



FuelMaker

Model FMQ-2/
FMQ-2.5/FMQ-2-36

Vehicle Refueling Appliance



Installation and Service Instructions

**This Equipment Shall Only Be Installed By Properly Trained
And Certified Installation Personnel**

*FuelMaker Corporation
70 Worcester Road, Toronto, Ontario, Canada, M9W 5X2
4745 Amelia Earhart Drive, Suite 470, Salt Lake City, Utah, U.S.A. 84116
Technical Support (North America): 1-800-263-8569
Technical Support (International): 001-416-674-3034 (extension 258)
Internet: www.fuelmaker.com*



SAFETY INSTRUCTIONS

PLEASE READ CAREFULLY

1. NO USER-SERVICEABLE COMPONENTS

The FuelMaker FMQ-2/FMQ-2.5/FMQ-2-36 Modules (Control Module, Compression Module, and Electronics Module) must be installed and serviced by personnel specifically trained and authorized by FuelMaker Corporation.

Modules must not be dismantled in the field. To do so will void all warranties and could result in serious injury.

2. READ INSTRUCTIONS CAREFULLY

Please read this manual carefully and those of any other FuelMaker Equipment supplied prior to installation and operation. If you are unsure about any feature or are experiencing any difficulties, please contact FuelMaker's Technical Support Group at:

1-800-263-8569 (North America)
001-416-674-3034 extension 258 (International)

3. LOCATION OF THE FUELMAKER

The VRA is to be installed outdoors in non-hazardous locations as defined by the C22.1 Canadian Electrical Code (Canada), and the NEC National Electrical Code (USA). Do not install the VRA under or near a window or directly under potential gas accumulating overhangs. Leaves, snow and other debris should be kept clear of the air inlet and outlet of the VRA. The VRA and the vehicle cylinders must be located so they are both exposed to the same ambient temperature during refueling.

4. FOR REFUELING NATURAL GAS VEHICLES ONLY

Attempts to use the VRA for any other purpose could result in serious injury or death. Vehicle cylinders must be certified for Natural Gas storage at 3000 psig (207 bar) or higher for the FMQ-2 / FMQ-2.5 and 3600 psig (248 bar) or higher for the FMQ-2-36. The FuelMaker may be used for residential and commercial applications in accordance with the requirements of the authorities having jurisdiction.

5. REFUELING PRECAUTIONS

Do not run vehicle engine while refueling and ensure all ignition sources are OFF (including pilot lights in recreational vehicles). Do not smoke or bring an open flame within 3 metres (10 ft.) of the vehicle being refueled.

6. IF YOU SMELL GAS

Shut off the manually-operated valve in the gas supply to the VRA. If possible, close the manual gas valve in the vehicle. Extinguish any open flames. Contact an authorized service representative.

7. REFUELING HOSE

The fill hose must be protected from physical damage, abrasion or from being driven over. When a sign of wear, deterioration, or other damage is apparent in the hose or hose connector, the hose or hose connector must be inspected or replaced immediately by an authorized service representative.

CAUTION

NEVER USE ACETONE, THINNER, OR OTHER STRONG CHEMICAL AGENTS ON THE PLASTIC HOUSING. TO CLEAN THE OUTER SURFACES USE ONLY MILD SOAPS AND HOUSEHOLD CLEANERS.



TABLE OF CONTENTS

| | Page |
|---|------|
| 1 INTRODUCTION | 1 |
| 2 TECHNICAL SPECIFICATIONS | 1 |
| 3 INSTALLATION INSTRUCTIONS | |
| 3.1 GENERAL | 2 |
| 3.2 LOCATION OF THE FUELMAKER | |
| Positioning of Base | 2 |
| Vehicle Refueling Point | 2 |
| Gas and Electrical Supplies | 2 |
| Pressure Start System..... | 3 |
| Sound Levels | 3 |
| Protection from Vehicle Impact | 3 |
| 3.3 INSTALLATION OF THE FUELMAKER | |
| Mounting to Base | 3 |
| Gas Piping - Inlet Side | 3 |
| Gas Piping - Outlet | 4 |
| Vent Connection | 5 |
| Field Wiring | 6 |
| Field Programming | 6 |
| 3.4 TESTING AND COMMISSIONING | 8 |
| 4 USER PANEL OPERATION | |
| 4.1 User Panel Indications | 9 |
| 4.2 Abnormal User Panel Indications (Flashing Lights) | 10 |
| 4.3 Indicator Lights Check | 11 |
| 4.4 Service Hours | 11 |
| 5 FAULT DIAGNOSTICS | |
| 5.1 Diagnostics When In "INCORRECT" Mode | 12 |
| 5.2 Diagnostics When In "CALL FOR SERVICE" Mode | 18 |



TABLE OF CONTENTS (CONT'D)

Page

6 SERVICE INSTRUCTIONS

| | |
|--|----|
| 6.1 SERVICE INTRODUCTION | 20 |
| Service Interval | 20 |
| Regular Service Checks | 20 |
| 6.2 INTERCHANGABILITY OF MODULES BETWEEN FMQ-2/FMQ-2.5 | |
| 6.3 REPLACEMENT OF FUELMAKER COMPONENTS | |
| ModuleReplacement Preparation | 22 |
| Compression Module Removal | 22 |
| Compression Module Replacement | 25 |
| Control Module Removal | 26 |
| Control Module Replacement | 27 |
| Fan Removal and Replacement | 28 |
| Electronics Module Removal | 29 |
| Electronics Module Replacement | 30 |
| Electronics Module Settings | 30 |
| Start / Stop Button Height Adjustment | 31 |
| Removing the FuelMaker | 32 |

TABLES and FIGURES

| | |
|---|----|
| Table 1 Technical Specifications | 1 |
| Table 2 Shutdown Pressure vs Ambient Temperature for FMQ-2 & FMQ-2.5 | 8 |
| Table 3 Shutdown Pressure vs Ambient Temperature for FMQ-2-36..... | 8 |
| Table 4 Hours Remaining Before Service | 11 |
| Table 5 Diagnostics For "INCORRECT" Mode | 12 |
| Table 6 Diagnostics For "CALL FOR SERVICE" Mode | 18 |
| Figure 1 Service Clearances and Mounting Dimensions | 2 |
| Figure 2 FuelMaker Unit | 4 |
| Figure 3 Schematic Diagram of Electronics Module | 5 |
| Figure 4 FuelMaker Main Components | 7 |
| Figure 5 User Panel | 9 |
| Figure 6 Electronics Module in Servicing Position | 22 |
| Figure 7 Hour-meter Location | 23 |
| Figure 8 Hour-meter Storage Location and Blow-down Vessel Pressure Relief | 23 |
| Figure 9 Compression Module Removal | 24 |
| Figure 10 Service Plate Location | 24 |



TABLE OF CONTENTS (CONT'D)

| Tables and Figures (cont'd) | Page |
|--|-------------|
| Figure 11 Compression Module Replacement | 25 |
| Figure 12 Compression Module Connections and Reset Button Location | 26 |
| Figure 13 Control Module Removal and Replacement | 27 |
| Figure 14 Fan Removal and Replacement | 28 |
| Figure 15 Location of Fan Motor Connector on Electronics Module | 28 |
| Figure 16 Electronics Module Removal | 29 |
| Figure 17 Electronics Module Connections | 30 |
| Figure 18 Start - Stop Buttons Clearance | 31 |
| Figure 19 External Power Disconnect | 32 |
| Figure 20 FuelMaker Removal | 32 |



1 INTRODUCTION

Model FMQ-2/FMQ-2.5/FMQ-2-36 VRAs are self-contained, oil-free outdoor appliances used for compressing Natural Gas. The VRA can be used in direct fill applications where one or two hoses are connected to the vehicle to be filled or; remote fill applications where one or more hoses of a remote panel or auxillary fueling panel are connected to the vehicle or; manifold fill application where the VRAs are hard piped to ground storage. The FMQ-2 will fill a 100 litre (26.4 US gal) gas cylinder to a pressure of 20.7 MPa @ 21°C (3000 psig @ 70°F) within 7.5 hours. The FMQ-2.5 will fill a 100 litre (26.4 US gal) gas cylinder to a pressure of 20.7 MPa @ 21°C (3000 psig @ 70°F) within 6.0 hours. The FMQ-2-36 will fill a 100 litre (26.4 US gal) gas cylinder to a pressure of 24.8 MPa @ 15°C (3600 psig @ 59°F) within 9 hours. The flow rate is roughly the energy equivalent to about 3.7 litres (1 US gal) to 4.4 litres (1.2 US gal) of gasoline per hour, depending on the model and energy content of Natural Gas. The VRA is equipped with automatic temperature compensation and will shut down at a maximum pressure determined by the temperature sensed at the VRA air inlet.

Each appliance is air-cooled and is rated for an operating ambient temperature range of -40°C to +45°C (-40°F to +113°F). The air is drawn into the FuelMaker through one set of vents in the rear of the housing (See Figure 2) and exhausted through another set of vents in the front of the housing (See Figure 2). The FuelMaker has a hinged lid to allow access to the *User Panel* and vehicle fill hose/refueling nozzle (See Figure 2). Starting, stopping and monitoring of the FuelMaker takes place at the *User Panel*.

Important: FMQ-2 and FMQ-2.5 are CGA and AGA certified for Canada and the United States. FMQ-2-36 is AGA certified only for the United States.

Note: VRAs equipped with *Pressure Start System* are AGA certified for commercial and industrial applications only for the United States of America.

2 TECHNICAL SPECIFICATIONS

| GAS | FMQ-2 | FMQ-2.5 | FMQ-2-36 |
|--------------------------------|--|---|--|
| Maximum Discharge Pressure: | 20.7 MPa (3000 psig) @ 21°C (70°F) | 20.7 MPa (3000 psig) @ 21°C (70°F) | 24.8 MPa (3600 psig) @ 15°C (59°F) |
| Minimum Inlet Pressure: | 1.7 kPa (7" w.c.) | 1.7 kPa (7" w.c.) | 1.7 kPa (7" w.c.) |
| Maximum Inlet Pressure: | 14 kPa (2 psig) | 3.5 kPa (14" w.c.) | 3.5 kPa (14" w.c.) |
| Nominal Flow Rate (60Hz) | 3.4 m ³ /hr @ 21°C and 1.7 kPa inlet (2.0 scfm @ 70°F and 7" w.c. inlet) | 4.25 m ³ /hr @ 21°C and 1.7 kPa inlet (2.5 scfm @ 70°F and 7" w.c. inlet) | 3.1 m ³ /hr @ 15°C and 1.7 kPa inlet (1.8 SCFM @ 59°F and 7" w.c. inlet) |
| ELECTRICAL | | | |
| Electrical Supply: | 208*/240 Volt AC, Single Phase, 60 Hz 220 Volt AC, Single Phase, 50 Hz | 240 Volt AC, Single Phase, 60 Hz 220 Volt AC, Single Phase, 50 Hz | 240 Volt AC, Single Phase, 60 Hz 220 Volt AC, Single Phase, 50 Hz |
| Circuit Ampacity: | 15 Amps | 15 Amps | 15 Amps |
| Full Load Amperage (60/50 Hz): | 7.0 / 6.5 Amps | 8.0 / 7.25 Amps | 7.0 / 6.5 Amps |
| Average Power Consumption: | 0.9 to 1.2 kWh *Subject to FuelMaker evaluation and approval | 1.1 to 1.5 kWh | 0.9 to 1.2 kWh |
| MECHANICAL | | | |
| Dimensions (L x W x H): | 540 x 500 x 990 mm (21" x 20" x 39") | 540 x 500 x 990 mm (21" x 20" x 39") | 540 x 500 x 990 mm (21" x 20" x 39") |
| Unit Weight: | 66 kg (145 lbs) | 66 kg (145 lbs) | 66 kg (145 lbs) |
| Sound Level: | 49 dBA @ 5 m (16.5 ft.), hemispherical field | 49 dBA @ 5 m (16.5 ft.), hemispherical field | 49 dBA @ 5 m (16.5 ft.), hemispherical field |
| With noise reduction package: | 45 dBA @ 5 m (16.5 ft.), hemispherical field | 45 dBA @ 5 m (16.5 ft.), hemispherical field | 45 dBA @ 5 m (16.5 ft.), hemispherical field |
| Ambient Temperature Rating: | -40° C to +45° C (-40°F to +113°F) | -40° C to +45° C (-40°F to +113°F) | -40° C to +45° C (-40°F to +113°F) |

Table 1 Technical Specifications

3 INSTALLATION INSTRUCTIONS

3.1 GENERAL

Inspect the unit for shipping damage; report any to your distributor immediately. **Please do not return product to the manufacturer without prior authorization.**

Verify that the nameplate ratings of the FuelMaker are compatible with the electrical and gas supplies available. In Canada, the FuelMaker must be installed in accordance with CAN/CGA-B149.1 Natural Gas Installation Code, CSA-B108 Natural Gas Fuelling Stations Installation Code, CSA-C22.1 Canadian Electrical Code-Part 1 and with the requirements of the authorities having jurisdiction. In the United States, the FuelMaker shall be installed in accordance with NFPA 52 CNG Vehicular Fuel Systems, NFPA 54 National Fuel Gas Code, NFPA 70 National Electrical Code and the requirements of the authorities having jurisdiction.

Do not install the FuelMaker under or near a window or directly under potential gas accumulating overhangs. Local codes and regulations take precedence over any recommendations contained in these instructions.

Particular attention should be paid to codes dealing with fuel storage, vehicle refueling, and permissible sound levels

at the property line.

The Installer shall instruct the User in the proper operation of the FuelMaker and any approved ancillary devices. Before leaving the site, the Installer shall complete Table 7 on Page 13 in the Owner Instructions manual and shall leave the Owner Instructions manual, and any ancillary device manuals, with the User.

3.2 LOCATION OF THE FUELMAKER

Positioning of Base

The FuelMaker must be installed outdoors only in accordance with the requirements of the authorities having jurisdiction.

The FuelMaker must be mounted on a firm, level, non-combustible base. Where ground is not level a poured or precast concrete slab placed on a suitably prepared base (e.g. crushed stone, 150 mm (6") deep) is acceptable. Ensure that the servicing clearances stated on the nameplate are maintained, (See Figure 1). Avoid areas where damage from excessive ice build-up may occur such as building overhangs or where vegetation, snow or debris may clog the cooling air inlet/outlet.

Vehicle Refueling Point

The VRA is supplied with a coiled high pressure hose to deliver fuel to the vehicle. Single hose lengths from 2 m (7 ft.) to 7.5 m (25 ft.) are available. Dual hoses are restricted to a combined length of 9 m (30 ft) for FMQ-2/FMQ-2.5 VRAs and 6 m (20 ft) for FMQ-2-36 VRAs. The VRA contains a temperature sensor to determine the allowable fill pressure for any ambient temperature. The VRA must be installed in the vicinity of the cylinders to be refueled. The VRA should not be situated where the vehicle fill hose or outlet tubing must cross a walkway or access route.

Electrical and Gas Supply

FuelMaker FMQ-2, FMQ-2.5 and FMQ-2-36 VRAs require a dedicated 240 Volt, 15Amp, Single Phase, 60 Hertz electrical supply.

Lower input voltage to the FuelMaker can cause the unit to overheat and shut off during warm weather - see *Field Wiring* section in this manual.

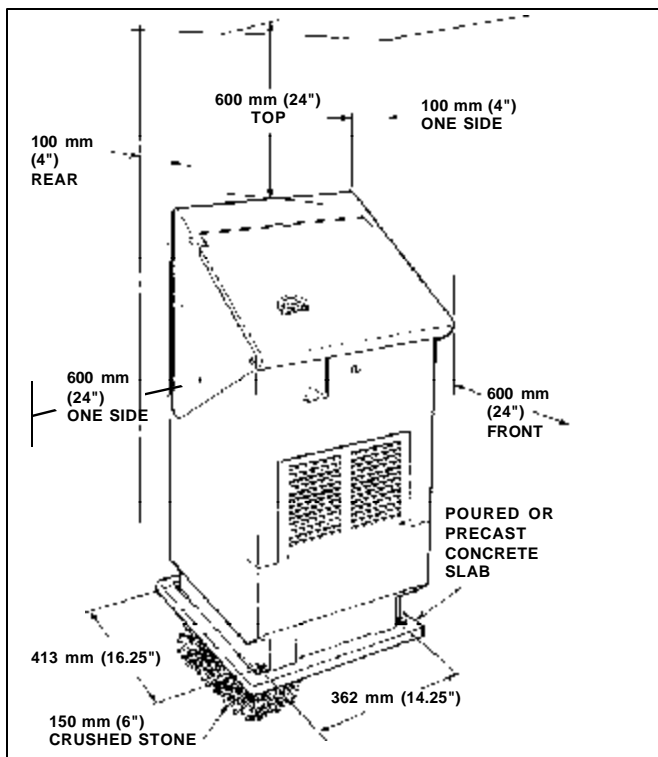


Figure 1 Service Clearances and Mounting Dimensions



The VRA should only be installed in distribution areas of relatively dry gas, typically not more than 110 mg/m³ (7 lbs per million cubic feet) of water vapour. The pressure supplied to the VRA must not exceed the rated supply pressure. Higher pressure will cause damage to the VRA.

Pressure Start System (Optional)

All VRAs equipped with the Pressure Start option will automatically restart and fill the storage or manifold line. All VRAs are equipped with automatic temperature compensation and will shut down at a maximum pressure determined by the ambient temperature sensed at the VRA (see Table 3). When connected to a storage system or manifold line the Pressure Start System continuously monitors the line pressure and turns the VRAs on when the line pressure drops below a pre-determined level. The *Electronics Module* must have software version 64Q22B.

Sound Levels

The VRA is designed to ensure a sound pressure level of less than 49 dBA (hemispherical field) at a distance of 5 m (16.5 ft). Some local codes restrict the sound level at a property line. Units should not be located where direct or reflected noise is aimed at neighbouring windows or other building opening. Avoid locating the unit near a sound reflecting surface or between buildings which are close together.

A noise reduction package is available (model FMQ-2 only) as a factory option which ensures a sound pressure level of less than 45 dBA hemispherical field. Contact FuelMaker for details.

Protection from Vehicle Impact

Position the VRA in a location where it will not become damaged from possible vehicle impact. If the FuelMaker must be located close to a driveway, provision must be made to protect the unit from damage.

Typically, 4" diameter steel posts embedded at least 1m (3 ft.) in the ground, with at least 1 m (3 ft.) extending above-ground, and filled with concrete are suitable. Heavy squared timbers or wheel stops may also be used. In any case, the local gas distribution utility should be consulted to determine what practice is locally accepted by the authority having jurisdiction.

3.3 INSTALLATION OF THE FUELMAKER

Mounting to Base

Prepare the base as explained in Section 3.2. Lag Bolts (3/8 inch) and anchors must be used to secure the FuelMaker feet to the base; the locations of the mounting bolt holes in the FuelMaker base are indicated in Figure 1.

It is very important to bolt the FuelMaker to the base as the FuelMaker must resist the force applied to it in the event of a break-away (e.g. vehicle driven away with the fill hose still attached).

Gas Piping - Inlet side

The gas supply is connected to the FuelMaker via a 1/2" NPT nipple provided (See Figure 2). A coupling and transition fittings need to be field-supplied in order to adapt to the supply piping system. Where the supply piping is fixed to a wall, a flex connector may be required to prevent noise transmission into the building.

It is important to clean any contaminants such as cutting oil, rust, and metal shavings out of the interior of the gas inlet piping. Pipe dope and other sealing compounds must not enter the piping.

On low-pressure gas systems in the range of 1.7 kPa (7" w.c.), the VRA must be connected using 1" (minimum) pipe unless the pipe run is less than 3 m (10 ft.); in that case, 3/4" piping can be used. In order to prevent operation with excessively low pressures at the gas inlet to the FuelMaker (e.g. as a result of a partially closed shut-off valve), the FuelMaker has been equipped with a low-pressure switch factory-set to 1.3 kPa (5.2" w.c.).

The FuelMaker may shut down due to low inlet pressure when other gas loads (e.g. furnace, water heater, etc.) draw from the gas supply system. The utility regulator set provided by the local gas utility must have an orifice/spring/setting appropriate for the maximum gas load that the system will experience. In Canada, the installer shall ensure that the compressor and integral low-pressure cut-off switch operates so as to prevent a piping system pressure loss in excess of that specified in CAN/CGA-B149.1 Natural Gas Installation Code.



VEHICLE REFUELING APPLIANCE

MODEL FMQ-2/FMQ-2.5/FMQ-2-36

It is strongly recommended that the VRA be started while simultaneously operating all major gas appliances on the User's system in order to verify the regulator setting. If the FuelMaker shuts down from low inlet pressure, the gas regulator should be reset or resized.

Gas Piping - Outlet

The VRA is available with one or two fibre-reinforced high pressure fill hose. The fill hose is connected to the VRA via a break-away fitting which allows the hose to be pulled free from the VRA without damage should the user drive the vehicle away without disconnecting. The break-away force is approximately 150 N (34 lbs.) and is independent of the pressure contained in the fill hose.

The VRA can be connected to a Remote Fueling Panel, Auxillary Fueling Panel or Fast Fill Storage System. The VRA can also be manifolded to other VRAs via manifold adaptor assemblies and tubing.

For slow fill applications the FuelMaker must be used with

a refueling nozzle that is AGA/CGA NGV1 Type 3 approved. The nozzle must seal reliably throughout the temperature range and conditions anticipated for the location. An integral normally-closed poppet valve in the nozzle is absolutely essential as it must maintain a positive pressure in the FuelMaker's Blow-down System at all times; air must not migrate up the fill hose and into the *Blow-Down Vessel* during standby.

The use of the Canadian Gas Association (CGA) Certification Seal is contingent upon the use of a refueling nozzle that is CGA NGV1 Type 3 approved for use with a Vehicle Refueling Appliance. Therefore, installations requiring the CGA certification to be in force must be equipped with a CGA NGV1 Type 3 approved nozzle.

FuelMaker Corporation has done, and continues to perform, extensive testing on fueling nozzles. Please contact FuelMaker for recommendations.

The fill hose incorporates a fitting and a seal to connect the refueling nozzle. Various adapters are available from FuelMaker Corporation to facilitate the attachment of vari-

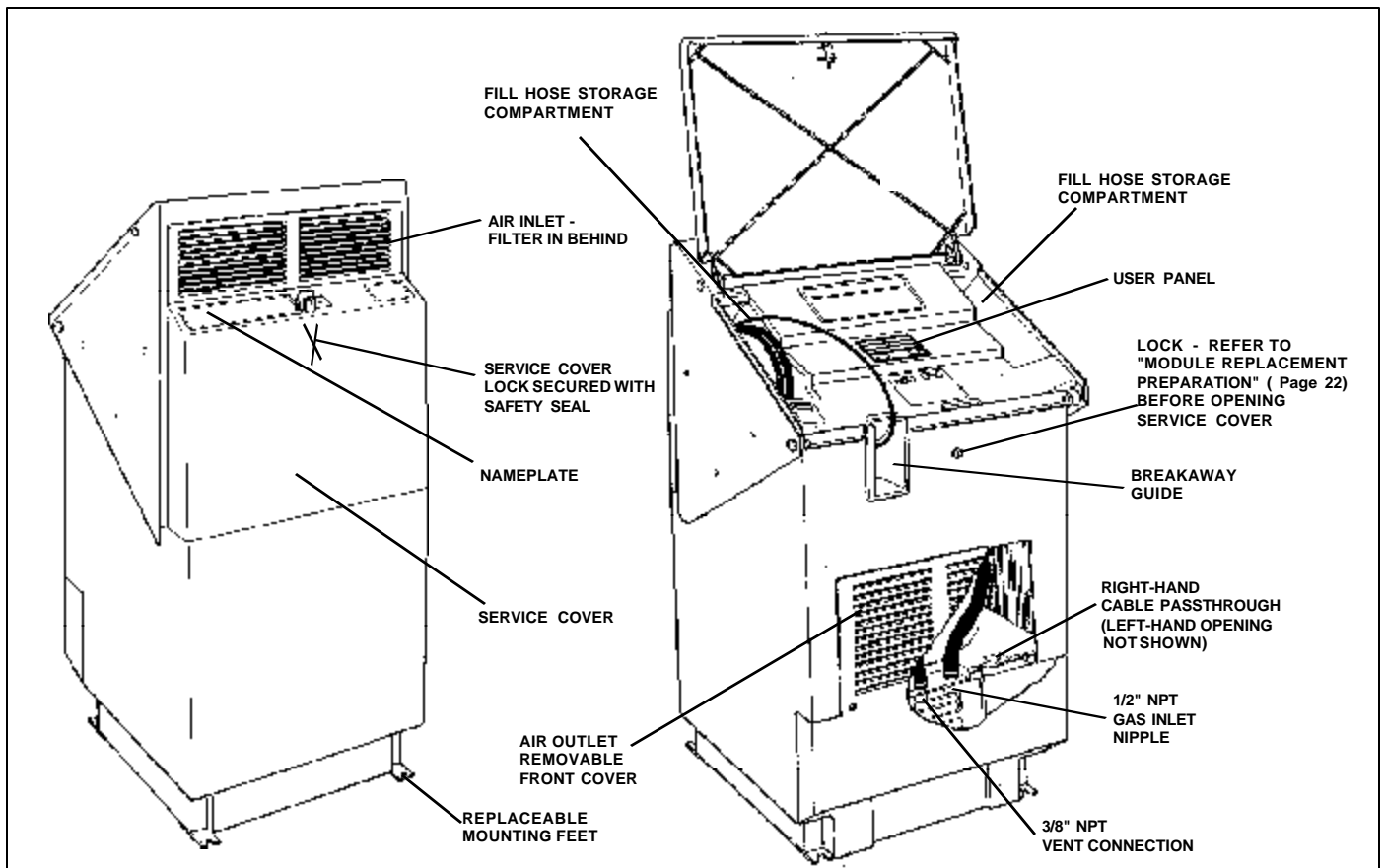


Figure 2 FuelMaker Unit

Gas Piping - Outlet (cont'd)

ous nozzles, including angular or straight take-offs. The fill hose is coiled to allow storage within one of the side pockets of the VRA.

IMPORTANT

The break-away in the FMQ-2-36 will not engage the hose designed for the FMQ-2/FMQ-2.5 or vice versa. Please ensure proper hose is used on the VRA. Attempt to use an incorrect hose on the VRA may result in serious injury.

At the completion of each refueling cycle the high pressure gas contained downstream of the compressor is returned to a *Blow-Down Vessel* (See Figure 4) thus reducing the pressure in the fill hose to approximately 2 bar g (29 psig). "Blow-down" allows the nozzle to be disconnected from the vehicle.

The FuelMaker Blow-down System has been designed to accommodate the volume of gas contained by the fill hose, refueling nozzle, and the space between the vehicle receptacle and check valve only. Therefore, the allowable maximum length of fill hose has been limited to a combined

length of 6 m (20 ft.) for FMQ-2-36 and 9 m (30 ft.) for FMQ-2 and FMQ-2.5. Refueling nozzles used with the VRA shall not have an internal volume exceeding 5 cc (0.3 in³) per nozzle. When connecting a VRA to a Remote Panel or Auxiliary Fueling Panel, refer to the Installation and Operating instructions for that product regarding maximum allowable tubing and hose lengths. When connecting the VRA to a Fast Fill Storage System, a check valve must be installed between the VRA and the Fast Fill Storage System. When using 1/8" tubing, the check valve must be no more than 27m (85 ft.) from the VRA. When using 1/4" tubing, the check valve must be no more than 6m (20 ft.) from VRA. When manifolding VRAs, a check valve must be installed in the branch line to each VRA. Contact FuelMaker for information regarding accessories available to connect VRAs to the above noted products.

Do not connect additional devices or hose lengths to the delivery side of the VRA. To do so will over-pressurize the Blow-down System and cause the pressure relief valve to open, venting Natural Gas to the atmosphere. Contact the local authority having jurisdiction for requirements pertaining to manifolding VRAs or connecting VRAs to ground Storage.

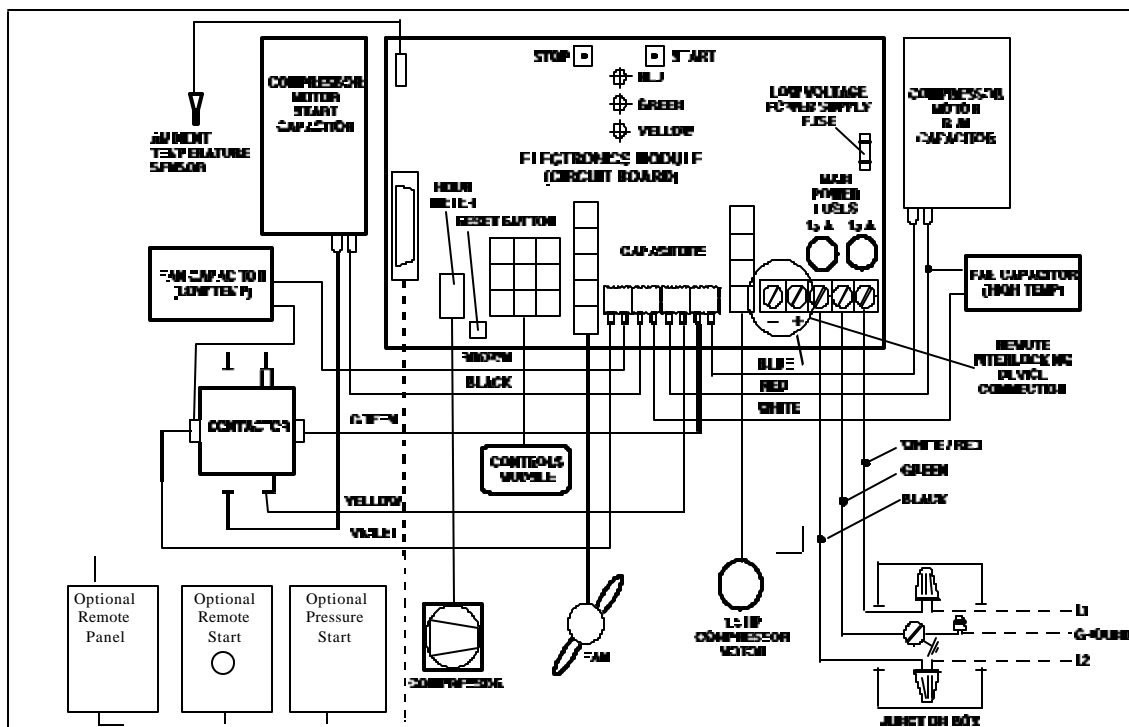


Figure 3 Schematic Diagram of Electronics Module



Vent Connection

The 3/8" NPT vent connection (*See Figure 2*) is protected from blockage by ice or insects by the supplied screen fitting. The Vent discharges any gas released by the pressure relief valve in order to protect the Blow-down System from over-pressurization. If the VRA must be installed near building openings, a 10 mm (3/8") minimum inside diameter steel vent line should be connected to the 3/8" NPT Vent Connection and routed to a safe place of discharge as required by the local codes. The maximum allowable vent line length is limited to 5 m (17 ft.) when using 3/8" vent to protect the low pressure switch from over-pressurization. Refer to the applicable gas code for appropriate pipe size if vent line must extend beyond 5m (17 ft.). Be sure to transfer the screen fitting to the end of the remote vent line (if applicable) to protect it from blockage.

It is extremely important to terminate the remote vent line in such a way that water cannot enter the vent line and freeze. Do not allow ice to build up at the open vent connection or the remote vent line termination. The vent line must remain clear if it is to be able to vent gas and protect the Blow-down System from over-pressurization.

Field Wiring

The VRA has been wired at the factory and is ready for connection to the electrical service. The junction box can be accessed by opening the *service cover* of the VRA (*See Figure.4*). Three No. 16 gauge wires have been provided; Line 1, Line 2, and a grounding conductor. The connections can be made with any approved wire splicing devices such as wire nuts. The junction box incorporates 7/8" knock-outs to accept various wiring methods (e.g. armoured liquid-flex, BX, portable cable with strain relief, etc.). The cable/conduit is passed through one of the two cable passthrough openings located on either side of the piping bulkhead (the left-hand passthrough opening is most convenient) and then routed up to the junction box.

The electrical wiring must comply with the latest revision of the Canadian Electrical Code Part I in Canada, or the National Electrical Code NEC in the United States and the requirements of the authority having jurisdiction. Each branch circuit feeding the VRA should be protected from overcurrent by a separate 2-pole circuit breaker, or time delay fuse disconnect. In addition to the overcurrent protection device, an emergency disconnect should be located within sight and within 30 feet of the VRA. If allowed by

local codes, a manually operated general purpose AC switch rated at 15A 240 VAC housed in a suitable enclosure, may be used as the emergency disconnect.

Low-voltage wiring is required when connecting an interlocking (remote shutdown) device such as a *natural gas detector*. The low-voltage wiring can be routed into the VRA adjacent to electrical supply cable or conduit, and connected to the terminal strip on the electronics board as shown in Figure 3 (do not run low-voltage wiring and electrical supply wiring within the same conduit). The interlocking device should be selected to provide a 12 VDC Normally-On signal. Once the interlocking device has been installed, the VRA, must be programmed to acknowledge the presence of the device.

Field Programming

A programming device is available from FuelMaker Corporation to allow the installer or service personnel to change the following parameters in the field:

- recognition of remote panel connected
- maximum tank volume, 140 or 280 litres (37 or 74 US gal.)
- recognition of remote shutdown device (eg. Natural Gas Detector) connected
- pressure rise monitoring ON/OFF

Upon receipt of a new VRA, the parameters have been factory-set to: *Remote Panel* not connected (OFF), 280 litres, and pressure rise monitoring ON. The programming device is connected to the *Electronics Module* via the programming device connection located underneath the *Electronics Module* (*See Figure 4*). Follow the instructions included with the programming device.

IMPORTANT

After the changing of any of the settings, the unit must be powered down at the main electrical switch (NOT the STOP button only) for 1 minute and turned on again. If this procedure is not followed, the settings may not change.

The VRA monitors the pressure rise at the fill hose during refueling in order to check for possible leaks. A leak is presumed if the pressure does not rise at a sufficient rate. Since the rate of pressure rise depends on the volume of the vehicle cylinder(s), some adjustment must be made to ac-

commodate the slower pressure rise associated with the larger cylinder(s). The programming device provides such an adjustment. For the greatest leak detection sensitivity, the lowest cylinder setting should be used, where possible. In the rare case where the tank volume is in excess of 280 litres, or where the VRA is connected to ground storage or piping system exceeding 280 litre water capacity, the pressure rise

monitoring system must be programmed OFF. This setting should not be used unless absolutely necessary and the User must be made aware that fill hose leakage will not be monitored.

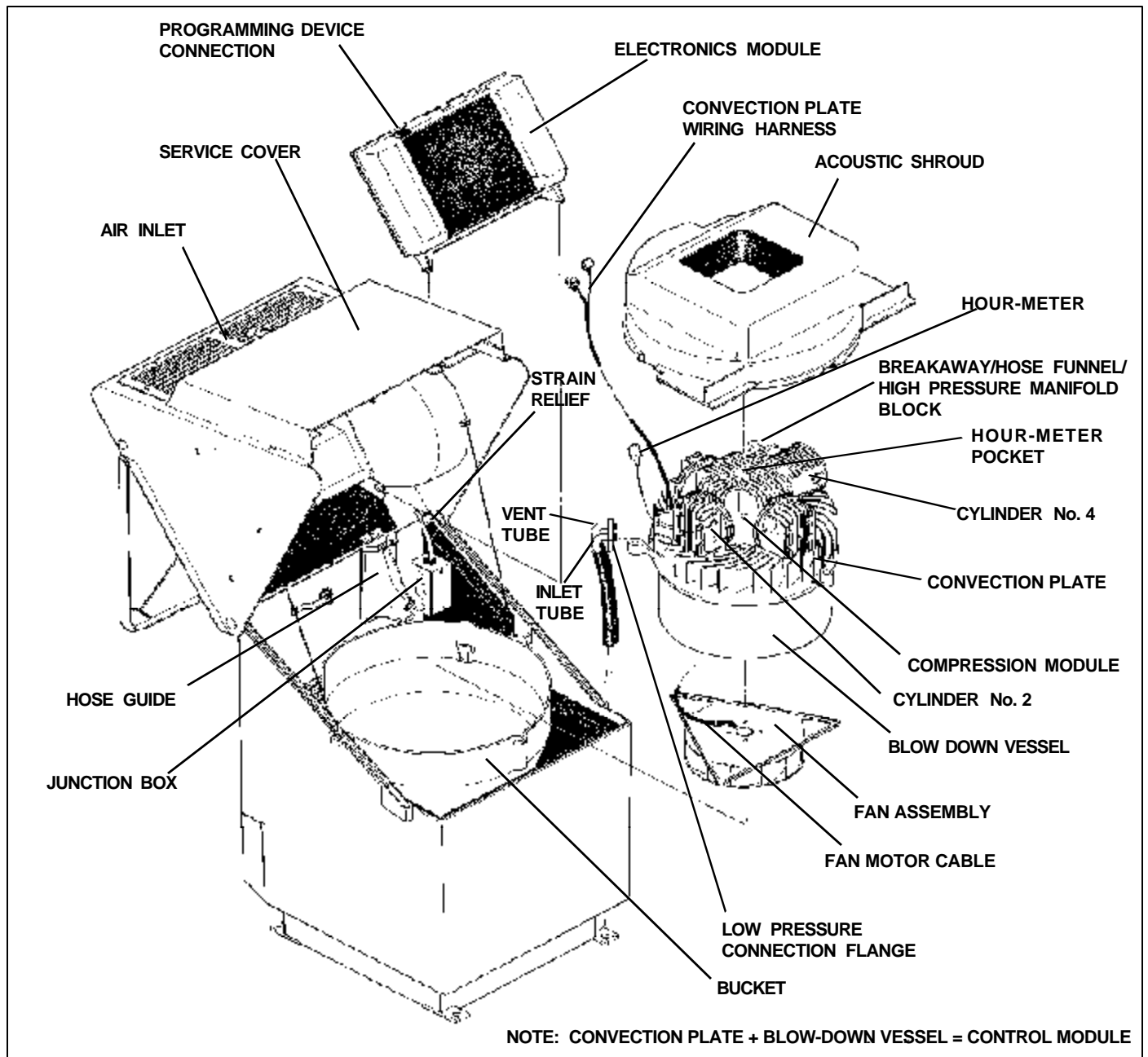


Figure 4 FuelMaker Main Components



3.4 TESTING AND COMMISSIONING

To commission (and service) the VRA, an approved high pressure test cylinder is required. A *test kit* is available from FuelMaker Corporation, complete with a CGA/AGA NGV 1 vehicle refueling receptacle, a hand-operated vent valve, and a calibrated pressure gauge.

Purge the Natural Gas supply piping of air as follows:

- Attach the fill hose to the *test kit* via the refueling nozzle, and then open the vent valve.
- Purge the VRA of air by running it on natural gas and venting the gas through the *test kit* vent valve for 30 seconds.
- Verify that the cooling fan is operating by checking for air flow out of the front grill.
- After purging, close the vent valve and allow the VRA to fill the test cylinder until the VRA shuts off with the "Vehicle Full" indication on the *user panel* (e.g. yellow lamp illuminated steadily). The *test kit* cylinder should be full within 13 minutes for models FMQ-2 and FMQ-2-36; 10 minutes for model FMQ-2.5, and the shut-off pressure should be within the allowable limits as indicated in Table 2 & Table 3.

- If the shutdown pressure is out of tolerance, refer to Section 6 "Service Instructions" on page 20, in this manual.

Following installation, the fittings should be leak-tested using a suitable soap solution. The high pressure connections should be leak-checked while the VRA is in operation filling the *test kit* cylinder in the range of 238 to 248 bar (3450-3600 psig) for FMQ-2-36 and 190 to 200 bar (2760-2900 psig) for FMQ-2/FMQ-2.5. As a minimum, the following locations must be leak-tested:

- All inlet piping connections
- All high-pressure piping connections including the break-away fitting(s) and refueling nozzle(s)
- The screen fitting at the end of the vent line (small leaks from the pressure relief valve may not be detected by the VRA's fault diagnostic system). Ensure that the leak-detection fluid does not freeze and block the vent line.

Safety precautions require that the FuelMaker's internal components be inaccessible to the user and other unauthorized persons. Therefore, before leaving the site, authorized personnel **must** ensure that the service cover is locked with a safety seal. (See Figure 2. Page 4).

| | |
|--------------------------------|----------------------------------|
| 207 ± 7.0 bar @ 21°C and above | 3000 ± 100 psig @ 70°F and above |
| 183 ± 7.5 bar @ 10°C | 2660 ± 110 psig @ 50°F |
| 166 ± 8.0 bar @ 0°C | 2410 ± 115 psig @ 32°F |
| 150 ± 8.5 bar @ -10°C | 2180 ± 120 psig @ 14°F |
| 133 ± 9.0 bar @ -20°C | 1930 ± 130 psig @ -4°F |
| 116 ± 9.5 bar @ -30°C | 1690 ± 135 psig @ -22°F |
| 100 ± 10 bar @ -40°C | 1450 ± 145 psig @ -40°F |

At temperatures below -45°C (-49°F) and +55°C (131°F) the micro-processor will not allow the FuelMaker to start, and indicate an "Incorrect" condition at the *user panel*.

Table 2 Shutdown Pressure vs Ambient Temperature for FMQ-2 & FMQ-2.5

| | |
|--------------------------------|----------------------------------|
| 248 ± 7.0 bar @ 15°C and above | 3600 ± 100 psig @ 59°F and above |
| 232 ± 7.5 bar @ 10°C | 3370 ± 110 psig @ 50°F |
| 210 ± 8.0 bar @ 0°C | 3050 ± 115 psig @ 32°F |
| 188 ± 8.5 bar @ -10°C | 2730 ± 120 psig @ 14°F |
| 165 ± 9.0 bar @ -20°C | 2390 ± 130 psig @ -4°F |
| 143 ± 9.5 bar @ -30°C | 2073 ± 135 psig @ -22°F |
| 121 ± 10 bar @ -40°C | 1754 ± 145 psig @ -40°F |

At temperatures below -45°C (-49°F) and +55°C (131°F) the micro-processor will not allow the FuelMaker to start, and indicate an "Incorrect" condition at the *user panel*.

Table 3 Shutdown Pressure vs Ambient Temperature for FMQ-2-36

4 USER PANEL OPERATION

Starting, stopping and monitoring of the VRA takes place at the *User Panel*. The *User Panel* has separate "START" and "STOP" buttons and three indicator lights, as shown in Figure 5.

After shut-down the pressure in the refueling hose will be automatically reduced to less than 2 bar (29 psig), making it possible to disconnect the refueling nozzle from the vehicle.

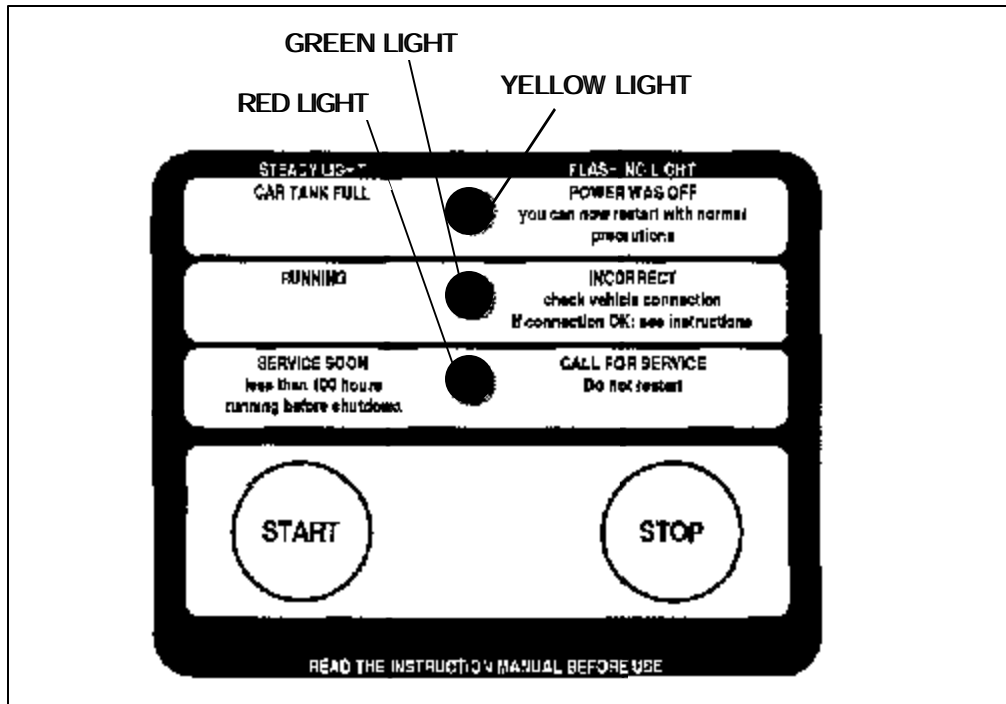


Figure 5 - User Panel

The lights on the *user panel* indicate the following conditions:

4.1 USER PANEL INDICATIONS

| INDICATION | DESCRIPTION |
|----------------------|---|
| No Light Illuminated | READY to start, or electrical power is disconnected or fuses require replacement. Note: If a power failure lasts less than 15 seconds, the VRA will start automatically 15 seconds after the return of power (provided it was running before the power failure). |
| Yellow Light Steady | VEHICLE CYLINDER(S) FULL The vehicle is full or the maximum pressure has been reached in a disconnected fill hose. The VRA can be restarted by pressing the START button. |
| Green Light Steady | RUNNING The VRA is running. |
| Red Light Steady | SERVICE SOON The VRA will run for another 100 hours after which it will shut down if not serviced. Note: During the last 100 hours of operation, both the green light and red light will illuminate steadily while the VRA is in operation. |



4.2 ABNORMAL USER PANEL INDICATIONS (FLASHING LIGHTS)

| INDICATION | DESCRIPTION |
|--|--|
| Yellow Light Flashing | <p>POWER WAS OFF for more than 15 seconds. Press START to operate the FuelMaker. Note: If the power failure lasts for less than 15 seconds, the FuelMaker will start automatically 15 seconds after the return of power (provided it was running before the power failure).</p> |
| Green Light Flashing | <p>INCORRECT - The Fuelmaker is shut down in an INCORRECT state but may be restarted by the User if the fault is corrected. The most common causes of an "INCORRECT" indication will be:</p> <ul style="list-style-type: none"> - incorrect or damaged connection to the vehicle. - gas supply shut-off valve closed. - blockage of FuelMaker air vents. - faulty filling hose (e.g. leak) <p>excessive filling time (25 hours continuous running).</p> |
| <p>Note: Vehicles with total tank capacities in excess of 140 litres (37 US gal) may take longer than 25 hours to fill from empty under certain conditions (e.g. high ambient temperature, <i>Compression Module</i> approaching service interval, etc.) In this case, a thorough check for gas leakage shall be conducted. The VRA may be simply restarted after a positive check that there is no other cause of the "INCORRECT" indication. If the User is routinely filling vehicles with a cylinder capacity greater than 140 litres, the maximum tank volume can be set using a programming device.</p> <p>Details on the above faults are given in the "FAULT DIAGNOSTICS" tables. When the above have been checked and any obvious faults corrected, the unit may be restarted after first pressing the "STOP" button.</p> | |
| Red Light Flashing | <p>CALL FOR SERVICE - The VRA is shut down and a CALL FOR SERVICE is necessary. The automatic safety system will prevent a restart unless the fault is corrected by authorized personnel.</p> |
| Yellow, Green and Red lights flashing (simultaneously) | <p>HOURLY-METER MISSING - The VRA is shut down and the automatic safety system will prevent a restart. IMPORTANT: Before plugging the <i>hour-meter</i> into the <i>Electronics Module</i> circuit board, the main electrical power must be disconnected. Hour-meter data will be destroyed if power is not disconnected and the VRA will not re-start unless the <i>Compression Module</i> is changed.</p> |
| Yellow, Green and Red lights flashing (sequentially) | <p>SYSTEM LOCKOUT FOR APPROXIMATELY 15 SECONDS - The VRA automatic safety system will prevent immediate restart due to internal requirements.</p> |



**4.3 INDICATOR LIGHTS CHECK:
(FUELMAKER NOT RUNNING)**

To check that the indicator lights are working correctly, press and hold the **STOP** button. All three indicator lights should light briefly (about one second) and then go out. If no indicator lights come on, there is probably no power to the *Electronics Module* or the fuses require replacement. (If one or more indicator lights fail to illuminate there is probably an error in the *User Panel*).

4.4 SERVICE HOURS:

Table 3 displays the operating hours until the VRA requires service (or hours since service up to the first 50 hours). To obtain the indications, the following button(s) have to be pressed:

When the VRA is **"RUNNING"**:
Press and hold the **"START"** button.

When the VRA is not running:
First press and hold the **"STOP"** button, then press the **"START"** button.

After the code is displayed, release the **"START"** button first, followed by the **"STOP"** button (the VRA will not start if this sequence is not followed)

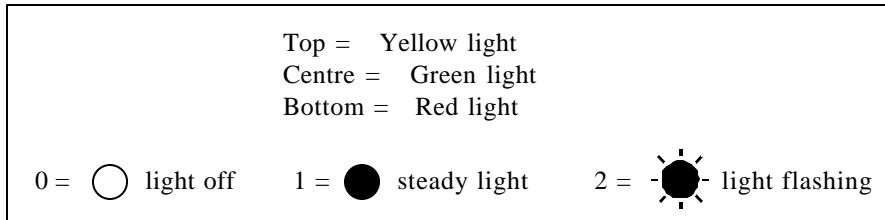
At first, all lights are illuminated briefly as a light check. The light check is followed by the operating hours check.

| | (1 = steady light; 0 = off) | | | | | | | |
|---------------|-------------------------------|--------|--------------------------------------|----------|----------|----------|---------|--------|
| Yellow | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| Green | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| Red | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| | Hours since service | | Hours remaining until service | | | | | |
| Hours | fault or no power | 0 - 49 | 650- Max. | 350- 649 | 250- 349 | 150- 249 | 50- 149 | 0 - 49 |

table 4 - Hours remaining before service

5 FAULT DIAGNOSTICS (Software Version 64):

The VRA has diagnostic capabilities both in the "INCORRECT" (green light flashing) and the "CALL FOR SERVICE" (red light flashing) mode. To display the cause of an "INCORRECT" or a "CALL FOR SERVICE" mode, press and hold the "STOP" button. Tables 4 and 5 show the fault diagnostics and corrective actions. The digits 0, 1 and 2 in Tables 4 and 5 correspond to the following light status.



5.1 DIAGNOSTICS WHEN IN "INCORRECT" MODE (GREEN LIGHT FLASHING) :

Pressing and holding the "STOP" button first acts as a light check by illuminating all 3 lights briefly. After this brief delay, error codes are displayed:







| ERROR CODE | DESCRIPTION | CORRECTIVE ACTION |
|---|---|---|
| <p>0  YEL off</p> <p>0  GRN off</p> <p>0  RED off</p> | <p>Error indication lost or error in display, <i>Electronics Module</i>, or in connecting cables.</p> | <p>Check power and lights by pressing and holding "STOP" button. All lights should illuminate briefly.</p> <p>If OK: try normal filling procedure. If fault persists, check fuses. If fuses OK and fault persists, fit new <i>Electronics Module</i>.</p> <p>Test VRA and re-seal.</p> |
| <p>0  YEL off</p> <p>0  GRN off</p> <p>1  RED steady</p> | <p>Excessive motor temperature</p> | <p>Check <i>Cooling Fan</i> operation. Check the 60Hz input voltage (should be between 200 - 252V for FMQ-2 and 216 - 252V for FMQ-2.5/FMQ-2-36). For 50Hz input voltage is 200 - 252V for FMQ-2/FMQ-2.5/FMQ-2-36. If OK: Check for stuck relay contacts (lack of distinctive sound change after 7 seconds of operation). If stuck, fit a new <i>Electronics Module</i>. If fault persists, check if cooling air path is clear. If OK: try normal filling procedure. If fault persists, replace <i>Fan Assembly</i>. If fault persists, remove <i>Compression Module</i>. If the rotor shaft is stiff or seized, fit a new <i>Compression Module</i>. If rotor is showing signs of overheating, or damage, fit a new <i>Compression Module</i> and <i>Control Module</i>. If OK: refit old <i>Fan Assembly</i>. Note: Overheating may occur if the inlet pressure is above 14 KPa (2 psig) for FMQ-2 or above 3.4 KPa (0.5 psig) for FMQ-2.5/FMQ-2-36 and/or the ambient temperature is above 45°C (113°F). Also if the input voltage drops below the tolerances noted above. Test and purge FuelMaker, re-seal.</p> |

Table 5 - Diagnostics for "INCORRECT" Mode.



VEHICLE REFUELING APPLIANCE

MODEL FMQ-2/FMQ-2.5/FMQ-2-36

| ERROR CODE | DESCRIPTION | CORRECTIVE ACTION |
|--|---|--|
| <p>0 <input type="radio"/> YEL off</p> <p>1 <input checked="" type="radio"/> GRN steady</p> <p>0 <input type="radio"/> RED off</p> | <p>Insufficient rise of filling pressure at beginning of fill cycle, and below 20 bar g (290 psig).</p> | <p>Check that refueling nozzle is properly connected to vehicle.</p> <p>If OK: check that total vehicle cylinder volume does not exceed the maximum volume of 140 litres (37 U.S. gal.) [may be reset to 280 litres (74 U.S. gal.) -refer to Field Programming in Section 3.3.</p> <p>If OK: check high-pressure system for leaks.</p> <p>If OK: turn off gas supply and start VRA. VRA should shut down within 1 minute indicating "INCORRECT" and display code 101. If FuelMaker does not shut down within 1 minute, the <i>Compression Module</i> may have a blown burst disk. Fit a new <i>Compression Module</i>.</p> <p>If shutdown OK: restore gas supply, connect empty <i>Test Kit</i> and check cylinder filling time. If cylinder filling time is above 13 minutes for model FMQ-2 and FMQ-2-36; 10 minutes for model FMQ-2.5, Check <i>combination valve</i>, if okay, fit a new <i>Compression Module</i>.</p> <p>If fault persists, fit a new <i>Electronics Module</i>.</p> <p>If OK with the new <i>Electronics Module</i>, refit original <i>Compression Module</i>.</p> <p>Test and purge VRA, re-seal.</p> |
| <p>0 <input type="radio"/> YEL off</p> <p>1 <input checked="" type="radio"/> GRN steady</p> <p>1 <input checked="" type="radio"/> RED steady</p> | <p>Sudden pressure drop in high pressure system to below 20 bar g (290 psig).</p> | <p>Check high pressure system for leaks.</p> <p>If OK: start VRA with refueling nozzle disconnected from vehicle (approved refueling nozzles will seal when disconnected from vehicle). Allow VRA to run until "FULL" is indicated.</p> <p>If VRA continues to run for longer than 1 minute with disconnected refueling nozzle, fit new <i>Control Module</i>.</p> <p>Test and purge FuelMaker, re-seal.</p> |

Note: Error Code 011 can also result from:

- a) Filling two vehicles simultaneously if either of the vehicle check valves stick, or if a second vehicle is connected while the VRA is running. **To start filling procedure, always connect the refueling nozzle to the vehicle receptacle first, open the nozzle shut-off valve if provided, and subsequently start the FuelMaker.**
- b) Hydrate (ice) blockages (snow-like) within the fill hose fittings that are suddenly blown clear. Low temperatures and wet gas contribute to hydrate formation.

Table 5 - Diagnostics for "INCORRECT" Mode (continued)



VEHICLE REFUELING APPLIANCE

MODEL FMQ-2/FMQ-2.5/FMQ-2-36

| ERROR CODE | | DESCRIPTION | CORRECTIVE ACTION |
|---|----------------|--|---|
| 0 | ○ YEL off | External interlock (remote shut-down) | Check condition which caused interlock (if an external interlock has been installed). Restart the unit, if safe to do so. |
| 2 | ⊙ GRN flashing | | |
| 1 | ● RED steady | | |
| 1 | ● YEL steady | Temperature too low or failure of temperature sensor. | Restart unit if cause was temperature below -45° C (-49°F). Otherwise , fit a new <i>Electronics Module</i> (or the <i>User Panel</i> in the remote, if installed). Test VRA, re-seal. |
| 0 | ○ GRN off | | |
| 0 | ○ RED off | | |
| 1 | ● YEL steady | Insufficient inlet pressure | On 7" w.c. (1.7 kPa) systems, check that the main Natural Gas supply valve is open and that adequate pressure is present at the inlet to the VRA during operation . Ensure that the VRA is connected with 1" supply piping (minimum) [3/4" piping can be used if supply piping is less than 10 feet (3 metres) long.] Piping must be arranged to minimize pressure drop and regulator must be set for 7" w.c. (1.7 kPa) at full gas flow. Model FMQ-2 can be supplied with up to 2 psig (14 kPa) gas inlet pressure. Models FMQ-2.5 and FMQ2-36 can be supplied with up to .5 psig (3.4 kPa). Note: The unit will shut down below 5.2" (1.3 kPa) w.c. with air temperature of approximately 20°C (68°F). Test by restarting the unit with all other gas appliances operating (furnace, dryer, water heater etc.) If fault persists , fit a new <i>Control Module</i> . If fault persists , fit a new <i>Electronics Module</i> and refit the original <i>Control Module</i> . Test and purge VRA, re-seal |
| 0 | ○ GRN off | | |
| 1 | ● RED steady | | |
| <p>NOTE: This error code may appear, if VRA is started prior to turning on the unit's gas valve.</p> | | | |

Table 5 - Diagnostics for "INCORRECT" Mode (continued)



VEHICLE REFUELING APPLIANCE

MODEL FMQ-2/FMQ-2.5/FMQ-2-36

| ERROR CODE | | DESCRIPTION | CORRECTIVE ACTION |
|------------|----------------|---|--|
| 1 | ● YEL steady | Excessive surface temperature or failure of temperature sensor while VRA is running. | <p>Check to see if the cooling air path is clear, the fan inlet at bottom of the bucket is not blocked and the <i>Acoustic Shroud</i> is in place. If OK: fit a new <i>Electronics Module</i>.</p> <p>If fault persists, replace the <i>Fan Assembly</i>. If OK: re-fit old <i>Electronics Module</i>.</p> <p>If fault persists, fit a new <i>Controls Module</i>. If OK: re-fit old <i>Fan Assembly</i>.</p> <p>Test and purge VRA, re-seal.</p> |
| 0 | ○ GRN off | | |
| 2 | ● RED flashing | | |
| 1 | ● YEL steady | Stop button sequencing error. | <p>Press "STOP" button then "START" button to restart the unit. If fault persists, replace the <i>Electronics Module</i>.</p> <p>Test VRA, re-seal.</p> |
| 1 | ● GRN steady | | |
| 0 | ○ RED off | | |
| 1 | ● YEL steady | Electronics error. | <p>Press "STOP" button then "START" button to restart the unit. If fault persists, replace the <i>Electronics Module</i>.</p> <p>Test VRA, re-seal.</p> |
| 1 | ● GRN steady | | |
| 1 | ● RED steady | | |
| 1 | ● YEL steady | No storage of operating hours during last power failure. | Restart the unit. |
| 1 | ● GRN steady | | |
| 2 | ● RED flashing | | |
| 1 | ● YEL steady | Failure or motor controls. | <p>Restart the unit.</p> <p>If fault persists, replace the <i>Electronics Module</i>.</p> |
| 2 | ● GRN flashing | | |
| 0 | ○ RED off | | |

Table 5 - Diagnostics for "INCORRECT" Mode (continued)



VEHICLE REFUELING APPLIANCE

MODEL FMQ-2/FMQ-2.5/FMQ-2-36

| ERROR CODE | | DESCRIPTION | CORRECTIVE ACTION |
|------------|----------------|--|--|
| 1 | ● YEL steady | Excessive Pressure Rise | Ensure that the refueling hose is properly connected to the vehicle or <i>Test Kit</i> . If OK: Check for refueling hose blockage. Test VRA, re-seal |
| 2 | ● GRN flashing | | |
| 1 | ● RED steady | | |
| 1 | ● YEL steady | Maximum running time exceeded (more than 25 hours) | Verify that the maximum vehicle cylinder volume does not exceed the maximum volume of 140 litres (37 U.S. gal.) [may be set to 280 litres (74 U.S. gal.)]. If OK: check for leaks. If OK: check flow rate of <i>Compression Module</i> by filling empty <i>Test Kit</i> . If filling time is above 13 minutes for model FMQ-2 and FMQ-2-36; 10 minutes for model FMQ-2.5 , fit a new <i>Compression Module</i> . If fault persists , fit a new <i>Electronics Module</i> and refit the original <i>Compression Module</i> . |
| 2 | ● GRN flashing | | |
| 2 | ● RED flashing | | |
| 2 | ● YEL flashing | Power was off. | Restart the unit. |
| 0 | ○ GRN off | | |
| 0 | ○ RED off | | |
| 2 | ● YEL flashing | Failure of Blow-down System. | Check the voltage to the combi-valve , [black wire (P383-1) white wire (P383-2) contained in the <i>Controls Module connector</i> (P383), see Figure 17 on page 30]. With VRA not running the reading should be 0 Volts, when running the reading should be 8 Volts. If indications are not correct , replace the <i>Electronics Module</i> . If indications are correct and the refueling nozzle is difficult to disconnect , reduce pressure in the hose by closing the valve between the vehicle cylinder(s) and engine, then start and run the engine until it quits. Open the fuel supply valve and restart the unit. If fault persists , fit a new <i>Control Module</i> . Test and purge VRA, re-seal. |
| 0 | ○ GRN off | | |
| 1 | ● RED steady | | |

table 5 - Diagnostics for "INCORRECT" (continued)



| ERROR CODE | | DESCRIPTION | CORRECTIVE ACTION |
|---|--------------|--|--|
| 2 | YEL flashing | Insufficient pressure rise with tank pressure exceeding 20 bar g (290 psig) or beyond 6 minutes after start up [with 280 litre (74 U.S. gal.) setting: 14 minutes] | <p>Check high pressure system for leaks.</p> <p>If OK: turn off gas supply and restart the FuelMaker. It should shut down within 1 minute indicating "INCORRECT" 101.</p> <p>If FuelMaker does not shut down within 1 minute, fit a new <i>Compression Module</i>.</p> <p>If shutdown OK, restore gas supply, connect <i>Test Kit</i> and check filling time.</p> <p>If filling time is over 13 minutes for model FMQ-2 and FMQ-2-36; 10 minutes for model FMQ-2.5, check test kit guage, if no pressure rise, fit a new <i>compression Module</i>.</p> <p>If fault persists, fit a new <i>Control Module</i>.</p> <p>If OK with the new Control Module, refit the original <i>Compression Module</i>.</p> <p>Test and purge VRA, re-seal.</p> |
| 1 | GRN steady | | |
| 0 | RED off | | |
| <p>Note: This shutdown function is not operative if the pressure rise monitoring override has been programmed (refer to Field Programming in section 3.3 of this manual).</p> | | | |
| 2 | YEL flashing | Faulty Hour-meter | <p>Check for proper engagement of the <i>hour-meter</i> in the <i>Electronics Module</i>.</p> <p>If OK: replace the <i>Compression Module</i> (with the <i>hour-meter</i> attached).</p> <p>If condition persists, fit a new <i>Electronics Module</i> and refit the original <i>Compression Module</i>.</p> <p>Test and purge VRA, re-seal.</p> |
| 2 | GRN flashing | | |
| 0 | RED off | | |
| <p>Note: Make sure electrical power is disconnected before connecting or disconnecting the hourmeter</p> | | | |

Table 5 - Diagnostics for "INCORRECT" (continued)

5.2 DIAGNOSTICS WHEN IN "CALL FOR SERVICE" MODE (RED LIGHT FLASHING):

Pressing and holding the "STOP" button first acts as a light check by illuminating all three lights briefly. After this brief delay, the error codes described in Table 5 are displayed by pressing and holding the "STOP" button. Up to five error conditions are stored and retrieved by respectively pressing the "START" button (while the "STOP" button remains pressed continuously) until the 222 indication (end of stored messages) is given. After the appropriate corrective action is taken, as indicated in Table 5, the reset button (shown in Figure 3) should be pushed to clear the error.










| ERROR CODE | | DESCRIPTION | CORRECTIVE ACTION |
|------------|--|--|---|
| 0 |  YEL off | Error indication lost or error in display, <i>Electronics Module</i> , or in connecting cables. | Check power and lights by pressing and holding "STOP" button. All lights should illuminate briefly. If OK: try normal filling procedure. If fault persists, check fuses. If fuses OK and fault persists, fit new <i>Electronics Module</i> . Test VRA and re-seal. |
| 0 |  GRN off | | |
| 0 |  RED off | | |
| 0 |  YEL off | Service overdue | Replace <i>Compression Module</i> . Test and purge VRA, re-seal. |
| 0 |  GRN off | | |
| 2 |  RED flashing | | |
| 0 |  YEL off | Excessive blow down pressure or vehicle check valve stuck | Check that refueling nozzle is in accordance with installation instructions (combined hose length not to exceed 9 metres for FMQ-2/FMQ-2.5 and 6 metres for FMQ-2-36). If OK: Start FuelMaker with refueling nozzle disconnected from vehicle. Allow unit to run until "FULL" is indicated and blow-down is heard. If "blow-down" is OK, the problem may be either excessive total volume between VRA and vehicle/ground storage check valve or faulty vehicle/ground storage check valve; correct these if applicable. If fault persists, fit a new <i>Electronics Module</i> . If fault persists, fit a new <i>Control Module</i> , replace the original <i>Electronics Module</i> . Test VRA and re-seal. |
| 1 |  GRN steady | | |
| 2 |  RED flashing | | |

table 6 - Diagnostics for "CALL FOR SERVICE" Mode.



VEHICLE REFUELING APPLIANCE

MODEL FMQ-2/FMQ-2.5/FMQ-2-36

| ERROR CODE | | DESCRIPTION | CORRECTIVE ACTION |
|------------|--------------|--------------------------------------|--|
| 0 | YEL off | Failure of high pressure transducer. | Fit a new <i>Control Module</i> . If fault persists , fit a new <i>Electronics Module</i> . If OK : refit the original <i>Control Module</i> . Test and purge VRA, re-seal. |
| 2 | GRN flashing | | |
| 0 | RED off | | |
| 1 | YEL steady | Multiple errors | While depressing the " STOP " button, retrieve the additional error codes (up to five) with each push of the " START " button until the 222 indication (End of Stored Messages) appears. |
| 0 | GRN off | | |
| 1 | RED steady | | |
| 1 | YEL steady | Failure of motor controls | Restart FuelMaker. If fault persists , replace the <i>Electronics Module</i> . Test VRA, re-seal. |
| 2 | GRN flashing | | |
| 0 | RED off | | |
| 2 | YEL flashing | Faulty <i>hour-meter</i> | Check for proper engagement of the <i>Hour-Meter</i> in the <i>electronics module</i> . If OK : replace the <i>Compression Module</i> (with the <i>Hour-Meter</i> attached). If fault persists , fit a new <i>Electronics Module</i> and refit the original <i>Compression Module</i> . Test and purge VRA, re-seal. |
| 2 | GRN flashing | | |
| 0 | RED off | | |
| 2 | YEL flashing | End of stored messages | If the FuelMaker fails to start, check whether the <i>Hour-Meter</i> is properly engaged. If not , disconnect the main power supply and reconnect the <i>Hour-Meter</i> to the <i>Electronics Module</i> . Resume operation. |
| 2 | GRN flashing | | |
| 2 | RED flashing | | |

Table 6 - Diagnostics for "CALL FOR SERVICE" Mode (continued)



6 SERVICE INSTRUCTIONS

6.1 SERVICE INTRODUCTION

Safety precautions require that the VRA's internal components be inaccessible to the user and other unauthorized personnel, and accordingly the *service cover* is sealed by authorized service personnel before they leave the site. Only authorized service representatives may service the VRA at the user's premises.

When carrying out a service call on a VRA, the service representative should:

1. Check the Fault Diagnostics System as described in Section 5.
2. Correct the faults indicated by changing modules or correcting installation errors.
3. Test to determine if the fault has been corrected.

Any detailed service not described in this document must only be carried out by FuelMaker Corporation service staff at a factory service facility. Service undertaken by unauthorized persons may cause the VRA to operate incorrectly, may result in damage or serious injury and will void the warranty.

Service Interval

At the time of publication, FuelMaker Corporation requires that the *Compression Module* be serviced after every 3,000 hours of running time. Depending on the local gas quality or future technical advancements, the service interval may be increased beyond 3,000 hours in the future. A red lamp on the *User Panel* will begin to illuminate steadily indicating to the user that less than 100 hours of running time remaining on the VRA; if the *Compression Module* is not serviced during this period, the VRA will shut down and lock out after the final 100 hours have elapsed.

The following modules must be serviced or remanufactured at one of FuelMaker Corporation's factory service facilities only:

- **Compression Module** (after 3000 hours, or if a fault is indicated by the diagnostics)
- **Control Module** (if a fault is indicated by the diagnostics)
- **Electronics Module** (if a fault is indicated by the diagnostics)
- **Cooling Fan** (if noisy or vibrating excessively, or if a fault is indicated)

All normal safety precautions must be observed when undertaking on-site service and replacing FuelMaker modules.

Regular Service Checks

Whenever service work is performed, the checks described in section 3.4 "Testing and Commissioning" on page 8, should be performed. The VRA's shut-down pressure should correspond with the values indicated in Table 2 or 3, page 8, within the allowable limits specified. If the fill pressure is outside the allowable limits, either the *Electronics Module* or the *Control Module* requires replacement. First replace the *Electronics Module*; if the shut-off pressure is still out of tolerance then replace the *Control Module* and re-install the original *Electronics Module*. Any abnormal deviation in shut-off pressure must be reported to FuelMaker Corporation when the malfunctioning module is returned for service.

The fibre-reinforced high pressure *fill hose* connects to the *Compression Module* via a break-away fitting. The *hose* should be carefully inspected for evidence of abrasion, cuts, or kinks and should be replaced if such deterioration is found. The *break-away fitting* allows the *fill hose* to be pulled free from the VRA without damage should the User drive away without disconnecting. Pull on the *fill hose* using a force gauge and check that the break-away force does not exceed 150 N (34 lbs); if excessive, the *hose nipple* and *breakaway fitting* should be inspected for wear or damage and the faulty part replaced.



6.2 INTERCHANGABILITY OF MODULES BETWEEN FMQ-2 AND FMQ-2.5

IMPORTANT

The *Compression Modules*, *Control Modules* and *Electronic Modules* in model FMQ-2-36 are designed for 248 bar (3,600psig) service. The *Compression Modules*, *Control Modules* and *Electronic Modules* in models FMQ-2 and FMQ-2.5 are designed for 207 bar (3,000) psig service. Modules designed for 248 bar (3,600 psig) are not compatible nor interchangeable with modules designed for 207 bar (3,000 psig). Installing modules from model FMQ-2-36 into models FMQ-2 and FMQ-2.5 or vice versa could result in damage to equipment, electrical shock, fire or serious injury.

Please consult FuelMaker if you are experiencing any difficulty or are unsure about any feature.

COMPRESSION MODULES BETWEEN FMQ-2 AND FMQ-2.5

The *Compression Modules* in models FMQ-2 and FMQ-2.5 are not interchangeable. *Compression Module* for model FMQ-2 must not be installed into model FMQ-2.5 or vice versa. Interchanging *Compression Modules* between FMQ-2 and FMQ-2.5 will result in overheating or loss of flow.

ELECTRONIC AND CONTROL MODULES BETWEEN FMQ-2 AND FMQ-2.5

The *Electronic Modules* and *Control Modules* in models FMQ-2 and FMQ-2.5 are identical and therefore, are interchangeable. Please refer to Section 6.3 for module removal and replacement.

6.3 REPLACEMENT OF VRA COMPONENTS

IMPORTANT: Turn off the gas and electrical power supply before working inside the VRA. Under most circumstances the VRA can be repaired on site. In the rare case when it is necessary to remove the entire VRA, please refer to the section entitled “Removing the VRA”, on page 31.

Module Replacement Preparation

Shut off the electrical power to the VRA. Grasp the *Fill Hose* with both hands and pull out of the break-away fitting using a sharp horizontal pulling action (do not wrap the fill hose around the hands). **IMPORTANT:** Before breaking the safety seal and opening the *service cover*, ensure that the *lid* is unlocked and the key removed (if equipped), otherwise **serious damage to the plastic housing and the lock could result.** If the VRA is configured for remote or manifold filling, remove the manifold block assembly from cylinder No. 4 and transfer to replacement *Compression Module*.

If servicing cannot be completed in one visit, the following steps should be taken by the repair personnel before leaving the site: seal up all gas passage openings including the rotor hole in the *convection plate* (if the *Compression Module* has been removed, use the *service plate*), lift and lock the *Electronics Module* back into the operating position, replace the *Acoustic Shroud*, close the *Service Cover*, and then apply the *safety seal*.

Compression Module Removal

- The gas and electrical supply must be **OFF**.
- Release the latch from the the *Electronics Module* and tilt module down into servicing position (See Figure 6).
- Remove the *hour-meter* from the *Electronics Module* circuit board (See Figure 7).
- Tilt the *Electronics Module* back up and pull latch into locked position.
- Remove the *Acoustic Shroud*.
- Store the *hour-meter* in the pocket provided in the top of the compressor housing and lay the cord in the cooling fins (See Figure 8).
- Loosen the Allen head *Compression Module* mounting bolts about 4 to 5 turns until residual pressure in the *blow-down vessel* is released, but **DO NOT REMOVE THEM**. This precaution is necessary since an abnormally high pressure may exist in the *Blow-Down Vessel* under certain conditions (e.g. remote vent line plugged)
- Completely remove the 4 *Compression Module* bolts and washers (See Figure 9).
- Lift the *Compression Module* straight out of the *convection plate* and set it down on a clean surface.

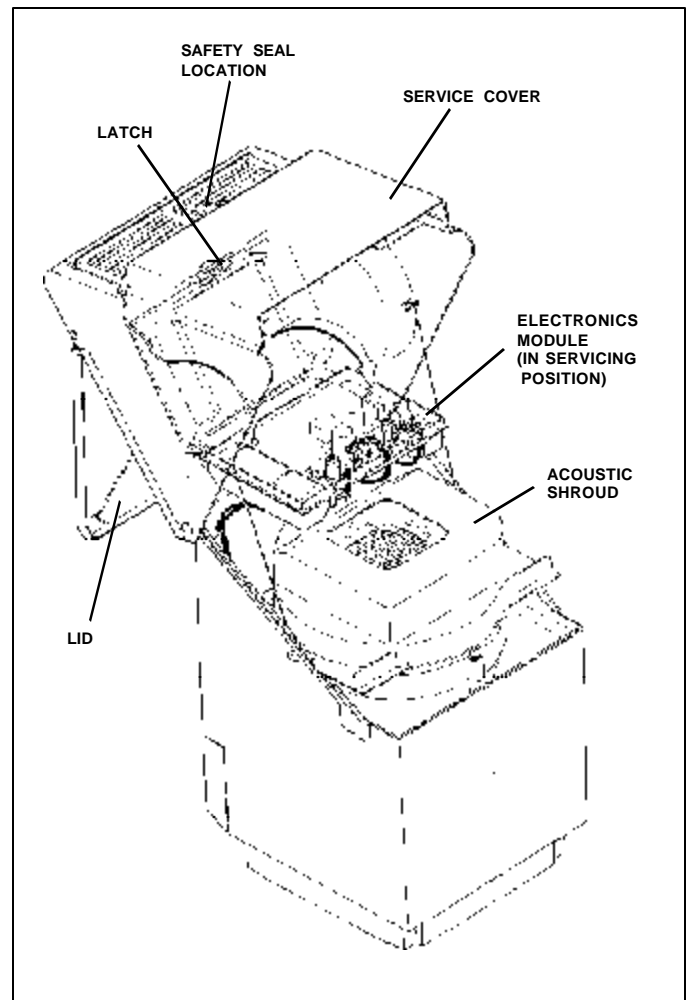


figure 6 Electronics Module in Servicing Position

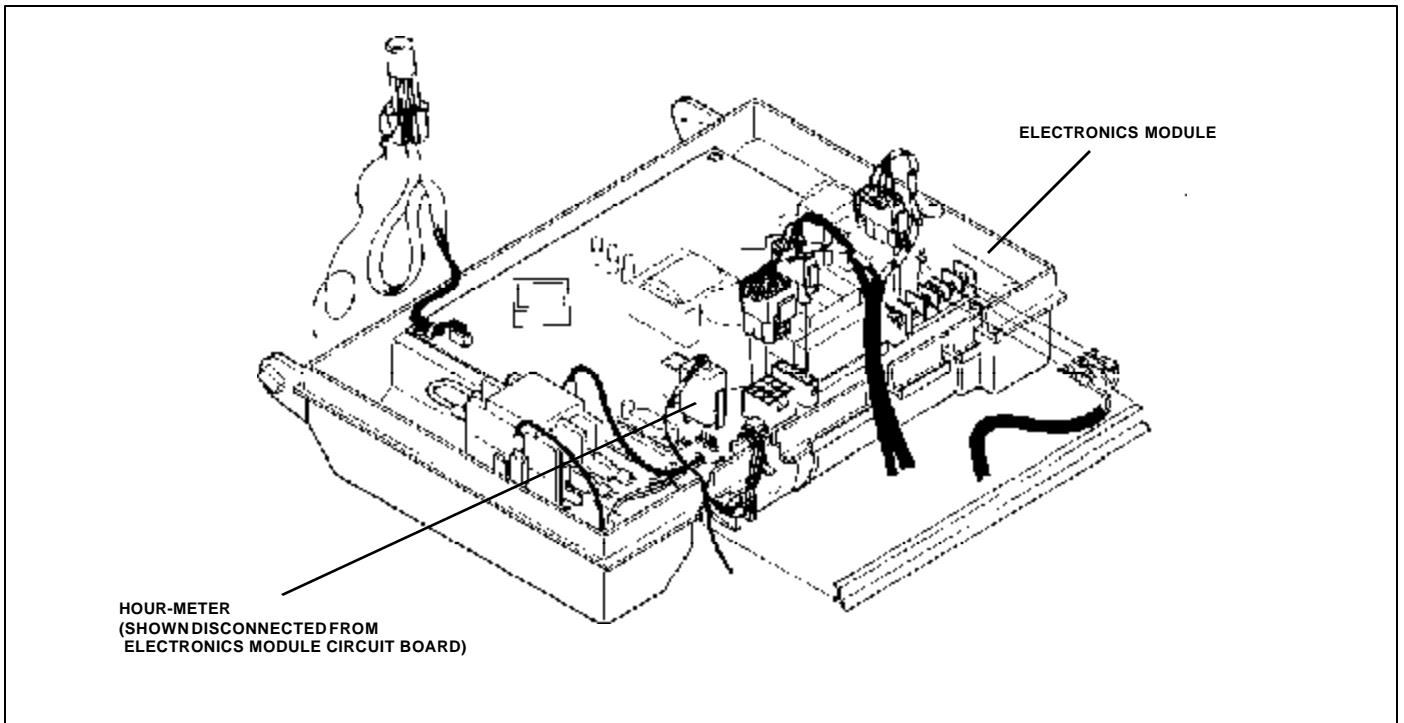


Figure 7 Hour-meter Location

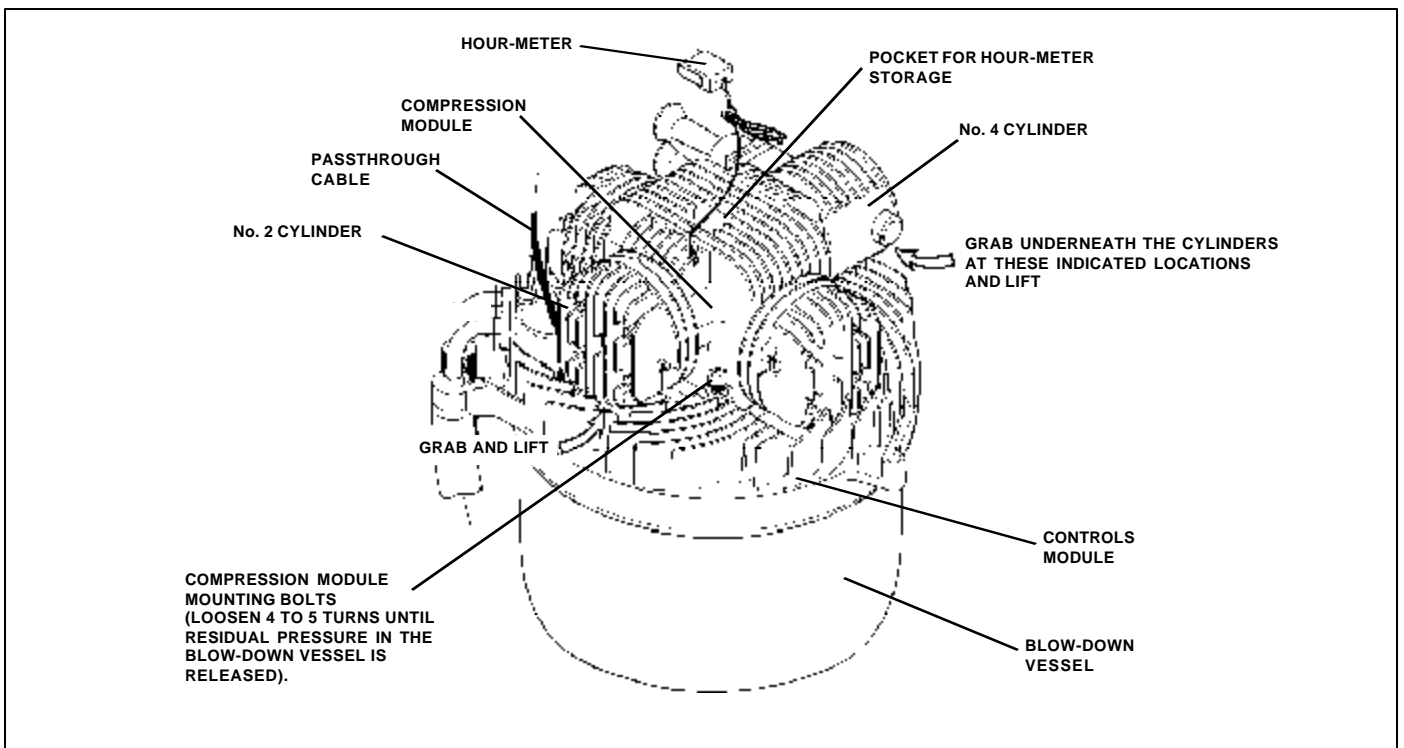


Figure 8 Hour-meter Storage Location and Blow-down Vessel Pressure Relief

CAUTION: To avoid serious damage to the *Compression Module* internal parts, do not knock the bottom of the rotor when setting the *Compression Module* down.

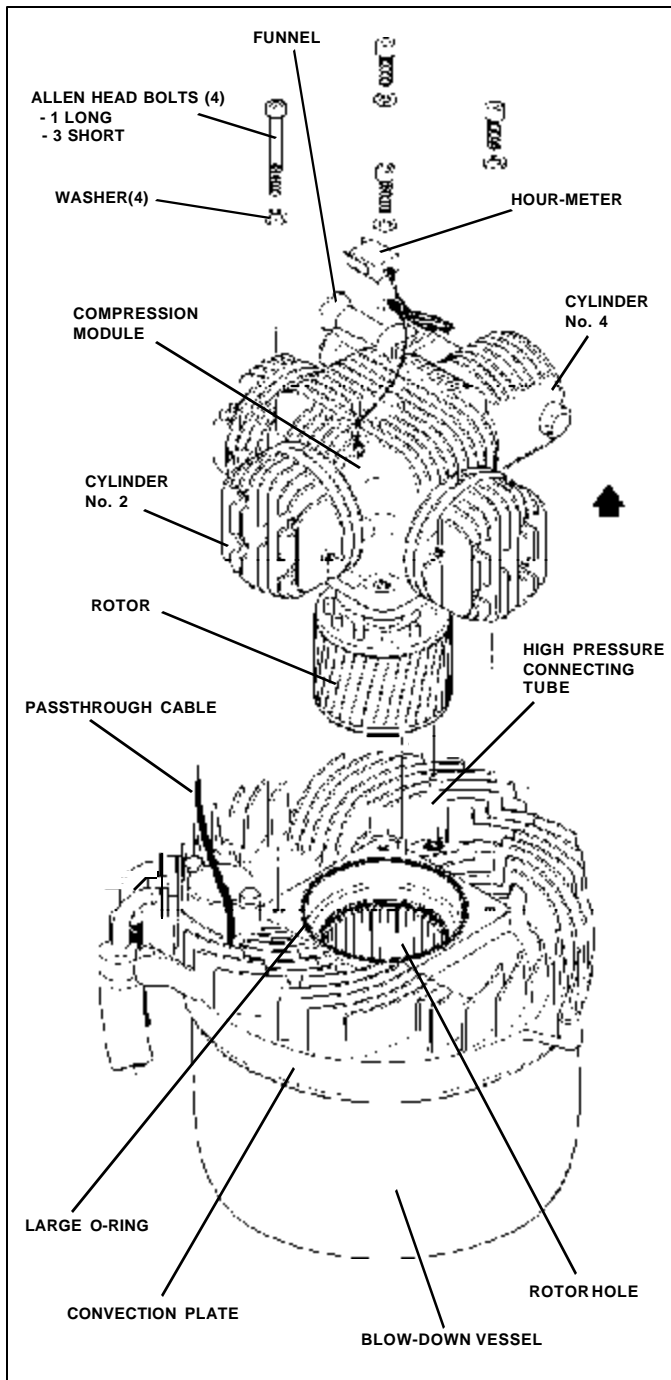


Figure 9 Compression Module Removal

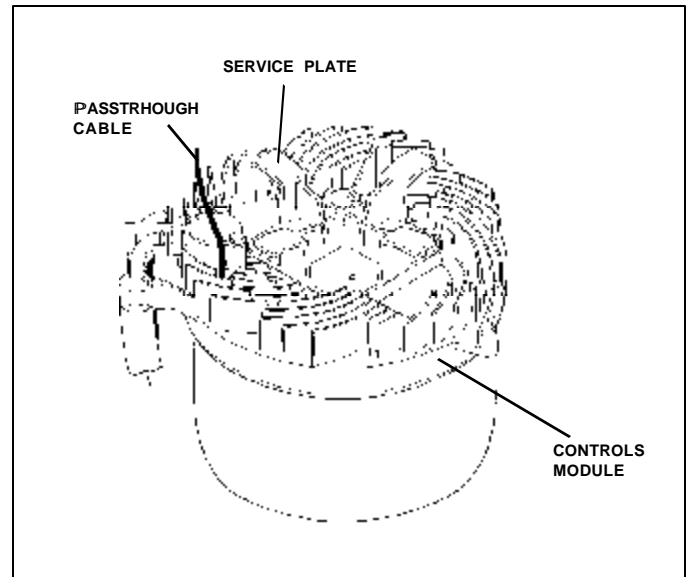


figure 10 Service Plate Location

IMPORTANT: Be sure that the *high pressure connecting tube* located beneath cylinder No.4 remains in the *convection plate* seat and not in *Compression Module* seat.

If the *high pressure connecting tube* is accidentally pulled out of the *convection plate* seat, the seat and the gas passage must be completely cleared of dirt and debris before re-inserting the *high pressure connecting tube* back into the *convection plate* seat.

- Ensure that the large *O-ring* remains in its seat in the *convection plate*.
- If the *Compression Module* will not be replaced immediately, the rotor hole in the *convection plate* must be covered with the *service plate* available from FuelMaker Corporation (See Figure 10).
- Cover all exposed gas passages on the *Compression Module* with tape.

NOTE: To prevent damage in transit - Before packaging the *Compression Module* for shipment to a maintenance/repair facility, remove and retain the *funnel* and secure the *hour-meter* in the pocket provided using tape (See Figure 9).

Compression Module Replacement

- Transfer all transportation protection from the new *Compression Module* to the one removed from the VRA.
- Ensure that the mating surfaces of the *Compression Module* and *Control Module* are clean.
- Check for proper seating of *large O-ring* in the groove of the *convection plate*.
- Closely inspect the *O-ring* on top of the *high pressure connecting tube*; replace if damaged (See Figure 11).
- Grasp the *Compression Module* by cylinders No. 2 and 4 and then orientate it so that the guide pin in the *convection plate* lines up directly with its respective hole in the *Compression Module* as shown in Figure 11.
- Gently lower the *Compression Module* onto the guide pin until it seats; **DO NOT FORCE THE MODULE DOWNWARD.**
- Reinsert the Allen head bolts (3 short, 1 long) and washers; finger tighten with an appropriate tool then alternately (diagonally) tighten each bolt another 1/8 turn.
- Unlatch and tilt the *Electronics Module* down into servicing position.
- Remove the *hour-meter* from its pocket in the *Compression Module* and plug it into the *Electronics Module* circuit board; ensure positive engagement of the retaining clip (See Figure 12).

CAUTION: Never plug the *hour-meter* into the *Electronics Module* circuit board when the main electrical power is connected.

- Tilt the *Electronics Module* back up and pull latch into locked position.

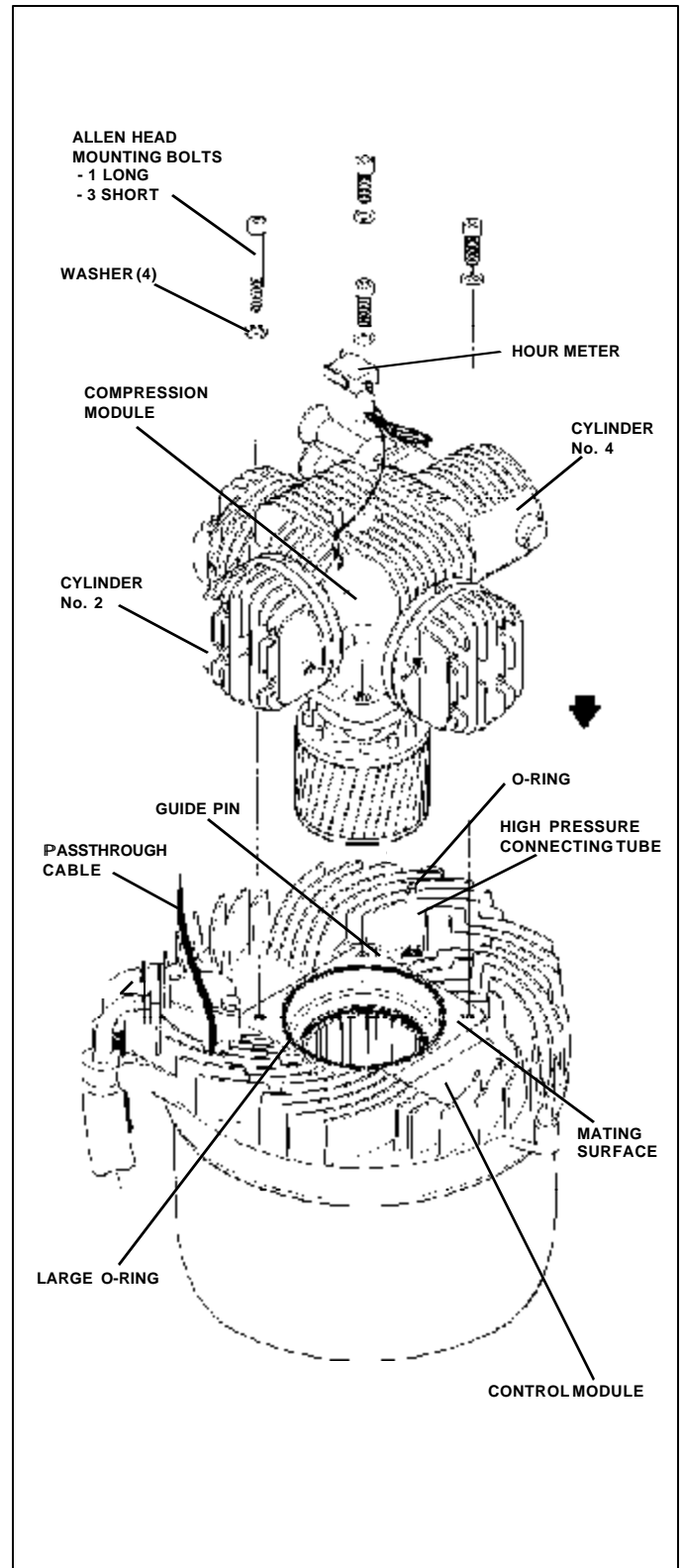


Figure 11 Compression Module Replacement

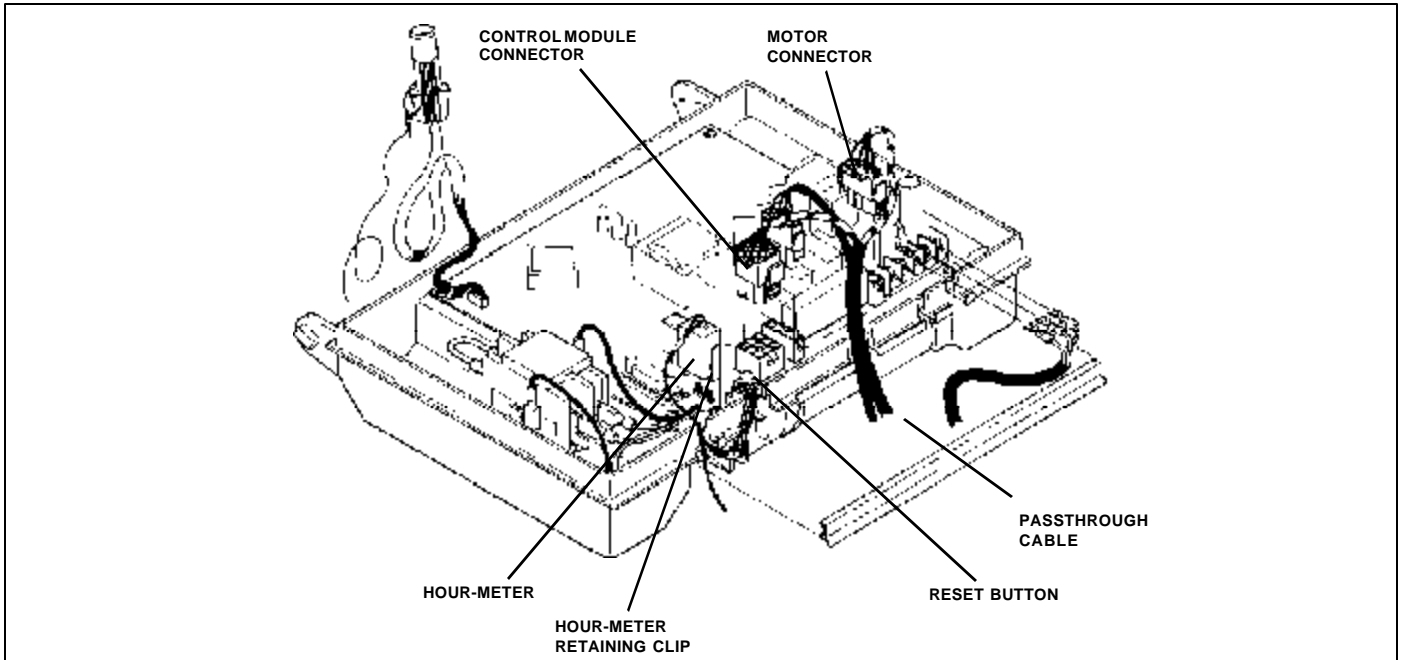


Figure 12 Compression Module Connections and Reset Button Location

NOTE: If a “Call for Service” (e.g. red light flashing) was evident before servicing the VRA, the electronics must to be “reset” by pushing the blue reset button located on the lower left corner of the *Electronics Module* circuit board (See Figure 12).

WARNING: To reset the electronics, the power supply must be switched on while the *Electronics Module* is in its lowered position, thereby exposing service personnel to **HIGH VOLTAGE** contacts.

Use **EXTREME CAUTION** when inserting fingers into the **HIGH VOLTAGE** area to push the reset button.

SWITCH OFF THE POWER SUPPLY IMMEDIATELY AFTER THE RESETTING PROCEDURE HAS BEEN ACCOMPLISHED.

Control Module Removal

- Ensure that the power supply and gas supply have been turned off.
- Remove the *Compression Module* as detailed in "Compression Module Removal" on pages 21 to 23.
- Ensure that the *high pressure connecting tube* remains installed in the *convection plate* (See Figure 11).
- Unplug the two connectors on the end of the *pass through cable*, from the *Electronics Module* (See Figure 12).
- Undo loosen the *low pressure connection flange* screw
- and pull the *inlet tube* and *vent tube* away from the manifold (See Figure 13).

Before removing the *low pressure connection flange*, **BE AWARE**, that an abnormally high pressure may exist in the *Blow-Down Vessel* under certain conditions (e.g. remote vent line plugged).

- Remove and inspect the *O-rings* on the *inlet* and *vent tubes*; replace if damaged or hard (See Figure 13).
- Re-install the *O-rings* on the *inlet* and *vent tubes*.

Control Module Removal (Cont'd)

- Remove the three *convection plate* mounting bolts from the vibration mounts, and lift the *Control Module* out of the FuelMaker.
- Plug all openings with tape; the shipping plugs from the new *Compression Module* could be used for this purpose. Plug the rotor hole in the *convection plate* with the *service plate* available from FuelMaker.
- Coil the *passthrough* cable around the outside of the *service plate* to protect the wiring.

Control Module Replacement

- Align the new *Control Module* with the *vibration mounts* in the *bucket* and lower into position.
- Install and tighten the three *convection plate* mounting bolts.
- Install the *inlet* and *vent tubes* into the low pressure manifold in the *convection plate*.
- Install the *Compression Module* following all the steps outlined in the “*Compression Module Replacement*” instructions, found on page 24.

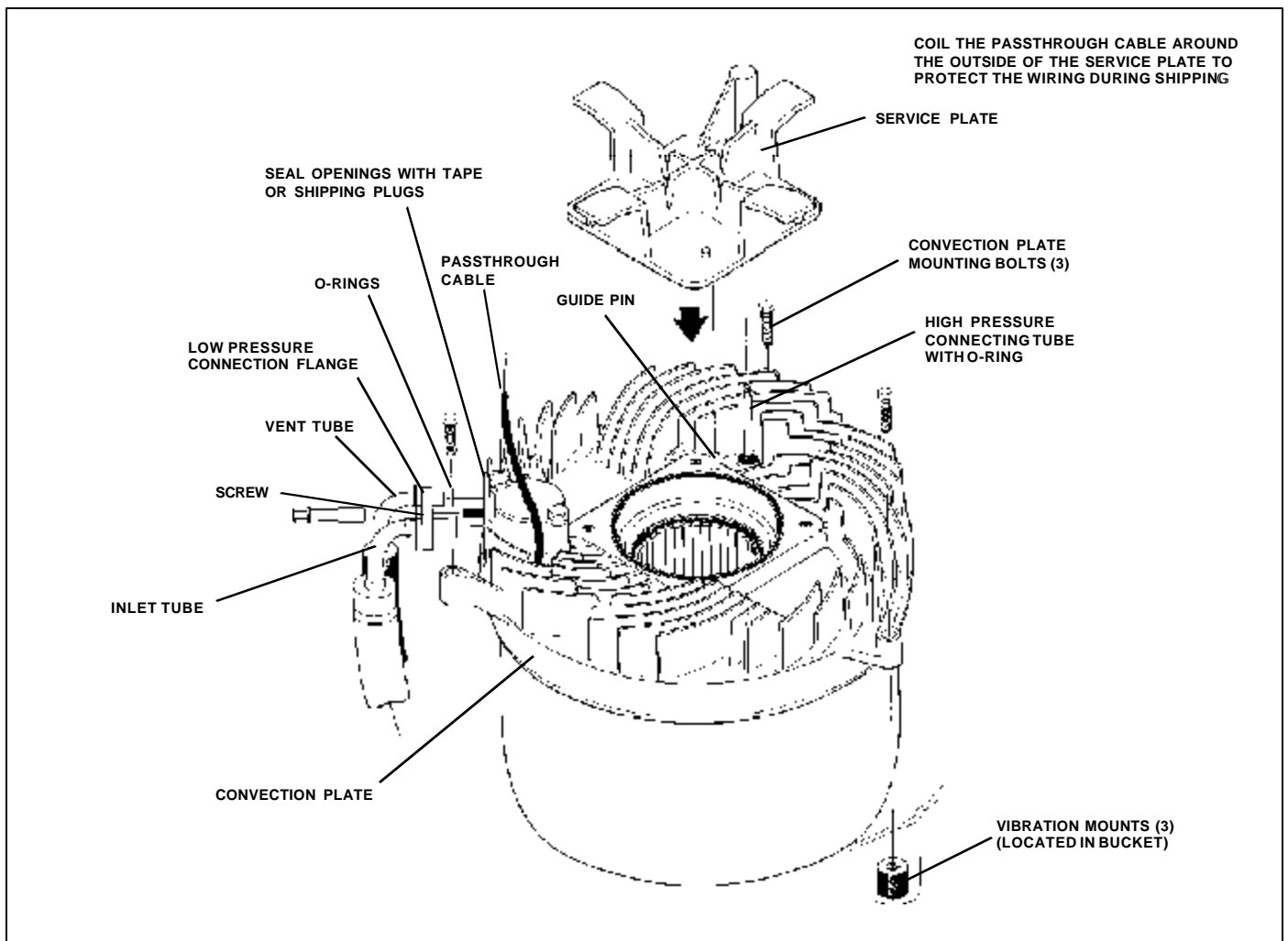


Figure 13 Control Module Removal and Replacement

Fan Removal and Replacement

- Remove the *Compression Modules* and *Control Modules* as described in previous sections.

NOTE: The combined weight of the *Compression Module* and the *Controls Module* is approximately 90 lbs (41 kg.). If the combination can be lifted (e.g. by two people) then the removal of the *compression module* is an unnecessary step.

- Release the latch from the *Electronics Module* and tilt the module down into servicing position.
- Unplug the *fan motor cable* from the *Electronics Module* (See Figure 15).
- Remove the three tapping screws from the *Fan Assembly* in the bottom of the *bucket* (See Figure 14).
- Remove the *Fan Assembly* from its seat and install a new *Fan Assembly* using the previously removed screws.
- Tighten the three *Fan Assembly* screws, and plug the *fan motor cable* into the *Electronics Module* (See Figure 14).
- Tilt the *Electronics Module* back up and pull latch into locked position.
- Replace the *Compression Module* and *Controls Modules* as described in previous sections.

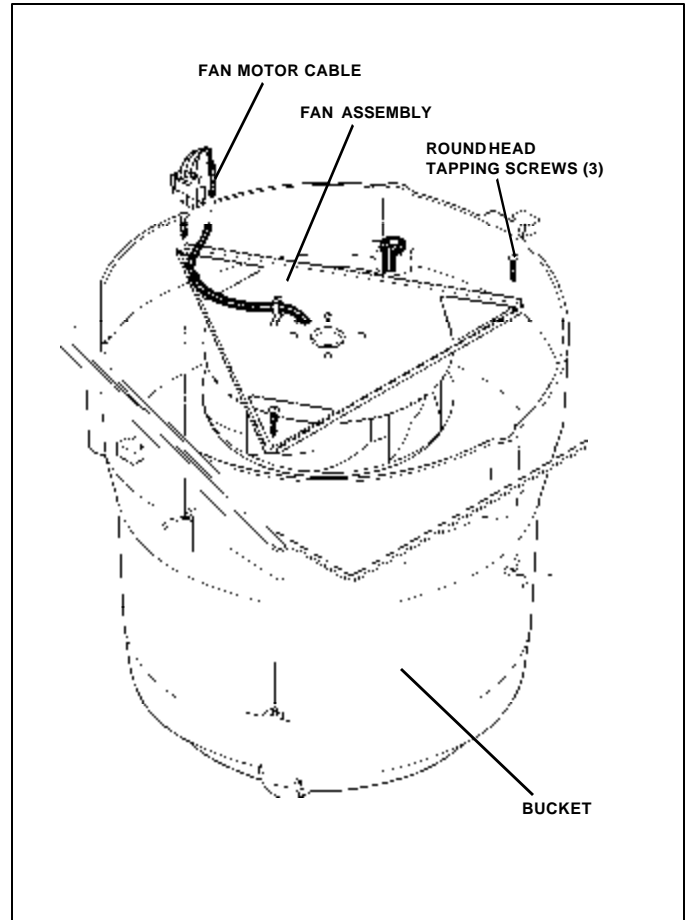


Figure 14 Fan Removal and Replacement

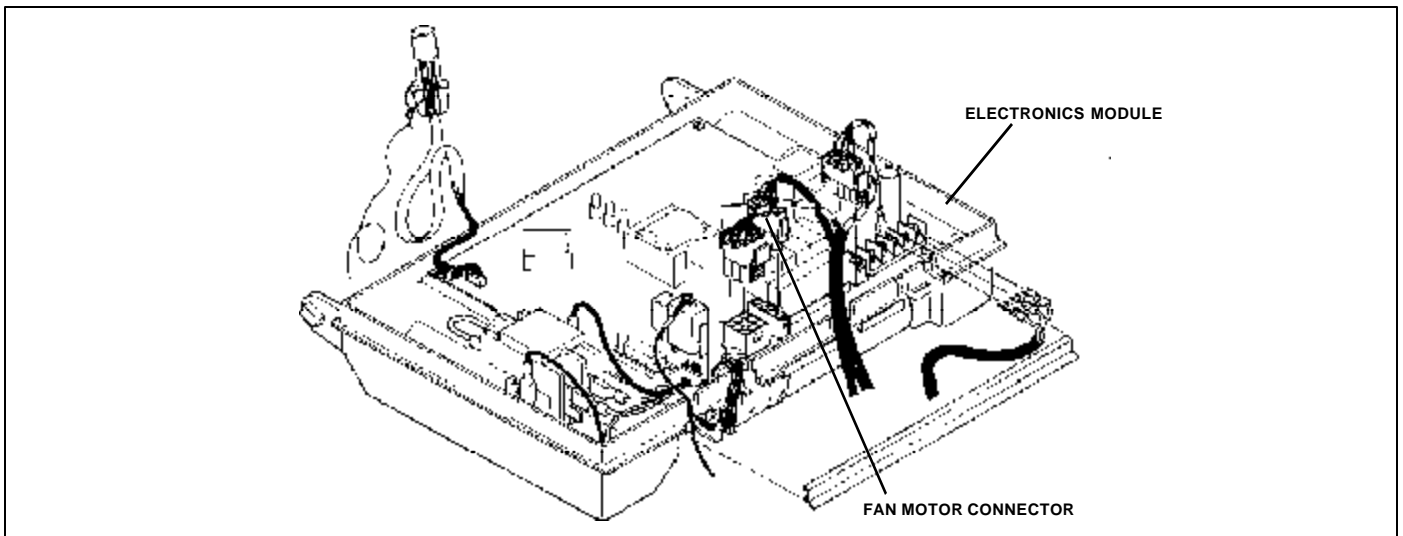


Figure 15 Location of Fan Motor Connector on Electronics Module

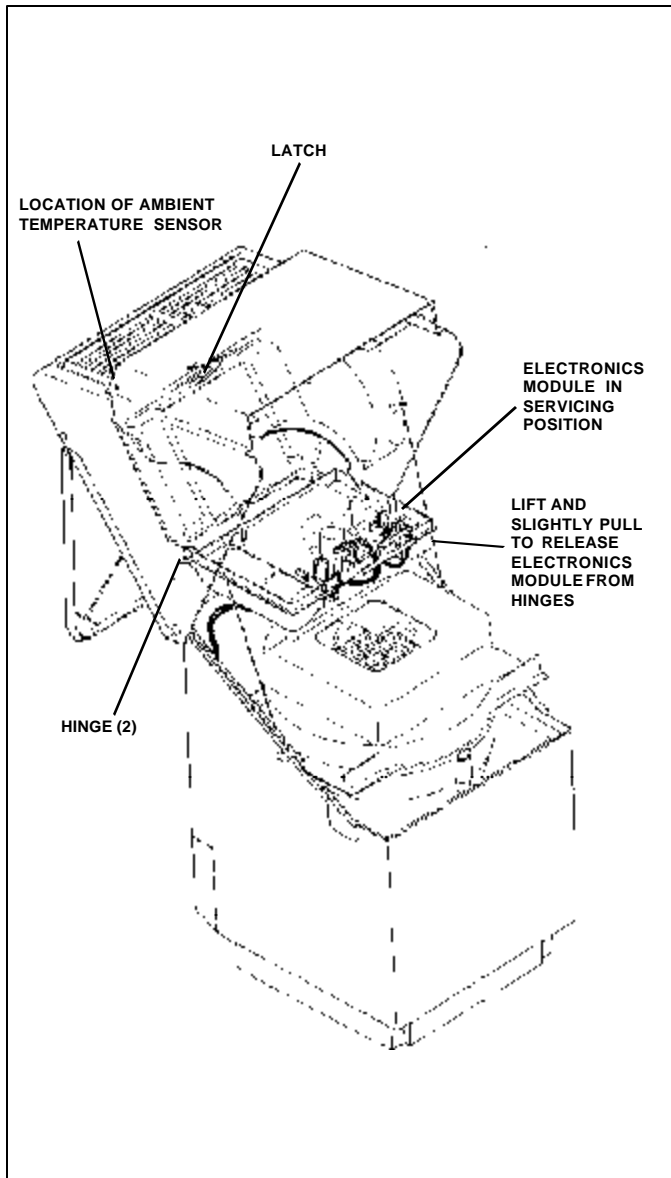


Figure 16 Electronics Module Removal

Electronics Module Removal

- Turn off the electrical power supply.
- Release the latch from the *Electronics Module* and tilt module down into servicing position (See Figure 16).
- Disconnect the *hour-meter* from the *Electronics Module* circuit board (See Figure 17).
- Unplug the two connectors on the end of the *passthrough cable*, from the *Electronics Module* (See Figure 17).
- Squeeze and pull the winged tabs on the *ambient temperature sensor* to remove it from the *service cover housing* - **DO NOT PULL ON THE FLEXIBLE CABLE** (See Figure 16 & 17).
- Disconnect the power supply wires at the terminal strip on the *Electronics Module* (See Figure 17).
- Disconnect the power supply wires from the terminal strip located on the *Electronics Module* circuit board (See Figure 17).
- Lift the *Electronics Module* slightly and pull to release it from the VRA hinges (See Figure 16).

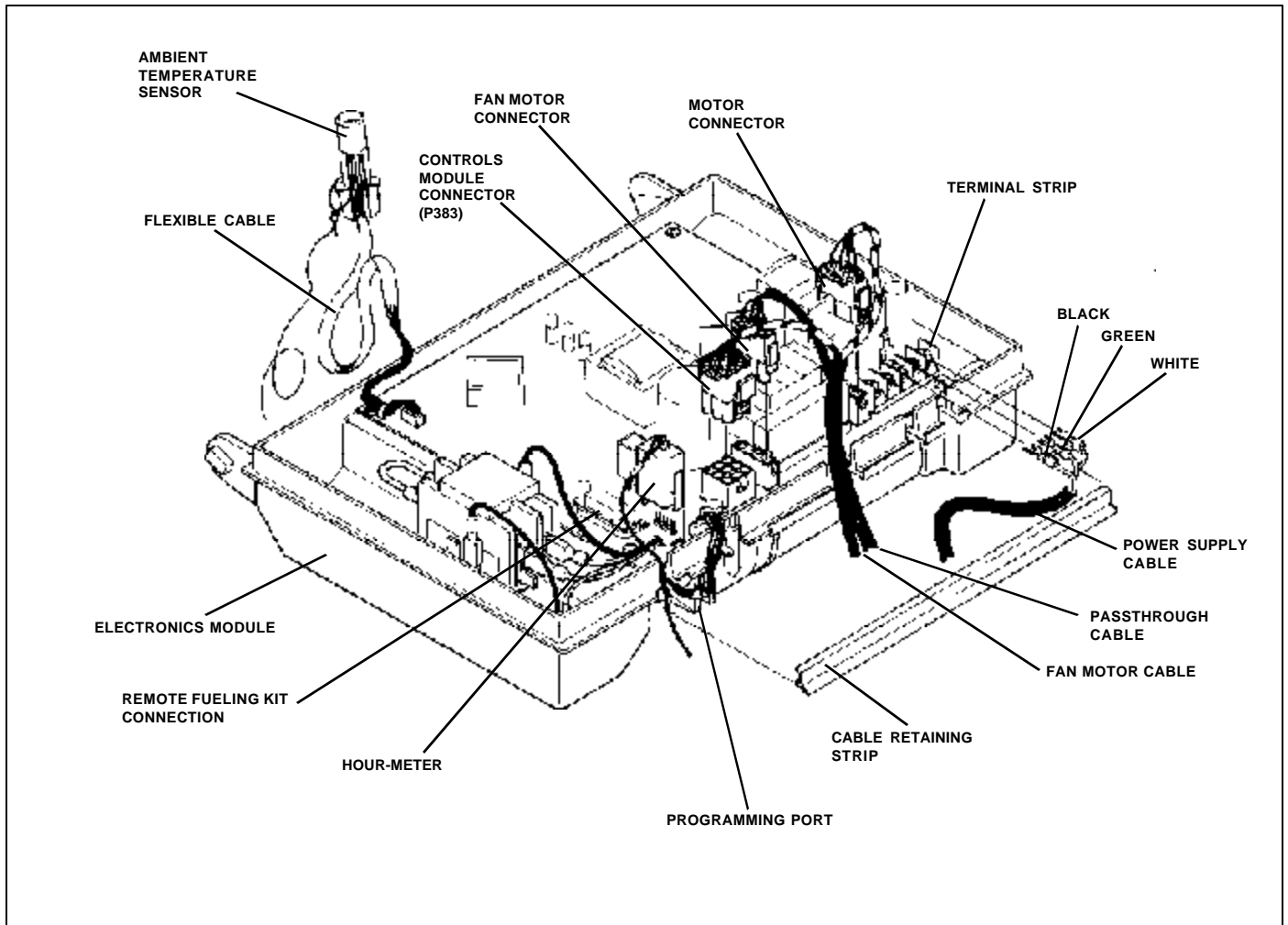


Figure 17 Electronics Module Connections

Electronics Module Replacement

- Slide the *Electronics Module* into the hinges at the same angle required for removal, and then lower the module into the servicing position (See Figure 16).
- Re-establish all connections that were previously removed, according to the "*Electronics Module Removal*" instructions (See Figure 17).
- Insert the *ambient temperature sensor* into its socket; ensure that it is positively locked in position (See Figure 16 for Sensor location).

- Switch on the power supply to the VRA.
- Perform the pressure test as described in Section 3.4 "Testing and Commissioning", on page 8 of this

Electronics Module Settings

The Programming Port is located on the underside of the *Electronics Module* (See Figure 17). To change settings, refer to the Section 3.3 "Field Programming" in this manual.

Start / Stop Button Height Adjustment

- The height of the START and STOP buttons has been adjusted at the factory to fit the service cover that comes with the new VRA. However, during installation and during the course of connecting the 240 V electrical power supply, some shifting of components can take place. This may require a START/STOP BUTTON HEIGHT ADJUSTMENT.
- After replacing an existing *Electronics Module* with a spare *Electronics Module*, there is a possibility that the components of the spare will stack up differently than the components of the existing *Electronics Module*. This will require a START / STOP BUTTON HEIGHT ADJUSTMENT.
- If after completion of installation or servicing of the VRA, the unit does not function as described in the Installation and Field Service Manual, test if an adjustment of the START / STOP buttons is required.
- Power down the VRA. Lift the VRA’s service cover open, and tilt the *Electronics Module* down to the service position. Try to operate the VRA by pressing the buttons directly on the board.
- If the VRA operates properly, a START / STOPBUTTON HEIGHT ADJUSTMENT is required. Otherwise refer to the “Installation and Field Service Instructions” for troubleshooting procedures.
- Depending on the assembly, the Start and Stop buttons may protrude either **too much** or **not enough** into the bubble below the start / stop label.
- If the plastic buttons do **not protrude enough**, add rubber pads to the top surfaces of the buttons. The symptom of buttons not protruding enough is a VRA that shows the yellow LED blinking but is not responding to the buttons.
- If the plastic buttons protrude **too much**, remove the existing rubber pads. If the fault persists, check if the service cover properly engages with the housing when closed. The symptom of buttons protruding too much is a VRA that displays meaningless messages.
- Extra *plastic buttons* and extra *rubber pads* have been included with every spare *Electronics Module* and every new VRA.

WARNING: Apply extreme caution when pressing the buttons. HIGH VOLTAGE is connected to some components of the *Electronics Module*. DO NOT TOUCH any other components of the *Electronics Module* to avoid serious injury or death.

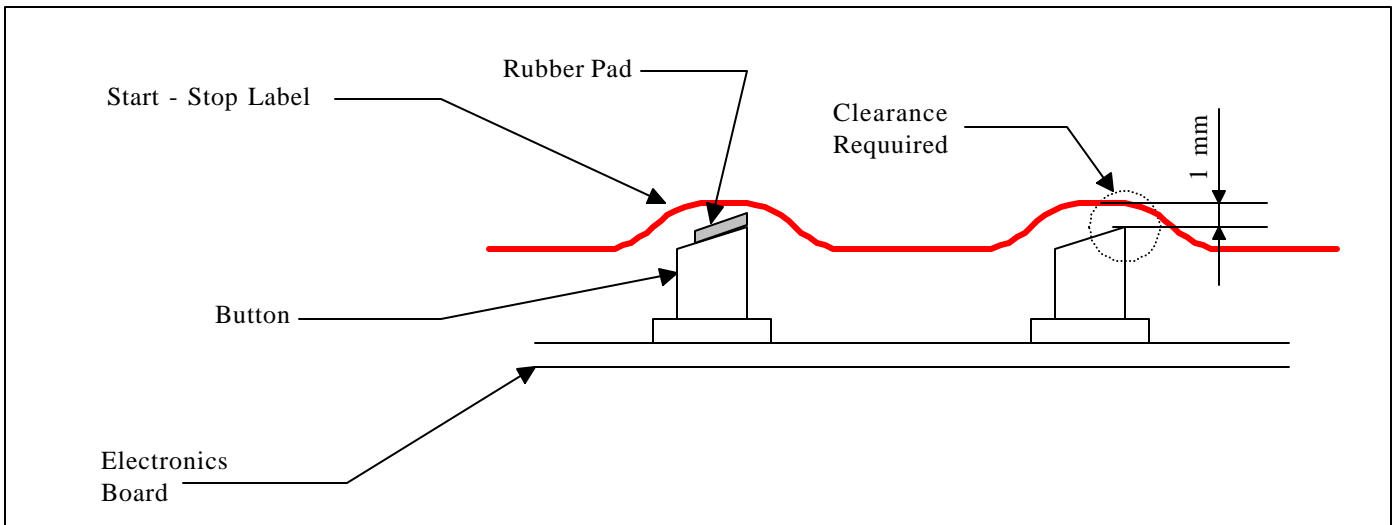


Figure 18 Start Stop Button Clearance

Removing the VRA

If for any reason the entire VRA needs to be removed:

- All normal safety precautions must be observed when disconnecting the VRA.
- Turn off the electrical power supply to the VRA.
- Remove the fill hose(s) or tubing as described in the section "Module Replacement Preparation" on page 21.
- Disconnect the power supply wires inside the junction box and not at the terminal strip on the *Electronics Module* (See Figure 17).
- Turn off and disconnect the gas supply.
- Release the pressure inside the *blow-down system* by temporarily connecting an open dummy fill hose to the breakaway fitting.
- Plug the gas inlet and vent connections before transporting the VRA (See Figure 20).
- The *fill hose* should either be neatly stowed inside the VRA or removed for shipping.

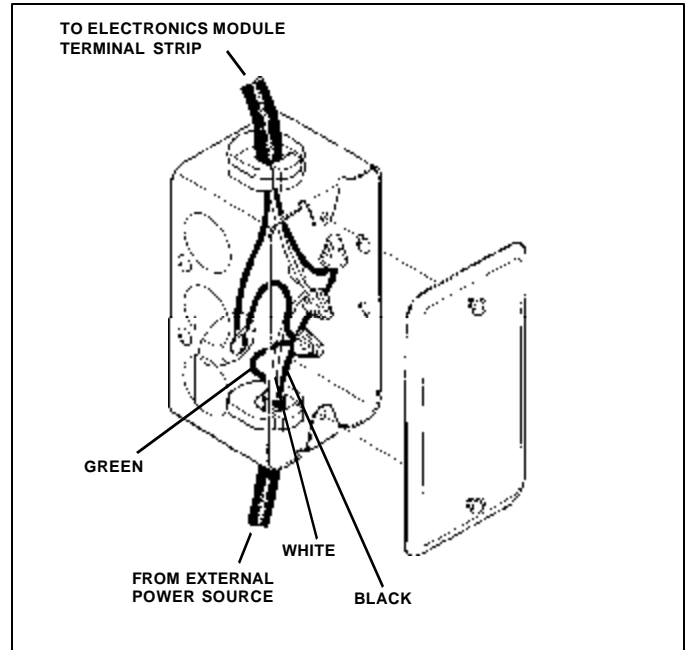


Figure 19 External Power Disconnect

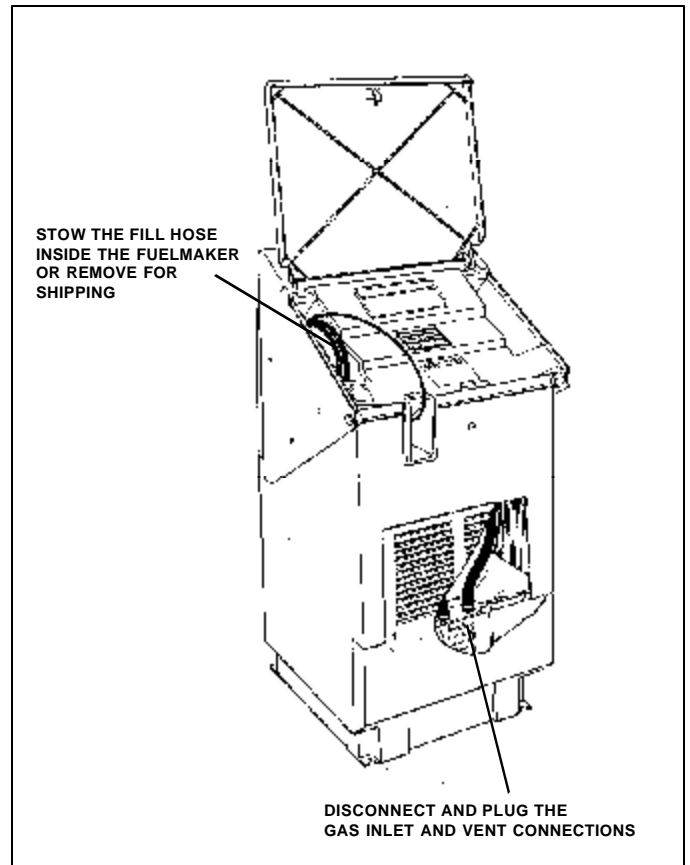


Figure 20 VRA Removal