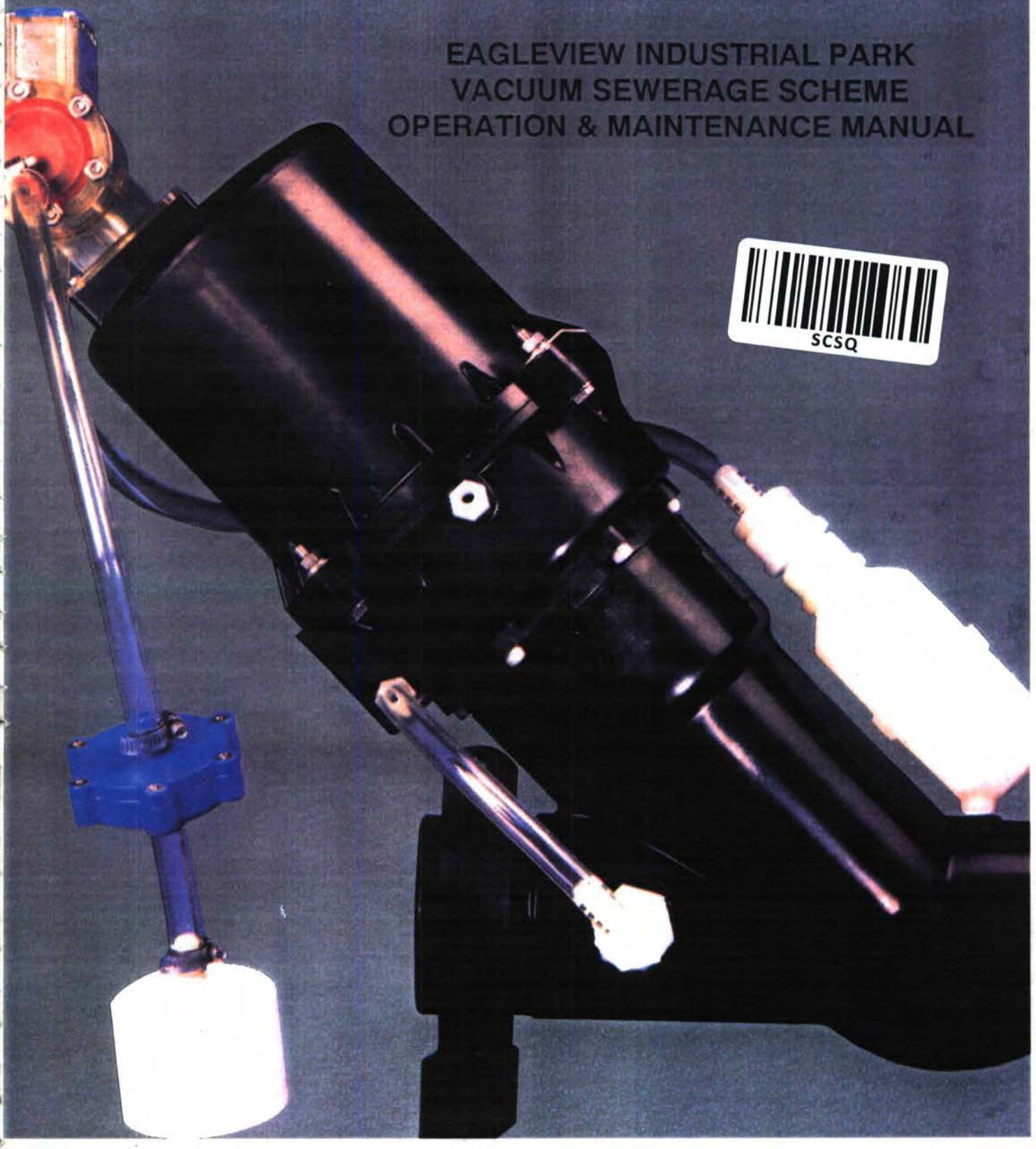
BRISBANE CITY COUNCIL

AIRVAC®

VACUUM SEWER SYSTEMS

The Viable Alternative®

EAGLEVIEW INDUSTRIAL PARK VACUUM SEWERAGE SCHEME OPERATION & MAINTENANCE MANUAL



EAGLEVIEW INDUSTRIAL PARK

BRISBANE CITY COUNCIL

OPERATION & MAINTENANCE MANUAL

March 1995

Confidential Information

AIRVAC-RSM PTY LIMITED
Suite 11,
283 Penshurst Street,
Willoughby, N.S.W. 2068.

Telephone: (61 2) 417 8133

Facsimile: (61 2) 417 8162

EAGLEVIEW INDUSTRIAL PARK

BRISBANE CITY COUNCIL

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EAGLEVIEW INDUSTRIAL PARK

BRISBANE CITY COUNCIL

CONTRACTORS

Project Manager	Connell Wagner 433 Boundary Street, Spring Hill, Queensland, 4004. Telephone No. (07) 246 1000 Facsimile No. (07) 246 1001
Contractor	Prime Development Corporation Pty Limited. Level 1 World Care House 47–49 Sherwood Road Toowong, Queensland, 4060. Telephone No. (07) 371 0455 Facsimile No. (07) 371 5275
Designer, Supplier/Vacuum Equipment	AIRVAC–RSM Pty Limited. Suite 11, 283 Penshurst Street, Willoughby, N.S.W. 2068. Telephone: (02) 417 8133 Facsimile: (02) 417 8162
Piping Contractor	Fairfield Plumbing & Mechanical Services. Private Bag 3, Moorooka, Queensland, 4105. Telephone No. (07) 892 9243 Facsimile No. (07) 892 9271

EAGLEVIEW INDUSTRIAL PARK

BRISBANE CITY COUNCIL

CONTRACTORS

Cont..

Vacuum Pumps	Siemens Ltd Australia. 383 Pacific Highway, Artarmon, N.S.W. 2064. Telephone No. (02) 436 8700 Facsimile No. (02) 546 8701
Sewage Discharge Pumps	Envirotech Australia Pty Limited. Gindurra Road, Somersby, N.S.W. 2250. Telephone No. (043) 402 388 Facsimile No. (043) 401 080

SECTION 1

EAGLEVIEW INDUSTRIAL PARK VACUUM SEWERAGE SCHEME

1.1 Description

1.2 Reticulation

1.3 Pumping Station

1. TRANSPORT SYSTEM

1.1 DESCRIPTION

Sewage Transport System has been generally designed and constructed using technology and equipment provided by AIRVAC–RSM Pty Limited under a licence arrangement from AIRVAC, Rochester, Indiana, U.S.A. AIRVAC–RSM Pty Limited is the major supplier of vacuum sewerage systems in Australia and internationally.

The Vacuum Sewer System used and as shown in copyright drawings submitted during the course of the contract is covered by AUSTRALIAN PATENT No. **522719.**

1.2 RETICULATION SYSTEM

The system consists of a network of pipes radiating from the Pumping Station. The 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.

Figure 9224–1 and 9442–2 shows the reticulation system. Drawing list is shown on Figure 9224–1.

The grading of the system conforms to level grade transport, upgrade transport and downgrade transport as shown in Figure 1–2.

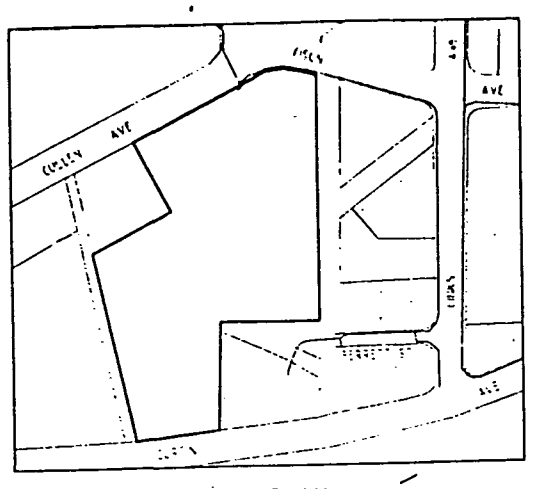
1.3 PUMPING STATION

The heart of the vacuum system is the pumping station which is shown in Figure 9442–03. Sewage enters the collection tank from the vacuum main. The level rises and the duty sewage pump is switched on by a signal from the level probe. The sewage is pumped via the Ø110 HDPE rising main to a new discharge manhole adjacent to the existing manhole. Duty and standby sewage pumps are provided.

The vacuum within the system is maintained within the operating range by vacuum switches. Duty and standby vacuum pumps are provided.

The control philosophy for the pumps is:–
Selector switch auto/manual. Automatic start up is provided in the event of power failure.

PROJECT NORTH



CONNECTION BY BCC

CULLEN AVENUE

150 SEWER RISING MAIN FLOW

CULLEN AVENUE
No. 2 VACUUM PUMP STATION

FISON AVENUE

EXISTING MANHOLE

VP 2
1500 DEEP

110 HDPE RISING MAIN APPROX. 1 TO 1.5 m INSIDE PROPERTY ALIGNMENT

NEW RISING MAIN DISCHARGE MANHOLE

VH 1.00

VH 1.00

VH 1.00

VP 1
1800 DEEP

VP 3
1500 DEEP

VP 4
1500 DEEP

VP 5
1800 DEEP

VP 6
1800 DEEP

VP 10
1800 DEEP

ROAD No. 1

JOIN LINE

1 2 3 4 5 7 8 9 10 11 12 13 14 15

2.75 3.00 2.50 2.25

DRAWING LIST

9442-1	VACUUM RETICULATION LAYOUT SHEET 1 OF 2
9442-2	VACUUM RETICULATION LAYOUT SHEET 2 OF 2
9442-3	PUMP STATION BUILDING LAYOUT
9442-4	SINGLE VALVE COLLECTION PIT – MODULAR CONSTRUCTION HDPE
9442-5	LONGITUDINAL SECTION SHEET 1 OF 2
9442-6	LONGITUDINAL SECTION SHEET 2 OF 2
9442-7	STANDARD DRAWING HDPE FITTINGS

DIRECTOR OF PLANNING & DESIGN (DEPT. OF WS & S)
..... DATE .....
(APPROVAL VALID FOR 12 MONTHS ONLY) FROM SIGNED DATE

VACUUM POT

RISING MAIN

VACUUM MAIN

DIVISION VALVE

NAME OF ESTATE		EAGLEVIEW INDUSTRIAL PARK
SUB. PLAN NO.		253/30/5 – 1672/94 & 268/94
B.C.C. REG. BOARD		(268) 20/05/94
APPROVAL DATE		(1672) 29/08/94
NO. OF ALLOTS.		18
AREA IN Ha.		9.346 Ha.
LENGTH	90 mm	101.25
OF VACUUM	110 mm	682.00
SEWERS	160 mm	47.80
RETICULATION NO.		

Mk	Details of Amendment	Approved
A	BOUNDARY BETWEEN LOTS 3 & 4 REVISED, VP-10 ADDED, VP-2 RELOCATED, VM RELOCATED, RM SHOWN, CONTOURS ADDED, B.C.C. INFORMATION TABLE ADDED.	18 11/1/95
B	AMEND TO B.C.C REQUIREMENTS	15 10/3/95
		/ /
		/ /

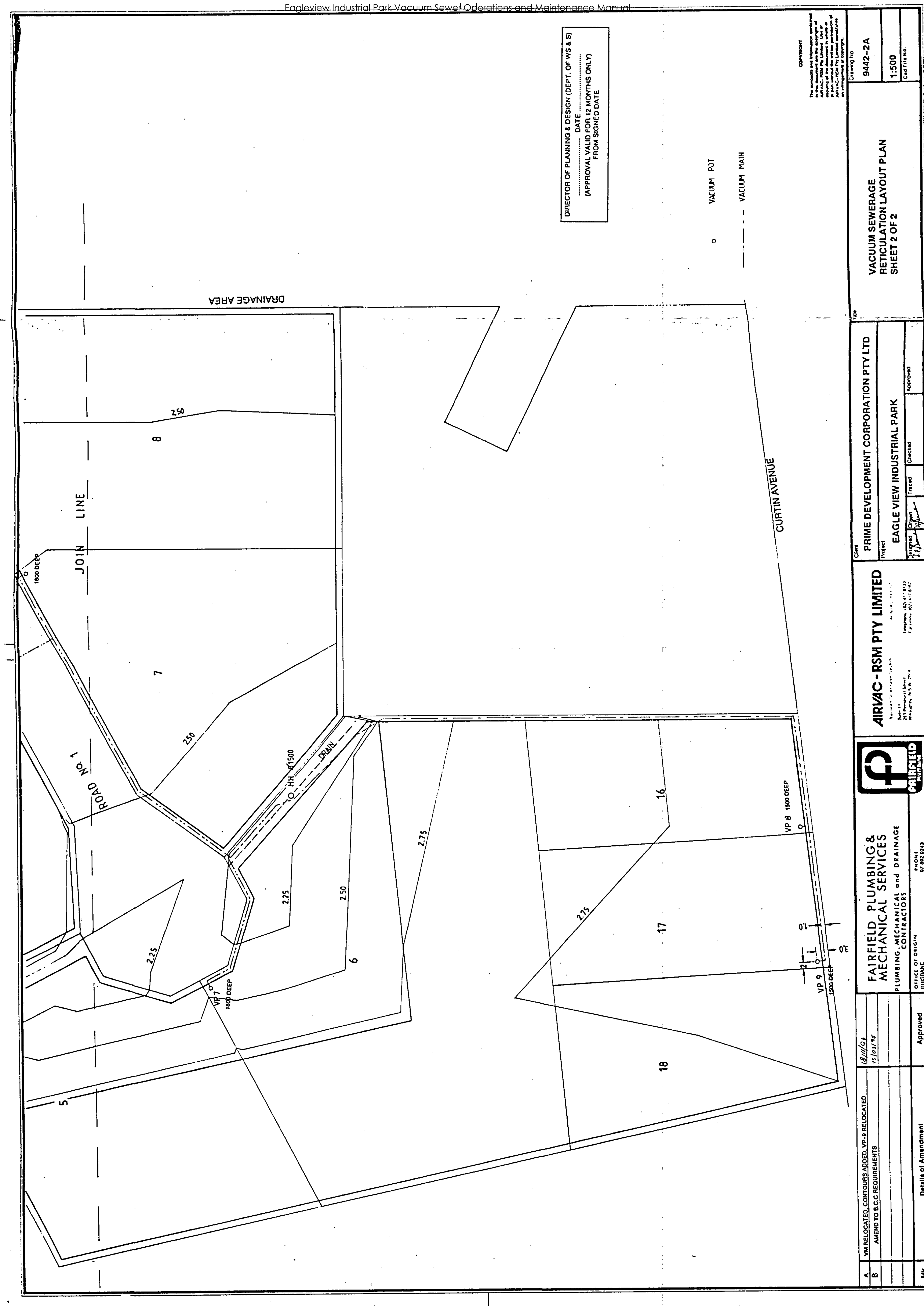
FAIRFIELD PLUMBING & MECHANICAL SERVICES
PLUMBING, MECHANICAL and DRAINAGE CONTRACTORS
OFFICE OF ORIGIN BRISBANE PHONE 07 852 9243

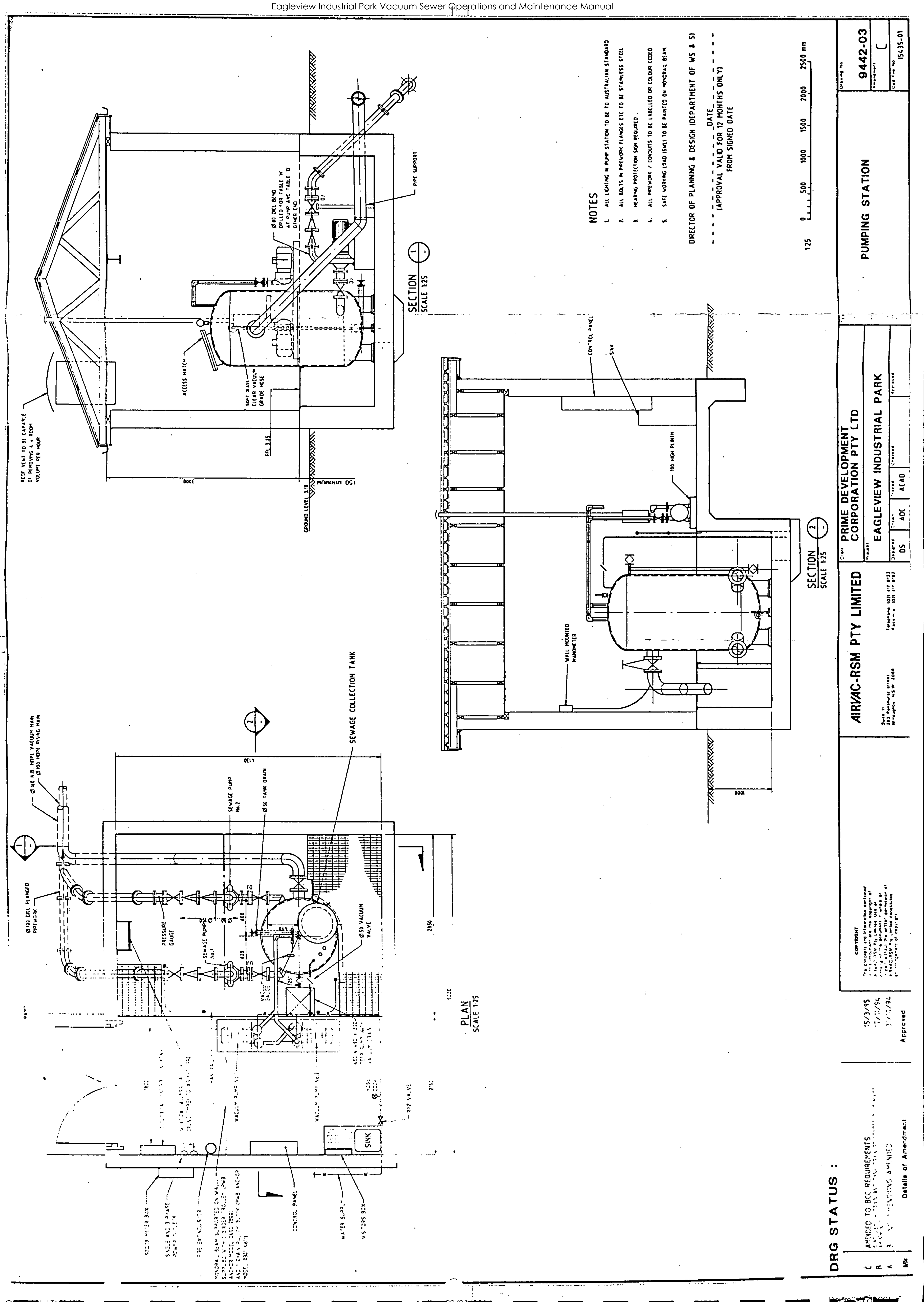
AIRVAC - RSM PTY LIMITED
Vacuum Sewerage Systems
Suite 11, 281 Pennant Street, Telephone: (02) 417 8133, Facsimile: (02) 417 8162

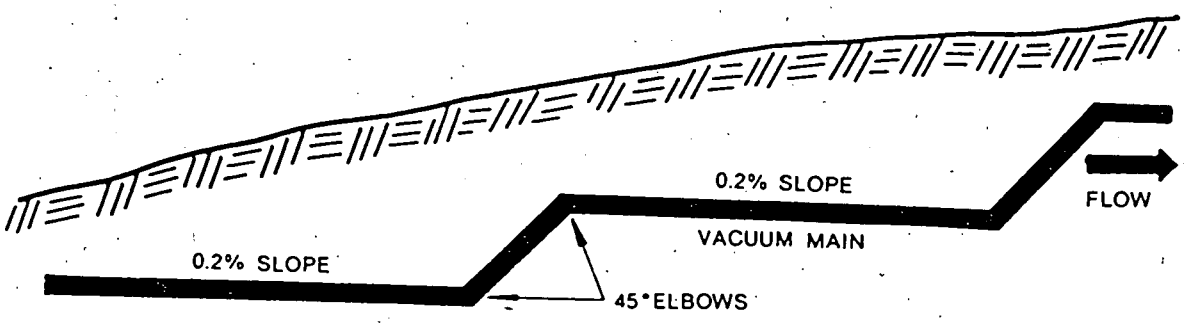
Client: PRIME DEVELOPMENT CORPORATION PTY LTD
Project: EAGLE VIEW INDUSTRIAL PARK
Designed / Drawn / Traced / Checked / / Approved / /

Title: VACUUM SEWERAGE RETICULATION LAYOUT PLAN SHEET 1 OF 2

Drawing No: 9442-1A
Scale: 1:500
Amendment

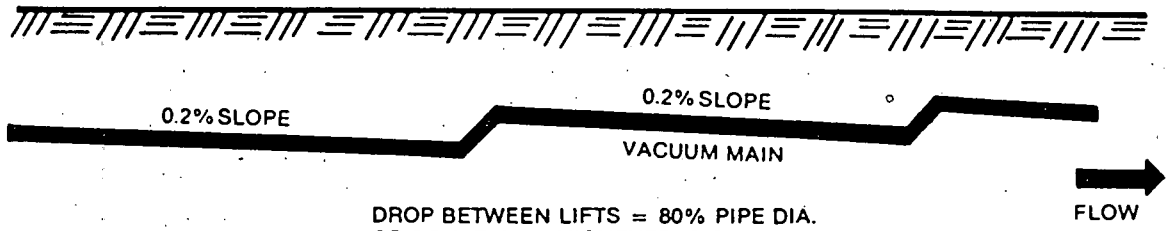

DIRECTOR OF PLANNING & DESIGN (DEPT. OF WS & S)
DATE
(APPROVAL VALID FOR 12 MONTHS ONLY) FROM SIGNED DATE
VACUUM POT
VACUUM MAIN
DRAINAGE AREA
JOIN LINE
CURTIN AVENUE
ROAD No 1
DRAIN
HH ⌀1500
1800 DEEP
VP 7
VP 8 1500 DEEP
VP 9 1500 DEEP
VACUUM SEWERAGE RETICULATION LAYOUT PLAN SHEET 2 OF 2
PRIME DEVELOPMENT CORPORATION PTY LTD
EAGLE VIEW INDUSTRIAL PARK
AIRVAC-RSM PTY LIMITED
FAIRFIELD PLUMBING & MECHANICAL SERVICES
PLUMBING, MECHANICAL and DRAINAGE CONTRACTORS
9442-2A
1:500
A VM RELOCATED, CONTOURS ADDED, VP-9 RELOCATED
B AMEND TO B.C.C REQUIREMENTS
Details of Amendment
Approved


PLAN
SCALE 1:25
SECTION 1
SCALE 1:25
SECTION 2
SCALE 1:25
SEWAGE COLLECTION TANK
SEWAGE PUMP No.1
SEWAGE PUMP No.2
PRESSURE GAUGE
Ø50 TANK DRAIN
Ø50 VACUUM VALVE
Ø100 DICL FLANGED PIPEWORK
Ø160 N.B. HDPE VACUUM MAIN
Ø100 HDPE RISING MAIN
CONTROL PANEL
WATER SUPPLY
VISITORS BOX
SINK
ACCESS HATCH
SIGHT GLASS CLEAR VACUUM GRADE HOSE
PIPE SUPPORT
GROUND LEVEL 3.10
FFL 3.25
150 MINIMUM
WALL MOUNTED MANOMETER
100 HIGH PLINTH
ROOF VENT TO BE CAPABLE OF REMOVING 6 x ROOM VOLUME PER HOUR
NOTES
1. ALL LIGHTING IN PUMP STATION TO BE TO AUSTRALIAN STANDARD
2. ALL BOLTS IN PIPEWORK FLANGES ETC TO BE STAINLESS STEEL
3. HEARING PROTECTION SIGN REQUIRED.
4. ALL PIPEWORK / CONDUITS TO BE LABELLED OR COLOUR CODED
5. SAFE WORKING LOAD (SWL) TO BE PAINTED ON MONORAIL BEAM.
DIRECTOR OF PLANNING & DESIGN (DEPARTMENT OF WS & S)
DATE
(APPROVAL VALID FOR 12 MONTHS ONLY)
FROM SIGNED DATE
1:25
0 500 1000 1500 2000 2500 mm
DRG STATUS :
C AMENDED TO BCC REQUIREMENTS 15/3/95
Mk Details of Amendment Approved
COPYRIGHT
AIRVAC-RSM PTY LIMITED
PRIME DEVELOPMENT CORPORATION PTY LTD
EAGLEVIEW INDUSTRIAL PARK
PUMPING STATION
DS ADC ACAD
9442-03
C
15435-01



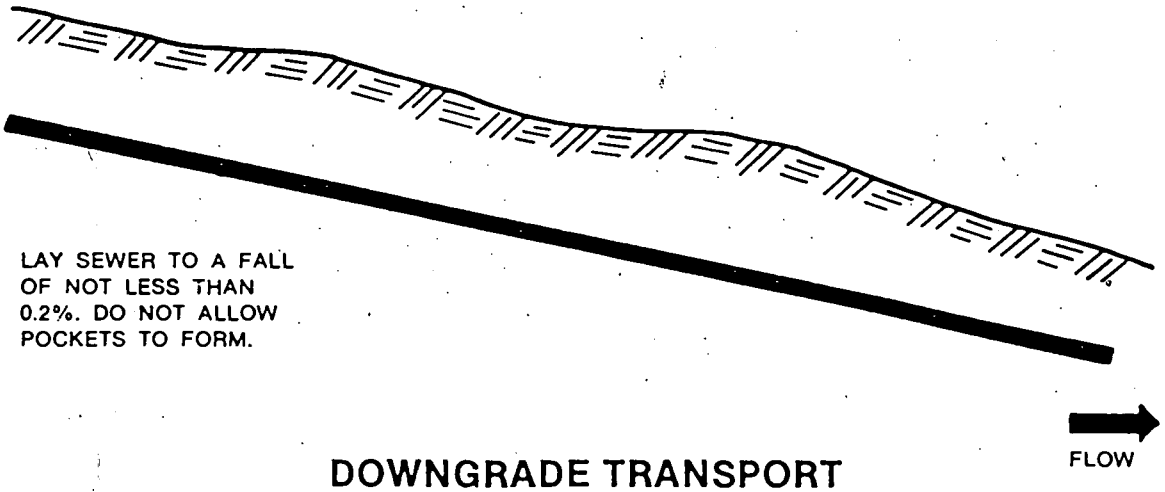
DROP BETWEEN LIFTS = 80% PIPE DIA.
OR 0.2% FALL WHICHEVER IS GREATER

UPGRADE TRANSPORT



DROP BETWEEN LIFTS = 80% PIPE DIA.
OR 0.2% FALL WHICHEVER IS GREATER

LEVEL GRADE TRANSPORT



DOWNGRADE TRANSPORT

AIRVAC - RSM PTY LIMITED

Suite 11,
283 Penshurst Street,
Willoughby, N.S.W. 2068

Telephone: (02) 417 8133
Facsimilie: (02) 417 8162

VACUUM SEWER PROFILES

FIGURE 1-2

Auto Mode

Both duty pumps (vacuum and sewage) are automatically selected and toggled after each start. If the duty pump is unavailable the remaining unit automatically becomes the duty pump. If the high/high sewage level is reached the vacuum pump will stop and an interlock will prevent it restarting until the waste level drops below the high level switch setting.

Manual Mode

Start/stop push buttons are provided to control each pump. The duty vacuum pump will shut down and an interlock will prevent restarting with high/high level switch activated. Alarms, telemetry and auto dialler are detailed in the control panel description – Section 2.

The pumping station consists of:–

- Vacuum Collection Tank
- Vacuum Pumps. Comprehensive details of the vacuum pumps are contained in Section 4 – SIEMENS Vacuum Pumps
- Sewage Discharge Pumps. Details of the sewage discharge pumps are contained in Section 5 – Hidrostal Sewage Pumps.
- Control Panel.
- Isolation Valve for the incoming vacuum line and the suction and discharge of sewage pumps.
- Check Valve
- Lifting Equipment

SECTION 2

EAGLEVIEW INDUSTRIAL PARK VACUUM SEWERAGE SCHEME

CONTROL PANEL

2. CONTROL PANEL

The Control Panel is a wall mounted, front opening cabinet housing the following items.

- PLC
- Multitrode Level Controller

  (Note PLC and Multitrode are mounted inside the panel)
- Fascia Indicator Lights for the following:–

Vacuum Pump 1	...	pump available light
	...	running light
Vacuum Pump 2	...	pump available light
	...	running light
Sewage Pump 1	...	pump available light
	...	running light
Sewage Pump 2	...	pump available light
	...	running light

  High Liquid Level Alarm

  Low vacuum level alarm (i.e. vacuum is greater than operational range –50 kPa)

- Fascia mounted push buttons are provided on the panel for the following:–

  System Start (manual mode)

  Lamp test Button

Each Vacuum Pump	...	start
	...	stop
Each Sewage Pump	...	start
	...	stop

- Selector Switches

  Auto/off/manual

  Vacuum pump selector switch No. 1/Off/No. 2

  Sewage pump selector switch No. 1/Off/No.2

- Emergency Stop Button

- Amp meter on each pump motor

- Hour run meters on each pump motor

2.2 FIELD INSTRUMENTS/LOCAL ELECTRICAL ISOLATION

- Vacuum Switches
  1. Vacuum Inadequate. Alarm contact switch set –40 kPa.
  2. Vacuum Pump Controls (on/off)
  3. Vacuum Excessive. Alarm contact switch (and panel light) set for vacuum exceeding –80 kPa.

- Vacuum Gauges wall mounted

  Tank vacuum

  Mains vacuum

- Tank Level Indication

  Multitrode 10 point conductivity type probe. Level indication lights are on the pump controller inside the door.

  Sight Glass

- Local Isolation Switches

  Sewage pumps

  Vacuum pumps

2.3 SYSTEM OPERATION

The panel is designed for manual or fully automatic operation.

2.3.1 AUTOMATIC MODE OPERATION

Select auto on the selectors switch. In this mode the vacuum pumps will automatically start/stop on initiation from the vacuum switches. Similarly the sewage pumps will start/stop automatically on the level switch (Multitrode). The switching range of all vacuum switches and the liquid level control is variable and have been set at commissioning. They should not require adjustment. If adjustment is thought to be required please contact AIRVAC–RSM Pty Limited prior to undertaking any adjustment.

Normally the amber lamps should light up showing all pumps are available.

In this situation the selected duty pump will run until the switch shuts it down and then the other pump becomes the next duty pump. If a pump is unavailable the other will always be selected as the duty unit.

Note that the Multitrode HIGH/HIGH level switch will activate voltage free alarm contacts for telemetry or phone alarm and simultaneously cut out the duty vacuum pump. Duty vacuum pump will not restart until the overriding level switch condition has been corrected. This would be a most unusual occurrence (HIGH/HIGH LEVEL) and it would normally be corrected by the sewage pump lowering the liquid level.

In the event a power failure the pump will automatically restart with the return of power. The vacuum collection system will then automatically come back on line as vacuum in the mains permits valves to open and drain the pits.

2.3.2 MANUAL MODE OPERATION

Manual operation is selected on the panel with Selector Switch and then system start PB. Initiate the respective pumps as required. In this mode the level and vacuum switches are not functional and both pumps will run until manually shut down.

2.3.3 NOMINAL SETTINGS OF SWITCHES

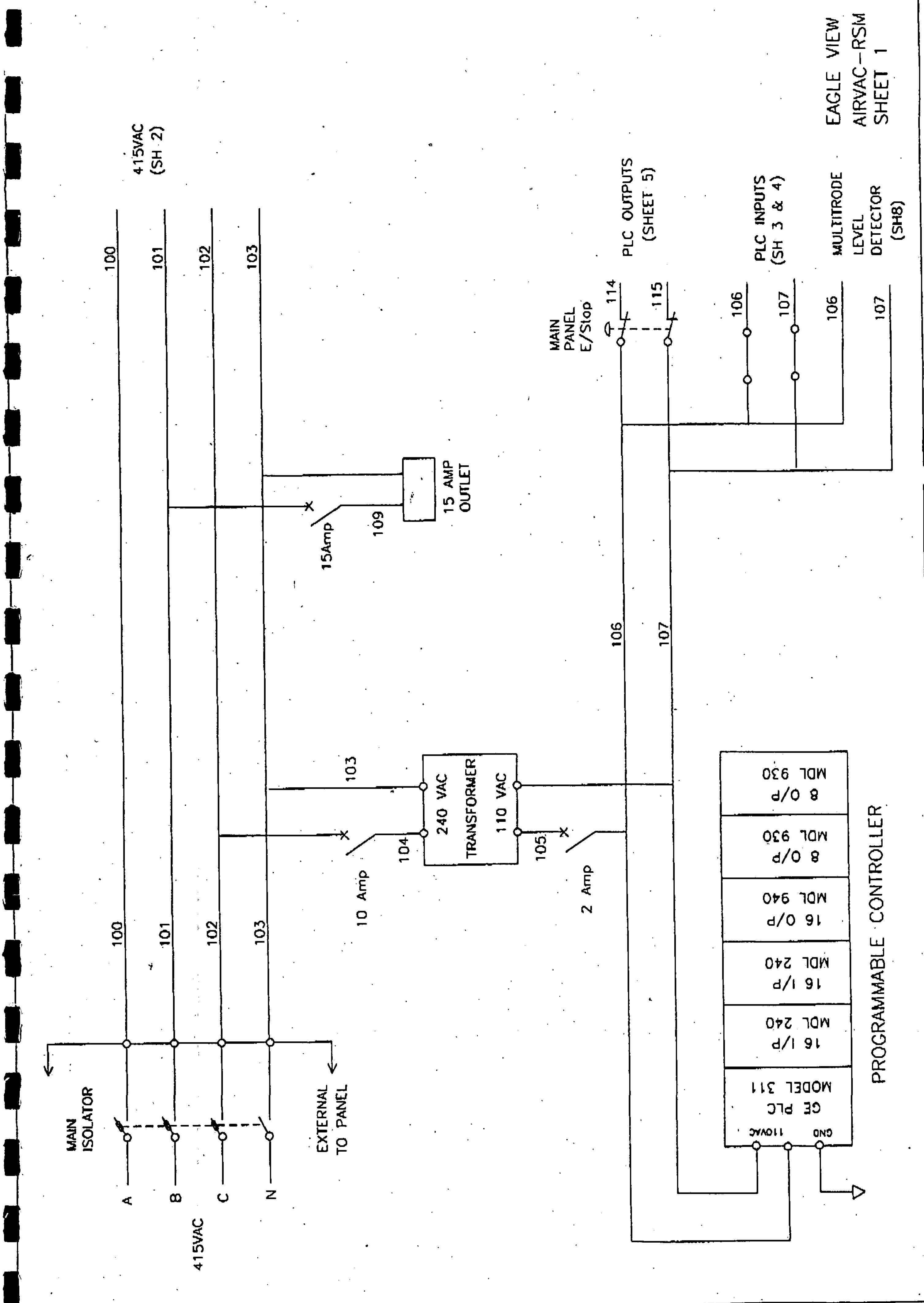
Vacuum Switch Function

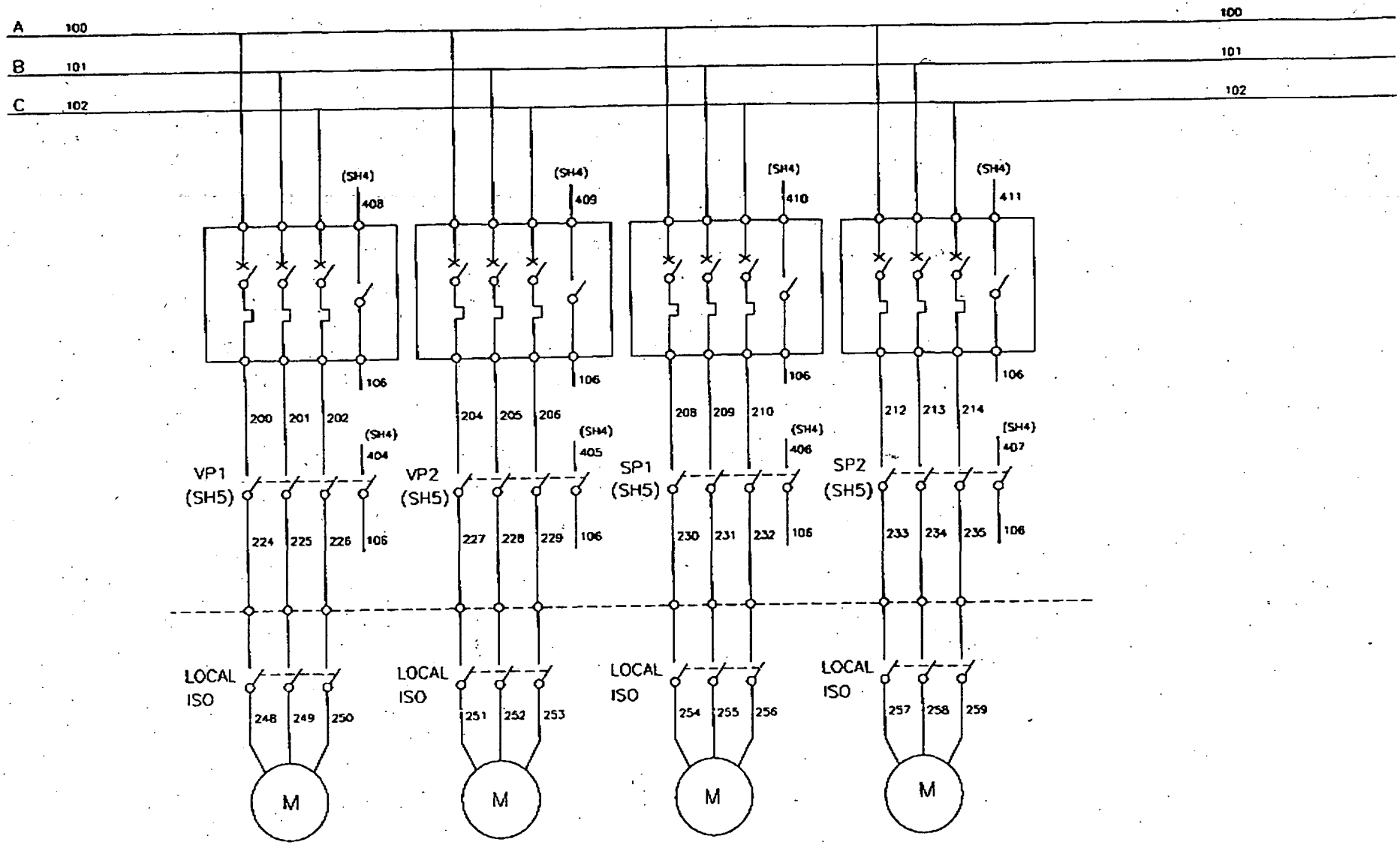
PS–1 HHV	Alarm Contact	–80 kPa rising
PS–2 LLV	Vacuum pump starts	–50 kPa
PS–2 HHV	Vacuum pump shut down	–70 kPa
PS–3 LLV	Alarm Contact	–40 kPa falling

Multitrode Sewage Pump Controller

HHL	Alarm Contact	Cuts off locks out duty vacuum pump
HL	Sewage Pump Starts	
LL	Sewage Pump Stops	

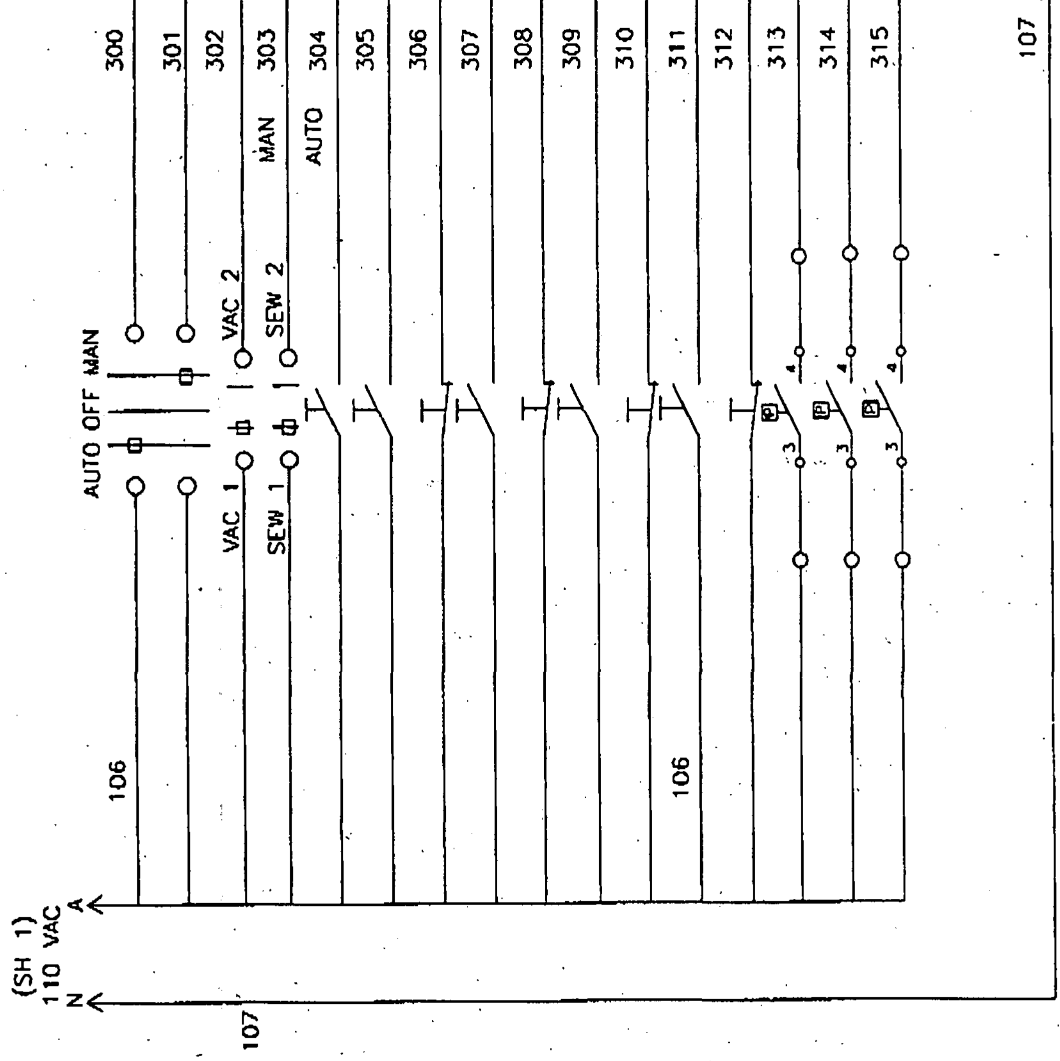
Note:
1. Contacts are adjustable within Multitrodes Indicating Controller Unit (M.T.I.C.)
2. Liquid level is indicated by on face of control by L.E.D.


EAGLE VIEW
AIRVAC-RSM
SHEET 1
415VAC
(SH 2)
100
101
102
103
PLC OUTPUTS
(SHEET 5)
PLC INPUTS
(SH 3 & 4)
MULTITRODE
LEVEL
DETECTOR
(SH8)
MAIN
PANEL
E/Stop
114
115
106
107
15 AMP
OUTLET
109
15Amp
240 VAC
TRANSFORMER
110 VAC
104
105
10 Amp
2 Amp
MAIN
ISOLATOR
EXTERNAL
TO PANEL
A
B
C
N
415VAC
PROGRAMMABLE CONTROLLER
GE PLC
MODEL 311
16 I/P
MDL 240
16 O/P
MDL 940
8 O/P
MDL 930
110VAC
GND



AIRVAC–RSM
SHEET 2

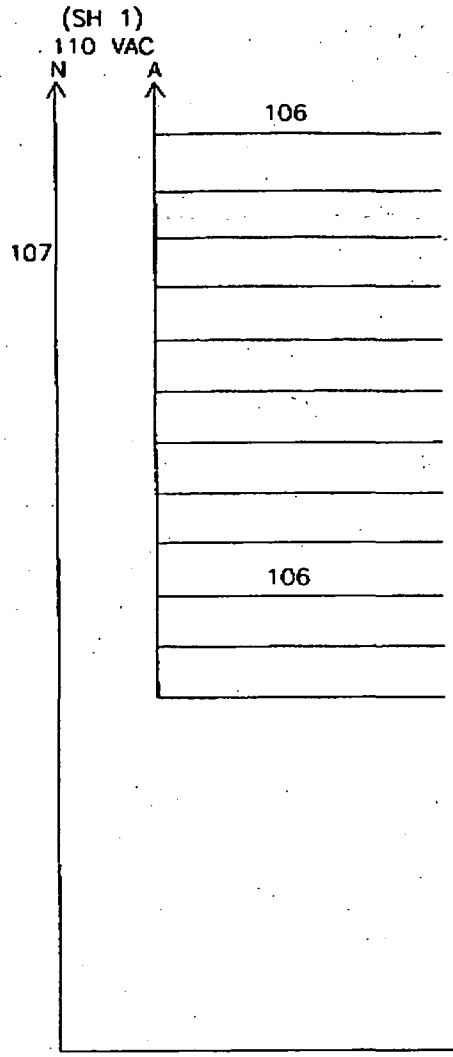
BOC3A



TERM	ADDR	INPUT DESCRIPTION	
1	I1	AUTOMATIC SELECT	
2	I2	MANUAL SELECT	
3	I3	VACUUM PUMPS 1 / 2 SELECT	
4	I4	SEWER DISCHARGE 1 / 2 SELECT	
5	I5	LAMP TEST 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 -70 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

AIRVAC-RSM
SHEET 3



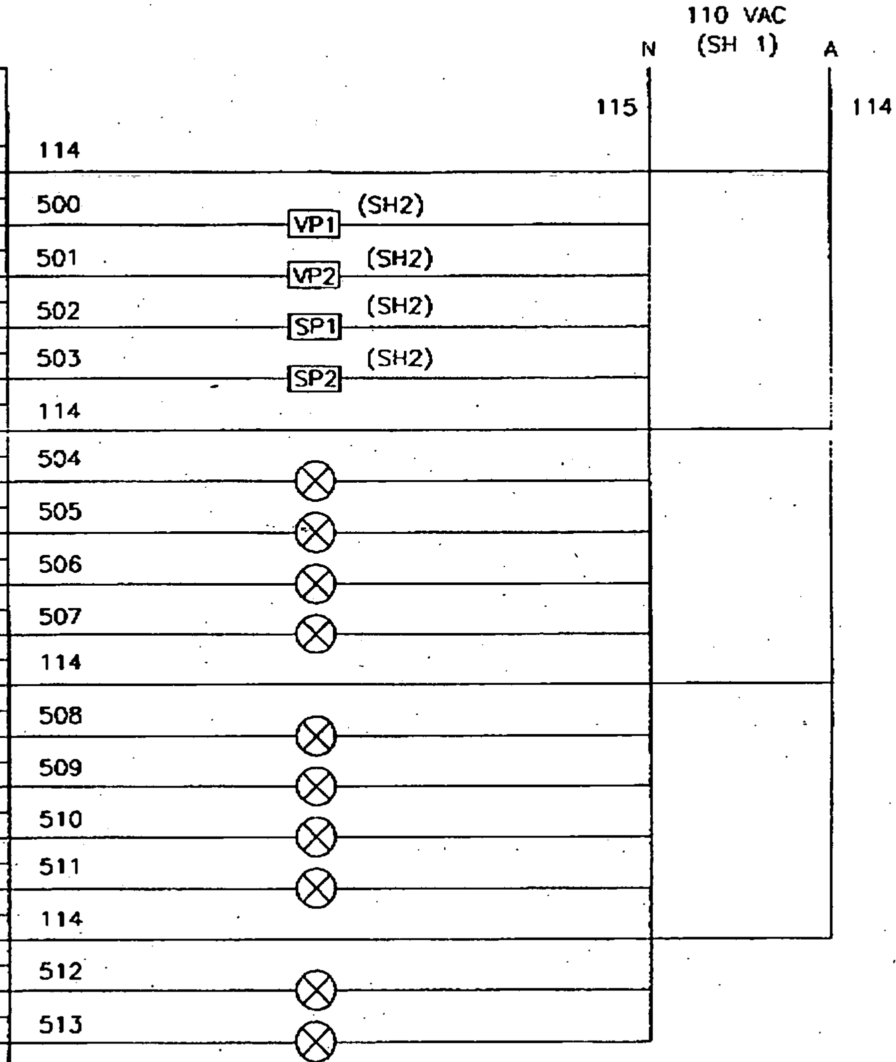
		TERM	ADDR	INPUT DESCRIPTION	
400	(SHEET 8)	1	117	HIGH HIGH TANK LEVEL	CLOSED ABOVE LEVEL
401	(SHEET 8)	2	118	HIGH TANK LEVEL	CLOSED ABOVE LEVEL
402	(SHEET 8)	3	119	LOW TANK LEVEL	CLOSED ABOVE LEVEL
403	(SHEET 8)	4	120	LOW LOW TANK LEVEL	CLOSED ABOVE LEVEL
404	VAC PUMP 1 (SH2)	5	121	VAC PUMP 1 RUNNING	
405	VAC PUMP 2 (SH2)	6	122	VAC PUMP 2 RUNNING	
406	SEWER PUMP 1 (SH2)	7	123	SEWER PUMP 1 RUNNING	
407	SEWER PUMP 2 (SH2)	8	124	SEWER PUMP 2 RUNNING	
408	VAC PUMP 1 (SH2)	9	125	VAC PUMP 1 OVERLOAD	
409	VAC PUMP 2 (SH2)	10	126	VAC PUMP 2 OVERLOAD	
410	SEWER PUMP 1 (SH2)	11	127	SEWER PUMP 1 OVERLOAD	
411	SEWER PUMP 2 (SH2)	12	128	SEWER PUMP 2 OVERLOAD	
		13	129		
		14	130		
		15	131		
		16	132		
		17			
		18			
107		19			
		20			

GE SERIES 90 PLC – IC693MDL240

AIRVAC–RSM
SHEET 4

BCC5A

OUTPUT DESCRIPTION	ADDR	TERM
		1
VACUUM PUMP 1 CONTACTOR	Q1	2
VACUUM PUMP 2 CONTACTOR	Q2	3
SEWER PUMP 1 CONTACTOR	Q3	4
SEWER PUMP 2 CONTACTOR	Q4	5
		6
SEWERAGE HI HI LEVEL ALARM	Q5	7
VACUUM LOW PRESSURE ALARM	Q6	8
VACUUM PUMP 1 AVAILABLE	Q7	9
VACUUM PUMP 2 AVAILABLE	Q8	10
		11
SEWERAGE PUMP 1 AVAILABLE	Q9	12
SEWERAGE PUMP 2 AVAILABLE	Q10	13
VACUUM PUMP 1 RUNNING	Q11	14
VACUUM PUMP 2 RUNNING	Q12	15
		16
SEWERAGE PUMP 1 RUNNING	Q13	17
SEWERAGE PUMP 2 RUNNING	Q14	18
	Q15	19
	Q16	20
GE SERIES 90 PLC – IC693MDL940		



AIRVAC–RSM
SHEET 5

BCC6

TELEMETRY INDICATION

OUTPUT DESCRIPTION	ADDR	TERM	
		1	
SITE POWER FAIL	Q17	2	600
		3	601
AUTO/MANUAL SELECTION	Q18	4	602
		5	603
SEWERAGE HI HI LEVEL ALARM	Q19	6	604
		7	605
VACUUM LOW PRESURE ALARM	Q20	8	606
		9	607
		10	
		11	
VACUUM PUMP 1 AVAILABLE	Q21	12	608
		13	609
VACUUM PUMP 2 AVAILABLE	Q22	14	610
		15	611
SEWERAGE PUMP 1 AVAILABLE	Q23	16	612
		17	613
SEWERAGE PUMP 2 AVAILABLE	Q24	18	614
		19	615
		20	

GE SERIES 90 PLC - IC693MDL930

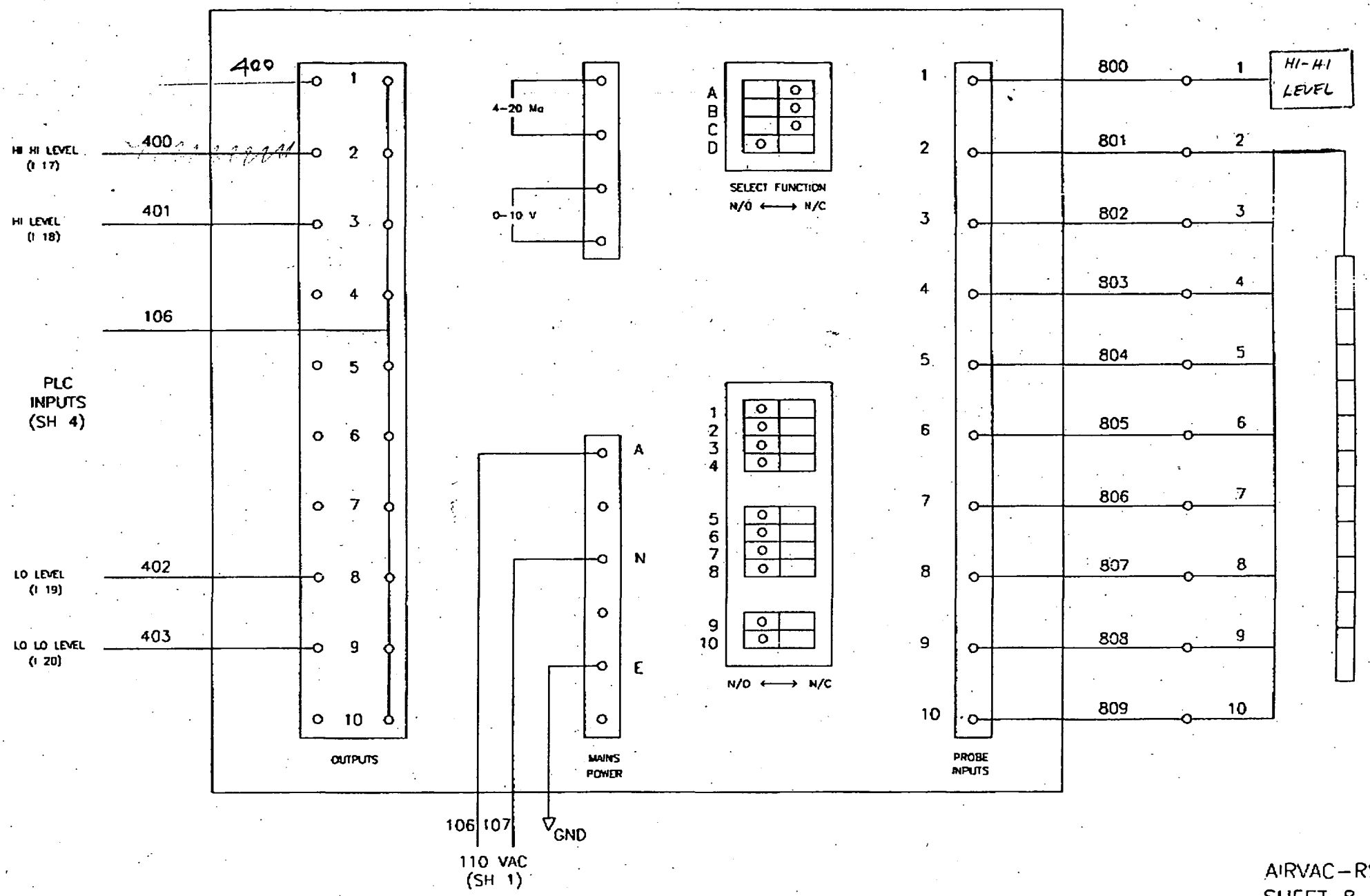
AIRVAC-RSM
SHEET 6

TELEMETRY INDICATION

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

AIRVAC–RSM
SHEET 7

MULTI TRODE MTIC 10/10



AIRVAC – RSM
SHEET 8

```
 GGGG EEEEE      FFFFF  AAA  N   N U   U  CCCC
G     E          F     A   A NN  N U   U C
G  GG EEEE       FFF   AAAAA N N N U   U C
G   G E          F     A   A N  NN U   U C
 GGG  EEEEE      F     A   A N   N  UUU   CCCC

 AAA  U   U TTTTT  OOO  M   M  AAA  TTTTT IIIII  OOO  N   N
A   A U   U   T   O   O MM MM A   A   T     I   O   O NN  N
AAAAA U   U   T   O   O M M M AAAAA   T     I   O   O N N N
A   A U   U   T   O   O M   M A   A   T     I   O   O N  NN
A   A  UUU    T    OOO  M   M A   A   T   IIIII  OOO  N   N
```

```
(*****************************************************************************
(*                                                                           *
(*                          Program:  EAGLEVU                                *
(*                                                                           *
(*  PLC PROGRAM ENVIRONMENT                 HIGHEST REFERENCE USED           *
(*  ------------------------                ----------------------           *
(*                                                                           *
(*          INPUT (%I):    512                  INPUT:   %I00028             *
(*         OUTPUT (%Q):    512                 OUTPUT:   %Q00028             *
(*       INTERNAL (%M):   1024               INTERNAL:   %M00035             *
(*    GLOBAL DATA (%G):   1280            GLOBAL DATA:      NONE             *
(*      TEMPORARY (%T):    256              TEMPORARY:      NONE             *
(*       REGISTER (%R):    512               REGISTER:   %R00018             *
(*  ANALOG INPUT (%AI):     64          ANALOG INPUT:      NONE             *
(* ANALOG OUTPUT (%AQ):     32         ANALOG OUTPUT:      NONE             *
(*                                                                           *
(*                  PROGRAM SIZE (BYTES):    848                            *
(*                                                                           *
(*****************************************************************************
```

Program: EAGLEVU C:\LM90\EAGLEVU

```
(*****************************************************************************)
(*                                                                           *)
(*                          BLOCK:   _MAIN                                   *)
(*                                                                           *)
(*                                                                           *)
(*                     BLOCK SIZE (BYTES):    836                            *)
(*                 DECLARATIONS (ENTRIES):     91                            *)
(*                                                                           *)
(*                                                                           *)
(*                     HIGHEST REFERENCE USED                                *)
(*                     ----------------------                                *)
(*                                                                           *)
(*                          INPUT (%I):    %I0028                            *)
(*                         OUTPUT (%Q):    %Q0028                            *)
(*                       INTERNAL (%M):    %M0035                            *)
(*                    GLOBAL DATA (%G):       NONE                           *)
(*                      TEMPORARY (%T):       NONE                           *)
(*                       REGISTER (%R):    %R0018                            *)
(*                  ANALOG INPUT (%AI):       NONE                           *)
(*                 ANALOG OUTPUT (%AQ):       NONE                           *)
(*                                                                           *)
(*****************************************************************************)
```



```
|L  START OF LD  PROGRAM EAGLEVU  ]      (*                                 *)
|
|     VARIABLE DECLARATIONS       ]
```

```
[        BLOCK DECLARATIONS        ]
[      START OF PROGRAM LOGIC      ]

(*************************************************************************)
(*                          SYSTEM START                                 *)
(*************************************************************************)

<< RUNG 5  STEP #0022 >>

                                                                  SYSTEM
AUTO                                                              AUTO
SELECT                                                            START
I0001                                                             %M0001
--] [-------------------------------------------------------------( )--

(*************************************************************************)
(*                      VACUUM PUMP ONE DUTY SELECT                      *)
(*************************************************************************)

<< RUNG 7  STEP #0005 >>

VACUUM  TOGGLE
PUMP    TO      SYSTEM                                            VACUUM
1/2     VACUUM  AUTO                                              PUMP 1
SELECT  PUMP 2  START                                             DUTY
I0003   %M0004  %M0001                                            %M0002
--] [---+---]/[-------] [-------------------------------------------( )--
        |
TOGGLE  |
TO      |
VACUUM  |
PUMP 1  |
%M0007  |
--] [---+

<< RUNG 8  STEP #0010 >>

                TOGGLE
VACUUM  VACUUM  TO      SYSTEM  VACUUM                            VACUUM
PUMP 1  PUMP 1  VACUUM  AUTO    PUMP 1                            PUMP 1
DUTY    RUNNING PUMP 2  START   AVAIL                             CONTROL
%M0002  %I0021  %M0004  %M0001  %M0032                            %M0003
--] [-------] [---+---]/[-------] [-------] [-------------------------( )--
                  |
VACUUM            |
PUMP 1            |
CONTROL           |
%M0003            |
--] [-------------+

Program: EAGLEVU              C:\LM90\EAGLEVU              Block: _MAIN

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                    EAGLE VIEW SEWAGE PUMPING STATION
                        AIRVAC RSM / OSCILLATION

<< RUNG 9  STEP #0017 >>

        VACUUM  TOGGLE                                            TOGGLE
VACUUM  PUMP    TO      VACUUM  SYSTEM                            TO
PUMP 1  1/2     VACUUM  PUMP 1  AUTO                              VACUUM
CONTROL SELECT  PUMP 1  RUNNING START                             PUMP 2
%M0003  %I0003  %M0007  %I0021  %M0001                            %M0004
```

```
|TOGGLE  |VACUUM   TOGGLE
|TO      |PUMP     TO
|VACUUM  |1/2      VACUUM
|PUMP 2  |SELECT   PUMP 2
|%M0004  |%I0003   %M0004
|--] [---+---]/[-------]/[--+

|  (*************************************************************************************)
|                              VACUUM PUMP TWO DUTY SELECT                                |
|  (*************************************************************************************)
|
|  << RUNG 11   STEP #0029 >>
|
|VACUUM  TOGGLE
|PUMP    TO       SYSTEM                                                          VACUUM
|1/2     VACUUM   AUTO                                                            PUMP 2
|SELECT  PUMP 1   START                                                           DUTY
|%I0003  %M0007   %M0001                                                          %M0003
|---]/[---+---]/[-------] [-------------------------------------------------------------( )--
|        |
|TOGGLE  |
|TO      |
|VACUUM  |
|PUMP 2  |
|%M0004  |
|--] [---+
|
|  << RUNG 12   STEP #0034 >>
|
|                TOGGLE
|VACUUM  VACUUM  TO       SYSTEM  VACUUM                                          VACUUM
|PUMP 2  PUMP 2  VACUUM   AUTO    PUMP 2                                          PUMP 2
|DUTY    RUNNING PUMP 1   START   AVAIL                                           CONTROL
|M0005   %I0022  %M0007   %M0001  %M0033                                          %M0006
+---   [-------] [---+---]/[-------] [-------] [-------------------------------------( )--
|                    |
|VACUUM              |
|PUMP 2              |
|CONTROL             |
|M0006               |
|--] [---------------+
|
|
|
|
|Program: EAGLEVU                    C:\LM90\EAGLEVU                    Block: _MAIN
|
|
|
|
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|                          EAGLE VIEW SEWAGE PUMPING STATION
|                              AIRVAC RSM / OSCILLATION
|
|<< RUNG 13   STEP #0041 >>
|
|        VACUUM  TOGGLE                                                           TOGGLE
|VACUUM  PUMP    TO       VACUUM  SYSTEM                                          TO
|PUMP 2  1/2     VACUUM   PUMP 2  AUTO                                            VACUUM
|CONTROL SELECT  PUMP 2   RUNNING START                                           PUMP 1
|M0006   %I0003  %M0004   %I0022  %M0001                                          %M0007
+--]  [---+---]/[-------]/[---+---]/[-------] [-------------------------------------( )--
|         |                  |
|TOGGLE  |VACUUM   TOGGLE  |
|TO      |PUMP     TO      |
```

```
|%M0007  |%I0003   %M0007
+---] [---+---] [--------]/[---+
|
|\*************************************************************************(>
|(*                          SEWER PUMP ONE DUTY SELECT                     *
|\*************************************************************************(>
|
|  << RUNG 15   STEP #0053 >>
|
|EWER    TOGGLE
|PUMP    TO        SYSTEM                                                    SEWER
|1/2     SEWER     AUTO                                                      PUMP 1
|ELECT   PUMP 2    START                                                     DUTY
|I0004   %M0010    %M0001                                                    %M0025
+---] [---+---]/[------] [-------------------------------------------------------( )--
|         |
|TOGGLE   |
|TO       |
|EWER     |
|UMP 1    |
|M0013    |
+---] [---+
|
|  << RUNG 16   STEP #0058 >>
|
|                 TOGGLE
|EWER    SEWER    TO        SYSTEM   SEWER                                     SEWER
|PUMP 1  PUMP 1   SEWER     AUTO     PUMP 1                                    PUMP 1
|DUTY    RUNNING  PUMP 2    START    AVAIL                                     CONTROL
|M0008   %I0023   %M0010    %M0001   %M0034                                    %M0009
+---] [--------] [---+---]/[------] [------] [-------------------------------------( )--
|                   |
|EWER               |
|MP 1               |
|L  :KOL            |
|I0009              |
+---] [-------------+
|
|
|
|
|Program: EAGLEVU                  C:\LM90\EAGLEVU                  Block: _MAIN
|
|
|
|
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|                        EAGLE VIEW SEWAGE PUMPING STATION
|                              AIRVAC RSM / OSCILLATION
|
|  << RUNG 17   STEP #0065 >>
|
|        SEWER    TOGGLE                                                     TOGGLE
|EWER    PUMP     TO        SEWER    SYSTEM                                  TO
|UMP 1   1/2      SEWER     PUMP 1   AUTO                                    SEWER
|CONTROL SELECT   PUMP 1    RUNNING  START                                   PUMP 2
|  I09   %I0004   %M0013    %I0023   %M0001                                  %M0010
+---] [---+---] [------]/[---+---]/[------] [-------------------------------------( )--
|         |                   |
|TOGGLE   |SEWER    TOGGLE    |
|TO       |PUMP     TO        |
|EWER     |1/2      SEWER     |
|PUMP 2   |SELECT   PUMP 2    |
|M0010    |%I0004   %M0010    |
+---] [---+---]/[------]/[---+
```

```
(*************************************************************************)
(*                                                                       *)
(*************************************************************************)

<< RUNG 19  STEP #0077 >>

EWER    TOGGLE
UMP     TO      SYSTEM                                                  SEWER
1/2     SEWER   AUTO                                                    PUMP 2
  LCT   PUMP 1  START                                                   DUTY
I0004   %M0013  %M0001                                                  %M0011
]/[---+---]/[-------] [-------------------------------------------------------( )--
      |
OGGLE |
O     |
SEWER |
UMP 2 |
M0010 |
]  [--+

<< RUNG 20  STEP #0082 >>

                TOGGLE
EWER    SEWER   TO      SYSTEM  SEWER                                   SEWER
UMP 2   PUMP 2  SEWER   AUTO    PUMP 2                                  PUMP 2
UTY     RUNNING PUMP 1  START   AVAIL                                   CONTROL
M0011   %I0024  %M0013  %M0001  %M0035                                  %M0012
]  [-------] [---+---]/[-------] [-------] [-------------------------------( )--
               |
 SEWER         |
UMP 2          |
ONTROL         |
%M0012         |
]  [-----------+

ogram: EAGLEVU                  C:\LM90\EAGLEVU                 Block: _MAIN

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                    EAGLE VIEW SEWAGE PUMPING STATION
                        AIRVAC RSM / OSCILLATION

<< RUNG 21  STEP #0089 >>

        SEWER   TOGGLE                                                  TOGGLE
EWER    PUMP    TO      SEWER   SYSTEM                                  TO
UMP 2   1/2     SEWER   PUMP 2  AUTO                                    SEWER
ONTROL  SELECT  PUMP 2  RUNNING START                                   PUMP 1
%M0012  %I0004  %M0010  %I0024  %M0001                                  %M0013
]  [---+---]/[------]/[---+---]/[-------] [-------------------------------( )--
       |                  |
TOGGLE |SEWER    TOGGLE   |
       |PUMP     TO       |
EWER   |1/2      SEWER    |
PUMP 1 |SELECT   PUMP 1   |
%M0013 |%I0004   %M0013   |
]  [---+---] [------]/[---+

(*************************************************************************)
(*                          VACUUM PUMP ONE CONTROL                      *)
(*************************************************************************)
```
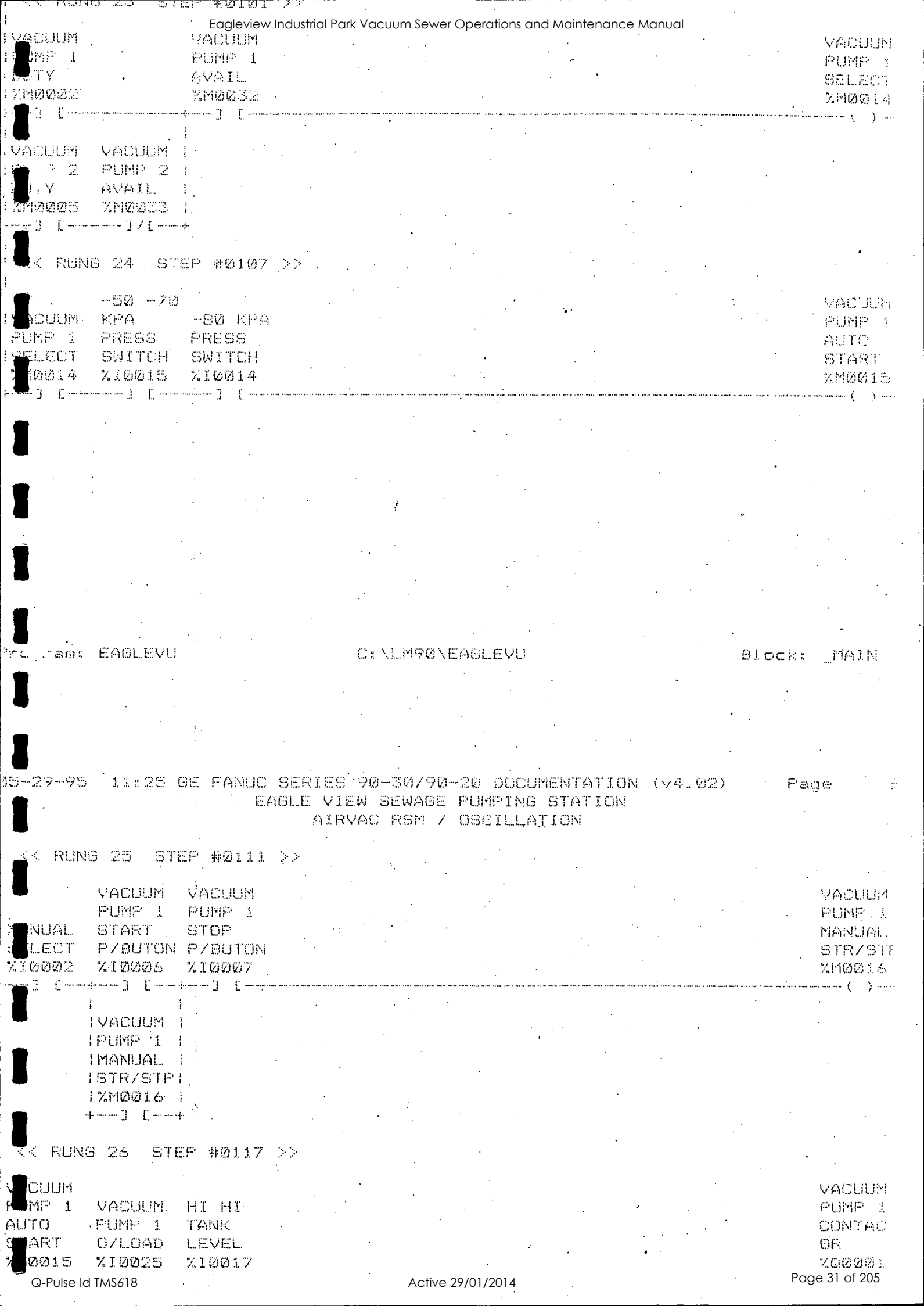
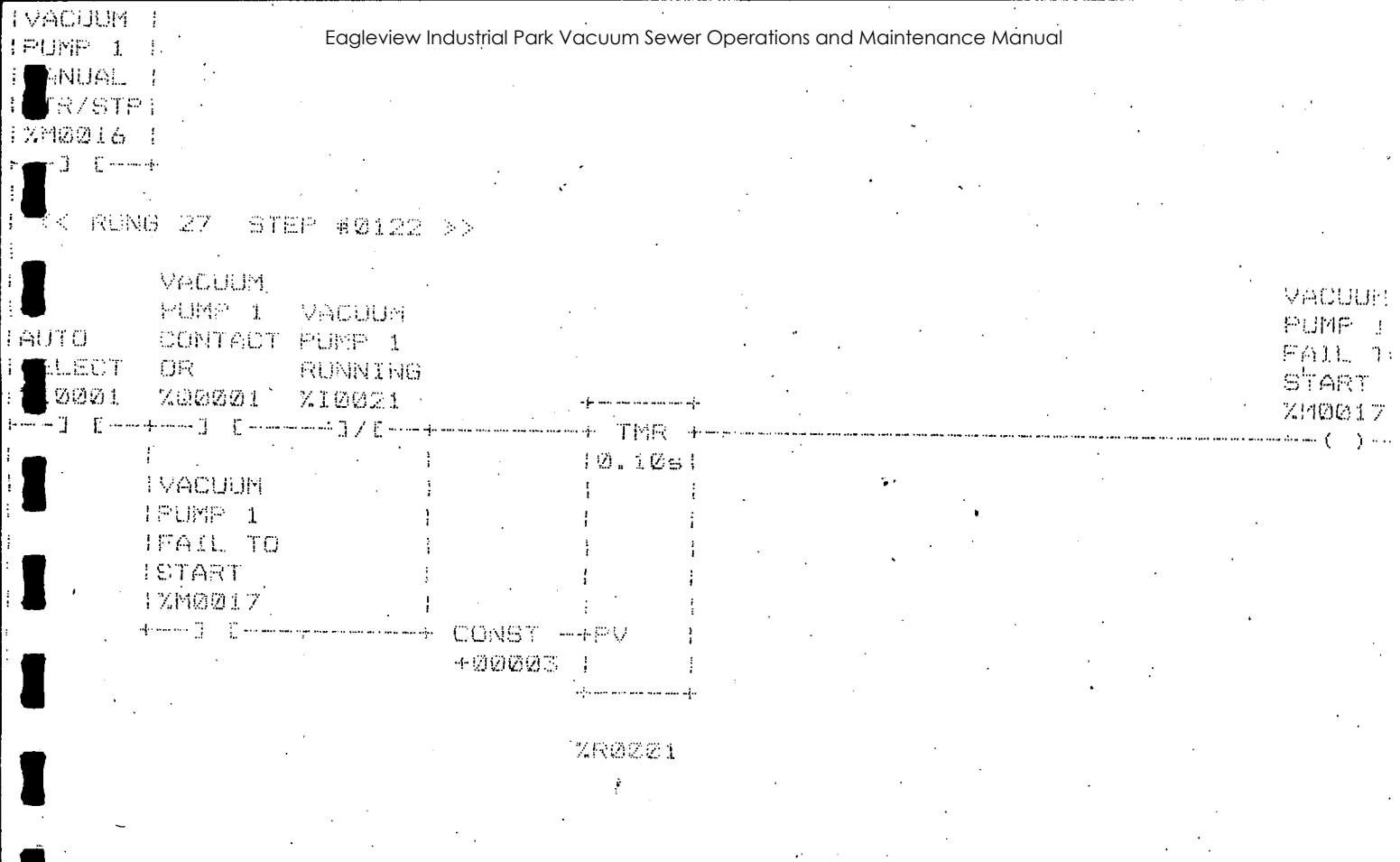
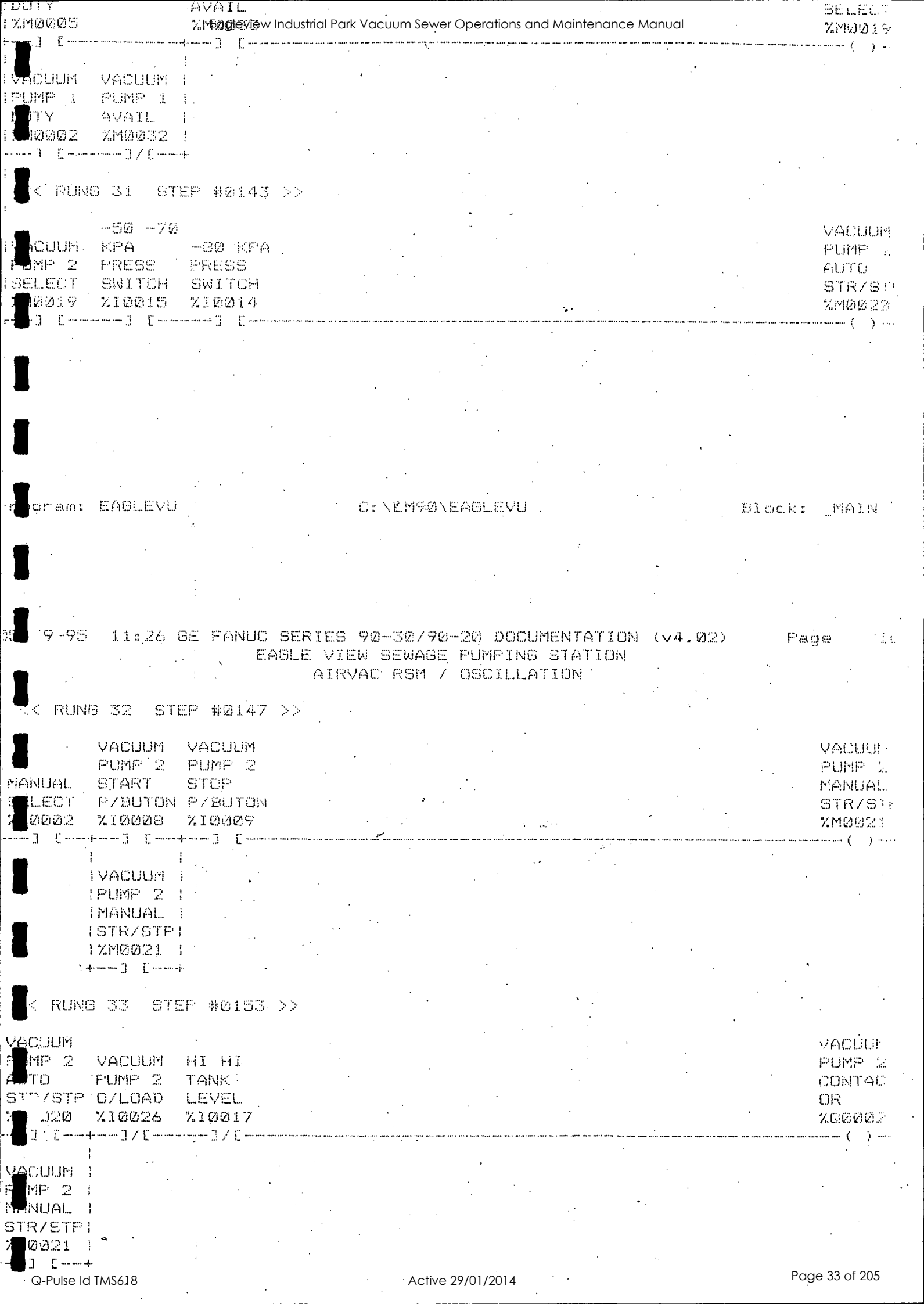
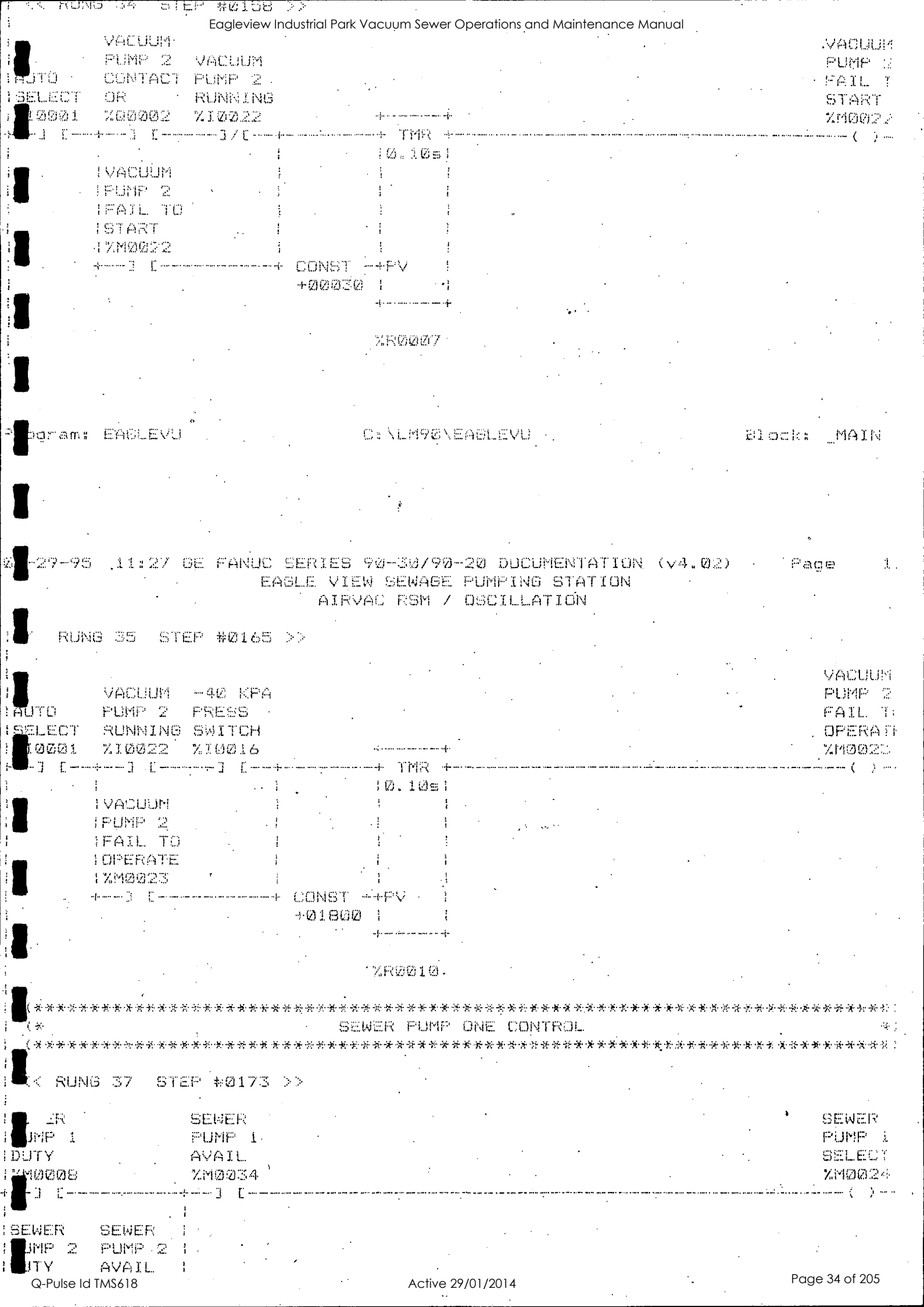


VACUUM PUMP 1 AVAIL %M0032
VACUUM PUMP 1 SELECT %M0014
VACUUM PUMP 2 AVAIL %M0033
<< RUNG 24 STEP #0107 >>
-50 -70 KPA PRESS SWITCH %I0015
-80 KPA PRESS SWITCH %I0014
VACUUM PUMP 1 AUTO START %M0015
Program: EAGLEVU C:\LM90\EAGLEVU Block: _MAIN
05-29-95 11:25 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.02) Page
EAGLE VIEW SEWAGE PUMPING STATION
AIRVAC RSM / OSCILLATION
<< RUNG 25 STEP #0111 >>
VACUUM PUMP 1 MANUAL SELECT %I0002
VACUUM PUMP 1 START P/BUTON %I0006
VACUUM PUMP 1 STOP P/BUTON %I0007
VACUUM PUMP 1 MANUAL STR/STP %M0016
<< RUNG 26 STEP #0117 >>
VACUUM PUMP 1 AUTO START %I0015
VACUUM PUMP 1 HI HI TANK LEVEL %I0017
VACUUM PUMP 1 CONTAC OR %Q0001


VACUUM
PUMP 1
MANUAL
STR/STP
%M0016
<< RUNG 27 STEP #0122 >>
VACUUM
PUMP 1 VACUUM
AUTO CONTACT PUMP 1
SELECT OR RUNNING
%I0001 %M0001 %I0021
TMR
0.10s
VACUUM
PUMP 1
FAIL TO
START
%M0017
CONST
+00003
%R0001
Program: EAGLEVU
C:\LM90\EAGLEVU
Block: _MAIN

VACUUM
PUMP 1
FAIL TO
OPERATE
%M0018
<< RUNG 28 STEP #0129 >>
VACUUM -40 KPA
AUTO PUMP 1 PRESS
SELECT RUNNING SWITCH
%M0001 %I0021 %I0016
TMR
0.10s
VACUUM
PUMP 1
FAIL TO
OPERATE
%M0018
CONST
+01800
%R0004
(* VACUUM PUMP TWO CONTROL *)
<< RUNG 30 STEP #0137 >>
VACUUM
VACUUM


DUTY AVAIL SELECT
%M0005 %M0032 %M0019
VACUUM VACUUM
PUMP 1 PUMP 1
DUTY AVAIL
%M0002 %M0032
< RUNG 31 STEP #0143 >>
-50 -70
VACUUM KPA -20 KPA VACUUM
PUMP 2 PRESS PRESS PUMP 2
SELECT SWITCH SWITCH AUTO
%M0019 %I0015 %I0014 STR/STP
%M0020
Program: EAGLEVU C:\EM90\EAGLEVU Block: _MAIN
9-95 11:26 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.02) Page
EAGLE VIEW SEWAGE PUMPING STATION
AIRVAC RSM / OSCILLATION
< RUNG 32 STEP #0147 >>
VACUUM VACUUM VACUUM
PUMP 2 PUMP 2 PUMP 2
MANUAL START STOP MANUAL
SELECT P/BUTON P/BUTON STR/STP
%M0002 %I0008 %I0009 %M0021
VACUUM
PUMP 2
MANUAL
STR/STP
%M0021
< RUNG 33 STEP #0153 >>
VACUUM VACUUM
PUMP 2 VACUUM HI HI PUMP 2
AUTO PUMP 2 TANK CONTAC
STR/STP D/LOAD LEVEL OR
%M0020 %I0026 %I0017 %Q0002
VACUUM
PUMP 2
MANUAL
STR/STP
%M0021


VACUUM
PUMP 2
AUTO
SELECT
%I0001
%I0002
%I0022
TMR
0.10s
CONST
+00030
PV
%R0007
Program: EAGLEVU
C:\LM90\EAGLEVU
Block: _MAIN
02-29-95 11:27 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.02)
Page 1
EAGLE VIEW SEWAGE PUMPING STATION
AIRVAC RSM / OSCILLATION
RUNG 35 STEP #0165
VACUUM
PUMP 2
-40 KPA
PRESS
RUNNING
SWITCH
%I0016
FAIL TO
OPERATE
%M0023
+01800
%R0010
SEWER PUMP ONE CONTROL
RUNG 37 STEP #0173
SEWER
PUMP 1
DUTY
AVAIL
%M0008
%M0034

Program: EAGLEVU C:\LM90\EAGLEVU Block: _MAIN

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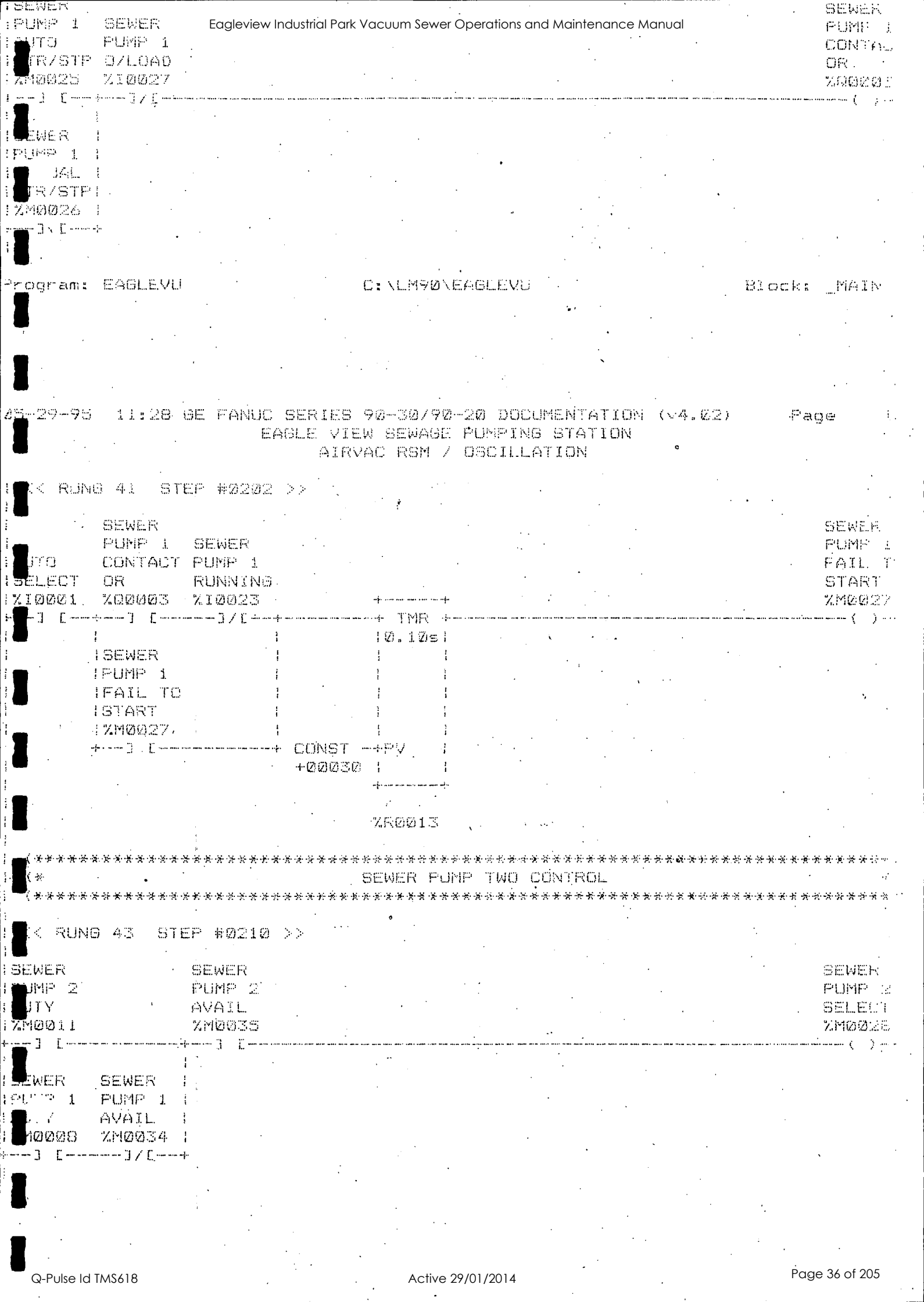
EAGLE VIEW SEWAGE PUMPING STATION
AIRVAC RSM / OSCILLATION

<< RUNG 38 STEP #0179 >>

<< RUNG 39 STEP #0192 >>

<< RUNG 40 STEP #0198 >>


SEWER
PUMP 1 SEWER
AUTO PUMP 1
STR/STP O/LOAD
%M0025 %I0027
SEWER
PUMP 1
JAL
TR/STP
%M0026
Program: EAGLEVU
C:\LM90\EAGLEVU
Block: _MAIN
05-29-95 11:28 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.02)
Page
EAGLE VIEW SEWAGE PUMPING STATION
AIRVAC RSM / OSCILLATION
<< RUNG 41 STEP #0202 >>
SEWER
PUMP 1 SEWER
AUTO CONTACT PUMP 1
SELECT OR RUNNING
%I0001 %Q0003 %I0023
TMR
0.10s
SEWER
PUMP 1
FAIL TO
START
%M0027
CONST
+00030
PV
%R0013
(*
SEWER PUMP TWO CONTROL
*)
<< RUNG 43 STEP #0210 >>
SEWER
PUMP 2
AUTY
%M0011
SEWER
PUMP 2
AVAIL
%M0035
SEWER
PUMP 1
AVAIL
%M0034

```
Program: EAGLEVU                    C:\LM90\EAGLEVU                    Block: _MAIN

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                    EAGLE VIEW SEWAGE PUMPING STATION
                        AIRVAC RSM / OSCILLATION

|  << RUNG 44  STEP #0216 >>
|
|                                                                          SEWER
|HIGH              SEWER    LO LO                                         PUMP 2
|TANK              PUMP 2   TANK                                          AUTO
|LEVEL             SELECT   LEVEL                                         STR/ST
|%I0018            %M0028   %I0020                                        %M0024
+--] [--------------+--] [--+--] [--+-------------------------------------( )--
|                   |        |        |
|         SEWER     |        |        |
|LOW      PUMP 2    |        |LOW     |
|TANK     AUTO      |        |TANK    |
|LEVEL    STR/STP   |        |LEVEL   |
|%I0019   %M0029    |        |%I0019  |
+--] [-------] [--+          +--] [---+
|                              |        |
|FI HI    SEWER                |HIGH    |
|TANK     PUMP 2               |TANK    |
|LEVEL    AVAIL.               |LEVEL   |
|I0017    %M0035               |%I0018  |
+--] [-------] [----------------+--] [---+
|
|  << RUNG 45  STEP #0229 >>
|
|         SEWER   SEWER                                                    SEWER
|         PUMP 2  PUMP 2                                                   PUMP 2
|MANUAL   START   STOP                                                     MANUAL
|SELECT   P/BUTON P/BUTON                                                  STR/S
|I0002    %I0012  %I0013                                                   %M0030
+--] [--+--] [--+--] [-------------------------------------------------------( )--
|       |        |
|       |SEWER   |
|       |PUMP 2  |
|       |MANUAL  |
|       |STR/STP |
|       |%M0030  |
|       +--] [--+
|
|   RUNG 46  STEP #0235 >>
|
|SEWER                                                                     SEWER
|PUMP 2   SEWER                                                            PUMP 2
|AUTO     PUMP 2                                                           CONTAC
|STR/STP  O/LOAD                                                           OR
|%M0029   %I0020                                                           %Q0004
+--] [--+--]/[-------------------------------------------------------------( )--
|       |
```

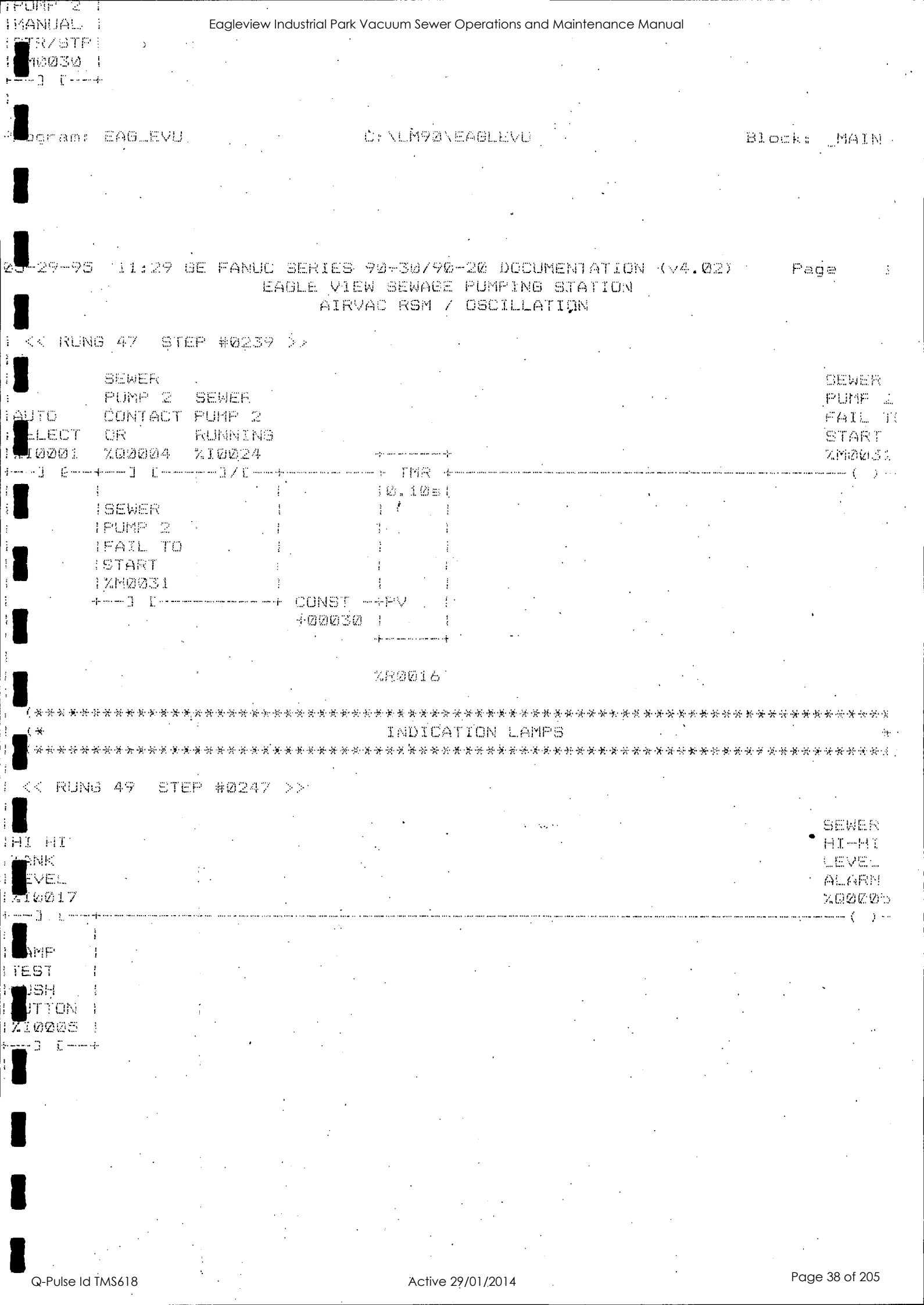
PUMP 2
MANUAL
STR/STP
M0030
Program: EAG_EVU
C:\LM90\EAGLEVU
Block: _MAIN
29-29-95 11:29 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.02)
Page
EAGLE VIEW SEWAGE PUMPING STATION
AIRVAC RSM / OSCILLATION
<< RUNG 47 STEP #0239 >>
SEWER
PUMP 2 SEWER
AUTO CONTACT PUMP 2
SELECT OR RUNNING
I0001 %Q0004 %I0024
SEWER
PUMP 2
FAIL TO
START
%M0031
TMR
0.10s
CONST
PV
+00030
%R0016
(* INDICATION LAMPS *)
<< RUNG 49 STEP #0247 >>
SEWER
HI-HI
LEVEL
ALARM
%Q0020
HI HI
TANK
LEVEL
%I0017
LAMP
TEST
PUSH
BUTTON
%I0005

```
Program: EAGLEVU                    C:\LM90\EAGLEVU                    Block: _MAIN

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                    EAGLE VIEW SEWAGE PUMPING STATION
                         AIRVAC RSM / OSCILLATION

<< RUNG 50  STEP #0250 >>

                                                                    VACUUM
0 KPA                                                               LOW
PRESS                                                               PRESS
SWITCH                                                              ALARM
 0014                                                               %Q0006
--]/[---+-------------------------------------------------------------( )--
        |
LAMP    |
TEST    |
PUSH    |
BUTTON  |
 0005   |
--]  [---+

<< RUNG 51  STEP #0253 >>

        VACUUM  VACUUM
VACUUM  PUMP 1  PUMP 1  SYSTEM                                      VACUUM
PUMP 1  FAIL TO FAIL TO AUTO.                                       PUMP 1
OVLOAD  START   OPERATE START                                       AVAIL.
 0025   %M0017  %M0018  %M0001                                      %M0032
--]/[-----]/[-----]/[-----]  [-------------------------------------------( )--

<< RUNG 52  STEP #0258 >>

                                                                    VACUUM
VACUUM                                                              PUMP 1
PUMP 1                                                              AVAIL
FAIL                                                                LAMP
%M0032                                                              %Q0007
--]  [---+-------------------------------------------------------------( )--
        |
LAMP    |
TEST    |
PUSH    |
BUTTON  |
%I0005  |
--]  [---+

<< RUNG 53  STEP #0261 >>

        VACUUM  VACUUM
VACUUM  PUMP 2  PUMP 2  SYSTEM                                      VACUUM
PUMP 2  FAIL TO FAIL TO AUTO                                        PUMP 2
OVLOAD  START   OPERATE START                                       AVAIL
 0026   %M0022  %M0023  %M0001                                      %M0033
--]/[-----]/[-----]/[-----]  [-------------------------------------------( )--
```

```
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                    EAGLE VIEW SEWAGE PUMPING STATION
                        AIRVAC RSM / OSCILLATION

<< RUNG 54  STEP #0266 >>

                                                                      VACUUM
ACUUM                                                                 PUMP 2
UMP 2                                                                 AVAIL
AVAIL                                                                 LAMP
M0033                                                                 %Q00006
-] [---+-------------------------------------------------------------------( )-
       |
AMP    |
EST    |
USH    |
UTTON  |
I0005  |
-] [---+

<< RUNG 55  STEP #0269 >>

       SEWER
EWER   PUMP 1  SYSTEM                                                 SEWER
UMP 1  FAIL TO AUTO                                                   PUMP 1
O/LOAD START   START                                                  AVAIL
%I0027 %M0027  %M0001                                                 %M0034
-]/[------]/[------] [-------------------------------------------------------( )-

<< RUNG 56  STEP #0273 >>

                                                                      SEWER
SEWER                                                                 PUMP 1
PUMP 1                                                                AVAIL
AIL                                                                   LAMP
M0034                                                                 %Q00007
---] [---+-------------------------------------------------------------------( )-
         |
AMP      |
TEST     |
USH      |
UTTON    |
%I0005   |
---] [---+

<< RUNG 57  STEP #0276 >>

       SEWER
EWER   PUMP 2  SYSTEM                                                 SEWER
PUMP 2 FAIL TO AUTO                                                   PUMP 1
O/LOAD START   START                                                  AVAIL
I0028  %M0031  %M0001                                                 %M0035
-]/[------]/[------] [-------------------------------------------------------( )-


Program: EAGLEVU              C:\LM90\EAGLEVU                  Block: _MAIN
```

EAGLE VIEW SEWAGE PUMPING STATION
AIRVAC RSM / OSCILLATION

```
|  << RUNG 58  STEP #0280 >>
|
|                                                                                    SEWER
|    IR                                                                              PUMP 1
|UMP 2                                                                               AVAIL
|AVAIL                                                                               LAMP
|%M0035                                                                              %Q0015
+--] [---+-------------------------------------------------------------------------------( )--
|        |
|LAMP    |
|TEST    |
|USH     |
|SUTTON  |
|%I0005  |
+--] [---+
|
|  << RUNG 59  STEP #0283 >>
|
|                                                                                    VACUUM
|VACUUM                                                                              PUMP 1
|PUMP 1                                                                              RUNNING
|RUNNING                                                                             LAMP
|%I0021                                                                              %Q0011
+--] [---+-------------------------------------------------------------------------------( )--
|        |
|LAMP    |
|TEST    |
|PUSH    |
|BUTTON  |
|%I0005  |
+--] [---+
|
|  << RUNG 60  STEP #0286 >>
|
|                                                                                    VACUUM
|VACUUM                                                                              PUMP 2
|PUMP 2                                                                              RUNNING
|RUNNING                                                                             LAMP
|%I0022                                                                              %Q0012
+--] [---+-------------------------------------------------------------------------------( )--
|        |
|LAMP    |
|TEST    |
|PUSH    |
|BUTTON  |
|%I0005  |
+--] [---+
```

Program: EAGLEVU C:\LM90\EAGLEVU Block: _MAIN

```
|[redacted]<< RUNG 61   STEP #0289 >>
|[redacted]
|                                                            SEWER
|SEWER                                                       PUMP
|[redacted]UMP 1                                             RUNNI
|[redacted]UNNING                                            LAMP
|%I0023                                                      %Q001
+[redacted]  [---+-------------------------------------------( )--
|[redacted]      |
|LAMP      |
|[redacted]EST      |
|[redacted]USH      |
|[redacted]UTTON |
|%I0005 |
+[redacted]--] [---+
|[redacted]
| << RUNG 62   STEP #0292 >>
|[redacted]
|                                                            SEWER
|SEWER                                                       PUMP 2
|PUMP 2                                                      RUNNIN
|[redacted]UNNING                                            LAMP
|[redacted]I0024                                             %Q0014
+---] [---+--------------------------------------------------( )-
|[redacted]        |
|[redacted]AMP      |
|TEST      |
|PUSH      |
|[redacted]UTTON |
|%I0005 |
+---] [---+
|[redacted]
|[redacted]  *****************************************************************
|  (*                         TELEMETRY                              *)
|[redacted](*****************************************************************)
|[redacted]
| << RUNG 64   STEP #0296 >>
|
|[redacted]ELEM                                                      TELEM
|[redacted]OWER                                                      POWER
|SITE                                                        SITE
|[redacted]AIL                                                       FAIL
|[redacted]Q0017                                                     %Q0017
+---] [---+--------------------------------------------------( )--
|        |
|[redacted]ELEM      |
|[redacted]OWER      |
|SITE      |
|[redacted]AIL      |
|[redacted]Q0017 |
+---]/[---+
|[redacted]

[redacted]ogram: EAGLEVU              C:\LM90\EAGLEVU              Block: _MAIN

[redacted]

0[redacted]-29-95  11:32 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.02)     Page    2
                 EAGLE VIEW SEWAGE PUMPING STATION
                     AIRVAC RSM / OSCILLATION

|[redacted]<< RUNG 65, STEP #0299 >>
```

```
!AUTO                                                                    TELEM
!SELECT                                                                  AUTO
!I0001                                                                   SELECT
+---] [-------------------------------------------------------------------%Q0015-
!
!<< RUNG 66  STEP #0301 >>
!
!                                                                        TELEM
!   HI                                                                   HI-HI
!TANK                                                                    LEVEL
!LEVEL                                                                   ALARM
!I0017                                                                   %Q00019
+---] [-------------------------------------------------------------------( )-
!
! << RUNG 67  STEP #0303 >>
!
!-30 KPA                                                                 TELEM
!PRESS                                                                   LO VAC
!SWITCH                                                                  ALARM
!I0014                                                                   %Q00020
+---]/[-------------------------------------------------------------------( )-
!
!<< RUNG 68  STEP #0305 >>
!
!         VACUUM  VACUUM                                                 TELEM
!VACUUM   PUMP 1  PUMP 1                                                 VACUUM
!PUMP 1   FAIL TO FAIL TO                                                PUMP 1
!O/LOAD   START   OPERATE                                                AVAIL
!%I0025  %M0017  %M0018                                                  %Q00021
+---]/[-------]/[-------]/[-------------------------------------------------( )-
!
! << RUNG 69  STEP #0309 >>
!
!         VACUUM  VACUUM                                                 TELEM
!VACUUM   PUMP 2  PUMP 2                                                 VACUUM
!PUMP 2   FAIL TO FAIL TO                                                PUMP 2
!O/LOAD   START   OPERATE                                                AVAIL
!%I0026  %M0022  %M0023                                                  %Q00022
+---]/[-------]/[-------]/[-------------------------------------------------( )-
!
!<< RUNG 70  STEP #0313 >>
!
!         SEWER                                                          TELEM
!SEWER    PUMP 1                                                         SEWER
!PUMP 1   FAIL TO                                                        PUMP 1
!O/LOAD   START                                                          AVAIL
!%I0027  %M0027                                                          %Q00023
+---]/[-------]/[-------------------------------------------------------------( )-
!
!
!
!Program: EAGLEVU                C:\LM90\EAGLEVU                  Block: _MAIN
!
!
!
!
!0-95  11:32 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.02)      Page    2
                    EAGLE VIEW SEWAGE PUMPING STATION
                        AIRVAC RSM / OSCILLATION
!
!<< RUNG 71  STEP #0316 >>
!
!         SEWER                                                          TELEM
!SEWER    PUMP 2                                                         SEWER
!PUMP 2   FAIL TO                                                        PUMP 2
```

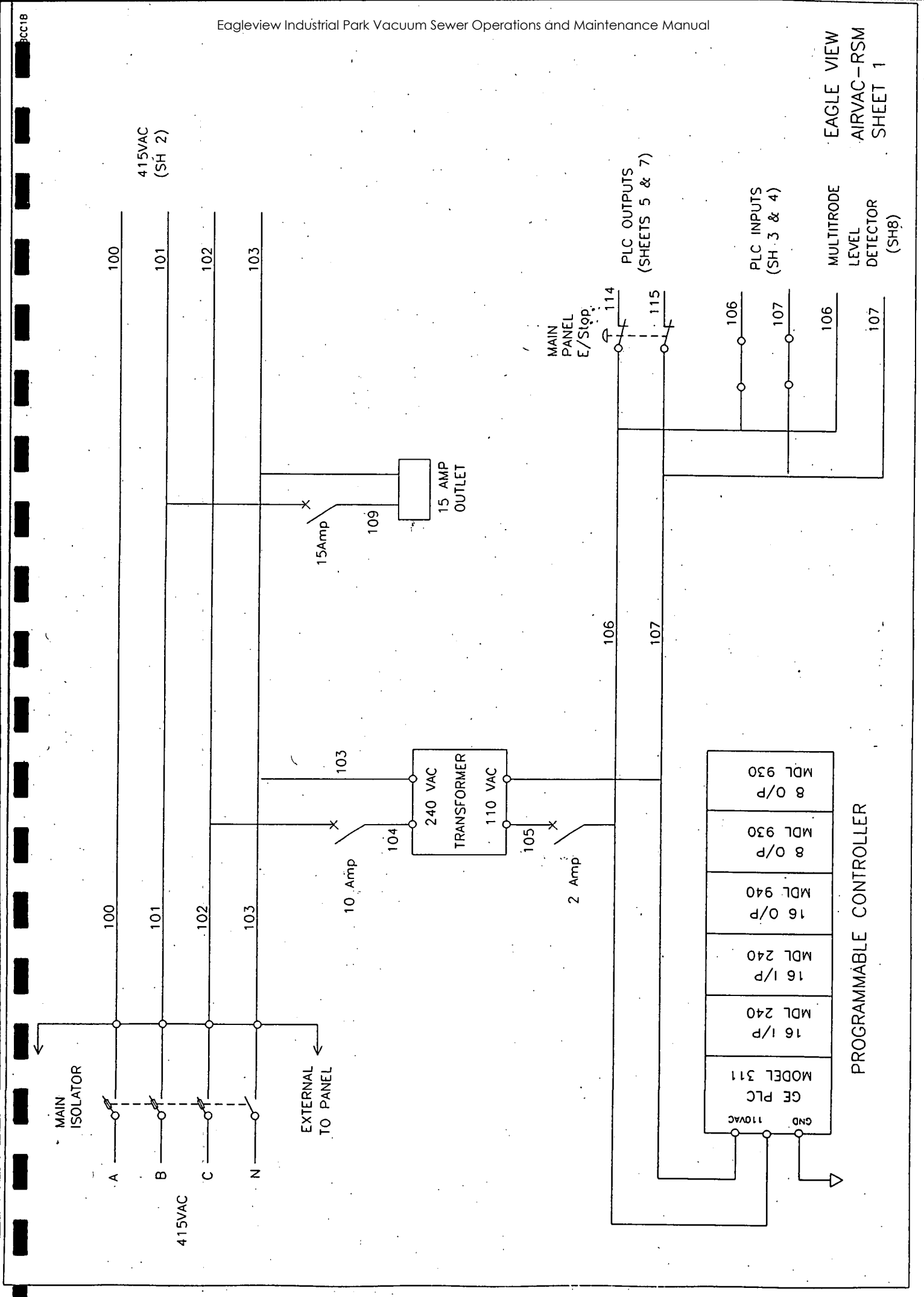
```
|%I0028  %M0031                                                          %Q0024
+---]/[-------]/[---------------------------------------------------------( )-
|
| << RUNG 72  STEP #0319 >>
|
|                                                                        TELEM
| ACUUM                                                                  VACUUM
| UMP 1                                                                  PUMP 1
|RUNNING                                                                 RUNNING
|  I0021                                                                 %Q0025
+---] [-------------------------------------------------------------------( )-
|
| << RUNG 73  STEP #0321 >>
|
|                                                                        TELEM
|VACUUM                                                                  VACUUM
| UMP 2                                                                  PUMP 2
| UNNING                                                                 RUNNIN
|%I0022                                                                  %Q0026
+---] [-------------------------------------------------------------------( )-
|
| << RUNG 74  STEP #0323 >>
|
|                                                                        TELEM
| EWER                                                                   SEWER
|PUMP 1                                                                  PUMP 1
| UNNING                                                                 RUNNIN
| I0023                                                                  %Q0027
+---] [-------------------------------------------------------------------( )-
|
| << RUNG 75  STEP #0325 >>
|
|                                                                        TELEM
| EWER                                                                   SEWER
|     2                                                                  PUMP 2
|RU NING                                                                 RUNNING
| I0024                                                                  %Q0028
+---] [-------------------------------------------------------------------( )-
|
|[      END OF PROGRAM LOGIC          ]
```

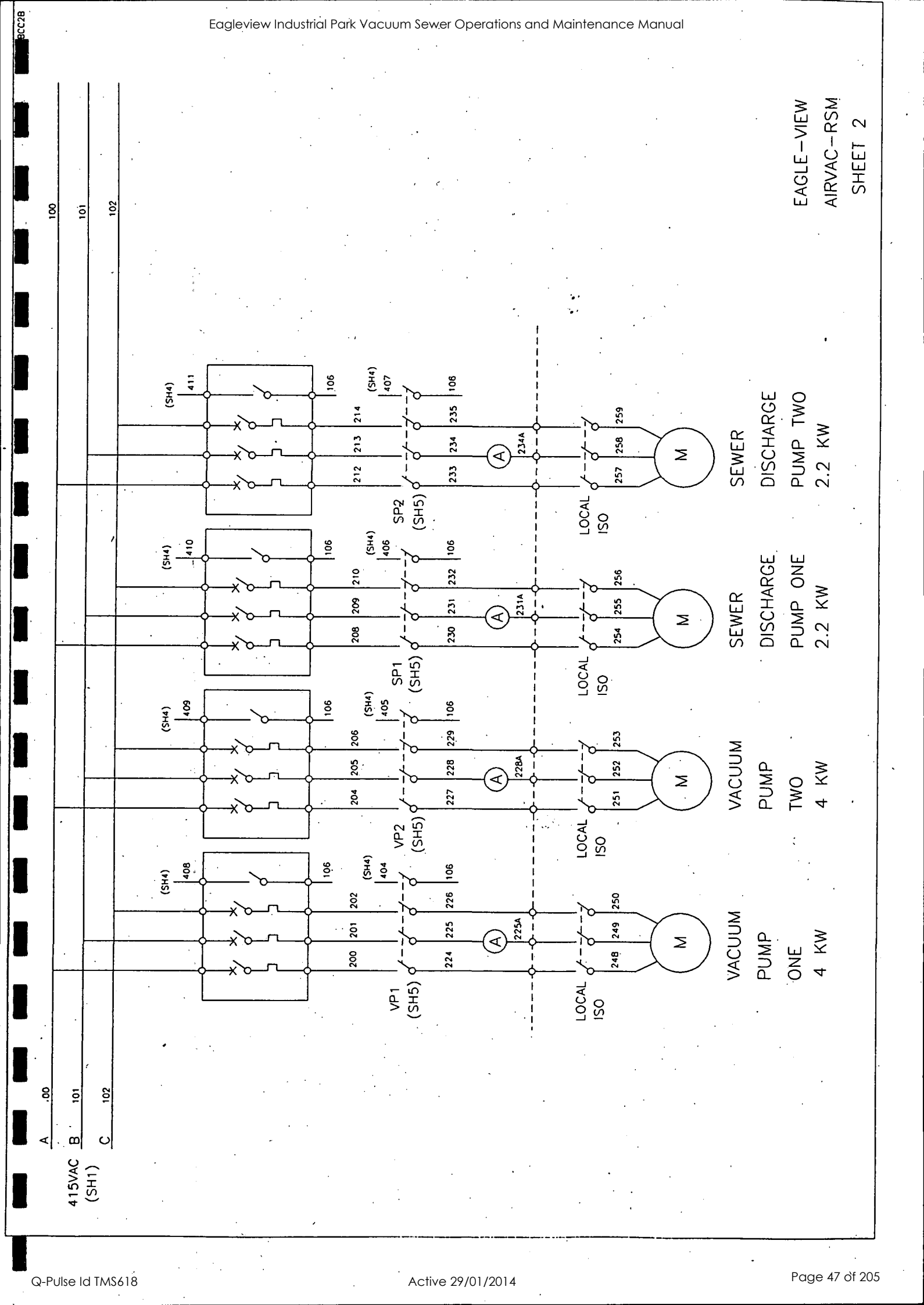
```
Program: EAGLEVU                C:\LM90\EAGLEVU                  Block: _MAIN
```

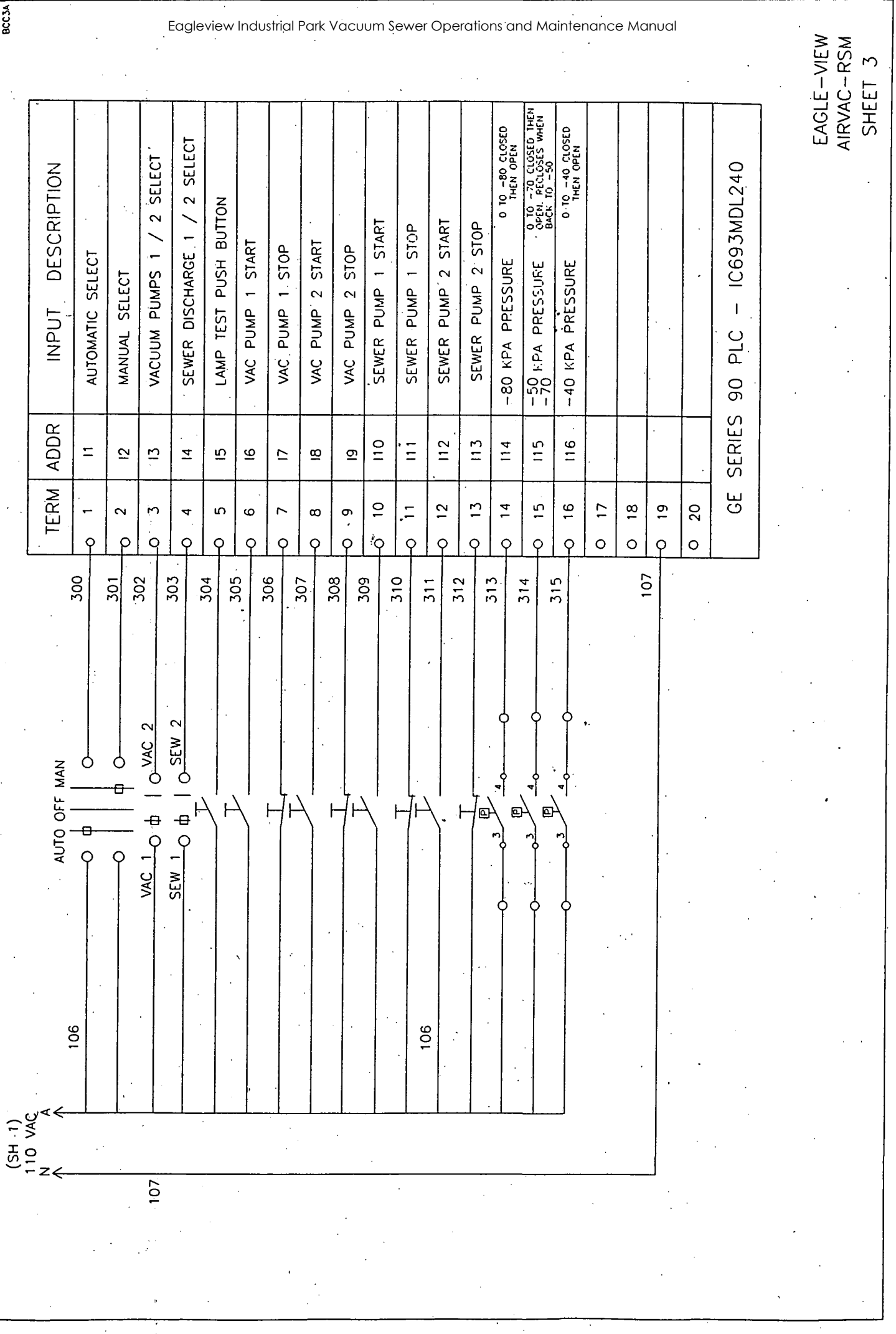
```
05-29-95  11:33 GE FANUC SERIES 90-30/90-20 DOCUMENTATION (v4.02) Contents
```

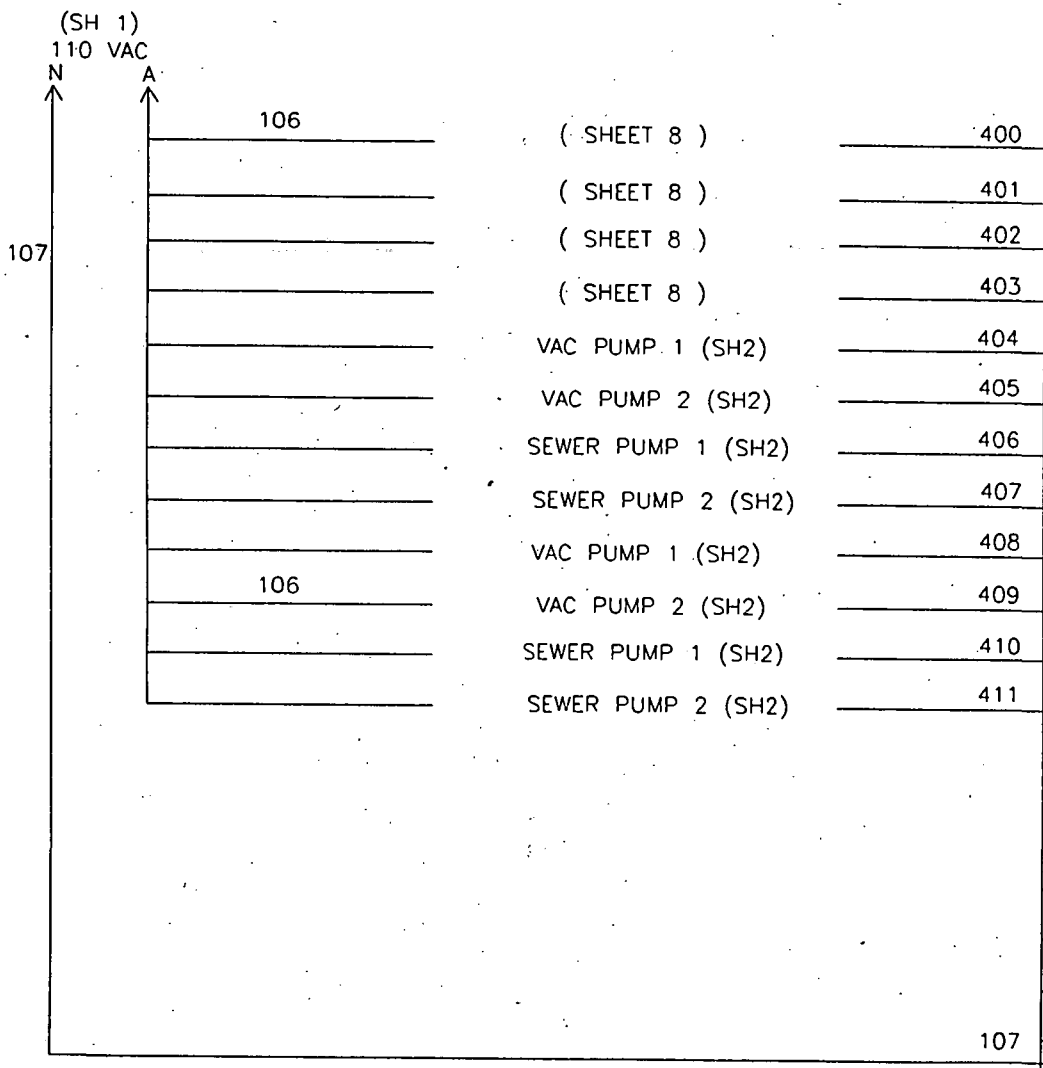
***** L O G I C T A B L E O F C O N T E N T S *****

Program: EAGLEVU C:\LM90\EAGLEVU TABLE OF CONTENTS


EAGLE VIEW
AIRVAC–RSM
SHEET 1
415VAC
(SH 2)
PLC OUTPUTS
(SHEETS 5 & 7)
PLC INPUTS
(SH 3 & 4)
MULTITRODE
LEVEL
DETECTOR
(SH8)
MAIN
PANEL
E/Stop
114
115
106
107
100
101
102
103
15 AMP
OUTLET
15Amp
109
240 VAC
TRANSFORMER
110 VAC
104
105
10 Amp
2 Amp
MAIN
ISOLATOR
A
B
C
N
415VAC
EXTERNAL
TO PANEL
PROGRAMMABLE CONTROLLER
GE PLC
MODEL 311
110VAC
GND
16 I/P
MDL 240
16 I/P
MDL 240
16 O/P
MDL 940
8 O/P
MDL 930
8 O/P
MDL 930


BCC2B
415VAC (SH1)
A 00
B 101
C 102
100
101
102
VP1 (SH5)
VP2 (SH5)
SP1 (SH5)
SP2 (SH5)
(SH4) 408
(SH4) 409
(SH4) 410
(SH4) 411
(SH4) 404
(SH4) 405
(SH4) 406
(SH4) 407
200 201 202
204 205 206
208 209 210
212 213 214
224 225 226
227 228 229
230 231 232
233 234 235
106
A
225A
228A
231A
234A
LOCAL ISO
248 249 250
251 252 253
254 255 256
257 258 259
M
VACUUM PUMP ONE 4 KW
VACUUM PUMP TWO 4 KW
SEWER DISCHARGE PUMP ONE 2.2 KW
SEWER DISCHARGE PUMP TWO 2.2 KW
EAGLE-VIEW
AIRVAC-RSM
SHEET 2


BCC3A
EAGLE-VIEW
AIRVAC-RSM
SHEET 3
(SH 1)
110 VAC
A
N
107
106
AUTO OFF MAN
VAC 1
SEW 1
VAC 2
SEW 2
300
301
302
303
304
305
306
307
308
309
310
311
312
313
314
315
107
TERM | ADDR | INPUT DESCRIPTION
1 | I1 | AUTOMATIC SELECT
2 | I2 | MANUAL SELECT
3 | I3 | VACUUM PUMPS 1 / 2 SELECT
4 | I4 | SEWER DISCHARGE 1 / 2 SELECT
5 | I5 | LAMP TEST 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 / -70 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



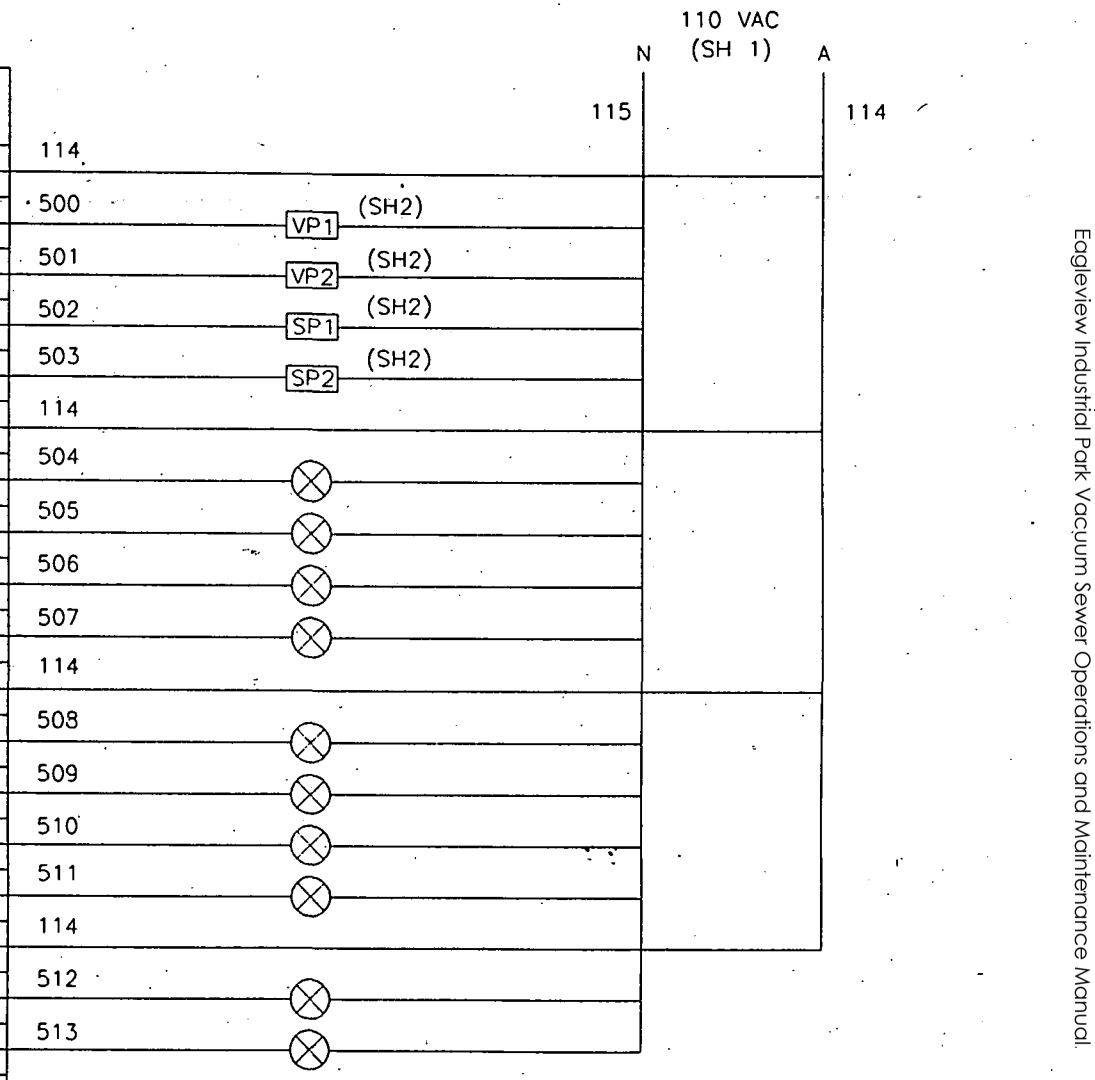
TERM	ADDR	INPUT DESCRIPTION
1	I17	HIGH HIGH TANK LEVEL CLOSED ABOVE LEVEL
2	I18	HIGH TANK LEVEL CLOSED ABOVE LEVEL
3	I19	LOW TANK LEVEL CLOSED ABOVE LEVEL
4	I20	LOW LOW TANK LEVEL CLOSED ABOVE LEVEL
5	I21	VAC PUMP 1 RUNNING
6	I22	VAC PUMP 2 RUNNING
7	I23	SEWER PUMP 1 RUNNING
8	I24	SEWER PUMP 2 RUNNING
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

EAGLE–VIEW
AIRVAC–RSM
SHEET 4

OUTPUT DESCRIPTION	ADDR	TERM
		1
VACUUM PUMP 1 CONTACTOR	Q1	2
VACUUM PUMP 2 CONTACTOR	Q2	3
SEWER PUMP 1 CONTACTOR	Q3	4
SEWER PUMP 2 CONTACTOR	Q4	5
		6
SEWERAGE HI HI LEVEL ALARM	Q5	7
VACUUM LOW PRESSURE ALARM	Q6	8
VACUUM PUMP 1 AVAILABLE	Q7	9
VACUUM PUMP 2 AVAILABLE	Q8	10
		11
SEWERAGE PUMP 1 AVAILABLE	Q9	12
SEWERAGE PUMP 2 AVAILABLE	Q10	13
VACUUM PUMP 1 RUNNING	Q11	14
VACUUM PUMP 2 RUNNING	Q12	15
		16
SEWERAGE PUMP 1 RUNNING	Q13	17
SEWERAGE PUMP 2 RUNNING	Q14	18
	Q15	19
	Q16	20

GE SERIES 90 PLC – IC693MDL940



EAGLE–VIEW
AIRVAC–RSM
SHEET 5

TELEMETRY INDICATION

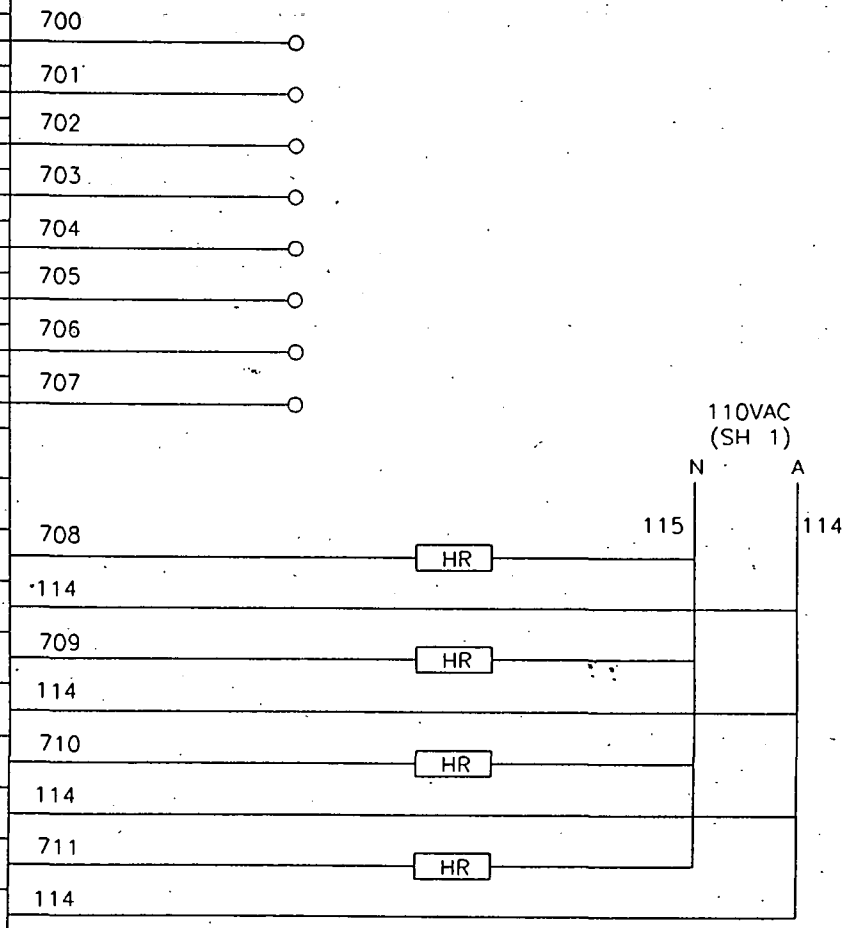
OUTPUT DESCRIPTION	ADDR	TERM	
		1	
SITE POWER FAIL	Q17	2	600
		3	601
AUTO/MANUAL SELECTION	Q18	4	602
		5	603
SEWERAGE HI HI LEVEL ALARM	Q19	6	604
		7	605
VACUUM LOW PRESURE ALARM	Q20	8	606
		9	607
		10	
		11	
VACUUM PUMP 1 AVAILABLE	Q21	12	608
		13	609
VACUUM PUMP 2 AVAILABLE	Q22	14	610
		15	611
SEWERAGE PUMP 1 AVAILABLE	Q23	16	612
		17	613
SEWERAGE PUMP 2 AVAILABLE	Q24	18	614
		19	615
		20	
GE SERIES 90 PLC – IC693MDL930			

EAGLE–VIEW
AIRVAC–RSM
SHEET 6

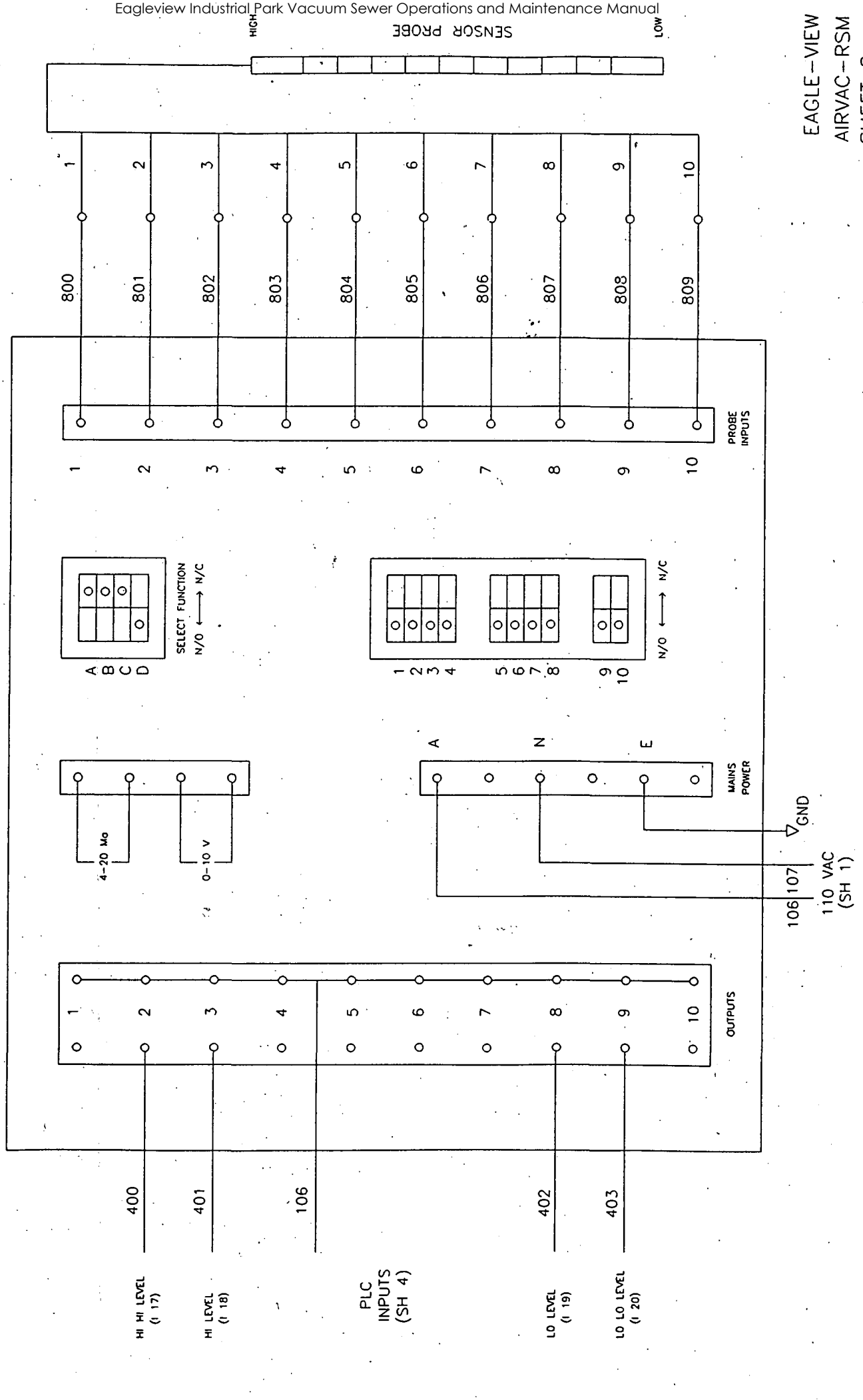
OUTPUT DESCRIPTION	ADDR	TERM
		1
VACUUM PUMP 1 STATUS	Q25	2
		3
VACUUM PUMP 2 STATUS	Q26	4
		5
SEWERAGE PUMP 1 STATUS	Q27	6
		7
SEWERAGE PUMP 2 STATUS	Q28	8
		9
		10
		11
VACUUM PUMP 1 HOUR RUN	Q29	12
		13
VACUUM PUMP 2 HOUR RUN	Q30	14
		15
SEWER PUMP 1 HOUR RUN	Q31	16
		17
SEWER PUMP 2 HOUR RUN	Q32	18
		19
		20

GE SERIES 90 PLC – IC693MDL930

TELEMETRY INDICATION



EAGLE–VIEW
AIRVAC–RSM
SHEET 7


EAGLE-VIEW
AIRVAC-RSM
SHEET 8
MULTI TRODE MTIC 10/10
SENSOR PROBE
HIGH
LOW
800
801
802
803
804
805
806
807
808
809
PROBE INPUTS
SELECT FUNCTION
N/O ⟷ N/C
A
B
C
D
4-20 Ma
0-10 V
MAINS POWER
A
N
E
GND
110 VAC (SH 1)
106
107
OUTPUTS
400
401
106
402
403
HI HI LEVEL (I 17)
HI LEVEL (I 18)
PLC INPUTS (SH 4)
LO LEVEL (I 19)
LO LO LEVEL (I 20)

SECTION 3

EAGLEVIEW INDUSTRIAL PARK VACUUM SEWERAGE SCHEME

AIRVAC VACUUM VALVES

3. AIRVAC VACUUM VALVES

3.1 DESCRIPTION

The AIRVAC vacuum sewer system has been in use under varied circumstances since 1970 during which time it has proven its ability in such applications as housing developments, schools, small towns and industrial plant.

The AIRVAC system relies on the use of vacuum for the transportation of sewage. Under most conditions, the vacuum pumps will maintain the collection tank and mains system at a negative pressure range of –50 to –70 kPa. Because of its pressure characteristics, the vacuum main may be approached in the same manner as the usual positive pressure force main. For example, installations may be made relatively independent of grade. The piping material used is HDPE Class 6 and the pipe diameters are (90, 110 and 160 mm). The AIRVAC valve separates the collection system, which is under constant vacuum from the house plumbing at atmospheric pressure. This valve is a pneumatically operated device and is designed so that it will not open unless there is a vacuum of approximately –16 kPa in the main and a pre-determined depth of sewage in the holding tank located beneath the valve.

When there is sufficient sewage in the tank and adequate vacuum in the main, the AIRVAC valve opens and the sewage is admitted to the main. This sewage flows through the vacuum main due to the pressure differential of atmosphere behind it and one half atmosphere on the downstream side. At –60 kPa vacuum the total lift available is approximately 6 meters of water column. Part of this lift must be used to overcome pipe friction and fitting losses. Another part must be allowed for the operation of the AIRVAC valve and the remainder may be used for vacuum lift. One and a half meter of water column is reserved to operate the AIRVAC valve thus four and a half metres is available for line losses and lift.

Sewage from the vacuum main is collected at the collection station in a steel tank maintained under vacuum by two vacuum pumps. From the collection tank the sewage is pumped via a Ø110mm rising main to the collecting manhole.

3.2 PRINCIPLES OF OPERATION

The AIRVAC 75mm valve is manufactured in ABS and is designed to operate when submerged in water. When correctly installed the AIRVAC valve is capable of handling flows of 2.5 L/s.

As a safety precaution to prevent 'waterlogging' or 'bog down' of the pipework system, the control circuits have been designed not to operate the AIRVAC valve unless 16 kPa vacuum is available in the vacuum main.

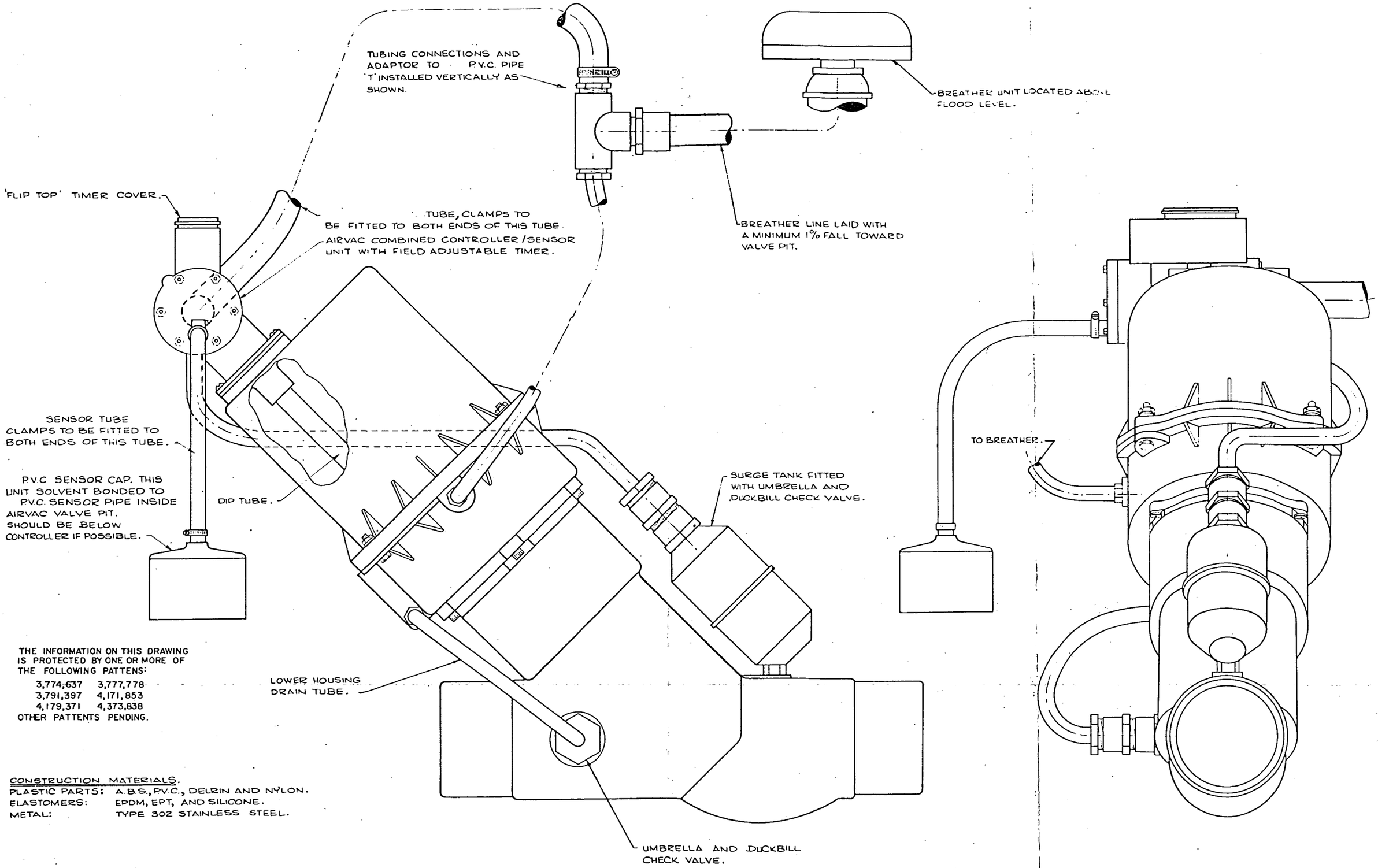
The principle components of the AIRVAC valves are the valve body, controller/sensor unit and surge tank. The valve is shown on Figure 2–1 75mm AIRVAC valve. The function of the various components are as follows:

3.3 CONTROLLER/SENSOR UNIT

The controller/sensor unit first senses the level of the sewage present in the holding tank. When the sewage level reaches a preset height, the sensor portion of the controller opens a two–way valve. This activates the second portion of the controller, the three–way valve.

When activated this valve takes a vacuum supply from the sewer and providing not less than 16 kPa vacuum is available, applies it to the upper piston operator. Evacuation of this operator pulls up the piston and opens the AIRVAC valve. As the valve opens the sewage is evacuated from the holding tank which relieves the sensor pressure. The timing circuit of the controller commences the timing to a preset valve cycle. When the cycle time has expired the three–way valve switches over to connect atmospheric pressure to the operator. The valve spring then starts the piston moving toward the closed position. At around half stroke, the vacuum of the sewer takes over and pulls the valve firmly closed. The valve and controller are now in standby position.

However, in some circumstances, a whole system or just a small portion of a system, is designed to operate at higher air/liquid ratios. The ability to field adjust the air/liquid ratio is a major attraction of the AIRVAC controller/sensor.



THE INFORMATION ON THIS DRAWING IS PROTECTED BY ONE OR MORE OF THE FOLLOWING PATTENS:

3,774,637 3,777,778
3,791,397 4,171,853
4,179,371 4,373,838
OTHER PATTENTS PENDING.

CONSTRUCTION MATERIALS.

PLASTIC PARTS:	A.B.S., P.V.C., DELRIN AND NYLON.
ELASTOMERS:	EPDM, EPT, AND SILICONE.
METAL:	TYPE 302 STAINLESS STEEL.

AIRVAC - RSM PTY LIMITED
Suite 11,
283 Penshurst Street,
Willoughby, N.S.W. 2068
Telephone: (02) 417 8133
Facsimilie: (02) 417 8162

75mm AIRVAC VALVE

FIGURE 2–1

3.4 VALVE CYCLE COUNTER

An AIRVAC valve operation cycle counter is available for fitting to the standard valve to permit the sewer owner to monitor the quantity of effluent passing though a particular valve. This counter is normally fitted to a valve for a short period only to monitor the number of cycles any one valve is achieving. It is not usually a permanent installation and hence only one or two such counters are normally required for a large system.

3.5 SURGE TANK

The surge tank (Figure 2–1) is fitted to the vacuum side of the AIRVAC 75mm valve. The controller vacuum supply is drawn through the surge tank. Fitted to the surge tank is a nylon check valve fitted with an umbrella and duckbill rubber check valve. The purpose of these checks and surge tanks is to absorb the small volume of high pressure water surge that occurs in the controller vacuum tube when the AIRVAC 75mm valve is on its air cycle.

3.6 FIELD ADJUSTMENT OF THE AIRVAC VALVE

3.6.1 Controller Timing

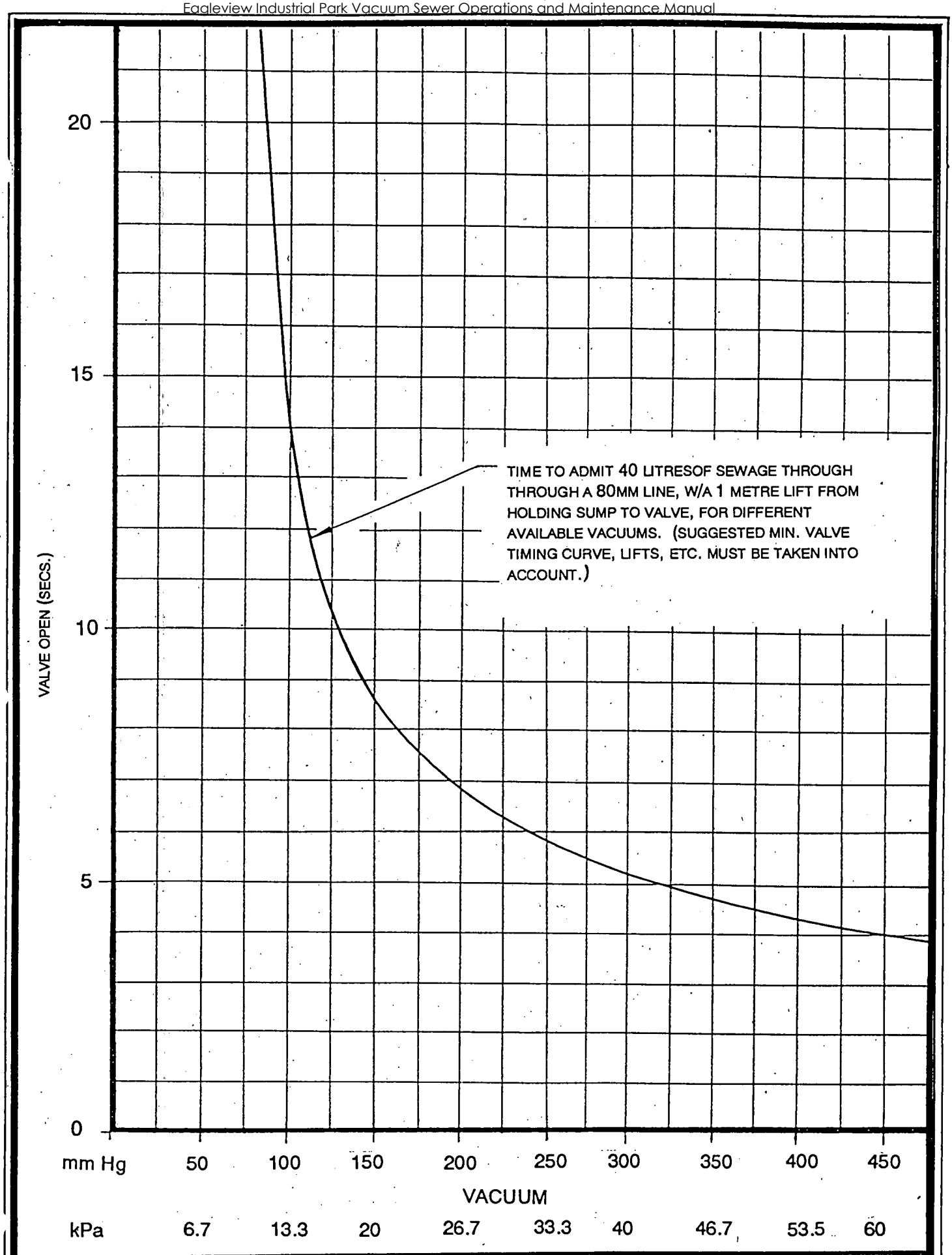
The AIRVAC vacuum main system is designed to operate at a nominal air to liquid ratio of approximately 6:1. The procedures given below are for that ratio. If different air to liquid ratios are required or any portion of the system a separate detailed instruction regarding timing the valve will be given by AIRVAC at the time of system start–up. Figures 2–2 Valve Timing give minimum recommended valve timing required for different vacuum levels.

3.6.2 Equipment Required

Small screwdriver (3mm wide blade), stop–watch and a vacuum gauge.

3.6.3 Procedure

Remove the side check valve hose and fit the vacuum gauge as shown in Figure 2–3. Check that the sewer vacuum is in excess of 16 kPa. Run water or sewage into the holding tank until the AIRVAC valve cycles. As the valve cycles, time the sewage flow through the valve, i.e. start stop–watch immediately when valve opens.



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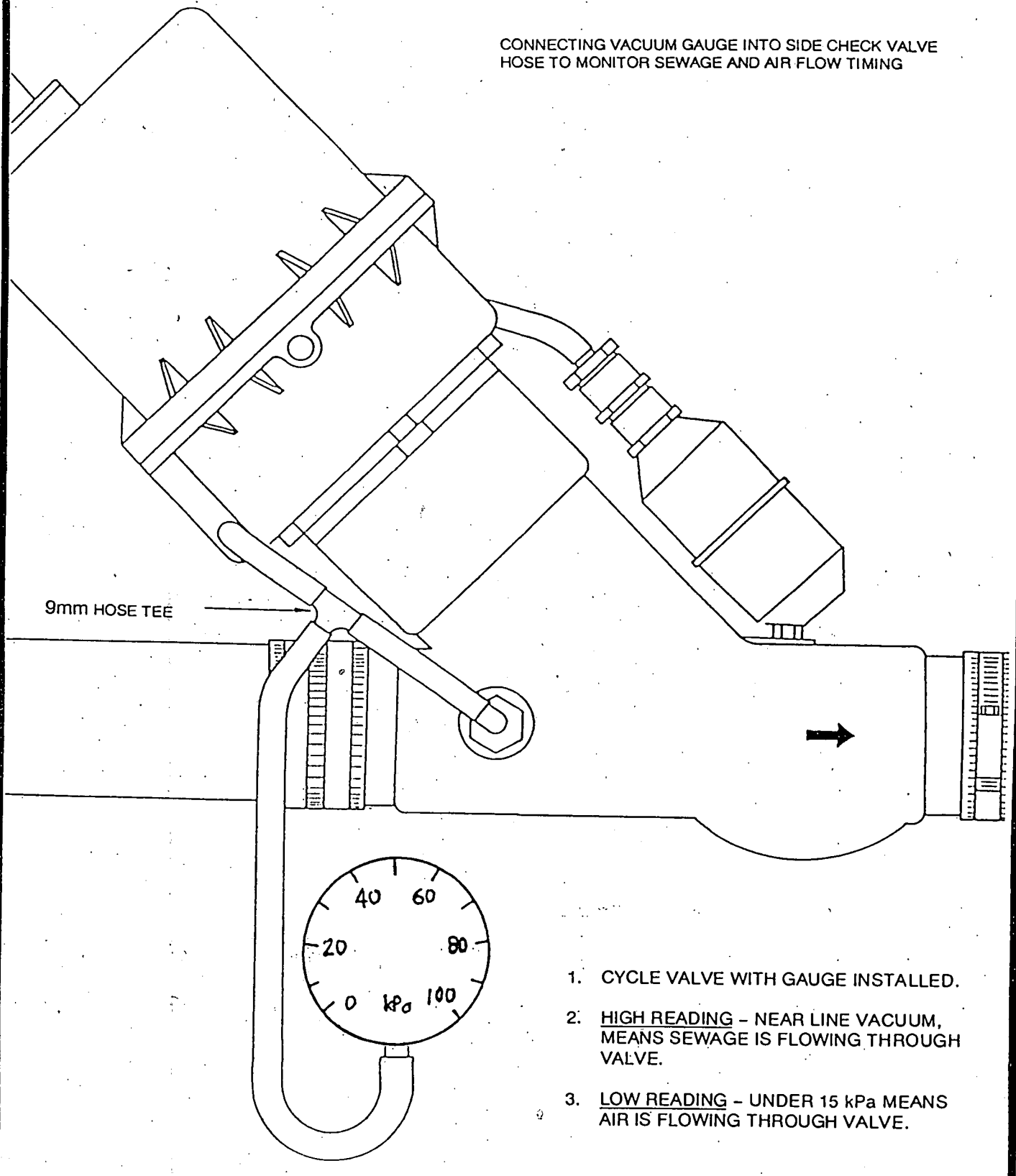
75mm VALVE TIMING

FIGURE 2-2

CONNECTING VACUUM GAUGE INTO SIDE CHECK VALVE
HOSE TO MONITOR SEWAGE AND AIR FLOW TIMING



1. CYCLE VALVE WITH GAUGE INSTALLED.
2. HIGH READING – NEAR LINE VACUUM, MEANS SEWAGE IS FLOWING THROUGH VALVE.
3. LOW READING – UNDER 15 kPa MEANS AIR IS FLOWING THROUGH VALVE.

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FIELD ADJUSTMENT

FIGURE 2-3

Watch the vacuum gauge carefully. When the AIRVAC valve cycle commences the gauge will show a vacuum reading. As the valve stops admitting sewage and starts on its air cycle the vacuum gauge will flicker to zero. This point is the end of the sewage cycle. Stop the stop-watch. Usually the sewage time will be 2 to 3 seconds. Run more water into the holding tank and using the stop-watch time a complete AIRVAC valve cycle.

The complete AIRVAC valve cycle time should be double the sewage entry time. For example, 2 seconds for sewage plus 2 seconds for air = 4 seconds open time. If this is not so, re-adjust the controller timing as follows:

Remove the timer cover. The timer valve pin is now exposed. To INCREASE valve timing, turn the centre screw a small amount clockwise or inward. To DECREASE the valve timing turn the centre screw a small amount counter-clockwise or outward. Continue to cycle the AIRVAC valve check and adjust timing until satisfactory.

REMEMBER: If at any time a replacement or repaired controller is fitted to an AIRVAC valve, check and adjust the time cycle.

Remove vacuum gauge and re-connect hose to side check valve. Refit timer cover.

NOTE: Once an operator has developed his skill, the stop-watch will not be necessary. Simply count the seconds by saying 1001, 1002, 1003, etc.

3.6.4 Sensor Setting

The sensor setting of the AIRVAC controller/sensor unit is not adjustable and should be returned to AIRVAC for checking.

If there is real doubt about the performance of a controller/sensor a spare unit can be substituted and the operation level/timing compared. If this indicates a faulty controller/sensor AIRVAC should be consulted and the unit may require servicing.

3.7 INSTALLATION AND COMMISSIONING

3.7.1 Vacuum Sewers

The vacuum sewage collection system drawings include profiles, branch connections, location of division valves, crossovers (the connections from the sewer main to the AIRVAC valve) installation of the AIRVAC valve and valve pits.

Incorrect sewer installation and incorrect connections from the sewers to the AIRVAC valves will result in system malfunction and increase operation and maintenance costs.

Wye connections installed other than vertical to the main will cause flooding of the connection or branch sewer. A correctly installed AIRVAC system will require little maintenance.

3.7.2 Valve Pit

All seams in pit and pipe entrance holes must be tightly sealed to prevent ingress of ground water.

It is important that a sump be formed in the bottom of the buffer tank that has approximately 40 L capacity at a 300mm liquid height. Larger capacities may cause valve malfunction.

The 80mm suction elbow should be placed touching the base of sump and firmly anchored with at least two brackets to the side of the pit.

The 50mm sensor line should be 100 to 150mm from base of sump and firmly anchored to the pit.

Assemble 50mm sensor line using a section of 50mm pipe, chamfer both ends of pipe, install the 50mm AIRVAC sensor cap on one end. See Figure 2-7. Sensor line must be leak tested.

Cap the open end of pipe using no-hub clamp and plug made from a short piece of pipe with a cap glued on. Connect a 9mm hose to the sensor cap, apply air pressure, pinch off hose and connect to a 0-13 kPa magnehelic gauge. Test at 9.8 kPa. There should be zero leakage.

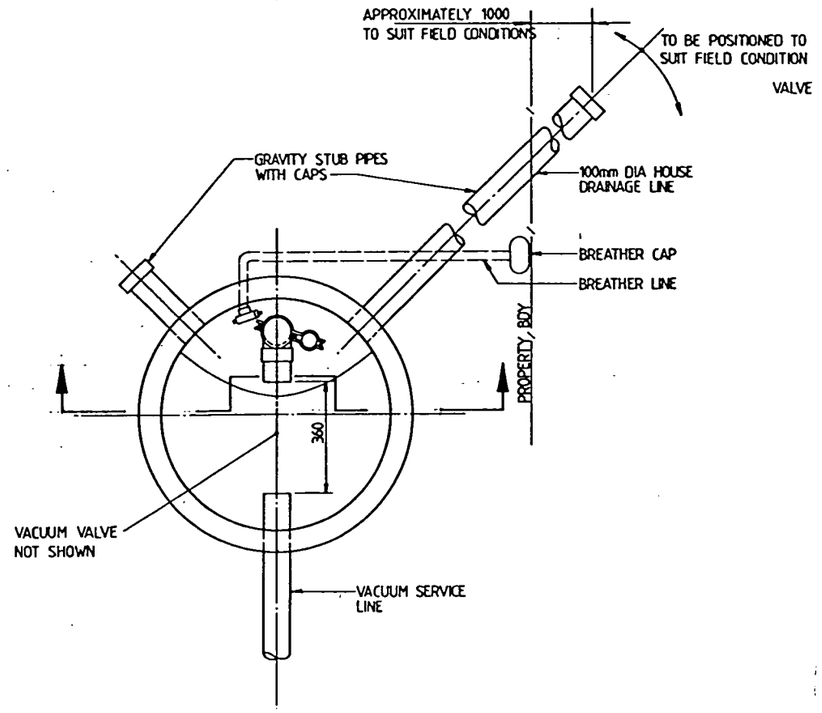
Gravity line stubs should have PVC caps glued in place outside the pit.

After pit installation, cap the 80mm PVC house service vacuum line to allow testing of the complete sewer.

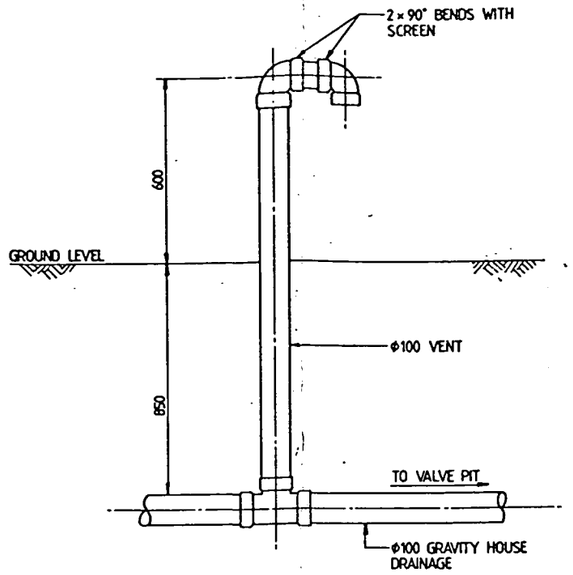
The valve pit shall be hydrostatically tested for infiltration or exfiltration at this time. Method of testing depends upon ground conditions during testing period.

Leakage must be repaired before proceeding.

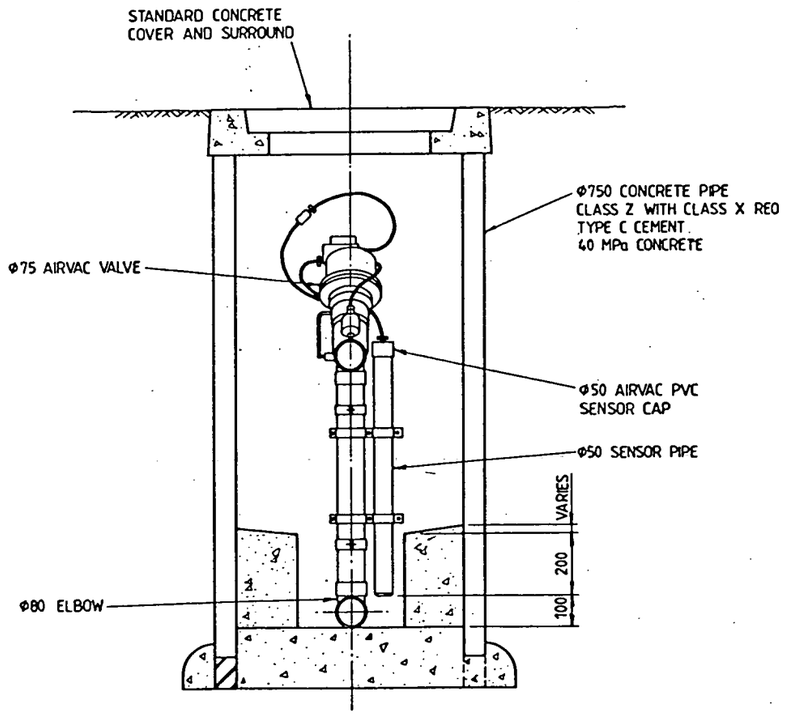
Install the AIRVAC breather unit as shown on the engineers drawings. For the standard outside breather, it is important that the breather line be laid with a slight fall towards the AIRVAC valve and be leak tested. See Figure 2-8.

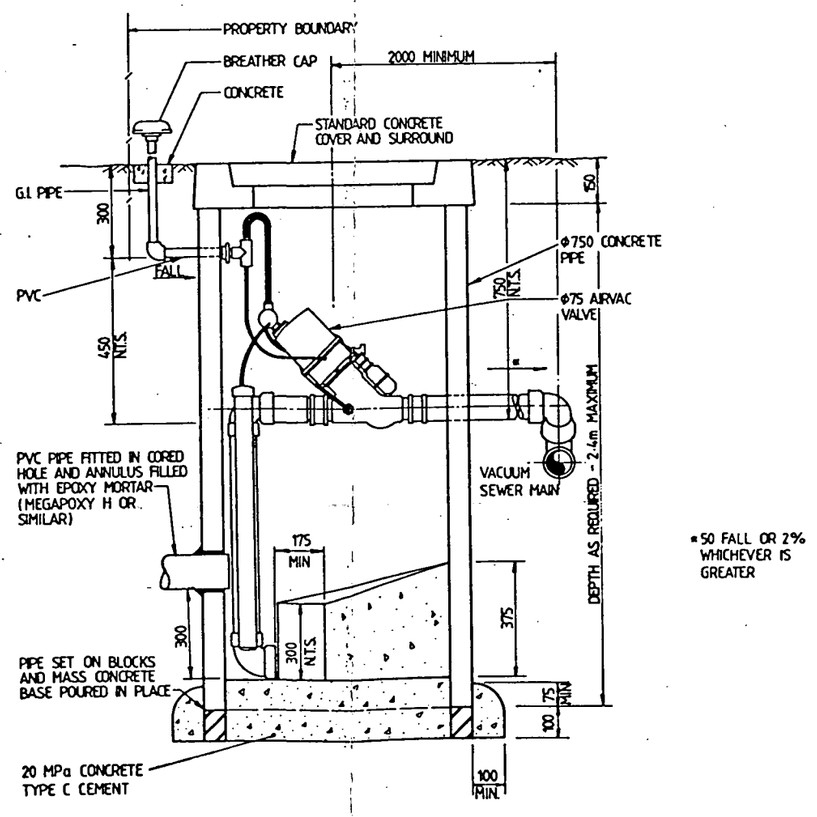


PLAN



VENT ON HOUSE DRAINAGE LINE
(BY HOME OWNER)





*50 FALL OR 2%
WHICHEVER IS
GREATER

SINGLE VALVE PIT

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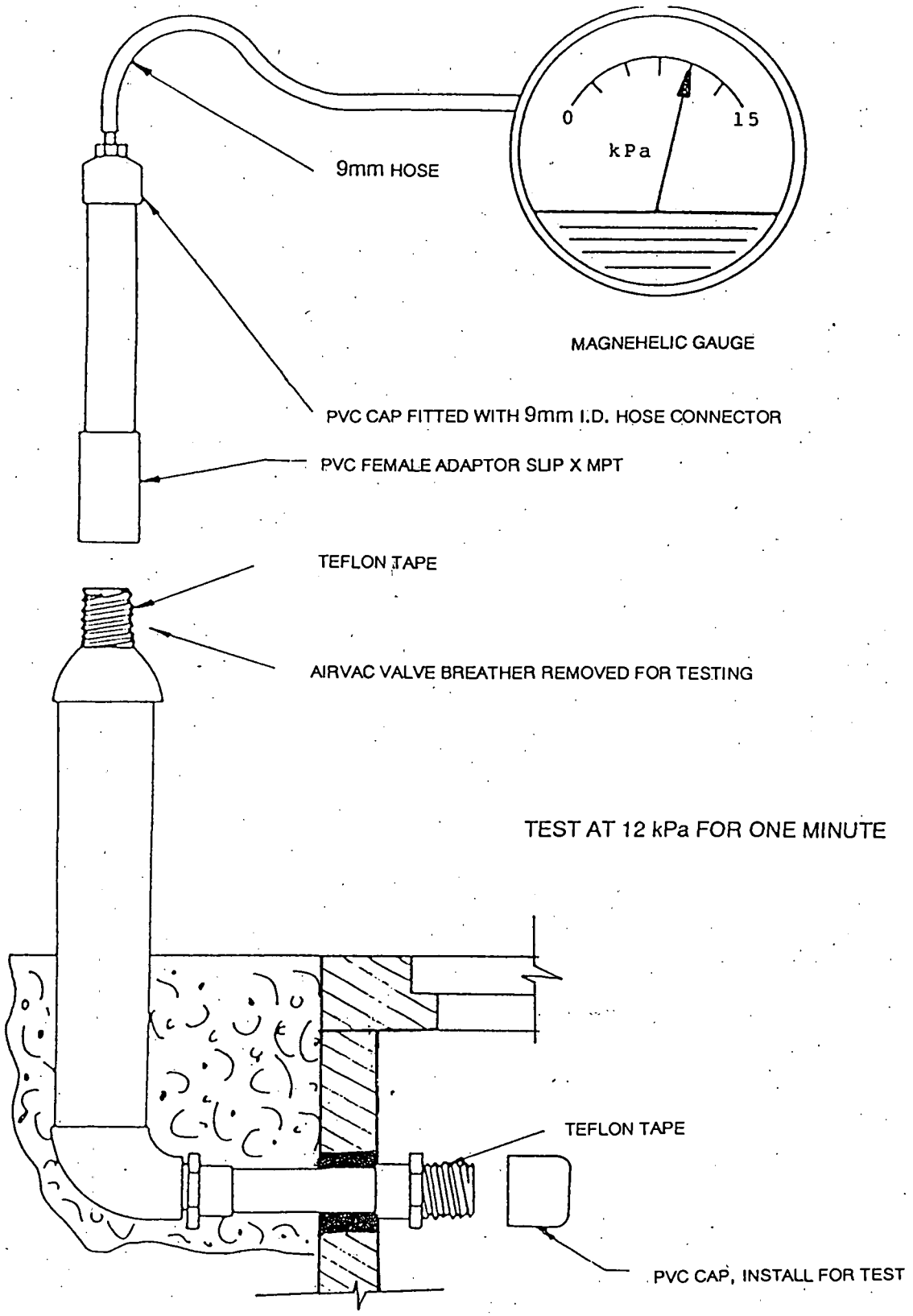
VALVE PIT

FIGURE 2-7



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BREATHER LINE TESTING

FIGURE 2-8

Fabricate a test pipe out of a short length of 20mm PVC pipe, one end fitted with a screwed male adaptor, the other with a cap to which 9mm tube adaptor is fitted.

Remove breather dome, Teflon tape the 20mm male fitting and fit the test pipe. Teflon tape the 12mm male connection in the pit and cap. Blow air by mouth or hand pump into 9mm tubing connected to test pipe, pinch tube to contain air and fit to HIGH port of 0–13 kPa magnehelic gauge, release pinched tube and test at 9.8 kPa for one minute. If pressure is constant, breather line is satisfactory. Should the gauge pressure drop more than 0.25 kPa per minute, remake joints and retest.

Installation is now ready for vacuum testing. After successful vacuum testing the final process is the installation of the AIRVAC valve.

3.7.3 AIRVAC Vacuum Valve

Remove cover.

Increase the cut out in the Ø80mm line to a total of 365mm.

After cut out is made trim and debur the cut ends with a file or sandpaper.

Slide no–hub soil clamp onto both ends of valve. Carefully roll the diaphragms back atop themselves providing ample room to insert the AIRVAC valve.

Slide stainless steel clamps of No–Hubs onto vacuum sewer and suction line.

Install the vacuum side of the AIRVAC valve so that the rolled diaphragm seats against the vacuum sewer. Unroll diaphragm.

Align the opposite end of the valve with rolled diaphragm to the suction line. Unroll diaphragm.

Check both No–Hubs for proper fit. Check that index in No–Hub diaphragms are seated between pipe and valve, otherwise a leak will form when tightening clamps. The AIRVAC valve must be positioned in a vertical position.

Slide stainless steel clamp portions of No–Hubs over the diaphragms with securing bolts in vertical position and equally tighten clamps until snug. Be sure smooth portion of the corrugated band slides inside the other end of the band. Using a "T" handle torque wrench, tighten both No–Hub clamps. Torque should not exceed 0.693 kg.m or 60 in.lb.

Connect 9mm tube with clamps from sensor cap to controller sensor port. Tighten the clamps on both of these connections. Sensor surge suppressor will not be required.
Blow out breather line to remove any dirt or liquid. Cap and pressure test breather as previously described. Install breather "T" on breather line sealing with teflon tape. "T" must be nearly vertical with 16mm connection turned up.

Connect a piece of 9mm hose from lower connection on "T" to lower housing centre port.

Connect 16mm tube with clamps from "T" to the controller air port. Tighten clamps at both of these connections.

If the AIRVAC valve installation is being made to an operating sewer system, the controller timing should be set at this stage. The controller sensor setting should be 1 – 1.5 kPa and is not adjustable. It should be checked however to ensure proper operation.

3.7.4 Crossovers

A cross-over is defined as the connection from the AIRVAC valve to the vacuum sewer main. It is important that crossovers are installed with the wye connection at the main in the vertical position. The Ø80mm PVC or Ø90 HDPE cross-over shall be laid with a fall of not less than 0.2% or 50mm, whichever is greater, towards the vacuum main. The recommended method of connection of the cross-over to the vertical wye fitting is through a long radius elbow.

3.8 PREVENTATIVE MAINTENANCE

3.8.1 AIRVAC 75mm Valve

Maintenance products required:

The following products are required during valve disassembly and cleaning or replacement of the component to which the product is applied.

For application to valve shafts to lubricate shaft seal and bearings:
Dow Corning #111 compound silicone lubricant.

THIS SHOULD NEVER BE USED IN AN AIRVAC CONTROLLER as it will damage the controller shaft seals. This may also be applied to the screw plug thread and o-ring for easier threading into the wye body.

For application to valve rolling diaphragms:
Dow Corning #200 silicone fluid, 350 centistokes viscosity. The diaphragm must be fully cleaned by soap and water then dried. Apply a thin coat of oil by hand to the entire surface of the diaphragm.

For assembly of check valve components or rubbing connections:

Leaklock thread sealant. Available in jars with brush applicator.
This is a blue thread sealant which should be re-applied if unit was originally assembled using this. It is a hard setting thread sealant which will seal leak paths yet allow disassembly. The product may be dissolved with isopropyl alcohol.

For application AIRVAC controller shafts:

Dow Corning Molykote #FS-3451, No. 2 consistency
Fluorosilicone grease. Cat No. 47633-16.

Just a very small amount of this is required during controller overhaul so a tube lasts a very long time. This grease may be used on valve shafts if the other grease is not available. Refer to controller maintenance section for proper application procedure.

Any other products required are locally available such as teflon thread seal tape.

3.8.1.1 Yearly Maintenance

No actual valve maintenance is required on a yearly basis. The valve installation and its operation should be inspected once a year as a trouble-shooting procedure. Check for dirt or water in controller, valve or tubes. Clear above ground vent screens of spider webs etc. Screens may require replacement. Cycle the valve preferably by running water and monitor the operation. Check valve timing and adjust if necessary.

3.8.1.2 75mm AIRVAC Valve Disassembly and Rebuilding

Routine maintenance of the valve is normally handled by an AIRVAC trained operator. However in this system with only 6 or 7 valves we expect it will be more expedient to substitute a valve known to be in good order and forward the valve in question to us for service. The following instructions 3.8.1.2 through 3.8.2.1 however describe the maintenance procedures should you elect to service the valves yourselves. For average flow values less than 1 L/s the valve should be removed and inspected for wear every 10 years.

The valve should be replaced and returned to the workshop. Rebuilding typically required ½ hour to perform and involves replacing the valve seat (AVD-R-O) shaft seal (AVD-S-83) and bearing (AVD3-12B). Check valve rubber components should also be replaced (UCV, DD-83 and RW-83).

For average flow valves greater than 1 L/s the valve should be re-built every four years or 500,000 cycles.

In the workshop wash the valve, remove all tubing, controller, surge tank and side check valve. Apply vacuum to the upper housing to open the valve. Place vinyl caps to the two 9mm hose connections on the lower housing. Disconnect the vacuum from the upper housing. The valve will now remain open. Unscrew complete operator from wye body. Remove vinyl caps from lower housing.

NOTE: If the valve is unscrewed with the piston in the closed position, the rolling diaphragm may become twisted causing the valve to malfunction when it is reassembled.

Inspect the wye fitting for hard water scale build-up. If scale is present soak whole fitting in 15% muriatic acid solution for 10-15 minutes. Rinse thoroughly with water. Check to see that all scale is removed. Repeat acid soaking if necessary.

CAUTION: OBSERVE THE CORRECT SAFETY PRECAUTIONS WHEN USING MURIATIC ACID.

Remove the four nuts, bolts and lock-washers (Items 3, 4, 11 & 34) of Figure 2-9 and remove the upper housing. Remove the diaphragm cup and piston plate (Items 6, 7 & 8). Pull the shaft and plunger out downward through the screw plug (Item 16) and set aside.

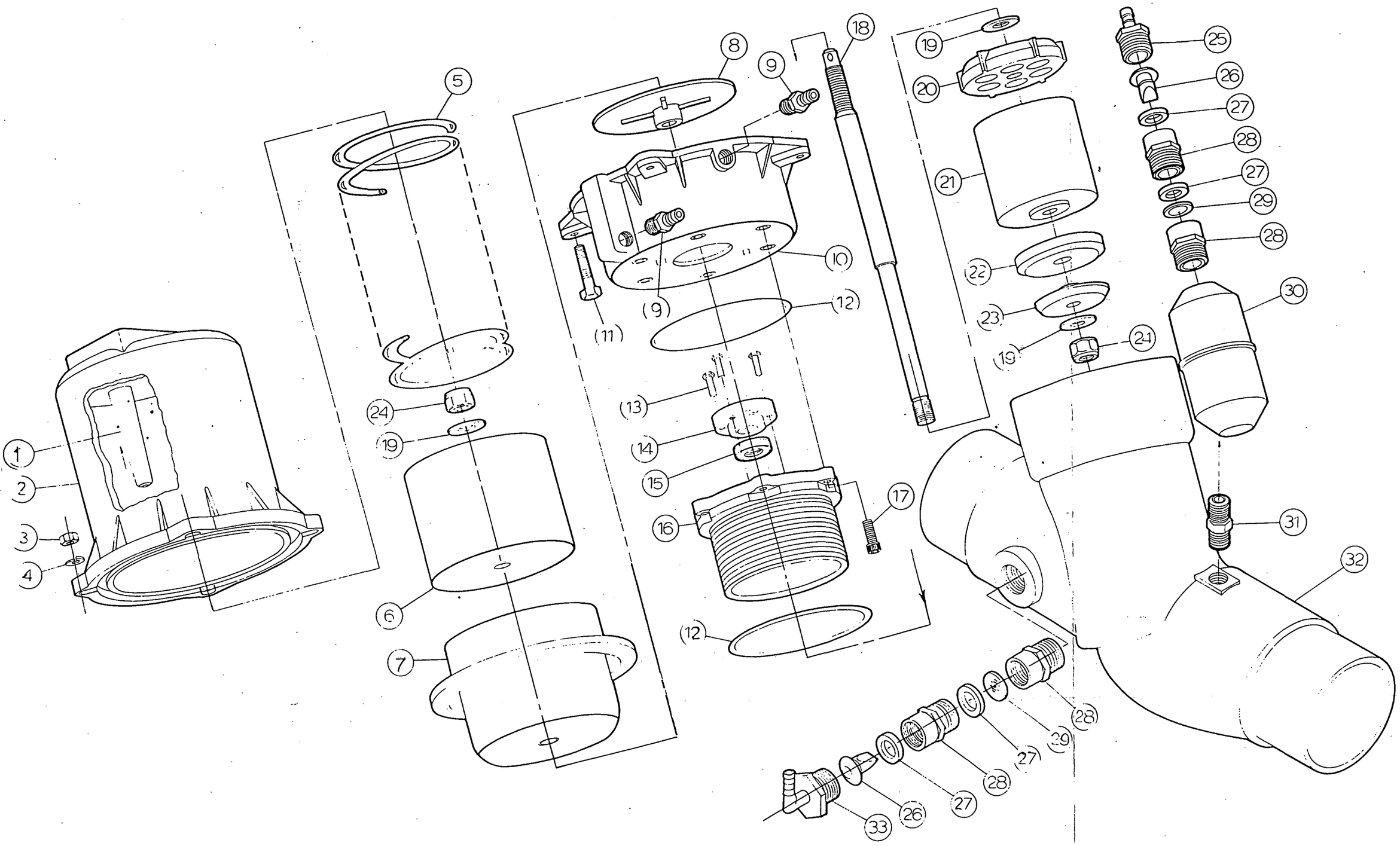
If piston and seat need to be removed from the shaft the procedure is as follow:

Clamp shaft in PADDED vice jaws (wooden blocks work well for this). Loosen locknut on seat and remove retaining washer, seat plunger, plunger guide and washers (Items 19, 20, 21, 22 & 23). The shaft must never be clamped with a metal wrench or vice that could nick shaft in the seal or bearing area.

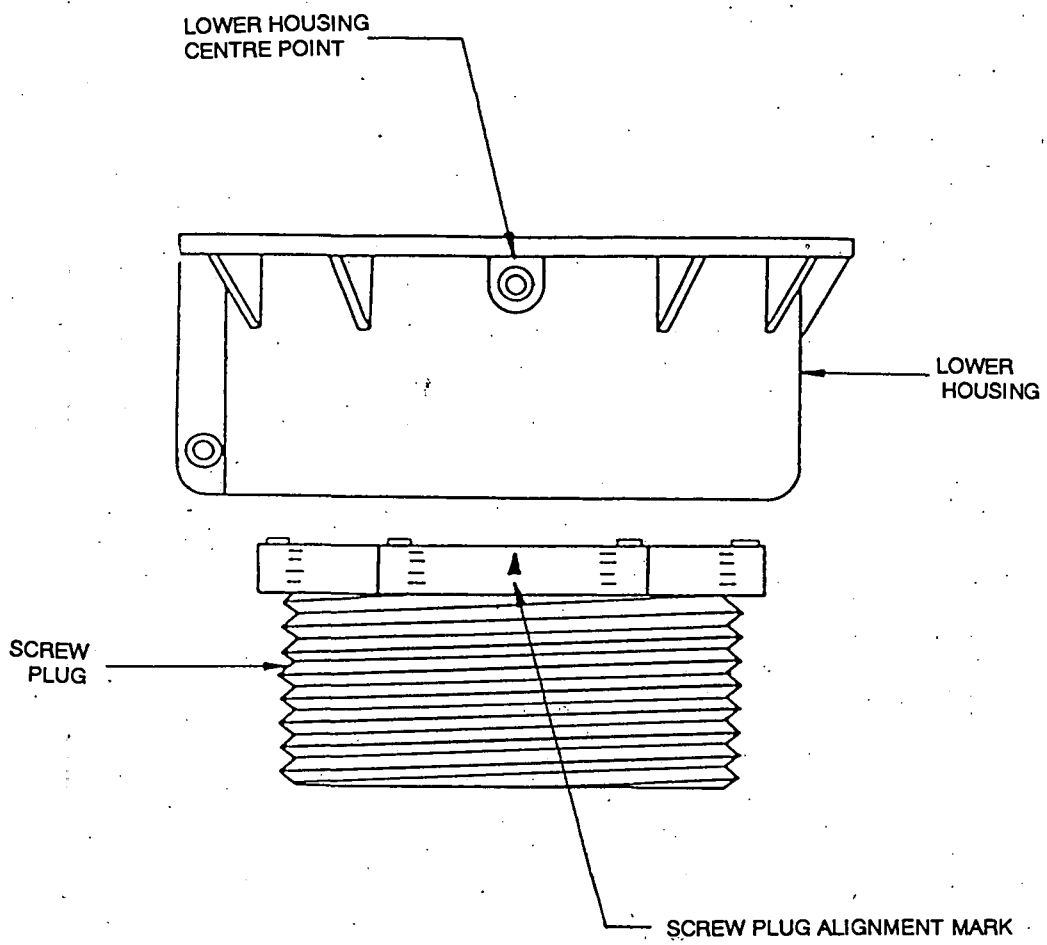
Remove the three bearing screws, bearing and shaft seal (Items 13, 14 & 15) from the screw plug. The lower housing may now be disassembled from the screw plug by removing the six cap screws (Item 17). This need not be disassembled under normal maintenance.

Remove the lower housing from screw plug and remove the o-ring (Item 12) from groove in the screw plug.

Clean the o-ring groove, o-ring and lower housing sealing face. Replace the o-ring in the screw plug, realign with lower housing and replace six cap screws (Item 17). Replace the lower housing on the screw plug to the lower housing centre port (Figure 2-10). Replace and secure the six cap screws, lock-washers and nuts (Item 3, 4 & 17).



	AIRVAC - RSM PTY LIMITED Suite 11, 283 Penshurst Street, Willoughby, N.S.W. 2068 Telephone: (02) 417 8133 Facsimilie: (02) 417 8162	**EXPLODED VIEW 75mm VALVE** **FIGURE 2–9**



ALIGN LOWER HOUSING CENTER PORT WITH ARROW ON SCREW PLUG THEN BOLT TOGETHER LATEST MODEL SCREW PLUGS, HAVE LOCATING PINS TO PREVENT MISALIGNMENT.

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PROCEDURE FOR ATTACHING SCREW PLUG TO LOWER HOUSING

FIGURE 2-10

Install a new shaft seal (printed side up) (Item 15) and new bearing (Item 14). Secure the three screws (Item 13).
Coat valve shaft with silicone grease compound (Dow Corning #111) then install shaft with plunger and seat through seal and bearing. Screw on piston place to stop (Item 8). Clean and inspect valve diaphragm #DC-200 apply light coat of silicone oil then place on shaft. Replace piston cup washer and locknut (Item 6, 19 & 24). Tighten locknut until secure. It may be necessary to use two wooden blocks a C-clamp and vice to hold shaft between plunger and screw plug to enable tightening of locknut.

Replace the o-ring (Item 12) on the screw plug and tighten screw plug into clean wye body. Dow Corning #111 grease may be applied to o-ring and threads to ease assembly.

Turn the piston cup such that the "X" in the cup is diagonally at 45° and not vertical and horizontal. The dip tube in the upper housing protrudes into the cup vertically below the locknut.

Thus any leg of the "X" must not be in that position. If the "X" is aligned incorrectly and the valve is assembled and cycled the dip tube will be broken. This may be repaired by aligning the "X" correctly in the piston cup. Using ABS cement glue the dip tube where broken and allow to dry.

Align the spring (Item 5) in the upper housing and place the upper housing in place on the valve. Using spring clamps hold the upper housing to the lower housing. Then install four bolts, washers, lock-washers and nuts.

Apply vacuum to the upper housing and cycle the valve to seat spring and ensure correct operation.

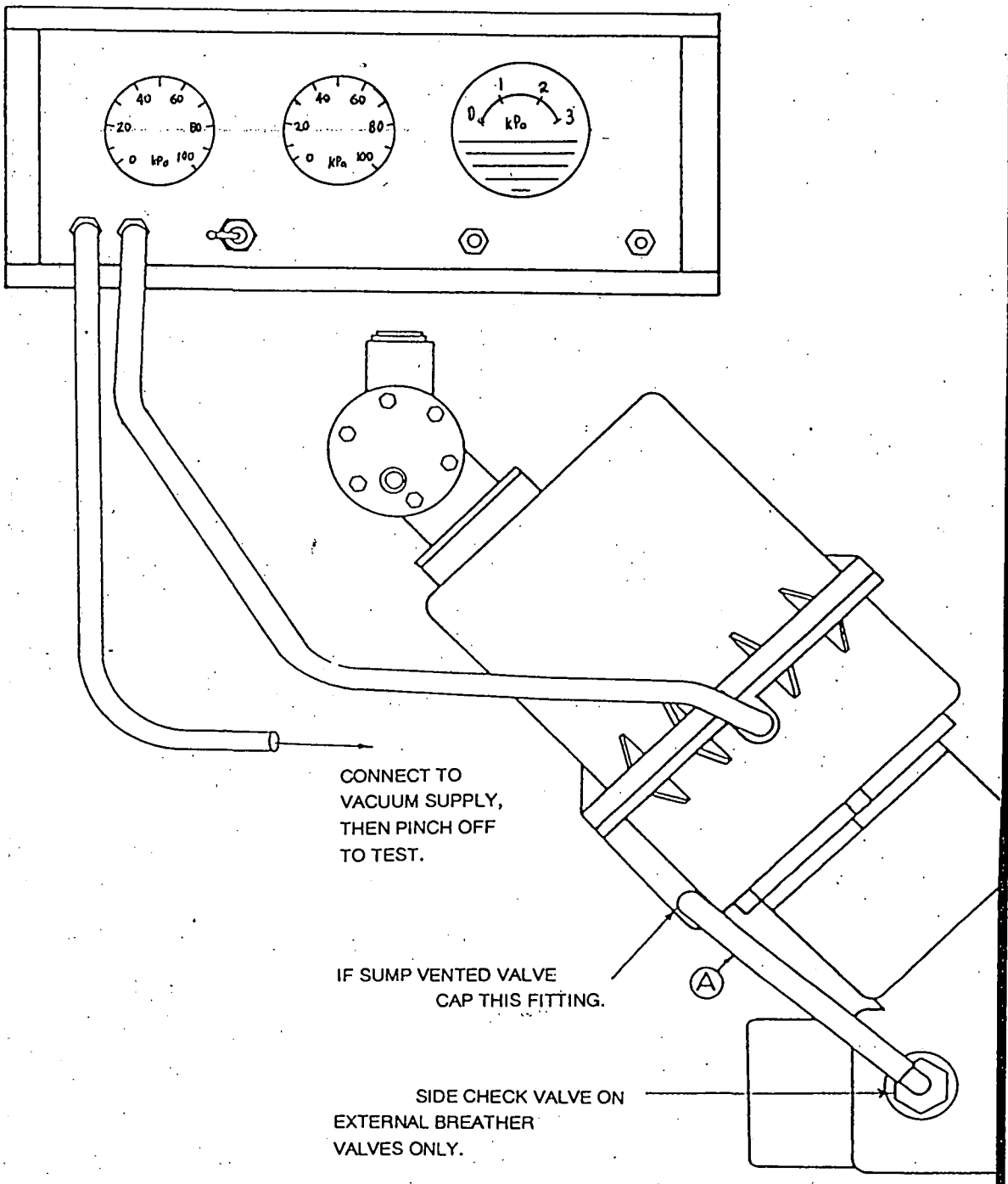
Next test the lower housing and seal for leaks as follows: Refer to Figure 2-11.

Connect a 9 mm hose from the test-box valve testing barb to the lower housing barb of the valve. Be sure the other barb of 75 mm valve lower housing is either connected to the side check valve if present or capped.

Connect vacuum to test box and allow to rise to 35 kPa. Pinch off vacuum supply. The gauge must drop less than 0.8 kPa per minute. If the gauge drops apply vacuum to operator and place caps on both the lower housing spigots.

Remove vacuum from operator and immerse in water and watch for bubbles. If no bubbles emerge and it still leaks, then a leak is present from the upper housing to the lower housing. Check for loose nut on shaft in the upper housing.

TESTBOX SET TO VALVE TESTING



ALLOW VACUUM TO RISE TO 35 kPa AND PINCH OFF SUPPLY. MAXIMUM LEAKAGE 0.8 kPa PER MINUTE. IF A LEAK IS PRESENT, PINCH TUBE AT A, TO ISOLATE CHECK VALVE PRESENT.

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LOWER HOUSING TIGHTNESS TEST

FIGURE 2-11

Unscrew the check valve from the surge tank and dismantle. Wash parts in clean water. Reassemble check valve using new rubber parts.
Repeat above procedure for the lower housing drain check valve. Put teflon tape on both check valves and install on surge tank and wye body.

Clean 6 mm nylon nipple on the surge tank. Apply teflon tape and refit to the wye body.

Fit a new or re-built controller to the valve using three hex screws. No silicone sealant is necessary when installing the controller.

Connect the 9 mm hose from the side check valve to the lower housing connection. Connect vacuum to the controller and cycle valve. Connect 9 mm hose from surge tank to vacuum connection of controller.

Perform complete valve test (Figure 2-12). Connect hose from test-box to testing tee and connect to controller and valve ports. Connect vacuum and allow to rise to 35 kPa then pinch off supply. Gauge should not drop over 0.8 kPa per minute. If the leak continues, check for a leak in the lower housing, controller, or a missing o-ring on the controller. Return valve to inventory.

3.8.2 AIRVAC 50 mm Valve (one only/pump station)

3.8.2.1 Yearly Maintenance

No actual valve maintenance is required on a yearly basis. The valve installation and its operation should be inspected once a year as a trouble-shooting procedure. Check for dirt or water in controller valve or tubes. Cycle the valve preferably by running water and monitor the operation. Check valve timing and adjust if necessary.

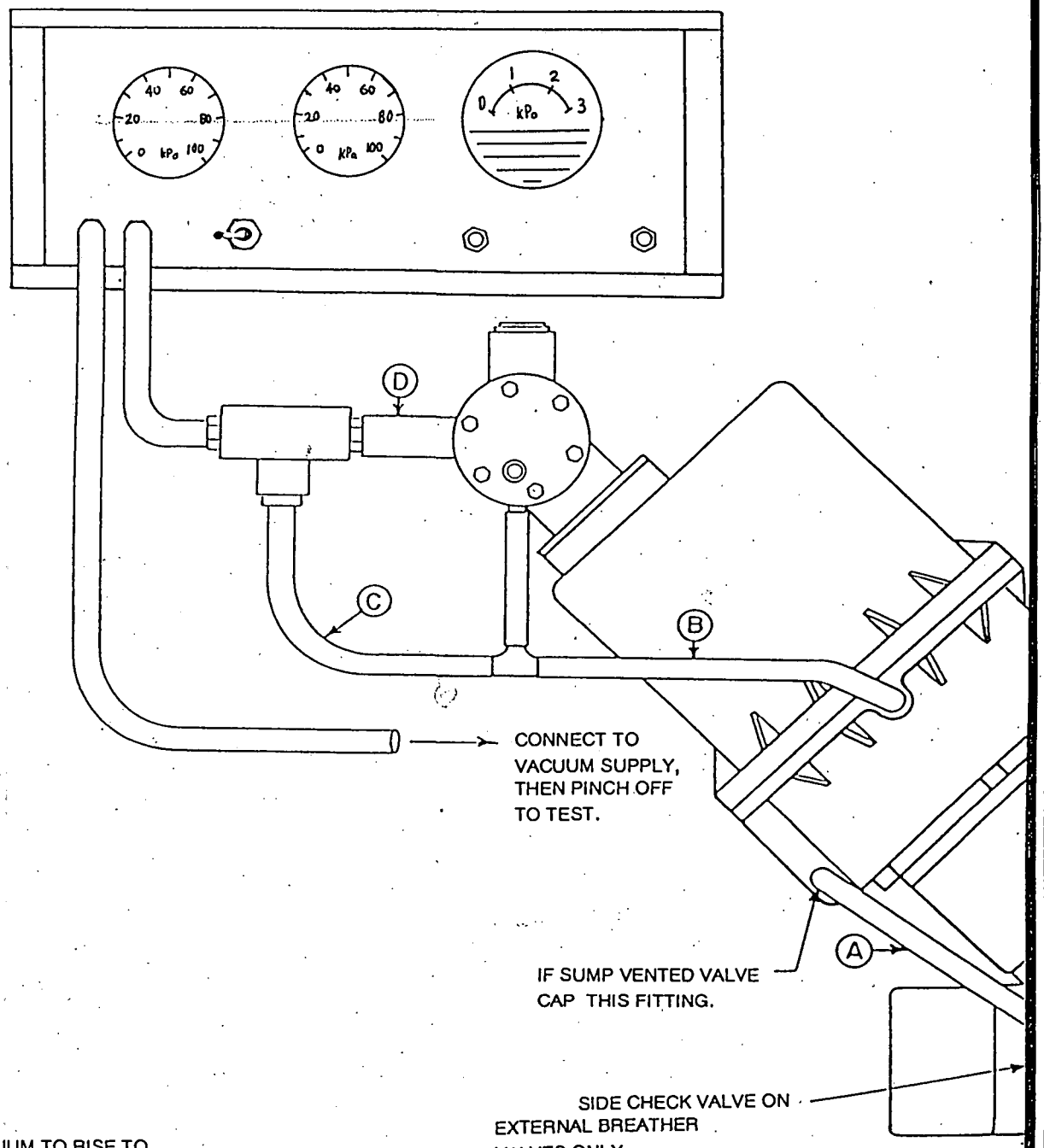
50 mm AIRVAC Valve Disassembly and Rebuilding

The valve should be removed and inspected for wear every 10 years. Rebuilding typically required ½ hour to perform and involves replacing the valve seat (AV2-10RSO) shaft seal (AVD-S-83) and check valve rubber umbrellas (AVRU-2).

In the workshop first cap the controller spigots and wash the valve. Next remove the vacuum line controller four nuts bolts washers and lock-washers (Item 2, 3, 4 & 12 Figure 2-9) the upper housing (Item 1) and lower housing (Item 11). Remove the locking bolt and the washer securing the diaphragm and cup to the shaft (Item 8, 9 & 10). Pull the shaft out downward through the lower housing (Item 17). To remove the seat remove the locking bolt first (Item 7).

To remove the shaft seal first remove four bolts, shaft seal retainer plate rubber gasket and shaft seal (Items 13, 14, 15 & 16).

TESTBOX SET TO VALVE TESTING



ALLOW VACUUM TO RISE TO 35 kPa AND PINCH OFF SUPPLY. MAXIMUM LEAKAGE 0.8 kPa PER MINUTE. IF A LEAK IS PRESENT, PINCH TUBES AT A, B, C, D TO ISOLATE AREA.

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VALVE TIGHTNESS TEST

FIGURE 2-12

All parts should be cleaned prior to re-assembly. Check the shaft for nicks which could cause sticking or seal leakage. Use a fine sandpaper if necessary. Clean any build-up in the bearing area of the lower housing and the umbrella check valve holes.

The rubber umbrella check valve and the shaft seal should also be replaced at this time (Item 13 & 22). A silicone grease lubricant (Dow Corning #111) is available from AIRVAC and should be used on shaft when reassembling. A dry teflon lubricant (Fluoroglide) was used on the rolling diaphragm at the factory this may be replaced with a silicone oil coating by washing the diaphragm thoroughly in laundry detergent then applying a thin film of #DC-200 silicone oil by hand.

Re-assembly is in reverse order of disassembly. It may be necessary to rotate the shaft to get proper seating of the valve seat. After re-assembly connect vacuum and cycle the valve to check operation. Install an AIRVAC controller/sensor unit on the valve. To perform the lower housing leak test and complete valve leak test follow the steps outlined in the AIRVAC 75 mm valve section (Figures 2-11 & 2-12).

3.9 COLLECTION STATION

Specific preventative maintenance procedures for vacuum pumps and sewage pumps is given elsewhere.

General maintenance items for the collection station are as follows:

3.9.1 Monthly

Test all alarm systems including auto dialler. Test cycle the AIRVAC sump valve.

Check control panel lights

Check all motor couplings tighten set screws etc. if required.

3.10. MODEL 5 - AIRVAC CONTROLLER/SENSOR UNIT OPERATION & MAINTENANCE

The AIRVAC controller/sensor unit is designed and manufactured by AIRVAC and has been in operation since December 1980. It has proven to be an extremely reliable unit. We recommend in the event of problems with controller/sensor that you substitute a unit known to be operating satisfactorily and if this corrects the problem the faulty unit be sent to us for repair.

3.10.1 AIRVAC Controller Installation

The AIRVAC 50 mm sensor cap should be installed and pressure tested. To pressure test, cap opposite end of sensor line then connect a 9 mm tube to the sensor cap and "T" in a 0–15 kPa magnehelic gauge. Blow or pump air into the 9 mm tube and cap. The line should be tested at 13 kPa for one minute. If the gauge pressure drops remake joint and retest.

Connect the 9mm tube from 50mm sensor cap to sensor port on controller put hose clamps on both ends of this hose. This tube must be clean and preferably not have any traps. The 50mm sensor cap should be lower than the controller. When the 50mm sensor cap is installed in an in–line installation the 9mm tube must not have any traps and be a minimum of 600mm long.

Mount the breather tee to the valve pit wall slightly higher than the controller. Connect a 9 mm tube from 9 mm connection on breather unit to the 9 mm connection on the side of the valve. Connect a 16 mm tube with two clamps from the breather unit to the 16 mm connection on the end of the controller. There must not be any kinks in this tube and it should not have any traps from the breather to the controller.

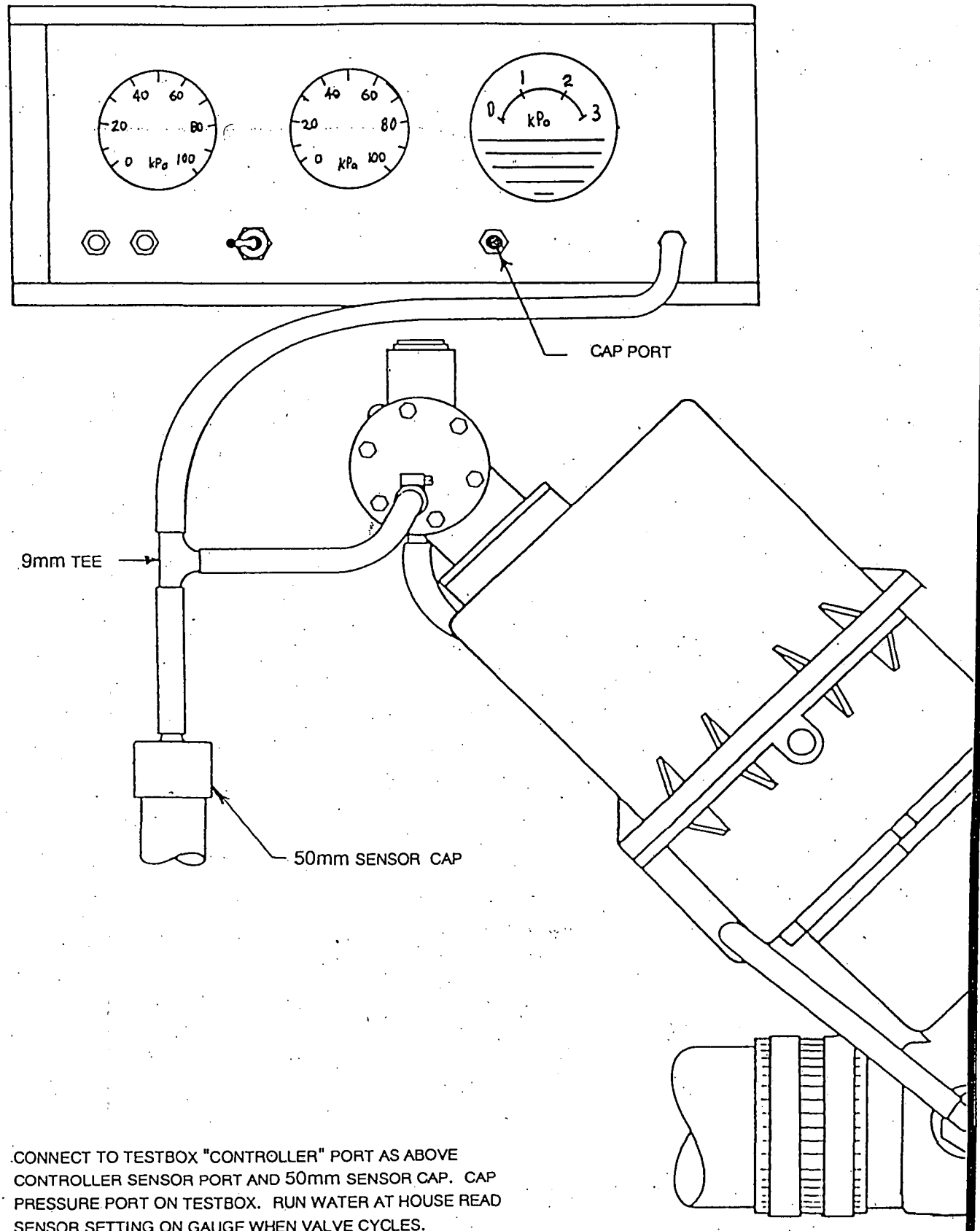
To set the controller timing install a "T" and vacuum gauge in the tube going to the side check valve (not possible for sump vented valves). Have a stop–watch ready. Run water into the gravity line to operate the valve. When the valve cycles the vacuum gauge will rise to line vacuum while liquid is going through the valve (time this period). Then the gauge will drop to about 17 kPa until the valve closes while air is being taken.

The air time should be equal to the liquid time. First measure the time it took to admit the liquid then adjust the needle valve under the cover on the controller until the total valve open time is twice the time it took to admit the liquid.

A chart is enclosed which is approximate for most cases (Figure 2–2). Measure the vacuum available then check the chart for the minimum timing required. In cases where the valve has a lift in front of it the timing may have to be increased to increase the air to liquid ratio.

To check the sensor setting cycle the controller disconnect the 9 mm tube from the controller to the 50 mm sensor cap. Connect 9 mm tubes to the test–box sensor setting test (Figure 2–5). Slowly blow into the tube watching the magnehelic gauge. When the controller cycles the sensor setting should be in the range 1–1.5 kPa.

Another method of cycling the controller is to pinch the sensor hose then fold it towards the controller until the valve cycles.



CONNECT TO TESTBOX "CONTROLLER" PORT AS ABOVE CONTROLLER SENSOR PORT AND 50mm SENSOR CAP. CAP PRESSURE PORT ON TESTBOX. RUN WATER AT HOUSE READ SENSOR SETTING ON GAUGE WHEN VALVE CYCLES.

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CONTROLLER SENSOR SETTING TEST BY RUNNING WATER AT HOUSE

FIGURE 2-5

3.10.2 AIRVAC Controller/Sensor Unit in the Standby Position (Figure 2-15)

The sensor diaphragm has less than 1 kPa of pressure (Port A).

The sensor seat is sealed by spring force and vacuum, therefore no air is flowing through the air passage into Chamber A.

The vacuum has been equalised in Chamber A & B by the needle valve and orifice; each of which are connected to line vacuum through the open check valve. Spring force holds the three-way valve closed to vacuum.

AIRVAC valve Port C is open to the atmosphere Port D but no air is flowing.

3.10.3 AIRVAC Controller/Sensor Unit in the Switched Position (Figure 2-16)

The sensor pressure (Port A) increased closing the gap between the diaphragm and the lever. When the pressure reaches 1.1 kPa the diaphragm pushes the lever lifting the sensor seat. This allows atmospheric air to enter Chamber A from the air passage through the sensor seat.

The vacuum not being equalised across the three-way valve diaphragm causes the diaphragm to be pulled to the right. This opens the vacuum passage and closes the atmosphere Port D.

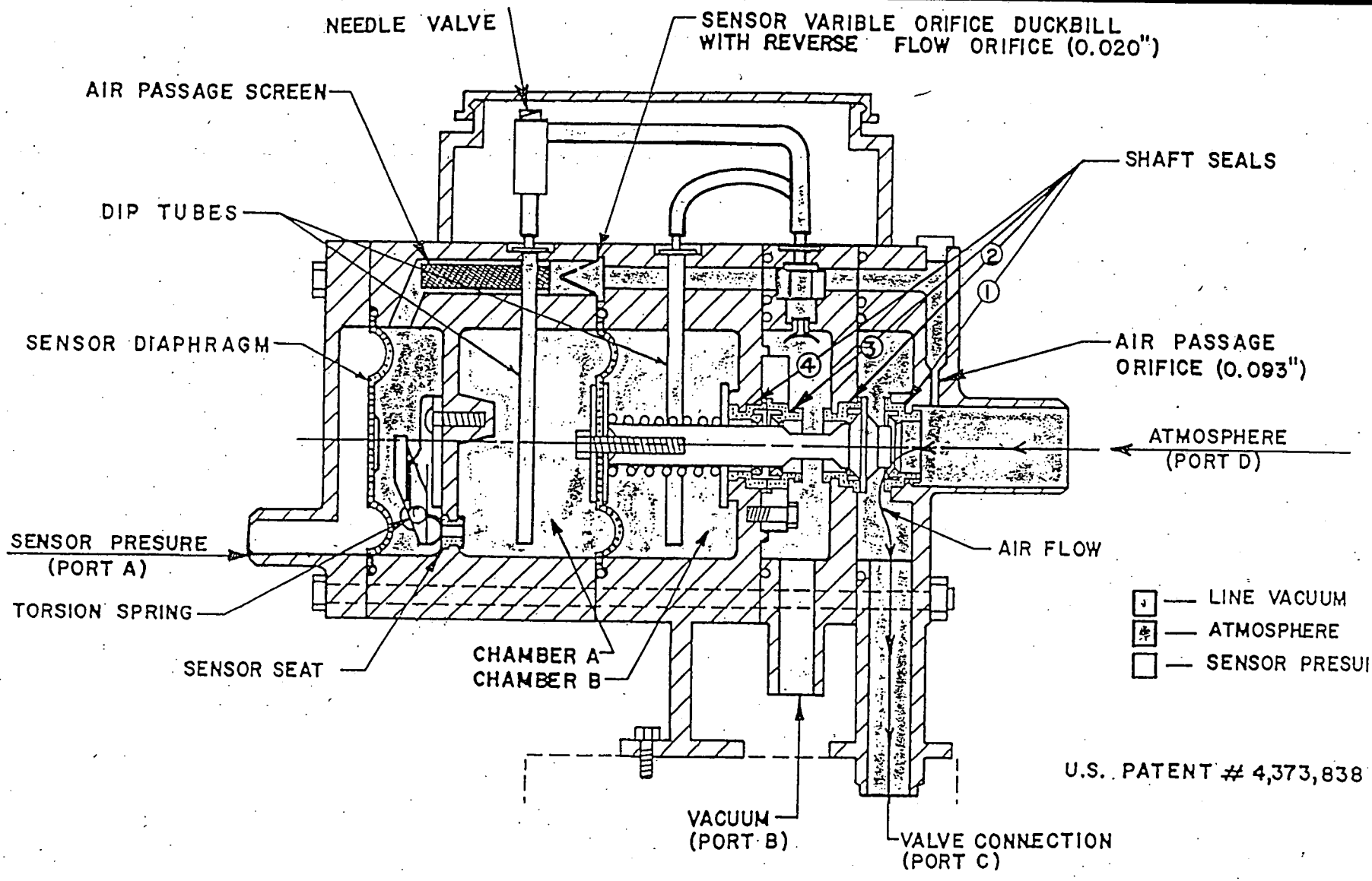
This allows vacuum (Port B) to pass through the vacuum passage in the shaft to Port C opening the AIRVAC valve.

The sensor pressure immediately drops closing off the sensor seat and air flow through the air passage.

The check valve closes due to dropping line vacuum and Chamber A equalises to Chamber B vacuum through the needle valve and 0.4 mm orifice.

When the vacuum is equalised in Chamber A & B the three-way valve diaphragm shifts back to the left closing the vacuum passage.

Port D is again open and air flows through to Port C which closes the AIRVAC valve. It is now in the standby position.



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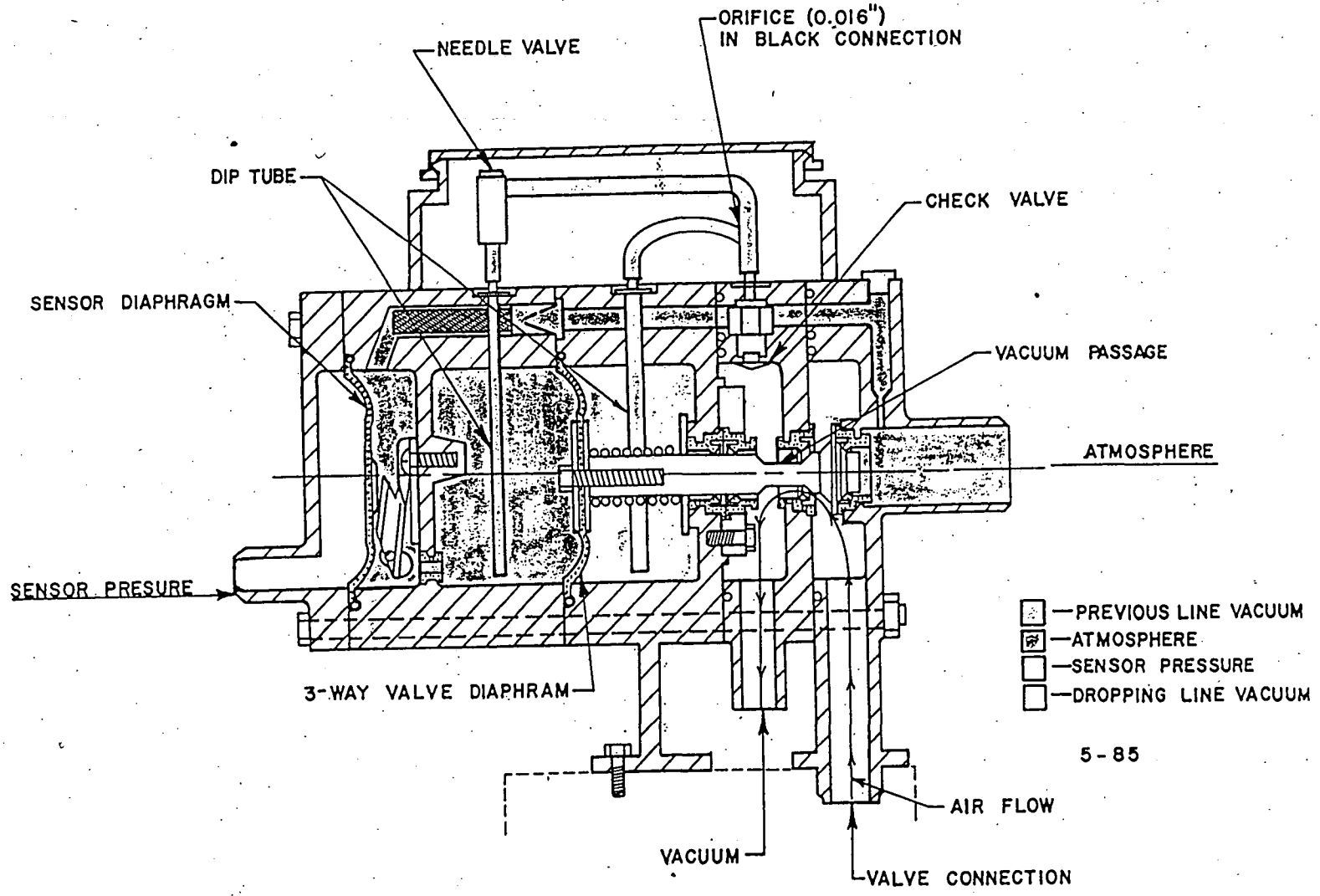
STANDBY POSITION CONTROLLER/SENSOR UNIT

FIGURE 2-15



U.S. PATENT # 4,373,838

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SWITCHED POSITION CONTROLLER/SENSOR UNIT

FIGURE 2-16

3.10.4 Minor Parts

3.10.4.1 Sensor Port A

Sensor Port A is positioned low to allow draining of condensation back through the sensor line.

3.10.4.2 Vacuum Port B

Vacuum Port B is also positioned low to allow moisture to be drawn out of the Chamber. This is also the reason why the sensor seat is positioned as low as possible.

3.10.4.3 Duckbill

The purpose of the duckbill in the sensor air passage is to cause an instantaneous vacuum under the sensor diaphragm when the sensor seat is lifted. Therefore allowing Chamber A to come to atmospheric pressure.

3.10.4.4 Dip Tube

The purpose of the dip tube is to remove moisture from Chamber A through the needle valve and vacuum Port B.

3.10.4.5 Orifice Chamber B

The purpose of the orifice on Chamber B is so that when vacuum is first connected to a controller it is not caused to cycle and so that after a valve cycles the rapidly rising vacuum will not cause a second cycle.

3.10.4.6 Sensor Surge Suppressor

The purpose of the AIRVAC sensor surge suppressor is to prevent air flow into the holding tank from setting off the sensor when the AIRVAC valve suddenly closes.

3.10.4.7 Reverse Flow Orifice

The purpose of the reverse flow orifice in the sensor variable orifice duckbill is so that as the sensor pressure rises and pushes the sensor diaphragm the air under the sensor diaphragm is allowed to be pushed back through the air passage and the reverse flow orifice.

3.10.4.8 Umbrella Check Valve

The purpose of the umbrella check valve is to isolate the controller from the dropping line vacuum while the valve is open and give consistent valve timing.

3.11 AIRVAC CONTROLLER/SENSOR UNIT REPAIR

This section is provided by way of information only.

For average cycling valve (under 250 cycles per day) the controller should be removed and inspected for wear every five years. The controller should be replaced and returned to the workshop.

Rebuilding typically requires ½ hour to perform and involves replacing the shaft seal (AC 22) greasing the shaft and cleaning all components. The vent connection filter (AC 48) should be replaced on exterior vented valves.

3.11.1 Controller Repair

The first step is to clean the exterior of all dirt, etc. This may be done by loosening the timer box capping the tubing connections then immersing the controller in water and cleaning.

The controller should then be fully disassembled cleaned and dried. Use a damp rag to wipe off rubber parts such as check valve and sensor seat etc. Also clean off sensor lever sealing surface controller shaft and check valve sealing surface.

Disassemble needle valve and clean tip of needle if any black build-up is visible. The body may be cleaned by using a damp piece of paper towel on the end of a wire being careful not to damage the seat.

Blow out needle valve body and all tubing. Also blow out all plastic parts and connections before reassembling controller.

Blow air through air passage screen to remove any accumulated particles. If necessary screen may be removed by threading a controller body bolt in then pulling out the filter.

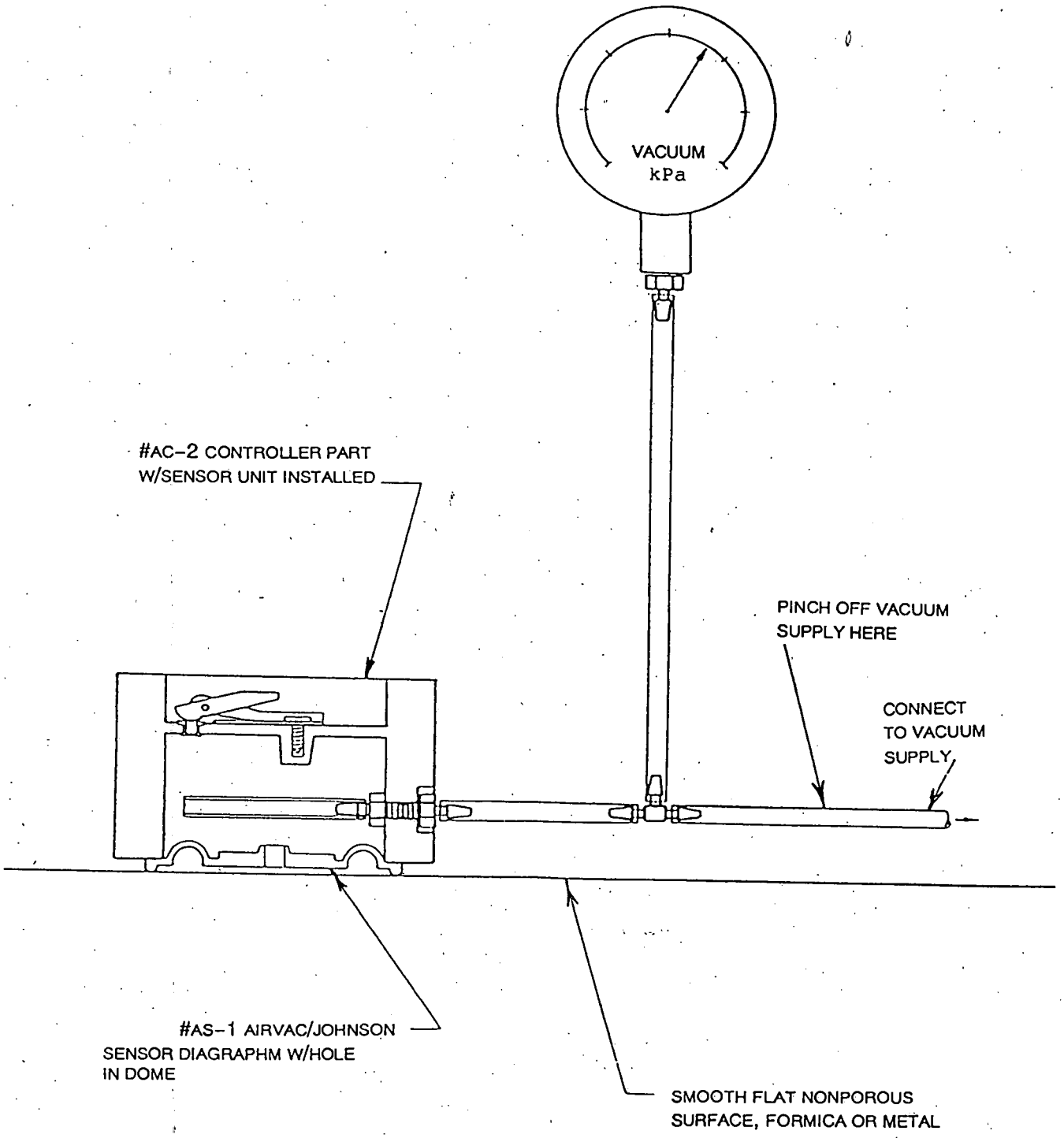
Check that 0.4 mm orifice in tubing connection to Chamber B is clear.

The umbrella check valve must be installed fully with no dirt on check valve or mating surface.

Reassemble sensor unit first and perform sensor seat leakage test before finishing assembly.

3.11.2 Sensor Seat Leakage Test

Assemble Part #AC-2 sensor seat and sensor lever unit of controller and connect as in the diagram (Figure 2-17). The Chamber A which you are testing for leakage is best sealed for testing by using a #ASP-1 surge suppressor diaphragm.



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SENSOR SEAT LEAKAGE TEST DIAGRAM

FIGURE 2-17

The clean diaphragm should be placed upon a smooth clean surface. The Chamber A should be placed over the diaphragm with the gauge and vacuum already connected. Depress the lever a couple of times then allow the gauge to rise to match your vacuum supply.

Next pinch off the vacuum supply tube with needle nose pliers. Watch the gauge while holding the vacuum supply pinched. If the gauge does not move at all in a 10 second period tap the sensor lever to lower the vacuum in the timing volume to 17 kPa. Now with 17 kPa in the timing volume and the vacuum supply pinched watch the gauge again for any movement in a 10 second interval. If there is no leakage it is okay for use. If it does not pass either test (the vacuum dropped) there is a leak in one of three places.

The sensor lever is not sealing on the rubber seat. In the very early models the sensor unit is adjustable on the sensor seat. This must be aligned and tested as aboye until it passes.

A loose or cracked tubing spigot.

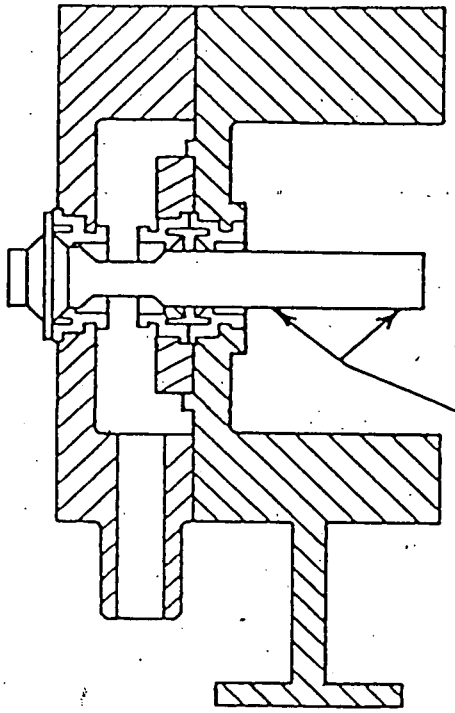
The #ASP–1 surge suppressor diaphragm or testing surface is not sealing properly. Clean the diaphragm and surfaces or try another diaphragm. Factory experience indicates the #ASP–1 diaphragm seals very easily. Whenever the sensor unit is removed from the #AC–2 controller part the above test should be performed when reassembling to be sure of correct operation.

Next reassemble the three–way valve. Replace any shaft seals that look worn ('v' sealing lip is not sharp). Insert shaft through seal in Part #AC 4 then through two seals in Part #AC 3 (Chamber B). Next apply a very thin film of Fluorosilicone grease Dow Corning Part #FS–3451) to whole shaft visible within Chamber B. Next place fingers on each end of shaft and oscillate within seals to lubricate seals and shaft (Figure 2–18).

If grease is not applied as above unnecessary dirt build–up may result and cause sticking of shaft and premature wear of seals.

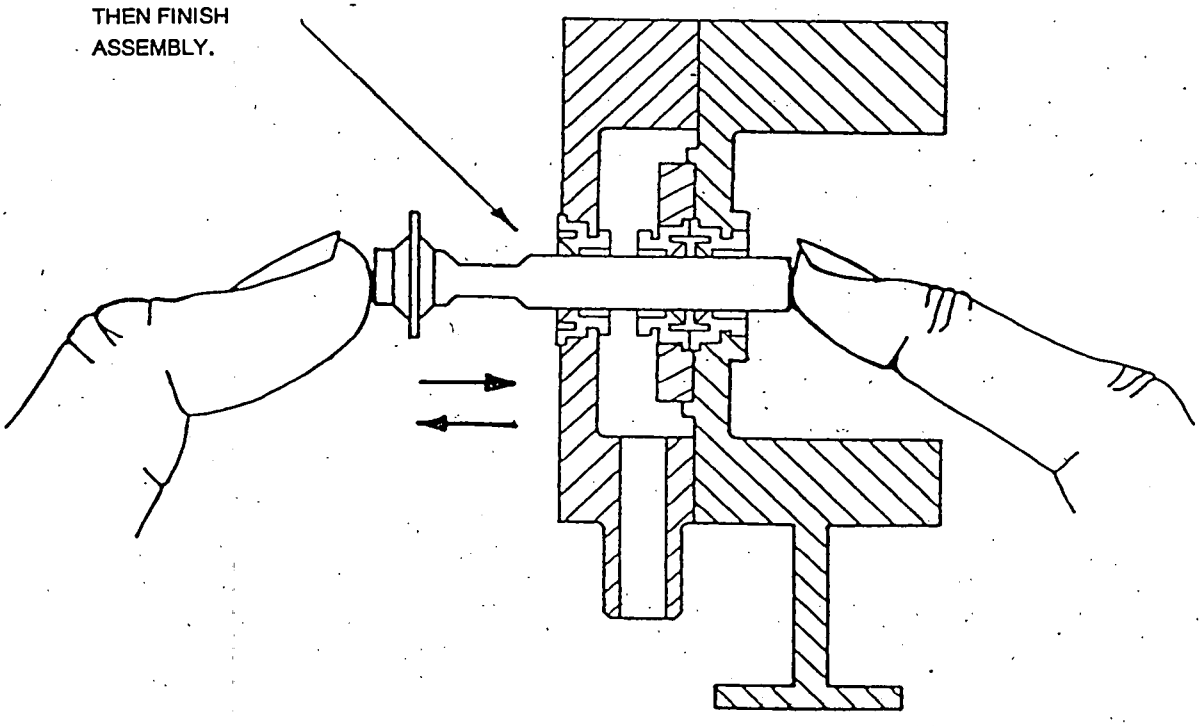
Finish valve assembly and seals etc., into other parts. To finish assembly use a controller assembly jig which is supplied with the AIRVAC controller test–box. Stack the parts on it: Part #AC5 first (breather connection) then valve assembly etc. Three body bolts should then be installed and tightened 10cm Kg. before controller is removed from jig. Install remaining bolts connect tubes to timer box and controller is ready for testing.

After controller passes all tests timer box must be rotated ½ turn to prevent kinking of tubing when re–installed.



ASSEMBLE PART AC3,4, SHAFTSEALS AND SHAFT AS SHOWN THEN APPLY A VERY THIN FILM OF FLUOROSILICONE GREASE.

NEXT OSCILLATE SHAFT BETWEEN SEALS TO COAT SURFACES OF SHAFT AND SEALS. THEN FINISH ASSEMBLY.



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PROPER METHOD OF APPLYING GREASE TO CONTROLLER SHAFT

FIGURE 2–18

3.11.3 Water Effects

As water enters the breather line it first encounters the "T" where water will flow down the line to the lower housing where it will be sucked out when the valve cycles. Some liquid may run into the 16mm line to the controller (Figure 2–15).

The liquid will enter the atmosphere port and flow down the valve connection into the valve bonnet where it will be sucked out when the valve cycles.

If the atmosphere port is filled when the controller cycles some liquid will be pulled through the air passage through the sensor and into Chamber A.

The liquid will be taken out by the dip tube in Chamber A through the needle valve. Liquid has a higher viscosity and therefore the controller will have a long cycle while removing the liquid. The liquid flows out of the needle valve through the tubing and out the check valve. Some liquid will return by other tube and go into Chamber B.

The liquid in Chamber B will not do any harm. The AIRVAC controller has a dip tube within Chamber B to remove any water. This works by removing the water after the valve is pulled up the dip tube through the check valve and out the 9 mm vacuum supply tube.

If a PVC breather line is improperly laid with reverse fall a trap in the line could collect water. When the valve cycles the controller would operate properly the valve will open and the side check valve will also open.

The side check valve will be pulling air through the "T" and against the trapped liquid. If there is over 75 mm of liquid in the trap then approximately 0.74 kPa of vacuum will be put on the controller and in turn on the sensor diaphragm. This vacuum will hold the controller open until the liquid is removed or the breather is disconnected.

The 16 mm breather tube must not be allowed to hang lower than the top of the 75 mm line. Otherwise too much liquid can collect in the pocket and cause a continuous cycle as previously discussed.

In some installations the breather "T" may be lower than the controller. This is not the recommended installation but it will function, though it will not be able to handle as much water if the breather line leaks. As water builds in the breather "T" it can start to rise up the 9 mm lower housing drain tube and the 16 mm controller breather tube.

As the sensor pressure rises it pushes the sensor diaphragm and it will be pushing air out the air passage and breather tube and against the water there.

The resistance of this water will cause the sensor setting to rise in proportion of the level of the water in the 16 mm tube. The controller will cycle and the water will be removed by the lower housing drain and the controller. A small amount may be splashed into the controller air passage where it will be removed upon the next cycle.

3.11.4 Dirt Effects

The only way dirt may enter the controller is through the 16mm breather connection with the atmospheric air or with water if present.

After entering the breather connection it must pass through the air passage where the air passage screen filter will trap larger particles. Any continuing particles flow to the sensor seat and through when the sensor is triggered. From there they are pulled up the dip tube through the needle valve and check valve then out the vacuum line.

A large accumulation of dirt particles can cause clogging of the air passage filter which will hold the controller open. To clean thread a controller body bolt into filter and pull out then blow off. Re-install until flange hits step in hole.

If sufficient dirt particles build up on sensor seat or lever seat will leak causing long time cycles or controller not to close. Remove and clean with a damp rag then re-install and test.

Over a period of time dirt may build up on the needle valve. This will lengthen the set time cycle. If any water is pulled into the controller it is likely some dirt particles will be in the water which may restrict the needle valve. To clean remove needle valve and clean all surfaces of tip with a damp rag. Wind a small piece of paper towel on a small wire (0.7 mm diameter approximately) dampen and rotate in the needle valve body to clean the seat. Blow out with air pressure and re-install needle valve.

A 16 mm vent connection filter and filter bushing (part #AC48, AC47) (see Figure 2-19) are supplied with 'D' model valves (exterior breather). This is a moulded filter that filters the air going to the controller circuitry only, not air flow to the valve. Its purpose is to prevent dirt build-up on the sensor seat and in the needle valve yet allow water flow if present.

3.11.5 AIRVAC Controller Testing

Following are the procedures for testing a controller including an explanation of what is being tested.

After each explanation there is a separate diagram for each test showing the proper procedure and allowable leak rates.

A condensed testing procedure sheet is also included which may be pinned up on your test bench.

3.11.5.1 Component Testing

Remove the screws from the timer box to expose the tubing.

Connect the vacuum gauges to Chamber A & B (Figure 2-20)

Connect vacuum to the controller

Apply pressure to sensor port to trigger controller. Always cover valve connection while controller is cycling for proper readings. When the controller cycles Chamber A vacuum should drop to 0 kPa. immediately. Chamber B vacuum should remain at line vacuum.

3.11.5.2 Sensor Setting

Apply pressure to sensor port through test-box while watching magnehelic gauge. Sensor setting should be between 1-1.5 kPa water gauge. If under 1 kPa check sensor seat for leak (Test C). If over 1.5 kPa change diaphragm or sensor lever unit.

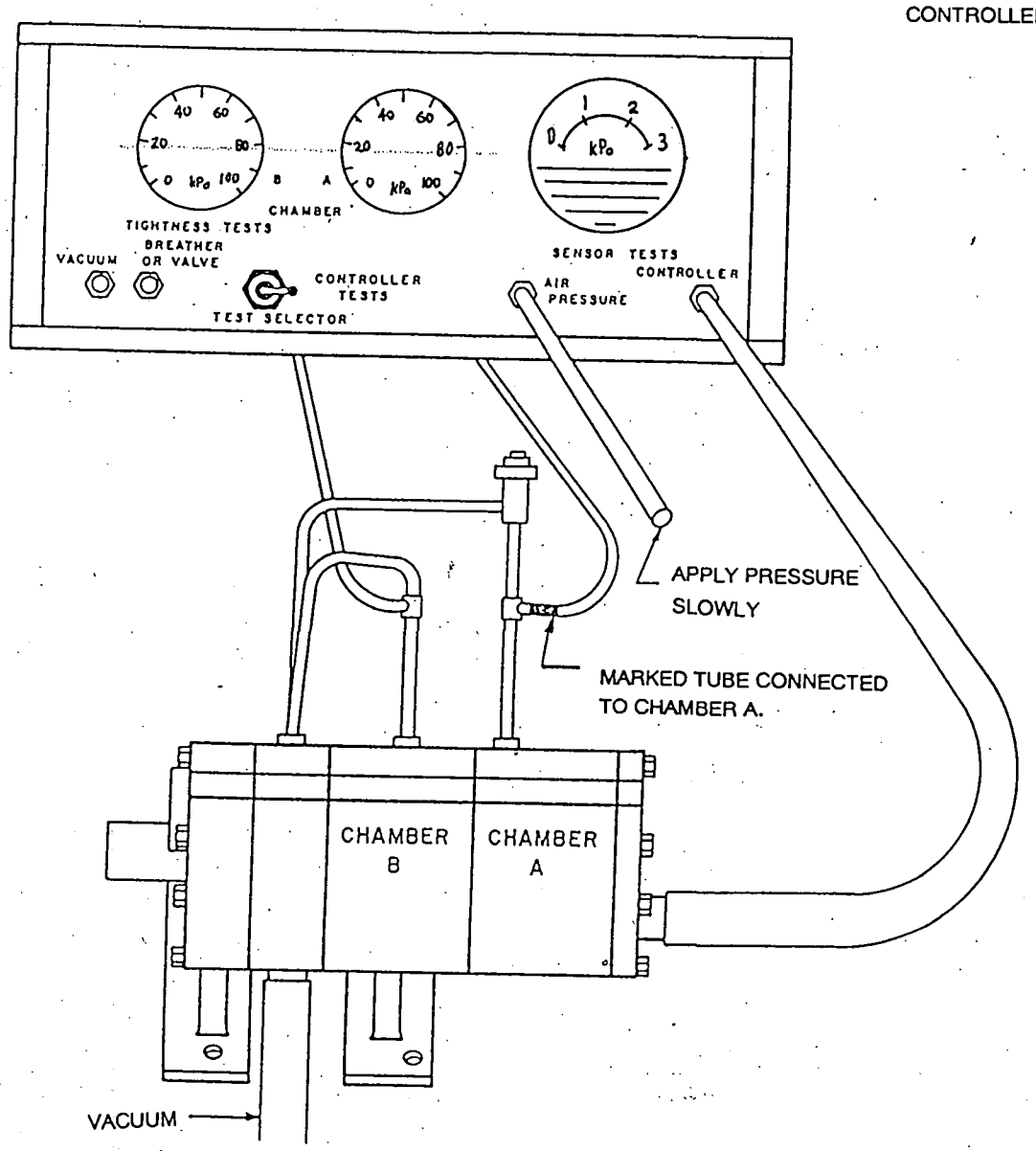
3.11.5.3 Sensor Variable Orifice Duckbill

If pressure is applied very slowly to the sensor port just before the controller cycles Chamber A vacuum may slowly begin to drop. At some point Chamber A vacuum will suddenly go to 0 kPa. This gap where Chamber A vacuum slowly begins to drop until it triggers should always be less than 10 kPa. (Figures 2-21 & 2-22). This gap is controlled by the sensor variable orifice duckbill. If it is larger the duckbill is not completely closing or is damaged.

In the sensor variable orifice duckbill there is a 0.5 mm diameter hole punched in one of the angled faces. If this hole is blocked the sensor will not trigger. The reason is that there is a volume of air trapped between the sensor diaphragm and the sensor duckbill. As pressure is put on the sensor port the sensor diaphragm is pushing against this trapped volume of air and creating pressure in that volume. This will vastly increase the sensor setting. If the air passage orifice is blocked it can also cause the same condition by trapping an air volume.

The air passage orifice is 2.4 mm diameter and if it is partially blocked the sensor can trigger but not enough air may be admitted to allow the Chamber A vacuum to drop to 0 kPa and for the sensor to close (a vacuum may be maintained under the sensor diaphragm).

TESTBOX SET TO
CONTROLLER TESTS.



WATCH MAGNEHELIC GAUGE.
SENSOR SETTING MUST BE
BETWEEN 1.0 AND 1.5 kPa.

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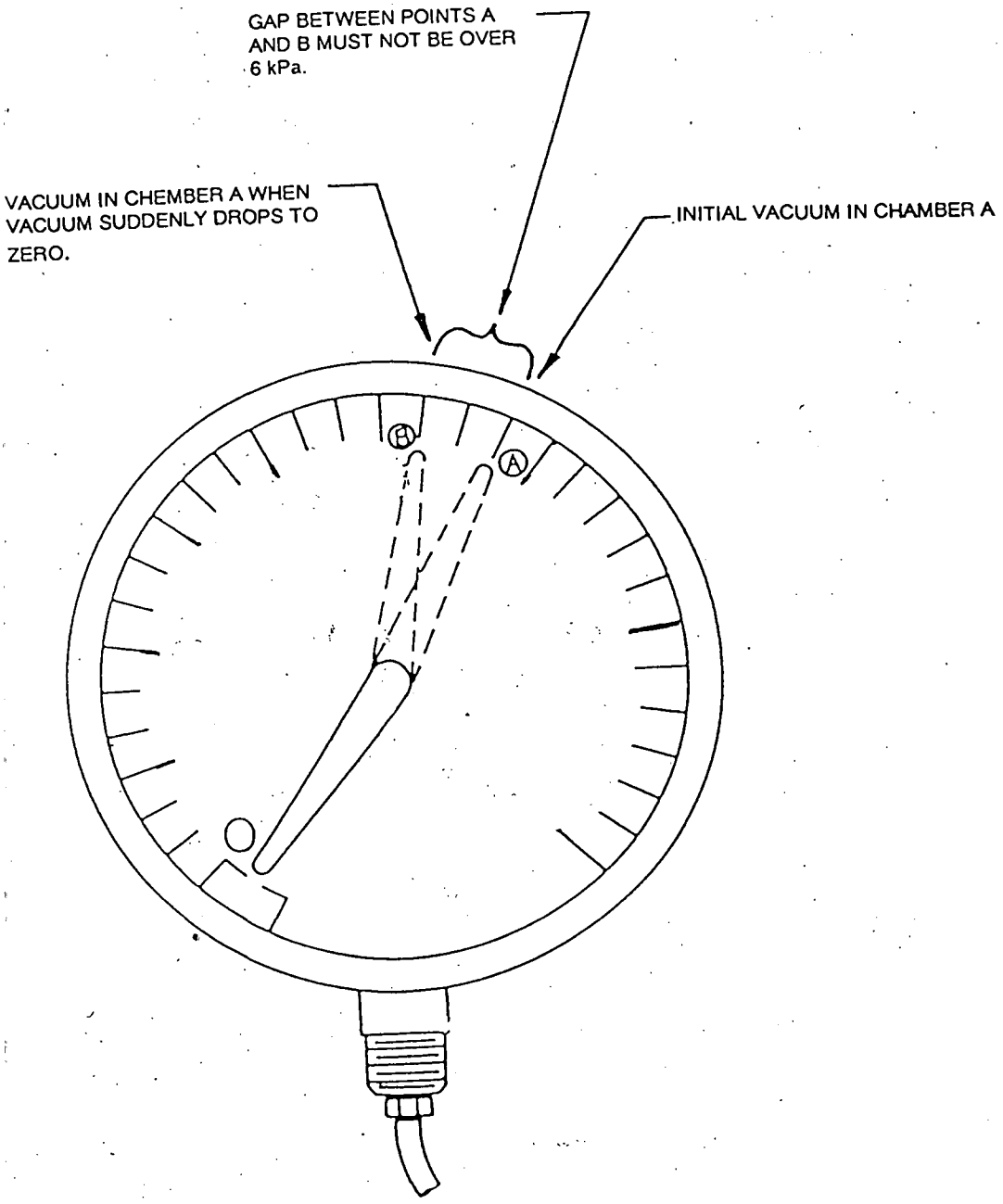
SENSOR SETTING TEST

FIGURE 2-20



THE INITIAL VACUUM IN CHAMBER A (LINE VACUUM AVAILABLE), BEFORE SENSOR PRESSURE IS APPLIED TO THE CONTROLLER, IS SHOWN AT POINT A.

AS SENSOR PRESSURE IS APPLIED VERY SLOWLY TO THE CONTROLLER, WHEN THE PRESSURE IS VERY NEAR TO THE CONTROLLERS SENSOR SETTING, THE VACUUM IN CHAMBER A MAY SLOWLY BEGIN TO DROP UNTIL IT REACHES A POINT (POINT B) WHERE IT WILL SUDDENLY TRIGGER AND THE CHAMBER A VACUUM WILL INSTANTLY GO TO 0 kPa.

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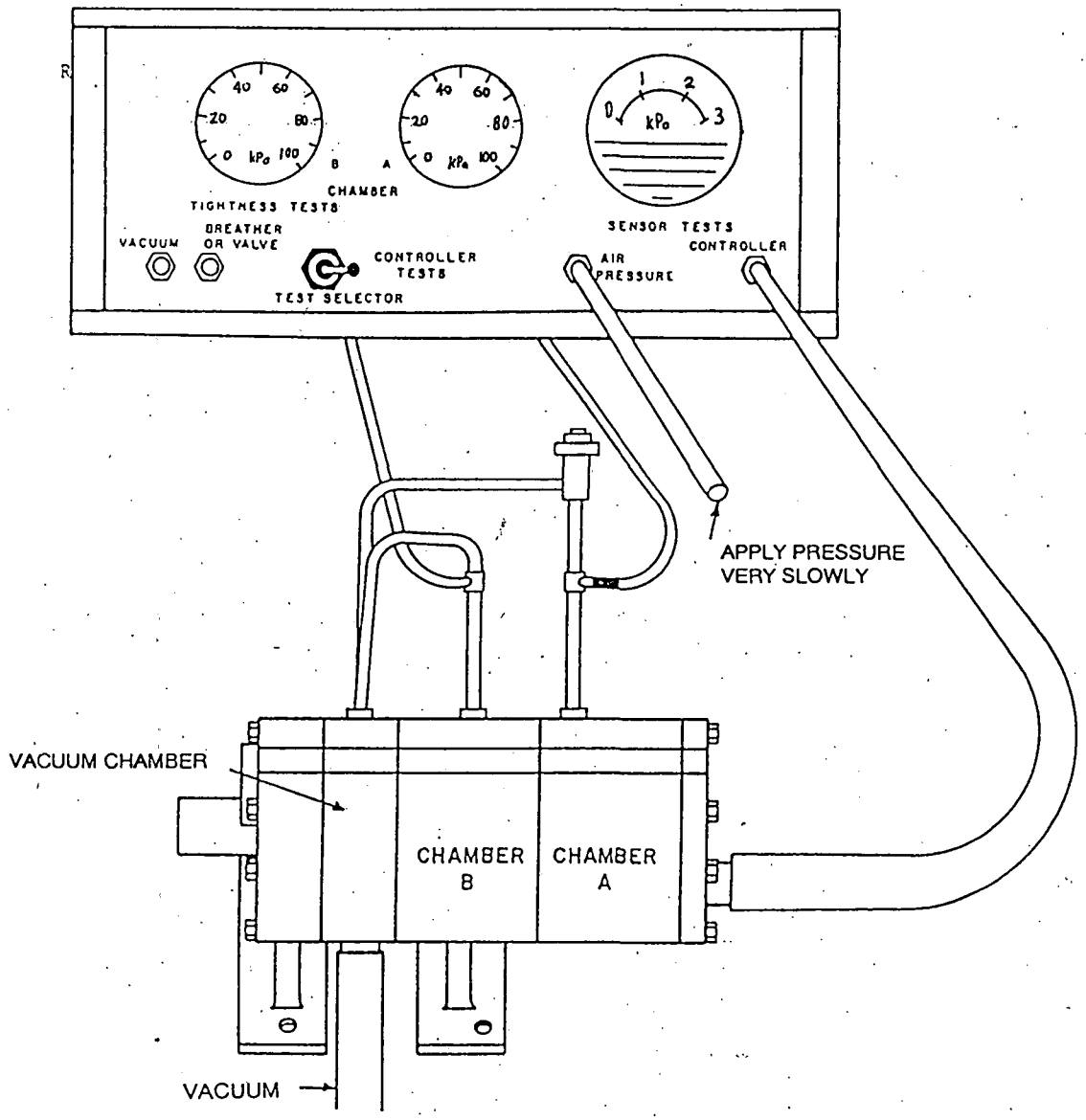
TESTING THE SENSOR VARIABLE ORIFICE DUCKBILL

FIGURE 2-21

TESTBOX SET TO CONTROLLER TESTS



BLOW VERY SLOW AND WATCH CHAMBER A GAUGE. VACUUM SHOULD NOT DROP SLOWLY FOR OVER 6 kPa BEFORE SUDDENLY DROPPING TO ZERO.

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VARIABLE ORIFICE DUCKBILL TEST

FIGURE 2-22

The needle valve setting will determine just how much the air passage orifice may be blocked before affecting the operation. For example if the air passage is blocked to Ø1 mm and the controller was set for a 10 second timing it would operate fine. If the needle valve was then opened for a shorter timing there would not be enough air flow and the controller would hold open.

3.11.5.4 Chamber A

Pinch the Chamber A tube under the needle valve (closing the needle valve will have the same effect). When pinched the Chamber A vacuum should not drop. If it does drop the sensor lever is not sealing the rubber sensor seat 0.3 kPa maximum leakage is allowed.

3.11.5.5 Valve Diaphragm

Again pinch off the same connection as above. Now apply pressure to the sensor port. The controller will cycle and the Chamber A vacuum should go to 0 kPa and not rise (approximately 1.6 kPa may register on the gauge, but it should not continue to rise). If it does rise the valve diaphragm is defective or loose.

3.11.5.6 Third Seal

Disconnect 1.5 mm tube from Chamber B at vacuum chamber. Chamber B gauge will drop to zero. Pinch off hose with needle nose pliers and re-connect hose to vacuum chamber with hose pinched. Gently release hose and allow vacuum to Chamber B to rise to 33.3 kPa vacuum then pinch hose. Vacuum should not increase over 33.3 kPa in 10 seconds.

3.11.5.7 Check Valve & Fourth Seal Test

Next disconnect 9 mm vacuum hose from vacuum chamber. The vacuum gauges should not drop. If a leak is present pinch off the 1.5 mm tube from Chamber B to the vacuum chamber and:

1. If the Chamber B gauge no longer drops but the Chamber A gauge continues then the check valve is leaking.

2. If the Chamber B gauge continues to drop then the fourth seal is leaking.

3. The check valve and fourth seal each should leak less than 3.33 kPa in 10 seconds. If the leak continues when pinching off both 1.5mm tubes at the vacuum chamber a leak is present in the fluidics, cracked spigot or needle valve proceed to pinch fluidics to isolate leak.

3.11.5.8 Controller Exterior

Connect a test tee with hose to controller 16 mm air port 9 mm vacuum port 9 mm sensor port a vacuum supply and vacuum gauge. Cover the controller valve connection tightly then pinch off the vacuum supply. The vacuum gauge should not drop over 0.8 kPa per minute. A controller that does not pass this test will leak water from the valve pit into the controller. Check for a cracked plastic part or leaking 1.5 mm tube or fitting.

3.11.5.9 Sensor Diaphragm

With test tee connected as above (Figure 2-31) disconnect 9 mm hose from sensor port and plug hose. Do not cap sensor port. Pinch off vacuum supply to test tee. The vacuum gauge should not drop faster than it did in the previous test. If it does a hole is present in the sensor diaphragm.

3.11.5.10 Second Shaft Seal & Sensor Seat

With the vacuum connected to the controller cover the valve connection and the atmosphere port. This tests the second shaft seal and the sensor seat (which was previously tested) for leaks. If either leaks, vacuum will build up under the sensor diaphragm and trigger the sensor (the sensor diaphragm may be watched for movement).

3.11.5.11 First Shaft Seal

Close the needle valve and trigger the controller (cover the valve connection). Cover the atmosphere port. You are now testing the first shaft seal. If vacuum builds or the sensor diaphragm moves the seal is leaking.

3.12 CONDENSED TESTING PROCEDURES

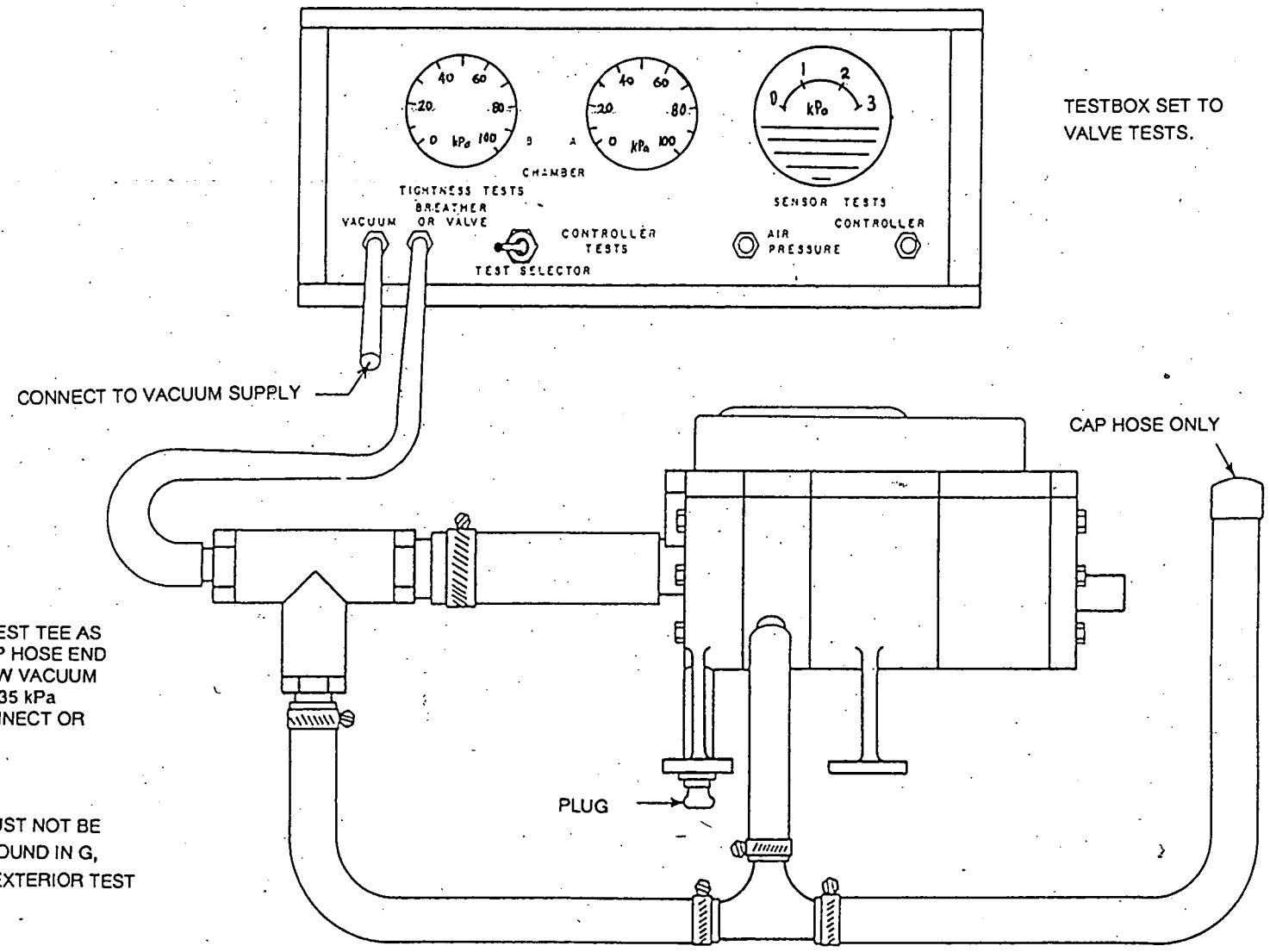
After assembly, the following tests shall be made on the controllers with vacuum gauge connected to Chamber B and manometer connected to Chamber A:

3.12.1 Sensor Setting

Must be between 1-1.5 kPa. Apply pressure very slowly.

3.12.2 Sensor Variable Orifice Duckbill

Cycle controller with extremely slow steady pressure rise. Vacuum in Chamber A should not drop under 6.8 kPa. Before controller triggers and Chamber A vacuum drops to zero.



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SENSOR DIAPHRAGM

FIGURE 2-31

3.12.3 Chamber A

Block vacuum supply to Chamber A as above and trigger sensor. Vacuum in Chamber A should drop and not rise.

3.12.4 Third Seal Test

Disconnect hose from Chamber B to vacuum chamber. Pinch hose with needle nose pliers, re-connect hose to vacuum chamber with hose pinched. Gently release hose and allow vacuum in Chamber B to rise to 33.9 kPa. vacuum, then pinch hose. Vacuum in Chamber B should not rise over 3.39 kPa in 10 seconds.

3.12.5 Check Valve and Fourth Seal Test

Disconnect 9 mm vacuum supply from controller. If Chamber B vacuum drops, then pinch hose from Chamber B to vacuum chamber:

If Chamber B gauge no longer drops, but Chamber A gauge continues, then check valve is leaking.

If Chamber B gauge continues to drop, the fourth seal is leaking.

The check valve and fourth seal each should leak less than 3.33 kPa in 10 seconds.

3.12.6 Complete Controller Leak Test

Connect test tee to all controller ports, manometer and vacuum supply. Cap controller valve connection port. Pinch off vacuum supply. Leakage must be under 0.8 kPa per minute.

3.12.7 Sensor Diaphragm

Connect test tee to all controller ports, except sensor port, manometer and vacuum supply. Cap controller valve connection. Sensor port must not be capped. Pinch off vacuum supply. Leakage must not be greater than any leakage found in Step C.

3.13 TROUBLE SHOOTING

Malfunctions of the AIRVAC system can be divided into three (3) parts:

i. vacuum collection lines;
ii. AIRVAC valve; and
iii. collection station.

3.13.1 Vacuum Collection Lines

Malfunctions of the collection lines may be divided into three (3) categories:

a. break in the vacuum lines;
b. closed isolation valves and
c. AIRVAC valve malfunction.

The operator will observe a low vacuum in the station. He should then determine the cause of the low vacuum using the following approach.

Break in the Vacuum Line

Shut the vacuum mains isolation valve and observe the vacuum gauge to ascertain whether the leak is in the main of the collection tank/accessories. If the vacuum leak is determined to be in the mains system close the division valve on main in the street.

Usually due to excavation work being carried out in the area. Check utility companies for areas where work is in progress. Use isolation valves if necessary to locate leaks and repair.

Closed Isolation Valves

An isolation valve may accidentally be left shut in which case a section of vacuum line will not have vacuum. This will give the same symptoms as a valve(s) failed to open.

Close off the leaking line

Build–up the vacuum in the other lines to clear out as much sewage as possible. Close off the non–leaking lines. Open the leaking line. Go to the division valve located halfway on the leaking sewer. Close it off.
Go to each valve pit and by listening determine which valve is malfunctioning and correct the problem. Check on which side of the division valve the leak is located.

If no AIRVAC valves are found to be malfunctioning, a break in the vacuum piping exists. Check for underground construction in the area by utility companies and possible cutting of the lines.

3.13.1.3 AIRVAC Valve Malfunction

If the valve failed to close, it will show up as a low vacuum alarm.

If the valve failed to open, it will show up the same as a blocked gravity lateral, i.e. as the sump fills, the home owner will experience surcharging at yard gully.

3.13.2 AIRVAC Valve

When a fault is found to be due to a defective valve or controller, the complete valve or controller should be exchanged. The faulty unit can then be overhauled at the workshop or returned to AIRVAC for service.

3.13.2.1 Valve failed to close

Disconnect vacuum from controller. If the valve closed then:

a. Controller is faulty.

b. Pressure is present on the sensor due to blocked sensor line or a blocked suction line.

c. Breather line is restricted by dirt on vent dome or a water trap in breather line because of improper slope, or the breather line is broken and blocked.

If after checking above and the AIRVAC valve still fails to close, the fault is in the valve. Remove the valve and fit a spare. At the workshop strip the valve and check for a blocked controller port, damaged shaft or bearing, rags, rocks, etc., jammed in the body, nuts off shaft, etc. Repair and put valve into spare inventory.

3.13.2.2 Valve fails to open

Remove vacuum hose from the controller. Remove 16 mm breather hose from the controller air port and insert vacuum hose. If the valve opens, the problem is not in the valve.

If the valve does not open, check to ensure 16 kPa vacuum is available by fitting a vacuum gauge to the surge tank. If 16 kPa is not available, remove the surge tank to check if vacuum is available in sewer. If vacuum is available to the sewer, the problem is in the surge tank.

With no vacuum available at the sewer, the problem could be:

a. station failure;
b. closed isolation valve;
c. damaged vacuum sewer; or
d. AIRVAC valve open at a different location.

If the problem is not in the valve, re-connect the vacuum hose to the controller. Remove the hose from the 50 mm sensor cap and apply pressure at this hose to cycle the controller. If the AIRVAC valve opens, this indicates the problem is in the 50 mm sensor line. This line may be blocked or leaking.

On the combined holding tank and valve pit installation, pull out the 50mm sensor line and inspect for blockage or leakage.

If the valve fails to operate when pressure is applied to the sensor hose, the controller is faulty and should be replaced. Advise AIRVAC–RSM Pty Limited and return faulty item.

3.14 TROUBLE SHOOTING CHART (Figure 2–32)

3.14.1 AIRVAC Valve

The purpose of the AIRVAC valve is to isolate vacuum from the gravity lateral.

PROBLEMS

1.1 Nuts or Bolts Off Shaft

a. valve will not open

1.2 Shaft Out of Round, Nicked or Dirt Build–up

a. valve may not open
b. valve may not closed

1.3 Torn Rubber Diaphragm

a. valve will not open

1.4 Foreign Material in Wye Body

a. valve will not open
b. valve will not close

1.5 Defective Bearing

a. hanging valve on downward travel preventing closing

1.6 Broken Seat Preventing Valve from Closing

1.7 Not Adequate Vacuum to Seat Valve Causing Vacuum Leak

1.8 Blocked Dip Tube or Lower Housing Ports

a. valve will not close

PROBLEM	TEST AIRVAC VALVE COMPONENTS IN SEQUENCE FROM LEFT TO RIGHT.*									
AIRVAC VALVE WILL NOT OPEN	3.1	6.1	1.1	1.3	1.2	1.4	2.1	4.1	5.1	2.3
AIRVAC VALVE CYCLES	5.2	7.1	7.2	4.3	2.5					
AIRVAC VALVE WILL NOT CLOSE	1.4	1.5	1.6	1.7	1.8	2.2	4.2	5.2	1.2	

NUMBERS REFER TO ITEMS ON FOLLOWING PAGES

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TROUBLESHOOTING CHART

FIGURE 2-32

3.14.2 AIRVAC Controller/Sensor Unit

The purpose of the AIRVAC controller/sensor unit is to activate the valve.

PROBLEMS:

2.1 Valve Will Not Open

a. low vacuum (sump vent valve closed if present)
b. sensor air pressure blocked
c. sensor diaphragm damaged
d. 0.5 mm orifice blocked or tube kinked
e. water in sensor chamber
f. 2.5 mm air passage orifice blocked
g. leaking valve diaphragm

2.2 Valve Will Not Close

a. water in timing volume and needle valve
b. 2.5 mm air passage orifice blocked
c. needle valve closed or blocked
d. shaft in controller sticking
e. sensor seat leaking
f. 0.05 mm orifice blocked or tube kinked

2.3 Water in Sensor Line and Controller Fails

a. leaking sensor tubing connection or sensor diaphragm. Clamps on all connections
b. leaking surge suppressor

2.4 Unable to Adjust Controller for Long Timing (12 seconds)

a. leak in 3-way valve diaphragm loose on shaft (closing needle valve does not prevent controller from timing out).
b. cracked diaphragm plate
c. leaking Chamber B seal #4 (in field use when the valve is cycled, Chamber B vacuum will drop faster than usual because of dropping line vacuum if seal is leaking)
d. bad controller check valve – leaking
e. check valve in vacuum line to controller is leaking.

2.5 After Valve is Cycled and Closes, it Triggers Again for a Second Short Cycle

a. third seal is leaking
b. bad surge suppressor or excessive sensor line back pressure (consult AIRVAC)

2.6 Covering Valve Connection and the Atmosphere Port Sets off the Controller

a. bad #2 shaft seal – leaking
b. sensor seat leaking

2.7 Controller Works but Vacuum Flow is Low and Vacuum is Leaking through Atmosphere Port

a. bad shaft seal on air port #1

3.14.3 Surge Tank

The purpose of the surge tank is to prevent backwash due to differential pressure when the valve opens and the sewage passes.

PROBLEM

3.1 Valve Will Not Open

a. sewage in the surge tank inlet is blocking vacuum flow or check valves are reversed

3.14.4 50 mm Sensor Line

The purpose of the 50 mm sensor line is to trap air within to operate the sensor.

PROBLEM

4.1 Valve Will Not Open

a. no-hub clamp installed incorrectly
b. solvent bonded joints leak
c. Ø50 mm line too close to bottom of tank. If sensor line is closer to the bottom of the tank than the Ø80 mm suction line, a vacuum may be created in the sensor line.
d. 9 mm hose from 50 mm sensor cap to controller installed incorrectly or not clamped

4.2 Valve Will Not Close

a. line incorrectly graded, creating blockage holding pressure on sensor line.
b. Ø80 mm suction line blocked. Sewage not being removed from tank

4.3 Valve Cycles Frequently

a. length of Ø50 mm line too long
b. ground infiltration

3.14.5 Breather Line

The purpose of the breather line is to supply atmospheric air for the controller and valve operation.

PROBLEMS

5.1 Valve Will Not Open

a. 20 mm line blocked

5.2 Valve Will Not Close

a. 20 mm line blocked
b. screen on breather dome blocked

3.14.6 Vacuum

The purpose of vacuum is to operate the valve and to aid in the transport of sewage.

PROBLEMS

6.1 Valve Will Not Open

a. no vacuum at Collection Station
b. 9 mm vacuum hose blocked
c. surge tank blocked
d. isolation valve closed
e. broken vacuum line
f. less than 16 kPa vacuum available.

3.14.7 Gravity House Service Line

The purpose of the gravity house service line is to allow the sewage from the home to flow by gravity to the AIRVAC valve pit.

PROBLEMS

7.1 Valve Cycles a Second Cycle After Sensor is Triggered

a. excessive back pressure on gravity line due to extremely long gravity line. Install a special orifice in 50mm sensor cap to eliminate

7.2 Valve Cycles Several Cycles After Sensor is Triggered and When Vacuum Gauge is Hooked into Side Check Valve Hose Vacuum does not Drop on Air Cycle

a. gravity line is not properly laid, Pockets in gravity line are collecting sewage. When valve cycles, it empties holding tank, applies vacuum to gravity line and closes. Then sewage is pulled from gravity line pocket to tank which triggers valve.

3.14.8 Collection Station

A vacuum sewage collection station is similar to the district pumping station of a gravity scheme which is fed by several lift stations. The main difference is that the vacuum station is fitted with two (2) vacuum pumps.

Loss of Vacuum

PROBLEMS

8.1 If the vacuum is low and the vacuum pumps are running, the leak is in one of the sewers.

8.2 If no leaks are found in the sewers, the problem could be insufficient liquid inside the vacuum pumps (liquid ring vacuum pumps only) or leaking check valves.

8.3 Vacuum reading is low and the vacuum pumps are not running. The vacuum pumps will be 'locked off' by the high sewage level probe by overloads in the pump starters, by a faulty vacuum switch or no electric power present.

3.14.9 Discharge Pumps

PROBLEMS

9.1 Loss of Prime is the Main Problem Associated with the Discharge Pumps. This can be caused by:

a. incorrect or faulty seats fitted to the force main check valves
b. faulty mechanical shaft seals

c. seal pressurising system malfunction
d. blocked equalising line
e. leaking gaskets between the check valve flanges and the pump discharge connection
f. sand in collection tank

9.2 Pumps Locked Off by the Motor Overloads

a. This situation may be caused by a blocked pump or a pump in which a mechanical failure has occurred.

3.15 ADVICE WITH PROBLEMS

Any operator who is uncertain of the cause of any malfunction with the AIRVAC valve or system is requested to telephone AIRVAC for advice on (02) 417 8133.

3.16 AIRVAC EQUIPMENT RETURNED UNDER WARRANTY FOR WARRANTY

When AIRVAC valves or controller/sensor units are returned to the supplier, they should be tagged to indicate: (1) valve pit number and location; and (2) failure symptom(s).

All failures should be recorded on the AIRVAC valve card index .

3.17 RECORD KEEPING

Accurate records are essential for controlling operation and maintenance costs. AIRVAC recommends that, as a minimum, a register of consumer complaints, AIRVAC valve failures and collection station breakdowns should be made.

Each AIRVAC valve installation should be maintained with a card for each AIRVAC valve installation. These cards should list:

- AIRVAC valve installation reference number and date installed.
- AIRVAC controller/sensor reference number and date installed.
- Any AIRVAC valve malfunctions.
- Preventative maintenance due dates.
- Maintenance carried out.
- Details of any spare parts fitted.

Suggested layout for record register and cards shown in Figure 2–33 & 2–34.

3.18 CONTROLLER AND VALVE REPAIR REPORT FORMS

The following forms may be used by maintenance personnel to report their findings for later reference. Examination may find a valve frequently in for repair or other patterns.

3.19 TRAINING

Training of the system operators is an important part of any sewage scheme. The AIRVAC system will require no more maintenance than a high quality gravity system.

AIRVAC recommends that the system operator be available during the construction and commissioning phases of an AIRVAC system. At that time, the AIRVAC site representative will be available to give "on–the–job" training. AIRVAC is willing to train any replacement operators.

The AIRVAC training program includes:

- Installation of AIRVAC valve, valve pit, holding tanks, crossovers and sewers as most owners make minor additions to their system.
- Trouble shooting procedures. Faults are set up in the demonstration rig for trainees to locate and rectify.
- Record keeping.

3.20 AIRVAC EQUIPMENT PARTS LIST

The following detail of parts diagrams and ordering information.

Figure 2–35	Standard 75 mm Valve Package
Figure 2–36	Part No for 75 mm Valve for Above Ground Venting.
Figure 2–37	Parts List for 75 mm AIRVAC Valve
Figure 2–38	Exploded View 50 mm AIRVAC Valve
Figure 2–39	Parts List for 50 mm AIRVAC Valve
Figure 2–40	Exploded View of Controller
Figure 2–41	Parts List for Controller

LOCATION. LINE.

VALVE NUMBER

Maintenance Due.	Maintenance Completed.	SPARE PARTS USED.	Intials.

FRONT

FAILURES AND COMPLAINTS LOG.

Date	PROBLEM.	REASON.	REMEDY.	Initials.

REAR

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VALVE CARD INDEX

FIGURE 2-33

DATE AND TIME	HOURS RUN BY VACUUM PUMPS.			HOURS RUN BY SEWAGE PUMPS		Hours Run By Standby Generator.	Flow Meter.	Power Meter Reading.	WEATHER.	OPERATOR'S INITIALS.
	#1	# 2	#3	#1	#2					

DAILY OPERATING LOG

FAILURES & COMPLAINTS REGISTER

DATE AND TIME OF REPORT.	FAILURE OR COMPLAINT.	CAUSE.	SPARES USED.	Time Repairs Completed.	Operator's Signature.

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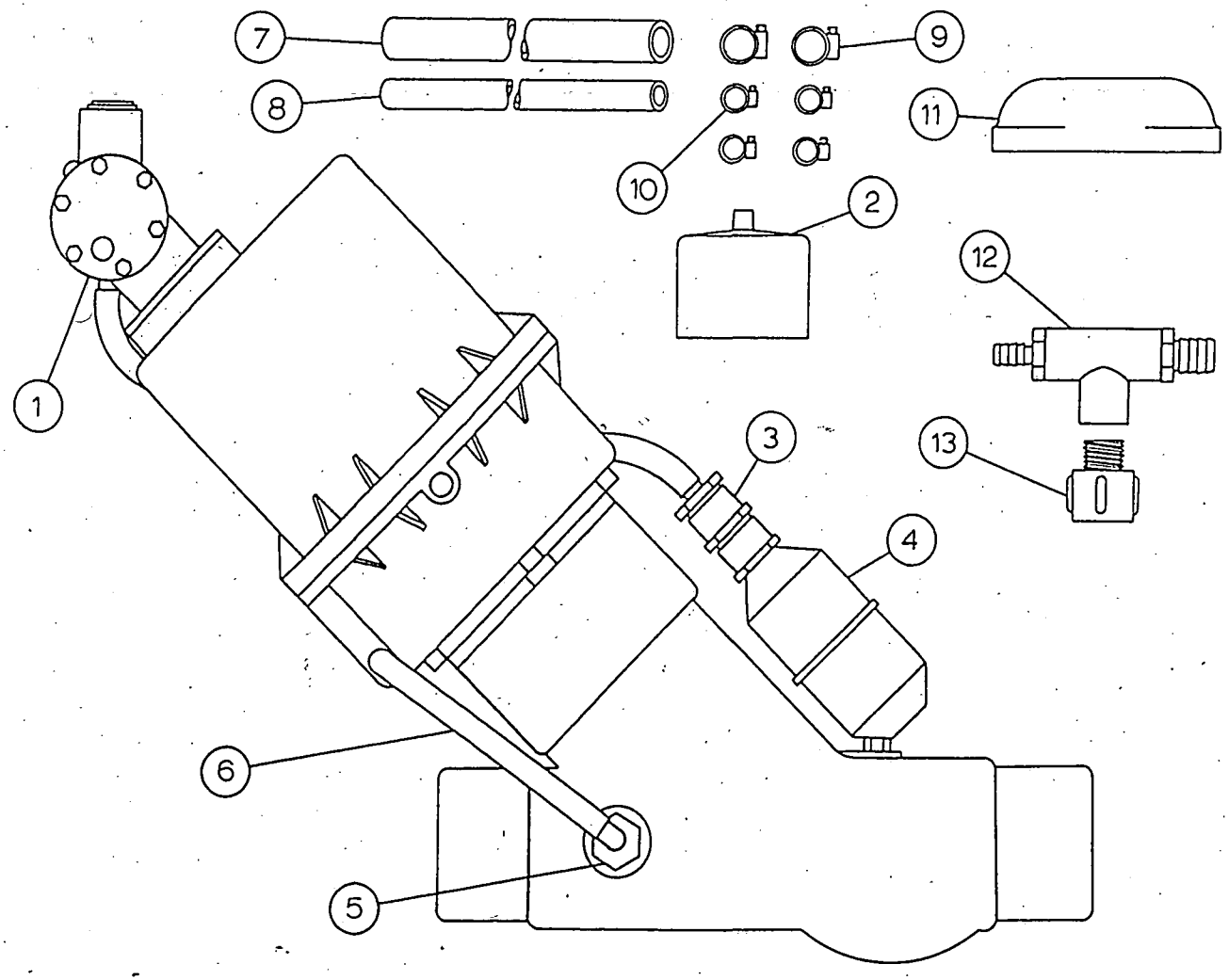
DAILY OPERATING LOG
FAILURES & COMPLAINTS REGISTER

FIGURE 2-34



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STANDARD 75mm VALVE PACKAGE

FIGURE 2-35

Item No.	Part Number	Part Description	No. Per Unit	Item No.	Part Number	Part Description	No. Per Unit
1	AC	AIRVAC® Controller/Sensor Unit	1				
2	ACS-1	2 inch Sensor Cap	1				
3	CHST-83	Surge Tank Check Valve	1				
4	ST-83	Surge Tank with Check Valve and Nipple	1				
5	CHLH-83	Lower Housing Check Valve	1				
6,8	38T	3/8" I.D. Tubing	7.5ft				
7	58T	5/8" I.D. Tubing	3 ft				
9	C58	5/8" Clamp	2				
10	C38	3/8" Clamp	4				
11	BD	Breather Dome	1				
12	BT	1/2" Breather Tee with 3/8" hose 5/8" hose adapter	1				
13	PV12	3/4" PVC Adapter	1				
14	ASP-D	Blue Colored - 'D' Model Sensor Surge Suppressor	1				

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PART NUMBERS FOR 75mm VALVES FOR ABOVE GROUND VENTING

FIGURE 2-36

Item No.	Part Number	Part Description	No. Per Unit	Item No.	Part Number	Part Description	No. Per Unit
1	AVD3-13B	Dip Tube	1	20	AVD-B-03	1/4" - 20 X 1-1/2" Bolt	2
2	AVD3-1B	Upper Piston Housing	1	21	AVD3-5B	Conical Plunger	1
3	AVD-HN-O	1/4" Hex Nut	10	22	AVD-R-OB	Rubber Valve Seat	1
4	AVD-LW-O	1/4" Lockwasher	10	23	AVD3-7B	Retaining Washer	1
5	AVD-SP-O	Spring	1	24	AVD-LN-1	1/2"-13 Locknut w/nylon insert	2
6	AVD3-3	Piston Cup	1	25	NST-83	Nylon tube adapter	1
7	AVD-D-O	Rolling Diaphragm	1	26	DD-83	Rubber duckbill check valve	2
8	AVD3-4	Piston Plate	1	27	RW-83	Rubber Washer	4
9	PTA-83 (Was WTSP-78)	3/8" Tubing Adapter	2	28	NMA-83	3/4" Nylon Adapter	4
10	AVD3-2	Lower Piston Housing	1	29	UCV-83	Rubber umbrella check valve	2
11	AVD-B-01	#1/4-20 x 1-1/4" bolt	2	30	STB-83	Surge Tank Body	1
12	AVD-S-02	O-ring	2	31	NNI-83	1/4" Nylon Nipple	1
13	AVD-SC-7B	#6-32 x 5/8" Hex Head Bearing Screw	3	32	AVD3-11	Wye Body	1
14	AVD3-12B	Bearing - Blue	1	33	NEL-83	Nylon Ell Tube Adapter	1
15	AVD-S-83	Wiper Shaft Seal	1	34	AVD-W-0	1/4" x 5/8" Flatwasher	8
16	AVD3-10	Screw Plug	1	35	AVD-S-014	014 O-ring	1
17	AVD-B-O2	1/4" - 20 x 3/4" SOCKET Head Cap Screw	6				
18	AVD3-SS	Stainless Steel Shaft	1				
19	AVD-W-1	1/2" x 1-1/8" Flatwasher	3				

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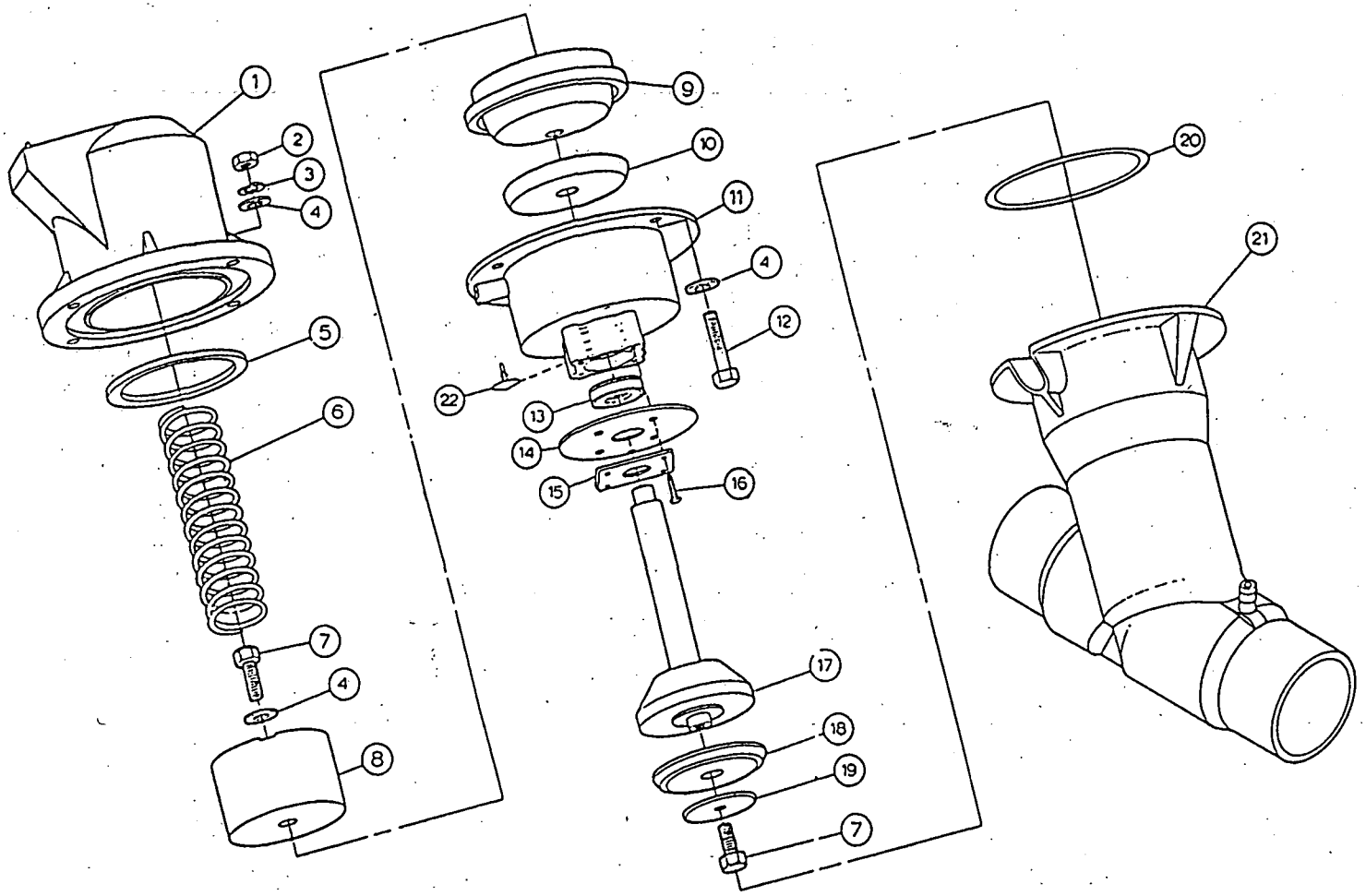
PARTS LIST FOR

75mm AIRVAC VALVE

FIGURE 2-37



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EXPLODED VIEW

50mm AIRVAC VALVE

FIGURE 2-38

Item No.	Part Number	Part Description	No. Per Unit	Item No.	Part Number	Part Description	No. Per Unit
1	AV2-6	Valve Bonnet	1	20	AV2-150R	O-Ring	1
2	AVD-HN-0	1/4" - 20 Hex Nut	4	21	AV2-1	Wye Body	1
3	AVD-LW-0	1/4" lockwasher	4	22	AVRU-2	Orange Silicone Rubber Umbrella	1
4	AVD-W-0	1/4" Washer	9		RW-32	Rubber Washer	1
5	AV2-230R	Square Ring	1		NMT-38	3/8" hose x 3/4" MPT Adapter	1
6	AV2-7S	Spring	1		NFT-38	3/8" hose x 3/4" FPT Adapter	1
7	AV2-LB-0	1/4"-20 x 3/4" Locking Bolt	2		UCV-83	Rubber Umbrella Check Valve and Plate Assembly	1
8	AV2-5	Diaphragm Cup	1				
9	AV2-11RD	Valve Diaphragm	1				
10	AV2-4	Diaphragm Plate	1				
11	AV2-2	Lower Housing	1				
12	AVD-B-02	1/4"-20 x 1-1/8" Bolt	4				
13	AVD-S-83	Shaft Seal	1				
14	AV2-12RB	Rubber Baffle/Gasket	1				
15	AV2-8M	Shaft Seal Retainer	1				
16	AV2-B-08	8-32 x 3/8" Bolt	4				
17	AV2-3	Shaft and Piston	1				
18	AV2-10RS	Valve Seat	1				
19	AV2-9M	Seat Retaining Washer	2				

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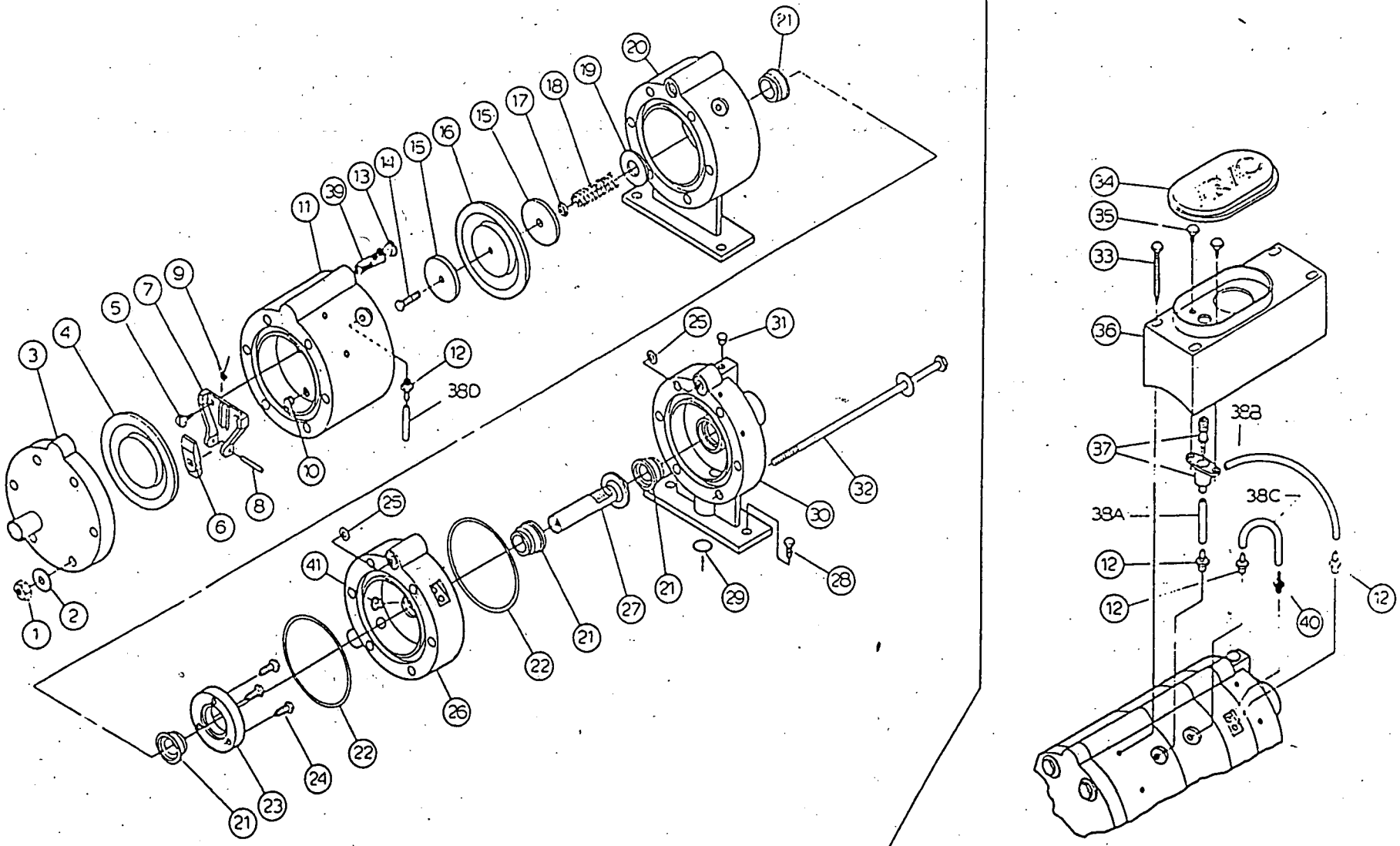
PARTS LIST FOR

50mm AIRVAC VALVE

FIGURE 2-39



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EXPLODED VIEW OF CONTROLLER

FIGURE 2-40

Item No.	Part Number	Part Description	No. Per Unit	Item No.	Part Number	Part Description	No. Per Unit
1,2, 32	AC-31	#10-24 x 4-5/8" Bolt Nut and Washers	6	21	AC-22	Shaft Seal	4
3	AC-1	Sensor End Plate	1	22	AC-39	031 O-Ring	2
4	AC-24	Sensor Diaphragm	1	23	AC-7	3rd Seal Mounting Plate	1
5	AC-32	#4 x 5/16" Self Tap Sensor Screw and Washer	2	24	AC-35	#6 x 3/8" Self Tap Screw 3rd Seal Mounting Plate	3
6	AC-14	Sensor Lever	1	25	AC-40	009 Air Passage O-Ring	2
7	AC-13	Sensor Base	1	26	AC-4	Vacuum Chamber	1
8	AC-33	.078" Dix. x 5/8" Roll Pin	1	27	AC-12	Shaft	
9	AC-17B	Sensor Spring	1	28	AC-38	#8-32 x 3/8" Hex Head Screw Mounting to Valve	2
10	AC-21	Sensor Seat	1	29	AC-42	013 Controller Mounting O-Ring	1
11	AC-2	Chamber A	1	30	AC-5	Air and Valve Connection	1
12	AC-26	1/16" Tubing Adapter for Solvent Welding (Yellow no/orifice)	3	31	AC-10	Air Passage Plug	1
13	AC-25	Sensor Variable Orifice Duckbill	1	33	AC-37	#8 x 1-1/2" Self Tap Screw Timer Box	4
14	AC-34	#6-32 x 1/2" Hex Head Shaft Screw	1	34	AC-15	Timer Cover	1
15	AC-9	Valve Diaphragm Plate	2	35	AC-36	#6 x 5/16" Self Tap Screw Needle Valve	2
16	AC-23	Valve Diaphragm	1	36	AC-11	Timer Box	1
17	AC-41	007 Shaft Screw O-Ring	1	37	AC-18	Needle Valve	1
18	AC-16S	Valve Spring	1	38	116T	1/16" Clear Tubing	12-3/8"
19	AC-8	Spring Washer	1	39	AC-43	Air Passage Filter	1
20	AC-3	Chamber B	1	40	AC-27	1/16" Tubing Adapter for Solvent Welding (Black w/orifice)	1
				41	AC-46	Umbrella Check Valve	1

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PARTS LIST FOR CONTROLLER

FIGURE 2-41

SECTION 4

EAGLEVIEW INDUSTRIAL PARK VACUUM SEWERAGE SCHEME

SIEMENS VACUUM PUMPS

1 SIEMENS VACUUM PUMPS

Material No.	...	00518861
Catalogue No.	...	2BV2 071-0NC23-1P 415V 50Hz 3.85kW ELMO-F

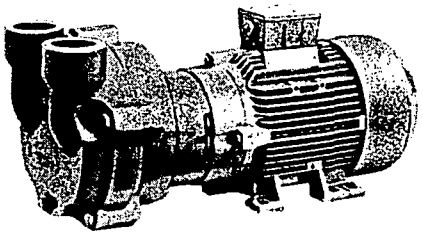
SIEMENS

ELMO-F-Vakuumpumpen 2BV2

ELMO-F vacuum pumps
Pompes à vide ELMO-F
Bombas de vacío ELMO-F
Pompe a vuoto ELMO-F
ELMO-F-vakuumpumpar

Betriebsanleitung/Instructions
Reparaturanleitung/Repair Instructions

EWN-Bestell-Nr./Order No. 610.41184/21 b



Betriebsanleitung

Beschreibung

Anwendung und Betriebsbedingungen

Die Vakuumpumpen sind einstufige Flüssigkeitsring-Gaspumpen in Blockbauform. Sie sind für Dauerbetrieb ausgelegt. Als Betriebsflüssigkeit wird normalerweise Wasser, in Sonderfällen werden auch Säuren, Laugen, Lösungsmittel usw. verwendet (der Werkstoff der Pumpenteile muß den aggressiven Betriebsflüssigkeiten oder aggressiven Gasen angepaßt sein). Geringe Mengen leichter Schwebstoffe oder Flüssigkeiten können mitgefördert werden. Bei größeren Mengen sind Abscheider vorzuschalten.

Bei ELMO-F-Vakuumpumpen mit (Ex)e-G3-Motoren sind die entsprechenden Sicherheitsvorschriften zu beachten.

Der kleinste Ansaugdruck der Vakuumpumpen beträgt – bei Wasser von 15 °C als Betriebsflüssigkeit – 40 mbar (30 Torr), bei vorgeschalteten Gasstrahlern 11 mbar (8 Torr).

Die Betriebsflüssigkeit (vorwiegend Wasser) muß frei von Fremdkörpern sein. Sie wird zum Teil mit dem Gas aus dem Druckstutzen ausgeschoben und muß deshalb laufend ergänzt werden. Die Temperatur der Betriebsflüssigkeit beeinflußt das Saugvermögen. Sie sollte mit 5 bis 15 °C der Pumpe zugeführt werden. Die Vakuumpumpe saugt die Betriebsflüssigkeit auch selbsttätig bis zu einer Saughöhe von ca. 1 m an. Die Druckleitung darf bei Betrieb ohne aufgebauten Abscheider nicht mehr als 0,5 m über Pumpendruckstutzen geführt werden bzw. der Gegendruck darf 1,1 bar (absolut) nicht überschreiten.

Bauart und Wirkungsweise

Die Pumpe arbeitet nach dem Flüssigkeitsringprinzip. In einem exzentrisch zur Welle gelegenen, zylindrischen Pumpengehäuse ist ein Laufrad angeordnet, welches die Antriebsleistung auf einen Flüssigkeitsring überträgt, der sich beim Inbetriebsetzen der Pumpe konzentrisch zum Gehäuse bildet.

Bei Bewegung der Flüssigkeit nach außen wird Gas durch den Saugschlitz in der Steuerscheibe angesaugt, nach innen verdichtet und durch den Druckschlitz in der Steuerscheibe ausgeschoben.

Instructions

Description

Application and operating conditions

The vacuum pumps are single-stage liquid-ring gas pumps of monobloc construction, designed for continuous operation. The working liquid is normally water, but in special cases acids, alkalis and solvents etc. may be used (the material of the pumps must then be suitable for aggressive liquids or gases). Small amounts of light suspended matter or liquids can be entrained (but if these amounts are large, separators must be fitted on the upstream side).

In the case of ELMO-F vacuum pumps with (Ex)e G3 motors, the appropriate safety regulations must be observed.

The suction pressure of the vacuum pumps must not be less than 40 mbar (30 Torr) if water at 15 °C is used as working liquid. If a gas ejector is fitted, the minimum suction pressure is 11 mbar (8 Torr).

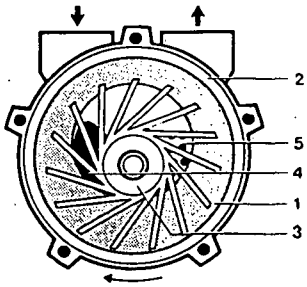
The working liquid (usually water) must not contain any foreign matter. Part of it is expelled with the gas from the discharge nozzle and must therefore be continually replaced. As the temperature of the working liquid affects the suction capacity, the liquid should be supplied to the pump at 5 to 15 °C. The vacuum pump is, however, self-priming up to a suction head of approximately 1 m. If a separator is not used, the maximum height of the discharge line above the pump discharge nozzle should not exceed 0.5 m nor the backpressure a value of 1.1 bar (absolute).

Type of construction and mode of operation

The pump operates on the liquid-ring principle. An impeller is fitted in a cyclindrical casing which is arranged off centre to the shaft. The impeller transfers the drive power to a liquid ring which rotates concentrically to the casing when the pump is started up.

When the working liquid is flung outwards, the gas is drawn in through the suction port in the port plate, compressed, and then forced out through the discharge port in the port plate.

1 Flüssigkeitsring
2 Pumpendeckel
3 Laufrad
4 Saugschlitz
5 Druckschlitz



Schematischer Schnitt durch den Arbeitsraum (vom Motor her gesehen)

1 Liquid ring
2 Pump cover
3 Impeller
4 Suction port
5 Discharge port

Section through the compression chamber (viewed from the motor)

Die Welle ist mit einer Gleitringdichtung abgedichtet. Als Lager sind Rillenkugellager eingebaut.

The shaft is sealed off with sliding-ring packings. The pumps have deep-groove ball bearings.

Betriebsflüssigkeit

Die Pumpe benötigt während des Betriebes laufend Betriebsflüssigkeit (im Normalfall Wasser). Sie wird zum Teil mit dem verdichteten Gas durch den Druckstutzen in den Abscheider ausgeschoben. Der Flüssigkeitsring muß deshalb kontinuierlich durch neue, kühle Betriebsflüssigkeit ergänzt werden. Neben der eigentlichen Arbeitsfunktion des Flüssigkeitsringes hat die Betriebsflüssigkeit die Aufgabe, die Verdichtungswärme abzuführen, die Spalte zwischen Laufrad und Steuerscheibe abzudichten und die Gleitringdichtung zu schmieren.

Die Temperatur der Betriebsflüssigkeit beeinflußt das Saugvermögen. Je niedriger die Temperatur ist, desto mehr wird das Saugvermögen durch Kondensation der Dampfanteile aus dem Fördergas erhöht. Deshalb ist möglichst kühle Betriebsflüssigkeit (in der Regel Wasser von 5 °C bis 15 °C) der Pumpe zuzuführen. Eine Betriebsflüssigkeitstemperatur von > 15 °C mindert das Saugvermögen der Pumpe gegenüber den Listendaten; sie darf 80 °C nicht überschreiten.

Bezüglich der Betriebsflüssigkeitsart ist zu beachten, daß die von der Flüssigkeit berührten Teile hinsichtlich des Werkstoffes geeignet sind bzw. angepaßt werden müssen. – Bitte anfragen!

Die Betriebsflüssigkeit muß frei von Feststoffen, wie z. B. Sand, sein, da sonst starker Verschleiß im Gehäuse auftritt.

Montage und Bedienung

Aufstellung

Zum Schutz der Motoren gegen Überlastung sind stets Motorschutzschalter zu verwenden. Diese müssen auf den im Leistungsschild angegebenen Nennstrom eingestellt sein.

In der Saugleitung ist eine mit möglichst geringem Widerstand ausgelegte Rückschlagklappe (4, siehe Seite 3) vorzusehen, um ein Rückströmen von Gas oder Betriebsflüssigkeit bei Betriebsunterbrechungen zu vermeiden.

Zum Einstellen des Betriebsflüssigkeitsstromes ist in die Flüssigkeitsleitung nach dem Absperrventil (11) ein Regelventil (10) einzubauen, welches nach dem Einstellen nicht mehr betätigt wird und so einen gleichmäßigen Betriebsflüssigkeitsstrom gewährleistet.

Die druckseitig abzuleitende Betriebsflüssigkeit sollte zur Kontrolle über Trichter abgeführt werden.

Schaltungen

a) Kühlschaltung
wird bevorzugt, wenn genügend Betriebsflüssigkeit zur Verfügung steht und ein niedriger Ansaugdruck erzielt werden soll. Die zugeführte Betriebsflüssigkeit wird druckseitig vollständig abgeleitet und durch neue Flüssigkeit ersetzt.

b) Sparschaltung (mit Abscheider)
wird verwendet, um Betriebsflüssigkeit zu sparen. Ein Teil der im Abscheider abgeschiedenen Betriebsflüssigkeit wird der Vakuumpumpe ungekühlt wieder zugeleitet, der andere Teil wird durch neue Flüssigkeit ersetzt. Die dazu notwendige Verteilleitung wird mit dem Abscheider geliefert.

c) Vorschalten eines Gasstrahlers
wird angewandt, wenn Ansaugdrücke kleiner 40 mbar (30 Torr) benötigt werden. Kleinster Ansaugdruck bei Wasser von 15 °C als Betriebsflüssigkeit 11 mbar (8 Torr).

d) Schaltung für Pumpen mit Kavitationsschutz
wird angewandt, wenn Kavitationsgeräusche auftreten (überhöhte Betriebsflüssigkeitstemperatur bzw. bei Dampfabsaugung). An der Kavitationsschutzöffnung (17) kann bei größeren Ansaugdrücken Wasser und Geräusch austreten. Es ist deshalb eine Leitung (18) so zu verlegen, daß diese in den Abscheider oder in den Betriebsflüssigkeitsablauf mündet. Es muß gewährleistet sein, daß durch diese Leitung nur Luft angesaugt werden kann. Deshalb ist darauf zu achten, daß diese Leitung nicht unterhalb der Betriebsflüssigkeitsoberfläche endet.

Working liquid

The pump requires working liquid (normally water) during operation. Some of this is expelled together with the compressed gas to the separator through the discharge nozzle. The liquid ring therefore has to be continually replenished with fresh, cool working liquid. Besides its proper function of making up the liquid ring, the working liquid also dissipates the heat developed by compression, seals the gap between the impeller and the port plates and lubricates the sliding-ring packing.

The suction capacity depends on the temperature of the working liquid. The lower the temperature the higher the suction capacity rises due to condensation of the vapour content of the medium. For that reason working liquid which is as cool as possible should be employed (normally water at 5 to 15 °C). A working-liquid temperature above 15 °C reduces the suction capacity of the pump as stated in the performance data; it must not exceed 80 °C.

With respect to the type of working liquid, care must be taken to see that parts coming into contact with the liquid are of suitable material. If necessary, please enquire.

The working liquid must not contain any solid materials, e.g. sand, otherwise the casing will be subjected to heavy wear.

Installation and operation

Setting up

Motor protection circuit-breakers should always be fitted to safeguard the motors against overload. These must be set to the rated current given on the rating plate.

A check valve (4; see page 3) designed to offer as little resistance as possible should be fitted in the suction pipe to prevent gas or working liquid from flowing back into the pump if operations is interrupted.

A control valve (10) should be fitted in the working-liquid pipe downstream of the shut-off valve (11) in order to control the working-liquid flow. To ensure uniform flow this value should not be readjusted.

The working liquid to be carried away on the pressure side should be drained off through funnels to enable it to be checked.

Working liquid connections

a) Cooling-circuit connection
This is preferred where there is an ample supply of working liquid and where a low suction pressure is required. The working liquid discharged from the pump is completely drained off and replaced by fresh liquid.

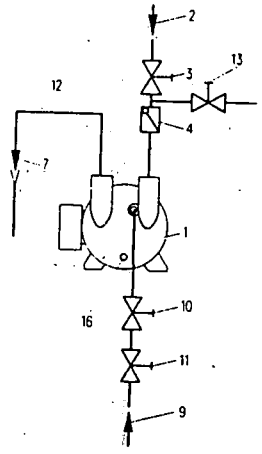
b) Economy-circuit connection (with separator)
This connection is used where working liquid must be used sparingly. Part of the working liquid recovered from the discharge in the separator is recirculated to the pump without cooling, the remainder being replaced by fresh liquid. The required distribution pipe is supplied with the separator.

c) Fitting a gas ejector
This connection is used where suction pressures below 40 mbar (30 Torr) are required. The minimum suction pressure with water at 15 °C used as a working liquid is 11 mbar (8 Torr).

d) Connection for pumps with cavitation protection
This connection must be employed if the sound of cavitation has been heard (caused by excessive working-liquid temperature or by the extraction of vapour). Water may flow out of the anti-cavitation hole (17) and noise may also be heard at extremely high suction pressures. A line (18) must therefore be laid which terminates either in the separator or the working-liquid drain. Steps must be taken to ensure that this line sucks in air only, for which reason it is essential to prevent it from terminating below the surface of the working liquid.

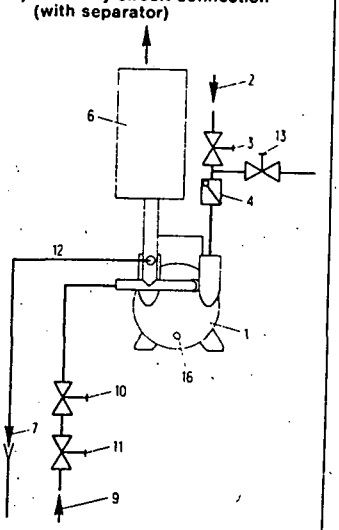
a) Kühlschaltung

a) Cooling-circuit connection



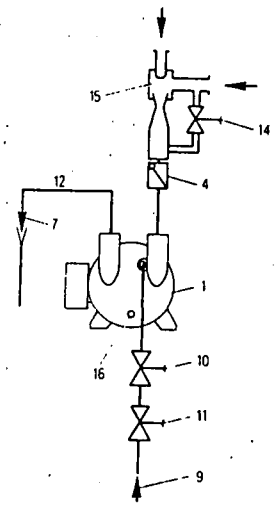
b) Sparschaltung (mit Abscheider)

b) Economy-circuit connection (with separator)



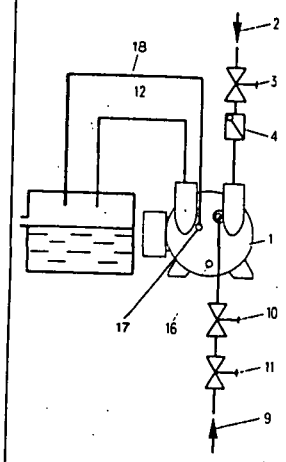
c) Vorschalten eines Gasstrahlers

c) Fitting a gas ejector



d) Schaltung für Pumpen mit Kavitationsschutz

d) Connection for pumps with cavitation protection



1 ELMO-F-Vakuumpumpe
2 Saugleitung
3 Schieber
4 Rückschlagklappe
6 Flüssigkeitsabscheider
7 Überlauf
9 Betriebsflüssigkeitszuführung
10 Regelventil
11 Absperrventil (Magnetventil)
12 Druckleitung
13 Luftschnüffelventil
14 Schieber (bei Bedarf)
15 Gasstrahler
16 Spül- und Entleerungsbohrung
17 Kavitationsschutzöffnung
18 Leitung

1 ELMO-F vacuum pump
2 Suction line
3 Shut-off valve
4 Check valve
6 Separator
7 Overflow
9 Working-liquid feed
10 Control valve
11 Shut-off valve (solenoid)
12 Discharge line
13 Blow valve
14 Shut-off valve (as required)
15 Ejector
16 Flushing and draining outlet
17 Anti-cavitation hole
18 Line

Erste Inbetriebnahme

Alle Anschlußöffnungen sind bei Lieferung verschlossen, um ein Eindringen von Fremdkörpern zu vermeiden. Die Verschlüsse sind erst beim Anbringen der Rohrleitungen zu entfernen. Beim Anbau der Rohrleitungen an die Pumpe und an den Flüssigkeitsabscheider sind Verspannungen zu vermeiden.

Schieber (3) schließen.

Regelventil (10) und Absperrventil (11) öffnen und Vakuumpumpe mit Betriebsflüssigkeit auffüllen.

Soll die Betriebsflüssigkeit selbst angesaugt werden, so ist die Pumpe über den Saug- oder Druckstutzen mit Betriebsflüssigkeit aufzufüllen.

Pumpe nicht trocken laufen lassen!

Pumpe kurz einschalten – Drehrichtung prüfen (Vergleich der Drehrichtung des Motorlüfters (501 A; siehe Seite 24) mit Pfeil auf Pumpengehäuse (002 A)).

Schieber (3) öffnen.

Pumpe einschalten.

Nennbetriebsflüssigkeitsstrom überprüfen und evtl. mit Regelventil (10) korrigieren.

Einstellen des Betriebsflüssigkeitsstromes:
Während einer Zeiteinheit ist der am Überlauf (7) austretende Betriebsflüssigkeitsstrom in ein Gefäß zu leiten und auszulitern oder mit einem Flüssigkeitsmengenmesser einzustellen.

Typ	Nennbetriebsflüssigkeitsstrom (Wasser)			
	Kühlschaltung		Sparschaltung	
2 BV	m³/h	l/min	m³/h	l/min
2060	0,20	3,3	0,12	2,0
2061	0,23	3,8	0,12	2,0
2070	0,28	4,7	0,15	2,5
2071	0,45	7,5	0,25	4,2

Sofern Pumpe stark zu kreischen beginnt (Kavitationsgeräusch), ist am Schnüffelventil (13) so viel Luft einzulassen, bis das Geräusch zurückgeht.

Initial operation

All the openings of the pump are closed off at the factory to prevent the ingress of foreign bodies. These plugs should not be removed until the lines are fitted. When fitting the lines to the pump and separator ensure that they are not subjected to stress or tension.

Close shut-off valve (3).

Open control valve (10) and shut-off valve (11) and fill vacuum pump with working liquid.

If the pump is to run in self-priming operation, fill it with working liquid via the suction or discharge nozzles.

Never let the pump run dry.

Switch on motor briefly – check direction of rotation (compare direction of rotation of motor fan (501 A; see page 24) with arrow on pump casing (002 A).

Open shut-off valve (3).

Switch on pump motor.

Check working-liquid flow rate and correct with control valve (10) if necessary.

Adjusting the flow rate:
Collect working-liquid discharge from overflow (7) in a vessel over a given period and measure in litres or alternatively fit a flow meter.

Type	Working-liquid flow rate (water)			
	Cooling connection		Economy connection	
2 BV	m³/h	l/min	m³/h	l/min
2060	0.20	3.3	0.12	2.0
2061	0.23	3.8	0.12	2.0
2070	0.28	4.7	0.15	2.5
2071	0.45	7.5	0.25	4.2

If the pump starts to screech (cavitation) admit air through the blow valve (13) until the noise decreases.

Anfahren und Abstellen

Anfahren: Pumpe einschalten – sofort Absperrventil (11) öffnen.

Abstellen: Absperrventil (11) schließen – Pumpe sofort ausschalten.

Achtung: Wird die Pumpe bei einem Eintrittsdruck < 100 mbar abgeschaltet, so ist die Saugseite (zwischen Rückschlagklappe (4) und Pumpe (1)) gleichzeitig mit dem Abschalten der Pumpe zu belüften. (Nicht erforderlich bei Pumpen mit Kavitationsschutz.)

Bei automatischem Betrieb ist das Absperrventil (11) durch ein vom Motorbetrieb abhängiges Magnetventil in der Betriebsflüssigkeitszuleitung zu ersetzen. Dabei bedeutet Pumpe eingeschaltet = Ventil offen, und Pumpe ausgeschaltet = Ventil geschlossen.

Das Regelventil (10) bleibt bei Betriebsunterbrechung eingestellt.

Betriebshinweise

Pumpe nicht trocken laufen lassen!

Bei einem Betriebsflüssigkeitsstrom von > 2,5 x Nennbetriebsflüssigkeitsstrom oder bei Überschreitung des Gegendruckes von 1,1 bar (absolut) wird der Motor überlastet.

Bei Absaugung von heißen Gasen und Dämpfen ab 80 °C empfehlen wir eine Erhöhung des Betriebsflüssigkeitsstromes bis auf das max. 2,5fache oder einen Vorkondensator.

Gelangt mit dem geförderten Gas oder der Betriebsflüssigkeit feinkörniger Schmutz in die Pumpe, so kann dieser während des Betriebes durch die unten liegende Spülbohrung G ¼ (siehe 16 bei „Schaltungen") ausgespült werden, um den Verschleiß des Laufrades (047 A; siehe Seite 24) und Pumpengehäuses (002 A) bzw. Festsetzen des Laufrades (047 A) zu verhindern.

Bei festsitzendem Laufrad (047 A) ist in das Wellenende auf der Außenlüfterseite eine Schraube M 10 bzw. M 12 einzudrehen. Damit kann die Welle freigedreht werden (Lüfterhaube (500 A) vorher abnehmen). **Achtung!** Vor dem Einschalten ist die Schraube wieder zu entfernen und die Lüfterhaube (500 A) wieder aufzusetzen.

Wartung

Allgemeines

Falls stark kalkhaltiges Wasser als Betriebsflüssigkeit verwendet wird, ist die Betriebsflüssigkeit zu enthärten oder die Vakuumpumpe in entsprechenden Zeiträumen mit einem Entkalker zu spülen.

Vor längerem Stillstand (ca. 4 Wochen) oder bei Frostgefahr Pumpe komplett entleeren und anschließend konservieren, d. h., ½ Liter Konservierungsmittel in Saug- oder Druckstutzen gießen und Pumpe kurz einschalten. Sollte das Laufrad trotzdem einmal festsitzen, empfehlen wir, die Pumpe mit 10prozentiger Oxalsäure zu füllen und diese ca. 30 Minuten einwirken zu lassen.

Schmierung

Unter normalen Betriebsbedingungen (50 Hz) für Motorisolierstoffklasse B oder F gilt:
Nach etwa 10 000 Betriebsstunden, jedoch nach maximal 2½ Jahren, sind die Rillenkugellager (007 A und 008 A) und benachbarten Fetträume von Altfett und anderen Verunreinigungen zu säubern. Lager und angrenzende Fetträume in Nilos-Ring (032 A), Lagerdeckel (027 A) und Lagerschild (400 A) sind mit neuem Fett zu versehen.

Fettsorte: Mikrogel Wälzlagerfett Aero Shell Grease 16 oder gleichwertiges Schmierfett DIN 51825/DIN 51502-KTC E 2 R (Schmierfett auf Syntheseölbasis).
Fettfüllung: Ca. 50 % des freien Raumes im Rillenkugellager und ca. ⅔ des benachbarten Fettraumes im Nilos-Ring (032 A), im Lagerdeckel (027 A) und im Lagerschild (400 A); siehe Seite 25.

Das Mischen verschiedener Fettsorten ist zu vermeiden.

Starting-up and shutting-down

Starting-up: Switch on motor and immediately open shut-off valve (11).
Shutting-down: Close shut-off valve (11) and immediately switch off motor.

Note: If the pump is shut down at a suction pressure of less than 100 mbar, the suction side (between check valve (4) and pump (1)) should be vented while the motor is switched off. This is not necessary in the case of pumps with cavitation protection.

In automatic operation the shut-off valve (11) is replaced by a solenoid valve in the working-liquid feed line whose operation depends on the motor, i.e. when the latter is switched on the valve is open and when it is switched off the valve is closed.

The control valve (10) remains closed during a pause in operation.

Operating guidelines

Never let the pump run dry.

The motor will be overloaded if the working-liquid flow exceeds 2.5 times the rated value or the maximum backpressure (absolute) of 1.1 bar.

When pumping gases and vapours at high temperatures (from 80 °C upwards), we recommend fitting an upstream condenser or raising the working-liquid flow rate by a maximum of 2½ times the normal rate.

If fine-particled dirt is borne into the pump together with the gas or working liquid, it can be washed out during operation through the flushing outlet G¼ underneath (see diagram, part 16 in "Working-liquid connections") in order to prevent wear to the pump casing (002 A) and the impeller (047 A; see page 24) and also to obviate seizing of the latter.

If the impeller jams, an M10 or M12 bolt should be screwed into the shaft extension on the motor fan side so that the shaft can be turned freely (remove the fan cowl (500 A) first).

Warning: Before switching on remove the bolt and replace the fan cowl.

Maintenance

General remarks

If very hard water is used as a working liquid, it must either be softened or the vacuum pump flushed with a deliming agent at appropriate intervals.

Before long shutdowns (approximately 4 weeks) or if there is any risk of freezing, the pump should be completely drained and half a litre of anti-corrosive solvent poured into the suction or discharge nozzle and the pump then briefly switched on. Should the impeller nevertheless seize, we recommend that the pump be filled with a 10 % solution of oxalic acid and that this be left to act for approximately 30 minutes.

Lubrication

The following applies to normal operating conditions (50 Hz) and class B or F insulation:
Proceed as follows after approximately 10 000 hours of operation or a maximum of 2½ years: The deep-groove ball bearings (007 A and 008 A) and the adjacent grease chambers should be cleaned of old grease and other impurities, after which the bearings and grease chambers in the Nilos ring (032 A), bearings cap (027 A) and endshield (400 A) should be regreased.

Types of grease: Microgel rolling-contact bearing grease, Aero-Shell Grease 16 or equivalent to DIN 51825/DIN 51502 - KTC E 2 R (grease on a synthetic oil base).
Grease charge: approximately 50 % of the empty space in the deep-groove ball bearing and approximately ⅔ of the adjacent grease space in the Nilos ring (032 A), in the bearing cap (27 A) and in the endshield (400 A); see page 25.

Do not mix different types of grease.

Störungen und deren Beseitigung

Störungen	Ursache	Abhilfe
Motor läuft nicht an, kein Laufgeräusch	Unterbrechung in mindestens zwei Leitungen der Stromversorgung	Sicherungen, Klemmen und Zuleitung prüfen
Motor läuft nicht an, Brummgeräusch	Unterbrechung in einer Leitung der Stromversorgung Pumpe sitzt fest	Sicherungen, Klemmen und Zuleitung prüfen Pumpe durchdrehen (siehe unter „Betriebshinweise"), evtl. entleeren und säubern (siehe unter Rep.-Anltg. Pkt. 1.1 und 1.2, wobei das Ausdrücken der evtl. im Deckel festsitzenden Steuerscheibe entfällt), oder siehe auch „Pumpe blockiert".
Pumpe blockiert	Laufrad festsitzend Laufrad defekt Pumpe verkalkt Motorlager defekt	Siehe „Motor läuft nicht an, Brummgeräusch" Laufrad ersetzen (siehe Rep.-Anltg. Pkt. 2.1 u. 2.2) siehe unter Wartung Lager ersetzen (siehe Rep.-Anltg. Pkt. 4.1 und 4.2)
Motorschutzschalter löst nach Einschalten wieder aus	Kurzschluß in der Wicklung Motor überlastet Gegendruck im Druckstutzen zu hoch mitgeförderter Flüssigkeitsanteil zu hoch Pumpe sitzt fest	Wicklung prüfen lassen Betriebsflüssigkeitsstrom drosseln Gegendruck verkleinern Flüssigkeitsanteil verkleinern Siehe „Motor läuft nicht an, Brummgeräusch" oder „Pumpe blockiert"
Pumpe erzeugt kein Vakuum	keine Betriebsflüssigkeit vorhanden große Undichtheit in der Anlage falsche Drehrichtung	Zufuhr des Betriebsflüssigkeitsstromes am Überlauf prüfen Anlage abdichten Drehrichtung ändern durch Vertauschen von 2 elektr. Anschlußleitungen
Pumpe erzeugt zu geringes Vakuum	Pumpe zu klein Betriebsflüssigkeitsstrom zu gering Betriebsflüssigkeit zu warm >15 °C Gasstrahler nicht passend Gasstrahler verschmutzt kleine Undichtheit in der Anlage Gleitringdichtung undicht	größere Pumpe einsetzen Betriebsflüssigkeitsstrom bis zum 2,5fachen erhöhen Betriebsflüssigkeitsstrom kühlen bzw. erhöhen passenden Gasstrahler einsetzen Gasstrahler reinigen Anlage abdichten Gleitringdichtung überprüfen
Anomale, kreischende Geräusche	Kavitation der Pumpe Betriebsflüssigkeitsstrom zu groß	am Luftschnüffelventil mehr Luft einlassen oder Gasstrahler vorschalten Betriebsflüssigkeitsstrom prüfen und reduzieren
Pumpe undicht	Dichtungen	Dichtungen überprüfen

Reparaturanleitung

()-Angaben siehe Seite 24

Allgemein

Achtung! Vor Beginn der Arbeiten ELMO-F-Vakuumpumpen sichtbar vom Netz trennen. Saug-, Druck- und Betriebsflüssigkeitsleitungen (2,9 und 12, siehe Seite 3) entfernen und nach Beendigung aller Arbeiten unverspannt wieder anschließen. Es empfiehlt sich, vor Demontagearbeiten die Pumpe zu entkalken! Bei Reparatur alle Teile gründlich reinigen, evtl. nacharbeiten und auf Wiederverwendbarkeit prüfen.

ELMO-F-Vakuumpumpen in (Ex)e-Ausführung dürfen nur in von der PTB anerkannten Werkstätten repariert bzw. müssen von einem Sachverständigen abgenommen werden.

Faults and their remedy

Fault	Cause	Remedy
Motor does not start, no running sound	Fault in at least two phase conductors	Check fuses, terminals and supply line
Motor does not start. Humming sound	Fault in one phase conductor Pump jammed	Check fuses, terminals and supply line Rotate pump by hand (see "Operating guidelines"), drain and clean (see "Instructions for repairs", Points 1.1 and 1.2, it not being necessary to press out the port plate jammed in the cover). See also "Pump blocked".
Pump blocked	Impeller jammed Impeller defective Pump furred by hard water Motor bearing defective	See "Motor does not start, Humming sound" Replace impeller (see "Instructions for repairs", Point 2.1 and Point 2.2) See "Maintenance" Replace bearing (see "Instructions for repairs", Points 4.1 and 4.2
Motor-protection circuit-breaker trips after switching on	Interturn short-circuit Motor overloaded Backpressure at discharge nozzle too high Proportion of entrained liquid too high Pump jammed	Have winding checked Reduce working-liquid flow rate Reduce backpressure Reduce proportion See "Motor does not start. Humming sound" or "Pump blocked"
Pump does not produce e vacuum	No working liquid available Serious leak in the system Incorrect direction of rotation	Check working liquid at overflow Seal system Reverse direction of rotation by interchanging two phase leads
Pump produces insufficient vacuum	Pump too small Working-liquid flow rate too low Working liquid too warm (above 15 °C) Gas ejector not suitable Gas ejector dirty Small leaks in system Sliding-ring packing defective	Use larger pump Increase rate by up to 2.5 times Cool working liquid or increase rate Fit suitable gas ejector Clean it Seal system Check sliding-ring packing
Unusual screeching noise	Pump cavitating Working-liquid flow rate too high	Let more air through blow valve or fit gas ejector Check and reduce working-liquid flow rate
Pump leaking	Seals	Check seals

Instructions for repairs

(For Nos. in () see page 24)

General remarks

Note: Before beginning any work on the ELMO-F vacuum pumps isolate them from the supply. Remove suction, pressure and working-liquid lines (2,9 and 12, see page 3) and after conclusion of repairs connect them up again, ensuring that they are not subjected to stress or tension. It is recommended that the pump be delimed before dismantling it. When conducting repairs, clean all parts thoroughly, remachine them if necessary and check them for further use.

(Ex)e ELMO-F vacuum pumps must be repaired only in workshops approved by the German Federal Testing Authority (PTB) or be acceptance tested by an authorized offical.

1.1 Demontage der Deckeldichtung bzw. Steuerscheibe

Pumpe senkrecht auf Lüfterhaube (500 A) stellen; Schrauben (063 A) lösen; Pumpendeckel (061 A) abnehmen; Steuerscheibe (048 B) mit Dichtung (057 A), Fangplatte (051 A) und Ventilplatte (050 A) abnehmen und voneinander trennen. Bei festsitzender Steuerscheibe (048 B) im Pumpendeckel (061 A) kann durch die Spülbohrung (16, siehe Seite 3) mit einem Bolzen ø 10 x 24 lang für 2BV206. bzw. ø 10 x 30 lang für 2BV207. durch Eindrehen der Verschlußschraube (068 A) die Steuerscheibe (048 B) aus dem Pumpendeckel (061 A) gedrückt werden.

1.2 Montage der Deckeldichtung bzw. Steuerscheibe

Steuerscheibe (048 B) mit Dichtung (057 A), Fangplatte (051 A) und Ventilplatte (050 A) komplettieren und auf Pumpengehäuse (002 A) auflegen. Dabei ist darauf zu achten, daß die in der Steuerscheibe (048 B) befindliche Aussparung (4 mm breit, 9 mm tief) mit dem im Pumpengehäuse (002 A) befindlichen Zentrierstift (037 A) übereinstimmt. Pumpendeckel (061 A) auflegen und mit Schrauben (063 A) am Pumpengehäuse (002 A) anschrauben. Pumpe wieder auf Motorfüße stellen.

2.1 Demontage von Laufrad und Gleitringdichtung (GLRD)

Pumpe senkrecht auf Lüfterhaube (500 A) stellen. Schrauben (063 A) lösen, Pumpendeckel (061 A) abnehmen – dabei ist darauf zu achten, daß die Steuerscheibe (048 B) beim Abnehmen des Pumpendeckels (061 A) nicht herunterfällt. Laufrad (047 A) abziehen (mit Abziehvorrichtung, über in die Laufradnabe eingeschraubte Schrauben). Paßfeder (006 A) aus der Motorwelle herausnehmen, Toleranzring (048 A) entfernen, Gleitringdichtung (035 A) mit Scheibe (036 A) abziehen. (Zur leichteren Demontage der GLRD Welle vor der Dichtung mit Öl benetzen).
Gegenring der GLRD mit, falls vorhanden, Abdrückring (034 A) aus dem Pumpengehäuse (002 A) mit zwei Hebeln, z. B. Schraubendrehern, durch die seitlichen Schlitze am Pumpengehäuse (002 A) nach vorne abhebeln und entfernen. Bei stark verkalkter Pumpe Demontage nach Punkt 3.1.

2.2 Montage der GLRD und des Laufrades

Abdrückring (034 A), falls vorhanden, und Gegenring der GLRD (035 A) in das Pumpengehäuse (002 A) einsetzen. (Leichtere Montage des Gegenringes, wenn O-Ring mit Öl benetzt ist.)

Dabei ist zu beachten, daß der im Pumpengehäuse (002 A) befindliche Stift (030 A), falls vorhanden, in die Aussparung des Gegenringes paßt. Motorwelle am Sitz der Gleitringdichtung (035 A) leicht einölen. Gleitringdichtung (035 A) mit Scheibe (036 A) auf Motorwelle schieben. Paßfeder (006 A) und Toleranzring (048 A) in die Motorwelle einlegen. Der Toleranzring (048 A) ist nach jeder Demontage durch einen neuen zu ersetzen.
Laufrad (047 A) auf die Welle aufziehen, so daß ein Spalt zwischen Laufrad (047 A) und Steuerscheibe (048 B) von 0,1 bis 0,15 mm entsteht. Kontrolle des Spaltes: Pumpe lüfterseitig auf Wellenende stellen. Lineal anstelle der Steuerscheibe (048 B) auf Pumpengehäuse (002 A) legen und Luftspalt zwischen Lineal und Laufrad (047 A) prüfen (z. B. mit Fühllehre). Mit Ventilplatte (050 A), Fangplatte (051 A) und Dichtung (057 A) komplettierte Steuerscheibe (048 B) auf das Pumpengehäuse (002 A) aufsetzen. Fixierung der Steuerscheibe (048 B) erfolgt durch Zentrierstift (037 A), wie unter Punkt 1.2 beschrieben.
Pumpendeckel (061 A) aufsetzen und mit Schrauben (063 A) anschrauben. Pumpe auf Motorfüße stellen. Pumpe muß sich nach Montage leicht durchdrehen lassen (von Hand Motorlüfter drehen). Dazu Schrauben (503 A) lösen und Lüfterhaube (500 A) abnehmen. Am Außenlüfter (501 A) drehen. Lüfterhaube (500 A) wieder aufsetzen und mit Schrauben (503 A) festschrauben.

3.1 Demontage des Pumpengehäuses

Wie „Demontage von Laufrad und Gleitringdichtung" (Punkt 2.1), wobei das Heraushebeln des Gegenringes mit, falls vorhanden, Abdrückring (034 A) aus dem Pumpengehäuse (002 A) entfallen kann, da bei der weiteren Demontage der Gegenring mit dem Pumpengehäuse (002 A) von der Welle abgezogen werden kann. Schrauben (503 A) lösen, Lüfterhaube (500 A) abnehmen, Sicherungsring (507 A), falls vorhanden, entfernen. Außenlüfter (501 A) abziehen und Paßfeder (505 A), falls vorhanden, bzw. Toleranzring (043 A), falls vorhanden, aus der Welle nehmen.

Schrauben (025 A) lösen, dabei auf Einlegemuttern (082 C), falls vorhanden, achten (werden bei der Montage wieder benötigt). Pumpengehäuse (002 A), Lagerschild (026 A) und Motorläufer (005 A) vom Motorgehäuse mit eingedrücktem Ständerpaket (001 A) trennen. Schrauben (038 B) lösen und Pumpengehäuse (002 A) von Lagerschild (026 A) und Läufer (005 A) trennen. Bei stark verkalkter Gleitringdichtung (035 A) Pumpengehäuse (002 A) mit Abziehvorrichtung über Wellenspiegel abziehen.

1.1 Removing the cover gasket and port plate

Place the pump vertically on the fan cowl (500 A); slacken bolts (063 A); remove pump cover (061 A); lift off the port plate (048 B) together with the gasket (057 A), catch plate (051 A) and valve plate (050 A), then separate them from each other (if the port plate (048 B) jams, it can be forced out of the pump cover (061 A) through the flushing outlet (16, see page 3) by turning in a 10 mm dia. x 24 mm bolt (for 2BV2 06) or a 10 mm dia. x 30 mm one (for 2BV2 07).

1.2 Fitting the cover gasket and port plate

Fit the port plate (048 B) with gasket (057 A), catch plate (051 A) and valve plate (050 A) together and mount them on the pump casing (002 A). Ensure that the recess (4 mm wide, 9 mm deep) in the port plate coincides with the centering pin (037 A) in the casing. Now mount the pump cover (061 A) and screw it to the casing with the bolt (063 A). Put the pump back on its feet.

2.1 Dismantling the impeller and sliding-ring packing

Place the pump vertically on the fan cowl (500 A), slacken the bolt (063 A) and remove the pump cover (061 A), ensuring that the port plate (048 B) does not fall out. Pull the impeller (047 A) by means of a puller tool attached to the bolts screwed into the impeller hub. Withdraw the featherkey (006 A) from the motor shaft, remove the spacer ring (048 A) and pull off the sliding-ring packing (035 A) with washer (036 A). (To facilitate removal of the packing, coat that part of the shaft protruding from the packing with oil).

Now prise the backing ring off the sliding-ring packing – together with the forcing-off ring (034 A) – through the slot in the side of the casing (002 A) by using two screwdrivers, for example, as levers and take it out. Observe Point 3.1 if the pump furred with lime.

2.2 Fitting the sliding-ring packing and the impeller

Insert the forcing-off ring (034 A), if one is fitted, and the backing ring of the sliding-ring packing (035 A) in the pump casing (002 A). It is easier to fit the backing ring if the O-ring has been lubricated with oil.
Ensure that the pin (030 A) in the pump casing (002 A) coincides with the recess in the backing ring. Oil the motor shaft lightly at the seat of the sliding-ring packing (035 A). Now push the sliding-ring packing together with the washer (036 A) onto the motor shaft. Insert the featherkey (006 A) in the motor shaft and fit spacer ring (048 A). The spacer ring should be replaced every time the sliding-ring packing and impeller are dismantled. Mount the impeller (047 A) on the shaft so that a gap of 0.1 to 0.15 mm remains between the impeller and the port plate (048 B). Check the gap as follows: Set the pump vertically on the fan cowl. Place a rule – instead of the port plate (048 B) – on the pump casing (002 A) and check the air gap between the rule and the impeller (e.g. with a thickness gauge). Mount the valve plate (050 A), catch plate (051 A) and gasket (057 A) together with the port plate (048 B) on the pump casing (002 A). The port plate (048 B) is then secured by means of the centering pin (037 A) as described under Point 1.2.
Place the pump cover (061 A) in position and screw it on with the bolts (063 A). Now put the pump back on its feet. After assembly, the pump must rotate easily (turn the fan by hand); to do so, remove bolts (503 A) and take off the fan cowl (500 A). Turn the outer fan (501 A), then replace the cowl and tighten up the bolts (503 A).

3.1 Dismantling the pump casing

Proceed as described in "Dismantling the impeller und sliding-ring packing" (Point 2.1); it is not necessary to lever the packing ring (or forcing-off ring (034 A) if fitted) out of the pump casing (002 A) because the packing ring can be withdrawn from the shaft together with the casing during further dismantling. Unscrew bolts (503 A), remove fan cowl (500 A) and also the circlip (507 A), if fitted. Withdraw outer fan (501 A) and featherkey (505 A), or remove spacer ring (043 A) from shaft, if fitted.

Unscrew bolts (025 A), retaining nuts (082 C), if fitted, (required for assembly). Separate pump casing (002 A), endshield (026 A) and motor rotor (005 A) from motor frame (001 A), containing the stator core. Unscrew bolts (038 B) and separate pump casing (002 A) from endshield (026 A) and rotor (005 A). If sliding-ring packing (035 A) is heavily scaled, pull the pump casing (002 A) off over the end of the shaft with the puller tool.

3.2 Montage des Pumpengehäuses

Pumpengehäuse (002 A) mit Schrauben (038 B) und Federringen (038 A) an Lagerschild (026 A) anschrauben. Lageranstellsatz (018 A) – bestehend aus einer Federscheibe und evtl. einer oder mehreren Ausgleichsscheiben in den Lagerschild (400 A) einlegen. Motorläufer (005 A) mit Lagerschild (026 A) und Pumpengehäuse (002 A) in Motorgehäuse mit eingedrücktem Ständerpaket (001 A) einführen, Einlegemuttern (082 C), falls vorhanden, in die im Motorgehäuse (001 A) dafür vorgesehenen Taschen einlegen und Motorgehäuse mit Lagerschild (026 A) mit Schrauben (025 A) verschrauben.

Paßfeder (505 A), falls vorhanden, bzw. Toleranzring (043 A), falls vorhanden, in die Welle einlegen (der Toleranzring (043 A) ist nach jeder Demontage durch einen neuen zu ersetzen), Außenlüfter (501 A) bündig mit Wellenende bzw. bis Anschlag an Paßfeder (505 A), falls vorhanden, aufdrücken und mit Sicherungsring (507 A), falls vorhanden, sichern. Weitermontage wie „Montage der GLRD und des Laufrades" (Punkt 2.2).

4.1 Demontage Läufer und Rillenkugellager (siehe Seite 25)

Wie „Demontage von Laufrad und GLRD" (Punkt 2.1) und „Demontage des Pumpengehäuses" (Punkt 3.1).

Schrauben (028 A) lösen und Lagerschild (026 A) vom Läufer (005 A) nehmen. V-Ring (033 A) abziehen, Nilos-Ring (032 A) abnehmen, Rillenkugellager AS (007 A) mit Abziehvorrichtung von Welle abziehen, Hülse (031 A) abnehmen. Lagerdeckel (027 A) abnehmen.

Rillenkugellager BS (008 A) und Cox-Ring (428 B) mit Abziehvorrichtung abziehen, Hülse (017 A), falls vorhanden, abnehmen.

4.2 Montage Läufer und Rillenkugellager (siehe Seite 25)

Neue Rillenkugellager (007 A und 008 A) mit Schmierfett nach Tabelle Seite 25 füllen. Hülse (017 A), falls vorhanden, und neuen Cox-ring (428 B) aufschieben. Rillenkugellager (008 A) mit Vorrichtung aufdrücken, dabei auf Lage der Z-Scheibe achten (Z-Scheibe muß an der dem Läuferpaket abgewandten Seite sein).

Lagerdeckel (027 A) aufstecken, Hülse (031 A) aufschieben und Rillenkugellager (007 A) mit Vorrichtung aufdrücken. Nilos-Ring (032 A) und V-Ring (033 A) aufschieben. Welle muß im Bereich des V-Ring-Sitzes fettfrei sein.

3.2 Assembling the pump casing

Bolt pump casing (002 A) to endshield (026 A) using bolts (038 B) and spring washers (038 A). Insert bearing contact set (018 A), consisting of a spring washer and possibly one or more end-float washers, in the endshield (400 A). Insert motor rotor (005 A) with endshield (026 A) and pump casing (002 A) into motor frame containing the stator core (001 A). If fitted, insert nuts (082 C) in recesses provided in motor frame (001 A) and bolt motor frame to endshield (026 A) using bolts (025 A).

If fitted, insert featherkey (505 A) in motor shaft or fit spacer ring (043 A). The spacer ring should be replaced every time the pump casing is dismantled. Fit outer fan (501 A) flush with shaft end or until in contact with featherkey (505 A), if fitted, and secure with circlip (507 A), if fitted. Continue assembly as described in "Fitting the sliding-ring packing and the impeller" (Point 2.2).

4.1 Dismantling the rotor and deep-groove ball bearings (see page 25)

Proceed as described in "Dismantling the impeller and sliding-ring packing" (Point 2.1) and "Dismantling the pump casing" (Point 3.1).

Unscrew bolts (028 A) and remove endshield (026 A) from rotor (005 A). Remove V ring (033 A), Nilos ring (032 A) and remove drive-end bearing (007 A) from the shaft with the puller tool. Remove spacer sleeve (031 A) and inner bearing cap (027 A).

Pull off non-drive-end bearing (008 A) and Cox ring (428 B) with puller tool and remove sleeve (017 A), if fitted.

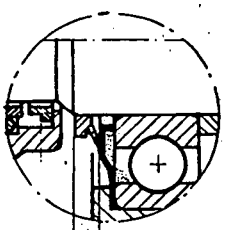
4.2 Fitting the rotor and ball bearing (see page 25)

Fill new ball bearings (007 A und 008 A) with grease in accordance with Table on page 25. Push on sleeve (017 A), if fitted, and new Cox ring (428 B). Force on ball bearing (008 A) with fitting tool, paying attention to the position of the serrated lock washer (this must be on the side facing away from the rotor core).

Fit bearing cap (027 A) and push on sleeve (031 A) and force on ball bearing (007 A) with fitting tool. Push on Nilos ring (032 A) and V ring (033 A). There must not be any grease on the shaft near the V ring seat.

Einbauraum für V-Ring (033 A) bei:

2BV2 060, 2BV2 061, 2BV2 070	8,2 – 0,5 mm
2BV2 071	9,7 – 0,5 mm



Fitting dimensions for V ring (033 A) with:

2BV2 060, 2BV2 061, 2BV2 070	8,2 – 0,5 mm
2BV2 071	9,7 – 0,5 mm

Einbauraum für V-Ring (033 A) — Fittig dimensions for V ring (033 A)

Lagerschild (026 A) auf Läufer (005 A) aufschieben und mit Schrauben (028 A) Lagerdeckel (027 A) anschrauben.

Weitermontage wie „Montage des Pumpengehäuses" (Punkt 3.2) und „Montage der GLRD und des Laufrades" (Punkt 2.2).

5.1 Demontage Motorgehäuse mit eingedrücktem Ständerpaket

Schrauben (503 A) lösen, Lüfterhaube (500 A) abnehmen. Sicherungsring (507 A), falls vorhanden, herausnehmen. Außenlüfter (501 A) abziehen und Paßfeder (505 A), falls vorhanden, bzw. Toleranzring (043 A), falls vorhanden, aus der Motorwelle herausnehmen.

Schrauben (401 A) lösen, dabei auf Einlegemuttern (408 A), falls vorhanden, achten (werden bei der Montage wieder benötigt) und Lagerschild (400 A) abnehmen. Schrauben (025 A) lösen, dabei auf Einlegemuttern (082 C), falls vorhanden, achten (werden bei der Montage wieder benötigt) und Motorgehäuse mit eingedrücktem Ständerpaket (001 A) von der Pumpe trennen.

Push endshield (026 A) onto rotor (005 A) and secure bearing cap (027 A) with bolts (028 A).

Continue assembly as described in "Assembling the pump casing" (Point 3.2) and "Fitting the sliding-ring packing and the impeller" (Point 2.2).

5.1 Dismantling the motor frame with stator core

Unscrew bolts (503 A) and remove fan cowl (500 A). Remove circlip (507 A), if fitted. Remove outer fan (501 A) and remove featherkey (505 A) or spacer ring (043 A), if fitted, from motor shaft.

Unscrew bolts (401 A), retaining nuts (408 A), if fitted, (required for assembly) and remove endshield (400 A). Unscrew bolts (025 A) and retaining nuts (082 C), if fitted, (required for assembly) and separate motor frame with stator core (001 A) from the pump.

5.2 Montage Motorgehäuse mit eingedrücktem Ständerpaket

Motorgehäuse mit eingedrücktem Ständerpaket (001 A) über Motorläufer (005 A) schieben. Einlegemuttern (082 C), falls vorhanden, in die im Motorgehäuse (001 A) dafür vorgesehenen Taschen einlegen und Motorgehäuse (001 A) mit Schrauben (025 A) an Pumpe anschrauben. Überprüfen, ob Lageranstellsatz (018 A) – bestehend aus einer Federscheibe und eventuell einer oder mehreren Ausgleichscheiben – in den Lagerschild (400 A) eingelegt ist. Dann Lagerschild (400 A) auf Motorwelle aufschieben. Einlegemuttern (408 A) in die im Motorgehäuse (001 A) dafür vorgesehenen Taschen einlegen und Lagerschild (400 A) mit Schrauben (401 A) an Motorgehäuse (001 A) anschrauben. Paßfeder (505 A), falls vorhanden, bzw. Toleranzring (043 A), falls vorhanden, in die Motorwelle einlegen (der Toleranzring (043 A) ist nach jeder Demontage durch einen neuen zu ersetzen), Außenlüfter (501 A) bündig mit Wellenende bzw. bis Anschlag an Paßfeder (505 A), falls vorhanden, aufdrücken und mit Sicherungsring (507 A), falls vorhanden, sichern.

Außenlüfter (501 A) von Hand drehen; Pumpe muß sich nach der Montage leicht durchdrehen lassen.

Lüfterhaube (500 A) aufsetzen und mit Schrauben (503 A) anschrauben.

5.2 Fitting the motor frame with stator core

Push motor frame with stator core (001 A) over rotor (005 A) and insert nuts (082 C), if fitted, in the recesses provided in the motor frame and secure frame to pump with bolts (025 A). Check whether bearing contact set (018 A), consisting of one spring washer and one or more end-float washers, ist fitted in the endshield (400 A). Push endshield (400 A) onto motor shaft. Insert nuts (408 A) in recesses provided in motor frame (001 A) and secure endshield (400 A) to motor frame with bolts (401 A). Fit featherkey (505 A) or spacer ring (043 A), if fitted, to motor frame (the spacer ring should be replaced every time the pump casing is dismantled). Press on outer fan (501 A) until flush with shaft end or as far as stop on featherkey (505 A), if fitted, and secure with circlip (507 A) if fitted.

Turn the outer fan (501 A) by hand; after fitting, the pump must turn easily.

Replace fan cowl (500 A) and secure it with bolts (503 A).

Instructions de service

Description

Application et conditions de fonctionnement

Les pompes à vide ELMO F sont des pompes à gaz à anneau liquide, mono-étagées, en construction monobloc, prévues pour le service continu. Le liquide de fonctionnement normalement utilisé est l'eau; dans les cas particuliers, il est également fait usage d'acides, de réactifs basiques, de solvants, etc. (le matériau constitutif des éléments de la pompe doit être adapté aux liquides de fonctionnement agressifs ou aux gaz agressifs). Il n'y a aucun inconvénient à ce que de petites quantités de matière légère en suspension ou de liquides soient entraînées; mais si elles étaient plus importantes, il faudrait monter des séparateurs en amont.

Dans le cas des pompes à vide ELMO F à moteur G3 (Ex)e, il y a lieu d'observer les prescriptions de sécurité y afférentes.

La pression d'aspiration minimale des pompes à vide est de 40 millibars (30 torrs) avec de l'eau à 15 °C comme liquide de fonctionnement, et de 11 millibars (8 torrs) avec un éjecteur à gaz monté en amont.

Le liquide de fonctionnement (de l'eau dans la plupart des cas) doit être exempt de corps étrangers. Il est en partie expulsé de la tubulure de refoulement avec le gaz et doit par conséquent être complété constamment. Sa température influe sur le pouvoir d'aspiration; il devrait parvenir à la pompe à une température comprise entre 5 et 15 °C. La pompe l'aspire aussi automatiquement jusqu'à la hauteur d'aspiration de 1 m. En fonctionnement sans séparateur monté sur la pompe, il ne faut pas amener la conduite de refoulement à plus de 0,50 m au-dessus de la tubulure de refoulement, ou bien la contre-pression ne doit pas y dépasser 1,1 bar (abs.).

Fonctionnement

La pompe opère selon le principe de l'anneau liquide. Une roue est disposée dans un corps de pompe cylindrique excentrique par rapport à l'arbre; elle transmet la puissance d'entraînement à un anneau liquide qui se forme lors de la mise en service de la pompe de manière à être concentrique par rapport au corps de cette dernière.

Lorsque le liquide circule vers l'extérieur, du gaz est aspiré à travers la fente d'aspiration du disque de distribution; il est comprimé vers l'intérieur puis expulsé à travers la fente de refoulement du disque de distribution.

Instrucciones de servicio

Descripción

Aplicaciones y condiciones de servicio

Las bombas de vacío son del tipo de anillo líquido, de una etapa. Su construcción es en forma de bloque. Están diseñadas para servicio permanente. Como líquido de servicio se utiliza normalmente agua y, en casos especiales, ácidos, bases, disolventes, etc. (el material de las piezas de la bomba deberá estar adaptado a los líquidos de servicio o gases agresivos). Pueden impulsar cantidades reducidas de partículas ligeras o líquidos en suspensión. En caso de cantidades mayores hay que anteponer separadores.

Para las bombas de vacío ELMO F provistas de motores con protecciones (EX) e-G3 deberán observarse las correspondientes prescripciones de seguridad.

La presión de aspiración mínima de las bombas de vacío – si el líquido de servicio es agua a 15 °C – es de 40 mbar (30 Torr). Con eyectores de gas antepuestos, es de 11 mbar (8 Torr).

El líquido de servicio (preferentemente agua) deberá estar libre de cuerpos extraños. Este líquido sale en parte con el gas por las bocas de impulsión, por lo que hay que reponerlo continuamente. La temperatura del líquido de servicio influye sobre la capacidad de aspiración. El líquido se alimentará a temperaturas entre 5 y 15 °C. La bomba de vacío puede aspirar automáticamente el líquido de servicio hasta una altura de 1 m aproximadamente. Si se opera sin separador, la tubería de impulsión no deberá tenderse a más de 0,5 m por encima de la boca de impulsión de la bomba ni sobrepasar una contrapresión de 1,1 bar (absolutos).

Construcción y funcionamiento

La bomba funciona según el principio del anillo líquido. Dentro de la carcasa cilíndrica va dispuesto de manera excéntrica el eje con el rodete que transmite la potencia del accionamiento al anillo líquido, que se forma concéntricamente con la carcasa al poner en servicio la bomba.

Al desplazarse hacia afuera el líquido, se aspira gas a través de la lumbrera de aspiración del disco de distribución. Este gas se comprime hacia adentro y se expulsa por la lumbrera de impulsión del disco de distribución.

Contents:

TERMINOLOGY

In accordance with all supplied operating and repair manuals and the warnings on the machines and devices themselves.

Operation

encompasses the installation, commissioning (preparation for use) and controls by operator (actuation, switching on and off, etc.).

Servicing

encompasses the testing and preventive maintenance (inspections and overhauls), maintenance, corrective maintenance (troubleshooting with repair).

⚠ ...WARNING NOTICES

⚠ DANGER means that death, grievous injury or extensive damage to property will occur if the appropriate precautions are not taken.

⚠ WARNING means that death, grievous injury or extensive damage to property may occur if the appropriate precautions are not taken.

⚠ CAUTION means that minor injury or damage to property may occur if the appropriate precautions are not taken.

NOTE means that particular attention is drawn to the interaction of technical processes because they may not be obvious even to qualified personnel.

Even though not specifically mentioned, compliance with transport, assembly, operating and maintenance notes and technical data (in the operating manuals, the product documents or on the machine itself) is, however, equally crucial in order to avoid disruptions which might in turn directly or indirectly cause grievous injury or serious damage to property.

Qualified personnel are persons who, due to their training, experience and instruction and their knowledge of pertinent standards, specifications, accident prevention regulations and operating conditions, have been authorized by the party responsible for the safety of the system to carry out the activities necessary in each case and are capable of recognizing and avoiding possible inherent dangers in doing so. Among other skills, a knowledge of first aid is required.

GENERAL NOTE

In the interest of clarity and in view of the possible wealth of information, these operating and repair manuals do not detail every bit of information and, in particular, cannot discuss every possible operational or servicing-related situation.

If you wish additional information, or if specific problems arise which are not dealt with in sufficient detail in the operating and repair manuals supplied, you can request the information required through your local Siemens office.

The contents of these operating and repair manuals are neither part of, nor are they intended to alter a former or existing agreement, commitment or legal relationship. All obligations on Siemens' part arise from the pertinent purchase agreement, which also contains the complete and sole valid warranty terms. These contractual warranty terms are neither extended nor restricted by the statements made in these operating and repair manuals.

GENERAL INFORMATION, DESCRIPTION

Basic Information about Safety

⚠ DANGER **Due to their function-related electrical and mechanical properties, the machines can cause extremely serious damage to health and property if they are not used, operated and serviced as intended or if they are tampered with. It is therefore assumed that planning and execution of all mechanical and electrical facilities and transport, operation and servicing will be executed and supervised by responsible, qualified personnel.**

⚠ WARNING **When electric machines or devices are running some of their components are conducting dangerous electricity and/or are subjected to mechanical stress. The persons working on the machine and/or the device must be appropriately qualified. They must be thoroughly acquainted with the contents of these and all other operating and repair manuals provided. Correct, safe use of this machine and the device requires proper transport, proper storage, operation as intended and careful servicing. All notes and information on the machines or devices must be observed.**

APPLICATIONS, DESIGN, OPERATING MODE

NOTE: The electrical machines for which these operating manuals are intended are component parts of electrical power installations, units and equipment chiefly for industrial applications and have been constructed in accordance with the information specified on their rating and other plates, in certificates, order documents and catalogs, e.g. VDE 0530, IEC 34-1. Accordingly, the operating manuals contain basically only information pertaining to safety which must be observed when used as intended in industrial applications. The pertinent applicable national, local and system-specific specifications and requirements must also be taken into account.

The machines are also employed in **non-industrial** applications, however, i.e. in commercial or private sectors (e.g. the trades, farming, home and garden, etc.). If the safety precautions according to rating plate data and certificates are not adequate for these or special industrial applications due to special safety regulations or requirements, the operator of this machine or the manufacturer of the system, unit or device in which the machine is installed must make certain that these special safety regulations and requirements are complied with (e.g. by ordering special models of the machines, installing additional protective equipment, appropriate installation, etc.).

TRANSPORT, STORAGE

NOTE: Certain machines must be picked up only at the main lifting fittings provided for this purpose, at lifting lugs for example. Use hoisting tackle appropriate in terms of machine weight. Use suitable cable guides or spreading devices if the machine in the delivery state has any attachments, etc. fitted (see Operating Manual).

OPERATION AND MAINTENANCE

General Safety Notes

⚠ WARNING **To be safe, operation and servicing of the machine or device must be performed properly by qualified personnel who observe the warnings in these and other operating and repair manuals supplied and the notes on the machines and devices.**
In particular, the general standards for installation and safety (DIN and VDE for example), are to be followed for work on power installations, as are the standards for the proper use of lifting tackle and equipment and the use of personal protective equipment such as safety goggles, etc.

⚠ DANGER **Do not reach into the machine through air intake or discharge ports: The rotor is very dangerous. Keep in mind that, due to its rotating mass, the machine may continue to turn several minutes after being shut off. If the gas in the system has not expanded, the machine can start to rotate due to leakage through shut-off units.**

The rotor can cause injury even when the machine is switched off if the rotor is rotated manually.

INSTALLATION

⚠ CAUTION Under unfavourable operating conditions, parts of the housing may reach temperatures of over 80 °C, possibly necessitating the use of a touch guard - depending on the installation conditions. Note, too, that material being handled can be ejected at these temperatures through discharge ports and pressure control valves. Site these openings so that they are not directed towards personnel and flammable or explosive materials. Temperature-sensitive parts such as cables or electronic components are not to be placed next to or attached to parts of the housing or incoming or outgoing piping.
The machines can be installed in a dusty or damp location. The insulation is tropic-proof. Normally, no special protective measures are required to protect the machines against the weather when they are properly stored or installed out of doors. When instlling machines with the shaft in the vertical position, EEx-e motors require a cover to prevent foreign bodies from falling into the motor fan cowl (see EN 50 014/VDE 0170/0171, Part 1, Section III, 16.1). This cover must not hinder the cooling of the motor by its fan.
The vacuum pumps and compressors are only suitable for conveying dustfree air and other noncombustible, noncorrosive and nonexplosive gases, vapours or liquids.
Solids and contaminants must be removed before the intake port (intake filter).
The use of machines with **EEx-e drive motors** is permitted in rooms in which explosive gases are occasionally present. However, the conveyance of explosive gases and liquids is not permitted. The temperature class specified on the rating plate must be complied with.
Where machines with cooling by ambient air are involved, there must be unrestricted passage of the cooling air to and from the machines. The re-intake of heated exhausted air is not permitted.

⚠ WARNING **Ensure that water cannot enter the motor.**

Attention is drawn to the general requirements for **protection against contact** with moving parts such as pulleys.

CONNECTIONS

Comply with data in the manuals supplied. Connection cables must be selected according to the type of use and to the voltages and current levels at hand. Connect machine in accordance with the circuit diagram in the terminal box or - if the machine has no terminal box - in accordance with the separate circuit diagram.
Tighten the connection terminals of the machines to the torques stated in the terminal box.

⚠ CAUTION **To avoid danger, the feeder cables in the terminal box must be professionally connected. In particular, this means that:**

- the inside of the terminal box is clean and contains no cable remains
- protective conductor or protective earthing is connected
- all terminal lugs are tight
- the minimum clearances in air are adhered to (beware of protruding wire ends)
- unused penetrations are sealed and the cover elements are screwed in tight
- all sealing surfaces of the terminal box are in a proper state to maintain the type of protection. If tightness of the joints is achieved only with metal sealing surfaces, these have to be cleaned and then lightly lubricated.
- Before the initial start-up, connect liquid pumps and liquid ring pumps to the pipes provided so that no fluid can reach energized components.
- The material and dimensioning of all pipes, containers and fittings must be matched to the pressure and temperature conditions involved and must be suitable for the type of material to be conveyed.

⚠ CAUTION **There is a danger of bursts if the machine is subjected to impermissibly high pressure from the plant. Where applicable, suitable pressure-relief devices must be used to prevent this.**

⚠ CAUTION **Where pumps or compressors are involved which conduct hot or dangerous gases, vapours or liquids, or are operated with dangerous working liquids, or have to be emptied at temperatures over 60°C, all drain connections must be equipped with shut-off fittings and the material conveyed and/or the working liquids must be taken away in closed systems.**

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"Dangerous" materials are, for example, materials which are hazardous to the health or the environment. Local statutory regulations are to be observed for their appropriate disposal.

COMMISSIONING

⚠ CAUTION **If the machine is started up without being connected or fastened, for example, for test purposes the initial torque of the motor may cause it to move suddenly and topple over.**

NOTE: For safe operation of the machine the following conditions as a minimum must be observed:

- The machine is assembled and operated in accordance with the data on the plate and, where applicable, with the documentation supplied (voltage, current, frequency, connection, model, type of protection, cooling method).
- When frequency converters are used, operating speeds are not to exceed those permitted according to plate data.
- The machine is properly assembled, aligned and connected to piping or hoses, as appropriate.
- The elevation of the installation location is taken into account when adjusting the pressure control valves.
- The drive elements are adjusted correctly for their type, e.g. belt tension if belt-driven, alignment of couplings.
- The cooling air circuit is not impaired; the cooling effect must also not be impaired by dirt on the cooling surfaces.
- The rotor can be rotated without it touching.
- The direction of rotation of the machine is as specified.
- All fastening screws/bolts, fasteners and electrical connections are tightened as specified in the operating manual or in the terminal box cover.
- The earthing and equipotential bonding connections have been made properly.
- Any supplementary equipment present (thermostat in coil, anti-condensation heater, etc.) are properly connected and operative.
- All measures have been taken to protect against contact with moving or energized parts.
- Any separate fans are ready for operation and are connected for the specified direction of rotation and do not impair the running smoothness of the machine during operation.

⚠ CAUTION **The intake ports must be sited so that no foreign elements can be sucked in and ejected through the discharge port (hazard for eyes and skin, danger of poisoning).**

⚠ CAUTION **When air is sucked in from the atmosphere, the intake ports must be covered with protective devices (gratings or the like) in order to prevent foreign elements including parts of the body and clothing from being sucked in.**

It is not possible for this listing to be exhaustive. Additional tests in accordance with other manuals or system-specific conditions may be required.

NOTE: To ensure that the machine is also permanently safe, the following precautions are recommended for commissioning and then at protracted intervals, initially after about 500 operating hours:

- Check whether all screw/bolt connections are tightened to the torques given in the operating manual.
- Make certain that cables and insulation parts - where accessible - are in good condition and are not discoloured.
- During operation, check for noises or vibrations at the bearings, end shields, covers and housing components.
- Switch off the machine if it is not running smoothly or is making abnormal noises; initiate immediate repair.
- If the machine is running satisfactorily, check the values for voltage current and performance.
- As far as possible, monitor the temperatures of the bearings, etc. until the steady-state point is reached.

OPERATION

Safety Notes

⚠ WARNING **Covers which prevent contact with active or rotating parts or are required to direct the flow of air for effective cooling are not to be open during operation.**

⚠ WARNING **Sound pressure levels over 85 dB (A) may cause prolonged damage to health. Where applicable, suitable corrective action must be initiated.**

After protracted **machine shutdowns** the measures recommended under "Commissioning" in the section "Operation and Servicing" are to be performed as appropriate, depending on the length of the standstill period.

SERVICING

NOTE: Careful and regular inspections, overhauls and maintenance are required to detect any malfunctions at an early stage and to eliminate them before extensive damage results.

GENERAL SAFETY PRECAUTIONS

⚠ DANGER **Before any work is performed on the machine or equipment, especially covers over energized or moving parts are removed, the machine, item of equipment or system is to be properly disconnected from the supply. Apart from the main electrical circuits, particular attention is to be paid to any supplementary or auxiliary electrical circuits, especially anti-condensation heaters. Wait until the machine is at a standstill (coasting due to flywheel). See note on danger, page 5, 6.**
The standard safety rules, according to VDE 0105 for example, are:

- **disconnect from supply**
- **secure against re-actuation**
- **confirm de-energization**
- **cover or provide barriers for adjacent live components.**

⚠ DANGER **The above measures are not to be reversed until the machine has been completely assembled and the servicing concluded.**

⚠ CAUTION **The operational reliability of the machine can only be maintained if original parts or authorized replacement parts are used during every corrective maintenance and the repair manual is consistently adhered to.**

CORRECTIVE MAINTENANCE

⚠ WARNING **Repairs to EEx-e motors must be carried out in Siemens shops or acceptance-tested by an officially recognized expert.**

DISMANTLING

Sectional diagrams and representations in operating manuals and other manuals contain information regarding the technical design of normal machines and assemblies. However, special models and versions may deviate in technical details. If any uncertainty exists, we strongly recommend that you contact us, stating the machine type and serial number, or that you have the maintenance work performed at a SIEMENS service centre.

⚠ CAUTION **After fastening screws/bolts are removed, some parts are just held in centring fits. Even during proper dismantling it is still possible that some heavy parts may therefore suddenly become loose and drop off, possibly causing injuries and damage. Take suitable measures to secure all parts being worked on.**

ASSEMBLY

Joints that are sealed due to stringent requirements for type of protection must be resealed during assembly with a suitable non-hardening sealant (type: consult the proper operating and repair manuals).
If gaskets and sealing elements are installed to ensure the degree of protection, they must be examined and replaced if they are no longer effective.

⚠ CAUTION **Tightening torques are specified in the terminal box for bolted connections of electrical terminals. If these are not complied with, some cables may become loose and pose a danger.**

Sommaire

TERMINOLOGIE

Au sens des instructions de service et de dépannage accompagnant le produit ainsi que des marques d'avertissement figurant sur les machines et les appareils mêmes :

Exploitation

concerne la mise en place, la mise en service (préparatifs pour l'utilisation) et l'utilisation (manoeuvres, mise en marche et à l'arrêt, etc.)

Maintenance

concerne le contrôle (inspections, révisions), l'entretien et le dépannage (localisation du défaut et réparation).

⚠ ... MARQUES D'AVERTISSEMENT

⚠ DANGER signifie que la non-application des mesures de précaution appropriées **conduit** à la mort, à des lésions corporelles graves ou à un dommage matériel important.

⚠ ATTENTION signifie que la non-application des mesures de précautions appropriées **peut conduire** à la mort, à des lésions corporelles graves ou à un dommage matériel important.

⚠ AVERTISSEMENT signifie que la non-application des mesures de précautions appropriées peut conduire à des lésions corporelles légères ou à un dommage matériel.

NOTA attire l'attention sur des interdépendances techniques qui ne sont pas toujours évidentes, mêmes aux yeux des personnes compétentes.
Afin d'éviter les incidents susceptibles d'occasionner directement ou indirectement des lésions corporelles graves ou des dommages matériels importants, il importe aussi de respecter les autres instructions de transport, de montage, d'exploitation et d'entretien, qui ne sont pas mises spécialement en relief, de même que les caractéristiques techniques (figurant dans les instructions de service, dans la documentation des produits et sur la machine même).

Ersatzteile, vom Werk lieferbar *

001A Motorgehäuse vollst.
002A Pumpengehäuse
005A Motorläufer
007A Rillenkugellager
008A Rillenkugellager
011A Spiralstift
017A Hülse für Rillenkugellager (BS)
018A Lageranstellsatz
026A Lagerschild
027A Lagerdeckel innen
030A Stift für Gleitringdichtung
031A Distanz-Hülse für Rillenkugellager
032A Nilos-Ring
033A V-Ring
034A Abdrückring
035A Gleitringdichtung
036A Scheibe
037A Zentrierstift
040A Leistungsschild
041A Schraube
042A Klemmenkasten komplett
043A Toleranzring für Lüfter (Ex)
047A Laufrad
048A Toleranzring für Laufrad
048B Steuerscheibe
050A Ventilplatte
051A Fangplatte
057A Dichtung für Deckel
061A Pumpendeckel
065A Schutzstopfen
066A Kappe
068A Verschlußschraube
068B Dichtung
081A Erdungsschraube
083A Erdungswinkel
084A Kontaktwinkel
085A Erdungsschraube **
085C Abdeckung
087A Erdungswinkel **
088A Kontaktwinkel **
400A Lagerschild
428B Cox-Ring
500A Lüfterhaube
501A Außenlüfter
503A Sechskantschraube mit Kreuzschlitz
505A Paßfeder für Außenlüfter
640A Klemmenbrett
648A Zwischenstück
651A Zwischenstück
654A Dichtung
656A Oberteil
657A Dichtung
660A Verschlußstopfen
662A Erdung
663A Dichtung
665A Deckel
668A Schild (Schutzzeichen)
674A Leitung

** für Potentialausgleichsleitung im Motorgehäuse

Spare parts, available from the works *

001A Motor frame, complete
002A Pump casing
005A Motor rotor
007A Deep-groove ball bearing
008A Deep-groove ball bearing
011A Spiral pin
017A Spacer sleeve
018A Bearing contact set
026A Endshield
027A Bearing cap, inner
030A Pin
031A Spacer sleeve
032A Nilos ring
033A V ring
034A Forcing-off ring
035A Sliding-ring packing
036A Washer
037A Centering pin
040A Rating plate
041A Bolt
042A Terminal box, complete
043A Fan spacer ring (Ex)
047A Impeller
048A Impeller spacer ring
048B Port plate
050A Valve plate
051A Catch plate
057A Cover gasket
061A Pump cover
065A Plug
066A Cap
068A Screw plug
068B Seal
081A Earthing screw
083A Earthing bracket
084A Contact bracket
085A Earthning screw **
085C Cover
087A Earthing bracket **
088A Contact bracket **
400A Endshield
428B Cox ring
500A Fan cowl
501A Outer fan
503A Slot-head bolt
505A Featherkey for outer fan
640A Terminal board
648A Adapter
651A Intermediate plate
654A Gasket
656A Upper part of terminal box
657A Gasket
660A Screw plug
662A Earthing
663A Gasket
665A Cover
668A Protection symbol
674A Conductor

** for equipotential conductor in motor frame

Pièces de rechange, livrables départ usine *

001A Carter de moteur complet
002A Corps de pompe
005A Rotor de moteur
007A Roulement à billes
008A Roulement à billes
011A Ergot
017A Douille pour roulement à billes (côte N)
018A Rondelles Belleville de serrage
026A Flasque palier
027A Couvercle intérieur de palier
030A Goupille pour joint rotatif
031A Entretoise pour roulement à billes
032A Bague Nilos
033A Joint torique à lèvres
034A Bague d'extraction
035A Joint rotatif
036A Rondelle plate
037A Goupille creuse fendue
040A Plaque signalétique
041A Vis
042A Boîte à bornes complète
043A Douille pour ventilateur (Ex)
047A Roue
048A Douille pour roue
048B Disque de distribution
050A Plaquette de soupape
051A Plaquette de butée
057A Joint de couvercle
061A Couvercle de pompe
065A Bouchon de protection
066A Capot
068A Bouchon fileté
068B Joint
081A Vis de mise à la terre
083A Equerre de freinage
084A Equerre de contact
085A Vis de terre **
085C Couvre-bornes
087A Equerre de freinage**
088A Equerre de contact **
400A Flasque palier
428B Bague Cox
500A Capot de ventilateur
501A Ventilateur extérieur
503A Vis à tête hexagonale à encoche cruciforme
505A Clavette pour ventilateur extérieur
640A Plaque à bornes
648A Entretoise
651A Pièce intercalaire
654A Joint
656A Partie supérieure
657A Joint
660A Bouchon fileté
662A Pièces de mise à la terre
863A Joint
665A Couvercle
668A Plaque (symbole)
674A Conducteur

** pour conducteur d'équipotentialité dans le carter du moteur

Piezas de recambio, suministrables de fábrica *

001A Carcasa del motor completa
002A Carcasa de la bomba
005A Rotor del motor
007A Rodamiento de bolas rígido
008A Rodamiento de bolas rígido
011A Perno en espiral
017A Casquillo para el rodamiento de bolas (lado B)
018A Juego de ajuste de rodamiento
026A Escudo portacojinetes
027A Tapa interior del rodamiento
030A Espiga para el retén
031A Casquillo distanciador para el rodamiento
032A Anillo Nilos
033A Anillo en V
034A Casquillo de presión
035A Retén
036A Disco
037A Espiga de centrado
040A Placa de caractertsticas
041A Tornillo
042A Caja de bornes completa
043A Anillo de tolerancia para el ventilador (Ex)
047A Rodete
048A Anillo de tolerancia para el rodete
048B Disco de distribución
050A Placa de válvula
051A Placa de retención
057A Junta de la tapa
061A Tapa de la bomba
065A Tapón de protección
066A Caperuza
068A Tornillo de cierre
068B Junta
081A Tornillo de puesta a tierra
083A Angular de puesta a tierra
084A Angular de contacto
085A Tornillo de puesta a tierra **
085C Cubierta
087A Angular de puesta a tierra **
088A Angular de contacto **
400A Escudo portacojinetes
428B Anillo Cox
500A Caperuza del ventilador
501A Ventilador exterior
503A Tornillo hexagonal con hueco cruciforme
505A Chaveta para el ventilador exterior
640A Regleta de bornes
648A Pieza intermedia
651A Pieza intermedia
654A Junta
656A Parte superior
657A Junta
660A Tapón de cierre
662A Puesta a tierra
663A Junta
665A Tapa
668A Placa (distintivo de la clase de protección)
674A Cable

** para el cable de compensación de potenciales de la carcasa del motor

Pezzi di riserva, forniblli dalla fabbrica *

001A Carcassa del motore, completa
002A Carcassa della pompa
005A Rotore del motore
007A Cuscinetto a sfere a gola profonda
008A Cuscinetto e sfere a gola profonda
011A Spina
017A Boccola per cuscinetto a sfere (BS)
018A Corredo di cuscinetto
026A Scudo di supporto
027A Coperchio interno del supporto
030A Spinotto per guarnizione anello scorrevole
031A Boccola distanziatrice per cuscinetto a sfere
032A Anello Nilos
033A Anello elastico (guarnizione)
034A Anello di separazione
035A Guarnizione ad anello scorrevole
036A Rondella
037A Spina di centraggio
040A Targa dei dati
041A Vite
042A Morsettiera completa
043A Anello di tolleranza per ventola (Ex)
047A Girante
048A Anello di tolleranza per girante
048B Disco distributore
050A Piastrina di valvola
051A Piastrina di ritegno
057A Guarnizione del coperchio
061A Coperchio per la pompa
065A Tappo di protezione
066A Coperchio
068A Tappo filettato
068B Guarnizione
081A Vite di messa a terra
083A Angolare di messa a terra
084A Angolare di contatto
085A Vite di messa a terra **
085C Coperchio
087A Angolare di messa a terra **
088A Angolare di contatto **
400A Scudo di supporto
428B Anello Cox
500A Cappa della ventola
501A Ventola esterna
503A Vite esagonale con intaglio a.croce
505A Chiavetta per ventola esterna
640A Basetta portamorsetti
648A Adattatore
651A Adattatore
654A Guarnizione
656A Parte superiore
657A Guarnizione
660A Tappo
662A Collegamento a terra
663A Guarnizione
665A Coperchio
668A Targa (simbolo di protezione)
674A Conduttore

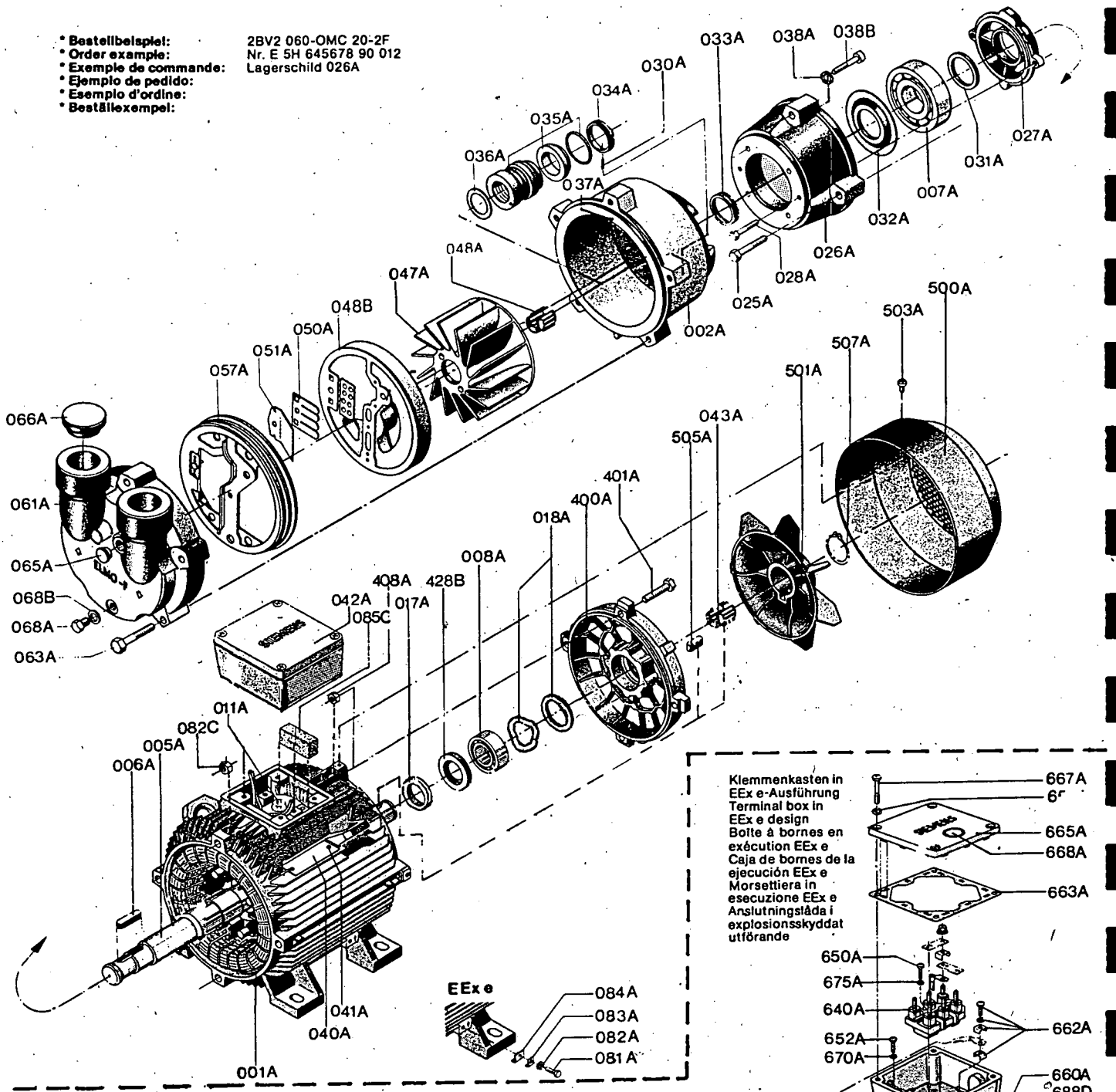
** per collegamento a terra della carcassa del motore

Reservdelar, tillgängliga från fabriken *

001A Motorhus, komplett
002A Pumphus
005A Motorrotor
007A Kullager
008A Kullager
011A Spiralstift
017A Hylsa för kullager (BS)
018A Lageransättningssats
026A Lagersköld
027A Inre lagerlock
030A Stift för glidringstätning
031A Distanshylsa för kullager
032A Nilos-ring
033A V-ring
034A Avtryckningsring
035A Glidringstätning
036A Skiva
037A Centreringsstift
040A Märkplåt
041A Skruv
042A Kopplingslåda, komplett
043A Toleransring för fläkt (Ex)
047A Löphjul
048A Toleransring för löphjul
048B Styrskiva
050A Ventilplatta
051A Fångplatta
057A Tätning för lock
061A Pumplock
065A Skyddspropp
066A Kåpa
068A Låsskruv
068B Tätning
081A Jordningsskruv
083A Jordningsvinkel
084A Kontaktvinkel
085A Jordningsskruv **
085C Lock
087A Jordningsvinkel **
088A Kontaktvinkel **
400A Lagersköld
428B Cox-ring
500A Fläkthuv
501A Yttre fläkt
503A Sexkantskruv
505A Kil för yttre fläkt
640A Kopplingsplint
648A Mellanstycke
651A Mellanstycke
654A Tätning
656A Överdel
657A Tätning
660A Avslutningspropp
662A Jordning
663A Tätning
665A Lock
668A Skyddsmärke
674A Ledning

** för potentialutjämningsledning i motorhuset

* **Bestellbeispiel:** 2BV2 060-OMC 20-2F
* **Order example:** Nr. E 5H 645678 90 012
* **Exemple de commande:** Lagerschild 026A
* **Ejemplo de pedido:**
* **Esempio d'ordine:**
* **Beställexempel:**



Normteile sind nach Muster im freien Handel zu beziehen.

Las **piezas normalizadas,** según muestra, pueden adquirirse en el comercio.

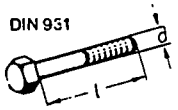
The **standard parts** can be procured according to samples from local dealers.

Le **parti** sono **normalizzate** e reperibili, secondo campione, in commercio.

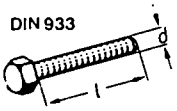
On se procurera dans le commerce les **pièces normalisées** sur le vu d'un échantillon.

Normerad del kan erhållas i fria handeln enl. mönster.

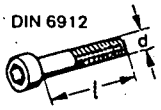
025A 028A 038B 063A 401A 650A 652A 655A 667A 671A — DIN 931



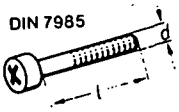
DIN 933



DIN 6912



DIN 7985

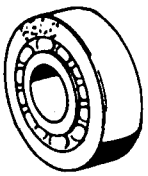


038A 082A 086A 653A 670A 672A 673A 675A — DIN 128

006A DIN 6885

007A 008A DIN 625

Lagertyp: / Type of bearing: / Type de roulement: / Tipo de cojinete: / Tipo di cuscinetto: / Lagertyp:



507A DIN 471

688D DIN 46320

082C 408A DIN 934

658A DIN 46320 Bl. 4

658B DIN 46320

Schmiertabelle / Tabla de engrase / Lubricating table / Tabella di lubrificazione / Tableau de graissage / Smörjningstabell

Fettsorte / Type of grease / Graisse / Tipo del grasa / Marca di grasso / Fettsort: AeroShell Grease 16

Vakuumpumpentyp / Vacuum pump type / Pompe à vide-type / Bomba de vacío-Tipo / Pompa a vuoto, tipo / Typ av vakuumpump	007A DIN 625 Rillenkugellager AS / Drive-end deep-groove ball bearing / Roulements à billes côté D / Rodamiento de bolas, lado A / Cuscinetto a sfere lato A / Spårkullager AS		008A DIN 625 Rillenkugellager BS / Non-drive-end deep-groove ball bearing / Roulements à billes côté N / Rodamiento de bolas, lado B / Cuscinetto a sfere lato B / Spårkullager BS		027A Lagerdeckel innen / Bearing cap (inner) / Couvercle intérieur de palier / Tapa interior del rodamiento / Coperchio interno del supporto / Inre lagerlock	428 B Cox-Ring / Cox ring / Bague Cox / Anillo Cox / Anello Cox / Cox-ring
	Kurzzeichen / Code number / Désignation / Denominación / Sigla / Kortbeteckning	Fettmenge / Quantity of grease / Quantité de graisse / Cantidad de grasa / Quantità di grasso / Fettmängd g	Kurzzeichen / Code number / Désignation / Denominación / Sigla / Kortbeteckning	Fettmenge / Quantity of grease / Quantité de graisse / Cantidad de grasa / Quantità di grasso / Fettmängd g	Fettmenge / Quantity of grease / Quantité de graisse / Cantidad de grasa / Quantità di grasso / Fettmängd g	
2BV2 060 –.... 0 –. 2BV2 060 –.... 1 –.	6205-J	3,2	6004-Z-J-C3	1,7	3	A 6004
2BV2 061 –.... 2 –. 2BV2 061 –.... 3 –.	6206-J	4,8			16	
2BV2 070 –.... 0 –.	6207-J	6,2			21	
2BV2 070 –.... 1 –. 2BV2 070 –.... 2 –.	6308-J-C3	15	6205-Z-J-C3	3,2	50	A 6205
2BV2 071 –.... 3 –.			6206-Z-J-C3	4,8		A 6206
2BV2 071 –.... 4 –. 2BV2 071 –.... 5 –.			6208-Z-J-C3	8,7		A 6208

9 Treibhülse
10 Spindel

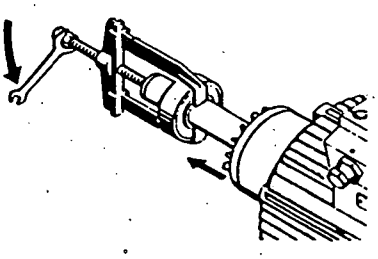
9 Driving sleeve
10 Spindle

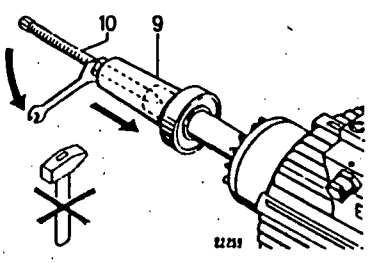
9 Douille d'emmanchement
10 Tige

9 Casquillo de empuje
10 Husillo

9 Campana di spinta
10 Perno filettato

9 Drivhylsa
10 Spindel





SECTION 5

EAGLEVIEW INDUSTRIAL PARK VACUUM SEWERAGE SCHEME

HIDROSTAL SEWAGE PUMPS

1. HIDROSTAL SEWAGE PUMPS

Serial No.	...	H 2397
		H 2398
Product	...	Sewage and Waste Water
Flow	...	5 L/s
Head	...	9 m
Temperature	...	Ambient
Suction	...	Flooded
NPSHA	...	3 m

Hidrostal Model D100-R01+DDM1B-M100+D0 Close Coupled horizontal screw impeller centrifugal solids handling pump driven by 2.2 kW 1450r/m TEFC IP 55 Electric Motor complete with mild steel galvanised base plate.

Pump suction and delivery flange is 100 mm drilled DIN 16.

Pump is in material 1 construction as follows:-

Casing	...	Cast Iron
Suction Liner	...	Cast Iron
Impeller	...	S.G. Iron
Shaft	...	420 Stainless Steel
Shaft sealing	...	Double Mechanical Seals

Mechanical seals are tandem type with the product side mechanical seal mounted behind the impeller and the motor side seal mounted in an oil filled chamber.

With this feature the pump is capable of running dry without damage.

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

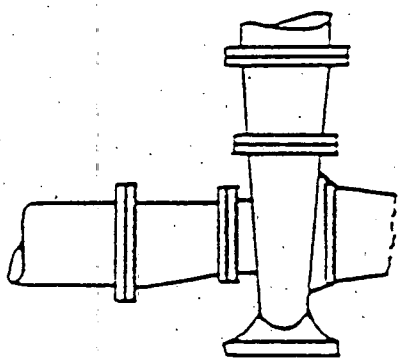


Figure 1.1

BAD

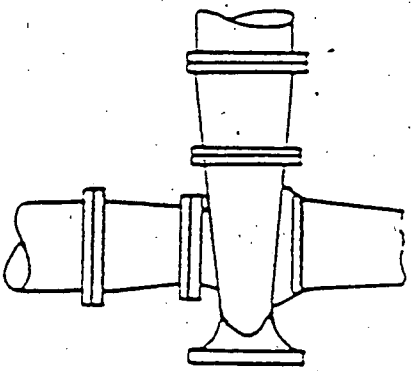


Figure 1.2

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.

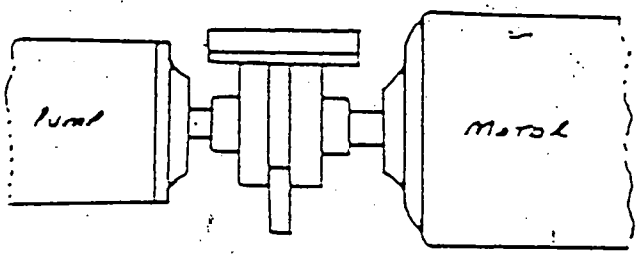
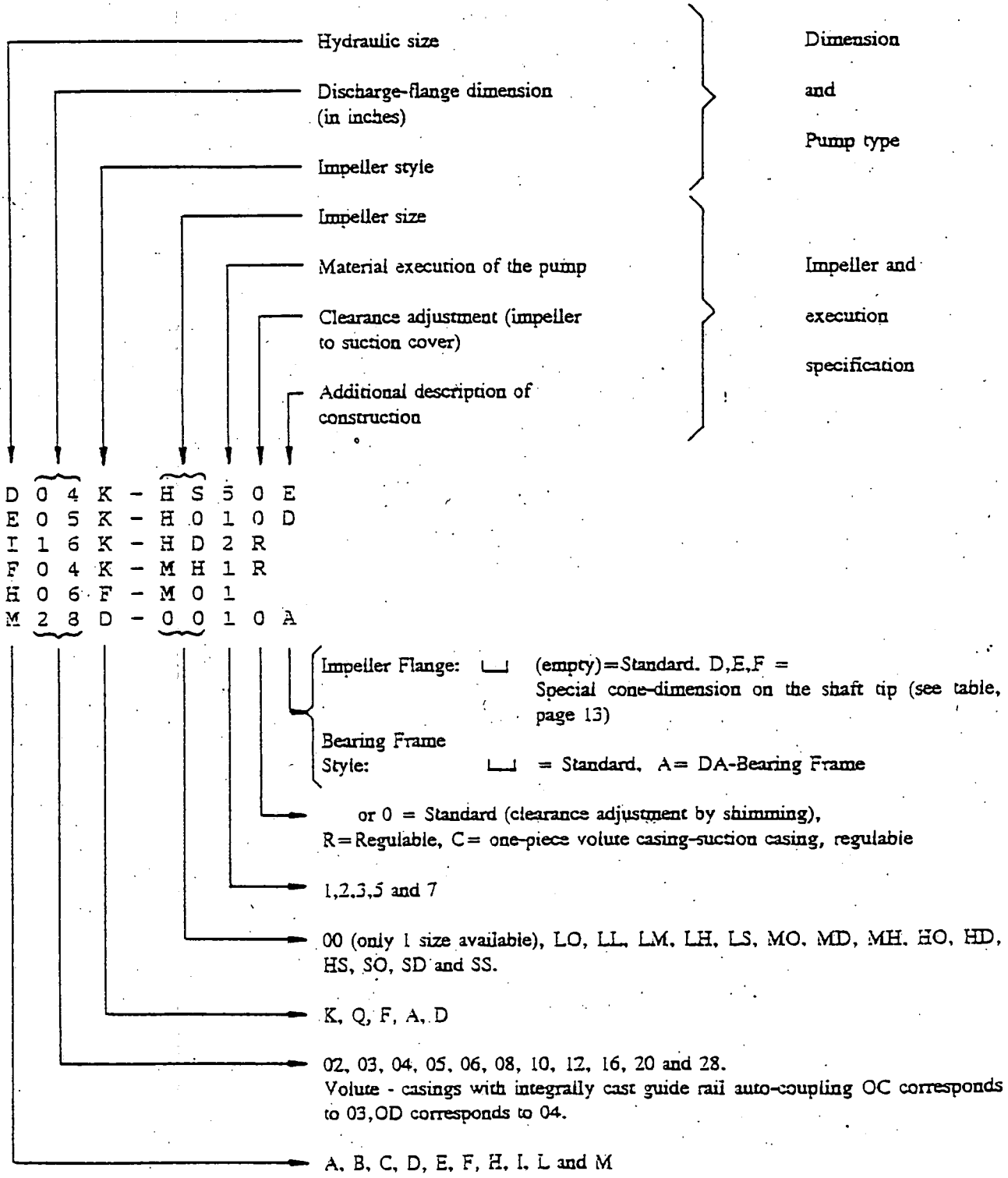


Figure 1.3

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

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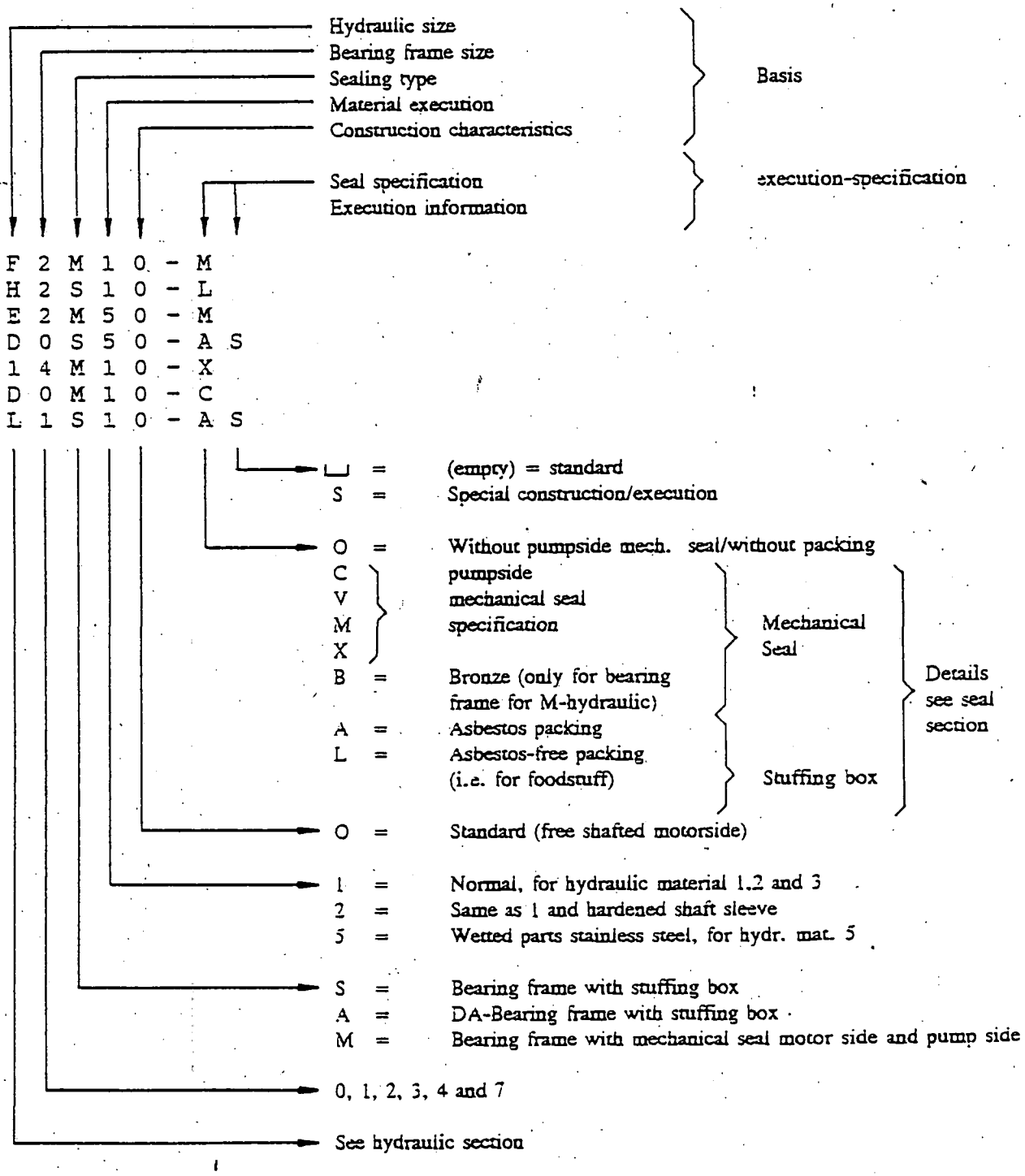
TYPE CODE
BEARING FRAME STANDARD CONSTRUCTION



NOTE: As a rule the cone dimension for the impeller flange is fixed by the Hydraulic size. As an exception D2S and D2M bearing frames (heavy construction) request a "D"-hydraulic suitable for an "E" shaft end cone dimension, for example D03K-S010E. (Also see type Code hydraulic.)

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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.

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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.

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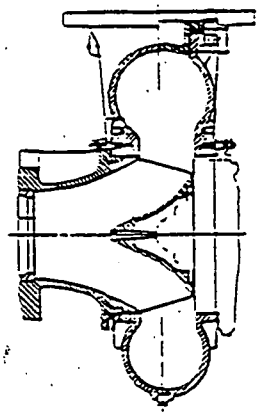
D-TYPE

Figure 1



Obsolete Model

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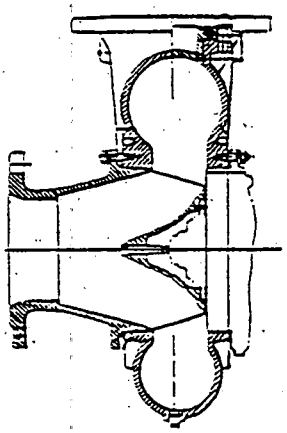
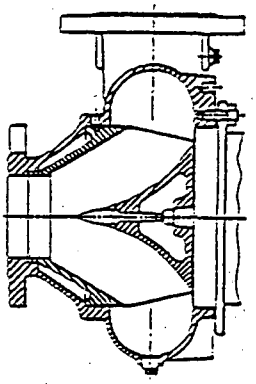
K-TYPE

Figure 2



Suction cover non regulable

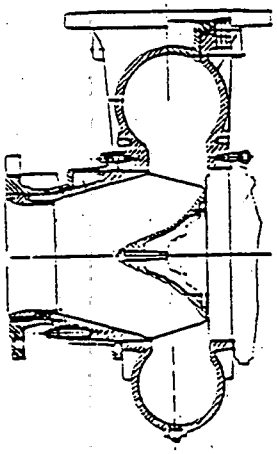
Figure 3



One piece volute/suction casing with non regulable liner

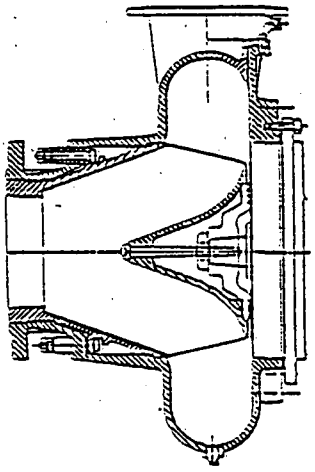
K-TYPE

Figure 4



Suction casing with regulable liner

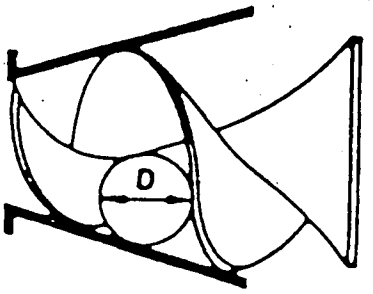
Figure 5



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

For further details see sectional drawings of this section.

Hidrostal



D03K-H — 2900 m
— — 1460 m

H (m)

30
20
10
0

2900
2830
65
68
70
71 %
60
71
70
68
65
DN2Y2
1460
2900
NPSH

NPSH (m)
10
8
6
4
2
0

P (kW)
8
6
4
2
0

2900 P
1460 P

83-K 3163b

0 10 Q(l/s) 20 30 40

22.4.85 /31.3.87

83-K3163 b

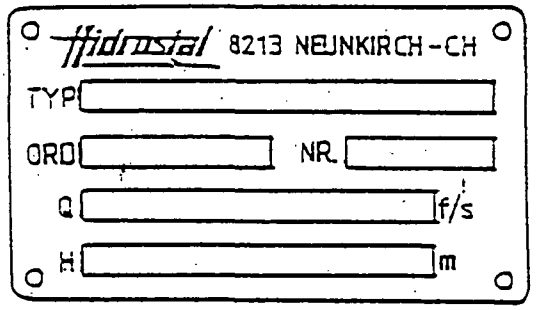
SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR K-LINE BEARING FRAME PUMPS. NON REGULABLE/MECHANICAL SEAL.

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.



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.

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

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.

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

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.

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

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".

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

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 lit 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					

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

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							

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

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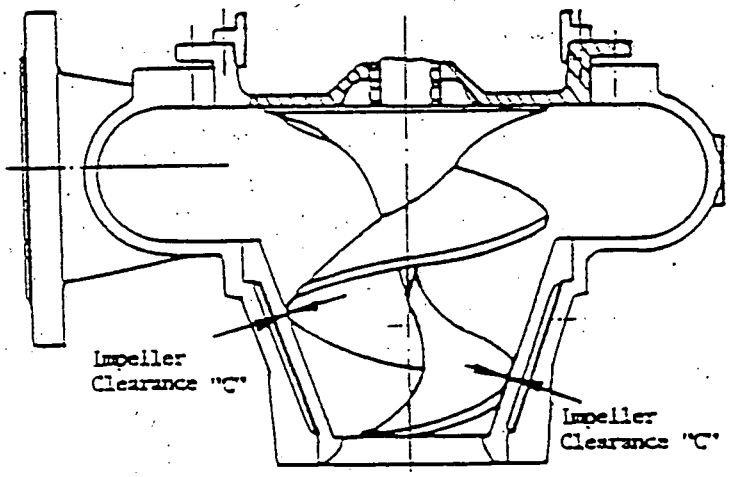
PUMP TYPE	CLEARANCE C(MM)	TRAVEL OF THE REGULATOR NUT B (mm)	APPROX. NO OF TURNS FOR REGULATOR NUT
D3K/D4K	0.35		
E 5 K	0.6	1.12	2/3
E8K-LS/LL			
E8K-HD/SS		1.55	1
F 6 K			1/2
F 6 K	0.5	1.40	1
F 10 K		1.93	1-1/3
H 5 K		0.85	1/2
H 8 K	0.6	1.67	1-1/6
H 12 K		2.32	1-1/2
I 6 K		1.02	2/3
I 10 K	0.75	2.09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

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

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.

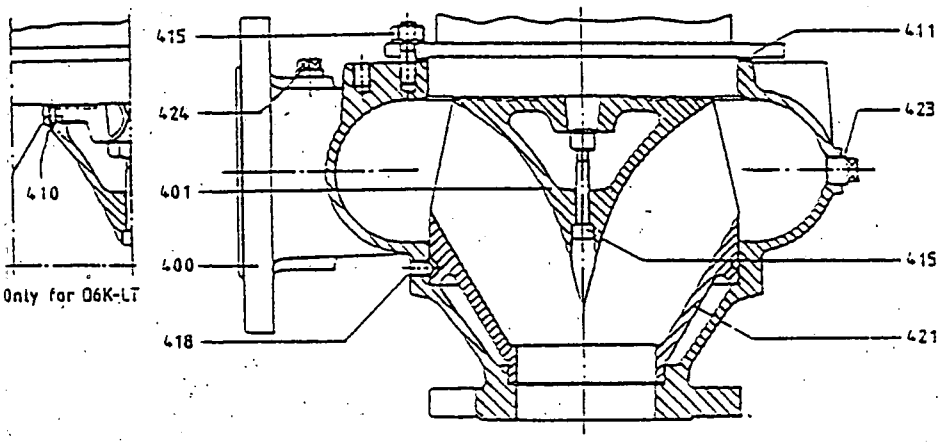


Figure 15 D3K, D4K, E4T

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.

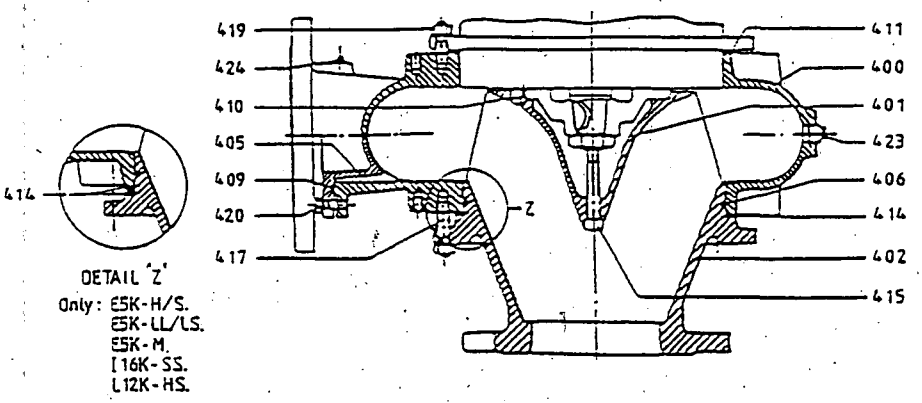
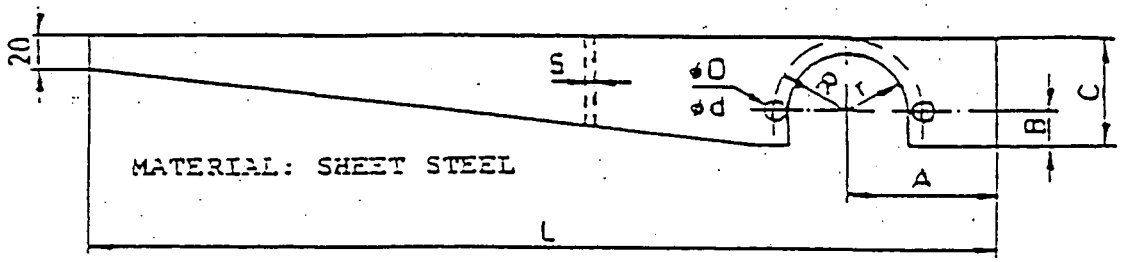


Figure 16: E5K, E8K, F6K, F10K, H8K, H12K, I10K, I16K, L12K, L20K: Non-Regulable.

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

REMOVAL OF IMPELLER FLANGE
(For pumps where impeller flange is used)

Bend tabs on the locking washer (167). When loosening the impeller flange nut (166), it may be necessary to hold the impeller flange from turning, by bolting up the special tool shown on Figure 20 to the tapped holes in the impeller flange. Use bolt thread size as indicated in last column of table in Figure 20. After nut is removed, tap impeller flange (165) with a mallet, and the impeller flange should drop off the shaft taper. If not, use a pulley-extractor tool as shown in Figure 21, bolted to the impeller flange with bolts of the size shown in the last column of Figure 20.



PUMP SIZE	R	r	o D	A	B	C	L	IMPELLER	FLANGE NUT	HOLE SIZE
								SIZE	WRENCH SIZE [1]	
D	30	25	10	65	15	70	500	M20	32	M8
E	40	33	14	80	20	80	500	M28	41	M12
F	55	48	14	110	20	100	900	M35	46	M12
H	80	65	18	150	30	130	900	M35[2]	46[2]	M16

(1) MM across flats.
(2) Except for "H" pump size with "H" motor size. In this case a special nut 70mm across flats is used.

Figure 20

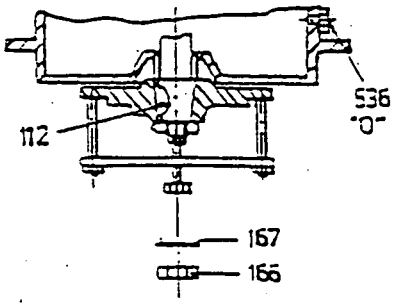


Figure 21

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

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).

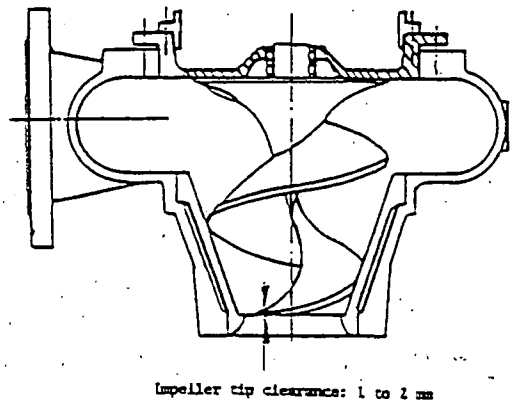


Figure 32

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.

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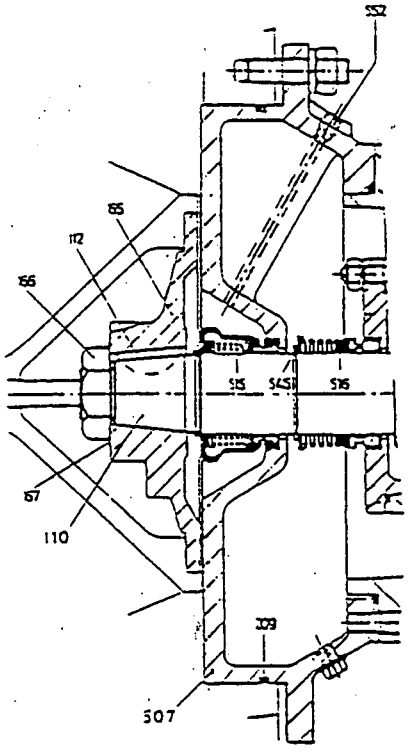
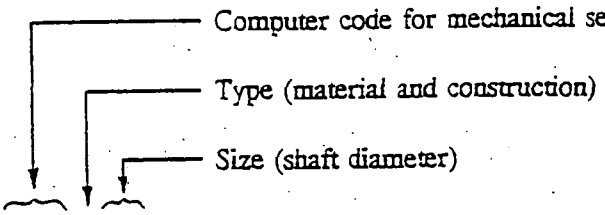


PART	DESCRIPTION	MATERIAL OF CONSTRUCTION	
		1, 2 + 3	5
110	SHAFT	RUSTLESS STEEL	STAINLESS STEEL A4
112	KEY	STEEL	STAINLESS STEEL A4
165	IMPELLER KEY	NODULAR IRON	STAINLESS STEEL A4
166	NUT	RUSTLESS STEEL	STAINLESS STEEL A4
167	WASHER	RUSTLESS STEEL	STAINLESS STEEL A4
209	O-RING	NITRILE	
507	BACK COVER	GREY CAST IRON	STAINLESS STEEL A4
515	MECH. SEAL	C, V, M, X, B **	
516	MECH. SEAL	C, X **	
545	SNAP RING	SPRING STEEL	
546 *	SNAP RING	SPRING STEEL	
552	PLUG	STEEL	-

* Only for Mech. Seal: C, V X
** See type code description of this section (REFER NEXT PAGE)

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

CODE DESCRIPTION



8DM-CO.6
8DM-B4.0
8dm-V1.1
8dm-M2.0
8dm-X100

Size Code	0,6	0.8	1.1	1.3	1.5	2.0	3.0	4.0	95	100
Size	5/8"	7/8"	1 1/8"	1 3/8"	1 1/2"	2"	3"	4"	95mm	100mm

	Stationary Part	Rotating Part	Seal Outside (casing)
C	Ceramic	Carbon	Spring
M	Silicon-carbide	Tungsten-carbide	Buna-N Casing completely enclosing spring
X	Silicon-carbide	Tungsten-carbide	Stainless steel casing, completely enclosing springs

AVAILABILITY

SIZE-CODE		0,6	0,8	1,1	1,3	1,5	2,0	3,0	4,0	95	100
TYPE	C	x	x	x	x	x	x	x			
	M	x		x		x	x				
	X							x		x	x

NOTES:

- Every bearing frame and motor is of double mechanical seal construction.
- Up to size 3.0 the motor side seal is always of type c, sizes 95 and 100 always of type x.
- The B-type seal is only for M1M and M2M bearing frames (motor and pumpside).
- For block pump with single mechanical seal only type C is available.
- Sizes 0,8 and 1,3 are only used for motor side seals.

Refer: HID003/5/28 for seal and bearing data

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR BEARING FRAME PUMPS/Q-TYPE HYDRAULICS

2.0 SERVICE CONNECTIONS

On Bearing Frame

The service connections that are built into all pumps as standard are listed below. Please refer to sectional drawing of bearing frame at end of the manual for specific details.

552a/552b Seal Flushing Connections

For applications handling lightly contaminated liquids this connection is not used: However, in special cases when pumping high concentrations of solids with a tendency to dehydration or sedimentation, such as high concentrations of sludge or mud, there should be a connection to clean water flush. This connection will conduct clean water between the impeller and the lower mechanical seal (515), providing periodic removal of accumulated solids.

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Flushing water must be pressure-regulated between 7 and 14 psi (½ to 1 bar) above pump discharge pressure. Typically, water is controlled by a solenoid valve on a time clock. Adequate duration of each flushing is 60 seconds; frequency of flushing must be established for each different installation, starting with once per day.

The quantity of flushing water varies according to pump size and application: In most cases, flow rates of 6-8 l/min will be sufficient.

Alternatively or even in addition to the above function, this connection may be used to manually bleed the air from the casing prior to start-up, if there is no other place for air to escape through the discharge piping.

In most cases the connection 552b will be closed and flushing water mixes with product pumped. In cases where the solid accumulate, could form lumps or be fibrous, flushing out via 552b would be the preferred-solution. Connection 552b also permits complete draining of horizontal units if required.

536a/536b Oil fill and Oil Drain Connections

Connections 536a is positioned in such a manner that it should always be regarded as the oil fill connection.

Connections 536b is the oil drain connection.

IMPORTANT

SEE SECTION DESCRIBING 'SEAL OIL CHECKING' AND 'SEAL OIL CHANGING' FOR DETAILED INFORMATION.

Connection D:-

This connection tapped - ¼" BSP permits any leakage through the inboard mechanical seal (POS 516) to drain away thus preventing contamination of bearing grease and premature failure of bearing (POS 125).

This drain must be left open. As soon as leakage via 'D' is noted the pump should be removed to a workshop for inspection.

On horizontally units Connection D must always be at the bottom of the bearing frame. The factory build pumps with drain 'D' on the opposite side to pump discharge flange, as most horizontally mounted pumps have the discharge flange vertically. If the discharge flange is in any other position the bearing frame must be unbolted from the hydraulic end and re-positioned so drain is vertically down.

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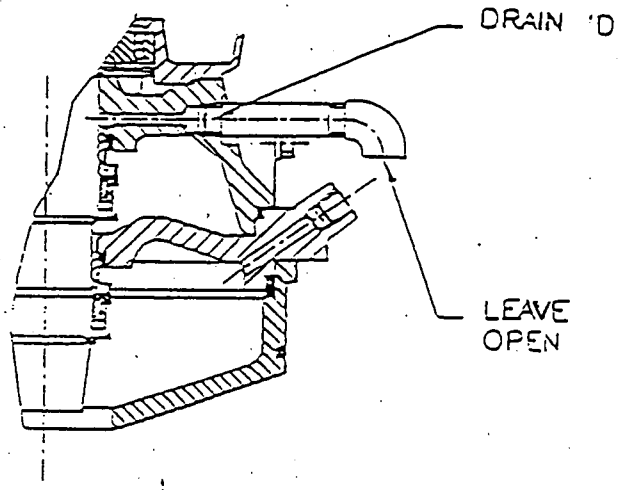
On vertical units the drain can be in any position relative to the discharge nozzle.

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 frames	BCM.0	Connection 163 is
	DCM.0	permanently plugged
	DFM.0	

These bearing frames are oil lubricated, 163 is the grease nipple connections [Pos 131] on the grease lubricated version of this pump.

Connection 131

Greasing point for bearings on grease-lubricated version.

SEE SECTION "BEARING LUBRICATION" FOR FULL DETAILS

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR BEARING FRAME PUMPS/Q-TYPE HYDRAULICS

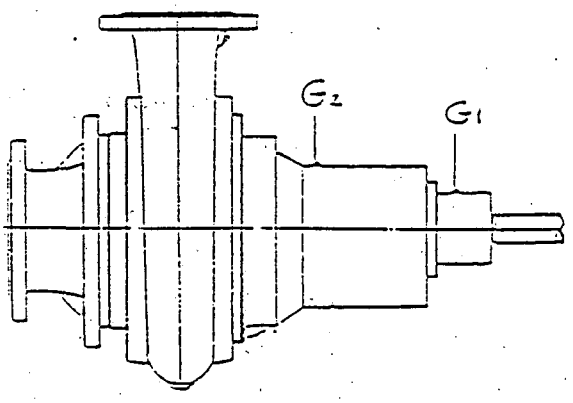
3.0 BEARING LUBRICATION

1. Grease Lubricated Bearings

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

HYD. SIZE	BEARING FRAME CODE	SECTION DRAWING	R.P.M.	LUBRICATION INTERVAL HOURS	AMOUNT OF GREASE [GRAMS]	
					G1	G2
B	BCM.F	90-TU-4115	3,000	500	3	2
			5,000			
D	DBM.F	90-TU 4110	2,900	500	-	2
	DCM.F	90-TU-4157	3,500	500	3	2
E	ECM.F	90-TU 4163	1,500 2,000	500	3	1
	EFM.F		2,900 1,500	500 1,000	5 5	
F	FFM.F FGM.G	90-TU 4165	1,500 1,500 2,100			

The factory grease the bearings with the following grease and we recommend that, where possible, the same grease is used for periodic greasing. STABUAGS NBU 8 EP by Kluber-Lubrication.



Equivalent Lubricants:

1. Mobilux EP2 (Mobil)
2. Lidok EP2 (Exxon)
3. SKF LGEP2 (SKF)
4. Alvania EP2 (Shell)
5. Multifak EP2 (Texaco)
6. Amolith Grease #2EP (Amoco)

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

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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 [0.1mm]	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 BEARING FRAME PUMPS/Q-TYPE HYDRAULICS

OIL LUBRICATED BEARINGS

For high speed and heavy duty applications, Hidrostal pumps can be supplied with oil lubricated bearings. These can only be used on horizontal applications. Bearing frames for oil lubrication can be identified by the letter 'O' at the end of the bearing frame code [ie BCM10]

IMPORTANT

When factory supply bare-shaft pumps they are shipped without bearing lubricating oil. The oil fill is to be made either by local agent, who may fit the pump to a base-plate or by installer. Commissioning engineer should check oil fill has been made prior to start-up.

The following Bearing Frames are oil lubricated and the oil should be changed according to table below or when oil looks dirty and/or contaminated.

HYD CODE	BEARING FRAME CODE	SECTION DRAWING	R.P.M.	OIL CHANGE INTERVAL	QUANTITY OF OIL [LITRES]
B	DCM.0	90-TU 4123	3,000 6,300	Once per year or every 5,000 hours	0.15
D	DCM.0	91-TU 4159	3,000 6,300		0.15
D	DFM.0	90-TU 4161	2,900 4,100		0.85
E	EGM.0		2,900 3,500		1.2
F	FHM.0		2,900		1.5

The correct level for the lubrication oil is the centre line of the sight-glass [Pos 536].

The factory recommend the following oil for bearing lubrication.

Automobile Transmission Fluid [ATF] Universal Oil. Factory fill with version having red additive.

WARNING

Oil temperature should not be allowed to exceed 80°C. For applications where this would occur consult your local Hidrostal agent.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR BEARING FRAME PUMPS/Q-TYPE HYDRAULICS

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 1,000 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 [Pos 549] 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.

BE CAREFUL in oil lubricated bearing frames to check the correct sight-glass. Seal oil sight-glass [Pos 549] is located nearest the hydraulic end; whereas the bearing lubrication oil sight-glass [Pos 536] is low down, between the bearings.

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 plus 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 plus 536a 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 is advisable that the seal oil is then checked after a further 500 hours of operation.

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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

OIL CONDITION	ACTION	
Oil is clean	Top up to correct level*	PUMP INSITU
Oil is milky	Draining 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 discolours oil]	Completely drain old oil, flush out, refill* with new 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

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SEAL OIL QUANTITIES

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

BEARING FRAME	QUANTITY [Litres]
DBM.F	0.9 - 1.0
BCM.F/BCM.0 DCM.F/DCM.0	0.9 - 1.0
ECM.F -	1.2 - 1.3
DFM.0	1.5
EFM.F -	3.3
FFM.F - - EGM.0 FGM.F -	3.3
- FHM.0	3.8

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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 pump liquid.

5. In case of Bearing Frames equipped with electrical moisture probes, it is important that the liquid has good electric insulation qualities.

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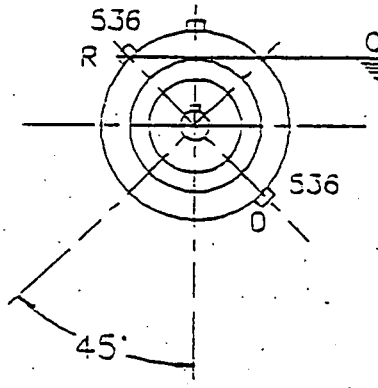
CHANGING SEAL OIL ON INSITU HORIZONTAL PUMPS

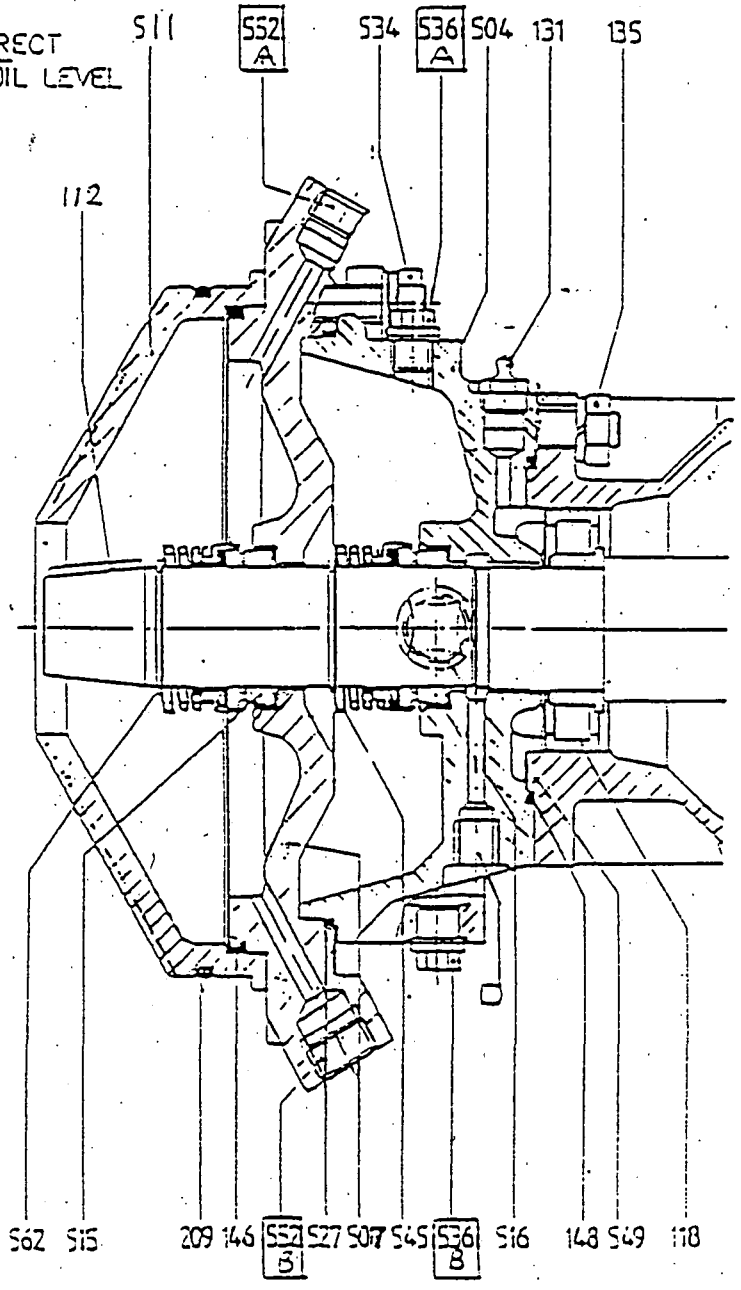
For horizontally installed pumps the oil can be drained via plug 536b into a suitable container.

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-instal plugs 536 using a new softened copper seal [see note above] and re-instal 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.



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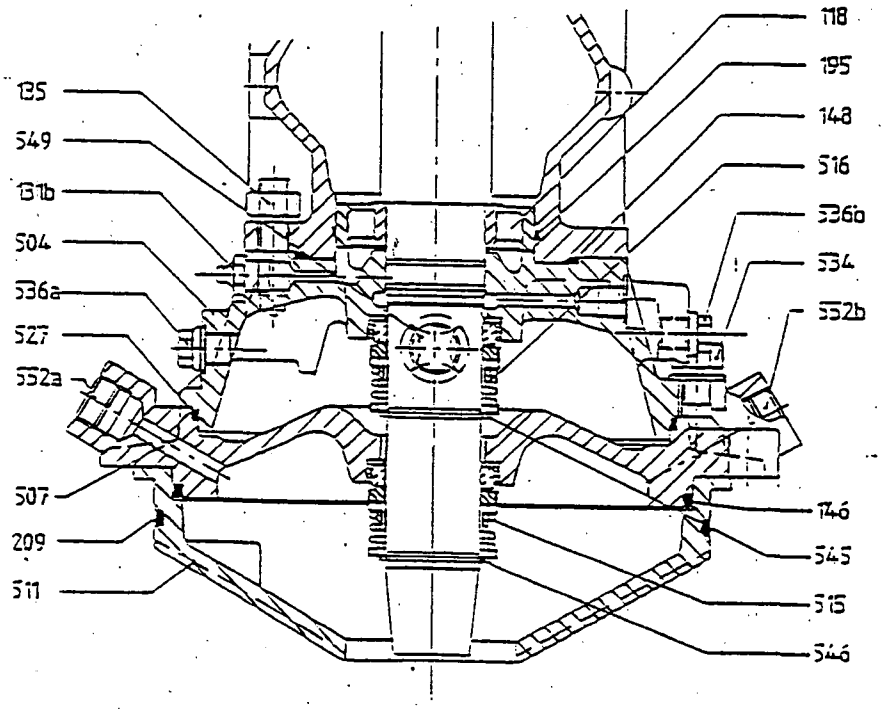
CHANGING SEAL OIL ON INSITU VERTICAL PUMPS

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 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.

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MAINTENANCE OF HYDRAULIC PARTS

PUMPS WITH HEAVY DUTY HYDRAULIC END AND REGULABLE LINERS

B050 Sectional Drawing 90-TU 4144 Mat Code 1R/3R/5R
D080-D100 Sectional Drawing 90-TU 4148 Mat Code 3R/5R
E080-E200 Sectional Drawing 90-TU 4150 Mat Code 3R

This family of pumps have been designed for the more arduous applications where ease of impeller clearance adjustment is a requirement, particular in situations where the liquid may contain abrasive solids. In this case the clearance is adjusted by three external screws without disturbing the pump or pipework.

For a pump on a new application the impeller clearance should be checked and re-adjusted whenever a significant decrease in pump performance is noticed or at least once every six months, until a history is developed as to how often adjustment will be required.

Excessive clearance is not desirable especially in the smaller pump sizes, as a greater percentage of total flow can thus re-circulate 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 between the impeller and the liner.

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, set clearance to 2 times that shown in table.

The three adjusting screws can be found on the suction side of the volute, immediately behind the suction flange.

A. IMPELLER CLEARANCE ADJUSTMENT OF PUMPS WITH REGULABLE LINER

Loosen and back-off lock nuts [Pos 412] on end of each regulator assembly. Now slowly and evenly screw-in each regulator bush [Pos 422] just until pump shaft cannot be turned [this will eliminate all clearance between the impeller and the liner]. Be sure to take the same number of turns on each threaded regulator bush; this keeps the liner concentric to the impeller.

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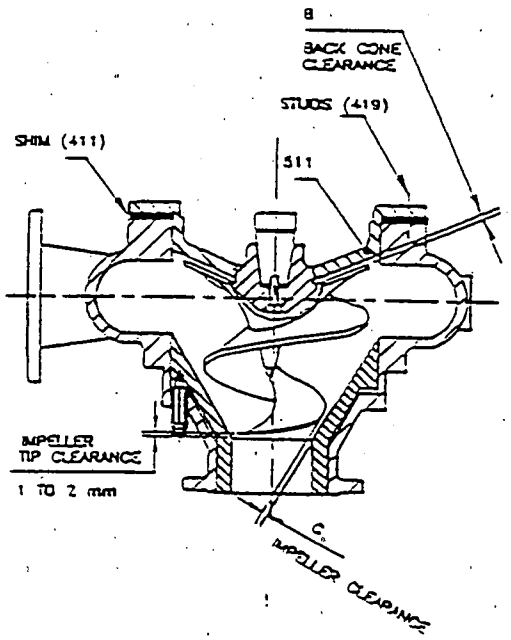
If the impeller tip is binding on the lip in the suction eye, or if there is less than 1mm clearance, between the impeller tip and the lip when the spiral edge of the impeller is firmly seated against the conical taper inside the volute, then the tip clearance must be opened up. To adjust the tip clearance the impeller tip must be ground off parallel to the suction flange, until 1-2mm clearance is obtained.



Now back off the threaded regulator bush [Pos 422] exactly the number of turns specified in the table [according to pump size]. Holding each threaded regulator bush from turning, tighten the three standard hex lock nuts [Pos 412]. This pulls liner away from impeller the required clearance, and also locks the regulator bush in place.

Ideally a feeler gauge should then be used to check the actual clearance between the impeller and liner, access being via the suction of the pump.

If the clearance is significantly different than 'C' shown in table, it is possible that the wear is excessive or uneven, disassembly and inspection is recommended.

In situations where the actual clearance 'C' cannot be measured, i.e. pump is installed in a system, it can only be assumed the clearance is correct, unless a noticeable reduction in performance would indicate otherwise. In this case, the pump should be removed so that the hydraulic end can be disassembled and inspected for wear.

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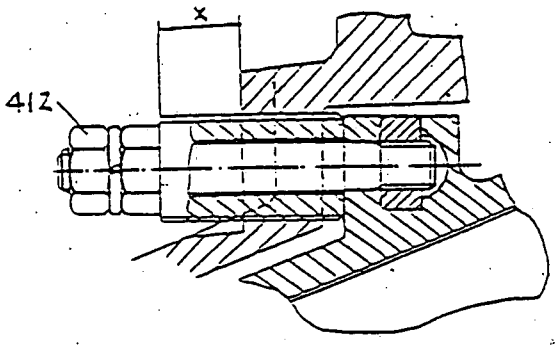

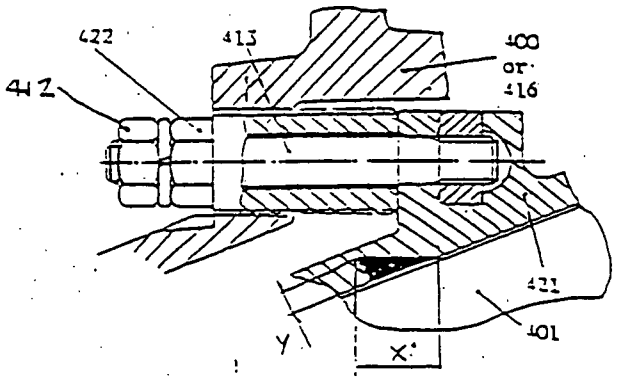

Type	Max. Regulating distance X' [mm]	Max. clearance Y [mm]	Max. recommended adjusted clearance C' [mm]	Regulation nut Pos. 422	No. of turns of regulator nut 422 for C' [from C=ø] n [1]	Clearance 'B' [mm]
B050	10	5.9	0.2	M 18 X 1.5	0.23	
D050	8	4.7	0.3	M 22 X 1.5	0.34	
D080		4.7			0.34	
D100-/S		4.7			0.34	
D100-H/M		4			0.40	
E080	13	7.6	0.4	M 27 X 1.5	0.45	
E125-SH/M/H						
E125-MH	7	4.1	0.4	M 22 X 1.5	0.45	
E200-HL/SL	8	2	0.4	M 22 X 1.5	1.06	
E200-ML	13	3.4			1.01	

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 BEARING FRAME PUMPS/Q-TYPE HYDRAULICS

REPLACEMENT OF WORN HYDRAULIC PARTS.

If, after re-adjusting the impeller clearance "C' there remains big discrepancies in this clearance and the reset pumps does not sufficiently restore the pump performance then the impeller and/or suction liner are worn beyond their service life and should be replaced.

An impeller is considered worn when:-

a) **The outer edge [that which runs next to the liner] no longer presents a smooth continuous surface but is grooved and is no longer conical. This is best checked by placing the impeller into a new liner, if available.**

b) **The discharge edge is worn so thin that small abraded valleys on the surface of the blade have, or are about to break through.**

c) **The impeller tip is worn such, that it is no longer hidden behind the shoulder [lip] in the suction eye of the liner [check that it is the impeller that is worn and, not the entrance to the liner, which forms the shoulder].**

Wear patterns on the flat surfaces of the impeller are not critical to the performance, nor is a gentle rounding of the impeller edge.

The liner/suction cover is considered worn when:-

a) **Deep circumferential grooving is present on the conical surface.**

b) **The spiral groove is no longer visible, or it is generally less than 1.5mm deeper than the conical surface.**

c) **The shoulder lip at the inlet eye is not longer of sufficient width to protect the impeller tip.**

NOTE: If the impeller tip is visible through the suction eye of the assembled pumps, it is possible that fibrous materials and rags will hang up on this tip and the pump will no longer provide the excellent 'solids handling capability' for which it was originally purchased.

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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:	C	B	D	E
Wrench Sizes:	10 mm	10 mm	10 mm or 14 mm	14 mm

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.

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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 1¼ 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-size compound here], then install impeller directly onto shaft.

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

FACTORY FITTED IMPELLER BOLTS

HYDRAULIC	SIZE	HEXAGON	TORQUE N-M
B050 D050] DDM1B D080] DDM1C D100]	M12	10	60
D080] E125] 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.

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REMOVAL OF "REGULABLE" LINER

The liner [Pos 421] is housed in the front portion of the volute in the case of the smaller pumps B050/D080/D100. The larger pumps E080→ have a removable suction casing. [Pos 416] in which is housed with regulable liner [Pos 421]. See section drawing of each pump for exact construction details.

Pumps with regulable liners can easily be recognised by the presence of three large regulation bushes with lock nuts just behind the suction flange.

If the conical surfaces is worn, only the liner needs to be replaced. The liner can be removed while the volute casing and suction casing remain attached to the piping, if desired. Alternatively, the suction casing may be removed from the volute casing by removing nuts [Pos 417], if more convenient.

To remove liner, completely remove small lock nuts [Pos 412] on end of regulator bush [Pos 422], then push the three screws [Pos 413] through the holes in the large regulator bushes. If stubborn, the large regulator bushes can be turned all the way into the casing to force the liner out. No attempt should be made to disassemble the regulator screws [Pos 415] from the liner until the liner is removed from the pump; they are loctited in place and, must be heated with a torch to break the loctite bond.

The wear ring [Pos 408] should not typically require disassembly; remove from suction casing only if badly damaged by unusual circumstances. It will be necessary to heat the mating surfaces with a torch to destroy the special adhesive between these two parts. Then press out wear ring with a hydraulic press.

REPLACEMENT OF "REGULABLE" LINER

Install three regulator screws [Pos 413] into liner, using 'Loctite' "stud-mount".

Thoroughly grease 'O'-ring [Pos 430] and install into groove in casing [Pos 400] - this groove is nearly hidden by the suction ring in some pump models. Grease 'O'-ring [Pos 431] and install into groove in wear ring [Pos 408]. Assemble ring into suction casing with a lead hammer, until suction ring is flush with flange surface.

IMPORTANT

Make sure wear ring is flush with or slightly below flange surface. If it is protruding above surface the connection of the suction pipework will push wear ring into casing and close-up tip clearance, or in extreme cases bind on impeller tip which could cause bearing or seal failures.

Grease and install 'O'-ring [Pos 406] onto large end of liner.

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Coat the external threaded portion of large regulator bushes with anti-size compound and, install these into the casing [Pos 400] or [Pos 416] hex-side toward the outside [toward the suction flange]. Screw these into the casing until they are flush with the inside of the casing.

Now place liner into casing, engaging the three screws into the holes through the three regulator bushes. [**Note:** The three screws are not spaced evenly around the liner, so there is only one orientation of the liner where the screws will correctly fit through the regulator bushes].

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 527] and fit into spigot of sealplate [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 assemble and re-assemble the pumps.

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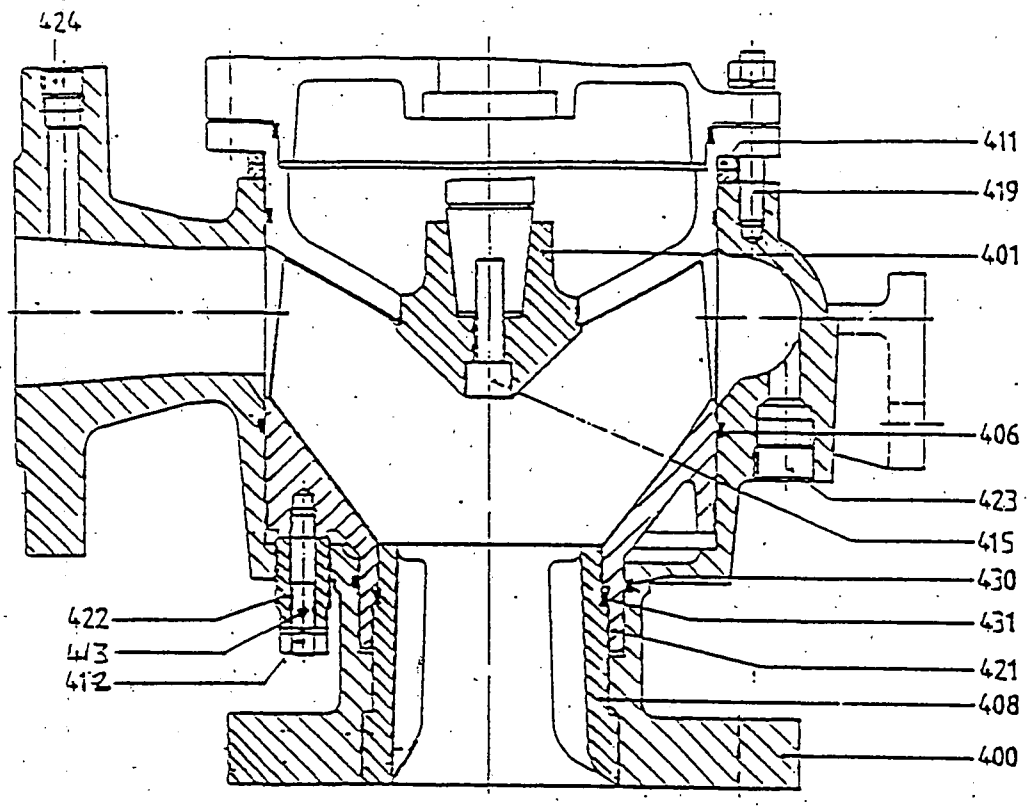

PART	DESCRIPTION	MATERIAL CODE		
		1R	3R	5R
400	VOLUTE	GREY CAST IRON	GREY CAST IRON	STAINLESS STEEL A4
401	IMPELLER	NODULAR IRON	STAINLESS STEEL A4	STAINLESS STEEL A4
406	'O'-RING	NITRILE		
408	WEAR RING	GREY CAST IRON	HIDRO HARD	STAINLESS STEEL A4
411	SHIMS	STEEL		
413	ADJUSTING BOLT	STAINLESS STEEL A4		
415	IMPELLER BOLT	RUSTLESS STEEL	RUSTLESS STEEL	STAINLESS STEEL A4
419	FASTENING SET	RUSTLESS STEEL		
421	LINER	GREY CAST IRON	HIDRO HARD	STAINLESS STEEL A4
422	REGULATION NUT	STAINLESS STEEL A4		
423	DRAIN PLUG	STEEL	STEEL	STAINLESS STEEL A4
424	PLUG	STEEL	STEEL	STAINLESS STEEL A4
430	'O' - RING	NITRILE		
431	'O' - RING	NITRILE		

Hidrostal reserves the right to make changes without giving prior notice.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR BEARING FRAME PUMPS/Q-TYPE HYDRAULICS

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 100] proceed as follows:-

c) Remove shaft key [114] labyrinth [130] unfasten nuts [136] and remove bearing cap [103] and 'O'-ring [147].

d) Remove oil chamber casing [504] if still fixed to [100], taking care not to damage the stationary mech seal face. Press shaft and bearing assembly from pump end out of bearing housing [100].

e) Unfasten lock washer [127] and remove lock nut [126].

f) 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, bearing housing and bearing caps 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 but 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], and all threads on shaft [110]. If unit is not to be installed immediately, store in a clean and dry place.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR BEARING FRAME PUMPS/Q-TYPE HYDRAULICS

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 grease nipples and plugs with Teflon tape. 'O'-rings must be greased before assembling.

b) Special recommendation:- To facilitate the mounting of the rolling 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 rolling bearings on the shaft, hand-pack bearings 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 first lubrication service [refer to lubrication chart] this will prevent excessive heating of bearings during initial pump operation.

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

e) For disassembling rolling bearings from bearing housing or from the shaft, use special extractor or press. Do not use hammer or other conventional tools, which might damage bearing. When mounting roller bearings, take care to rotate shaft in order to avoid damage to inner face of bearing race.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR BEARING FRAME PUMPS/Q-TYPE HYDRAULICS

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. This is particularly important in respect of the rating of the thrust bearings.

When re-assembling this Bearing Frame, it is important that Sectional Drawing stated at the beginning of the manual, is available and the assembly should be made as follows:-

1. Assemble the bearings at the driven end of the shaft as follows: NOTE: This operation is best done with the shaft vertical.

   a) Place spacer ring [109] on shaft then fit thrust bearings [121] taking care to ensure that they are installed according to the orientation shown on the Sectional Drawing.

      In order to assist the fitting of these bearings on the shaft, it is best that they are first pre-heated on a suitable hot-plate prior to attempting to slide them over the shaft. After each bearing has cooled, it should be packed with grease, see 'maintenance Section' of the Manual for appropriate grade of grease.

   b) Place spacer ring [106] on bearings, taking note that this ring has a inner and outer piece, when fitting the larger diameter outer ring would you please note that the slots on one side should be placed so that they face the pump end of the bearing frame, i.e., they face the two bearings that are already fitted to the shaft.

   c) Fit inner ring of roller bearing [119], again after pre-heating. Once the inner race has cooled, fit outside ring of bearing and pack with grease.

   d) Place locking-washer [127] and tighten bearing assembly, using locking nut [126] bend over locking tab on washer [127].

2. Pre-heat inner ring of roller bearing [118] and fit onto shaft pushing up hard against shoulder.

3. Prepare bearing housing [100] for assembly of shaft by fitting snap-ring [150] and spacer ring [157].

4. Heat bearing frame by gas torch to a temperature of approximately 80°C and install shaft bearing assembly, pushing down by hand hard up against the shoulder provided by snap ring [150].

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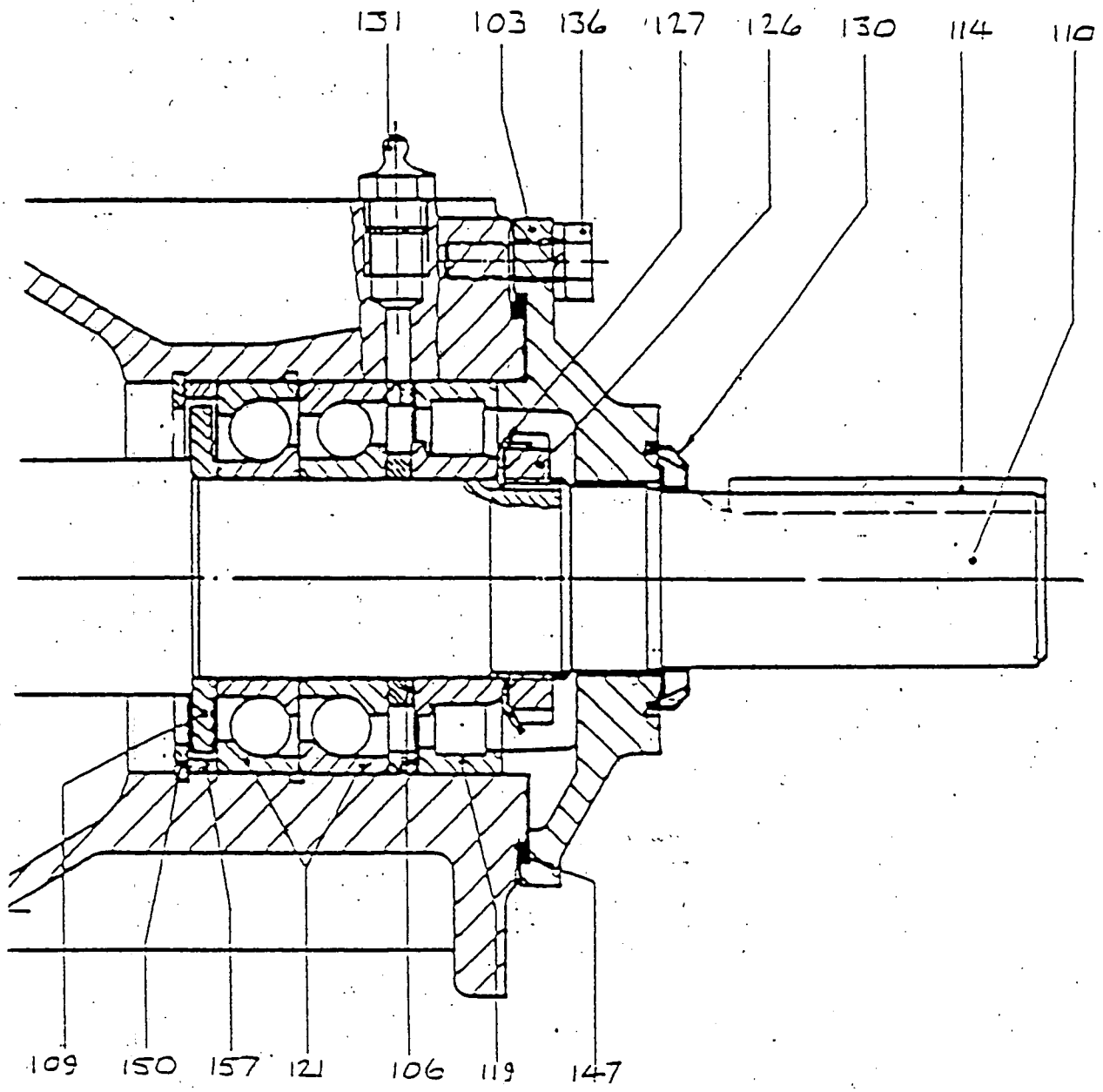
Re-assembly, continued



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Re-assembly, continued

5. Install 'O'-ring [147] and mount cap [103] and secure using fastening set [135].

6. Press labyrinth [130] onto shaft using special tool number . This special tool is used to prevent the labyrinth being pressed too far and rubbing against and stationary cap.

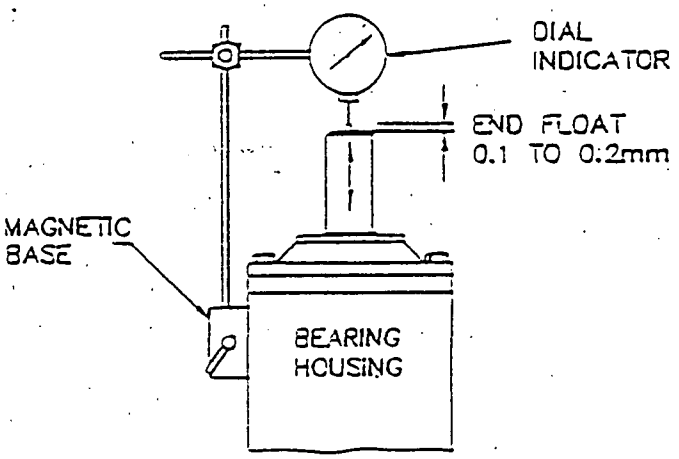
7. Heat bearing frame [100] at pump end, using gas torch, and instal outer part of bearing [118] this should be pushed into place by fitting oil chamber casing [504]. Having put the bearing into the correct position part [504] should again be removed and after allowing for the bearing to cool, the bearings packed with grease, according to appropriate specification.

8. Place 'O'-ring [148] onto [100] and fit oil chamber casing [504] by fastening set [534].

WARNING

When fitting position [504] ensure that drain position 'D' is on the bottom of the casing, i.e. on the same side as the mounting bracket at the shaft-end of the bearing frame.

9. The end float in the bearings must now be checked at this stage of the assembly. This is best done by fitting a magnetic base to the bearing frame and positioning a clock-gauge on the end of the shaft. The shaft should now be lifted and pushed down, so as to register the amount of end float that is available. This lifting can sometimes be best achieved by screwing an 'eye bolt' into the tapped hole on the end of the shaft and lifting the bearing frame on a crane.



The correct end-float for this Bearing frame is 1/10th to 2/10th of a millimetre [4/1000 to 8/1000 inch.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR BEARING FRAME PUMPS/Q-TYPE HYDRAULICS

10. 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 grove when sliding along shaft. Take care to keep the seal square when sliding along shaft, also apply uniform gentle pressure when installing into seat.

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.

Install 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 been rolled out from under the metal part of the seal face.

Install seal-spring and spring-retaining ring.

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

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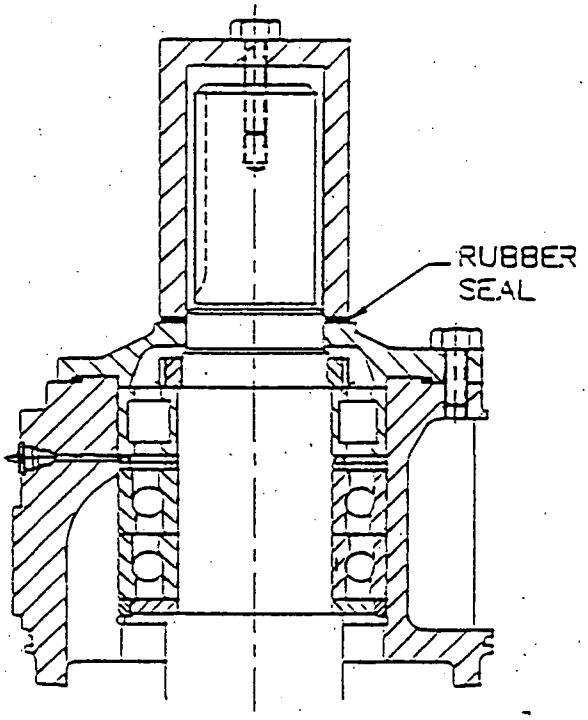
11. The next step is to prepare the bearing frame, so that the tightness of mechanical seal [516] can be checked.

Seal off shaft end of Bearing frame, using hydraulic test tool ensuring a rubber sealing ring is placed between the end of the tool and the bearing cap.

All plugs in bearing frame must be installed at this stage.

Connect a dry-air supply to connection 'D' using a length of rubber/plastic hose.



The interior of the bearing frame should now be pressurised using dry-air to a pressure not exceeding 0.5 bar. We have found from experience, a bicycle pump is often a 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 oil chamber casing [504] with water and observe for air leaks around mechanical seal.

12. Fit 'O'-ring [527] onto [504] and secure mechanical seal-plate [507] using fastening set [534]. Install pump side seal according to type of seal, as follows:-

13. <u>ASSEMBLY OF OUTER MECHANICAL SEAL 515</u>

Install stationary part into seal following same instructions and precautions as for inner seal 516, as instructions and precautions as for inner seal 516, as previously described.

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The rotating part should be installed according to type of seal.

a) OPEN-SPRING Type 'C' and 'V' Seals

Follow instructions as previously described for inner seal [516]

b) RUBBER BELLOWS Type 'M' Seal

Lubricate with oil the rotating part of the mechanical seal, put the retaining ring 'A' on the rubber boot with rounded edge towards the rubber boot. [See figure 29]. Push the whole assembly nut hand over the shaft as far as possible. Mount the special tool over the shaft tip [See figure 30], and compress the mechanical seal until the lip of the rubber boot is engaged in the shaft groove. Remove special tool. Turn the shaft by hand and watch that the retaining ring turns perfectly in line with the rubber boot and that it is not cocked. Then try to pull the rubber boot off shaft by hand to make sure that the lip has reliably engaged in the shaft groove.

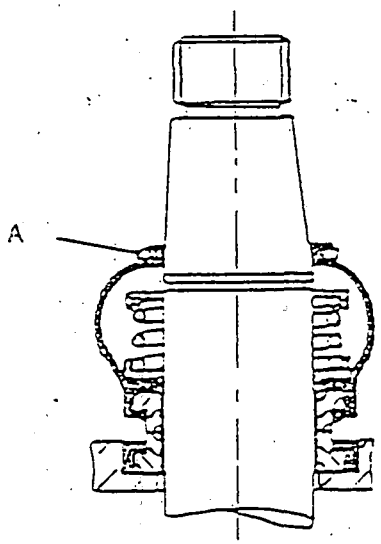

FIG 29

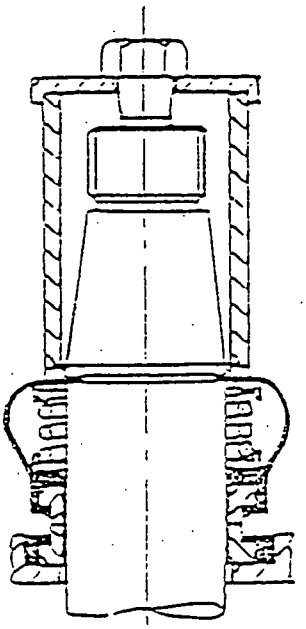

FIG 30

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c) STAINLESS STEEL BODIED Type 'X' Seal

Lubricate inner rubber 'O'-rings of seal with light oil, and put a small amount of oil onto shaft. Install entire seal over shaft, and press gently down shaft until rotating face touches stationary face. Now install snap-ring over shaft, and push on snap-ring [compressing springs in seal] until snap-ring snaps into its groove. It may be necessary to use the special tool pushing against the snap-ring, turning the tool's bolt to provide sufficient pressure to start the snap-ring. Remove special tool. Then re-install the three small setscrews into the seal rotating part, and tighten firmly.

14. 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 connected 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 given in section dealing with seal oil and assembly to hydraulic end, according to instructions given in "Maintenance of Hydraulic Parts".

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REPAIR OF BEARING FRAMES

GENERAL

Before proceeding to strip-down the bearing frame, check the pump code, by referring to the stainless steel nameplate secured to the bearing frame and, then check you have the correct manual. The 'Reference Data' sheet at the front of every manual states the complete pump code to which manual refers and separately states:

a) Bearing Frame Code
b) Type of Product side seal [Pos 515] fitted by factory
c) Number of the 'Sectional Drawing' of bearing frame.
d) Serial number of pump[s] to which manual relates.

Only when it has been established that the correct manual is available, should the service engineer proceed to strip down the bearing frame. In situations where the nameplate has been removed or damaged, each bearing frame has the serial number heavily stamped into the casting, which can be used to select the correct service manual. In case of difficulty, contact your authorised service centre or Hidrostal agent.

Essential Facilities

In order that repair can be carried out in accordance with this manual, it is essential that the repair centre has available any special tools required for fitting Hidrostal 'M'-type Mechanical Seal, [if fitted] plus other tools as described in the manual and have available a water tank and means of pressurising the bearing frames with dry air at 0.5 bar.

it is assumed that the usual facilities of clean work benches, presses, metric tools, oils and greases to the correct specification will be available.

REPAIRS TO BEARING FRAME

In order to repair the bearing frame the volute and impeller will have already have been removed per instructions under heading "Maintenance of Hydraulic Parts" and the seal oil drained out per instructions, under heading "Checking of Seal Oil".

To strip down the bearing frame, place on a suitable bench and strip from the impeller side, as follows:

1. Remove the back-cone [Pos 511] by gently tapping with a lead or plastic hammer, or gently lever off using screw drivers, this will expose the product side mechanical seal.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR BEARING FRAME PUMPS/Q-TYPE HYDRAULICS

2. REMOVAL OF PRODUCT SIDE MECH. SEAL [Pos 515]

General

The first step is to determine the type of seal which is fitted. Factory provide the option of four types 'C' + 'V' + 'M' + 'X' and can be identified as follows:

a) Referral to the 'Reference Data' sheet at the front of the manual.

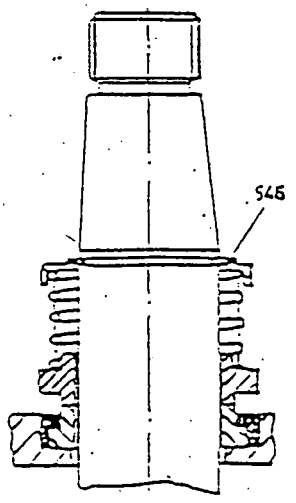
b) Examination of the pump code, product side seal type is the single digit at the end of the code, i.e. BCMIF-M. [Refer to explanation of pump code at the front of this manual].

c) Examine the seal and refer to following diagrams. In certain instances, the application may have required a change of seal type to that originally fitted.

NOTE: All seal options, are interchangeable and therefore a different type of seal can be fitted during repair if it is felt this is necessary refer to your nearest Hidrostal agent for the correct selection of an alternative seal, giving full application details and the reason for requesting an alternative seal.

REMOVAL OF OPEN-SPRING 'C' AND 'V' TYPE SEALS

Remove snap ring [Pos 546]. Make sure the Woodruff key groove has no sharp edges to that the rubber parts of the seal cannot be damaged as they are removed. Oil the shaft for ease of disassembly. Now the seal rotating parts can be pulled off the shaft by hand.



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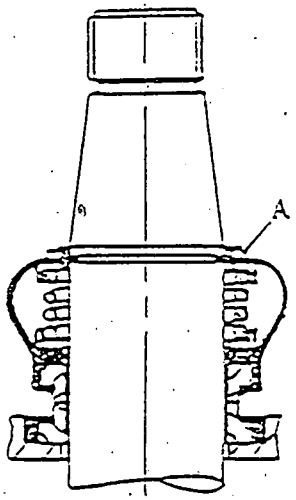
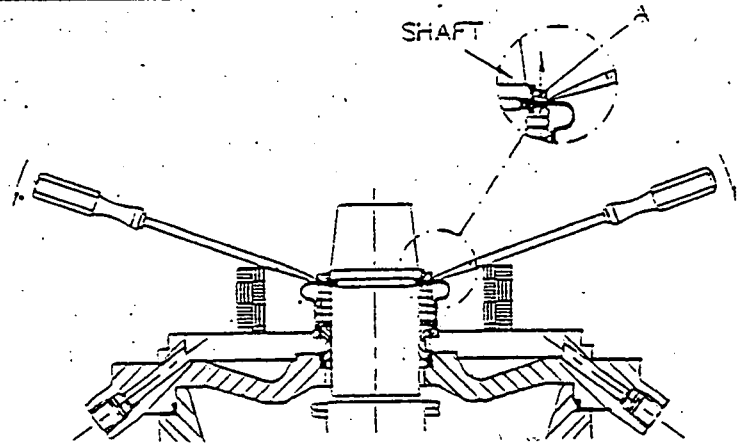


REMOVAL OF RUBBER-BOOT, 'M'-TYPE SEALS

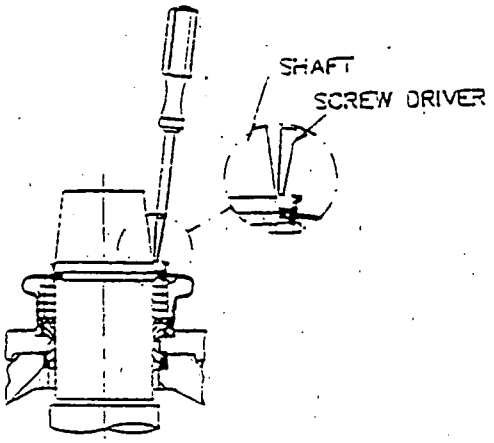
Remove retaining ring "A" from the rubber boot of the seal by gently prying with two dull-edged screwdrivers, as this can puncture rubber boot. Rather, lay some convenient object onto back-plate, to act as a fulcrum for each screwdriver, and pry ring directly up, away from rubber boot.

CAUTION:

Use only dull-edged screwdrivers since sharp edges could cut the rubber-boot. Do not twist screwdriver, as this can puncture rubber boot. Rather. lay some convenient object onto back-plate, to act as a fulcrum for each screwdriver, and pry ring directly up, away from rubber boot.



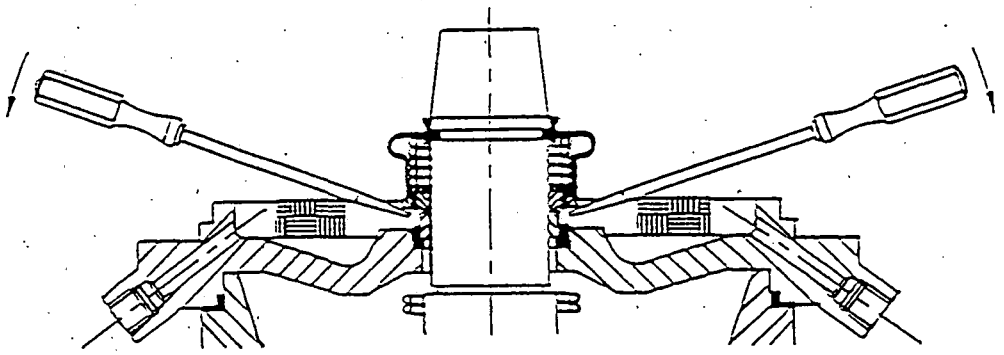
Make sure the Woodruff key groove has no sharp edges so that the rubber parts cannot be damaged as they are removed. Gently insert a small dull screwdriver between the shaft and the rubber boot.



By lifting and turning the screwdriver around the shaft, the lip of the rubber boot can be lifted out of the shaft groove. Lubrication of the shaft and the boot helps this disassembly. Once the boot is free of the groove, the entire rotating part of the seal with boot can be pulled off the shaft.

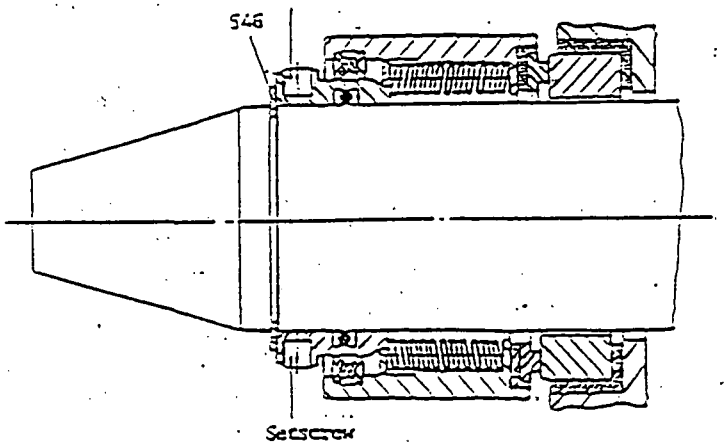
SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR BEARING FRAME PUMPS/Q-TYPE HYDRAULICS

If necessary, use two blunt ended screwdrivers to pry the seal face loose, see below:-



REMOVAL OF STAINLESS STEEL BODIES 'X'-TYPE SEAL

Remove all three small set-screws from outer body of rotating part. Remove snap-ring [546]. Oil the shaft for ease of disassembly. Now the seal rotating part can be pulled off the shaft by hand.

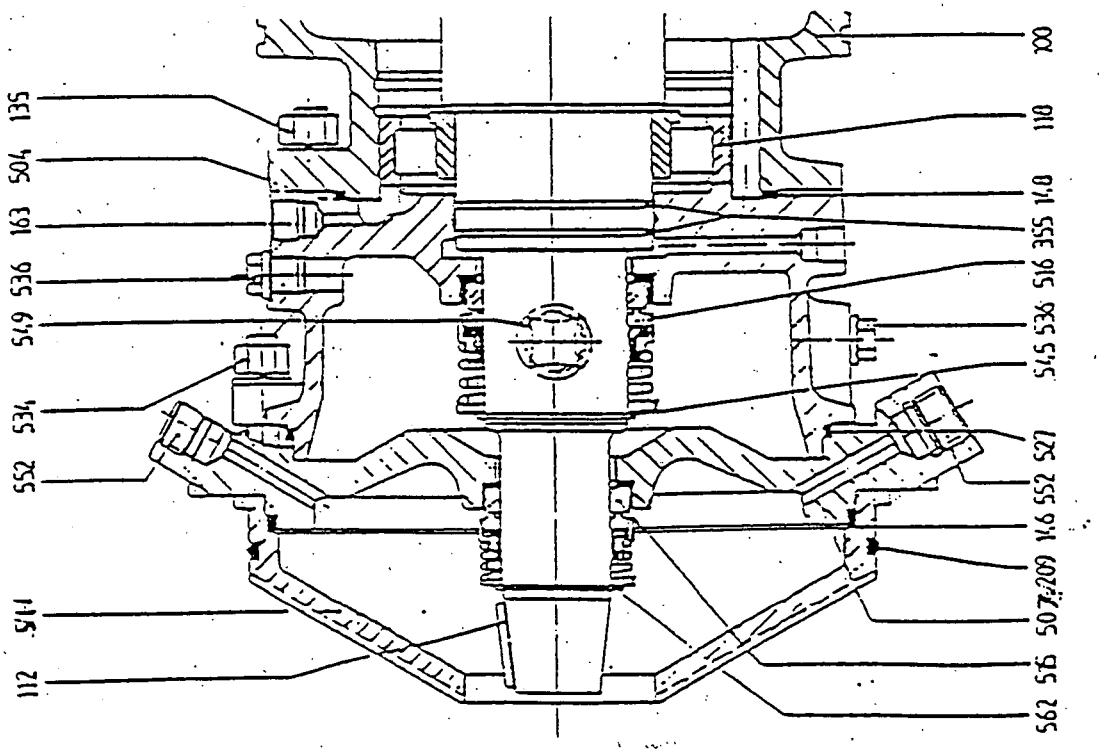


SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR BEARING FRAME PUMPS/Q-TYPE HYDRAULICS

REMOVAL OF STATIONARY SEAT [ALL SEAL TYPES]

Unfasten nuts [Pos 534] and carefully remove seal-plate [Pos 507] taking care that the stationary seat of the seal does not contact the shaft. The seat can easily become chipped and, therefore unusable if contact is made with the shaft, pay particular attention as seal passes over grooves for snap-ring [Pos 545].

The stationary seal can now be pushed out of its seal-plate from the back-side.



REMOVAL OF INNER SEAL [POS 516].

Except for special circumstances this seal will always be Hidrostal type 'C' and therefore proceed to remove per instructions for 'C'-type seal.

Any alternative seal will be 'M' or 'X' and can easily be identified by its construction and therefore should be removed per instructions for product side seal [Pos 515].

The stationary seat for Seal 516 can be removed by the same procedure as for Seal [Pos 515], after the oil chamber casing [Pos 504] has been stripped from the bearing frame taking the same precautions to protect seal from contacting the shaft.

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR BEARING FRAME PUMPS/Q-TYPE HYDRAULICS

POS	DESCRIPTION	CODE	MATERIAL* 1 (2)	5
GENERAL				
100	Bearing Housing	1GL	A	A
101	Bearing Support	1TL/1TS	A	A
102	Bearing Cap P.S	1DL	A	A
103	Bearing cap M.S.	1DL	A	A
104	Spacer ring P.S.	1RD/8RS	K	K
105	Spacer ring M.S.	1RD/1SF	K	K
106	Bearing spacer	1RD	K	K
107	Spacer ring	1RD	K	K
108	Fastening set 116-101	8BB	M	M
109	Spacer ring for 119 disassembly	1SA/5SA	K	K
110	Shaft	1WO	H/L**	F+L
112	Woodruff key	2FK	L	F
114	Coupling key	8FK	L	L
115	Oil seal sleeve for 123 (bearing frame size 7)	8DB	I	I
116	Intermediate supporting frame	1TZ	A	A
117	Deep groove ball bearing M.S.	8LW	-	-
118	Roller bearing P.S.	8LW	-	-
119	Roller bearing M.S.	8LW	-	-
120	Deep groove ball bearing (old execution P.S.)	8LW	-	-
121	Angular contact ball bearing	8LW	-	-
122	Spherical roller bearing (old execution P.S.)	8LW	-	-
123	Axial-spherical roller bearing	8LW	-	-
124	Spherical roller bearing (oil execution M.S.)	8LW	-	-
125	Double row angular contact ball bearing	8LW	-	-
126	Lock nut for shaft/Locking sleeve	8LM	L	L
127	Lock washer for 126	8LF	O	O
128	Oil seal M.S. for bearing frame size 7	8DS	Q	Q
129	V-ring P.S.	8DV	Q	Q
130	Labyrinth M.S.	1RL/3RL	K/A	K/A
131	Grease nipple	8NF	N	N
132	Grease cup R 1/4"	8NS	N	N
133	Plug M10	8F0	M	M
134	Lubricant drain plug for 101 or 116	8F0	N	N
135	Fastening set 100-101 and 116	8BB	M	M
140	Thrower disc P.S.	8DG	K	K
141	Fastening set 102-101	8BB	M	M
144	Labyrinth P.S.	1RL	K/A	F
145	O-ring for 144	8D0	Q	Q
146	O-ring	8D0	Q	Q
147	O-ring for 100	8D0	Q	Q
148	O-ring for 100-116 or 102-300	8D0	Q	Q
149	Snap ring for 144	8RF	O	O
150	Snap ring for 102	8RF	O	O
151	Spacer ring for bearing 118	1RD	K	K
152	Oil seal P.S. for bearing frame size 7	8DS	Q	Q
153	Snap ring for 152, bearing frame size 7	8RF	O	O
154	Lubricant drain plug for 100	8FV	N	N
157	Spacer ring	1RD	K	K
158	Distance ring for 152 (for immersible inst.)		K	K
159	Driving pin, bearing size 7	8FG	O	O

*For material explanation see material
**Depending on size
***Brass

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR BEARING FRAME PUMPS/Q-TYPE HYDRAULICS

POS	DESCRIPTION	CODE	MATERIAL* 1 (2)	5
GENERAL				
160	Snap ring for 118	8RF	O	O
161	Spring	8LD	O	O
162	Snap Ring M.S.	8RF	O	O
163	Plug	8FO	N	N
164	O-ring for 130/126	8D0	Q	Q
165	Impeller flange	2SF	B	C
166	Impeller nut	2FM	K	F
167	Impeller locking washer for 165	2FF	K	F
168	Fastening set 102-116	8BB	M	M
169	Spacer ring for L2 + I4	1RV	K	K
170	Bearing cap for 102 (L20DA)	1DD	A	A
171	Fastening set for 102-170 102-172	8BB	M	M
172	Sleeve bearing frame M28DA	1GG	A	A
173	Housing for Mechanical seal seat P.S. (M28DA)	1DD	A	A
174	Oil Impeller for oil circ for bearing frame 2A		A	A
175	Cap for mech. seal 516 M.S. (M28DA old execution)		A	A
176	Fastening set 173-400	8BB	M	M
177	O-ring for 172	8DO	Q	Q
178	Sleeve bearing for (M28DA)	8LG		
179	Nozzle for bearing lubrication frame size 7S	179-01	***	***
191	O-ring for 173	8DO	Q	Q
192	Masher for 165		M	F
STUFFING BOX				
200	Back cover for stuffing box	1GD	A	C
201	Stuffing box sealplate	1PS	A	C
202	Gland	1DS	A	C
203	Neck bush	1RP	K	F
204	Lantern ring	1RS	E	C
205				
206	Fastening set 101-200	-	M	F
208	Shaft sleeve	1DB	I(J)	F
209	O-ring for 200	8DO	Q	Q
210	O-ring for 201	8DO	Q	Q
213	Shaft sleeve pin	8FZ	G	F
214	Rubber sealing washer for 208	8DG	Q	Q
215	Soft packing	8DP	**	**
216	O-ring for 208	8DO	Q	Q
218	Plug for flushing connection 2	8FO	N	F
219	Plug for flushing connection (old execution)		N	F
220	Stuffing box gland bolt	8FS	F	F
221	Fastening set 201-200	8BB	M	F
222	Nipple	8NB	N	-
226	Socket head screw (for DA old execution)	8FI	M	-
227	Insert ring (for DA old execution)		K	-
228	Rubber ring for 227 (for DA old execution)		Q	-
229	Flat washer for 220		M	F
230	Set of shims of wire between 200-101	8FU	M	F

*For material explanation see material
**Depending on size
***Brass

SERVICE MANUAL FOR INSTALLATION AND OPERATION FOR BEARING FRAME PUMPS/Q-TYPE HYDRAULICS

POS	DESCRIPTION	CODE	MATERIAL 1 (2)	5
MECHANICAL SEAL				
209	O-ring for 507	8DO	Q	Q
346	Filling plug with air relief device	8OE	-	-
350	Magnetic lubricant drain plug	8OM	-	-
355	FEY laminar ring P.S.	8DF	O	O
356	FEY laminar ring M.S.	8DF	O	O
549	Oil sight glass	8OG	-	-
563	Oil sight glass	8OG	-	-
544	Backcover	1K.	A	c/D
515	Mechanical seal P.S.	8DM/8dm	**	**
516	Mechanical seal M.S.	8DM	**	**
527	O-ring for 200 M.S.	8DO	Q	Q
534	Fastening set 101-507	8BB	M	F
536	Plug with gasket	8FV	F+P	F
545	Snap ring for 516	8RF	O	O
552	Plug for flushing connection 581	8FO	N	F
562	Snap ring for mechanical seal 515	8RF	O	F
507	Mech seal plate	1PM	A	C

*For material explanation see material
**Depending on size
***Brass

Hidrostal

SECTIONAL DRAWINGS K-HYDRAULIC D03K/D04K/D0DK

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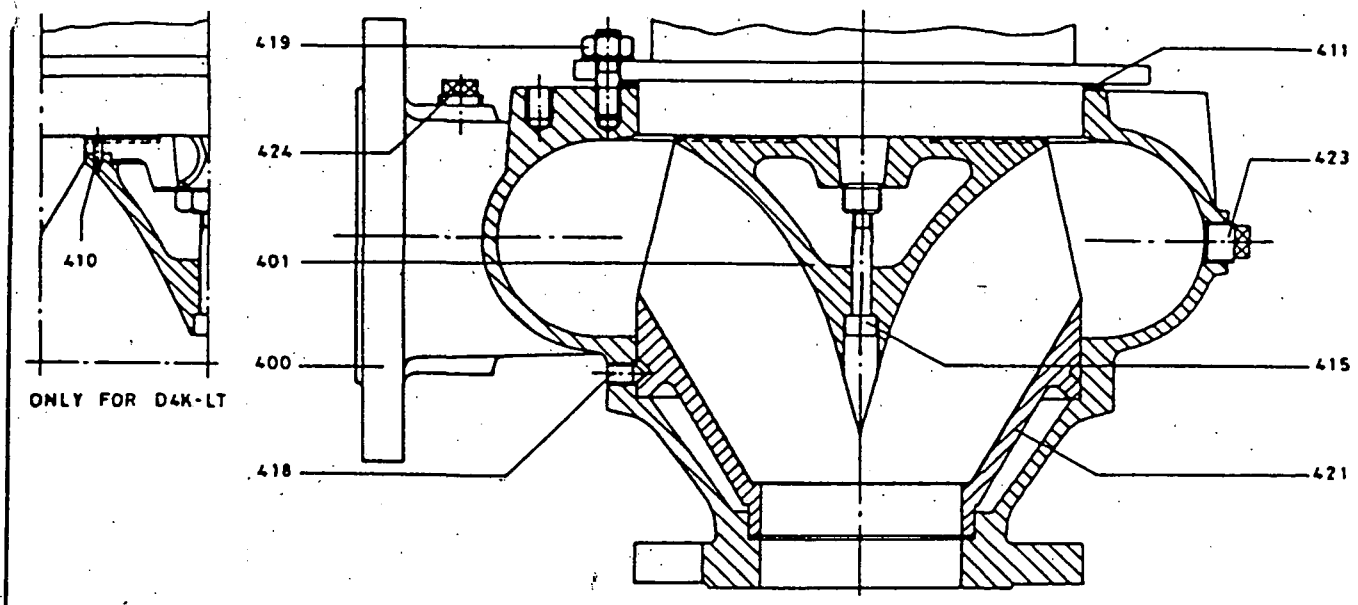

NOTE: D0DK WILL BE SUPPLIED: -WITH CLAW FOR LOWERING DEVICE INSTEAD OF DISCHARGE FLANGE
-WITHOUT SUCTION FLANGE

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

Hidrostal

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

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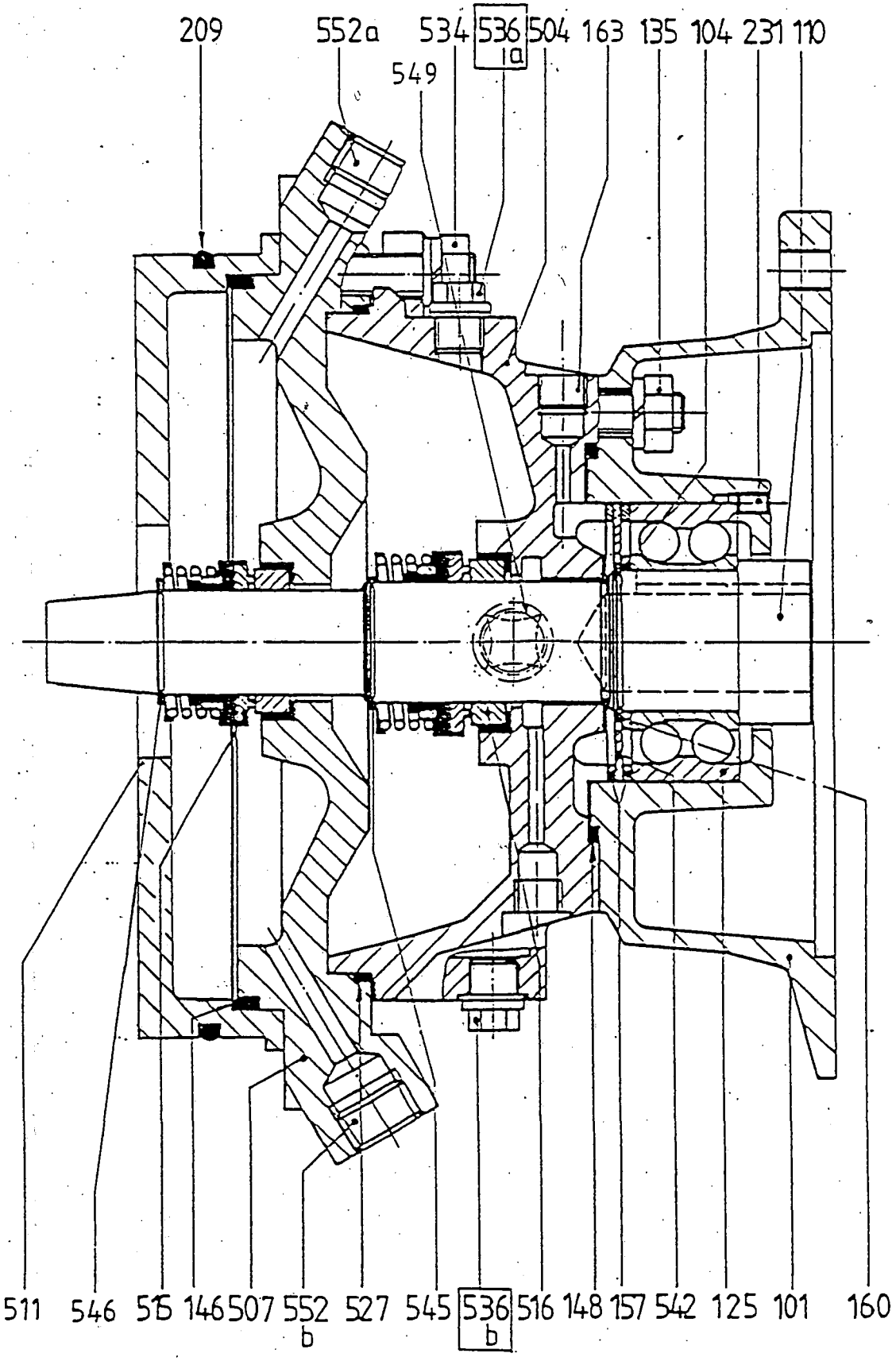

SECTION 6

EAGLEVIEW INDUSTRIAL PARK VACUUM SEWERAGE SCHEME

MISCELLANEOUS ITEMS

SECTION 7

EAGLEVIEW INDUSTRIAL PARK VACUUM SEWERAGE SCHEME

WORK-AS-EXECUTED DRAWINGS

SECTION 8

EAGLEVIEW INDUSTRIAL PARK VACUUM SEWERAGE SCHEME

VALVE RECORD CARDS

8.1 Vacuum Valves

8.2 Collection Pits

8.3 Collection Pipe System

8.4 Vacuum Pumps

8.5 Sewage Pumps

8.6 Control Panel

8.1 VACUUM VALVES

Refer to card index system for individual valve service log.

8.2 Collection Pits

House No. Serviced / Street	Service Date	Problem	Remarks	Sign

8.3 Collection Pipe Systems

Pipe No.	Service Date	Problem	Remarks	Sign

8.4 Vacuum Pumps

Service Date	Pump No.	Hours of Operation	Remarks	Sign

8.5 Sewage Pumps

Service Date	Pump No.	Hours of Operation	Remarks	Sign

8.6 Control Panel

Service Date	Pump No.	Hours of Operation	Remarks	Sign