

RML2000

Installation Manual



IMPORTANT: To assure proper installation of this product, thoroughly review the information in this revision of the manual. Information is subject to change as new features are implemented. Failure to follow instructions may result in system malfunction.

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WARNINGS, CAUTIONS AND NOTES

Throughout this manual you will see **WARNINGS, CAUTIONS** and **NOTES**. They are here for your benefit and warrant attention. By paying careful attention to them you can prevent injury and possible equipment damage.

Below are examples:

WARNINGS: **INFORM THE READER OF POSSIBLE BODILY INJURY IF PROCEDURES ARE NOT FOLLOWED EXACTLY.**

CAUTION: **Alert the reader to possible equipment damage if procedures are not followed correctly.**

NOTES: **Inform the reader of a general rule for a procedure or of exception to such a rule.**

NOTICE

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This document contains proprietary information, which is protected by copyright. All rights reserved. No part of this document may be reproduced without prior written consent of Actaris Metering Systems.

This equipment is intended for use in Class I, Division 2, Groups A, B, C and D or non-hazardous locations only.

WARNING - Explosion hazard, substitution of components may impair suitability for Class I, Division 2.

WARNING - Explosion hazard, do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

Hazardous area approval only valid when connected to an isolated source such as a truck battery.

Power and input & output (I/O) wiring must be in accordance with Class I, Division 2 wiring methods, Article 501-4 (b), or the National electrical Code, NFPA 70 for installations in the U.S., or as specified in Section 18-1J2 of the Canadian Electrical Code for installations within Canada, and in accordance with the authority having jurisdiction.

Table of Contents

- 1. FUNCTIONAL OVERVIEW**
- 2. SPECIFICATIONS AND APPROVALS**
 - 2.1. System Specifications
 - 2.2. Weights and Measures Approvals
 - 2.3. Safety Approvals
 - 2.4. Environmental Ratings
- 3. SYSTEM COMPONENTS**
 - 3.1. RML2000 Coriolis Mass Flowmeter
 - 3.2. E4000
 - 3.2.1 Display
 - 3.2.2 Control Buttons
 - 3.3. Electronic Temperature Compensation
 - 3.4. Valve control
 - 3.5. Junction Box
 - 3.6. Printer
 - 3.7. Mobile Computer
- 4. INSTALLATION**
 - 4.1. Introduction
 - 4.2. Parts Checklist
 - 4.3. Truck Preparation
 - 4.4. Installing a New RML2000 Coriolis Metering System
 - 4.5. Installing a Retrofit RML2000 Coriolis Metering System
 - 4.6. Positioning the Register Head
 - 4.7. Installing the RTD
 - 4.8. Wiring the RTD
 - 4.9. Installing the Single-Stage LPG Solenoid Valve
 - 4.10. Wiring the Single-Stage LPG Solenoid Valve
 - 4.11. Installing the Dual-Stage LPG Valve
 - 4.12. Wiring the Dual-Stage LPG Valve
 - 4.13. Installing the Junction Box and Printer
 - 4.14. Wiring the E4000 Register Head
 - 4.15. Wiring the RML2000 Meter to the E4000 Register
 - 4.16. Wiring the Junction Box
 - 4.17. Installing the Printer
 - 4.18. Connecting the Power Cable
 - 4.19. Connecting a Mobile Computer
- 5. ZEROING THE METER**
- 6. START UP AND CALIBRATION**
 - 6.1 Route Mode
 - 6.2 Supervisor Mode
 - 6.3 Weights and Measures (W&M) Mode
 - 6.4 Calibrating the Meter

1. Functional Overview

The RML2000 Coriolis metering system for LPGas delivery trucks consists of two main elements:

- The RML2000 Coriolis mass meter complete with Vapor release and Differential valve
- The E4000 Electronic Register system

The Coriolis meter is a true mass flow meter in that it directly measures the mass flow rate of the product passing through the sensor. The sensor consists of a vibrating U-tube arrangement, which tends to flex under the action of fluid flow. The degree of flexing of the tube is measured and is directly proportional to the mass flow rate. The Coriolis meter vibration frequency is related to the density of the product in the tubes. The combination of a direct mass and density reading allows the meter electronics to calculate the gross volume of propane delivered through the meter. The resultant volume measurement is highly accurate and the meter has the operational advantage compared to traditional volumetric meters of having no moving parts.

The E4000 electronic register system automates delivery and invoicing operations for deliveries of LPG, distillate fuels and other commercially distributed liquids from flow meters on bulk delivery trucks.

The E4000 displays the delivered volume as measured by the Coriolis meter at the rear of the truck. Electronic temperature compensation is achieved via an RTD temperature probe installed in the vapor release strainer cover. Temperature compensation allows deliveries to be made in gross or net volumes according to local practice. A printer in the cab provides a simple volume delivery ticket or, using the E4000's pricing capability, a complete priced invoice as a record of the transaction. Tickets are time and date stamped for security. An "end of shift" report can be conveniently generated to totalize the day's deliveries by product. This allows administrative staff to reconcile individual tickets with the shift as a whole. Delivery data is held for up to 100 deliveries in battery-backed memory. (Battery life is approximately 10 years.)

The driver controls the E4000 from a push button panel on the front of the register. This allows yes/no type decisions to be made and numerical values to be entered that are associated with delivery functions. The buttons are used to navigate menus that appear on the display screen, guiding the user to perform the required function. This interactive approach makes the register easy to operate by inexperienced personnel.

The E4000 can control a security valve to prevent fraudulent LPG deliveries being made without the register recording them. The solenoid valve is used with the LPG meter's existing differential valve to prevent flow. An optional driver-programmable dual-stage preset valve allows the delivered amount to be set at a predetermined volume or monetary amount, subject to volume measurement resolution.

The E4000 is designed to interface with the latest mobile computing products. Mobile computers bring customer database and delivery information from the office onto the truck. The register updates the customer record as deliveries are made during the shift. Formatted tickets can be

printed that include customer information that has been downloaded from the computer. At the end of the shift, captured delivery information is carried back to the office in the computer to be downloaded to the main customer accounts database.

The E4000 features a calibrated pulse output which can be used to interface with remote meter displays and/or remote control truck delivery systems.

2. Specifications and Approvals

RML2000 Specifications

1" Coriolis Mass Flow Transducer

Wetted Parts: 316L Stainless Steel

Sensor Housing: 304L Stainless Steel

Line Size: 2" (51mm)

Power Rating:

Flowrate:

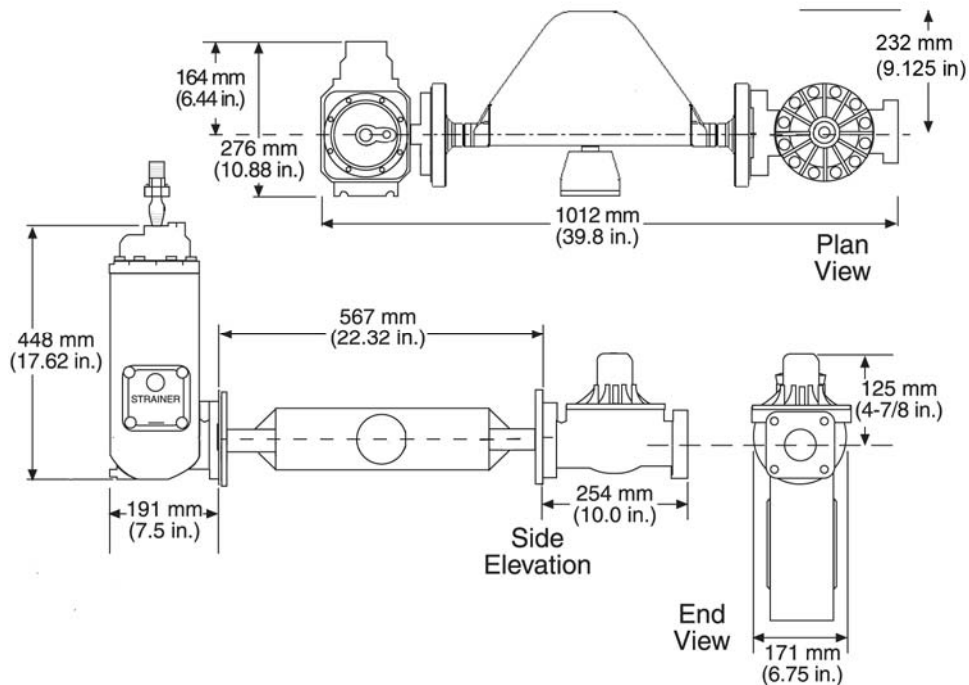
NTEP Approved Volumetric Flowrate 12-70 GPM

Weight: 28lb (13kg)

Operating Temperature Range: -40 – 150°F (-40 – 65°C)

Pressure Rating: 350psi (24bar)

Size:



E4000 Specifications

- Display
 - 143 x 19 mm text area
 - 2 lines, 20 characters per line
 - 8.3 x 5.9 mm Character area
- Power Rating (Supply From Isolating or Battery Source)
 - 9-16 VDC, 14.6 VDC nominal
 - 0.25 Amps (0.63 Amps with optional display heater)
- Relay Rating
 - Number of Relays: 2
 - Type: Normally open
 - Contact Style: Form C contacts
 - Contact Ratings: 230 VAC @ 3 amps
30 VDC @ 3 amps
- LPG Single-Stage Valve (3/8" NPT)
 - 0.8 Amp
 - 12 VDC
 - 9.5 Watts
- LPG Dual-Stage Valve

<u>High Flow 3/8"</u>	<u>Low Flow 3/8"</u>
0.8 Amp	0.8 Amp
12 VDC	12 VDC
9.5 Watts	10 Watts
- Petroleum Valve Specifications

<u>Hi Flow 2"</u>	<u>Lo Flow 19/32"</u>
0.8 Amp	1.85 Amp
12 VDC	12 VDC
10 Watts	22 Watts
- RTD Temperature Probe Specifications
 - Platinum
 - 4 wire
 - Resistance at 32 F, 100 Ohms +/- 0.12%
- Pulse Input
 - Number of inputs: one
 - Configurations supported: single input, single, dual or quad channel (menu selectable)
 - Input Impedance: 10K Ohms nominal to common
 - Trigger level:
 - Logic on: 3 to 30 VDC
 - Logic off: 0 to 1 VDC

- Communication to printer and computer: RS232
- Printer - Epson TM—U295 Dot Matrix
 - Ticket Type: Blank / Pre-Printed up to 3 ply
 - Ticket Size: 102 mm x 257 mm (4 x 10")
 - Power: 24 VDC +/- 2.4 VDC
 - Ribbon: Epson ERC—27
 - Can also be used with Blaster printer
- Size
 - 9.0 in x 8.9 in x 6.3 in
 - 229 mm x 227 mm x 161 mm
- Weight
 - 5.4 lbs, 2.45 kg
- Operating Temperature Range
 - -18 C to 55 C (0 F to 131 F)
 - -40 C to 40 C (-40 F to 104 F) with optional display heater
- Enclosure Rating
 - NEMA 3

Approvals

- NTEP Approval to NIST Handbook 44 and NCWM Publication 14 certificate 02-105.

Safety Approvals

- UL Suitable for use in Class 1, Division 2, Group A, B, C and D or non-Hazardous locations only.

3. System Components

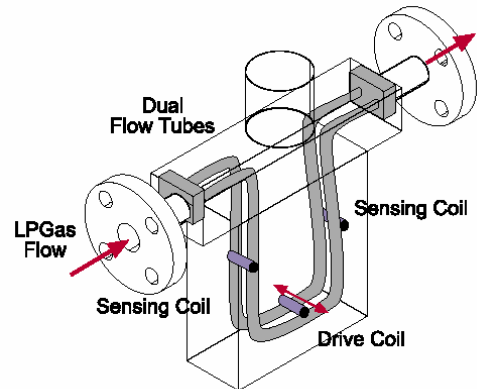
3.1. RML2000 Coriolis mass flow meter

The Coriolis meter is mounted in a similar position to a traditional volumetric meter at the rear of the truck. The meter is connected in line via 2" 300 lb pressure rated flanges to the Vapor release and Differential valve.

The meter is constructed from stainless steel and consists of a double U-tube arrangement enclosed in a rectangular case. The drive coil, used to vibrate the tubes, and the sensor coils which measure the flexing of the tubes under flow conditions, are mounted inside the box.

The instrument electronics are enclosed within the small junction box at the top of the meter. Power and communication connections to the register are made here. The only means of communicating directly to the Coriolis meter is to connect a computer to these same terminals. The computer is only required to "zero" the meter as part of the calibration process, to be discussed later in this manual.

Once the junction box lid is closed, there are no operator controls on the meter; all functions are performed at the E4000 register head.



3.2. E4000 Register Head

The E4000 electronic register is designed and field proven to withstand the harsh environment on tank trucks. The enclosure is plastic with a NEMA 3 rating.

The E4000 can be mounted directly on the positive displacement flowmeter so that the mechanical drive of the meter rotates an optical pulse encoder mounted in the register. Alternately, the register can be mounted wherever required when receiving a pulse output from a meter. Counting the pulses indicates the amount of product measured by the flowmeter during a delivery. An optional temperature compensation kit can be added to the base unit.



Figure 3-1. E4000 Register

An operator communicates with the register via an LCD screen and a 4 button control panel. Internally mounted relays operate electrical solenoid valves to control the flow of product. Delivery ticket information is transmitted through the power/data cable from the rear of the register to a cab mounted junction box, then to the ticket printer or hand-held computer.

Power and data connections are made to terminal strips inside the register and junction box. Configuration parameters are programmed into the register manually by the buttons or from an external computer using the E4000 configuration program.

An internal calibration switch is positioned inside the register to allow access to the Weights and Measures configuration menu, and is mechanically sealed on the outside of the register.

3.2.1 Display

The 2x20 character LCD display is primarily intended to show the volume of product being delivered. The 2 line display configuration also allows 2 parameters to be shown simultaneously such as delivered volume and price during delivery or Net and Gross volume during calibration. The display is also the method by which the E4000 communicates instructions to operators as they navigate through the software menus.

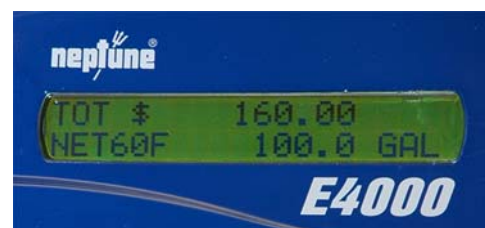


Figure 3-2. E4000 Display

3.2.2 Control Buttons

The 4 button control panel is the method used to enter configuration data and select function options for the E4000 register.

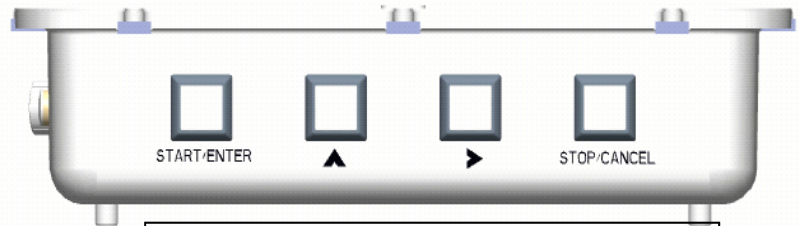


Figure 3-3. Control Buttons

- START/ENTER** Confirms/accepts selected option on display
- ▲ Increments the displayed character through the available character set
- > Moves cursor to the right .
- STOP/CANCEL** Terminates delivery or exits current selection.

Pressing the up arrow on the control panel will scroll the selected character through a complete ASCII character set (upper and lower case letters, all numerals and symbols). A “space” character is also included in the character set. It is the fifth character after the lowercase “z”.and is located between the right facing arrow and the exclamation point:

➔ , [space], !

Access the Weights and Measures functions by depressing the internal switch beneath the seal screw on the side of the register and pressing the > button simultaneously.

3.3 Electronic Temperature Compensation

A temperature probe is available as an option for electronic temperature correction of the delivered volume of product. This correction is mandatory for some products under Weights and Measures legislation in certain states and countries. The probe is a 100 Ohm RTD. The E4000 measures the product temperature during delivery and uses the approved API volume correction table for the product at that temperature. The resulting calculation when applied to the Gross volume gives a Net volume corrected to 60°F or 15°C depending on the chosen units.

The use of electronic temperature correction has been shown to reduce the amount of un-measured product by approximately 1% versus mechanical ATC. For fluids without a recognized correction table, approved formulas or expansion factors are used to calculate Net volume. The RTD probe can be installed in a Neptune meter replacing the mechanical ATC bellows or in the strainer cover.

3.4 Valve control

Actaris provides an optional single stage solenoid valve (Figure 3-4) to control the opening and closing of the differential valve on LPG meters. The valve is opened only when the E4000 is powered and the start button has been pressed to commence a delivery. The valve will close whenever the stop button is pressed during a delivery or power is lost to the register.

A dual-stage valve is also available for making LPG deliveries in the Preset mode (Figure 3-5). Preset deliveries for petroleum or other liquids require a dual stage valve (Figure 3-6). The E4000 has 2 relays which control the two stage shut off either by volume or monetary amount. The first stage reduces flow by 90% to slowly bring delivered volume up to the preset amount. The second stage shuts off flow when the preset amount is reached without hydraulic shock to the delivery system.



Figure 3-4. Single Stage LPG Valve



Figure 3-5. Dual Stage LPG Valve

3.5 Junction Box

The junction box, located in the vehicle cab, houses a PC board and serves as the connection point for the E4000 peripherals mounted in the cab. The power to the E4000 and printer is distributed from here. Data passes through the junction box on its way to the printer. The RS232 data link from the E4000 to any peripheral-computing device such as a Hand held or Laptop is made here. The same RS232 connector is used for downloading the E4000 configuration parameters from a laptop using the **E4000 Configuration Program**.



Figure 3-7. Junction Box



Figure 3-8. Printer

3.6. Printer

The E4000 printer is an Epson TM-U295 single feed style dot-matrix printer which uses a standard 4-1/8" wide truck meter delivery ticket, Neptune or Veeder Root. The printer is intended for internal use only and should be mounted in the cab of the truck. A data cable is supplied with the printer kit. The printer power cable comes with the Junction Box. The junction box steps up truck voltage from 12V to 24V to power the printer. The E4000 can also be used with a Blaster printer or an EPSON TM-U220D roll printer.

3.7. External Computer

The E4000 has been specifically designed to operate with a mobile computer such as a Laptop, Hand-Held or PDA. The computer plugs directly into the 9 pin RS-232 serial connector on the junction box that is not occupied by the printer.

There are two modes of operation with an external computer:

1. The computer is running the **E4000 Configuration Program** and is temporarily connected to the junction box to change non metrological parameters and update stand alone pricing.
2. The computer has Fuel Delivery application software running and carries customer account information required by the driver during a shift. The computer interacts digitally with the E4000, extracts volume data and uses this to calculate the customer invoice and update the account records. The mobile computer updates the company database when returned to the office at the end of the shift.

4. Installation

4.1 Introduction

Before attempting to install an RML2000 read this manual!

To simplify installation and reduce the time required follow the directions provided in this document. Each installation will vary depending on the layout and overall condition of the truck, the fluid being measured and the personnel's experience with electronic registers and flowmeters.

WARNING: LPG systems should be installed in accordance with national standards ref: NFPA 58. Power, input and output (1/0) wiring must be in accordance with Class I, Division 2 wiring methods Article 501-4(b) or the National Electrical Code, NFPA 70 for installations in the U.S., or as specified in Section 18-1J2 of the Canadian Electrical Code for installations within Canada and in accordance with the authority having jurisdiction.

4.2 Check Parts

Before commencing installation, unpack the entire contents of the E4000 packaging. Lay out the parts as they would be installed on the truck. This will highlight any missing or incorrectly ordered/supplied parts. Verifying that all the necessary parts are available in advance will reduce the truck downtime and avoid any wasted truck preparation work.

4.3 Truck Preparation

Before commencing the installation: Check that the condition of the truck battery is within the E4000 specifications. Disconnect the battery. Close the manual supply valves and bleed down the meter. Disconnect the pressure line from the top of the differential valve. **Warning: Pressure must be completely relieved before proceeding.**

4.4 Installing a new RML2000 Coriolis Metering System

The unit must be mounted using the approved bracket available from Actaris (or a similarly fabricated bracket that will hold the unit securely, place no stress on the meter, and transmit minimal vibration). The four bolts securing the clamps which attach the meter to the bracket should be torqued to 80-85 ft-lbs.

The unit should be mounted horizontally so that the electronics module faces outward.



Figure 4-1. RML2000 in Bracket

The meter may be mounted for either left or right handed flow; however, the flow of liquid through the meter must always be in the direction indicated by the arrow on the meter housing. (Left to right flow when the unit is viewed with the nameplate on the right.)

Isolate the meter with valves upstream, downstream, and in the vapor return line, as close to the meter as practicable. The valves are required to ensure the meter remains filled with propane during the “zeroing” procedure. (see section 5).

Use flexible hose for connections to both the inlet and outlet of the meter to eliminate stress on the meter due to misalignment of piping. (See Figure 4-2, tank to meter inlet, and Figure 4-3, differential valve to hose reel.)

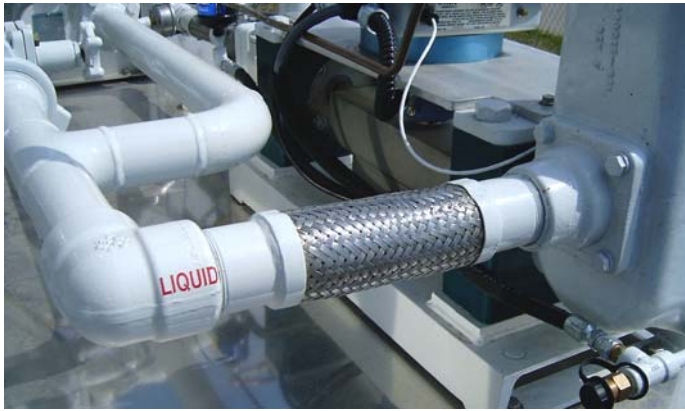


Figure 4-2. Flexible Hose at Inlet



Figure 4-3. Flexible Hose at Outlet

4.5 Installing a retrofit RML2000 Coriolis Metering System

The installation procedure for a retrofit RML2000 is essentially the same as for a new installation. The vapor release and differential valve from a previous Neptune 2” 4D-MT meter can be reused. If the prior installation used mechanical temperature compensation, the installer will be required to replace the strainer cover with one that accommodates the E4000 thermowell. (See section 4.7, Installing the RTD). The 80 mesh strainer can be replaced with 16 mesh. (80 mesh is acceptable but will result in reduced flow and more frequent cleaning.)

4.6 Positioning the E4000 Register Head

The E4000 is normally ordered with an adapter ring to allow it to be bolted down in a convenient position adjacent to the meter on the rear deck of the truck. The installer will be required to manufacture a custom bracket to secure the register. An example is shown in Figure 4-4.. When considering a position for the bracket, ensure that the register controls will be easily and safely accessible by a driver. Also, the RTD probe cable must reach to the vapor release strainer cover as discussed in Section 4.7, Wiring the RTD.

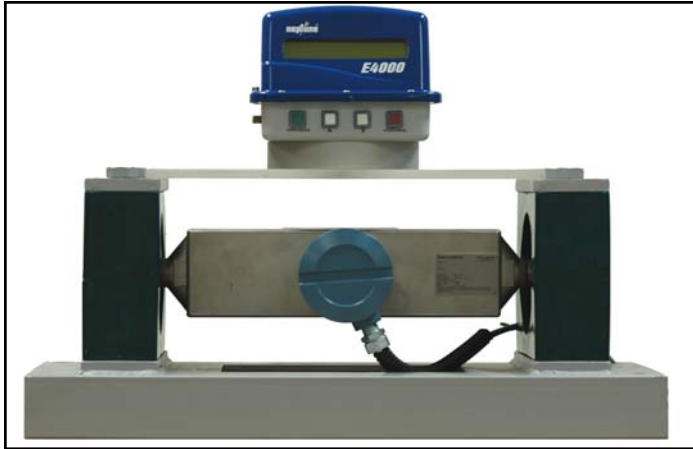


Figure 4-4. E4000 Mounting

4.7 Installing the RTD

E4000 registers equipped with an RTD (See Figure 4-4) are supplied with a ½” NPT male threaded thermowell. The thermowell can be installed in the available dual-port strainer cover (Figure 4-6). To ensure good conductivity to the RTD, fill the thermowell with anti-freeze or mineral oil before inserting the probe.

Note: If replacing the strainer cover, this is a good time to check the strainer and clean if necessary.

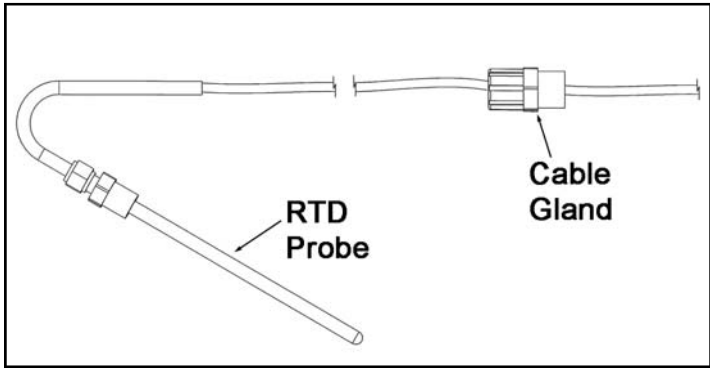


Figure 4-5. RTD



Figure 4-6. Dual-Port Strainer Cover

4.8 Wiring the RTD

The RTD is a 4 wire shielded probe. There is a cable entry port specifically for the RTD on the side of the E4000. Run the cable through this port and connect the wires to the RTD terminals 6, 7, 8 and 12 as shown in Figure 4-13. If mounting the RTD in the strainer cover ensure enough slack to allow the strainer cover to be removed for servicing. Secure the RTD cable with the cable gland supplied. The lock washer supplied with the RTD cable gland can be discarded.

4.9 Installing the Single Stage LPG Solenoid Valve

Mount the solenoid valve to the meter body (as shown) using the bracket provided. Mount the valve with the ports configured as shown in Figure 4-7. Connect the COM port of the solenoid valve to the top of the differential valve. Pipe the NO or Normally Open port to pump pressure at the drain plug on either the vapor eliminator or the meter connector. Pipe the NC or Normally Closed port to the vent line check valve on top of the vapor eliminator. Figure 4-8 shows the completed plumbing.

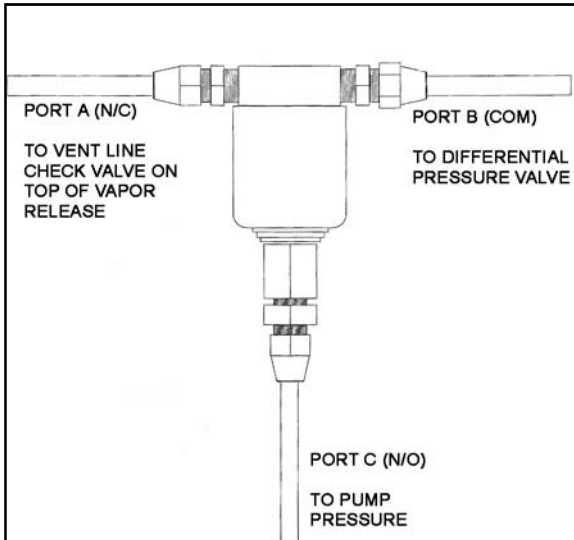


Figure 4-7. Solenoid Valve



Figure 4-8. Valve Wiring and Plumbing

4.10 Wiring the Single Stage LPG Solenoid Valve

Install a straight conduit nipple, supplied with the valve kit, in the threaded electrical opening of the LPG solenoid valve. Teflon tape should be used on the threads of the conduit nipple to make a watertight seal. Run the two black wires from the solenoid valve through the factory supplied conduit, into the register using the conduit hub at the left side of the rear of the register. The green ground wire is not required and can be cut off. Teflon tape should be applied to the threads of the 90 degree conduit nipple before it is inserted in the conduit hub.

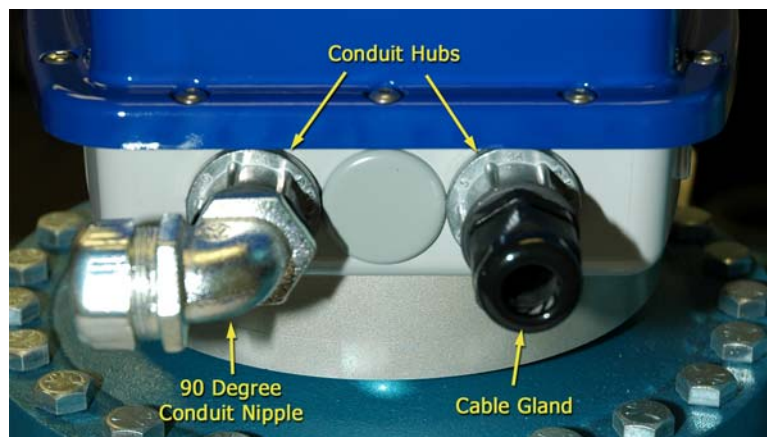


Figure 4-9. Conduit Fittings

The following connections will be made after the 9 pair power/data cable is installed in the E4000 register (see section 4-13).

Using the white/black twisted pair, connect the white wire to terminal 23 and the black wire to terminal 24 on the register "POWER 12 VDC" terminal strip (See Figure 4-13).

Using the orange/black twisted pair, connect the orange wire to "PRESET" terminal 18, and the black wire from the twisted pair to either (there is no required polarity for the solenoid valve) black wire from the solenoid valve and secured with the supplied wire nut. The other black wire from the solenoid valve should be connected to "PRESET" Terminal 19.

No wires will be connected to the "PRE-WARN" Terminals 20, 21, and 22. NOTE: The solenoid valve used must feature a transient voltage suppressor. Check for the TVS to have been previously installed, by Actaris, under a section of heat shrink tubing where the two black wires enter the solenoid valve. If the TVS is not present, contact the factory for additional wiring instructions.

4.11 Installing the Dual-Stage LPG Valve

Install the LPG solenoid valve (first stage) per section 4.8.

Remove the drain plugs from the dual-stage LPG differential valve. (See Figure 4-10.) Verify that the threads on the valve body are clean and undamaged.

Apply a pipe sealer (approved for LPG service) to the NPT threads on the 90 degree elbows.

Caution: Make sure that sealant does not enter tubing as this may damage the solenoid valve. Install the two 90 degree elbows in the differential valve body. Install the tubing/solenoid valve assembly, aligning the elbows as shown. Securely tighten the tube fittings.

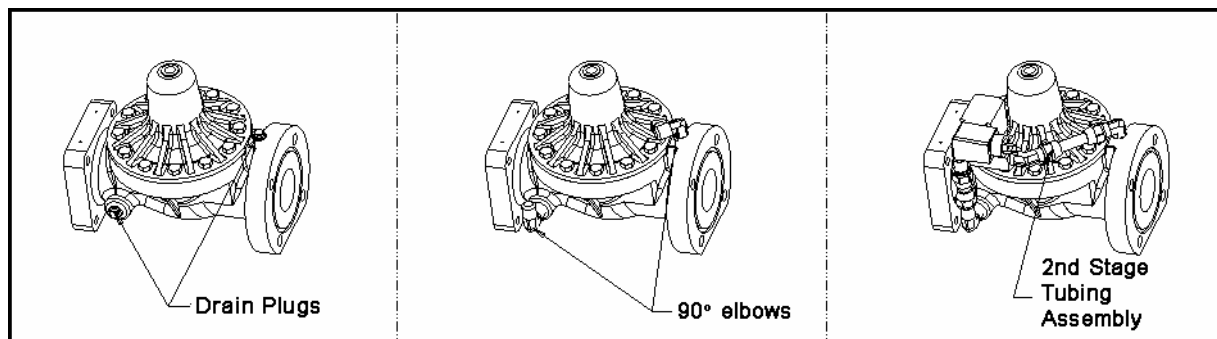


Figure 4-10. Dual Stage Valve Assembly

4.12 Wiring the Dual Stage LPG Valve

Install two straight conduit nipples, supplied with the valve kit, in the threaded electrical opening of each solenoid valve. Teflon tape should be used on the threads of the conduit nipples to make a watertight seal.

Install a junction box as shown in figure 4-15. Run the two orange wires from the shutdown valve and the two black wires from the main valve into the junction box using the conduit and fittings. All four wires should run out of the junction box through conduit and enter the E4000 through the conduit hub at the left side of the rear of the register. Teflon tape should be applied to the threads of the 90 degree conduit nipple before it is inserted in the conduit hub.

The following connections will be made after the 9 pair power/data cable is installed in the E4000 register (see section 4-13).

Using the white/black twisted pair, connect the white wire to terminal 23 and the black wire to terminal 24 on the register "POWER 12 VDC" terminal strip (See Figure 4-15).

Using the orange/black twisted pair, connect the orange wire to "PRESET" terminal 18, and the black wire from the twisted pair to one of the orange wires from the shutoff valve and one of the black wires from the main valve. Secure all three wires with the supplied wire nut.

The remaining orange wire from the LPG shutdown solenoid valve should be connected to "PRESET" Terminal 19, and the remaining black wire from the main valve should be connected to terminal 22.

Connect a jumper wire from "PRESET" terminal 18 to "PRE-WARN" terminal 21.

NOTE: Both the main solenoid valve and the shutdown valve must feature a transient voltage suppressor. Check for the TVS to have been previously installed, by Actaris, under a section of heat shrink tubing where the two black or orange wires enter the solenoid valve. If the TVS is not present, contact the factory for additional wiring instructions.

4.13 Installing the Junction Box and Printer

Select a suitable location in the cab to position the junction box so that the two RS-232 ports are easily accessible and the junction box cover can be removed for service (Figure 4-12). Route the 40 ft. power/data cable from the E4000 register head at the rear of the truck before permanently fixing the junction box. Route the cable away from sharp edges, drive train components, hot exhaust components, or other sources of potential damage. It is recommended that the cable be run through liquid-tight conduit for protection.

Select a suitable location, orient the box, and mark and drill the bolt holes in the mounting surface. The mounting holes are accessible from inside the box. Route the power and data cables to the junction box. Secure excess cable to prevent damage.



Figure 4-12. Junction Box Installation

4.14 Wiring the E4000 Register Head

The supplied 9 pair (22 AWG) individually shielded cable connects the E4000 and the cab mounted junction box.

Run the (40 ft.) power / data cable the length of the truck from the flowmeter to the cab and into the area selected for the junction box. Automotive conduit is recommended to protect the cable from the environment. Secure the cable to the truck frame or existing truck wiring using cable ties. Some drilling may be required to pass through plating at the back of the truck and through bulkheads into the cab. Placing grommets on any holes to prevent cable damage is recommended.

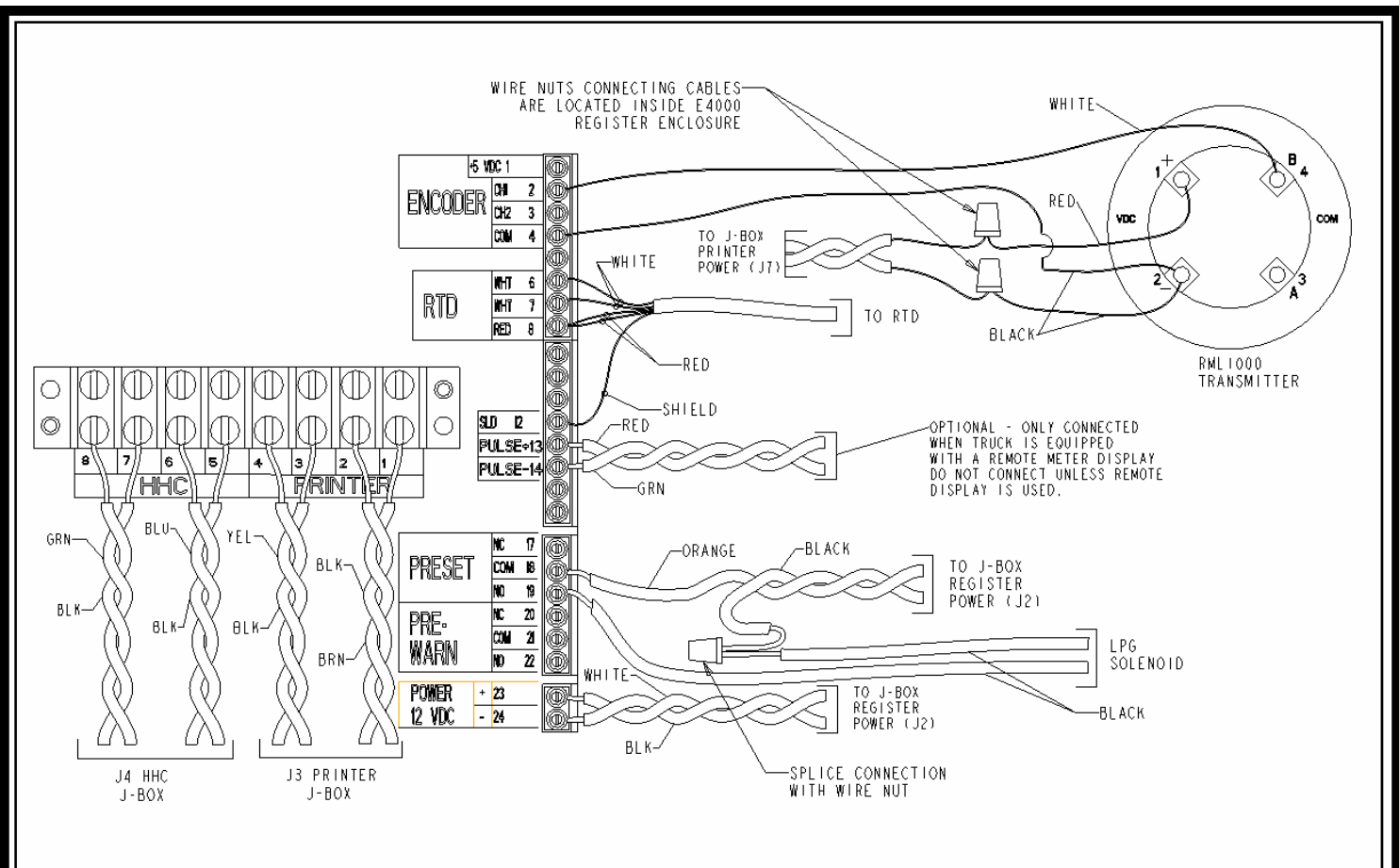


Figure 4-13. E4000 Register Wiring Diagram for RML2000, Single Stage Valve

Make the connections as shown in the wiring diagrams for the E4000 register (Figure 4-13, single-stage valve or Figure 4-15, dual-stage valve).

The colors of the wire pairs are shown in the diagram for identification purposes. The numbers correspond to the E4000 terminal strip position to which the wire is connected.

Caution: The foil should be removed from each twisted pair where the cable enters the register, and the register cable shields and drain wires should be cut off on the register end to prevent interference with power or data lines. Shield wires are connected at the junction box end only. (See Figure 4-14 for an example of proper wire routing and connection.)

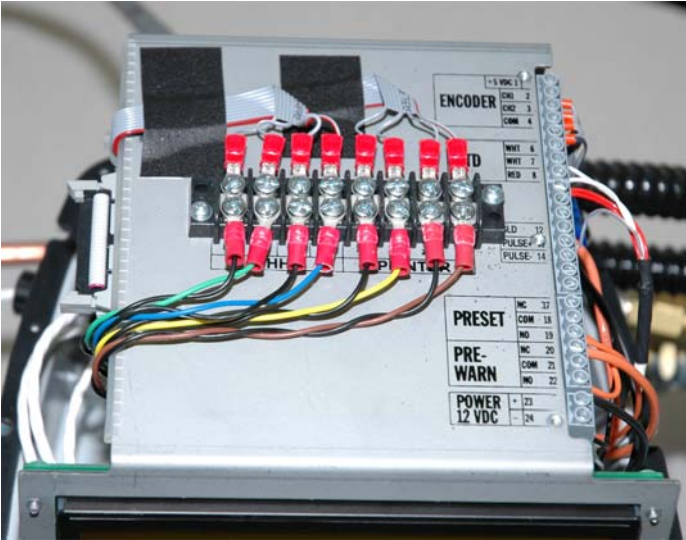


Figure 4-14. E4000 Register Terminals

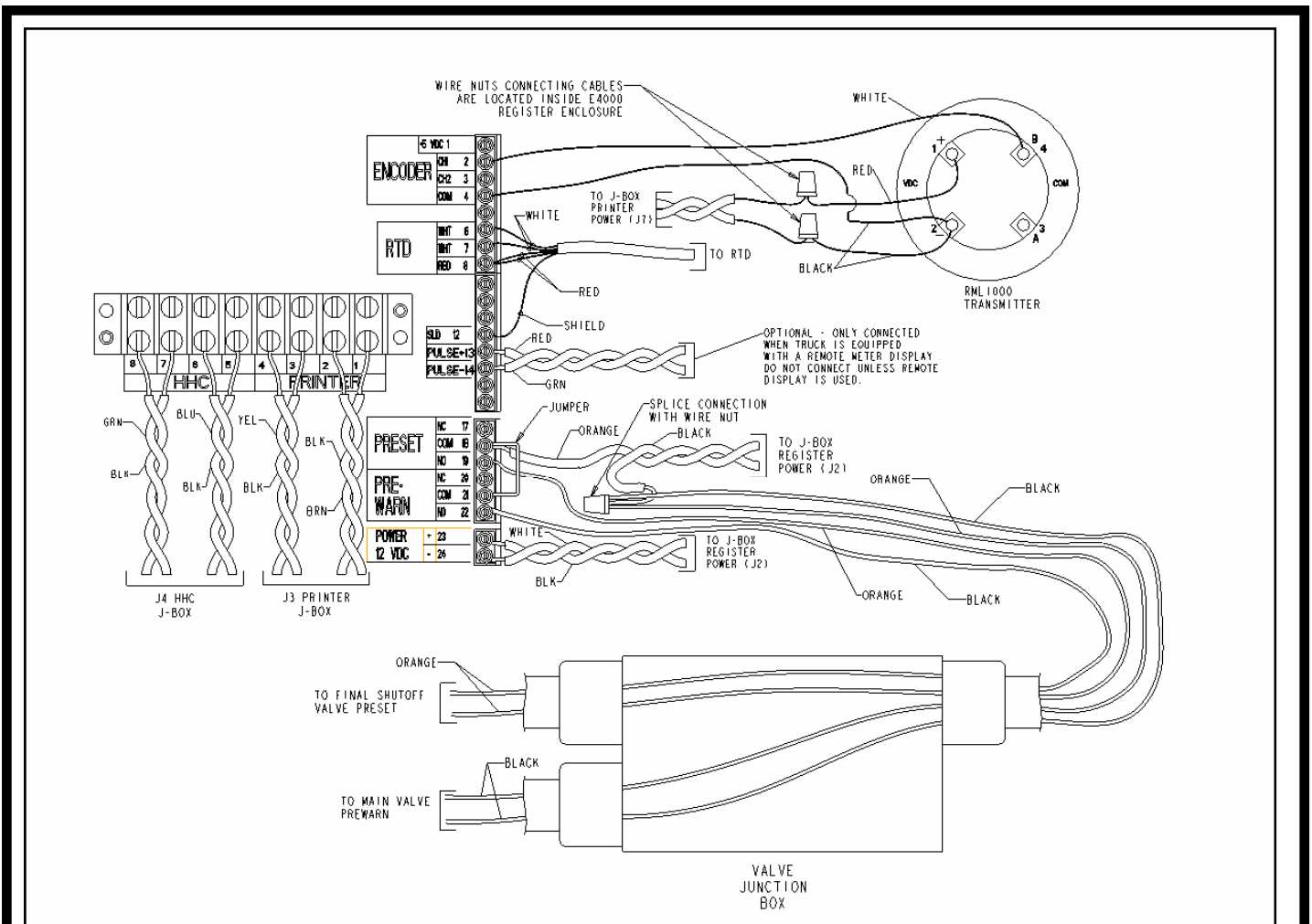


Figure 4-15. E4000 Register Wiring Diagram for RML2000, Dual Stage Valve

The data / power cable should pass through the right side port at the rear of the E4000 Register (as viewed from the rear).

Caution: Factory supplied plastic cable glands and metal liquid tight connectors prevent moisture from entering the E4000 Register. Rubber gaskets should be installed over the threads of the conduit hubs so that they are on the outside of the register base. Teflon tape should be used to seal the plastic cable gland and metal conduit nipple where they are inserted into the conduit hubs. Also, the factory supplied hole plug should be installed in the center port at the rear of the E4000, and must be installed with the step on the inside washer facing the hole in the register base. This will center the hole plug correctly and assure it will not leak.



Figure 4-16. E4000 Wiring Ports

4.15 Wiring the RML2000 meter to the E4000 Register

Using the RML2000 cable kit, run the 4-conductor power/encoder signal cable from the meter retransmitter housing to the register terminal strip via the center hole at the rear of the E4000. The necessary cable glands and conduit are provided. The straight connector screws into the meter transmitter housing and the 90-degree elbow to the rear of the E4000. Take care to ensure water-tight seals between the conduit and the enclosures by repeating the method described in “Wiring the E4000 and Junction Box” above

Connect the power/encoder signal cable as shown in figure 4-13 or 4-15. The 24 volt power cable pair (Red/Black) coming from the cab junction box is connected to the meter power cable (Black/Red) inside the E4000 enclosure using wires nuts.



Figure 4-16a.
RML2000 Transmitter Connections

Section 4.16 Wiring the Junction Box

The data/power cable should pass through the center hole in the junction box. The printer power cable should pass through the left hole, and the truck power cable should pass through the right hole. **Caution: Factory supplied cable strain relievers are required to prevent damage to cables as they enter the junction box.**

Make the connections as shown in the wiring diagram (figure 4-17) for the junction box. Note: Always complete the Hand Held Computer (HHC DATA) wiring as this is required to communicate with the register via the non-printer serial port on the junction box.

Remove the foil from each of the nine twisted pairs where the cable enters the junction box, but do not trim the shield wires. At each terminal block, (HHC DATA, PRINT DATA, and REGISTER POWER) twist together the two bare shield wires and connect them to the single SHIELD terminal. The length of the shield wires should be such that they cannot contact the metal junction box or lid. (See Figure 4-18 for an example of correct wire dressing.)

Do not replace the E4000 cover at this point. Do not replace the junction box lid at this point.

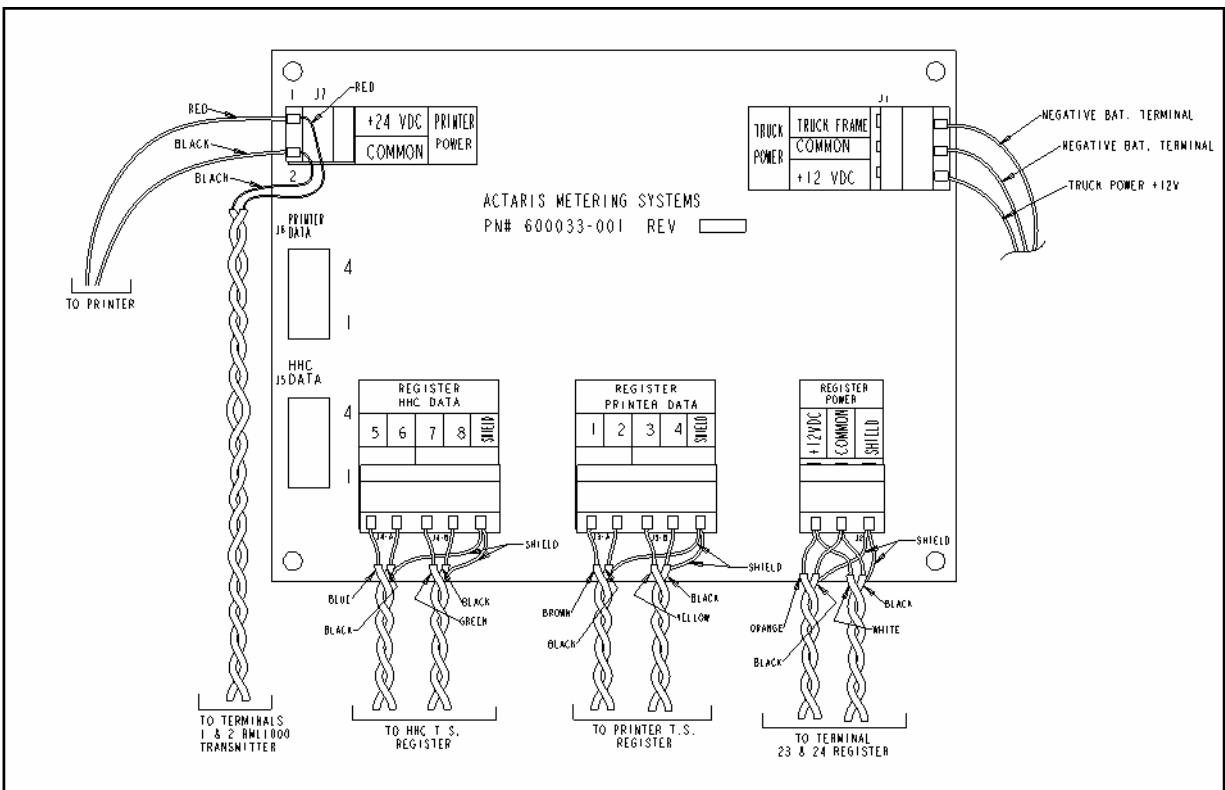


Figure 4-17. E4000 Junction Box Wiring Diagram for RML2000

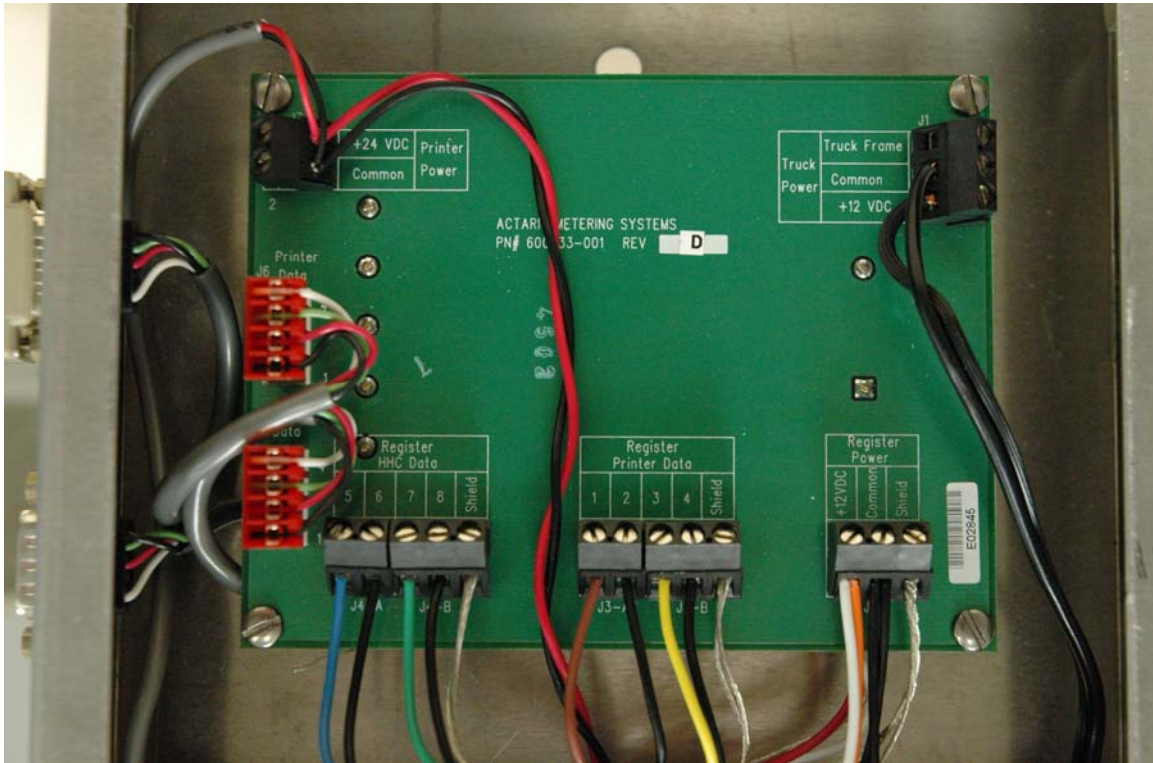


Figure 4-18. E4000 Junction Box for RML2000

4.17 Installing the Printer

The Epson TM-U295 printer is available with the E4000. Find a suitable location in the cab for the printer. End user requirements may vary but a commercially available stand is recommended to secure the printer. Bolt the printer stand to a sturdy section of the cab floor and attach the printer with Velcro strips. Remove the printer's rubber feet to get maximum holding force from the Velcro. (Figure 4-19.)

Data and power cables are supplied with the printer kit and junction box. The printer power cable is wired to the "printer power" terminal of the junction box as shown in Figure 17. Plug the power connector into the round DC24V port as marked on the rear of the printer. The 9-pin connector on the printer data cable plugs into the "printer data" socket provided on the junction box. Attach the 25-pin end of the data cable to the RS-232 socket on the rear of the printer. (Note: To ensure proper operation, use only the cable supplied with the printer.)



Figure 4-19. Printer Installation

In the E4000 software under Supervisor/Com Ports/Printer/Handshaking, set Handshaking to "Hardware". All of the DIP switches on the bottom of the printer should be off. (Figure 4-20.) (This is for software EA.01.05.E and later versions.)

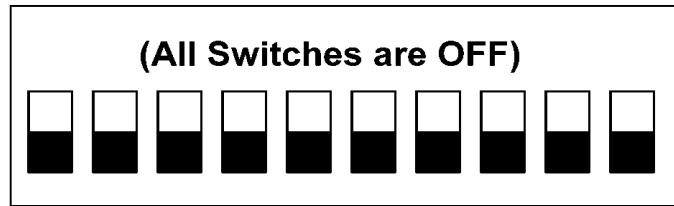


Figure 4-20. Printer DIP Switches

4.18 Connecting the Power Cable

The power cable to the E4000 is an installer supplied item and should be to the following specification:

- 2 conductor (black and red) 16 AWG cable
- Length approx. 6 ft

Attach "TRUCK POWER +12 VDC" to a switched accessory circuit on the truck fuse panel, using a 16 AWG cable with an in-line 5 amp fuse.

Attach "TRUCK POWER COMMON" to the negative terminal of the battery, using a 16 AWG cable, and verify that the resistance from the terminal connection to the negative terminal of the battery is less than 1 ohm (measured with power to the E4000 system switched off).

Attach "TRUCK FRAME" connection as a separate wire (not same wire as "TRUCK POWER COMMON") to the negative terminal of the battery, using a 16 AWG cable, and verify that the resistance from the terminal connection to the negative terminal of the battery is less than 1 ohm (measured with power to the E4000 system switched off).

Caution: The E4000 system will not function reliably unless two separate grounds of less than 1 ohm are used.

With all connections completed turn the ignition switch to the "ON" position. The E4000 will power up as indicated by the LCD back light illuminating. Replace the E4000 register cover taking care to position the cover gasket correctly.

Check the printer power light is illuminated. Replace the Junction Box cover.

To configure and calibrate the E4000 before it enters service refer to Section 6 of this manual.

4.19 Connecting a Mobile Computer

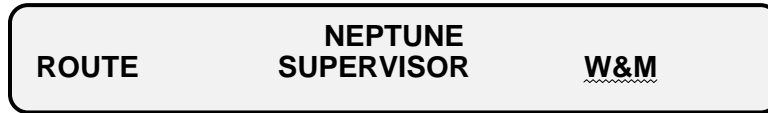
To operate with the E4000, a mobile computer plugs into a 9 pin serial connector on the junction box. Actaris has prepared a Communications Protocol document specifying how a computer can interface directly to the register. The protocol allows the external computer to extract data and control the operation of the register from a position in the cab. Application developers wishing to interface their product to the E4000 should contact Actaris directly.

5. Zeroing the RML2000 Coriolis Meter

See Appendix A for RML2000 zeroing procedure.

6. Start Up and Calibration

The E4000 will turn on automatically on power up. This is indicated by the LCD display illuminating, followed by a screen test operation and a display of the software version. The screen will stop at the root software menu in the following condition:



6.1 Route Mode

The Route Mode is the menu selection the operator uses to make deliveries from the meter, print out reports that record what deliveries were made and how the register is calibrated, and access the volume of product on the truck.



Register functions carried out in Route Mode are as follows:

- Select 1 of 10 possible programmed products. priced or unpriced
- Display delivered volume and print delivery ticket or priced invoice
- Make deliveries
- Print End-of-Shift Report to record number of deliveries made and total volume of each product delivered. Report current cumulative totalizer value
- Print Calibration Report to show the K-Factors and temperature compensation parameters set for each programmed product
- Enter, edit, and access the onboard volume

6.2 Supervisor Mode

The Supervisor Mode is the menu selection that allows an operations supervisor to set up password protected parameters within the E4000 that dictate how the register is operated.



Register functions carried out in Supervisor Mode are as follows:

Program prices, taxes and discounts for up to 10 individually named products

- Set the time and date for the E4000, printed on delivery, end-of-shift and calibration reports.
- Program the register flow control parameters
- With no valve control (E4000 relays do not operate a valve)
- With non-preset valve control (LPG security solenoid valve)
- With preset valve control (2 stage shut off valve)

- Configure the communication ports for the printer and mobile computer connection
- Allow multiple deliveries (disable 3 minute timeout to print ticket)
- Edit delivery ticket number, supervisor password, truck number
- Program a miscellaneous fee

*Note: Complete software details are listed in the **E4000 Software Manual***

6.3 W&M Mode (Weights and Measures Mode)

The W&M Mode is the menu selection allowing a technician to calibrate the E4000 to the flow-meter it will operate with. The Weights and Measures menu is only accessible via a physically sealed internal calibration switch positioned on the side of the register. Remove the drilled filler-head screw and use a paper clip, small Allen wrench, or similar item to depress the switch.



Register functions carried out in W&M Mode are as follows

- Assign product name to each of a possible 10 products
- Add temperature compensation to each product, if required
- Enter meter K-Factor manually, if known
- Calculate meter K-Factor automatically using calibration prover volume
- Calibrate temperature probe in field to known thermometer standard
- Input meter and E4000 serial number to be printed on reports
- Select units, gal/°F or liters/ °C, and resolution of the display
- Select type of input pulse to match internal encoder or external device.

*Note: Complete software details are listed in the **E4000 Software Manual***

6.4 Calibrating a meter equipped with E4000

The following is a procedure to calibrate the E4000 once it has been installed correctly according to this manual. After calibration, the register is ready to be put into service by the end user. For detailed E4000 operating instructions consult the **E4000 Software Manual**.

This procedure applies to E4000 firmware version EA.01.08E and later. The firmware version of the E4000 can be determined by viewing the display during the first 5 seconds after powering up the register (the version will be shown in the lower left corner of the display), or by printing a calibration report. To calibrate E4000s with earlier firmware versions, contact the factory or visit www.neptuneflowmeter.com.

6.4.1 Configuring the E4000

1. At the root menu, remove the seal screw and firmly depress the Calibration switch. Press the [>] button simultaneously using an allen key or stiff wire to enter the W&M mode indicated by flashing W&M. Press [Enter] to continue.



2. Select MISC from the calibration menu [Enter]

VOL	CALIBRATION TEMP	MISC
------------	-----------------------------	-------------

3. Use the push buttons [>] [^] to enter the Meter Serial Number [Enter]

METER SN 536659

4. Use the push buttons [>] [^] to enter the Register Serial Number [Enter]

REGISTER SN E001HE

5. Select the correct volume units according to local standards. [Enter]

UNITS VOLUME LITERS	GALLONS
--------------------------------------	----------------

6. Select the correct temperature units according to local standards. [Enter]

TEMPERATURE SCALE Deg_C	Deg_F
--	--------------

7. Select the required display resolution for the volume units. [Enter]

VOLUME RESOLUTION 0.001	0.01	0.1
--	-------------	------------

8. Select "single" for the type of input pulses to be counted. [Enter]

PULSE TYPE SINGLE	DUAL	QUAD
------------------------------------	-------------	-------------

NOTE: For a mass flow meter, set to SINGLE.

6.4.2 Calibrating the Temperature Probe (RTD)

Check the temperature probe calibration before doing any volume proving runs.

The RTD is factory set and should not need adjustment on a new unit.

For best results, always check the RTD reading against a Weights and Measures thermometer when product is flowing and when both readings have stabilized.

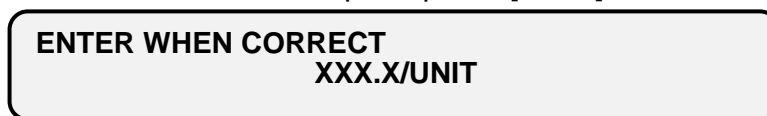
1. Starting from the root menu shown below, remove the seal screw from the left side of the register and depress the internal Calibration switch using a paper clip or small Allen key (3/32" is ideal). Press the [>] button simultaneously to access the **W&M** mode. When **W&M** is flashing, press [Enter] to continue.



2. Select TEMP from the calibration menu, and press [Enter].



3. The screen captures and "freezes" the current product temperature as measured by the register. Using the push buttons [>] [^] edit the temperature on the screen to agree with a W&M thermometer standard. When complete press [Enter].



4. The display now shows the updating product temperature as measured by the register, check this against the W&M thermometer standard. Press [Enter] to accept the revised temperature and exit to the CALIBRATION menu. If the temperature is incorrect, repeat the procedure again.

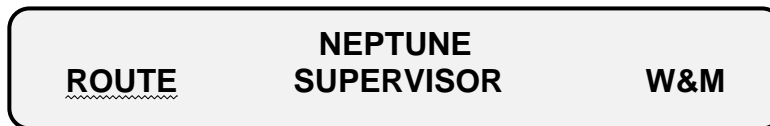


6.4.3 Calibrating the E4000 volumetric K-Factor

NOTE: The Version 08 and later software permits W&M inspectors to check calibration, by viewing both the gross and net volumes for the last delivery, without breaking the seal to enter the W&M menus. If the ^ or > buttons are pressed after the delivery ticket is printed, but before the cancel button is pressed to return to the “Select Product” screen, the screen will display both the gross and net volumes. If calibration is required, it is recommended that a shift report be printed before and after the calibration procedure, in order to reconcile the customer’s inventory. The shift reports will show the totalizer readings at the start and completion of the calibration process. Any quantity pumped through the meter during the calibration process will be added to the register totalizer reading.

To print a shift report

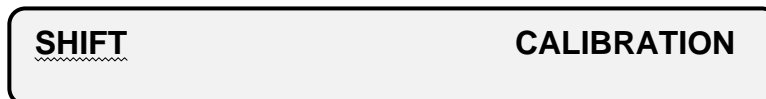
1. From the NEPTUNE root menu, press either > or ^, on the four button front panel, until “ROUTE” is flashing, then press the START/ENTER button.



2. Press > or ^ until “REPORTS” is flashing, then press the START/ENTER button.



3. Press > or ^ until “SHIFT” is flashing, then press the START/ENTER button.



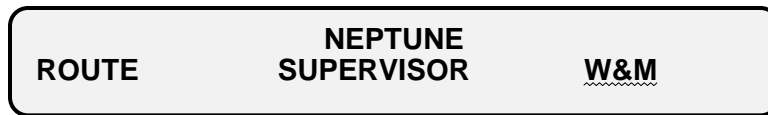
4. Press the START/ENTER button when the display reads “PRINT-END-OF SHIFT REPORT?”



5. The end of shift report will now print.

To Calibrate the Volumetric K-Factor:

1. Depress the Calibration switch and press the [>] button simultaneously to enter the **W&M** mode. When **W&M** is flashing, press [Enter] to continue.



2. Select VOL to enter the volume calibration menu, and press [Enter].



3. Select [^] the desired product code for the fluid to be calibrated 0-9, and press [Enter].



4. Assign a name to the product code selected.
Scroll [>] [^] through the characters to enter the name, and then press [Enter].



5. Select [^] the required product class for temperature compensation
None, 505 LPG (US), or 510 LPG (Canada), then press [Enter].



6. Select the method of calibration to be used:
If the K-Factor is known and is being re-entered manually select **MANUAL**, press [Enter], and follow steps 7 and 8.

If the K-Factor is not yet known select **AUTO**, then press [Enter] to skip to step 9.

Starting K-Factors* of **123 pulses/unit** are programmed at the factory for Product 0. For an RML2000, the starting K-Factor should be changed manually to "596".



* Note: Any product programmed with a K-Factor of 999999 cannot be selected for delivery in route mode, and you cannot perform an "AUTO" calibration without first doing a "MANUAL" calibration to change the K-factor from 999999 to a starting K-factor of around 123.

7. Use [>] [^] to enter the known K-Factor, and press [Enter].

To calculate a new K-factor: $NEW = OLD \times \frac{REGISTER\ READING}{CORRECTED\ PROVER\ READING}$

ENTER K-FACTOR
596/gal

8. Verify the K-Factor is entered correctly, and press [Enter].

K-FACTOR CORRECT?
596/gal

Auto Calibration using an approved volumetric prover

9. To prepare for the calibration tests first **wet down and zero the prover**.

If the register controls flow, press [Enter] to open the solenoid valve.

Open the prover manual valve to allow fluid into the prover.

AUTO CALIBRATION
START FLOW

10. As the fluid flows into the prover the register displays Gross and Net volume to allow the tester to monitor the operation of the meter.

GROSS XXXXXXX
NET XXXXXXX

11. When the prover is full, drain the prover down and zero it.

12. Press [Cancel] twice to return to "Calibration Method".

CALIBRATION METHOD
MANUAL AUTO

13. To perform a **calibration test run**, select **AUTO**, and press [Enter].

AUTO CALIBRATION
START FLOW

14. Press [Enter], and open the prover manual valve to allow fluid into the prover. As fluid flows Gross and Net volumes are displayed as before.

GROSS	XXXXXXX
NET	XXXXXXX

Note: Pressing [Stop/Cancel] at any time during the AUTO CALIBRATION procedure will close the solenoid valve, if equipped, and flow cannot continue until [Enter] is pressed to re-open the solenoid valve. Pressing [Stop/Cancel] twice will terminate the AUTO CALIBRATION procedure.

15. By pressing [>] or [^] the display can be toggled to show the instantaneous RTD temperature and the flowrate through the meter. Press [>] or [^] to go back to step 14.

TEMPERATURE	XXX.X/unit
RATE	XXXX.XX/unit

When the prover reaches the calibrated volume close the manual valve. Wait at least 5 seconds after closing the manual prover valve, and press [Enter]. The display changes to:

FLOW STOPPED
CONTINUE?

Press [Enter] to continue.

16. Measured Gross and Net volumes are displayed to allow tester verification against calculated prover uncompensated and compensated volumes.

GROSS	XXXXXXX
NET	XXXXXXX

Press [Enter] to calculate a new K-Factor.

17. Gross volume as measured by the register is displayed. If the volume is incorrect, enter the calculated *Gross volume of the prover to calculate a new K-factor.

ENTER PROVER VOLUME
XXXX.XXX units

*Note: For LPG, corrections must be made for the difference in temperature of the product as it passed through the meter and the temperature of the product as it occupies the prover, along with a correction for the thermal expansion of the prover based on it's temperature, and also a

correction of the prover volume based on pressure effects, when calculating the Gross (uncompensated) volume of the prover. (Reference Tables 1, 2, & 3 of National Conference on Weights and Measures "Course 305").

Press [Enter] to continue.

18. Verify that the prover volume was entered correctly and press [Enter].

PROVER VOL CORRECT?
XXXX.XXX units

19. The new K-Factor is calculated and displayed

Press [Enter] to verify the new K-Factor and return the display to step 12.

K-FACTOR CORRECT
XXXXXX/unit

Note: Any product programmed with a K-Factor of 999999 cannot be selected for delivery in route

20. A second run should be performed to check the accuracy of the new K- Factor and the temperature compensated (Net) volume:

Drain and zero the prover once more.

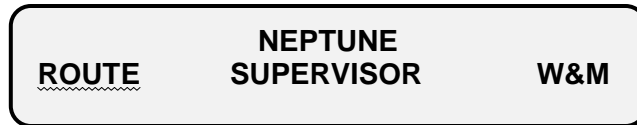
To check the accuracy of the new K- Factor, return to the auto calibration process, and repeat steps 12- 17.

21. If the accuracy is acceptable, press [Stop/Cancel] six times to exit the calibration menu, or once to repeat steps 12- 17 if further test runs are necessary.

To Print a Calibration Report:

Note: Insert 4 1/2"x 11" paper into the printer

1. From the NEPTUNE root menu, press either of the white buttons \rangle or \wedge , on the four button front panel, until "ROUTE" is flashing, then press the green START/ENTER button.



2. Press \rangle or \wedge until "REPORTS" is flashing, then press the START/ENTER button.



3. Press \rangle or \wedge until "CALIBRATION" is flashing, then press the START/ENTER button.



4. Press the START/ENTER button when the display reads "PRINT-END-OF SHIFT REPORT?"



5. Press [Cancel] three times to return to the root menu.

CONSULT YOUR LOCAL WEIGHTS AND MEASURES REPRESENTATIVE FOR GUIDELINES ON SEALING THIS UNIT.

7. Installation Checklists

Junction Box

- ___ Mount the JBox in cab oriented so that the two RS232 ports are easily accessible, and Jbox cover can be easily removed to access terminal connections.
- ___ Route power/data cable thru center port, printer power cable thru left port (RS232 connector side), and truck power cable thru right port.
- ___ Tighten three plastic cable glands to prevent pulling cables from JBox.
- ___ Remove all foil from the power/data cable twisted pairs within 1 inch of where the cable enters the Jbox.
- ___ Check wiring pair color connections as shown in the wiring diagram (See Figure 4-17, LPG; Figure 5-12, Petroleum), and tighten all terminal connections.
- ___ Use the corresponding shield wire for each twisted pair in the power/data cable, and connect two shield wires to each of the three (“REGISTER HHC DATA”, “REGISTER PRINTER DATA”, and “REGISTER POWER”) terminal connections.
Do not allow the bare shield wires to contact the metal junction box.
- ___ Attach “TRUCK POWER +12 VDC” to a switched accessory circuit on the truck fuse panel, using a 16 AWG cable with an in-line 5 amp fuse.
- ___ Attach “TRUCK POWER COMMON” to the negative terminal of the battery, using a 16 AWG cable, and verify that the resistance from the terminal connection to the negative terminal of the battery is less than 1 ohm (measured with power to the E4000 system switched off).
- ___ Attach “TRUCK FRAME” connection as a separate wire (not same wire as “TRUCK POWER COMMON”) to the negative terminal of the battery, using a 16 AWG cable, and verify that the resistance from the terminal connection to the negative terminal of the battery is less than 1 ohm (measured with power to the E4000 system switched off).

Register

- ___ Attach to meter and tighten all connections (Section 4.5, LPG; 5.5, Petroleum).
- ___ Install and wire “RTD”, if equipped (Section 4.7, LPG; 5.6, Petroleum).
- ___ Install rubber gaskets on the plastic cable gland and metal liquid tight connector so that the gaskets are positioned on the outside of the register.
- ___ Route power/data cable thru right side port at rear of register (looking from the rear), and tighten the plastic cable gland to compress the rubber gasket.
- ___ Route valve cable (if equipped with valve) thru the left side port (nameplate side), and tighten the metal liquid tight connector to compress the rubber gasket.
- ___ Route the 4-conductor power/encoder signal cable from the meter transmitter housing to the E4000 through the center port and tighten the metal liquid-tight connector to compress the rubber gasket.
- ___ Remove all foil from the power/data cable twisted pairs to within 1 inch of where the cable enters the register base.
- ___ Cut and remove from the power/data cable all of the twisted pair shield wires to within 1 inch of where the cable enters the register base. **Cut the shield wires on the register end of the cable only, not on the Jbox end**.
- ___ Route the 4 twisted pairs of wires for the “HHC” and “PRINTER” around the left side (from front of register) and connect to the terminal strip on top of register

(See Figure 4-13 for LPG and Figure 5-9 for Petroleum).

- ___ Route the orange/black(LPG) or red/black(Petroleum) and white/black twisted pairs across to the right side of the register and connect to the terminal strip on the side.
- ___ Check wiring pair color connections (See Figure 4-13 for LPG and Figure 5-9 for Petroleum) and tighten all connections.
- ___ Check the voltage across terminals 23 and 24 and verify it is 12-14 VDC.
- ___ Check to be sure the display ribbon cable connectors are attached securely.

Printer

- ___ Set DIP switches all to "OFF" (See Figure 4-20).
- ___ Install printer ribbon.
- ___ Mount the printer in the cab.
- ___ Plug the printer power connector into the round DC24V port on back of printer.
- ___ Plug the 9-pin connector on the printer data cable plug into the RS-232 socket on the rear of the printer.

LPG Single-Stage Solenoid Valve- If equipped

- ___ Check to be certain there is a Transient Voltage Suppressor installed in the valve, under a section of heatshrink, where the two black wires enter the valve.
- ___ Check that "Port A" (N/C) of the valve is connected to the vent line check valve of the vapor release.
- ___ Check that "Port B" (Common) of the valve is connected to the top of the meter differential valve.
- ___ Check that "Port C" (N/O) of the valve is connected to line pressure.

System

- ___ **Check to see that the E4000 LCD Display turns on automatically when the truck ignition is "ON".**
- ___ Configure the E4000 (Section 6.4.1).
- ___ Set the "BATCH" mode in the Supervisor menu to program the correct valve operation (Section 6.2).
- ___ Set the "COM PORTS" mode in the Supervisor menu, for the "PRINTER", to BAUD RATE "9600", PARITY "None", and HANDSHAKING "Hardwre".
- ___ Verify printer wiring is correct by printing a "Calibration Report" (Section 6.4.3).
- ___ Verify HHC wiring is correct by using the "Neptune E4000 Configuration Software" to download a configuration from a computer to the E4000.
- ___ Pump product thru the meter and verify the E4000 operates correctly.
- ___ Calibrate the meter (Section 6.4.3).

E4000 Serial No. _____

Date Installed _____

Installed By _____

Checked By _____

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