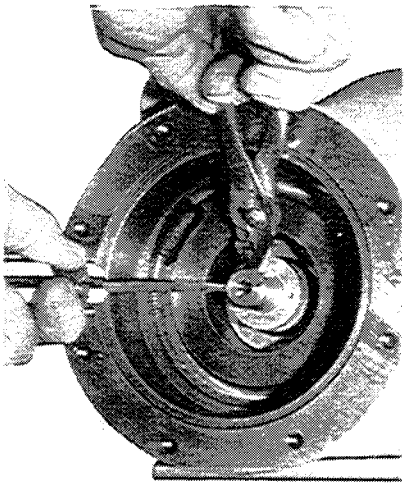
7. Clean the seal housing (No.12) and apply a light coat of oil on the inside surfaces. Remove the new seal seat (No. 10) from its package and oil the seal seat 'O' ring (No. 11). Wipe the smooth lapped face clean **being very careful not to scratch it or leave any finger prints on it.** Insert the seal seat (No. 10) into the seal housing (No.12) with the notch pointing down and in line with the locator pin in the back of the seal housing (No.12). Place the small round piece of cardboard found in the seal package (being sure it is very clean) on the seal face. Use a hammer handle to push the seal seat (No. 10) into place. **Check to make sure the locator pin is in the seal seat notch.**



8. Using a knife remove the old seal housing 'O' ring (No.16). Carefully clean the 'O' ring groove and install a new 'O' ring after applying a thin coat of oil. Clean the shaft and remove any burrs around the keyway. Replace all the shims (No. 13) on the seal housing (No.12) and apply a light coat of oil to the outside surfaces. Reinstall the seal housing (No.12) into the pump case.

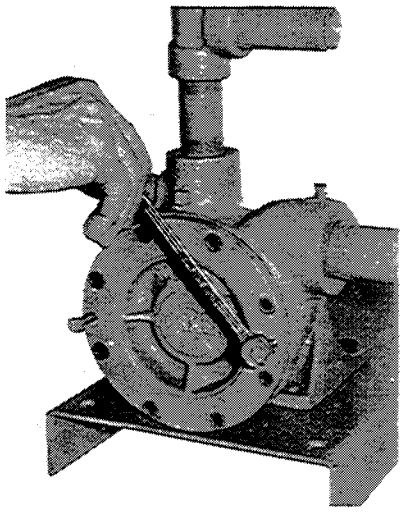


9. Carefully unwrap the remainder of your seal assembly which includes the new retainer shell (No. 6), carbon rotor (No. 9) and seal sleeve assembly (No. 5). Carefully wipe the carbon rotor clean with a soft cloth **being sure that it is not scratched** and slide the entire assembly in place on the shaft. Oil and insert the follower 'O' Ring (No. 4) and the follower ring (No. 3). Make certain the follower ring is pointing out.



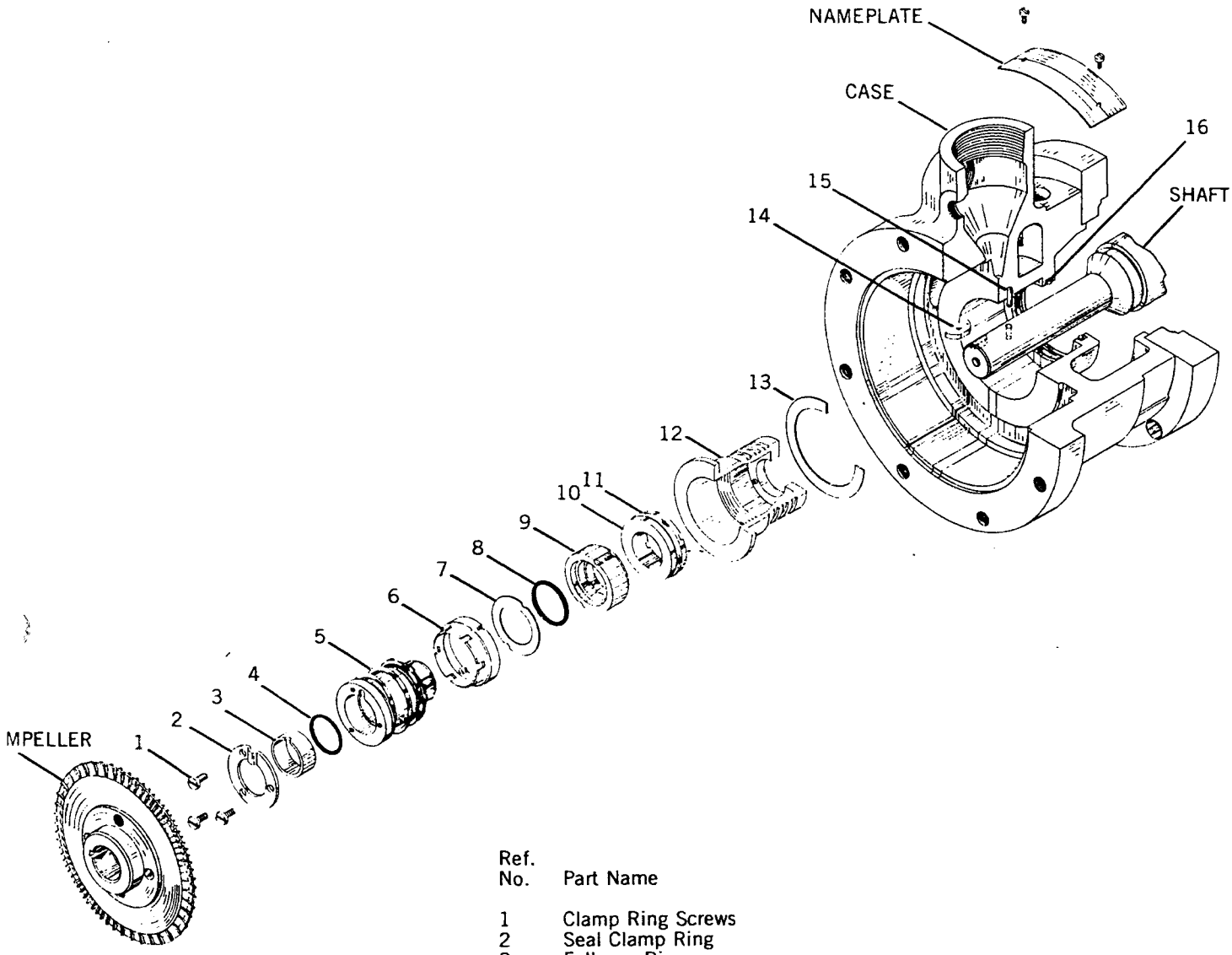
10. Align the notches in the seal sleeve (No. 5) and the follower ring (No. 3) with the small hole in the shaft. With a screw driver push the seal sleeve (No. 5) and the follower ring (No. 3) back in order to drop a new drive pin (No.15) into the hole in the shaft. Install the clamp ring (No. 2).

11. Install the new impeller key (No. 14) by using pliers to squeeze the key in to the keyway slot. A small piece of cardboard should be used as a pad between the pliers and the shaft. The impeller must slide on the shaft very freely. If it is tight carefully remove any burrs from the keyway or key with a small file. Be certain to clean all filings off of the impeller before reinstalling.



12. Replace the cover and nameplate and check to see if the pump will spin freely. **If at all possible pressurize the pump case with vapor first.** After the pump has been pressurized with vapor then allow liquid to slowly enter the pump.

FIGURE 1. PART DETAILS — CORO-FLO BALANCED SEAL



Ref. No.	Part Name
1	Clamp Ring Screws
2	Seal Clamp Ring
3	Follower Ring
4	Follower 'O' Ring
5	Seal Sleeve Assembly
6	Retainer
7	Disc
8	Rotor 'O' Ring
9	Rotor
10	Seat
11	Seat 'O' Ring
12	Seal Housing
13	Housing Adjustment Shim
14	Impeller Key
15	Drive Pin
16	Seal Housing 'O' Ring

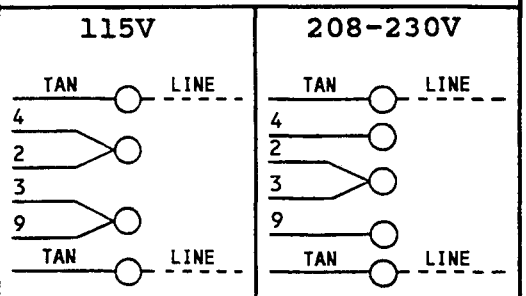
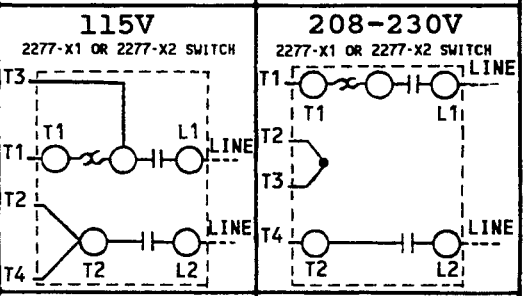
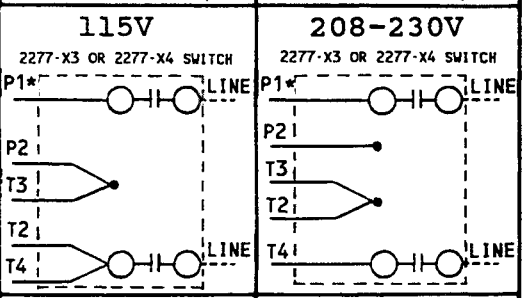
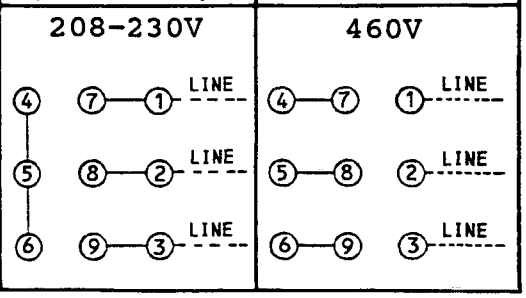
NOTE: These numbers are for general reference only and **should not be used when ordering parts.** Consult your Service Manual, Section F, for the correct part numbers for your pump model.

SERVICE BULLETIN

#44B
9/88

CORKEN

WIRING CONNECTIONS
CURRENT CORKEN CORO-FLO AND SMALL CORO-VANE COUPLED PUMPS

CORKEN MODEL	CORKEN PART #	NAMEPLATE HP	PHASE	VOLTAGE	APPROX. FULL LOAD AMPERAGE	MINIMUM WIRE SIZE, AWG LENGTH OF RUN IN FEET 0-100	TO 200	TO 300	WIRING CONNECTIONS
C51	2767	1/2	1	115 230	7 4	12 16	8 14	6 12	
C9 C10	2555	3/4	1	115 230	10 5	12 12	8 12	6 12	
C12	2556	1	1	115 230	18 9	8 12	6 12	4 10	
C13	3760	2	1	115 230	24 12	8 12	4 10	2 8	
									*P1 should be connected to the ungrounded line.
C14	2557	3	3	230 460	10 5	12 12	12 12	12 12	
									Pump must rotate in the direction shown on pump case. If not, switch any two of the three incoming 3 phase lines.

NOTES: 1. Green wire, if present should be grounded.
2. For Coro-Flo units with oversized motors (ie, a C12 with a 2 HP), follow the wiring information for the appropriate motor and operating voltage.
3. Any differences on the motor nameplate should take precedence over the data presented on this sheet.
4. All electrical work should be done by a qualified electrician familiar with local codes.

MOTOR				(a) Recommended Wire Size, AWG		
				Length of Run in Feet		
Hp.	Motor Phase	Volts	Approx. Full Load Amperes	0 – 100	to 200	to 300
¾	1	115	10.0	12	8	6
		230	5.0	12	12	12
	3	230	2.8	12	12	12
		460	1.4	12	12	12
1	1	115	14.0	10	6	6
		230	7.0	12	12	12
	3	230	3.6	12	12	12
		460	1.8	12	12	12
1½	1	115	18.0	8	6	4
		230	9.0	12	12	10
	3	230	5.2	12	12	12
		460	2.6	12	12	12
2	1	115	24.0	8	4	2
		230	12.0	12	10	8
	3	230	6.8	12	12	12
		460	3.4	12	12	12
3	1	115	34.0	6	4	2
		230	17.0	12	8	8
	3	230	9.6	12	12	12
		460	4.8	12	12	12
5	1	115	56.0	4	1	1/0
		230	28.0	10	6	4
	3	230	15.2	12	12	10
		460	7.6	12	12	12
7½	1	230	40.0	8	6	4
	3	230	22.0	10	10	8
		460	11.0	12	12	12
10	3	230	28.0	8	8	8
		460	14.0	12	12	12
15	3	230	42.0	6	6	6
		460	21.0	10	10	10
20	3	230	54.0	4	4	4
		460	27.0	8	8	8
25	3	230	68.0	2	2	2
		460	34.0	6	6	6
30	3	230	80.0	1	1	1
		460	40.0	6	6	6
40	3	230	100.0	2/0	2/0	2/0
		460	52.0	4	4	4
50	3	230	130.0	3/0	3/0	3/0
		460	65.0	2	2	2

(a) Based upon 3% voltage loss copper wire type TW. Single phase motor calculations are based on 2 times distance.

NOTES:

CORKEN

by-pass valves

or LP Gas, Anhydrous Ammonia, nd Other Pressurized Liquefied Gases

3177 (1¼" — 1½" — 2" — 2½")

FFERENTIAL BY-PASS VALVE

pical Application: In liquefied gas bulk plant installations for the loading and unloading pumps.

low pressure build-up by-pass valve specifically designed for plications requiring protection for positive displacement mps in the 40 — 350 GPM (151.4 — 1324.9 Lit/Min) range. This ecise, quality valve requires a pressure sensing line from the rage tank. It can also be used as a differential back pressure lve to assure adequate pressure on meters, etc.

3166 (¾" — 1")

JTOMATIC, DUAL PURPOSE BY-PASS VALVE

pical Application: On all Corken Coro-Flo pumps as well as bottle pumps of other manufacturers. On propellent feed pumps at aerosol filling plants.

combination by-pass and priming valve specifically signed for small bottle filling type pumps, especially of e regenerative turbine type, such as the Corken Coro-Flo p series. The patented vapor elimination systems keep fied gas pumps primed to increase system reliability decrease pump and seal wear. A smooth operating pass with moderate pressure build-up.

T166 (1¼" — 1½")

UMP FLO-CONTROL VALVE

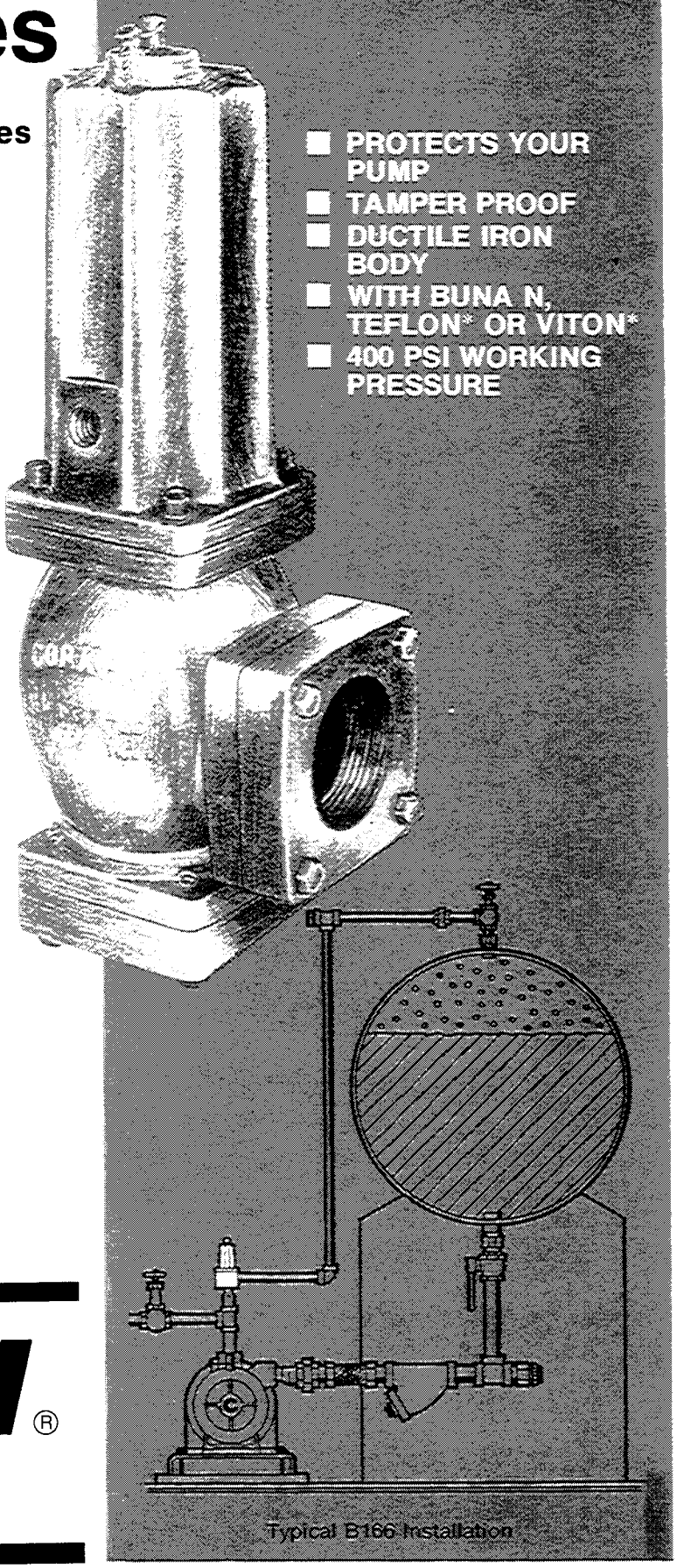
pical Application: Large capacity pumps filling variable size tanks and bottles such as those used with delivery trucks or multi-spot bottle filling plants.

high pressure build-up valve for smooth acting flow control. ecifically designed for by-pass protection for pumps in the 30 100 GPM (113.6 — 378.5 Lit/Min) range, such as those used on elivery trucks. In contrast to the B177, the T166 valve opens adually as pressure builds up to modulate the flow, by-passing e excess capacity smoothly and silently back to the supply tank. continuous bleed in this valve offers vapor eliminating.

B177, B166, T166 are listed by Underwriters' Laboratories, Inc. for use in LP-Gas and Anhydrous Ammonia.

LSO AVAILABLE – B235 (3/4"-1") for installations requiring a apor eliminating or priming valve.

- PROTECTS YOUR PUMP
- TAMPER PROOF
- DUCTILE IRON BODY
- WITH BUNA N, TEFLON* OR VITON*
- 400 PSI WORKING PRESSURE



Typical B166 Installation

CORKEN® IDEX

MEMBER PEI

CORKEN B166 BY-PASS VALVE FUNCTIONS

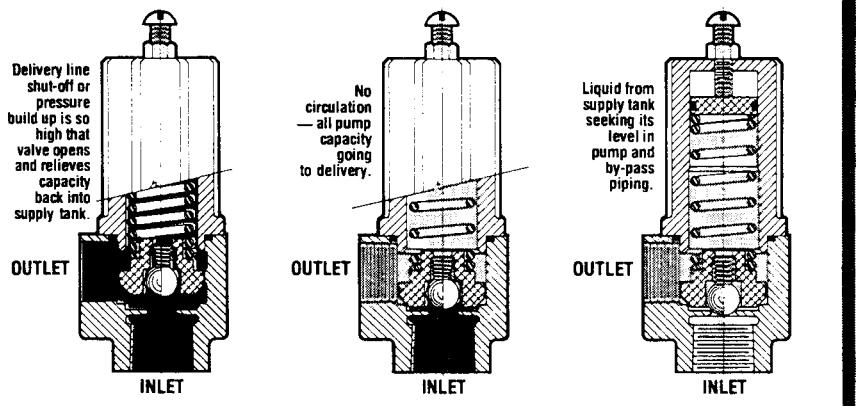


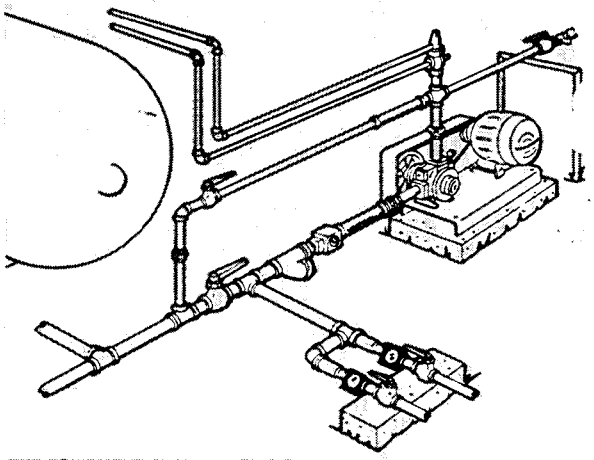
FIG 1 RELIEVING OPERATION OPEN

FIG 2 PUMPING OPERATION CLOSED

FIG. 3 PRIMING OPERATION OPEN

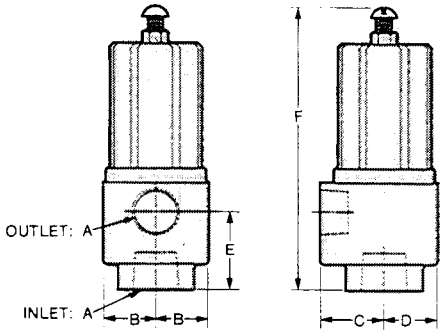
LIQUID — VAPOR — VAPOR and/or LIQUID

TYPICAL INSTALLATION DETAIL — CORO-VANE STATIONARY PUMP WITH B177 VALVE



THE EQUIPMENT SHOWN IN THIS BULLETIN IS COVERED IN WHOLE OR IN PART BY PATENT NO. 2,973,779.

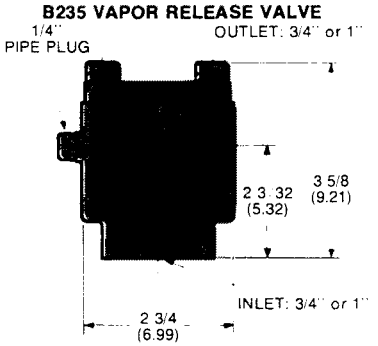
B166, T166, B177 BY-PASS VALVES



OUTLINE DIMENSIONS

DIMENSION IN INCHES (CM.)						
VALVE	A	B	C	D	E	F
B166	3/4 or 1	1 3/8 (3.49)	1 11/16 (4.29)	1 3/8 (3.49)	2 3/32 (5.32)	8 1/8 (20.6)
T166	1 1/4 or 1 1/2	1 5/16 (3.33)	2 7/16 (6.19)	1 5/16 (3.33)	1 5/16 (3.33)	8 3/16 (20.8)
B177	1 1/4 or 1 1/2	1 7/8 (4.76)	2 5/8 (6.67)	2 1/8 (5.40)	2 5/8 (6.67)	11 25/32 (29.9)
B177	2 or 2 1/2	2 5/8 (6.67)	3 (7.62)	2 7/8 (7.30)	3 (7.62)	16 21/32 (42.3)

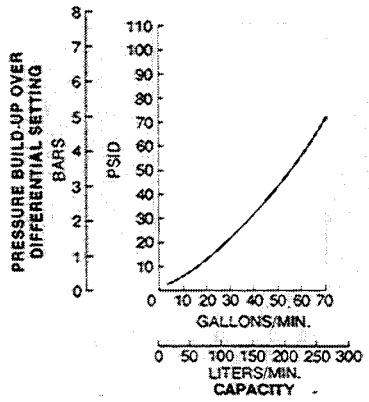
B235 VAPOR RELEASE VALVE



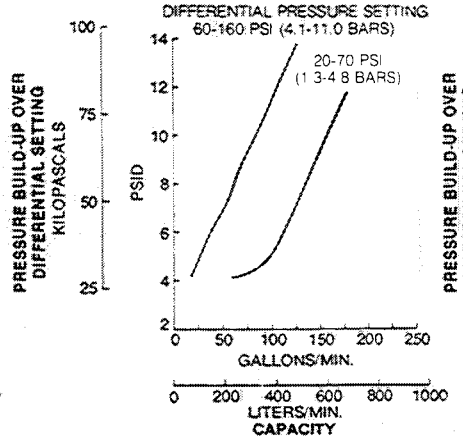
PERFORMANCE CURVES

BASED ON PROPANE

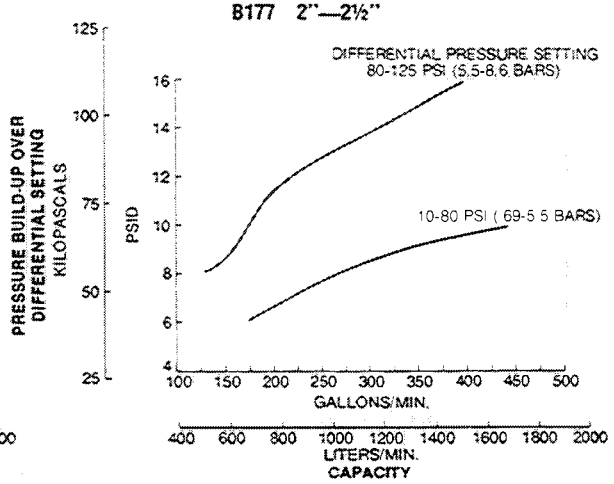
B166 3/4"—1"
T166 1 1/4"—1 1/2"



B177 1 1/4"—1 1/2"



B177 2"—2 1/2"



SPRING SELECTION TABLE					
B166 & T166		B177 (1 1/4 -1 1/2)		B177 (2 -2 1/2)	
Spring No	Differential Range PSID (Bars)	Spring No	Differential Range PSID (Bars)	Spring No	Differential Range PSID (BARS)
1138	25-60 (1.7-4.1)	1817	20-70 (1.3-4.8)	1783	10-40 (.69-2.8)
1193	50-150 (3.4-10.3)	1818	60-100 (4.1-6.9)	1785	30-80 (2.1-5.5)
1193 & 1313	100-225 (6.9-15.5)	1819	80-160 (5.5-11.0)	1786	80-110 (5.5-7.6)
				1786-1	100-125 (6.9-8.6)

WARNING: (1) Periodic inspection and maintenance of Corken products is essential. (2) Inspection, maintenance and installation of Corken products must be made only by experienced, trained and qualified personnel. (3) Maintenance, use and installation of Corken products must comply with Corken instructions, applicable laws and safety standards (such as NFPA Pamphlet 58 for LP-Gas and ANSI K61.1-1972 for Anhydrous Ammonia). (4) Transfer of toxic, dangerous, flammable or explosive substances using Corken products is at user's risk and equipment should be operated only by qualified personnel according to applicable laws and safety standards.

CORKEN IDEX

P O Box 12338, Oklahoma City, OK 73157
3805 N W. 36th St., 73112 • Fax (405) 948-7343
Phone (405) 946-5576 • Telex 262513 Corkn Ur

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JANUARY 1993

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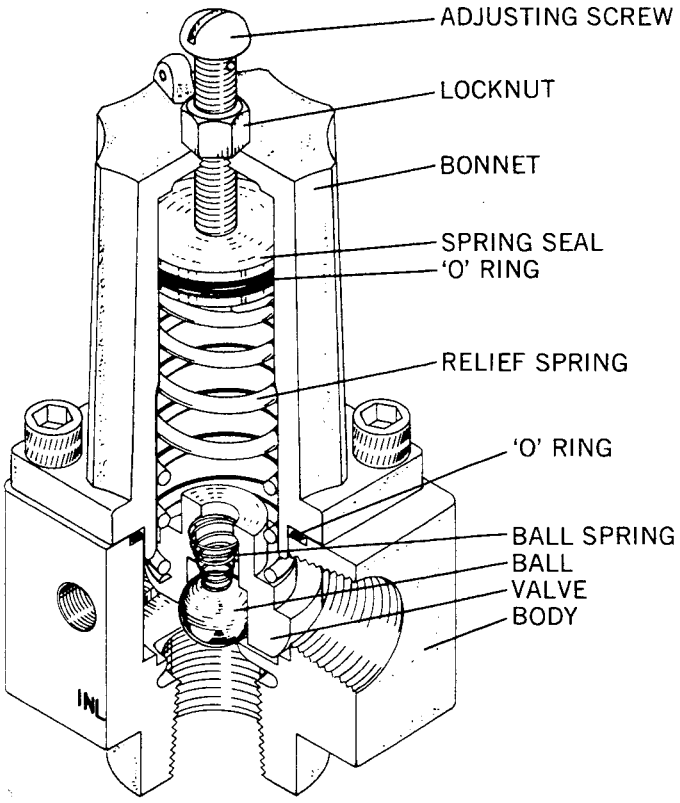


Figure 1. B166 Construction Details

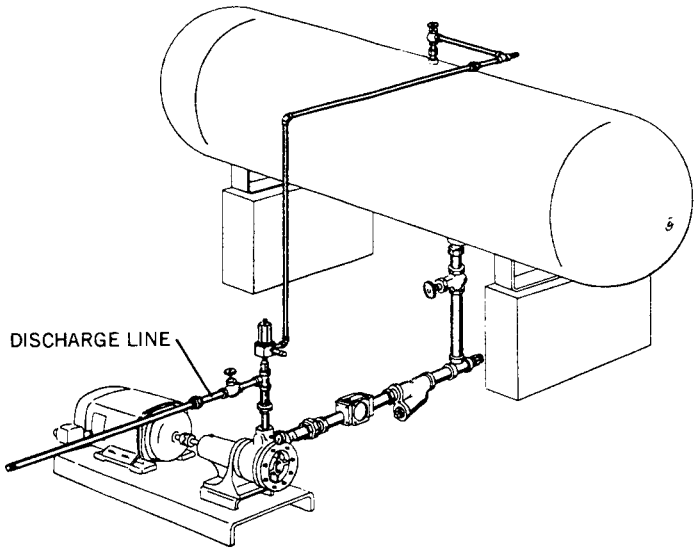


Figure 2. Typical Installation

THE CORKEN B166 VALVE

Your new CORKEN B166 Valve (Figure 1) is a patented, dual purpose automatic priming and differential bypass valve especially designed for high pressure volatile liquid service, but it is suitable also as a bypass valve for handling stable liquids. The B166 Valve was developed for use with the CORKEN Coro-Flo turbine regenerative pumps to keep the pump primed at all times and to act as a differential bypass when needed. The B166 is also ideal for centrifugal and other non-positive displacement pumps.

INSTALLATION OF B166 VALVE

Proper installation of the CORKEN B166 Valve will insure optimum performance of the pump as well as the valve. Install your B166 Valve on the discharge side of the pump, either vertically or horizontally. All CORKEN Coro-Flo turbine pumps have a ¾" NPT opening in the discharge nozzle for piping this valve. For other non-positive displacement pumps a tee in the discharge line must be provided. The discharge piping from the valve must go to the vapor section of the supply tank into an excess flow valve, **not a back check valve.** The typical installation is shown in Figure 2. The recommended valve discharge pipe line sizes are given in the table below. For distances of 50 feet or more, the next larger pipe size should be used.

Recommended Valve Discharge Line Sizes

Flow Rate GPM	B166 Valve Size	
	¾"	1"
Up to 20	¾"	¾"
Up to 40	1"	1"

ADJUSTMENT OF CORKEN B166 VALVE

The proper setting of the valve must be made at the time of installation. Start the pump and circulate liquid through the valve back to the tank. Turn the valve adjusting screw out (counter-clockwise) to decrease the pressure and in (clockwise) to increase the pump discharge pressure.

Adjust the valve to open at the maximum pump pressure required to fill all containers. Nothing is to be gained by setting the pump discharge pressure higher than necessary.

Tighten the lock nut and permit the pump to circulate liquid through the valve. On stationary applications, if the motor overload protection device stops the motor, readjust the valve by turning the screw out another turn or two.

Once a satisfactory pressure adjustment has been made, attach the "tamper-proof" seal furnished with your valve to prevent unauthorized valve adjustment. On installations where the pump has an internal safety relief valve, the B166 bypass valve should be set at a pressure slightly lower than the pump internal safety relief valve.

Note:
On LP-gas installations, a maximum differential pressure of 125 psi is allowed by Underwriters' Laboratories, Inc. and NFPA Pamphlet No. 58.

PATENT NUMBER 2,973,779

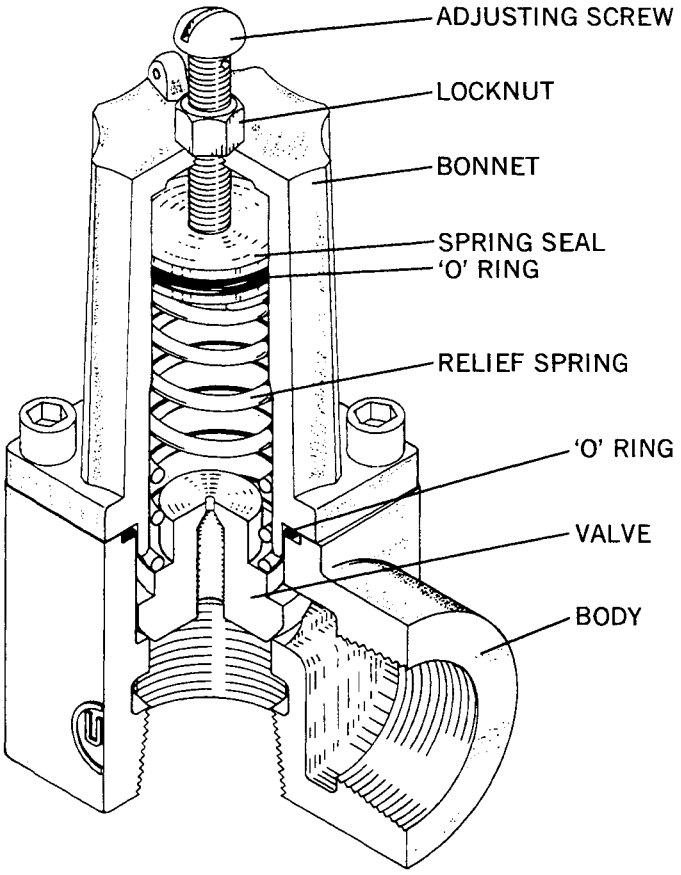


Figure 3. T166 Construction Details

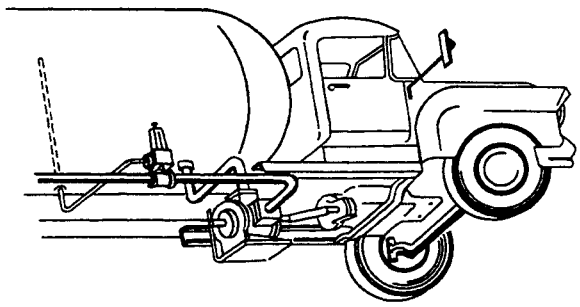


Figure 4. Typical Delivery Truck Installation

THE CORKEN T166 VALVE

Your new CORKEN T166 Valve (Figure 3) has been especially designed for use with delivery truck pumps to control the pump discharge pressure and to bypass excess liquid back to the truck tank. It is also quite satisfactory for service with any positive displacement pump within its capacity range, and has been used in many stationary installations.

INSTALLATION OF T166 VALVE

Proper installation of the CORKEN T166 Valve will ensure optimum performance of the pump as well as the valve. Install your T166 Valve on the discharge side of the pump, either vertically or horizontally. The discharge piping from the valve should go to the vapor section of the truck tank into a filler type valve or a back check valve. A typical truck installation is shown in Figure 4. When the valve is being used for vapor venting on stationary applications using pumps with internal safety relief valves, the piping should be the same as that used for the CORKEN B166. The recommended valve discharge pipe line sizes are given in the table below. For distances of 50 feet or more, the next larger pipe size should be used.

Recommended Valve Discharge Line Sizes

Flow Rate GPM	T166 Valve Size	
	1¼"	1½"
Up to 60	1¼"	1¼"
Up to 80	1½"	1½"

ADJUSTMENT OF CORKEN T166 VALVE

The proper setting of the valve must be made at the time of installation. Start the pump and circulate liquid through the valve back to the tank. Turn the valve adjusting screw out (counter-clockwise) to decrease the pressure and in (clockwise) to increase the pump discharge pressure.

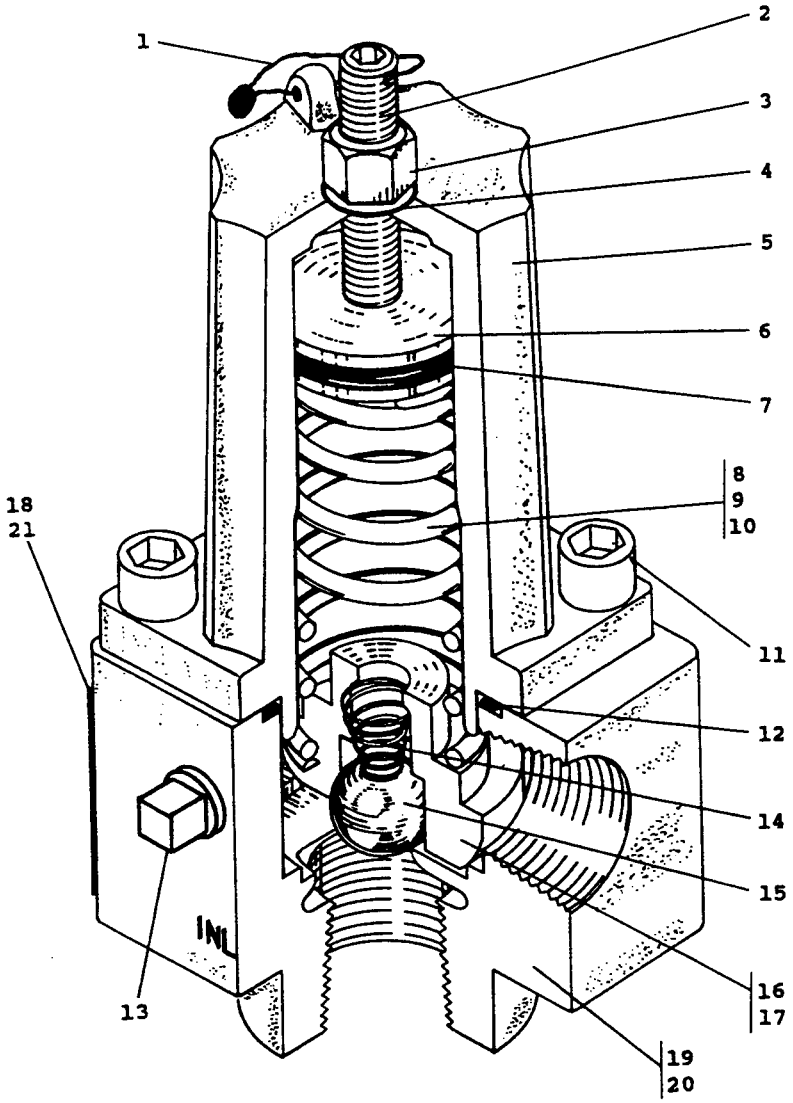
Adjust the valve to open at the maximum pump pressure required to fill all containers. Nothing is to be gained by setting the pump discharge pressure higher than necessary.

Tighten the lock nut and permit the pump to circulate liquid through the valve. On stationary applications, if the motor overload protection device stops the motor, readjust the valve by turning the screw out another turn or two.

Once a satisfactory pressure adjustment has been made, attach the "tamper-proof" seal furnished with your valve to prevent unauthorized valve adjustment. On installations where the pump has an internal safety relief valve, the T166 bypass valve should be set at a pressure slightly lower than the pump internal safety relief valve.

Note:
On LP-gas installations, a maximum differential pressure of 125 psi is allowed by Underwriters' Laboratories, Inc. meeting the requirements of NFPA Pamphlet No. 58.

Patent No. 2,973,799.



REF NO.	PART NO.	DESCRIPTION
1.	3546	Seal Wire
2.	2911	Adjusting Screw
3.	7101-037 NC01A	Lock Nut
4.	2732	Washer
5.	1134	Bonnet
6.	1136	Spring Seal
7.	2-217	O-Ring
8.	1138	Relief Spring (25 to 60 psi)
9.	1193	Relief Spring (50 to 150 psi)
10.	1193 1313	Relief Spring (100 to 225 psi) Relief Spring (100 to 225 psi)
11.	7002-037 NC087A	Socket Head Cap Screw
12.	2-224	O-Ring
13.	3442	Pipe Plug (1/4" NPT)
14.	1139	Ball Spring
15.	1137	Ball
16.	1251	Valve (Steel)
17.	1251-1	Valve-Continuous Bypass(Steel)
18.	2030	Nameplate
19.	1200	Body 3/4" NPT (B166B-.75)
20.	1200-1	Body 1" NPT (B166B-1)
21.	7012-006 SF025E	Phillip Hd, 6-32 x 1/4"

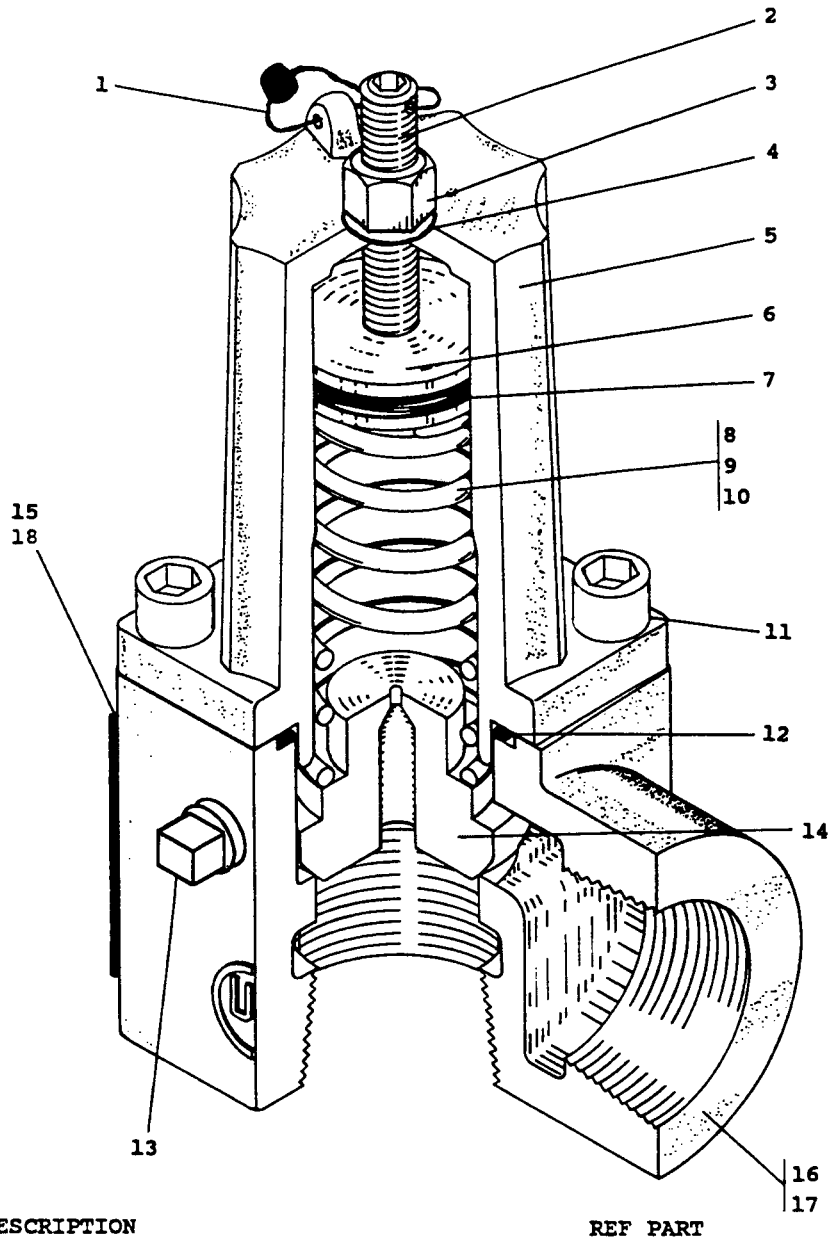
CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.

For O-Ring Material Code See Page A500.

PARTS DETAILS

BYPASS VALVE

MODELS T166-1.25 AND T166-1.5

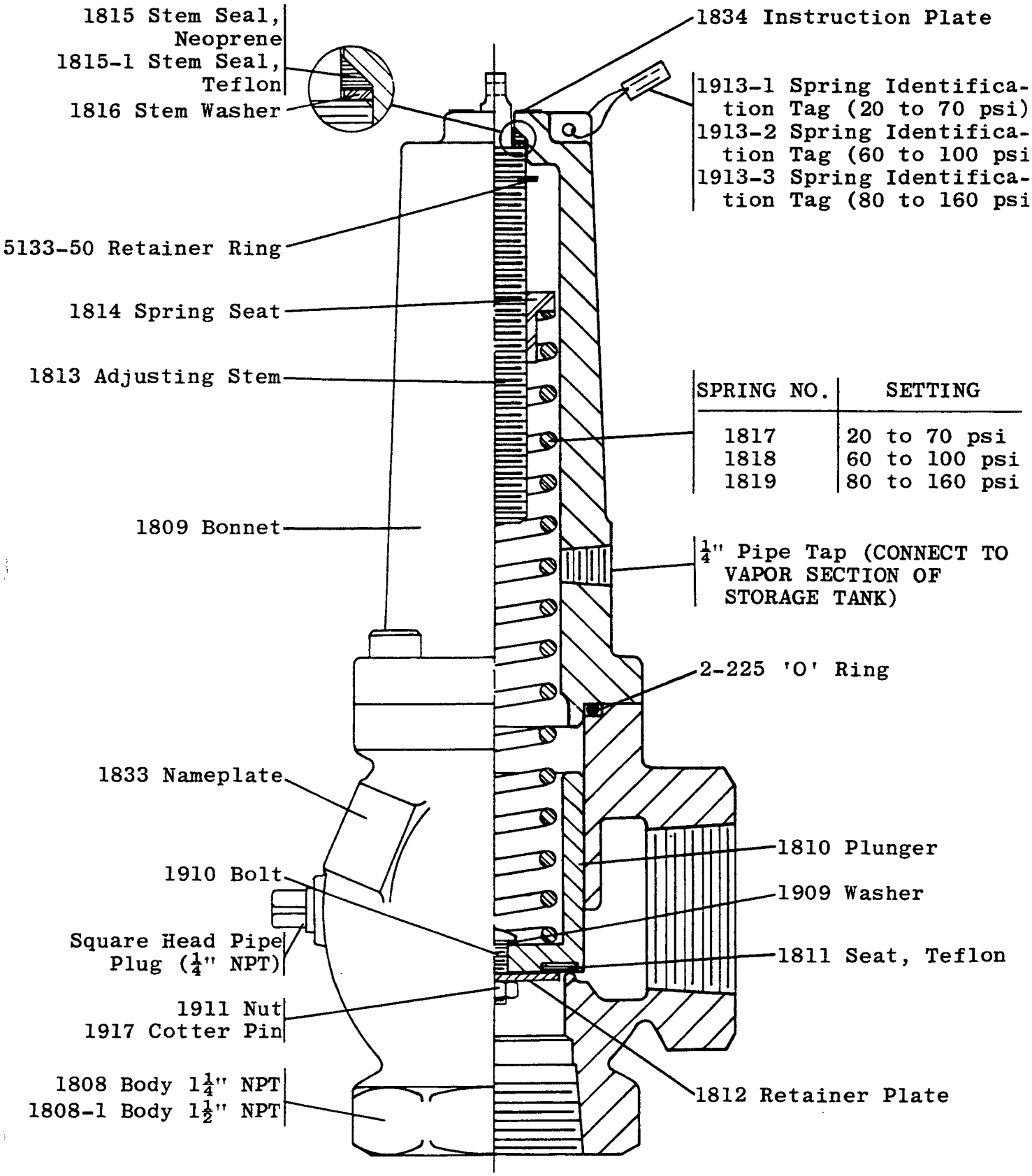


REF NO.	PART NO.	DESCRIPTION
1.	3546	Seal Wire
2.	2911	Adjusting Screw
3.	7101-037 NC01A	Lock Nut
4.	2732	Washer
5.	1134	Bonnet
6.	1136	Spring Seal
7.	2-217	O-Ring
8.	1138	Relief Spring (25 to 60 psi)
9.	1193	Relief Spring (50 to 150 psi)
10.	1193	Relief Spring (100 to 225 psi)
	1313	Relief Spring (100 to 225 psi)
11.	7002-037 NC087A	Socket Head Screw

REF NO.	PART NO.	DESCRIPTION
12.	2-224	O-Ring
13.	3442	Pipe Plug (1/4" NPT)
14.	2215	Valve
15.	2216	Nameplate
16.	1320-2	Body 1-1/4" NPT (T166-1.25)
17.	1320-3	Body 1-1/2" NPT (T166-1.5)
18.	7012-006 SF025E	Phillip Hd., 6-32 x 1/4"

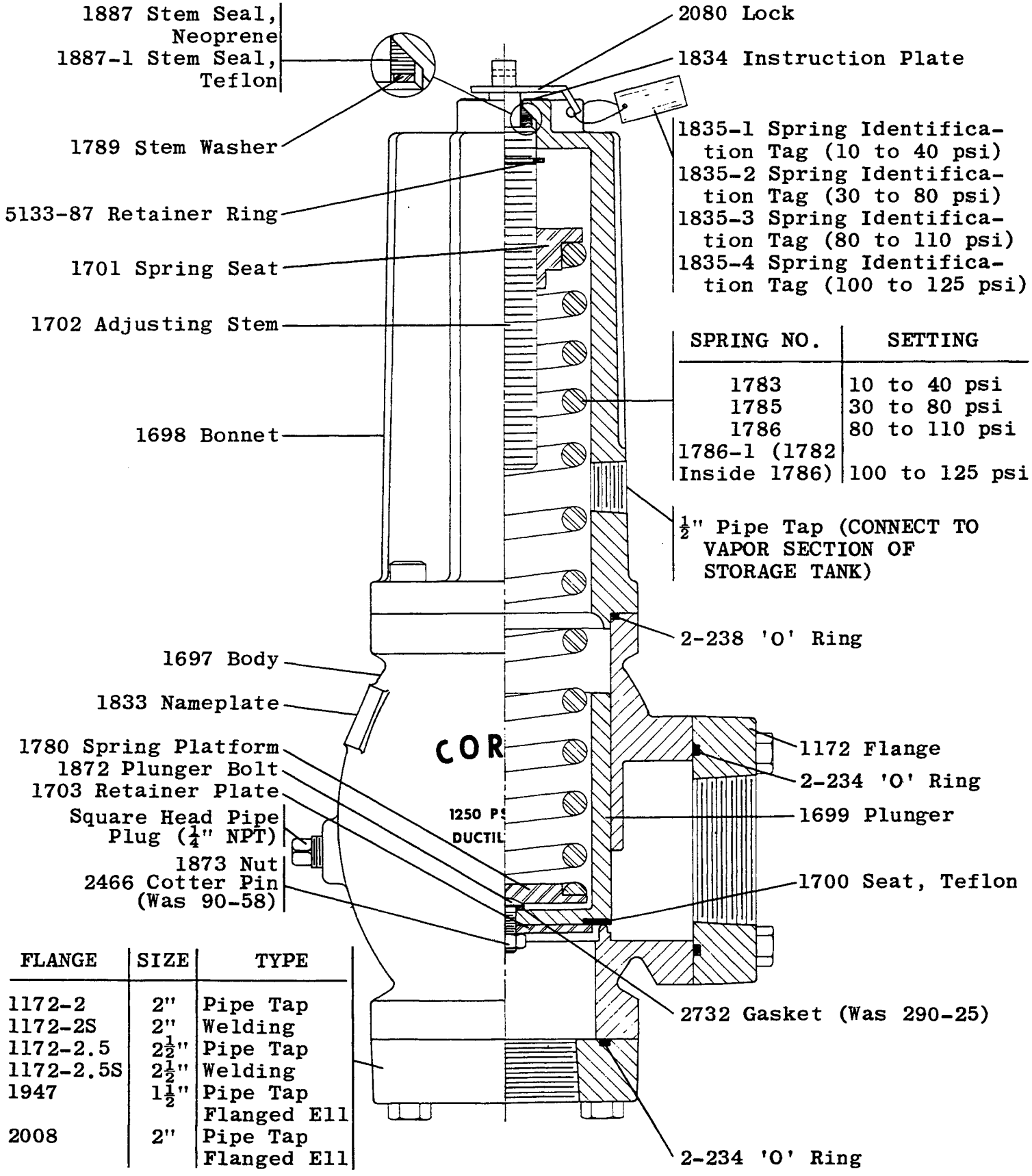
CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.

For O-Ring Material Code See Page A500.



SPRING NO.	SETTING
1817	20 to 70 psi
1818	60 to 100 psi
1819	80 to 160 psi

DIFFERENTIAL BY-PASS VALVE
MODEL B177
2" OR 2½" SIZE
SERIAL NO. KA AND LATER



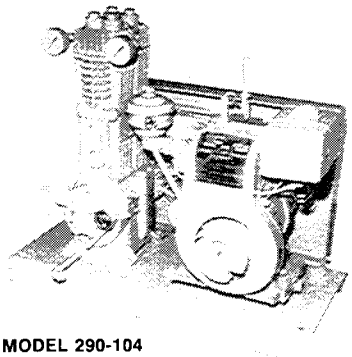
SPRING NO.	SETTING
1783	10 to 40 psi
1785	30 to 80 psi
1786	80 to 110 psi
1786-1 (1782 Inside 1786)	100 to 125 psi

FLANGE	SIZE	TYPE
1172-2	2"	Pipe Tap
1172-2S	2"	Welding
1172-2.5	2½"	Pipe Tap
1172-2.5S	2½"	Welding
1947	1½"	Pipe Tap Flanged Ell
2008	2"	Pipe Tap Flanged Ell

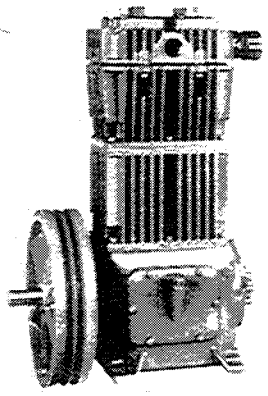
CORKEN

LIQUEFIED GAS TRANSFER COMPRESSORS

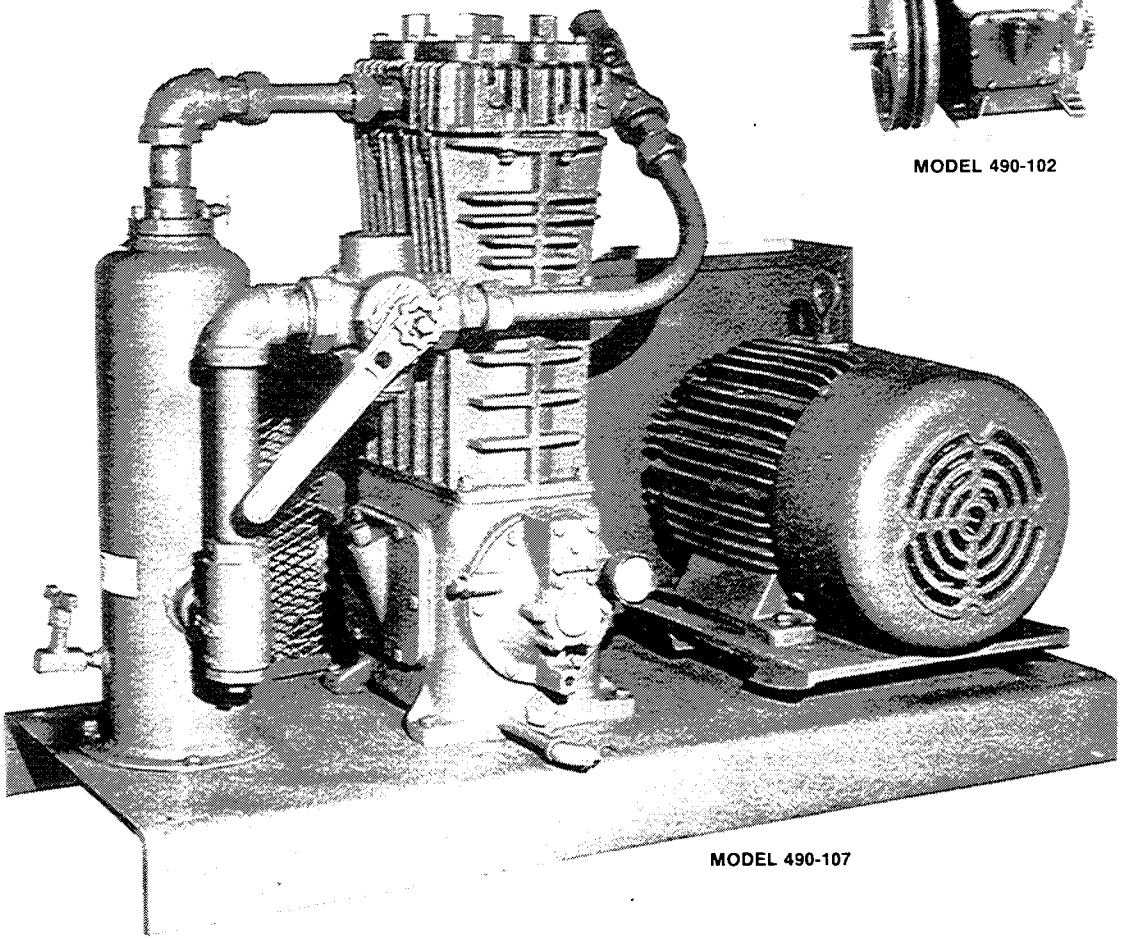
Contamination-free, Oil-free Delivery for LP-Gas and Anhydrous Ammonia



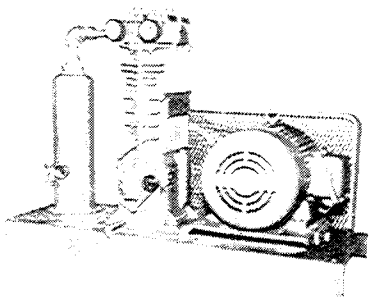
MODEL 290-104



MODEL 490-102



MODEL 490-107



MODEL 490-109

WHY USE A COMPRESSOR TO TRANSFER HIGHLY VOLATILE LIQUIDS?

Liquefied gases must be transferred from one container to another either with a liquid pump or a gas compressor, and there are very definite reasons for selecting either one. Because Corken International Corporation has had many years of experience as the only manufacturer making both pumps and compressors for volatile liquid service it is possible for our personnel to analyze this problem objectively and present the following comparisons to assist you in making the proper choice.

LIQUID PUMPS

A liquid pump, such as the CORKEN Coro-Vane has the advantage of producing higher differential pressures than the compressor to overcome high pressure losses caused by inadequate discharge piping, pumping into small, hard to fill tanks, and particularly through meters. A compressor cannot successfully discharge volatile liquid through a meter. However, the liquid pump does have certain limitations:

- Volatile liquids with their tendency to boil or "flash" readily whenever the pressure is reduced require particular attention to pump installation.
- To reduce this "flashing" effect, pump inlet piping must be designed carefully with larger and more expensive valves, strainer and flexible piping arrangement to provide the pump's required N.P.S.H. (Net Positive Suction Head).
- Most tank cars have top outlets, necessitating a "siphon leg" which contributes to liquid flashing.
- The flashing liquid may cause pump "vapor lock", with the attendant loss of capacity and accelerated wear on the shaft seals and running parts.
- Tanks are seldom emptied entirely of liquid; uneven unloading sites and variations in the vehicle undercarriage increase this possibility.
- None of the valuable residual vapors remaining in the unloaded tank may be recovered.

GAS COMPRESSORS

A gas compressor will overcome all the obstacles of liquid pumping with a pump: poor piping conditions, top outlet vessels, and will utilize lower cost piping and valves. The compressor will do everything the pump will do in low pressure liquid transfer, with the same horsepower requirement, and will recover the valuable residual vapors. The quantities of recoverable residual vapors are shown in Figure No. 1 for typical gases.

Transports have bottom openings and may be unloaded with a liquid pump successfully. The amount of valuable vapors remaining usually is not as great as in a tank car, and a transporter understandably is reluctant to leave his expensive equipment idle for an hour or so while the residual vapors are being recovered. Because of these factors, many "transport only" bulk plants utilize only a liquid pump. Yet it is reasonable to expect that the plant operator could recover vapors for the period of time the driver is performing his accounting chores, if a plant compressor were available. Figure 2 illustrates that a large percentage of the vapors may be recovered in the first 15 to 30 minutes. Actually, more equivalent pounds or gallons of vapor will be recovered during the first few minutes while the residual liquid is being vaporized than will be reclaimed during the same period of time later on. The vaporized liquid content is in addition to the values shown in Figure 1.

Even when gas ownership does not change hands, as in the case when a producer delivers to his own terminal, the vapor recovery compressor can develop an increased transporting capacity of about 3%! This means a fleet of 97 tank cars unloaded with vapor recovery can do the job of 100 when the vapor is not recovered!

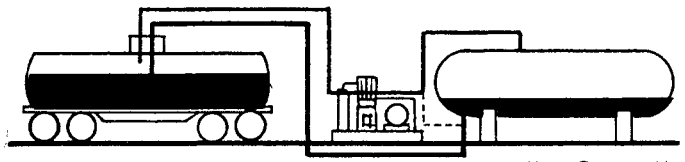
Maintenance of a pump or a compressor is about the same if the equipment is not abused. The liquid pump can be damaged seriously if allowed to run dry, either from "vapor locking" or after the unloading tank is emptied, whereas the compressor is remarkably resistant to this kind of abuse.

Safety of plant operation is a factor often not considered in compressor selection: a safety minded operator will use the versatile compressor to evacuate tanks and piping rather than "bleeding down", and he will find the purging of new tanks is more effectively done by first evacuating the air with the compressor.

Today, in the gas distribution business with the price of product increasing and competition more pressing, profits are more difficult to produce than ever before. The profit contribution of vapor recovery may very well make the difference in an acceptable profit margin; the discussion on the "Economics of Compressor Operation" indicates this clearly, and is a logical method you may use to justify your own decision.

Profits will continue to accrue whenever vapor recovery operations are performed.

THE TRANSFER COMPRESSOR OPERATING PRINCIPLE



---- Vapor Recovery Line

Most people are somewhat familiar with the operating principles of a liquid pump; the transfer compressor is another matter entirely. Visualize a tank car full of volatile liquid on a plant siding ready to be unloaded into storage tanks. Both tank car and storage tank are normally under approximately the same vapor pressure.

A piping connection is made between the tops of vapor sections of the tank car and the storage tank, and a similar connection is made between the liquid sections of the two tanks. As the connections are opened, the liquid will seek its own level and then flow will stop; however, by creating a pressure in the tank car which is high enough to overcome pipe friction and any static elevation difference between the tanks, all the liquid is forced into the storage tank quickly. The gas compressor does this job by drawing gas from the top of the storage. This procedure lowers the storage tank pressure slightly and increases the tank car pressure, normally 10 to 20 psig (.7 to 1.4 Bars) above vapor pressure.

After all possible liquid has been transferred in this manner, some liquid still remains, and the tank car is still full of valuable vapors. To remove the remaining liquid and the residual vapors, piping connections are reversed by means of the compressor four-way control valve, and the direction of flow through the compressor is reversed. After closing the connection between the liquid sections of the two tanks the gas can now be drawn from the top of the tank car, thereby vaporizing the remaining liquid. After all liquid has been vaporized, the compressor continues to draw gas from the tank car until the tank car pressure is reduced to an economical point.

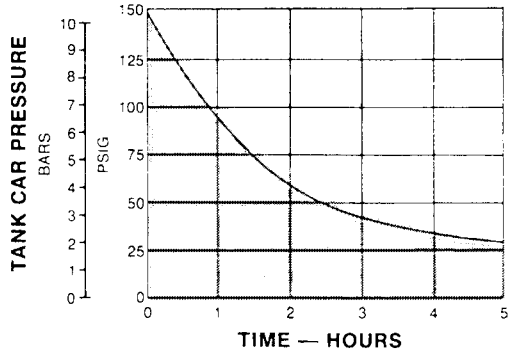
The recovered vapors must be discharged into the storage tank liquid section where they will be condensed. If the recovered vapors are not condensed, the storage tank will develop an excessive pressure.

Figure 1. Vapor left in a 33,000 water gallon (124,905 Liter) capacity Tank Car expressed in liquid capacity.

Tank Car Pressure, psig (Bars)[1]	Gallons (Liters) of LP-GAS[2]	Pounds (Kilograms) of Ammonia[2]
200 (13.79)	—	2090 (948)
175 (12.06)	1170 (4428)	1790 (812)
150 (10.34)	970 (3671)	1490 (676)
125 (8.61)	770 (2914)	1190 (540)
100 (6.90)	570 (2157)	890 (404)
75 (5.17)	370 (1400)	590 (268)
50 (3.45)	170 (643)	290 (132)

NOTES
1 This pressure is that of the tank car before vapor recovery operations are begun Capacities are based upon recovering vapors to 25 psig (1 72 Bars).
2 There are several different tank car and transport tank capacities. When the unloading tank is of a different capacity than 33000 gallons, the liquid recovery capacities shown here will be proportional. For example, if the tank car is only 11000 water gallon capacity the values shown here will be multiplied by 11000 33000, or one third.

Figure 2. Propane Evacuation Time for 33,000 water gallon (124,905 Liter) capacity Tank Car.



NOTES
1 Economic recovery time is about 3 hours More than half of economically recoverable vapor is removed in the first hour
2 Vapor recovery is economic to about 25% of storage tank pressure
3 Curve is based on the use of a 36 CFM (1020 Lit min) displacement CORKEN Dry-Cylinder Model 490 Compressor recovering vapor through 1½" vapor piping into 150 psig (10 34 Bars) storage tank pressure

ECONOMICS OF USING A COMPRESSOR:

Any claim of an equipment manufacturer should be supported by facts, including the economics or payout calculations. If the profitability of a piece of machinery cannot be proven, it probably should not be purchased. The "proof of profit" of an unloading compressor is quite simple, if certain conservative assumptions are agreed upon:

1. Either a liquid pump or a compressor must be used to transfer the liquid product.
2. The liquid transfer capacity of either a pump or a compressor, horsepower for horsepower, is comparable. In the CORKEN Line a gas compressor requires the same horsepower **for liquid transfer only** as does a liquid pump.
3. Since a transfer compressor may recover residual vapors, and a liquid pump cannot, it is to be expected that the horsepower requirements for this cycle of operation are greater for a compressor.
4. Only the difference in cost between the compressor and its motor and that of a pump and its motor is to be considered in the payout since one or the other must be utilized to transfer the liquid, anyway.
5. The cost of operation of the compressor for the vapor recovery cycle is offset by the recovery of the vaporized liquid left in the tank after all possible liquid transfer is completed.

Example A:

How many tank cars of propane, 33000 w.g. capacity, must be unloaded of vapor to pay for a $4940 compressor? For sake of simplicity, we shall be unloading cars with an average pressure of 125 psig, and a product cost, including freight of $0.52 per gallon. A liquid pump of comparable capacity costs approximately $1525. The recoverable vapors in equivalent gallons of liquid is shown in Figure 1 as 770 gallons.

$$\text{Number of Tank Cars} = \frac{\$4940 - \$1525}{770 \text{ gal.} \times \$0.52/\text{gal.}} = 8$$

ONLY 8 TANK CARS TO PAY FOR A 15 HP. COMPRESSOR UNIT...THEREAFTER ALL VAPORS RECOVERED ARE PROFIT!!!

Example B:

How many tank cars of ammonia, 11000 w.g. capacity, must be unloaded of vapor to pay for a 90 GPM, 5 Hp. compressor, if the tank car pressures are approximately 150 psig, and the product value is $225 per ton, or $0.113 per pound. A 2½" liquid pump of the same horsepower would remove the liquid as quickly as the compressor. The approximate difference in cost between the compressor and pump is $2860. Figure 1 shows 1490 equivalent lbs. of vapor remaining in a 33000 w.g., car; since our example tank car is only 11000 w.g., the remaining equivalent vapor is approximately 500 lbs.

$$\text{Number of Tank Cars} = \frac{\$2860}{500 \text{ lbs.} \times \$0.113} = 50$$

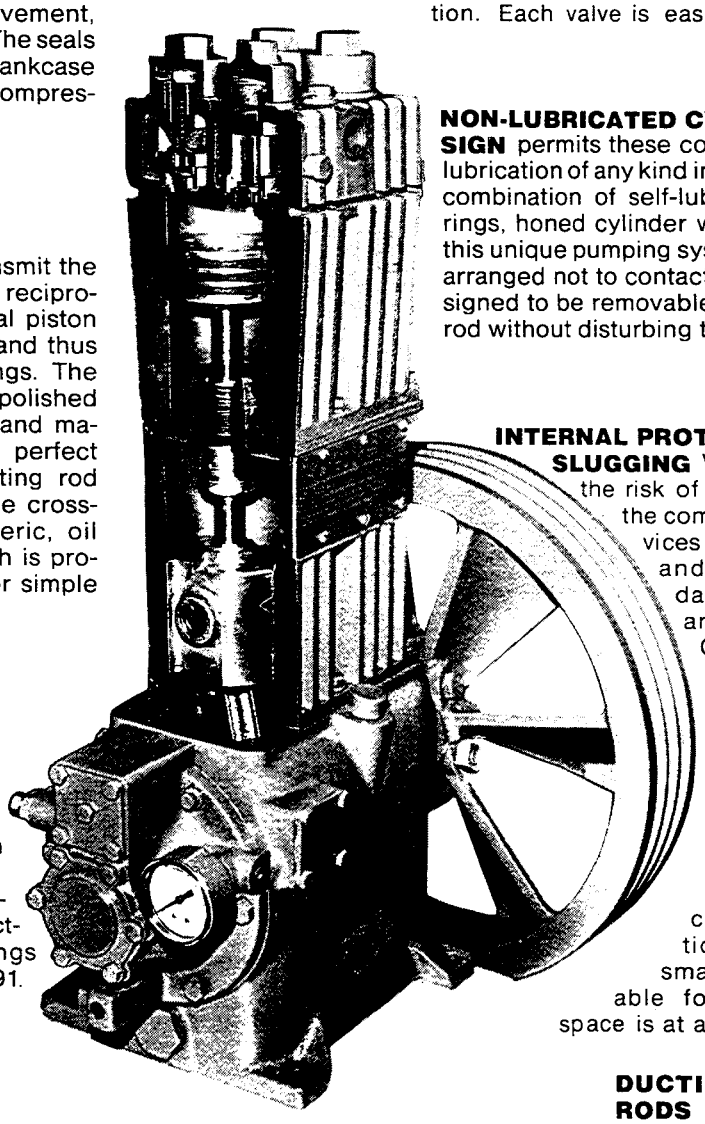
EXCLUSIVE FEATURES THAT MAKE THE CORKEN GAS COMPRESSOR THE ACKNOWLEDGED LEADER IN THE VOLATILE LIQUID TRANSFER INDUSTRIES

- **No contamination in compression cylinder**
- **No contamination of product**

PISTON ROD SEALS of glass-filled, self-lubricating Teflon* are spring loaded and adjustable to compensate for lateral rod movement, wear and temperature variations. The seals minimize gas leakage into the crankcase and crankcase oil entry into the compression cylinders.

CROSSHEAD – PISTON ROD assemblies transmit the crankshaft motion into vertical, reciprocating piston motion. The vertical piston motion provides no side thrust, and thus the pistons require no rider rings. The crosshead and the hard chrome polished steel piston rod are assembled and machined as one piece to assure perfect alignment between the connecting rod wrist pin and the piston rod. The crosshead operates in the atmospheric, oil lubricated crosshead guide which is provided with a large cover plate for simple inspection and observation.

CRANKSHAFTS have integral, balanced counterweights for smoother operation. Bearing surfaces are extra large and the crankshaft is precision ground to size. The crankshafts are rifle drilled for positive oil distribution to the connecting rods and wrist pin bearings on all models except the Model 91.



CUSHIONED VALVES are designed and lapped for long life. The valve bumpers have a gas cushion to prevent valve slamming and provide quiet operation. Each valve is easily removable for inspection.

NON-LUBRICATED CYLINDER AND PISTON DESIGN permits these compressors to operate with no lubrication of any kind in the compression cylinders. A combination of self-lubricating filled Teflon* piston rings, honed cylinder walls and low lift valves make this unique pumping system possible. The pistons are arranged not to contact the cylinder wall and are designed to be removable from the cylinder and piston rod without disturbing the cylinder.

INTERNAL PROTECTION AGAINST LIQUID SLUGGING Volatile liquid transfer incurs the risk of liquid entering or "slugging" the compressor. Reliable relieving devices are built into the cylinder head and suction valves to prevent damage from reasonable amounts of this liquid. The CORKEN LIQUID TRAP provides additional protection externally, and is recommended for most bulk plant installations.

LARGE FLYWHEEL FAN provides maximum crankcase cooling and smooth operation. On the Models 290, 490 smaller flywheel fans are available for transport models where space is at a premium.

THE CRANKCASE is operated at atmospheric pressure, but is totally enclosed with an automatic breather valve to prevent entrance of dust or foreign matter. Since no oil is consumed in the compression process, the oil remains clean in the crankcase, and the major sources of crankcase wear are virtually eliminated. THE OIL STAYS IN THE CRANKCASE WHERE IT BELONGS! On all models except the Model 91 the crankshaft running parts are pressure lubricated by filtered oil from an automatically reversible pump (reversing does *not* require disassembly). The pump assembly may be removed easily for inspection. A dial type, easy to read, oil pressure gauge indicates proper functioning of the lubrication system.

TAPERED ROLLER BEARINGS are mounted on each end of the crankshaft to absorb radial and thrust loads. These oversize bearings assure added years of service, and can be adjusted easily from the external position of the crankcase if required.

DUCTILE IRON CONNECTING RODS provides great strength for heavy duty applications. The connecting rod bearing inserts are steel-backed, babbit-lined, removable automotive type, and on all except Model 91 the rod is constructed with a communicating lubrication port from the crank to the honed bronze wrist pin bearing for lubrication from the crankcase oil pump.

**Teflon is a registered trademark of DuPont.*

SPECIFICATIONS

MECHANICAL SPECIFICATIONS

SPECIFICATION	MODEL SIZE 91	291	491	691
Number of Stages	1	1	1	1
Number of Cylinders	1	2	2	2
Bore of Cylinder, inches (cm.)	3(7.62)	3(7.62)	4(10.16)	4½(11.43)
Stroke, inches (cm.)	2½(6.35)	2½(6.35)	3(7.62)	4(10.16)
Piston Displacement, CFM (m^3/hr)				
Min. at 400 RPM	4(6.8)	8(13.6)	17(28.9)	29(49.3)
Max. at 825 RPM	8(13.6)	16(27.2)	36(61.2)	60(102)
Max. Discharge Pres., psig (Bars – g)	335(23.1)	250(17.2)[2]	250(17.2)[2]	250(17.2)[2]
Max. Compression Ratio:[1] Continuous Duty	5	5	5	5
Intermittent Duty	7	7	7	7
Maximum Allowable Driver Size, Hp.	7½	15	15	30

Notes: 1. Compression Ratio is defined as Discharge Pressure Absolute (psia or Bars absolute) divided by Inlet Pressure Absolute (psia or Bars absolute).
2. Optional ductile iron units are rated for 335 psig (23.1 Bars).

COMPRESSOR SELECTION CHART

APPROX. CAPACITY GPM (Lit/Min)[1] BUTANE	PROPANE	AMMONIA	Compressor Model Size	Motor Size, Horsepower[2]
22 (83)	—	—	91	¾
30 (114)	—	—		1
34 (129)	22 (83)	22 (83)		1½
—	28 (106)	28 (106)		2
—	44 (166)	44 (166)		3
34 (129)	—	—	291	1½
50 (189)	—	—		2
67 (254)	44 (166)	44 (166)		3
—	77 (291)	77 (291)		5
—	88 (333)	88 (333)		7½
72 (273)	—	—	491	3
121 (458)	77 (291)	77 (291)		5
153 (579)	110 (416)	110 (416)		7½
—	148 (560)	148 (560)		10
—	198 (749)	198 (749)		15
—	—	—	691	5
180 (681)	—	—		7½
259 (980)	132 (500)	132 (500)		10
—	198 (749)	198 (749)		15
—	265 (1003)	265 (1003)		20
—	330 (1249)	330 (1249)		25

Notes: 1. The actual capacity will vary depending upon piping factors. The capacities shown are conservative and may be increased as much as 10% in well designed plants.
2. The driver horsepower shown is based upon recovering residual vapors in moderate climates.

CHOOSE FROM A VARIETY OF MOUNTING ARRANGEMENTS TO SUIT YOUR PARTICULAR APPLICATION

There are a number of standard base mounted gas compressor units to fit most installations, but special mounting and piping arrangements to fit your particular need can be designed and manufactured. The various special fittings mentioned with each mounting arrangement are described in detail under Optional Accessories.

Style — 107
Complete Gas Compressor Bulk Plant Unit with pressure gauges, steel baseplate, liquid trap, 4-way valve, relief valve, strainer, interconnecting piping, adjustable driver slide base, V-belt drive and enclosed belt guard — ready to receive an electric motor driver.

Style — 108
Same as Style — 107 but to receive an engine driver.

Style — 109
Gas Compressor Unit with pressure gauges, steel baseplate, liquid trap, adjustable driver slide base, V-belt drive and enclosed belt guard — ready to receive an electric motor driver.

Style — 110
Same as Style — 109 but to receive an engine driver.

Style — 103
Gas Compressor Unit with pressure gauges, steel baseplate, adjustable driver slide base, V-belt drive and enclosed belt guard — ready to receive an electric motor driver.

Style — 104
Same as Style — 103 but to receive an engine driver.

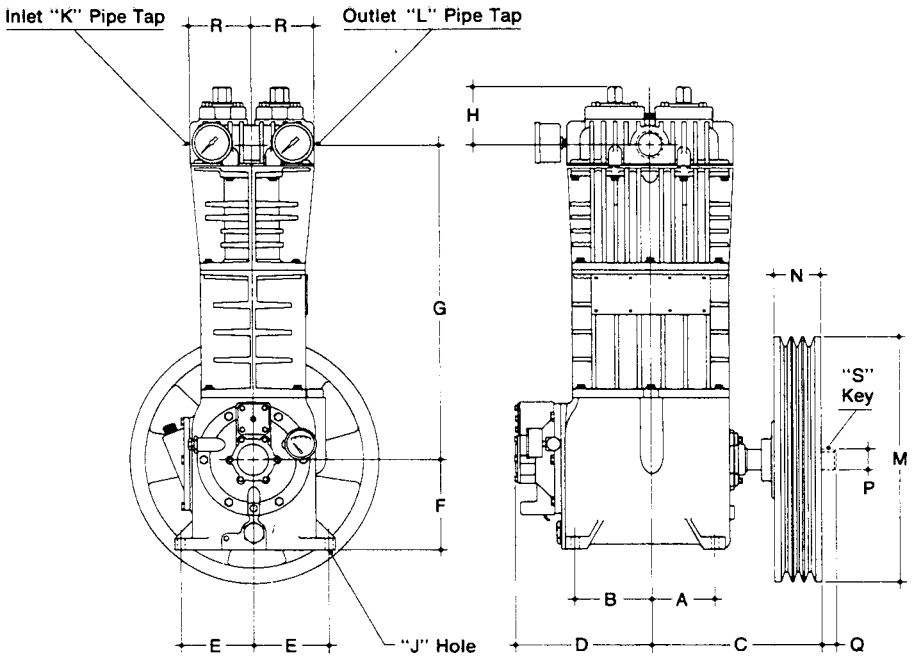
Style — 102
Gas Compressor with flywheel, extended crankshaft and pressure gauges mounted on the head.

Style — 101
Gas Compressor with flywheel and extended crankshaft.

Style — 100
Gas Compressor with flywheel and pressure gauges mounted on the head.

Bare
Gas Compressor with flywheel.

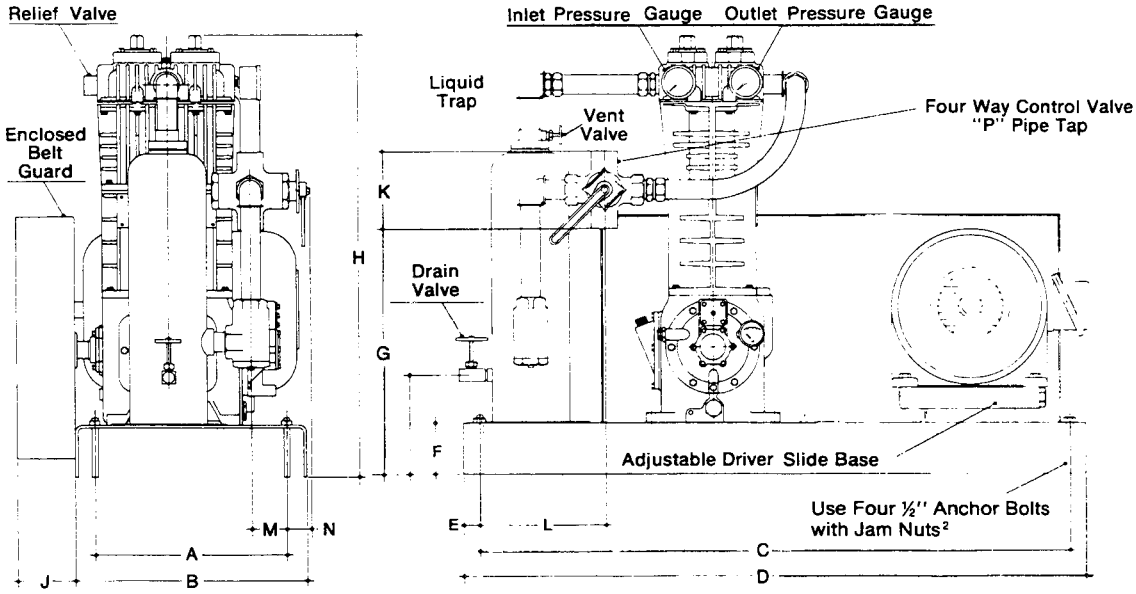
OUTLINE DIMENSIONS



BARE COMPRESSOR
Dimensions in Inches (Cm.)

MODEL NUMBER	A	B	C	D	E	F	G	H	J
91	1 13/16(4.60)	2 3/8(6.03)	6 1/4(15.9)	3 7/8(9.84)	3 11/16(9.37)	5(12.7)	17 11/16(45.0)	2 5/8(6.67)	13/32(1.03)
291	3 3/8(8.57)	4 1/8(10.5)	9 13/16(24.9)	6 11/16(17.0)	3 11/16(9.37)	5 3/8(13.7)	18 1/16(45.9)	2 3/8(6.03)	13/32(1.03)
491	4 1/8(10.5)	5(12.7)	10 11/16(27.1)	7 3/4(19.7)	4 11/16(11.9)	5 7/8(14.9)	20 5/16(51.6)	3 9/16(9.05)	1/2(1.27)
691	4 3/4(12.1)	5 1/2(14.0)	11 1/2(29.2)	9(22.9)	5 3/8(13.7)	8 1/4(21.0)	26 7/8(68.3)	4 1/16(10.3)	9/16(1.43)

MODEL NUMBER	K	L	M Std.	M Opt.[1]	N	P[1]	Q[1]	R	S[1]
91	3/4	3/4	14(35.6)	—	3(7.62)	1 1/8(2.86)	1 1/4(3.18)	2 3/8(6.03)	1/4(.635)
291	3/4	3/4	16(40.6)	14(35.6)	3(7.62)	1 1/4(3.18)	1 1/4(3.18)	2 11/16(6.83)	1/4(.635)
491	1 1/4	1 1/4	16(40.6)	14(35.6)	3(7.62)	1 3/8(3.49)	1 1/4(3.18)	4(10.2)	5/16(.794)
691	2	1 1/2	19 1/2(49.5)	—	3 3/4(9.52)	1 5/8(4.13)	1 1/4(3.18)	6 3/8(16.2)	5/16(.794)



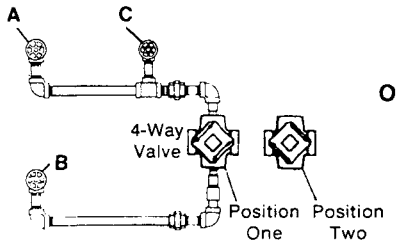
COMPLETE BULK PLANT UNIT
Dimensions in Inches (Cm.)

MODEL NUMBER	A	B	C	D	E	F	G	H	J	K	L	M	N	P
91-107	12(30.5)	15(38.1)	31 1/2(80.0)	34(86.4)	1 1/4(3.18)	3(7.62)	17 7/8(45.4)	31 1/8(79.1)	4(10.2)	4 3/16(11.1)	8 9/16(21.7)	0	4 1/2(11.4)	1
291-107	12(30.5)	15(38.1)	39 1/2(100.3)	42(106.7)	1 1/4(3.18)	3(7.62)	17 7/8(45.4)	30 7/8(78.4)	4 1/2(11.4)	4 3/8(11.1)	9 1/4(23.5)	0	4 1/2(11.4)	1
491-107	15(38.1)	18(45.7)	45 1/2(115.6)	48(121.9)	1 1/4(3.18)	4(10.2)	19 1/8(48.6)	33 3/4(85.7)	4 1/2(11.4)	6(15.2)	9 3/4 (24.8)	2 3/4(6.98)	1 7/8(4.76)	1 1/4
691-107	17(43.2)	20(50.8)	49 1/2(125.7)	52(132.1)	1 1/4(3.18)	4(10.2)	24 1/4(61.6)	43 3/16(109.7)	4 1/2(11.4)	6(15.2)	10 1/2(26.7)	2 3/4(6.98)	1 7/8(4.76)	1 1/4

Notes: 1. Styles 101 and 102 for Transport service have the extended crankshaft. In this case, the smaller flywheel-fan is standard on Models 290 and 490.
2. The Model 690 requires six 1/2 inch anchor bolts.

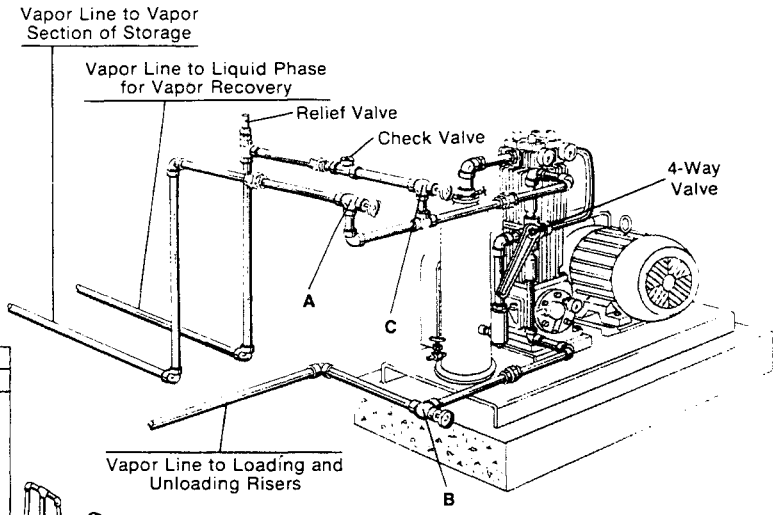
SIMPLIFIED BULK PLANT PIPING DETAILS

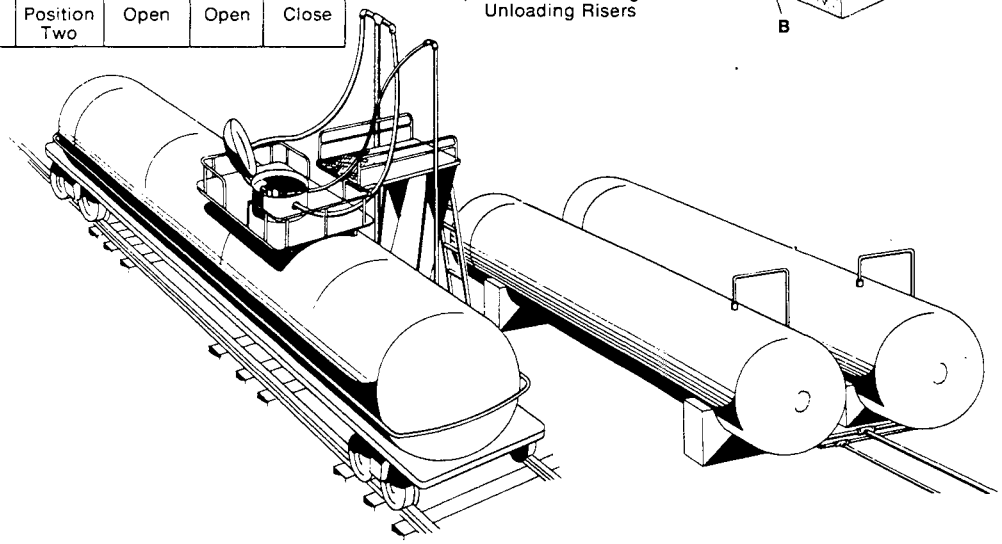
Installation piping details are available for the arrangement shown here or for larger and more complex operations.



OPERATION OF VALVES

SERVICE TO PERFORM	VALVES			
	4-WAY	A	B	C
1. Unload into Storage Tank	Position One	Open	Open	Close
2. Recover Vapors into Storage Tank	Position Two	Close	Open	Open
3. Load Out From Storage Tank	Position Two	Open	Open	Close

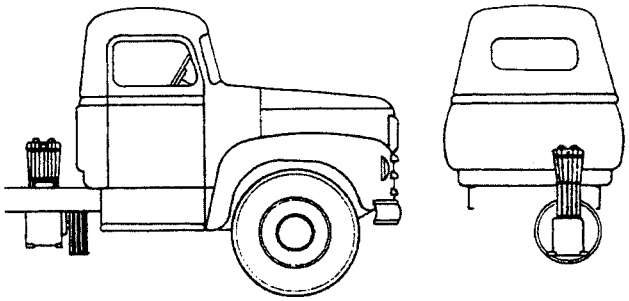




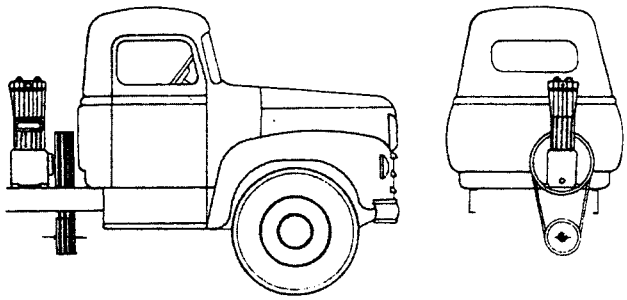
TYPICAL TRANSPORT MOUNTING ARRANGEMENT

Many companies increase their operating efficiency by equipping their transports with CORKEN Compressors, enabling them to handle a greater variety of liquids with complete independence from the pumping facilities at the destination. The increased time-saving in unloading pays for the compressor. CORKEN Compressors often are mounted behind the tractor cab for direct drive from the truck PTO or through a V-belt arrangement.

An engine driven compressor is used whenever it is impractical to use the truck engine, and it may be mounted anywhere on the cab or tanker.



DIRECT DRIVE MOUNTING: The compressor is hung inside the main truck frame in line with the PTO. Power is transmitted through a U-Joint drive shaft directly to the compressor. Use extended crankshaft compressor models.



BELT DRIVE MOUNTING: The location of the fifth wheel and design of the tanks determine whether the compressor can be mounted behind the cab, above the frame, or outside the frame.

PROPANE COMPRESSOR SELECTION TABLE

APRIL 1995
SUPERSEDES VE200H

SERVICE	CAPACITY GPM(1)	DISPLACEMENT CFM	COMPRESSOR		DRIVER SHEAVE SIZE P.D."(2)		DRIVER HORSEPOWER				PIPING SIZE (3)	
							LIQUID TRANSFER AND RESIDUAL VAPOR RECOVERY		LIQUID TRANSFER WITHOUT RESIDUAL VAPOR RECOVERY			
			MODEL	RPM	1750RPM	1460RPM	100°F	80°F	100°F	80°F	VAPOR	LIQUID
SMALL BULK PLANTS	23	4	91	400	A 3.0	A 3.6	5	3	3	3	¾	1¼
	29	5	91	505	A 3.8	B 4.6	5	5	5	5	¾	1¼
	34	6	91	590	B 4.6	B 5.6	5	5	5	5	1	1¼
	40	7	91	695	B 5.4	B 6.6	5	5	5	5	1	1½
	39	7	290,291	345	A 3.0	A 3.6	3	3	3	3	1	1½
UNLOADING SINGLE TANK CAR OR TRANSPORT	45	8	91	795	B 6.2	B 7.4	7½	7½	7½	7½	1	1½
	44	8	290,291	390	A 3.4	B 4.0	5	3	3	3	1	1½
	50	9	290,291	435	A 3.8	B 4.6	5	5	3	3	1	1½
	56	10	290,291	490	B 4.4	B 5.2	5	5	5	5	1	2
	61	11	290,291	535	B 4.8	B 5.8	5	5	5	5	1	2
	66	12	290,291	580	B 5.2	B 6.2	7½	5	5	5	1	2
	71	13	290,291	625	B 5.6	B 6.6	7½	5	7½	5	1¼	2
	79	14	290,291	695	B 6.2	B 7.4	7½	7½	7½	7½	1¼	2
	84	15	290,291	735	B 6.6	B 8.0	10	7½	10	7½	1¼	2½
	84	15	490,491	345	A 3.0	A 3.6	7½	7½	5	5	1¼	2½
	89	16	290,291	780	B 7.0	B 8.6	10	10	10	10	1¼	2½
	89	16	490,491	370	A 3.2	A 3.8	7½	7½	7½	5	1¼	2½
UNLOADING TWO OR MORE TANK CARS AT ONE TIME, OR LARGE TRANSPORT WITH EXCESS FLOW VALVES OF ADEQUATE CAPACITY	95	17	490,491	390	A 3.4	B 4.0	7½	7½	7½	7½	1¼	3
	101	18	490,491	415	A 3.6	B 4.4	10	7½	7½	7½	1¼	3
	106	19	490,491	435	A 3.8	B 4.6	10	7½	7½	7½	1¼	3
	108	20	490,491	445	B 4.0	B 4.8	10	7½	7½	7½	1¼	3
	114	21	490,491	470	B 4.2	B 5.0	10	7½	7½	7½	1¼	3
	119	22	490,491	490	B 4.4	B 5.2	10	10	7½	7½	1¼	3
	125	23	490,491	515	B 4.6	B 5.6	10	10	10	7½	1¼	3
	130	24	490,491	535	B 4.8	B 5.8	15	10	10	10	1¼	3
	136	25	490,491	560	B 5.0	B 6.0	15	10	10	10	1¼	3
	141	26	490,491	580	B 5.2	B 6.2	15	10	10	10	1¼	3
	147	27	490,491	605	B 5.4	B 6.4	15	10	15	10	1¼	3
	152	28	490,491	625	B 5.6	B 6.6	15	15	15	15	1½	3
	158	29	490,491	650	B 5.8	B 7.0	15	15	15	15	1½	3
	163	30	490,491	670	B 6.0		15	15	15	15	1½	3
	163	30	690,691	400	B 4.4	B 5.2	15	15	10	10	1½	3
	168	31	490,491	695	B 6.2	B 7.4	15	15	15	15	1½	3
	171	31	690,691	420	B 4.6	B 5.6	15	15	10	10	1½	3
	179	32	490,491	740	B 6.6	B 8.0	15	15	15	15	1½	3
	178	32	690,691	440	B 4.8	B 5.8	15	15	10	10	1½	3
	186	34	690,691	455	B 5.0	B 6.0	15	15	15	10	1½	3
	193	35	690,691	475	B 5.2	B 6.2	15	15	15	10	1½	3
	200	36	690,691	495	B 5.4	B 6.4	15	15	15	15	1½	3
UNLOADING LARGE TANK CARE, MULTIPLE VESSELS, BARGES OR TERMINALS	208	38	690,691	510	B 5.6	B 6.8	20	15	15	15	1½	4
	215	39	690,691	530	B 5.8	B 7.0	20	15	15	15	1½	4
	223	41	690,691	550	B 6.0	A 7.0	20	15	15	15	1½	4
	230	42	690,691	565	B 6.2	B 7.4	20	15	15	15	2	4
	237	43	690,691	585	B 6.4	A 7.4	20	15	15	15	2	4
	245	45	690,691	605	B 6.6	B 8.0	20	15	15	15	2	4
	252	46	690,691	620	B 6.8		20	20	15	15	2	4
	260	47	690,691	640	B 7.0	A 8.2	20	20	20	15	2	4
	275	48	690,691	675	B 7.4	B 8.6	25	20	20	20	2	4
	297	54	690,691	730	B 8.0	B 9.4	25	20	20	20	2	4
	319	58	690,691	785	B 8.6		25	20	25	20	2	4
	334	60	690,691	820	TB 9.0	A 10.6	30	25	25	20	2	4
	452	82	D891	580	5V 7.1	5V 8.5	30	30	30	30	3	6
	623	113	D891	800	5V 9.75	5V 11.8		40	40	30	3	6

Consult factory for compressors for higher flows.

NOTES:

(1) The capacities shown are based on 70°F, but will vary depending upon piping, fittings used, product being transferred and temperature. The factory can supply a detailed computer analysis if required.

(2) Driver sheaves: 91 - 2 belts; 290,291,490,491 - 3 belts; 690,691 - 4 belts.

(3) The piping sizes shown are considered minimum. If the length exceeds 100 ft., use the next larger size.

BUTANE COMPRESSOR SELECTION TABLE

APRIL 1995
SUPERSEDES VE201H

SERVICE	CAPACITY GPM(1)	DISPLACEMENT CFM	COMPRESSOR MODEL	COMPRESSOR RPM	DRIVER SHEAVE SIZE P.D."(2) 1750RPM	DRIVER SHEAVE SIZE P.D."(2) 1460RPM	DRIVER HORSEPOWER LIQUID TRANSFER AND RESIDUAL VAPOR RECOVERY 100°F	DRIVER HORSEPOWER LIQUID TRANSFER AND RESIDUAL VAPOR RECOVERY 80°F	DRIVER HORSEPOWER LIQUID TRANSFER WITHOUT RESIDUAL VAPOR RECOVERY 100°F	DRIVER HORSEPOWER LIQUID TRANSFER WITHOUT RESIDUAL VAPOR RECOVERY 80°F	PIPING SIZE (3) VAPOR	PIPING SIZE (3) LIQUID
SMALL BULK PLANTS	13	4	91	400	A 3.0	A 3.6	3	3	3	3	¾	1¼
	17	5	91	505	A 3.8	B 4.6	3	3	3	3	¾	1¼
	20	6	91	590	B 4.6	B 5.6	3	3	3	3	1	1¼
	24	7	91	695	B 5.4	B 6.6	5	5	5	5	1	1½
	23	7	290,291	345	A 3.0	A 3.6	2	2	2	2	1	1½
UNLOADING SINGLE TANK CAR OR TRANSPORT	27	8	91	795	B 6.2	B 7.4	5	5	5	5	1	1½
	26	8	290,291	390	A 3.4	B 4.0	2	2	2	2	1	1½
	30	9	290,291	435	A 3.8	B 4.6	3	3	3	3	1	1½
	33	10	290,291	490	B 4.4	B 5.2	3	3	3	3	1	2
	36	11	290,291	535	B 4.8	B 5.8	3	3	3	3	1	2
	39	12	290,291	580	B 5.2	B 6.2	5	3	5	3	1	2
	42	13	290,291	625	B 5.6	B 6.6	5	5	5	5	1¼	2
	47	14	290,291	695	B 6.2	B 7.4	5	5	5	5	1¼	2
	50	15	290,291	735	B 6.6	B 8.0	5	5	5	5	1¼	2½
	50	15	490,491	345	A 3.0	A 3.6	5	5	5	5	1¼	2½
	53	16	290,291	780	B 7.0	B 8.6	7½	5	7½	5	1¼	2½
	53	16	490,491	370	A 3.2	A 3.8	5	5	5	5	1¼	2½
UNLOADING TWO OR MORE TANK CARS AT ONE TIME, OR LARGE TRANSPORT WITH EXCESS FLOW VALVES OF ADEQUATE CAPACITY	56	17	490,491	390	A 3.4	B 4.0	5	5	5	5	1¼	3
	60	18	490,491	415	A 3.6	B 4.4	5	5	5	5	1¼	3
	63	19	490,491	435	A 3.8	B 4.6	5	5	5	5	1¼	3
	65	20	490,491	445	B 4.0	B 4.8	5	5	5	5	1¼	3
	68	21	490,491	470	B 4.2	B 5.0	5	5	5	5	1¼	3
	71	22	490,491	490	B 4.4	B 5.2	7½	5	7½	5	1¼	3
	75	23	490,491	515	B 4.6	B 5.6	7½	5	7½	5	1¼	3
	77	24	490,491	535	B 4.8	B 5.8	7½	7½	7½	7½	1¼	3
	81	25	490,491	560	B 5.0	B 6.0	7½	7½	7½	7½	1¼	3
	84	26	490,491	580	B 5.2	B 6.2	7½	7½	7½	7½	1¼	3
	87	27	490,491	605	B 5.4	B 6.4	7½	7½	7½	7½	1¼	3
	91	28	490,491	625	B 5.6	B 6.6	7½	7½	7½	7½	1½	3
	94	29	490,491	650	B 5.8	B 7.0	10	7½	10	7½	1½	3
	97	30	490,491	670	B 6.0		10	7½	10	7½	1½	3
	94	30	690,691	400	B 4.4	B 5.2	7½	7½	7½	7½	1½	3
	100	31	490,491	695	B 6.2	B 7.4	10	7½	10	7½	1½	3
	98	31	690,691	420	B 4.6	B 5.6	10	7½	10	7½	1½	3
	107	32	490,491	740	B 6.6	B 8.0	10	10	10	10	1½	3
	103	32	690,691	440	B 4.8	B 5.8	10	7½	10	7½	1½	3
	110	33	490,491	760	B 6.8	B 8.0	10	10	10	10	1½	3
	113	34	490,491	780	B 7.0	B 8.6	10	10	10	10	1½	3
	107	34	690,691	455	B 5.0	B 6.0	10	10	10	10	1½	3
	111	35	690,691	475	B 5.2	B 6.2	10	10	10	10	1½	3
	119	36	490,491	825	B 7.4	B 8.6	15	10	15	10	1½	3
	116	36	690,691	495	B 5.4	B 6.4	10	10	10	10	1½	3
UNLOADING LARGE TANK CARE, MULTIPLE VESSELS, BARGES OR TERMINALS	120	38	690,691	510	B 5.6	B 6.8	10	10	10	10	1½	4
	124	39	690,691	530	B 5.8	B 7.0	10	10	10	10	1½	4
	129	41	690,691	550	B 6.0	A 7.0	10	10	10	10	1½	4
	133	42	690,691	565	B 6.2	B 7.4	10	10	10	10	2	4
	137	43	690,691	585	B 6.4	A 7.4	10	10	10	10	2	4
	142	45	690,691	605	B 6.6	B 8.0	15	10	15	10	2	4
	145	46	690,691	620	B 6.8		15	10	15	10	2	4
	150	47	690,691	640	B 7.0	A 8.2	15	10	15	10	2	4
	158	48	690,691	675	B 7.4	B 8.6	15	15	15	15	2	4
	171	54	690,691	730	B 8.0	B 9.4	15	15	15	15	2	4
	184	58	690,691	785	B 8.6		15	15	15	15	2	4
	193	60	690,691	820	TB 9.0	A 10.6	15	15	15	15	2	4
	260	82.1	D891	580	5V 7.1	5V 8.5	20	20	20	20	3	6
	359	113.3	D891	800	5V 9.75	5V 11.8	25	25	25	25	3	6

Consult factory for compressors for higher flows.

NOTES:

(1) The capacities shown are based on 70°F, but will vary depending upon piping, fittings used, product being transferred and temperature. The factory can supply a detailed computer analysis if required.

(2) Driver sheaves: 91 - 2 belts; 290,291,490,491 - 3 belts; 690,691 - 4 belts.

(3) The piping sizes shown are considered minimum. If the length exceeds 100 ft., use the next larger size.

AMMONIA COMPRESSOR SELECTION TABLE

APRIL 1995
SUPERSEDES VE202B

SERVICE	CAPACITY GPM(1)	DISPLACEMENT CFM	COMPRESSOR MODEL	COMPRESSOR RPM	DRIVER SHEAVE SIZE P.D."(2) 1750RPM	DRIVER SHEAVE SIZE P.D."(2) 1460RPM	DRIVER HORSEPOWER LIQUID TRANSFER AND RESIDUAL VAPOR RECOVERY 100°F	DRIVER HORSEPOWER LIQUID TRANSFER AND RESIDUAL VAPOR RECOVERY 80°F	DRIVER HORSEPOWER LIQUID TRANSFER WITHOUT RESIDUAL VAPOR RECOVERY 100°F	DRIVER HORSEPOWER LIQUID TRANSFER WITHOUT RESIDUAL VAPOR RECOVERY 80°F	PIPING SIZE (3) VAPOR	PIPING SIZE (3) LIQUID
SMALL BULK PLANTS	23	4	91	400	A 3.0	A 3.6	5	3	3	3	¾	1¼
	29	5	91	505	A 3.8	B 4.6	5	5	5	3	3/4	1¼
	34	6	91	590	B 4.6	B 5.6	5	5	5	5	1	1¼
	40	7	91	695	B 5.4	B 6.6	5	5	5	5	1	1½
	43	7	290,291	345	A 3.0	A 3.6	5	3	3	3	1	1½
UNLOADING SINGLE TANK CAR OR TRANSPORT	46	8	91	795	B 6.2	B 7.4	7½	5	5	5	1	1½
	45	8	290,291	390	A 3.4	B 4.0	5	3	3	3	1	1½
	50	9	290,291	435	A 3.8	B 4.6	5	5	3	3	1	1½
	56	10	290,291	490	B 4.4	B 5.2	5	5	5	3	1	2
	62	11	290,291	535	B 4.8	B 5.8	7½	5	5	5	1	2
	67	12	290,291	580	B 5.2	B 6.2	7½	5	5	5	1	2
	72	13	290,291	625	B 5.6	B 6.6	7½	5	5	5	1¼	2
	80	14	290,291	695	B 6.2	B 7.4	7½	7½	7½	5	1¼	2
	85	15	290,291	735	B 6.6	B 8.0	10	7½	7½	7½	1¼	2½
	85	15	490,491	345	A 3.0	A 3.6	7½	7½	5	5	1¼	2½
	90	16	290,291	780	B 7.0	B 8.6	10	7½	7½	7½	1¼	2½
	90	16	490,491	370	A 3.2	A 3.8	10	7½	5	5	1¼	2½
UNLOADING TWO OR MORE TANK CARS AT ONE TIME, OR LARGE TRANSPORT WITH EXCESS FLOW VALVES OF ADEQUATE CAPACITY	96	17	490,491	390	A 3.4	B 4.0	10	7½	5	5	1¼	3
	102	18	490,491	415	A 3.6	B 4.4	10	7½	7½	7½	1¼	3
	107	19	490,491	435	A 3.8	B 4.6	10	7½	7½	7½	1¼	3
	110	20	490,491	445	B 4.0	B 4.8	10	7½	7½	7½	1¼	3
	115	21	490,491	470	B 4.2	B 5.0	10	7½	7½	7½	1¼	3
	120	22	490,491	490	B 4.4	B 5.2	15	10	7½	7½	1¼	3
	126	23	490,491	515	B 4.6	B 5.6	15	10	7½	7½	1¼	3
	131	24	490,491	535	B 4.8	B 5.8	15	10	10	7½	1¼	3
	138	25	490,491	560	B 5.0	B 6.0	15	10	10	7½	1¼	3
	142	26	490,491	580	B 5.2	B 6.2	15	10	10	7½	1¼	3
	148	27	490,491	605	B 5.4	B 6.4	15	10	10	10	1¼	3
	153	28	490,491	625	B 5.6	B 6.6	15	10	10	10	1½	3
	160	29	490,491	650	B 5.8	B 7.0	15	15	10	10	1½	3
	165	30	490,491	670	B 6.0		15	15	15	10	1½	3
	165	30	690,691	400	B 4.4	B 5.2	15	15	10	10	1½	3
	170	31	490,491	695	B 6.2	B 7.4	15	15	15	10	1½	3
	173	31	690,691	420	B 4.6	B 5.6	15	15	10	10	1½	3
	181	32	490,491	740	B 6.6	B 8.0	15	15	15	15	1½	3
	180	32	690,691	440	B 4.8	B 5.8	15	15	10	10	1½	3
	188	34	690,691	455	B 5.0	B 6.0	20	15	10	10	1½	3
	195	35	690,691	475	B 5.2	B 6.2	20	15	10	10	1½	3
	203	36	690,691	495	B 5.4	B 6.4	20	15	15	10	1½	3
UNLOADING LARGE TANK CARE, MULTIPLE VESSELS, BARGES OR TERMINALS	211	38	690,691	510	B 5.6	B 6.8	20	15	15	10	1½	4
	218	39	690,691	530	B 5.8	B 7.0	20	15	15	15	1½	4
	226	41	690,691	550	B 6.0	A 7.0	20	15	15	15	1½	4
	233	42	690,691	565	B 6.2	B 7.4	20	15	15	15	2	4
	240	43	690,691	585	B 6.4	A 7.4	20	20	15	15	2	4
	248	45	690,691	605	B 6.6	B 8.0	20	20	15	15	2	4
	255	45	690,691	620	B 6.8		25	20	15	15	2	4
	263	47	690,691	640	B 7.0	A 8.2	25	20	15	15	2	4
	278	48	690,691	675	B 7.4	B 8.6	25	20	15	15	2	4
	301	54	690,691	730	B 8.0	B 9.4	25	20	20	15	2	4
	323	58	690,691	785	B 8.6		30	25	20	20	2	4
	338	60	690,691	820	TB 9.0	A 10.6	30	25	20	20	2	4
	459	82	D891	580	5V 7.1	5V 8.5	40	30	30	30	3	6
	633	113	D891	800	5V 9.75	5V 11.8		40	40	30	3	6

Consult factory for compressors for higher flows.

NOTES:

(1) The capacities shown are based on 70°F, but will vary depending upon piping, fittings used, product being transferred and temperature. The factory can supply a detailed computer analysis if required.

(2) Driver sheaves: 91 - 2 belts; 290,291,490,491 - 3 belts; 690,691 - 4 belts.

(3) The piping sizes shown are considered minimum. If the length exceeds 100 ft., use the next larger size.

This list includes all parts and assemblies that can be purchased individually for a Model 290 or 291 Compressor. Any one unit will not use all of these parts. For example, a compressor will not use both 2716 and 2716-1 Gaskets. Parts and Assemblies are listed separately and in numerical order. No entry for specification indicates the part is used for all units. *Preceding number indicates optional equipment. For material coding on O-Rings, Gasket Sets and Valve Assemblies See Page A500.

PART NO.	PART NAME	SPEC.	QTY.
90-4RA	Suction Valve Body	K3	2
90-4RB	Suction Valve Seat	K3	2
90-4RC	Suction Valve Bumper	K3	2
90-4RD	Suction Valve	K3	2
90-4RE	Suction Valve Spring	K3	2
*290-13	Flywheel, 14"-2 Groove		1
1012	Washer		2
1044	Bushing	K82	1
1054	Needle Valve	K78	1
1071	Nipple	K78	2
1076	Nipple	K82	1
1132-X2	Crosshead Assembly		2
1183-1	Adapter Plate		2
1190	Adapter Plate Gasket		2
1272	Pump Cover		1
1273	Bearing Adjustment Shim		As Req.
1273-1	Bearing Adjustment Shim		As Req.
1273-2	Bearing Adjustment Shim		As Req.
1274	Crankcase		1
1275	Oil Filter Screen		1
1276	Filter Screen Washer		1
1277	Bearing Cover		1
1278	Oil Seal		1
1279	Breather Cap		1
1280	Filter Screw		1
1281	Filter Screen Screw Gasket		1
1283-X	Breather Assembly		2
1284	Crankshaft Orifice		1
1285	Bearing Carrier Gasket		1
1286	Pump Shaft Drive Pin		1
1290	Relief Valve Adjusting Screw		1
1291	Adjusting Screw Locknut		1
1292	Relief Valve Spring		1
1293	Relief Valve Ball		1
1296	Cam Stop Pin		1
1298	Vane Spring		2
1301	Rotor Key		1
1302	Oil Pressure Gauge		1
1367	Connecting Rod Bearing, Pair		2
1374	Suction Valve Seat	K4,7,78,8,9	2
1387	Adjusting Screw, Steel		2
1395	Unloader Body	K7,78,8,9	2
1396	Unloader Plunger, Steel	K7,78,8,9	2
1397	Unloader Diaphragm	K7,78,8,9	2
1398	Unloader Cover	K7,78,8,9	2
*1398-1	Unloader Cover,Steel	K7,78,8,9	2
1399	Elbow, Brass	K7,78,8,9	1
*1399-1	Elbow, Steel	K7,78,8,9	1
1401	Unloader Piston, Brass	K7,78,8,9	2
*1401-1	Unloader Piston, Steel	K7,78,8,9	2
1402	Suction Valve Bumper	K4,7,78,8,9	2
1403	Valve Disc	K3	2
1403	Valve Disc	K4,7,78,8,9	4
1404	Suction Valve Spring	K4,7,78,8,9	2
1410	Relief Ball	K3	2
1411	Spring	K3,7,78,8,9	2
1434	Straight Connector, Brass	K7	1
1434	Straight Connector, Brass	K78	3
1435	Tee, Brass	K7,78,81,9	1
*1435-1	Tee, Steel	K7,78,81,9	1
1436	Tube, Unloader to Unloader	K7,78,81,9	1
1436-1	Tube, Unloader to Unloader	K82	1
1437	Tube, Unloader to Hydraulic Unloader	K7,78	1
1452-1	Female Packing Ring		2
1453-1	Male Packing Ring		2
1454	Packing Ring		As Req.
1459	Crankshaft Plug		1
1482	Locknut		2
1483	Lock Pin		2
1498	Wrist Pin Retainer Ring		4
1500	Bearing Cup		1
1501	Bearing Cone		1
1515	Closure Cap	K3,4,8,9	1
1516	Closure Body	K3,4,8,9	1
1527	Thrust Washer		2
1528	Shim Washer, Thick		As Req.
1528-1	Shim Washer, Thin		As Req.
1575	Compressor Wrench		1
1576	Discharge Valve Seat		2
1577	Discharge Valve Bumper		2
1578	Discharge Valve Spring		2
1597	Diaphragm Stop	K7,78,8,9	2
1599	Connecting Rod Bolt		4
1600	Connecting Rod Nut		4
1602	Adjusting Screw	K3	2
1603	Adjusting Screw Locknut	K3	2
1628	Packing Spring		2
1630	Tube, Unloader to Pilot Valve	K81	1
1632	Pilot Valve Adapter	K78,81	1
1649	Crosshead Guide		1
1650	Inspection Plate, Gas		1
1651	Inspection Plate, Gasket		1
1661	Oil Drain Plug		1
1669	Elbow, Brass	K81	1
*1669-1	Elbow, Steel	K81	1
1670	Straight Connector, Brass	K78	2
1670	Straight Connector, Brass	K82	1
*1670-1	Straight Connector, Steel	K78	2
*1670-1	Straight Connector, Steel	K82	1
1671	Flywheel Key		1
1714	Packing Box Washer		2
1772	Teflon Piston Ring		6
1775	Ring Expander		6
1846	Wrist Pin Bushing		2
1983	Piston Head		2
1984	Piston Platform		2
2058	Dual Unloader Check Valve	K78	1
2463	Head (290 Only)		1
2473	Cylinder (290 Only)		1
2505	Wrist Pin		2
2549	Flywheel, 16"-3 Groove		1
2702	Crankcase Gasket		1
2713	Crankcase Inspection Plate Gasket		1
(a)2714	Valve Cap		4
(b)2714-1	Valve Cap		4
2715	Holddown Screw		4

CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.

PARTS LIST

MODELS 290 AND 291 COMPRESSORS

ALL SPECIFICATIONS

PART NO.	PART NAME	SPEC.	QTY.
(a) 2716	Valve Cap Gasket, Aluminum		4
(a)*2716-1	Valve Cap Gasket, Copper		4
(a)*2716-2	Valve Cap Gasket, Lead		4
2717	Valve Gasket, Aluminum		4
*2717-1	Valve Gasket, Copper		4
*2717-2	Valve Gasket, Iron		4
2718	Bearing Cup		1
2719	Bearing Cone		1
2731	Center Head Bolt		2
2732	Gasket, Steel		2
*2732-1	Gasket, Copper		2
2733	Crankcase Inspection Plate		1
2912	Head (291 Only)		1
2913	Cylinder (291 Only)		1
3218	Flywheel Bushing Type SF 1-1/4 Bore		1
5000-137	Retainer Ring		6
2-011	O-Ring, Adjusting Screw		1
(b) 2-031	O-Ring, Valve Cap		4
2-111	O-Ring, Breather Cap		1
2-112	O-Ring, Pump Shaft		1
2-112	O-Ring, Oil Bayonet		1
2-113	O-Ring, Center Head Bolt		2
2-116	O-Ring, Filter Screen		1
2-218	O-Ring, Closure Body	K3,4,8,9	2
2-228	O-Ring, Pump Cover		1
2-235	O-Ring, Adapter Plate		2
2-235	O-Ring, Head		2

ASSEMBLY NO.	ASSEMBLY NAME	SPEC.	QTY.
90-4RX2	Suction Valve Assembly	K3	2
90-4RX3	Suction Valve Subassembly	K3	2
1132-X2	Crosshead Assembly		2
1279-X	Breather Cap Assembly		1
1281-X	Gasket Set with 1190(2) 2717(4) 1281(1) 2732(2) 1285(1) 2768(1) 1651(1) 2-113(2) 2702(1) 2-228(1) 2713(1) 2-235(4) 2716(4)		
1282-X2	Bearing Carrier Assembly		1
1341-X1	Crankshaft Assembly with Plug		1
*1342-X1	Extended Crankshaft Assembly with Plug		1

ASSEMBLY NO.	ASSEMBLY NAME	SPEC.	QTY.
1368-X1	Oil Bayonet Assembly		1
1374-X	Suction Valve Assembly	K4,7,78,8,9	2
*1374-X1	Same as 1374-X but with Copper Gaskets	K4,7,78,8,9	2
*1374-X2	Same as 1374-X but with Iron-Lead Gaskets	K4,7,78,8,9	2
1395-X	Suction Valve Unloader Assembly	K7,78,8,9	2
1419-2X1	Hydraulic Unloader Assembly	K7,8	1
*1419-2X2	Hydraulic Unloader Assembly	K7,78	1
1452-1X1	Packing Set, Gas		2
1515-X	Closure Cap Assembly	K3,4,8,9	1
1576-X	Discharge Valve Assembly		2
*1576-X1	Same as 1576-X but with Copper Gaskets		2
*1576-X2	Same as 1576-X but with Iron-Lead Gaskets		2
1579-X1	Unloader Pilot Valve Assembly	K78,8	1
*1579-X2	Unloader Pilot Valve Assembly	K78,8	1
*1579-X3	Unloader Pilot Valve Assembly	K78,8	1
*1579-X4	Unloader Pilot Valve Assembly	K78,8	1
1889-X	Connecting Rod Assembly		2
*1980-X	Unloader Pilot Valve,Iron	K78,8	1
1983-X	Piston Assembly, Iron		2
2463-X1	Head Assembly (290 Only)	K3	1
2463-X2	Head Assembly (290 Only)	K4	1
2463-X3	Head Assembly (290 Only)	K7,78,8,9	1
2549-X1	Flywheel Assembly		1
2912-X1	Head Assembly (291 Only)	K3	1
2912-X2	Head Assembly (291 Only)	K4	1
2912-X3	Head Assembly (291 Only)	K7,78,8,9	1
3550-X1	Compressor Repair Kit with 1278(1) 1281-XA(1) 1367(2) 1452-1X1(2) 1576-X(2) 1772(6) 1775(6) 90-4RX2(2)	K3	1

NOTES:
(a) Prior to S/N FS43290.
(b) S/N FS43290 and Later.

PARTS LIST
MODEL 490, 491 COMPRESSORS
SPECIFICATION: M3, M4, M7, M78, M81, M82, M9
SERIAL NO. YC32239 and Later

This list includes all parts and assemblies that can be purchased individually for a Model 490M or 491M Compressor Serial No. YC32239 and later. Any one unit will not use all of these parts. For example, a compressor will not use both 1418 and 1418-1 Gaskets. Parts and Assemblies are listed separately and in numerical order. No entry for specification indicates the part is used for all units. * Preceding number indicates optional equipment. For material coding on O-Rings, Gasket Sets, and Valve Assemblies see page A500.

PART NUMBER	PART NAME	SPEC.	QTY.
1012	Washer		2
1044	Bushing	M82	1
1054	Needle Valve	M78	1
1071	Nipple	M78	2
1076	Nipple	M82	1
1275	Oil Filter Screen		1
1276	Filter Screen Washer		1
1279	Breather Cap		1
1280-X	Filter Screw Assembly		1
1281	Filter Screen Screw Gasket		1
1284	Crankshaft Orifice		2
1286	Pump Shaft Drive Pin		1
1290	Relief Valve Adjust.Screw		1
1291	Adjusting Screw Locknut		1
1292	Relief Valve Spring		1
1293	Relief Valve Ball		1
1302	Oil Pressure Gauge		1
1384-X	Crosshead Assembly		2
1394	Head (490 Only)		1
1399	Elbow, Brass	M7,8,9	1
1399	Elbow, Brass	M78	2
*1399-1	Elbow, Steel	M7,8,9	1
*1399-1	Elbow, Steel	M78	2
1407	Valve Spring		4
1409	Valve Spacer	M3,4	4
1409	Valve Spacer	M7,78,8,9	2
1410	Relief Ball	M3	2
1411	Relief Ball Spring	M3	2
1418	Valve Gasket, Aluminum		4
*1418-1	Valve Gasket, Copper		4
*1418-2	Valve Gasket, Iron		4
1434	Straight Connector, Brass	M7	1
1434	Straight Connector, Brass	M78	3
1435	Tee, Brass	M7,78,81,9	1
1435-1	Tee, Steel	M7,78,81,9	1
1452-1	Female Packing Ring		2
*1453-1	Male Packing Ring		2
1454	Packing Ring		As Req.
1459	Crankshaft Plug		1
1474-1	Cylinder (490 Only)		1
1475	Valve Cover Plate	M3,4	4
1475	Valve Cover Plate	M7,78,8,9	2
1476	Valve Holddown Screw	M3,4	4
1476	Valve Holddown Screw	M7,78,8,9	2
1477	Valve Screw Nut	M3,4	4
1477	Valve Screw Nut	M7,78,8,9	2
1478	Gasket, Aluminum	M3,4	4
1478	Gasket, Aluminum	M7,78,8,9	2
*1478-1	Gasket, Copper	M3,4	4
*1478-1	Gasket, Copper	M7,78,8,9	2
*1478-2	Gasket, Lead	M3,4	4
*1478-2	Gasket, Lead	M7,78,8,9	2
1479	Center Head Bolt		2
1480	Gasket, Steel		2
*1480-1	Gasket, Copper		2
1481	Head Gasket		1
1482	Locknut		2
1483	Lock Pin		2
1486	Adapter Plate Gasket		1
1487	Inspection Plate, Gas		1
1488	Inspection Plate Gasket		1
1489	Crankcase Gasket		1
1490	Connecting Rod		2
1491	Connecting Rod Bearing,Pair		2
1492	Connecting Rod Bolt		4
1493	Connecting Rod Nut		4
1495	Wrist Pin Bushing		2
1496	Wrist Pin		2
1498	Wrist Pin Retainer Ring		4
1500	Bearing Cup		1
1501	Bearing Cone		1
1502	Bearing Cup		1
1503	Bearing Cone		1
1504	Bearing Adjustment Shim		As Req.
1504-1	Bearing Adjustment Shim		As Req.
1504-2	Bearing Adjustment Shim		As Req.
1504-3	Bearing Adjustment Shim		As Req.
1508-X	Oil Bayonet		1
1511	Inspection Plate Gasket		1
1513	Bearing Carrier Gasket		1
1515	Closure Cap	M3,4,8,9	1
1516	Closure Body	M4,8,9	1
1527	Thrust Washer		2
1528	Shim Washer, Thick		As Req.
1528-1	Shim Washer, Thin		As Req.
*1596	Flywheel, 14" - 2 Groove		1
1604	Tube,Unloader to Unloader	M7,78,81,9	1
1604-1	Tube,Unldr. to Pilot Valve	M82	1
1620-1	Tube,Unldr. to Hyd. Unldr.	M7	1
1628	Packing Spring		2
1631-1	Tube,Unldr. to Pilot Valve	M81	1
1632	Pilot Valve Adapter	M81	1
1661	Oil Drain Plug		1
1663	Flywheel Key		1
1669	Elbow, Brass	M81	1
*1669-1	Elbow, Steel	M81	1
1670	Straight Connector, Brass	M78	2
1670	Straight Connector, Brass	M82	1
*1670-1	Straight Connector, Steel	M78	2
*1670-1	Straight Connector, Steel	M82	1
1714	Packing Box Washer		2
1773	Teflon Piston Ring		6
1776	Ring Expander		6
1910	Bolt	M7,78,8,9	2
1985	Piston Head		2
1986	Piston Platform		2
2058	Dual Unldr. Check Valve	M78	1
2063	Tee	M78	1
2205	Valve Cover Plate	M7,78,8,9	2
2207	Valve Spacer	M7,78,8,9	2
2438	Suction Valve Seat	M4,7,78,8,9	2
2439	Discharge Valve Seat		2
2440	Suction Valve Bumper	M4,7,78,8,9	2
2441	Discharge Valve Bumper		2
2442	Valve Plate		4
2445	Spacer		8

PARTS LIST
MODEL 490, 491 COMPRESSORS
SPECIFICATION: M3, M4, M7, M78, M81, M82, M9
SERIAL NO. YC32239 and Later

PART NUMBER	PART NAME	SPEC.	QTY.
2446	Bolt	M3	2
2446	Bolt	M4,7,78,8,9	4
2447	Suction Valve Bumper	M3	2
2448	Cage		4
2449	Unloader Actuator	M7,78,8,9	2
2450	Unloader Spring	M7,78,8,9	2
2532-1	Suction Valve Seat	M3	2
2533-1	Adjusting Screw	M3	2
2534-1	Suction Valve Post	M3	2
2549	Flywheel, 16" - 3 Groove		1
2590	Crankshaft Plug		1
2598-1	Unloader Cap	M7,78,8,9	2
2618	Unloader Piston	M7,78,8,9	2
2715	Holddown Screw	M7,78,8,9	2
2716	Valve Cap Gasket, Alum.	M7,78,8,9	2
2716-1	Valve Cap Gasket, Copper	M7,78,8,9	2
2716-2	Valve Cap Gasket, Lead	M7,78,8,9	2
2765	Crosshead Guide		1
2796	Breather Ball		1
2798	Pump Cover Pin		1
2799	Packing Box Cartridge		2
2801	Cartridge Holddown Screw		2
2803	Crankcase		1
2804	Bearing Carrier		1
2805	Pump Shaft Bushing		1
2806	Plug		2
2847	Bearing Cover		1
2848	Pump Cover		1
2849-X	Oil Pump Assembly		1
2850	Pump Shaft Adapter		1
2851	Spring Guide		1
2852	Oil Pump Spring		1
2853	Crankcase Inspection Plate		1
2857	Piston Cap	M7,78,8,9	2
2858	Gasket	M7,78,8,9	2
2901	Compressor Wrench		1
(a) 2914	Head, Ductile Iron (491 Only)		1
(a) 2915	Cylinder, Ductile Iron (491 Only)		1
2961-X	Air Release Valve Assembly		1
3355	Washer		4
(b) 3712	Head, Ductile Iron (491 Only)		1
(b) 3713	Cylinder, Ductile Iron (491 Only)		1
5000-137	Retainer Ring		2
(a) 7005-043 NC125A	Bolt, 7/16 - 14 X 1-1/4" Ferry Hd.		8
(b) 7005-043 NC150A	Bolt, 7/16 - 14 X 1-1/2" Ferry Hd.		12
(c) 2-011	O-Ring, Adjusting Screw		1
(c) 2-031	O-Ring, Unloader Cap		2
(c) 2-111	O-Ring, Breather Cap		1
(c) 2-112	O-Ring, Oil Bayonet		1
(c) 2-112	O-Ring, Pump Shaft		1
(c) 2-116	O-Ring, Filter Screen		1
(c) 2-139	O-Ring, Packing Cartridge		2
(c) 2-143	O-Ring, Cover Plate		4
(c) 2-218	O-Ring, Closure Body	M3,4,8,9	2
(c) 2-228	O-Ring, Pump Cover		1
(c) 2-243	O-Ring, Cylinder		2
(b) 2-253	O-Ring, Head (491 Only)		2

ASSEMBLY NUMBER	ASSEMBLY NAME	SPEC.	QTY.
1279-X	Breather Cap Assembly		1
1280-X1	Filter Screen Screw Assembly with 1275, 1280-X		1
1384-X	Crosshead Assembly		2
1394-X8	Head Assembly with Valves (490 Only)	M4	1
1394-X9	Head Assembly with Valves (490 Only)	M7,78,8,9	1
1394-X10	Head Assembly with Valves (490 Only)	M3	1

ASSEMBLY NUMBER	ASSEMBLY NAME	SPEC.	QTY.
1419-2X1	Hydraulic Unloader Assembly	M7,78	1
1419-2x2	Hydraulic Unloader Assembly	M7,78	1
1452-1X1	Packing Set, Gas		2
1481-X6	Gasket Set with 1281(1) 1480(2) 1489(1) 2-143(4) 1418(4) 1481(1) 1511(1) 2-228(1) 1478(4) 1488(1) 1513(1) 2-243(2) 2-139(2)	M3,4	1
1481-X7	Gasket Set with 1281(1) 1480(2) 1489(1) 2716(2) 1418(4) 1481(1) 1511(1) 2-139(2) 1478(2) 1488(1) 1513(1) 2-143(4) 2-228(1) 2-243(2) 2-031(2)	M7,78,8,9	1
1490-X	Connecting Rod Assembly		2
1499-X	Crankshaft Assembly		1
*1499-SX	Extended Crankshaft Assembly		1
1508-X1	Oil Bayonet Assembly		1
1515-X	Closure Cap Assembly	M3,4,8,9	1
1579-X1	Unldr. Pilot Valve Assembly	M78,8	1
*1579-X2	Unldr. Pilot Valve Assembly	M78,8	1
*1579-X3	Unldr. Pilot Valve Assembly	M78,8	1
*1579-X4	Unldr. Pilot Valve Assembly	M78,8	1
1985-X	Piston Assembly		2
2438-X	Suction Valve Assembly	M4,7,78,8,9	2
*2438-X1	Suction Valve Assy. w/Copper	M4,7,78,8,9	2
*2438-X2	Suction Valve Assembly with Iron-Lead	M4,7,78,8,9	2
2439-X	Discharge Valve Assembly		2
*2439-X1	Discharge Valve Assembly with Copper		2
*2439-X2	Discharge Valve Assy. with Iron-Lead		2
2532-1X	Suction Valve Assembly	M3	2
*2532-1X1	Suction Valve Assy. w/Copper	M3	2
*2532-1X2	Suction Valve Assembly with Iron-Lead	M3	2
2549-X	Flywheel Assembly		1
2618-X	Suction Valve Unloader Assy.	M7,78,8,9	2
*2618-X1	Suction Valve Unloader Assembly with Copper	M7,78,8,9	2
*2618-X2	Suction Valve Unloader Assembly with Iron-Lead	M7,78,8,9	2
2619-X	Piston Seal Assembly	M7,78,8,9	4
2799-X	Packing Box Cartridge Assembly Less Packing		2
2803-X	Crankcase Assembly	M3,4,8,9	1
2803-X1	Crankcase Assembly	M7,78	1
2804-X	Bearing Carrier Assembly		1
2914-X2	Head Assembly with Valves (491 Only)	M4	1
2914-X3	Head Assembly with Valves (491 Only)	M7,78,8,9	1
2914-X4	Head Assembly with Valves (491 Only)	M3	1
3551-X1	Compressor Repair Kit with 1452-1X1(2) 1486(2) 1507(1) 1776(6) 1481-X6A(1) 1491(2) 1773(6) 2-242A(2) 2439-X(2) 2448(4) 2532-1X(2)	M3	1

Notes: (a) Prior to S/N FZ44188
(b) S/N FZ44188 and Later.
(c) For O-Ring Material Code See Page A500.

CAUTION: Always relieve pressure in the unit before attempting repairs.

This list includes all parts and assemblies that can be purchased individually for Model 690 Compressors. Any one unit will not use all of these parts. For example, a compressor will not use both 1625 and 1625-1 Gaskets. Parts and Assemblies are listed separately and in numerical order.

PART NO.	PART NAME	QTY.
R 2886	Tube, 1/4"x.035 Copper x Length	1
R 2920	Tube, 1/4"x.035 Steel x Length	1
1044	Bushing	1
1054	Needle Valve	1
1071	Nipple	2
1076	Nipple	1
1192	Locking Device	2
1275	Oil Filter Screen	1
1276	Filter Screen Washer	1
1280	Filter Screw	1
1281	Filter Screen Screw Gasket	1
1302	Oil Pressure Gauge	1
1399	Elbow, Brass	1
1399-1	Elbow, Steel	1
1434	Straight Connector, Brass	2
(a)1434-1	Straight Connector, Steel	2
1435	Tee, Brass	1
1482	Locknut	1
1483	Piston Lock Pin	1
1606	Unloader Cover	2
(a)1606-1	Unloader Cover, Steel	2
1625	Gasket, Steel	2
(a)1625-1	Gasket, Copper	2
1632	Pilot Valve Adapter	1
1669	Elbow, Brass	1
(a)1669-1	Elbow, Steel	1
1670	Straight Connector, Brass	2
(a)1670-1	Straight Connector, Steel	2
1721	Inspection Plate	1
1722	Adjusting Screw, Steel	2
1725-X	Packing Set	2
1727	Connecting Rod Nut	4
1728	Packing Washer	2
1735	Shim Washer, Thick	1
1735-1	Shim Washer, Thin	1
1739	Teflon Piston Ring	3
1740	Ring Expander	3
1742	Cylinder	1
1742-4	Cylinder	1
1743	Head	1
1744	Head Gasket	1
1748	Cartridge Plate	2
1749	Cartridge Holddown Screw	2
1760	Inspection Plate Gasket	1
1761	Crankcase Gasket	1
1762	Flywheel	1
1764	Cover Plate	4
1765	Valve Spacer	4
1885-1	Cover	1
1980-X	Unloader Pilot Valve, Iron	1
1986	Piston Platform	1
1987	Piston Head, Iron	1
(b)2-031	O-ring	6
(b)2-116	O-ring	1
(b)2-233	O-ring	2
(b)2-235	O-ring	8
(b)2-247	O-ring	4
2006	Nipple,	1
2010	Flange Gasket	1
2058	Dual Unloader Check Valve	1
2063	Tee, Steel	1
2114	Valve Gasket, Aluminum	4
(a)2114-1	Valve Gasket, Copper	4
(a)2114-2	Valve Gasket, Iron	4
2122	Crankcase Inspection Plate	1
2123	Crankcase Inspection Plate Gasket	1
2126	Breather Ball	1
2136	Center Headbolt	2
2144-1.5	Flange - 1-1/2" NPT	1
2144-2	Flange - 2" NPT	1
2177	Flange Gasket	2
2250	Vent	1
2405	Crosshead Guide	1
2406	Piston Rod	1
2407	Packing Cartridge	2
2409	Compressor Wrench	1
2411	Compressor Wrench Liner	1
2412	Dowell Pin	2
2609	Tee, Steel	2
2644	Compressor Wrench	1
2714-1	Valve Cap	4
2715	Holddown Screw	4
2716	Valve Cap Gasket, Aluminum	4
2814	'In' Decal	1
2817	'Out' Decal	1
2870	Plastic Nozzle Plug, 1-1/2"	1
2871	Plastic Nozzle Plug, 2"	1
2893	Locking Device	2
2894	Unloader Warning Tag	1
2903	Jam Nut	1
3221	Crankcase, Spec M	1
3255	Warning Tag	1
3289	Pipe Plug-1/4 NPT	2
3442	Pipe Plug-1/4 NPT	3
3443	Pipe Plug-1/2 NPT	1
3503	Flywheel Key	1
3504	Plastic Nozzle Plug - 1/8"	1
3526	Oil Seal	1
3539	Bearing Cover	1
3540	Wrist Pin	2
3542	Connecting Rod Bearing - Pair	1
3544	Crosshead	1
3579	Bearing Cup	1
3589	Bearing Adjustment Shim	3
3589-1	Bearing Adjustment Shim	5
3589-2	Bearing Adjustment Shim	3
3590	Wrist Pin Retainer Ring	4
3607	Nipple	2
3633	Chain	1

PARTS LIST

MODEL 690 COMPRESSOR

CRANKCASE SPEC. L,M

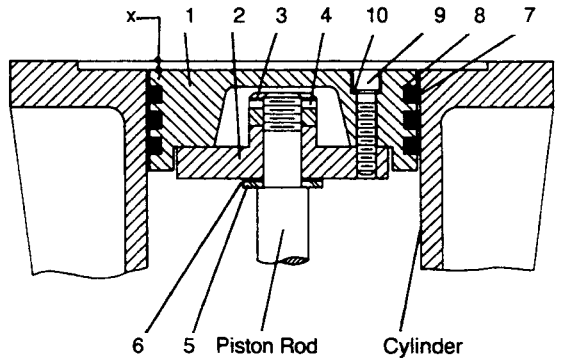
PART NO.	PART NAME	QTY.
3634	Spring Clip Connecting Link	1
3651-1	Elbow, Steel	1
3654	Blow Out Disc	2
3656	Quill-Check Valve	1
3874	Lubricator Access Cover Gasket	1
3875	Lubricator Access Cover	1
3880	Driven Sprocket 28 T, Spec M	1
3881	Breather Stop Pin	1
4016	Flywheel Bushing	1
4022	Pilot Valve Spring	1
4023	Pilot Valve Spring	1
5000-175	Retainer Ring	2
7001-025 NC050A	Bolt, 1/4-20 x 1/2", Hex Hd	4
7001-025 NC125A	Bolt, 1/4-20 x 1-1/4", Hex Hd	1
7001-031 NC075A	Bolt, 5/16-18 x 3/4", Hex Hd	6
7001-037 NC100A	Bolt, 3/8-16 x 1", Hex Hd	16
7001-043 NC137A	Bolt, 7/16-14 x 1-3/8", Hex Hd	16
7001-043 NC150A	Bolt, 7/16-14 x 1-1/2", Hex Hd	8
7002-025 OC125A	Bolt, 1/4-20 x 11/4, Soc Hd	8
7005-043 NC125A	Bolt,7/16-14 x 1-1/4",Ferry Hd	10
7005-050 NC175A	Bolt, 1/2-13 x 1-3/4",Ferry Hd	16
7006-025 NC100A	Bolt, 1/4-20 x 1", Soc Hd Set	1
7012-010 NC025B	Bolt, 10-24 x 1/4", Phillip Hd	10
7101-037 NC01A	Hex Nut, 3/8-16,	4
7206-037A	Regular Lockwasher	4
7206-043A	Regular Lockwasher	10
7206-050A	Regular Lockwasher	16
7207-025A	Hi Collar Lockwasher	8

ASSEMBLY NO.	ASSEMBLY NAME	QTY.
1419-2X1	Hydraulic Unloader Assy.	1
1515-X	Closure Cap Assy.	1
1743-X	Head Assy., Spec. 3	1
1743-X1	Head Assy., Spec. 4	1
1743-X2	Head Assy., Spec. 7,8,9	1
1762-X	Flywheel Assy., Spec. M	1
1987-X1	Piston Assy., Iron	2
2110-X	Suction Valve Assy.	2
2200-1X	Suction Valve Unloader Assy.	2
2255-X	Suction Valve Assy., Aluminum	2
2255-X1	Suction Valve Unl, Assy., Alum.	2
2259-X	Discharge Valve Assy.,Aluminum	2
2405-X	Crosshead Guide Assy.	1
2409-X	Compressor Wrench Assy.	1
3220-2X	Bearing Carrier Assy.	1
3221-X1	Crankcase Assy., Spec. M3,4,8,9	1
3221-X2	Crankcase Assy., Spec. M7,78	1
3221-X3	Crankcase Assy., Spec. L3,4,8,9	1
3221-X4	Crankcase Assy., Spec. L7,78	1
3225-X1	Oil Bayonet Assy., with O-rings	1
3544-X4	Crosshead Assy., Spec. M	2
3639-X	Lubricator Assy.	1
3785-X1	Connecting Rod Assy., Spec M	2
3786-X1	Crankshaft Assy., Spec M	1
4020-X2	Unloader Pilot Valve Assy.	1

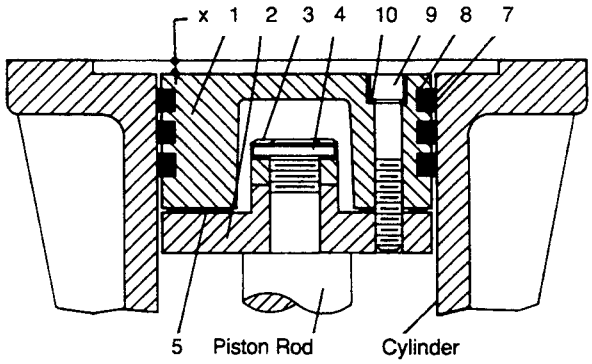
NOTES:
(a) Optional Equipment
(b) For Material Coding on O-rings, Gasket Sets and Valve Assemblies see Page A500.

CAUTION: Always Relieve Pressure In The Unit Before Attmpting Any Repairs.

MODELS 91, 191, 291, 391, 491, 491-3



MODELS 590, 691, 691-4



TWO-STAGE	ALL MODELS 190/191				ALL MODELS 390/391				ALL MODELS 590/591			
Piston Assembly No.	1983-X		2001-X		1987-X		1981-X		1754-X		1755-X	
Piston Diameter	3" (7.62 cm)		1¾" (4.45 cm)		4½" (11.43 cm)		2½" (6.35 cm)		6" (15.24 cm)		3¼" (8.26 cm)	
Ref. No. Part Name	Part No.	Qty./ Piston	Part No.	Qty./ Piston	Part No.	Qty./ Piston	Part No.	Qty./ Piston	Part No.	Qty./ Piston	Part No.	Qty./ Piston
1. Head, Iron	1983	1	2001	1	1987	1	1981	1	1754	1	1755	1
2. Piston Platform	1984	1	2002	1	1986	1	1982	1	1986	1	1986-1	1
3. Locknut	1482	1	1448	1	1482	1	1482	1	1482	1	1482	1
4. Lock Pin	1483	1	1483	1	1483	1	1483	1	1483	1	1483	1
5. Thrust Washer	1527	1	None	-	1527	1	1527	1	None	-	None	-
6. Shim Washer, Thick	1528	As	1378	As	1528	As	1528	As	1735	As	1735	As
Shim Washer, Thin	1528-1	Req.		Req.	1528-1	Req.	1528-1	Req.	1735-1	Req.	1735-1	Req.
7. Piston Ring	1722	3	1770	3	1739	3	1771	3	1752	3	1756	3
8. Ring Expander	1775	3	2015	3	1740	3	1774	3	1753	3	1757	3
9. Screw, Soc. Hd.	7002-010 OC100A	4	7002-008 NC125A	4	7002-025 OC125A	8	7002-008 NC125A	6	7002-025 OC175A	8	7002-025 OC175A	4
10. Lock Washer	7207-010A	4	7207-008A	4	7207-025A	8	7207-008A	6	7207-025A	8	7207-025A	4

SINGLE STAGE	ALL MODELS 90/91, 290/291		ALL MODELS 490/491		ALL MODELS 491-3		ALL MODELS 690/691		ALL MODELS 690-4/691-4	
Piston Assembly No.	1983-X		1985-X		1983-X		1987-X1		1985-X1	
Piston Diameter	3" (7.62 cm)		4" (10.16 cm)		3" (7.62 cm)		4.5" (11.43 cm)		4" (10.16 cm)	
Ref. No. Part Name	Part No.	Qty./ Piston	Part No.	Qty./ Piston	Part No.	Qty./ Piston	Part No.	Qty./ Piston	Part No.	Qty./ Piston
1. Head, Iron	1983	1	1985	1	1983	1	1987	1	1985	1
2. Piston Platform	1984	1	1986	1	1984-1	1	1986	1	1986	1
3. Locknut	1482	1	1482	1	1482	1	1482	1	1482	1
4. Lock Pin	1483	1	1483	1	1483	1	1483	1	1483	1
5. Thrust Washer	1527	1	1527	1	1527	1	None	-	None	-
6. Shim Washer, Thick	1528	As	1528	As	1528	As	1735	As	1735	As
Shim Washer, Thin	1528-1	Req.	1528-1	Req.	1528-1	Req.	1735-1	Req.	1735-1	Req.
7. Piston Ring	1722	3	1773	3	1772	3	1739	3	1773	3
8. Ring Expander	1775	3	1776	3	1775	3	1740	3	1776	3
9. Screw, Soc. Hd.	7002-010 OC100A	4	7002-025 OC125A	8	7002-010 OC100A	4	7002-025 OC125A	8	7002-025 OC125A	8
10. Lock Washer	7207-010A	4	7207-025A	8	7207-010A	4	7207-025A	8	7207-025A	8

PISTON CLEARANCE (COLD)

MODEL	'X' Inches (Millimeter) Minimum	Maximum
91, 191, 291, 491 (b)	.020 (.51)	.044 (1.12)
A91, D91, A191, D191, A291, D291, WA391, WD391, D491 (b)	.025 (.64)	.049 (1.24)
T191, T291	.030 (.76)	.054 (1.35)
T690-4, WT690-4, WT690, WT590	.100 (2.54)	.112 (2.84)
T691	.115 (2.92)	.127 (3.22)
190, 390, 490, 491 (a)	.000 (.00)	.024 (.61)
A190, D190, A390, D390, A490, D490, D491, D490-3	.005 (.13)	.029 (.74)
T491, T490-3	.010 (.25)	.034 (.86)
WT391, T491 (b)	.030 (.76)	.054 (1.36)
590, 690, W690	.000 (.00)	.012 (.30)
691	.015 (.38)	.027 (.68)
A590, WA590, A690, WA690	.045 (1.14)	.057 (1.45)
D590, WD590, D690, D690-4, WD690, WD690-4	.050 (1.27)	.062 (1.57)
D691	.065 (1.65)	.077 (1.95)

NOTES:

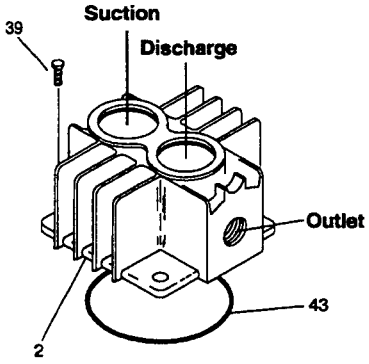
(a) For 491 Compressor with flat gasket.

(b) For 491 Compressor with O-rings.

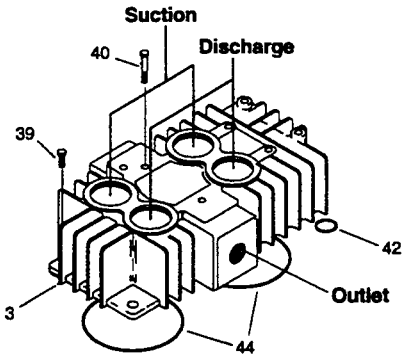
CAUTION: Always Relieve Pressure In The Units Before Attempting Any Repairs.

HEAD

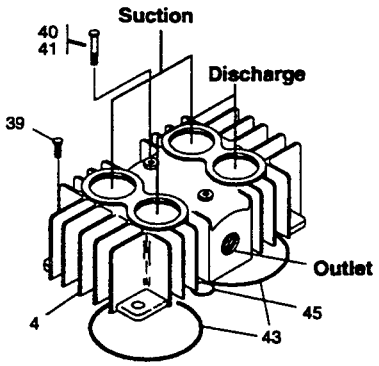
90/91



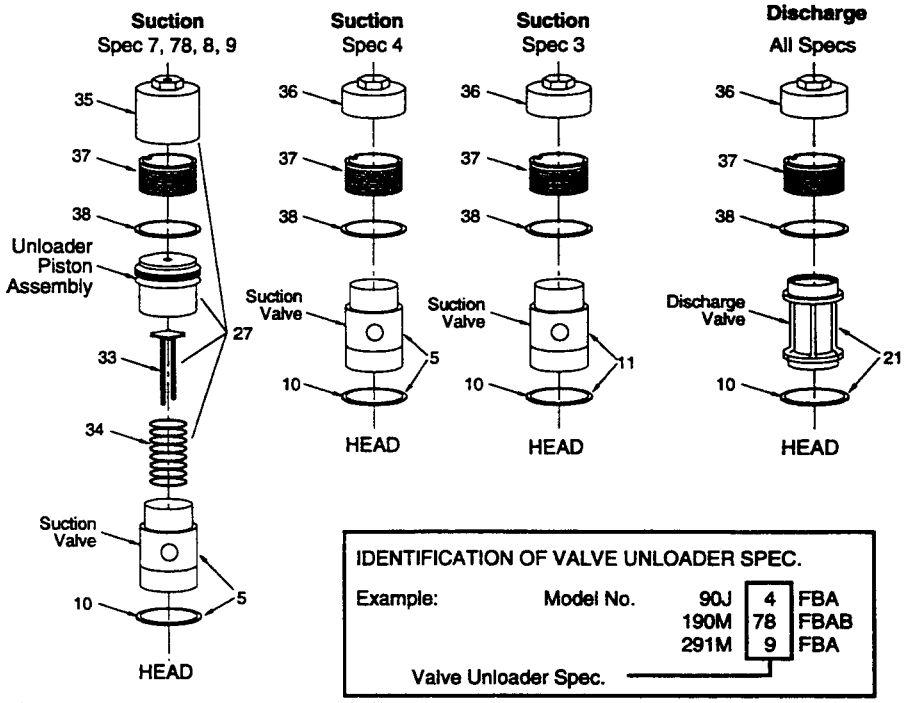
191



290/291



VALVE REMOVAL



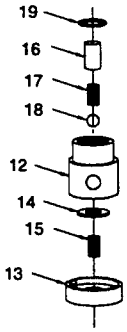
IDENTIFICATION OF VALVE UNLOADER SPEC.

Example: Model No. 90J 4 FBA
190M 78 FBAB
291M 9 FBA

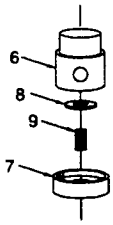
Valve Unloader Spec.

VALVE DETAILS

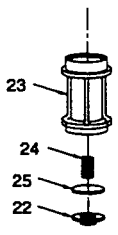
Suction Valve
Spec 3



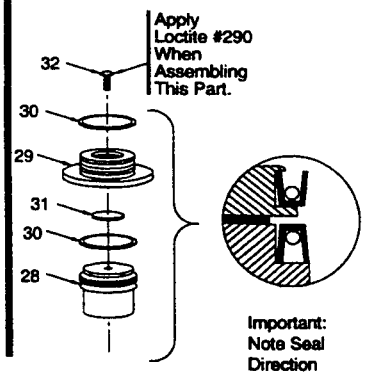
Suction Valve
Spec 4, 7, 78, 8, 9



Discharge Valve



Unloader Piston Assembly



HEAD ASSEMBLY DETAILS
ALL MODELS 91 AND 291 S/N JW47628 AND LATER
ALL MODELS 191

NOTE: When ordering parts use "PART NO." not "REF NO."

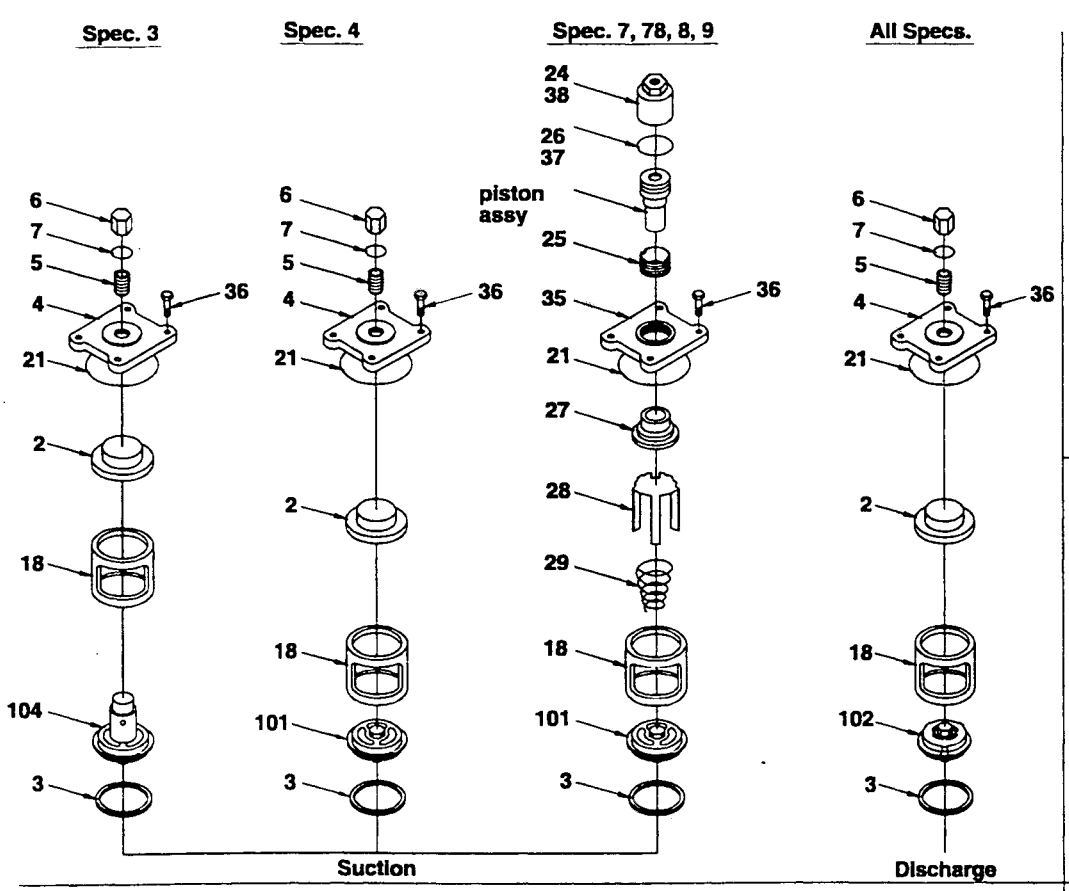
REF NO.	PART NO.	DESCRIPTION
(a)1.	2374-X	Head Assy, Spec 3, Model 90, 91, D90, D91
	2463-X1	Head Assy, Spec 3, Model 290, D290
	2912-X1	Head Assy, Spec 3, Model 291, D291
	2374-X1	Head Assy, Spec 4, Model 90, 91, D90, D91, A90, A91
	4013-X1	Head Assy, Spec 4, Model 191, A191, D191
	2463-X2	Head Assy, Spec 4, Model 290, A290, D290
	2912-X2	Head Assy, Spec 4, Model 291, D291
	2374-X2	Head Assy, Spec 8,9, Model 90, 91, D90, D91
	2374-X3	Head Assy, Spec 8,9, Model A90, A91
	4013-X2	Head Assy, Spec 7,78,8,9, Model 191, Al9l, D191
	2463-X3	Head Assy, Spec 7,78,8,9, Model 290, D290
	2463-X4	Head Assy, Spec 7,78,8,9, Model A290
	2912-X3	Head Assy, Spec 7,78,8,9, Model 291, D291
2.	2374	. Head Model 90, 91
	4302	. Head Model F91 (ANSI FLANGE)
3.	4013	. Head Model 191
	4371	. Head Model F191 (ANSI FLANGE)
4.	2463	. Head Model 290, A290, D290 (Obsolete replace by 2912)
	2912	. Head Model 291, A291, D291
	4300	. Head Model F291 (ANSI FLANGE)
5.	3483-X	. Suction Valve Assy, Spec 4,7,78,8,9
(b)	3483-X1	. Same as above but with Copper Gaskets
(b)	3483-X2	. Same as above but with Iron-Lead Gaskets
6.	3483	. . Suction Valve Seat
7.	3484	. . Suction Valve Bumper
8.	3972	. . Suction Valve Plate
9.	4009	. . Suction Spring
10.	2717	. . Valve Gasket, Alum.
(b)	2717-1	. . Valve Gasket, Copper
(b)	2717-2	. . Valve Gasket, Iron-Lead
11.	3483-1X	. Suction Valve Assy, Spec 3
(b)	3483-1X1	. Same as above but with Copper Gaskets
(b)	3483-1X2	. Same as above but with Iron-Lead Gaskets
12.	3483-1	. . Suction Valve Seat, Spec 3
13.	3484	. . Suction Valve Bumper
14.	3972	. . Suction Valve Plate
15.	4009	. . Suction Spring
16.	3977	. . Suction Valve Relief Housing
17.	1411	. . Spring
18.	1410	. . Ball
19.	5000-77	. . Retainer Ring
20.		
21.	3485-X	. Discharge Valve Assy
(b)	3485-X1	. Same as above but with Copper Gaskets
(b)	3485-X2	. Same as above but with Iron-Lead Gaskets
22.	3485	. . Discharge Valve Seat
23.	3486	. . Discharge Valve Bumper
24.	4008	. . Discharge Spring
25.	3973	. . Discharge Valve Plate

REF NO.	PART NO.	DESCRIPTION
27.	3919-X	. Unloader Assy
28.	3919	. . Unloader Piston
29.	2857	. . Piston Cap
30.	2619-X	. . Piston Seat Assy
31.	2858	. . Unloader Piston Cap Gasket
32.	1910	. . Bolt 1/4-20 x 1/2 Soc. Button Hd.
33.	3975	. . Unloader Actuator
34.	3976	. . Unloader Spring
35.	2598-1	. . Unloader Cap
36.	2714-1	. Valve Cap
37.	2715	. Holddown Screw
(c)38.	2-031_	. O-ring
39.	7001-037 NC100A	Bolt, 3/8-16 x 1" Gr.5 Hex Hd.
40.	2731	Center Headbolt
41.	2732	Gasket
42.	2-118E	O-ring, Teflon (Intercooler)
(c)43.	2-235_	O-ring
(c)44.	2-236_	O-ring
(c)45.	2-113_	O-ring

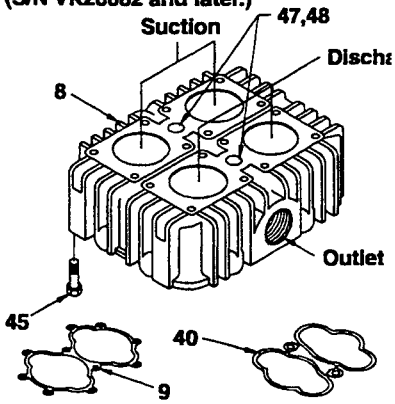
NOTES:
(a) Not Shown.
(b) Optional.
(c) For O-ring material coding see page A500

CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.

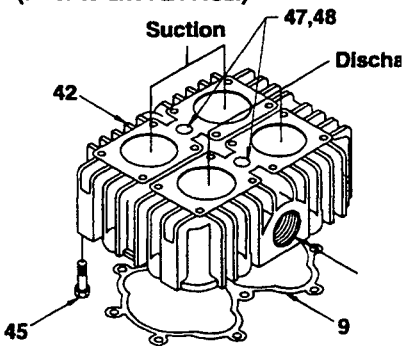
HEAD ASSEMBLY DETAILS
MODEL 490, 491, ALL CONFIGURATIONS
SERIAL NO. VK28082 AND LATER, SPEC 4, 7, 78, 8, 9
SERIAL NO. YC32239 AND LATER, SPEC 3



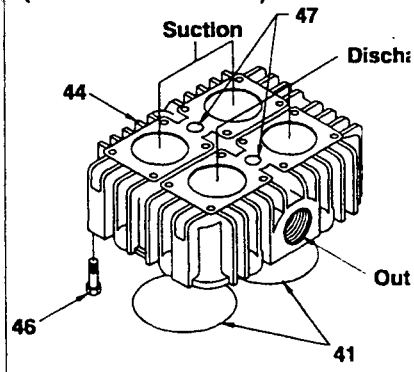
Model: 490, A490, D490, D490-3, T490- (S/N VK28082 and later.)



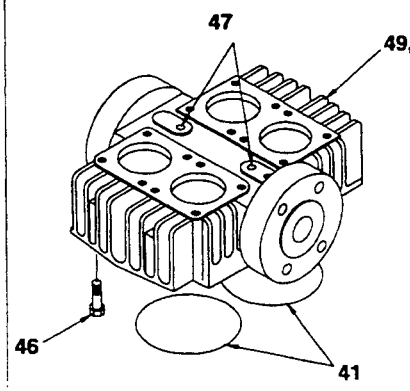
Model: 491, D491, T491. (Prior to S/N FZ44188.)



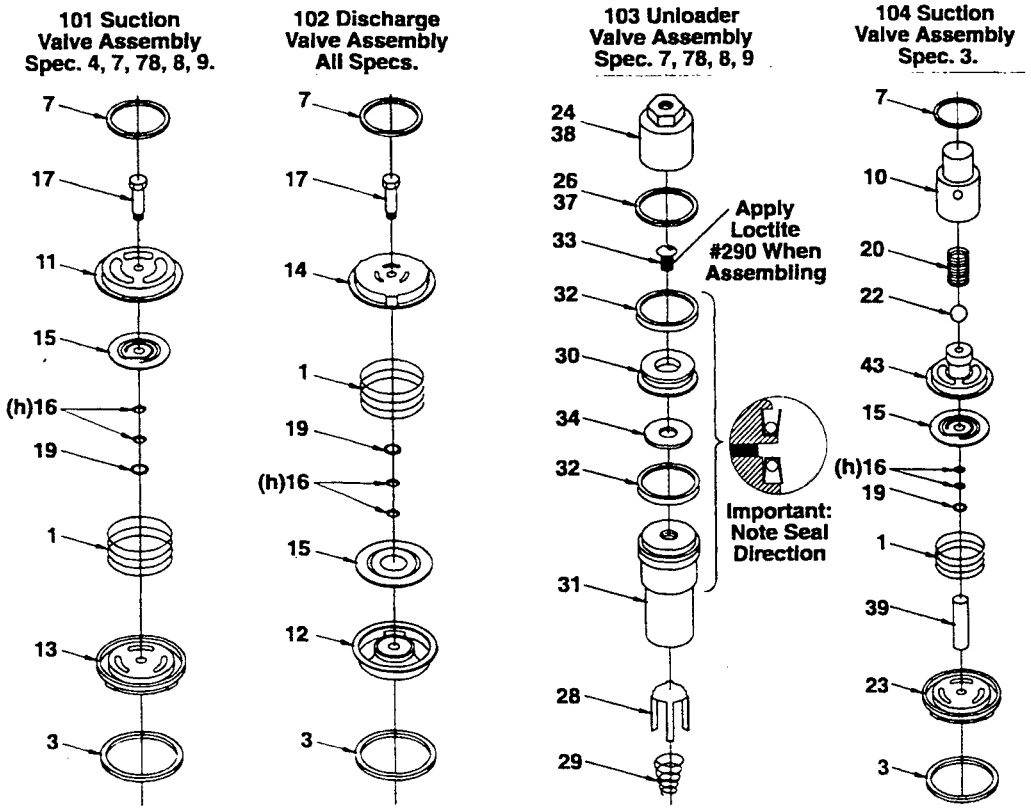
Model: 491, D491, T491. (S/N FZ44188 and later.)



All models: F491, FD491, FT491



VALVE ASSEMBLY DETAILS



HEAD ASSEMBLY DETAILS
MODEL 490, 491, A490, D490, D490-3, D491, T490-3, T491 COMPRESSORS
SERIAL NO. VK28082 AND LATER, SPEC 4, 7, 78, 8, 9
SERIAL NO. YC32239 AND LATER, SPEC 3

REF NO.	PART NO.	DESCRIPTION
1.	1407	Valve Spring
2.	1409	Valve Spacer
3.	1418	Valve Gasket, Aluminum
(a)	1418-1	Valve Gasket, Copper
(a)	1418-2	Valve Gasket, Iron
4.	1475	Valve Cover Plate
5.	1476	Valve Holddown Screw
6.	1477	Valve Screw Nut
7.	1478	Gasket, Steel
(a)	1478-1	Gasket, Copper
8.	1394	Head (490, D490, D490-3 Only)
(c) 9.	1481	Head Gasket (490, 491, A490, D490, D491, T491)
10.	2533-1	Adjusting Screw
11.	2438	Suction Valve Seat
12.	2439	Discharge Valve Seat
13.	2440	Suction Valve Bumper
14.	2441	Discharge Valve Bumper
15.	2442	Valve Plate
(h) 16.	2445	Spacer (2 Per Valve)
17.	2446	Bolt
18.	2448	Cage
19.	3355	Washer
20.	1411	Relief Ball Spring
(b) 21.	2-143	O-ring, Cover Plate
22.	1410	Relief Ball
23.	2447	Suction Valve Bumper
(d) 24.	2598	Unloader Cap
25.	2715	Holddown Screw
(d) 26.	2716	Valve Cap Gasket, Aluminum
	2716-1	Valve Cap Gasket, Copper
	2716-2	Valve Cap Gasket, Iron-Lead
27.	2207	Valve Spacer
28.	2449	Unloader Actuator
29.	2450	Unloader Spring
30.	2857	Piston Cap
31.	2618	Unloader Piston
32.	2619-X	Piston Seal Assembly
33.	1910	Bolt
34.	2858	Gasket
35.	2205	Valve Cover Plate
36.	7001-043NC125A	Bolt, 7/16-14 x 1¼" Hex Head
(b,e) 37.	2-031	O-ring, Unloader Cap
(e) 38.	2598-1	Unloader Cap
39.	2534-1	Suction Valve Post
(c) 40.	2345	Head Gasket (D490-3, T490-3 Only)
(b, c, g) 41.	2-253	O-ring (491, D491, T491 Only)
(f) 42.	2914	Head, Ductile Iron (491, D491, T491 Only)
43.	2532-1	Suction Valve Seat
(g) 44.	3712	Head Ductile Iron (491, D491, T491 Only)
(c) 45.	7005-043NC125A	Bolt, 7/16-14 x 1¼" Ferry Head
(c, g) 46.	7005-043NC150A	Bolt, 7/16-14 x 1½" Ferry Head (491, D491, T491)
(c) 47.	1479	Center Head Bolt
(c) 48.	1480	Center Head Bolt Gasket, Steel
(a, c)	1480-1	Center Heat Bolt Gasket, Copper
49.	4297	Head ANSI Flanged (F491, FD491, FT491)
50.	4297-1	Head Flanged - Din Spec. Only (F492, FD492, FT492)

REF NO.	ASSEMBLY NO.	DESCRIPTION
101.	2438-X	Suction Valve Assy with 1, 3, 7, 11, 13, 15, 16(2), 17, 19
(a)	2438-X1	Same as 2438-X but with Copper Gaskets
(a)	2438-X2	Same as 2438-X but with Iron-Lead Gaskets
102.	2439-X	Discharge Valve Assy with 1, 3, 7, 12, 14, 15, 16(2), 17, 19
(a)	2439-X1	Same as 2439-X but with Copper Gaskets
(a)	2439-X2	Same as 2439-X but with Iron-Lead Gaskets
103.	2618-X	Unloader Assy with 24, 26, 28, 29, 30, 31, 32(2), 33, 34
104.	2532-1X	Suction Valve Assy with 1, 3, 7, 10, 15, 16, 19, 20, 22, 23, 39
	2532-1X1	Same as 2532-1X but with Copper
	2532-1X2	Same as 2532-1X but with Iron-Lead

IDENTIFICATION OF VALVE UNLOADER SPEC.

EXAMPLE: MODEL 490M 4 FBA
A490M 78 FBA
D490AM 9 FBA

VALVE UNLOADER SPEC.

HEAD ASSY NO.	MODELS	VALVE SPEC.
1394-X8	490, A490, D490, D490-3, T490-3	4
1394-X9	490, A490, D490, D490-3, T490-3	7, 78, 8, 9
1394-X10	490, D490, D490-3, T490-3	3
(f) 2914-X2	491, D491, T491	4
(f) 2914-X3	491, D491, T491	7, 78, 8, 9
(f) 2914-X4	491, D491, T491	3
(g)3712-X1	491, D491, T491	3
(g)3712-X2	491, D491, T491	4
(g)3712-X3	491, D491, T491	7, 78, 8, 9
(j) 4297-X1		3
(j) 4297-X2		4
(j) 4297-X3		7, 8, 9
4297-1X1		3
4297-1X2		4
4297-1X3		7, 8, 9

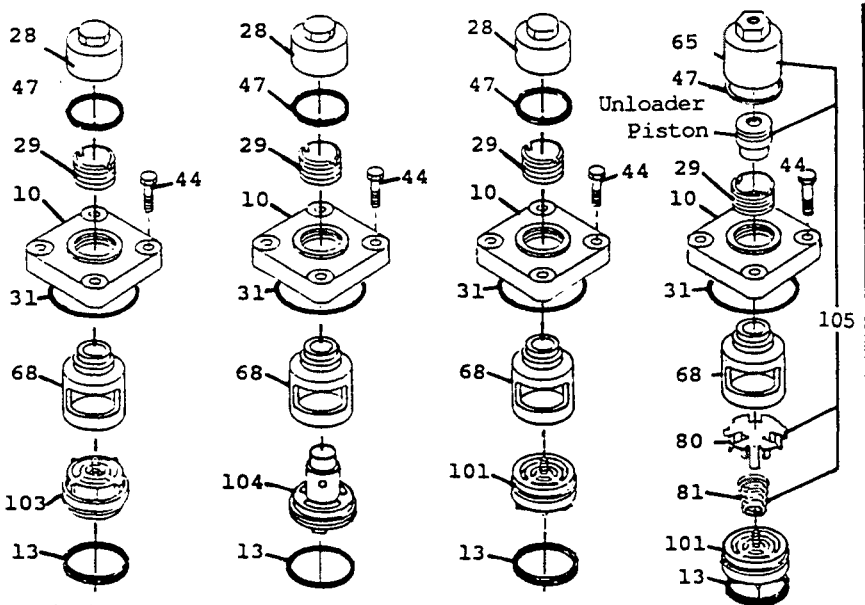
NOTES:

(a) Optional equipment
(b) For O-ring material coding see page A500.
(c) Not included in Head Assembly.
(d) Prior to S/N FU43504 Unloader Cap.
(e) S/N FU43504 and later. Valve Cap 2714 (with 2716) is interchangeable with Valve Cap 2714-1 ([with 2-031]).
(f) Prior to S/N FZ44188.
(g) S/N FZ44188 and later.
(h) Place Spacers back to back as shown.
(j) Flanged models only.

CAUTION: ALWAYS RELIEVE PRESSURE IN THE UNIT BEFORE ATTEMPTING ANY REPAIRS.

HEAD ASSEMBLY DETAILS
MODEL 690,W690,691,WA691,D690, D690-4,D691,WD690,WD690-4 S/N MR50653 AND LATER ALL SPECIFICATIONS

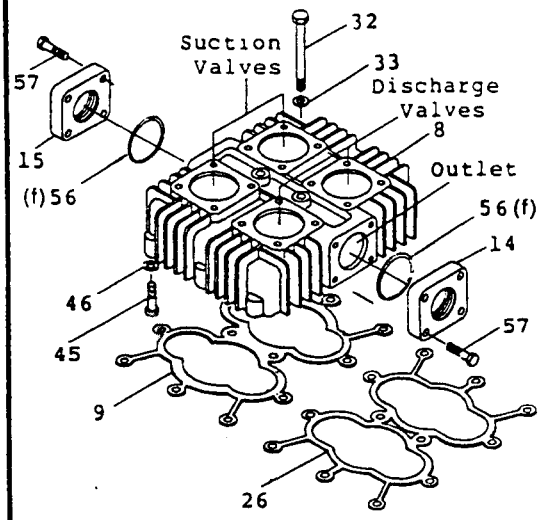
SERVICE MANUAL PAGE	E330F
November	1991
Supersedes	E33(



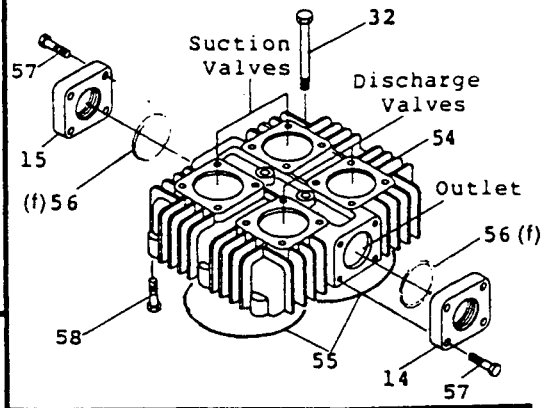
CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.

IDENTIFICATION OF VALVE UNLOADER SPEC.
Example: Model No. 690P [4] FBA
690K [78] FBAB
690M [9] FBA
Valve Unloader Spec.

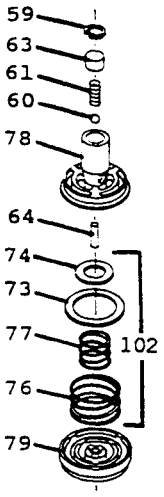
Model: 690,A690,D690,D690-4



Model: 691,D691

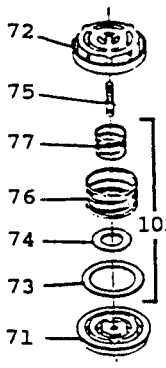


Valve Details

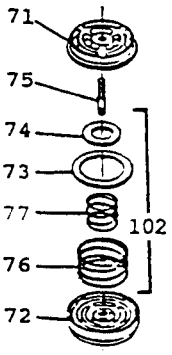


104 Suction Valve Assembly Spec 3.

Note Stud Direction

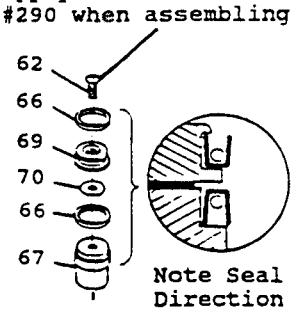


103 Discharge Valve Assembly



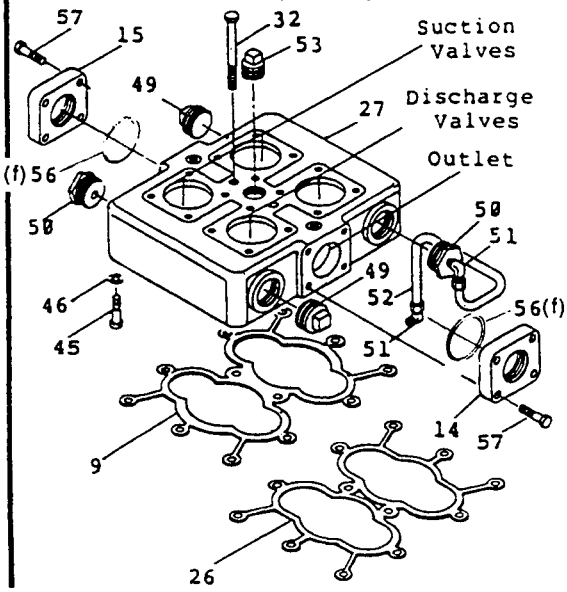
101 Suction Valve Assembly

Apply Loctite #290 when assembling



Unloader Piston Assembly

Model: W690,WA690,WD690,WD690-4



HEAD ASSEMBLY DETAILS
MODEL 690,W690,691,WA691,D690, D690-4,D691,WD690,WD690-4 S/N MR50653 AND LATER ALL SPECIFICATIONS

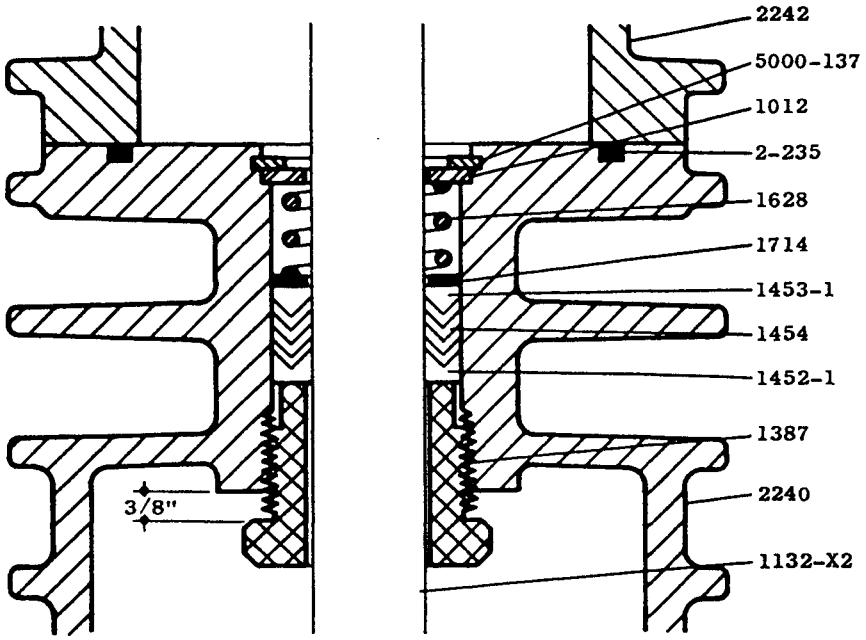
When ordering parts use "Part No." not "Ref No."

REF. NO.	PART NO.	PART NAME
1.	thru 7.	Omitted
8.	1743	Head (690,A690,D690,D690-4 Only)
(d) 9.	1744	Head Gasket (690,W690,A690,WA690, D690, WD690 Only)
(e)	1744-1	Head Gasket Grafoil
10.	1764	Valve Cover Plate
11.	——	Omitted
12.	——	Omitted
13.	2114	Valve Gasket, Aluminum
(e)	2114-1	Valve Gasket, Copper
(e)	2114-2	Valve Gasket, Iron
14.	2144-1.5	Flange(Discharge) 1-1/2" NPT
	2144-1.5S	Flange 1-1/2" Weld
15.	2144-2	Flange(Suction) 2" NPT
(e)	2144-2S	Flange 2" Weld
16.	thru 25.	Omitted
(d) 26.	2498	Head Gasket (D690-4,WD690-4 Only)
(e)	2498-1	Head Gasket, Grafoil
27.	2579	Head, Water-Cooled (W690,WA690, WD690, WD690-4 Only)
(a) 28.	2714	Valve Cap
(b)	2714-1	Valve Cap, Grooved for O-ring
29.	2715	Holddown Screw
(a) 30.	2716	Valve Cap Gasket, Aluminum
)	2716-1	Valve Cap Gasket, Copper
e)	2716-2	Valve Cap Gasket, Lead
(c) 31.	2-235	O-ring (Cover Plate)
32.	2136	Center Head Bolt
33.	1625	Center Head Bolt Gasket, Aluminum
(e)	1625-1	Center Head Bolt Gasket, Copper
(e)	1625-2	Center Head Bolt Gasket, Iron-Lead
34.	thru 42.	Omitted
43.	7001-021 NC075A	Screw, 1/4-20 x 3/4" Hex Hd.Gr 5
44.	7001-043 NC137A	Bolt, 7/16-14 x 1-3/8" Hex Hd.
45.	7005-043 NC125A	Bolt, 7/16-14 x 1-1/4" Ferry Hd.
46.	7006-043A	Reg. Lockwasher 7/16"
(c) 47.	2-031	O-ring, Valve Cap
49.	2825	Pipe Plug 1-1/2" NPT
50.	2876	Bushing 1-1/2 x 1/2 Galv.
51.	2322	Elbow, 1/2P x 1/2T Brass
(e)	2322-1	Elbow, 1/2P x 1/2T Steel
52.	R2918	Tube, 1/2" (Specify Length), Copper
(e)	R3433	Tube, 1/2" (Specify Length), Steel
53.	3643	Pipe Plug, 1" NPT
54.	3458	Head (691,D691 Only)
(c) 55.	2-261	O-Ring, Head(691,D691 Only)
(f) 56.	2-231	O-Ring
57.	7001-043 NC150A	Bolt, 7/16-14 x 1-1/2" Hex Hd.
58.	7005-050 NC150A	Bolt, 1/2-13 x 1-1/2" Ferry Hd.
59.	5000-77	Retainer Ring
60.	1410	Relief Ball
61.	1411	Spring
62.	1910	Bolt, 1/4-20 x 1/2 Soc. Button Hd.
63.	3977	Suction Valve Relief Housing (Spec 3)
64.	2534-1	Suction Valve Post (Spec 3)
65.	2598-1	Unloader Cap
66.	2619-X	Piston Seal Assembly
67.	2710	Unloader Piston
68.	2797	Valve Cage
69.	2857	Piston Cap
70.	2858	Unloader Piston Cap Gasket
71.	3856	Valve Seat
72.	3857	Valve Bumper
73.	3871	Outer Valve Plate
74.	3872	Inner Valve Plate
75.	3920	Valve Stud
76.	3928	Outer Valve Spring
77.	3929	Inner Valve Spring
78.	3948	Valve Seat (Spec. 3)
79.	3949	Valve Bumper (Spec. 3.)
80.	4032	Unloader Actuator
81.	4033	Unloader Spring

REF NO.	ASSY. NO.	ASSEMBLY NAME
101.	3856-X	Suction Valve Assy (Incl.Valve Gasket)
(e)	3856-X1	Same as above but with Copper Gasket
(e)	2255-X2	Same as above but with Iron-Lead Gasket
102.	3146-X1	Valve Repair Kit (Suction & Discharge)
103.	3857-X	Discharge Valve Assy (Incl.Valve Gasket)
(e)	3857-X1	Same as above but with Copper Gasket
(e)	3857-X2	Same as above but with Iron-Lead Gasket
104.	3948-X	Suction Valve Assembly (Spec.3) (Incl. Valve Gasket)
(e)	3948-X1	Same as above but with Copper Gasket
(e)	3948-X2	Same as above but with Iron-Lead Gasket
105.	4032-X	Suction Valve Unloader Assembly

Spec.	Head Assy No.	Model No.
3:	1743-X	690,D690,D690-4,
3:	2579-X	W690,WD690,WD690-4,
3:	3458-X	691,D691
4:	1743-X1	690,D690,D690-4,A690
4:	2579-X1	W690,WD690,WD690-4,WA690
4:	3458-X1	691,D691
7,78,8,9:	1743-X2	690,D690,D690-4
7,78,8,9:	1743-X3	A690
7,78,8,9:	2579-X2	W690,WD690,WD690-4
7,78,8,9:	2579-X3	WA690
7,78,8,9:	3458-X2	691,D691

NOTES:
(c) For O-Ring Material Coding see Page A500.
(d) Not Included in Head Assembly.
(e) Optional.
(f) S/N NQ51455 and later. Earlier models use Gasket #2177



PART NUMBER	PART NAME
1012	Washer
1387	Adjusting Screw
1452-1	Female Packing Ring
1453-1	Male Packing Ring
1454	Packing Ring
1628	Packing Spring
1714	Packing Box Washer
2240	Crosshead Guide
2242	Cylinder
5000-137	Retainer Ring
2-235	'O' Ring

ASSEMBLY NUMBER	ASSEMBLY NAME
1132-X2	Crosshead-Piston Rod Assembly
1452-1X1	Packing Set with 1452-1, 1453-1, 1454 (10), 1628, 1714

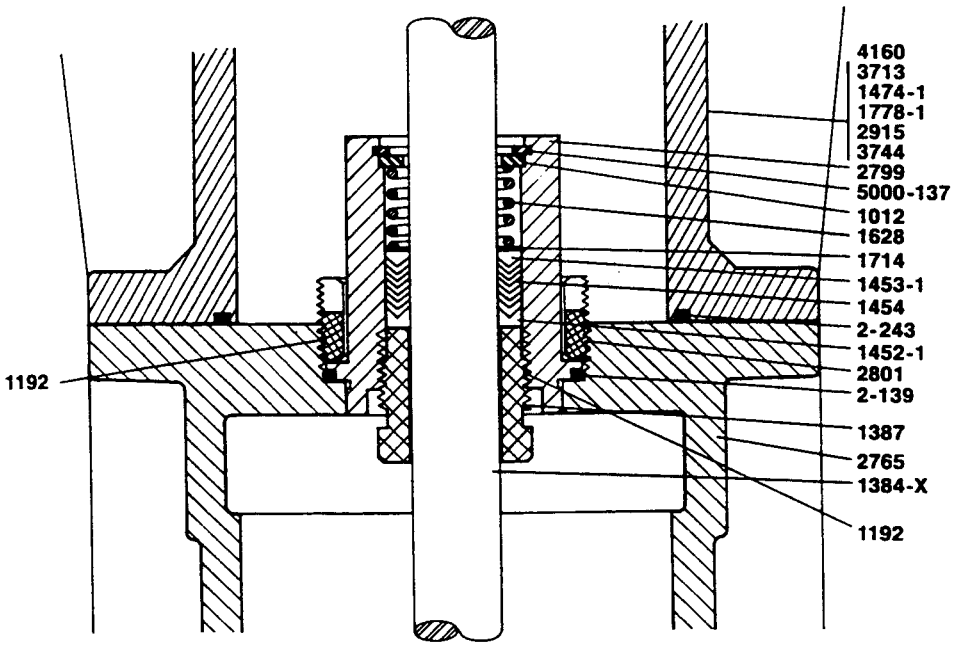
*Optional Equipment

The quantity of 1454 packing rings required will vary due to tolerances.

For 'O' Ring Material Coding see Page A500.

Caution: Always relieve pressure in the unit before attempting any repairs.

PACKING CARTRIDGE DETAILS
MODELS 390, 391, W391, 490, 491 COMPRESSORS
ALL SPECIFICATIONS
S/N XC30633 AND LATER



PART NO.	PART NAME
1012	Washer
1192	Locking Device
1387	Adjusting Screw
1452-1	Female Packing Ring
1453-1	Male Packing Ring
1454	Packing Ring
1474-1	Cylinder (490 Only)
1628	Packing Spring
1714	Packing Box Washer
1778-1	Cylinder (390 Only)
2765	Crosshead Guide
2799	Packing Box Cartridge
2801	Cartridge Holddown Screw
(a) 2915	Cylinder, Ductile Iron (491 Only)
(b) 3713	Cylinder, Ductile Iron (491 Only)
3744	Cylinder (W391 Only)
4160	Cylinder for D391
5000-137	Retainer Ring
2-139	O-Ring (Packing Cartridge)
2-243	O-Ring (Cylinder)

ASSEMBLY NO.	ASSEMBLY NAME
1384-X	Crosshead Assembly
1452-1X1	Packing Set with 1452-1, 1453-1, 1454 (8), 1628, 1714

NOTES:
(a) Prior to S/N FZ44188
(b) S/N FZ44188 and Later.

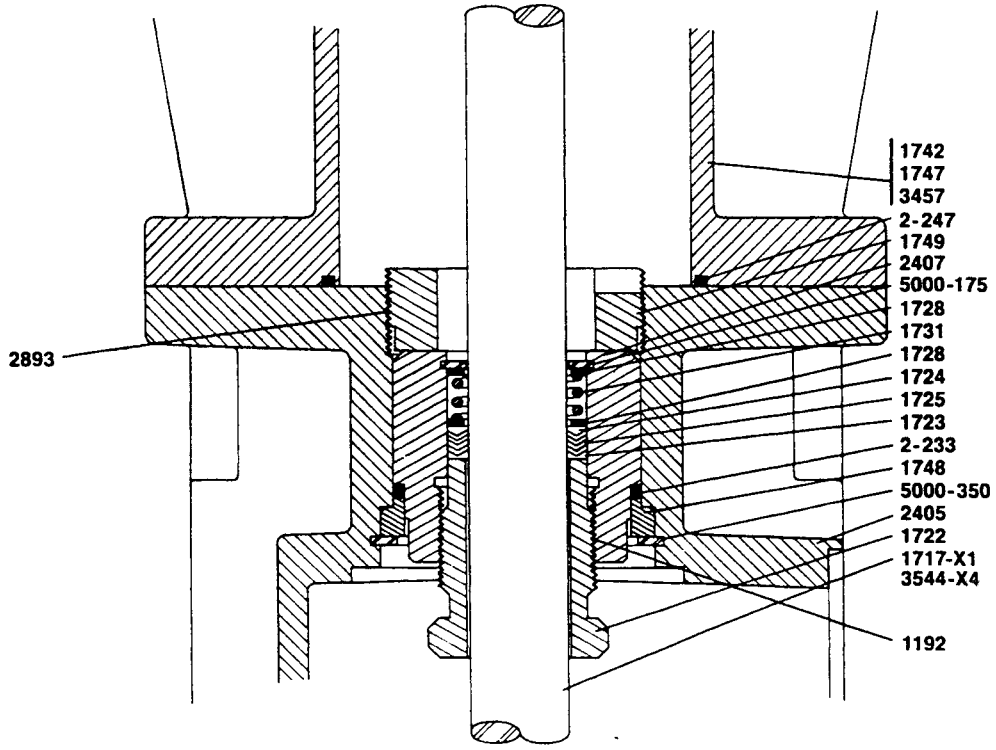
The quantity of 1454 packing rings required will vary due to tolerances.

For O-Ring Material Coding See Page A500.

Use Cone 4005 for Packing Installation.

CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.

PACKING CARTRIDGE DETAILS
MODELS 590, W590, 690, W690, 691 COMPRESSORS
ALL SPECIFICATIONS



PART NO.	PART NAME
1192	Locking Device
1722	Adjusting Screw
1723	Female Packing Ring
1724	Male Packing Ring
1725	Packing Ring
1728	Packing Washer
1731	Packing Spring
1742	Cylinder (690, W690 Only)
1747	Cylinder (590, W590 Only)
1748	Cartridge Plate
1749	Cartridge Holddown Screw
2405	Crosshead Guide
2407	Packing Box Cartridge
2893	Locking Device
3457	Cylinder (691 Only)
5000-175	Retainer Ring
5000-350	Retainer Ring
2-233	O-Ring (Packing Cartridge)
2-247	O-Ring (Cylinder)

ASSEMBLY NO.	ASSEMBLY NAME
1717-X1	Crosshead Assembly "P" Style
1725-X	Packing Set with 1723, 1724, 1725 (4) 1728, 1731
2405-X	Crosshead Guide Assembly with 1748 (2), 2405, 5000-350 (2)
3544-X4	Crosshead Assembly "M" Style

For O-Ring Material Coding See Page A500.

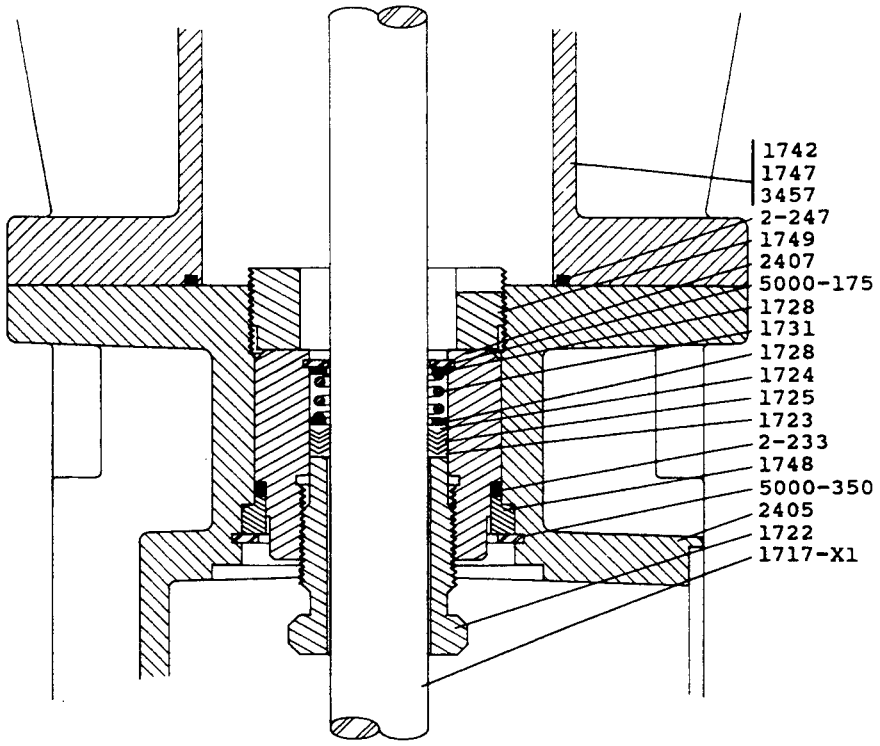
Use Cone 3905 for Packing Installation.

CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.

PACKING CARTRIDGE DETAILS

MODELS 590,W590,690,W690,691 COMPRESSORS

ALL SPECIFICATIONS

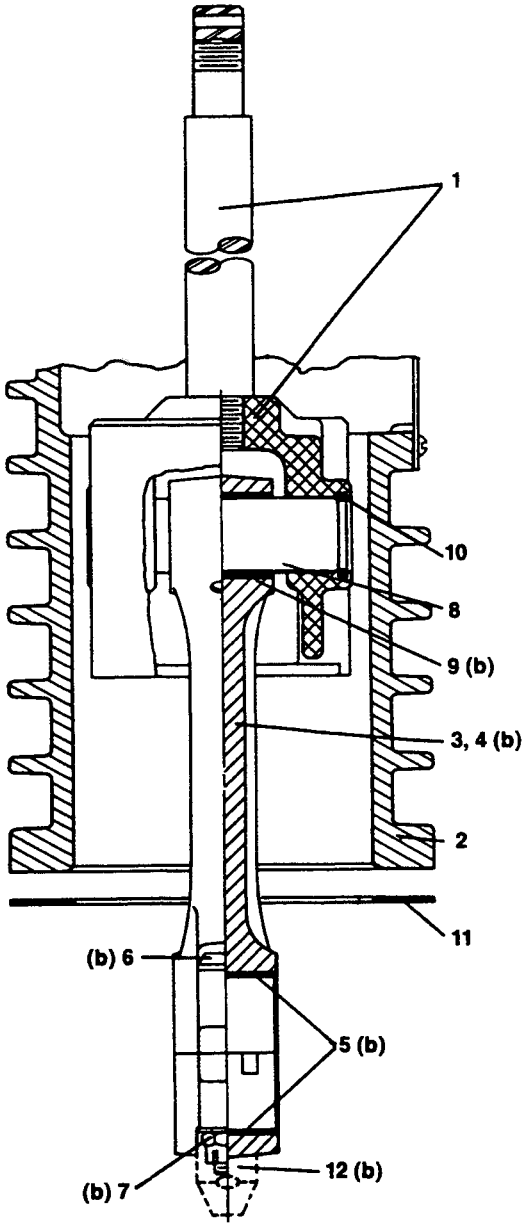


PART NO.	PART NAME
1722	Adjusting Screw
1723	Female Packing Ring
1724	Male Packing Ring
1725	Packing Ring
1728	Packing Washer
1731	Packing Spring
1742	Cylinder (690,W690 Only)
1747	Cylinder (590,W590 Only)
1748	Cartridge Plate
1749	Cartridge Holddown Screw
2405	Crosshead Guide
2407	Packing Box Cartridge
3457	Cylinder (691 Only)
5000-175	Retainer Ring
5000-350	Retainer Ring
2-233	O-Ring, Packing Cartridge
2-247	O-Ring Cylinder

ASSEMBLY NO.	ASSEMBLY NAME
1717-X1	Crosshead-Piston Rod Assembly
1725-X	Packing Set with 1723, 1724, 1725(4), 1728, 1731
2405-X	Crosshead Guide Assembly with 1748(2), 2405, 5000-350(2)

For O-Ring Material Coding See Page A500.

CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.



Refer to Parts List on back side of this sheet.

CAUTION: Always relieve pressure in the unit before attempting any repairs.

CONNECTING ROD AND CROSSHEAD ASSEMBLY DETAILS
ALL MODELS
ALL SPECIFICATIONS

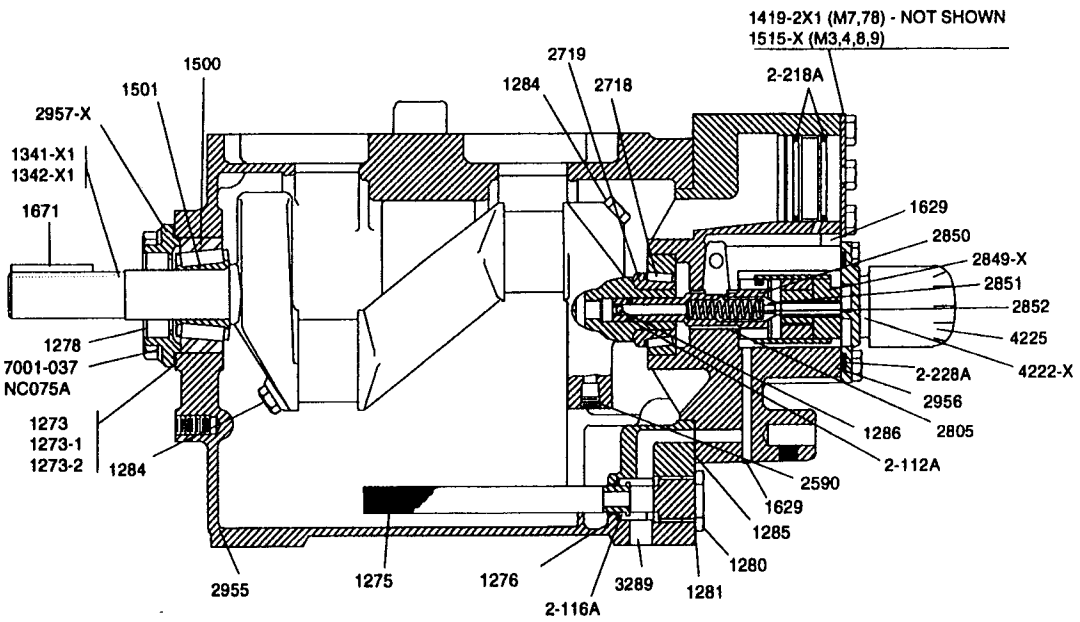
MODEL NUMBER		91	A91 D91	191	A191 D191	T191	291	A291 D291	T291	391 W391 491	A391 WA391 D391 WD391 A491 D491-3 D491	T391 T491-3 T491	A590 WA590 D590 WD590 A691 WA690 D691 D691-4 D691 WD690 WD690-4 SPEC. K,P ONLY	590 W590 W690 691 SPEC. K,P ONLY	A590 WA590 D590 WD590 A691 WA690 D691 D691-4 D691 WD690 WD690-4 SPEC. K,P ONLY	590 W590 W690 691 SPEC. K,P ONLY	D791 D891
NO.	DESCRIPTION																
1.	Crosshead Assembly	1132-X2	1132-X3	1132-X1 (g) 1132-X2	1132-X3 1132-X4	1132-X8 (g) 1132-X7 1132-X9 (f) 1132-X10 (f)(g)	1132-X2 (f)	1132-X3 1132-X5	1132-X7 1132-X9 (f)	1384-X	1384-X1 1384-X4 (f)	1384-X2 1384-X3 (f)	1717-X	1717-X1	3544-X5	3544-X4	3544-X3
2.	Crosshead Guide	2240	2240	4393	4383	4383	4393	4383	4383	2765(h) 1366(j)	2773-X	2773-X	1716-X	2405-X	1716-X	2405-X	2405-X
3.	Conn. Rod Assy.	1889-1X	1889-1X	1889-X	1889-X	1889-X	1889-X	1889-X	1889-X	1490-X	1490-X	1490-X	1720-X	1720-X	3785-X1	3785-X1	3785-X1
4.	Conn. Rod	1889-1	1889-1	1889	1889	1889	1889	1889	1889	1490	1490	1490	1720	1720	3785	3785	3785
5.	Conn. Rod Bearing	1367	1367	1367	1367	1367	1367	1367	1367	1491	1491	1491	1719	1719	3542	3542	3542
6.	Bolt	1599	1599	1599	1599	1599	1599	1599	1599	1492	1492	1492	1726	1726	1726	1726	1726
7.	Nut	1600(c)	1600(c)	1600(c)	1600(c)	1600	1600(c)	1600(c)	1600	1493(d)	1493(d)	1493(d)	1727(e)	1727(e)	1727(e)	1727(e)	1727(e)
8.	Wrist Pin	2505	2505	2505	2505	2505	2505	2505	2505	1496	1496	1496	1718	1718	3540	3540	3540
9.	Wrist Pin Bushing	1846(a)	1846(a)	1846(a)	1846(a)	1846(a)	1846(a)	1846(a)	1846(a)	1495(a)	1495(a)	1495(a)	1495(a)	1495(a)	3541(k)	3541(k)	3541(k)
10.	Retainer Ring	1498	1498	1498	1498	1498	1498	1498	1498	1498	1498	1498	1498	1498	3590	3590	3590
11.	Crankcase Gasket	2526	2526	2702	2702	2702	2702	2702	2702	1489	1489	1489	1761	1761	1761	1761	1761
12.	Dipper	2011	2011	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

NOTES:

(a) Must be rebored after replacing (0.8754/0.8751 Dia.)
(b) Included with Conn. Rod Assembly
(c) Torque Conn. Rod Nut to 28 ft.lbs.
(d) Torque Conn. Rod Nut to 30 ft.lbs.
(e) Torque Conn. Rod Nut to 40 ft.lbs.
(f) Optional Chrome Oxide Piston Rods Only
(g) Second Stage (Smaller Piston)
(h) S/N XC30633 and Later
(j) Prior to S/N XC30633
(k) Must be rebored after replacing (1.1256/1.1252 Dia.)

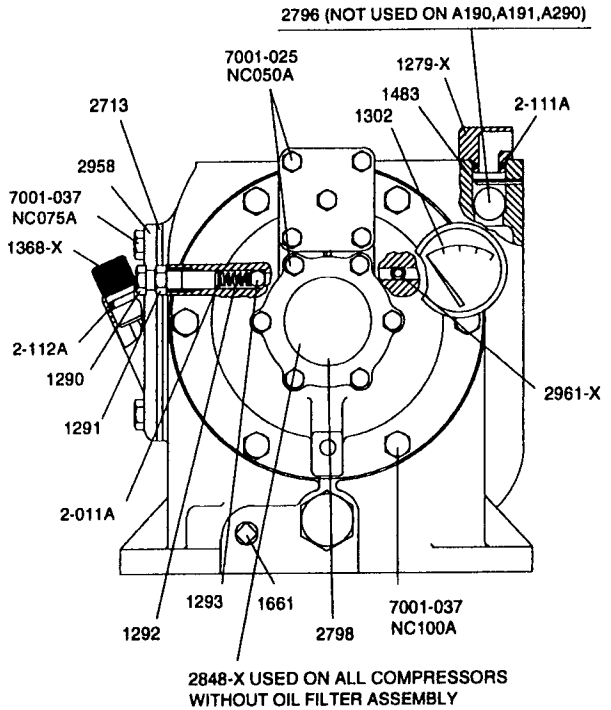
Never attempt to separate the Piston Rod and Crosshead. When repair becomes necessary the entire Crosshead Assembly must be replaced.

IDENTIFICATION OF CRANKCASE SPEC.:			
EXAMPLE:	MODEL NO. A191	M	4FBA
	291	M	78FBAB
	D290	M	9FBA
CRANKCASE SPEC.			



CRANKCASE ASSEMBLY NO. 2955-X1 (M3,4,8,9)
CRANKCASE ASSEMBLY NO. 2955-X2 (M7,78)

2549-X1 FLYWHEEL ASSEMBLY NOT SHOWN
OPT. FLYWHEEL ASSEMBLY 3271-X1 NOT SHOWN



2848-X USED ON ALL COMPRESSORS
WITHOUT OIL FILTER ASSEMBLY

CAUTION: ALWAYS RELIEVE PRESSURE IN THE UNIT BEFORE ATTEMPTING ANY REPAIRS.

CRANKCASE DETAILS
ALL MODELS 191 - 291
COMPRESSORS
CRANKCASE SPECIFICATION: M

PART NO.	PART NAME
1273	Bearing Adjustment Shim (0.005")
1273-1	Bearing Adjustment Shim (0.007")
1273-2	Bearing Adjustment Shim (0.020")
1275	Oil Filter Screen
1276	Filter Screen Washer
1278	Oil Seal
1279	Breather Cap
1280	Filter Screw
1281	Filter Screen Screw Gasket
1284	Crankshaft Orifice (2)
1285	Bearing Carrier Gasket
1286	Pump Shaft Drive Pin
1290	Relief Valve Adjusting Screw
1291	Adjusting Screw Locknut
1292	Relief Valve Spring
1293	Relief Valve Ball
1302	Oil Pressure Gauge
1368-X	Oil Bayonet
1483	Piston Lock Pin - 1/8 x 1"
1500	Bearing Cup
1501	Bearing Cone
1629	Pipe Plug - 1/16 NPT, Flush Seal
1661	Pipe Plug - 3/8 NPT
1671	Flywheel Key
2590	Pipe Plug - 1/8 NPT, Flush Seal
2713	Crankcase Inspection Plate Gasket
2718	Bearing Cup
2719	Bearing Cone
2796	Breather Ball
2798	Pump Cover Pin
2805	Pump Shaft Bushing
2848-X	Pump Cover (Includes Pin)
2849-X	Oil Pump Assembly (Individual pump parts not available)
2850	Pump Shaft Adapter
2851	Spring Guide
2852	Oil Pump Spring
2955	Crankcase
2956	Bearing Carrier
2957	Bearing Cover
2958	Crankcase Inspection Plate
3289	Pipe Plug - 1/4 NPT, Flush Seal
4222-X	Oil Filter Assembly
4225	Filter
2-011A	O-Ring (Relief Valve Adj. Screw)
2-111A	O-Ring (Breather Cap)
2-112A	O-Ring (Oil Bayonet)
2-112A	O-Ring (Pump Shaft)
2-116A	O-Ring (Filter Screen)
2-218A	O-Ring (Closure Body) (2 Required) (Spec 3, 4, 8, 9 Only)
2-228A	O-Ring (Pump Cover)
7001-025 NC050A	Bolt, 1/4-20 x 1/2, Hex Head
7001-037 NC075A	Bolt, 3/8-16 x 3/4, Hex Head
7001-037 NC100A	Bolt, 3/8-16 x 1, Hex Head

ASSEMBLY NO.	ASSEMBLY NAME
1279-X	Breather Cap Assembly with 1279, 2-111A
1341-X1	Crankshaft Assembly with 1284 (2), 1286, 1341, 1501, 2590, 2719
(a) 1342-X1	Extended Crankshaft Assembly with 1284 (2), 1286, 1342, 1501, 2590, 2719
1368-X1	Oil Bayonet Assembly with 1368-X, 2-112A
1419-2X1	Hydraulic Unloader Assembly (Up to 200 psi) (Spec 7, 78 Only)
(a) 1419-2X2	Hydraulic Unloader Assembly (200 psi & Above) (Spec 7, 78 Only)
1515-X	Closure Cap Assembly including 2-218A (2) (Spec 3, 4, 8, 9 Only)
2549-X1	Flywheel Assembly, 16" O.D. 3 Groove with 2549 and 3218 (Not part of Crankcase Assembly) (Not Shown)
2956-X	Bearing Carrier Assembly with 1285, 1290, 1291, 1292, 1293, 1515-X, 2718, 2805, 2806 (2), 2848-X, 2849-X, 2850, 2851, 2852, 2956, 2961-X, 2-011A, 2-112A, 2-228A.
2957-X	Bearing Cover Assembly with 2957 and 1278
2961-X	Air Release Valve Assembly with 2961, 2962, 2963
(a) 3271-X1	Flywheel Assembly, 14" O.D. 2 Groove with 3218 and 3271 (Not part of Crankcase Assembly) (Not Shown)
4222-X	Oil Filter Assembly with 4222, 4225, 2798 (Standard on All Models Starting January 1, 1993)

NOTE:
(a) Optional Equipment

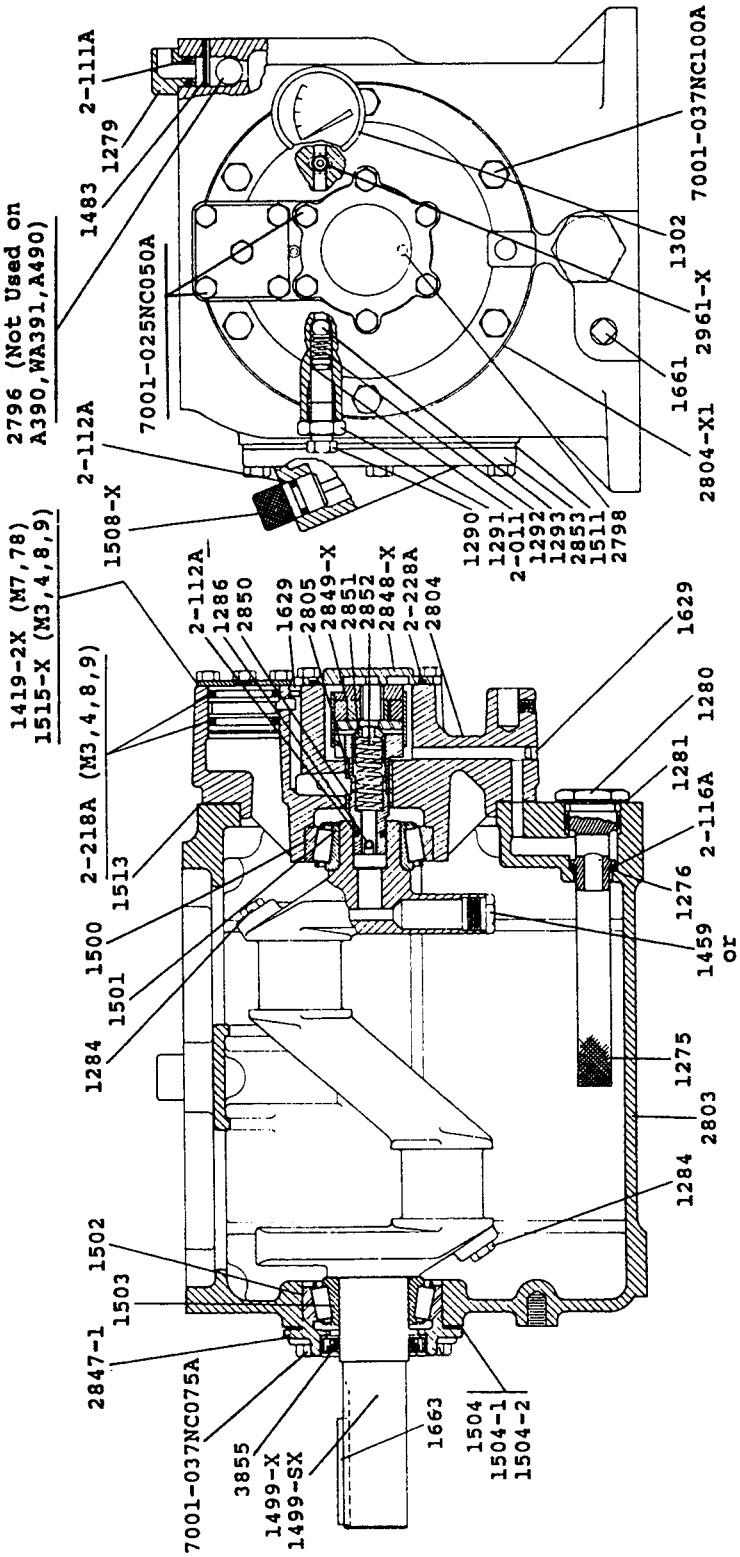
Crankcase Capacity: 1.5 Quarts (1.4 Liters)

CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs.

CRANKCASE ASSEMBLY NO. 2803-X; M3, 4, 8, 9
CRANKCASE ASSEMBLY NO. 2803-X1; M7, 78

IDENTIFICATION OF CRANKCASE SPEC.:

Example: Model No.	Crankcase Spec.	
A390	M	4FBA
491	M	78FBAB
D491	M	9FBA



CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs

2549-X Flywheel Assembly Not Shown
Optional Flywheel Assembly 3271-X Not Shown

CRANKCASE DETAILS
MODEL 390,W391,A390,WA391,D390,T390,WD391,WT391,490, 491,A490,D490,D490-3,D491,T490-3,T491 COMPRESSORS
CRANKCASE SPEC.: M

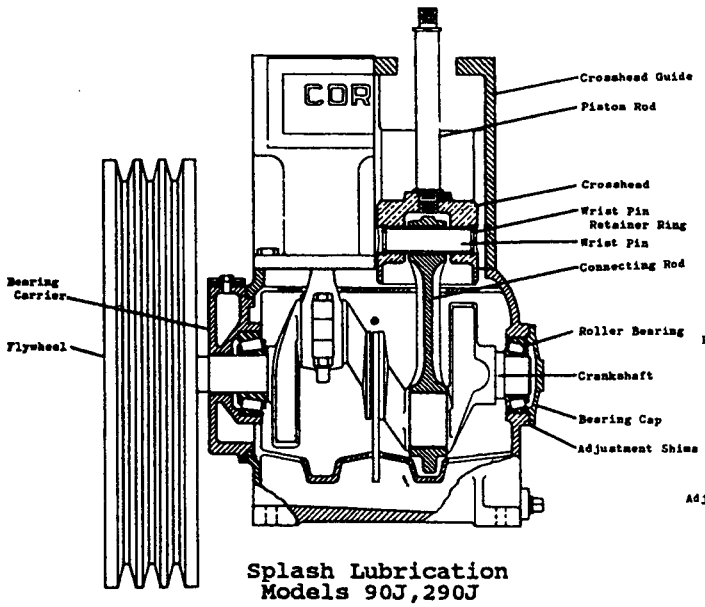
PART NUMBER	PART NAME
1275	Oil Filter Screen
1276	Filter Screen Washer
1279	Breather Cap
1280	Filter Screw
1281	Filter Screen Screw Gasket
1284	Crankcase Orifice(2)
1286	Pump Shaft Drive Pin
1290	Relief Valve Adjusting Screw
1291	Adjusting Screw Locknut
1292	Relief Valve Spring
1293	Relief Valve Ball
1302	Oil Pressure Gauge
1459	Crankshaft Plug
1483	Lock Pin
1499	Crankshaft
*1499-S	Extended Crankshaft
1500	Bearing Cup
1501	Bearing Cone
1502	Bearing Cup
1503	Bearing Cone
1504	Bearing Adjustment Shim (0.005")
1504-1	Bearing Adjustment Shim (0.007")
1504-2	Bearing Adjustment Shim (0.020")
1508-X	Oil Bayonet
1511	Crankcase Inspection Plate Gasket
1513	Bearing Carrier Gasket
1629	1/16" NPT Pipe Plug, Flush Seal
1661	Plug 3/8" NPT
1663	Flywheel Key
2549	Flywheel, 16" O.D. 3 Groove (Requires 3217 Flywheel Bushing for Mounting. See Assembly No. 2549-X) (Not Part of Crankcase Assembly) (Not Shown)
2590	Pipe Plug
2796	Breather Ball
2798	Pump Cover Pin with 2848-X
2803	Crankcase
2804	Bearing Carrier
2805	Pump Shaft Bushing
2847-1	Bearing Cover
2848-X	Pump Cover
2849-X	Oil Pump Assembly (Individual Pump Parts Not Available)
2850	Pump Shaft Adapter
2851	Spring Guide
2852	Oil Pump Spring
2853	Crankcase Inspection Plate
2961-X	Air Release Valve Assembly with 2961, 2962, 2963
3217	Flywheel Bushing (Not Part of Crankcase Assembly) (Not Shown)
*3271	Flywheel, 14" O.D. 2 Groove (Requires 3217 Flywheel Bushing for Mounting. See Assembly No. 3271-X) (Not Part of Crankcase Assembly) (Not Shown)
3855	Oil Seal

PART NUMBER	PART NAME
2-011A	O-Ring(Relief Valve Adjusting Screw)
2-111A	O-Ring(Breather Cap)
2-112A	O-Ring(Oil Bayonet)
2-112A	O-Ring(Pump Shaft)
2-116A	O-Ring(Filter Screen)
2-218A	O-Ring(Closure Body)(2)(Spec.3,4,8,9 Only)
2-228A	O-Ring(Pump Cover)
7001-025 NC050A	Hex Head Bolt 1/4-20 x 1/2
7001-031 NC075A	Hex Head Bolt 5/16-18 x 3/4
7001-037 NC075A	Hex Head Bolt 3/8-16 x 3/4
7001-037 NC100A	Hex Head Bolt 3/8-16 x 1

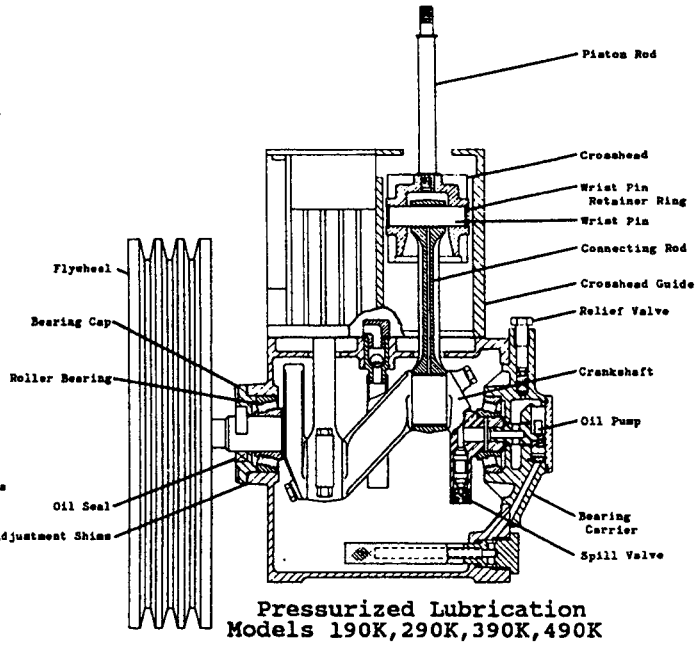
ASSEMBLY NUMBER	ASSEMBLY NAME
1279-X	Breather Cap Assembly with 1279, 2-111A
1419-2X1	Hydraulic Unloader Assembly (Up to 200 PSI) (Spec.7,78 Only)
*1419-2X2	Hydraulic Unloader Assembly (200 PSI and above)(Spec.7,78 Only)
1499-X	Crankshaft Assembly with 1284(2), 1286,1499,1501,1503,2590
*1499-SX	Extended Crankshaft Assembly with 1284(2),1286,1499-S,1501,1503,2590
1508-X1	Oil Bayonet Assembly with 1508-X 2-112A
1515-X	Closure Cap Assembly including 2-218A(2),(Spec.3,4,8,9 Only)
2549-X	Flywheel Assembly with 2549,3217 (Not Part of Crankcase Assembly) (Not Shown)
2804-X1	Bearing Carrier Assembly with 1290, 1291,1292,1293,1500,1508-X1,1513, 1515-X,1629(2),2590,2804,2848-X, 2849-X,2850,2851,2852,2961-X,2-011A, 2-112A,2-228A
2847-1X	Bearing Cover Assembly with 2847-1, 3855
*3271-X	Flywheel Assembly with 3271,3217 (Not Part of Crankcase Assembly) (Not Shown)

*Optional Equipment
Crankcase Capacity: 3 Quarts (2.8 Liters)

CAUTION: Always Relieve Pressure In The Unit Before Attempting Any Repairs



Splash Lubrication
Models 90J,290J



Pressurized Lubrication
Models 190K,290K,390K,490K

TABLE OF SIZES

Parts Fitted	Compressor Model 90J,190K 290J,290K	390K,490K
Crankcase Pin Diameter	1.7500/1.7505	1.7500/1.7505
Wrist Pin Diameter	.8748	.8748
Wrist Pin Bushing Bore	.8755	.8755
Crosshead Diameter	3.429/3.431	3.994/3.996
Wrist Pin Boss Bore	.8748/.8752	.8748/.8752
Piston Rod Diameter	.7490/.7500	.7490/.7500
Crosshead Bore	3.4350/3.4370	4.000/4.002

DISASSEMBLY OF COMPRESSOR

1. Remove the cylinder head, pistons, cylinder and adapter plates (stuffing boxes) according to the method outlined for the specific model involved.
2. Remove the crosshead guide.
3. Remove the crosshead-piston rod assembly from the connecting rod by removing the wrist pin retainer rings and wrist pin. Use a soft object to drive out the pin. Use your hand to "back-up" the crosshead while driving out the pin. The piston rod and connecting rod are easily knocked out of alignment.
4. Remove the crankcase inspection plate and disassemble the connecting rod.

5A. Removing the crankshaft on splash lubricated Models 90J and 290J compressors only.
   a. Remove the flywheel, the bearing cap and bearing carrier.
   b. Remove the crankshaft.

5B. Removing the crankshaft on pressure lubricated Models 190K, 290K, 390K, 490K compressors only.
   a. Remove the flywheel, bearing cap and bearing carrier.
   b. Remove the crankshaft.

INSPECTION OF PARTS

1. After cleaning all parts, inspect them carefully to determine which ones are reusable.
2. Crankshaft
   a. Check for score marks and metallic pick-up. Slight score marks can be cleaned up with crocus cloth soaked in oil.
   b. With a micrometer, check the diameter of the crank pins. If the diameter is less than the limits, or if it is out-of-round, replace the crankshaft and the roller bearing cones.
3. Connecting Rod
   a. With an inside micrometer, check the diameter of the wrist pin bushing. If the diameter exceeds the limits, press out the old bushing. On some older Model 90 and 290 compressors, the pin end of the rod must be rebored to .995/.997" D.
4. Wrist Pin
   a. With a micrometer, check the diameter of the pin. If the diameter is less than the limits, replace the pin.
5. Crosshead-Piston Rod Assembly
   a. With a micrometer, check the diameter

of the crosshead, the wrist pin bosses and the piston rod. If the diameters are outside the limits, replace the assembly.
b. Scuff marks or scoring on the crosshead will not cause any harm.
c. The piston rod must be perfectly smooth.

6. Bearing Carrier Assembly on Model 190K, 290K, 390K, 490K Compressors only.
a. If the oil pressure has been satisfactory before reconditioning, this assembly may be reused after cleaning. If the oil pressure has been low, and if the relief valve has been adjusted inward completely, the complete bearing carrier assembly should be replaced. The pump parts are ground to a precision dimension after assembly, so separate oil pump parts cannot be supplied. A new bearing carrier includes the oil pump assembly and the roller bearing cup.

7. Crankshaft Oil Seal on Model 190K, 290K, 390K 490K Compressors only.
a. It is a good safety precaution to replace the oil seal regardless of appearance.

8. Crosshead Guide
a. Very little wear takes place on the bore of the crosshead guide.

9. Main Bearings
a. If the tapered roller bearings, cups or cones, are galled or pitted replace them.
b. The cones located on the shaft and the cup in the bearing carrier may be removed with a wheel puller. The cone in the crankcase may be driven out with a soft object.
c. Proper bearing installation procedure must be followed.

10. Crankshaft "spill" valve on Model 190K, 290K, 390K, 490K Compressors only.
a. Some pressurized crankshafts are equipped with "spill" valves.
b. Unthread the seat and inspect the seat, valve and spring. Replace as required.

ASSEMBLY OF PARTS

1. Connecting Rod
a. To install the wrist pin bushing, heat the pin end of the rod: Aluminum rods to approximately 212°F; Iron rods to 450°F.
b. Some rods are "rifle" drilled for pressurized lubrication of the pin bushing, and some are plain rods for "splash" lubrication. For pressurized lubrication the pin bushing has a hole which must line-up exactly with the "rifle" drilling of the rod. For splash lubrication, after the bushing has been inserted, drill through the bushing at the two drilled holes in the pin end of the rod.
c. Bore the pin bushing. The fit between the pin and the bushing should be almost a selective fit. The bore must be exactly parallel to the bore of the crank end of the rod.

2A. Assemble Crankshaft in Crankcase of Model 90J and 290J Compressors only.
a. Insert the crankshaft and install the bearing carrier.
b. Install the bearing cover with the original shims for adjustment.
c. If any looseness should be apparent, remove one or more of the shims, rap the end of the crankshaft several times and replace the bearing cap. Turn the compressor over by hand to make sure the bearings are not too tight. If the compressor does not turn as easily as it did before the shim was removed, the adjustment will have been unnecessary and the shim will have to be replaced.

2B. Assemble Crankshaft in Crankcase of Model 190K, 290K, 390K, 490K Compressors only.
a. Insert the crankshaft and install the bearing carrier.
b. Install the bearing cover with the original shims for adjustment. Care must be taken not to damage the oil seal while slipping it over the crankshaft.
c. Follow 2A-c instruction above.

3. Flywheel
a. Tighten the bolt of the flywheel clamp tighter than seems necessary. A slightly loose flywheel will make a sound like a "knock" when the compressor is running.

4. Crosshead-Piston Rod Assembly
a. Assemble the crosshead to the connecting rod by tapping (with a soft mallet)the pin through the bosses of the crosshead and the pin bushing. Use your hand to "back-up" the crosshead while driving in the pin.
b. Be sure the retainer rings are fully engaged in the grooves of the crosshead bosses.
c. Insert the connecting rod bearings in the rod and cap lock notches. Be sure the oil hole in the bearing is in line with the oil hole in the rod.

5. Attaching the connecting Rod to the Crankshaft
a. Oil the rod and crankpin.
b. IT IS IMPORTANT THAT THE ARROW ON THE ROD AND THE ARROW ON THE CAP LINE UP.
c. Attach the rod to the crankpin with the lockwashers and locknuts.
d. Tighten the nuts with a torque wrench to 33 ft-lbs. Back off the nuts and retighten to 28 ft-lbs. This will assure a tight fit of the rod to the shaft and avoid the possibility that the nuts may be tight in the threads while the rod is still slightly loose on the shaft.

6. Assemble the Crosshead and Crosshead Guide
a. Oil the crossheads and bring them to equal positions on the crank. After installing the crankcase gasket, lower the crosshead guide block over the crossheads. Normally, the crosshead guide inspection plate is opposite the crankcase inspection plate, but this is not necessary.
b. Bolt the crosshead guide to the crankcase with uniform bolting pressure. Turn the flywheel over by hand to be sure everything is free.

7. Assemble the Cylinder and Pistons
a. Follow the instructions for the specific compressor model involved.

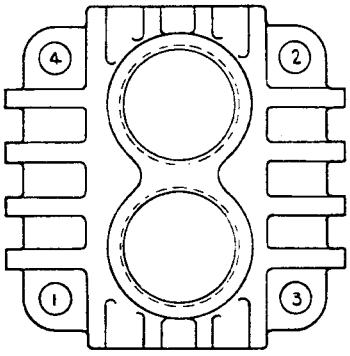
BOLT TORQUE VALUES
(ft-lbs)

Model	Con Rod Bolt	Bearing Carrier	Bearing Cover	Crank Case Inspec. Plate	Crank Case to X-head Guide	X-head Guide to Cyl.	X-head Guide to D-piece	D-piece to Cyl.	Cyl. to Head *	Valve Cover Plate	Valve Hold-down Screw
91	28	38	38	15	30	30	30	30	20	—	—
291	28	30	30	13	25	25	25	25	20	—	—
191	28	30	30	13	25	25	25	25	20	—	—
491	30	26	35	8	33	33	33	33	33	35	40
391	30	26	35	8	33	33	33	33	33	35	40
691 591	40	40	40	9	40	40	40	40	30	37	40

* See following drawings for tightening sequence

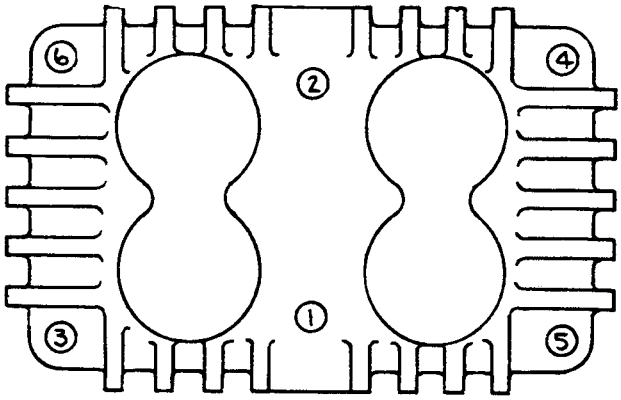
HEAD TO CYLINDER TORQUE SEQUENCE

Preliminary Tightening - Snug up all bolts in sequence shown.



MODELS 91, A91, D91

Final Torquing - Torque all bolts to 20 ft.lbs. in the sequence shown.

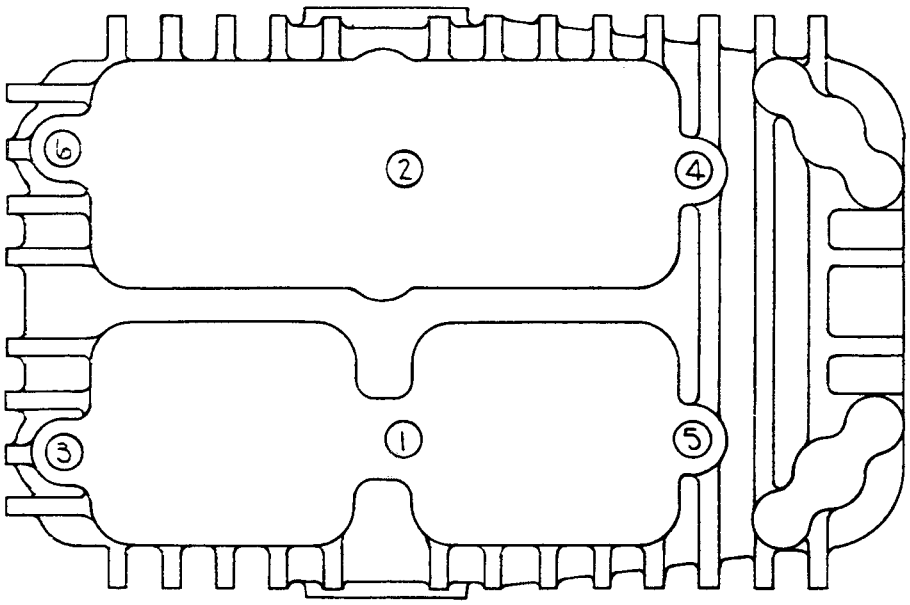


MODELS 291, A291, D291

Final Torquing - Torque all bolts to 20 ft.lbs. in the sequence shown.

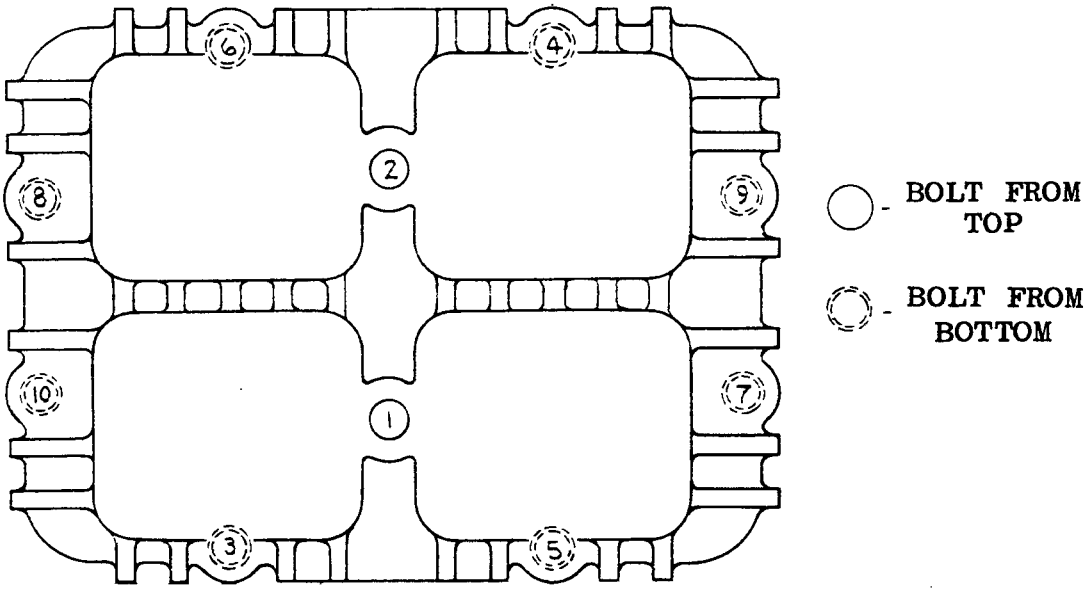
HEAD TO CYLINDER TORQUE SEQUENCE

Preliminary Tightening - Snug up all bolts in sequence shown.



MODELS A391, D391

Final Torquing - Torque all bolts to 33 ft.lbs. in the sequence shown.



MODELS 491, A491, D491, 491-3, D491-3

Final Torquing - Torque all bolts to 33 ft.lbs. in the sequence shown.

SERVICE BULLETIN

8-74
#2

CORKEN

CORKEN, INC. • A Unit of IDEX Corporation

P. O. Box 12338, Oklahoma City, OK. 73157
3805 N.W. 36th St., 73112 • Fax (405) 948-7343
Phone (405) 946-5576 • Telex 262513 Corkn Ur

TROUBLESHOOTERS' GUIDE
LIQUEFIED GAS TRANSFER COMPRESSORS

PROBLEM	CAUSE	WHAT TO DO
Slow Transfer	Belts loose and slipping	Tension is correct when thumb can depress belts slightly less than 1" with firm pressure.
	Four-Way Valve Dry	Lubricate it. Use stick lubricant of the proper specifications. A very dry valve will usually require several sticks to make a seal. When properly lubricated the handle will move with some difficulty. To test for four-way valve leakage, close the suction line valve and vent the liquid trap through the drain valve. The discharge gauge should hold pressure as the suction gauge goes down to 0 psi. If the discharge gauge loses pressure either the four-way valve or the compressor discharge valve is leaking (see below). If lubrication fails to seal the four-way valve, take it apart to clean and inspect for damage.
	Compressor Valves	Check the valves by closing the suction line valve with the compressor running. The suction gauge should pull down to 0 psi as the valve is closed. If it does not, then remove the suction valves and inspect for foreign matter under the disc, a broken spring or a broken disc. Repair or replace as necessary. Shut down the compressor when the pressure is reduced to a minimum and note the time required to break the vacuum. If the pressure rises readily, the discharge valves are leaking and should be checked. Next, open the suction line and repeat the procedure with the discharge line valve. The discharge gauge should increase almost immediately to 250 lbs. (Note: Safety relief valve may release with considerable noise.) If this pressure is not reached rapidly, then remove the discharge valves, inspect and replace if necessary.

PROBLEM	CAUSE	WHAT TO DO
	Worn Piston Rings	The condition of the piston rings can be determined during the discharge valve test. Note the time required to pull to 0 and increase to 250 lbs. If it is slow but steady on the discharge test, this indicates that piston rings are worn or broken and should be replaced.
	Clogged Strainer	Inspect strainer for foreign matter and clean it thoroughly.
	Liquid or Vapor Line Too Small or Too Long	Use pipe sizes as recommended in Corken instructions.
Gas escaping through crankcase breather	The Packing is Leaking	Remove the crosshead guide inspection plate and adjust the packing nut. This is done with pressure on the compressor but without the compressor running. The packing nut is tightened just enough to stop the leakage. Use the special wrench attached to the compressor. If adjustment does not stop the leakage the packing should be replaced. (60 minutes). Refer to service manual page E 822.
Oil Leakage Around Base of Compressor	Leaking Gas Blowing Oil Out Through Crankcase Breather	Refer to "packing leaks" above.
	Failure in Oil Seal	Replace Oil Seal.
No Oil Pressure	No Oil In Crankcase	Check the crankcase oil level with the dip stick. Model 290 requires three pints, Model 490 requires four pints. Use the same weight motor oil you use in your truck engines for that particular season of the year. Change oil several times a year - at least with every major season change. If the compressor is located in an unusually dirty atmosphere (transport mounted for example), change oil more often. If compressor RPM is less than 400, use heavier oil, such as SAE 40.

PROBLEM	CAUSE	WHAT TO DO
	Oil Pump Not Working	Remove the oil pressure gauge, place your thumb over the openings and start the compressor. (You can hold the pressure easily.) Lift your thumb slightly to determine if oil pump is working. If there is no oil pressure, remove the oil pump cover plate (part no. 1272). Press in on the cam (part no. 1297) with the fingers and turn in the direction of rotation until the cam turns about 5/8". If cam will not move, remove it and inspect for burrs on the O.D. Clean and replace. Test for performance as above. Inspect the bypass spring and ball seat. Adjust the spring tension to hold a pressure of 15 to 20 lbs., approximately the middle of the gauge. Tighten lock nut on oil pressure adjusting pressure screw.
Noise in Compressor	Loose Flywheel	Tighten flywheel clamp bolt.
	Valves Bad	Proceed as above under "compressor valves".
	Worn Internal Parts	Visually inspect through access plate in crosshead guide and crankcase. Repair or replace parts as necessary.
	Loose Belts	Tighten belts by turning the adjusting nut on the slide rail motor mount.
	Loose Gland Nut	Remove inspection plate on crosshead guide and inspect gland nut. Tighten with special wrench attached to compressor if necessary.
	Liquid Coming Into Compressor	Check to make sure no liquid line is connected to vapor line. If this condition is chronic, install liquid trap.
Flow Stops	Liquid Trap Full	Bleed off liquid through drain valve in liquid trap and then release vacuum in suction line by opening vent valve at the top of the liquid trap.
	Excess Flow Valves Slugged	Stop the compressor until the excess flow valve opens. If the excess flow valve continues to close, throttle a valve on the inlet of the compressor. If the condition repeats from day to day, install a bypass line with a globe valve between the compressor outlet and inlet. Controlling this bypass stream will prevent excess flow valve closure.

PROBLEM	CAUSE	WHAT TO DO
Motor Troubles Starter Kicks Out Motor Overheats	Low Voltage	Check motor nameplate for motor voltage and measure line voltage at motor with voltmeter. Check voltage with motor operating under load as well as line voltage with motor off. More than 5% voltage difference indicates wiring is too small for length of run. Motors are normally O.K. for voltage 10% above or below the nameplate rating. Beware of low voltage on rural lines.
	Motor Wired Wrong	Most modern motors are dual voltage (115/230 single phase of 220/440 three phase) and the leads in the motor junction box must be wired correctly for the voltage required. Check wiring with diagram on motor plate.
	Wrong Power Characteristics.	Voltage, phase and frequency all must coincide with motor nameplate.
	Overload Heaters in Switch Gear Wrong Size	Check motor load with ammeter and confirm heater size with manufacturer's instructions.
	Compressor Overloading	Too high discharge pressure with high inlet pressure. Reduce compressor speed in accordance with manufacturer's suggestions.
	Motor Shorted Out	T.E.F.C. (totally enclosed) and explosion proof motors are subject to moisture accumulation inside when used intermittently. This is brought about by hot-cold "breathing" of moist air into motor housing. Many motor burnouts are a direct result of a "wet" motor. To preclude troubles, allow unit to operate at least once a week for several hours continuously. This is not necessary during off seasons when equipment is not normally operating.
	Bad Motor Bearing	Over-greasing causes bearing to run hot. Lubricate twice a year per manufacturer's instructions.
	Excessively High Temperatures - Poor Ventilation	Protect motor and switch gear from direct sun in very hot weather. Assure good ventilation.

ENGINEERING BULLETIN

CORKEN

CORKEN, INC. • A Unit of IDEX Corporation

THE RELATIVE ADVANTAGES OF LIQUID PUMPS & VAPOR COMPRESSORS

Very few LP-Gas plants operate without transfer compressors, but too few plant operators probably understand why they use these compressors rather than liquid pumps. The advent of new types of tank cars, more emphasis on truck-transport, and the ever-changing propane distribution industry leads one to believe that a reexamination of the benefits and limitations of vapor-transfer might be well taken at this time. Some of the questions to be considered are:

-- Why do we use vapor compressors rather than liquid pumps for many LPG transfer applications?
-- Which method is most desirable?
-- Horsepower for horsepower, which will pump the most product?
-- Which system has the least maintenance?
-- In short, should you use liquid pumps or compressor on your next bulk plant?

LIMITATIONS OF LIQUID PUMPS

The nature of a liquefied gas presents a very real challenge to the liquid pump. The fact that pressurized liquefied gases are always stored exactly at their boiling point lies at the heart of most pumping problems. Since the liquid is ready to vaporize, any reduction in pressure or any increase in the temperature causes boiling. These conditions occur quite readily in piping leading to the pump inlet. When suction piping is heated in the sun, for instance, it is quite normal to have a mixture of liquid and vapor in the pump suction. Similarly, with flow through too small an inlet pipe, the pressure drop caused by fluid friction will allow the liquid to boil. This condition can be confirmed visually with a sight glass at the pump inlet.

A question to ask when applying pumps to liquefied gas is "will the gas flow by gravity through the suction piping in sufficient capacity to feed the pump?" Don't expect the pump to "pull" liquid in! A pump "pulls" by dropping the inlet pressure, and this is undesirable since this pressure drop causes additional boiling.

But why not pump a boiling liquid? First, the positive displacement pumps used in this service will handle a gallon of vapor thinking it is a gallon of liquid. With only moderate vaporization in the pump inlet, it is possible to have 25 to 30% vapor in the pumpage. Pump capacity is cut in a similar proportion. Second, the mechanical seal in the pump is designed to operate with a fluid film between the seal faces. Flashing of product in the pump because of poor suction conditions must lead ultimately to unusual seal wear. And, finally, all the internal pump parts are subject to abnormal wear when vapor replaces the cushioning liquid. To the knowledgeable plant operator the audible "cavitation" noise associated with poor suction conditions acts as a warning signal of premature pump failure.

Since most existing tank cars for liquefied gases have only top openings, it is quite obvious that they cannot meet the pump's requirement of a "gravity flooded suction". This means the pump has to "pull" the liquid

over the siphon leg, with the inevitable problems mentioned here. This is one of the basic reasons for the use of alternative means for unloading tank cars of liquefied gas.

HOW IS LIQUID TRANSFERRED WITH VAPOR?

All gas plant operators have noted that a tank car readily starts unloading itself when it comes in at a higher pressure than the storage tank. An open liquid line is all that is required for this process and the car will unload itself to the point where its pressure is equal to that in the storage tank. The compressor utilizes the same unloading technique by creating an artificial pressure difference between the storage tank and the tank car. This is done by taking vapor out of the storage, thereby reducing tank pressure, and compressing it into the tank car to increase this pressure. Liquid is literally "blown out" of the tank car into the storage tank. Since the compressor handles only vapor, the unstable nature of the liquid gas cannot affect it mechanically.

VAPOR RECOVERY

The second phase of the tank car unloading process, however, is where the compressor really earns its keep. An "empty" jumbo LP-Gas tank car holds approximately 1400 gallons of liquid propane in vapor form when the tank car pressure is 150 PSIG. (See Figure 1) The compressor can be used to recover almost 900 gallons of this by reducing the pressure to about 35 PSIG. At this rate a dealer who uses only one jumbo tank car per month would actually pay for his compressor in gas savings in two years' time! Even when gas ownership does not change hands, as might be the case when a producer is delivering to his own terminal, the vapor recovery compressor can result in an increased transporting capacity of about 3% per car. This means that a fleet of 97 tank cars unloaded with vapor recovery can do the job of 100 tanks cars where vapor is not recovered! The capital investment in a compressor is small indeed compared to that required for extra rolling stock.

In addition to, and as a direct consequence of, the recovery of vapor, the compressor also recovers the residual liquid "heel" which usually remains in the tank after the liquid has been pumped off. As tank pressure is reduced in the vapor recovery process, the liquid heel volatilizes and is recovered as vapor. This liquid is in addition to the product recovery predicted by Figure 1.

TRANSPORT TRUCK UNLOADING

Since transport trucks have bottom openings, they successfully can be unloaded with liquid pumps. In addition, transporters are understandably reluctant to wait around an hour or so while the customer recovers $20.00 worth of vapor. Because of these factors, many "transport only" bulk plants utilize only liquid pumps. It is not unusual, however, for the plant operator with a compressor to profitably utilize as much transport time as might be available in the recovery of the liquid heel and vapors. Figure 2 shows the large percentage of vapors recoverable in the first 15 to 30 minutes. At many transport unloading locations it is almost impossible to level the tank trailer properly and considerable product remains in residual liquid that can be recovered quite quickly with a compressor.

COMPRESSOR EFFICIENCY VERSUS LIQUID PUMPS

Occasionally, someone not acquainted with compressor design will perform pump versus compressor tests and will find that a 15 horsepower compressor, for instance, can unload a bottom opening tank at 175-200 GPM, while a liquid pump with a 15 horsepower motor might unload at 300 GPM. From this they draw the erroneous conclusion that the compressor is less efficient than the liquid pump. Further investigation would reveal that the 15 horse-

power motor on the compressor was sized not for unloading liquid, but for the greater load encountered when recovering vapor! Sizing a compressor for only liquid transfer drops the horsepower to a value comparable to the liquid pump for equivalent capacity. (See Figure 3) In actual practice a propane transfer compressor can be considered to be equal or better than the liquid pump - on a straight efficiency basis - at the lower differential pressures. As the differential pressure climbs to 30 or 40 PSI, the liquid pump rapidly assumes a commanding position.

VAPOR ALLOWANCES

What about vapor allowances from the product supplier as a substitute for vapor recovery? The inherent inequity of this procedure makes this an undesirable solution to the problem. Since temperature plays such a large part in the amount of vapor left in a tank car (note vapor recovery chart, Figure 1) it is almost impossible to develop a formula that is equitable to both the gas dealer and the product supplier. This problem, plus the improvement in fleet utilization brought about by vapor recovery, makes any broad program of vapor allowances unrealistic.

RELATIVE MAINTENANCE COST

When used without abuse, both the compressor and the liquid pump are capable of many years of service with a minimum of maintenance. Pumps need bearings greased occasionally and the crankcase oil in the compressor should be changed periodically. The greatest difference between the two, maintenance-wise, lies in the equipment's vulnerability to improper usage. The liquid pump can be damaged from any action or inaction of the operator which might allow the pump to run dry. This could occur because of a closed valve in the pump inlet piping or attempting to pump from an empty tank. Similarly, over-pressure from a valved-off or faulty by-pass valve could cause the liquid pump to wear excessively. The vapor compressor, on the other hand, is remarkably resistant to abuse. A closed inlet valve causes no harm and excessive discharge pressures are relieved harmlessly in the internal relief valves. A compressor can give many years of trouble-free transfer service in a poorly-plumbed plant, but a liquid pump operating with inadequate piping soon becomes an expensive repair job.

LIMITATIONS OF COMPRESSORS

The prime limitation of the vapor transfer compressor is in the metering of liquefied gases. The instability of the liquid causes flashing in the metering chamber and inaccurate measurements. Also, where high differential pressures are to be encountered, the compressor is limited in effectiveness. Since the vapor compressor could cost 60% more than a comparable liquid pump it is reasonable to assume that where vapor recovery is not anticipated and where gravity feed is available, the liquid pump would be the desirable selection.

CONCLUSIONS

Today in the LP-Gas distribution business where profits are counted in pennies, the vapor recovery compressor makes more "cents" than ever before. The profit-minded dealer will continue to use his compressor wherever possible for the recovery of vapors ... whether from transport trucks or tank cars. The safety and environmentally-minded dealer will utilize the versatile compressor more and more for such applications as evacuating tanks and lines rather than "bleeding donw". He will find that the purging of new tanks can be most effectively done by first evacuating air with his versatile compressor. In short, the vapor compressor is firmly entrenched in our industry and will be around for a long time to come.

USE COMPRESSOR:	USE LIQUID PUMP:
1. To unload Top-Opening Tank Cars	1. When "Flooded Suction" is available
2. To recover vapor	2. No vapor recovery
3. If no gravity-flow to pump	3. Differential Pressures above 30 psi
4. For versatility—when plant has only one transfer device	4. If liquid is to be metered
5. For long equipment life at poorly-plumbed plant.	5. For lower First-Cost

TRANSFER EQUIPMENT SELECTION TABLE

FIGURE 1

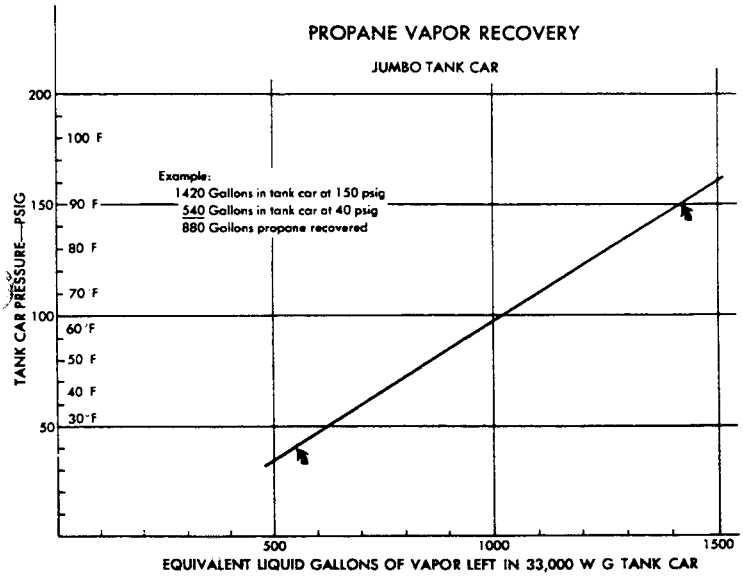


FIGURE 2

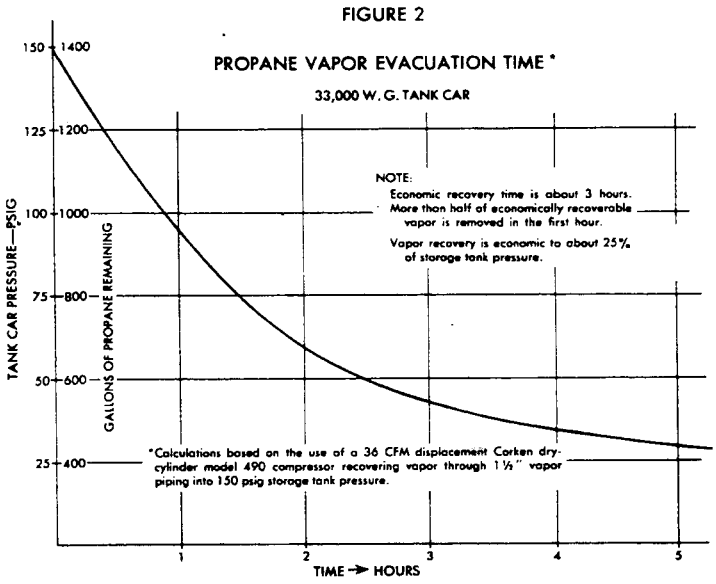


FIGURE 3
CAPACITY COMPARISON—PUMP vs. COMPRESSOR

Motor Horsepower	VAPOR COMPRESSOR				LIQUID PUMP
	With Vapor Recovery		Liquid Transfer Only		30 PSI Diff'l
	Displacement	GPM	Displacement	GPM	Gallons/Min.
5	14 CFM	75	24 CFM	135	95
7½	20 CFM	110	38 CFM	210	160
10	27 CFM	150	50 CFM	275	200
15	36 CFM	200	60 CFM	340	320

All capacities estimated on the basis of piping common today in the LP Gas

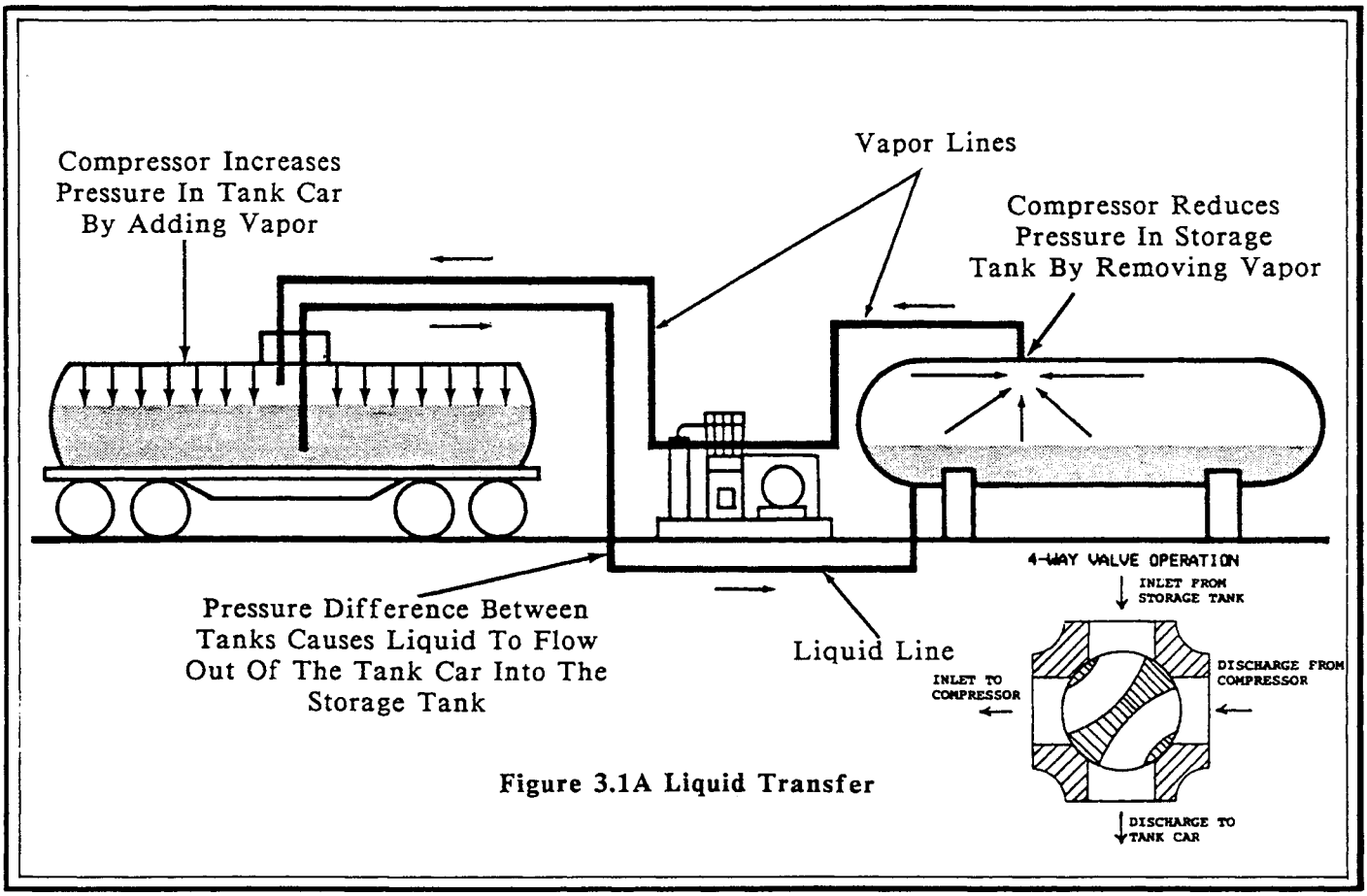


Figure 3.1A Liquid Transfer

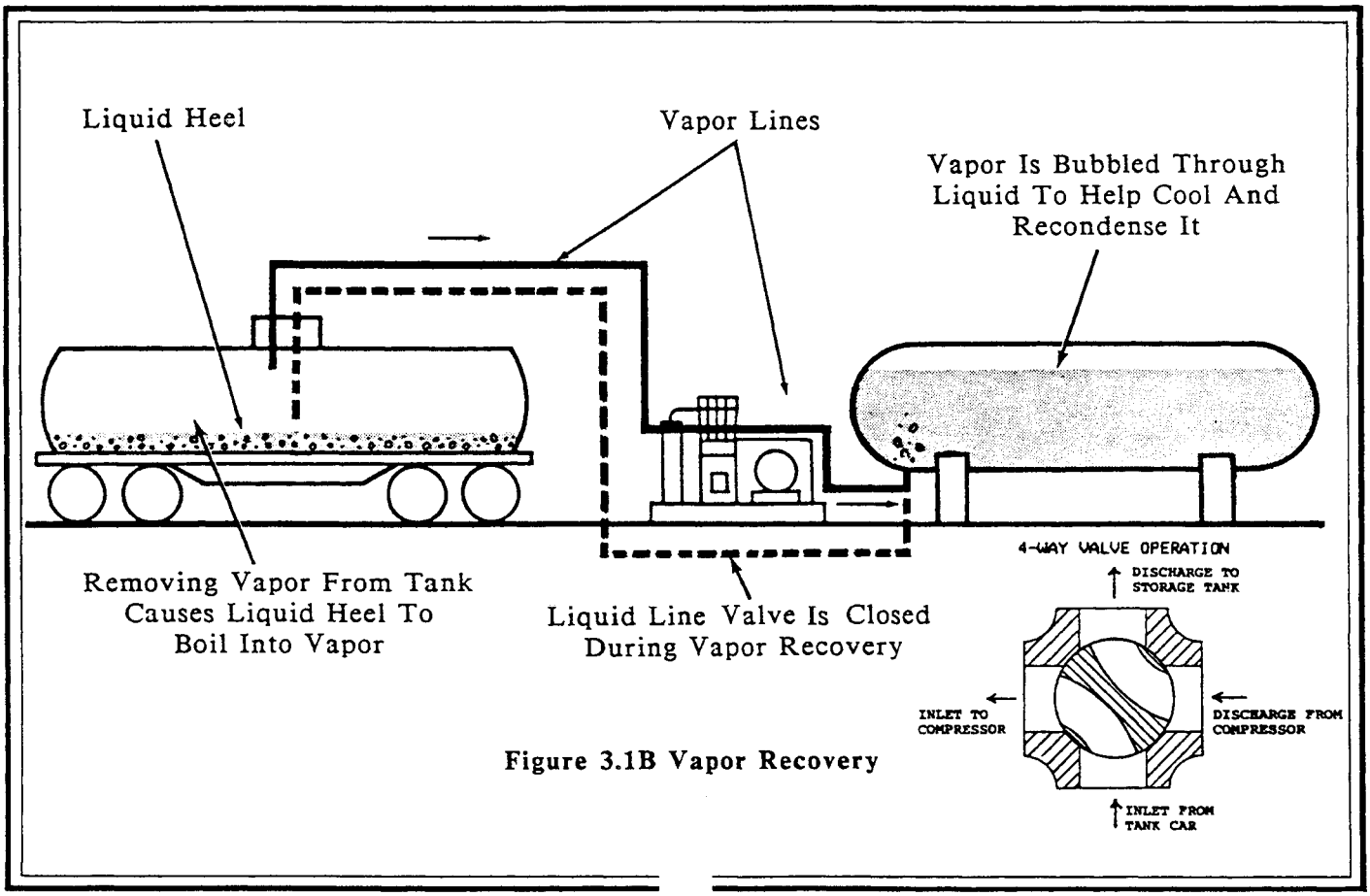


Figure 3.1B Vapor Recovery

CORKEN

PRACTICAL TIPS FOR MAXIMIZING PERFORMANCE OF CORO-FLO PUMPS INSTALLED OVER UNDERGROUND TANKS OR ON TANKS WITH LOW FOUNDATIONS

The Corken Coro-Flo Regenerative Turbine Pump has an unrivaled reputation among bottle filling pumps. However, in some underground pumping applications it has received an undeserved reputation for vapor locking in systems where vane pumps don't vapor lock.

The Coro-Flo Regenerative Turbine Pump offers several advantages over vane pumps on underground piping applications. The LP gas liquid pumped from an underground tank is actually boiling as it enters the pump. In effect, the pump must handle a liquid/vapor mixture even after the pump is primed. Vapor is a poorer coolant and lubricant than liquid so more vapor means more wear will occur at rubbing surfaces in the pump. The Coro-Flo Pump reduces these rubbing surfaces to a single mechanical seal, a decisive advantage over vane pumps. The Coro-Flo Pump is also much quieter than vane pumps in most audible frequencies.

The primary advantage of a vane pump over a regenerative turbine is its ability to evacuate vapor from the suction piping against a relative high discharge pressure - in effect, vane pumps can be used as compressors. Regenerative turbine pumps can only move vapor against relatively small differential pressures.

Fortunately, there is absolutely no reason why an LP gas pump over an underground tank should be required to double as a gas compressor. Indeed, any application that forces a pump to act as a compressor will result in unnecessary damage to the pump.

Each time an underground pumping system starts up, the piping between the pump and liquid level in the tank must be evacuated of vapor to prime the pump. A well designed system will only require the pump to slightly pressurize the vapor to push it back into the vapor space of the underground tank. In well designed systems, the Coro-Flo Pump will give superior performance. The practical tips for maximizing performance of underground pumping systems can be split in two groups:

1) Tips to minimize the volume of vapor to be evacuated in order to achieve rapid priming.

2) Tips to minimize the amount of differential pressure required to push the vapor pulled from the suction piping back to the vapor space of the feed tank.

Tips for minimizing the amount of vapor that must be evacuated are:

A) Keep the length of suction line as short as possible (about 5 ft. for 1000 gallon tanks and 10 ft. for 6000 gallon tanks). For 1000 gallon tanks, use models 9, 10, 12, or 15. For 6000 gallon tanks use models 13 or 14.* Not only does this reduce the vapor volume to be evacuated, it holds the amount of vapor the pump must handle after priming to a reasonable level. While vane pumps do tend to generate larger suction lifts than turbine pumps, they spend more and more time as gas compressors and less and less as liquid pumps at the deeper depths. Operating any LP gas liquid pump as a vapor compressor will result in lower capacity, accelerated wear and poor service life. On applications where a vapor return line can be used, LP gas compressors can be used instead of pumps to allow liquid transfer from deeper depths.

B) Don't bury the tank over 1 foot deep.

C) Locate the pump directly over the tank as close to the ground as possible. For best results, rotate the pump head 90^{o} so no bends are required in the suction pipe.

(See Figure A).

---

* This data is based on actual field tests in customer installations.

D) Use 3/4" suction pipe for models 9,10 & 15, 1" for model 12 and 1 1/4" for models 13 & 14.

E) Eliminate the suction strainer (you can rely on gravity to do this job). The strainer creates a pressure drop which causes the vapor to expand before reaching the pump. It also causes more vapor formation to occur in the liquid after the pump is primed.

Tips for minimizing the differential pressure required to evacuate the suction piping:

F) Install a backcheck valve in the discharge line as shown in Fig. A. This is especially important on discharge lines over 20 ft. The backcheck valve isolates the pump from the discharge pressure during priming. On hot days, pressures in the above ground, uninsulated pipe can greatly exceed pressure in the below ground dip pipe. By isolating the higher pressure during priming, the pump can avoid doing double duty as a gas compressor. Make sure to use a soft seat check valve that forms a tight seal when closed (such as the Corken Flo-Chek Valve).

G) Install an excess flow valve as shown in Fig. A (Rego 901H5 or equivalent). This gives the vapor an "easy" low-pressure drop route back to the feed tank during priming. The valve will close as soon as liquid flow exceeds 3 GPM.

H) Use a B166 continuous by-pass valve. This valve routes most of the vapor present at the pump discharge after priming back to the feed tank. This minimizes the possibility of any vapor present at the pump discharge from creating an unstable flow.

I) Vent the vapor eliminator on the liquid meter back to the tank, <u>not</u> to the bypass line. During bypass, pressure will be present in the bypass line. Under this condition, no differential pressure exists to allow vapor to flow out of the vapor eliminator back to the tank.

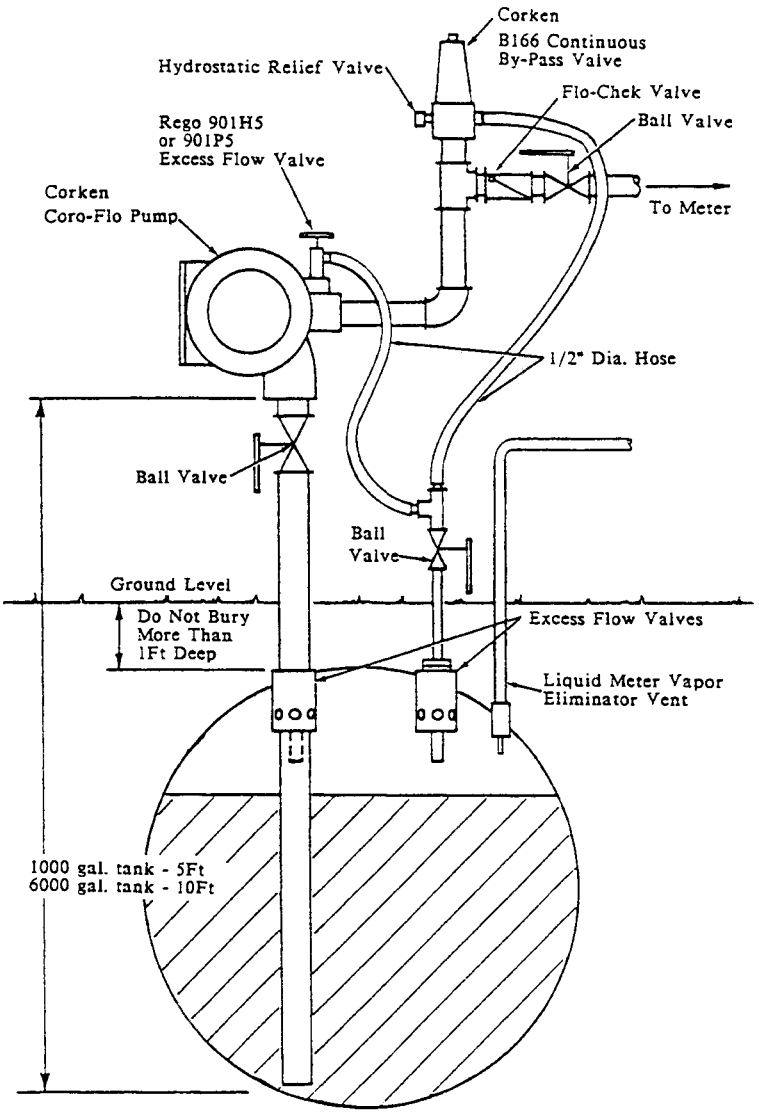
J) Minimize the number of fittings and elbows and only use full flow ball valves in the suction and by-pass piping.

K) Use an excess flow valve instead of a back check valve at the entry of the bypass line into the vapor space of the feed tank. (This is good practice on any system, it is of particular importance on underground systems).

Tips F thru K can also be applied to above ground tank systems with low, little, or no suction head in order to prevent vapor locking. Also, some systems have an automatic shutoff valve between the pump and the feed tank. These pumps should be controlled so the shutoff valves open about 15 seconds before the pump starts up.

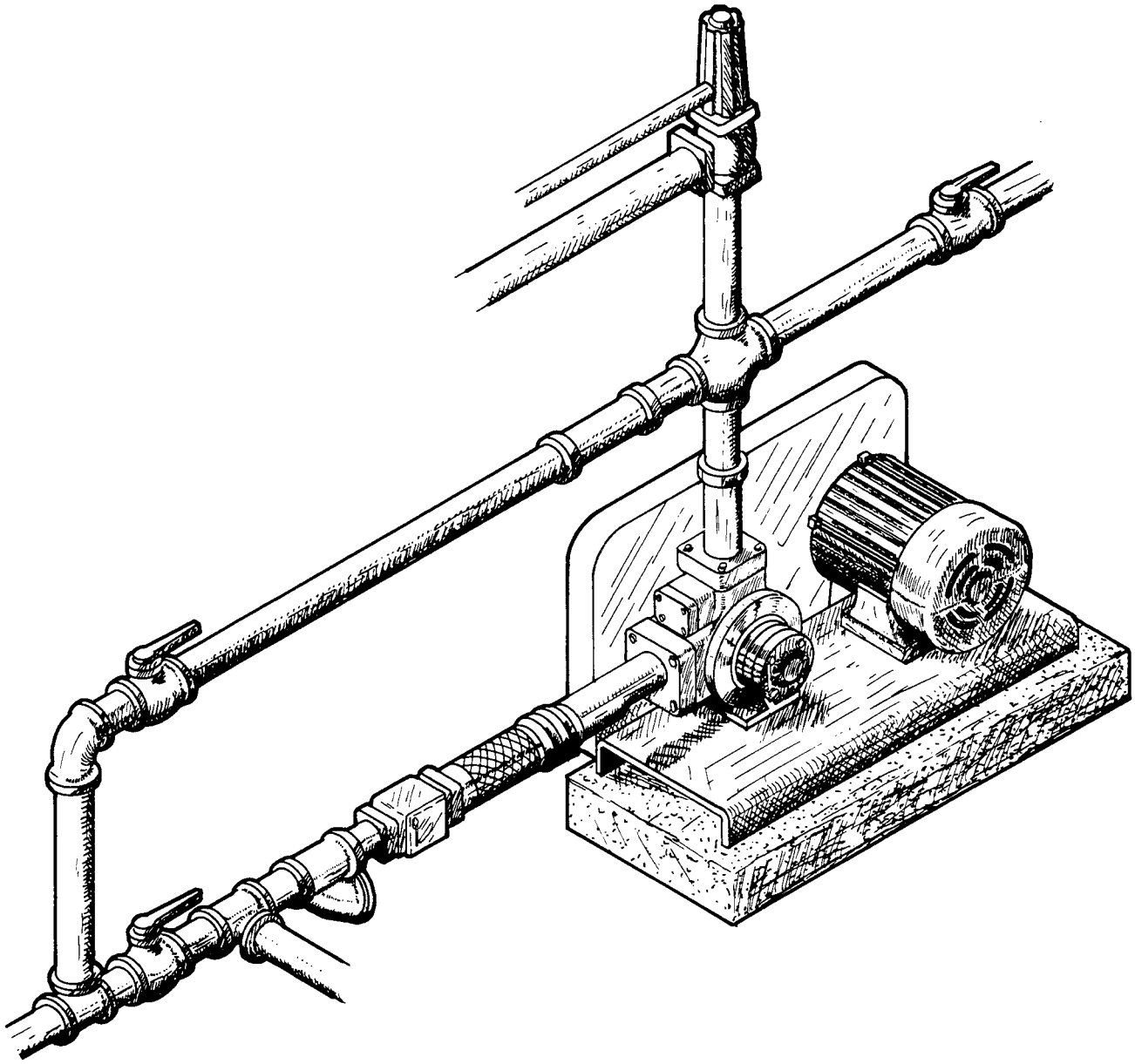
Finally, for best results, installations in 50 Hz countries should V-belt drive the pump so it can be operated at 3600 RPM.

If you are considering an underground installation, we suggest you follow these tips carefully for the best performance. If you have further question on proper installation of Corken pumps over underground tanks, contact Corken. Our customer engineering staff will be glad to help you "do it right the first time".



DESIGN HANDBOOK
LIQUEFIED GAS PUMP INSTALLATION

SUPERCEDES Z400



CORKEN®

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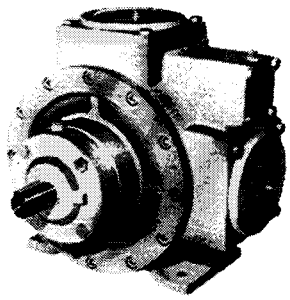
P. O. Box 12338, Oklahoma City, OK. 73157
3805 N.W. 36th St., 73112 • Fax (405) 948-7343
Phone (405) 946-5576 • Telex 262513 Corkn Ur

THE APPLICATION OF PUMPS TO LP-GAS TRANSFER



Of the many hundreds of pump manufacturers in the United States, only a handful recommend their equipment for transferring liquefied gases. There are various reasons for this, but the basic problem has to do with the nature of a liquefied gas. The specific peculiarity of a liquefied gas is that a liquefied gas is normally stored at its boiling point . . . exactly at its boiling point! This means that any reduction in pressure, regardless of how slight, or any increase in temperature, no matter how small, causes the liquid to start to boil. If either of these things happen in the inlet piping coming to the pump, the pump performance is severely affected. Pump capacity can be drastically reduced, the pump can be subjected to severe wear and the mechanical seal and the pump may run completely dry causing dangerous wear and leakage.

Although we cannot change the nature of the liquefied gas, there are many things we can and must do, to design an acceptable liquefied gas pumping system.

Many of these design hints are incorporated in the accompanying illustrations. You will note that each drawing is over-simplified and illustrates just one principle. Normal fittings, strainers, unions, flex lines, valves, etc. have been ignored so that just that portion of the piping which applies to the problem is shown. **Do not pipe a plant from these incomplete illustrations!** You should also note that all of these rules can be violated to a degree and still have a workable pumping system. You may see several places where your plant is at variance from some of these. However, you should be aware that every violation is reducing your pumping efficiency and increasing your pump maintenance cost. The principles apply to all makes and styles of liquefied gas pumps . . . rotary positive displacement, regenerative turbine or even centrifugal types.

This booklet is used in Corken Training Schools. Corken cooperates with gas marketers, trade associations and other groups to conduct complete training schools for persons involved in the transfer of liquefied gases. These presentations include product information, safety, plant design and equipment service/maintenance. Training slides and cassettes are also available from Corken. Other information is available in various sections of your Corken Catalog.

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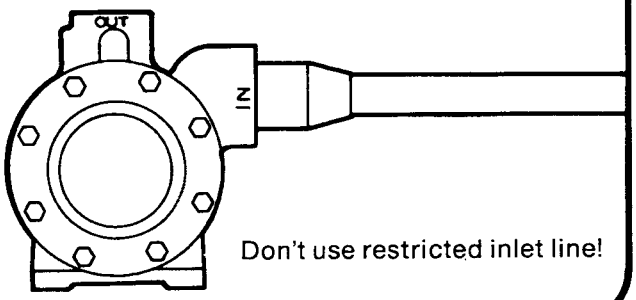
1

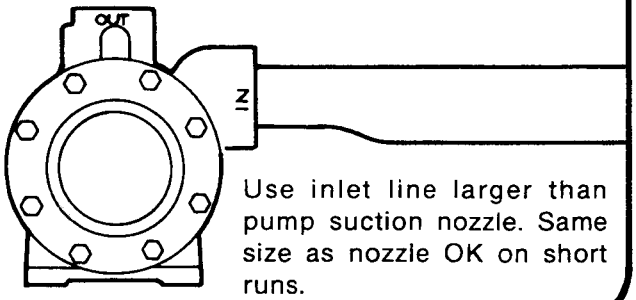
No!



Don't use restricted inlet line!

2

Yes!

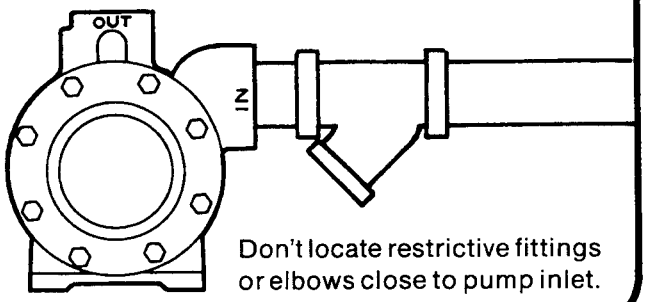


Use inlet line larger than pump suction nozzle. Same size as nozzle OK on short runs.

Pressure drop caused by restriction in suction line will cause vaporization and cavitation.

3

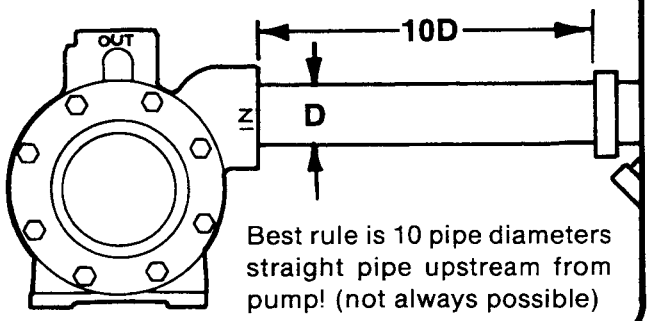
No!



Don't locate restrictive fittings or elbows close to pump inlet.

4

Yes!

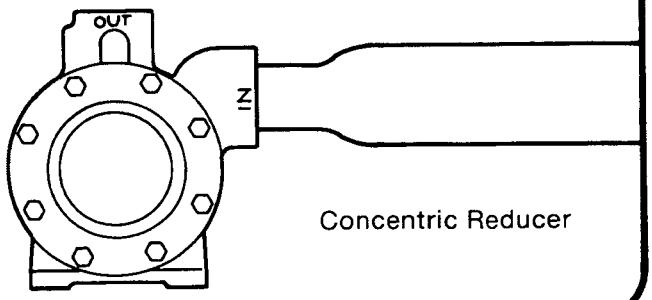


Best rule is 10 pipe diameters straight pipe upstream from pump! (not always possible)

Turbulence caused by flow interference close to the pump accentuates incipiant cavitation.

5

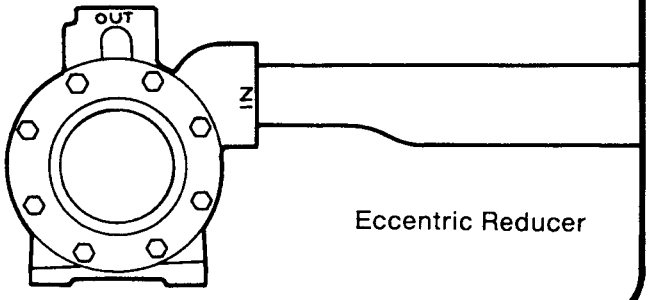
No!



Concentric Reducer

6

Yes!

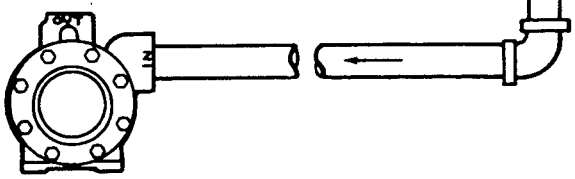


Eccentric Reducer

An eccentric reducer should always be used when reducing into any pump inlet where vapor might be encountered in the pumpage. The flat upper portion of the reducer prevents an accumulation of vapor that could interfere with pumping action.

7

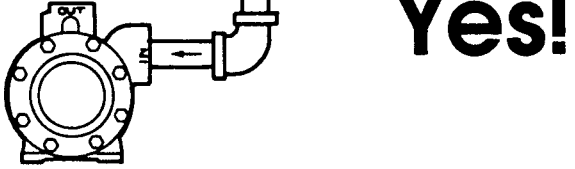
No!



Don't place pump far from tank!

8

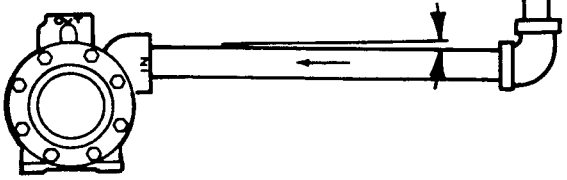
Yes!



Locate pump close to tank! Directly under is best.

9

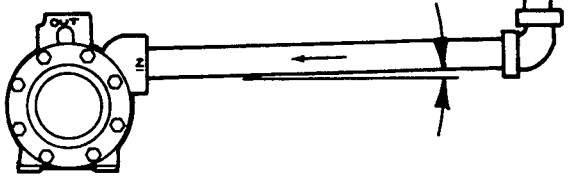
No!



Don't slope liquid line up toward pump!

10

Yes!

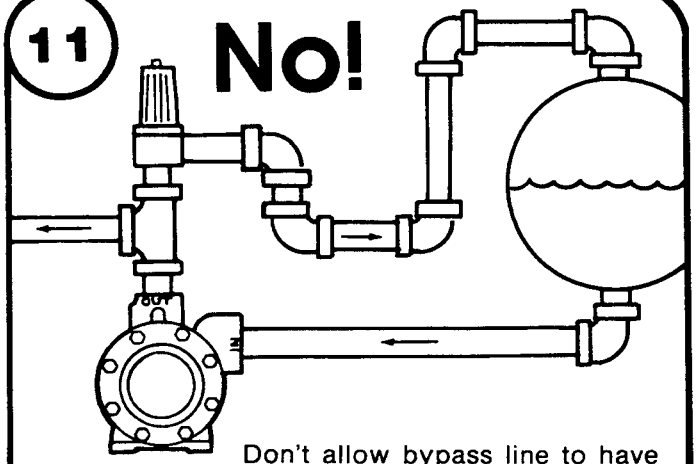


Slight slope down toward pump is best. Perfectly level is OK.

Vaporization in the pump inlet line can displace liquid in the pump so that pump may start up in a dry condition. A slope back toward the tank of only an inch or two in a 10 foot run will allow vapor to gravitate back into the tank and be replaced with liquid.

11

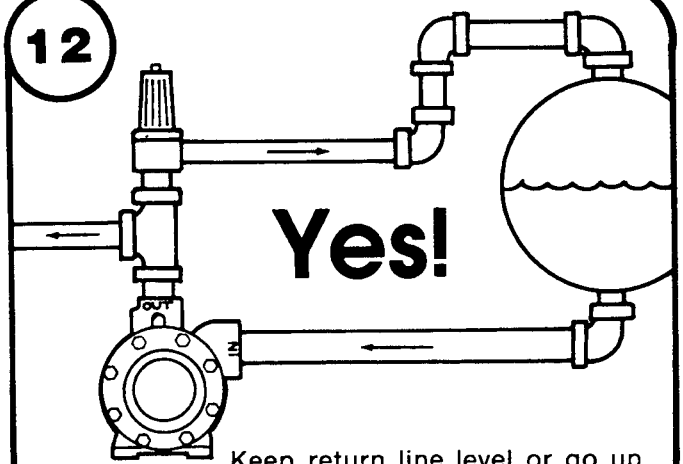
No!



Don't allow bypass line to have low spot.

12

Yes!

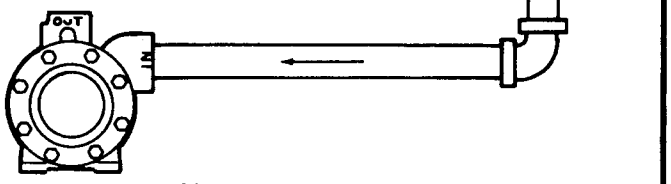


Keep return line level or go up toward tank!

Low spots in bypass line can collect liquid which prevents normal vapor passage for priming purposes just like the P trap in the drain of a kitchen sink. This is not a problem for bypass lines where vapor elimination is not required.

13

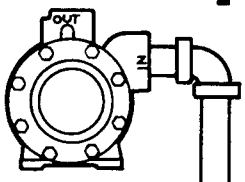
Yes!



Always locate pump below tank level . . . the lower the better!

14

No!

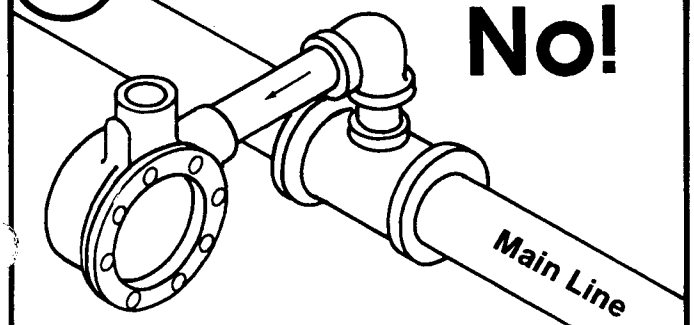


Never locate pump above level of liquid feeding pump. Product must be able to flow by gravity into pump.

Since liquefied gases boil when drawn into a pump by its own suction, the pump must be fed by gravity flow to give stable, trouble-free operation.

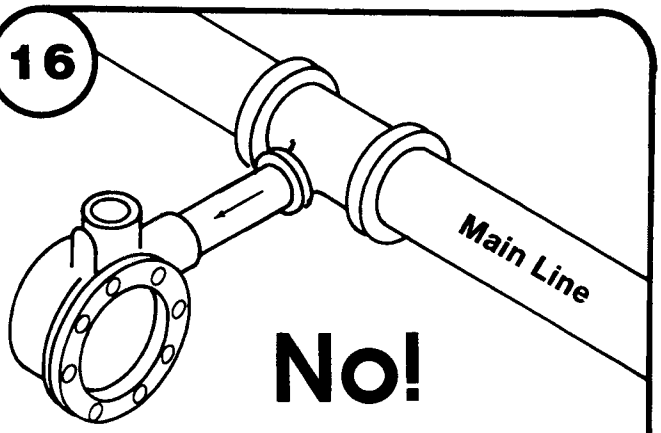
15

No!



Feeding small pump from tee off of large supply line. Come out the bottom of pipe line, not top or side!

16

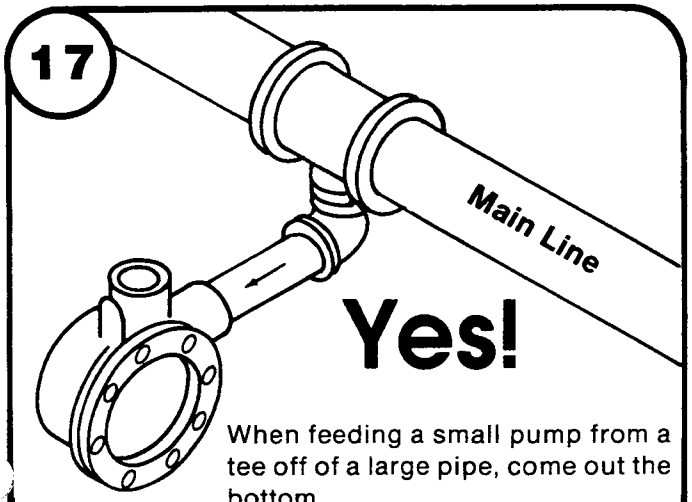


No!

When feeding small pump from large main line, don't tee off the side. Tee out the bottom!

Low capacity flow through large lines often does not sweep out vapor. Flow occurs like liquid in a flume. Drawings 15 and 16 would allow vapor slugs to be drawn into the small pump causing erratic performance. Drawing 17 shows the best chance for stable feed into a small pump from a large line.

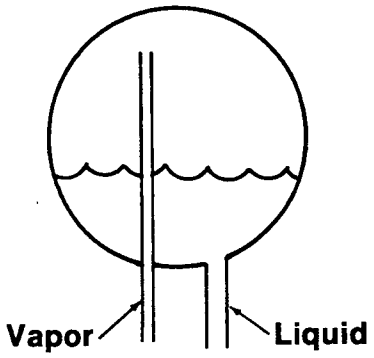
17



Yes!

When feeding a small pump from a tee off of a large pipe, come out the bottom.

18

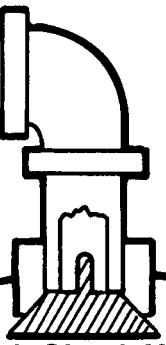


Some tanks have vapor connections in the bottom. These have stand pipes inside. A bottom vapor connection can be used instead of a top opening with any of the drawings in this booklet.

19

By-Pass Line →

No!



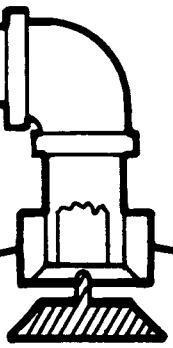
Back Check Valve

Positive closure of back check valve prevents proper vapor return for pump priming.

20

By-Pass Line →

Yes!

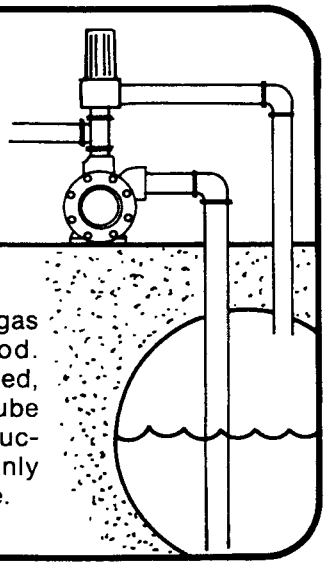


Excess Flow Check Valve

Necessary for proper vapor elimination when using priming type bypass valves.

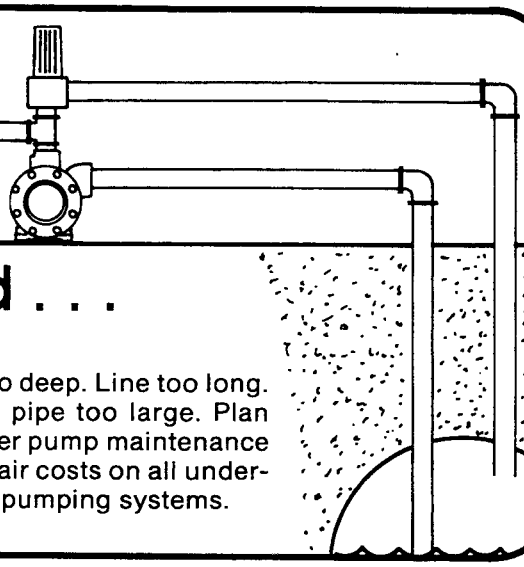
21

Better . . .



No underground liquefied gas pumping system is good. Where tank must be buried, use one size smaller dip tube pipe, shallow tank, keep suction line short and use only Corken B166 bypass valve.

22



Bad . . .

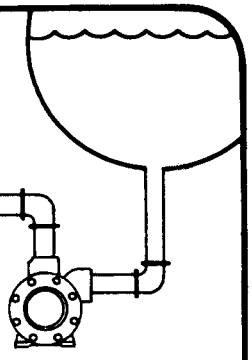
Tank too deep. Line too long. Suction pipe too large. Plan on higher pump maintenance and repair costs on all underground pumping systems.

Where pumping from underground storage must be done, consult Engineer Data Page Z402.

23

No!

Long Discharge Line

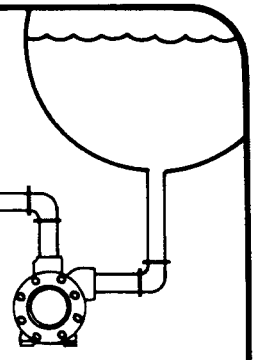


Large quantity of liquid in long lines allows continuing vaporization over long periods of time during which the pump will be full of vapor and will run dry during start-up attempts.

24

Yes!

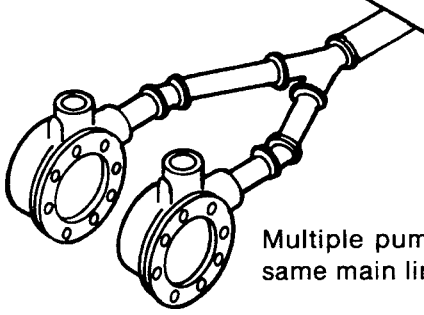
Back Check Valve



Use soft-seat back check valve near pump in long discharge lines to prevent vaporization from coming back thru pump when pump is not in operation.

25

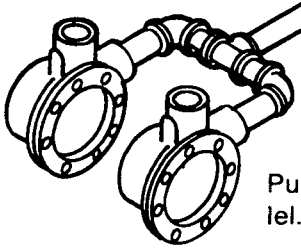
Good . . .



Multiple pumps fed from same main line.

26

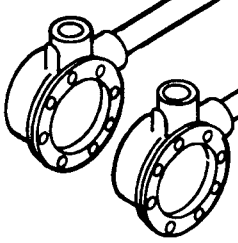
OK . . .



Pumps operating in parallel.

27

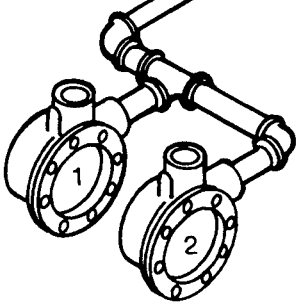
Best . . .



Parallel piping of liquefied gas pumps.

28

Bad . . .

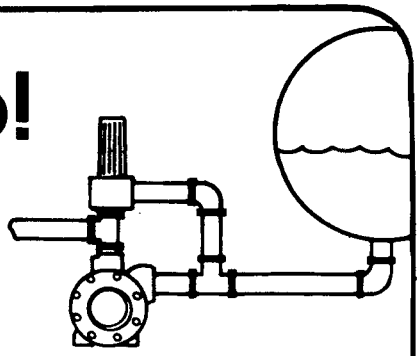


Pump No. 1 is starved because of venturi action at tee. This would be acceptable for installations where both pumps would never operate at the same time.

Inquire about Corken's Duplex-Series Pump Set.

29

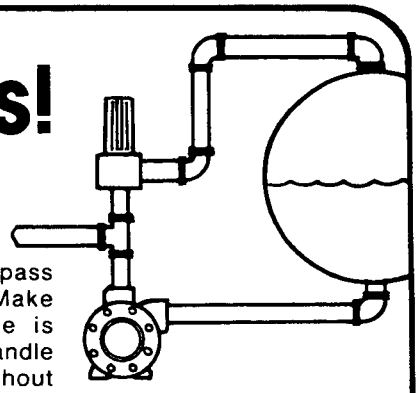
No!



Don't pipe bypass line back into suction piping! Heat Buildup in recirculated products causes flashing of liquid to vapor with immediate cavitation and ultimate dry-running. This is why the bypass relief valves which are built into many positive displacement pumps should not be used for normal bypass action when handling liquefied gases. The internal valve should be considered to be a back-up safety relief in addition to a back-up safety relief in addition to a back-to-tank bypass valve and should be set to relieve at a pressure 10 to 20 psi higher than the working bypass. Some built-in bypass valves have the capability of being piped back-to-tank so check with the pump manufacturer.

30

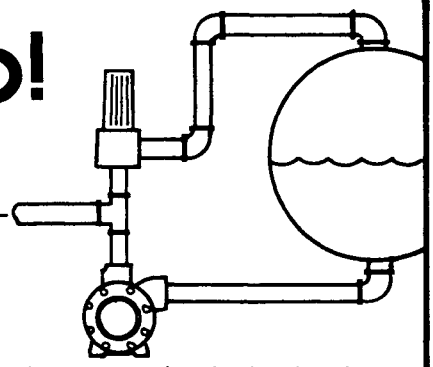
Yes!



Always pipe bypass back to tank! Make sure bypass line is large enough to handle full pump flow without excessive pressure build-up. Note that bypass line must be capable of bypassing full pump capacity without excessive pressure build-up. High pressure rise can cause bypass valve to chatter and vibrate.

31

No!



On vaporizer feed pumps, a back check valve should be installed between pump and vaporizer to prevent back-flow of vapor from entering pump.

32

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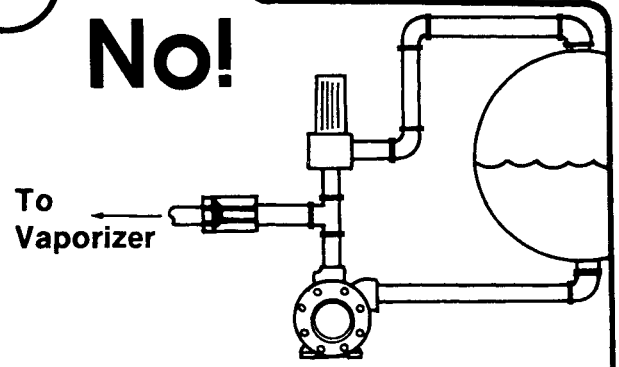
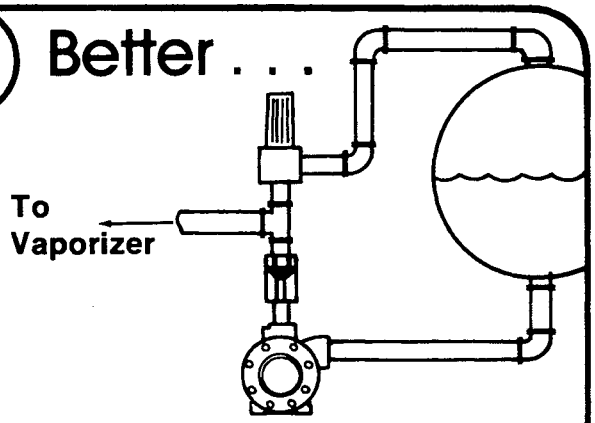
No!



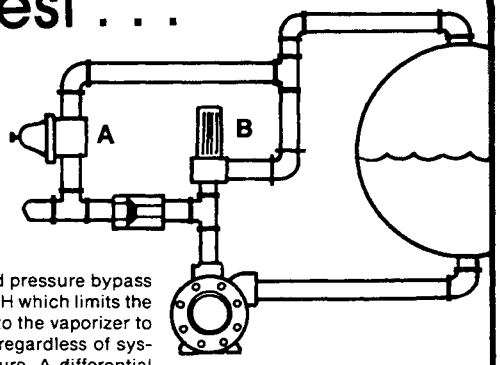
Back check must be located to allow back-flow into tank from vaporizer.

33 Better . . .



Back check valve protects pump but allows back flow thru bypass valve into storage tank. **Use back check without spring loaded valve to allow normal vapor elimination.**

34 Best . . .



Where A is a constant pressure bypass control valve and B is Corken B166 bypass and vapor elimination valve.

Valve A is a fixed pressure bypass like the Fisher 98H which limits the feed pressure into the vaporizer to a specific value regardless of system vapor pressure. A differential bypass valve like the Corken B166, T166 or B177 controls a fixed difference in pressure between the pump discharge and the tank. Differential valve B must be set to the maximum acceptable differential of the pump while fixed pressure valve A is set for the vaporizer pressure requirement.

35 CORKEN B166 BY-PASS VALVE FUNCTIONS

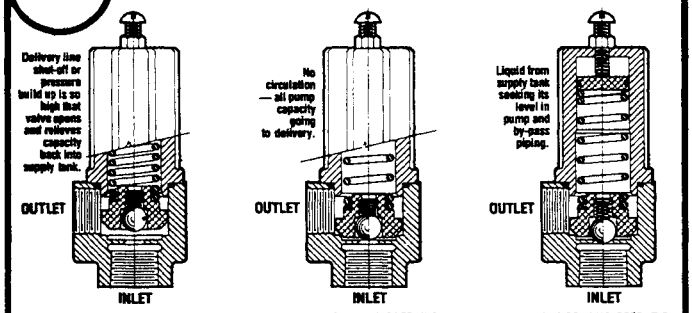


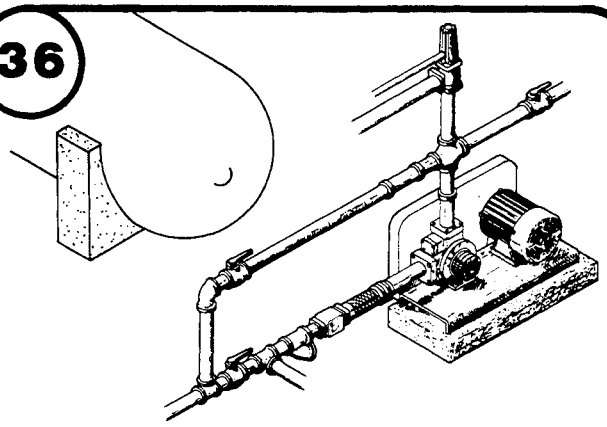
FIG. 1 RELIEVING OPERATION OPEN

FIG. 2 PUMPING OPERATION CLOSED

FIG. 3 PRIMING OPERATION OPEN

For pump capacities under 100 GPM, use a bypass valve with built-in vapor elimination where possible. Like Corken's B166 or T166 Valves.

36



Some bypass valves, like the Corken B177, require tank pressure sensing lines. Check instructions for your valve.

SUMMARY

1. MINIMIZE PRESSURE LOSSES IN PUMP SUCTION LINE. PRESSURE DROP CAUSES INCREASED VAPORIZATION WHICH, IN TURN, CAUSES DECREASED PUMP PERFORMANCE AND INCREASED PUMP MAINTENANCE.
2. AVOID VAPOR TRAPS IN PUMP SUCTION LINE AND LIQUID TRAPS IN PUMP BYPASS LINES. VAPOR POCKETS IN THE PUMP INLET CAUSE ERRATIC PUMP PERFORMANCE AND LIQUID POCKETS IN BYPASS LINES INTERFERE WITH VAPOR ELIMINATION FROM THE SYSTEM.
3. CONTROL VAPOR FROM BACKING UP INTO PUMP FROM THE DISCHARGE LINE.
4. MINIMIZE HEAT BUILDUP IN THE PUMPING SYSTEM BY PIPING BYPASS LIQUID BACK TO THE TANK RATHER THAN DIRECTLY TO THE PUMP INLET.
5. MAXIMIZE THE ELEVATION DIFFERENCE BETWEEN THE TANK AND THE PUMP.
6. ALWAYS USE EQUIPMENT APPROVED FOR USE WITH LP-GAS AND CAREFULLY FOLLOW THE REQUIREMENTS OF NFPA
7. DO NOT PIPE A PLANT FROM THE DRAWINGS SHOWN HERE. THEY ARE SCEMATIC ONLY AND INTENDED TO ILLUSTRATE SPECIFIC PIPING PRINCIPLES.

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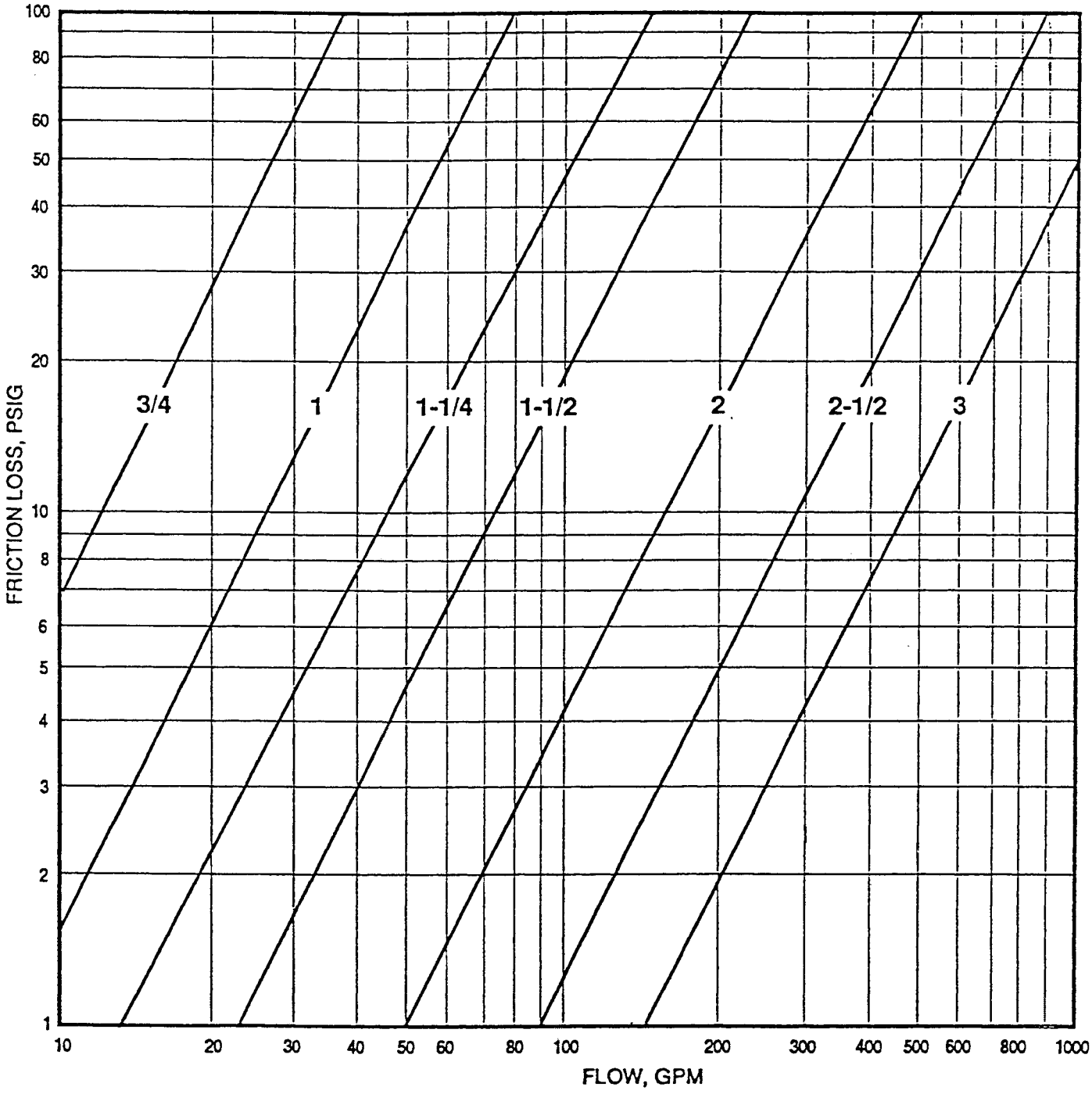
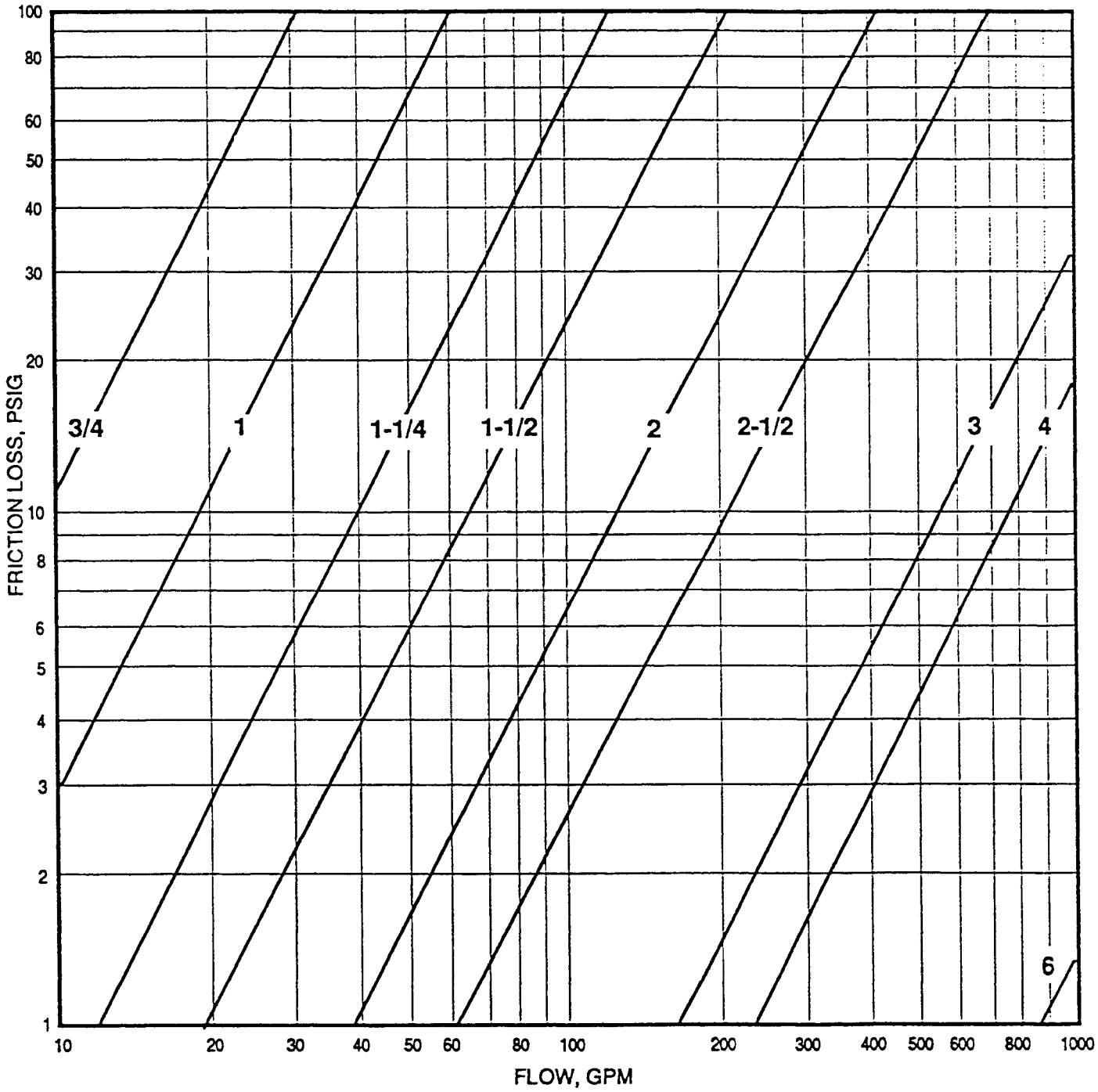


Hose friction loss in psi for 100 ft. smooth bore rubber hose with inside diameters as shown. These values may vary due to manufacturing tolerances of hose diameters.

Propane: Values as shown.
Butane: Multiply values by 1.15.
Anhydrous Ammonia: Multiply Values by 1.21.



Pipe Friction loss in psi for 100 ft. new, clean extra strong schedule 80 pipe. Data taken from Crane Technical Paper No. 410 "Flow of fluids through valves, fittings, and pipe" and adjusted for propane sp. gr. = .5077.

Propane: Values as shown.
Butane: Multiply values by 1.15.
Anhydrous Ammonia: Multiply Values by 1.21.

LP-GAS HANDLING QUIZ

STUDENT'S NAME _____

COMPANY _____

MAILING ADDRESS _____

TRUE OR FALSE QUESTIONS

		TRUE	FALSE
1.	Temperature affects LP-Gas.	_____	_____
2.	The differential pressure of a pump is the difference between the inlet and outlet pressures.	_____	_____
3.	LPG vapor is lighter than air.	_____	_____
4.	All pumps and accessory equipment should have a minimum rated working pressure of 250 psig.	_____	_____
5.	Propane is always stored exactly at its boiling point.	_____	_____
6.	A back-to-tank bypass valve is a good idea, but not essential, for LP-Gas pumps.	_____	_____
7.	Boiling of propane in the pump inlet can cause a drastic reduction in pump capacity.	_____	_____
8.	At temperatures below -44°F., propane could be carried in an open container.	_____	_____
9.	Propane liquid expands about 270 times when changing from a liquid to a vapor at normal atmospheric conditions.	_____	_____
10.	Never bleed vapors, in large amounts, to the air.	_____	_____
11.	All filler valves on domestic tanks will accept the full capacity of a truck pump.	_____	_____
12.	Pumps on delivery trucks should be greased once a year.	_____	_____
13.	Increasing the RPM's of a truck pump always results in faster deliveries.	_____	_____

	TRUE	FALSE
14. The pump's mechanical seal is the part most likely to wear our.	_____	_____
15. Most LP-Gas pump wear is caused by dry running.	_____	_____
16. The 4-way walve on a compressor requires no maintenance.	_____	_____
17. Compressors usually require very little maintenance.	_____	_____

18. In diagnosing pump capacity problems, which of the following is necessary?

_____ Pressure at the pump suction

_____ Pressure at the pump discharge

_____ Pressure in the supply tank

_____ Pressure in the tank being filled

_____ Pipe size and length of suction and discharge line

_____ Size and length of vapor equalizing line

19. Which of the following can reduce the capacity of a pump powered by an electric motor?

_____ Pump speed too low

_____ Low Voltage

_____ High differential pressure

_____ Bypass valve stuck open or set too low

_____ Clogged strainer

_____ Suction piping too small or restricted

_____ Worn sideplate

_____ Poor suction condition

20. What are some of the main causes of noise in a pump?

_____ Worn pump liner

_____ Poor suction conditions

_____ Worn Bearings

_____ Very high differential

21. The following conditions reduces efficient product transfer with a compressor.

_____ Slipping V-belts

_____ Compressor Valves worn, fouled or broken.

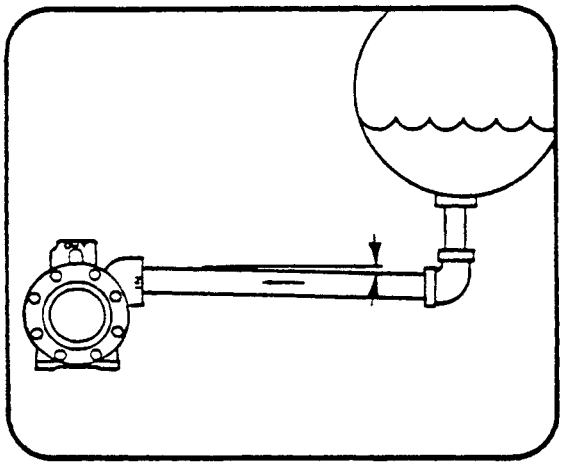
_____ Worn piston rings

_____ Clogged strainer

_____ Piping too small

Write GOOD or BAD on each of the following.

22.



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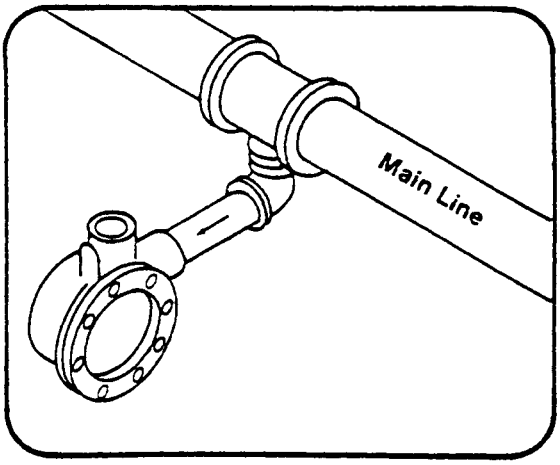

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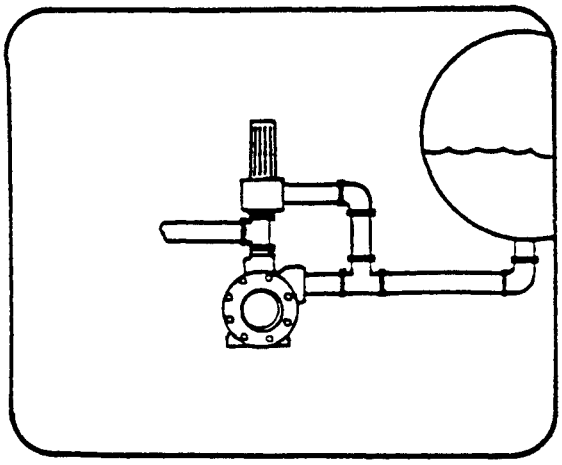

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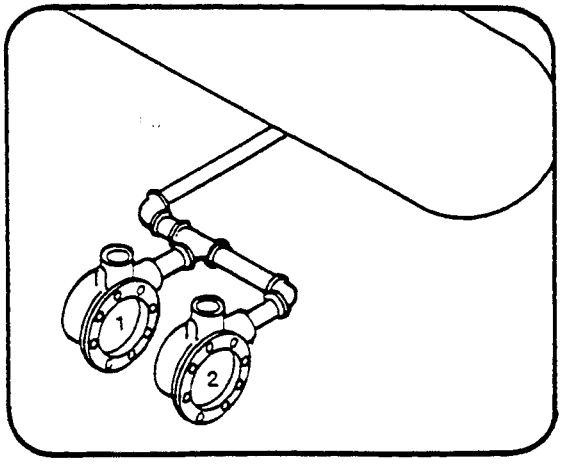

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PRINTED IN U.S.A.
APRIL 1998