LIQUIVAC®

LIQUID RING VACUUM PUMPS

INSTALLATION, OPERATION & MAINTENANCE

MANUAL

www.liquivac.co.uk

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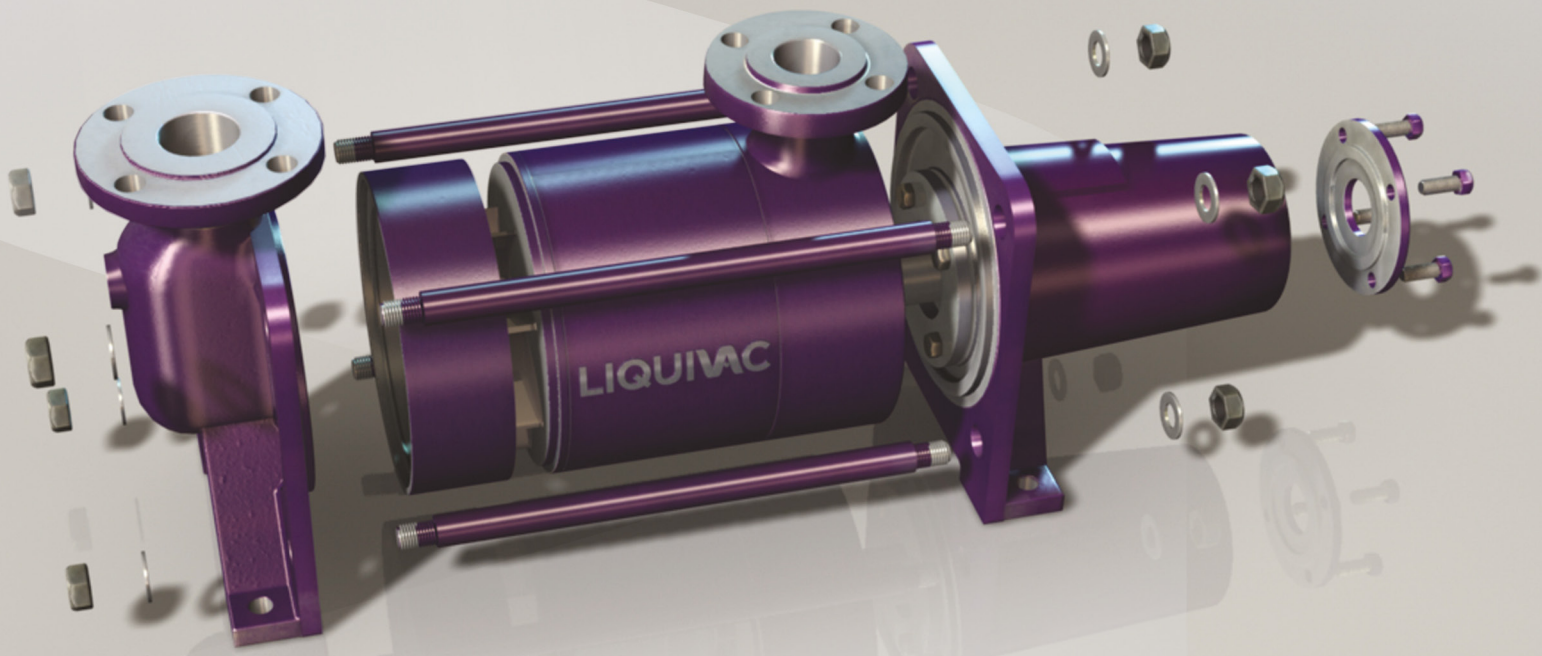


LIQUIVAC®

LIQUID RING VACUUM PUMPS

INTRODUCTION

INSTALLATION

Pump should be mounted on a rigid baseplate and secured firmly to a suitable base. Anti-vibration mountings can be supplied if required.

Couplings are laser aligned during production and should be checked after securing the baseplate to the foundations. Pipework should be installed from the pump avoiding any pre-stressing.

Isolation valves should be incorporated on suction and discharge pipework for ease of maintenance. Isolation valves can be supplied if required.

The suction side is always furthest away from the drive end.

Subject to the type of application, it may be necessary to provide a service liquid to the pump. Fitting a priming pot to the discharge side of the pump with a small bore service liquid line running from the priming pot to a connection on the suction chamber can do this (see diagram 2 on page 22). If more convenient, service liquid can be supplied from a separate tank mounted at the side of the pump (diagram 3 on page 22).
Isolation/regulating valves can be fitted in the service liquid line to regulate the flow.
Priming pots and isolation/regulation valves can be supplied if required.

It is recommended that a swing check non-return valve be fitted to the suction side of the pump. Swing check non-return valves can be supplied if required.

PUMP ROTATION

Direction of rotation is always clockwise looking from the drive end.

Please check rotation before starting pump. This is to prevent the possibility of the impeller unscrewing on the LVK range.

DRY RUNNING

The pump must not be run dry.
Ensure that the pump is filled with liquid before start up. Failure to do this will damage the mechanical seal.

COUPLINGS

It is recommended that pinned type couplings are used, rubber buffer or cone ring type. See section on couplings.

CONE-FLEX COUPLING CONSTRUCTION & WORKING OF CONE-FLEX COUPLING

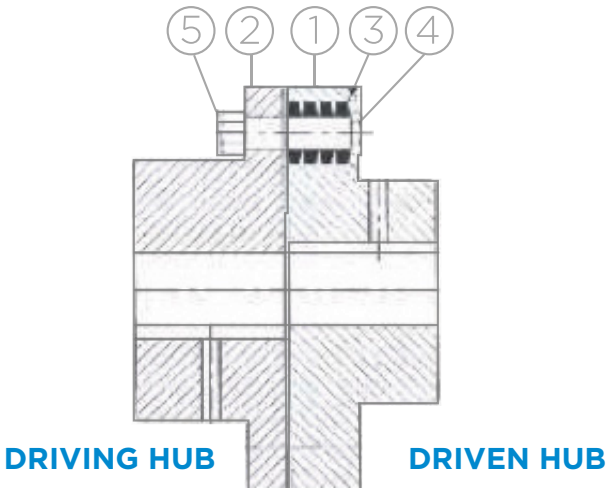


Fig. 1

CONE-FLEX COUPLING CONSISTS OF THE FOLLOWING MAIN PARTS:-

1. BUSH HALF
2. PIN HALF
3. CONE RING
4. PIN
5. NYLOCK NUT

VARYING TORSIONAL STIFFNESS - AN EXCLUSIVE FEATURE OF CONE-FLEX COUPLING

Cone-Flex Coupling consists of a set of resilient cone rings. These cone rings provide varying torsional stiffness characteristics.

Torsional stiffness is the property of flexible coupling, which enables the coupling to absorb shocks and vibrations.

If torsional stiffness of a coupling varies according to loading level, coupling can give better performance in shock and vibration absorption.

Cone-Flex Coupling has a specially designed conical shaped ring. Due to its shape, at light loads, torque is transmitted through line of contact of mating parts giving less torsional stiffness.

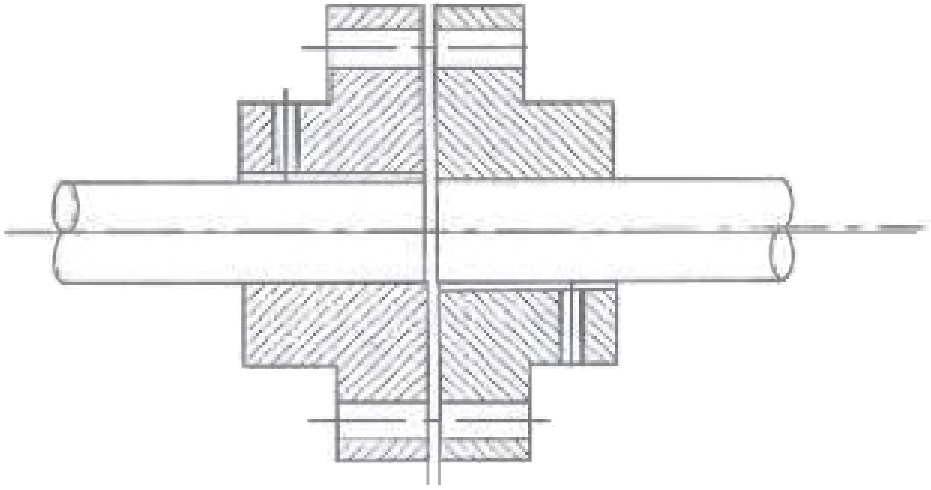
As load goes on increasing, area of contact also increases, hence coupling gives higher torsional stiffness.

Thus varying torsional stiffness is achieved in Cone-Flex Coupling.

CONE-FLEX COUPLING: INSTALLATION INSTRUCTIONS FOR CONE-FLEX COUPLINGS

MOUNTING PROCEDURE

Mount hubs on their respective shafts such that the shaft ends are flush with the inner face of the hub, and tighten the set screw over the key. Bring both the coupling hubs (along with equipment) closer so as to maintain the gap (Fig. 2). Values for the gap, initial and maximum allowable axial misalignment are given in Tables ‘A1’ and ‘A2’ on page 9.



GAP 3MM

Fig. 2

For normal applications, the shaft ends should be flush with the inner face of the hub, however they can protrude beyond the inner face of the hub or remain inside* if required, but sufficient gap should be allowed to take care of the end float of both shafts (i.e. axial misalignment).

*Ensure that the effective length of the key is sufficient for the transmission of the rated torque of the coupling.

CONE-FLEX COUPLING ALIGNMENT PROCEDURE

Alignment procedure is given separately for each type of alignment for simplicity. However all three types of misalignments may be present at the same time.

CHECKING PARALLEL/RADIAL ALIGNMENT

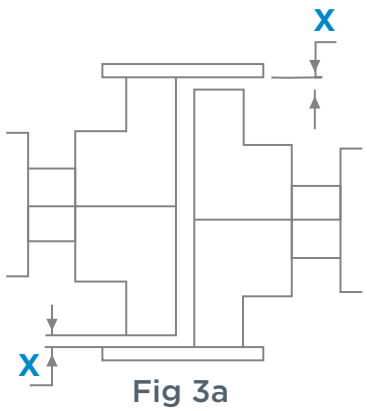


Fig 3a

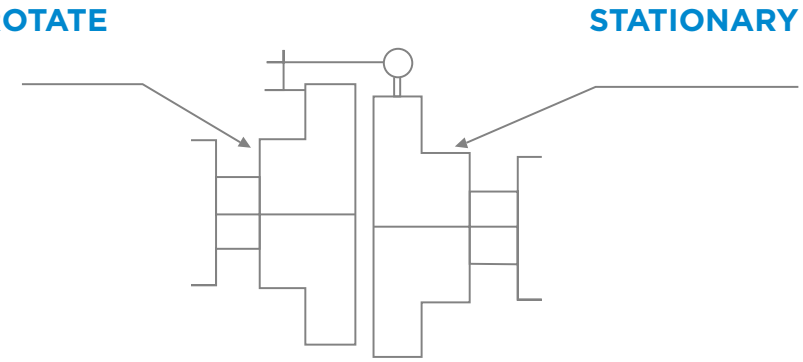


Fig 3b

Using straight edge (Fig 3a): Align straight edge on OD of one half, measure 'X' at four places 90 Deg apart without rotating shafts. Gap 'X' should be less than the allowable initial parallel misalignment (P) mentioned in table 'A1'.

Using dial gauge (Fig 3b): Fix dial gauge on hub OD of one of the half and set plunger on the flange of another half. Rotate the coupling slowly to one complete revolution by taking dial gauge readings at for places 90 Deg apart. The parallel misalignment is half of the Total Indicated Reading (TIR) of dial gauge, which is equal to value of 'P' given in table 'A1'.

CHECKING ANGULAR ALIGNMENT

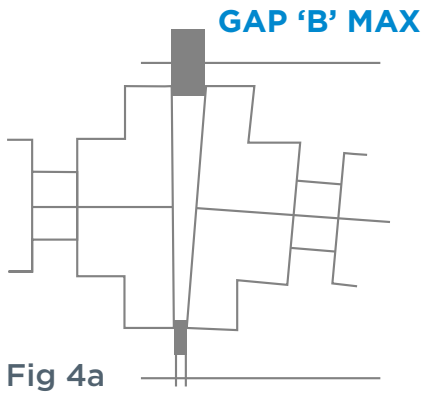


Fig 4a

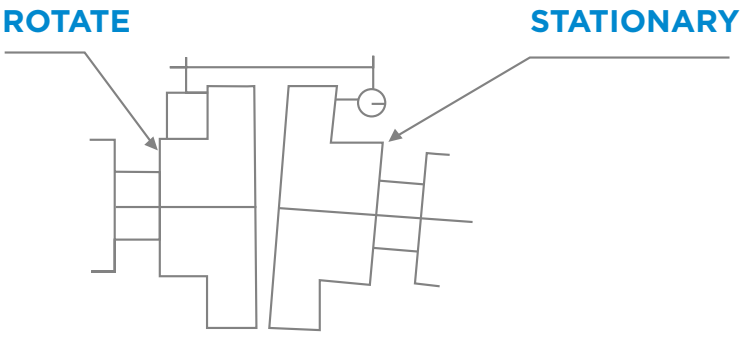


Fig 4B

Using feeler gauge (Fig 4a): Measure gap 'B' at four places 90 Deg apart without rotating shafts. The difference in max and min gap will be the Total Indicated Reading (TIR), which will be the angular misalignment present (refer Table 'A1' for allowable TIR values in mm).

Using dial gauge (Fig 4b): Fix the dial gauge on hub OD of one of the halves and set plunger on the face of another half as shown. Rotate the coupling slowly to one complete revolution by taking dial readings at four intervals 90 Deg apart. The Total Indicated Reading (TIR) will be the angular misalignment (refer Tables 'A1' and 'A2').

CONE-FLEX COUPLING

TABLE A1

Permissible Initial Misalignment						
SR No	Coupling Size	Parallel/ Radial 'P' (mm)	Angular		Axial (mm) Gap 'B' (Std) (mm)	
			Degree	Total Indicated Reading (TIR)		
1	RC-038	0.1	0.25 Deg	0.58	±0.5	3
2	RC-042	0.1	0.25 Deg	0.64	±0.5	3

Gap 'B' in the above table is when angular and axial misalignments are zero.

Note:- For permissible maximum misalignments, refer to table 'A2'.

Attention: The permissible initial misalignments given in the above table must not be exceeded during installation.

The permissible initial misalignments given in the above table – parallel, axial and angular must not occur simultaneously.

TABLE A2

Permissible Initial Misalignment						
SR No	Coupling Size	Degree			Parallel/ Radial (mm) 'P'	Gap 'B' (Std) (mm)
			Total Indicated Reading (TIR)	Axial ±mm		
1	RC-038	1	2.30	±2	±0.5	3
2	RC-042	1	2.55	±2	±0.5	3

Gap 'B' in the above table is when angular and axial misalignments are zero.

Important
At the time of installation, INITIAL misalignments should not exceed 25% of permissible maximum misalignments.

Note
For permissible initial misalignments, refer to Table 'A'.

Attention
The maximum permissible misalignments given in the above table must not be exceeded during operation.

The maximum permissible misalignments given the in the above table – parallel, axial and angular must not occur simultaneously.

CONE-FLEX COUPLING

CHECKING AXIAL MISALIGNMENT (END FLOAT)

Deviation from standard due to axial movement of shaft is defined as axial misalignment (end float). For normal applications the shaft ends should be flush with inner face of flange.

The distance between two faces of coupling halves is to be maintained as specified. The variation in this distance should not exceed the permissible initial axial misalignment given in Table 'A1'.

Repeat all the above steps until the required permissible initial misalignment limits are achieved. Tighten foundation/baseframe bolts and ensure the tightening of set screws over keys.

Attention: The misalignment capabilities shown in drawings and product literature allow for dynamic conditions and variations. For optimum service from the coupling, the installation misalignment (initial misalignment) should not exceed 25% of the maximum allowable misalignment limits. Allowance should be made for any anticipated movements, which will occur during operation (e.g. thermal movements).

ASSEMBLY PROCEDURE
COUPLING ASSEMBLY

After ensuring that the equipment is aligned properly, proceed as follows:-

Insert all pins with cone rings from the bush half side and fasten the Nylock nut on the other side (pin half). Tighten the nuts evenly so as to achieve the rated tightening torque of 39NM.

DECOMMISSIONING AND DISMANTLING

DECOMMISSIONING THE EQUIPMENT

If the pump has been used on toxic or hazardous fluids, ensure that the pump is correctly decontaminated and made safe prior to commencing work.
Remember that fluid can be trapped during draining and may be present in the discharge chamber and pump body.

DISMANTLING

1. Ensure that the appropriate check valves isolate the pump. Check that the fluid is drained and pressure fully released.
2. Disconnect pump from pipework and baseplate. Remove pump to a suitable workstation.
3. Unscrew nuts on the four tie rods and remove them.
4. Remove suction chamber and casing.
5. Remove bolt securing rotor to shaft (in the case of the LVK20-20, unscrew impeller and remove shaft sleeve, diffuser plate and casing).
6. Remove rotor from shaft using suitable levers.
7. The discharge chamber can now be removed.
8. Now remove the rotor key and withdraw the shaft sleeve. The rotating part of the mechanical seal can be removed. Lubricating the shaft prior to this would be beneficial.
9. Remove 'V' ring seal and spacer.
10. Unscrew the four M8 set screws retaining the seal housing, allowing the seal houing complete with the stationary seal seat to be withdrawn. The seal seat can now be removed from the seal housing.
11. The shaft and ball bearings can now be pressed out of the bearing housing. In the case of the LV10-5, LV20-5 and LV30-5, in either direction. The LV20-20, LV40-20 and LVK20-20 shaft can only be removed in one direction by pressing from the drive end.
12. Examine all components and prepare to replace those items identified as worn.

If double mechanical seals are used, please refer to the following additional instructions overleaf.

ADDITIONAL INSTRUCTIONS FOR LIQUIVAC® PUMPS WITH DOUBLE MECHANICAL SEALS

To be read in conjunction with standard instructions.

DECOMMISSIONING AND DISMANTLING

Proceed with guidelines 1 to 6

REMOVAL OF MECHANICAL SEALS

To remove the mechanical seal disconnect pressurised sealing system in line with manufacturer's recommendation. Remove feed and discharge pipe to seal housing. Unscrew bolts retaining the seal housing allowing the seal housing and mechanical seal to be removed.

Proceed with guidelines 7 to 12.

ASSEMBLY

Proceed with guidelines and instructions 1 to 3 replacing worn components and 'o' rings on seal housing. Ensure that non-drive end bearing butts up against seal housing when fixing position on shaft.

Proceed with guidelines 4 to 8.

ASSEMBLY AND SPARES

ASSEMBLY

Assembling the pump is carried out in the reverse order to dismantling.
Bearings should be heated on a bearing heater in accordance with the manufacturer's instructions prior to fitting to the shaft.

Ensure that all components are clean, in particular spigots and recesses that require sealants. With the LVK pump, ensure that TDC (Top Dead Centre) mark on the diffuser plate is set at TDC.

Give consideration to the following during assembly: -

1. Deposit silicon or suitable sealant material as an approximately 2mm strip on spigot joint.
2. Use silicon sealant or suitable sealant or gasket to achieve seal between flange of seal housing and bearing housing, prior to fitting mechanical seal seat.
3. Mechanical seals should be fitted in accordance with manufacturer's recommendations. For guidance, see section on Mechanical Seals.
4. Lubricate shaft prior to fitting mechanical seal. Only use lubricants that are compatible with the product being pumped. Oils and greases should not be used as they do not wash out during operation and can allow the seal to spin on the shaft.
5. The spacer between the bearing and seal housing is to be fitted with a drain hole at the bottom position.
6. Ensure that the non-drive end bearing butts up against the spacer when fixing position of the shaft.
7. When the pump has been assembled, it should be placed on a flat surface for final alignment. Ensure that the discharge connection points vertically upwards.
8. Tighten nuts on the tie rods, in a corner-to-corner sequence.

See additional Liquivac® build illustrations.

SPARES

When ordering spares, please quote pump type and serial number and identify component from relevant drawing and parts list.

MECHANICAL SEALS

These instructions apply to the mechanical seal as installed in the Liquivac® pump, and lubricated by the liquid being pumped.

The selection of materials used in the construction of a seal should be made with regard to their temperature and chemical resistance/compatibility with the liquid being pumped.

SAFETY INSTRUCTIONS

Only qualified personnel who have read and understood this instruction manual must carry out installation, removal and maintenance of the seal.

The seal must only be used in technically perfect condition and in conjunction with a suitable seat and must be operated within the recommended performance limits.

If the pumped fluid is hazardous or toxic, appropriate precautions must be taken to ensure that any seal leakage is adequately contained.

PTFE and fluorocarbon components should never be burned or incinerated as the fumes are highly toxic.

INSTALLING THE SEAL

Before installing the seal, ensure that all components are clean and free from oil and grease. However, it is essential to use a suitable lubricant when fitting the seal.

The recommended lubricants for elastometric bellows are soft hand soap and water or glycerine; do not use washing-up liquid, liquid soap or hand cleaning gels.

Do not use hydrocarbon-based liquids on ethylene propylene bellows and do not use grease (including silicon grease) on any elastomer bellows.

1. With the seal housing fixed in position, fit the seat into the seal housing.
2. Ensure that all components are clean, and lightly lubricate the shaft and neck of the bellows.
3. Carefully slide the seal along the shaft to its required position. Fitting the shaft sleeve and locking in position with the shaft/rotor key will fix this position. If the seal has a locking collar then locate as required. Ensure that all components are correctly engaged.
4. Remove any excess lubricant.

ATEX AND EXPLOSION PROTECTION GUIDELINES SHORT OPERATING INSTRUCTIONS CONCERNING EXPLOSION PROTECTION FOR LIQUIVAC® PUMPS

Caution

These short operating instructions cover only the main issues concerning explosion protection. The operating instructions for the pump or pump set as applicable, for the specific works number must also be complied with. The following must be adhered to.

1. The explosion protection marking on the pump only refers to the pump part. The coupling, if any, must have an EC manufacturer's declaration. The driver must be regarded separately. Example of marking on pump part:- 'E.II 2G T2-T4'.

2. Any operation of the pump outside the specified operating range and in any unauthorised modes of operation may result in the specified temperature limits being exceeded.

3. In all areas of elevated temperatures (bearing brackets), in particular, the unit surfaces must be freely exposed to the atmosphere.

4. Explosion protection is subject to the following material requirements:-
   For combustible liquids, all pressure-retaining components must be made of ductile materials.

   The material variants supplied by Tomlinson Hall meet these requirements.

5. If there is a risk of explosion during the installation phase, the direction of rotation must not be checked by starting up the unfilled pump set, even for a short period. If it is not possible to fill the pump, the direction of rotation must be checked with the pump/motor coupling removed.

6. The pump must never be operated with the shut off valves in the suction and discharge lines closed.

7. For minimum flow operation with liquids whose physical properties are distinctly different from water, it is essential to check if an additional heat build up may occur and if the flow rate must therefore be increased. Contact the manufacturer if necessary and observe the information provided in the data sheet.

8. Responsibility for compliance with the specified product temperature lies with the operator.

9. If temperature classes T5 (100C) and T6 (85C) have to be complied with, special measure may have to be taken with regard to bearing temperature. In such cases, and if ambient temperature exceeds 40C, contact the manufacturer.

10. To avoid the risk of excessive temperatures, dry-running is not permitted.
    Dry running may result from:-

    • Incompletely filled seal chamber
    • Excessive gas content in the medium handled or
    • Impermissible operating mode

11. The bearing assembly must be checked regularly for correct function, running noises and heat build-up. The same applies to lubricants.

12. In hazardous areas, compliance with IEC60079-14 is an additional requirement for electrical connection.

PREVENTATIVE MAINTENANCE SCHEDULE

WEEKLY

Check general conditions – unusual noises or vibrations, leaks, temperature.

QUARTERLY

Check pump coupling alignment and rubber inserts.

Subject to site conditions it may be necessary to change bearing and mechanical seal.

NOTE

Refer to operating instructions for dismantling, assembly and installation.

ANCILLARY LIST

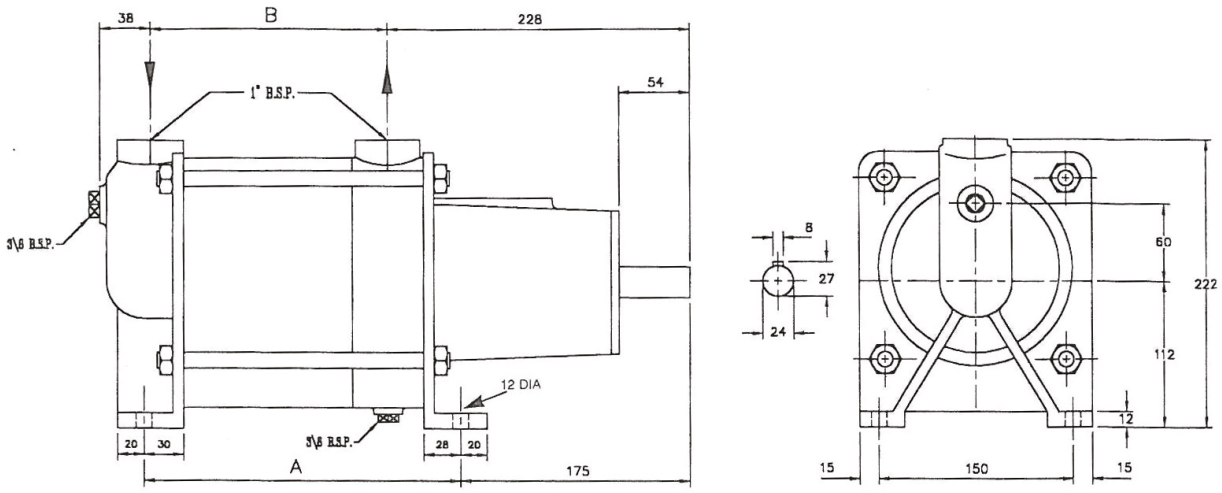
The following items are also available from stock:-

- Anti-vibration mountings
- Regulation valves
- Isolation valves
- Swing check non-return valves
- Priming pots

LIQUIVAC® PUMPS
PROBLEM SOLVING GUIDE

PROBLEM	POSSIBLE CAUSE	REMEDY
Pump fails to prime	Loss of liquid ring	Fill pump with liquid
	Non return valve damaged or blocked	Clean or replace
	Air leak in suction pipe	Correct leak
	Suction lift or discharge head too high	Check piping installation
	Restriction in pump or pipework	Check system and remove any obstructions
Pump stops or fails to Deliver rated flow or pressure	Air leak in suction line	Correct leak
	Restriction in pump or pipework	Check system and remove any obstruction
	Suction intake not submerged	Check installation and correct as required
	Rotor or other parts worn or damaged	Replace worn or damaged parts
	Suction lift too high	Measure vacuum. reduce lift and/or friction losses in suction line
Pump requires too much power	Cavitation in pump	Reduce suction lift and/or friction losses in suction line. Adjust discharge valve to reduce flow
	Pump or drive not securely mounted	Make pump set secure
	Debris in pump	Clean out debris; replace damaged parts
Bearings run too hot	Loss of service liquid	Check service liquid supply
	Restriction in suction or delivery	Remove restriction
	Loss of liquid from process	Review operation and control
	Air leak on suction	Control correct leak

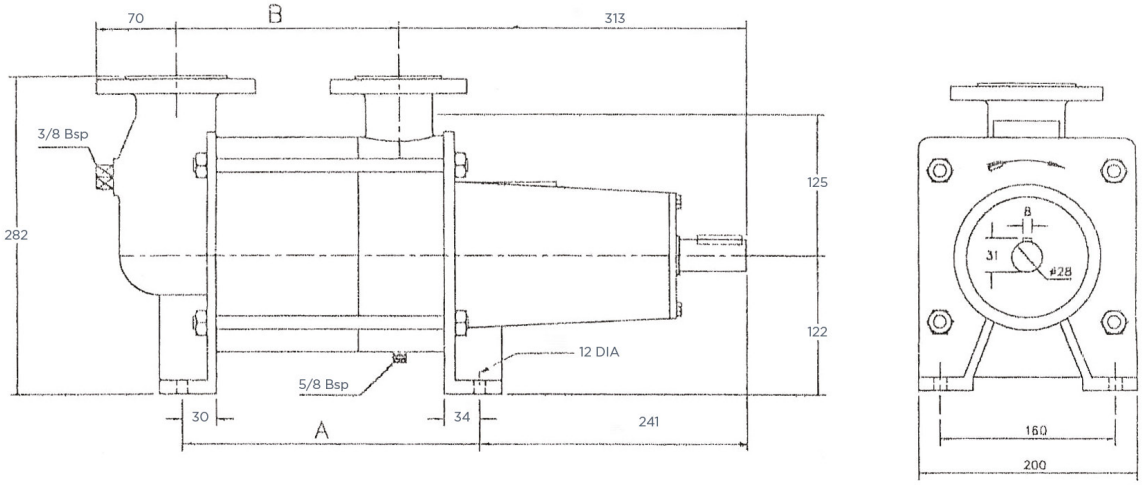
LIQUIVAC® LV10-5, LV20-5, LV30-5



ROTATION = CLOCKWISE LOOKING ON DIRECTION OF DRIVE SHAFT

TYPE	A	B	APPROX WEIGHT
LV10-5	195mm	133mm	25kg
LV20-5	240mm	178mm	28kg
LV30-5	285mm	223mm	32kg

LIQUIVAC® LV20-20, LV40-20, LVK20-20

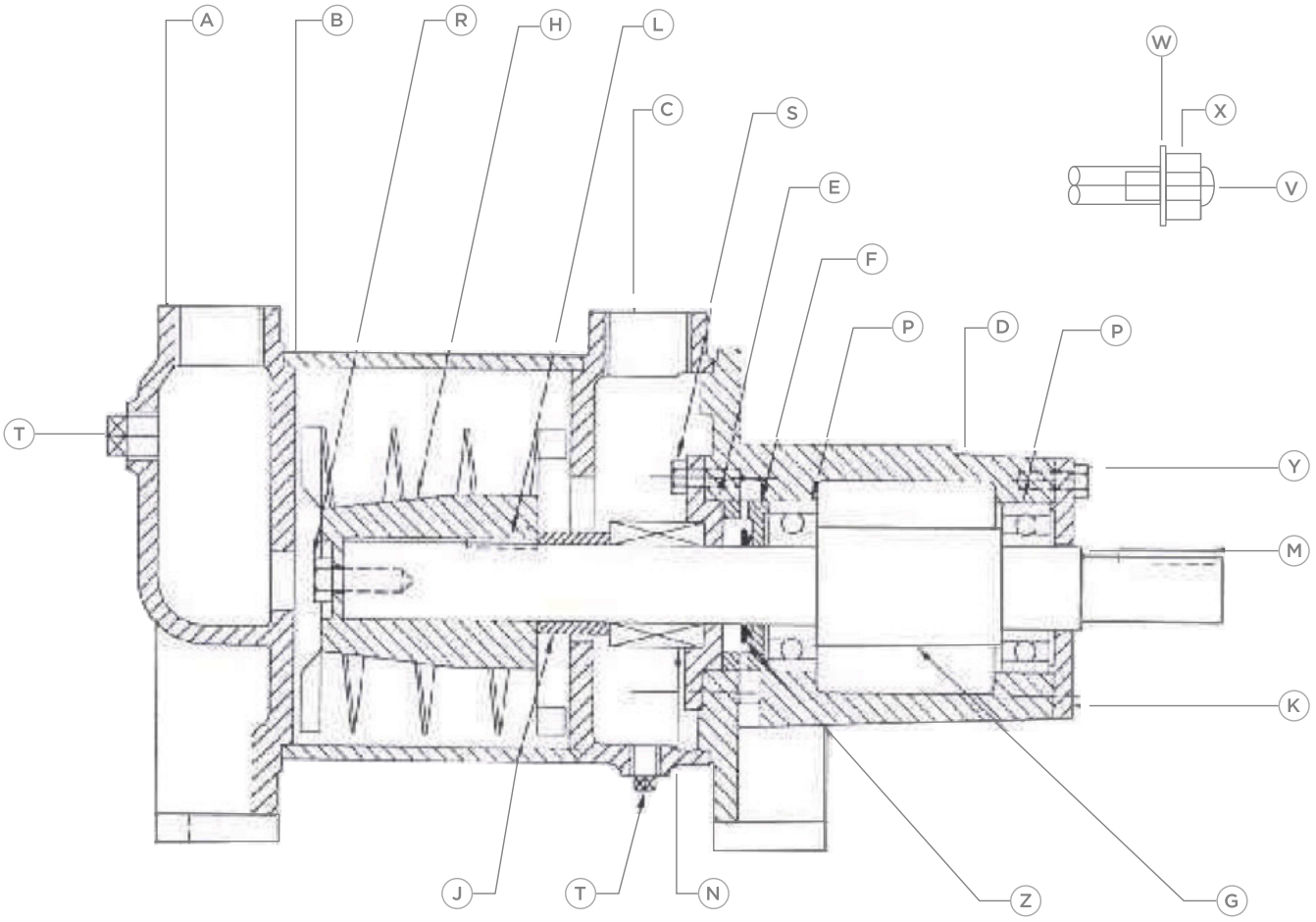


ROTATION = CLOCKWISE LOOKING ON DIRECTION OF DRIVE SHAFT

TYPE	A	B	APPROX WEIGHT
LV20-20	267mm	200mm	45kg
LV40-20	329mm	262mm	50kg
LVK20-20	332mm	265mm	52kg

It is the continuing policy of Tomlinson Hall to develop and improve our products. We reserve the right to change dimensions and amend specification without prior notice.

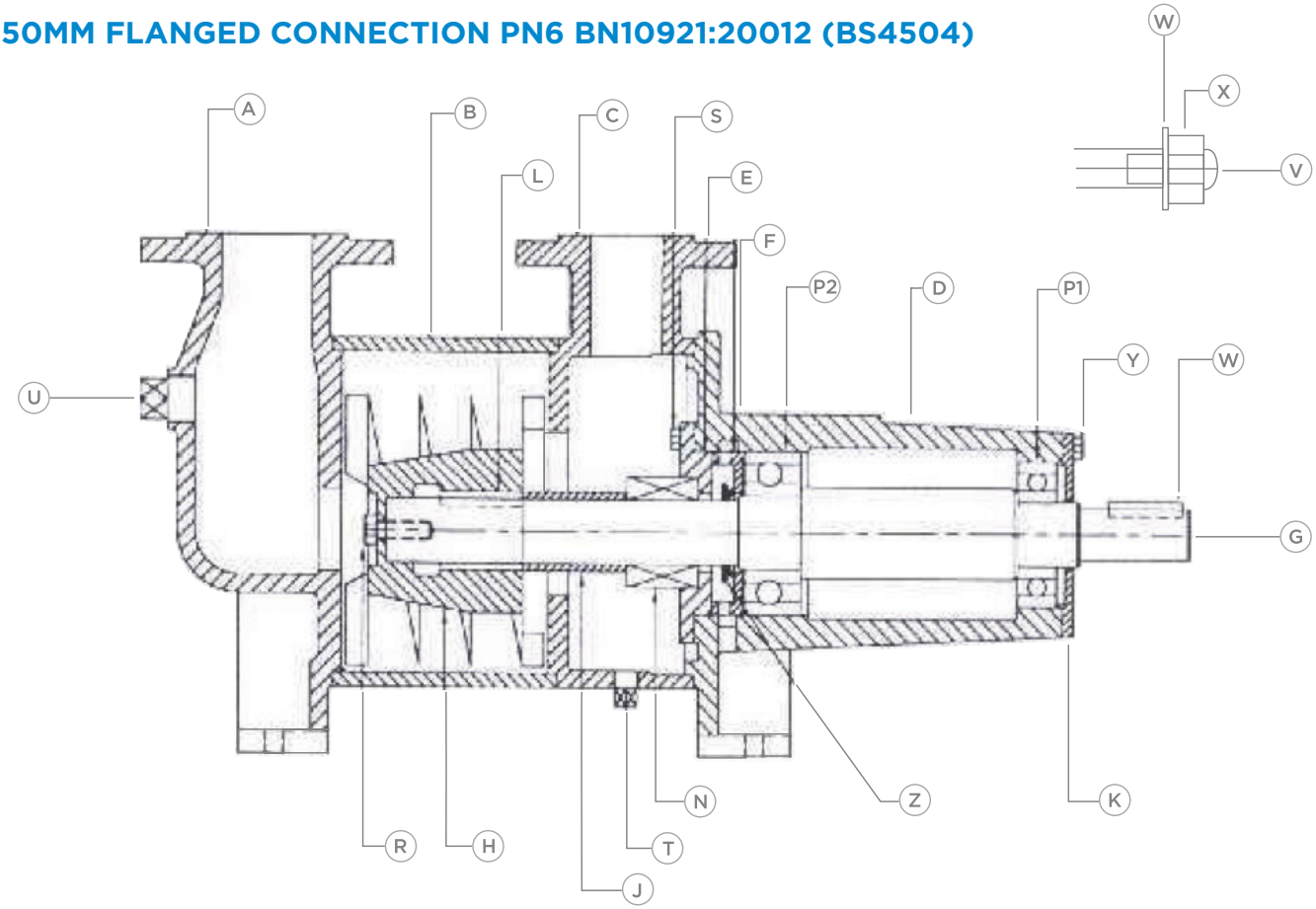
1” SCREWED BSP CONNECTION



LIQUIVAC® LV10-5/LV20-5/LV30-5 PARTS LIST

ITEM	DESCRIPTION	QTY	PUMP CASING MATERIAL CAST IRON	PUMP CASING MATERIAL STAINLESS STEEL
A	Suction Chamber	1	CI	316
B	Rotor Casing (Barrel)	1	316	316
C	Discharge Chamber	1	CI	316
D	Bearing Housing	1	CI	316
E	Seal Housing	1	CI	316
F	Spacer	1	CI	316
G	Shaft	1	316	316
H	Rotor Hub	1	316	316
J	Sleeve	1	316	316
K	Bearing End Cover	1	CI	CI
L	Rotor Key	1	316	316
M	Coupling Key	1	316	316
N	Mechanical Seal	1		
P	Ball Bearing	1		
R	Set Screw	1	316	316
S	Set Screw	1	316	316
T	Plug	1	MI	316
U		1		
V	Tie Rod	1	316	316
W	Washer	1	Zinc Coated	Zinc Coated
X	Nut	1	316	316
Y	Set Screw	1	316	316
Z	V-Ring	1	Nitrile	Nitrile

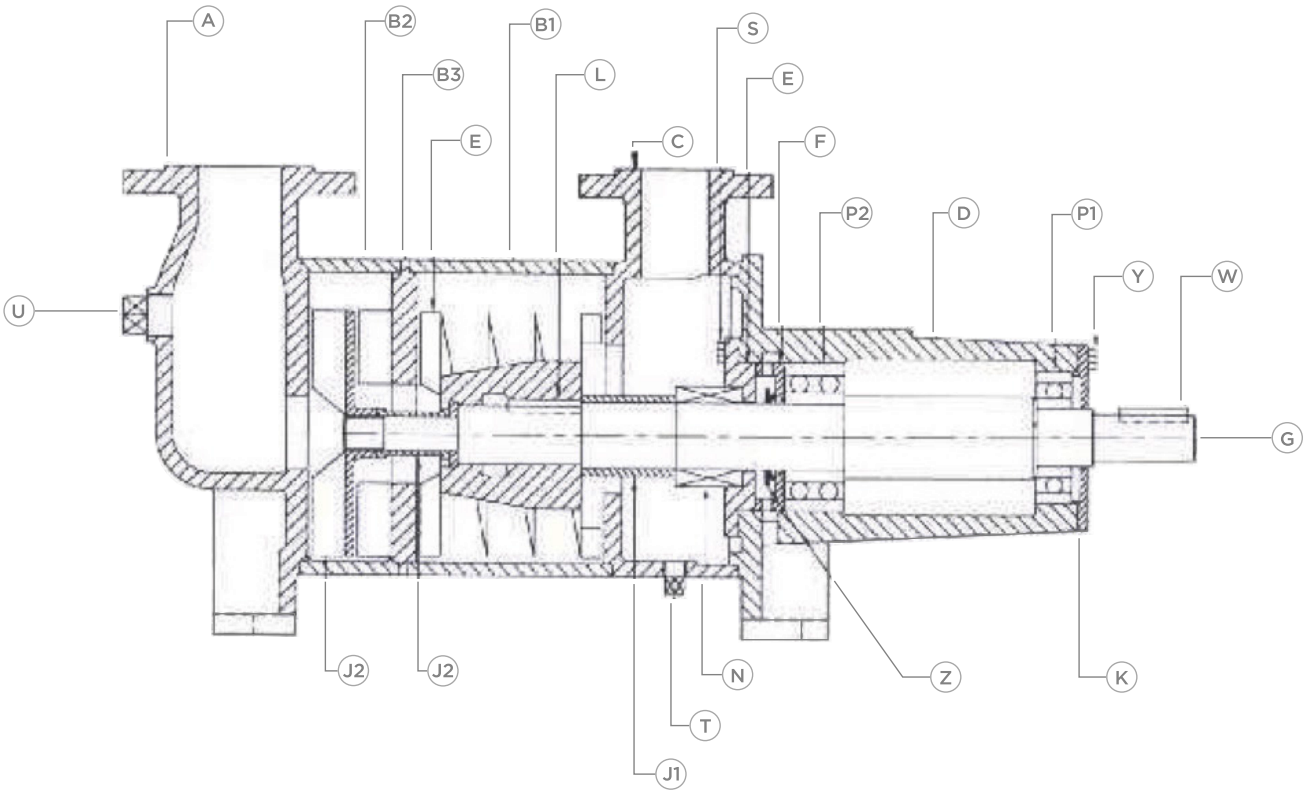
50MM FLANGED CONNECTION PN6 BN10921:20012 (BS4504)



LIQUIVAC® LV20-20/LV40-20 PARTS LIST

ITEM	DESCRIPTION	QTY	PUMP CASING MATERIAL CAST IRON	PUMP CASING MATERIAL STAINLESS STEEL
A	Suction Chamber	1	CI	316
B	Rotor Casing (Barrel)	1	316	316
C	Discharge Chamber	1	CI	316
D	Bearing Housing	1	CI	316
E	Seal Housing	1	CI	316
F	Spacer	1	CI	316
G	Shaft	1	316	316
H	Rotor Hub	1	316	316
J	Sleeve	1	316	316
K	Bearing End Cover	1	CI	CI
L	Rotor Key	1	316	316
M	Coupling Key	1	316	316
N	Mechanical Seal	1		
P1	Ball Bearing	1		
P2	Ball Bearing	1		
R	Set Screw	1	316	316
S	Set Screw	4	316	316
T	Plug	1	MI	316
U	Plug	1	MI	316
V	Tie Rod	4	316	316
W	Washer	8	Zinc Coated	Zinc Coated
X	Nut	8	316	316
Y	Set Screw	4	316	316
Z	V-Ring	1	Nitrile	Nitrile

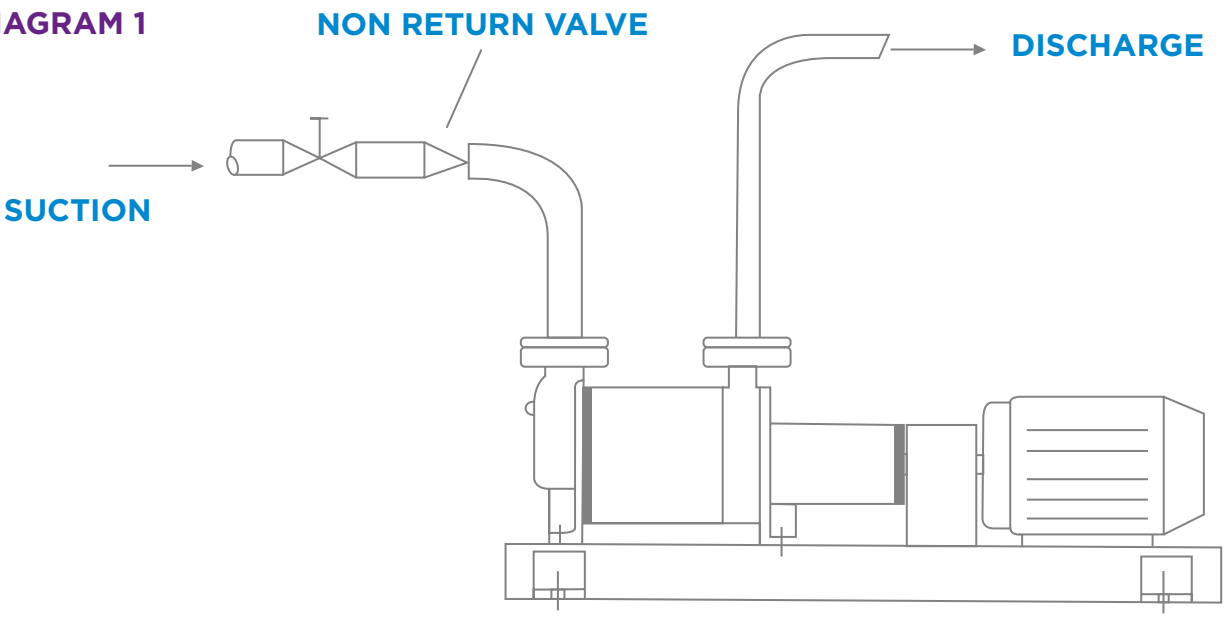
50mm FLANGED CONNECTION PN6 BS4504



LIQUIVAC® LVK20-20 PARTS LIST

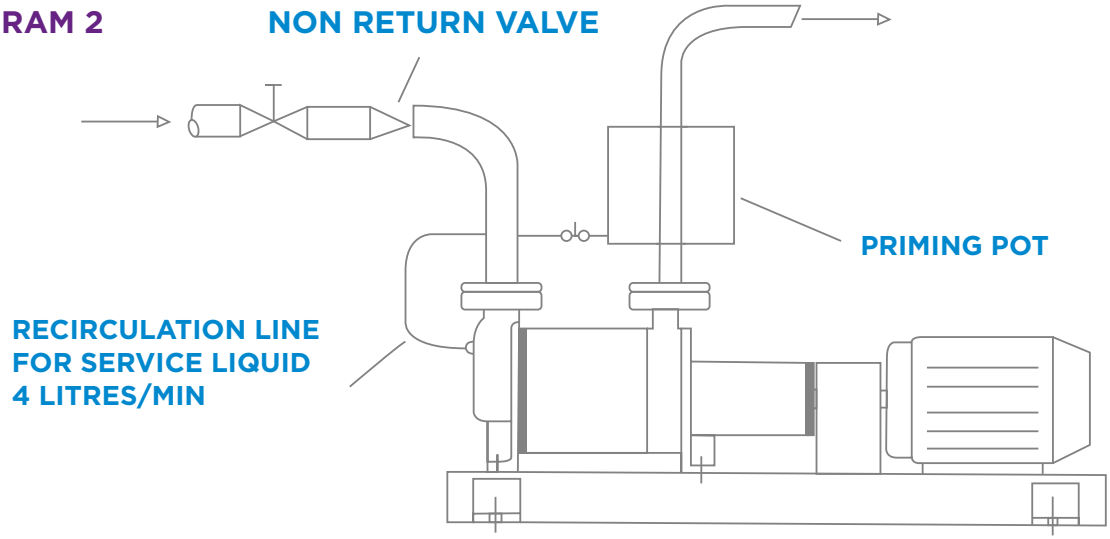
ITEM	DESCRIPTION	QTY	PUMP CASING MATERIAL CAST IRON	PUMP CASING MATERIAL STAINLESS STEEL
A	Suction Chamber	1	CI	316
B1	Rotor Casing (Barrel)	1	316	316
B2	Impeller Chamber	1	CI	316
B3	Diffuser Plate	1	316	316
C	Discharge Chamber	1	CI	316
D	Bearing Housing	1	CI	316
E	Seal Housing	1	CI	316
F	Spacer	1	CI	316
G	Shaft	1	316	316
H1	Rotor Hub	1	316	316
H2	Impeller	1	316	
J1	Sleeve	1	316	316
J2	Impeller Sleeve	1	316	316
K	Bearing End Cover	1	CI	CI
L	Rotor Key	1	316	316
M	Coupling Key	1	316	316
N	Mechanical Seal	1		
P1	Ball Bearing	1		
P2	Ball Bearing	1		
R	Set Screw	1	316	316
S	Set Screw	1	316	316
T	Plug	1	MI	316
U	Plug	1	MI	316
V	Tie Rod	4	316	316
W	Washer	8	Zinc Coated	Zinc Coated
X	Nut	8	316	316
Y	Set Screw	4	316	316
Z	V-Ring	1	Nitrile	Nitrile

DIAGRAM 1



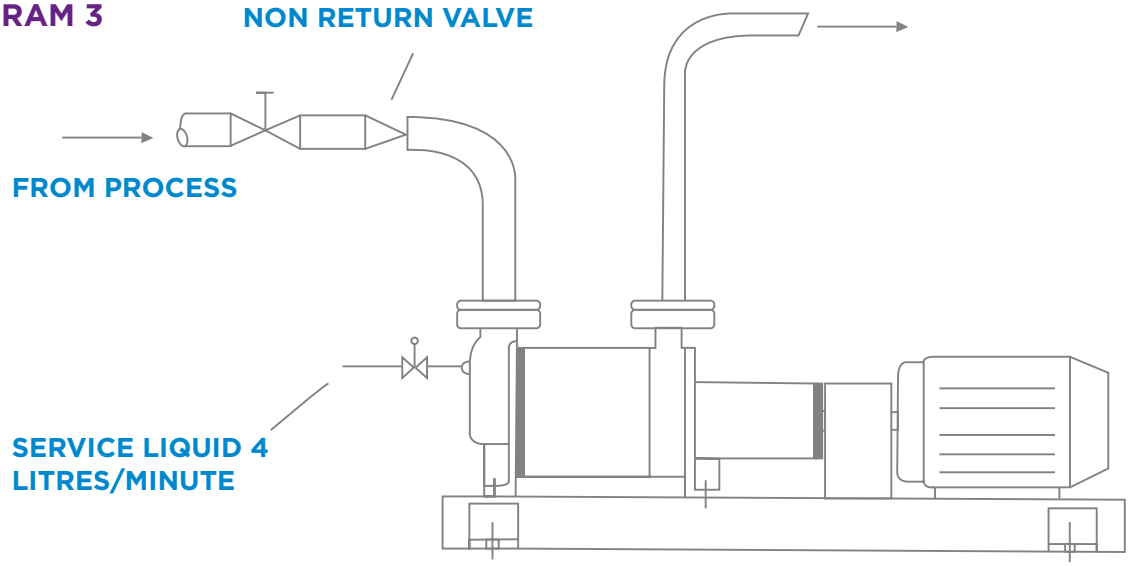
PUMPING LIQUID IN A PROCESS

DIAGRAM 2



PRIMING SYSTEMS SUCTION UP TO 500M

DIAGRAM 3



VACUUM DUTIES

Tomlinson Hall Ref	
Customer Ref	

LIQUIVAC®

LIQUID RING VACUUM PUMPS

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