

INSTRUCTION MANUAL

MODEL LDE 700 ***MODEL E-700-1***

(Revised January 5, 2004)

Operation and Installation Manual

NOTICE: PNEUMERCATOR CO., INC. reserves the right to make improvements to the product described in these instructions at any time and with no notice.

WARNING: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart B of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

IMPORTANT: Installation of this equipment must be in accordance with these instructions as adopted from the following codes:

ISA RP12.6, "Installation of Intrinsically Safe Instrument Systems in Class I Hazardous Locations".

NFPA 70, "National Electrical Code".

Alteration, modification or replacement with non-factory components could impair the intrinsic safety of this equipment.

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Section 1: Introduction

The PNEUMERCATOR LDE-700 and E-700-1 are advanced inventory management and control systems. Drawing upon PNEUMERCATOR's more than 75 years of experience in liquid level controls and measurement systems, the LDE-700 and E-700-1 are designed to help simplify the inventory process, and to be extremely easy to operate.

These 16-bit microprocessor controlled systems continuously monitor the level of product in a storage tank. The product level is available on the daylight visible display in units of either inches of product height (to the nearest hundredth of an inch), or in gallons. The product level and tank volume display is directly selectable from the Inch/Gallon switch.

The LDE-700 and E-700-1 easily accommodate different sizes of underground and aboveground storage tanks, and are suitable for all types of fluids. Some of the fluids that are suitable for monitoring with the LDE-700 and E-700-1 are petroleum products, waste oil, conductive fluids, water, alcohols, solvents, lubricants, and corrosive chemicals. The gauges offer conversion of level to volume preprogrammed to match the geometry of the storage tank used. PNEUMERCATOR's many years of experience help guarantee an accurate conversion of height to gallons for all types and configurations of storage tanks.

The gauges provide audible, visible and (optional) printed outputs for high level (overflow) and low level alarms, and 2 switch input alarms. Alarms are provided for loss detection. The LDE-700 also provides 2 channels of precision leak detection. Visible alarms are continuously on until the conditions are corrected. The audible alarm may be silenced for a particular condition by pressing the RESET pushbutton on the front panel and may be programmed from the integral keypad to automatically shut off after a specified period of time. The audible alarm may be disabled for all conditions, by using a keypad command in PROGRAMMING mode.

The gauges have 4 relays with dry contacts that will activate on keypad-programmed conditions. The relay contacts are available at the terminal block as 1 Form C contacts that may be programmed for normally energized or normally unenergized states. The relay contacts are rated at 5 amps at 120 VAC.

Printed hardcopy inventory reports of product level and volume in the tank may be requested at any time by pressing the PRINT pushbutton on the front panel if the optional printer is present.

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The systems feature self-diagnostics that test the audible alarm, visual alarms, clock, relay operation, and data storage memory. These tests are available from the keypad, and help to ensure reliable and trouble-free operation of the LDE-700 and E-700-1.

Set-up parameters for the storage tank, and for the system as a whole may be printed at any time by a keypad command. This allows for hardcopy verifications and records of the conditions that the system is operating under.

Variations in tank installations, fitting tolerances, and tank tilts may be compensated for by entering an installation offset adjustment. This allows the system to maintain maximum accuracy in its measurements.

The LDE-700 can take inputs from 2 leak detection sensors designed to monitor collection sumps and the annular spaces of double wall tanks for leakage of hydrocarbons. The system provides individual indications for detection of air, water, and hydrocarbons. Detection of air is indicated by a Green light. Detection of hydrocarbons is indicated by a Red light. Detection of water is indicated by an Amber light. The leak detection capabilities meet EPA requirements for annual testing and monthly monitoring.

The LDE-700 will retain memory of a hydrocarbon or water alarm even if the alarm condition later disappears. The alarm memory is battery backed up, so the memory will remain in the event of a power failure. The alarm memory may be cleared by a keypad command.

The adjustable volume system horn will sound an audible alarm while the selected alarm conditions are present. Audible alarm silencing may be done by manually by pressing the RESET button on the cover of the console, or may be automatically timed for a selectable automatic time delay reset. Time delay periods of 1 to 7 minutes are available. Relay outputs may be programmed to actuate on selected conditions and may be programmed to shut off after time delays of from 1 to 15 minutes.

Sensors may be tested and calibrated by keypad programming. The switch inputs may be programmed to accept normally open or normally closed mechanical contacts. The LDE-700 can be programmed to accept switch inputs at one or both leak detection inputs. Sensors for both sump and annular space detection may be mixed in a system with no limitations.

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The system alarm console may be mounted in any non-hazardous area where it can be provided with 120 VAC $\pm 10\%$ at 60 Hz. The standard enclosure is NEMA 1 with a NEMA 4 console optionally available.

The system sensors are designed for intrinsically safe operation in Class I, Division 1, Group A, B, C, D areas. The gauging sensors may be separated from the console by 3 wire #18 AWG runs of up to 5000 feet. Leak sensors may be separated from the console by 3 wire #18 AWG runs of up to 1000 feet. Switch sensors may be separated from the console by 2 wire #18 AWG runs of up to 5000 feet.

The system is designed to provide safe and reliable operation when installed as instructed in the Installation section of this manual. All requirements of the National Electrical Code (NEC) as well as local electrical and fire codes should be followed in the installation procedures. It is recommended that the user read and understand ANSI/ISA RP12.6, "Installation of Intrinsically Safe Instrument Systems in Class I Hazardous Locations".

If additional information is needed concerning equipment selection, system planning, installation, operation, servicing, or maintenance, please contact:

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Section 2: Specifications

Power - 120 VAC \pm 10%, 60 hertz, 48 Watts, MOV surge protection, undervoltage detection and protection.

Fuse - 3 A.G. SLO-BLO, 1/4 Amp, 250 VAC or equivalent.

Operating Temperature - -40° F to 122° F (-40° C to 50° C).

Enclosure - NEMA 1 standard, NEMA 4 optional.

Installation - Wall mount.

Calibrations - Alarm points and programming set by keypad & maintained for 10-year data retention on power failure.

Gauging Resolution - 0.1% of tank height.

Gauging Accuracy - \pm 0.12% of tank height or \pm 1/8" w/2-412 or \pm 1/4" w/2-501, whichever is greatest.

Gauging Repeatability - \pm 0.1% of tank height.

Displays - Red, 0.8 inch high, seven segment displays. Inch/Gallon, Loss mode and Data recall switches.

Alarm Indications - High (overflow) and Low level red LEDs, 2 Switch indication red LEDs.

Horn - Min. 85 dB at 3 meters on axis, manual horn reset (silence) pushbutton, automatically timed horn silence.

Relay Outputs - 4 SPDT dry relay contacts, rated at 5 Amps at 120 VAC, individually keypad programmable for actuating condition(s) and normally energized or normally unenergized.

Clock - The clock maintains the time and date and year for (optional) printer functions. It automatically compensates for Leap Year corrections and Daylight Savings Time. The time is maintained with an accuracy of \pm 11 sec/day. 10-year data retention on power failure.

Gauging Sensor - Standard: 2-412 or 2-501. Intrinsically safe for Class I, Division 1, Groups A, B, C, D, 5 VDC @45 mA. Optionally from isolated self-powered 4 to 20 mA sensor capable of driving 500 Ω (not intrinsically safe).

Switch Inputs - 2 from any mechanical switch input. Intrinsically safe for Class I, Division 1, Groups A, B, C, D, 5 VDC @25 mA. Individually keypad programmable for normally open or normally closed switch inputs.

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Output Signals - Optional RS-232 (standard with LDE-700). Optional 4 to 20 mA non-isolated output, 500Ω max. load, keypad programmable for percent of height or volume. Optional 20-column dot matrix printer.

Leak Detection Sensors (LDE-700) - 2 from 9-901, 9-902, and 9-903 sensors. Intrinsically safe for Class I, Division 1, Groups A, B, C, D, 5 VDC @45 mA. Can be individually programmed from keypad to alternately accept normally open or normally closed mechanical switch inputs.

Leak Detection Testing (LDE-700) - Meets EPA requirements for annual testing and monthly monitoring.

Hydrocarbon Detection (LDE-700) -

Products that are to be detected must be non-conductive fluids having a dielectric value of between 2 and 12.

9-901: 0.33", 100% pfd, 0% pfa @ 0.1 gph.

9-902: 0.35", 100% pfd, 0% pfa @ 0.1 gph.

9-903: 0.68", 100% pfd, 0% pfa @ 0.1 gph.

Leak Detection Response Time (LDE-700) - Less than 1 second for detection, 1 minute for alarm latch.

Leak Detection Indicators (LDE-700) -

Red LED indicates oil detection.

Amber LED indicates water detection.

Green LED indicates air (normal condition).

Sensor Operating Temperature -

9-901,9-902,9-903 Sensors: -40°F to 130°F (-40°C to 55°C).

2-412,2-501 Sensors: -20°F to 180°F (-29°C to 82°C).

LS-600 Switch Sensors: -20°F to 180°F (-29°C to 82°C).

LS-600LD Leak Sensors: -40°F to 160°F (-40°C to 71°C).

Sensor Operating Pressure -

9-901,9-902,9-903 Sensors: ambient (vented).

2-412 Sensor: to 50 psi.

2-501 Sensor: to 15 psi.

LS-600 Switch Sensors: to 150 psi. LS-600LD Leak Sensors: to 100 psi.

Sensor Cable -

2-412,2-501,9-901,9-902,9-903: Standard 3 conductor #18 AWG, 2-412 and 2-501 up to 5000 feet. 9-900 sensors up to 1000 feet. Switch sensors: Standard 2 conductor #18 AWG, up to 5000 feet.

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Section 3: Installation

NOTE: INSTALLATION MUST BE DONE BY QUALIFIED PERSONNEL, FAMILIAR WITH LOCAL WIRING CODES AND EXPLOSION HAZARD ELECTRICAL SAFETY PRACTICES.

Section 3.1: --Mechanical Installation

The LDE-700 or E-700-1 console is a NEMA 1 enclosure intended for indoor installation. An optional NEMA 4 enclosure intended for indoor or outdoor installation is available and offers protection against splashing water, seepage of water, falling of hose directed water, and severe external condensation. The NEMA 4 enclosure is also sleet resistant. Either enclosure has mounting flanges that allow permanent fastening to walls, panels, etc.

The console should be located in an area that is easily accessible to the personnel responsible for operating the system. This is to allow easy maintenance access, and access to the console for operation and testing. The console must be located in a non-hazardous area, as close as possible to the demarcation point of the hazardous area, with available 120 VAC power brought to the console through a dedicated metal wiring conduit. The metal conduits for sensors and power should be weathertight. Bottom entrance holes are provided for 1/2" NPT pipe or rigid metal conduit, with sensors entering on the bottom left and power entering on the bottom right.

Consult the local electrical codes for specific requirements.

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Section 3.2 Sensor Installation

Section 3.2.1 Tank Sensors

There are two tank-gauging sensors available for the LDE-700 and E-700-1. The model 2-412 is designed for installation in 4" minimum tank openings. The model 2-501 is designed for installation in 2" minimum tank openings and is designed for use with heavy viscous fluids like #6 oil. Self-powered sensors that provide an isolated 4 to 20 mA output may be used for tank gauging if the LDE-700 or E-700-1 are ordered from the factory with this option. If a 4 to 20 mA output sensor is used, two (2) 18 AWG wires are required.

Three (3) 18 AWG wires are required for the model 2-412 and model 2-501 sensors. The wiring should be run through NEMA 4 or better junction boxes and 1/2" weatherproof liquid tight metal conduit. The metal conduit and junction boxes should be sealed against entry of water. If required, vapor seals may be installed to prevent gas vapors from propagating back to the console. The sensor wiring to the console should be run in a dedicated metal wiring conduit. No non-intrinsically safe wires should be in the same conduit unless a metal barrier is provided.

The tank sensor is wired to TB2 on the circuit board. The Red wire is connected to position 1, the White wire is connected to position 2 and the Black wire is connected to position 3. If a 2-wire sensor is used, the (+) wire is connected to position 2 and the (-) wire is connected to position 3. Position 1 is not used with a 2-wire sensor.

The wiring and terminal block (TB2) are intrinsically safe and are physically separated from the AC power and relay contact and 4 to 20 wiring and terminal blocks on the right side (TB5, 6, 7). This separation must be maintained.

See Figure 7, System Wiring Diagram: LDE-700, Page 56.

See Figure 8, System Wiring Diagram: E-700-1, Page 57.

2-412 Installation (see Figure 1, Pages 48,49)

2-501 Installation (see Figure 2, Pages 50,51)

Section 3.2.2: Switch Sensors

PNEUMERCATOR makes a number of different LS-600 series switch sensors that may be used with the E-700-1 and LDE-700. See the appropriate LS-600 bulletins for details on these. Any other mechanical switch closure may also be used as switch inputs. The LDE-700 may also be programmed from the keypad to accept

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switch inputs at one or both LEAK inputs. If this feature is used, the two (2) wires of the switch are connected to TB4 positions 1 and 2 if LEAK input 1 is programmed as a switch and to TB4 positions 4 and 5 if LEAK input 2 is programmed as a switch.

Two (2) 18 AWG wires are required for each switch sensor. The wiring should be run through NEMA 4 or better junction boxes and 1/2" weatherproof liquid tight metal conduit. The metal conduit and junction boxes should be sealed against entry of water. If required, vapor seals may be installed to prevent gas vapors from propagating back to the console. The switch sensor wiring to the console should be run in a dedicated metal wiring conduit. No non-intrinsically safe wires should be in the same conduit unless a metal barrier is provided.

The switch sensors are wired to TB3 on the circuit board. The first switch sensor is wired to positions 1 and 2, and if there is a second switch sensor it is wired to positions 3 and 4.

The wiring and terminal block (TB3) are intrinsically safe and are physically separated from the AC power and relay contact and 4 to 20 wiring and terminal blocks on the right side (TB5, 6, 7). This separation must be maintained.

See Figure 7, System Wiring Diagram: LDE-700, Page 56.

See Figure 8, System Wiring Diagram: E-700-1, Page 57.

Section 3.2.3: Leak Detection Sensors

There are three leak detection sensors available for the LDE-700. The model 9-901 is designed for installation in a horizontal position in the annular space of F.R.P. double wall tanks. The model 9-902 and 9-903 are designed for installation in a vertical position in collection sumps, monitoring pipes and steel double-wall tank sumps.

Three (3) 18 AWG wires are required for each sensor. The wiring should be run through NEMA 4 or better junction boxes and 1/2" weatherproof liquid tight metal conduit. The metal conduit and junction boxes should be sealed against entry of water. If required, vapor seals may be installed to prevent gas vapors from propagating back to the console. The sensor wiring to the console should be run in a dedicated metal wiring conduit. No non-intrinsically safe wires should be in the same conduit unless a metal barrier is provided.

The sensors are wired to TB4 on the circuit board. The first sensor is wired to positions 1, 2 and 3, and if there is a second sensor it is wired to positions 4, 5 and 6. The Red wire is connected to position 1, the White wire is connected to position 2,

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and the Black wire is connected to position 3. If there is a second sensor, the Red wire is connected to position 4, the White wire is connected to position 5, and the Black wire is connected to position 6.

The wiring and terminal block (TB4) are intrinsically safe and are physically separated from the AC power and relay contact and 4 to 20 wiring and terminal blocks on the right side (TB5, 6, 7). This separation must be maintained.

9-901 Installation (see Figure 3, Page 52 for drawing)

Tank size	Measurement length
4'	81"
6'	118"
8'	149.5"
10'	193.5"
12'	222"

1. Use the chart above to determine the cable measurement length for the size of the tank being monitored.
2. Unroll the sensor/cable assembly and measure from the sensor bottom to the cable measurement length. Mark the cable at that point.
3. Feed the cable through the bottom of the mounting bushing and cord connector until the mark on the cable is even with the top of the mounting bushing. Insert the sensor and cable through the 2" NPT opening and into the annular space.
4. Screw in the mounting bushing and connector.
5. Tighten the connector with the cable mark in the correct position.
6. Wire the sensor cable end to three 18 AWG wires in a NEMA 4 or better junction box or in an optional epoxy splice kit, part number 100007-1.

9-902 Installation (see Figure 4, Page 53 for drawing)

1. Measure the distance from the top of the 2" opening to the bottom of the area being monitored. This is the mounting height.
2. Add 2 and 3/16 inches to this dimension to find the cable length measurement.

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3. Unroll the sensor/cable assembly and measure from the sensor bottom to the cable measurement length. Mark the cable at that point.
4. Feed the cable through the bottom of the mounting bushing and cord connector until the mark on the cable is even with the top of the mounting bushing. Insert the sensor and cable through the 2" NPT opening.
5. Screw in the mounting bushing and connector.
6. Tighten the connector with the cable mark in the correct position.
7. Wire the sensor cable end to three 18 AWG wires in a NEMA 4 or better junction box or in an optional epoxy splice kit, part number 100007-1.

9-903 Installation (see Figure 5, Page 54 for drawing)

1. Measure the distance from the top of the opening to the bottom of the area being monitored. This is the mounting height.
2. If using the optional Pneumercator leak monitor tube assembly for Convault tanks (assembly #900379-1), add 1 inch to this dimension to find the cable length measurement.
3. Unroll the sensor/cable assembly and measure from the sensor bottom to the cable measurement length. Mark the cable at that point.
4. Feed the cable through the bottom of the tube cover and cord connector until the mark on the cable is visible. Insert the sensor and cable through the monitoring opening.
5. Screw the cord connector into the tube cover and place back on the tube.
6. Tighten the connector with the cable mark in the correct position.
7. Wire the sensor cable end to three 18 AWG wires in a NEMA 4 or better junction box or in an optional epoxy splice kit, part number 100007-1.

Section 3.3: Electrical Installation

WARNING: Do not connect 120 VAC or turn on 120 VAC until all other connections have been made, all equipment has been installed, and final inspection has been completed.

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The LDE-700 or E-700-1 requires a power input of 120 VAC, $\pm 10\%$, 60 Hz. The unit is fused with a 1/4 Amp, 3AG Slo-Blo fuse. Total power usage is less than 40 Watts. The power input is protected against common-mode power surges with a metal-oxide varistor (MOV). The power line for the alarm console should not share a breaker circuit with any motors, compressors, or other sources of power surges or voltage sags. The power wiring to the alarm console should be run in a dedicated metal wiring conduit. No other wires should be in the same conduit unless a metal barrier is provided. Three wires make up the power input to the LDE-700 or E-700-1: Black (hot), White (neutral) and Green (ground).

The A.C. power wires run to the terminal block labeled TB7, to positions 1, 2, and 3. Position 1, labeled HI, is the hot lead. Position 2, labeled LO, is the neutral lead. Position 3, labeled GND, is the ground lead. The terminal blocks will accept wire sizes up to 14 AWG stranded wire. The wiring and terminal block on the left side (TB1, 2, 3, 4) are intrinsically safe and are physically separated from the AC power and relay contact and 4 to 20 mA output wiring and terminal block on the right side (TB5, 6, 7). This separation must be maintained.

IMPORTANT

Connect a 12 AWG copper wire from the terminal block TB1 (labeled Earth Ground) to a good earth ground. The ground connection must be within 1 OHM of true ground and must be made at only one point for the system to maintain intrinsic safety.

Properly dress all wires inside the wiring sections and securely clamp down the enclosure door and tighten all conduit entrances to seal the system watertight. Install vapor seals in accordance with local codes for hazardous locations if applicable.

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Section 3.4: Installation Checklist

Do not apply power to the unit until its installation has been checked and found to be in accordance with the instructions in this manual; the National Electrical Code; federal, state and local codes; and other applicable safety codes.

1. Check to be sure that the sensor wires are contained in a dedicated, separate metal wiring conduit.
2. Verify that all conduits enter the alarm console through the proper conduit openings on the bottom of the console.
3. Verify that a 12 AWG copper wire has been connected between TB1 (labeled Earth Ground) and a good earth ground.
4. Verify that the power supply terminals are correctly wired.
5. Verify that system power is properly wired to a separate, dedicated circuit breaker.
6. Verify that all sensors have been properly wired with color-coded or marked 18 AWG wires and that the proper color-coding or marking has been maintained throughout the wiring runs.
7. Verify that all wiring splices are waterproof. Pneumercator part #100007-1 (epoxy splice kit) or equivalent or NEMA 4 or better junction box should be used for all wiring splices.
8. Securely clamp down the enclosure door.

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Section 4: Operation

IMPORTANT: Before operating the system, make sure that all items on the installation checklist in the Installation section of this manual have been checked out and complied with.

Circuit Board layout (see Figure 6, Page 55 for drawing)

Section 4.1: Normal Operation

In normal operation there will be no alarm lights on and the horn will be silent. The display will show the level of product in the storage tank in either gallons of volume or inches of height. The display of gallons or inches is controlled by the position of S1 on the circuit board (labeled GALLONS on the left and INCHES on the right). The Loss mode switch (S2) should be toward the left, in the NORMAL position. LDE-700 units should have Green light(s) on for installed leak detection sensors.

The system will continuously monitor the level of product in the tank and will display in the selected mode. Alarms will actuate the appropriate light and relay and the horn (if the relay or horn is programmed for that alarm). Alarm conditions and levels may be individually programmed from the keypad or the RS-232 communications port.

Section 4.2: Leak Detection

Leak detection testing with 9-901, 9-902 and 9-903 (LDE-700 only) meets EPA requirements for annual testing and monthly monitoring. These sensors are intrinsically safe for use in Class I, Division 1, Groups A, B, C, D areas. Products that are to be detected must be non-conductive fluids having a dielectric value of between 2 and 12.

Leak detection response time (LDE-700 only) is less than 1 second for detection of product or water at the threshold level. The system will latch a leak detection alarm after 1 minute of continuous detection. This is to ensure that an alarm state is not ignored or bypassed. A leak detection alarm latch may be cleared by keypad or RS-232 communications port command or by re-calibrating the leak input channels.

Calibration may be done either from the keypad or the RS-232 communications port. The sensors must be clean and dry and in air. If the sensors are in oil or water, clean and dry them off before calibrating.

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Leak Detection Indicators (LDE-700 only)

Red LED indicates oil detection.

Amber LED indicates water detection.

Green LED indicates air (normal condition).

Either or both leak input channels may be programmed as extra switch inputs from the keypad or the RS-232 communications port. Using a leak channel as a switch input disables it for use as a leak input channel. Switches and leak sensors may not be mixed on the same input.

Section 4.3: Loss Mode

Loss (Theft) mode may be entered by toggling S2 on the circuit board to the THEFT position (right). When Loss mode is entered, the system records the product level in battery-backed memory. Any removal of 1% of the recorded product level will trigger the Theft alarm and cause the display to flash. The original product level before the loss may be displayed by pressing the Data Recall momentary pushbutton switch on the circuit board. Releasing the Data Recall pushbutton will resume display of the current product level. Toggling S2 to the NORMAL position (left) will exit Loss mode.

This mode is intended to detect only gross unauthorized removal of product. It is not intended to comply with EPA or other regulations in regard to leak detection.

Section 4.4: The Horn

The volume of the audible alarm may be controlled by rotating the louver on the face of the horn. The maximum volume of the horn is a minimum of 85 dB at two feet, and the loudness may be varied by about 40 dB.

The horn may be reset (silenced) after detection of a warning condition by pressing the RESET button on the cover of the system console. This will silence the horn, but the condition light will remain on.

The system is normally set at the factory to only actuate the horn on High (overflow), Low level, Switch 1, and Switch 2 alarms and Hydrocarbon detection (LDE-700). These conditions may be changed by programming the horn with the keypad or RS-232 communications port. The horn may also be programmed to be disabled.

The system is normally set at the factory to disable the automatic horn reset function. This setup will let the horn sound on detection of the programmed alarm

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conditions until it is manually silenced by pressing the RESET button on the system console cover. The automatic horn reset function may be programmed to operate after a period of from 1 to 7 minutes with the keypad or the RS-232 communications port.

The horn has a delay built-in, so that the same repeating alarm condition will not re-energize the audible alarm before 10 minutes. Other alarm conditions will activate the horn regardless of the delay state for a different condition.

Section 4.5: The Relay Contacts

There are 4 relays in the system that provides SPDT 1 Form C dry relay contacts. The terminal block relay contacts for the relays are brought out to TB6, and are labeled as outputs 1 through 4, Normally Closed (NC), Common (C) and Normally Open (NO) positions. These contacts are rated to 5 amps at 120 VAC. Wire sizes up to 14 AWG stranded wire may be used to connect to these relay contact outputs. If the load on the relay contacts exceeds this rating, then the relay should be used to actuate an external power relay of appropriate rating (not supplied by PNEUMERCATOR).

The default programming for the relays is:

Relay 1 - actuate on High (overflow) alarm.

Relay 2 - actuate on Low level alarm.

Relay 3 - E-700-1 : actuate on Switch 1 alarm.

LDE-700 : actuate on Switch 1,2 alarms.

Relay 4 - E-700-1 : actuate on Switch 2 alarm.

LDE-700 : actuate on Hydrocarbon alarm.

These conditions may be changed by programming the horn with the keypad or RS-232 communications port.

In the default programming, the relays are normally unenergized in a non-alarm state, there is no continuity between the Normally Open (NO) and Common (C) contacts and there is continuity between the Normally Closed (NC) and Common (C) contacts. When a programmed alarm condition is detected the relay actuates. This gives continuity between the Normally Open (NO) and Common (C) contacts, and breaks continuity between the Normally Closed (NC) and Common (C) contacts. The relays may be individually programmed to be in a normally energized state, which will toggle the states of the contacts. In this case, the relay(s) will de-energize on a programmed alarm condition. This may also be used to give indication of a power failure, since the relay will de-energize when the power is off.

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The system is normally set at the factory to actuate the relays for the duration of an alarm condition. The relays may be individually programmed to de-activate after a preselected time period of from 1 to 15 minutes. The relays may also be individually programmed to have a delay of 5 minutes from the time an alarm is detected and maintained until relay actuation. All relay programming may be done from the keypad or from the RS232 communication port.

Section 4.6: System Tests

The system LEDs, horn, RAM (memory), clock and relays may be tested from the keypad. The LEDs test will light all the LEDs on the cover until a keypress cancels the test and returns to normal mode. The horn test will sound the horn until a keypress cancels the test and returns to normal mode. This test may be left running to test operation of the autosilence mode. The operation of the RESET pushbutton may also be verified during this test. The RAM and clock tests will return to normal mode automatically unless a fault is detected. In that case, an error code will be displayed. The relay test will first activate the relays and then deactivate them after a keypress.

Section 4.7: 4 to 20 mA Output

The optional 4 to 20 mA output can be used to feed a current output to process control equipment, energy management systems or chart recorders. The normal 4 to 20 mA module has a non-isolated output and can drive loads with a maximum impedance of 500Ω. The minus (-) line of the output should not be connected to ground either directly or through a resistance. If the equipment that will receive the signal has a grounded input, then the output of the 4 to 20 mA converter must be isolated, either by an in-line isolation module or by ordering the system with a special isolated 4 to 20 mA converter.

The output will normally provide an output as a percentage of product volume. It may be programmed to provide an output as a percentage of product height in the tank from the keypad or from the RS-232 communications port. 4 mA will always represent 0 gallons and 0" of product height. 20 mA will always represent full capacity of the tank in gallons or inches. The outputs are not necessarily the same between output modes due to the non-linear geometry of many storage tanks. Because of gauging losses at the top and bottom of the storage tank, the outputs observed may not ever reach the 4 mA or 20 mA points.

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Section 4.8: Maintenance

The time between maintenance periods is a variable that will depend upon the environment in which the sensors and system console are operating. The console should be tested every six months by using the keypad self-diagnostic commands.

The leak detection sensors should be visually inspected for fouling or clogging at least once a year. A fouled or clogged leak sensor can give false alarms. If the leak sensor is fouled or clogged, it should be cleaned with soap and water or a mild solvent, and unclogged with compressed air. After visual inspection, the leak sensors should be reinstalled, and recalibrated.

If an actual leak occurs, after corrective action is taken, the leak sensors should be cleaned and inspected and recalibrated before reinstallation.

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Section 5: Keypad Command

Key Definitions

Key	Meaning
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
A	Null (reserved)
B	Backspace
C	Cancel
D	Dash (Minus Sign)
E	Enter
F	Function

How To Enter Keypad Commands

FUNCTION: The FUNCTION key, which is labeled 'F', precedes all commands given in PROGRAM mode.

- (MINUS): The minus sign, which is labeled 'D' (for DASH), is used in the entry of installation offset adjustments.

BACKSPACE: The BACKSPACE key, which is labeled 'B', is used to correct an error in key entry in PROGRAM mode. The BACKSPACE will erase the mistaken key entry and correct the display.

ENTER: The ENTER key, which is labeled 'E', is used to terminate ALL command entries in PROGRAM mode. A command will not be performed until the ENTER key is pressed. Until the ENTER key is pressed, the command line can be edited with the BACKSPACE and CANCEL LINE keys.

CANCEL LINE: The CANCEL LINE key, which is labeled 'C', can be used to cancel a command line at any time until the ENTER key is pressed.

NULL: The NULL key, which is labeled 'A', has no defined use at the present time. Entry of the NULL key should be corrected by use of the BACKSPACE or CANCEL LINE keys.

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**** Where braces { } are shown bracketing parameters in the commands, they are shown for reasons of clarity only, and must not be entered into the command line entered into the E-700-1 or LDE-700. ****

**** When PROGRAMMING mode is entered by pressing the FUNCTION key on the keypad, the front panel display is cleared, and the function symbol is displayed. The function symbol is a box in the bottom right of the display window. As command numbers and parameters are entered, the characters displayed move left. Characters that scroll off the left end of the display are not lost, merely past the display window. They may be reshown when the backspace key is used. During PROGRAMMING mode all normal gauging and alarm functions are performed. If no key has been pressed for two minutes, PROGRAMMING mode is automatically canceled, and the normal display is resumed. ****

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Key Command Table - Keypad Initiated Commands

<u>Function</u>	<u>Command Number</u>	
<u>Clock</u>		
Display Time	00	
Enter Time	01	
Display Date	02	
Enter Date	03	
Display Weekday	04	
Enter Weekday	05	
Print Clock	06	
<u>Alarm</u>		
Display High Alarm Setting	07	
Print High Alarm Setting	08	
Enter High Alarm Setting	09	
Display Low Alarm Setting	10	
Print Low Alarm Setting	11	
Enter Low Alarm Setting	12	
<u>Tank</u>		
Print Tank Parameters	13	
Display Offset Adjustment	14	
Print Offset Adjustment	15	
Enter Offset Adjustment	16	
<u>Diagnostics</u>		
Test LEDs	17	
Test Horn	18	
Test Ram (memory)	19	
Test Clock	20	
Test Relays	21	
Test RS-232 Port	57	Note 3
<u>Printer</u>		
Enter Automatic Print Time	22	
Print Automatic Print Times	23	
Enter Product Code	24	
Print Product Name	25	
Clear Printer Buffer	26	
<u>RS-232</u>		
Display Baud Rate	27	
Print Baud Rate	28	
Enter Baud Rate	29	

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System

Print System Setup	30	
Print Alarm Status	31	
Program Horn	32	
Program Horn Shutoff	33	
Print Horn Setup	34	
Program Relays	35	
Program Relay Shutoff	36	
Program Relay State	37	
Program Relay Delay	38	
Print Relay Setup	39	
Program Switches	40	
Print Switch Setup	41	
Program Leak Detection	42	
Calibrate Leak Detection	43	
Clear Leak Detection Latch	44	
Print Leak Detection Setup	45	
Program 4 to 20 mA Output	46	
Calibrate 4 to 20 mA Output	47	
Print 4 to 20 mA Setup	48	
Calibrate Zero	49	
Calibrate Span	50	
Warm Reset System	51	
Cold Reset System	52	
Test LEDs and Horn	53	Note 1
Enter Auto Answer Ring Count	54	Note 2
Display Auto Answer Setup	55	Note 2
Print Auto Answer Setup	56	Note 2
Test RS-232 Port	57	Note 3

Note 1: Available with software version 1.06 and greater

Note 2: Available with software version 1.07 and greater

Note 3: Available with software version 1.08 and greater

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Keypad Command Entry

**** NOTE: All character positions shown in the command definition, except for braces { }, must be entered, i.e. 'nnnnn' calls for the entry of 5 digits.

Display Time (00): **F 00 E**

Displays time until any keypress or timeout.

Enter Time (01): **F 01 hh mm E**

hh is the hours (in military time), i.e. 15 is 3 PM.

mm is the minutes, i.e. 20 is 20 after the hour.

Display Date (02): **F 02 E**

Displays the date until any keypress or timeout.

Enter Date (03): **F 03 mm dd yy E**

mm is the month, i.e. 04 is April.

dd is the date, i.e. 03 is the third day of the month.

yy is the year, i.e. 92 is 1992, 00 is 2000, 01 is 2001.

Display Weekday (04): **F 04 E**

Displays the day of the week until any keypress or timeout.

Enter Weekday (05): **F 05 d E**

d is the day of the week.

Sunday = 1.

Monday = 2.

Tuesday = 3.

Wednesday 4.

Thursday 5.

Friday = 6.

Saturday = 7.

Print Clock (06): **F 06 E**

Prints clock date and time settings.

Display High Alarm Setting (07): **F 07 E**

Displays the level set for high alarm until any keypress or timeout.

Print High Alarm Setting (08): **F 08 E**

Prints high (overflow) alarm setting.

Enter High Alarm Setting (09): **F 09 nnnnn E**

nnnnn is the level to set the alarm (5 digits required).

Leading zeroes are required, i.e. 6000 gallons must be entered as 06000.

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Display Low Alarm Setting (10): F 10 E

Displays the level set for low alarm until any keypress or timeout.

Print Low Alarm Setting (11): F 11 E

Prints low alarm setting.

Enter Low Alarm Setting (12): F 12 *nnnnn* E

nnnnn is the level to set the alarm (5 digits required).

Leading zeroes are required, i.e. 600 gallons must be entered as 00600.

Print Tank Parameters (13): F 13 E

Prints the setup parameters for the tank. The parameters printed are: tank product name; high level and low level alarm settings; tank capacity; tank diameter; and installation offset for the tank.

Display Offset Adjustment (14): F 14 E

Displays the level set for the offset adjustment until any keypress or timeout.

Print Offset Adjustment (15): F 15 E

Prints the offset adjustment for the tank.

Enter Offset Adjustment (16): F 16 {-}nnn E

nnn is the level to set the offset to (this level is entered in hundredths of an inch, i.e. 2 inches is entered as 200. The offset for a tank may range from -9.99 inches to +9.99 inches.

Leading zeroes are required, i.e. 0.50 inches of positive offset must be entered as 050.

If a negative offset is desired, it is preceded by a minus (-) sign. This is accomplished by pressing the key labeled 'D'. No sign is required or allowed for a positive offset.

The offset for the tank is derived as follows:

1. First remove any pressurized or vapor recovery tubes from the dipstick measurement opening. These tubes can cause a reading to vary by as much as 3 inches depending upon the pressure in the tank.

2. Take a very careful dipstick reading with an accurate dipstick. Write down the reading.

3. Write down the fuel height in inches shown by the Gauge.

4. Subtract the Gauge reading from the dipstick reading (Dipstick - Gauge = Difference) to get the Installation Offset and record it for reference.

Test LEDs (17): F 17 E

Lights all the system LEDs, any keypress turns off the LEDs.

Test Horn (18): F 18 E

Turns on the horn, any keypress turns off the horn.

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Test RAM (19): F 19 E

Tests the scratchpad memory, if an error is found, an error code is displayed (error code #4). If no error is found, no message is presented.

Test Clock (20): F 20 E

Tests the clock, if an error is found, an error code is displayed (error code #2). If no error is found, no message is presented.

Test Relays (21): F 21 E

Toggles the state of all the relays, any keypress toggles the relay states again and ends the test.

Enter Automatic Print Time (22): F 22 *n hh mm d* E

n is the number of the automatic print time. There are 3 automatic print times. The printout will be the normal inventory printout.

hh is the hours (in military time), i.e. 15 is 3 PM.

mm is the minutes, i.e. 20 is 20 after the hour.

Entry of leading zeroes is required for both hours and minutes, i.e. 5 A.M. must be entered as 0500.

d is the day of the week.

Sunday = 1.

Monday = 2.

Tuesday = 3.

Wednesday 4.

Thursday 5.

Friday = 6.

Saturday = 7.

If 0 is entered as the day of the week, all days are selected.

If the command is entered in the form: F22*n*E that automatic print time will be disabled.

Print Automatic Print Times (23): F 23 E

Prints the times selected for automatic inventory printouts.

If an automatic print time is not in effect for one of the 3 times, the return message will be "AUTO PRINT # *n* DISABLED", where *n* is a number from 1 to 3. If none of the automatic print times is in effect, the message will be repeated for all three times.

Enter Product Code (24): F 24 *nn* E

nn is the 2-digit number which represents the name of the product in the tank (see APPENDIX B).

Print Product Name (25): F 25 E

Prints the name assigned to the tank contents.

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Clear Printer Buffer (26): F 26 E

Clears the printer buffer and cancels any print commands in progress, or in the command queue.

Display Baud Rate (27): F 27 E

Displays the baud rate set for the RS-232 communications port until any keypress or timeout.

- 1 = programmed for 300 baud.
- 2 = programmed for 1200 baud.
- 3 = programmed for 2400 baud.
- 4 = programmed for 4800 baud.
- 5 = programmed for 9600 baud.

Print Baud Rate (28) F 28 E

Prints the setup condition for the RS-232 communications port.

Enter Baud Rate (29): F 29 *n* E

n is a number from 1 to 5 for the baud rate desired.

- 1 = programmed for 300 baud.
- 2 = programmed for 1200 baud.
- 3 = programmed for 2400 baud.
- 4 = programmed for 4800 baud.
- 5 = programmed for 9600 baud.

Print System Setup (30): F 30 E

Prints system setup parameters. These parameters are: Serial number of system, automatic inventory printout times, clock data (time, date, day of week), the system software version, relay programming, horn programming, switch input programming, leak channel programming (LDE-700), RS-232 port programming, modem auto answer ring count and 4 to 20 mA output programming.

Print Alarm Status (31): F 31 E

Prints all current alarms that are now ON in the system. High level, Low level, Switch 1, Switch 2, Loss alarms are profiled. The LDE-700 also prints the status of the Leak detection (or Switch(es) if so programmed) channels.

Program Horn (32): F 32 *c* E

c is the condition that will actuate the horn. More than one condition may be set to actuate the horn. If more than one condition is set for the horn, the programming must be repeated for each condition.

- 0 = horn disabled.
- 1 = horn activated by High Level Alarm.
- 2 = horn activated by Low Level Alarm.
- 3 = horn activated by Switch 1 Alarm.
- 4 = horn activated by Switch 2 Alarm.
- 5 = horn activated by LDE 1 oil Alarm (LDE-700).

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- 6 = horn activated by LDE 2 oil Alarm (LDE-700).
- 7 = horn activated by LDE 1 water Alarm (LDE-700).
- 8 = horn activated by LDE 2 water Alarm (LDE-700).
- 9 = horn activated by Loss Alarm.

*Conditions 5, 6, 7, 8 not available with E-700-1.

Minus sign (-) before condition number disables that condition.

Program Horn Shutoff (33): **F 33 t E**

t is the time for automatic horn shutoff after alarm actuation. There is a 10-minute delay built-in between horn actuations for the same condition.

0 = manual horn shutoff (must be silenced with RESET pushbutton on enclosure cover.)

1 to 7 = will automatically silence after programmed number of minutes. May be manually silenced with RESET pushbutton on enclosure cover.

Print Horn Setup (34): **F 34 E**

Prints the setup conditions for the horn.

Program Relays (35): **F 35 n c E**

n is the number of the relay that is being set-up.

This is relay 1 to relay 4.

c is the condition that will actuate that relay. More than one condition may be set to actuate the relay being programmed. If more than one condition is set for that relay, the programming must be repeated for each condition.

- 1 = relay activated by High Level Alarm.
- 2 = relay activated by Low Level Alarm.
- 3 = relay activated by Switch 1 Alarm.
- 4 = relay activated by Switch 2 Alarm.
- 5 = relay activated by LDE 1 oil Alarm (LDE-700).
- 6 = relay activated by LDE 2 oil Alarm (LDE-700).
- 7 = relay activated by LDE 1 water Alarm (LDE-700).
- 8 = relay activated by LDE 2 water Alarm (LDE-700).
- 9 = relay activated by Loss Alarm.

*Conditions 5,6,7,8 not available with E-700-1.

Minus sign (-) before condition number disables that condition.

Program Relay Shutoff (36): **F 36 n tt E**

n is the number of the relay that is being set-up.

tt is the time for automatic relay shutoff after alarm actuation.

00 = no automatic shutoff (relay remains actuated as long as alarm condition exists.)

01 to 15 = will automatically toggle the relay state after the programmed number of minutes.

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Program Relay State (37): F 37 n s E

n is the number of the relay that is being set-up.

s is the state for an inactive relay output.

0 = normally unenergized (relay energized after alarm).

1 = normally energized (relay de-energizes after alarm). This condition can also be used to detect a power failure on a relay not in alarm condition.

Program Relay Delay (38): F 38 n c E

n is the number of the relay that is being set-up.

c is the time for relay actuation after alarm condition.

0 = no delay after alarm before relay actuates.

1 = 5 minute delay after alarm before relay actuates.

Print Relay Setup (39): F 39 E

Prints the setup conditions for all 4 relays.

Program Switches (40): F 40 n s E

n is the number of the switch that is being set-up.

s is the state of the switch input in a non-alarm condition.

0 = programmed as normally open switch input.

1 = programmed as normally closed switch input.

Print Switch Setup (41): F 41 E

Prints the setup conditions for both switches.

Program Leak Detection (LDE) (42): F 42 n s E

n is the number of the leak channel that is being set-up.

This is LDE 1 or LDE 2.

s is the state of the leak channel.

0 = programmed as leak channel.

1 = programmed as normally open switch input.

2 = programmed as normally closed switch input.

*Not available with E-700-1.

Calibrate Leak Detection (LDE) (43): F 43 E

Calibrates the leak detection sensors. The sensors must be clean and dry and in air.

If the sensors are in oil or water, clean and dry them off before calibrating.

*Not available with E-700-1.

Clear Leak Detection (LDE) Latch (44) F 44 E

Clears the alarm memory latch for both leak detector channels.

*Not available with E-700-1.

Print Leak Detection (LDE) Setup (45) F 45 E

Prints the setup conditions for both leak channels.

*Not available with E-700-1.

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Program 4 to 20 mA Output (46): F 46 s E

Programs the optional 4 to 20 mA output. 4 mA output is an empty tank (0 gallons or inches). 20 mA output is a full tank (100% of tank volume or height).

If $s = 0$ then the output will be programmed for percent volume.

If $s = 1$ then the output will be programmed for percent height.

Calibrate 4 to 20 mA Output (47): F 47 n E : E

Calibrates the optional 4 to 20 mA output. 4 mA output is an empty tank (0 gallons or inches). 20 mA output is a full tank (100% of tank volume or height).

If $n = 0$ then the output will be set to the minimum for calibration of the 4 to 20.

If $n = 1$ then the output will be set to the maximum for calibration of the 4 to 20.

The next press of E (or any other key) will end the calibration mode.

If the optional 4 to 20 mA output is ordered from the factory, the settings will already have been calibrated. No user adjustment is normally needed.

Print 4 to 20 mA Setup (48): F 48 E

Prints the setup condition for the optional 4 to 20 mA output.

Calibrate Zero (49): F 49 E : E

Calibrates the minimum gaugeable point of the tank level sensor. The first press of E will set the display to 49. The tank level sensor can then be adjusted to give its minimum output (float at the bottom of travel with the 2-412 and 2-501 sensors). The next press of E (or any other key) will lock this reading into the system as the minimum gaugeable point. This calibration is retained in battery backed system memory, and will be retained for up to 10 years in the event of power failures or shutoffs.

This calibration is made at the factory. No user adjustment is normally needed.

Calibrate Span (50): F 50 E : E

Calibrates the maximum gaugeable point of the tank level sensor. The first press of E will set the display to 50. The tank level sensor can then be adjusted to give its maximum output (float at the top of travel with the 2-412 and 2-501 sensors). The next press of E (or any other key) will lock this reading into the system as the maximum gaugeable point. This calibration is retained in battery backed system memory, and will be retained for up to 10 years in the event of power failures or shutoffs *

This calibration is made at the factory. No user adjustment is normally needed.

Warm Reset System (51): F 51 E

Warm resets the system. No system setup parameters are changed by this command. This command is used to return the system to a known state.

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Cold Reset System (52): F 52 E

Cold resets the system and performs all self-diagnostic system checks.

*****WARNING***** All system setup parameters are reset to their default conditions. All stored data is cleared from the system memory. Tank charts, tank diameters, tank capacities and gauge calibrations remain as factory programmed.

**** After cold resetting the system, the system will be in a memory loss state (Error Code 8). This necessitates pressing any key of the keypad to clear ERROR #8, which is displayed on the system front panel display, in order to re-start normal operation.

Test LEDs and Horn (53) F 53 E

Lights all the system LEDs and turns on the horn, any keypress turns off the LEDs and the horn.

Enter Auto Answer Ring Count (54) F 54 *n* E

Sets the modem auto answer ring counter register (S0) to the number of rings before the modem answers the call.

n is the number of rings. The modem may be set to answer on 1 to 6 rings. A setting of 0 will disable the modem auto answer function. The modem is initialized to the setup, and the setup is stored to the modem power-on default setup.

The default setting is 0 (modem auto answer disabled).

Display Auto Answer Setup (55): F 55 E

Displays the modem auto answer ring count until any keypress or timeout.

Print Auto Answer Setup (56) F 56 E

Prints the modem auto answer ring count. If the count is 0, the auto answer count is printed as disabled.

Test RS232 Port (57): F 57 E

Sends the word 'Hello' 25 times to the RS232 Port. A breakout box or computer set up in terminal mode may then be used to verify data flow through the RS232 Port.

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Section 6: RS-232 Communications

The PNEUMERCATOR Model LDE-700 comes with an RS-232 communications port that may be used to transfer data to a remote computer system or terminal. The RS-232 port is configured as a DTE, for connection to a modem. If a direct connection to a computer or terminal is desired, a null modem cable must be used. The RS-232 port is located on the case of the LDE-700, and is supplied with a standard DB-25 female connector (see APPENDIX C for pinout). The Model E-700-1 has an optional RS-232 communications port.

The RS-232 port is an answer only port, which will respond to commands from a remote computer or terminal. It will not initiate communication on its own. The default setup conditions for the RS-232 port are: 1 start bit, 1 stop bit, 7 data bits, 300 baud, even parity, no echo, DTR true, RTS true, and asynchronous communications (see APPENDIX D for setup options).

Communication with the RS-232 port uses the ASCII character set (7 data bits, with the 8th bit clear). Parity is handled internally and will not affect the high data bit, which is always clear.

If the communications interface between the system and the remote computer system or terminal does not work, check the cabling and connector pinouts to the modem and make sure they are correct (see APPENDIX C). If a null modem cable is used, check for correct wiring. Also make sure that all RS-232 setup parameters are the same for the system and the remote computer system or terminal (see APPENDIX D). Make sure that any communications software that is used has the capability of sending a SOH (start of header or CONTROL-A) character at the beginning of every command. If your communications software has the capability of using pre-defined macros, you may wish to define macros for either all commands or the most commonly used commands (see the instruction manuals for your communications software, computer system or terminal, and modem).

RS-232 Command Format

All commands are entered in a similar format, starting with SOH (start of header, which is CONTROL-A on a computer keyboard), then the two digit number of the command, followed by any parameter or parameters required by the command, ended by a carriage return or any other control character.

The system will respond by performing the desired command. If a response message is called for by the command, it will be sent immediately. All response messages begin and end with at least one blank line. A blank line from the system is

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generated by sending a carriage return and line feed (this forms a newline character), followed by six nulls (ASCII code 00). If no response message is called for, the system will echo the command number followed by "O.K.". Any errors detected by the system will result in a return message which consists of the command number and parameter(s) up to the error, followed by "**ERROR**".

How To Enter RS-232 Commands

Special Characters

Name	Hex code	Keyboard entry
SOH-start of header	01H	Ctrl-A
LF-line feed	0AH	Ctrl-J
CR-carriage return	0DH	Ctrl-M
New line	0D0AH	Ctrl-M, Ctrl-J

**** To enter a control character from a computer or teletype keyboard, hold down the key marked CTRL, and press the desired alphabetic key, then release both keys.

**** Any multi-line responses will terminate each line with a newline character, which is a compound ASCII character consisting of a carriage return and line feed (CR, LF - \$0D0A). Line terminations sent to the system may consist of only a carriage return, in which case the system will supply the line feed.

**** Where commas or braces { } are shown separating parameters in the commands, they are shown for reasons of clarity only, and must not be entered into the command string sent to the LDE-700 or E-700-1.

**** The end of every command is shown as {^}, which represents any control character. Normally, the control character chosen by the user will be a carriage return (CONTROL-M), but any control character may be used.

**** If there is no error, your computer or terminal will respond by displaying the result of the specific command entry or request.

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Command Table: RS-232 Initiated-Commands

<u>Function</u>	<u>Command Number</u>
<u>Clock</u>	
Print Clock	00
Enter Time	01
Enter Date	02
Enter Weekday	03
<u>Automatic</u>	
Print Automatic Print Times	04
Enter Automatic Print Time	05
<u>Alarm</u>	
Print High Alarm Setting	06
Enter High Alarm Setting	07
Print Low Alarm Setting	08
Enter Low Alarm Setting	09
Print Alarm Status	10
<u>Tank</u>	
Print Tank Parameters	11
Print Offset Adjustment	12
Enter Offset Adjustment	13
Print Product Name	14
Enter Product Code	15
<u>System</u>	
Print Inventory Report	16
Print System Setup	17
Print Horn Setup	18
Program Horn	19
Program Horn Shutoff	20
Print Relay Setup	21

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Program Relays	22
Program Relay Shutoff	23
Program Relay State	24
Program Relay Delay	25
Print Switch Setup	26
Program Switches	27
Print Leak Detection Setup	28
Program Leak Detection	29
Calibrate Leak Detection	30
Clear Leak Detection Latch	31
Print 4 to 20 &A Setup	32
Program 4 to 20 mA Output	33
Warm Reset System	34
Cold Reset System	35
Packed Data Dump	99

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RS-232 Command Entry

Print Clock (00): **{SOH} 00 {^}**

Prints the date, time, and day of the week.

Enter Time (01): **{SOH} 01 *hh mm* {^}**

hh is the hours (in military time), i.e. 15 is 3 PM.

mm is the minutes, i.e. 20 is 20 after the hour.

Entry of leading zeroes is required for both hours and minutes, i.e. 5 AM must be entered as 0500. 6 PM must be entered as 1800.

Enter Date (02) **{SOH} 02 *mm dd yy* {^}**

mm is the month, i.e. 04 is APRIL.

dd is the date, i.e. 03 is the third day of the month.

yy is the year, i.e. 92 is 1992, 00 is 2000, 01 is 2001.

Entry of leading zeroes is required for days and months, i.e. June must be entered as 06, and the third day of the month must be entered as 03.

Enter Weekday (03): **{SOH} 03 *d* {^}**

d is the day of the week.

Sunday = 1.

Monday = 2.

Tuesday = 3.

Wednesday = 4.

Thursday = 5.

Friday = 6.

Saturday = 7.

Print Automatic Print Times (04): **{SOH} 04 {^}**

Prints the times selected for automatic inventory printouts.

If an automatic print time is not in effect for one of the 3 times, the return message will be "AUTO PRINT # n DISABLED", where n is a number from 1 to 3. If none of the automatic print times is in effect, the message will be repeated for all three times.

Enter Automatic Print Time (05): **{SOH} 05 *n hh mm d* {^}**

n is the number of the automatic print time. There are 3 automatic print times. The printout will be the normal inventory printout.

hh is the hours (in military time), i.e. 15 is 3 PM.

mm is the minutes, i.e. 20 is 20 after the hour.

Entry of leading zeroes is required for both hours and minutes, i.e. 5 AM must be entered as 0500.

d is the day of the week.

Sunday = 1.

Monday = 2.

Tuesday = 3.

Wednesday = 4.

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Thursday = 5.

Friday = 6.

Saturday = 7.

If 0 is entered as the day of the week, all days are selected.

If the command is entered in the form: **{SOH} 05 n {^}**, that automatic print time will be disabled.

Print High Alarm Setting (06): {SOH} 06 {^}

Prints the set point for the overflow alarm.

Enter High Alarm Setting (07): {SOH} 07 nnnnn {^}

nnnnn is the level to set the alarm to in gallons, five (5) digits are required.

Leading zeroes are required, i.e. 6000 gallons must be entered as 06000.

Print Low Alarm Setting (08): {SOH} 08 {^}

Prints the set point for the low level alarm.

Enter Low Alarm Setting (09): {SOH} 09 nnnnn {^}

nnnnn is the level to set the alarm to in gallons, five (5) digits are required.

Leading zeroes are required, i.e. 60 gallons must be entered as 00060.

Print Alarm Status (10): {SOH} 10 {^}

Prints all current alarms that are now ON in the system. High level, Low level, Switch 1, Switch 2, Loss alarms are profiled. The LDE-700 also prints the status of the Leak detection (or Switch(es) if so programmed) channels.

Print Tank Parameters (11): {SOH} 11 {^}

Prints the setup parameters for the tank. The parameters printed are: tank product code and name; high level and low level alarm settings; tank capacity; tank diameter; and installation offset.

Print offset Adjustment (12): {SOH} 12 {^}

Prints the setting of the offset adjustment.

Enter Offset Adjustment (13): {SOH} 13 nnn {^}

nnn is the level to set the offset to (this level is entered in hundredths of an inch, i.e. 2 inches is entered as 200. The offset for a tank may range from -9.99 inches to +9.99 inches.

Leading zeroes are required, i.e. 0.50 inches of positive offset must be entered as 050.

If a negative offset is desired, it is preceded by a minus sign. No sign is required or allowed for a positive offset.

The offset for the tank is derived as follows:

1. First remove any pressurized or vapor recovery tubes from the dipstick measurement opening. These tubes can cause a reading to vary by as much as 3 inches depending upon the pressure in the tank.

Operation and Installation Manual

2. Take a very careful dipstick reading with an accurate dipstick. Write down the reading.

3. Write down the fuel height in inches shown by the Gauge.

4. Subtract the Gauge reading from the dipstick reading (Dipstick - Gauge = Difference) to get the Installation Offset and record it for reference.

Print Product Name (14): **{SOH} 14 {^}**

Prints the name assigned to the tank contents.

Enter Product Code (15): **{SOH} 15 nn {^}**

nn is the 2-digit number which represents the name of the product in the tank (see APPENDIX B).

Print Inventory Report (16): **{SOH} 16 {^}**

Prints the current status of the tank for level in inches, and volume in gallons. Also prints the assigned tank name and a time and date stamp.

Print System Setup (17): **{SOH} 17 {^}**

Prints system setup parameters. These parameters are: Serial number of system, automatic inventory printout times, clock data (time, date, day of week), the system software version, relay programming, horn programming, switch input programming, leak channel programming (LDE-700), RS-232 port programming, and 4 to 20 mA output programming.

Print Horn Setup (18): **{SOH} 18 {^}**

Prints the setup conditions for the horn.

Program Horn (19): **{SOH} 19 c {^}**

c is the condition that will actuate the horn. More than one condition may be set to actuate the horn. If more than one condition is set for the horn, the programming must be repeated for each condition.

0 = horn disabled.

1 = horn activated by High Level Alarm.

2 = horn activated by Low Level Alarm.

3 = horn activated by Switch 1 Alarm.

4 = horn activated by Switch 2 Alarm.

5 = horn activated by LDE 1 oil Alarm (LDE-700).

6 = horn activated by LDE 2 oil Alarm (LDE-700).

7 = horn activated by LDE 1 water Alarm (LDE-700).

8 = horn activated by LDE 2 water Alarm (LDE-700).

9 = horn activated by Loss Alarm.

*Conditions 5,6,7,8 not available with E-700-1.

Minus sign (-) before condition number disables that condition.

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Program Horn Shutoff (20): {SOH} 20 t {^}

t is the time for automatic horn shutoff after alarm actuation. There is a 10-minute delay built-in between horn actuations for the same condition.

0 = manual horn shutoff (must be silenced with RESET pushbutton on enclosure cover.

1 to 7 = will automatically silence after programmed number of minutes. May be manually silenced with RESET pushbutton on enclosure cover.

Print Relay Setup (21): {SOH} 21 {^}

Prints the setup conditions for all 4 relays.

Program Relays (22): {SOH} 22 n c {^}

n is the number of the relay that is being set-up.

This is relay 1 to relay 4.

c is the condition that will actuate that relay. More than one condition may be set to actuate the relay being programmed. If more than one condition is set for that relay, the programming must be repeated for each condition.

1 = relay activated by High Level Alarm.

2 = relay activated by Low Level Alarm.

3 = relay activated by Switch 1 Alarm.

4 = relay activated by Switch 2 Alarm.

5 = relay activated by LDE 1 oil Alarm (LDE-700).

6 = relay activated by LDE 2 oil Alarm (LDE-700).

7 = relay activated by LDE 1 water Alarm (LDE-700).

8 = relay activated by LDE 2 water Alarm (LDE-700).

9 = relay activated by Loss Alarm.

*Conditions 5,6,7,8 not available with E-700-1.

Minus sign (-) before condition number disables that condition.

Program Relay Shutoff (23): {SOH} 23 n tt {^}

n is the number of the relay that is being set-up.

tt is the time for automatic relay shutoff after alarm actuation.

00 = no automatic shutoff (relay remains actuated as long as alarm condition exists.)

01 to 15 = will automatically toggle relay state after programmed number of minutes.

Program Relay State (24): {SOH} 24 n s {^}

n is the number of the relay that is being set-up.

s is the state for an inactive relay output.

0 = normally unenergized (relay energized after alarm).

1 = normally energized (relay de-energizes after alarm). This condition can also be used to detect a power failure on a relay not in alarm condition.

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Program Relay Delay (25): {SOH} 25 n c {^}

n is the number of the relay that is being set-up.
c is the time for relay actuation after alarm condition.
0 = no delay after alarm before relay actuates.
1 = 5 minute delay after alarm before relay actuates.

Print Switch Setup (26): {SOH} 26 {^}

Prints the setup conditions for both switches.

Program Switches (27): {SOH} 27 n s {^}

n is the number of the switch that is being set-up.
s is the state of the switch.
This programs the state of the switch input in a non-alarm condition.
0 = programmed as normally open switch input.
1 = programmed as normally closed switch Input.

Print Leak Detection (LDE) Setup (28): {SOH} 28 {^}

Prints the setup conditions for both leak channels.

*Not available with E-700-1.

Program Leak Detection (LDE) (29): {SOH} 29 n s {^}

n is the number of the leak channel that is being set-up.
This is LDE 1 or LDE 2.
s is the state of the leak channel.
0 = programmed as leak channel.
1 = programmed as normally open switch input.
2 = programmed as normally closed switch input.

*Not available with E-700-1.

Calibrate Leak Detection (LDE) (30): {SOH} 30 {^}

Calibrates the leak detection sensors. The sensors must be clean and dry and in air. If the sensors are in oil or water, clean and dry them off before calibrating.

*Not available with E-700-1.

Clear Leak Detection (LDE) Latch (31): {SOH} 31 {^}

Clears the alarm memory latch for both leak detector channels.

*Not available with E-700-1.

Print 4 to 20 mA Setup (32): {SOH} 32 {^}

Prints the setup condition for the optional 4 to 20 mA output.

Program 4 to 20 mA Output (33): {SOH} 33 s {^}

Programs the optional 4 to 20 mA output. 4 mA output is an empty tank (0 gallons or inches). 20 mA output is a full tank (100% of tank volume or height).
0 = programmed for percent volume.
1 = programmed for percent height.

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Warm Reset System (34): {SOH} 34 {^}

Warm resets the system. No system setup parameters are changed by this command. This command is used to return the system to a known state. The system will respond with "34 O.K."

Cold Reset System (35): {SOH} 35 {^}

Cold resets the system and performs all self-diagnostic system checks. The system will respond with "35 O.K."

*****WARNING***** All system setup parameters are reset to their default conditions. All stored data is cleared from the system memory. Tank charts, tank diameters, tank capacities and gauge calibrations remain as factory programmed.

**** After cold resetting the system, the system will be in the same state as if a cold reset is performed at the keypad. This necessitates pressing any key of the keypad to clear ERROR #8, which is displayed on the system front panel display, in order to re-start normal operation.

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LDE-700, E-700-1 Packed (computer) Data Format

Packed data is requested from the system by sending the ASCII sequence: SOH, 9, 9, CTRL (in hex: 01H, 39H, 39H,...) via the RS-232 port. CTRL may be any control character, such as CR (0DH) or LF (0AH).

The data transmitted is sent in ASCII-coded format with the information in the following order: header; clock info; alarm, horn, switch, leak, & relay statuses; volume measurement; product height; checksum; footer.

HEADER (3 BYTES):

3 bytes ASCII consisting of 01H(SOH), 0DH and 0AH (newline). The header is not included in the checksum.

CLOCK INFO (13 BYTES):

Month (2 bytes) - 1 to 12, coded as 30H, 31H to 31H, 32H

Day (2 bytes) - 1 to 31, coded as 30H, 31H to 33H, 31H

Year (2 bytes) 00 to 99, coded as 30H, 30H to 39H, 39H

Hours (2 bytes) - 00 to 23, coded as 30H, 30H to 32H, 33H

Minutes (2 bytes) - 00 to 59, coded as 30H, 30H to 35H, 39H

Seconds (2 bytes) - 00 to 59, coded as 30H, 30H to 35H, 39H

Weekday (1 byte) - 1 to 7, coded as 31H to 37H

(Sunday = 1)

ALARM, HORN, SWITCH, LEAK, and RELAY STATUSES (16 BYTES):

Each byte is a 0, coded as 30H for OFF or 1, coded as 31H for ON.

The bytes are in the following order:

1. High (overflow) alarm
2. Low alarm
3. Horn status
4. Relay 1
5. Relay 2
6. Relay 3
7. Switch 1
8. Switch 2
9. Relay 4
10. Leak channel 1 air LED
11. Leak channel 1 oil LED
12. Leak channel 1 water LED
13. Leak channel 2 air LED
14. Leak channel 2 oil LED
15. Leak channel 2 water LED
16. Theft (loss) alarm

* NOTE - WITH E-700-1 THE LEAK INFORMATION IS ALL SET TO 0 (30H)

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MEASUREMENTS FOR THE TANK (8 BYTES):

Volume (4 bytes) - volume is stored in gallons as a hex number 0000H to 0FFFFH (ranging from 0 to 65535 gallons) that is converted into 4 nibbles that are sent as ASCII (9H is sent as 39H).

Inches (4 bytes) - level is stored as inches times 100 (ranging from 0.00 inches to 655.35 inches). Data is sent the same way as with volume.

CHECKSUM (4 BYTES):

4 bytes ASCII. Each ASCII byte transmitted is added to a 16-bit accumulator with no overflow or carry or wraparound. The final sum is converted into 4 hex nibbles which are converted into ASCII. The header (01H, 0DH, 0AH) and the footer (0DH, 0AH, 03H) are not included in the checksum.

FOOTER (3 BYTES):

3 bytes ASCII consisting of 0DH, 0AH, (newline) and 03H. The footer is not included in the checksum.

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Section 7: Troubleshooting & Servicing

PNEUMERCATOR CO., INC.
120 Finn Court
Farmingdale, N.Y. 11735
Phone (631) 293-8450
Fax (631) 293-8533
<http://www.pneumercator.com>

The PNEUMERCATOR LDE-700 and E-700-1 systems and all components are factory warranted for a period of 1 year from the date of shipment. No materials should be returned to the factory without first getting a Returned Materials Authorization number from PNEUMERCATOR. All materials returned should be marked with this R.M.A. number.

Because of the intrinsically safe operation of the system, no field repairs other than fuse changing should be attempted. All repairs should be done only at the factory or at a factory authorized repair center.

SYMPTOM: Display blank and no lights are on.

ACTION: Make sure that 120 VAC power is connected to the power connection terminal block and that the power is turned on. With power off, check the fuse labeled 1/4 AMP SLOW BLOW to make sure that it is not blown. If the fuse is blown, replace only with a 1/4 Amp, 3AG Slo-Blo fuse. There should be +5 VDC open circuit (with no wires attached) between TB2 position 1 and position 3. If system still does not respond, call factory for servicing.

SYMPTOM: Display flashes.

ACTION: Move the switch labeled S2 on the circuit board to the NORMAL position (left).

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SYMPTOM: System always displays the minimum or maximum gaugeable setting no matter how much product is in the tank.

SYMPTOM: System displays a negative reading or Error Code 9 (volume measurement underrange).

SYMPTOM: System displays a reading greater than full capacity or Error Code 7 (volume measurement overrange).

ACTION: Make sure that all wires are connected properly from the tank sensor to the tank input (TB2). Make sure that there are no shorted or open wires. Make sure that there is no water in a wire splice or in a sensor housing. See the sensor troubleshooting section. Make sure that the gauge calibrations are set properly (see keypad commands numbers 49 and 50).

If system still does not respond call factory for servicing.

SYMPTOM: Switch light is always on, or goes on when it shouldn't.

ACTION: Make sure that Switch is working properly and that the switch input is programmed for the proper state. Make sure that the switch has no current leakage in an open state.

If system still does not respond call factory for servicing.

SYMPTOM: Leak detection channel gives false water alarm.

LIGHT INDICATIONS

<u>Dry</u>	<u>Water</u>	<u>Hydrocarbon</u>	<u>Meaning</u>
off	on	off	water alarm

ACTION: Check to make sure that the sensor is in contact only with air. Make sure that the ground wire (marked B) and the sensor input wire (marked W) have continuity from the sensor to the alarm console. Make sure that the sensor input wire (marked W) is not shorted to power. Place system in Calibrate mode with the sensor in air. If sensor still does not work properly, call factory for servicing.

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SYMPTOM: Leak detection channel gives false alarms.

ACTION: Check to make sure that the sensor is in contact only with air. Pull sensor from installation and make sure that it is not fouled or clogged. If sensor is fouled or clogged, clean with soap and water solution or a mild solvent and dry and unclog with compressed air. Place system in Calibrate mode with the sensor in air. Check all wiring for continuity, proper connections and make sure that there are no shorts. If sensor still does not work properly, call factory for servicing.

When the sensor has been immersed in water, it takes a period of time for the sensor to drain completely and dry. During this time the sensor will oscillate between water/hydrocarbon and hydrocarbon/air readings. This may cause the hydrocarbon or water alarm to latch into the system memory. This may be cleared when the sensor is dry and in air by calibrating the leak detection sensor.

Testing the Gauge

In order to verify that the gauge is properly reading the tank unit, first shut off power to the gauge. Then disconnect the tank unit from the barrier block. A potentiometer (variable resistor or "pot") of a value of about one thousand to ten thousand ohms (the exact value is not critical) should be connected to the barrier block. One end terminal of the pot is connected to terminal 1 (Red), the other end terminal is connected to terminal 3 (Black), and the middle terminal of the pot (the wiper) is connected to terminal 2 (White). The gauge should then be powered up again. The gauge readings will vary as the position of the pot wiper is changed. At the extreme ends of the pot's rotational angle, the gauge readings may show a negative reading or a reading greater than the tank's capacity, but the pot can be used to move the gauge readings over the full span of possible volumes.

*** The readings from the potentiometer should not be used to calibrate the gauge, or to judge the accuracy of the gauge, as the potentiometer is only an approximation of the tank unit, which is custom made and calibrated for the particular tank.

Testing the Tank Sensor

In order to test the tank sensor, it must be disconnected from the gauge unit. Always shut off power to the gauge when connecting or disconnecting the tank units, the power cable, and any wires to the optional switches. With the tank unit disconnected from the gauge, use an ohmmeter to measure the resistance between the Red and the Black wires of the tank unit. The measurement should be 2000Ω on the 2-501 tank sensor. The resistance of the 2-412 is 72.5Ω per inch of sensing length. If the readings are incorrect, they should be repeated where the tank unit is

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joined to the conduit wires. These readings should be made with the conduit wires disconnected from the tank unit. If the readings are now correct, then there is a problem with the conduit wires. Always make sure that the wires running through the conduit follow the proper color-coding. Incorrect readings will result if the color-coding is not followed.

2-412: With the float at the bottom and the top of travel, the reading between White to Black and White to Red respectively is 0Ω . The reading between the Black and White wires will increase as the float moves up, and will be a ratio of the percentage of float travel to overall sensing length.

Example: Sensing length = 80 inches.

Float travel = 20 inches.

Overall resistance = 5800Ω (Red to Black).

Answer: Black to White resistance = 1450Ω .

Red to White resistance = 4350Ω .

If the float has been removed from the tube of the 2-412, make sure that it is replaced facing in the same orientation. The magnet in the float will only work if it is facing in the correct orientation.

The interior of the 2-412 is hermetically sealed and no field repairs can be made on it. The 2-501 contains no parts that can be field repaired.

2-501: With the float arm at bottom of travel, Black to White is 0Ω . Black to Red is always 2000Ω . The Black to White reading will increase as the float moves up, and will be a ratio of the percentage of float arm travel to overall float arm travel. The Red to White resistance will vary from unit to unit, and should be measured with the float arm at the top of travel.

Example: Overall float arm travel = 80 inches.

Example float arm travel = 20 inches.

Overall resistance = 2000Ω .

Red to White (at top of travel) = 280Ω (measured).

Black to White span = 1720Ω (calculated).

Answer: Black to White resistance = 430Ω .

Red to White resistance = 1290Ω .

*** Make sure that all splices are contained in waterproof junction boxes or are potted or sealed to be waterproof. Part number 100007-1 is an available wiring waterproofing kit. Make sure that no water can enter the housing of the 2-412 tank unit.

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Figure 1 - 2-412 Installation**STEPS FOR A TROUBLE FREE INSTALLATION****STEP 1** - EXAMINE THE SHIPMENT

1.1 Each system consists of two main components, which are packed separately, the transmitter float assembly and the indicator unit. Make sure you have both parts. If cartons are missing or damaged, have the fact noted on the delivery receipts to permit a claim to be filed against the transportation company.

1.2 Match the transmitter float assembly Serial No. with the Serial No. on indicating unit to insure compatibility.

1.3 The transmitter float assembly should be checked for damage, which may have occurred during shipping. The float switch should move freely from the bottom stop to the top stop on the rod. If the float can be rotated on the rod, then the float guides have been damaged. If any problems arise, contact the factory.

DO NOT ATTEMPT TO INSTALL DAMAGED UNITS.**STEP 2** - MAKE SURE THE SYSTEM MATCHES YOUR JOB

2.1 Compare the actual tank dimensions and capacity with the tank dimensions and capacity on the packing slip and the transmitter mounting tag to insure compatibility.

2.2 Standard construction is suitable for most petroleum products.

2.3 For potentially corrosive liquids, verify the liquid's compatibility with stainless steel and Teflon. When the unit is supplied with a water switch, verify the compatibility of the liquid with nitrophyl.

2.4 Verify that the tank is set level. To obtain accurate readings from a tilted tank, the indicator must be ordered with a special calibration.

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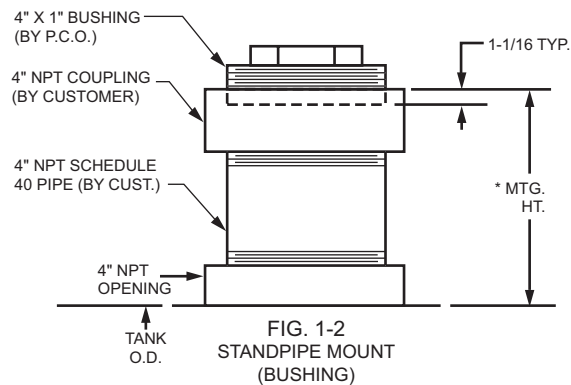
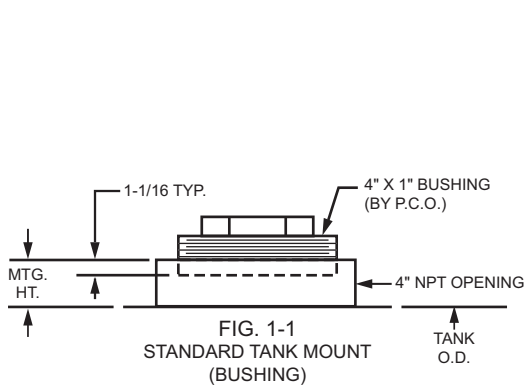
Figure 1 - 2-412 Installation (Continued)

STEP 3 - SELECT THE CORRECT LOCATION FOR THE INSTALLATION OF THE TRANSMITTER FLOAT ASSEMBLY

3.1 The transmitter float assembly should be installed through a 4" NPT half coupling in the top of the tank as shown in figure 1-1. It is recommended that a strike plate be situated directly below the coupling. If the unit is to be standpipe mounted, it should have been ordered for the special mounting height (*) and installed as shown in figure 1-2.

3.2 When the tank is indoors, sufficient clearance must be provided between tank and ceiling to permit installation and removal of the transmitter float assembly.

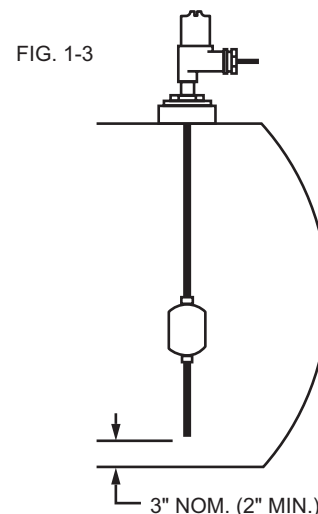
3.3 When the tank is underground, a suitable chamber and cover should be provided to permit installation and removal of the transmitter float assembly should it ever be required. This is especially important when the tank is to be covered with pavement or concrete. Do not bury tank unit.



STEP 4 - INSTALL WITH CARE

4.1 Screw the mounting bushing 1-1/16" into the proper opening in the top of the tank (see figure 1-1). There should be a clearance of at least 2.0" between the bottom of the probe and the bottom of the tank (see figure 1-3).

4.2 When using a standpipe, screw the mounting bushing 1-1/16" into the 4" NPT coupling on top of the standpipe (see figure 1-2). There should be a clearance of at least 2.0" between the bottom of the probe and the bottom of the tank (see figure 1-3).



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Figure 2 - 2-501 Installation

STEPS FOR A TROUBLE FREE INSTALLATION

- 1. Examine the shipment**
- 2. Make sure the system matches your job**
- 3. Select the correct location for the transmitter**
- 4. Install the transmitter float assembly with care**

STEP 1 - EXAMINE THE SHIPMENT

1.1 The system consists of two components, which are packed separately, the transmitter and the indicator. Make sure you have both parts. If cartons are missing or damaged note the delivery receipts to permit a claim to be filed against the transportation company.

DO NOT ATTEMPT TO INSTALL DAMAGED UNITS.

1.2 Match the serial no.'s on the transmitter and indicator to insure compatibility.

STEP 2 - MAKE SURE THE SYSTEM MATCHES YOUR JOB

2.1 Compare the dimensions and capacity on the packing slip with the tank drawing to insure compatibility.

2.2 Check that the tank is vented to atmosphere unless the order shows the system was designed for a pressurized tank.

2.3 Verify that the tank contents will not corrode the unit's wetted parts (Alum., Brass, Buna-N, nylon, 303 Stainless). Standard construction is suitable for most petroleum products.

2.4 Verify that the tank is set level. (Tilted tanks require special calibration.)

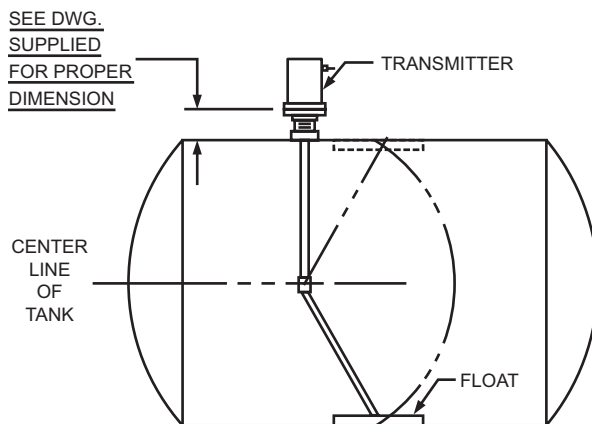


FIG 2-1

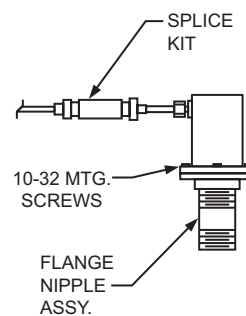


FIG 2-1A

NOTE: THE FLOAT ARM SHOULD SWING UPWARDS TOWARDS THE CONNECTOR ON THE HOUSING.

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Figure 2 - 2-501 Installation (Continued)

STEP 3 - SELECT THE CORRECT LOCATION FOR THE TRANSMITTER

3.1 Standard installation requires a 2" half coupling in the top of the tank. The fulcrum pipe will then reach the mid-point of tank as required for accurate measurement. If the transmitter is to be installed through a manway or a riser, it must be ordered with an extra long fulcrum pipe. THERE IS NO WAY TO ADJUST THE SYSTEM FOR ACCURATE GAUGING IF THE PIVOT LEVER IS NOT CORRECTLY POSITIONED. (See Figure 2-1 & 2-2)

3.2 The float arm must swing in an arc along the axis of the tank without hitting the end of the tank or other obstructions and not extend under manways or fill lines.

3.3 When tank is indoors, sufficient clearance must be provided to permit installation of the fulcrum pipe, which is approximately one-half the tank diameter plus 11 inches.

3.4 When the tank is underground or covered by pavement, a chamber should be provided to permit access to the transmitter. Covers to access chambers should provide clearance for installation and removal of the fulcrum pipe. (See 3.3 above).

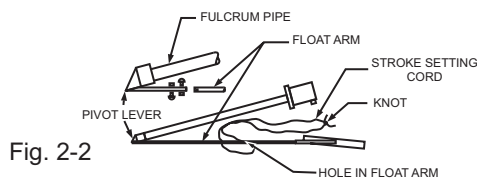


Fig. 2-2



Fig. 2-2A

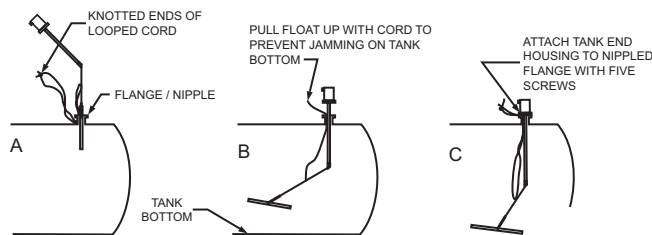


Fig. 2-3

STEP 4 - INSTALL THE TRANSMITTER WITH CARE

4.1 The transmitter should be installed when the tank is empty. Although it is possible to install when the liquid is below the tank mid-point, there is no way to verify factory settings and adjustments.

4.2 The flange / nipple has been pre-removed to protect the float arm assembly during installation. DO NOT re-attach until after the float arm assembly is in the tank.

4.3 Screw the flange / nipple into the proper tank opening. Align flange so float will rise and fall along the centerline of tank when transmitter assembly is installed. (Flange must be level). *Position gasket on flange using a suitable sealing compound on both sides.

NOTE: THE DIMENSION BETWEEN THE TANK TOP AND TOP OF THE FLANGE (SEE ATTACHED TAG) MUST BE EXACT FOR THE PIVOT TO REACH THE MIDPOINT OF THE TANK AS REQUIRED FOR ACCURATE GAUGING.

4.4 Attach the float arm to the pivot lever using the two bolts furnished. Insert the stroke setting cord through hole in float arm, then through hole in the nipple and knot ends together. (NOTE: MUST BE RE-INSTALLED UPON COMPLETION OF INSTALLATION.) (See Figures. 2-2 & 2-2A)

4.5 Insert the transmitter float assembly through the flange / nipple. (See Figure 2-3.) Note: the direction of float travel is toward the cable in the transmitter housing. DO NOT LET FLOAT ARM SWING BACKWARDS DURING INSTALLATION!

4.6 Attach the transmitter float assembly to the flange / nipple using the screws from 4.2. Tighten all five screws evenly to assure a tight seal. (See Fig. 2-1A).

4.7 Raise and lower the float arm with the stroke setting cord. Make certain that the float and arm move freely (DO NOT FORCE) from bottom to top of the tank unobstructed.

BULLETIN 105--700 Series

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Figure 3 - 9-901 Installation

APPLICATION		REVISIONS			
NEXT ASSY	USED ON	REV	DESCRIPTION	DATE	BY APP.
		A	SEE REVISION SHEET FOR THIS AND OTHER REVISION HISTORY	10/09/02	CHR

CABLE MEASUREMENT		MARK CABLE AT
TANK SIZE	MANUFACTURER/ BRAND	MARK CABLE AT
4 FT.	OWENS CORNING DWT	81"
4 FT.	XERXES DWT	
6 FT.	OWENS CORNING DWT	118"
6 FT.	XERXES DWT	
8 FT.	OWENS CORNING DWT	149.5"
8 FT.	XERXES DWT	
10 FT.	OWENS CORNING DWT	193.5"
10 FT.	XERXES DWT	
12 FT.	OWENS CORNING DWT	222"
12 FT.	XERXES DWT	

FIGURE 1

MODEL 9-901

ANNULAR SPACE INSTALLATION

NOTES:

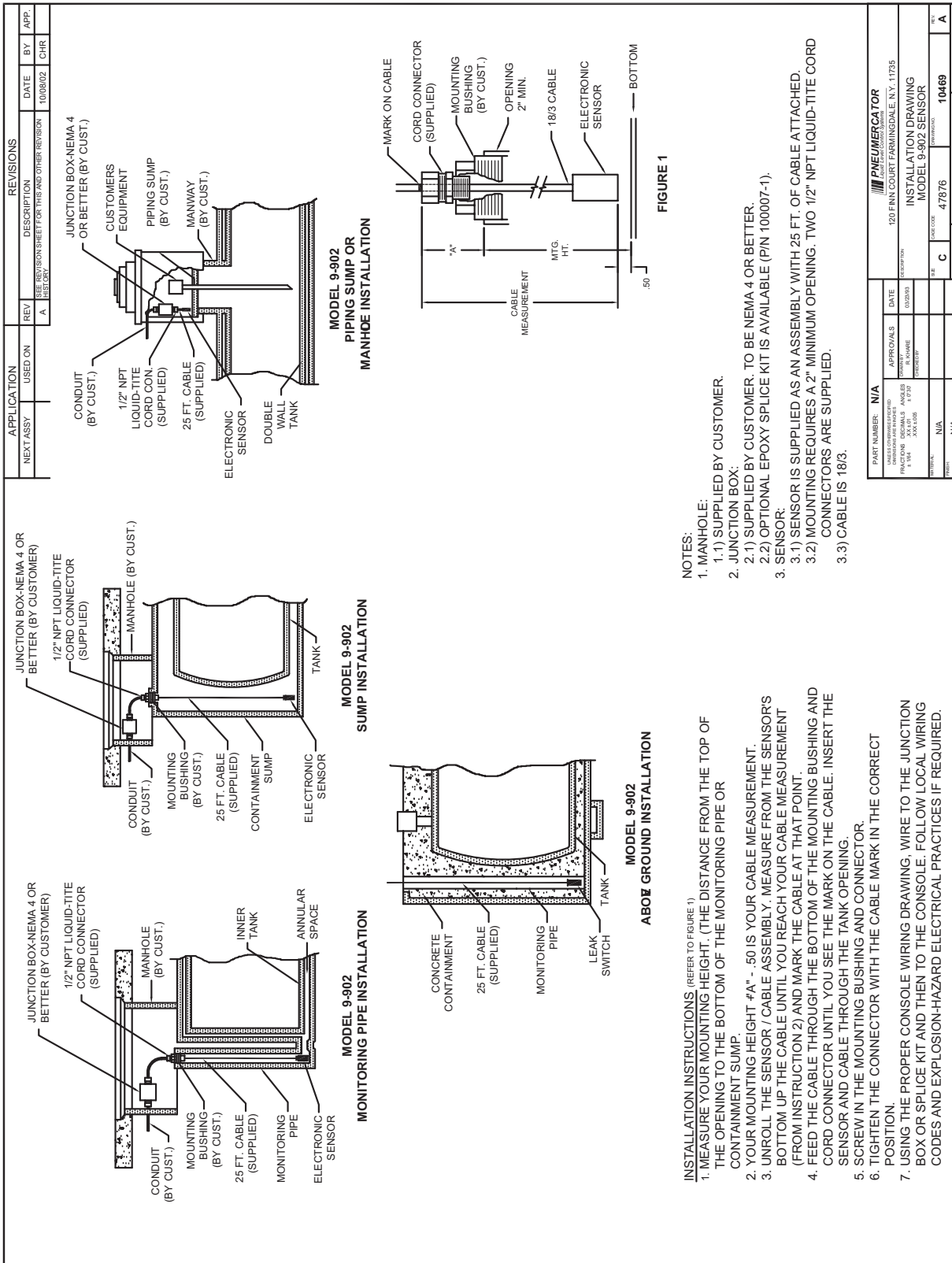
1. MANHOLE:
 - 1.1) SUPPLIED BY CUSTOMER.
 - 2.1) JUNCTION BOX: TO BE NEMA 4 OR BETTER.
 - 2.2) OPTIONAL EPOXY SPLICE KIT IS AVAILABLE (P/N 100007-1).
3. SENSOR:
 - 3.1) SENSOR IS SUPPLIED AS AN ASSEMBLY WITH 25 FT. OF CABLE ATTACHED. MOUNTING REQUIRES A 2" MINIMUM OPENING. TWO 1/2" NPT LIQUID-TITE CORD CONNECTORS ARE SUPPLIED.
 - 3.3) CABLE IS 18/3.

INSTALLATION INSTRUCTIONS: (REFER TO FIGURE 1)

1. IF YOUR TANK MANUFACTURER/BRAND IS NOT LISTED IN THE TABLE ABOVE, CALCULATE YOUR CABLE MEASUREMENT BY USING D 2 (CIRCUMFERENCE DIVIDE BY TWO). 'D' IS THE DIAMETER OF THE TANK.
2. UNROLL THE SENSOR / CABLE ASSEMBLY. MEASURE FROM THE SENSOR'S BOTTOM UP THE CABLE UNTIL YOU REACH YOUR CABLE MEASUREMENT (FROM INSTRUCTION 2) AND MARK THE CABLE AT THAT POINT.
3. FEED THE CABLE THROUGH THE BOTTOM OF THE MOUNTING BUSHING AND CORD CONNECTOR UNTIL YOU SEE THE MARK ON THE CABLE. INSERT THE SENSOR AND CABLE THROUGH THE TANK OPENING.
4. SCREW IN THE MOUNTING BUSHING AND CONNECTOR.
5. TIGHTEN THE CONNECTOR WITH THE CABLE MARK IN THE CORRECT POSITION.
6. USING THE PROPER CONSOLE WIRING DRAWING, WIRE TO THE JUNCTION BOX OR SPLICE KIT AND THEN TO THE CONSOLE. FOLLOW LOCAL WIRING CODES AND EXPLOSION-HAZARD ELECTRICAL PRACTICES IF REQUIRED.

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Figure 4 - 9-902 Installation



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Figure 5 - 9-903 Installation

FIGURE 1

INSTALLATION INSTRUCTIONS: (REFER TO FIGURE 1)

1. MEASURE YOUR MOUNTING HEIGHT. (THE DISTANCE FROM THE TOP TO THE BOTTOM OF THE LEAK DETECTION TUBE).
2. ADD 1" TO YOUR MOUNTING HEIGHT TO FIND YOUR CABLE MEASUREMENT.
3. UNROLL THE SENSOR / CABLE ASSEMBLY. MEASURE FROM THE SENSOR'S BOTTOM UP THE CABLE UNTIL YOU REACH YOUR CABLE MEASUREMENT (FROM INSTRUCTION 2) AND MARK THE CABLE AT THAT POINT.
4. FEED THE CABLE THROUGH THE BOTTOM OF THE MOUNTING BUSHING AND CORD CONNECTOR UNTIL YOU SEE THE MARK ON THE CABLE. INSERT THE SENSOR AND CABLE THROUGH THE TANK OPENING.
5. SCREW IN THE MOUNTING BUSHING AND CONNECTOR.
6. TIGHTEN THE CONNECTOR WITH THE CABLE MARK IN THE CORRECT POSITION.
7. USING THE PROPER CONSOLE WIRING DRAWING, WIRE TO THE JUNCTION BOX OR SPLICE KIT AND THEN TO THE CONSOLE. FOLLOW LOCAL WIRING CODES AND EXPLOSION-HAZARD ELECTRICAL PRACTICES IF REQUIRED.

**MODEL 9-903
CONVAULT INSTALLATION**

NOTES:

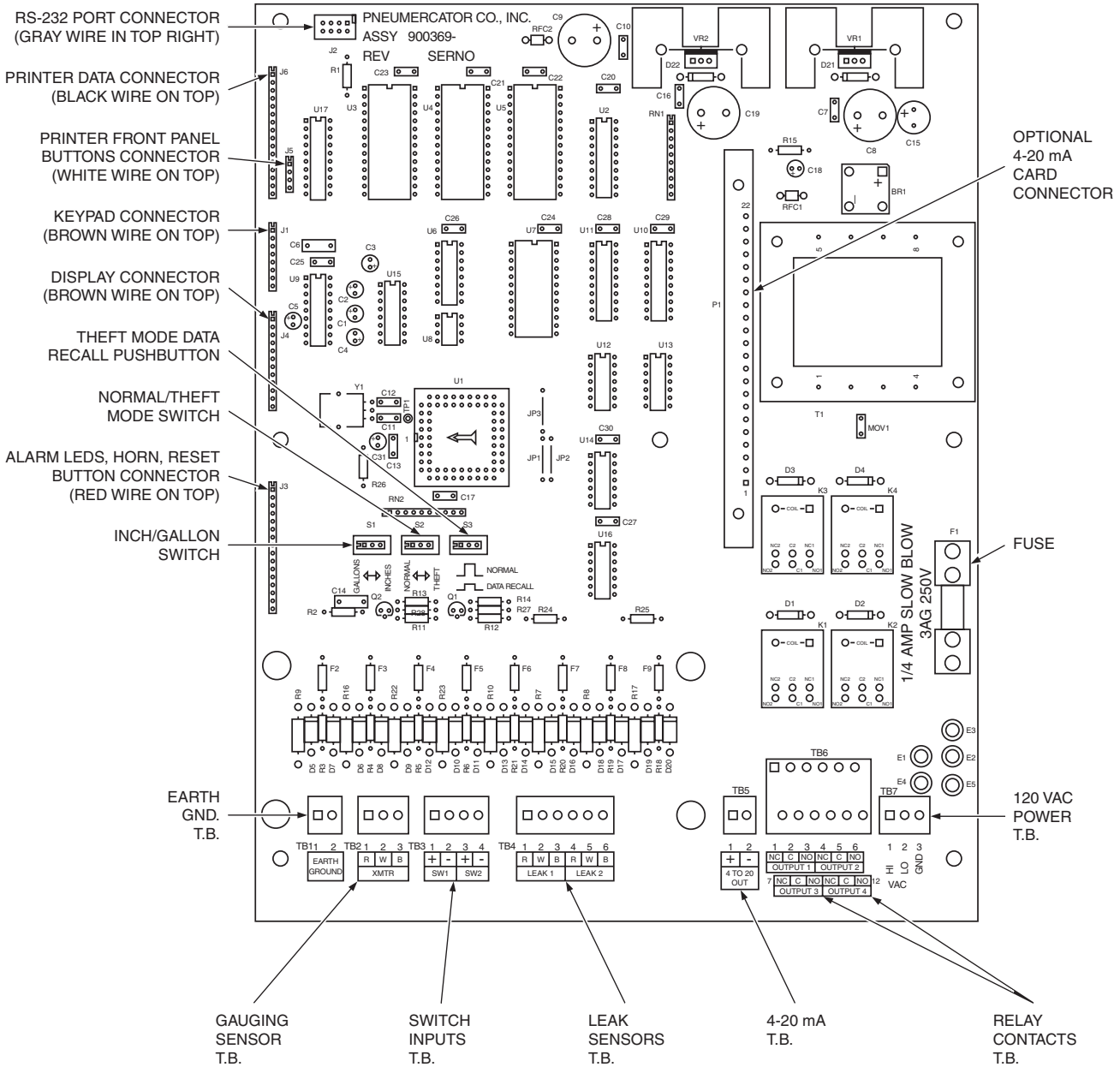
1. MANHOLE:
 - 1.1) SUPPLIED BY CUSTOMER.
 - 2.1) SUPPLIED BY CUSTOMER. TO BE NEMA 4 OR BETTER.
 - 2.2) OPTIONAL EPOXY SPLICE KIT IS AVAILABLE (P/N 100007-1).
3. SENSOR:
 - 3.1) SENSOR IS SUPPLIED AS AN ASSEMBLY WITH 25 FT. OF CABLE ATTACHED. 3.2) MOUNTING REQUIRES A 2" MINIMUM OPENING. TWO 1/2" NPT LIQUID-TITE CORD CONNECTORS ARE SUPPLIED.
 - 3.3) CABLE IS 18/3.

APPLICATION		REVISIONS		DATE	BY	APP.
NEXT ASSY	USED ON	REV	DESCRIPTION	DATE	CHR	
		A	SEE REVISION SHEET FOR THIS AND OTHER REVISION HISTORY	10/09/02		

PART NUMBER: N/A		PNEUMERCATOR <small>Liquid Level Control Systems</small>	
USERS'S DIMENSIONS AND ANGLES ARE IN INCHES		120 FINN COURT FARMINGDALE, N.Y. 11735	
FRACTIONS	DECIMALS	ANGLES	DESCRIPTION
± 1/64	± 0.005	± 0.30°	INSTALLATION DRAWING
MATERIAL: N/A		SIZE	MODEL 9-903 SENSOR
FINISH: N/A		CABLE CODE	DRAWING NO. 10470
		SCALE: NONE	REV. A
			SHEET 1 OF 1

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Figure 6 – Circuit Board Layout



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Appendix A

Keypad Error Codes:

- 0 - PRINT BUFFER OVERFLOW
- 1 - UNIMPLEMENTED COMMAND
- 2 - CLOCK HAS LOST TIME (BATTERY FAILURE)
- 3 - RANGE ERROR
- 4 - RAM ERROR
- 5 - KEYPAD BUFFER OVERFLOW
- 6 - SYNTAX ERROR
- 7 - PROBE (VOLUME) MEASUREMENT OVERRANGE
- 8 - COLD RESET
- 9 - PROBE (VOLUME) MEASUREMENT UNDERRANGE
- 10 - CLOCK TIMEOUT (BOX IN LOWER PART OF DISPLAY)

*** To cancel the display of an error code, press any key on the keypad.

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Appendix B

Tank Product Codes:

Product Code	Product Name
00	PRODUCT
01	#2 OIL
02	#3 OIL
03	#4 OIL
04	#5 OIL
05	#6 OIL
06	FUEL OIL
07	HEATING OIL
08	DIESEL
09	KEROSENE
10	MOTOR OIL
11	WASTE OIL
12	HYDRAULIC OIL
13	CUTTING OIL
14	QUENCH OIL
15	MINERAL SPIRITS
16	STEERING FLUID
17	TRANSMISSION OIL
18	ATF
19	GASOLINE
20	UNLEADED
21	UNLEADED GASOLINE
22	UNLEADED REGULAR
23	REGULAR UNLEADED
24	UNLEADED PREMIUM
25	PREMIUM UNLEADED
26	UNLEADED SUPER
27	SUPER UNLEADED
28	SUPREME UNLEADED
29	LEAD FREE
30	LEADED
31	LEADED GASOLINE
32	LEADED REGULAR
33	REGULAR LEADED
34	LEADED PREMIUM
35	PREMIUM LEADED

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36	LEADED SUPER
37	SUPER LEADED
38	REGULAR
39	PREMIUM
40	SUPER
41	GASOHOL
42	METHANOL
43	METHANOL BLEND
44	ALCOHOL
45	ANTIFREEZE
46	GLYCOL
47	ACETONE
48	TOLUENE
49	MEK
50	SOLVENT
51	WASTE PRODUCT
52	WASTE WATER
53	WATER
54	AV GAS
55	JET FUEL
56	JET A
57	JP-4
58	JP-5
59	JP-6
60	JP-8
61	SPECIAL
62	ETHANOL
63	TANK CONTENTS

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Appendix C

RS232 Connector Pinouts:

<u>DB-25 Connector pin</u>	<u>Signal</u>
1	Protective Ground
2	TxD
3	RxD
4	RTS
5	CTS
7	Signal Ground
20	DTR

NOTE DTR is actively pulled to a true state.
If DTR is not used, it may be left unconnected.

TxD	Transmitted data
RxD	Received data
RTS	Request to Send
CTS	Clear to Send
DTR	Data Terminal Ready

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Appendix D

RS232 Setup:

**** Baud rate changes must be entered from LDE-700 keypad

Baud Rates
300 (default)
1200
2400
4800
9600

Word Length
7 bits

Parity
Even Parity

Stop Bits
1 Stop Bit

Operation and Installation Manual

Warranty

We warrant that our equipment, if installed according to instructions will be free from defects in material and workmanship for a period of one (1) year following the date of original shipment by Pneumercator.

Our liability under this warranty shall be limited to, at our option,

- (i) repair of the defective equipment,
 - (ii) replacement of the original equipment with new equipment, or
 - (iii) refund of the original purchase price;
- and, we shall not be liable for any labor, other installation costs, indirect or consequential damages, or other damages in connection with such equipment.

This constitutes our obligation and none other stated for any purpose except the above shall apply.

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<http://www.pneumercator.com>

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