Gilbarco
Making Things Better

Mk II LOW-LINE MULTI PRODUCT PUMPS and DISPENSERS

SERVICE MANUAL

DQ98004-003

Issue A

***Related Documents* –**   Users' Manual DQ98004-001

Installation Manual DQ98004-002

Troubleshooting Guide DQ98004-004

Parts Manual DQ98004-005

Publication Releases

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CHAPTER 1
COMMISSIONING PUMPS & DISPENSERS

INTRODUCTION

The information provided in this chapter relates to the procedures necessary for commissioning of Series II Multi Product pump and dispenser equipment.

The information is intended for trained Gilbarco service personnel only, and those within Gilbarco involved in the planning and installation of the equipment.

The following procedures are necessary to ensure correct equipment and site operation.

PERSONALISATION

After the equipment has been installed, it is necessary for each side of a pump or dispenser to be assigned a Fuelling Position number, and for each hose pair to be assigned a Grade Priority.

The Fuelling Position number relates to the pump/dispenser number programmed on the Console, and the Grade Priority relates to the grade position programmed on the Console.

The "Type" should be set first, followed by the "Fuelling Position" numbers, then the "Grade Priority" numbers. Finally, all totals should be reset.

NOTE: If the "Type" is selected as 1 or 2, then the "Grade Priority" setting function will be automatically suppressed.

ENTERING PERSONALISATION

❑ Switch on the mains power to the pump/dispenser.

❑ Ensure all pump/dispenser hoses are hung up correctly.

❑ Unlock and open the Manager Access panel on the pump/dispenser..

❑ Set the Manager Function switch to the **TOTALS** position and press the hash (#) button on the numeric keypad. Refer to Fig. 1.
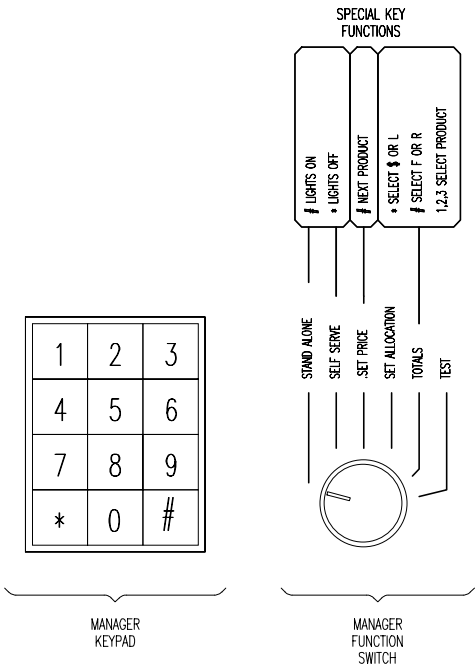
Fig 1 − Manager Function Panel

❑ Unclip the Processor PCB cover by gently pulling at the bottom tab.

❑ Remove, then replace, link **JP3** on the Processor PCB. Refer to Fig. 2.
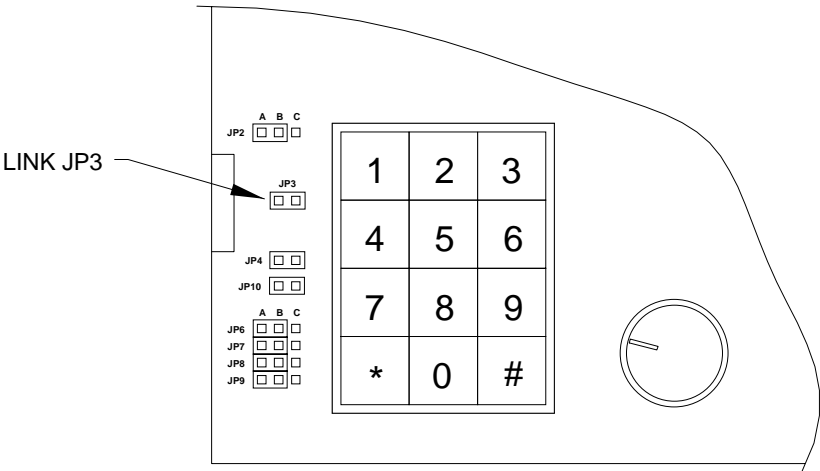
NOTE: Links not shown in correct positions. Diagram is for link locations only.

Fig. 2 − Link positions on Processor PCB

SETTING THE PUMP/DISPENSER TYPE

❑ The front Main Display will be flashing the currently selected "Type" number.

■ If the "Type" number *does not* require changing, press the hash (#) button to advance to the setting of "Fuelling Position" numbers.

■ If the "Type" number *does* require changing, select the required "Type" from the following list.

0 for 2, 3, or 4 product pumps/dispensers

1 for 1 product, normal flow pumps/dispensers

2 for 1 product, fast flow pumps/dispensers

After selecting the correct "Type", press the hash (#) button to initiate the change and advance to the setting of "Fuelling Position" numbers.

FUELLING POSITION NUMBERS

❑ On the front Main Transaction Display, the display digit second from the right on the Litres display will flash the *current* Fuelling Position number for the *front* of the pump/dispenser. Refer to Fig. 3.
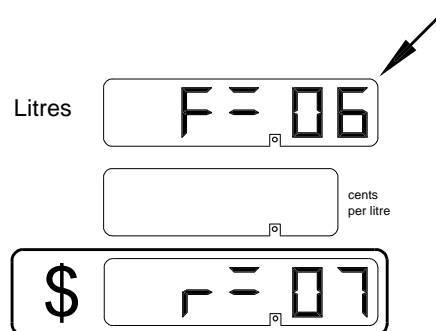
*Fig. 3 − Fuelling Position Numbers − **FRONT***

❑ On the numeric keypad, enter the *required* Fuelling Position number (allowed range 01 to 16) for the front of the pump/dispenser. Always enter a zero as the first digit if the number is below 10, eg., for position 6, enter 06.

NOTE: If the number entered is outside the allowed range, the error message Er will be displayed. Entering the correct number will clear the error message.

❑ Press the asterisk (✱) button on the numeric keypad. The display digit second from the right on the **$** display will flash the *current* Fuelling Position number for the ***rear*** of the pump/dispenser. Refer to Fig. 4.
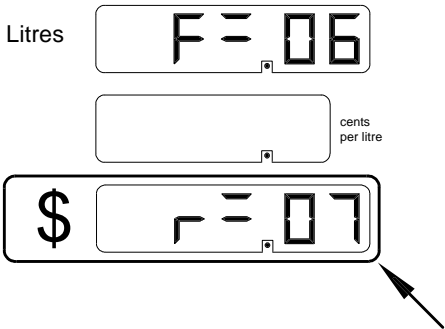
*Fig. 4 − Fuelling Position Numbers − **REAR***

❑ On the numeric keypad, enter the *required* Fuelling Position number (allowed range 01 to 16) for the rear of the pump/dispenser. Always enter a zero as the first digit if the number is below 10, eg., for position 6, enter 06.

> **NOTE:**   If the number entered is outside the allowed range, the error message Er will be displayed. Entering the correct number will clear the error message.

❑ Leave the Manager Function switch set in the TOTALS position and proceed to setting the Grade Priority numbers by pressing the hash (#) button.

GRADE PRIORITY NUMBERS

Use the chart below, and the examples following the chart, to determine the Grade Priority numbers before trying to set them.

Column 1	Column 2	Column 3
Product listed at Console	Hose pair dispensing product	Grade Priority number
SUP		
ULP		
DIST		
LPG		
PULP		
G6		
G7		
G8		

Example

❑ Draw a line through the columns for grades not being dispensed by the pump or dispenser.

❑ In the centre column, write the hose pair ("A", "B", "C", or "D" if 4 product) which dispenses the grade shown in the left column.

❑ In the right column, number the empty boxes from the top of the chart to the bottom as per the following list.

1, 2, 3 and 4	for 4-Product pumps and dispensers
1, 2 and 3	for 3-Product pumps and dispensers
1 and 2	for 2-Product pumps and dispensers

Column 1	Column 2	Column 3
Product listed at Console	**Hose pair dispensing product**	**Grade Priority number**
SUP	*A*	*1*
ULP	*C*	*2*
DIST		
LPG		
PULP	*B*	*3*
G6		
G7		
G8		

NOTE: If the same grade is to be dispensed from two hose pairs, they must be given the same Grade Priority number as shown in the next example chart.

Note also that *unused product* positions **must** be set to a valid number, ie., the same number as one of the *used products*.

Example: On a 2-Product pump or dispenser, Products "B" and "D" would be set to either 1 or 2.

On a 3-Product pump or dispenser, Product "D" would be set to either 1, 2 or 3.

Column 1	Column 2	Column 3
Product listed at Console	**Hose pair dispensing product**	**Grade Priority number**
SUP	*A* *B*	*1*
ULP		
DIST		
LPG		
PULP	*C*	*2*
G6		
G7		
G8		

❑ During the setting of Grade Priority numbers, the assigned grade number will be displayed on the corresponding hose Price Display *and* on the Main Transaction Display. This is to assist in checking that *unused products* are set to a valid *used product* number.

❑ To set the Grade Priority numbers for each hose pair. The hose Price Display will display the message Grd followed by the current Grade Priority number flashing.

❑ Enter the required Grade Priority number on the numeric keypad.

❑ Press the asterisk (✶) button to advance to the next hose and repeat the above procedure.

> **NOTE:** For 4-hose MPPs/MPDs, after setting hose "A" press the asterisk (✶) twice to advance to hose "C". The Grade Priority number for hose "D" must also be skipped if the unit is *not* a 4-Product 8-hose pump or dispenser.

RESETTING TOTALS

❑ Press the hash (#) button again. The display shown in Fig. 5 will appear on the front Transaction Display, indicating that the option to reset the totals is available.

> **NOTE:** The totals have not yet been reset.

Litres

rES.Et

₹   cents per litre

$
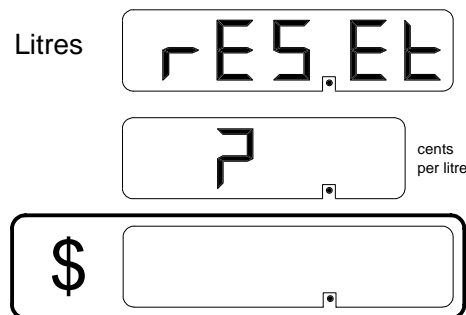
Fig. 5 – Totals Reset

❑ Press the asterisk (✶) button. The question mark (?) showing in the cents per litre display will disappear. TOTALS HAVE NOW BEEN RESET.

❑ Refit the Processor PCB cover by clipping into place.

❑ Reset the Manager Function switch to the required operating position (STAND-ALONE or SELF-SERVE).

❑ Close and lock the front upper cover.

FUNCTIONAL CHECKS

For information on operating multi product pumps and dispensers, refer to the Operating Instructions in Chapter 2 of the Users' Manual (DQ98004-001).

PUMP & DISPENSER CHECK

❑ Check the following on all pumps/dispensers.

■ All flameproof covers are fitted properly.

■ All components are properly located, and secure.

■ All cables are connected properly, and secure.

■ All panels are fitted properly, and secure.

❑ In the CDM, set each pump/dispenser to **STAND-ALONE** mode.

❑ At the switchboard, power down the pump/dispenser, wait about 20 seconds, then power up again.

❑ Check that the pump/dispenser lighting is operating correctly.

❑ On each pump/dispenser, set a valid PPU for each hose pair.

❑ On each pump/dispenser, carry out the following procedures for each hose.

■ Lift the nozzle and, *before* maximum outward travel of the nozzle flap, check that all pump/dispenser displays start the reset cycle.

■ Ensure all pump/dispenser displays complete the reset cycle, and that the pump motor or STP starts running.

■ Run the pump motor/STP for several minutes to prime the system. Check all hydraulic connections and rectify any leaks found.

■ Insert the nozzle into a container and dispense a small amount of fuel (approx. $1). Check that the readings on the money and volume totes increase by the amount shown on the Transaction Display.

    NOTE: For the first transaction after power has been applied or restored, the money tote will increase by 1 after only 50 cents of fuel has been dispensed. After that, it will increase normally by 1 for every $1 of fuel dispensed.

■ Return the nozzle to the boot and, *before* maximum inward travel of the nozzle flap, check that the pump motor/STP switches off.

DIAGNOSTICS CHECK

Carry out all diagnostics tests as described in Chapter 2 in this manual.

PRESET TRANSACTION CHECK

This is to test the functional operation of the pump/dispenser preset (if fitted).

❑ Press each preset button and ensure the preset display increases by the amount shown on the button pressed.

❑ Press the **CLEAR** or **FILL** button and ensure the Preset Display goes blank.

❑ Set an *allocation limit* of $5, and ensure the preset display shows $5.

Refer to Chapter 2 in the Users' Manual for instructions on setting allocation limits.

Press CLEAR or FILL and ensure the Preset Display does *not* go blank.

❑ Reset the allocation limit to zero (unlimited), then press CLEAR or FILL. Ensure the Preset Display goes blank.

❑ Select a preset value, say $2.

❑ Lift the nozzle and ensure the Preset Display return to the preset value after completing the reset cycle. Ensure the pump motor/STP is running.

❑ Start fuel delivery. Ensure that at approx. 0·1 to 1·5 litres *before* the preset value, the flow rate is sharply reduced to approx. 5 to 10 litres per minute.

❑ Hold the nozzle trigger in until the pump motor/STP stops. Ensure the value of fuel dispensed is the same as the preset value.

❑ Return the nozzle to the boot.

SELF SERVE SYSTEM CHECK

This check is to be carried out at the Console.

❑ Ensure the Console is programmed correctly. Refer to the appropriate Console Users' Manual for programming details.

❑ Ensure that all pumps/dispensers are set for Self-Serve mode.

❑ Place all pumps/dispensers on the loop by setting the corresponding switches on the Interconnect Box to the down (ON) position. Ensure the green LED on the Interconnect Box remains on.

❑ Press the corresponding pump select button for the first Fuelling Position, and ensure the two-digit pump/dispenser number appears on the Console display. This indicates that the Console and pump/dispenser are communicating correctly. Also ensure the correct grade is indicated.

   NOTE: If the Console fails to establish communications with the pump/dispenser, try the next two hose positions in turn. If the Console still fails to communicate, check loop polarity.

❑ Ensure the PPU displayed on the Console is the same as that displayed on the pump/dispenser.

   ■ **For a T12-AC Console**, press the appropriate pump select button followed by the PPU button.

   ■ **For a T-24 Console**, press the appropriate pump select button. The PPU is displayed on the main 40-character display.

❑ At the pump/dispenser, lift the nozzle and ensure that;

▪ the Console emits a series of beeps, and

▪ the correct status LED for the selected pump/dispenser flashes in fast flash (CALL) mode.

❑ Press the appropriate pump select button and AUTHORISE button and ensure that;

▪ the status LED for the selected pump/dispenser changes to steady ON (BUSY) mode, and

▪ all displays on the selected pump/dispenser complete the reset cycle. Also check that the pump motor/STP starts.

❑ Dispense some fuel and ensure the value of fuel displayed on the Console is the same as that displayed on the pump/dispenser.

❑ Replace the nozzle in the boot and ensure that;

▪ the Console emits a single beep, and

▪ the status LED for the selected pump changes to slow flash (COLLECT) mode.

❑ Press the appropriate pump select button and ensure the transaction values displayed on the Console, and auxiliary Customer Display if fitted, are the same as those displayed on the pump/dispenser.

❑ Pay off the transaction at the Console. Ensure the status LED for the selected pump/dispenser goes OFF (IDLE).

RESETTING TOTALS

After commissioning, it may be required by the station manager that the Transaction Count or Hose Throughput Totals be reset to zero. If so, carry out the following procedures.

TRANSACTION COUNT & THROUGHPUT TOTALS

❑ Ensure all transactions have been completed, and all nozzles hung up.

❑ Unlock and open the Manager Access panel.

❑ Unclip the Processor PCB cover by gently pulling at the bottom tab.

❑ Set the Manager Function switch to the TOTALS position, then press the hash (#) button.

❑ Remove, then replace link JP3 on the Processor PCB. Refer to Fig. 2.

❏ Press the hash (#) button until the rESEt option is displayed. Refer to Fig. 5.

    NOTE: The totals have *not* yet been reset.

❏ To complete the reset, press the asterisk (✳) button.

    When the totals *are* reset, the question mark (?) on the second line of the display will disappear.

❏ Refit and secure the Processor PCB cover.

❏ Set the Manager Function switch to the required operating position, Self Serve or Stand Alone.

❏ Close and lock the Manager Access panel.

TRANSACTION COUNT ONLY

❏ Ensure all transactions have been completed, and all nozzles hung up.

❏ Unlock and open the Manager Access panel.

❏ Unclip the Processor PCB cover by gently pulling at the bottom tab.

❏ Set the Manager Function switch to the TOTALS position.

❏ Remove, then replace link **JP3** on the Processor PCB. Refer to Fig. 2.

❏ Refit and secure the Processor PCB cover.

❏ Set the Manager Function switch to the required operating position, Self Serve or Stand Alone.

❏ Close and lock the Manager Access panel.

REPORTS

❏ Complete a Commissioning Report (G883) for each pump, dispenser, Console, Controller or ICR.

❏ If any service work was required during commissioning, complete a Service Report for each pump, dispenser, Console, Controller or ICR worked on. One copy of all reports is to be forwarded to:

        ATTN.   ENGINEERING MANAGER,
                  NORTH RYDE.

❏ At the completion of commissioning, ensure the current money and volume totaliser reading are given to the station manager.

CHAPTER 2
FIELD SERVICING

INTRODUCTION

The information in this chapter is proprietary and intended only for trained Gilbarco service personnel or their official agents.

It is to be used as a guide for locating problems, to assist in carrying out repairs, and for ordering and maintaining an adequate supply of spare parts.

Some of the procedures may involve the removal and replacement of components (connectors, links, etc.), either for start up procedures or to isolate a service problem.

CAUTION

For personal safety, as well as the protection of equipment, always remove mains power from the equipment *before* removal or reconnection of any component.

LUBRICATION & ADJUSTMENT

LUBRICATION

❑ All brass and sinter bushes should be lubricated with a drop of oil at regular intervals to ensure they do not dry out.

❑ Ensure all gear assemblies have adequate grease on them.

CAUTION

Do not over grease the gear assemblies as this may cause binding.

ADJUSTMENT

There are no adjustments to be made on the Mk2 Low Line pump and dispenser.

SPECIAL CONSIDERATIONS

❑ Record *all* pump/dispenser tote readings on a Transac Inventory Record form *before* carrying out any servicing.

❑ Many problems are created by operator error. Ensure the error(s) are cleared, that Operator Reference Card(s) are available, and that operators and attendants are fully aware of how to interpret them.

PROBLEM LOCALISATION

❑ Ensure all components within the system are connected properly, using the required cables and methods of connection.

❑ Ensure all components within the system which require mains power, are connected to the 240Vac mains, and that the power is turned ON.

❑ Ensure all sections of the system are programmed correctly to operate in the required manner.

❑ Attempt to duplicate the operation(s) which is reported to have produced the problem.

❑ Carry out all diagnostics tests available for each section of the system, to further verify or analyse the problem. Refer to the following sections in this chapter relating to diagnostics procedures.

❑ Refer to the Fault Symptoms listing in the Mk2 Low Line Troubleshooting Guide (DQ98004-004). Select a symptom which most closely resembles the problem reported or observed in your tests.

❑ Proceed to the Repair Action sequences and follow closely the repair steps listed. The same symptoms may be caused by different faulty items.

These steps are arranged to correct the most likely causes of the symptom first, followed by the least likely.

CAUTION

Before removing any PCBs or assemblies, refer to the Disassembly and Assembly procedures in this chapter.

❑ If any component is replaced and, when the system is rechecked, the repair action has *not* corrected the problem, re-install the original component as described.

❑ If any component is replaced and, when the system is rechecked, the repair action *does* correct the problem, adopt the following procedure.

■ Re-install the original component believed to be faulty, and verify the problem recurs.

■ If the problem *does* recur, remove the original component and re-install the replacement, then recheck the system again.

- ■ If the problem does **not** recur, proceed through the troubleshooting sequence to trace any new symptoms.

    NOTE: The recheck of suspected faulty components is necessary to ensure good components are not returned to the factory as faulty. Replacement of the suspect component may have disturbed the system and corrected the problem.

- ❑ If the problem is still present after all repair actions for that particular symptom have been carried out, select the next appropriate symptom Fault Symptoms list and proceed with the listed repair actions.

- ❑ If all possible corrective action has been carried out, and the problem is still evident, contact the Help Desk at North Ryde for further assistance.

AUTOMATIC SELF TESTS

There are two groups of automatic self tests built into the pump/dispenser programming to monitor the operation of both hardware and software. The first group operates during the power up sequence while the second group operate during fuelling transactions.

POWER UP TESTS

Each time the pump or dispenser is powered up, the items listed in the following table are automatically tested. Failures are indicated by the RUNNING LED.

Normal operation is indicated by a regular flashing rate (equal time ON and OFF) of the RUNNING LED.

Indication	Failure
Steady ON or OFF	CPU
One flash − pause (repeated)	RAM
Two flashes − pause (repeated)	NVRAM
Three flashes − pause (repeated)	ROM
Four flashes − pause (repeated)	Watchdog Timer
Five flashes − pause (repeated)	Rotary switch

Fig. 6 − Automatic tests & fault indications

TRANSACTION TESTS

The items listed in the following table are automatically tested during every transaction. Failures are indicated by an error message flashing on the centre display line (cents per litre) of the *front* Transaction Display.

- ❑ At the commencement of every transaction, the NVRAM is checked to ensure the totals were updated properly after the previous transaction.

- ❑ During delivery of fuel, the pulser and tote counters are monitored continuously. Refer to the section on *ERRORS* for details on clearing errors.

Error Message	Failure
Err 0	Totes unplugged
Err 1	Main pulser
Err 3	NVRAM

Fig. 7 – Error messages and failed items

NOTE: Detection of *unplugged totes* was first implemented in Software Version 3.

DIAGNOSTICS TESTS

The following diagnostics tests are available in the pump/dispenser program to assist service personnel in diagnosing a failure within the system.

TEST 0   Flashing 8's test

TEST 1   Walking segments test

TEST 2   Inputs status check

TEST 3   System check

TEST 4   Fuelling Position and Grade Assignment

TEST 5   Walking segments - Transaction Display only

TEST 6   Walking segments - PPU display - Hose A

TEST 7   Walking segments - PPU display - Hose B

TEST 8   Walking segments - PPU display - Hose C

TEST 9   Walking segments - Preset display only

TEST 10   Valve Index numbers

TEST 11   Links

TEST 12   Walking segments - PPU display - Hose D

TEST 13   Temperature Probe

To use the diagnostics correctly, proceed as follows.

❑ Ensure all transactions have been completed, and all nozzles are hung up.

❑ Set the Manager Function switch to the **TEST** position (refer to Fig. 1).

The version number of the software now installed is displayed on the top line (litres) of the front Transaction Display, with the Gilbarco product number displayed on the bottom line ($).

❑ On the numeric keypad, press the button corresponding to the number of the test required, followed by the hash (**#**) button to start the test.

❑ To exit from the test being carried out, select another test, or set the Manager Function switch to another position.

NOTE: The tests as listed are for Version 3 software for the "surface mount" Processor PCB. Other versions may vary/expand the tests.

TEST 0 – FLASHING 8'S

All display digits will continually alternate between the figure 8 and blank. This is to check the operation of each display segment, to ensure they are *written* to, and *erased* properly.

TEST 1 – WALKING SEGMENTS (ALL DISPLAYS)

This test further checks to ensure each individual segment is functioning properly. Each display digit consists of seven (7) segments.

Each segment of each digit is activated, then de-activated, in turn. As one segment is de-activated, the next is activated, making the segment appear to be moving (walking) around the digit. All digits, on all displays, are tested in turn, with the front and rear displays being tested simultaneously.

After the last digit has been checked, there is a three (3) second delay before the test restarts.

TEST 2 – INPUTS STATUS

This test displays the status of all inputs to the Processor PCB.

Type Setting

The right-hand most digit of the front *litres* display indicates the current Type Setting as follows.

0 = multi product pump/dispenser
1 = 1-Product Lo-flow pump/dispenser
2 = 1-Product Hi-flow pump/dispenser

Nozzle Status

The status of each nozzle switch is displayed on the corresponding hose PPU displays.

in = nozzle *in* boot
out = nozzle *out* of boot

Hydraulics Assignment

The hydraulics assignment status (for front nozzles) is indicated as follows.

❑ Hose A status – displayed on the **1st** digit of the front *litres* and *$* displays.

❑ Hose B status – displayed on the **2nd** digit of the front *litres* and *$* displays.

❑ Hose C status – displayed on the **3rd** digit of the front *litres* and *$* displays.

❑ Hose D status – displayed on the **4th** digit of the front *litres* and *$* displays.

Carry out the following check procedure.

❑ Lift nozzle "A" on the front of the pump/dispenser. Check that a **0** *or* **1** appears in the position indicated above.

❑ While holding nozzle "A", lift one of the other nozzles and ensure the displays on the *litres* and *$* displays does **not** change.

❑ Hang up **both** nozzles and ensure the display clears.

Repeat this procedure for all nozzles on the rear of the pump/dispenser.

Customer Preset

Press each button on the preset keypad and ensure the value of the button pressed is displayed on the preset display.

NOTE: The values of the buttons pressed **do not** accumulate. This test checks individual buttons only.

TEST 3 - SYSTEM CHECK

This test checks the following Processor PCB sub-systems.

1. CPU (micro processor chip)

2. RAM

3. ROM

4. NVRAM

5. Watchdog Timer

If all tests pass, the word **PASS** will be displayed on the front *litres* display.

If there is a fault, the message **Err** will be displayed on the front *litres* display, with the error code (number) displayed on the front *$* display. The error codes are as follows.

Error Message	Failure
0	CPU
1	RAM
2	NVRAM
3	ROM
4	Watchdog Timer

Fig. 8 − System Failure and Error messages

TEST 4 - FUELLING POSITION NUMBER & GRADE ASSIGNMENT

The Fuelling Position numbers, front and rear, are indicated as follows.

❑ The **front** Fuelling Position numbers are displayed on the front *litres* display. An **F** is displayed on the first digit, with the position number displayed on the last two digits of the display.

❑ The **rear** Fuelling Position numbers are displayed on the front *$* display. An **r** is displayed on the first digit, with the position number displayed on the last two digits of the display.

❑ If *NO* Fuelling Position number has been set, **Er** will be displayed in place of the position number.

The grade assignments for each hose, front and rear, are shown on the corresponding PPU display as **Grd** followed by the grade assignment number (**1**, **2**, **3** or **4**).

TEST 5 − WALKING SEGMENTS (TRANSACTION DISPLAY ONLY)

This test checks only the Transaction Display to ensure each individual segment is functioning properly. Each display digit consists of seven (7) segments.

Each segment of each digit is activated, then de-activated, in turn. As one segment is de-activated, the next is activated, making the segment appear to be moving (walking) around the digit. All digits, on all displays, are tested in turn, with the front and rear displays being tested simultaneously.

After the last digit has been checked, the test restarts. To exit the test, enter the number of the next test required, then press the hash (**#**) button.

TEST 6 – WALKING SEGMENTS (PPU DISPLAY – HOSE "A")

This test checks only the PPU Display for hose A to ensure each individual segment is functioning properly. Each display digit consists of seven (7) segments.

Each segment of each digit is activated, then de-activated, in turn. As one segment is de-activated, the next is activated, making the segment appear to be moving (walking) around the digit. All digits, on all displays, are tested in turn, with the front and rear displays being tested simultaneously.

After the last digit has been checked, the test restarts. To exit the test, enter the number of the next test required, then press the hash (**#**) button.

TEST 7 – WALKING SEGMENTS (PPU DISPLAY – HOSE "B")

This test checks only the PPU Display for hose B to ensure each individual segment is functioning properly. Each display digit consists of seven (7) segments.

Each segment of each digit is activated, then de-activated, in turn. As one segment is de-activated, the next is activated, making the segment appear to be moving (walking) around the digit. All digits, on all displays, are tested in turn, with the front and rear displays being tested simultaneously.

After the last digit has been checked, the test restarts. To exit the test, enter the number of the next test required, then press the hash (**#**) button.

TEST 8 – WALKING SEGMENTS (PPU DISPLAY – HOSE "C")

This test checks only the PPU Display for hose C to ensure each individual segment is functioning properly. Each display digit consists of seven (7) segments.

Each segment of each digit is activated, then de-activated, in turn. As one segment is de-activated, the next is activated, making the segment appear to be moving (walking) around the digit. All digits, on all displays, are tested in turn, with the front and rear displays being tested simultaneously.

After the last digit has been checked, the test restarts. To exit the test, enter the number of the next test required, then press the hash (**#**) button.

TEST 9 – WALKING SEGMENTS (PRESET DISPLAY ONLY)

This test checks only the Preset Display to ensure each individual segment is functioning properly. Each display digit consists of seven (7) segments.

Each segment of each digit is activated, then de-activated, in turn. As one segment is de-activated, the next is activated, making the segment appear to be moving (walking) around the digit. All digits, on all displays, are tested in turn, with the front and rear displays being tested simultaneously.

After the last digit has been checked, the test restarts. To exit the test, enter the number of the next test required, then press the hash (**#**) button.

TEST 10 – VALVE INDEX NUMBERS (VIN)

This test displays a number on the Hose PPU display in the range of 1 to 15 for the hydraulic valve for each hose. The number is adjusted automatically as preset deliveries are done, and is an indication of the speed of operation of the valve.

The *lower* the number, the faster the hydraulic valve is operating; likewise, the *higher* the number, the *slower* the hydraulic valve is operating. Eg., a very fast operating valve will have a number around 3 or 4 while a slow valve will have a number around 9 or 10.

If the VIN for a valve is 15, and does not change after a series of preset deliveries (say 6), then the valve is not operating correctly and should be serviced or replaced.

TEST 11 – LINKS

This test displays the current setting for the links on the Processor PCB. The status of each link is displayed on the front Main Transaction Display; "**1**" for link IN and "**0**" for link OUT. The link positions are indicated as follows.
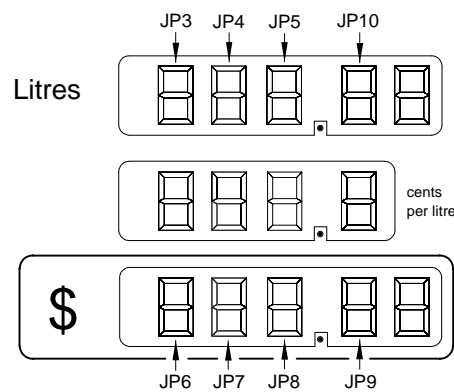
NOTE: If **JP5** does not exist, its display position will indicate the status of the tote cable.

TEST 12 – WALKING SEGMENTS (PPU DISPLAY – HOSE "D")

This test checks only the PPU Display for hose D to ensure each individual segment is functioning properly. Each display digit consists of seven (7) segments.

Each segment of each digit is activated, then de-activated, in turn. As one segment is de-activated, the next is activated, making the segment appear to be moving (walking) around the digit. All digits, on all displays, are tested in turn, with the front and rear displays being tested simultaneously.

After the last digit has been checked, the test restarts. To exit the test, enter the number of the next test required, then press the hash (**#**) button.

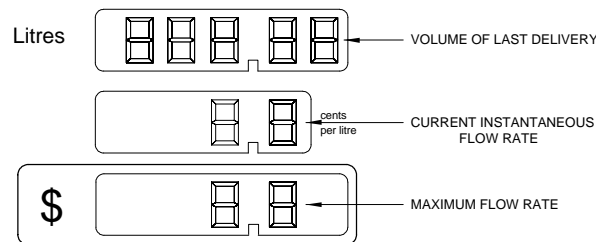### TEST 13 – TEMPERATURE PROBE

This test is for Factory use only.
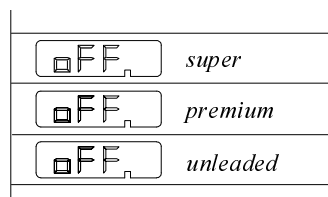
FLOW RATE TESTS

TO ENTER FLOW RATE TEST MODE

❑ Set the Manager Function switch to the **ALLOCATION** position (refer to Fig. 1).

❑ Remove, then replace link JP3 on the Processor PCB (refer to Fig. 2).

❑ The pump/dispenser will enter the Flow Rate Test mode and the Main Transaction Display (both front and rear) will indicate the following.

NOTE: The following examples are given for a 6-hose pump/dispenser.

Transaction displays:

Litres — VOLUME OF LAST DELIVERY

cents per litre — CURRENT INSTANTANEOUS FLOW RATE

$ — MAXIMUM FLOW RATE

Hose PPU displays:

oFF. *super*

oFF. *premium*

oFF. *unleaded*

TO DO A FLOW RATE TEST DELIVERY

❑ Lift a nozzle:

As the nozzle is lifted, the assigned hose PPU will change to "-on·-", and the volume amount will be reset.

❑ Select the required valve setting:

Pressing the asterisk (✷) and hash (#) buttons, for the front and rear respectively, will alternate the valve setting between *fast* and *slow*, and the hose PPU display of the assigned product will indicate "fas·t" or "slo·-". The motor will turn on.

NOTE: Delivery *cannot* start until a valve setting has been selected.

❑ Resetting the maximum flow rate display:

With a nozzle lifted, pressing button "1" or "3" on the Managers Keypad, for front and rear respectively, will reset the last recorded maximum flow rate for that side.

TO EXIT THE FLOW RATE TEST MODE

❑ Ensure all hoses are hung up.

❑ Set the Manager Function switch to any position other than **ALLOCATION**. This will force an exit from the test.

NOTE: If a hose from either side of the pump/dispenser is *not* hung up, then exiting the test is *not* possible.

ERROR CONDITIONS

The following error conditions are designed for, and may be caused by, transient conditions. These conditions, should they occur, may be reset as listed below.

ERROR	CAUSE	RESET ACTION
Err 0	Tote cable unplugged.	**NOTE:** This error will only be detected correctly with Vers. 3 software (or later), in combination with PCB Assembly -004 (or later). 1. Ensure tote is plugged in correctly. 2. Remove, then replace link JP3. 3. If the PCB Assembly is pre -004, remove the link on JP5.
Err 1	Faulty Pulser.	1. Power the pump/dispenser down, wait about 20 seconds, then power up again. 2. Carry out another delivery on the same hose. 3. If the error condition recurs, replace the Pulser Box.
Err 3	Faulty NVRAM.	1. Record all totals if the site requires them. **NOTE:** The totals *may not* be correct. 2. Enter Personalisation mode and carry out a Totals Reset. 3. If the error condition recurs, change the NVRAM or Processor PCB.

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CHAPTER 3
HYDRAULICS DESCRIPTION

INTRODUCTION

The information in this chapter may assist in understanding some of the basic hydraulics used in Mk 2 Low Line pumps and dispensers. The hydraulics system is discussed as a system, along with some individual part, to make you aware of the features and functions of each component.

SYSTEM OVERVIEW

The fuel is drawn from the storage tank by the pump. Fuel then passes through an air separation system, check valve (with integral thermal pressure relief), and enters the meter.

In the metering system, the liquid passes through a four-piston meter for measurement, then through a solenoid-controlled flow control valve positioned after the meter (if fitted), with a back-pressure valve installed in the outlet port of the flow control valve. Liquid then travels through the delivery pipe to the outside of the frame, through the hose and then to the nozzle – refer to Fig. 9 on the following page.

FOUR-PISTON METER

This meter is identical to those used in all Gilbarco pumps and dispensers. Flow of fuel through this meter causes movement of the measuring pistons, resulting in the rotation of the output shaft.
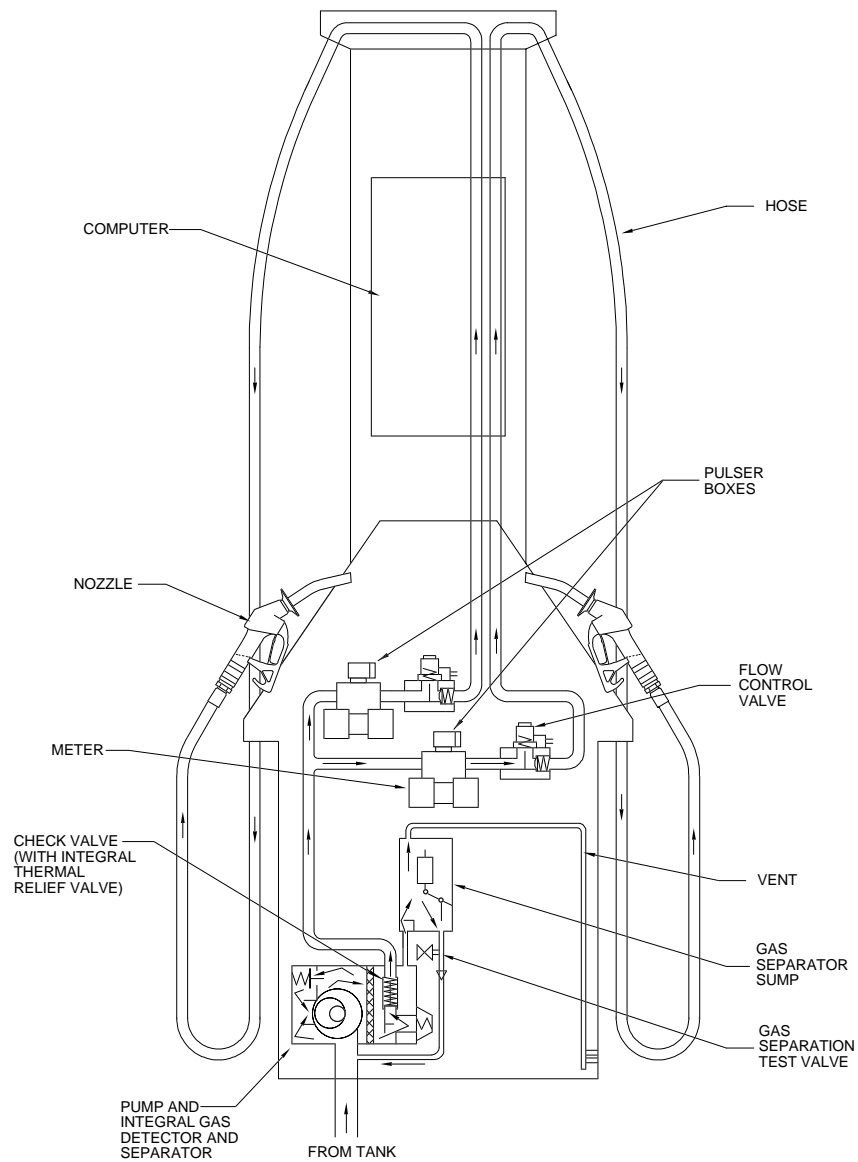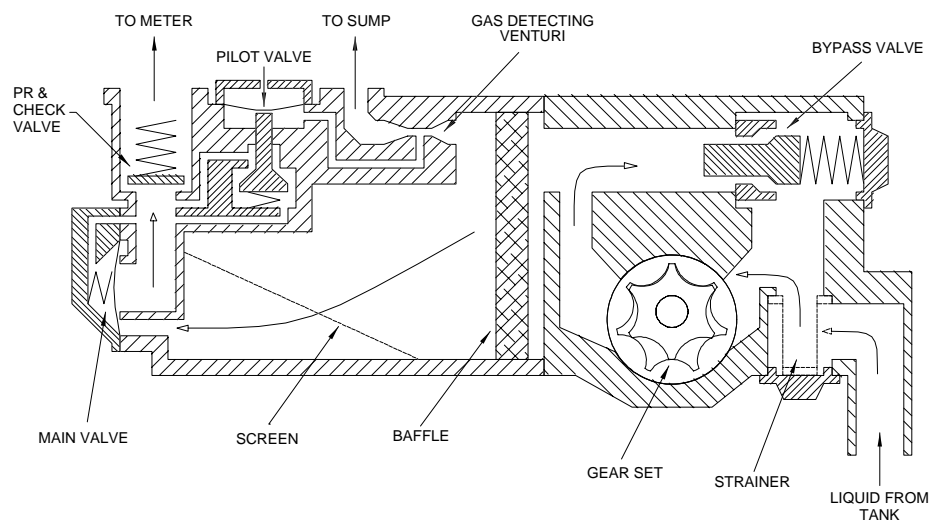
GEROTOR PUMP & AIR DETECTION SYSTEM

The Gerotor design is a type of gear pump. The pump consists of an "inner" and "outer" gear, the inner gear having one less tooth than the outer gear. Refer to the following diagram (Fig. 10).

Rotation of the inner gear, via the motor and pulleys, forms an expanding and contracting chamber between the inner and outer gear as the teeth engage and dis-engage.

Due to this action, liquid enters the pump, passes through the strainer, and on through the pump. Liquid is then passed into the air separator, with over-pressure protection being provided by a by-pass valve.

COMPUTER

HOSE

PULSER BOXES

NOZZLE

FLOW CONTROL VALVE

METER

CHECK VALVE
(WITH INTEGRAL THERMAL RELIEF VALVE)

VENT

GAS SEPARATOR SUMP

GAS SEPARATION TEST VALVE

PUMP AND INTEGRAL GAS DETECTOR AND SEPARATOR

FROM TANK

Fig. 9 – Hydraulic arrangement

TO METER

TO SUMP

GAS DETECTING VENTURI

BYPASS VALVE

PILOT VALVE

PR & CHECK VALVE

MAIN VALVE

SCREEN

BAFFLE

GEAR SET

STRAINER

LIQUID FROM TANK

Fig. 10 – Gerotor cross-section

Gas in the product is separated and is bled off to the sump. This sump feed passes through an orifice in the air separator body which is used for the detection of gas in the product.

Where there is no gas in the product, the orifice produces a vacuum, which in turn acts on the pilot valve diaphragm and opens the pilot valve against the spring and pump pressure. The pilot valve controls the flow valve.

The pilot valve bleeds product from behind the flow valve diaphragm to just before the check valve. The resultant pressure drop across the diaphragm causes the flow valve to open.

As increasing amounts of gas are introduced into the product, the orifice vacuum is reduced. When more than a predetermined amount of gas is detected, the pilot valve closes. This closure of the pilot valve closes the flow valve and stops delivery of product until the gas has been expelled.

The product flow will restart when the gas has been discharged.

NOTE: Due to the different viscosities of petrol and diesel, the gas detect pilot valve seat and spring are different. These can be easily changed over. (Refer to Appendix B for part number details.)

INTEGRATED FLOW CONTROL VALVE

NORMAL FLOW OPERATION

The flow control valve is required to independently control the flow of each nozzle, and is positioned after the meter. A diaphragm valve is used, controlled by a three-position pilot (2-coil) solenoid valve (refer to Fig. 10). The following explains the general operation of the valve.

❑ **Position 1**

When the valve is in the fully open position (both coils energised), the pressure from the pump opens the diaphragm, and full flow occurs.

❑ **Position 2**

In slow flow (preset) conditions, the pilot valve moves to an intermediate position (only coil "B" energised) where the flow through the inner eyelet is reduced to about 2 litres/min. In this case, the diaphragm is closed and fuel flow occurs only through the inner eyelet in the diaphragm.

❑ **Position 3**

With the pilot valve in the fully closed position (no coils energised), no flow passes through the inner eyelet of the diaphragm. Therefore, the inlet pressure and pressure behind the diaphragm equalise via the outer eyelet hole, allowing inlet fuel pressure and the diaphragm spring to hold the diaphragm closed, which prevents fuel flow.

NOTE: A back-pressure valve is incorporated in the outlet of the flow control valve to reduce the effects of hose dilation, and fuel expansion on the meter.
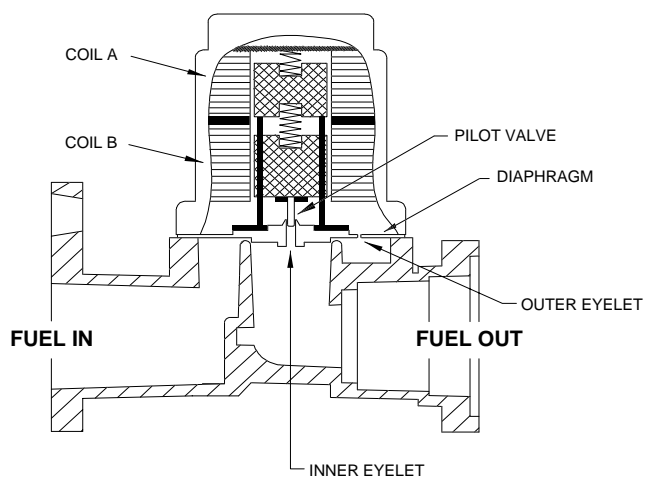
Fig. 10 – Flow Control Valve

NOZZLES

The nozzles used are identical to those used on all Gilbarco pumps, ie., ZVA Model 19 or 25 nozzles, or as specified by customer requirements.

CHAPTER 4
REMOVAL AND REPLACEMENT PROCEDURES

INTRODUCTION

The multi product pumps and dispensers consist of the following basic assemblies.

1. CDM assembly

2. Control Box

3. Upper hydraulics module

4. Pulser assembly

5. Processor PCB & Totes assembly

6. Lower hydraulics module

7. Hookup box assembly

Each of the above assemblies is further broken down into sub-assemblies. Removal and replacement of the major assemblies and sub-assemblies will be described in the following information.

CAUTION

1. Static electricity can damage an EPROM and other similar devices. Ensure any static charge on your person is completely discharged by touching the metal framework of the pump/dispenser *before* handling electronics components. When removing EPROMs/NVRAMs, do not touch the legs of the device.

2. When removing a PCB, lay it on top of the pump/dispenser, preferably resting on the anti static wrapping supplied with the replacement PCB.

CDM ASSEMBLY

The CDM assembly consists of the following main sub-assemblies. Refer to Fig. 11 for positions of the sub-assemblies.

1. PPU Display assemblies

2. Transaction Display PCB assemblies

3. Preset Display & Interconnect PCB assembly

4. Customer Preset Keypad

5. Lighting
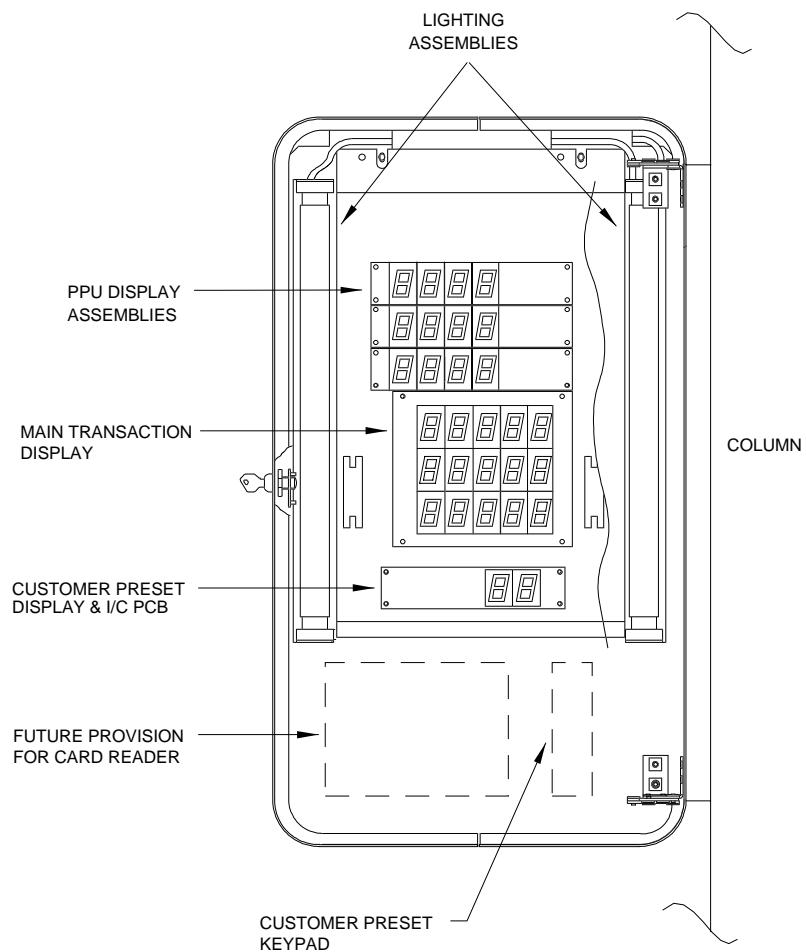
Fig. 11 – CDM Module components layout

PPU DISPLAY PCB ASSEMBLIES

Removal

❑ Push the Display Dial Face UP and lift it OFF to gain access to the PCB.

❑ Note the location of each cable connection to the suspect PCB, then unplug each connector.

❑ The mountings for this PCB assembly are clip on standoffs. To remove the PCB, squeeze the top of the standoff and gently ease the PCB out until free of the standoff. Repeat the procedure for each standoff.

Replacement

❑ The replacement procedure is the reverse of the removal procedure. Ensure the cable is connected properly.

DISPLAY PCB ASSEMBLIES

Removal

❑ Push the Display Dial Face UP and lift it OFF.

❑ Note the location of each cable connection to the PCB, then unplug each connector.

❑ The mountings for this PCB assembly are clip on standoffs. To remove the PCB, squeeze the top of the standoff and gently ease the PCB out until free of the standoff. Repeat the procedure for each standoff.

Replacement

❑ The replacement procedure is the reverse of the removal procedure. Ensure all cables are connected properly.

PRESET DISPLAY & INTERCONNECT PCB ASSEMBLY

Removal

❑ Push the Display Dial Face UP and lift it OFF.

❑ The mountings for the PCB assembly are clip on standoffs. To remove the PCB, squeeze the top of the standoff and gently ease the PCB out until free of the standoff. Repeat the procedure for each standoff.

Replacement

❑ The replacement procedure is the reverse of the removal procedure. Ensure the cable is connected properly.

CUSTOMER PRESET KEYPAD ASSEMBLY

Removal

❑ Note the orientation of the cable connection to the Preset Keypad, then unplug the connector.

❑ Remove the nuts securing the Preset Keypad to the Door Panel and carefully remove the Preset Keypad.

Replacement

❑ The replacement procedure is the reverse of the removal procedure. Ensure the cable is connected properly.

COLUMN ASSEMBLY

The column assembly consists of the following main sub-assemblies. Refer to Fig. 12 for positions of the sub-assemblies.

1. Control Box

2. Tote assembly

3. Processor PCB assembly

4. Intrinsically Safe Barrier PCB

CONTROL BOX

Removal

❑ Remove all connectors from the Control Box.

❑ Remove the EARTH strap from the *rear* of the Control Box.

❑ Supporting the Control Box, pull back the securing latch and carefully lower the Control Box.

❑ Lift the Control Box from the hinges and carefully withdraw the Control Box from the CDM.

Replacement

❑ The replacement procedure is the reverse of the removal procedure. Ensure the EARTH strap has been replaced securely and provides a good earth, and all cables are connected properly.

FRONT VIEW
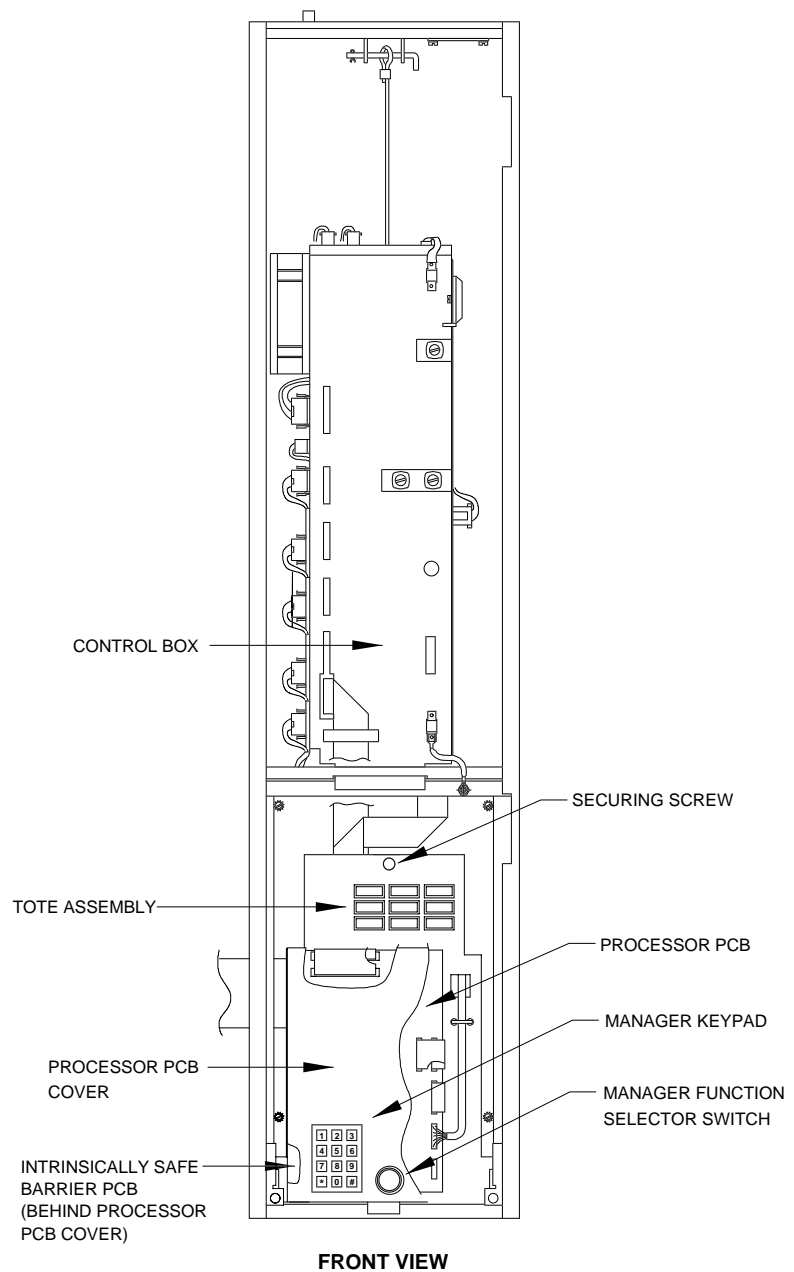
Fig. 12 – Column Assembly components layout

TOTE ASSEMBLIES

Removal

❑ Undo the securing screw and swing the hinged panel DOWN.

❑ Note the orientation of the leads to the suspect tote, then unsolder each lead.

❑ Remove the tote by squeezing the latches located on the *side* of the tote.

Replacement

❑ The replacement procedure is the reverse of the removal procedure. Ensure the cable is resoldered properly.

PROCESSOR PCB ASSEMBLY

Removal

❑ Unclip the Processor PCB cover by gently pulling at the bottom tab.

❑ Note the location of each cable connection to the PCB, then unplug each connector.

❑ The mountings for this PCB assembly are clip on standoffs. To remove the PCB, squeeze the top of the standoff and gently ease the PCB out until free of the standoff. Repeat the procedure for each standoff.

Replacement

❑ The replacement procedure is the reverse of the removal procedure. Ensure all cables are connected properly.

INTRINSICALLY SAFE BARRIER PCB ASSEMBLY

Removal

❑ Undo the securing screw and swing the hinged Processor/Tote mounting panel DOWN.

❑ Note the location of each cable connected to the small Barrier PCB, then unplug each connector.

❑ The mountings for this PCB assembly are clip on standoffs. To remove the PCB, squeeze the top of the standoff and gently ease the PCB out until free of the standoff. Repeat the procedure for each standoff.

Replacement

❑ The replacement procedure is the reverse of the removal procedure. Ensure all cables are connected properly.

APPENDIX A
SPECIFICATIONS

❑ **POWER REQUIREMENTS**

Voltage   220V, 230V, 240V, 250V
                           (by transformer tap selection) ±15%

Current   15 amps Maximum

❑ **PRICE SETTING RANGE**

Up to $9·999 per litre

❑ **ACCURACY**

Money	Displayed	To nearest cent, to a maximum of $993·00
	Calculated	To nearest tenth of a cent
Volume	Displayed	To nearest 1/100 litre, to a maximum of 995 litres
	Calculated	To nearest 1/200 litre
Preset	Displayed	$1·00 to $99·00 – in exact dollar amounts

❑ **FLOW RATE**

Standard Flow Models

Normal Flow   45 litres per minute, only one hose of pair in use.

35 litres per minute, both hoses of same hose pair in use at same time.

Slow Down   2 litres per minute

Hi-Flow Models

Normal Flow   85 litres per minute, with one or both hoses of pair in use.

Slow Down   2 litres per minute

❑ **OPERATING TEMPERATURE RANGE**

Minus 10°C to plus 45°C – with sun loading

❑ **OPERATING HUMIDITY RANGE**

0% to 90% relative humidity – outside the CDM

❑ **TOTALS ACCURACY**

Electro-mechanical

Money   For each product (hose pair) – in whole dollars up to $9,999,999

Volume   For each hose, – in whole litres up to 9,999,999 litres.

Electronic Totals   All electronic totals will automatically roll over to zero when they reach their maximum limits.

Transaction Count   For each product (hose pair) – up to 9,999

Preset Count   For *all* products (all hoses) – up to 9,999

Hose Throughputs   Money – up to $9,999,999·99
Volume – up to 9,999,999·99 litres

❑ **STP MOTOR PRIMARY RELAY REQUIREMENTS**
    (Dispensers only) AUSTRALIA

Coil Voltage	240Vac, 50Hz
Nominal Coil Current	3mA – 5mA RMS
Coil Pull-in Voltage	80% Nominal Maximum
Coil Drop-out Voltage	30% Nominal Minimum

❑ **NOZZLES**   Normally fitted with Elaflex ZVA 19mm slim-line automatic, with two-way swivel and splashguard.

❑ **APPROVALS**

National Standards Commission
    Document No. 101
    Certificate No. 5/6A/84A

Standards Association of Australia
    AS2229 – Part 1, AS3000 & AS3100
    Certificate No. EX1117

Energy Authority of New South Wales
    Certificate No. CS4971N

✱ *Refer to equipment name-plate for current certificate numbers*

APPENDIX B
PUMP CONVERSIONS

INTRODUCTION

NAMEPLATE

After any conversion, remove the old nameplate and fit a new nameplate (DQ59405-016) stamped in accordance with the Stamping Chart DT00102-518.

AIR SEPARATOR

The Mk2 Low Line pump uses the die cast Air Separator. This Air Separator has the part number DT06416 cast into the back face, and the Gilbarco "G" and part number DT06417 cast into the cap.

PILOT VALVES

Pilot Valve bodies look the same whether used in sand or die cast Air Separators, however, they are *not* interchangeable. The body for the die cast version has an identification groove on the outer face (under the diaphragm).
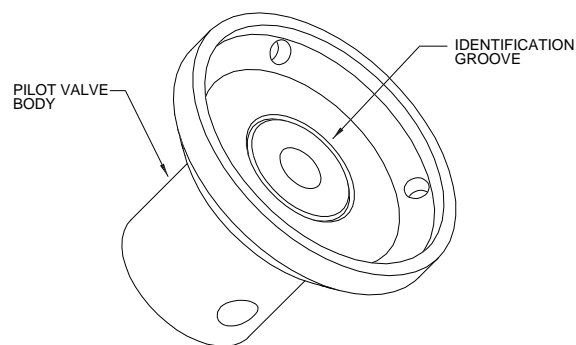
DIAPHRAGM KITS

There are two Diaphragm Kits available; DN07032-003, and -004 for easy conversion of pumps from petrol to diesel and diesel to petrol. The parts list for each kit can be found at the rear of this appendix.

DRESSINGS

Grades stripes and panels will also need to be changed when altering the type of fuel being dispensed.

LO-FLOW PETROL TO LO-FLOW DIESEL

❑ Convert the pump from T258AT-4 to T258AT-6 by changing the number of spacers (DK02505-001), located under the by-pass valve spring, from 2 spacer to 4 spacers.

❑ Remove the existing diaphragm, Pilot Valve and spring, and replace using Diaphragm Kit DN07032-004.

LO-FLOW DIESEL TO LO-FLOW PETROL

❑ Convert the pump from T258AT-6 to T258AT-4 by changing the number of spacers (DK02505-001), located under the by-pass valve spring, from 4 spacer to 2 spacers.

❑ Remove the existing diaphragm, Pilot Valve and spring, and replace using Diaphragm Kit DN07032-003.

LO-FLOW PETROL TO HI-FLOW DIESEL

The only Hi-Flow diesel model is the short two-hose unit which uses one hydraulic module per hose. This is *not* a simple conversion and is not covered in this document.

For further information if conversion is required, please contact Gilbarco Head Office.

LO-FLOW DIESEL TO HI-FLOW DIESEL

The only Hi-Flow diesel model is the short two-hose unit which uses one hydraulic module per hose. This is *not* a simple conversion and is not covered in this document.

For further information if conversion is required, please contact Gilbarco Head Office.

PARTS LIST FOR DIAPHRAGM KITS

KIT No.: DN07032-003 – DIESEL to PETROL – Die Cast A/S

Part No.	Description	Qty
DQ18202-002	Loctite 242	A/R
DQ38050-014	Nut M5	1
DN05728	Washer special	2
DN05729	Shaft – Pilot Valve	1
DR06528	Diaphragm Assembly	1
DN06703	Body – Pilot Valve – petrol	1
DN05761	Spring – light	1
DQ41002-014	"O" ring	1
DQ41002-022	"O" ring	1

KIT No.: DN07032-004 – PETROL to DIESEL – Die Cast A/S

Part No.	Description	Qty
DQ18202-002	Loctite 242	A/R
DQ038050-014	Nut M5	1
DN05728	Washer special	2
DN05729	Shaft – Pilot Valve	1
DR06528	Diaphragm Assembly	1
DN06703-001	Body – Pilot Valve – diesel	1
DN06092	Spring – heavy	1
DQ41002-014	"O" ring	1
DQ41002-022	"O" ring	1

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APPENDIX C
SCHEMATICS & DIAGRAMS

GENERAL

Schematic diagrams of printed circuit boards contain Gilbarco proprietary information, and are not included in this manual. However, they may be made available on request to Gilbarco H.O. Services.

Block diagrams, connection diagrams and wiring diagrams contained in this section of the manual are the property of Gilbarco Aust Ltd and, as such, must *not* be released without the express permission of Gilbarco.

NOTES: 1. All diagrams included herein are correct at the time of publication. However, changes may be made without prior notice.

2. For Console schematics, refer to the appropriate Console Service Manual.

3. For schematics pertaining to other pumps/dispensers, refer to the appropriate Pump/Dispenser Service Manual.

FRONT MAIN DISPLAY

FRONT PPU DISPLAYS

REAR MAIN DISPLAY

REAR PPU DISPLAYS

PRESET PCB FRONT

KEYBOARD ASS'Y

PRESET PCB REAR

KEYBOARD ASS'Y

REAR LIGHTS

TOTES

FRONT LIGHTS

PRESET REAR

PRESET FRONT

POWER SUPPLY

ELV

SMT PROC. PCB

PULSER

TOTES

TEMP. PROBE

CONTROL BOX

POWER SUPPLY

MAINS   A   B   C   D

I/SAFE PCB

FRONT

REAR

CABLE CONNECTOR

VAPOUR BARRIER

GLAND

SOLENOID VALVES

MAINS

MOTOR   A

MOTOR   B

MOTOR   C

PULSER BOXES

FRONT

NOZZLE BOOTS

REAR

Fig. 13 − Block diagram − Pumps
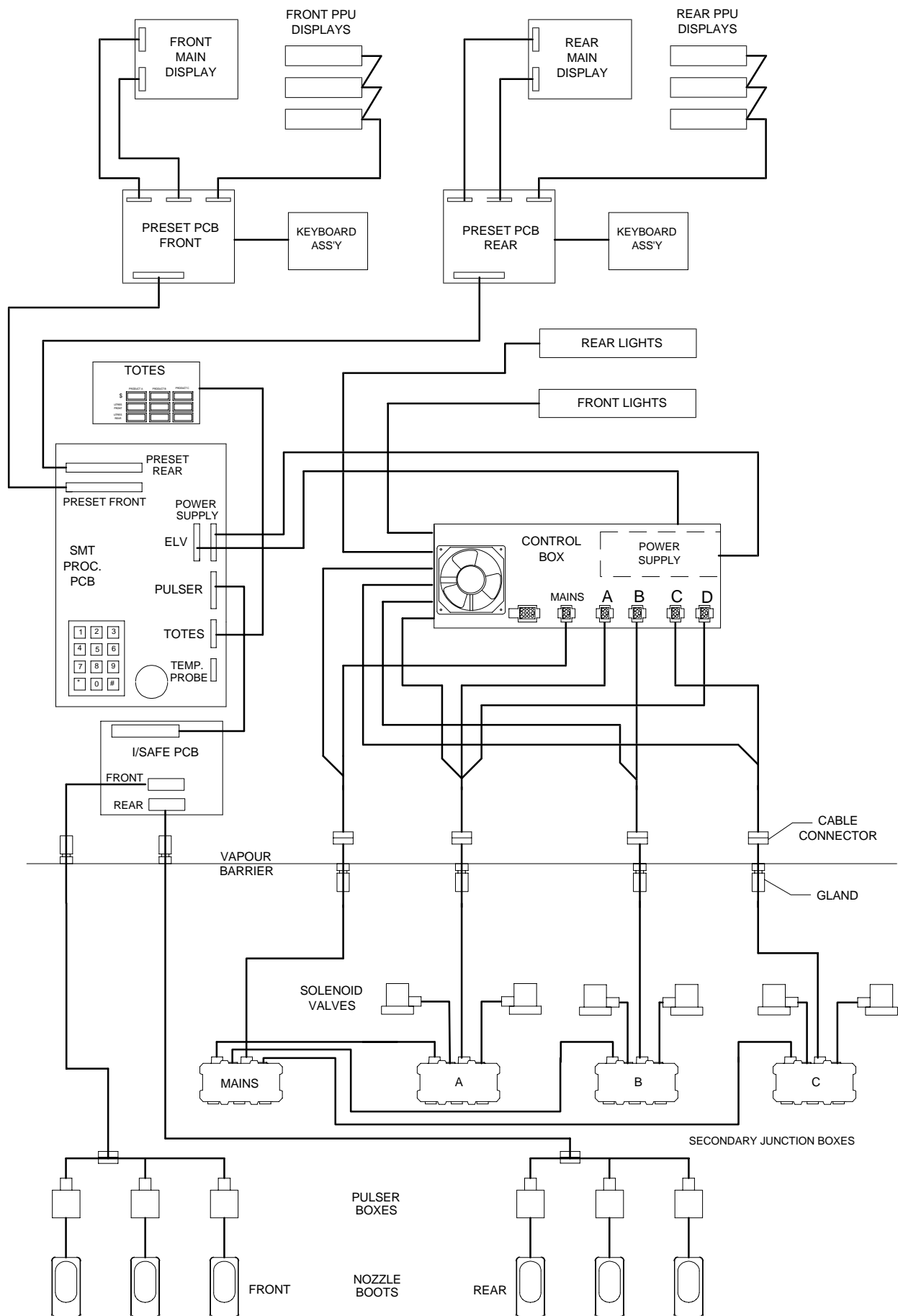
Fig. 14 − Block diagram − Dispensers

CONTROL BOX

P301 - PROD 'A'
P302 - PROD 'B'
P303 - PROD 'C'

PRODUCT J-BOX
Wiring for Pumps

CABLE - DN05482-001 - PRODUCT 'A'
CABLE - DN05482-002 - PRODUCT 'B'
CABLE - DN05482-003 - PRODUCT 'C'

GN/Y	BROWN	BLACK	RED	ORANGE	GREY	WHITE
E	1	2	3	4	5	6

J-BOX

MOTOR

GN/Y
BROWN
BLUE

RED
BLUE
WHITE

RED
BLUE

WHITE

REAR VALVE

FRONT VALVE

CONTROL BOX

P304

MAINS J-BOX
Wiring for Pumps

CABLE - DN05482-004

GN/Y	BROWN	BLACK	RED	ORANGE	GREY	WHITE
E	1	2	3	4	5	6
EARTH	240V (A)	240V (N)	PUMP LOOP (+)	PUMP LOOP (-)	ICR LOOP (+)	ICR LOOP (-)

J-BOX

MAINS CABLE

Fig. 15 – Junction Box connections for Pumps

PRODUCT J-BOX
Wiring for Low Flow Dispensers

CONTROL BOX

P301 - PROD 'A'
P302 - PROD 'B'
P303 - PROD 'C'

CABLE - DN05482-001 - PRODUCT 'A'
CABLE - DN05482-002 - PRODUCT 'B'
CABLE - DN05482-003 - PRODUCT 'C'

GN/Y   BROWN   BLACK   RED   ORANGE   GREY   WHITE

E   1   2   3   4   5   6   J-BOX

WHITE   REAR
BLUE   VALVE

RED

WHITE
BLUE   FRONT
BROWN   RED   VALVE

TO MAIN J-BOX

TERMINAL 7 - PROD 'A'
TERMINAL 8 - PROD 'B'
TERMINAL 9 - PROD 'C'

MAINS J-BOX
Wiring for Low Flow Dispensers

CONTROL BOX

P304

TO
PRODUCT J-BOXES
TERMINAL 7 - PROD 'A'
TERMINAL 8 - PROD 'B'
TERMINAL 9 - PROD 'C'

CABLE - DN05482-004

GN/Y   BROWN   BLACK   RED   ORANGE   GREY   WHITE   BROWN   BROWN   BROWN

E   1   2   3   4   5   6   7   8   9   10   J-BOX

EARTH 240V   240V   PUMP   PUMP   ICR   ICR   PROD   PROD   PROD
       (A)   (N)   LOOP   LOOP   LOOP   LOOP   'A'   'B'   'C'
                     (+)   (-)   (+)   (-)

MAINS CABLE

Fig. 16 –Junction Box connections for Low Flow Dispensers

PRODUCT J-BOX
Wiring for High Flow Dispensers

CONTROL BOX
P204 - P214

TO
PRODUCT J-BOXES
TERMINAL 7 - PROD 'A'
TERMINAL 8 - PROD 'B'

MAINS J-BOX
Wiring for High Flow Dispensers
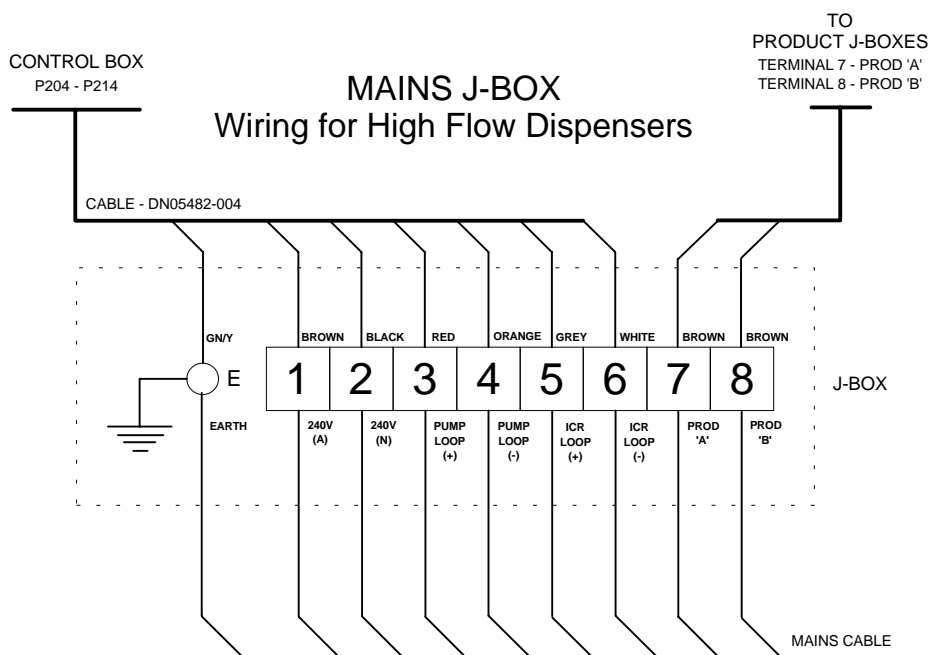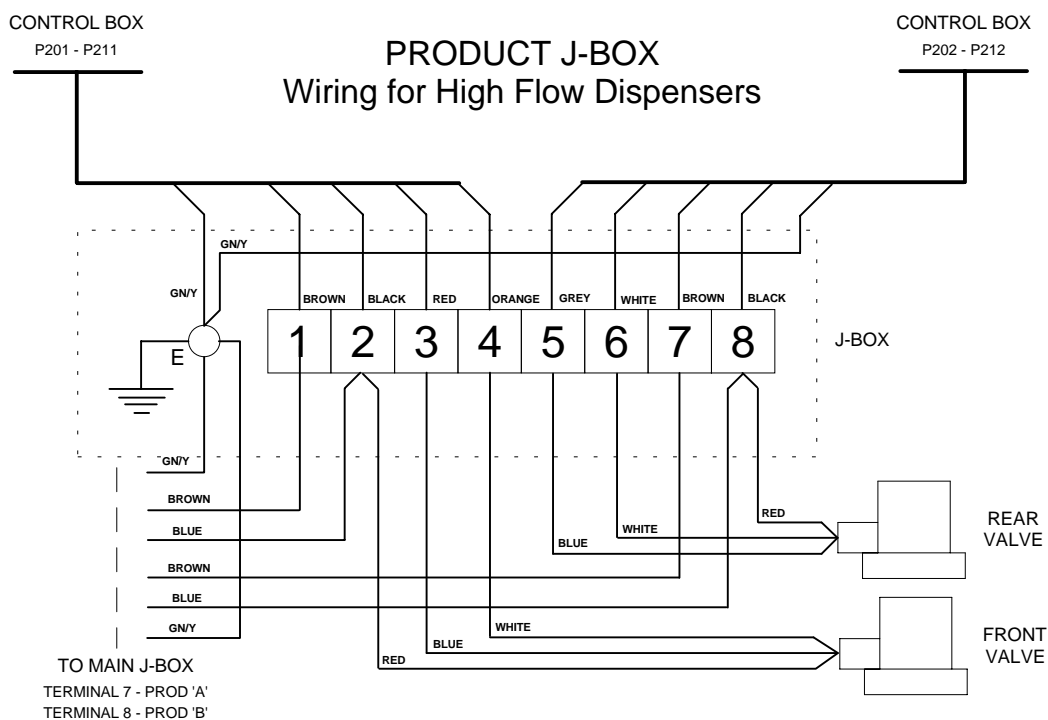
Fig. 17 – Junction Box connections for High Flow Dispensers

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