

OPERATION & MAINTENANCE MANUAL

77 SUNSET ROAD, KENMORE VACUUM SEWERAGE SCHEME

Brisbane City Council

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November 1994

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OPERATION & MAINTENANCE MANUAL

77 SUNSET ROAD, KENMORE VACUUM SEWERAGE SCHEME

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	• MULTITRODE

SEWERAGE PUMP STATION COMMISSIONING REPORT

STATION

SUNSET RD - VILLIAM SLAB 11572

SP No.

DATE

13/12/94

NUMBER OF PUMPS

2

HAS THE RISING MAIN BEEN PIGGED?

YES

☐

NO

☒

N/A

M & E PERSONNEL PRESENT

MARK VINCE

PUMP NO. 1 TEST

S.L. TO T.W.L1 (high)

2860

mm

PUMPING TIME

35

sec.

@ 6m head

S.L. TO B.W.L1 (low)

2860

mm

ARE THE PUMPS ONLY PUMPING DOWN THE WET WELL?

YES

☒

NO

☐

ESTIMATED TOTAL PUMP DOWN VOLUME

0.002

m³

ESTIMATED PUMP RATE

0.0012

m³/s

THEORETICAL DESIGNED PUMP RATE

0.0012

m³/s

Varies with head

PUMP NO. 2 TEST

S.L. TO T.W.L2 (high)

2860

mm

PUMPING TIME

2

sec.

@ 2m head

S.L. TO B.W.L2

2860

mm

ARE THE PUMPS ONLY PUMPING DOWN THE WET WELL?

YES

☒

NO

☐

ESTIMATED TOTAL PUMP DOWN VOLUME

0.004

m³

ESTIMATED PUMP RATE

0.002

m³/s

THEORETICAL DESIGNED PUMP RATE

0.002

m³/s

Varies with head

.. 2 ..

DO PUMPS ALTERNATE DUTY AUTOMATICALLY?

YES ☒ NO ☐

DO PUMPS ACTIVATE WHEN THE SURCHARGE LEVEL IS REACHED?

YES ☒ NO ☐

HAVE ALL VALVES BEEN LEFT OPEN?

YES ☒ NO ☐

Except man
val

HAS THE KNIFE GATE IN THE WET WELL BEEN LEFT OPEN?

YES ☐ NO ☐

N/A

IS THE PUMP STATION CONSIDERED TO BE COMMISSIONED?

YES ☒ NO ☐

ANY OUTSTANDING ISSUES OR COMMENTS

IS THE PUMP STATION ON MAINTENANCE?

YES ☐ NO ☒

COMMISSIONING ENGINEER

[Redacted Signature]

P.J. GLENNON

RPO

SECTION 1

77 SUNSET ROAD, KENMORE VACUUM SEWERAGE SCHEME

1.1	DESCRIPTION
1.2	RETICULATION
1.3	PUMPING STATION
1.4	PRE-COMMISSIONING PROCEDURES
1.5	COMMISSIONING TEST PROCEDURE

1. 77 SUNSET ROAD, KENMORE – STAGE 1 SEWAGE TRANSPORT SYSTEM

1.1 DESCRIPTION

The pump station in Stage 1 will be a conventional pump station lifting sewage from an adjacent MH and discharging it to a rising main. In Stage 2 it will be modified to a vacuum collection system. The pumps and control panel will be retained in this revamped system.

1.2 RETICULATION SYSTEM

The Stage 1 drainage system consists of a network of gravity mains collecting into a manhole, located next to the pumping station. The future system will include vacuum pipe main east and west of this station. These pipes are sized in accordance with AIRVAC developed flow resistance data which allows us to calculate the optimum pipe sizes for a given flow. Future extensions and modifications to the system should be referred to AIRVAC–RSM Pty Limited.

1.3 PUMPING STATION

The Stage 1 Pump Station consists of:–

- Pump Prime Tank
- Sewage Discharge Pumps. Details of the sewage discharge pumps are contained in Section 5 – Hidrostral Sewage Pumps.
- Control Panel.
- Isolation Valve on discharge of sewage pumps.
- Check Valves
- Lifting Equipment

The 350 litre collection tank is primed with water initially. During normal pump operation it syphons waste water from the collecting manhole next to the station via the 100 NB PVC top entry pipe. It is imperative for the successful operation of this syphon type prime tank to avoid air breaking the syphon in this tank. The most likely cause of this would be unauthorised opening of the 18 mm fill line valve on the top of the tank. We strongly recommend removal of the handle on this valve after commissioning to avoid this potential problem.

Section 1

The Hidrostal sewage pumps toggle between duty/standby and are controlled by the level probe located in the collecting manhole MH/1/1, adjacent on the southern pumping station side.

1.4 PRE-COMMISSIONING PROCEDURE

1.4.1 STAGE 1 SEWAGE PUMPS

The objective of this test is to confirm that the pumps will suck from the manhole and have sufficient head to force waste into the nearby rising main.

The procedure is as follows:-

1. Shut the prime tank drain valve.
2. Shut isolation valves on the standby Pump No. 2 and the discharge valve to the rising main on the selected pump (No. 1).
3. Fill the prime tank via hose connection to the prime tank (Ø18 connection on the top of the tank).
4. Fix any leaks which may be apparent. This is important as a leak in the system will reduce the ability of the pumps to suck adequately. Ensure that the prime tank is full by checking overflow into MH 1/1. Disconnect hose and shut the Ø18 ball valves.
5. Fix the level probe in MH 1/1 so that it clears the base by approximately 100 mm.
6. At the control panel depress system start push button. Open the control panel door and check that lights have come up on PLC and that Multitrode level controller is functioning. (No level lights will be showing) green lights for pump availability should be on.
7. Check the direction of rotation on both pumps by momentarily running. Correct wiring as necessary.
8. Partly open the discharge valve on Pump No. 1.
9. Select and P.B. initiate manual mode switch and then pump 1 switch. Pump will run although the Multitrode is not controlling. Run briefly then follow same procedure for Pump No. 2. Check valves should open (hold shaft and feel movement).

Section 1

10. Refill prime tank as 3 above after checking/confirming absence of piping leaks. REMOVE HOSE AND CHECK ISOLATION VALVE ON THE TOP OF THE PRIME TANK IS CLOSED.
11. Fill the MH 1/1 using hose. The pump switches should be set up so that the level controller will initiate a pump running when level is 50m below the invert of the incoming sewers. Pump cut out should be 200mm above base level of M/H. Emergency cut out alarm initiation should be 100 mm above concrete base.

NOTE: Remove the hose and ensure isolation valve.

1.5 COMMISSIONING PROCEDURE

1. Brisbane City Council staff to open isolation valve on our line into the rising main.
2. Check this length of pipe for any leaks. Fix as required.
3. Place hose into MH 1/1 and fill at maximum rate.
4. Partly open the discharge isolation valve on Pump No. 1.
5. Select and P. B. initiate the manual mode switch and then Pump No. 1 switch. Run pump for one (1) minute and observe satisfactory operation of check valve. Repeat with Pump No. 2.

NOTE: Do not pump below selected LLS cut out as indicated by Multitrode M.T.I.C. inside panel door.

6. Allow hose to refill the M/H1/1 to appropriate level P. B. switch to auto mode and allow pumps to automatically switch and run as required.
7. Measure the level difference in the M/H1/1 between pump switch HLS and pump low level cut out switch LLS.

Approximately HLS \approx 600 mm above base.

Approximately LLS \approx 200 mm above base.

Different HT \approx 400 mm approximately (but actual required)

\varnothing of MH is 1.2 m and volume pumped out is 114 L/100 mm of level change calculate volume – $114 \text{ L} \times \frac{\text{HT difference}}{100 \text{ mm}}$ in mm.

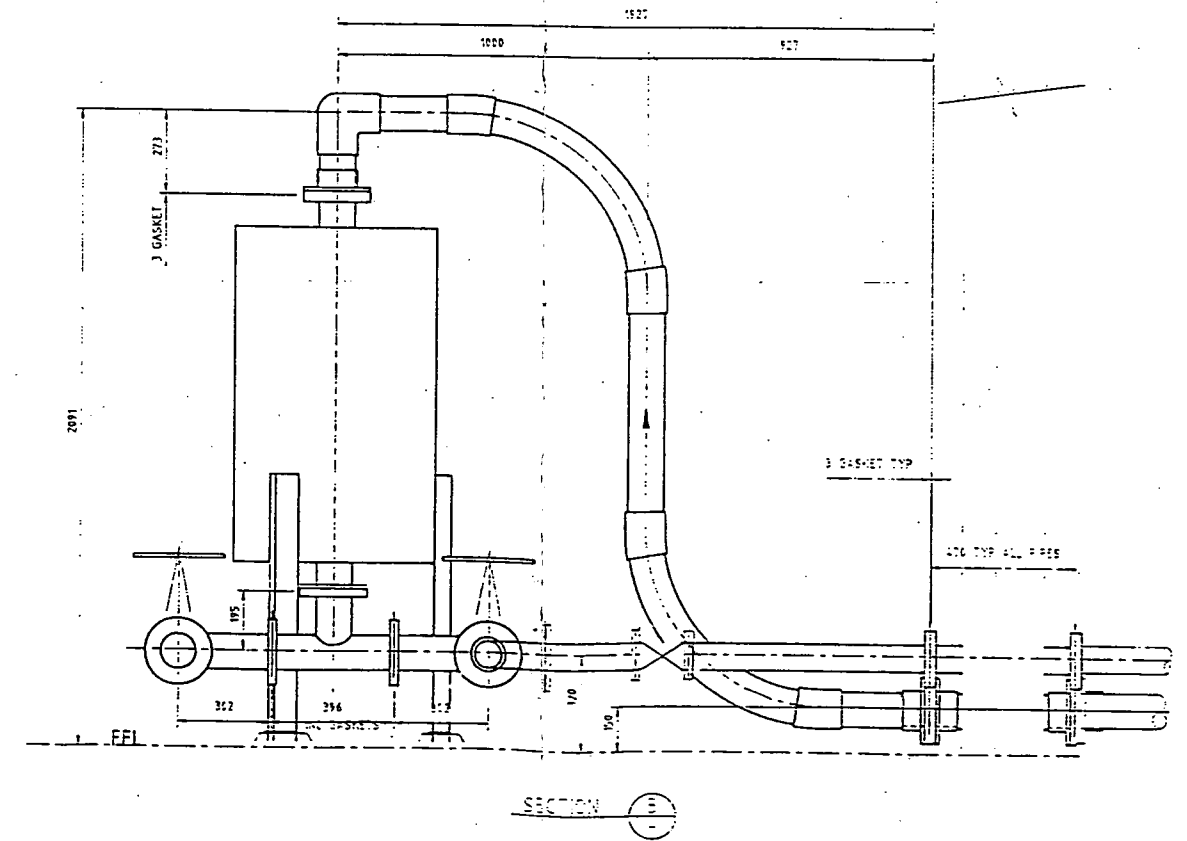
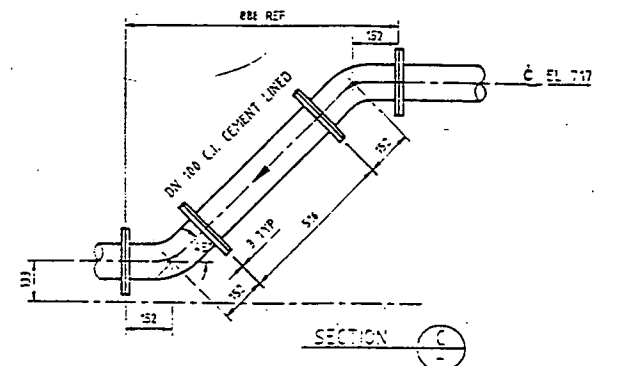
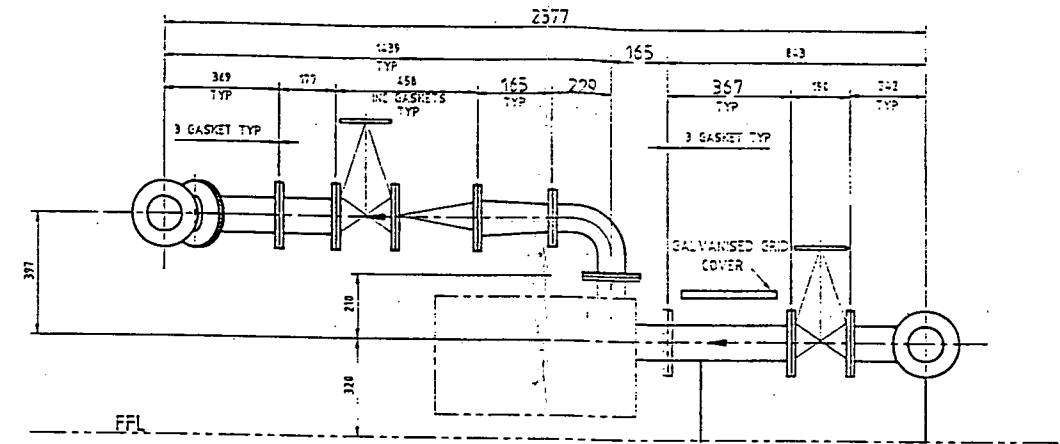
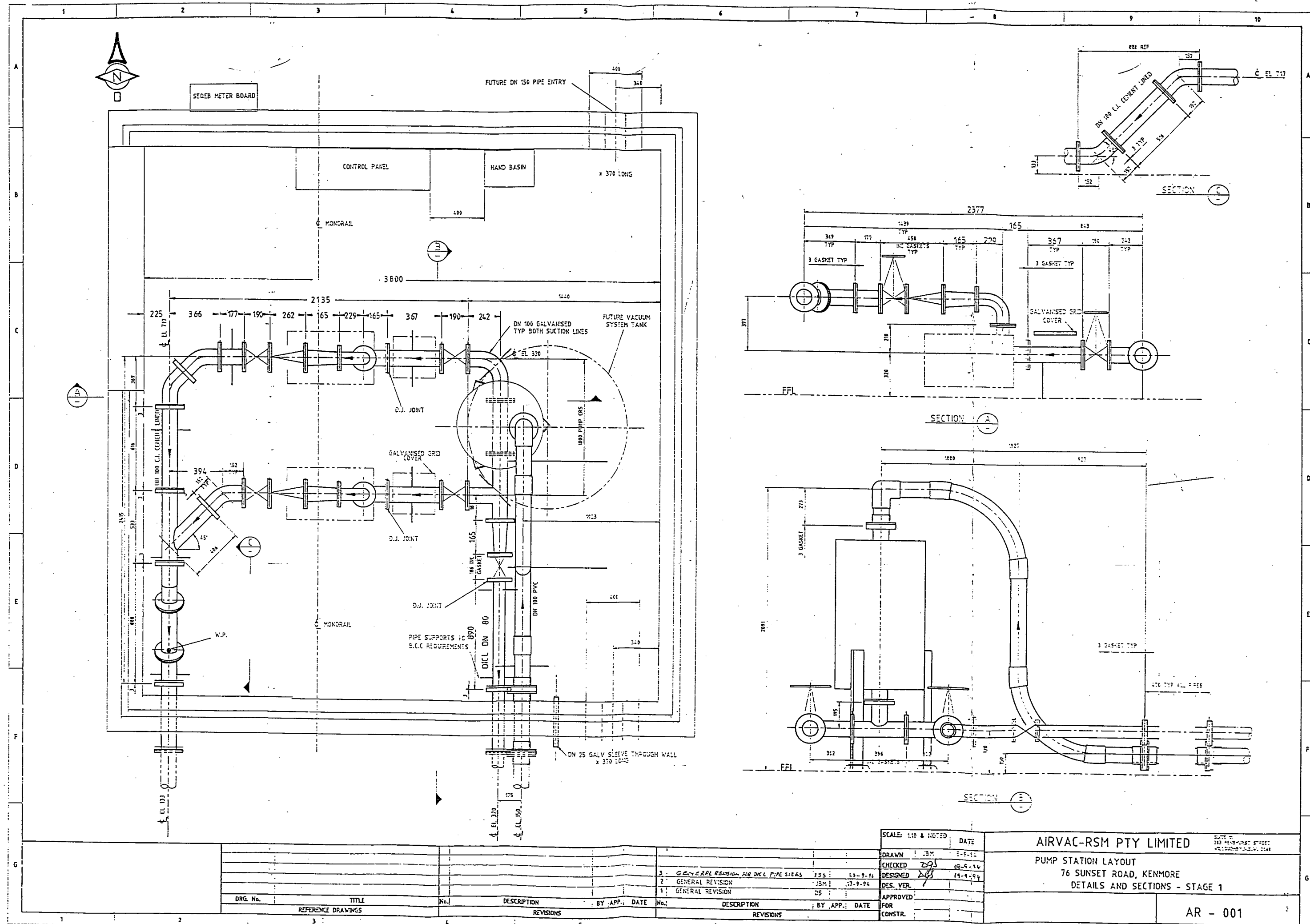
8. Check the pump capacity rate by determining the time required to pump between the high and low level switches on auto mode.

Section 1

Calculate the rate L/s.

9. Repeat using alternative pump.

Section 1



SCALE: 1:10 & NOTED		DATE	AIRVAC-RSM PTY LIMITED		DATE: 11/05/2011 110 KENNEDY STREET MELBOURNE, VIC 3000	
DRAWN		JBM	5-5-11	PUMP STATION LAYOUT		76 SUNSET ROAD, KENMORE DETAILS AND SECTIONS - STAGE 1
CHECKED		DJS	19-9-11			
DESIGNED		DJS	19-9-11			
DES. VER.						
APPROVED						AR - 001
FOR						
CONSTR.						

DRG. No.	TITLE	No.	DESCRIPTION	BY	APP.	DATE	No.	DESCRIPTION	BY	APP.	DATE
REFERENCE DRAWINGS			REVISIONS								

SECTION 2

CONTROL PANEL

2. CONTROL PANEL

The control panel is a standard AIRVAC–RSM Pty Limited panel for small vacuum pump station.

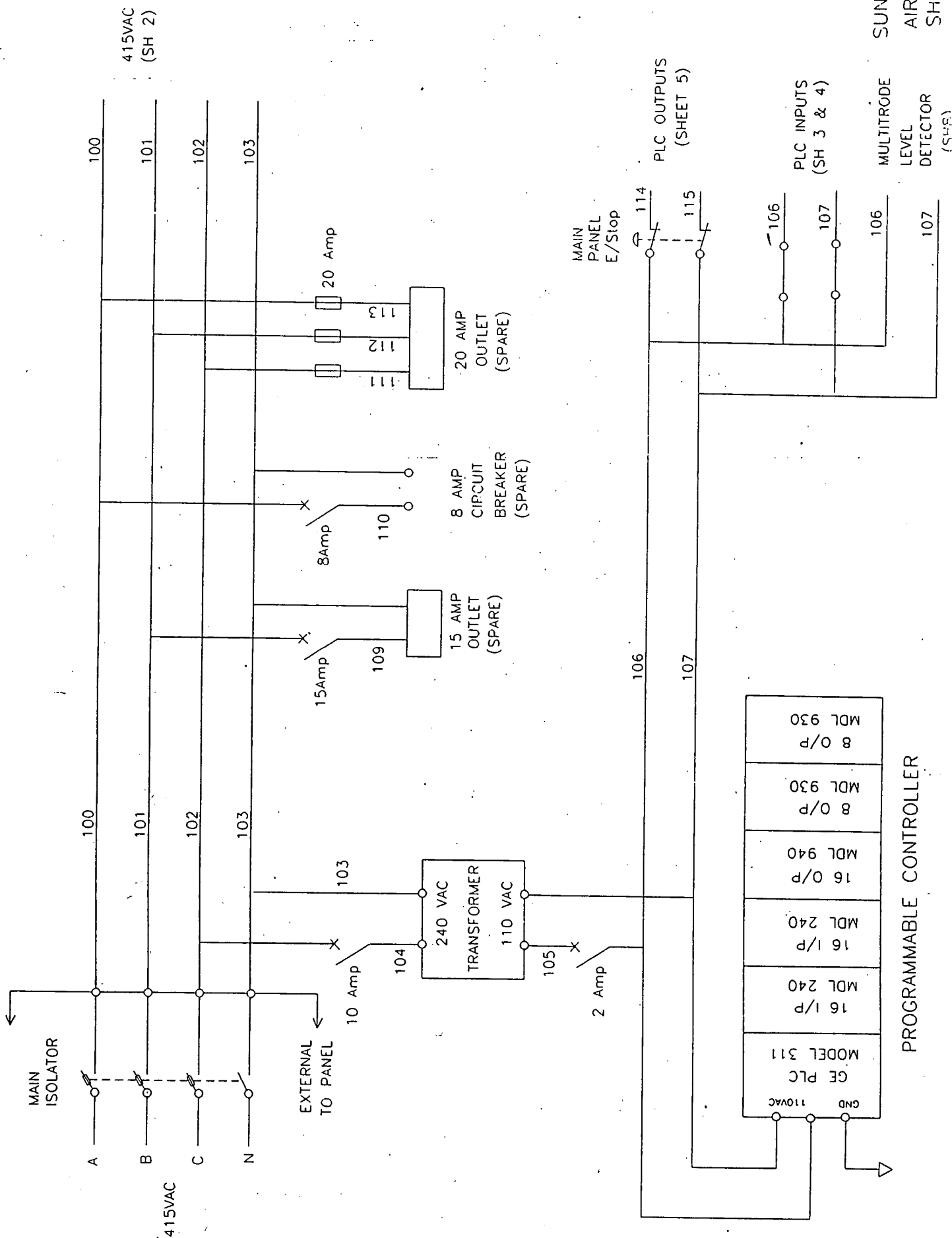
In the future development to a vacuum station it will be necessary to install vacuum pumps, vacuum tank and vacuum and level switches. These will be wired into the panel and will be accommodated without any changes to switches or the PLC. In Stage 1 AUTO mode the system running lights for the future stage vacuum pumps and low vacuum alarm lights will come on. A temporary sign on the panel should note that these lights are to be ignored in Stage 1.

2.1 STAGE 1 CONTROL PANEL

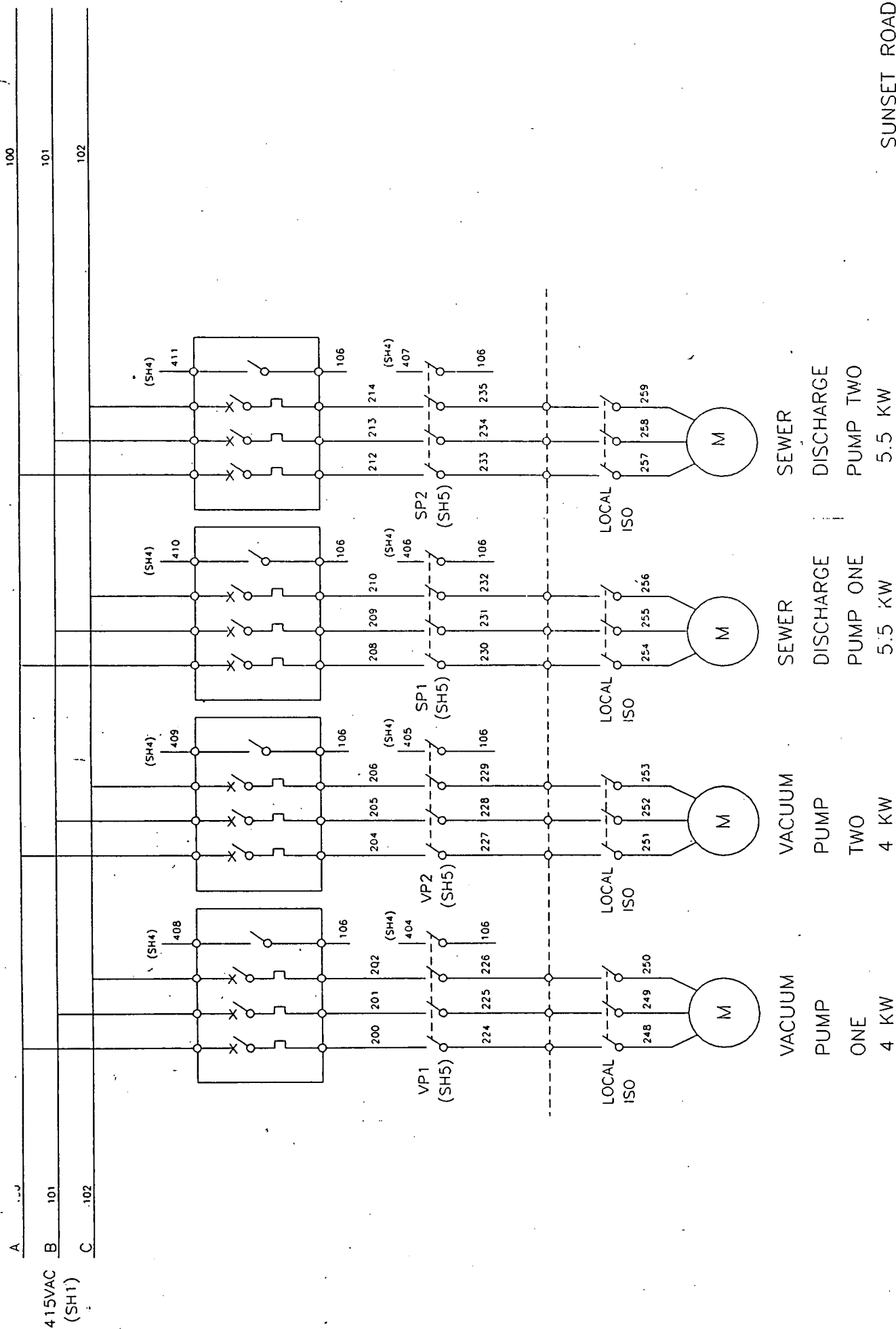
In Stage 1 the pump operation is as follows:–

1. P.B. select system start. Light should illuminate. PLC should have power lights illuminated.
2. P.B. select – auto start.
3. P.B. select duty pump.

The duty pump will now run whenever the liquid level in the manhole 1/1 activates the multitrode pump switch. Pump will run until water level drops to pump cut out level. Levels are shown on the scale 1 to 10 inside panel.

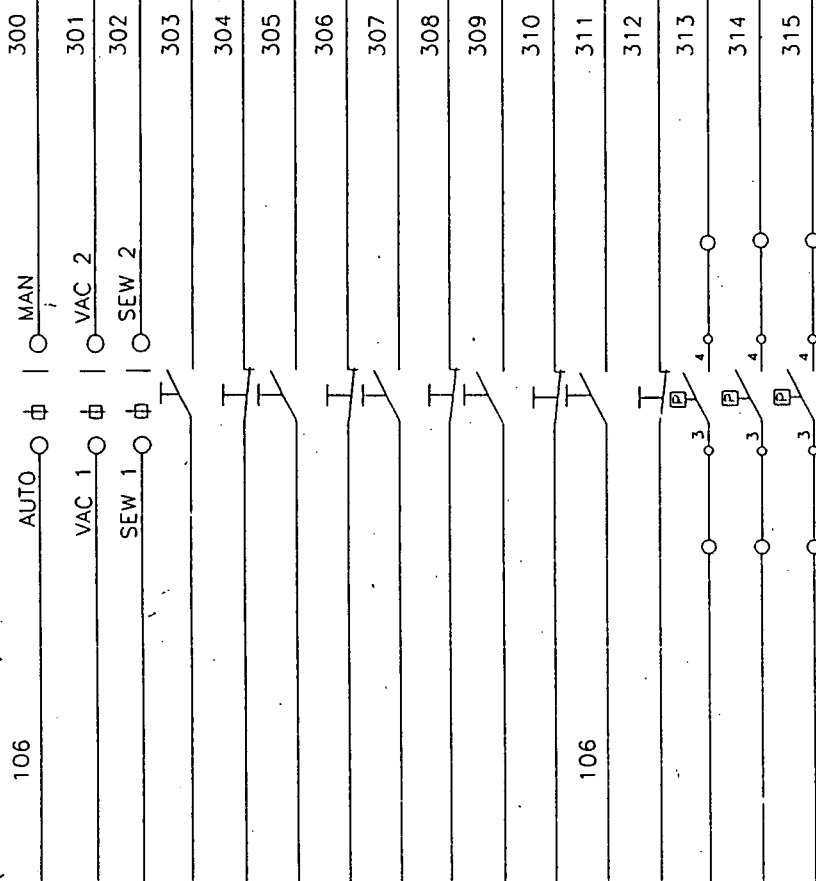


SUNSET ROAD
AIRVAC-RSM
SHEET 1



SUNSET ROAD
AIRVAC-RSM
SHEET 2

TERM	ADDR	INPUT DESCRIPTION
1	I1	AUTOMATIC / MANUAL SELECT
2	I2	VACUUM PUMPS 1 / 2 SELECT
3	I3	SEWER DISCHARGE 1 / 2 SELECT
4	I4	SYSTEM START PUSH BUTTON
5	I5	SYSTEM STOP PUSH BUTTON
6	I6	VAC PUMP 1 START
7	I7	VAC PUMP 1 STOP
8	I8	VAC PUMP 2 START
9	I9	VAC PUMP 2 STOP
10	I10	SEWER PUMP 1 START
11	I11	SEWER PUMP 1 STOP
12	I12	SEWER PUMP 2 START
13	I13	SEWER PUMP 2 STOP
14	I14	-80 KPA PRESSURE 0 TO -80 CLOSED THEN OPEN
15	I15	-50 KPA PRESSURE 0 TO -70 CLOSED THEN OPEN, RECLOSES WHEN BACK TO -50
16	I16	-40 KPA PRESSURE 0 TO -40 CLOSED THEN OPEN
17		
18		
19		
20		
GE SERIES 90 PLC - IC693MDL240		



TERM	ADDR	INPUT DESCRIPTION
1	I17	HIGH HIGH TANK LEVEL
2	I18	HIGH TANK LEVEL
3	I19	LOW TANK LEVEL
4	I20	LOW LOW TANK LEVEL
5	I21	VAC PUMP 1 RUNNING
6	I22	VAC PUMP 2 RUNNING
7	I23	SEWER PUMP 1 RUNNING
8	I24	SEWER PUMP 2 RUNNING
9	I25	VAC PUMP 1 OVERLOAD
10	I26	VAC PUMP 2 OVERLOAD
11	I27	SEWER PUMP 1 OVERLOAD
12	I28	SEWER PUMP 2 OVERLOAD
13	I29	
14	I30	
15	I31	
16	I32	
17		
18		
19		
20		
GE SERIES 90 PLC - IC693MDL240		

(SHEET 8)

(SHEET 8)

(SHEET 8)

(SHEET 8)

VAC PUMP 1 (SH2)

VAC PUMP 2 (SH2)

SEWER PUMP 1 (SH2)

SEWER PUMP 2 (SH2)

VAC PUMP 1 (SH2)

VAC PUMP 2 (SH2)

SEWER PUMP 1 (SH2)

SEWER PUMP 2 (SH2)

110 VAC (SH 1)		N		A	
OUTPUT	DESCRIPTION	ADDR	TERM	114	115
			1 O	114	
	VACUUM PUMP 1 CONTACTOR	Q1	2 O	500	(SH2) VP1
	VACUUM PUMP 2 CONTACTOR	Q2	3 O	501	(SH2) VP2
	SEWER PUMP 1 CONTACTOR	Q3	4 O	502	(SH2) SP1
	SEWER PUMP 2 CONTACTOR	Q4	5 O	503	(SH2) SP2
			6 O	114	
	SEWERAGE HI HI LEVEL ALARM	Q5	7 O	504	⊗
	VACUUM LOW PRESSURE ALARM	Q6	8 O	505	⊗
	VACUUM PUMP 1 AVAILABLE	Q7	9 O	506	⊗
	VACUUM PUMP 2 AVAILABLE	Q8	10 O	507	⊗
			11 O	114	
	SEWERAGE PUMP 1 AVAILABLE	Q9	12 O	508	⊗
	SEWERAGE PUMP 2 AVAILABLE	Q10	13 O	509	⊗
	VACUUM PUMP 1 RUNNING	Q11	14 O	510	⊗
	VACUUM PUMP 2 RUNNING	Q12	15 O	511	⊗
			16 O	114	
	SEWERAGE PUMP 1 RUNNING	Q13	17 O	512	⊗
	SEWERAGE PUMP 2 RUNNING	Q14	18 O	513	⊗
		Q15	19 O		
		Q16	20 O		
GE SERIES 90 PLC - IC693MDL940					

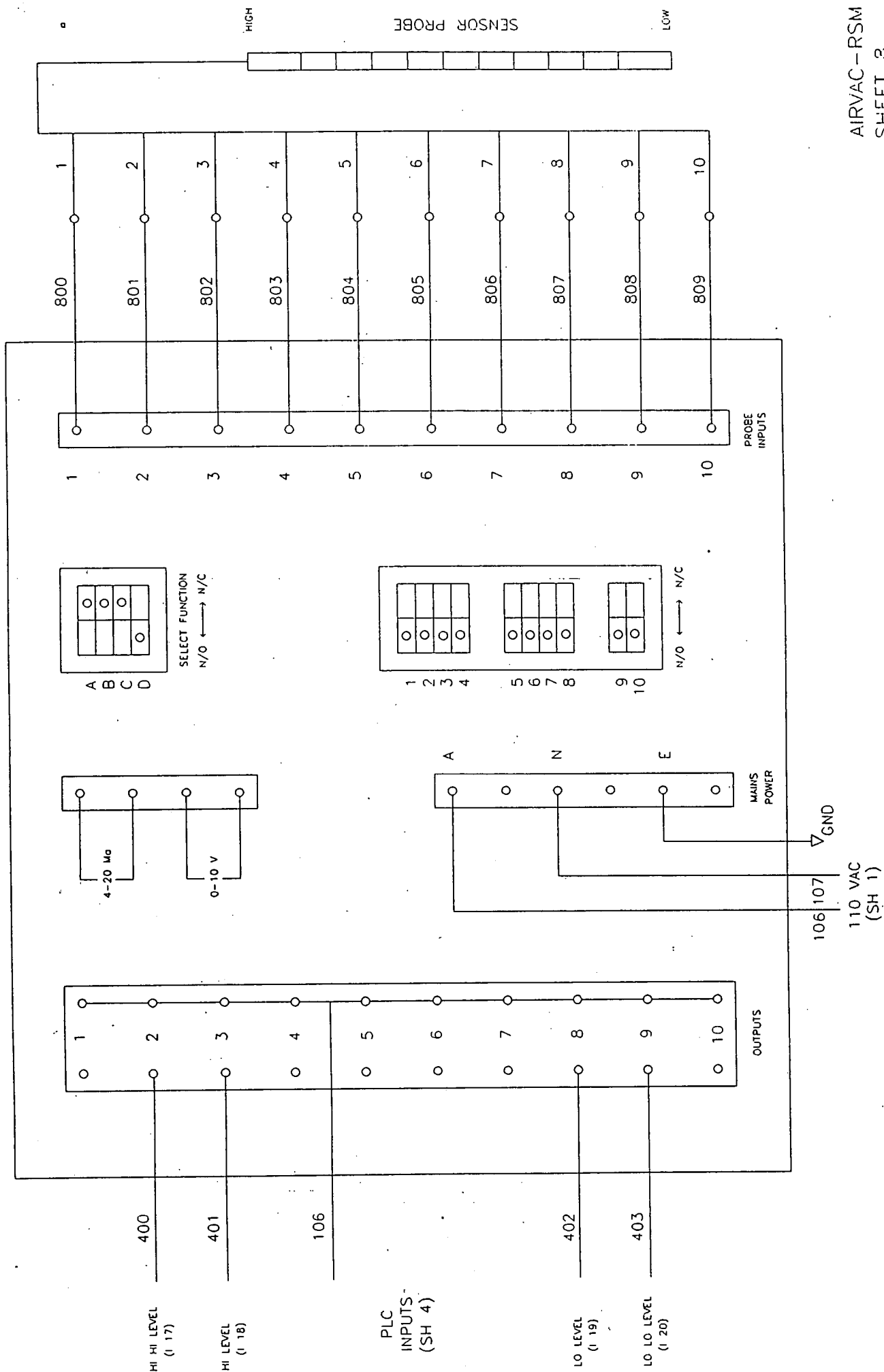
TELEMETRY INDICATION

OUTPUT DESCRIPTION	ADDR	TERM
		1 O
SITE POWER FAIL	017	600
		601
AUTO/MANUAL SELECTION	018	602
		603
		604
SEWERAGE HI HI LEVEL ALARM	019	605
		606
VACUUM LOW PRESURE ALARM	020	607
		608
		609
VACUUM PUMP 1 AVAILABLE	021	610
		611
VACUUM PUMP 2 AVAILABLE	022	612
		613
SEWERAGE PUMP 1 AVAILABLE	023	614
		615
SEWERAGE PUMP 2 AVAILABLE	024	
GE SERIES 90 PLC - IC693MDL930		

TELEMETRY INDICATION

OUTPUT DESCRIPTION	ADDR	TERM	
		1 O	
VACUUM PUMP 1 STATUS	Q25	2 O	700
		3 O	701
VACUUM PUMP 2 STATUS	Q26	4 O	702
		5 O	703
SEWERAGE PUMP 1 STATUS	Q27	6 O	704
		7 O	705
SEWERAGE PUMP 2 STATUS	Q28	8 O	706
		9 O	707
		10 O	
		11 O	
	Q29	12 O	708
		13 O	709
	Q30	14 O	710
		15 O	711
	Q31	16 O	712
		17 O	713
	Q32	18 O	714
		19 O	715
		20 O	
GE SERIES 90 PLC - IC693MDL930			

MULTI TRODE MTIC 10/10



SECTION 3

HIDROSTAL SEWAGE PUMPS

3. HIDROSTAL SEWAGE PUMPS

The Hidrostal sewage pumps and operation and maintenance are described in the manufacturers manual included in this section.

These pumps and downstream pipework will not require modifications for the future developments of Stage 2 and 3. However the Multitrode probe will require relocation to the collection tank.



PUMPS

AIRVAC - RSM PTY LTD

ORDER No: M038/92

ENVIROTECH JOB No: 946377

SALES AND TECHNICAL SERVICE

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CHARLES BUNN**

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**TELEPHONE (02) 950 5100
FACSIMILE (02) 950 5103**

HIDROSTAL PUMPS

D03K-M01+DDM1K-M112+D0

SERIAL No.	TAG No.
H 2347	-----
H 2348	-----

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR K-LINE BEARING FRAME PUMPS. NON REGULABLE/MECHANICAL SEAL.

Where adverse suction conditions exist and cause loss of prime, external priming devices should be used. Suction conditions such as liquid temperature, altitude above sea level and specific gravity must be compensated for by proper construction of the suction line.

When pumping liquids with gas separation, do not install the pipeline for negative suction.

Avoid gate valves for suction lift installations and for positive suction head installations, when the pump is operating ensure gate valves are completely open.

GOOD

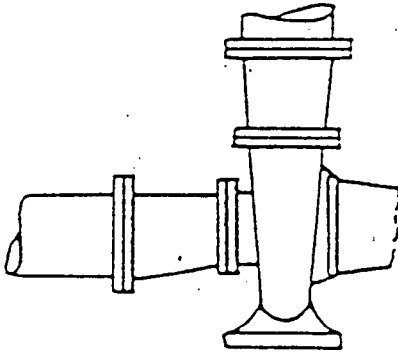


Figure 1.1

BAD

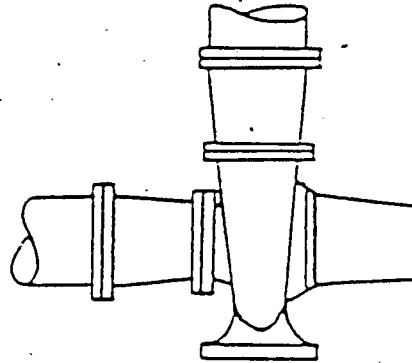


Figure 1.2

ALIGNMENT

The pump driver, if supplied, is correctly aligned on the baseplate at the factory. However, a certain amount of deformation of the baseplate is possible during transit and it is therefore necessary to check the alignment between the pump and driver before start-up. The pump shaft should be checked for both angular and parallel alignment, a flexible coupling will not compensate for misalignment. Inaccurate alignment will result in vibration and excessive wear on the bearings, shaft sleeve and mechanical seal faces.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR K-LINE BEARING FRAME PUMPS. NON REGULABLE/MECHANICAL SEAL.

The check for angular alignment (Figure 1.3) should be made by inserting an inside calliper or taper gauge at four points, 90° apart, between the coupling faces which must be within 0.3mm.

To check for parallel alignment place a straight edge across the coupling rims at the top, bottom and both sides. The unit will be in parallel alignment when the straight rests evenly on the coupling rim at all positions.

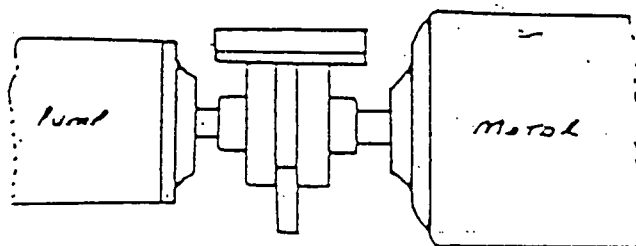
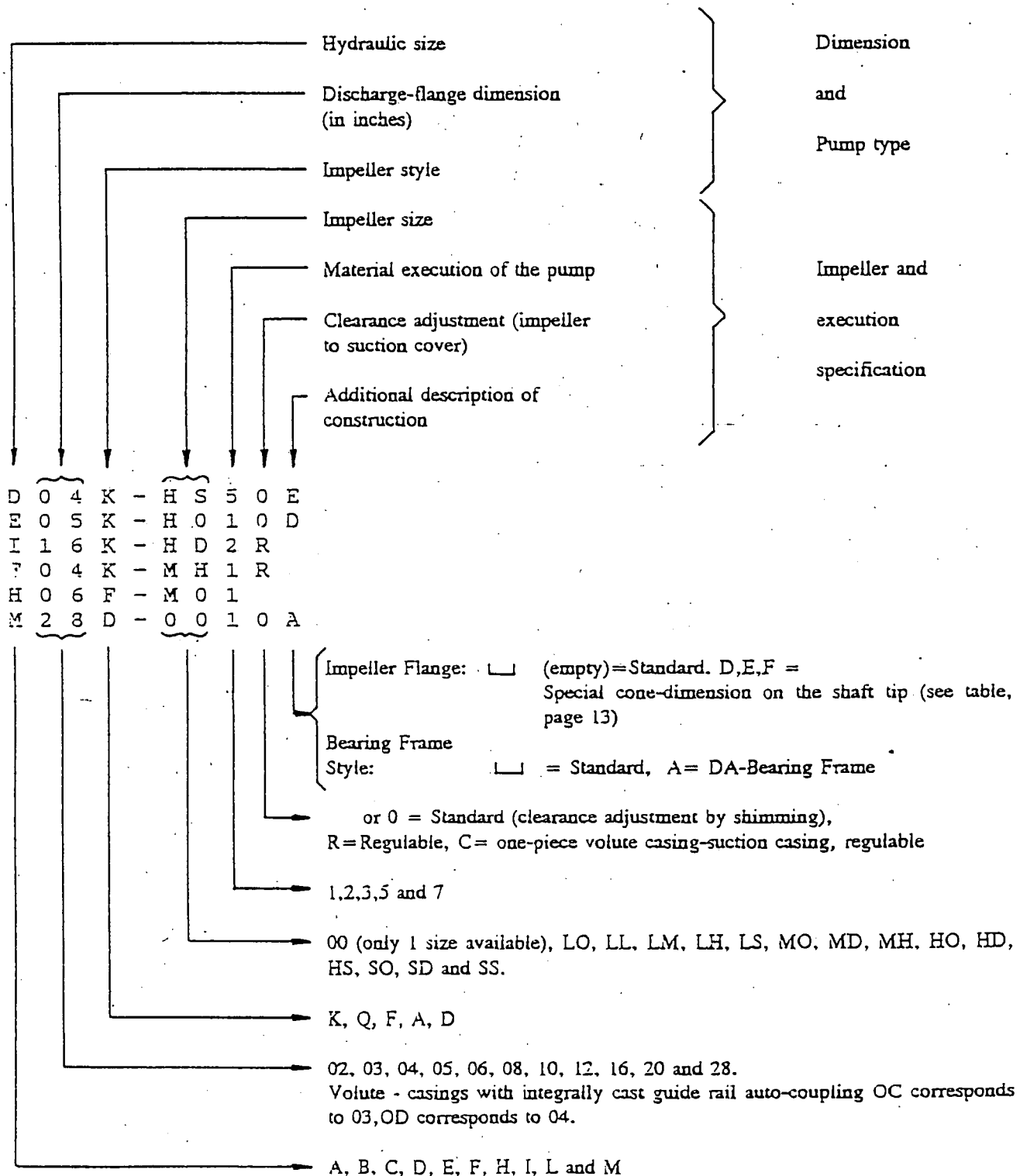


Figure 1.3

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR K-LINE BEARING FRAME PUMPS. NON REGULABLE/MECHANICAL SEAL.

TYPE CODE HYDRAULIC END



NOTE: On some sheets of the data book, where the discharge flange dimension of the hydraulic code is less than 10 inches, the zero has been left out.

Example: E05K E5K

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR K-LINE BEARING FRAME PUMPS. NON REGULABLE/MECHANICAL SEAL.

GENERAL

The original HIDROSTAL designs were of the D-Line construction: Most sizes utilised a parabolic suction piece as shown in Figure 1. The D-Line series is being replaced by the K-Line models, which utilise a straight conical suction for every pump size as shown in Figures 2 to 5. The advantage is in the ability to adjust uniformly for wear.

There are several different types of construction available for specific models. The design differences involve the volute/suction configuration and the availability of suction liners.

All models have been converted to the K-Line design. Refer to factory for possibility to retrofit D-Line pumps with K-Line impellers and suction pieces.

COMMON CONSTRUCTION THROUGHOUT THE K-LINE MODELS

A. IMPELLERS

Impellers are of the screw-centrifugal design. Impellers are mounted on an impeller flange by means of a pinned and registered fit at the periphery (with the exception of the D3K and D4K-HS/S, which mount impeller directly onto shaft taper). The impeller is secured against the impeller flange by an allen-head impeller bolt. The impeller flange is secured to the shaft by a nut, utilising a woodruff key to transmit torque (except some D3K and D4K pumps). This construction protects the flange nut from the pumped material and provides for quick assembly and disassembly. Section drawings illustrate these features.

All impellers are statically and dynamically balanced for smooth mechanical performance.

Impellers are available in nodular iron (materials 1 & 2) and stainless steel (materials 3 & 5) for all sizes.

NOTE: The pump is available only in clockwise rotation.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR K-LINE BEARING FRAME PUMPS. NON REGULABLE/MECHANICAL SEAL.

B. VOLUTE CASING

Volute casing is separate from suction part in all pumps (except D3K and D4K, where suction casing is cast integrally with volute casing, and F4K and H5K, where both constructions - separate or integral - exist).

Hand hole cleanouts exist on all but D3K and D4K. All sizes have the back pullout feature. All sizes have rings of drilled and tapped holes for various mounting options.

All have a tapped hole for gauge near the discharge flange, and a tapped hole for drain at the lowest point of the casing. May be assembled with discharge in different positions.

Available in cast iron (material 1) or stainless steel (material 5) for all models, except D3K which is not available in material 5.

C. SUCTION PART

Construction here varies according to pump size and material selected. The suction part construction may be in one of two categories:

1. Suction cover

- Figure 2

This is a non regulable model, that means the clearance must be adjusted by shims. This type is available in cast iron (material 1) or stainless steel (material 5).

2. Suction casing

There are three types of suction casing construction:

- Figure 3

One piece volute and suction casing with fixed (non regulable) liner. Clearance adjustment by shims.

- Figure 4

Regulable model. Clearance is adjusted by moving the liner within the suction casing by means of three external regulating screws.

- Figure 5 (obsolete model)

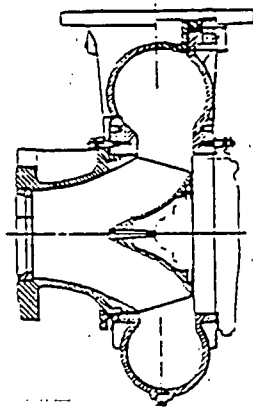
Same features as Figure 4 but with one-piece volute/suction casing.

NOTE: For availability of the different types of suction parts for the specific pump sizes and materials refer to the availability chart and the sectional drawings of this K-type section.

**SERVICE MANUAL FOR INSTALLATION AND
OPERATION FOR K-LINE BEARING FRAME PUMPS.
NON REGULABLE/MECHANICAL SEAL.**

D-TYPE

Figure 1

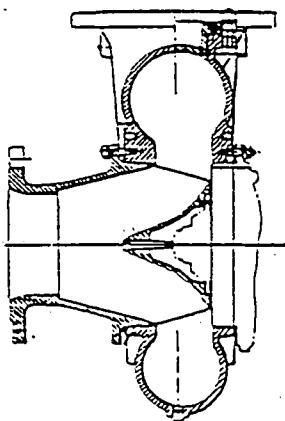


Obsolete Model

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR K-LINE BEARING FRAME PUMPS. NON REGULABLE/MECHANICAL SEAL.

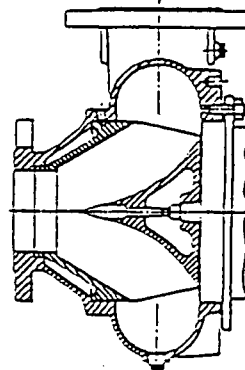
K-TYPE

Figure 2



Suction cover non regulable

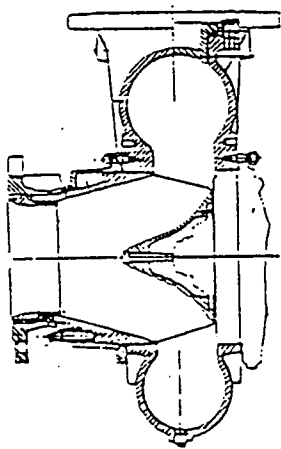
Figure 3



One piece volute/suction casing with non regulable liner

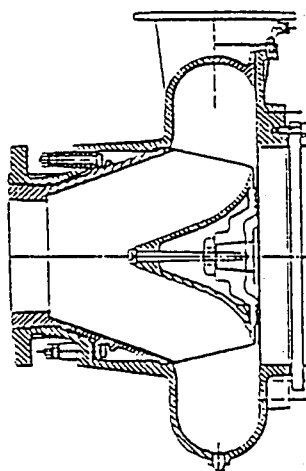
K-TYPE

Figure 4



Suction casing with regulable liner

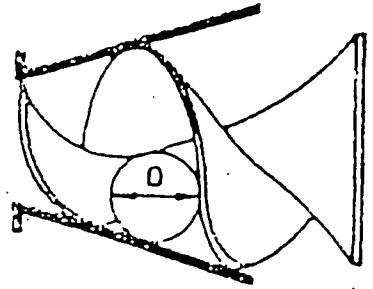
Figure 5



One piece volute/suction regulable liner (obsolete model, use Figure 4 instead)

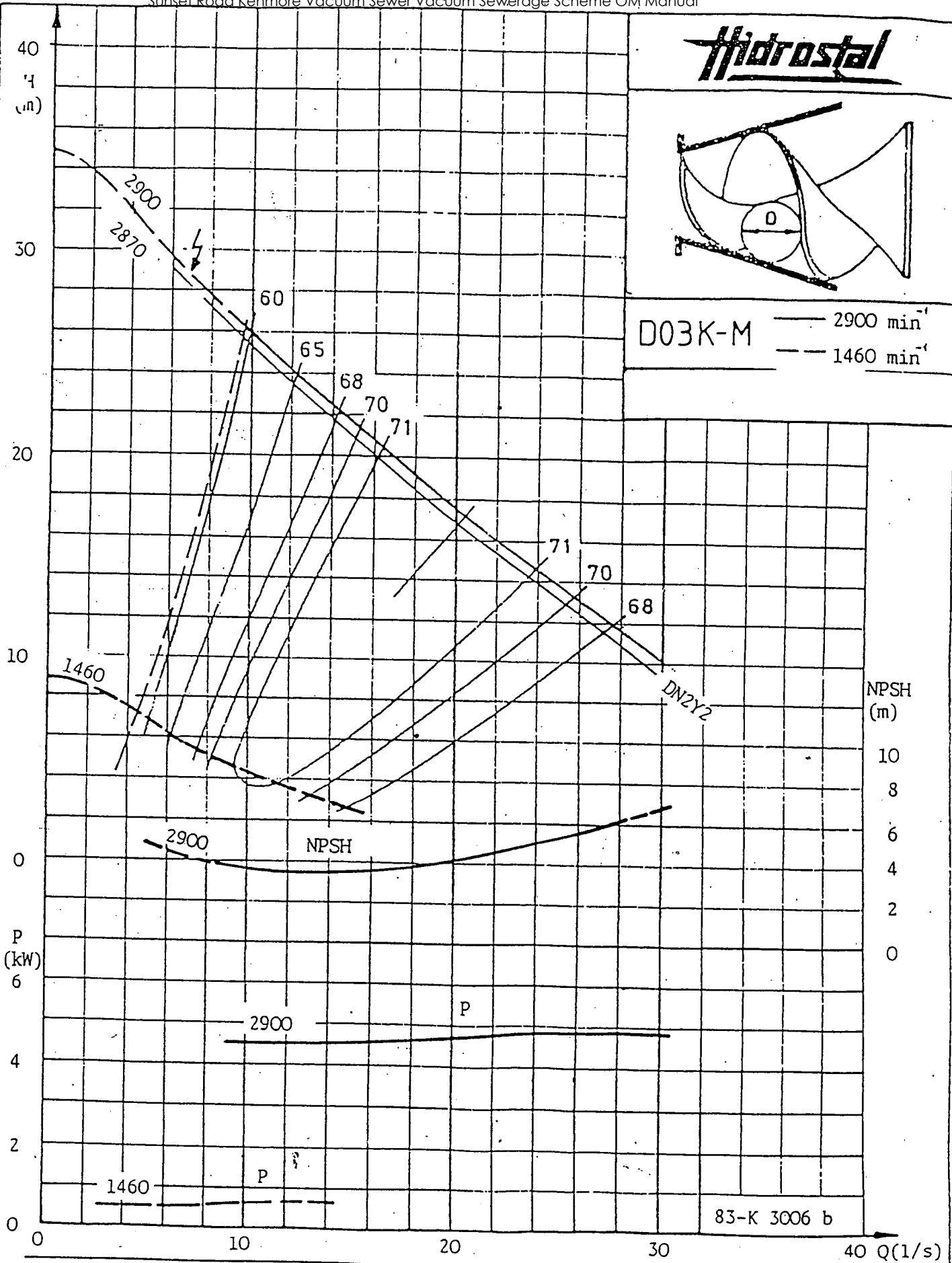
For further details see sectional drawings of this section.

hidrostal



D03K-M

— 2900 min⁻¹
- - 1460 min⁻¹




SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR K-LINE BEARING FRAME PUMPS. NON REGULABLE/MECHANICAL SEAL.

GENERAL INSTRUCTIONS FOR FRAME MOUNTED SOLIDS HANDLING PUMPS

INTRODUCTION

GENERAL INFORMATION

The HIDROSTAL distribution network provides service wherever our pumps are sold. Should you require sales or service information please contact your local HIDROSTAL representative.

 8213 NEJNKIRCH-CH	
TYP	<input type="text"/>
ORD	<input type="text"/> NR. <input type="text"/>
Q	<input type="text"/> f/s
H	<input type="text"/> m

NAMEPLATE DATA

Each pump has affixed to it a nameplate with the pertinent data as to rating and materials of construction. When enquiring about parts or service the above data should be supplied.

INSTALLATION

PRELIMINARY

Prior to signing shipping documents, inspect the shipment for shortages or damages and promptly report any to the carrier. When a horizontal pump is unloaded, ensure it is lifted at four equal points on the baseplate. When a vertical pump is unloaded, use lifting eyes; couplings, extended shafts and other accessories are normally shipped in separate containers to avoid damage during shipment.

STORAGE INSTRUCTIONS

If the unit is not to be installed shortly after arrival, store it in a clean and dry place having moderately small changes in the ambient temperature. Rotate the shaft several times every two weeks by hand. This will ensure a positive coating on lubricated surfaces so retard rust and oxidation.

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LOCATION OF PUMP

The pump should be placed as near the liquid source as possible, avoiding elbows where possible on the suction line.

PIPING

The suction and discharge piping should be independently supported near the pump, expansion joints must be used where necessary to take care of temperature and pressure expansion, so that there will be no external loading of the casing.

SUCTION PIPING

To obtain maximum available suction head, the suction line should be as direct and as short as possible, avoiding elbows. If elbows must be used, a long radius type is preferred. It is important in a suction line to avoid any sagging in which air may collect and thereby cause loss of prime. For this same reason it is imperative to have the suction line airtight when suction lift conditions exist. Unless a suction line runs entirely downward toward the pump all reducers must be eccentric (Figure 1.1) if installed in a horizontal position. A straight concentric taper reducer (Figure 1.1) should never be used in a horizontal position with the suction line rising toward a pump, as air pockets may collect in the top of the reducer and pipe.

GROUTING

A space of approximately 25mm (1") should be left between the baseplate and top of the foundation to be filled with grout. After the grout has dried, the foundation bolts should be firmly re-tightened and alignment rechecked.

SEAL CHAMBER CONNECTIONS

Water or grease connections to the sealing chamber must be provided according to applications, for details, see relevant section.

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OPERATION

ELECTRIC MOTOR DRIVE

A starter with overload protection should be installed to prevent the motor from being damaged by overload. The overload reset should be set so that they trip if the current exceeds the nominal current of the motor. (See motor nameplate).

BEFORE STARTING

The pump is ready to start when:

1. Pump baseplate is grouted and bolted to the foundation.
2. Pump and driver are correctly aligned.
3. Bearings are factory lubricated and ready for start-up. Refer to section entitled "Lubrication Instructions", after start-up to determine greasing procedure for each bearing frame type.
4. Seal water is supplied to the stuffing box, or oil level has been checked for units with mechanical seals as indicated in the relevant section "Seal chamber connections".
5. All rotating parts are found to be free when turned by hand.
6. Driver has been checked for correct rotation.
7. Pump is primed. Never run a pump dry. The liquid in the pump serves as a lubricant for close running surfaces within the pump and these may be damaged if operated dry for extended periods. If installed with suction lift, the pump may be primed by using an ejector or vacuum pump. Vertically installed solids handling pumps will prime automatically by having the impeller tongue submerged in liquid provided air evacuation through pump casing at ambient atmospheric pressure is allowed.
8. Inspect suction chamber to see that all debris from construction has been removed.
9. As momentum of inertia of the impeller is small, full load and full speed are reached within one second. Therefore, if reduced voltage starters are used (star delta) the time adjustment between star to delta should be no longer than two to three seconds.

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STARTING

While the pump is running, an initial then periodic inspection should be made of:

1. Stuffing box or mechanical seal (refer to section entitled "Operating instructions for solids handling pumps with stuffing box" or "Operating instruction for solids handling pumps with mechanical seal").
2. Bearing temperature should not exceed 90°C.
3. Alignment: Successful operation of the pump depends on accurate alignment. It is recommended to recheck the alignment after initial run, then one week later.
4. Lubrication: According to section entitled "Lubrication Instructions".

SHUTDOWN

To shut the pump down:

1. Disconnect power to the driver.
2. Close all valves.
3. Close seal water supply, if installed.
4. If the pump is to be out of service for a period longer than two weeks, the shaft must be rotated several times every two weeks to assure positive coating of lubricated surfaces.
5. If subject to freezing, the pump must be drained and blown down with compressed air. Also consult section entitled "Operating instructions for solids handling pumps with stuffing box" or "Operating instructions for solids handling pumps with mechanical seal".

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OPERATING TROUBLES

The following table is provided as a guide to common operating troubles and their causes. Should the trouble continue, consult your HIDROSTAL representative.

PROBABLE CAUSES	NO LIQUID DELIVERED	NOT ENOUGH LIQUID DELIVERED	NOT ENOUGH PRESSURE	LOSS OF CAPACITY AFTER STARTING	VIBRATION	MOTOR RUNS HOT	CAVITATION (NOISE)	BEARING TEMPERATURE ABOVE 90°
1. Pump not primed	x							
2. Speed too low	x		x					
3. Speed too high						x	x	
4. Air leak on suction	x	x		x	x		x	
5. Air leak in mechanical seal or stuffing box		x		x				
6. Air or gas in liquid	x	x	x	x	x		x	
7. Discharge head too high (above rating)	x	x			x			
8. Suction lift too high				x	x		x	
9. Not enough suction pressure for hot liquid		x			x		x	
10. Inlet pipe not submerged enough	x	x	x	x	x		x	
11. Viscosity of liquid greater than rating		x	x			x		
12. Liquid heavier than rating						x		
13. Excessive suction head	x	x		x	x		x	
14. Impeller clogged	x	x			x			
15. Wrong direction of rotation	x	x	x					
16. Excessive running clearance		x	x					

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PROBABLE CAUSES	NO LIQUID DELIVERED	NOT ENOUGH LIQUID DELIVERED	NOT ENOUGH PRESSURE	LOSS OF CAPACITY AFTER STARTING	VIBRATION	MOTOR RUNS HOT	CAVITATION (NOISE)	BEARING TEMPERATURE ABOVE 90°
17. Damaged impeller		x	x		x			
18. Rotor binding						x		
19. Defects in motor							x	
20. Voltage lower than rating							x	
21. Incorrect lubrication								x
22. Foundation not rigid					x			
23. Misalignment of pump and driver					x	x		
24. Bearings worn					x			x
25. Impeller out of balance					x			
26. Shaft bent					x	x		
27. Impeller too small			x					
28. Suction line clogged	x	x	x					
29. Suction flange not sealed, hard gasket	x	x	x		x		x	
30. Impeller rubbing against suction belt					x	x		
31. Thick sludge and small impeller clearance						x		
32. Gas accumulation behind impeller on vertical inst.	x			x				
33. Pump does not prime - Vertical	x							

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MAINTENANCE OF HYDRAULIC PARTS

IMPELLER CLEARANCE ADJUSTMENT FOR WEAR

After some time of operation, the impeller and suction cover (or liner) may have worn, increasing the impeller gap. The impeller gap should be checked and re-adjusted whenever a significant decrease in pump performance is noticed, or at least once every year (until a history is developed at each different application to indicate how often adjustment will be required). Adjustment is most critical on high-pressure pumps (D3, E4, F4, H5, I6, L8), and least critical on low-pressure pumps.

Excessive clearance is not desirable especially in the smaller pump sizes, as a greater percentage of total flow can thus recirculate causing a drop in performance. Conversely, less clearance than the minimum listed can overload the motor and/or cause vibration due to too great a friction in between the impeller and the suction cover.

When pumping thick sludges or viscous material, larger clearances may be necessary to avoid friction, larger clearances may actually increase flow capability. Therefore, for thick sludges and high consistency materials, double the clearances in Figure 14 should be used.

Some pumps are easily adjusted by means of a movable liner (421); its position is regulated by three external regulator nuts (446) found on the suction casing (416) volute or casing (400). These pumps are designated "Regulable", and include the letter R or C in the pump code on the nameplate.

Other pumps have a one-piece suction cover (402) (or in pumps D3K and D4K, a fixed liner (421)); these pumps are adjusted by changing the thickness of the shims (411) between the motor and the volute casing (400).

Examine your pump for presence or absence of the regulator nuts, and proceed to the corresponding section of these adjustment instructions.

Loosen fasteners (419), and place shims of calculated thickness between motor and volute casing. (Shims may be washers of uniform thickness, or U-shaped shimstock - these must be placed under each fastener (419). Thin shims may be a single piece of steel wire - diameter equal to calculated thickness - wrapped all the way around motor, under the studs (419); ends can be bent outward around last studs (419), to avoid overlapping.

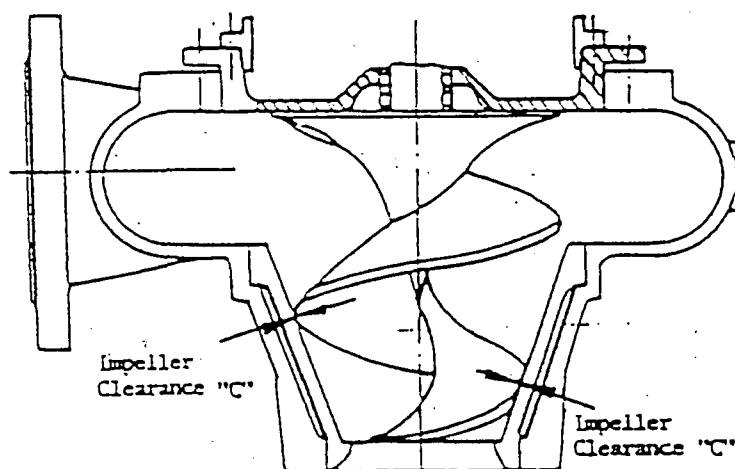
Tighten fasteners (419) again, and with a feeler gauge, check the actual clearance between impeller and liner (reaching in through the handhole cover (405) or through the suction of the pump). If the clearance is significantly different than "C" shown in column 2 of Figure 14, it is possible that the wear is excessive or not uniform: Disassembly and inspection is recommended.

If this adjustment procedure does not restore original pump performance, disassemble hydraulic end per following section to examine for uneven or excessive wear on impeller or suction cover/liner, and replace worn parts as necessary.

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PUMP TYPE	CLEARANCE C(MM)	TRAVEL OF THE REGULATOR NUT B (mm)	APPROX. NO OF TURNS FOR REGULATOR NUT
D3K/D4K	0.35		
E 5 K	0.6	1.12	2/3
E8K-LS/LL			
E8K-HD/SS		1.55	1
F 6 K			1/2
F 6 K	0.5	1.40	1
F 10 K		1.93	1-1/3
H 5 K		0.85	1/2
H 8 K		1.67	1-1/6
H 12 K	0.6	2.32	1-1/2
I 6 K		1.02	2/3
I 10 K		2.09	1-1/3
I 16 K	0.75	2.90	2
L 8 K		1.28	5/6
L 12 K	0.9	2.51	1-2/3
L 20 K		3.48	2-1/3

Figure 14



NOTE: Clearance "C" should be checked along entire impeller edge, and again after rotating impeller 1/4, 1/2, and 3/4 turns.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR K-LINE BEARING FRAME PUMPS. NON REGULABLE/MECHANICAL SEAL.

DISASSEMBLY OF HYDRAULIC PARTS

DISASSEMBLY FOR INSPECTION

For the following steps the casing-suction cover assembly should be placed with the suction flange flat on the floor or workbench, and the motor-impeller assembly removed or lowered into place from above by a suitable hoist.

The rotating assembly including impeller and motor can be lifted from the pump casing after removing nuts (419) around the motor flange. Areas to be examined for wear will be the impeller surface (especially the edges) and the conical machined surface in the liner or suction cover. Uniform wear on any of these surfaces can, up to a point, be compensated for by re-shimming or adjusting according to Section 3.1 of this manual. However, excessive or uneven wear will require replacement of the worn parts.

REMOVAL OF IMPELLER

Hold the impeller (401) from turning by hand, or by a strap wrench, or by locking pliers clamped to the impeller. Inset a hexagonal key wrench (allen-head wrench) into the impeller bolt (415) and with a hammer, tap the wrench counterclockwise to loosen the bolt.

WRENCH SIZES

Pump size:	D	E	F	H	I	L
Wrench size:	8mm	10mm	14mm	19mm	27mm	27mm

After removal of bolt, the impeller can be tapped loose from its fit against the impeller flange (165) by a few taps with a rubber mallet.

NOTE: For pumps D3K, D4K-HS/S and E4T, the impeller is fitted directly onto the shaft taper (no impeller flange is used).

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IMPELLER CLEARANCE ADJUSTMENT FOR NON-"REGULABLE" PUMPS

Adjustment is accomplished by moving the motor inward toward the volute casing. For the following steps it has proven easiest that the casing-suction cover assembly be placed with the suction flange on the floor or work bench, and the motor-impeller assembly be removed or lowered into place from above by a suitable hoist.

Loosen all fasteners (419) between motor and volute casing. Remove shims or shim wire.

To estimate correct shim thickness, lower motor into casing just until impeller cannot be turned. Measure gap between motor and volute casing at several places around motor flange and take average. Now add the distance "B" shown in column 3 of Figure 14 to the average gap measured, this will be the approximate shim thickness required to obtain correct clearance "C" shown in column 2 of Figure 14.

NOTE: If impeller tip is binding on suction lip, see Section 3.3.6.

REMOVAL OF LINER OR SUCTION COVER

(a) FOR D3K, D4K & E4T

These pumps have a non-adjustable liner (421) held in a fixed position inside a one-piece volute casing. After removal of the three allen-head setscrews (418), this liner can be pressed out of the casing. See Figure 15.

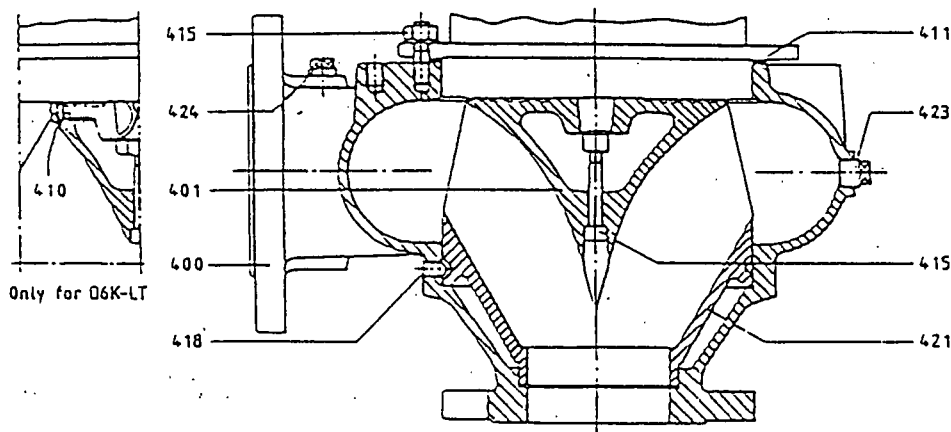


Figure 15 D3K, D4K, E4T

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR K-LINE BEARING FRAME PUMPS. NON REGULABLE/MECHANICAL SEAL.

(b) **FOR ALL OTHER PUMPS WITHOUT "REGULABLE" FEATURE**

These pumps have a one-piece suction cover (402) which is bolted to the volute casing (400) by studs and nuts (417). Adjustment of clearance is by shims (411) between the volute casing and the motor. Note that on certain models there may be a spacer ring (414) between mating surfaces of the suction cover and the volute casing. When there is excessive wear on the conical surface, the suction cover (402) should be replaced. See Figure 16.

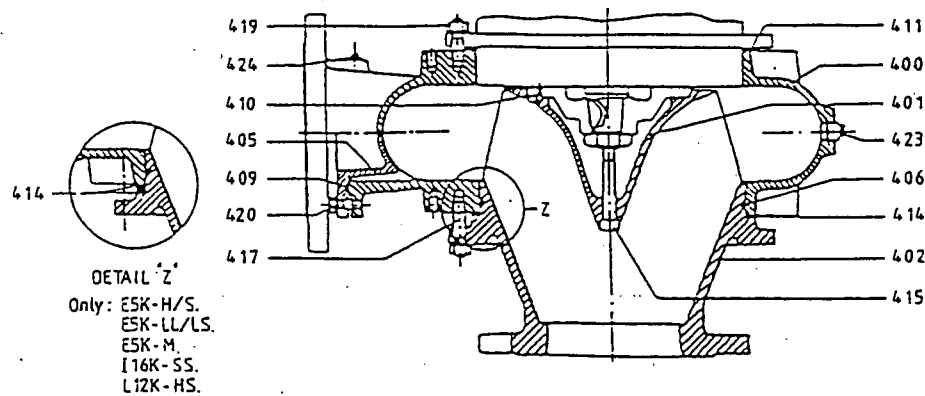


Figure 16: E5K, E8K, F6K, F10K, H8K, H12K, I10K, I16K, L12K, L20K: Non-Regulable.

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ASSEMBLY OF IMPELLER

Place the impeller (401) onto impeller flange (165) of motor so that the pin (410) on back of impeller will fit into the corresponding hole on the flange. (Note: Replacement impellers are always supplied with pin (410) already installed).

Before fitting a new impeller (or a new impeller bolt), the length of the impeller bolt should be checked as follows:

1. Place impeller onto impeller flange (or onto shaft taper for pumps D3 or D4), and using a thin rod measure distance from end of shaft to the step in the impeller bolt-hole. Remove impeller.
2. Now measure impeller bolt length, from tip to underside of head, and subtract 1 1/4 times the bolt diameter. If remaining distance is shorter than (1) above, a longer impeller bolt is needed, to ensure adequate engagement of threads.
3. Now screw impeller bolt into shaft end as far as it will go without excessive force, and measure distance from shaft end to underside of bolt head. If this distance is longer than (1) above the bolt must be shortened, (to ensure that the bolt pulls the impeller tight against the impeller flange before the bolt "bottoms out" in the shaft threads). If the impeller bolt must be shortened a significant amount, check if the threads on the bolt also must be re-cut to permit the required assembled length.

NOTE: Impellers for pumps D3K, D4K-HS/S and E4T mount directly to the motor shaft (no impeller flange is used). Coat shaft taper with alight oil **ONLY** (do NOT use grease or anti-size compound here), then install impeller directly into shaft.

TIGHTNESS TEST FOR LOWER MECHANICAL SEAL (All Types)

Remove oil plug "Oil" (536). This test assumes that oil has been previously drained from the motor. Connect dry compressed air source such as bicycle tyre pump to the opening. Use a pressure reducing valve and relief valve set to 7 psi (1/2 bar).

CAUTION:

MAKE SURE THAT THE PRESSURE NEVER EXCEEDS 1 BAR. THIS COULD DISPLACE THE SEAL. DO NOT IMMERSE END OF CABLE.

IMMERSE THE MOTOR INTO A TEST TANK FULL OF WATER AND WATCH FOR CONTINUOUSLY ESCAPING BUBBLES. THIS WOULD INDICATE LEAKAGE PAST THE SEAL OR ASSOCIATED "O"-RING. CORRECT FAILURE IF LEAKAGE HAS BEEN FOUND. AFTER FINISHING TIGHTNESS TEST REMOVE PRESSURE CONNECTION HOSE AND FILL WITH OIL ACCORDING TO SECTION 2.2.3.1 OR 2.2.3.2.

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ASSEMBLY OF IMPELLER FLANGE (Where Used)

Put in Woodruff key (112), coat the shaft taper with an anti-rust paste, put on the impeller flange (165), the locking washer (167) and the nut (166).

The impeller flange nut must be tightened to 12 mkp (90 ft-lbs) by using torque wrench. Bend over locking washer tab. Measure the clearance between the impeller flange (165) and the housing (507) with a feeler gauge. This clearance must be within the values given in the table below. If ever the clearance has to be adjusted, this can be done by inserting or revising shims between oil chamber casing (504) and seal chamber (507) close to fastening sets (534). See arrow, Figure 31.

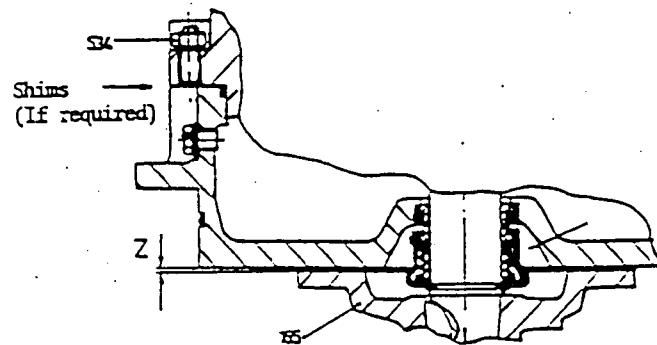


Figure 31

Coat the impeller bolt with grease or anti-seize compound. Install and tighten to following torque:

For Hi-chrome steel bolt (used with cast iron impeller) -

Pumpsize:	D	E	F	H
Torque(ft-lb):	32	56	140	510
(n-m):	44	77	190	700

for 316 stainless steel bolt (used with stainless steel impeller) -

Pumpsize:	D	E	F	H
Torque (ft-lb):	32	56	56	280
(n-m):	44	77	77	380

NOTE: If torque wrench not available, correct tightness can be approximated by hitting long end of standard L-shaped allen wrench with several sharp hammer blows.

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REPLACEMENT OF LINER OR SUCTION COVER

(a) FOR D3K, D4K,E4T (See Figure 15)

Carefully position liner (421) into one-piece casing (400); tap into place with lead hammer, or use hydraulic press (No "O"-rings are used between liner and casing). Fasten liner in place with three setscrews (418); use thread-sealant on these setscrews to avoid possible leakage.

**(b) FOR ALL OTHER PUMPS WITHOUT "REGULABLE" FEATURE:
(See Figure 16)**

Place spacer ring (414) over spigot of suction cover (402), then grease and install "O"-ring (406) into groove on suction cover.

Install suction cover into casing opening, on the side of the casing where the cast-in arrow points counter-clockwise.

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CAUTION:

SINCE BOTH SIDES OF THE VOLUTE CASING ARE MACHINED IDENTICALLY IN SOME MODELS, IT IS POTENTIALLY POSSIBLE TO ASSEMBLE THE PUMP WITH THE VOLUTE CASING BACKWARDS. PAY PARTICULAR ATTENTION TO THE ARROW DIRECTION AS DESCRIBED ABOVE.

FASTEN SUCTION COVER TO CASING WITH FASTENING SET (417).

FINAL ASSEMBLY

NOTE: (Whenever a new impeller is fitted, without also replacing the liner or suction cover at the same time, the following clearance check must be done: Install impeller-motor assembly into volute casing assembly. If the tip of the impeller touches the suction ring (408) or the lip in the liner (or suction cover) - or if there is less than 1mm clearance between the tip and the lip when the spiral edge of the impeller is firmly seated against the conical taper inside the liner (or suction cover), then the impeller tip must be ground off - parallel to the suction flange - until 1 to 2mm clearance is obtained. See Figure 32).

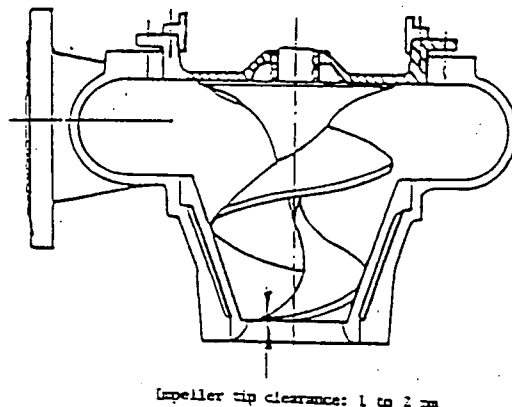


Figure 32

If (411) is a spacer ring in lieu of shims place this ring over the spigot of the motor.

Grease "O"-ring (209) and place into groove on spigot of motor.

Now install motor-impeller assembly into volute casing. Install and tighten nuts (416).

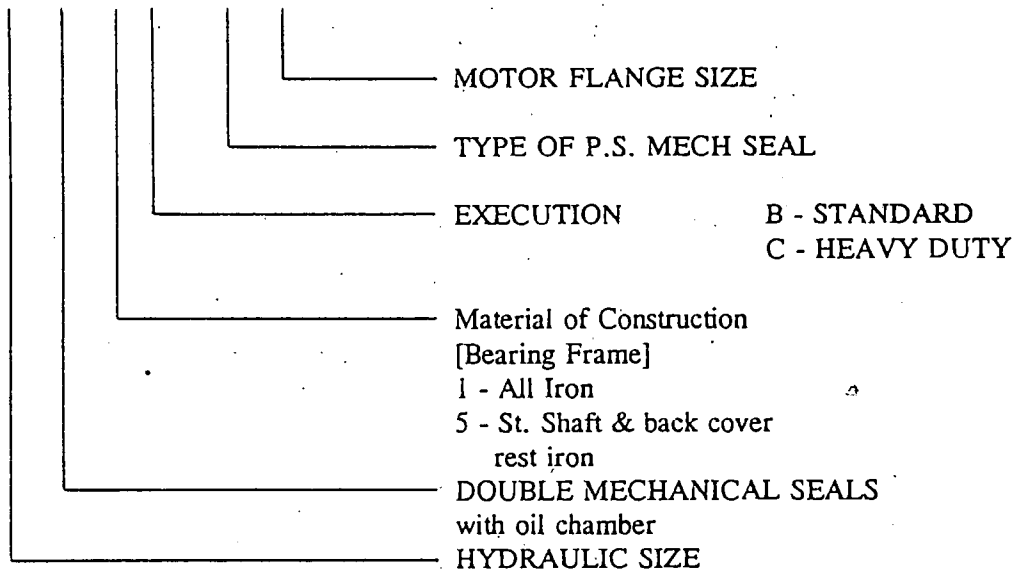
Proceed to Section 3.1 of these instructions for correct setting of regulator nuts - or for placement of shims (411) - for final adjustment of impeller clearance.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

PUMP CODE EXPLANATION

The HIDROSTAL pump code shown on the nameplate and referred to on our order confirmation uniquely defines all features of the pump. It is essential to give the complete data shown on the nameplate when enquiring about spares or services.

B DM 1 B - M 112

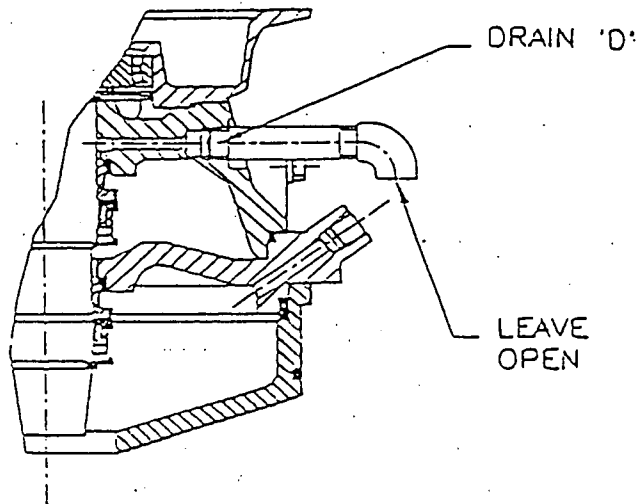


{2} For further detail see sectional drawing and parts list for Hydraulic end.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

On vertical units the drain can be in any position relative to the discharge nozzle.

When installed in dry environment, the drain can be left open. When installed out-doors, or in a situation where water could spray onto the bearing frame, i.e. when washing down, an elbow should be fitted to prevent ingress of casual water.



Connection 163

On bearing frame

BDM.B - .112] For 112
DDM.B - .112] Frame flange
EDM.B - .122] Mounted motor

This is permanently plugged and is not required for these bearing frames. On larger, heavy duty versions, this connection provides a greasing point for the bearings. [Pos 131].

Connection 131

Greasing point for bearings. SEE SECTION DEALING WITH "BEARING LUBRICATION" for full details.

This is applicable to bearing frames:-

BDM.B - .132]
DDM.B - .132] For 132 frame flange mounted motors
EDM.B - .132]

DDM.C - .160/180]
EDM.C - .160/180] For 160/180 frame flange mounted motors.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

3.0 BEARING LUBRICATION

The following bearing frames are factory greased on assembly and require no further additions of grease between major overhauls. In this instance Connection 163 is permanently plugged.

BEARING FRAME

BDM.B - .112

DDM.B - .112

EDM.B - .112

SECTION DRAWING

90 - TU 4125

90 - TU 4128

90 - TU 4131

digit indicates type of mech. seal [515]

digit indicates materials of construction

We recommend all major overhauls are carried out in a Hidrostal authorised repair centre.

The following bearing frames require periodic greasing according to table below:

BEARING FRAME	SECTION DRAWING	RPM	LUBRICATION INTERVAL HOURS	AMOUNT OF GREASE [GRMS]
BDM.B - .132	90 TU 4126	3000	1000	3
DDM.B - .132	90 TU 4129	3000	1000	3
		1500	1000	2
EDM.B - .132	90 TU 4153	1500	1000	2
DDM.C - .160/180	90 TU 4130	3000	500	3
		1500	1000	3
EDM.C - .160/180	90 TU 4154	1500	1000	3

The factory grease the bearings with the following grease and we recommend that, where possible, the same grease is used for periodic greasing. STABURAGS NBU 3 EP by Kluber-Lubrication. Available in Great Britain from:-

Kluber Lubrication

Hough Mills, Northowram, Halifax HX3 7BN

Tel: 0422 205115

Fax: 0422 206073

When it is not possible to use this grease, a grease of a similar specification should be used.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

STABURAGS NBU 8 EP by Kluber-Lubrication.

This grease is of a mineral oil base containing a barium complex as thickener.

Typical characteristics:

Colour	beige	
Apparent dynamic visco. [approx]	6000	mPas
Operating temp. range	-30..150	°C
Max. temp [short time]	170	°C
Consistency class [NLGI]	2	
Penetration DIN ISO 2137 [0.1 mm]	280	
Dropping point DIN ISO 2176	> 220	°C
Corrosion protection DIN 51802	0	
RPM-parameter [n x d m]	5 x 10s	

STABURAGS NBU 8 EP is:-

Rolling Bearing High Pressure Grease

suitable for long-life lubrication under high specific bearing loads and for the protection against unusual bearing wear. Proven for vehicle motors, axle bearings, electric motors, pumps and above all for taper roller bearings.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

4.0 CHECKING OF SEAL OIL

The condition of the Seal Oil gives a direct indication as to the condition of the product side mechanical seal. {Pos 515}.

An oil condition check must be made after the first 1000 hours of operation and once a year thereafter. Or more frequently, if site experience indicates.

Immediately before checking the oil, either run the pump for a few minutes or if the pump has been removed from site shake the pump to distribute any impurities through the oil.

NOTE: Before proceeding to check the oil condition, carefully clean the area around the oil-sight-glass and the oil plugs 536a and 536b.

IMPORTANT

When a bearing frame is fitted with an oil-sight-glass it should only be used to obtain a quick visual indication as to the oil condition. It should not be regarded as an indication of the correct oil level.

The correct oil level is above the level of the sight-glass for both horizontally and vertically mounted pumps and, as long as oil level surface cannot be seen through the sight glass it can be regarded as having sufficient oil for satisfactory operation, even though it may be nominally below the original fill level.

If the oil appears through the sight-glass to be relatively clean a small sample of oil should be removed from the bearing frame through plug 536b into a suitable container and examined. If the oil is clear, there is no problem with the pump side seal [Pos 515] and the removed oil can be refilled into the chamber, [Pos 515] and plug 536a and the oil topped up, using the correct grade of oil to the required level.

If the oil appears through the sight-glass to be somewhat milky, dirty, or the oil level is not apparent, a full oil check must be made by draining all of the oil through the plug 536b into a suitable container and examined.

If the oil is relatively clean and the water readily separates from the oil, the separated oil can be returned to the oil chamber and topped up with the same grade of oil to the required level. In this case it is advisable that the seal oil is then checked after a further 500 hours of operation.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

However, if too much water has entered the oil the viscosity will be much higher - as thick as motor oil or even thicker. In such cases it can be concluded that the pump side mechanical seal [Pos 515] must be repaired or replaced, which is best undertaken in an authorised workshop.

If there is a small quantity of water in the oil, but the oil is otherwise clean, it does not indicate a failure of the mechanical seal, as it is possible that a small quantity of water passed through the seal during the initial running-in period.

If the oil is dirty, or there has been a significant loss of oil, then it is recommended that the pump is removed to a workshop so that the mechanical seal assembly can be carefully examined.

If the oil level is at, or below, the sight-glass then there has been significant leakage of oil and the pump side mechanical seal 515 may require replacement, particularly if no oil leakage has been observed through drain connection "D". In this instance the pump should be scheduled for a workshop overhaul in the very near future.

NOTE: When re-installing plugs 536a and 536b always use a new copper sealing washer. The copper sealing washer must be softened as follows:-

Heat until red and quench immediately in cold water.

SUMMARY

<u>OIL CONDITION</u>	<u>ACTION</u>	
Oil is clean	Top up to correct level*	PUMP INSITU
Oil is milky	Drain oil, separate water refill separated oil. Top up to correct level* with same grade of oil CHECK AGAIN AFTER 500 HOURS	PUMP INSITU
Oil looks dirty but of low viscosity and free of sludge [Small amount of dirty liquid dis- colours oil}	Completely drain old oil, flush out, refill* with new grade of oil CHECK AGAIN AFTER 500 HOURS	PUMP INSITU
Seal Oil Very Dirty	Remove pump to authorised workshop for inspection	
Seal oil Below Sight-glass	Remove pump to authorised workshop for inspection	

*SEE SECTION COVERING 'CHANGING SEAL OIL WITH PUMP INSITU' FOR
METHOD OF DETERMINING CORRECT OIL LEVEL.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

OIL QUANTITIES

To refill the seal oil chamber to the required level the following oil quantities can be used as a guide:-

BEARING FRAME

BDM1B 0.9 - 1.0 litres

DDM1B 0.9 - 1.0 litres

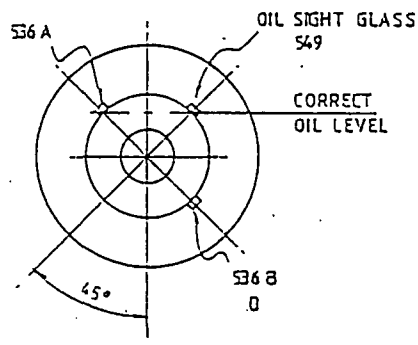
EDM1B 1.2 - 1.3 litres

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

CHANGING SEAL OIL ON INSITU HORIZONTAL PUMPS

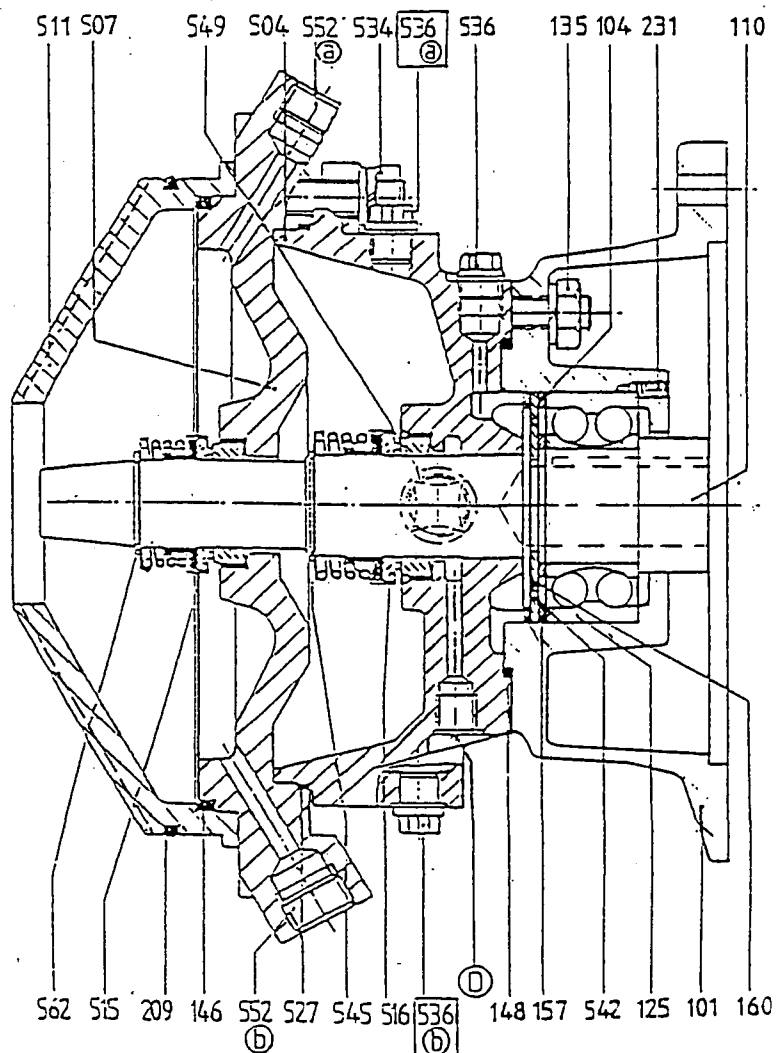
For horizontally installed pumps the oil can be drained via Plug 536b into a suitable container.

To refill the oil disconnect the bearing frame from the volute end, turn the bearing frame so that Plug 536a and the sight-glass [when fitted 549] are both lying at 45 degrees from the vertical [see sketch]. The oil should be refilled using Plug 536a and the correct level for the refilled oil is when the level is at the centre of the sight-glass, which is also the same level of the filling hole 536a.



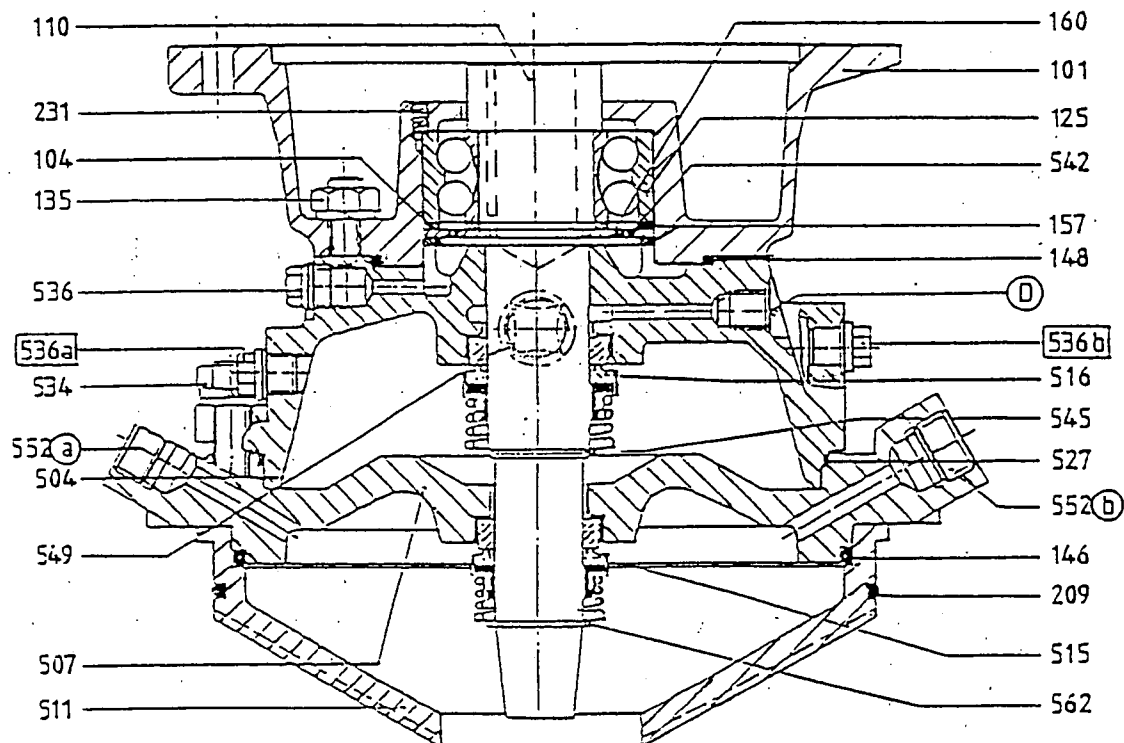
At this level the chamber is 90% full and leaves the required air space.

Re-install plugs 536 using a new softened copper seal [see note above] and re-install the bearing frame to the pump with Plug 536a on the top. Continue to monitor seal oil condition by visual inspection through the sight-glass.



CHANGING SEAL OIL ON INSITU VERTICAL PUMPS

The oil must be removed by firstly draining down to the level of 536b and then using some means to remove the remaining oil below the level of Plug 536b. This could be done by either using a rubber tube as a syphon or by employing some form of suction device. This is best undertaken after removing plug 536a.



Having removed all the old oil, flush with a little clean oil and refill with clean oil up to the level of 536a.

IMPORTANT

It is important the correct sectional drawing is studied to determine Plug 536a. The level of this plug ensures the correct air space is left above the oil. If connection 536b is used this would not be the case.

Plugs 536a and 536b should be replaced using a soft copper washer.

Continue to monitor seal oil conditions by visual inspection through sight-glass.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

SEAL OIL SPECIFICATION

GENERAL

The factory fill the seal oil chamber on double-mechanically sealed close-coupled pumps with the same low viscosity oil used for cooling systems on immersible motors.

TYPICAL ANALYSIS

Specific gravity at 20°C	0.812 g/ml
Viscosity at 20°C	6.75 mm ² /s [cst]
Viscosity at 40°C	3.52 mm ² /s [cst]
Solidification point	-38.0°C
Flash point	132.0°C
Burning point	142.0°C
Evaporation energy	251.0 kJ/kg
Solubility in water	none

For installations which are exposed to temperatures far below freezing point [e.g. outdoor installations], the solidification point is very important.

IMPORTANT FEATURES FOR APPLICATION IN PUMPS

Instead of this oil, another oil or even another liquid can be used. When selecting an alternative cooling medium the following features must be considered.

1. The viscosity may not be higher than indicated by ISO VG.
2. Emulsification with water is not acceptable, as water penetration could not be detected.
3. Corrosion resistance and non-aging quality are required.
4. Following temperatures must be considered:-
 - Solidification point and lowest possible surrounding temperature
 - Boiling point and highest possible temperature of pumped liquid.
5. In case of Bearing Frames equipped with electrical moisture probes, it is important that the liquid has good electric insulation qualities.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

LIST OF OIL SUPPLIERS

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

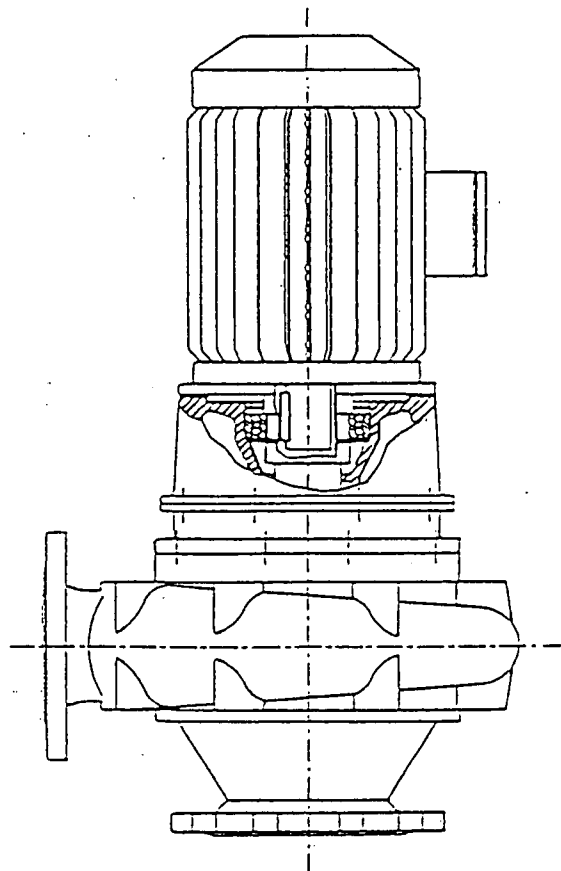
5.0

INSTRUCTIONS FOR FITTING MOTORS TO CLOSE-COUPLED PUMPS

Prior to commencing fitting of motor rotate impeller by hand to ascertain the degree of drag due to bearing and mechanical seals. This will assist in checking no increase in drag has occurred due to a badly fitted motor.

The motor should be assembled to the pump with the shaft vertical.

- a) Prior to commencing assembly carefully degrease and deburr motor shaft and key way.
- b) Deburr key way in hollow pump shaft, paying particular attention to run out at bottom of key way.
- c) The motor should be lowered slowly into the pump until the motor shaft engages into the hollow pump shaft, [Pos 110], ensure that the two shafts slide freely together with the key in position and that no undue force is necessary.
- d) Continue to lower the motor until the spigot on motor flange engages, then hold motor with a small axial clearance between motor flange and bearing casing [Pos 101].



Measure the axial clearance at the four motor fixing points using feeler gauges.

If there is a difference of more than 0.1mm [4/1000"] between the measurements, shims must be placed between the motor flange and bearing housing so that motor sits square onto the bearing housing. Failure to do this will preload the pump and motor bearings.

With shims in place tighten securing bolts.

If the motor should be removed at any time or replaced, repeat above instructions.

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FITTING MOTORS TO CLOSE-COUPLED PUMPS, CONTINUED

IMPORTANT

NEVER PUSH OR FORCE MOTOR SHAFT INTO HOLLOW PUMP SHAFT.

NEVER CLOSE UP A GAP BETWEEN PUMP AND MOTOR FLANGES BY TIGHTENING MOTOR FLANGE SECURING BOLTS. THIS WILL PRELOAD BEARINGS

BE CAREFUL KEY DOES NOT RIDE-UP ONTO RUN-OUT OF KEYWAY ON MOTOR.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

ADJUSTMENT OF BACK CLEARANCE "B"

Experience in the field has indicated that very little wear takes place between the back of the impeller and the back cone [Pos 511] and factory tests have shown that even with quite large back clearances "B" there is only a marginal effect on pump performance.

In most instances adjustment of this back clearance will be unnecessary between major overhauls. The factory build the pumps with "B" according to the dimensions shown in the table and in most instances it will be reasonable to allow this clearance to open up by 1-2mm. However, should it become necessary to reduce this clearance, shims should be placed between the back cone [511] and sealplate [507]. This might be particularly necessary if the pump is handling fibrous material which may become trapped between the impeller and the back cone.

The back cone is considered worn when; the spiral groove is heavily worn and is barely visible or has disappeared altogether. If the spiral groove is still clearly visible but the corners have become somewhat rounded, the pump will still operate at its design flow rate and head, but the cutting action of the impeller against the back cone will be somewhat reduced and if handling fibrous material it maybe worth considering replacing this back cone particularly if jamming of the material between the impeller and the cone has become a problem.

REMOVAL OF IMPELLER

Hold the impeller [401] from turning by hand, or by a strap wrench, or by locking pliers clamped to the impeller. Insert a hexagonal key wrench [allen-head wrench] into the impeller bolt [415] and with a hammer, tap the wrench counterclockwise to loosen the bolt.

Wrench sizes

Pump Size:	B	DDM1B	DDM1C	E
Wrench Size:	10	10	14	14

After removal of bolt, the impeller can be tapped loose using a plastic hammer, rap the impeller face [NOT edge or tip!] to free it from the shaft taper. If it does not pop-off the taper after a few sharp raps, then heat the hub of the impeller [near the impeller bolt hole] with a soft-flame torch, then rap again.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

Before fitting a new impeller [or a new impeller bolt], the length of the impeller bolt should be checked, as follows:-

- 1) Place impeller into shaft and using a thin rod measure distance from end of shaft to the shoulder in the impeller bolt-hole. Remove impeller.
- 2) Now measure impeller bolt length, from tip to underside of head and, subtract $1\frac{1}{4}$ times the bolt diameter. If remaining distance is shorter than [1] above, a longer impeller bolt is needed, to ensure adequate engagement of threads.
- 3) Now screw impeller bolt into shaft end as far as it will go without excessive force and, measure distance from shaft end to underside of bolt head. If this distance is longer than [1] above, the bolt must be shortened, [to ensure that the bolt pulls the impeller tight against shaft before the bolt "bottoms out" in the shaft threads]. If the impeller bolt must be shortened a significant amount, check if the threads on the bolt must be re-cut to permit the required assembled length.

NOTE: Coat shaft taper with a light oil ONLY [do not use grease or anti-seize compound here], then install impeller directly onto shaft.

Coat the impeller bolt with grease or anti-seize compound. Install and tighten to the torque listed below:

FACTORY FITTED IMPELLER BOLTS

HYDRAULIC	SIZE	HEXAGON	TORQUE N-M
B050 D050] D080] DDM1B D100]	M12	10	60
D050] D080] DDM1C D100]	M16	14	147
E080] E125] DDM1C E200]	M16	14	147

NOTE: If torque wrench not available, correct tightness can be approximated by hitting long end of standard 'L'-shaped allen-wrench with several sharp hammer blows.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

REPLACEMENT OF BACK CONE [Pos 511].

Firstly, remove impeller as previously described. The back cone [Pos 511] is an easy fit onto seal plate [Pos 507] and should remove easily, any resistance will be caused by the interference of 'O'-ring [Pos 146].

To replace back case, grease a new 'O'-ring [Pos 146] and fit onto spigot of seal plate [Pos 507]. Hand press a new back cone into place. On the larger sizes, a light tap with a plastic hammer maybe required to overcome the resistance of the 'O'-ring.

FINAL ASSEMBLY

After fitting a new impeller and/or liner, the correct impeller clearance should be set by following the steps defined in "Adjustment of Impeller Clearance for Wear" taking particular care to check and, if necessary, adjust the impeller tip clearance.

IMPORTANT

Should a complete strip-down of the pump be required and mechanical seals need replacing, we recommend this work is done in a HIDROSTAL authorised repair centre, who will have complete repair manuals and any special tools and facilities necessary to properly assembly and re-assembly the pumps.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

7.0

DISASSEMBLY

- a] Remove hydraulic end as described in "Maintenance of Hydraulic Parts".
- b] Remove both 'mechanical seal' seals, as previously described in this section.

To remove shaft and bearing assembly from bearing housing [Pos 101] proceed as follows:-

- c] Remove oil chamber casing [504] if still fixed to [101], taking care not to damage the stationary mech seal face. Press shaft and bearing assembly from motor end out of bearing housing [101].
- d] If bearings are to be replaced remove from shaft using pullers or press - depending on facilities available in workshop.

AFTER DISASSEMBLING

Wash all lubricants from bearings and bearing housing with kerosene, and dry bearings by thoroughly spinning by hand or gently with clean and dry compressed air. Replace bearings if they do not rotate freely or its running surfaces show signs of deterioration. Coat bearings with a rust preventive oil and wrap in protective paper.

Mount shaft [110] between two centres and using a dial indicator, check shaft trueness at four positions by turning shaft by hand. These readings must not vary more than 0.002" [0.05mm]. If so, replace the shaft. Examine all parts to be refitted for wear and deterioration. Replace any which are beyond reconditioning.

Scour scale from all parts with kerosene and wire brush. Coat all parts with a rust inhibiting lubricant, with special care given to impeller bolt [415]. If unit is not to be installed immediately, store in a clean and dry place.

ASSEMBLING PREPARATION

- a] Insure all parts to be refitted are free from burrs, with screws and abutting faces clean and free from damage. Replace all 'O'-rings. All studs to be refitted must be coated with Loctite Adhesive 307. Wrap threads on all plugs with Teflon tape. 'O'-rings must be greased before assembling.

Sunset Road Kenmore Vacuum Sewer Vacuum Sewerage Scheme OM Manual

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

ASSEMBLING PREPARATION/CONTINUED

b) Special recommendation:- To facilitate the mounting of the bearing on shaft, place bearing on an electric heating plate; do not exceed 80°C. Temperatures above 130°C may cause damage. After mounting of bearing on the shaft, hand-pack bearing full with grease.

c) Once lubricated, as explained, making sure that cavities between bearings are grease packed, there will be no need for further lubrication until next major strip-down is due.

d) When mounting bearing into the bearing housing, the bearing should be at ambient temperature. It is recommended to preheat the bearing housing to 80°C maximum.

RE-ASSEMBLY

When new bearings are to be used in the re-assembly, it is very important that the bearings are of 'good quality' and of exactly the correct specification.

- 1] a) Pre-heat bearing [125] and press onto shaft [110] ensuring inner-race is hard-up against shoulder.
- b) Place spacer ring [104] on shaft and fit snap-ring [160] which locks the bearing onto the shaft.

IMPORTANT

It is important that spacer ring is tight axially and if it can be rotated, shim rings must be fitted between [104] and the bearing. These shim rings are available in thicknesses of 1/10th and 2/10ths of a mm and it has been found that these two increments are sufficient for this shimming operation.

After bearing has cooled back with grease according to specification [See Section "Bearing Lubrication"].

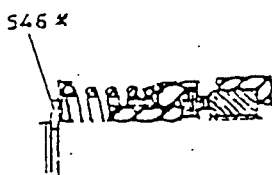
- 2] Heat bearing frame [101] by gas torch to a temperature of approximately 60°C and install shaft bearing assembly by pressing on the outside race of the bearing using a long tube.

DO NOT PRESS ON SHAFT OR INSIDE RING OF BEARING

CAUTION

When pressing the bearing into the housing it is important that set-screw [231] is not fitted at this stage. This will ensure that the bearing goes hard against the shoulder and does not accidentally rest against the end of the set-screw.

- 3] Place spacer ring [157] on bearing followed by grease retaining disc [542] which should be followed by a second spacer ring [157].
- 4] Grease 'O'-ring [148] and place on [101].
- 5] Assemble oil-chamber casing [504] onto [101] and secure with fastening set [135].
- 6] Coat threads of set-screw [231] with Red Loctite Sealer and tighten uniformly so as to eliminate any axial clearance within the bearing assembly.
- 7] Check setting length of Mechanical Seal 516 (See Table).



Bearing Frame	A*	H	I
516	38.1	28.59	12.7

* ± 1mm

8.0 ASSEMBLY OF INNER MECHANICAL SEAL 516

Unless the bearing frame has been built for a special application this inner seal will always be Hidrostal type 'C' with open spring and a ceramic stationary face and carbon rotating face.

WARNING

While cleanliness is important during the entire bearing frame assembly, it is of utmost importance when re-assembling the mechanical seals.

Lubricate outside of the rubber seal which supports the ceramic part and carefully press ceramic face and rubber enclosure all the way into its seat in oil chamber housing [504]. The ring must fit tightly and square in its seat. **TAKE CARE TO PROTECT THE FACE DURING THIS OPERATION.** Examine gap between shaft and inner diameter of seal face; when face is correctly installed, gap will be uniform all round the shaft.

WARNING

The seal face is brittle and can easily chip if the inside edge catches a shoulder or groove when sliding along shaft. Take care to keep the seal square when sliding along shaft, also apply uniform gentle pressure when installing into seal.

IMPORTANT

Carefully clean faces of stationary and rotating parts using clean Tissue and lightly oil. **ABSOLUTE CLEANLINESS OF SEAL FACES IS ESSENTIAL IF SEAL IS TO BE TIGHT.**

Remove spring and spring-retaining ring from mechanical seal lightly lubricate the bore of the rubber part of the seal with oil, at the same time, lightly oil the shaft, as this will assist in sliding the mechanical seal into place.

Instal rotating part of the seal by carefully sliding along the shaft, taking care that the face does not 'catch' on any of the snap-ring grooves [545], when installed the carbon face should touch the stationary face. Be sure the rubber part sits uniformly on the shaft and that it has not rolled out from under the metal part of the seal face.

Instal seal-spring and spring-retaining ring.

Compress spring by pushing on the retaining ring and instal snap-ring [546] then turn shaft by hand, to check for free-running.

9.0

The next step is to prepare the Bearing Frame so that the tightness test of mechanical seal [516] can be checked. This should be done as follows:

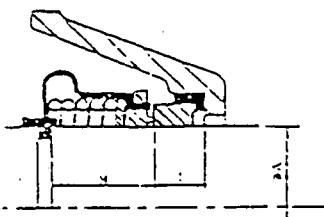
- a) Fit a seal plate, complete with gasket over motor mounted flange to completely seal off this end of the bearing frame.
- b) Ensure plug [163] is fitted and connect a dry air supply to connection 'D' using a length of plastic/rubber hose.
- c) The interior of the bearing frame should now be pressurised using dry air to a pressure not exceeding 0.5 of a bar. We have found, from experience, a bicycle pump is obviously the most convenient method of carrying out this function. Immerse bearing frame in a tank of water and carefully check for bubbles leaking through the mechanical seal assembly. If a water tank is not available, stand bearing frame vertical and fill the open end of the oil chamber casing [504] with water and observe for air leaks around the mechanical seal.

10.0

Fit 'O'-ring [527] onto [504] and secure seal-plate [507] by gently tightening fastening set [534].

11.0

Check setting length of Mechanical Seal 515



M-SEAL DEPICTED BUT DIMENSIONS SAME
FOR SEAL TYPES C.Y & X

BEARINGS FRAME	A*	H	I
BDM.B-112	28.58	27	11.1
DDM.B-112	28.58	27	11.1
EDM.D-112	38.1	28.59	12.7

* $\pm 1\text{mm}$

If this dimension is too long, shims should be placed between [504] and [507] by placing a shim either side of each stud. The maximum shim that should be used is 1.5 mm. If a thicker shim is required refer to your local Hidrostral Service Centre.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

12.0 Fit seal [515] according to instructions given previously in this manual.

13.0 The outer seal [515] has now to be air tested for tightness.

Ensure a length of open ended rubber pipe is connected to 'D' and the special tool enclosing drive shaft is still fitted.

Connect dry air supply to connection [536] and pressurise oil seal chamber to 0.5 bar. Immerse bearing frame into tank of water and check for leaks. Take care not to immerse free end of tube connected to 'D'. To check seal [516] is still tight when pressurised from opposite side carefully immerse free end of tube connection to 'D' from above into water, after a short while bubbles will appear if seal [516] is leaking.

If seals are tight fill seal chamber with oil according to instructions in section dealing with seal oil and assembly to hydraulic end, according to instructions given in "Maintenance of Hydraulic Parts".

WARNING

Connection 'D' must be left unplugged, otherwise any leakage through seal [516] will penetrate bearing.

14.0 Place 'O'-ring [146] onto [507] and fit back-cone [511].

15.0 Fit impeller [401] onto shaft and tighten impeller bolt [415] and check clearance 'B' is within tolerances shown in table in "Maintenance of Hydraulic Parts".

If it is necessary to reduce the clearance shims should be placed between parts [511] and [507] and the shims should be placed in the exact location of fixing studs [419], which secure the bearing frame to the volute.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR CLOSE COUPLED PUMPS

POS	DESCRIPTION	CODE	MATERIAL	
	General			
101	Bearing support	1TL	A	
104	Spacer ring P.S.	1RD/8RS	K	
110	Shaft	1WO	H	
112	Woodruff key	2FK	L	
125	Double row angular contact ball bearing	8LW		
150	Snap ring for 102	8RF		
157	Spacer ring	1RD/8RS	K	
160	Snap ring for bearing	8RF	K	
163	Plug for 504	8FD		
103	Bearing cap	1DL	A	
121	Angular contact ball bearing	8LW	-	
131	Grease nipple	8NF	N	
135	Fastening set 101-504	8BB	M	
136	Fastening set 101-103	8BB	M	
146	O-ring	8DO	Q	
148	O-ring	8DO	Q	
231	Socket set screw	8FG	F	
542	Grease retaining disc P.S. + Monoblock M.S.	5SF		
	Seal Parts			
209	O-ring for 507	8DO	Q	
504	Oil chamber casing	5GD	A	A/F
507	Seal Plate/Back Cover	1PM/1GD	A	D/C
511	Back Cone	1K		
515	Mechanical seal P.S.	8DM		
516	Mechanical seal M.S.	8DM		
527	O-ring for 507=504	8DO	Q	
534	Fastening set 507-504	8BB	M	
536A	Plug with gasket [oil filling]	8FV	F&P	
536B	Plug with gasket [oil drain]	8FV	F&P	
545	Snap ring for 516	3RF	O	
552A	Plug for flushing connection	8FO	N	
552B	Plug for flushing connection	8FO	N	
562	Snap ring for mechanical seal 515	8RF	O	C
D	Drain			

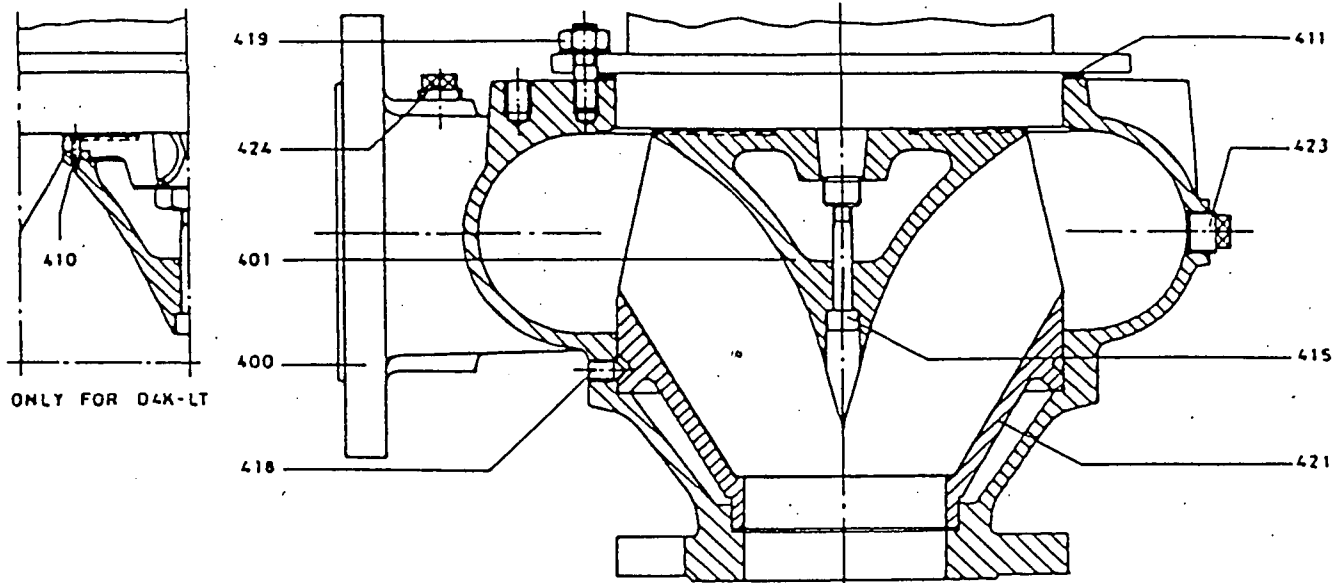
*For material explanation, see material specification sheet of section "ENGINEERING DATA" in 'PRODUCT DATA BOOK'.

HidrostatSECTIONAL DRAWINGS K-HYDRAULIC
D03K/D04K/D0DK

Dat: 09.06.87

No: 83-TU 3174 C

File:



NOTE: D0DK WILL BE SUPPLIED: -WITH CLAW FOR LOWERING DEVICE
-INSTEAD OF DISCHARGE FLANGE
-WITHOUT SUCTION FLANGE

PART	DESCRIPTION	MATERIALS OF CONSTRUCTION			
		1	2	3	5
400	VOLUTE	GREY CAST IRON			STAINLESS STEEL A4
401	IMPELLER	NODULAR IRON(1)	NODULAR IRON FLAME HARDENED	STAINLESS STEEL A4	
410	DRIVING PIN (1)	STAINLESS STEEL A4			
411	SHIMS	CARBON STEEL			
415	IMPELLER BOLT	STAINLESS STEEL A4			
418	GRUB SCREW	STEEL			STAINLESS STEEL A4
419	FASTENING SET	RUSTLESS STEEL			STAINLESS STEEL A4
421	LINER	GREY CAST IRON	HIDRO HARD		STAINLESS STEEL A4
423	DRAIN PLUG	STEEL			STAINLESS STEEL A4
424	PLUG	STEEL			STAINLESS STEEL A4

(1) ONLY FOR D4K-LT

D3K NOT AVAILABLE IN CODE 5

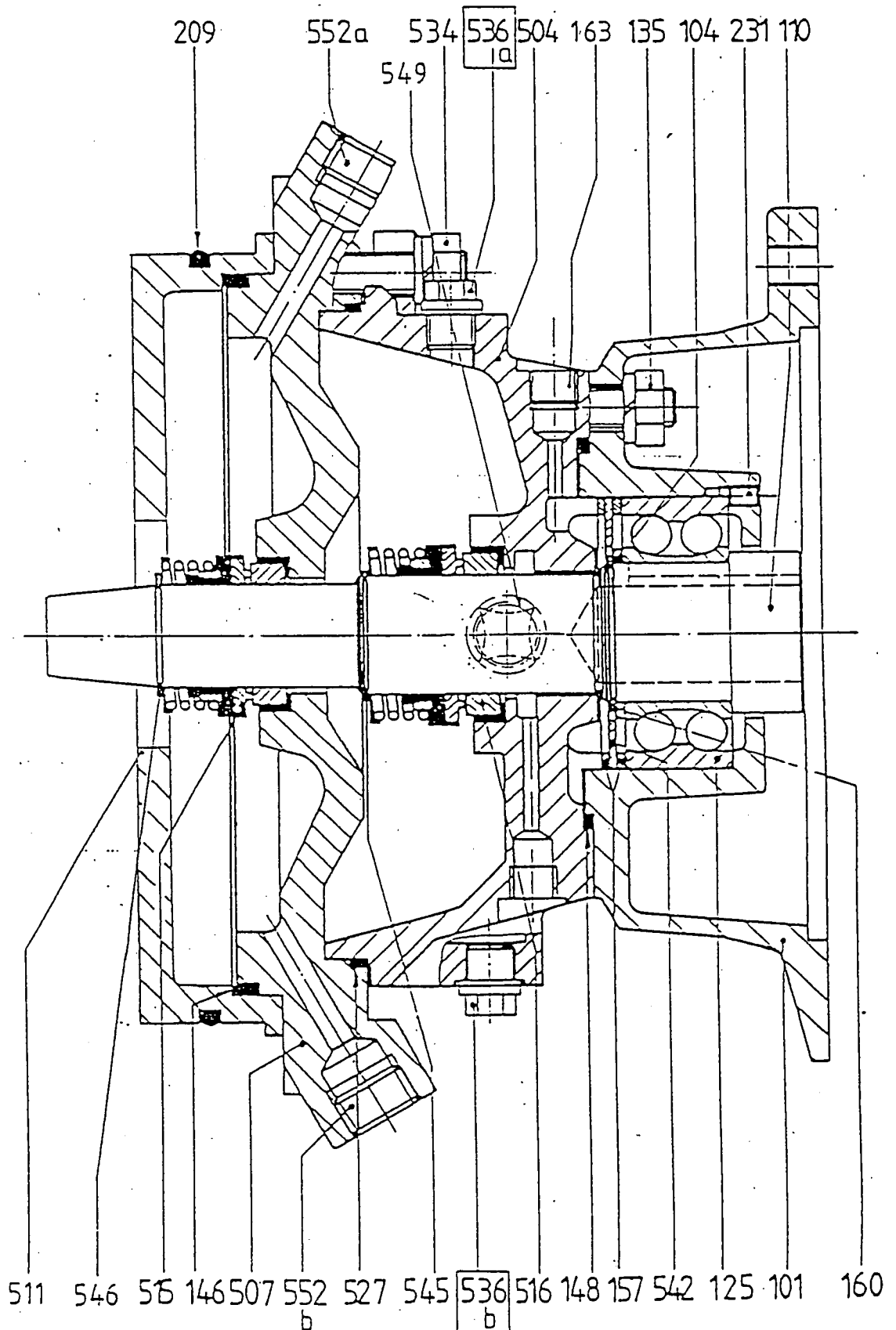
D0DK IS NOT AVAILABLE IN BEARING FRAME OR BLOCK CONSTRUCTION

hidrostatSECTIONAL DRAWINGS BLOCK-PUMPS
SCHNITTZEICHNUNGEN BLOCK-PUMPEN
DDM1K-112

Dat: 15.9.1992

No: 92-TU 4510

File:



SECTION 4

INSTRUMENTS

4. **INSTRUMENTS**

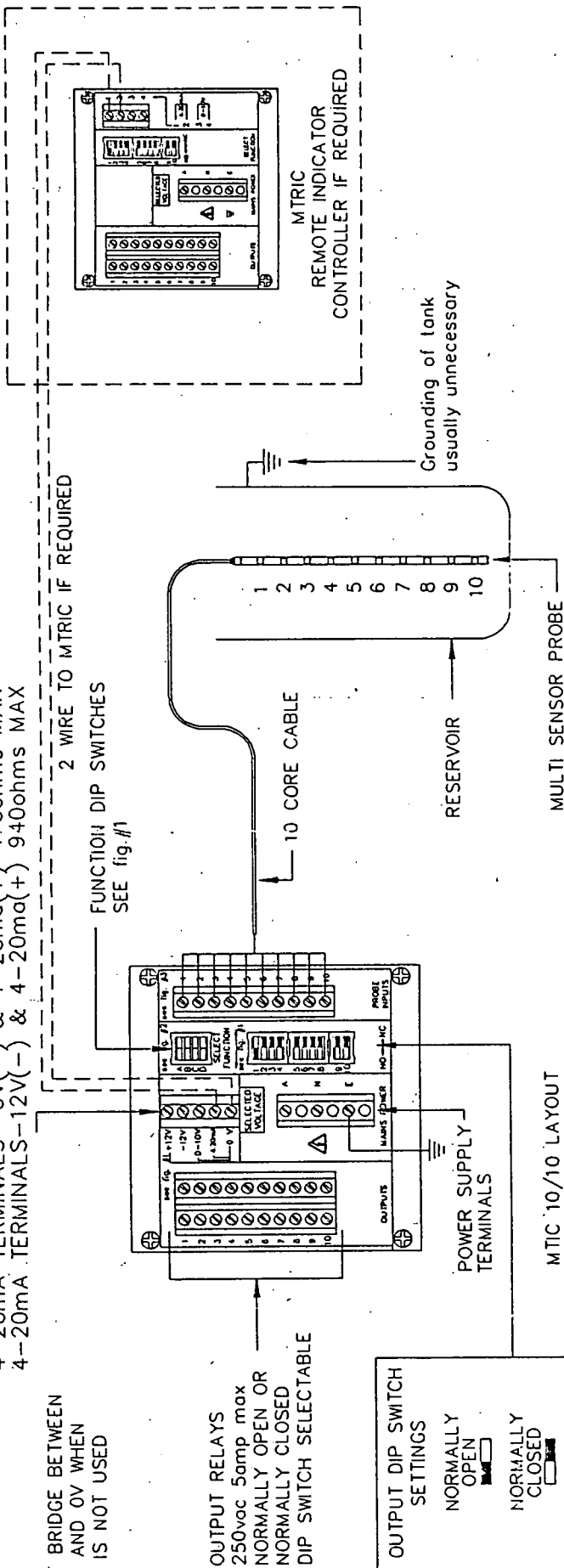
Multitrode and pump controller refer attached installation operation and maintenance instructions.

MULTI TRODE MTIC 10/10 INSTALLATION SHEET

STEPPED ANALOGUE OUTPUT TERMINALS

4-20mA TERMINALS 0V(-) & 4-20mA(+) 470ohms MAX
 4-20mA TERMINALS -12V(-) & 4-20mA(+) 940ohms MAX

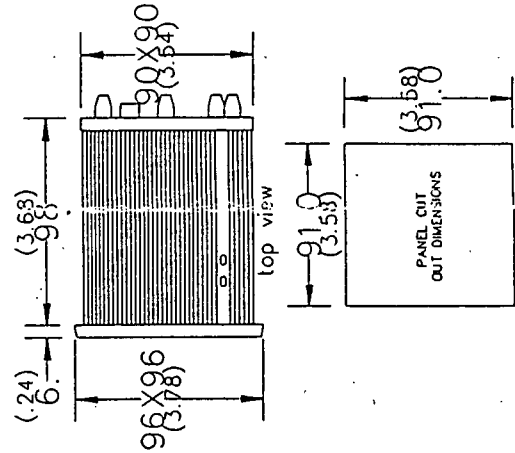
NOTE:
 CONNECT BRIDGE BETWEEN
 4-20mA AND 0V WHEN
 4-20mA IS NOT USED



DIP SWITCH SETTINGS SENSITIVITY AND TIME DELAY
 fig. #1

SWI FUNCTION	POSITION	DESCRIPTIONS
A	—	INSTANTANEOUS ACTUATION WHEN LEVEL REACHES SENSOR
B	—	TIME DELAY ON ACTUATION APPROX. 5 SECONDS
A	—	TIME DELAY ON ACTUATION APPROX. 10 SECONDS
B	—	TIME DELAY ON ACTUATION APPROX. 15 SECONDS
A	—	FOR CONCENTRATES SUCH AS ACIDS, MINERALS, ALKALINES, LEAVING RESIDUE
D	—	ACIDS, ALKALINES-DILUTED BRINE, SEA WATER
C	—	ACIDS, ALKALINES-DILUTED BRINE, SEA WATER
D	—	SULLAGE, SEWAGE EFFLUENT, TOWN WATER
C	—	EFFLUENTS AND PROCESSES WITH OIL CONTAMINANTS, PURIFIED WATER
D	—	

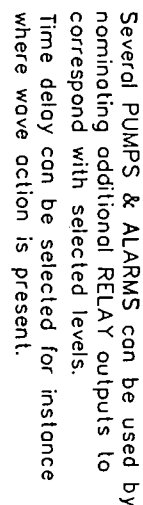
MTIC DIMENSIONS



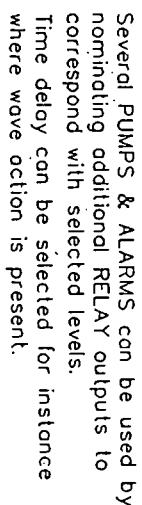
SPECIFICATIONS

MTIC INDICATOR CONTROLLER	MTIC INDICATOR CONTROLLER
Number of inputs	10 points via MULTI TRODE PROBE
Sensor voltage	12VAC nominal
Sensor current (per sensor)	0.8mA (short circuit)
Number of outputs	10 sets of programmable N.O. or N.C. contacts
Contact rating	5 amp 250VAC resistive
Contact life	10 operations
Supply voltage AC (+10%)	240.110vac 50/60Hz - 16 VA
Supply voltage DC	10 TO 30 VDC - 10 WATTS MAX
Dimensions mm.(inches)	H96(3.78")xW96(3.78")xD128(5.03")
Terminal size mm.(inches)	2.5mm ² /(0.64")
Display	High intensity LED per output on front panel arranged vertically to form bar graph
Enclosure type	Extruded aluminium
Mounting arrangements	Panel mounted trough cut-out brackets supplied
Sensitivity	Selectable by switch at rear of unit
Standard sensitivities	1k, 4k, 20k or 80k ohms
Operating temperature C(F)	Minus 10C (+14F)
Auxiliary outputs	Plus 60C (140F)
Other features	4-20mA 0-10 VDC
	Time delay of 5, 10, 15 sec. selectable via switch at rear

relay output 250vac 5amp max



relay output 250vac 5amp max

Q-Pulse Id TMS723