BRISBANE CITY COUNCIL

PARKER ISLAND VACUUM SEWERAGE SYSTEM

OPERATION & MAINTENANCE MANUAL

AIRVAC-RSM PTY LIMITED
Suite 11
283 Penshurst Street
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BRISBANE CITY COUNCIL

PARKER ISLAND
VACUUM SEWERAGE SYSTEM

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PARKER ISLAND
VACUUM SEWERAGE SYSTEM CONTRACTORS

Consulting Engineer:	Cullen, Grummitt & Roe (QLD) Pty Limited. 126 Wickham Street, Fortitude Valley QLD 4006 Phone: (07) 252 8400 Fax: (07) 252 5775
General Contractor:	Conway Constructions Pty Limited. P. O. Box 126, Robina QLD 4226 Phone: (075) 960 677 Fax: (075) 960 007
Designer supplier/Vacuum Equipment:	AIRVAC-RSM Pty Limited. Suite 11, 283 Penshurst Street, Willoughby NSW 2068 Phone: (02) 417 8133 Fax: (02) 417 8162
Vacuum Pumps:	Siemens Ltd. 544 Church Street, Richmond Vic. 3121 Phone: (03) 420 7111 Fax: (03) 420 7309
Sewage Discharge Pumps:	Baker Hughes Australia Pty Limited. Gindurra Road, Somersby NSW 2250 P. O. Box 461, Gosford NSW 2250 Phone: (043) 402 388 Fax: (043) 401 080
Control Panel:	Oscillation Pty Limited. Electrical Engineering. 10 James Street, Hornsby NSW 2077 Phone: (02) 476 5911 Fax: (02) 477 7584

P.L.C.	Control Systems International Pty Limited. 28/32 Egerton Street, Silverwater NSW 2141 Phone: (02) 647 1644
Autodialler:	I.E.I. (Aust.) Pty Limited. 7/192 Kingsgrove Road, Kingsgrove NSW 2208 Phone: (02) 554 4000
Division Valves:	OBE Valves Australia Pty Limited. 21-23 Porter Street, Ryde NSW 2112 Phone: (02) 744 3655 Fax: (02) 744 3612

SECTION 1

PARKER ISLAND SEWAGE TRANSPORT SYSTEM

PART 1.1 DESCRIPTION

1.2 RETICULATION

1.3 PUMPING STATION

1. PARKER ISLAND SEWAGE TRANSPORT SYSTEM

1.1 DESCRIPTION

Parker Island 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 Class 6 HDPE 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.

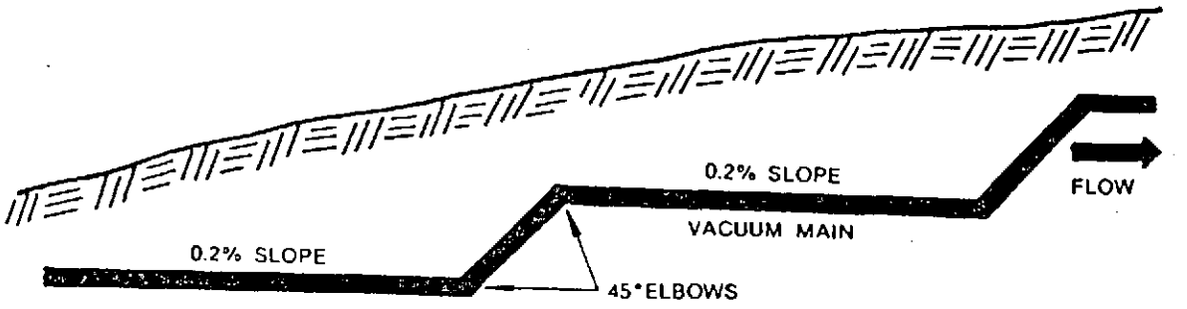
Figure 1–1 System Layout shows the reticulation system.

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

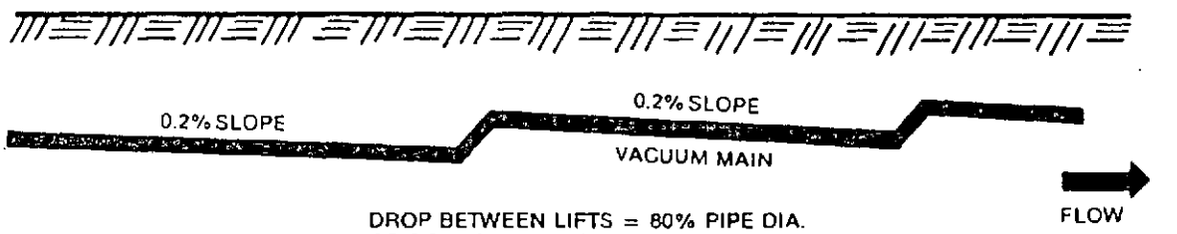
The heart of the vacuum system is the vacuum collection station which is shown in figure 1–3 Sewage enters the collection tank from the 160 NB sewer main. The level rises and the duty sewage pump is switched on by a signal from the level probe. The sewage is pumped via the rising main to the manhole near Farrer Street. 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.



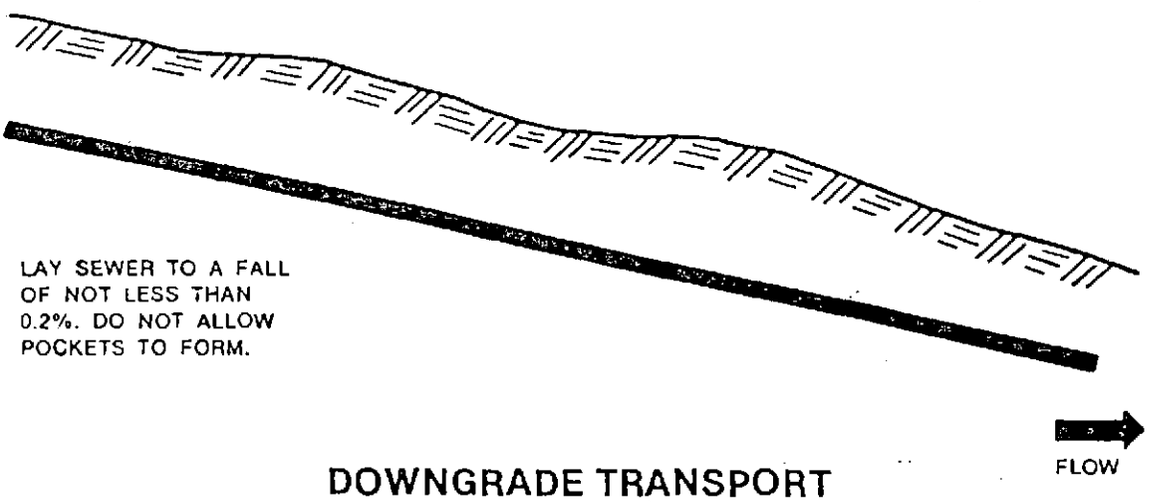
DROP BETWEEN LIFTS = 80% PIPE DIA.
OR 0.2% FALL WHICHEVER IS GREATER

UPGRADE TRANSPORT



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

LEVEL GRADE TRANSPORT



DOWNGRADE TRANSPORT

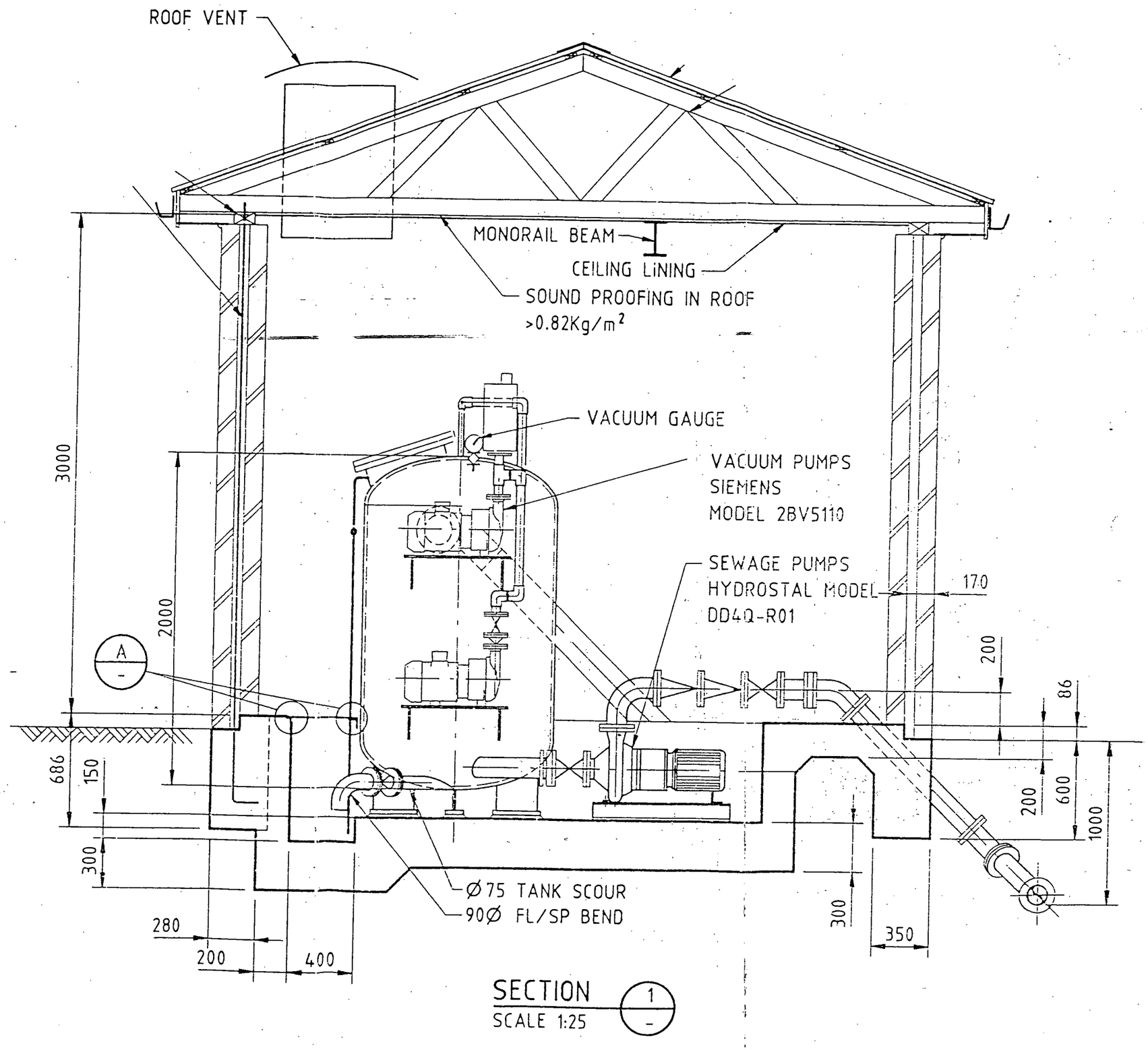
AIRVAC - RSM PTY LIMITED

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

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

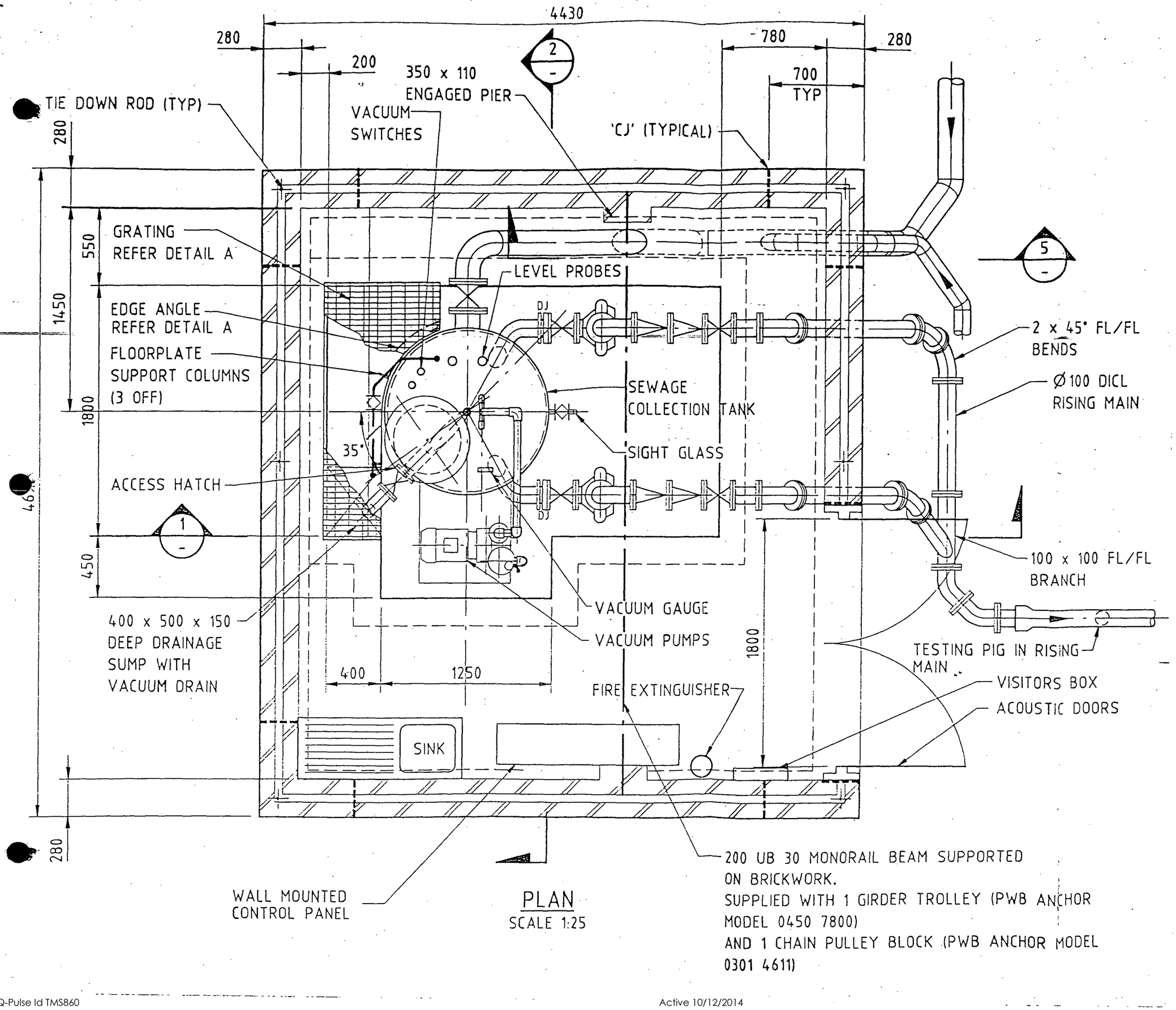
VACUUM SEWER PROFILES

FIGURE 1-2



SECTION 1
SCALE 1:25

FIGURE 1-3 SECTION



PLAN
SCALE 1:25

FIGURE 1-3 PLAN

The control philosophy for the pumps is:–
Selector switch auto/manual.

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 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 6.

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. Details of the panel and key components are contained in Section 6.
- Isolation Valve for the incoming vacuum line and the suction and discharge of sewage pumps – OBE Valves (Aust.) Pty Ltd. Elypso.
- Check Valve
- Lifting Equipment

The following start up procedure is for regular re–starting of the plant and assumes that no major items are being recommissioned after major overhauls or electrical work has been done viz. equipment is known to rotate in correct direction, control instrument settings are correct and all motors and rotating equipment are in working order.

PRE START up equipment condition check. Before starting any pump the following must be checked.

Vacuum Pump. Valves admitting fresh make up water are open. Isolation valves are open.

Sewage Pumps. Suction and delivery isolation valves are fully open. Isolation valve on equalizing line is open.

Electrical. Local P.B. cut out switches on pumps are pulled out.

Collection tank. Incoming main isolation valve is open. Tank drain valve and air inlet valve must be closed. Sight glass valves to the tank must be open. Sight glass drain valve must be closed and air release valve must be closed.

MANUAL START UP (Refer to Control Panel Manufacturers P.L.C. print out).

Mains Switch. Turn to on.

Mode Selector Switch. Select manual.

Vacuum Pumps. P.B. start selected pump. Pump will continue to run unless high/high level switch is reached which overrides the pump switch and shuts the vacuum pump down.
P.B. Start the selected sewage pump. Shut down.

Sewage Pumps. Manually at low liquid level. Not auto switched at low level. All alarms and unit availability lights and toggling of units is detailed in control panel print out.

AUTO START UP

Mains Switch. Turn to on.

Mode Selector switch. Select auto.

Refer to control panel manufactures sequence diagrams, for automatic controls, alarms and auto dialler outputs. Vacuum is controlled by on/off operation of duty vacuum pump between pressures -50 kPa and -70 kPa and timers will initiate the standby pump in the event the duty pump fails to start. Pumps are toggled to alternate duty and standby. All pumps are protected by thermal overload and will automatically switch off and interlock out in the event of high temperatures. Standby will then automatically switch on as required.

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```

```
 GGGG EEEEE        FFFFF  AAA  N   N U   U  CCCC
G     E            F     A   A NN  N U   U C
G GGG 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:  AIRVAC                             *)
(*                                                                           *)
(*       PLC PROGRAM ENVIRONMENT                HIGHEST REFERENCE USED      *)
(*       -----------------------                ----------------------      *)
(*              INPUT (%I):   512                       INPUT:  %I0028       *)
(*             OUTPUT (%Q):   512                      OUTPUT:  %Q0028       *)
(*           INTERNAL (%M):  1024                    INTERNAL:  %M0031       *)
(*        GLOBAL DATA (%G):  1280                 GLOBAL DATA:     NONE       *)
(*          TEMPORARY (%T):   256                   TEMPORARY:     NONE       *)
(*          REGISTER (%R):   512                    REGISTER:  %R0018       *)
(*     ANALOG INPUT (%AI):    64                  ANALOG INPUT:     NONE       *)
(*    ANALOG OUTPUT (%AQ):    32                 ANALOG OUTPUT:     NONE       *)
(*                                                                           *)
(*                      PROGRAM SIZE (BYTES):      832                       *)
(*                                                                           *)
(*                                                                           *)
(*****************************************************************************)
```

```
Program:  AIRVAC                    C:\LM90\AIRVAC
```

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

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```
(*****************************************************************************)
(*                                                                           *)
(*                          BLOCK:  _MAIN                                    *)
(*                                                                           *)
(*                                                                           *)
(*                     BLOCK SIZE (BYTES):    823                            *)
(*                  DECLARATIONS (ENTRIES):    88                            *)
(*                                                                           *)
(*                                                                           *)
(*                  HIGHEST REFERENCE USED                                   *)
(*                  ----------------------                                   *)
(*                                                                           *)
(*                        INPUT (%I):  %I0028                                *)
(*                       OUTPUT (%Q):  %Q0020                                *)
(*                     INTERNAL (%M):  %M0031                                *)
(*                  GLOBAL DATA (%G):     NONE                               *)
(*                    TEMPORARY (%T):     NONE                               *)
(*                     REGISTER (%R):  %R0018                                *)
(*                ANALOG INPUT (%AI):     NONE                               *)
(*               ANALOG OUTPUT (%AQ):     NONE                               *)
(*                                                                           *)
(*****************************************************************************)
```

Program: AIRVAC C:\LM90\AIRVAC Block: _MAIN

```
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 START OF LD  PROGRAM AIRVAC    ]        (*                                    *)
 [      VARIABLE DECLARATIONS       ]
 [         BLOCK DECLARATIONS       ]
 [      START OF PROGRAM LOGIC      ]
  (*****************************************************************************)
  (*                                SYSTEM START                               *)
  (*****************************************************************************)
  << RUNG 5  STEP #0002 >>
 SYSTEM  SYSTEM  AUTO
 START   STOP    MANUAL
 PUSH    PUSH    SELECTI                                                SYSTEM
 BUTTON  BUTTON  ON                                                     START
  START   STOP   AUT_MAN                                                S_START
 %I0004  %I0005  %I0001                                                 %M0001
+---] [---+---] [------] [-------------------------------------------------( )---
          |
 SYSTEM   |
 START    |
 S_START  |
    0001  |
+    | [---+
  (*****************************************************************************)
  (*                          VACUUM PUMP ONE DUTY SELECT                      *)
  (*****************************************************************************)
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0001	AUT_MAN	AUTO MANUAL SELECTION
0004	START	SYSTEM START PUSH BUTTON
%I0005	STOP	SYSTEM STOP PUSH BUTTON
%M0001	S_START	SYSTEM START

Program: AIRVAC C:\LM90\AIRVAC Block: _MAIN

```
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/*  < RUNG 7  STEP #0008 >>
|
|VACUUM  TOGGLE
|PUMP 1/ TO                                                              VACUUM
|2       VACUUM  SYSTEM                                                  PUMP 1
|SELECT  PUMP 2  START                                                   DUTY
|V12_SEL  V2TOG  S_START                                                 V1DUTY
|%I0002  %M0004  %M0001                                                  %M0002
+---] [---+---]/[------] [-------------------------------------------------------( )---
|         |
|TOGGLE   |
|TO       |
|VACUUM   |
|PUMP 1   |
| V1TOG   |
|%M0007   |
+---] [---+
|
| << RUNG 8  STEP #0013 >>
|
|         VACUUM  TOGGLE            VACUUM
|VACUUM   PUMP 1  TO                PUMP 1                               VACUUM
|PUMP 1   RUNNING VACUUM  SYSTEM    AVAILAB                              PUMP I
|DUTY      INTERLO PUMP 2  START    LE LAMP                              CONTROL
|V1DUTY   V1_RUN   V2TOG  S_START   V1AVLMP                              V1CNTRL
|%M0002   %I0021  %M0004  %M0001    %Q0007                               %M0003
+   ] [------] [---+---]/[------] [-----] [-------------------------------------( )---
|                  |
|VACUUM            |
|PUMP I            |
|CONTROL           |
|V1CNTRL           |
|%M0003            |
+---] [------------+
|
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%M0001	S_START	SYSTEM START
%I0002	V12_SEL	VACUUM PUMP 1/2 SELECT
%Q0007	V1AVLMP	VACUUM PUMP 1 AVAILABLE LAMP
%M0003	V1CNTRL	VACUUM PUMP I CONTROL
%M0002	V1DUTY	VACUUM PUMP 1 DUTY
%M0007	V1TOG	TOGGLE TO VACUUM PUMP 1
%I0021	V1_RUN	VACUUM PUMP 1 RUNNING INTERLOCK
%M0004	V2TOG	TOGGLE TO VACUUM PUMP 2

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

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 | << RUNG 9  STEP #0020 >>
 |
 |          VACUUM  TOGGLE  VACUUM                                          TOGGLE
 |VACUUM    PUMP 1/ TO      PUMP 1                                          TO
 |PUMP I    2       VACUUM  RUNNING SYSTEM                                  VACUUM
 |CONTROL   SELECT  PUMP 1  INTERLO START                                   PUMP 2
 |V1CNTRL   V12_SEL  V1TOG  V1_RUN  S_START                                  V2TOG
 |%M0003    %I0002  %M0007  %I0021  %M0001                                  %M0004
 +---] [---+---] [------]/[---+---]/[------] [-------------------------------------( )---
 |         |                  |
 |TOGGLE    |VACUUM  TOGGLE    |
 |TO        |PUMP 1/ TO        |
 |VACUUM    |2       VACUUM    |
 |PUMP 2    |SELECT  PUMP 2    |
 | V2TOG    |V12_SEL  V2TOG    |
 |%M0004    |%I0002  %M0004    |
 +---] [---+---]/[------]/[---+
 |
 | (*************************************************************************************)
 | (*                        VACUUM PUMP TWO DUTY SELECT                                *)
 | (*************************************************************************************)
 |
 | << RUNG 11  STEP #0032 >>
 |
 |VACUUM  TOGGLE
 |PUMP 1/ TO                                                                VACUUM
 |2       VACUUM  SYSTEM                                                    PUMP 2
 |SELECT  PUMP 1  START                                                     DUTY
 |V12_SEL  V1TOG  S_START                                                   V2DUTY
 |%I0002  %M0007  %M0001                                                    %M0005
 +---]/[---+---]/[------] [-------------------------------------------------------( )---
 |         |
 |TOGGLE    |
 |TO        |
 |VACUUM    |
 |PUMP 2    |
 | V2TOG    |
 |%M0004    |
 +---] [---+
 |

REFERENCE  NICKNAME       REFERENCE DESCRIPTION
 %M0001    S_START        SYSTEM START
 %I0002    V12_SEL        VACUUM PUMP 1/2 SELECT
 %M0003    V1CNTRL        VACUUM PUMP I CONTROL
 %M0007    V1TOG          TOGGLE TO VACUUM PUMP 1
 %I0021    V1_RUN         VACUUM PUMP 1 RUNNING INTERLOCK
 %M0005    V2DUTY         VACUUM PUMP 2 DUTY
 %M0004    V2TOG          TOGGLE TO VACUUM PUMP 2

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

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|     RUNG 12  STEP #0037 >>
|
|          VACUUM  TOGGLE            VACUUM
|VACUUM    PUMP 2  TO                PUMP 2                                    VACUUM
|PUMP 2    RUNNING VACUUM  SYSTEM    AVAILAB                                   PUMP 2
|DUTY      INTERLO PUMP 1  START     LE LAMP                                   CONTROL
|V2DUTY    V2_RUN   V1TOG  S_START   V2AVLMP                                   V2CNTRL
|%M0005    %I0022  %M0007  %M0001    %Q0008                                    %M0006
+--] [------] [--+--]/[------] [------] [-------------------------------------------( )--
|                |
|VACUUM          |
|PUMP 2          |
|CONTROL         |
|V2CNTRL         |
|%M0006          |
+--] [-----------+
|
| << RUNG 13  STEP #0044 >>
|
|          VACUUM  TOGGLE  VACUUM                                              TOGGLE
|VACUUM    PUMP 1/ TO      PUMP 2                                              TO
|PUMP 2    2       VACUUM  RUNNING SYSTEM                                      VACUUM
|CONTROL   SELECT  PUMP 2  INTERLO START                                       PUMP 1
|V2CNTRL   V12_SEL  V2TOG  V2_RUN  S_START                                      V1TOG
|%M0006    %I0002  %M0004  %I0022  %M0001                                      %M0007
+-  ] [--+--]/[------]/[--+--]/[------] [-------------------------------------------( )--
|        |                |
|TOGGLE  |VACUUM  TOGGLE  |
|TO      |PUMP 1/ TO      |
|VACUUM  |2       VACUUM  |
|PUMP 1  |SELECT  PUMP 1  |
| V1TOG  |V12_SEL  V1TOG  |
|%M0007  |%I0002  %M0007  |
+--] [--+--] [------]/[--+
|
|  (*************************************************************************)
|  (*                      SEWER PUMP ONE DUTY SELECT                       *)
|  (*************************************************************************)
|
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%M0001	S_START	SYSTEM START
%I0002	V12_SEL	VACUUM PUMP 1/2 SELECT
%M0007	V1TOG	TOGGLE TO VACUUM PUMP 1
%Q0008	V2AVLMP	VACUUM PUMP 2 AVAILABLE LAMP
%M0006	V2CNTRL	VACUUM PUMP 2 CONTROL
% 005	V2DUTY	VACUUM PUMP 2 DUTY
%M0004	V2TOG	TOGGLE TO VACUUM PUMP 2
%I0022	V2_RUN	VACUUM PUMP 2 RUNNING INTERLOCK

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

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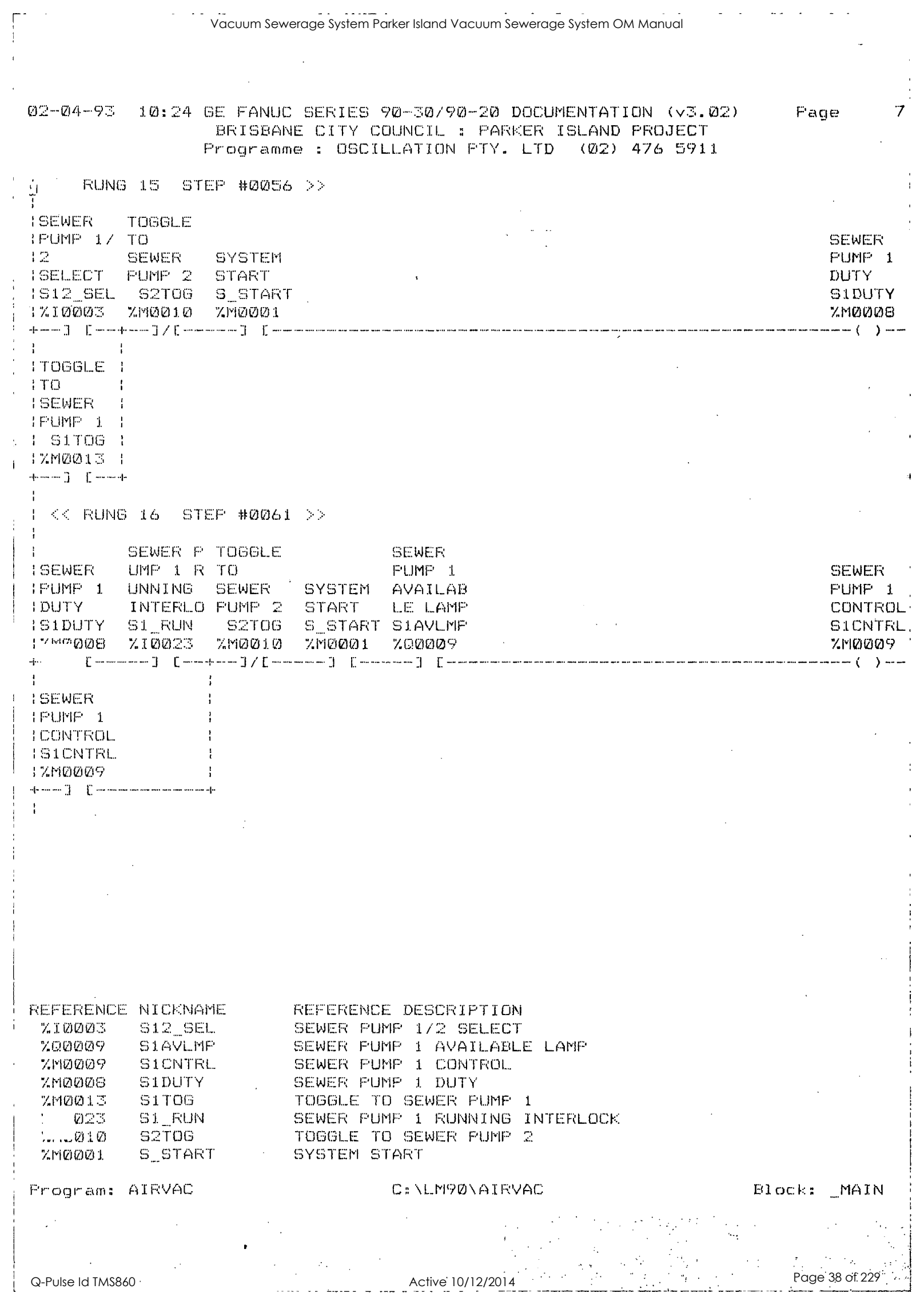

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0003	S12_SEL	SEWER PUMP 1/2 SELECT
%Q0009	S1AVLMP	SEWER PUMP 1 AVAILABLE LAMP
%M0009	S1CNTRL	SEWER PUMP 1 CONTROL
%M0008	S1DUTY	SEWER PUMP 1 DUTY
%M0013	S1TOG	TOGGLE TO SEWER PUMP 1
%I0023	S1_RUN	SEWER PUMP 1 RUNNING INTERLOCK
%M0010	S2TOG	TOGGLE TO SEWER PUMP 2
%M0001	S_START	SYSTEM START

Program: AIRVAC C:\LM90\AIRVAC Block: _MAIN

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|     RUNG 17  STEP #0068 >>
|
|          SEWER    TOGGLE   SEWER P                                          TOGGLE
|SEWER     PUMP 1/ TO       UMP 1 R                                          TO
|PUMP 1    2       SEWER    UNNING   SYSTEM                                  SEWER
|CONTROL   SELECT  PUMP 1   INTERLO  START                                   PUMP 2
|S1CNTRL   S12_SEL  S1TOG   S1_RUN   S_START                                  S2TOG
|%M0009    %I0003  %M0013   %I0023   %M0001                                   %M0010
+---] [---+---] [------]/[---+---]/[------] [-------------------------------------( )---
|         |                  |
|TOGGLE    |SEWER    TOGGLE  |
|TO        |PUMP 1/  TO      |
|SEWER     |2        SEWER   |
|PUMP 2    |SELECT   PUMP 2  |
| S2TOG    |S12_SEL   S2TOG  |
|%M0010    |%I0003   %M0010  |
+---] [---+---]/[------]/[---+
|
|  (*************************************************************************************)
|  (*                          SEWER PUMP TWO DUTY SELECT                               *)
|  (*************************************************************************************)
|
|  << RUNG 19  STEP #0080 >>
|
|SEWER    TOGGLE
|PUMP 1/  TO                                                                  SEWER
|         SEWER    SYSTEM                                                    PUMP 2
|SELECT   PUMP 1   START                                                     DUTY
|S12_SEL   S1TOG   S_START                                                   S2DUTY
|%I0003   %M0013   %M0001                                                    %M0011
+---]/[---+---]/[------] [-------------------------------------------------------( )---
|         |
|TOGGLE    |
|TO        |
|SEWER     |
|PUMP 2    |
| S2TOG    |
|%M0010    |
+---] [---+
|




REFERENCE  NICKNAME       REFERENCE DESCRIPTION
  %I0003   S12_SEL        SEWER PUMP 1/2 SELECT
  %M0009   S1CNTRL        SEWER PUMP 1 CONTROL
  %M0013   S1TOG          TOGGLE TO SEWER PUMP 1
  %I0023   S1_RUN         SEWER PUMP 1 RUNNING INTERLOCK
  %  0011  S2DUTY         SEWER PUMP 2 DUTY
  %...0010  S2TOG         TOGGLE TO SEWER PUMP 2
  %M0001   S_START        SYSTEM START

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

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 RUNG 20  STEP #0085 >>

          SEWER P TOGGLE              SEWER
SEWER     UMP 2 R TO                  PUMP 2                                    SEWER
PUMP 2    UNNING  SEWER    SYSTEM     AVAILAB                                   PUMP 2
DUTY       INTERLO PUMP 1  START      LE LAMP                                   CONTROL
S2DUTY    S2_RUN   S1TOG   S_START    S2AVLMP                                   S2CNTRL
%M0011    %I0024   %M0013  %M0001     %Q0010                                    %M0012
]  [------]  [---+--]/[------]  [------]  [-------------------------------------------( )--
                  |
SEWER             |
PUMP 2            |
CONTROL           |
S2CNTRL           |
%M0012            |
]  [-------------+

 << RUNG 21  STEP #0092 >>

          SEWER    TOGGLE  SEWER P                                              TOGGLE
SEWER     PUMP 1/  TO      UMP 2 R                                              TO
PUMP 2    2        SEWER   UNNING  SYSTEM                                       SEWER
CONTROL   SELECT   PUMP 2  INTERLO START                                        PUMP 1
S2CNTRL   S12_SEL   S2TOG  S2_RUN  S_START                                       S1TOG
%M0012    %I0003   %M0010  %I0024  %M0001                                       %M0013
]  [--+--]/[------]/[--+--]/[------]  [-------------------------------------------( )--
       |                 |
TOGGLE |SEWER   TOGGLE   |
TO     |PUMP 1/  TO      |
SEWER  |2        SEWER   |
PUMP 1 |SELECT   PUMP 1  |
 S1TOG |S12_SEL   S1TOG  |
%M0013 |%I0003   %M0013  |
]  [--+--]  [------]/[--+

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



REFERENCE NICKNAME       REFERENCE DESCRIPTION
 %I0003    S12_SEL       SEWER PUMP 1/2 SELECT
 %M0013    S1TOG         TOGGLE TO SEWER PUMP 1
 %Q0010    S2AVLMP       SEWER PUMP 2 AVAILABLE LAMP
 %M0012    S2CNTRL       SEWER PUMP 2 CONTROL
 %M0011    S2DUTY        SEWER PUMP 2 DUTY
 %  110    S2TOG         TOGGLE TO SEWER PUMP 2
 %  J24    S2_RUN        SEWER PUMP 2 RUNNING INTERLOCK
 %M0001    S_START       SYSTEM START

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

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|    RUNG 23  STEP #0104 >>
|
|                 VACUUM                                                  VACUUM
|VACUUM           PUMP 1                                                  PUMP 1
|PUMP 1           AVAILAB                                                 SELECTE
|DUTY             LE LAMP                                                 D
|V1DUTY           V1AVLMP                                                  V1SEL
|%M0002           %Q0007                                                  %M0014
+---] [-----------+---] [-------------------------------------------------------( )--
|                 |
|         VACUUM  |
|VACUUM   PUMP 2  |
|PUMP 2   AVAILAB |
|DUTY     LE LAMP |
|V2DUTY   V2AVLMP |
|%M0005   %Q0008  |
+---] [-----]/[---+
|
|  << RUNG 24  STEP #0110 >>
|
|VACUUM   -50 TO                                                          VACUUM
|PUMP 1   -70 KPA -90 KPA                                                 PUMP 1
|SELECTE  PRESSUR PRESSUR                                                 AUTO ST
|D        E       E                                                       OP STAR
|  V1SEL  M50_70P M80KPA                                                   V1ASS
|%M0014   %I0015  %I0014                                                  %M0015
+    | [-----] [-----] [-------------------------------------------------------( )--
|

REFERENCE NICKNAME      REFERENCE DESCRIPTION
  %I0015   M50_70P      -50 TO -70 KPA PRESSURE
  %I0014   M80KPA       -80 KPA PRESSURE
  %M0015   V1ASS        VACUUM PUMP 1 AUTO STOP START
  %Q0007   V1AVLMP      VACUUM PUMP 1 AVAILABLE LAMP
  %M0002   V1DUTY       VACUUM PUMP 1 DUTY
    M014   V1SEL        VACUUM PUMP 1 SELECTED
  ...J008  V2AVLMP      VACUUM PUMP 2 AVAILABLE LAMP
  %M0005   V2DUTY       VACUUM PUMP 2 DUTY

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

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|    RUNG 25  STEP #0114 >>
|
|AUTO     VACUUM  VACUUM                                                  VACUUM
|MANUAL   PUMP 1  PUMP 1                                                  PUMP 1
|SELECTI  START P STOP P/                                                 MANUAL
|ON       /BUTTON BUTTON                                                  STOP ST
|AUT_MAN  V1START V1STOP                                                   V1MSS
|%I0001   %I0006  %I0007                                                  %M0016
+--]/[--+--] [--+--] [-------------------------------------------------------( )--
|       |       |
|       |VACUUM |
|       |PUMP 1 |
|       |MANUAL |
|       |STOP ST|
|       | V1MSS |
|       |%M0016 |
|       +--] [--+
|
| << RUNG 26  STEP #0120 >>
|
|VACUUM  VACUUM  HIGH                                                     VACUUM
|PUMP 1  PUMP 1  HIGH                                                     PUMP 1
|AUTO ST THERMAL TANK                                                     CONTACT
|OP STAR OVERLOA LEVEL                                                    OR
| V1ASS  V1_TOL   HI_HI                                                    VP1
|%M0015  %I0025  %I0017                                                   %Q0001
+    [--+--] [------]/[-------------------------------------------------------( )--
|       |
|VACUUM |
|PUMP 1 |
|MANUAL |
|STOP ST|
| V1MSS |
|%M0016 |
+--] [--+
|
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0001	AUT_MAN	AUTO MANUAL SELECTION
%I0017	HI_HI	HIGH HIGH TANK LEVEL
%M0015	V1ASS	VACUUM PUMP 1 AUTO STOP START
%M0016	V1MSS	VACUUM PUMP 1 MANUAL STOP START
%I0006	V1START	VACUUM PUMP 1 START P/BUTTON
%I0007	V1STOP	VACUUM PUMP 1 STOP P/BUTTON
%I0025	V1_TOL	VACUUM PUMP 1 THERMAL OVERLOAD
%Q0001	VP1	VACUUM PUMP 1 CONTACTOR

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

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|    RUNG 27  STEP #0125 >>
|
|AUTO     VACUUM  VACUUM                                                  VACUUM
|MANUAL   PUMP 1  PUMP 1                                                  PUMP 1
|SELECTI  CONTACT RUNNING                                                 FAILED
|ON       OR      INTERLO                                                 TO STAR
|AUT_MAN    VP1   V1_RUN                                                   V1FTS
|%I0001   %00001  %I0021          +------+                                %M0017
+---] [---+---] [------]/[---+----------+ TMR +-------------------------------------------( )--
|         |                    |          |0.10s|
|         |VACUUM              |          |     |
|         |PUMP 1              |          |     |
|         |FAILED              |          |     |
|         |TO STAR             |          |     |
|         | V1FTS              |          |     |
|         |%M0017              |          |     |
|         +---] [--------------+ CONST  --+PV   |
|                                +00003   |     |
|                                         +------+
|
|                                        %R0001
|
|  << RUNG 28  STEP #0132 >>
|
|VACUUM                                                                   VACUUM
|PUMP 1                                                                   PUMP 1
|FAILED                                                                   FAILED
|TO STAR                                                                  TO STAR
| V1FTS                                                                   V1FTS
|%M0017                                                                   %M0017
+---] [-------------------------------------------------------------------------( )--
|


REFERENCE NICKNAME       REFERENCE DESCRIPTION
 %R0001
 %I0001    AUT_MAN       AUTO MANUAL SELECTION
 %M0017    V1FTS         VACUUM PUMP 1 FAILED TO START
 %I0021    V1_RUN        VACUUM PUMP 1 RUNNING INTERLOCK
 %00001    VP1           VACUUM PUMP 1 CONTACTOR

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

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```
|     RUNG 29  STEP #0134 >>
|
|AUTO     VACUUM                                                                VACUUM
|MANUAL   PUMP 1   -40 KPA                                                      PUMP 1
|SELECTI  RUNNING  PRESSUR                                                      FAILED
|ON       INTERLO  E                                                            TO OPER
|AUT_MAN  V1_RUN   M40KPA                                                        V1FTO
|%I0001   %I0021   %I0016            +-------+                                  %M0018
+--] [---+---] [------]/[--+---------+ TMR +-------------------------------------------( )--
|        |                  |         |0.10s|
|        |VACUUM            |         |     |
|        |PUMP 1            |         |     |
|        |FAILED            |         |     |
|        |TO OPER           |         |     |
|        | V1FTO            |         |     |
|        |%M0018            |         |     |
|        +--] [------------+ CONST --+PV   |
|                           +03000   |     |
|                                    +-------+
|
|                                    %R0004
|
|  (*************************************************************************************)
|  (*                          VACUUM PUMP TWO CONTROL                                  *)
|  (*************************************************************************************)
|
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%R0004		
%I0001	AUT_MAN	AUTO MANUAL SELECTION
%I0016	M40KPA	-40 KPA PRESSURE
%M0018	V1FTO	VACUUM PUMP 1 FAILED TO OPERATE
%I0021	V1_RUN	VACUUM PUMP 1 RUNNING INTERLOCK

Program: AIRVAC C:\LM90\AIRVAC Block: _MAIN

```
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|   < RUNG 31  STEP #0142 >>
|
|                  VACUUM                                                  VACUUM
|VACUUM            PUMP 2                                                  PUMP 2
|PUMP 2            AVAILAB                                                 SELECTE
|DUTY              LE LAMP                                                 D
|V2DUTY            V2AVLMP                                                  V2SEL
|%M0005            %00008                                                  %M0019
+---] [------------+---] [-------------------------------------------------------( )--
|                  |
|         VACUUM   |
|VACUUM   PUMP 1   |
|PUMP 1   AVAILAB|
|DUTY     LE LAMP|
|V1DUTY   V1AVLMP|
|%M0002   %Q0007   |
+---] [-------]/[---+
|
| << RUNG 32  STEP #0148 >>
|
|VACUUM   -50 TO                                                          VACUUM
|PUMP 2   -70 KPA -80 KPA                                                 PUMP 2
|SELECTE PRESSUR PRESSUR                                                  AUTO ST
|D        E       E                                                       OP STAR
| V2SEL  M50_70P M80KPA                                                    V2ASS
|  0019  %I0015  %I0014                                                   %M0020
+   ] [-------] [-------] [-------------------------------------------------------( )--
|
```

```
REFERENCE NICKNAME       REFERENCE DESCRIPTION
 %I0015   M50_70P        -50 TO -70 KPA PRESSURE
 %I0014   M80KPA         -80 KPA PRESSURE
 %Q0007   V1AVLMP        VACUUM PUMP 1 AVAILABLE LAMP
 %M0002   V1DUTY         VACUUM PUMP 1 DUTY
 %M0020   V2ASS          VACUUM PUMP 2 AUTO STOP START
   0008   V2AVLMP        VACUUM PUMP 2 AVAILABLE LAMP
 %M0005   V2DUTY         VACUUM PUMP 2 DUTY
 %M0019   V2SEL          VACUUM PUMP 2 SELECTED

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

```
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|  << RUNG 33  STEP #0152 >>
|
|AUTO     VACUUM  VACUUM                                                  VACUUM
|MANUAL   PUMP 2  PUMP 2                                                  PUMP 2
|SELECTI  START P STOP P/                                                 MANUAL
|ON        /BUTTON BUTTON                                                 STOP ST
|AUT_MAN  V2START V2STOP                                                  V2MSS
|%I0001   %I0008  %I0009                                                  %M0021
+--]/[--+--] [--+--] [-------------------------------------------------------( )--
|       |       |
|       |VACUUM |
|       |PUMP 2 |
|       |MANUAL |
|       |STOP ST|
|       | V2MSS |
|       |%M0021 |
|       +--] [--+
|
|  << RUNG 34  STEP #0158 >>
|
|VACUUM  VACUUM  HIGH                                                     VACUUM
|PUMP 2  PUMP 2  HIGH                                                     PUMP 2
|AUTO ST THERMAL TANK                                                     CONTACT
|OR STAR OVERLOA LEVEL                                                    OR
| V2ASS  V2_TOL   HI_HI                                                    VP2
|%M0020  %I0026  %I0017                                                   %Q0002
+    [--+--] [-----]/[-------------------------------------------------------( )--
|       |
|VACUUM |
|PUMP 2 |
|MANUAL |
|STOP ST|
| V2MSS |
|%M0021 |
+--] [--+
|



REFERENCE NICKNAME      REFERENCE DESCRIPTION
 %I0001   AUT_MAN       AUTO MANUAL SELECTION
 %I0017   HI_HI         HIGH HIGH TANK LEVEL
 %M0020   V2ASS         VACUUM PUMP 2 AUTO STOP START
 %M0021   V2MSS         VACUUM PUMP 2 MANUAL STOP START
 %I0008   V2START       VACUUM PUMP 2 START P/BUTTON
 %I0009   V2STOP        VACUUM PUMP 2 STOP P/BUTTON
 %I0026   V2_TOL        VACUUM PUMP 2 THERMAL OVERLOAD
 %Q0002   VP2           VACUUM PUMP 2 CONTACTOR

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

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```
| ~ RUNG 35  STEP #0163 >>
|
|AUTO     VACUUM  VACUUM                                                  VACUUM
|MANUAL   PUMP 2  PUMP 2                                                  PUMP 2
|SELECTI  CONTACT RUNNING                                                 FAILED
|ON       OR      INTERLO                                                 TO STAR
|AUT_MAN    VP2   V2_RUN                                                   V2FTS
|%I0001   %Q0002  %I0022          +------+                                %M0022
+--] [---+--] [-----]/[---+------+ TMR +-------------------------------------( )--
|        |                 |      |0.10s|
|        |VACUUM           |      |     |
|        |PUMP 2           |      |     |
|        |FAILED           |      |     |
|        |TO STAR          |      |     |
|        | V2FTS           |      |     |
|        |%M0022           |      |     |
|        +--] [------------+ CONST -+PV   |
|                           +00030 |     |
|                                  +------+
|
|                                  %R0007
|
| << RUNG 36  STEP #0170 >>
|
|AUTO     VACUUM                                                          VACUUM
|MANUAL   PUMP 2  -40 KPA                                                 PUMP 2
|S   CTI  RUNNING PRESSUR                                                 FAILED
|On       INTERLO E                                                       TO OPER
|AUT_MAN  V2_RUN  M40KPA                                                   V2FTO
|%I0001   %I0022  %I0016          +------+                                %M0023
+--] [---+--] [-----] [---+------+ TMR +-------------------------------------( )--
|        |                 |      |0.10s|
|        |VACUUM           |      |     |
|        |PUMP 2           |      |     |
|        |FAILED           |      |     |
|        |TO OPER          |      |     |
|        | V2FTO           |      |     |
|        |%M0023           |      |     |
|        +--] [------------+ CONST -+PV   |
|                           +03000 |     |
|                                  +------+
|
|                                  %R0010
|
```

REFERENCE NICKNAME		REFERENCE DESCRIPTION
%R0007		
%R0010		
%I0001	AUT_MAN	AUTO MANUAL SELECTION
%I0016	M40KPA	-40 KPA PRESSURE
%M0023	V2FTO	VACUUM PUMP 2 FAILED TO OPERATE
% I22	V2FTS	VACUUM PUMP 2 FAILED TO START
%__I22	V2_RUN	VACUUM PUMP 2 RUNNING INTERLOCK
%Q0002	VP2	VACUUM PUMP 2 CONTACTOR

Program: AIRVAC C:\LM90\AIRVAC Block: _MAIN

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```
|    (*************************************************************************)
|                              SEWER PUMP ONE CONTROL                          *)
|  (*************************************************************************)
|
|  << RUNG 38  STEP #0178 >>
|
|                   SEWER                                                SEWER
|SEWER              PUMP 1                                               PUMP 1
|PUMP 1             AVAILAB                                              SELECTE
|DUTY               LE LAMP                                              D
|S1DUTY             S1AVLMP                                               S1SEL
|%M0008             %Q0009                                               %M0024
+---] [-------------+---] [-------------------------------------------------( )---
|                   |
|          SEWER    |
|SEWER     PUMP 2   |
|PUMP 2    AVAILAB  |
|DUTY      LE LAMP  |
|S2DUTY    S2AVLMP  |
|%M0011    %Q0010   |
+---] [------]/[---+
|
```

REFERENCE NICKNAME	REFERENCE DESCRIPTION
%Q0009 S1AVLMP	SEWER PUMP 1 AVAILABLE LAMP
%M0008 S1DUTY	SEWER PUMP 1 DUTY
0024 S1SEL	SEWER PUMP 1 SELECTED
%Q0010 S2AVLMP	SEWER PUMP 2 AVAILABLE LAMP
%M0011 S2DUTY	SEWER PUMP 2 DUTY

Program: AIRVAC C:\LM90\AIRVAC Block: _MAIN

```
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|  RUNG 39  STEP #0184 >>
|
|                   SEWER                                                  SEWER P
|HIGH               PUMP 1  LOW LOW                                        UMP 1 A
|TANK               SELECTE TANK                                           UTO STO
|LEVEL              D       LEVEL                                          P START
|  HI                S1SEL   LO_LO                                          S1ASS
|%I0018             %M0024  %I0020                                         %M0025
+---] [-------------+---] [---+---] [-----------------------------------------( )--
|                   |         |
|         SEWER P   |         |
|LOW      UMP 1 A   |         |
|TANK     UTO STO   |         |
|LEVEL    P START   |         |
|  LO      S1ASS    |         |
|%I0019   %M0025    |         |
+---] [------] [----+         |
|                             |
|HIGH     SEWER               |
|HIGH     PUMP 1              |
|TANK     AVAILAB             |
|LEVEL    LE LAMP             |
| HI_HI   S1AVLMP             |
|%I0017   %Q0009              |
+---] [------] [--------------+
|

REFERENCE NICKNAME       REFERENCE DESCRIPTION
  %I0018   HI            HIGH TANK LEVEL
  %I0017   HI_HI         HIGH HIGH TANK LEVEL
  %I0019   LO            LOW TANK LEVEL
  %I0020   LO_LO         LOW LOW TANK LEVEL
  %I   25  S1ASS         SEWER PUMP 1 AUTO STOP START
  %L...09  S1AVLMP       SEWER PUMP 1 AVAILABLE LAMP
  %M0024   S1SEL         SEWER PUMP 1 SELECTED

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

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|     RUNG 40  STEP #0194 >>
|
|AUTO     SEWER    SEWER                                                  SEWER P
|MANUAL.  PUMP 1   PUMP 1                                                 UMP 1 M.
|SELECTI  START P  STOP P/                                                ANUAL S
|ON       /BUTTON  BUTTON                                                 TOP STA
|AUT_MAN  S1START  S1STOP                                                  S1MSS
|%I0001   %I0010   %I0011                                                 %M0026
+--]/[--+--] [--+--] [-------------------------------------------------------( )--
|       |        |
|       |SEWER P|
|       |UMP 1 M|
|       |ANUAL S|
|       |TOP STA|
|       | S1MSS |
|       |%M0026 |
|       +--] [--+
|
| << RUNG 41  STEP #0200 >>
|
|SEWER P SEWER P                                                          SEWER
|UMP 1 A UMP 1 T                                                          PUMP 1
|UTO STO HERMAL                                                           CONTACT
|P START OVERLOA                                                          OR
| S1ASS  S1_TOL                                                            SP1
|%M0025  %I0027                                                           %Q0003
+     [--+--] [-------------------------------------------------------------( )--
|       |
|SEWER P|
|UMP 1 M|
|ANUAL S|
|TOP STA|
| S1MSS |
|%M0026 |
+--] [--+
|

REFERENCE NICKNAME       REFERENCE DESCRIPTION
 %I0001   AUT_MAN        AUTO MANUAL SELECTION
 %M0025   S1ASS          SEWER PUMP 1 AUTO STOP START
 %M0026   S1MSS          SEWER PUMP 1 MANUAL STOP START
 %I0010   S1START        SEWER PUMP 1 START P/BUTTON
 %I0011   S1STOP         SEWER PUMP 1 STOP P/BUTTON
 %I0027   S1_TOL         SEWER PUMP 1 THERMAL OVERLOAD
 %Q0003   SP1            SEWER PUMP 1 CONTACTOR

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

```
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|    RUNG 42  STEP #0204 >>
|
|AUTO     SEWER    SEWER P                                                  SEWER P
|MANUAL   PUMP 1   UMP 1 R                                                  UMP 1 F
|SELECTI  CONTACT  UNNING                                                   AILED T
|ON       OR       INTERLO                                                  O START
|AUT_MAN    SP1    S1_RUN                                                    S1FTS
|%I0001   %Q0003   %I0023            +-------+                              %M0027
+---] [---+---] [------]/[---+-------+ TMR +-------------------------------------( )---
|         |                  |       |0.10s|
|         |SEWER P           |       |     |
|         |UMP 1 F           |       |     |
|         |AILED T           |       |     |
|         |O START           |       |     |
|         | S1FTS            |       |     |
|         |%M0027            |       |     |
|         +---] [------------+ CONST -+PV   |
|                              +00030  |     |
|                                      +-----+
|
|                                    %R0013
|
|  (*****************************************************************************)
|  (*                          SEWER PUMP TWO CONTROL                           *)
|  (*****************************************************************************)
|


REFERENCE NICKNAME       REFERENCE DESCRIPTION
  %R0013
  %I0001    AUT_MAN      AUTO MANUAL SELECTION
  %  027    S1FTS        SEWER PUMP 1 FAILED TO START
  %  023    S1_RUN       SEWER PUMP 1 RUNNING INTERLOCK
  %Q0003    SP1          SEWER PUMP 1 CONTACTOR

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

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```
|<  : RUNG 44  STEP #0212 >>
|
|                  SEWER                                                    SEWER
|SEWER             PUMP 2                                                   PUMP 2
|PUMP 2            AVAILAB                                                  SELECTE
|DUTY              LE LAMP                                                  D
|S2DUTY            S2AVLMP                                                   S2SEL
|%M0011            %00010                                                   %M0028
+--] [-------------+--] [-------------------------------------------------------( )--
|                  |
|          SEWER   |
|SEWER     PUMP 1  |
|PUMP 1    AVAILAB|
|DUTY      LE LAMP|
|S1DUTY    S1AVLMP|
|%M0008    %00009 |
+--] [------]/[---+
|
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%00009	S1AVLMP	SEWER PUMP 1 AVAILABLE LAMP
%M0008	S1DUTY	SEWER PUMP 1 DUTY
0010	S2AVLMP	SEWER PUMP 2 AVAILABLE LAMP
%0011	S2DUTY	SEWER PUMP 2 DUTY
%M0028	S2SEL	SEWER PUMP 2 SELECTED

Program: AIRVAC C:\LM90\AIRVAC Block: _MAIN

```
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|     RUNG 45  STEP #0218 >>
|
|                  SEWER                                                  SEWER P
|HIGH              PUMP 2  LOW LOW                                        UMP 2 A
|TANK              SELECTE TANK                                           UTO STO
|LEVEL             D       LEVEL                                          P START
|  HI               S2SEL    LO_LO                                        S2ASS
|%I0018            %M0028  %I0020                                         %M0029
+---] [-------------+---] [---+---] [-------------------------------------------( )--
|                   |         |
|         SEWER P   |         |
|LOW      UMP 2 A   |         |
|TANK     UTO STO   |         |
|LEVEL    P START   |         |
|  LO      S2ASS    |         |
|%I0019   %M0029    |         |
+---] [------] [---+         |
|                             |
|HIGH     SEWER               |
|HIGH     PUMP 2              |
|TANK     AVAILAB             |
|LEVEL    LE LAMP             |
| HI_HI   S2AVLMP             |
|%I0017   %00010              |
+---] [------] [--------------+
|
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%I0018	HI	HIGH TANK LEVEL
%I0017	HI_HI	HIGH HIGH TANK LEVEL
%I0019	LO	LOW TANK LEVEL
%I0020	LO_LO	LOW LOW TANK LEVEL
%M0029	S2ASS	SEWER PUMP 2 AUTO STOP START
%I0010	S2AVLMP	SEWER PUMP 2 AVAILABLE LAMP
%M0028	S2SEL	SEWER PUMP 2 SELECTED

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

```
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 <<  RUNG 46  STEP #0228 >>

 AUTO     SEWER    SEWER                                                    SEWER P
 MANUAL   PUMP 2   PUMP 2                                                   UMP 2 M
 SELECTI  START P  STOP P/                                                  ANUAL S
 ON       /BUTTON  BUTTON                                                   TOP STA
 AUT_MAN  S2START  S2STOP                                                    S2MSS
 %I0001   %I0012   %I0013                                                   %M0030
---]/[---+---] [---+---] [-------------------------------------------------------( )--
         |         |
         |SEWER P  |
         |UMP 2 M  |
         |ANUAL S  |
         |TOP STA  |
         | S2MSS   |
         |%M0030   |
         +---] [---+

 << RUNG 47  STEP #0234 >>

 SEWER P SEWER P                                                            SEWER
 UMP 2 A UMP 2 T                                                            PUMP 2
 UTO STO HERMAL                                                             CONTACT
 P START OVERLOA                                                            OR
  S2ASS   S2_TOL                                                              SP2
 %M0029   %I0028                                                            %Q0004
---] [---+---] [-------------------------------------------------------------( )--
         |
 SEWER P |
 UMP 2 M |
 ANUAL S |
 TOP STA |
  S2MSS  |
 %M0030  |
---] [---+


REFERENCE NICKNAME       REFERENCE DESCRIPTION
  %I0001   AUT_MAN       AUTO MANUAL SELECTION
  %M0029   S2ASS         SEWER PUMP 2 AUTO STOP START
  %M0030   S2MSS         SEWER PUMP 2 MANUAL STOP START
  %I0012   S2START       SEWER PUMP 2 START P/BUTTON
  %I0013   S2STOP        SEWER PUMP 2 STOP P/BUTTON
  %I0028   S2_TOL        SEWER PUMP 2 THERMAL OVERLOAD
  %Q0004   SP2           SEWER PUMP 2 CONTACTOR

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

```
|    RUNG 48  STEP #0238 >>
|
|AUTO     SEWER    SEWER P                                                    SEWER P
|MANUAL   PUMP 2   UMP 2 R                                                    UMP 2 F
|SELECTI  CONTACT  UNNING                                                     AILED T
|ON       OR       INTERLO                                                    O START
|AUT_MAN    SP2    S2_RUN                                                      S2FTS
|%I0001    %Q0004   %I0024              +-------+                             %M0031
+---] [---+---] [-------]/[---+---------+ TMR +-------------------------------( )---
|         |                  |         |0.10s|
|         |SEWER P           |         |     |
|         |UMP 2 F           |         |     |
|         |AILED T           |         |     |
|         |O START           |         |     |
|         | S2FTS            |         |     |
|         |%M0031            |         |     |
|         +---] [------------+ CONST --+PV   |
|                              +00030  |     |
|                                      +-----+
|
|                                      %R0016
|
|  (*************************************************************************************)
|  (*                              INDICATION LAMPS                                     *)
|  (*************************************************************************************)
|
|    RUNG 50  STEP #0246 >>
|
|HIGH                                                                         SEWER H
|HIGH                                                                         IGH HIG
|TANK                                                                         H LEVEL
|LEVEL                                                                        ALARM
| HI_HI                                                                      HIHIALM
|%I0017                                                                      %Q0005
+---] [-------------------------------------------------------------------------( )---
|
```

REFERENCE NICKNAME		REFERENCE DESCRIPTION
%R0016		
%I0001	AUT_MAN	AUTO MANUAL SELECTION
%Q0005	HIHIALM	SEWER HIGH HIGH LEVEL ALARM
%I0017	HI_HI	HIGH HIGH TANK LEVEL
031	S2FTS	SEWER PUMP 2 FAILED TO START
...024	S2_RUN	SEWER PUMP 2 RUNNING INTERLOCK
%Q0004	SP2	SEWER PUMP 2 CONTACTOR

Program: AIRVAC C:\LM90\AIRVAC Block: _MAIN

```
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|^ : RUNG 51  STEP #0248 >>
|
|                                                                          VACUUM
|-80 KPA                                                                   LOW
|PRESSUR                                                                   PRESSUR
|E                                                                         E ALARM
|M80KPA                                                                    LOPALM
|%I0014                                                                    %Q0006
+--]/[-------------------------------------------------------------------------( )--
|
| << RUNG 52  STEP #0250 >>
|
|VACUUM  VACUUM  VACUUM                                                    VACUUM
|PUMP 1  PUMP 1  PUMP 1                                                    PUMP 1
|THERMAL FAILED  FAILED  SYSTEM                                            AVAILAB
|OVERLOA TO STAR TO OPER START                                             LE LAMP
|V1_TOL   V1FTS   V1FTO  S_START                                           V1AVLMP
|%I0025  %M0017  %M0018  %M0001                                            %Q0007
+--] [------]/[------]/[------] [-------------------------------------------( )--
|
| << RUNG 53  STEP #0255 >>
|
|VACUUM  VACUUM  VACUUM                                                    VACUUM
|PUMP 2  PUMP 2  PUMP 2                                                    PUMP 2
|THERMAL FAILED  FAILED  SYSTEM                                            AVAILAB
|OVERLOA TO STAR TO OPER START                                             LE LAMP
|   TOL   V2FTS   V2FTO  S_START                                           V2AVLMP
|%I0026  %M0022  %M0023  %M0001                                            %Q0008
+--] [------]/[------]/[------] [-------------------------------------------( )--
|
```

REFERENCE	NICKNAME	REFERENCE DESCRIPTION
%Q0006	LOPALM	VACUUM LOW PRESSURE ALARM
%I0014	M80KPA	-80 KPA PRESSURE
%M0001	S_START	SYSTEM START
%Q0007	V1AVLMP	VACUUM PUMP 1 AVAILABLE LAMP
%M0018	V1FTO	VACUUM PUMP 1 FAILED TO OPERATE
%M0017	V1FTS	VACUUM PUMP 1 FAILED TO START
%I0025	V1_TOL	VACUUM PUMP 1 THERMAL OVERLOAD
%Q0008	V2AVLMP	VACUUM PUMP 2 AVAILABLE LAMP
%M0023	V2FTO	VACUUM PUMP 2 FAILED TO OPERATE
%M0022	V2FTS	VACUUM PUMP 2 FAILED TO START
%I0026	V2_TOL	VACUUM PUMP 2 THERMAL OVERLOAD

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

```
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  << RUNG 54  STEP #0260 >>

|SEWER P SEWER P                                                          SEWER
|UMP 1 T UMP 1 F                                                         PUMP 1
|HERMAL  AILED T SYSTEM                                                  AVAILAB
|OVERLOA O START START                                                   LE LAMP
|S1_TOL   S1FTS  S_START                                                 S1AVLMP
|%I0027  %M0027  %M0001                                                  %Q0009
+--] [------]/[------] [-----------------------------------------------------( )--
|
|  << RUNG 55  STEP #0264 >>
|
|SEWER P SEWER P                                                          SEWER
|UMP 2 T UMP 2 F                                                         PUMP 2
|HERMAL  AILED T SYSTEM                                                  AVAILAB
|OVERLOA O START START                                                   LE LAMP
|S2_TOL   S2FTS  S_START                                                 S2AVLMP
|%I0028  %M0031  %M0001                                                  %Q0010
+--] [------]/[------] [-----------------------------------------------------( )--
|
|  << RUNG 56  STEP #0268 >>
|
|VACUUM                                                                   VACUUM
|PUMP 1                                                                   PUMP 1
|RUNNING                                                                  RUNNING
|INTERLO                                                                  LAMP
|  _RUN                                                                   V1RNLMP
|%I0021                                                                   %Q0011
+--] [-----------------------------------------------------------------------( )--
|
|  << RUNG 57  STEP #0270 >>
|
|VACUUM                                                                   VACUUM
|PUMP 2                                                                   PUMP 2
|RUNNING                                                                  RUNNING
|INTERLO                                                                  LAMP
|V2_RUN                                                                   V2RNLMP
|%I0022                                                                   %Q0012
+--] [-----------------------------------------------------------------------( )--
|


REFERENCE NICKNAME       REFERENCE DESCRIPTION
 %Q0009   S1AVLMP        SEWER PUMP 1 AVAILABLE LAMP
 %M0027   S1FTS          SEWER PUMP 1 FAILED TO START
 %I0027   S1_TOL         SEWER PUMP 1 THERMAL OVERLOAD
 %Q0010   S2AVLMP        SEWER PUMP 2 AVAILABLE LAMP
 %M0031   S2FTS          SEWER PUMP 2 FAILED TO START
 %I0028   S2_TOL         SEWER PUMP 2 THERMAL OVERLOAD
 %M0001   S_START        SYSTEM START
 %Q0011   V1RNLMP        VACUUM PUMP 1 RUNNING LAMP
    I021  V1_RUN         VACUUM PUMP 1 RUNNING INTERLOCK
    Q012  V2RNLMP        VACUUM PUMP 2 RUNNING LAMP
 %I0022   V2_RUN         VACUUM PUMP 2 RUNNING INTERLOCK

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

```
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|  << RUNG 58  STEP #0272 >>
|
|SEWER P                                                                SEWER
|UMP 1 R                                                                PUMP 1
|UNNING                                                                 RUNNING
|INTERLO                                                                LAMP
|S1_RUN                                                                 S1RNLMP
|%I0023                                                                 %Q0013
+---] [-------------------------------------------------------------------( )---
|
|  << RUNG 59  STEP #0274 >>
|
|SEWER P                                                                SEWER
|UMP 2 R                                                                PUMP 2
|UNNING                                                                 RUNNING
|INTERLO                                                                LAMP
|S2_RUN                                                                 S2RNLMP
|%I0024                                                                 %Q0014
+---] [-------------------------------------------------------------------( )---
|
|  (*************************************************************************)
|  (*                              TELEMETRY                                *)
|  (*************************************************************************)
|
|  << RUNG 61  STEP #0277 >>
|
|T   :MET                                                               TELEMET
|RY SITE                                                                RY SITE
|POPWER                                                                 POPWER
|FAIL                                                                   FAIL
|  TPWR                                                                  TPWR
|%Q0017                                                                 %Q0017
+---] [---+---------------------------------------------------------------( )---
|         |
|TELEMET  |
|RY SITE  |
|POPWER   |
|FAIL     |
|  TPWR   |
|%Q0017   |
+---]/[---+
|



REFERENCE NICKNAME       REFERENCE DESCRIPTION
  %Q0013    S1RNLMP      SEWER PUMP 1 RUNNING LAMP
  %I0023    S1_RUN       SEWER PUMP 1 RUNNING INTERLOCK
  %   14    S2RNLMP      SEWER PUMP 2 RUNNING LAMP
  %   24    S2_RUN       SEWER PUMP 2 RUNNING INTERLOCK
  %Q0017    TPWR         TELEMETRY SITE POPWER FAIL

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

```
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|   << RUNG 62  STEP #0280 >>
|
|AUTO                                                                  TELEMET
|MANUAL                                                                RY AUTO
|SELECTI                                                               MANUAL
|ON                                                                    SELECT
|AUT_MAN                                                                 TAM
|%I0001                                                                %Q0018
+--] [-------------------------------------------------------------------( )--
|
|  << RUNG 63  STEP #0282 >>
|
|HIGH                                                                  TELEMET
|HIGH                                                                  RY HI H
|TANK                                                                  I LEVEL
|LEVEL                                                                 ALARM
|  HI_HI                                                                THIHI
|%I0017                                                                %Q0019
+--] [-------------------------------------------------------------------( )--
|
|  << RUNG 64  STEP #0284 >>
|
|                                                                      TELEMET
|-80 KPA                                                               RY LO
|PRESSUR                                                               VACUUM
|E                                                                     ALARM
|    KPA                                                                TVLP
|%I0014                                                                %Q0020
+--]/[-------------------------------------------------------------------( )--
|
|  << RUNG 65  STEP #0286 >>
|
|VACUUM   VACUUM   VACUUM                                              TELEMET
|PUMP 1   PUMP 1   PUMP 1                                              RY VP1
|THERMAL  FAILED   FAILED                                              AVAILAB
|OVERLOA  TO STAR  TO OPER                                             LE
|V1_TOL    V1FTS    V1FTO                                              TV1AV
|%I0025   %M0017   %M0018                                              %Q0021
+--] [------]/[------]/[-------------------------------------------------( )--
|


REFERENCE NICKNAME       REFERENCE DESCRIPTION
 %I0001   AUT_MAN        AUTO MANUAL SELECTION
 %I0017   HI_HI          HIGH HIGH TANK LEVEL
 %I0014   M80KPA         -80 KPA PRESSURE
 %Q0018   TAM            TELEMETRY AUTO MANUAL SELECT
 %Q0019   THIHI          TELEMETRY HI HI LEVEL ALARM
 %Q0021   TV1AV          TELEMETRY VP1 AVAILABLE
 %Q0020   TVLP           TELEMETRY LO VACUUM ALARM
 %M0018   V1FTO          VACUUM PUMP 1 FAILED TO OPERATE
 %M0017   V1FTS          VACUUM PUMP 1 FAILED TO START
 %I0025   V1_TOL         VACUUM PUMP 1 THERMAL OVERLOAD

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

```
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|     RUNG 66  STEP #0290 >>
|
|VACUUM  VACUUM  VACUUM                                                TELEMET
|PUMP 2  PUMP 2  PUMP 2                                                RY VP2
|THERMAL FAILED  FAILED                                                AVAILAB
|OVERLOA TO STAR TO OPER                                               LE
|V2_TOL   V2FTS   V2FTO                                                 TV2AV
|%I0026  %M0022  %M0023                                                %Q0022
+--] [------]/[------]/[-------------------------------------------------( )--
|
| << RUNG 67  STEP #0294 >>
|
|SEWER P SEWER P                                                       TELEMET
|UMP 1 T UMP 1 F                                                       RY SP1
|HERMAL  AILED T                                                       AVAILAB
|OVERLOA O START                                                       LE
|S1_TOL   S1FTS                                                         TS1AV
|%I0027  %M0027                                                        %Q0023
+--] [------]/[-------------------------------------------------------( )---
|
| << RUNG 68  STEP #0297 >>
|
|SEWER P SEWER P                                                       TELEMET
|UMP 2 T UMP 2 F                                                       RY SP2
|HERMAL  AILED T                                                       AVAILAB
|O""RLOA O START                                                       LE
|S  TOL   S2FTS                                                         TS2AV
|%I0028  %M0031                                                        %Q0024
+--] [------]/[-------------------------------------------------------( )---
|
| << RUNG 69  STEP #0300 >>
|
|VACUUM
|PUMP 1                                                                TELEMET
|RUNNING                                                               RY VP1
|INTERLO                                                               RUNNING
|V1_RUN                                                                TVP1RUN
|%I0021                                                                %Q0025
+--] [-------------------------------------------------------------------( )---
|

REFERENCE NICKNAME       REFERENCE DESCRIPTION
 %M0027    S1FTS         SEWER PUMP 1 FAILED TO START
 %I0027    S1_TOL        SEWER PUMP 1 THERMAL OVERLOAD
 %M0031    S2FTS         SEWER PUMP 2 FAILED TO START
 %I0028    S2_TOL        SEWER PUMP 2 THERMAL OVERLOAD
 %Q0023    TS1AV         TELEMETRY SP1 AVAILABLE
 %Q0024    TS2AV         TELEMETRY SP2 AVAILABLE
 %Q0022    TV2AV         TELEMETRY VP2 AVAILABLE
 %Q0025    TVP1RUN       TELEMETRY VP1 RUNNING
 %I0021    V1_RUN        VACUUM PUMP 1 RUNNING INTERLOCK
 %  023    V2FTO         VACUUM PUMP 2 FAILED TO OPERATE
 %  022    V2FTS         VACUUM PUMP 2 FAILED TO START
 %I0026    V2_TOL        VACUUM PUMP 2 THERMAL OVERLOAD

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

```
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|    RUNG 70  STEP #0302 >>
|
|VACUUM
|PUMP 2                                                                TELEMET
|RUNNING                                                               RY VP2
|INTERLO                                                               RUNNING
|V2_RUN                                                                TVP2RUN
|%I0022                                                                %Q0026
+---] [-------------------------------------------------------------------( )--
|
|  << RUNG 71  STEP #0304 >>
|
|SEWER P
|UMP 1 R                                                               TELEMET
|UNNING                                                                RY SP1
|INTERLO                                                               RUNNING
|S1_RUN                                                                TSP1RUN
|%I0023                                                                %Q0027
+---] [-------------------------------------------------------------------( )--
|
|  << RUNG 72  STEP #0306 >>
|
|SEWER P
|UMP 2 R                                                               TELEMET
|UNNING                                                                RY SP2
|INTERLO                                                               RUNNING
|S2_RUN                                                                TSP2RUN
|%I0024                                                                %Q0028
+---] [-------------------------------------------------------------------( )--
|
|  (*************************************************************************)
|  (*                          AUTO DIALLER                                 *)
|  (*************************************************************************)
|

REFERENCE NICKNAME       REFERENCE DESCRIPTION
 %I0023   S1_RUN         SEWER PUMP 1 RUNNING INTERLOCK
 %I0024   S2_RUN         SEWER PUMP 2 RUNNING INTERLOCK
 %Q0027   TSP1RUN        TELEMETRY SP1 RUNNING
 %Q0028   TSP2RUN        TELEMETRY SP2 RUNNING
 %Q0026   TVP2RUN        TELEMETRY VP2 RUNNING
 %I0022   V2_RUN         VACUUM PUMP 2 RUNNING INTERLOCK

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

```
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  RUNG 74  STEP #0309 >>

 TELEMET                                                                  AUTO
 RY SITE                                                                  DIALLER
 POPWER                                                                   ONE
 FAIL                                                                     RELAY
  TPWR                                                                      AD1
 %Q0017                                                                   %Q0015
+--]/[---+-------------------------------------------------------------------( )---
 |        |
 |AUTO    |
 |MANUAL  |
 |SELECTI |
 |ON      |
 |AUT_MAN |
 |%I0001  |
 +--]/[---+
 |        |
 |HIGH    |
 |HIGH    |
 |TANK    |
 |LEVEL   |
 | HI_HI  |
 |%I0017  |
 +--] [---+
 |


REFERENCE  NICKNAME        REFERENCE DESCRIPTION
 %Q0015    AD1             AUTO DIALLER ONE RELAY
 %I0001    AUT_MAN         AUTO MANUAL SELECTION
 %I0017    HI_HI           HIGH HIGH TANK LEVEL
 %Q0017    TPWR            TELEMETRY SITE POPWER FAIL

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

```
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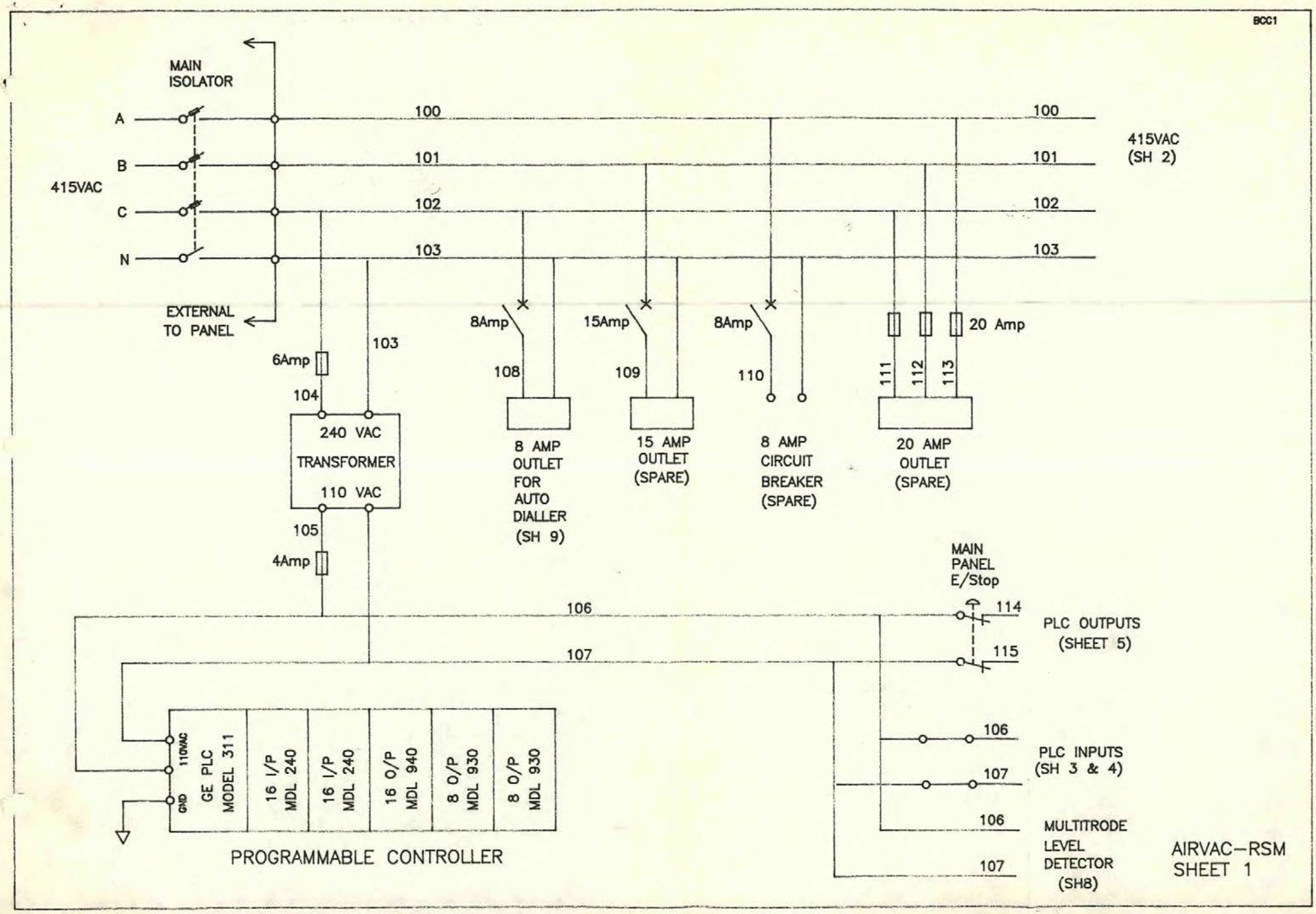
  << RUNG 75  STEP #0313 >>

 AUTO                                                                    AUTO
 MANUAL                                                                  DIALLER
 SELECTI                                                                 TWO
 ON                                                                      RELAY
 AUT_MAN                                                                   AD2
 %I0001                                                                  %Q0016
+---]/[---+-------------------------------------------------------------------( )---
 |         |
 TELEMET
 RY VP1
 AVAILAB
 LE
  TV1AV
 %Q0021
+---]/[---+
 |         |
 TELEMET
 RY VP2
 AVAILAB
 LE
  TV2AV
 %Q0022
+---]/[---+
 |         |
    EMET
 RY SP1
 AVAILAB
 LE
  TS1AV
 %Q0023
+---]/[---+
 |         |
 TELEMET
 RY SP2
 AVAILAB
 LE
  TS2AV
 %Q0024
+---]/[---+
 |
 [       END OF PROGRAM LOGIC       ]
 |

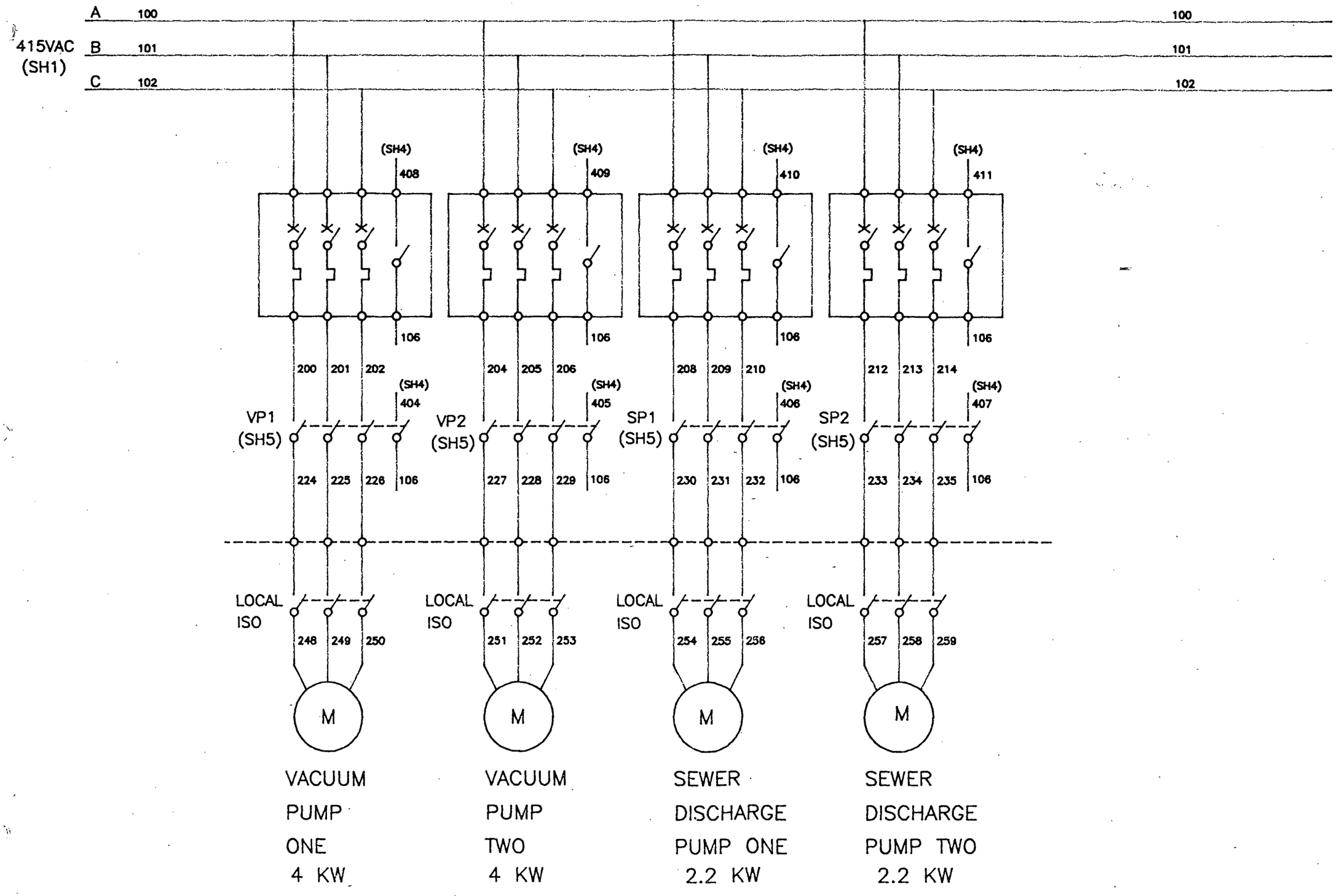


REFERENCE  NICKNAME       REFERENCE DESCRIPTION
 %Q0016    AD2            AUTO DIALLER TWO RELAY
 %I0001    AUT_MAN        AUTO MANUAL SELECTION
 %Q0023    TS1AV          TELEMETRY SP1 AVAILABLE
    1024   TS2AV          TELEMETRY SP2 AVAILABLE
    1021   TV1AV          TELEMETRY VP1 AVAILABLE
 %Q0022    TV2AV          TELEMETRY VP2 AVAILABLE

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

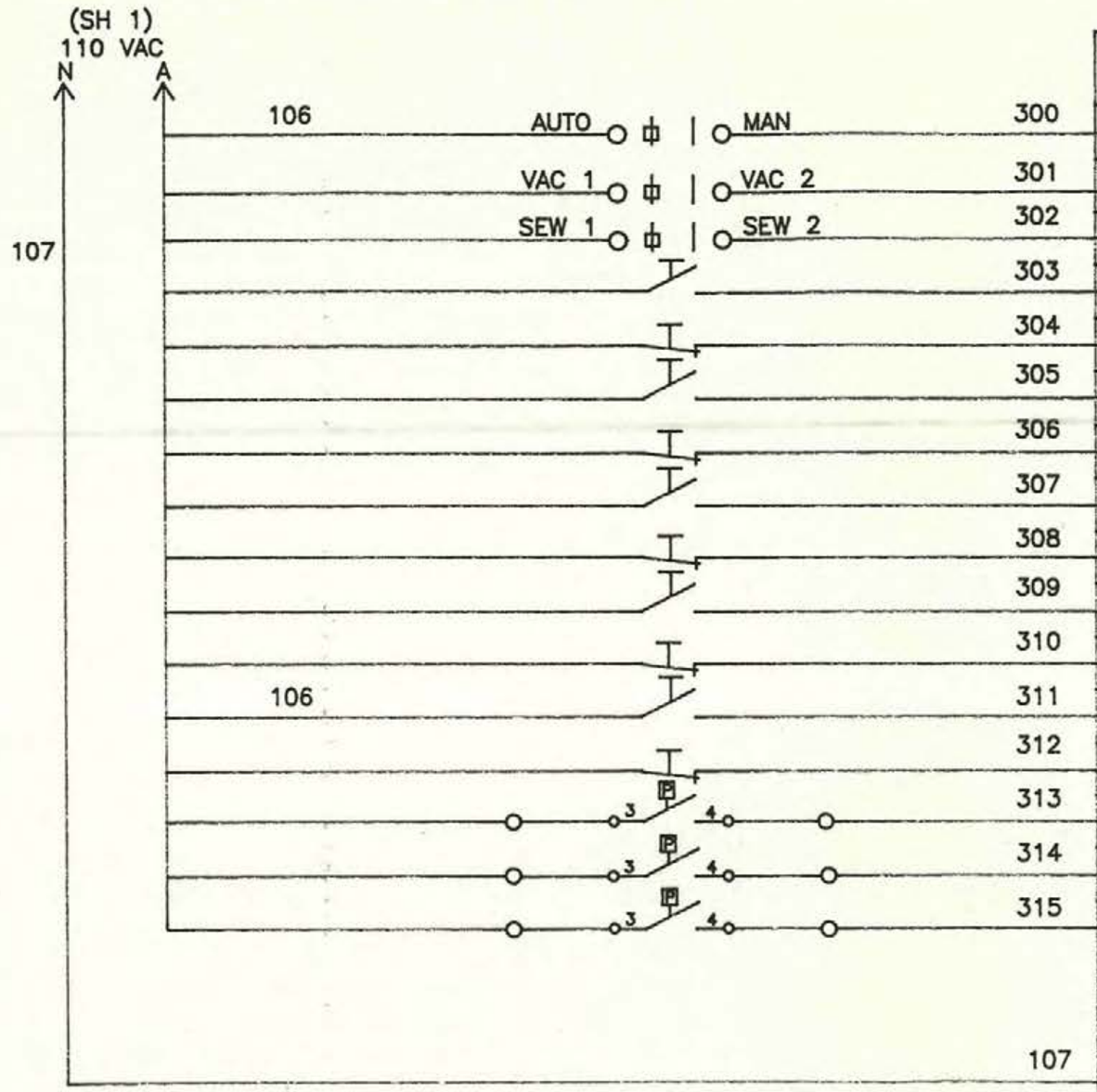

BCC1
MAIN ISOLATOR
A
B
C
N
415VAC
EXTERNAL TO PANEL
100
101
102
103
100
101
102
103
415VAC (SH 2)
6Amp
104
103
240 VAC TRANSFORMER
110 VAC
105
4Amp
8Amp
108
8 AMP OUTLET FOR AUTO DIALLER (SH 9)
15Amp
109
15 AMP OUTLET (SPARE)
8Amp
110
8 AMP CIRCUIT BREAKER (SPARE)
20 Amp
111
112
113
20 AMP OUTLET (SPARE)
MAIN PANEL E/Stop
106
107
114
115
PLC OUTPUTS (SHEET 5)
106
107
PLC INPUTS (SH 3 & 4)
106
107
MULTITRODE LEVEL DETECTOR (SH8)
110VAC
GND
GE PLC MODEL 311
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
PROGRAMMABLE CONTROLLER
AIRVAC–RSM SHEET 1

BCC2



AIRVAC–RSM
SHEET 2

BCC3



TERM	ADDR	INPUT DESCRIPTION	
1	I1	AUTOMATIC / MANUAL SELECT	
2	I2	VACUUM PUMPS 1 / 2 SELECT	
3	I3	SEWER DISCHARGE 1 / 2 SELECT	
4	I4	SYSTEM START PUSH BUTTON	
5	I5	SYSTEM STOP PUSH BUTTON	
6	I6	VAC PUMP 1 START	
7	I7	VAC PUMP 1 STOP	
8	I8	VAC PUMP 2 START	
9	I9	VAC PUMP 2 STOP	
10	I10	SEWER PUMP 1 START	
11	I11	SEWER PUMP 1 STOP	
12	I12	SEWER PUMP 2 START	
13	I13	SEWER PUMP 2 STOP	
14	I14	−80 KPA PRESSURE	0 TO −80 CLOSED THEN OPEN
15	I15	−50 / −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

BCC4

(SH 1)
110 VAC
N A

106

107

106

107

(SHEET 8)	400	1	
(SHEET 8)	401	2	
(SHEET 8)	402	3	
(SHEET 8)	403	4	
VAC PUMP 1 (SH2)	404	5	
VAC PUMP 2 (SH2)	405	6	
SEWER PUMP 1 (SH2)	406	7	
SEWER PUMP 2 (SH2)	407	8	
VAC PUMP 1 (SH2)	408	9	
VAC PUMP 2 (SH2)	409	10	
SEWER PUMP 1 (SH2)	410	11	
SEWER PUMP 2 (SH2)	411	12	
		13	
		14	
		15	
		16	
		17	
		18	
	107	19	
		20	

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			

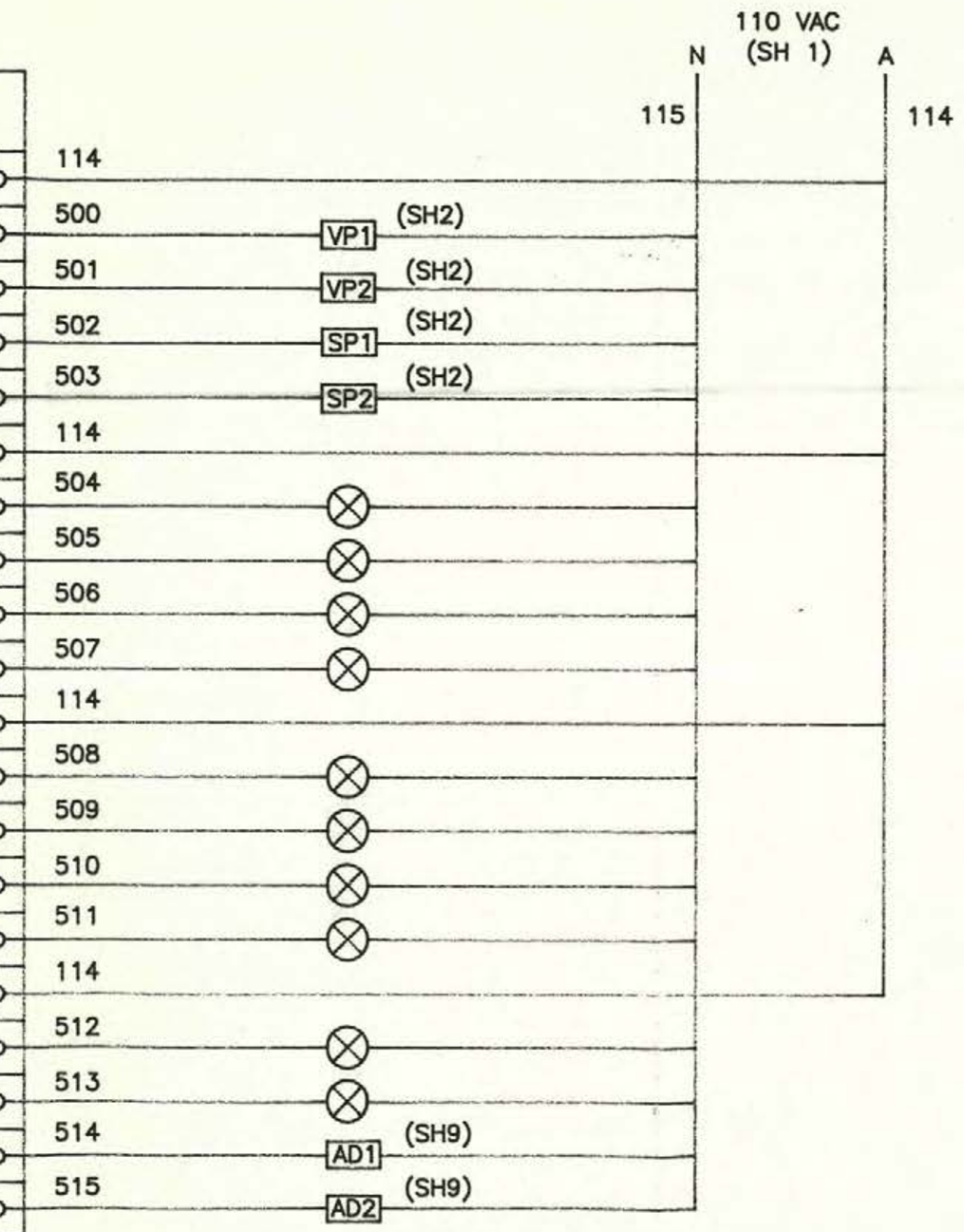
GE SERIES 90 PLC – IC693MDL240

AIRVAC–RSM
SHEET 4

BCC5

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
AUTO DIALLER ALARM ONE	Q15	19
AUTO DIALLER ALARM TWO	Q16	20

GE SERIES 90 PLC – IC693MDL940



AIRVAC–RSM
SHEET 5

BCC6

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			

TELEMETRY INDICATION

AIRVAC–RSM
SHEET 6

BCC7

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

TELEMETRY INDICATION

AIRVAC–RSM
SHEET 7

BCC8

MULTI TRODE MTIC 10/10

HI HI LEVEL (I 17) — 400

HI LEVEL (I 18) — 401

106

PLC INPUTS (SH 4)

LO LEVEL (I 19) — 402

LO LO LEVEL (I 20) — 403

OUTPUTS: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

4–20 Ma

0–10 V

A
B
C
D

SELECT FUNCTION
N/O ⟷ N/C

MAINS POWER: A, N, E

1 2 3 4 — 5 6 7 8 — 9 10

N/O ⟷ N/C

PROBE INPUTS: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

1 — 800 — 1
2 — 801 — 2
3 — 802 — 3
4 — 803 — 4
5 — 804 — 5
6 — 805 — 6
7 — 806 — 7
8 — 807 — 8
9 — 808 — 9
10 — 809 — 10

HIGH

SENSOR PROBE

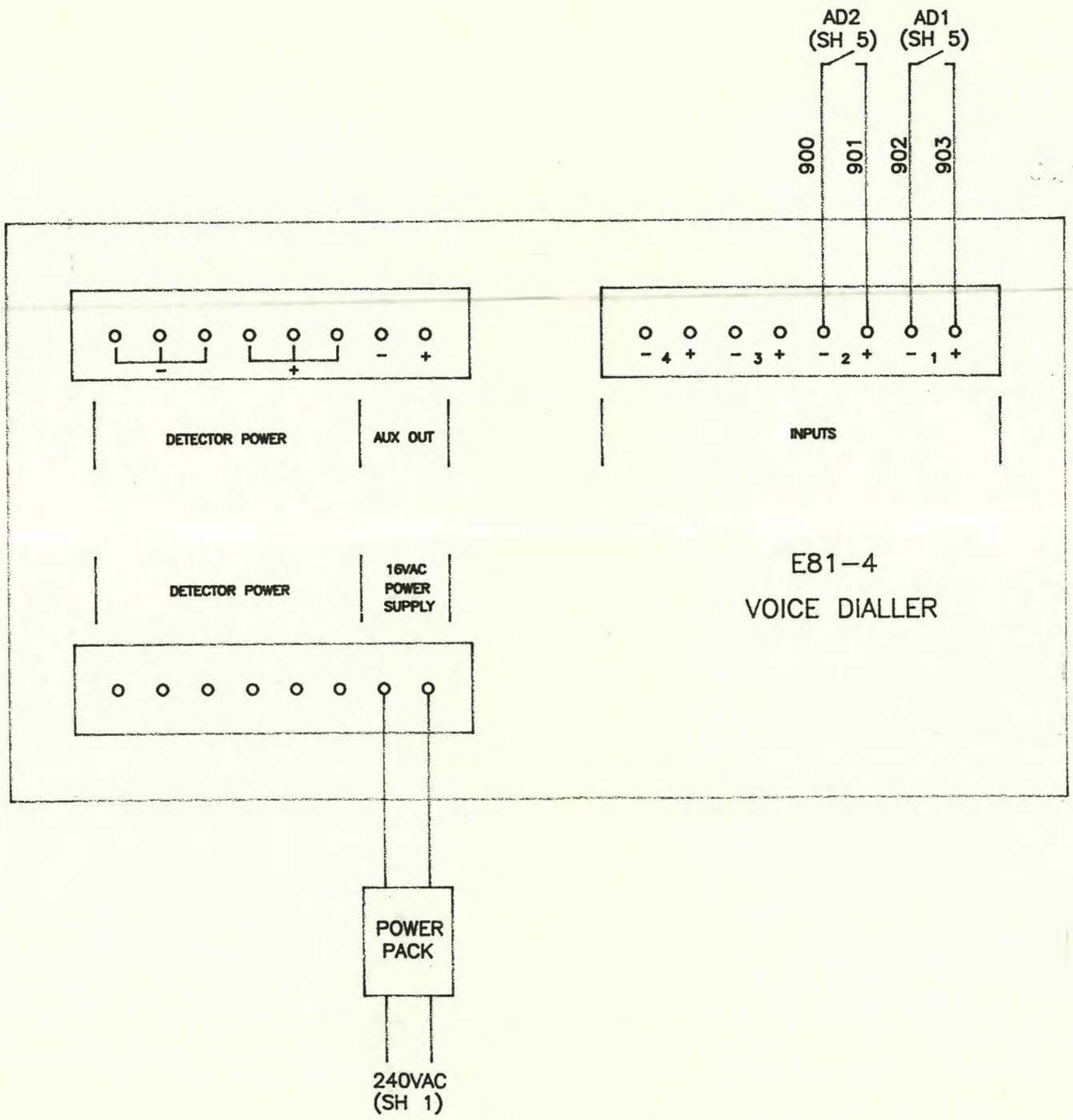
LOW

106 107 GND

110 VAC (SH 1)

AIRVAC–RSM
SHEET 8

BCC9



E81–4

VOICE DIALLER

AIRVAC–RSM

SHEET 9

3

SECTION 3

AIRVAC VACUUM VALVES

PART

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 and160 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 –17 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 mains 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 100mm dia. rising main to a manhole at a nearby pump station.

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 litre/second.

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 125 mm mercury vacuum is available in the vacuum main.

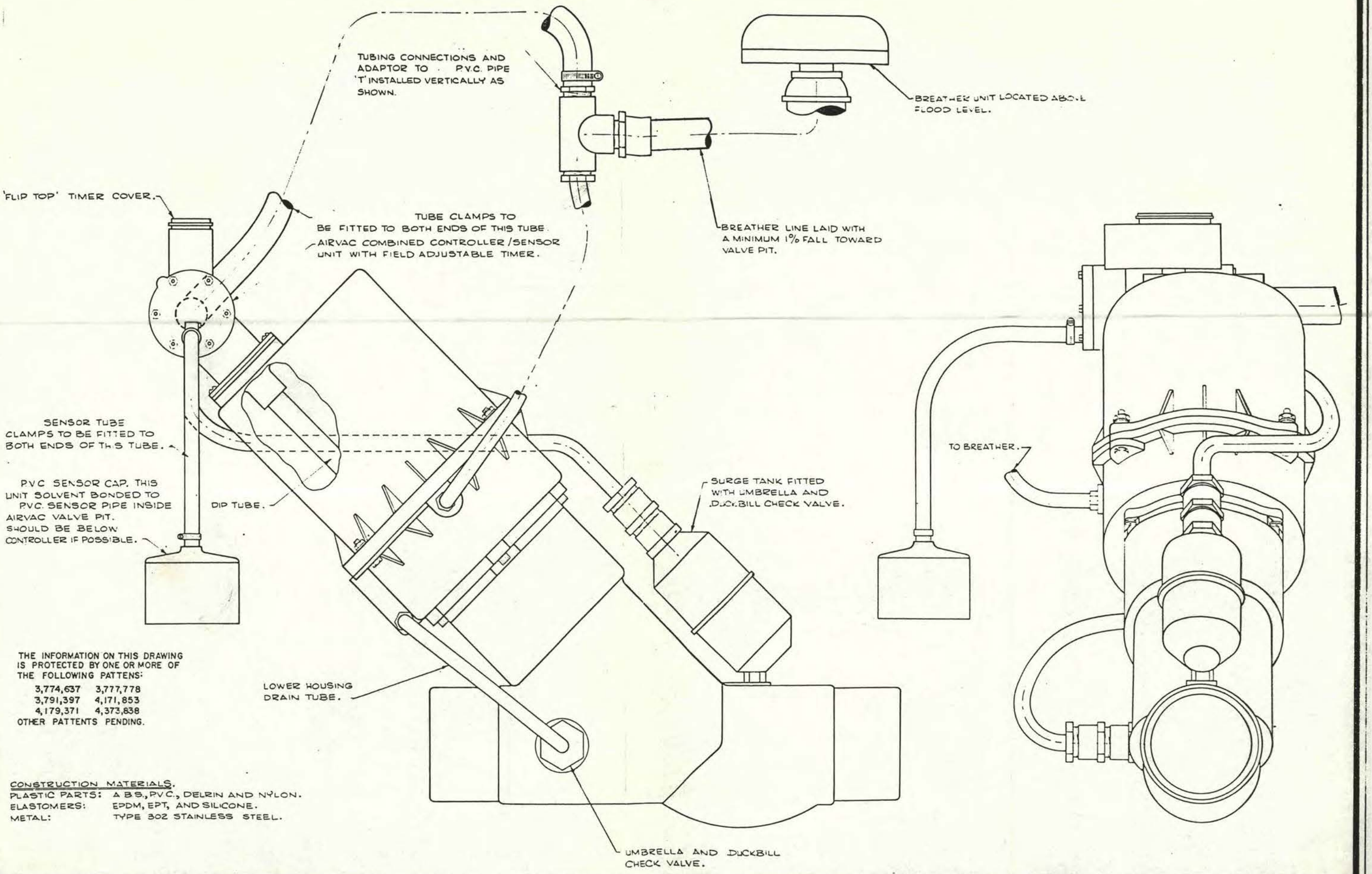
The principle components of the AIRVAC valves are the valve body, controller/sensor unit and surge tank. The valve is shown on Figure 2–1 75mm AIRVAC valve. The function of the various components are as follows:

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 125mm Hg. 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 the 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., PVC., DELRIN AND NYLON.
ELASTOMERS:	EPDM, EPT, AND SILICONE.
METAL:	TYPE 302 STAINLESS STEEL.

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Telephone: (02) 417 8133
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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. 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.

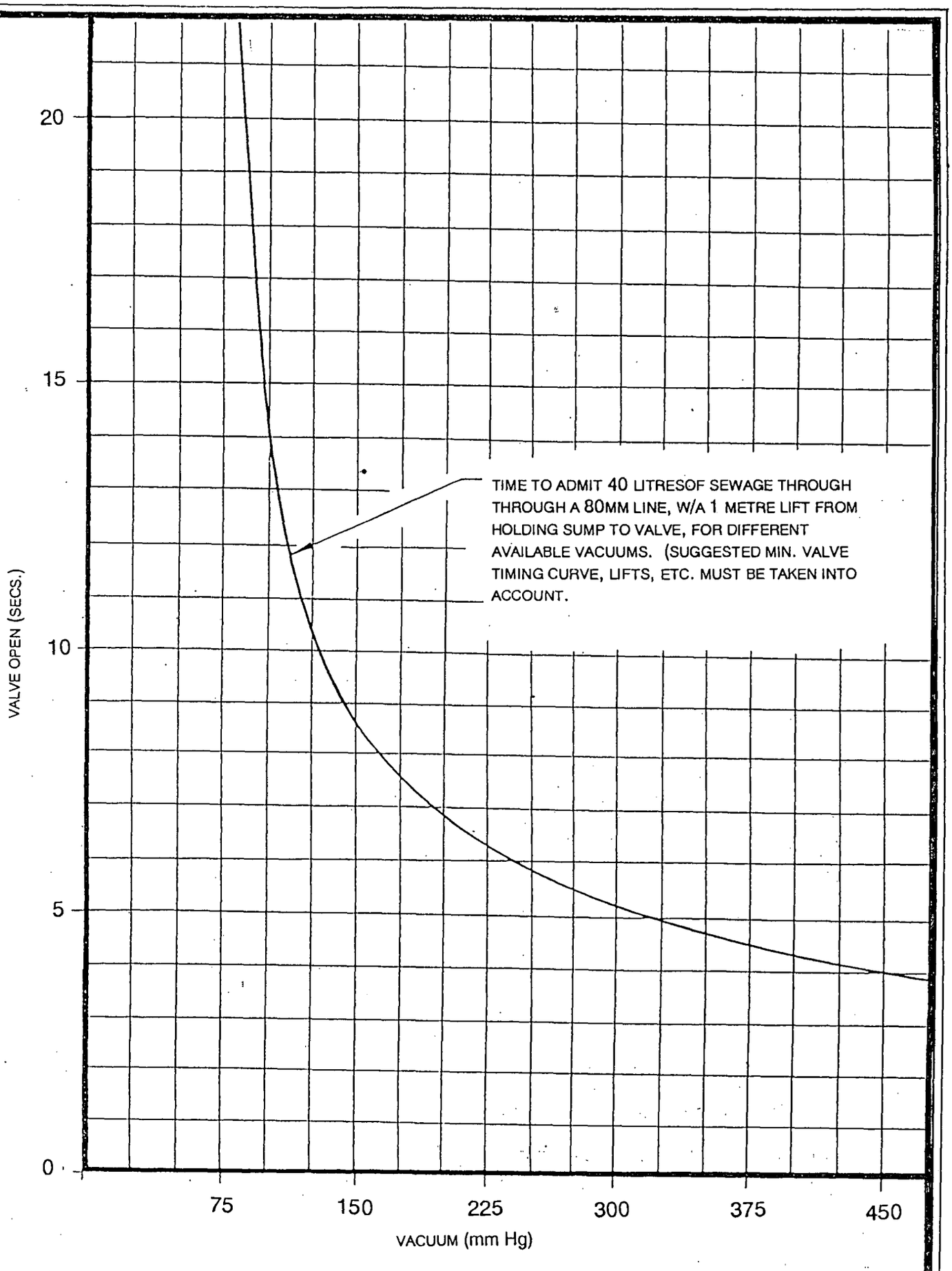
3.6 FIELD ADJUSTMENT OF THE AIRVAC VALVE

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.

3.5.2 Equipment Required

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



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75mm VALVE TIMING

FIGURE 2-2

3.5.3 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 125mm mercury. 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 the valve opens.

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.

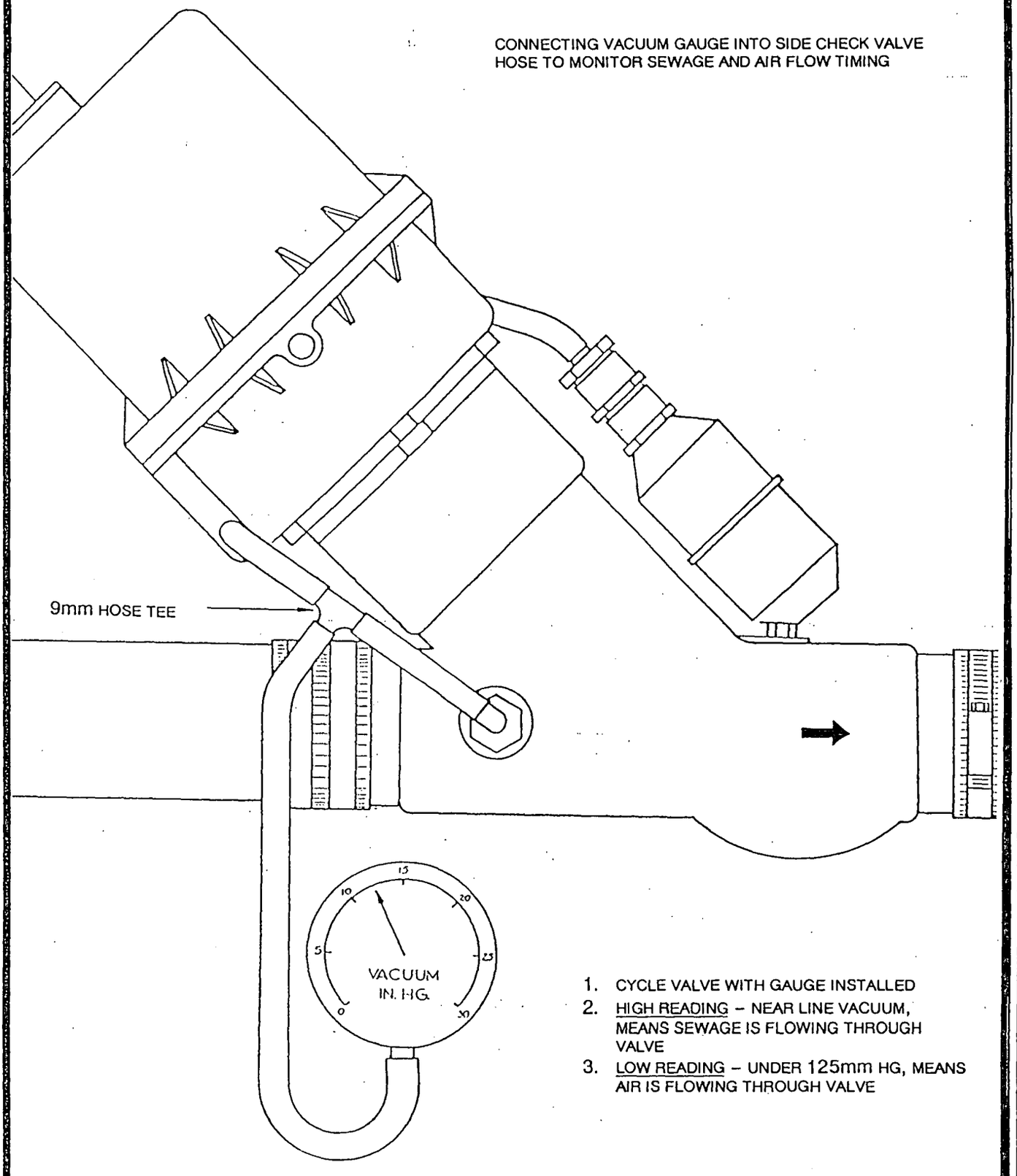
Remove vacuum gauge and re–connect hose to side check valve. Refit timer cover.

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.

3.5.4 Sensor Setting

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

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 125mm HG, MEANS AIR IS FLOWING THROUGH VALVE

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FIELD ADJUSTMENT

FIGURE 2-3

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, cross overs (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

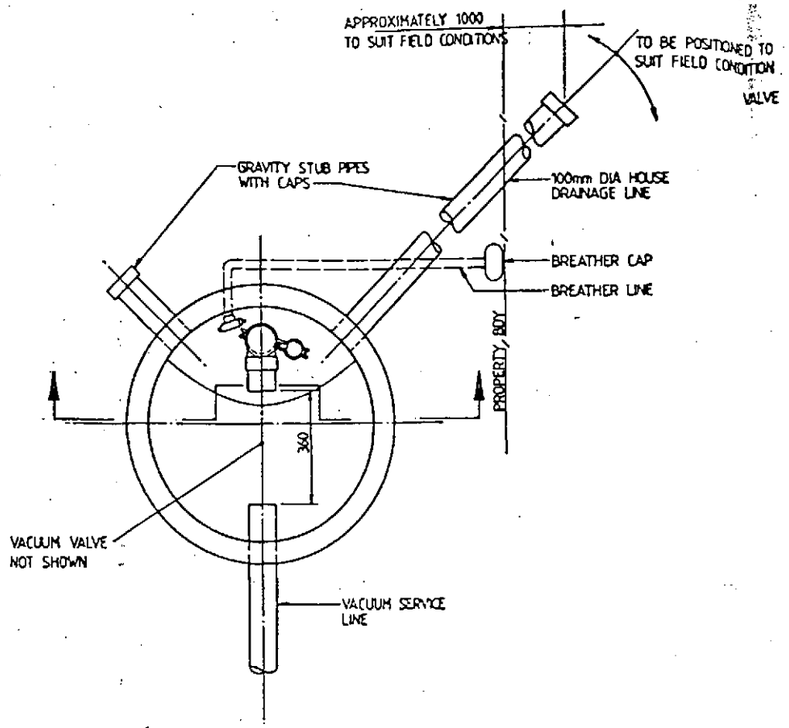
All seams in pit and pipe entrance holes must be tightly sealed to prevent ingress of groundwater.

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

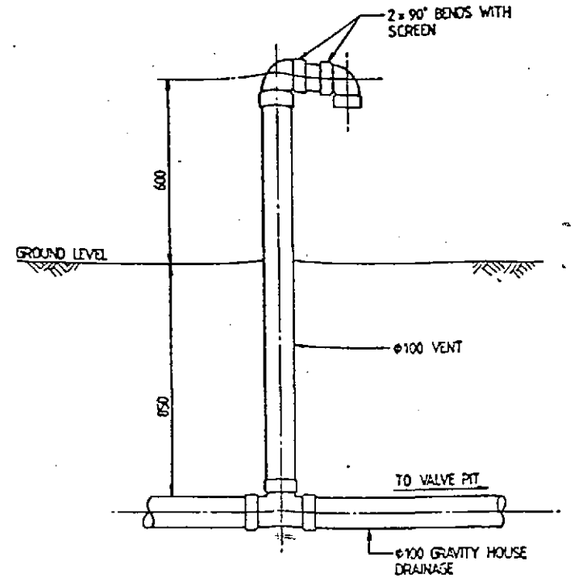
The 80mm suction elbow should be placed touching the base of sump and firmly anchored with at least two brackets to the side of the pit.

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

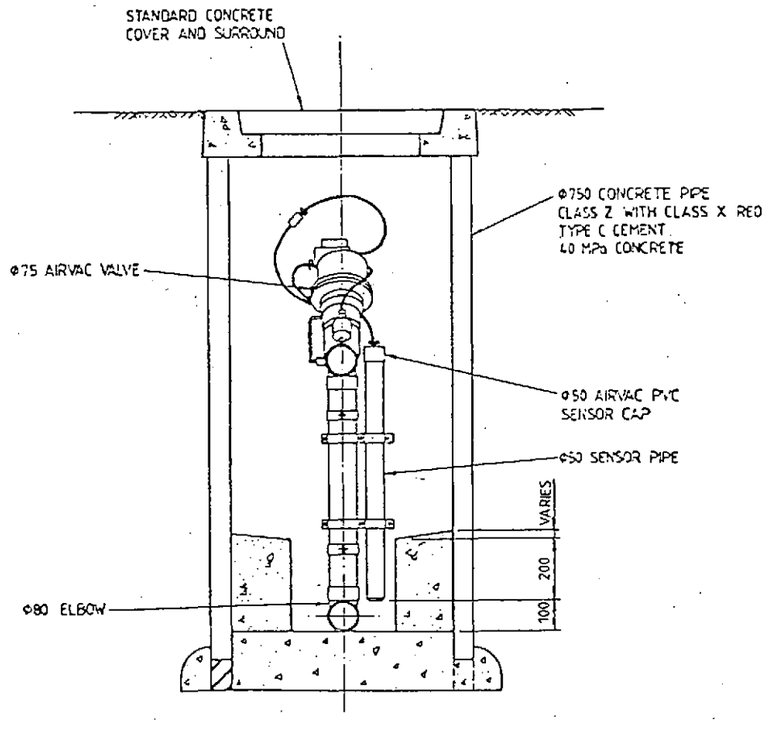
Assemble 50mm sensor line using a section of 50mm pipe, chamfer both ends of pipe, installed 50mm AIRVAC sensor cap. See Figure 2–7. Sensor line must be leak tested.

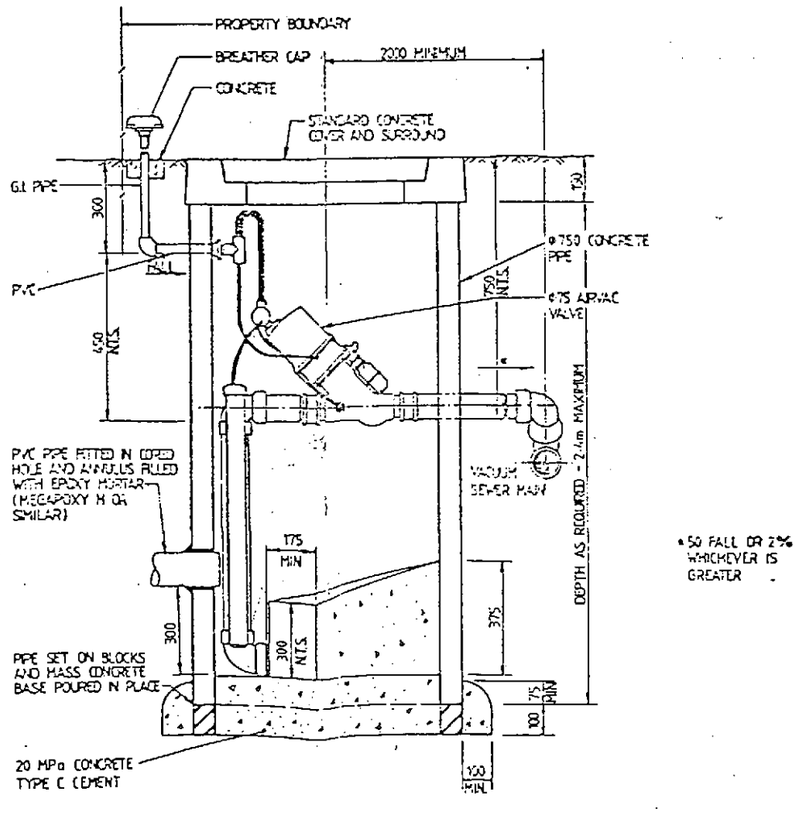


PLAN



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

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 0-1500mm W.G. magnehelic gauge. Test at 1000mm W.G. 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.

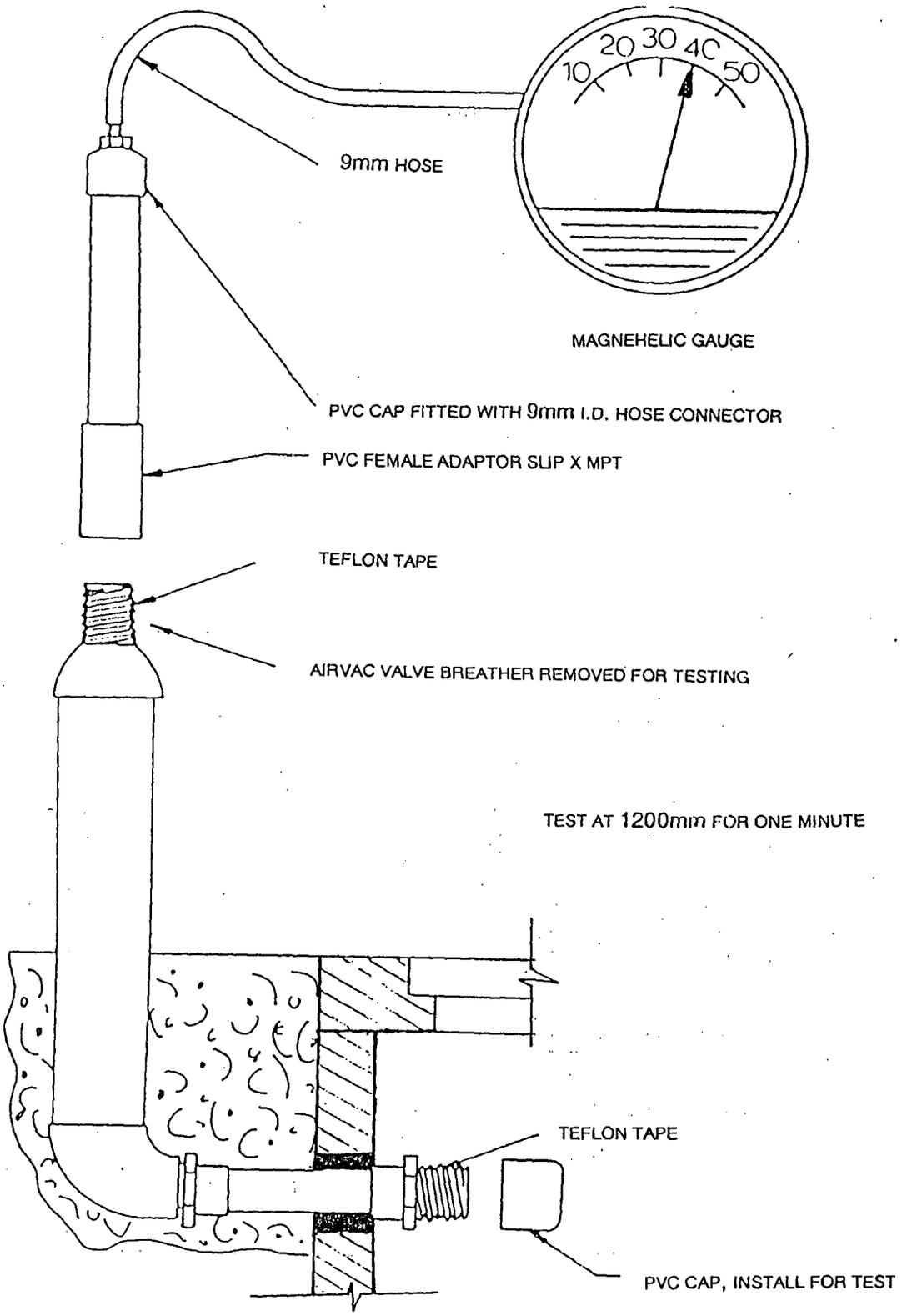
Install the AIRVAC breather unit as shown on the engineer's drawings. For the standard outside breather, it is important that the breather line be laid with a slight fall towards the AIRVAC valve and be leak tested. See Figure 2-8.

Fabricate a test pipe out of a short length of 20mm PVC pipe, one end fitted with a screwed male adapter the other 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 0-1200mm W.G. magnehelic gauge, release pinched tube and test at 1000mm W.G. for one minute. If pressure is constant, breather line is satisfactory. Should the gauge pressure drop more than 25mm W.G. 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.



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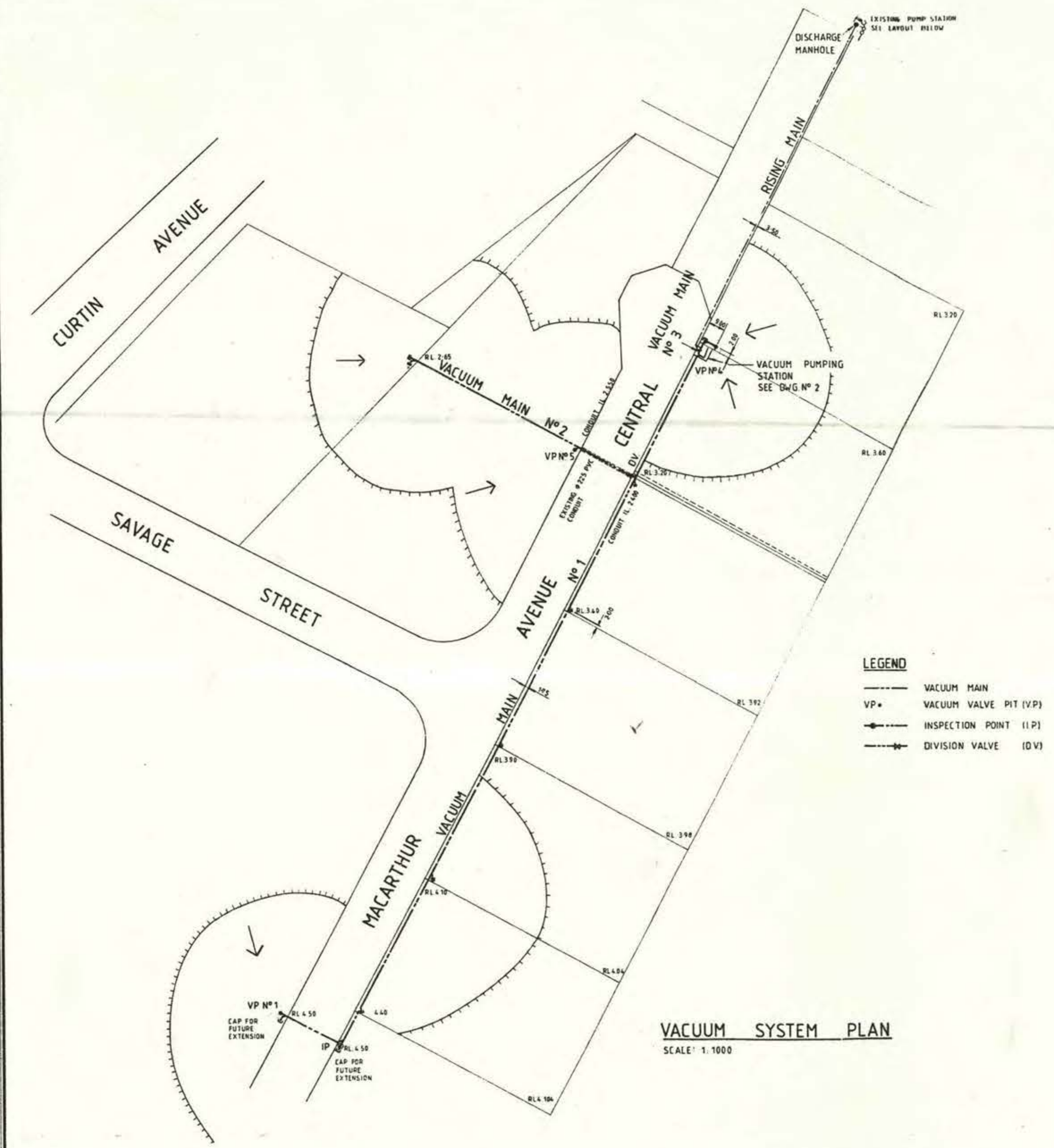
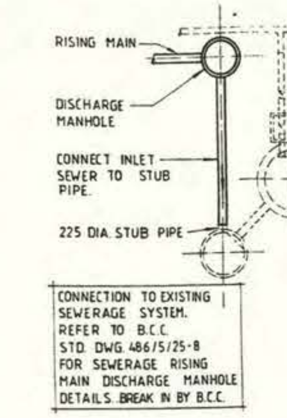
BREATHER LINE TESTING

FIGURE 2-8



VACUUM SYSTEM PLAN
SCALE 1:1000



EXISTING PUMPING STATION LAYOUT
SCALE 1:50

NAME OF ESTATE		PARKER ISLAND ROAD DEVELOPMENT
SUB. PLAN No.		(1)439/60/10-TR472
B.C.C. REG. BOARD APPROVAL DATE		
NO. OF ALLOTMENTS		6
AREA IN Ha.		4.8
LENGTH OF SEWERS	100mm DICL RISING MAIN	348.0m
	150mm V.C. PIPE	681.6m
RETICULATION No.		25/92

Mk	Details of Amendment	Approved
A	RISING MAIN CLEARANCE REVISED	

B1

AIRVAC - RSM PTY LIMITED
Vacuum Sewerage System

CULLEN GRUMMITT & ROE (QLD) PTY. LTD.

Client: PORT OF BRISBANE AUTHORITY
Project: PARKER ISLAND VACUUM SEWERAGE SYSTEM
Title: LOCALITY PLAN
Drawing No.: 9221-1
Amendment: A
Designed: RJE | Drawn: RJE

FIGURE 1-1

3.7.3 AIRVAC Vacuum Valve

Remove cover.

Increase the cut out in the 80mm dia. 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 band slides inside band. Using a "T" handle torque wrench, torque both No-Hub clamps.

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 100–150mm W.G. and is not adjustable. It should be checked however to ensure proper operation.

3.7.4 Cross overs

A cross–over is defined as the connection from the AIRVAC valve to the vacuum sewer main. It is important that cross overs are installed with the wye connection at the main in the vertical position. The 80mm dia. PVC 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 centistoke 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 $^1/_2$ 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 and AVB-11).

For average flow valves greater than 1 l/sec 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.

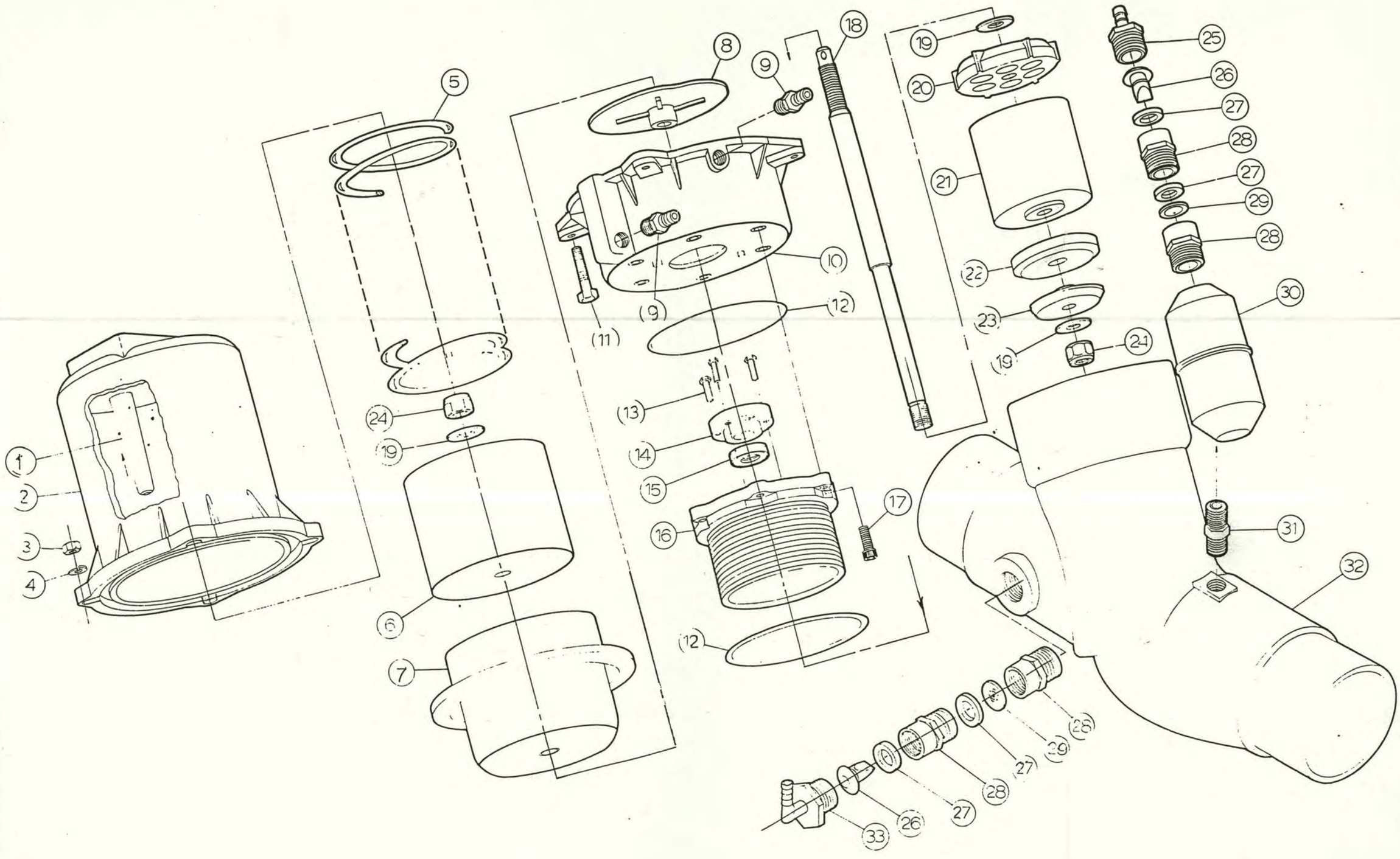
CAUTION: OBSERVE THE CORRECT SAFETY PRECAUTIONS WHEN USING MURIATIC ACID.

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.



	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**

A96/48097.

413/70-JN387.

Level.

BRISBANE CITY COUNCIL

Message

Date / / Time : a.m. p.m.

For

Caller

Of

Phone no. Urgent

Phoned ☐ Returned your call ☐

Please phone back ☐ Called to see you ☐

Will phone again ☐ Wants to see you ☐

Message .....

Taken by

CC1497 (10/97) Stock Code no. 562

Poinsettia Press

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).

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.

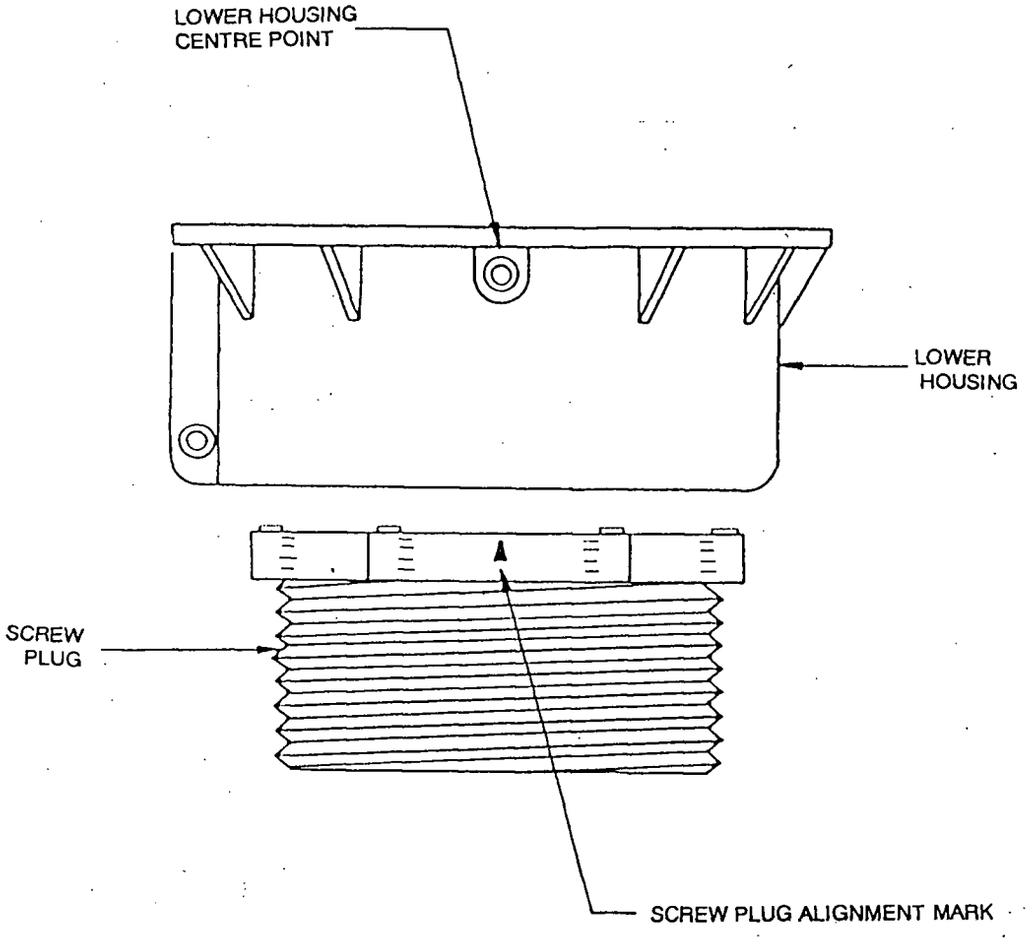
Replace the o-ring (Item 12) on the screw plug and tighten screw plug into clean wye body. Dow Corning #111 grease may be applied to o-ring and threads to ease assembly.

Turn the piston cup such that the "X" in the cup is diagonally at 45^{o} 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.



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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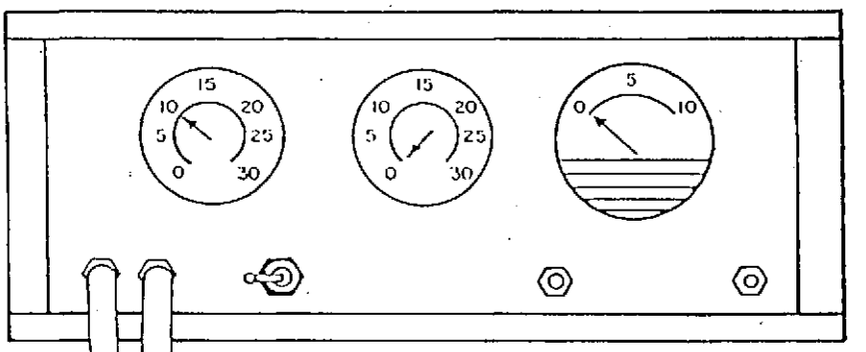
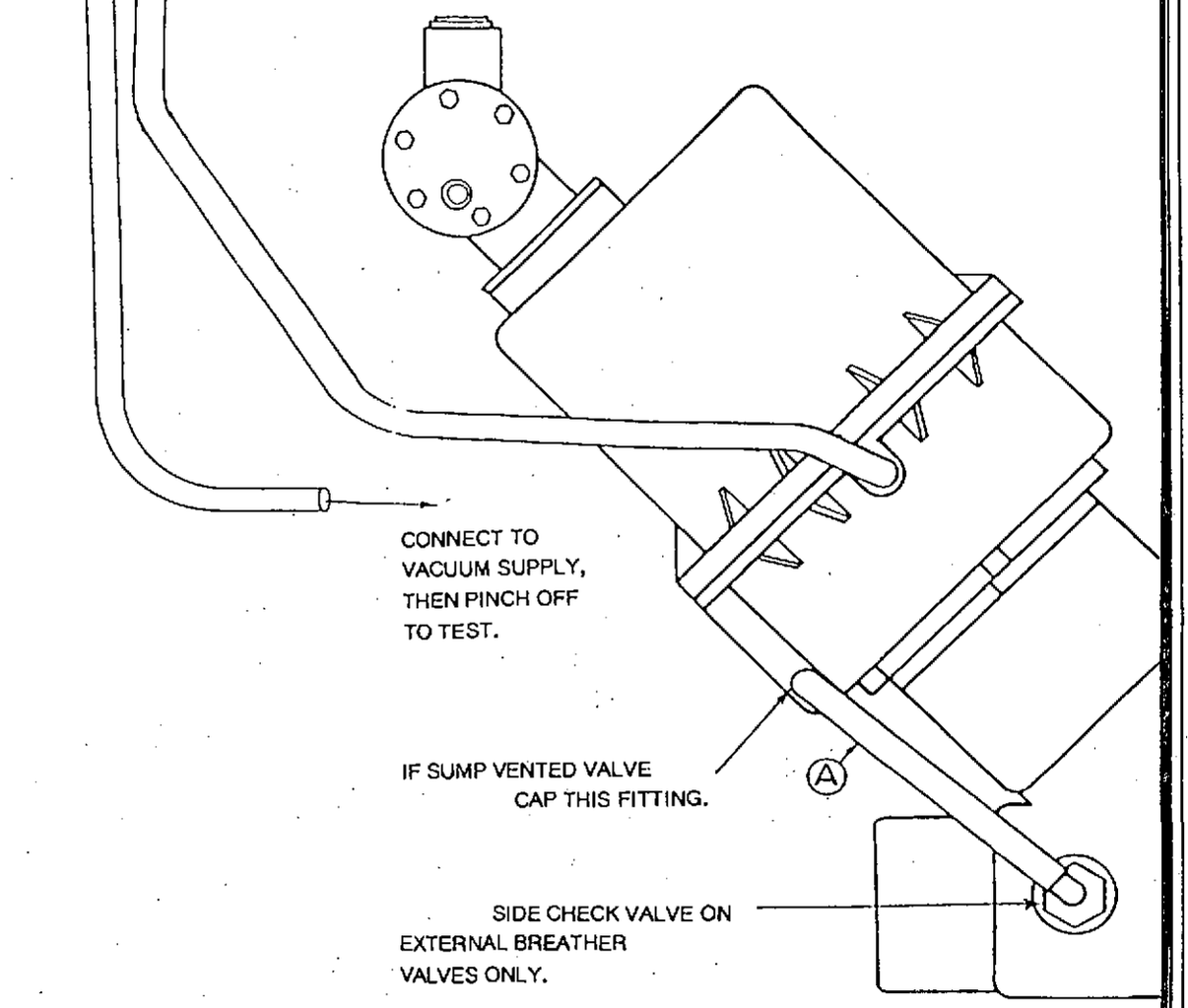
PROCEDURE FOR ATTACHING SCREW PLUG TO LOWER HOUSING

FIGURE 2-10

TESTBOX SET TO VALVE TESTING





ALLOW VACUUM TO RISE TO 250mm HG. AND PINCH OFF SUPPLY. MAXIMUM LEAKAGE 6mm HG. PER MINUTE. IF A LEAK IS PRESENT, PINCH TUBE AT A, TO ISOLATE CHECK VALVE I PRESENT.

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LOWER HOUSING TIGHTNESS TEST

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 250 mm Hg. Pinch off vacuum supply. The gauge must drop less than 6 mm Hg. 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.

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.

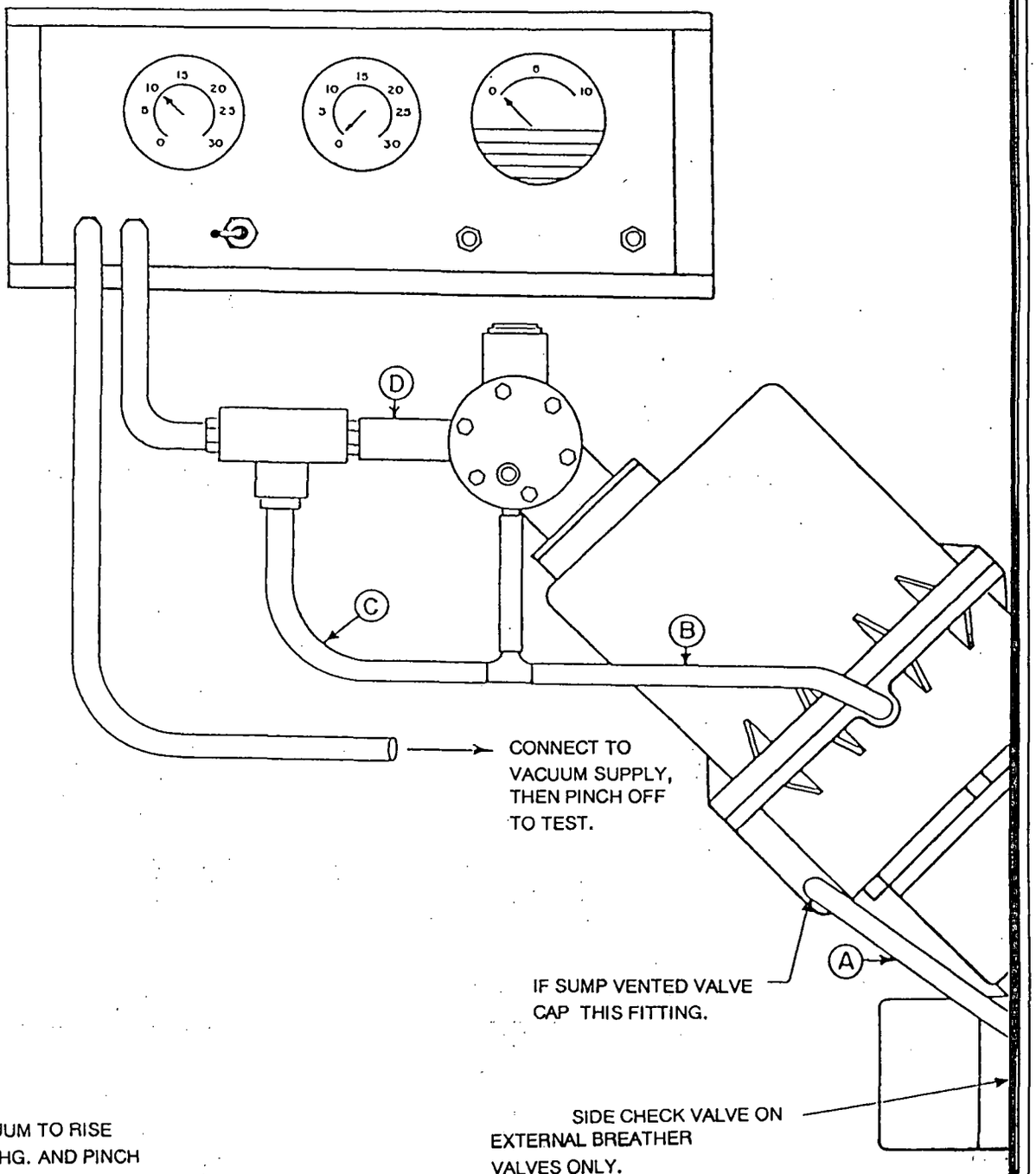
Fit a new or re-built controller to the valve using three hex screws. No silicone sealant is necessary when installing the controller.

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 250 mm Hg. then pinch off supply. Gauge should not drop over 6 mm Hg. 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.

TESTBOX SET TO VALVE TESTING



ALLOW VACUUM TO RISE TO 250mm HG. AND PINCH OFF SUPPLY. MAXIMUM LEAKAGE 6mm HG. 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

3.8.2 AIRVAC 50 mm Valve

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 $^1/_2$ 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).

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 autodialler. 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 0-150 mm W.G. magnehelic gauge. Blow or pump air into the 9 mm tube and cap. The line should be tested at 1200 mm W.G. for one minute. If the gauge pressure drops remake joint and retest.

Connect the 9 mm tube from 50 mm 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 50 mm sensor cap should be lower than the controller. When the 50 mm sensor cap is installed in an in-line installation the 9 mm tube must not have any traps and be a minimum of 600 mm 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 125 mm Hg. 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 100 – 150 mm W.G.

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

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

The sensor diaphragm has less than 100 mm W.G. 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 equalized 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 110mm water gauge 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 equalized 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.

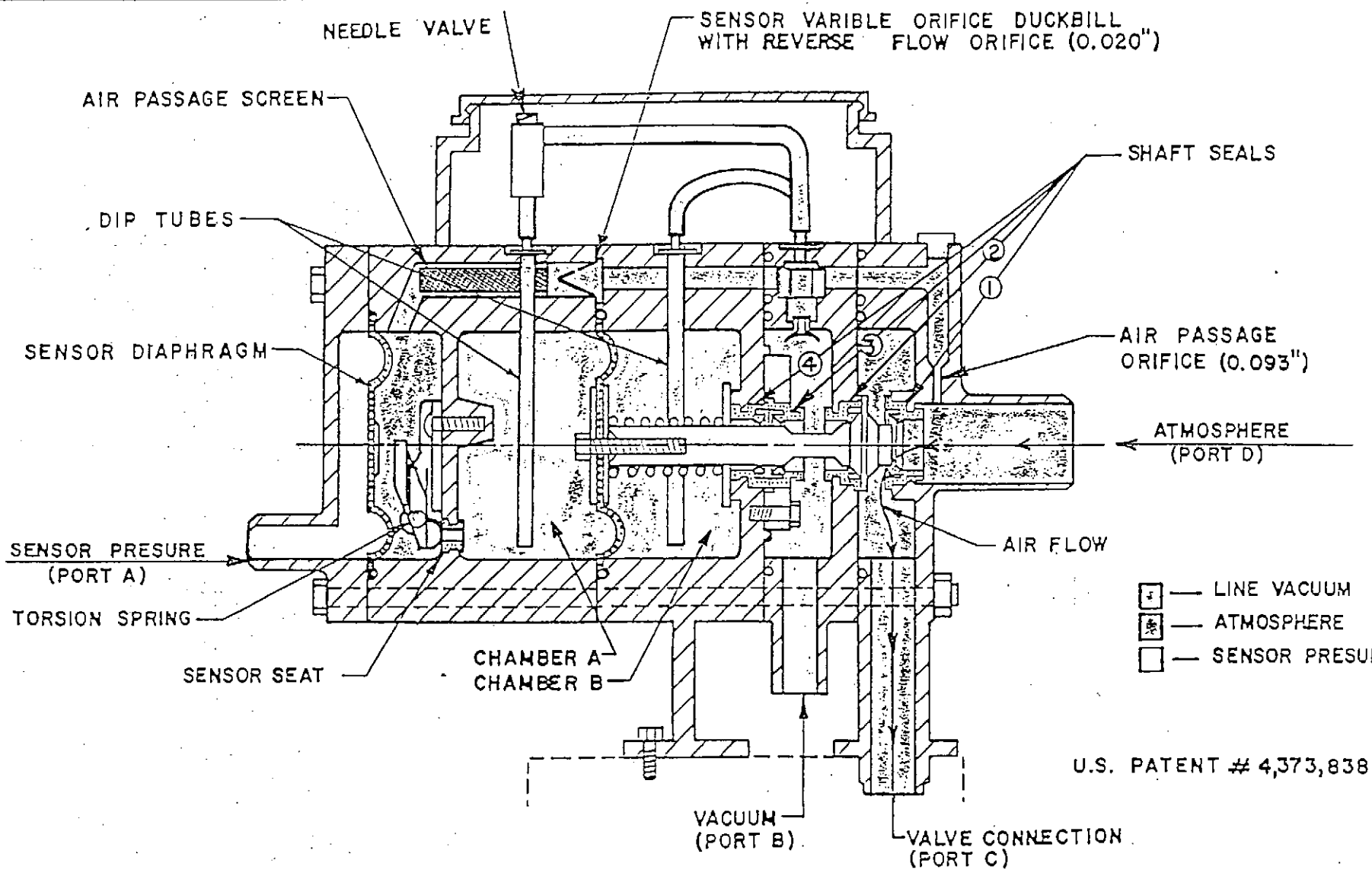
This allows vacuum (Port B) to pass through the vacuum passage in the shaft to Port C opening the AIRVAC valve.

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 equalizes to Chamber B vacuum through the needle valve and 0.4 mm orifice.

When the vacuum is equalized 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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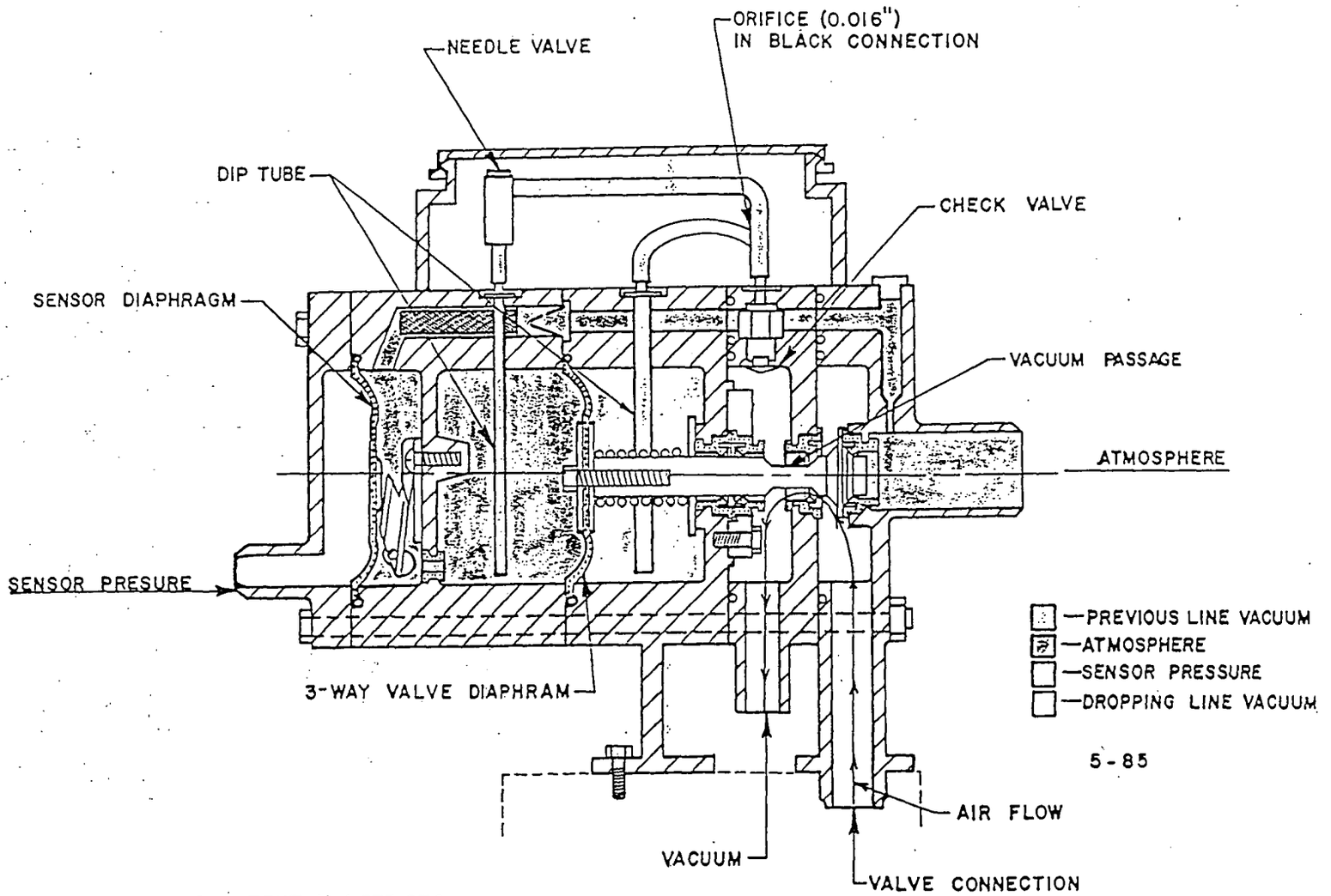
STANDBY POSITION CONTROLLER/SENSOR UNIT

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 $^1/_2$ 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. 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 125 mm Hg. Now with 125 mm Hg. 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.

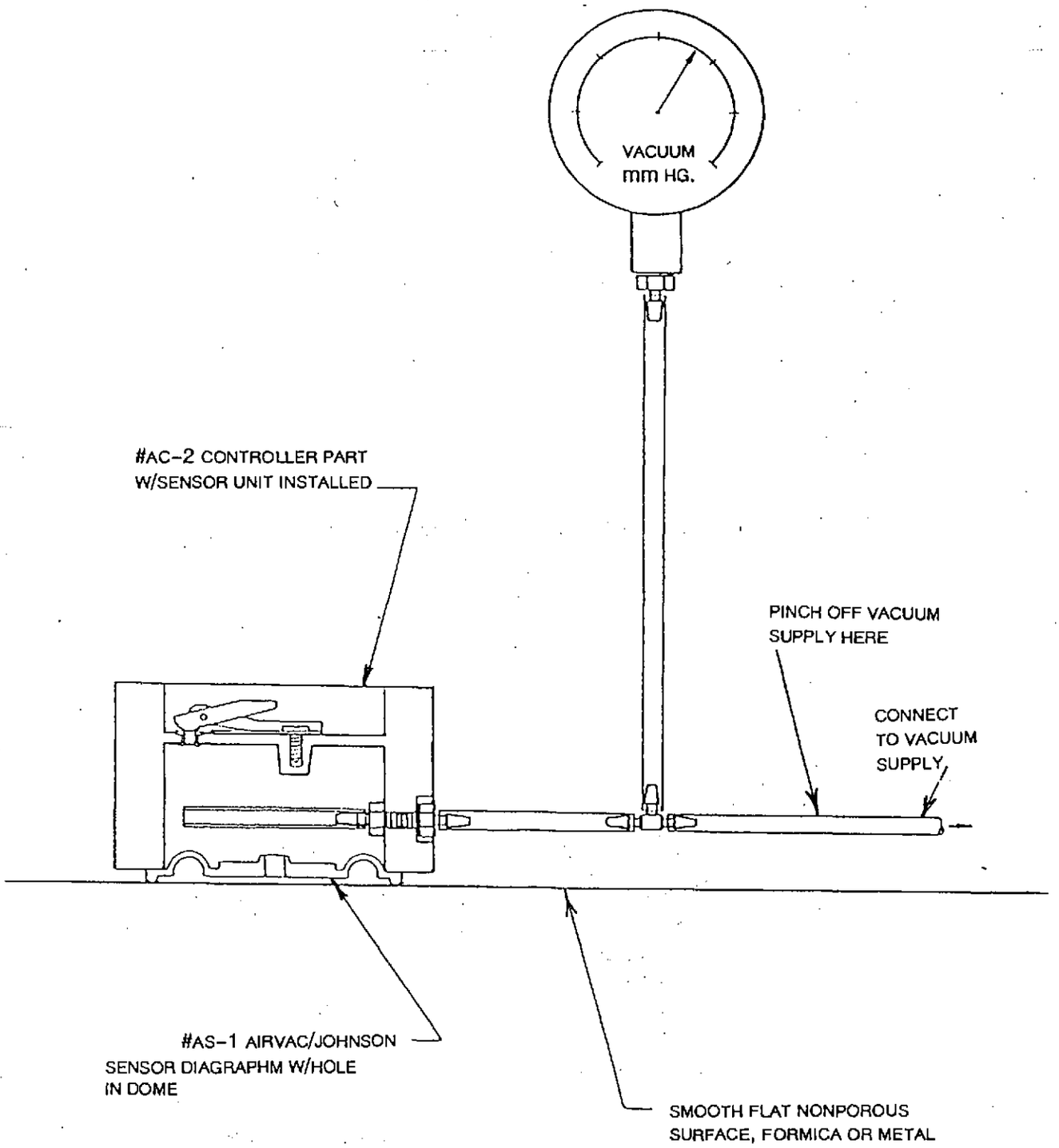
The sensor lever is not sealing on the rubber seat. In the very early models the sensor unit is adjustable on the sensor seat. This must be aligned and tested as above until it passes.

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).



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SENSOR SEAT LEAKAGE TEST DIAGRAM

FIGURE 2-17

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 $^1/_2$ turn to prevent kinking of tubing when re-installed.

3.11.3 Water Effects

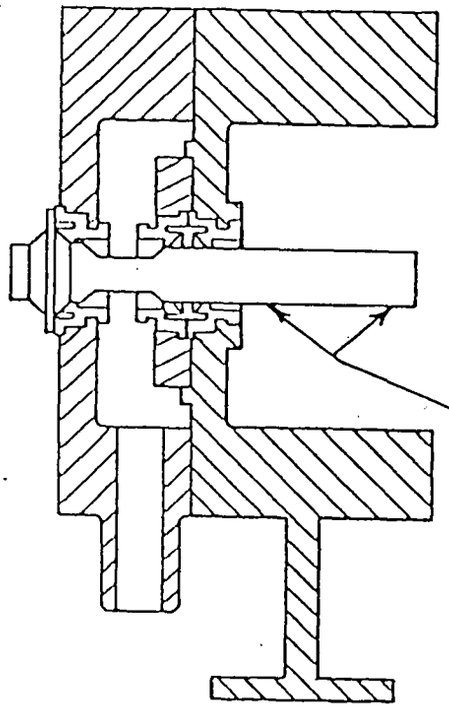
As water enters the breather line it first encounters the "T" where water will flow down the line to the lower housing where it will be sucked out when the valve cycles. Some liquid may run into the 16mm line to the controller (Figure 2-2).

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.

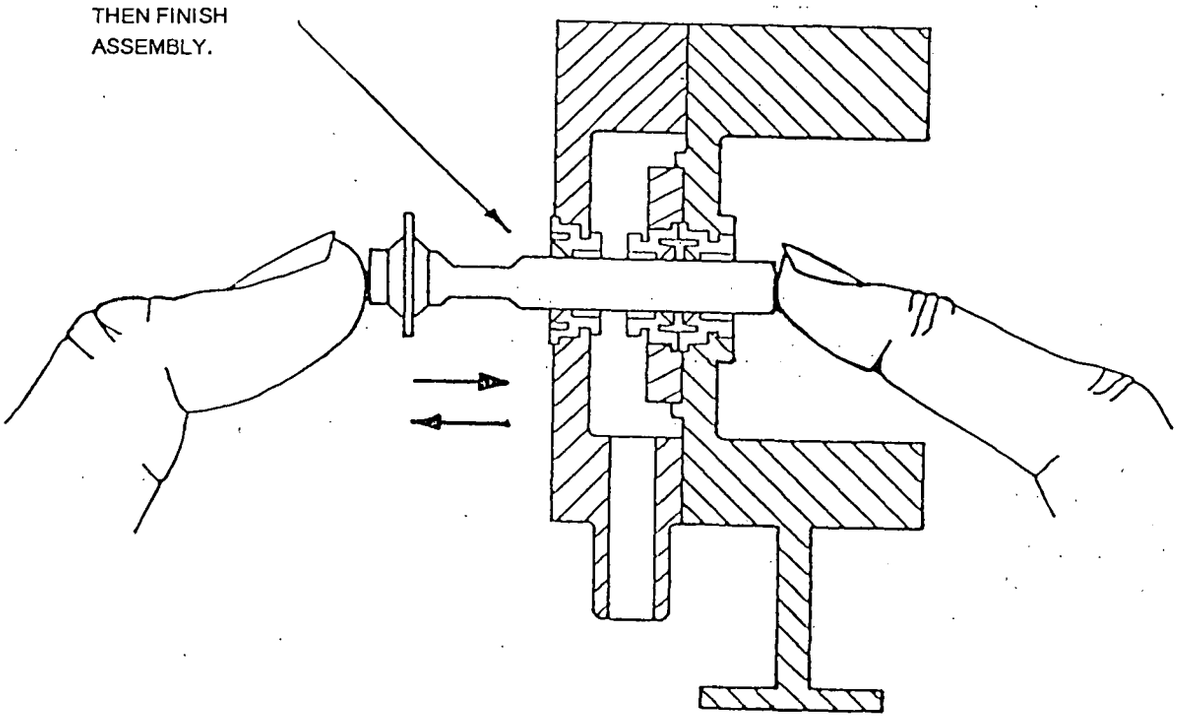
The liquid will be taken out by the dip tube in Chamber A through the needle valve. Liquid has a higher viscosity and therefore the controller will have a long cycle while removing the liquid. The liquid flows out of the needle valve through the tubing and out the check valve. Some liquid will return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



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

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 75 mm W.G. 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 molded 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.

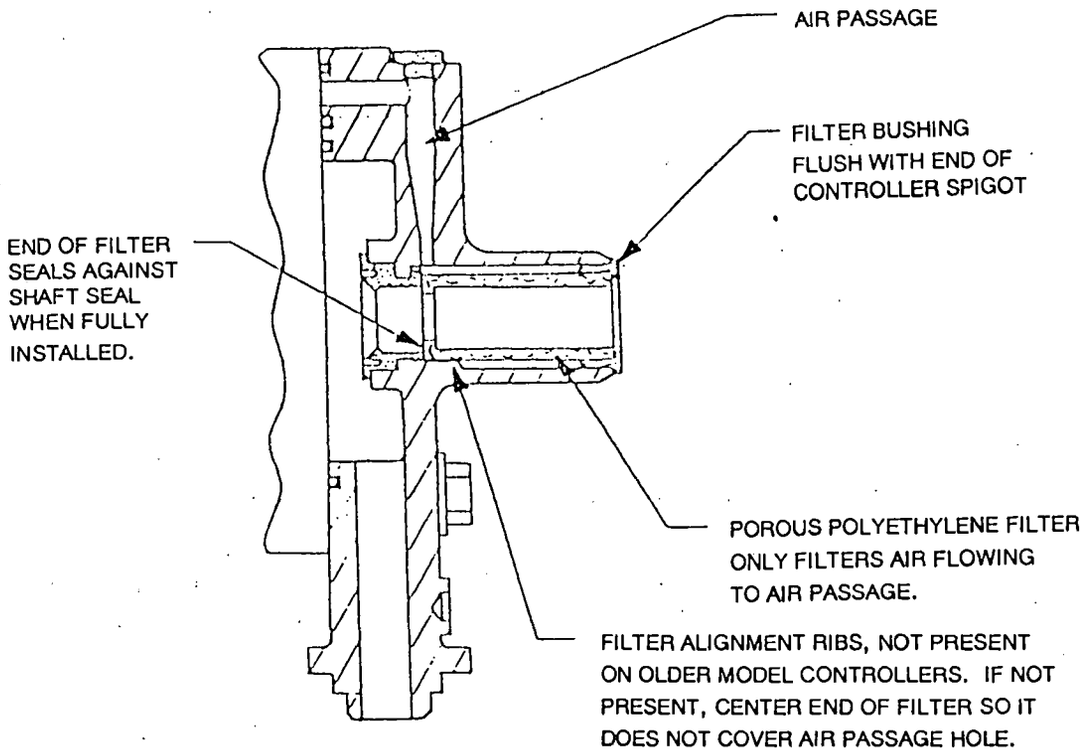
3.11.5.1 Component Testing

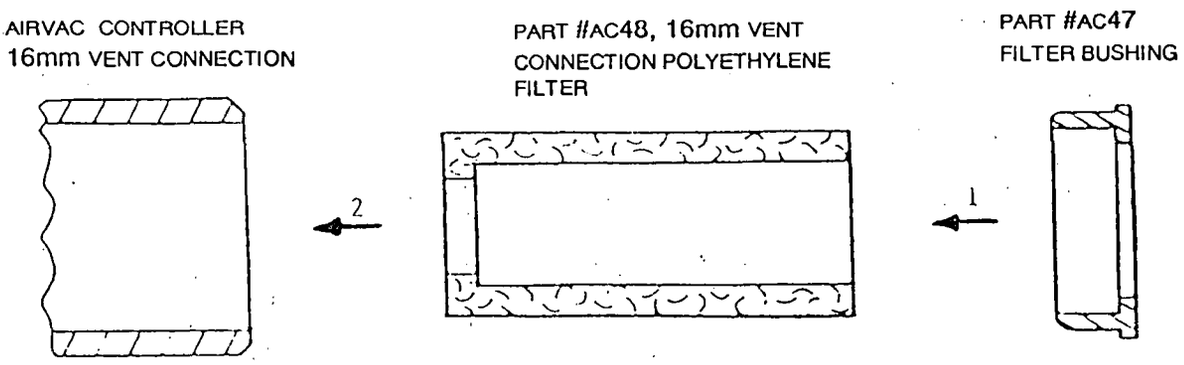
Remove the screws from the timer box to expose the tubing.

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

Connect vacuum to the controller

AIRVAC CONTROLLER 16mm VENT CONNECTION FILTER TO BE USED ONLY ON ABOVE GROUND BREATHER VALVES (NOT SUMP VENTED VALVES). COMES STANDARD WITH ALL 'D' MODEL AIRVAC VALVES AND CONTROLLERS WHERE 'D' MODEL VALVES ARE IN USE.





INSTALLATION: 1) PUSH FILTER BUSHING ONTO FILTER; 2) PUSH UNIT INTO CONTROLLER SPIGOT, TAP FILTER BUSHING FULLY INTO PLACE. CAUTION: REVERSING FILTER MAY CAUSE DOUBLE CYCLING OF VALVE.

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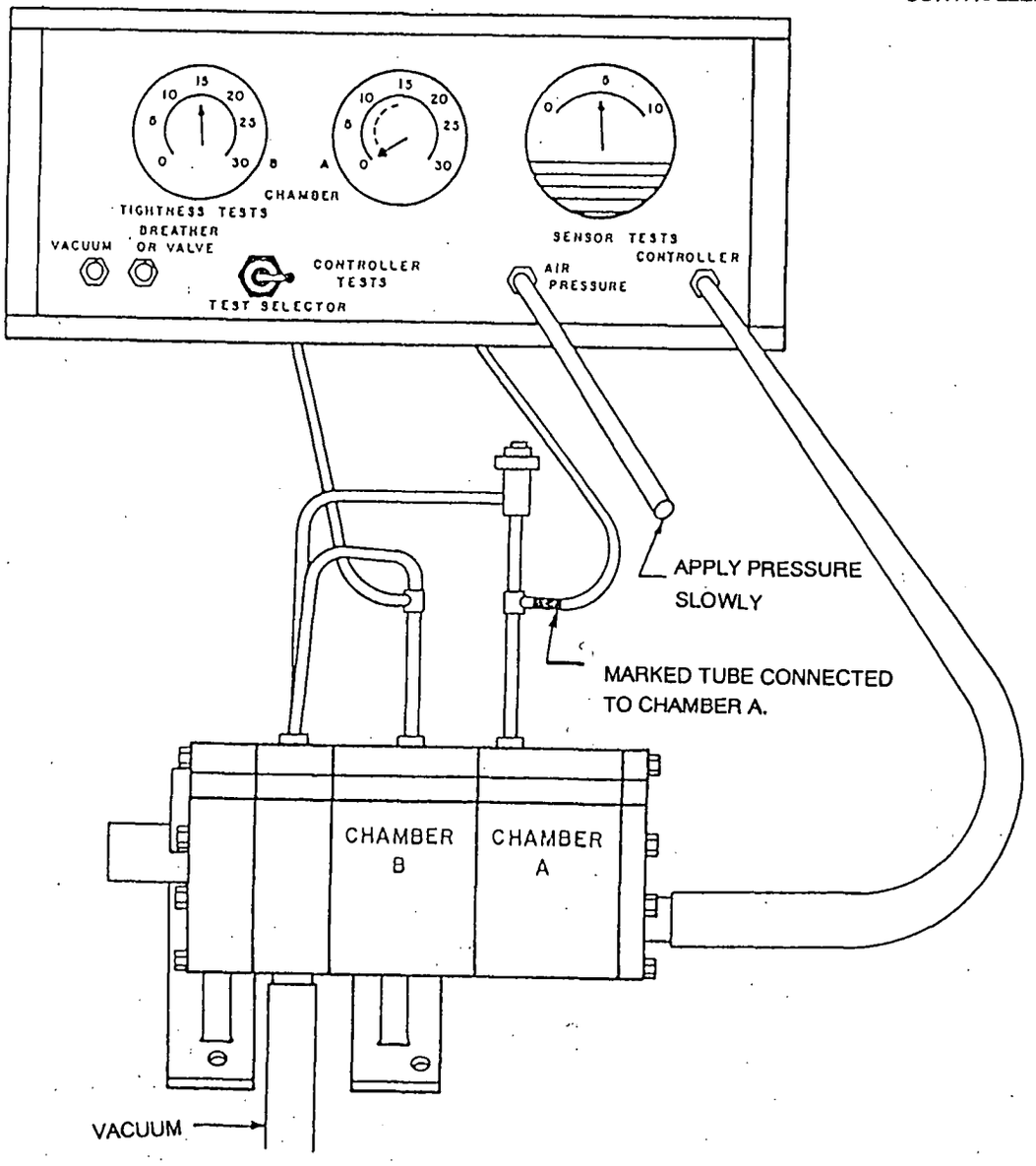
VENT CONVECTION FILTER

FIGURE 2-19

TESTBOX SET TO
CONTROLLER TESTS.



WATCH MAGNEHELIC GAUGE.
SENSOR SETTING MUST BE
BETWEEN 100mm AND 150mm W.G.

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SENSOR SETTING TEST

FIGURE 2-20

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 mm HG. 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 100 mm and 150 mm water gauge. If under 100 mm WG check sensor seat for leak (Test C). If over 150 mm WG change diaphragm or sensor lever unit.

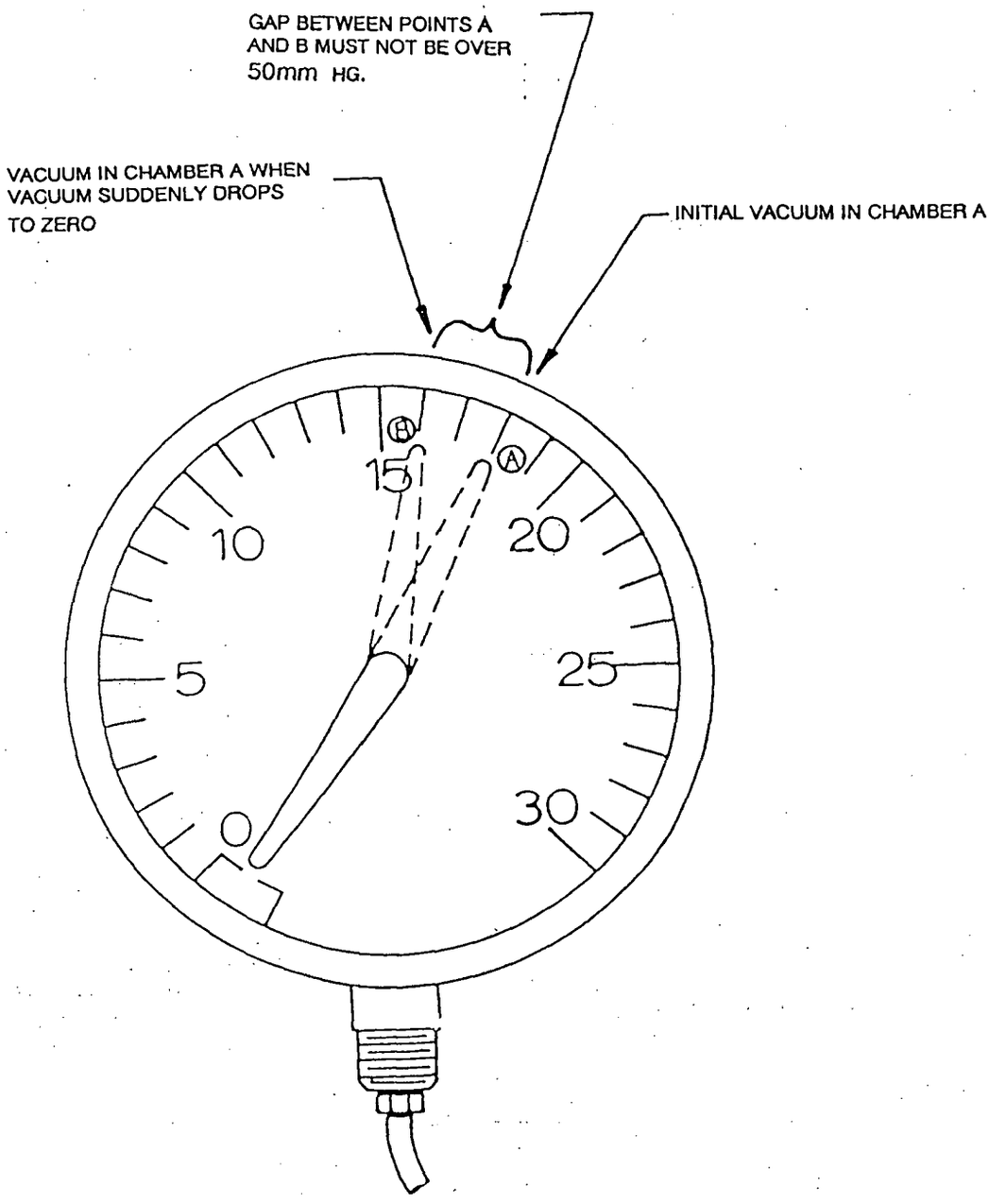
3.11.5.3 Sensor Variable Orifice Duckbill

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 mm Hg. This gap where Chamber A vacuum slowly begins to drop until it triggers should always be less than 75 mm Hg. (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 0mm Hg. and for the sensor to close (a vacuum may be maintained under the sensor diaphragm).

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 1 mm dia. 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.



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 OMM–HG.

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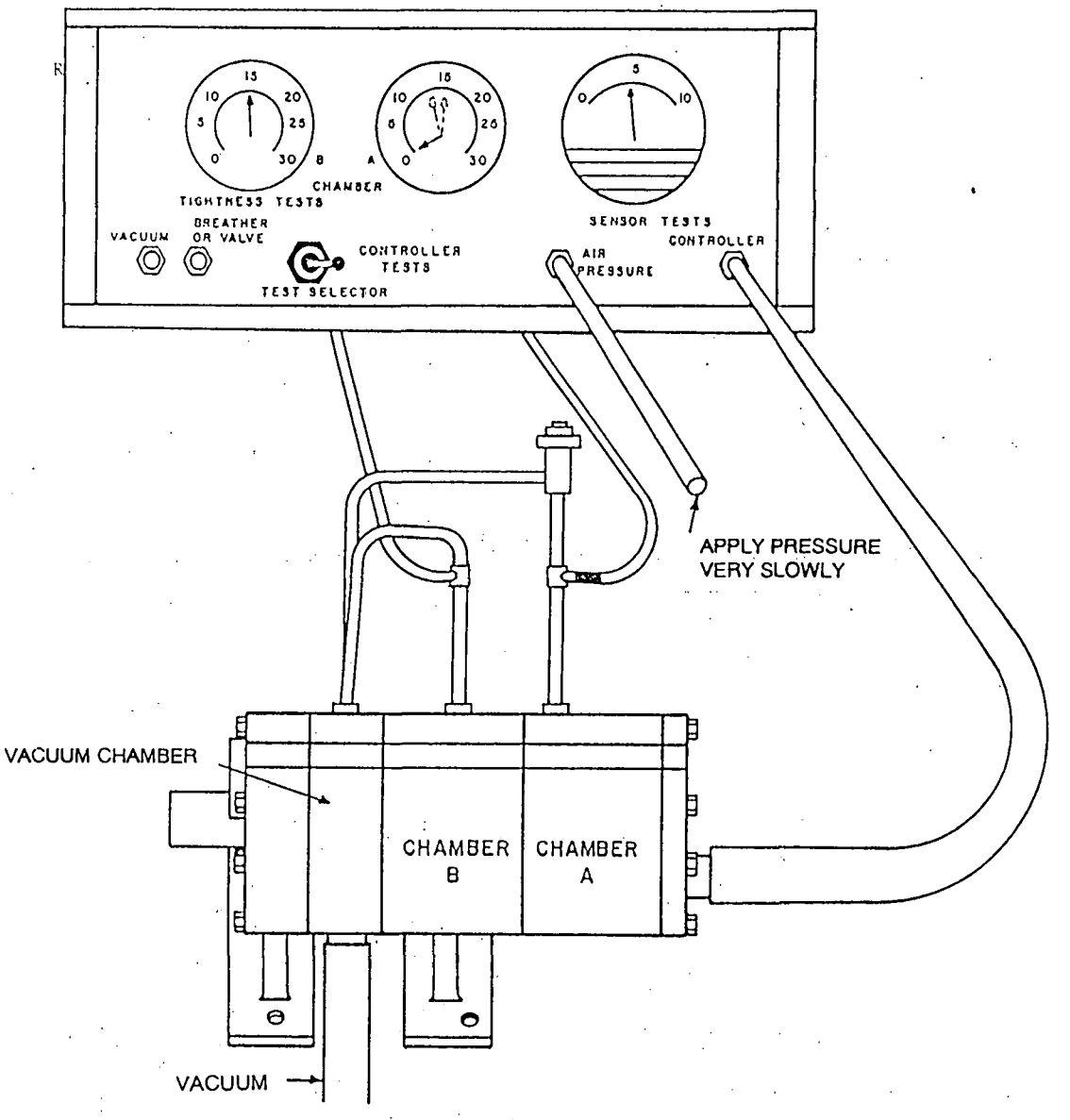
TESTING THE SENSOR VARIABLE ORIFICE DUCKBILL

FIGURE 2–21

TESTBOX SET TO CONTROLLER
TESTS



BLOW VERY SLOW AND WATCH CHAMBER A GAUGE. VACUUM SHOULD NOT DROP SLOWLY FOR OVER 50mm HG. BEFORE SUDDENLY DROPPING TO ZERO.

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VARIABLE ORIFICE

DUCKBILL TEST

FIGURE 2-22

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. 2.5 mm Hg. 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 mm Hg. and not rise (approximately 12 mm Hg. 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 250 mm Hg. vacuum then pinch hose. Vacuum should not increase over 25 mm Hg. 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.

The check valve and fourth seal each should leak less than 25 mm Hg. in 10 seconds. If the leak continues when pinching off both 1.5 mm 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 6 mm Hg. 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

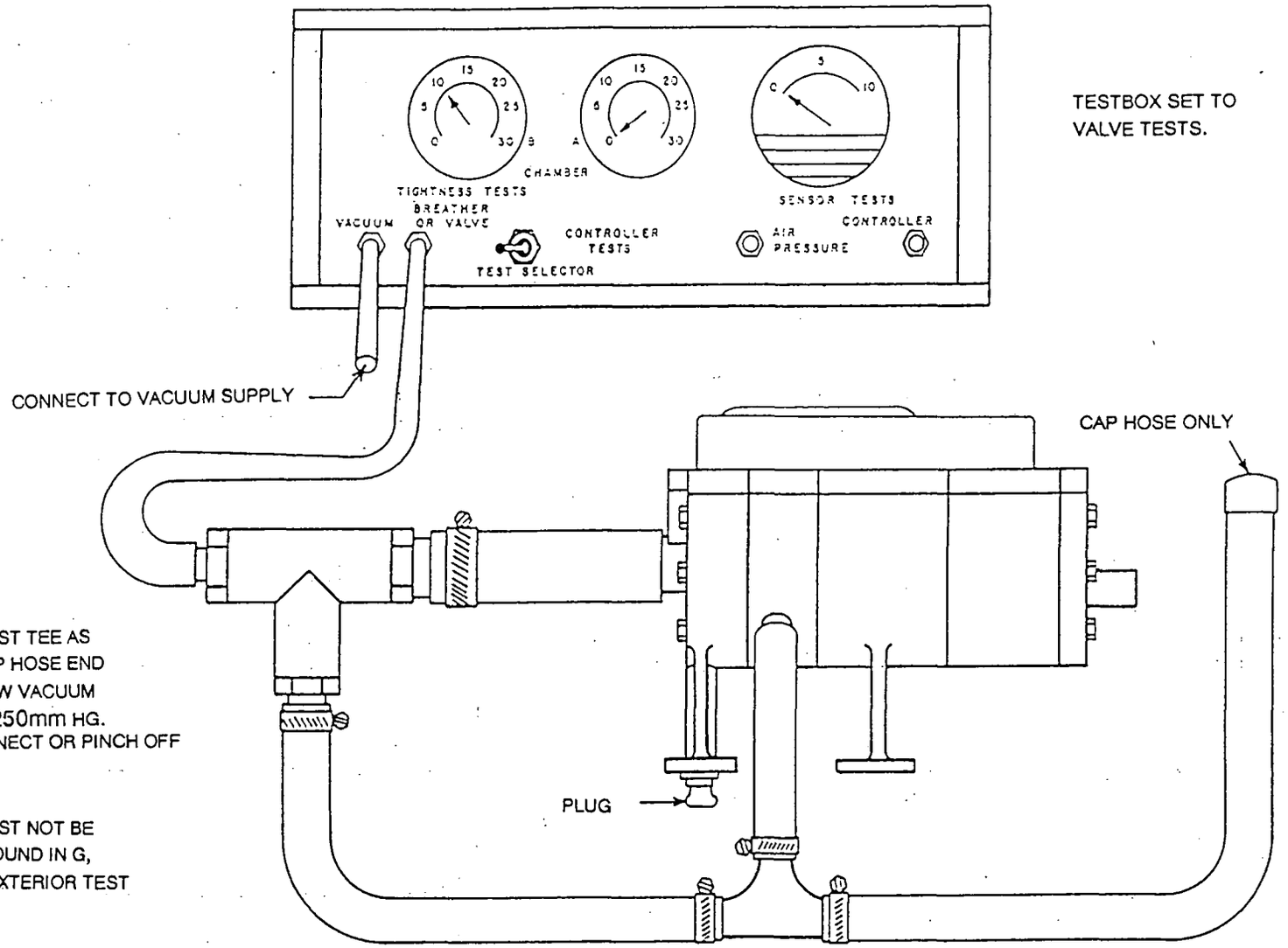
Close the needle valve and trigger the controller (cover the valve connection). Cover the atmosphere port. You are now testing the first shaft seal. If vacuum builds or the sensor diaphragm moves the seal is leaking.

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 100 mm and 150 mm W.G. Apply pressure very slowly.



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SENSOR DIAPHRAGM

FIGURE 2-31

3.12.2 Sensor Variable Orifice Duckbill

Cycle controller with extremely slow steady pressure rise. Vacuum in Chamber A should not drop over 50 mm Hg. Before controller triggers and Chamber A vacuum drops to zero.

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 250 mm Hg. vacuum, then pinch hose. Vacuum in Chamber B should not rise over 25 mm Hg. 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 25 mm Hg. 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 6 mm Hg. 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 No. 2 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 accidently 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 125 mm Hg. vacuum is available by fitting a vacuum gauge to the surge tank. If 125 mm Hg. 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 50 mm 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

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 close

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

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. 50 mm dia line too close to bottom of tank. If sensor line is closer to the bottom of the tank than the 80 mm dia 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. 80 mm dia suction line blocked. Sewage not being removed from tank

4.3 Valve Cycles Frequently

a. length of 50 mm dia 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 125 mm Hg 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 pressurizing system malfunction
d. blocked equalizing 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, cross overs 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.

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

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 Numbers for 75 mm Valve for Above Ground Venting.

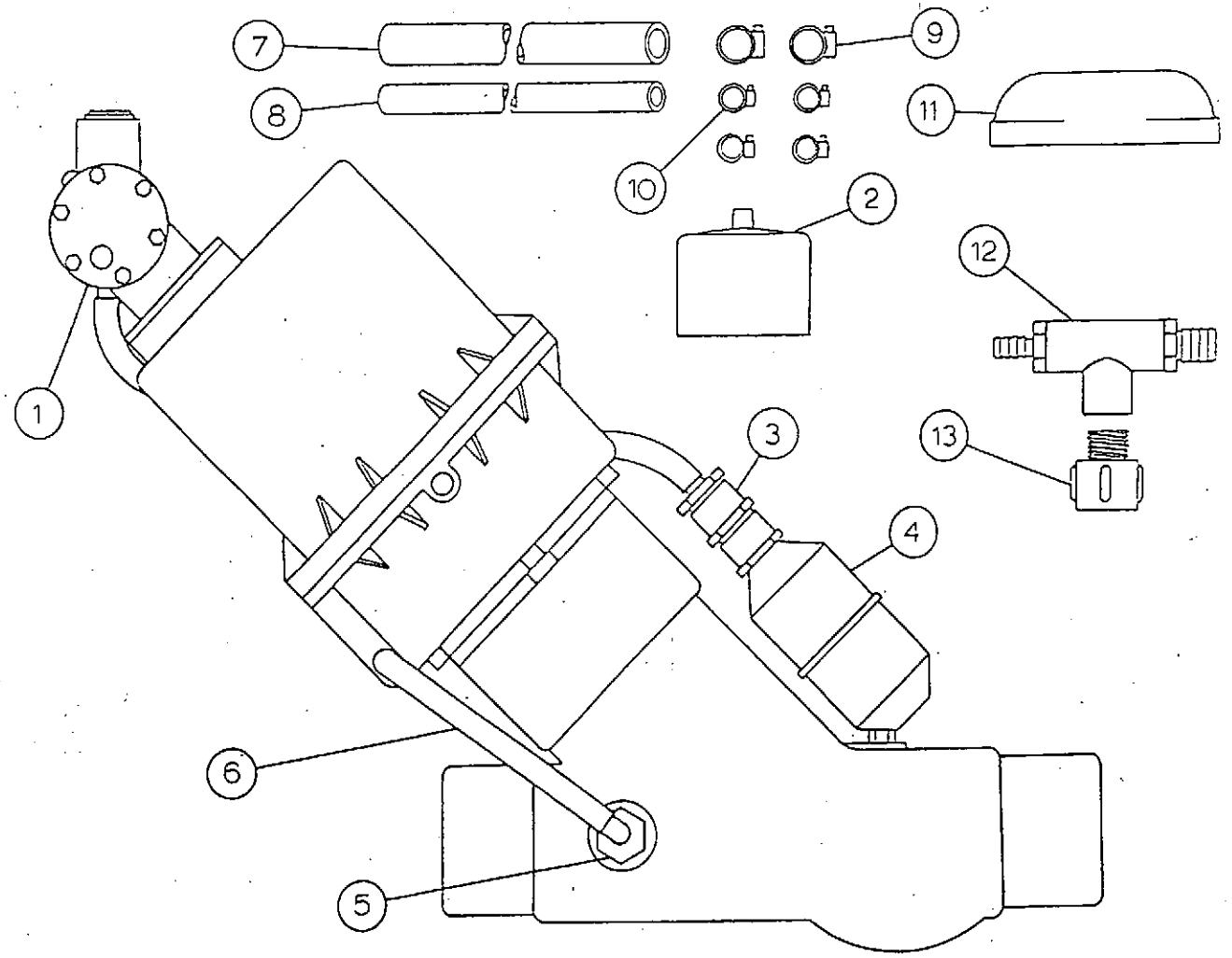
Figure 2–37 Parts List for 75 mm AIRVAC Valve

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



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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-0	1/4" Hex Nut	10	22	AVD-R-0B	Rubber Valve Seat	1
4	AVD-LW-0	1/4" Lockwasher	10	23	AVD3-7B	Retaining Washer	1
5	AVD-SP-0	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-0	Rolling Diaphragm	1	26	DD-83	Rubber duckbill check valve	2
8	AVD3-4	Piston Plate	1	27	RW-83	Rubber Washer	4
9	FTA-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-02	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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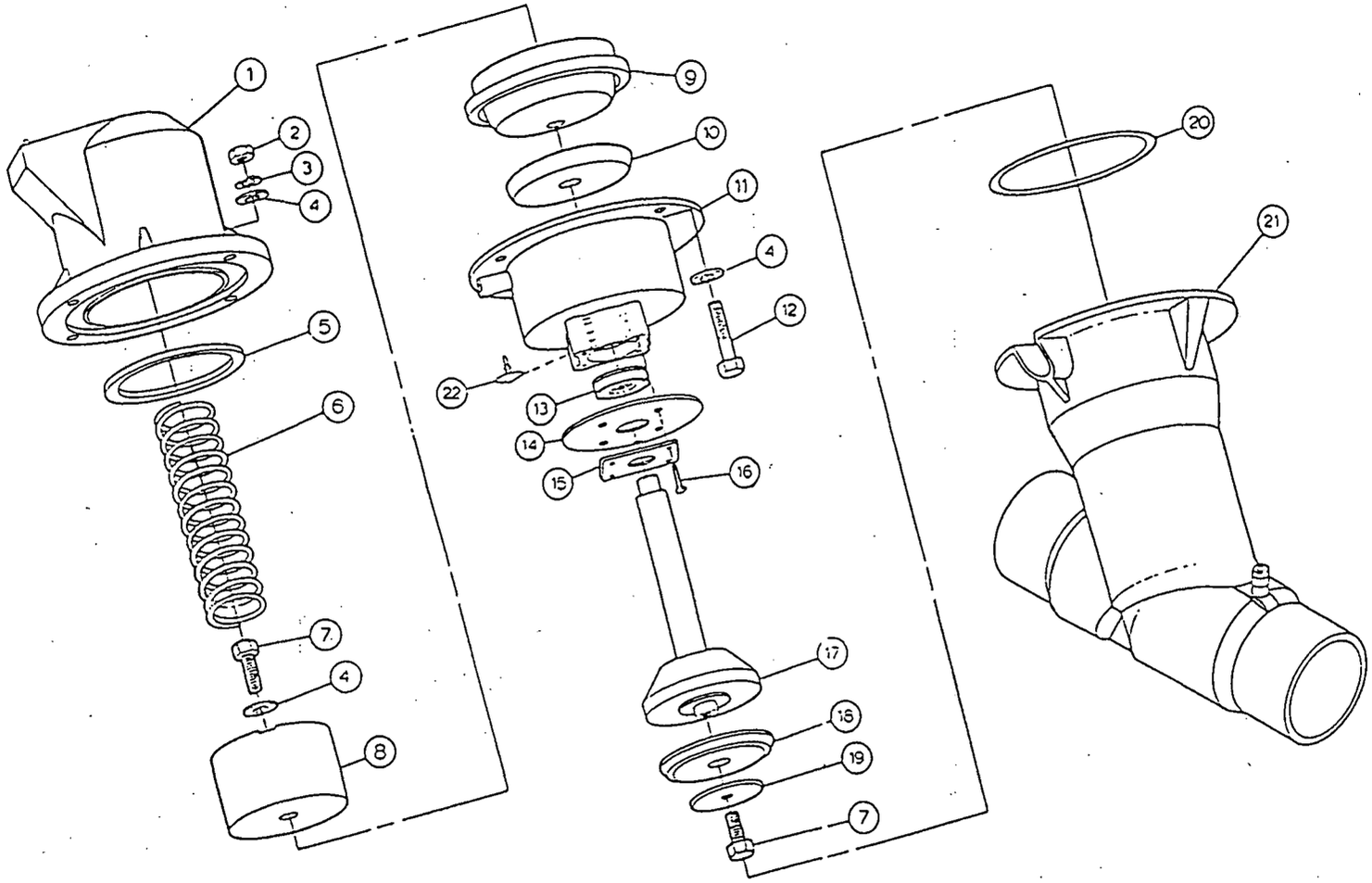
PARTS LIST FOR

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-S-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-S-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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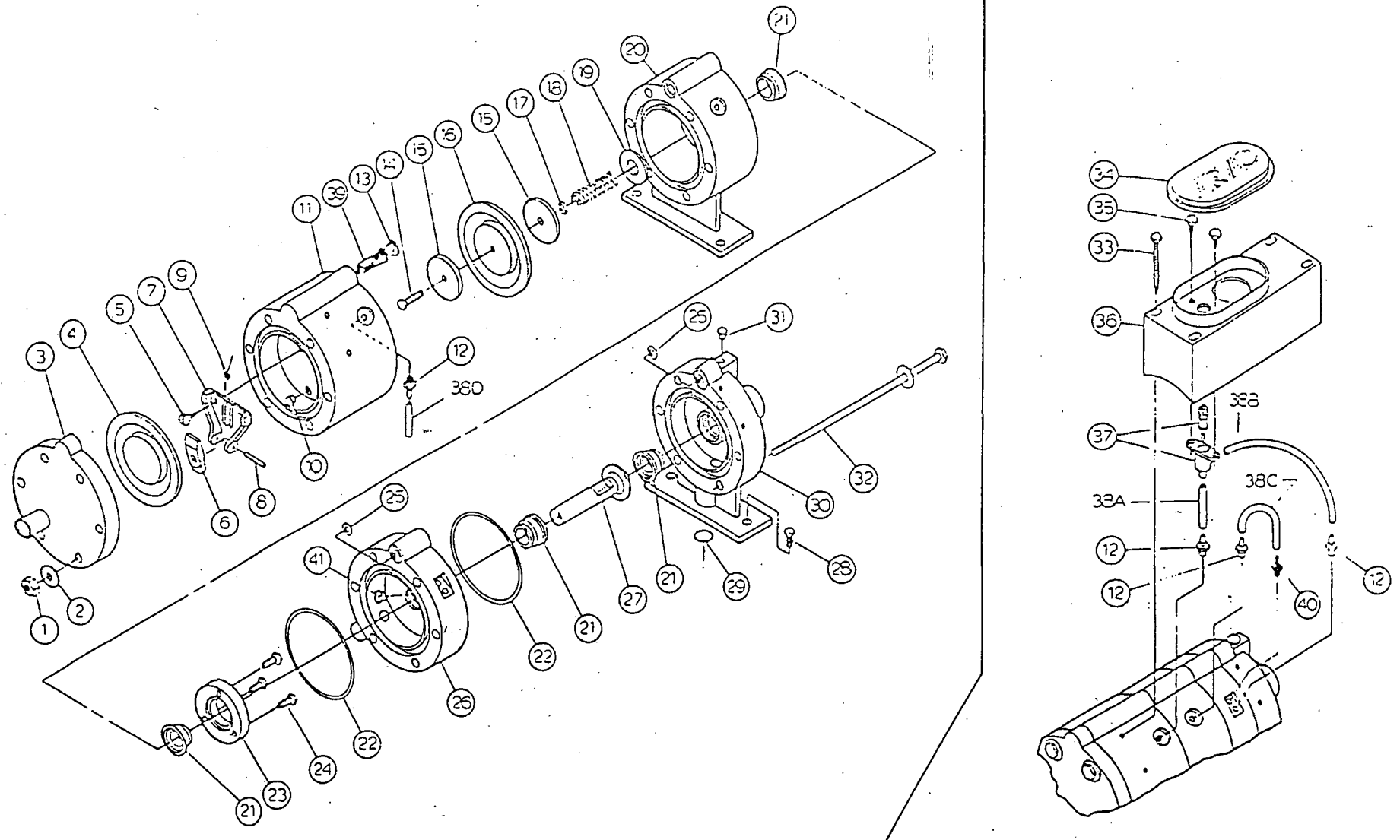
PARTS LIST FOR
50mm AIRVAC VALVE

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