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Nathaniel E Frank-White

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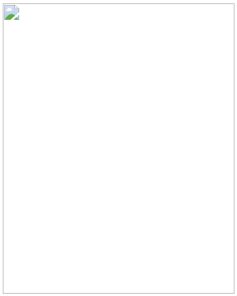
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IDEX CORPORATION

Print Version

LectroCount® family of Electronic Registers



Electronic Registration:

LectroCount® is Liquid Controls' series of electronic registers that replaces the mechanical register, calibration gears and/ or adjuster mechanism traditionally used on many flow meters. The LectroCount® series are Weights & Measures (custody transfer) approved advanced microprocessor based electronic register, presetting and printing control systems. LectroCount® is designed to meet - even adapt to - your flow meter and process control instrumentation requirements. Units are design to NEMA-4x non-incendive Class 1, Division 2, Group C & D. LectroCount® accepts pulse input from most flow meters and includes RS232/485 communications capability. The LCR-II is also available in a design for Class 1, Division 1 environments.

Two models of LectroCount® registers are available, the LCR-II and LCR 600. The LCR-II has been a standard in electronic registrations since its first appearance as the LCR-I in 1997. The LCR 600 is the next generation of electronic registration, incorporating a large display for displaying more information during a delivery as well as incorporating a keypad to eliminate the need for external devices to configure the unit. The LCR 600 also has a Point-of-Sale option that provides the ability to flexibly set prices, discounts and taxes for 100 products.

LectroCount® LCR-II
LectroCount® LCR 600
DMS Mobile Computing System

Specifications

REPEATABLILITY: Capable of .03% of reading over entire range.
LINEARITY: Capable of ±0.10% or better over a 5:1 range from maximum nominal meter capacity.
LINEARITY: Capable of ±0.10% or better over a 10:1 range from maximum nominal meter capacity.
LINEARITY: Capable of ±0.15% or better over a 40:1 range from maximum nominal meter capacity.

Due to the capabilities of multi-point calibration for meters equipped with LectroCount™ Electronic Registration, superior accuracy (linearity) can be provided as indicated above.

NOTE: Accuracy obtainable when all variables remain constant. Reading/ measurements must be equal to a minimum of one minute of flow at selected rate(s). All accuracy statements based on metering Stoddard Solvent, approximate viscosity 1 CPS. On higher viscosity products, the average deviation in accuracy will be even less.

Power Requirements:
LectroCount® LCR-II: +9 - 28 VDC
LectroCount® LCR 600: +9 - 28VDC

Environmental:
Enclosure: Class 1, Division 2, Group C&D design, Nema 4X
Operating Temp Range: -40° to 158°F (-40° to 70°C)

Approvals:
US Weights & Measures: LCR-II and LCR 600
Measurement Canada: LCR-II, LCR 600

Communications:
RS232/485
Printer: Epson, Okidata and Blaster Models

Electrical:
Power: +9 to 28VDC, 3A maximum (including solenoid valves)

Inputs:
Temperature input: 4-Wire Platinum RTD
Pulse Inputs: +5 to 28 volt peak to peak, open collector, single channel or quadrature

Outputs:
Control Valve (2): Open drain transistor for 2 stage valve control, 1A Max. per channel
Auxiliary (2): Open drain transistor for general purpose auxiliary control. Aux(1) 1A Max, Aux(2) 150mA Max
Scaled Pulse Output: Open drain output, 1 A Max.

Literature

Electronics Brochure
LCR 600 Specifications
LCR-II Specifications
LectroCount for Load Rack Brochure
Installation and Operation Manuals
LectroCount Delivery Tickets

Contact us for more information.

Accessories:
LectroCount™ electronic registers are available with a selection of accessories including optical air eliminators, two stage valves, printers, remote displays and that integrate with electronic registers to provide more control and accuracy during deliveries.

Print Version

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Liquid Controls Positive Displacement Flow Meters and Accessories



Materials of Construction

M-Series: Aluminum, Cast Iron or Stainless Steel

MA-Series: Aluminum

MS-Series: Steel with Aluminum Metering Chamber (optional Stainless Steel)

- **Seal Materials**: Buna "N"; Viton®; PTFE

Design Features

Meters provide exceptionally accurate service when using Liquid Controls' unique positive displacement metering principle, even under variable operating conditions (changes in temperature, pressure and viscosity). Provides the energy efficient and functional performance desired from an economical volumetric measuring instrument. Available with traditional mechanical seal or glandless magnetic driven pulse output device. A wide range of accessories are available to meet almost every metering need.

METER FEATURES

- High accuracy and repeatability
- Low maintenance, no metal-to-metal contact in measuring chamber
- Low pressure loss, a true gravity flow meter
- Choice of aluminum, cast iron, and stainless steel materials of construction
- Self-contained operation without electrical power or signal conditioning (for units equipped with mechanical registers, printers or presets); no special piping requirements
- Electronic output and registration equipment where enhanced accuracy and electronic communications are needed
- Weights & Measures approval (world-wide) for custody transfer with mechanical or electronic registration systems meeting API standards
- Electronic accessories designed and approved to Class 1 Div. 2 standards

Specifications

- **Accuracy / Performance**:
  - **Electronic Registration Linearity**:
    - Capable of ±0.10% over a 5:1 range
    - Capable of ±0.10% over a 10:1 range
    - Capable of ±0.15% over a 40:1 range
  - **Mechanical Registration Linearity**:
    - Capable of ±0.125% over a 5:1 range
    - Capable of ±0.22% over a 10:1 range
    - Capable of ±0.5% over a 40:1 range
  - **Repeatability**:
    - Capable of 0.02% or better at any flow rate over entire range

- **Sizes**: 1 1/2" through 6"
- **Flow Rates**: 5 GPM through 1,000 GPM
- **End Connections**: ANSI Flanged, NPT, BSPT, Slip Weld
- **Pressure Ratings**
- **M-Series and MA-Series Cast Case**: 150 & 350 PSI non shock working pressure
- **MS-Series Two Case Steel Case**: 150/150, 150/275, 300/300, 300/720 PSI; 600/1440 ANSI non- shock working pressure

Literature

Application Brochures
Bill of Materials
Engineering Documents
Installation and Operation Manuals
Product Overviews
Specification Sheets

Contact us for more information

Typical Applications

Adhesives	Agricultural Chemicals	Asphalt	Animal Feeds	Aviation Fuels
Beverages	Concrete Add Mixtures	Cosmetics	Crude Oil	Dairy Products
Fuel	Fuel Oil	Industrial Chemical	Liquid Fertilizers	Liquified Gasses
Lube Oils	Paints and Varnishes	Printing Ink	Processed Foods	Refined Petroleum Products

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IDEX CORPORATION

Print Version



Discover FlightConnect: Liquid Controls' Aviation Fueling System

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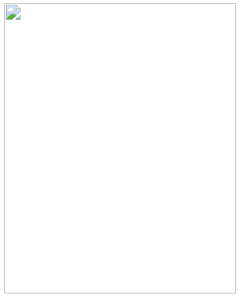
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- Distributor Webpage
- Standard Terms & Conditions

Print Version

LectroCount™ LCR 600



The LectroCount™ LCR 600, the latest edition of Liquid Controls' popular LectroCount™ line of electronic registers, is loaded with advanced functionalities that can produce real savings for your bottom line. New features—such as the large 5.7" QVGA display and the alphanumeric keyboard—enable valuable new functionalities like the full-featured point-of-sale (or POS, an optional upgrade), instant diagnostic messaging, and customized delivery screens. The LCR 600 is a standalone unit; no extraneous lap top or a lap pad is required. All configurations—including calibration, system setup, and point-of-sale (POS)—can be entered using the alphanumeric keypad.

LectroCount LCR 600 Benefits

- Simultaneously track volume, flow rate, and many other key values during delivery
- In the field configuration and setup—the LCR 600 functions as a stand-alone unit
- Quick setup and operation with intuitive navigation screens
- Prevent needless service calls with the comprehensive diagnostic package
- Compatible with most positive displacement flowmeters

LectroCount LCR 600 with/ Point-of-Sale (POS) Benefits

- Increase the number of daily deliveries by replacing handwritten tickets with printed priced and taxed tickets
- Reduce human error and office work created by handwritten tickets
- Reduce postage and invoices costs by printing POS tickets at delivery sites
- Customize discounts and pricing for all types of customers—up to 100 programmable products
- Add multiple products, pricing, and taxes to a single calibration (ex. diesel and dyed diesel)
  Serve different municipalities, states, and regions with complex tax structuring capability
- Add additional service and product transactions on-site with the miscellaneous charges feature

LectroCount™ LCR-II
DMS Mobile Computing System

Specifications

REPEATABLILITY: Capable of .03% of reading over entire range.
LINEARITY: Capable of ±0.10% or better over a 5:1 range from maximum nominal meter capacity.
LINEARITY: Capable of ±0.10% or better over a 10:1 range from maximum nominal meter capacity.
LINEARITY: Capable of ±0.15% or better over a 40:1 range from maximum nominal meter capacity.

Due to the capabilities of multi-point calibration for meters equipped with LectroCount™Electronic Registration, superior accuracy (linearity) can be provided as indicated above.

NOTE: Accuracy obtainable when all variables remain constant. Reading/ measurements must be equal to a minimum of one minute of flow at selected rate(s). All accuracy statements based on metering Stoddard Solvent, approximate viscosity 1 CPS. On higher viscosity products, the average deviation in accuracy will be even less.

Power Requirements:
LectroCount® LCR-II: +9 - 28 VDC
LectroCount® LCR 600: +9 - 28VDC

Environmental:
Enclosure: Class 1, Division 2, Group C&D design, Nema 4X
Operating Temp Range: -40° to 158°F (-40° to 70°C)

Approvals:
US Weights & Measures: LCR-II and LCR 600
Measurement Canada: LCR-II, LCR 600

Communications:
RS232/485
Printer: Epson, Okidata and Blaster Models

Electrical:
Power: +9 to 28VDC, 3A maximum (including solenoid valves)

Inputs:
Temperature input: 4-Wire Platinum RTD
Pulse Inputs: +5 to 28 volt peak to peak, open collector, single channel or quadrature

Outputs:
Control Valve (2): Open drain transistor for 2 stage valve control, 1A Max. per channel
Auxiliary (2): Open drain transistor for general purpose auxiliary control. Aux(1) 1A Max, Aux(2) 150mA Max
Scaled Pulse Output: Open drain output, 1 A Max.

Literature

Electronics Brochure
LCR 600 Specifications
LCR 600 Installation
LCR 600 Setup & Operation

Accessories:
LectroCount™ electronic registers are available with a selection of accessories including optical air eliminators, two stage valves, printers, remote displays and that integrate with electronic registers to provide more control and accuracy during deliveries.

Contact us for more information.

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LectroCount LCR 600
0.0
GALLONS
Corrected to 60°F
1 ONE ARI GAS GASOLINE
Gross Quantity: 0.0 GALLONS
Price/Unit: $ 1.9835
Total Price: $ 0.00
Flow Rate: 0.0 GALLONS PER MINUTE
Temperature: 34.7 DEG. F
Gross Totalizer: 651.0 GALLONS
Net Totalizer: 598.3 GALLONS
Next/Previous Screen
RUN
STOP
PRINT
SHIFT PRINT
ABC 1
DEF 2
GHI 3
JKL 4
MNO 5
Fn
PREV ESC
PQR 6
STU 7
VWX 8
YZ* 9
-:# 0
NEXT ENTER

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10. This Agreement and performance hereunder shall be construed and interpreted under the laws of the State of Illinois.

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12. Licensee may not assign or sublicense, without the prior written consent of Liquid Controls, its rights, duties, or obligations under this Agreement to any person or entity in whole or in part.

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⚠ WARNING

- Before using this product, read and understand the instructions.
- Save these instructions for future reference.
- All work must be performed by qualified personnel trained in the proper application, installation, and maintenance of equipment and/or systems in accordance with all applicable codes and ordinances.
- Failure to follow the instructions set forth in this publication could result in property damage, personal injury, or death from fire and/or explosion, or other hazards that may be associated with this type of equipment.

LectroCount LCR 600 Overview

GENERAL INFORMATION

This manual provides instructions for the initial setup, the calibration, and the operation of the LectroCount LCR 600. The Liquid Controls LectroCount LCR 600 is a microprocessor-based electronic meter register. Its primary functions consists of configuring the meter system to the properties of the liquids to be measured, interfacing with the electronic components of the meter system components (and external components such as pumps, injectors, and shutdown devices), and performing Weights & Measures approved custody transfer actions.

The LCR 600 performs well in mobile and fixed installations. It can control a meter system as a stand-alone unit or used as a slave to a host controller such as a process controller or an in-cab data management system.

The LCR 600 is a self-contained unit. All operation, setup and configuration functions can be entered using the LCR 600's red selector switch and the alphanumeric keypad. No lap pads, laptops, or other data entry devices are required.

A point-of-sale upgrade or POS is available for the LCR 600. The POS upgrade gives the LCR 600 the ability to print tickets with pricing, taxes, discounts, and miscellaneous charges at delivery sites.

BASIC FUNCTIONS

- Calibration (single and multipoint)
- Weights & Measures custody transfer (product delivery and ticket generation)
- Metrological data collection
- Presetting by volume
- Multiple production selection
- Four delivery screens
- Security settings
- Air and vapor elimination (with proper accessories)
- Valve control (with proper accessories)
- Electronic temperature volume compensation (ETVC) (with proper accessories)

POS UPGRADE FUNCTIONS

- Cash and volume discounting
- Multiple tax structures
- Priced and taxed tickets
- 16 product calibrations
- 100 product names
- Presetting by price

PERMIAN GLOBAL, INC. AND MANTICORE FUELS, LLC EXHIBIT 1013, Page 18

LectroCount LCR 600 Inputs and Outputs

The LCR 600 can communicate with a number of components on a Liquid Controls meter system. The following pages provide a brief description of the components, a drawing identifying these components on the meter system, and a list of the LCR 600 commands and fields that correspond to each component.

INTERNAL PULSER

Typically, an internal pulser is mounted to the bottom of the LCR 600 housing. A small shaft extends from the bottom of the internal pulser through the LCR 600 housing where it attaches to a drive shaft. The drive shaft turns directly off of the rotors inside the Liquid Controls meter. When the internal pulser shaft spins, the pulser manufactures a two channel quadrature pulse output. The LCR 600 uses the pulse output to calculate flow measurements. The number of pulses equal to a unit of measurement is set during calibration and proving in the **Pulse/Unit <k-Factor>:** field.

TEMPERATURE PROBE

The optional temperature probe, part of the Electronic Temperature Volume Compensation (ETVC) kit, monitors the temperature of the product being measured. Because the volume of many products expand and constrict considerably according to temperature fluctuations, the LCR 600 corrects the volume measurement to a base temperature (60º F for example).

PRINTER

Together, the LCR 600 and the Epson printer can print out four types of tickets (delivery, duplicate delivery, shift, and diagnostic). With the LCR 600 POS upgrade, delivery tickets can be configured to print completely priced tickets with complex tax and discount structures. The LCR 600 provides a “require ticket feature” to meet Weights & Measures standards and prevent unrecorded deliveries.

S1 SOLENOID

When energized by the LCR 600, the S1 solenoid-operated valve opens the control valve on the outlet side of the meter, allowing product to flow through the valve. When the S1 is deengergized, the control valve shuts off the product flow. The LCR 600 switches the S1 solenoid via the selector switch (RUN and STOP positions) and during two stage preset deliveries (according to the **S1 Close:** value).

S2 SOLENOID

The S2 solenoid-operated valve is used by two stage meter systems to provide a dwell flow for preset deliveries. Near the end of a two stage preset delivery, the LCR 600 de-energizes the S1 solenoid-operated valve to stop product flow. At the same time, the LCR 600 energizes the S2 solenoid to open a bypass pipe through which the remainder of the preset delivery passes. The solenoids are switched at a preset remaining volume or price determined by the value of the LCR 600 field **S1 Close:**.

S3 SOLENOID

The S3 solenoid opens and close the vent ports of the meter system’s optical air (or vapor) eliminator. The LCR 600 energizes and de-energizes the S3 according to the optical sensor’s reading.

OPTICAL SENSOR

An optical sensor detects the presence of liquid inside optical air (or vapor) eliminators. When the optical sensor does not detect liquid inside the optical air (or vapor) eliminator cavity, the LCR 600 de-energizes the S1 solenoid-operated valve and causes the control valve to close. At the same time, the optical sensor energizes the S3 solenoid-operated valve, opening the vent ports. As the air and vapor evacuates the cavity, the liquid level rises. When the level reaches the optical sensor, the sensor detects the liquid. The LCR 600 energizes the S1 solenoid, which opens the control valve, and deenergizes the S3 solenoid, sealing the vent ports.

ΔP TRANSDUCER

The differential pressure transducer, common in aviation applications, monitors the differential pressure (pressure drop) across a full flow fuel monitor/water coalescer. The highest differential pressure reached during the custody transfer is printed on the delivery ticket and displayed on the screen. If the differential pressure reaches a dangerous level, the LCR 600 can shut down the delivery. To set up a differential pressure shutdown value, a shutdown device (such as a valve or a dead-man) must be connected to the LCR 600, and a differential pressure shutdown value must be entered into the **dP Shutdown Value:** field.

AUXILIARY OUTPUTS

The LCR 600 provides three open drain transistor auxiliary outputs for different external devices such as pump controls and additive injectors. Two of the outputs have settings that can be set in the **Auxiliary 1 Output:** (Off, On, On During Delivery, and Monitor Flowrate) and **Auxiliary 2 Output:** (Off, On, On During Delivery, and Flow Direction) fields. The LCR 600 also provides auxiliary output connections for the LectroCount Remote Display (other types of displays are usually compatible). Signals from these outputs duplicate the volume data sent to the LCR 600 display.

Red Selector Switch

The LCR 600 red selector switch, located at the bottom left of the LectroCount LCR 600, has five positions. The selector switch's primary purpose is to control everyday delivery and print functions. Functions include opening and closing the control valve in order to start and stop deliveries and prompting the printer to print delivery tickets and shift tickets.

THE FIVE POSITIONS ON THE SELECTOR SWITCH

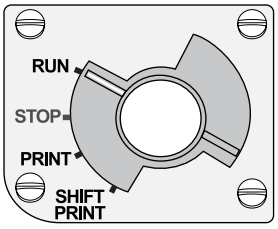
RUN - opens the control valve to begin a delivery

STOP - closes the control valve to pause a delivery

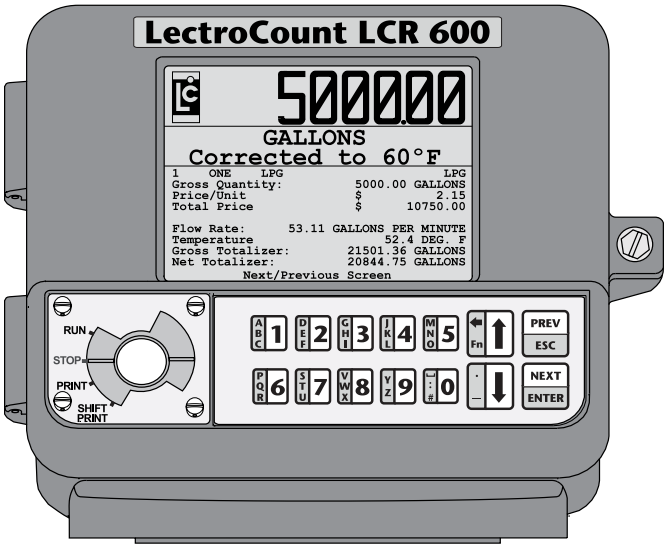
PRINT - ends a delivery and prints a delivery ticket

SHIFT PRINT - ends a shift, prints a shift ticket, and resets shift data in the LCR 600

Calibration Position - allows access to calibration configuration settings.



Red Selector Switch

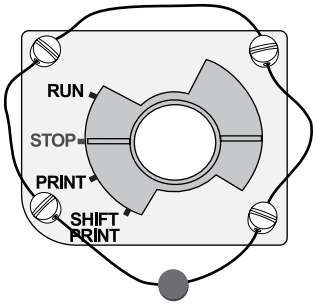


LCR 600

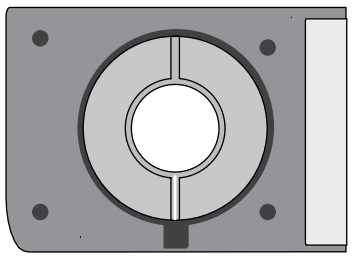
CALIBRATION POSITION

The red selector switch also provides a secure calibration position. When in the calibration position, the LCR 600 may be used to calibrate the meter and enter sensitive Weights & Measures data.

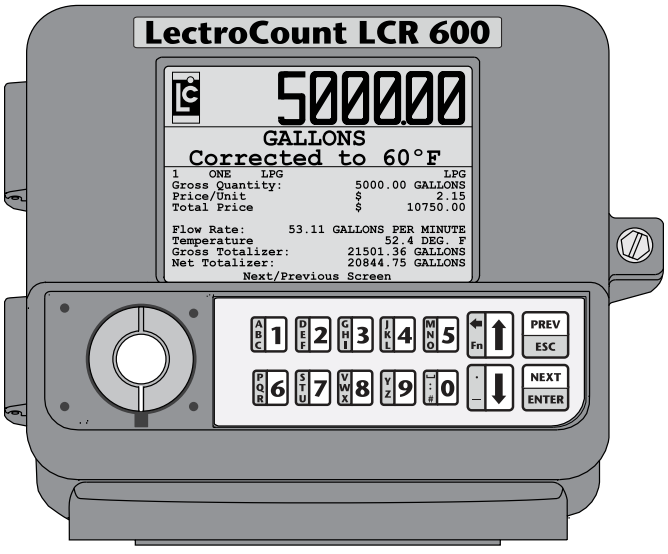
To turn the selector switch into the six o'clock calibration position, the LCR 600's switchplate must be removed. To take off the switchplate, remove the four screws holding it in place. If the LCR 600 has been previously calibrated and approved by Weights & Measures, you will need to remove the lead seal and the wire threaded through the switchplate screws.



Selector Switch & Seal



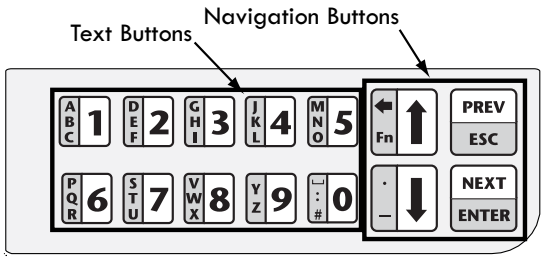
Six O'clock Calibration Position



LCR 600 without Switchplate

Alphanumeric Keypad

The alphanumeric keypad serves as a navigation and data entry tool for the LCR 600. The four larger buttons on the right side of the keypad are used primarily for navigating to fields on the display screen and navigating from one display screen to the next. The ten smaller buttons on the left side are used to enter numbers, characters, and text when changing the value of a field.



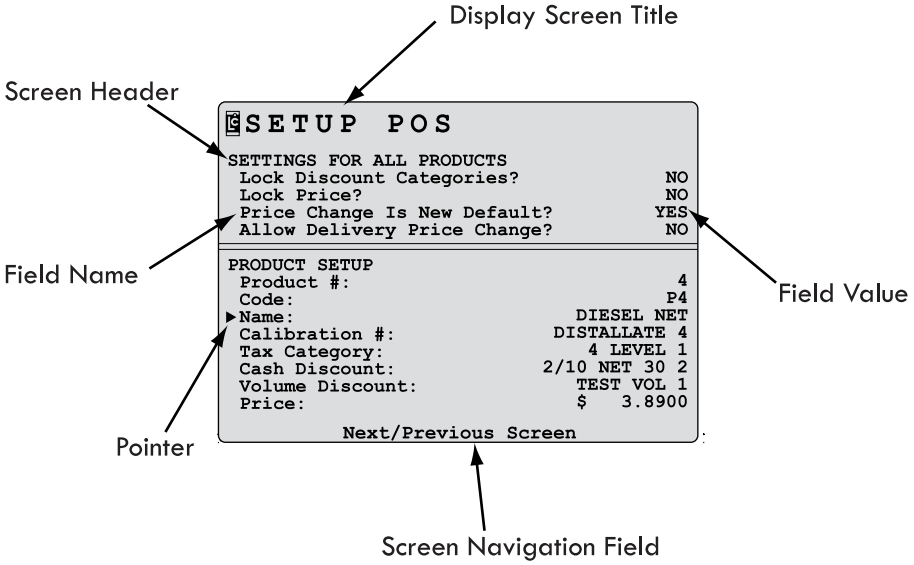
LCR 600 Alphanumeric Keypad

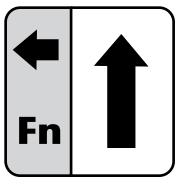
Display Screens

LCR 600 display screens can contain up to 16 fields. The values of most LCR 600 fields can be edited; however, some fields are shown for data monitoring and informational purposes only and can not be edited, for example **`Temperature`** and **`Flow Rate`**.

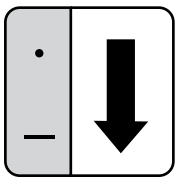
SELECTING FIELDS

To select a field for editing, the LCR 600 display screens use a pointer that scrolls up and down along the left side of the screen. If the field is not editable, the pointer will skip over it.





Arrow Button to scroll the pointer up the left side of the display



Arrow Button to scroll the pointer down the left side of the display

To select a field on a display screen:

1. Move the pointer ▶ on the far left of the display to the desired field using the ⬆ and ⬇ buttons.
2. Press the **ENTER** button to open a list box or a field edit box.

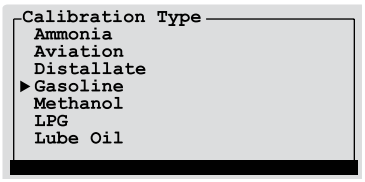
After a field is selected, the LCR 600 will bring up a list box or a field edit box, depending on the field, where the value of the field can be changed.

LIST BOX WINDOWS

Some LCR 600 fields only have a limited number of possible values. These fields use list box windows to display all of the possible values.

To select a value in a list box:

1. Move the pointer ▶ to your desired value using the ⬆ and ⬇ buttons.
2. Press the **ENTER** button to accept the value.



`Calibration Type` *List Box*



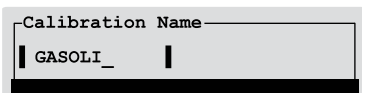
Press the PREV/ESC button to exit any list box or field edit window with changing its value

FIELD EDIT WINDOWS

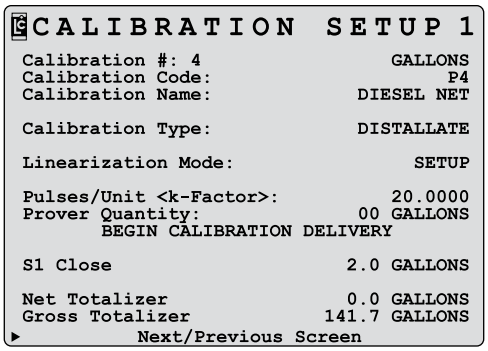
Some LCR 600 fields require a specific alphanumeric entry. For these fields, the LCR 600 will open a small box at the bottom of the screen where text, numbers, and characters can be entered using the keypad.

To enter a value in a field edit box:

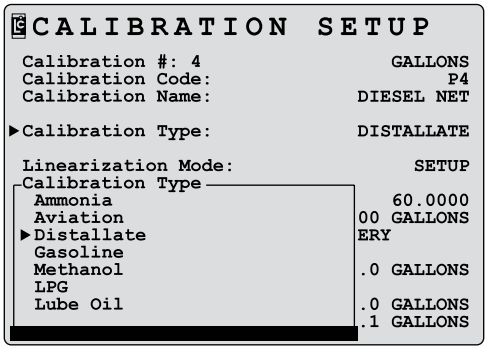
1. Enter text, numbers, or characters using the multitap functionality of the keypad's 10 alphanumeric buttons.
2. Press the **ENTER** button to accept the value.



`Calibration Name` *Field Edit Box*



Calibration Screen
Pointer on the **`Calibration Type`** *field*

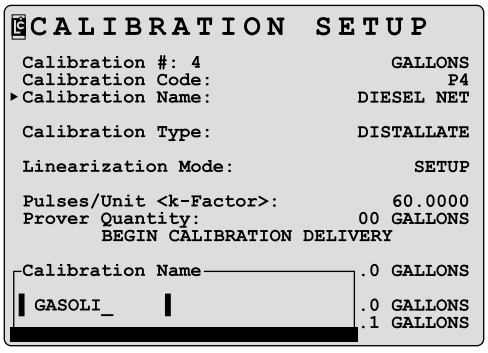


List Box Window after selecting **`Calibration Type`** *field*

Throughout this manual, the type of edit box for LCR 600 field is included with the field definition.

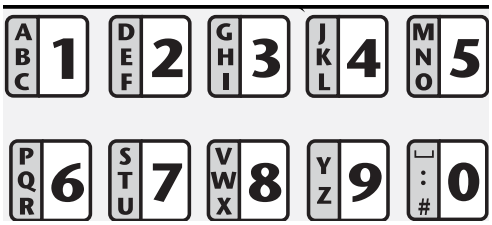
FE - Field Edit Box

LB - List Box



Field Edit Window after selecting **`Calibration Name`** *field*

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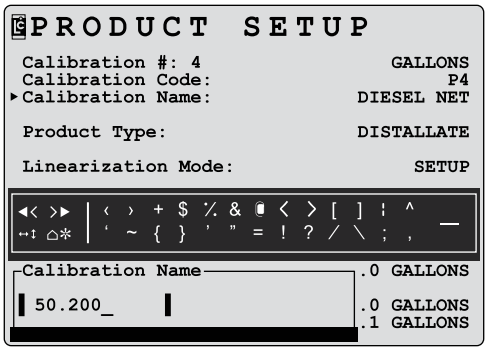
Alphanumeric Buttons



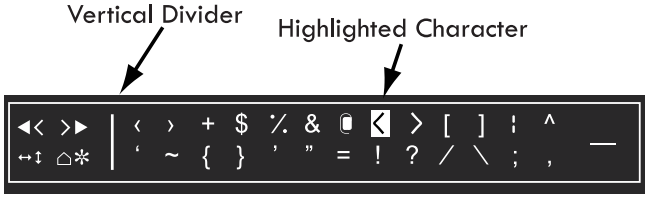
Press the ⬆ button to backspace in a field edit window



Fn Button



Display Screen with Fn Box



Fn Box

MULTITAP FUNCTIONALITY

While a field edit box is on the LCR 600 screen, the alphanumeric buttons and the down button can be used to enter characters in the field edit box. The character entered into the field edit box depends on the number of times the button is pressed successively, similar to text messaging on a cell phone.

VWX 8

TAPS	CHARACTER
1	8
2	V
3	W
4	X

·– ⬇

TAPS	CHARACTER
1	.
2	–

Fn BOX

The Fn command (on the up arrow button) provides a set of additional characters and commands that can be entered in a field edit box. The symbols on the left side of the Fn box are commands. The symbols on the right side are characters.

To activate an Fn command or insert an Fn **character:**

1. Tap the Fn button twice to bring up the Fn box.
2. Using the ⬆ and ⬇ buttons, move the highlighted cursor to the desired command or character
3. Press the **ENTER** button to accept the highlighted command or character.

FN COMMANDS

- ◀ Moves cursor to the farthest left position
- ❮ Moves cursor one space to the left
- ❯ Moves cursor one space to the right
- ▶ Moves cursor to the farthest right position
- ↔ Insert toggle
- ↕ Upper/Lower case toggle
- Δ Deletes character above cursor
- ✲ Deletes entire field

NAVIGATING FROM SCREEN TO SCREEN

The LCR 600 contains nine groups of screens: Delivery Setup, General Setup, System Setup, Calibration Setup, Diagnostics, Security, Setup POS, Advanced Features, and Machine Status. Once a group of screens is opened, you can rotate through the screens in the group using the **`Next/Previous Screen`** field at the bottom of the screen.

Two additional screens, independent of the nine groups, are essential to operating and navigating the LCR 600, the Delivery Screen and the Configuration Menu.
The Delivery Screen is opened when the red selector switch is turned to the RUN position. Once the Delivery Screen is open, the three Delivery Setup screens can be opened using the **`Next/Previous Screen`** field.
The Configuration Menu serves as a hub for opening the other eight groups of screens. It is included in the rotation of each group of screens. The Configuration Menu also opens when the red selector switch is turned to the calibration position.

To move from one screen to another:

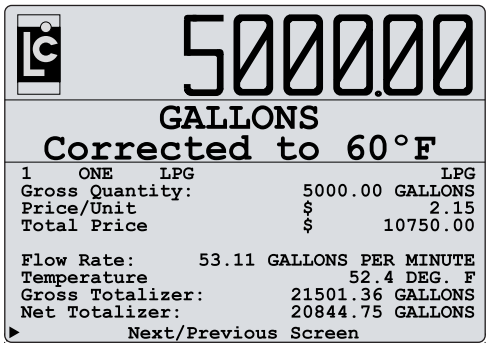
1. Move the pointer to the bottom line of the screen: **`Next/Previous Screen`**
2. Press the **NEXT** or the **PREV** button to navigate to the next screen or the previous screen.

---------- OR ----------

1. Move the pointer to any field in the Configuration Menu screen.
2. Press the **ENTER** button to open the screen.

Delivery Screen Fail-safe

In any LCR 600 screen, turning the selector switch to RUN will bring up the delivery screen and begin a delivery.



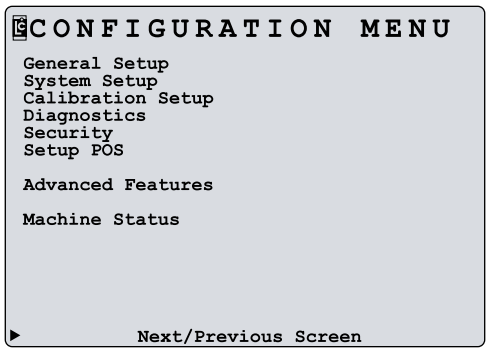
Delivery Screen Pointer on the **`Next/Previous Screen`** *line in position for a screen change*



Press NEXT/ENTER button while pointer is on the **`Next/Previous Screen`** *line to navigate to the next screen*



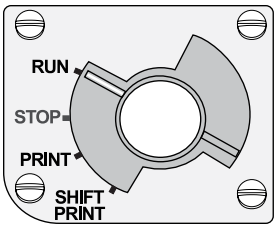
Press PREV/ESC button while pointer is on the **`Next/Previous Screen`** *line to navigate to the previous screen*



Configuration Menu

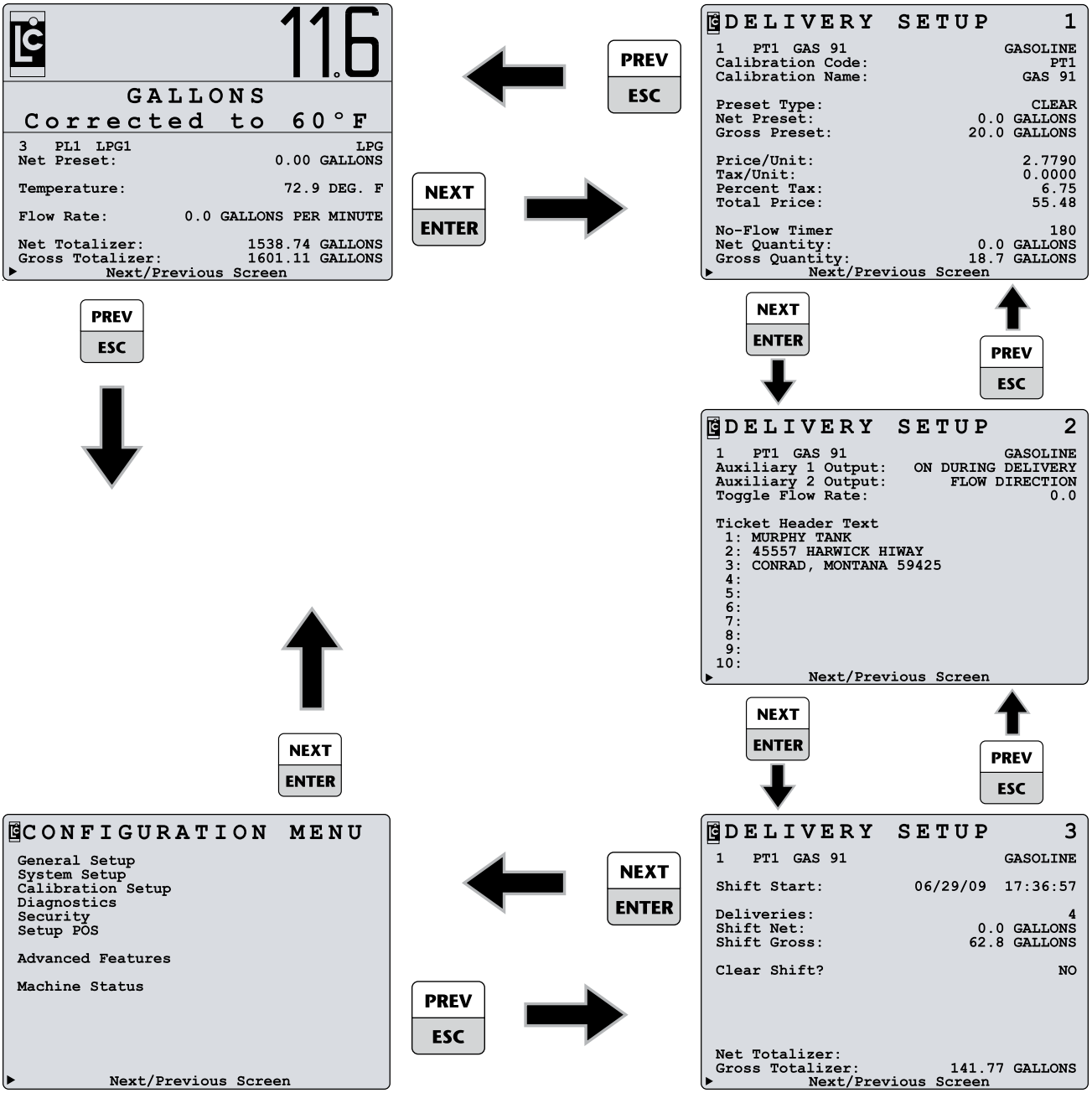
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Delivery Screens **Detailed Pump & Print • Aviation • Volume & Preset**

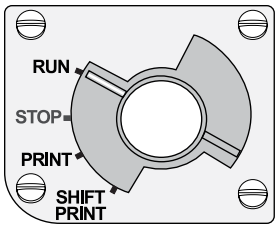


To navigate to the delivery screens:

1. Set the selector switch to RUN, and the delivery screen will appear and start a delivery. **-**OR**-** While the selector switch is set to STOP, PRINT, or SHIFT PRINT navigate to the Configuration Menu.
2. Move the pointer to the **`Next/Previous Screen`** field and press the **NEXT** or **PREV** button.

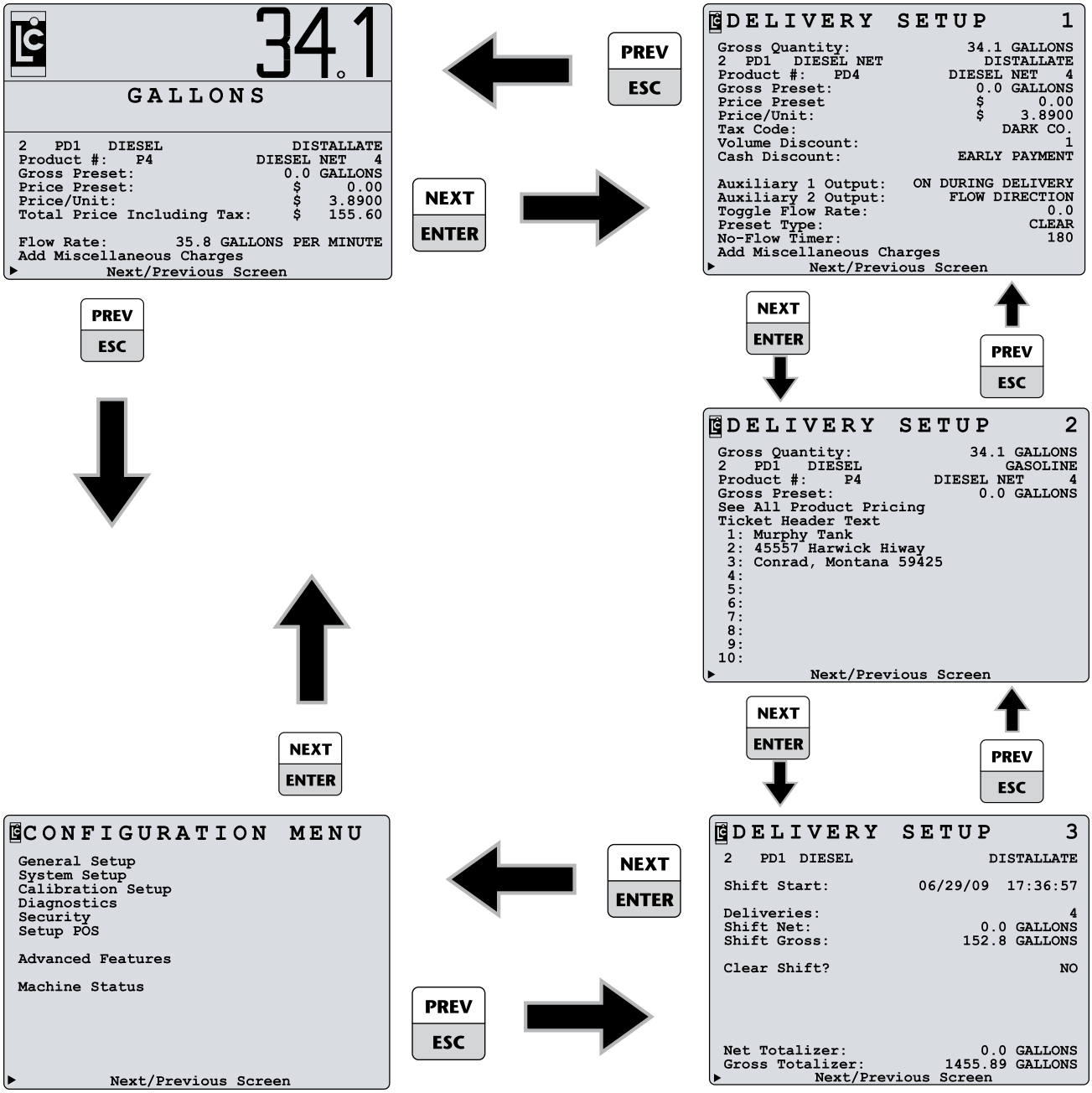


POS Delivery Screens **Detailed POS • Aviation • Volume & Preset**



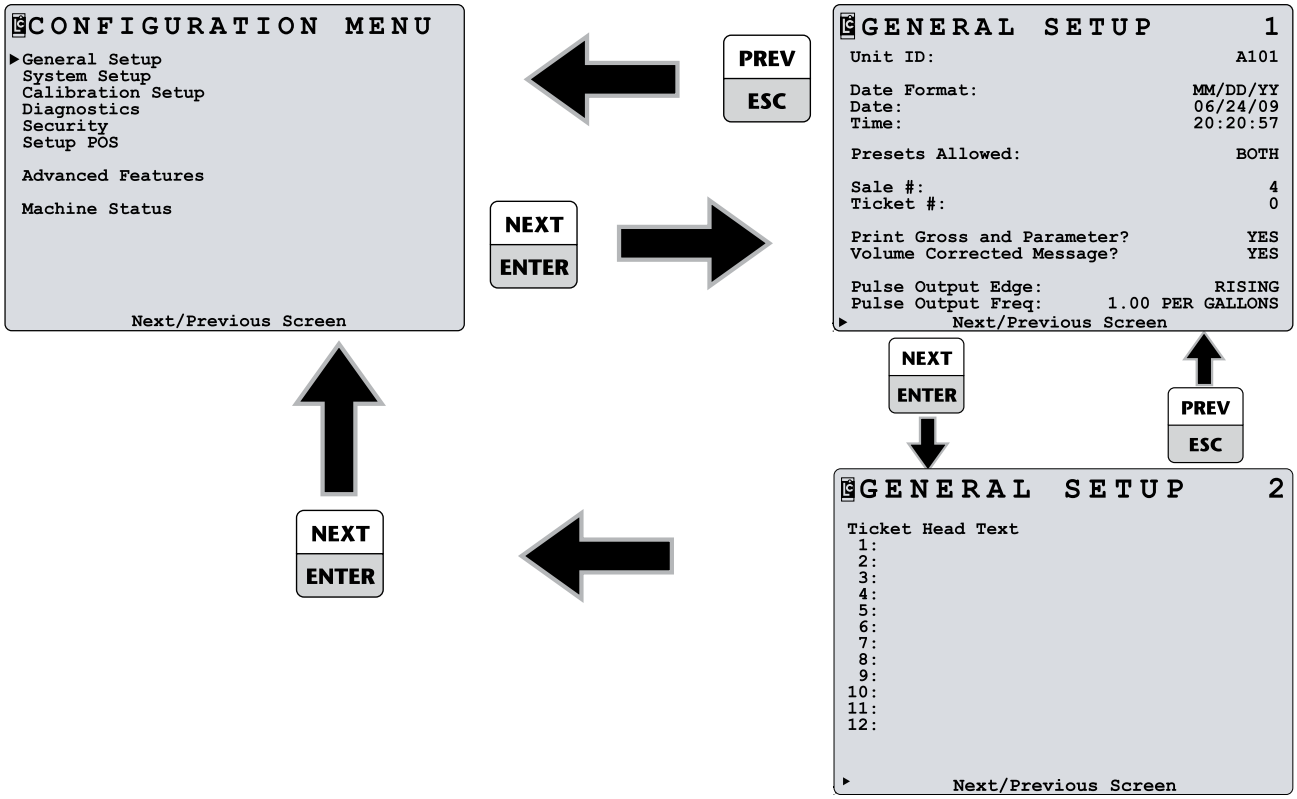
To navigate to the POS delivery screens:

1. Set the selector switch to RUN, and the delivery screen will appear and start a delivery. -OR- While the selector switch to STOP, PRINT, or SHIFT PRINT and navigate to the Configuration Menu.
2. Move the pointer to the **`Next/Previous Screen`** field and press the **NEXT** or **PREV** button.

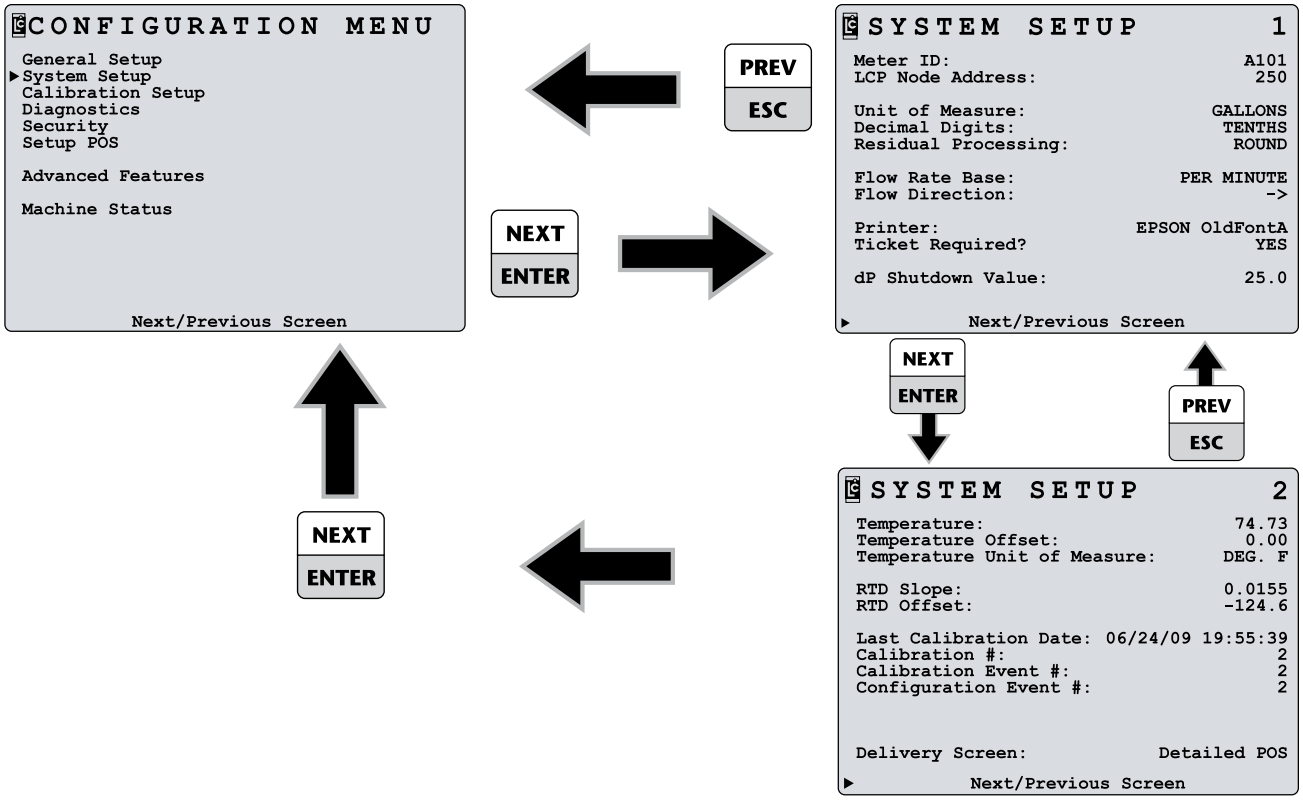


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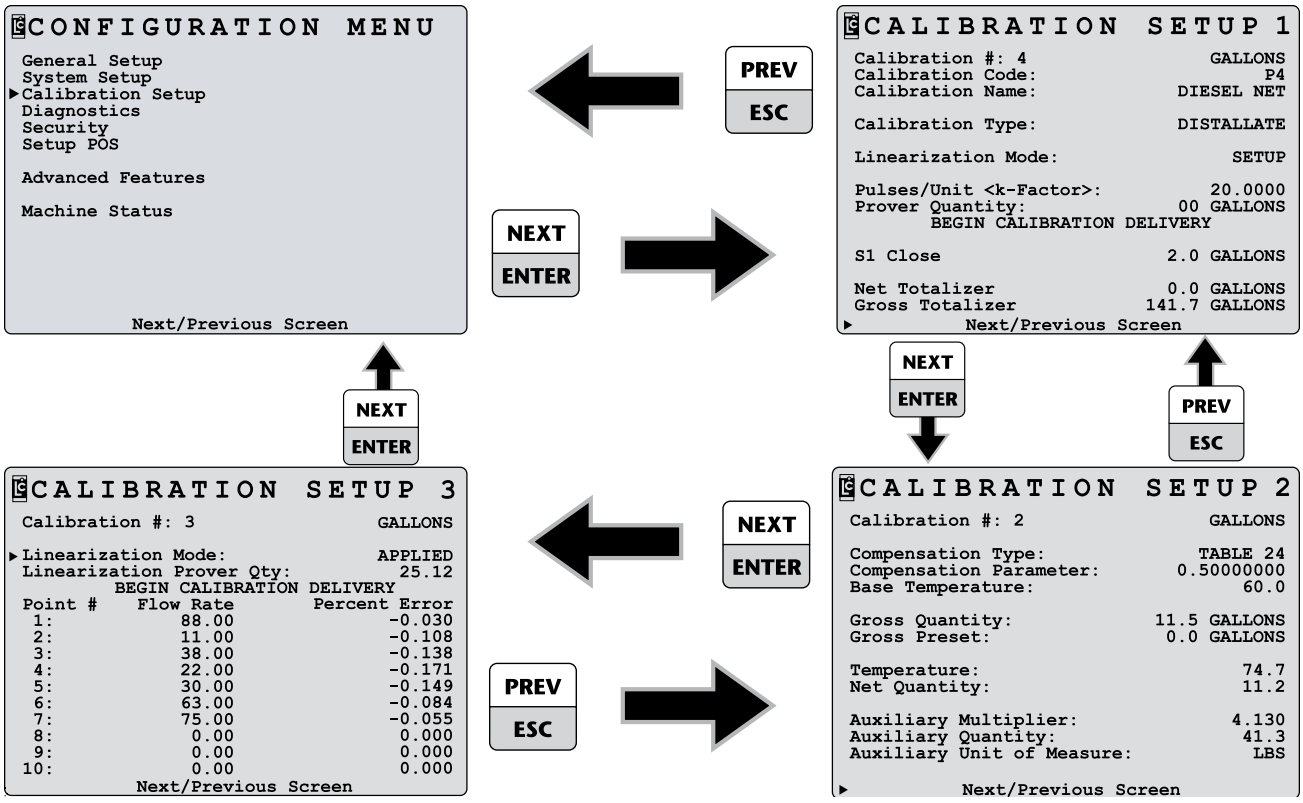
General Setup Screens



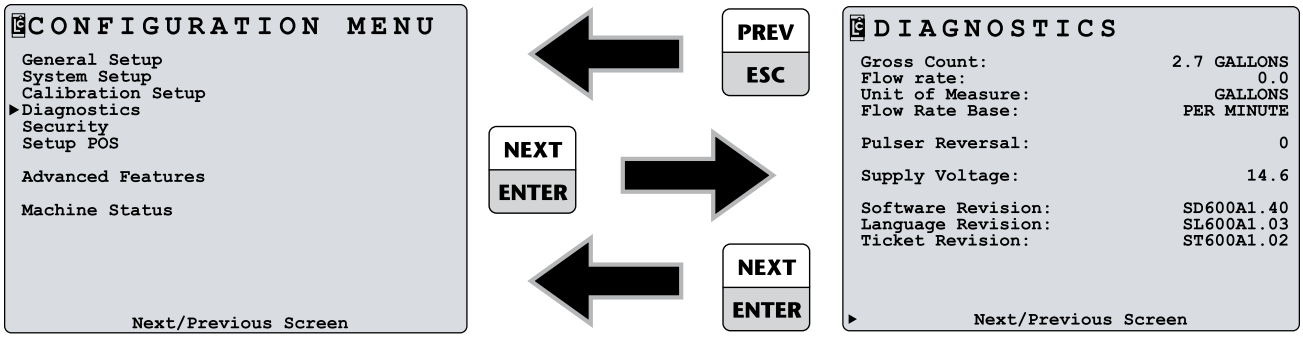
System Setup Screens



Calibration Setup Screens

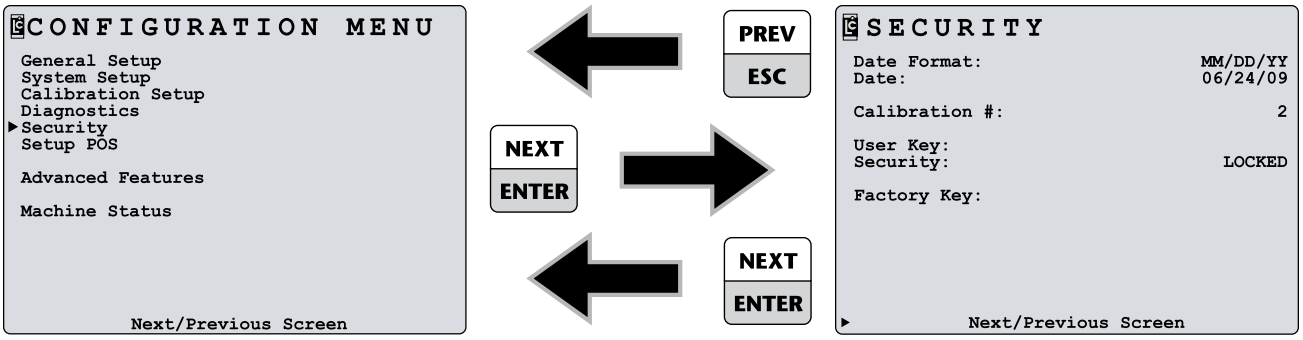


Diagnostics Screen

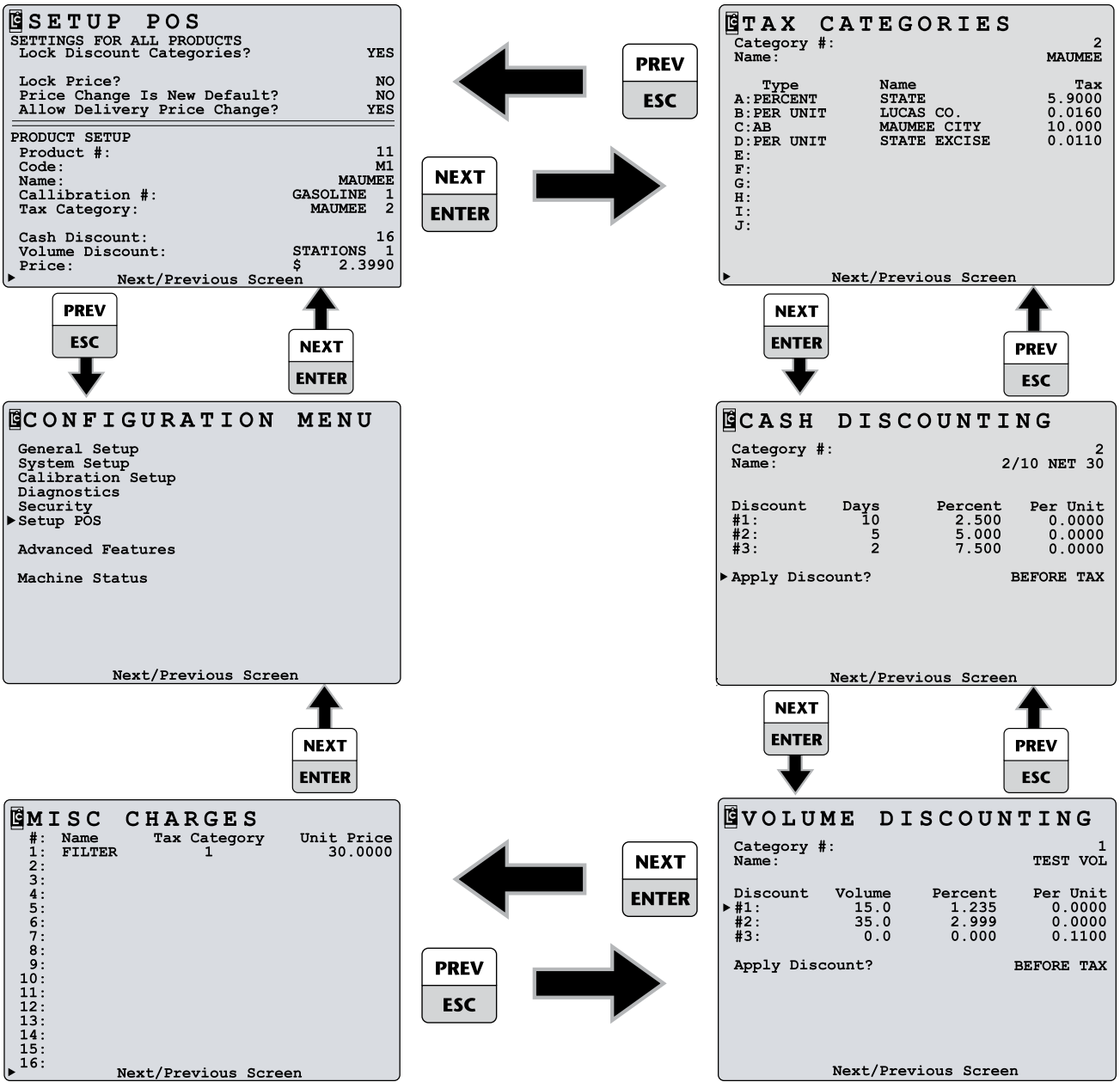


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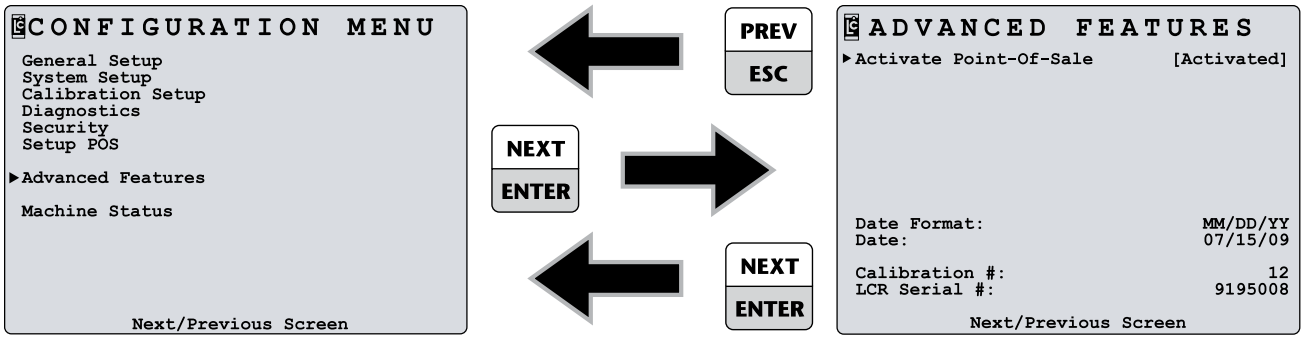
Security Screen



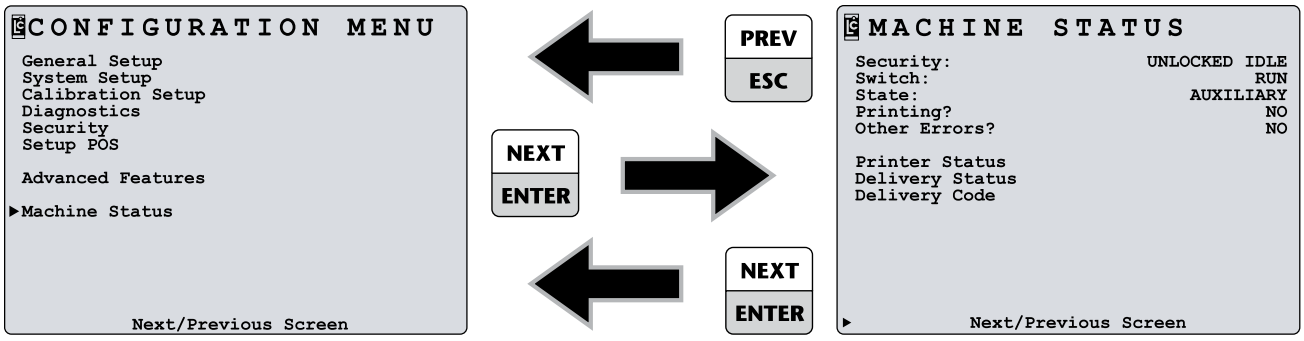
Setup POS Screens



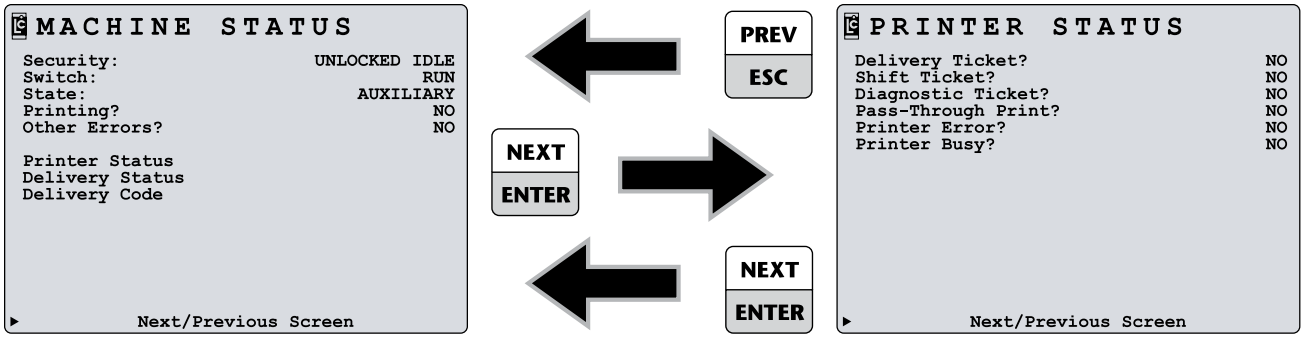
Advanced Features Screen



Machine Status Screen

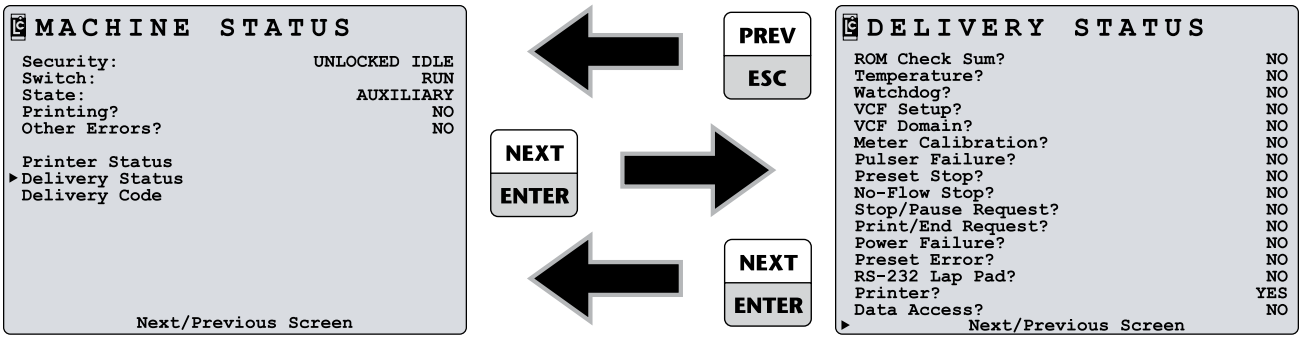


Printer Status Screen

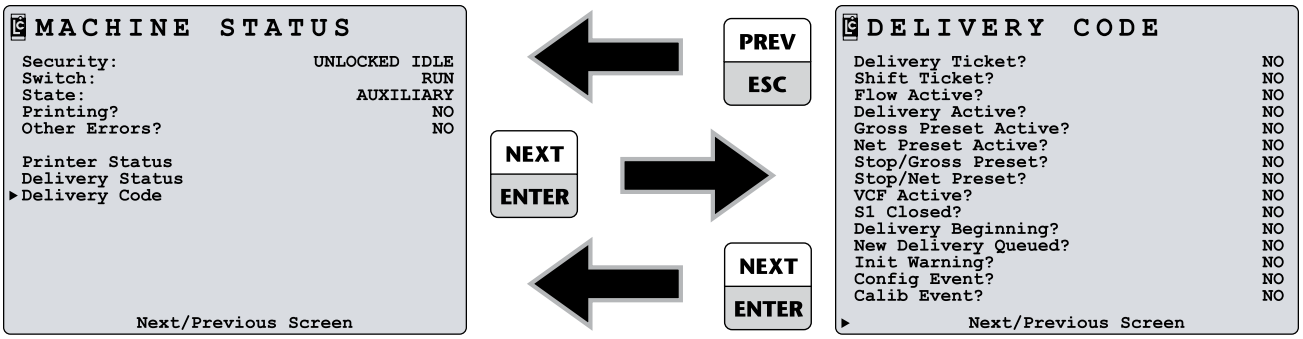


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Delivery Status Screen



Delivery Code Screen



Levels of Security

Many fields listed in the LCR 600 screens are accessible only while certain security levels are in place. The security levels provide the safeguards essential for Weights & Measures approval, and they give owners and operators a means of restricting drivers to certain functions. There are five levels of security on the LCR 600: Locked, Unlocked, Weights & Measures Calibration, Stop/Pause, and Factory.

LOCKED

An owner/office security setting that limits the access of drivers to a small number of delivery, system, and POS fields.

To lock the LCR 600

1. Select the Security screen from the Configuration Menu.
2. Move the pointer ▶ to **`User Key:`** field and press the **ENTER** button.
3. Enter an alphanumeric password in the field edit box and press the **ENTER** button
4. Move the pointer ▶ to the **`Security:`** field and press the **ENTER** button.
5. Move the pointer ▶ to **`Locked`** in the list box and press the **ENTER** button.

UNLOCKED

An owner/office security setting that allows drivers access to a large number delivery, system, and POS fields.

To unlock the LCR 600

1. Select the Security screen from the Configuration Menu.
2. Move the pointer ▶ to **`User Key:`** field and press the **ENTER** button.
3. Enter the same alphanumeric password that was entered when the LCR 600 was locked. The value of the **`Security:`** field will change to **`UNLOCKED`**.

Throughout this manual, the security levels that allow access to a each LCR 600 field is included with the field definition. The abbreviation for each security level is as follows:

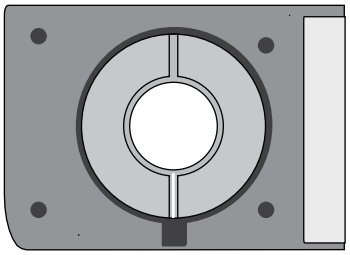
L - Locked
U - Unlocked
C - Weights & Measures Calibration
P - Stop/Pause
F - Factory

WEIGHTS & MEASURES CALIBRATION

The Weights & Measures Calibration security setting allows access to all fields and functions necessary for Weights & Measures approval and the complete configuration of the LCR 600 for service.

To enter the Weights & Measures Calibration mode

1. Remove the faceplate around the red selector switch. If the LCR 600 was Weights & Measures approved beforehand, you will need to remove the lead seal and wire threaded through the switchplate screws.



Six O'clock Calibration Position

2. Turn the selector switch to the six o'clock position.

STOP/PAUSE

During deliveries, there are certain fields that may be edited if the selector switch is turned to the STOP (pause) position, for example, preset and miscellaneous charges fields. After editing a field, the delivery can be continued by turning the selector switch back to RUN.

Active Delivery Status

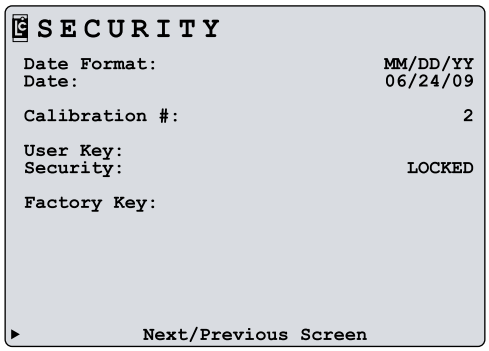
When a delivery is active LCR 600 fields are not editable.

FACTORY

A security setting restricted to LC factory personnel.

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SECURITY



Date Format: (LB) C - U
The format in which the date will be displayed and printed.

MM/DD/YY • DD/MM/YY

Date: (FE) C - U
The date according to the selected date format. Enter two digits for the day or month, a backslash, two digits for the month or day, a backslash, and two digits for the year.

Calibration #: *Display only*
The number of times the calibration switch position has been used.

User Key: (FE) C - U - L
The owner/office password. The password is required to unlock the system in order to gain access to secured menu and data entry fields.

Security: (LB) C - U
Locks and unlocks the system. If the system is locked, access is restricted to Gross Preset, Net Preset, Product Code, Product Code, and No-Flow Timer.

LOCKED • UNLOCKED

Factory Key: (FE) C - U - P - L
The pass key required for factory configurations.

Field Type
FE - Field Edit Box
LB - List Box

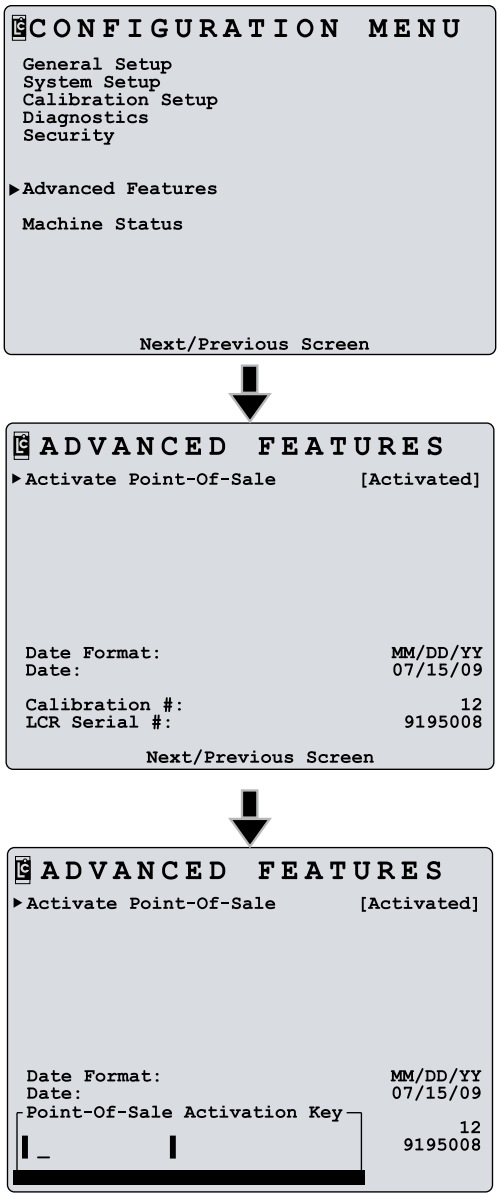
Security Clearance
L - Locked
U - Unlocked
C - Weights & Measures Calibration
P - Stop/Pause
F - Factory

Activating the LCR 600 Point-of-sale (POS)

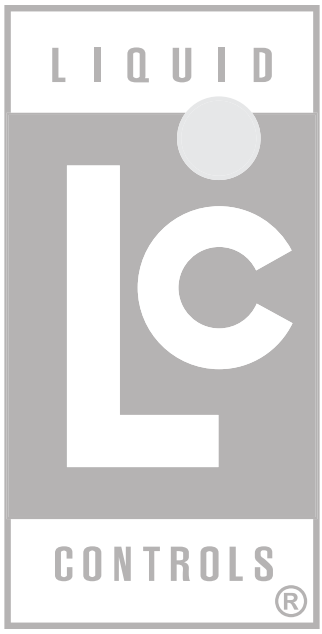
If you ordered the LCR 600 with the POS upgrade, POS was activated in the Liquid Controls factory before shipment. However, the POS upgrade can also be added to a LCR 600 that was shipped without the POS upgrade.

To activate the POS upgrade:

1. Navigate to the Advanced Features screen.
2. Call the Liquid Controls inside sales department at 800-458-5262 and ask for part number SR600POS.
3. Give the representative the values in the **`Date:`**, **`Calibration #:`**, and **`LCR Serial #:`** displayed on the Advanced Features screen. The representative will give you an activation key.
4. Move the pointer ▶ to **`Activate Point-Of-Sale`** and enter the activation key.



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LIQUID
CONTROLS

LCR 600 Setup Overview

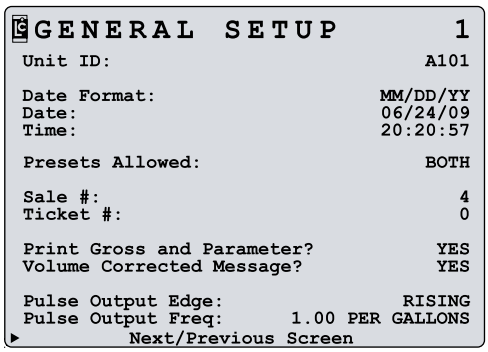
Before using the LCR 600 to deliver fuel, it must be setup to fit its specific application requirements.

A COMPLETE LCR 600 SETUP SHOULD

1. Configure the LCR 600 to all existing input and output components.
2. Calibrate the meter system for Weights and Measures approval.
3. Enter user information and preferences.
4. Enter all data needed to run the LCR 600 POS upgrade (optional).

The simplest and most comprehensive method of accomplishing these four tasks is to go through each field in each setup screen and make the necessary changes. Start with the General Setup and move down the Configuration Menu list through the System Setup, Calibration Setup, and Setup POS screens. The following pages provide an explanation of each field in these screens, calibration instructions, and instructions for setting up the LCR 600 POS.

GENERAL SETUP 1



Unit ID: (FE) C - U
A number used to identify the driver, location, or truck designated to the LCR 600.

Date Format: (LB) C - U
The format in which the date will be displayed and printed.

MM/DD/YY • DD/MM/YY

Date: (FE) C - U
The date in the selected date format. Enter two digits for the day or month, a backslash (or decimal point), two digits for the month or day, a backslash, and two digits for the year.

Time: (FE) C - U
The time of LCR 600's internal clock. The time is kept by the LCR 600 and printed on the delivery tickets. Enter the current hour, minutes, and seconds in military time, for example 13:01:15 for 1:01:15 PM.

Presets Allowed: (LB) C - U - L
Limits or allows preset options in the Delivery Screens.

None disables all presetting

Gross enables only gross presetting

Net enables only net presetting

Both enables gross and net presetting

Sale #: (FE) C
The number of transactions processed by the LCR 600. Any number entered in this field will restart the count and begin at the entered number. 0-999999 range.

Ticket #: (FE) C
The number of tickets printed by the LCR 600, including multiple and duplicate tickets. Any number entered will restart the count and begin at the entered number. 1-999999 range. If a 0 is entered, the ticket # will not print on the delivery ticket and the value will not increment.

Print Gross and Parameter? (LB) C
Determines if the gross volume and compensation parameter—if the product is temperature compensated—is printed on the ticket.

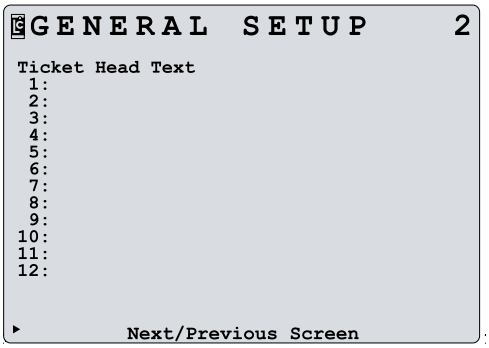
Volume Corrected Message? (LB) C
Determines if the message noting that the delivery volume has been corrected to a base temperature is printed on the ticket, for example "Gallons corrected to 60.0ºF"

Pulse Output Edge: (LB) C
Determines the signal of the calibrated pulse output waveform. Some external components function on rising pulse edges, others on falling pulse edges. Refer to the technical manual of the specific component to determine requirements.

Pulse Output Freq: (FE) C
Determines the frequency of the pulse output per unit of measure sent by the Auxiliary Output 3 on terminal 42 of the J12 terminal block. Common components include external counters and injection systems. The default value is 1.

GENERAL SETUP 2

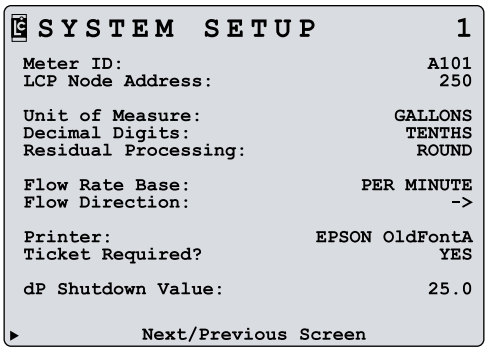
Ticket Header Text: (FE) C - U *(Lines 11 and 12* C *only)*
Supplies 12 lines where you can enter text for the ticket header. Every delivery ticket printed by the LCR 600 will print this text at the top of every ticket.



Field Type
FE - Field Edit Box
LB - List Box

Security Clearance
L - Locked
U - Unlocked
C - Weights & Measures Calibration
P - Stop/Pause
F - Factory

SYSTEM SETUP 1



Meter ID: (FE) C
The identification number of the meter the LCR 600 is mounted on. If the LCR 600 is installed in a multiple-meter system, it is important this number be unique. The number is printed on the calibration/diagnostic ticket. LC recommends entering the meter's serial number to ensure identification.

LCP Node Address: (FE) C - U
Node address used by a host application, like the DMS i1000, to communicate with the LCR 600.

Unit of Measure: (LB) C
The unit of flow measurement.

Gallons • Litres • Cubic M • Lbs (pounds) • Kgs • Barrels • Other

Decimal Digit: (LB) C
The decimal place of volume measurements shown on the display and printed tickets.

Hundredths • Tenths • Whole

Residual Processing: (LB) C
The treatment of excess decimal places when displaying and printing volume measurements

Round according to one half of the least significant digit

Truncate disregards the excess digits

Security Clearance
L - Locked
U - Unlocked
C - Weights & Measures Calibration
P - Stop/Pause
F - Factory

Flow Rate Base: (LB) C
The time unit of the measured flow rate.

Per Second • Per Minute • Per Hour

Flow Direction: (LB) C
The direction of flow through the meter. If the LCR 600 is counting in reverse (decreasing numbers), select the opposite Flow Direction.

<- • ->

Printer: (LB) C
The type of printer connected to the LCR 600.

EPSON NewFontB EPSON 200 Roll and EPSON 220 Roll

EPSON NewFontA EPSON TM-T88iii

EPSON OldFontA EPSON 290 Slip and EPSON 295 Slip

EPSON OldFontB EPSON 300 Roll

OKIDATA ML184T OKIDATA ML184T

BLASTER Cognitive Solutions Thermal Printer.

Field Type
FE - Field Edit Box
LB - List Box

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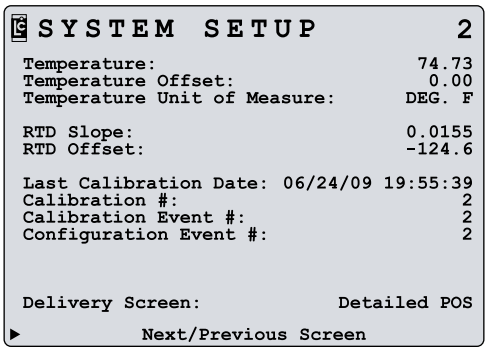
Ticket Required: (LB) C
Determines if the printer is required to be online and ready to print in order to start a delivery. Most Weights & Measures governed truck applications require a ticket.

Yes deliveries disabled unless a ticket is in the printer, the previous delivery ticket is completed, and the printer is operational.

No deliveries enabled without printer. Tickets will print if the printer is online and has paper.

ΔP Shutdown Value: (FE) C
The differential pressure amount that will shut down an active delivery. This feature pertains to meter systems with a differential pressure transducer and requires a shutdown device. If the value is set to 0, the feature is disabled. 0 to 59.9 range.

SYSTEM SETUP 2



Temperature: (FE) C
The current temperature reading of the RTD temperature probe. To calibrate, simply enter the Weights & Measures thermometer reading. If the LCR 600 does not have an ETVC Kit, this field will read "--".

Temperature Offset: (FE) C
The difference between the official Weights & Measures reading and the LCR 600 RTD reading. The offset is automatically calculated if an entry is made in the previous field. ±0.3°C or ±0.54°F range.

Temperature Unit of Measure: (LB) C
The unit of temperature measured, displayed, and printed.

Deg. C • Deg. F

RTD Slope: F
Factory calibration setting only.

RTD Offset: F
Factory calibration setting only.

Last Calibration Date: *Display only*
The date and time of the last calibration.

Calibration #: *Display only*
The number of times the calibration position has been entered. For Weights & Measures use only.

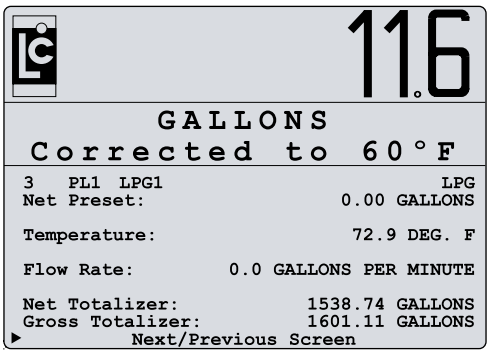
Calibration Event #: *Display only*
The number of times the calibration has been changed. For Weights & Measures use only. Calibration events include the following: Pulses Per Unit (k-Factor) • Linearization Flow Rate • Linearization Percent Error • Activating Linearization

Configuration Event #: *Display only*
The number of times the configuration has been changed. For Weights & Measures use only. Configuration events include the following: Sale Number • Gross Totalizer • Net Totalizer • Product Type • Compensation Type • Compensation Parameter • Base Temperature • Auxiliary Multiplier • Auxiliary Unit of Measure • S1 Close • Temperature Offset • Temperature Scale • Quantity Unit of Measure • Decimal Setting • Flow Rate Unit of Measure • Printer Type • Ticket Required Flag • Flow Direction • Meter ID • Ticket Number • Residual Processing • Print Gross and Parameter Flag • Print Volume Corrected Message Flag

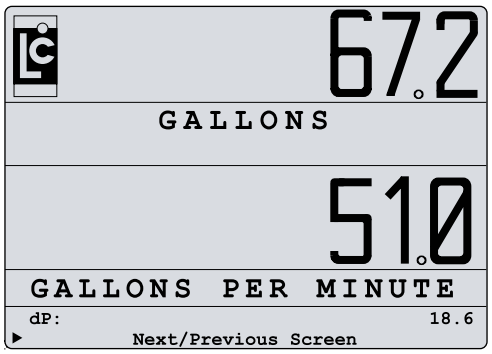
Delivery Screen: (FE) C
The format of the active delivery screen, four predefined. The **Detailed POS** is only available LCR 600 POS upgrade. See the pg. 26 for illustrations.

User Defined • Detailed Pump & Print • Volume and Preset • Aviation • Detailed POS

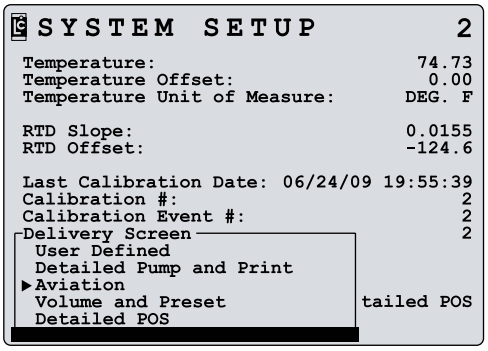
Delivery Screens



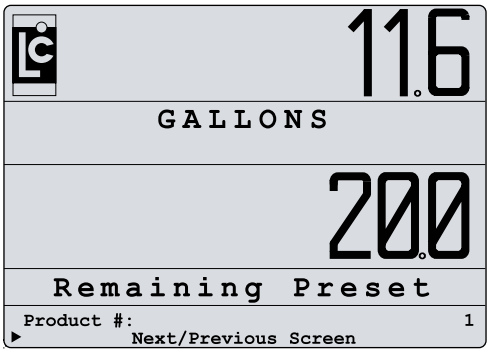
DETAILED PUMP & PRINT



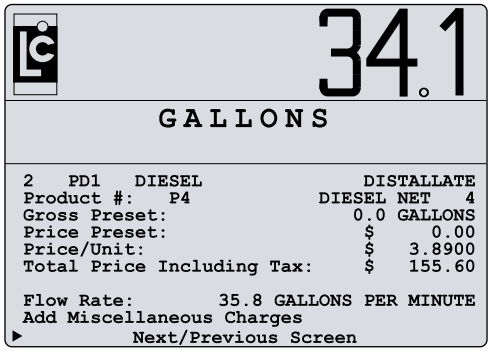
AVIATION



DELIVERY SCREEN LIST BOX



VOLUME AND PRESET



DETAILED POS

Preparing for Calibration

Before the LCR 600 is put into daily operation, the liquid(s) meant to be measured must be defined and proved. The Calibration Setup screens provide the means to do so. The LCR 600 can hold a total of 16 different calibrations. Calibrations must be defined according to type, and they can be named and coded for easy recognition. If the meter system is equipped with electronic temperature volume compensation, Weights & Measures temperature calibration can be made on Calibration Setup screen 2. The Calibration Setup screens also provide a field to set the dwell flow (**S1 Close:**) and to calculate a second volume in an additional unit of measurement (**Auxiliary Multiplier:** and **Auxiliary Unit of Measure:**). To prove the meter, you will use one of the **BEGIN CALIBRATION DELIVERY** fields and the **Pulses/Unit <k-Factor>:** field.

CALIBRATION AND PRODUCT TERMINOLOGY

Previous LectroCount models used the terms **Product Code**, **Product Name**, *and* **Product Type** *for calibration purposes. The LCR 600 has redefined these terms for the POS application and replaced them in the calibration setup with* **Calibration Code**, **Calibration Name**, *and* **Calibration Type**. *The definition of "product" has expanded to include not only calibration characteristics but also pricing and tax information.*

Be Careful

Calibration # *'s can be overwritten and reproved. Don't accidentally overwrite a* **Calibration #** *currently in use.*

The **Unit of Measurement:** *field is on the System Setup 1 screen .*

To setup a calibration for a product (before **proving):**

1. Remove the switchplate and move the selector switch to the calibration position.
2. Navigate to the Calibration Setup 1 screen.
3. Choose a calibration number (1-16) from the **Calibration #:** field.
4. Define the calibration #. Enter the **Calibration Code, Calibration Name,** and **Calibration Type**.
5. Navigate to the Calibration Setup 2 screen.
6. If using electronic temperature volume compensation, enter the correct **Compensation Type**. The **Compensation Parameter** and the **Base Temperature** fields will default to the values listed in the table on page 28. Ensure these values are correct for your application. Change them when necessary.
7. Make sure the hose is packed. *See instructions on page 29*.
8. You are now ready to prove the meter system.

```
CALIBRATION SETUP 1
Calibration #: 4                  GALLONS
Calibration Code:                      P4
Calibration Name:              DIESEL NET

Calibration Type:              DISTALLATE

Linearization Mode:                 SETUP

Pulses/Unit <k-Factor>:           20.0000
Prover Quantity:               00 GALLONS
       BEGIN CALIBRATION DELIVERY

S1 Close                      2.0 GALLONS

Net Totalizer                 0.0 GALLONS
Gross Totalizer             141.7 GALLONS
▸          Next/Previous Screen
```

```
CALIBRATION SETUP 2
Calibration #: 2                  GALLONS

Compensation Type:                TABLE 24
Compensation Parameter:        0.50000000
Base Temperature:                    60.0

Gross Quantity:               11.5 GALLONS
Gross Preset:                  0.0 GALLONS

Temperature:                         74.7
Net Quantity:                        11.2

Auxiliary Multiplier:                4.130
Auxiliary Quantity:                   41.3
Auxiliary Unit of Measure:             LBS

▸          Next/Previous Screen
```

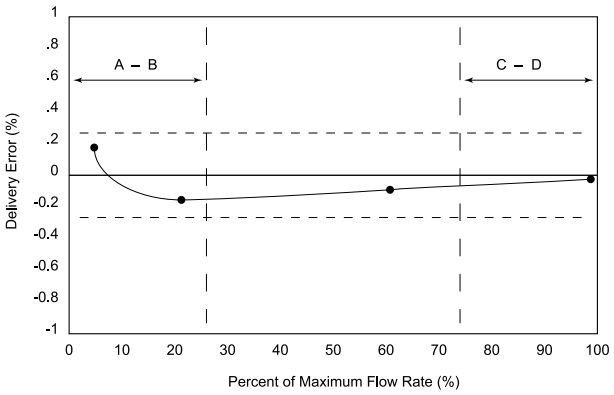
Compensation Types and Parameters

Product	VCF Type	Parameter **Coefficient**	Range	ºCelsius/ ºFahrenheit	Tbase	Tmin	Thold	**Tmax**
General	Linear	Linear	0 to 0.003	ºC	15	-90	N/A	+100
General	Linear	Linear	0 to 0.005	ºF	60	-130	N/A	+212
LPG *USA*	API Table 24	Specific Gravity	0.5 to 0.550	ºF	60	-50	-50	+140
LPG *Europe & Canada*	API Table 54	Density kg/L	0.5 to 0.600	ºC	15	-46	-46	+60
Refined Petroleum Products *Europe & Canada*	API Table 54B	Density kg/m3	653.0 to 1075.0	ºC	15	-50	-40	+95
Refined Petroleum Products *USA*	API Table 6B	API Gravity	0 to 85	ºF	60	-50	-40	+200
General	API Table 54C	Coefficient	0.000486 to 0.001674	ºC	15	-50	-40	+95
Lube Oil *Europe & Canada*	API Table 54B	Density kg/m3	800 to 1164	ºC	15	-50	-40	+95
Ammonia *Canada*	NH3	N/A	N/A	ºC	15	-30	-30	+40

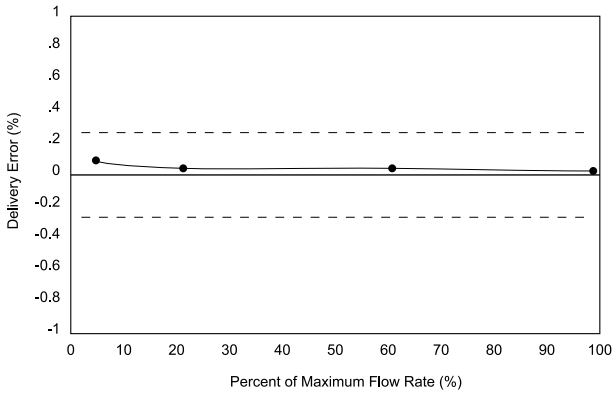
Single Point or Multi-Point Calibration

The LCR 600 provides two means of calibration, single point or multi-point calibration. A “point” corresponds to a particular flow rate along the meter’s accuracy curve. Single point calibration adjusts one point along the accuracy curve to zero percent error—typically at a flow rate representative of a normal delivery. Multi-point calibration zeroes the percent error at multiple flow rates in order to flatten out the accuracy curve across the meter’s range of flow rates. Multi-point calibration is ideal for applications in which deliveries are made at many different flow rates, while single point calibration is appropriate for applications where a high flow rate is typical for most deliveries.

Single Point and Multi-Point Calibration Accuracy Curves



Single Point Calibration Accuracy Curve



Multi-point Calibration Accuracy Curve

Packing the Hose

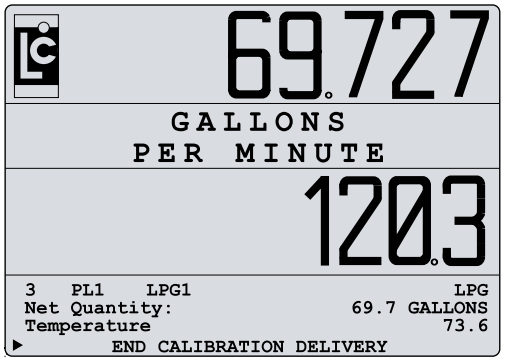
If you are proving the meter with a hose and a nozzle, you will want to make sure the hose is packed before beginning the proving delivery. This will ensure the same shut off point at the beginning and end of the delivery.

To pack the hose:

1. Turn the selector switch to RUN—do not open the hose nozzle. The display will reset and the solenoid will open the valve, packing the hose.
2. When the display has stopped incrementing, the hose is packed.
3. Turn the selector switch to STOP. This will de-energize the solenoid, close the valve, and reset the display.
4. Turn the selector switch to the calibration position and follow the proving instructions.

Single Point Calibration Proving

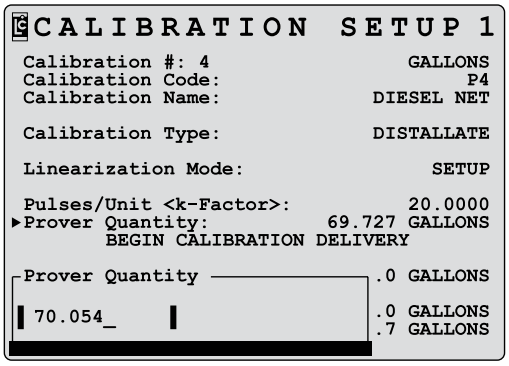
To single point calibrate a product, the LCR 600 must make a delivery into a volumetric prover. The measurement indicated by the volumetric prover is then entered into the LCR 600 to set the k-factor (pulses/unit). The new k-factor establishes the number of pulses the LCR 600's internal pulser registers for each unit of measurement that passes through the meter (for example, 205.8 pulses for every gallon). When proving for use in Weights and Measures applications, a qualified Weights and Measures technician must prove the meter.



Calibration Delivery Screen

Keep Flow Rates Even

Run the calibration delivery at the same flow rate of a typical delivery.



Prover Quantity list box with volumetric prover measurement

To prove a meter system with single point **calibration:**

1. With the selector switch in the calibration position, navigate to the Calibration Setup 1 screen.
2. Select the **Calibration #:** to be proved.
3. Move the pointer ▶ to **Linearization Mode:** and select **Setup**.
4. Enter a k-Factor that approximates the size of the meter being calibrated. *See table on page 30.*
5. Move the pointer ▶ to the **BEGIN CALIBRATION DELIVERY** field.
6. Press the **ENTER** button to begin the calibration delivery into a volumetric prover. A delivery screen will appear that shows the gross volume and flow rate.
7. Move the pointer ▶ to the **END CALIBRATION DELIVERY** field, at the bottom of the calibration delivery screen, and press **ENTER** to end the delivery.
8. Move the pointer ▶ to the **Prover Quantity:** and enter the quantity indicated by the volumetric prover. The LCR 600 will automatically adjust the value in the **Pulses/Unit <k-Factor>** field to the correct value.
9. Repeat step 5 through 8. Check the prover volume and the LCR 600 volume. If they are not within tolerance limits, reprove the meter.

Proving can only be done in gross volume.

Approximate k-Factors

VALUES ARE FOR PROVING USE ONLY. NOT TO BE USED AS ACTUAL K-FACTORS.

LC Meter Size	**Max Flow Rate/Gallon**	Revs / Gallon	Pulses / Gallon	Pulses / Litre
P	60	12.237	4894.8	1293.11
M/MA 5	60	4.079	1631.6	431.04
M/MA 7/10	150	5.555	2222.0	587.01
M/MA 15/25	300	2.058	823.2	217.47
M 30/40	450	0.742	296.8	78.41
M 60/80	800	0.398	159.2	42.06
MS-75	700	0.255	102.0	26.95
MS-120	1200	0.158	63.2	16.70

Multi-Point Calibration Proving

Multi-point calibration improves the overall meter accuracy by flattening out the accuracy curve across flow rates. Although accuracy tends to lessen at lower flow rates, the repeatability of the meter remains consistent. The meter might not be perfectly accurate at low flow rates, but it is inaccurate the same amount each time. Multi-point calibration takes advantage of the steadfast repeatability of a Liquid Controls meter by identifying the amount of inaccuracy and correcting it with a linearizing algorithm during deliveries. In order to apply the linearizing algorithm, the degree of error for points along the accuracy curve must be identified by making a number of deliveries at different flow rates into a volumetric prover. Multi-point calibration is very beneficial for meter systems that experience a wide range of flow rates (for example, trucks that fill tanks of varying sizes) and for meter systems that have recently undergone maintenance or other alterations that could change the accuracy curve itself.

To prove a meter system to a product with multi-**point calibration:**

1. With the selector switch in the calibration position, navigate to the Calibration Setup 1 screen.
2. Use the instructions on the page 29 to run a single point calibration.
3. Navigate to Calibration Setup 3. Move the pointer ▶ to **`Linearization Mode:`** and select **`Setup`**.
4. Move the pointer ▶ to the **`BEGIN CALIBRATION DELIVERY`** field.
5. Press the **ENTER** button to begin the calibration delivery into a volumetric prover. A delivery screen will appear that shows the gross volume and flow rate.
6. To end the delivery, move the pointer ▶ to the **`END CALIBRATION DELIVERY`** field at the bottom of the calibration delivery screen.
7. Move the pointer ▶ to the **`Prover Quantity:`** and enter the quantity indicated by the volumetric prover.
8. The LCR 600 will automatically display a **`Point #:`** list box with the numbers 1-10. Select a number.
9. The LCR 600 will then display a **`Linearization Flow Rate`** field edit box. Enter the flow rate of the proving run. The percent error is calculated automatically.

Multi-Point Calibration Tip

For the first two proving runs, one should be near the maximum flow rate and one near the minimum flow rate of the meter. When choosing flow rates after the initial two proving runs, split the difference until all points are within 0.25% of each other.

Keep Flow Rates Even

Run the first multi-point calibration delivery at the same flow rate used in step 2.

Proving runs are in gross volume only.

PERMIAN GLOBAL, INC. AND MANTICORE FUELS, LLC EXHIBIT 1013, Page 44

Multi-Point Calibration Proving - continued

```
CALIBRATION SETUP 3
 Calibration #: 3                GALLONS

▸Linearization Mode:             APPLIED
 Linearization Prover Qty:         25.12
        BEGIN CALIBRATION DELIVERY
 Point #    Flow Rate       Percent Error
  1:           88.00              -0.030
  2:           11.00              -0.108
  3:           38.00              -0.138
  4:           22.00              -0.171
  5:           30.00              -0.149
  6:           63.00              -0.084
  7:           75.00              -0.055
  8:            0.00               0.000
  9:            0.00               0.000
 10:            0.00               0.000
          Next/Previous Screen
```

To prove a meter system to a product with multi-**point calibration:**

10. Repeat steps 4 through 10 using a new flow rate for the next **`Point #:`** until all the points between the lowest flow rate and the maximum flow rate are within 0.25% of each other.
11. Navigate to Calibration Setup 1. Move the pointer ▶ to **`Linearization Mode:`** and select **`Applied`**.

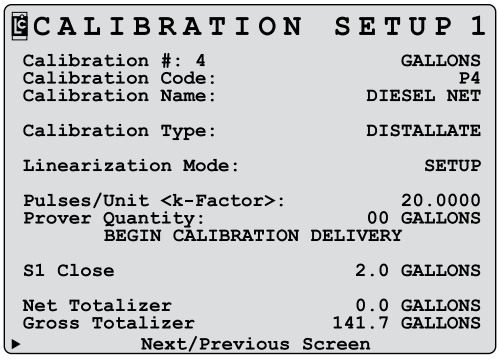
The LCR 600 will not allow you to enter the **`Applied`** *setting of the* **`Linearization Mode:`** *until all adjacent calibration points are within 0.25% of each other.*

```
LCR-600: 60011
Adjacent linearization points out of
0.25% range.
```

The linearization points on Calibration Setup 3 will automatically sort by flow rate after the **`Applied`** *setting is selected.*

CALIBRATION SETUP 1

Calibration #: (LB) C - U - L
The active calibration of four possible calibrations (16 calibrations possible with POS upgrade). The fields shown on the Calibration Setup 1 screen represent the values of the Calibration # shown. Any edits made to the fields are attributed to the calibration # shown.



Calibration Code: (FE) C - U
The code assigned to the active calibration. This code can be used to correspond with an office code.

Calibration Name: (FE) C - U
The text designation of the active calibration.

Calibration Type: (LB) C
The type of product of the active calibration.

Ammonia • Aviation • Distillate • Gasoline • Methanol • LPG • Lube Oil • blank

Linearization Mode: (LB) C
Disables and enables single and multi-point calibration.

Setup allows the setting of single and multi-point calibration. Disables single and multi-point calibration settings in deliveries.

Applied enables multi-point calibration settings in delivery .

Pulses/Unit <k-Factor>: (FE) C
The number of pulse edges per unit of measure. Applies only to gross volume. This number scales the prover quantity. A unit of 20.0000 is entered on all factory shipments. Changing the k-factor moves the entire meter accuracy curve either up or down.

Prover Quantity: (FE) C
The metered volume of the prover after a calibration delivery. When the prover volume is entered, the LCR 600 adjusts the k-factor to calibrate the pulses/unit. See calibration instructions.

BEGIN CALIBRATION DELIVERY
Starts a calibration delivery.

S1 Close: (FE) C
The point during a preset delivery when the valve switches from full flow to a dwell flow. The value is set according volume units remaining in the delivery. 0 to 500 range.

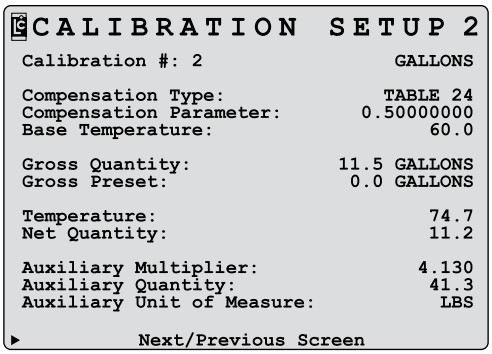
Net Totalizer: C
Net volume delivered by the LCR 600. In the calibration position, the field can be set to any positive value. The value resets after a clear all.

Gross Totalizer: C
Gross volume delivered by the LCR 600. In the calibration position, the field can be set to any positive value. The value resets after a clear all.

Security Clearance
L - Locked
U - Unlocked
C - Weights & Measures Calibration
P - Stop/Pause
F - Factory

Field Type
FE - Field Edit Box
LB - List Box

CALIBRATION SETUP 2



Calibration #: (LB) C - U - L
The active calibration of four possible calibrations (16 calibrations possible with POS upgrade). The fields shown on the Calibration Setup 1 screen represent the values of the **Calibration #** shown. Any edits made to the fields are attributed to the **Calibration #** shown.

Compensation Type: (LB) C
The type of temperature volume compensation applied to the active **Calibration #**. Refer to the Compensation Types and Parameters table on page 28 to find the correct compensation. If **NONE** is selected, deliveries will be in gross quantities only.

Linear F • Linear C • API Table 24 • API Table 54 • API Table 6B • API Table 54B • API Table 54C • API Table 54D • NH3 • NONE

Compensation Parameter: (FE) C
The coefficient of expansion, the standard density, API gravity, or the specific gravity applied to the **Compensation Type**. This field has default values that are set when **Compensation Type** changes. Ensure the default value is correct. Refer to the Compensation Types and Parameters table on page 30 for ranges.

Base Temperature: (FE) C
The base temperature for temperature compensated deliveries. Although this field is editable for some **Compensation Type** values, it defaults to 60°F or 15°C according to the selected **Compensation Type**.

Gross Quantity: *Display only*
The gross volume of the latest calibration delivery.

Gross Preset: (FE) C - U - L - P
The gross preset for the next calibration delivery.

Temperature: *Display only*
The current temperature reading of the RTD temperature probe.

Net Quantity: *Display only*
The net volume of the latest calibration delivery.

Auxiliary Multiplier: (FE) C
The factor used to convert the measured volume of a delivery to an alternate volume or mass unit. If this field is 0, it will not print on the delivery ticket. Users must furnish a conversion factor.

EXAMPLE Auxiliary Multiplier = (SpGr) x (8.345 lbs/gal)
SpGr = *specific gravity*

Auxiliary Quantity: (FE) C
The alternate volume or mass delivered using the **Auxiliary Multiplier**.

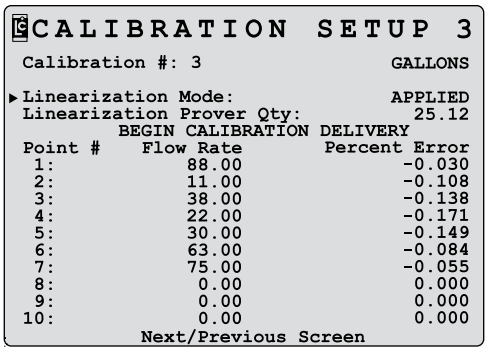
Auxiliary Unit of Measure: (LB) C
The auxiliary unit of measure printed on the delivery ticket.

Gallons • Litres • Cubic M • LBS • KGS • Barrels • Other

Security Clearance
L - Locked
U - Unlocked
C - Weights & Measures Calibration
P - Stop/Pause
F - Factory

Field Type
FE - Field Edit Box
LB - List Box

CALIBRATION SETUP 3



Calibration #: (LB) C - U - L
The active calibration of four possible calibrations (16 calibrations possible with POS upgrade). The fields shown on the Calibration Setup 1 screen represent the values of the **Calibration #** shown. Any edits made to the fields are attributed to the **Calibration #** shown.

Linearization Mode: (LB) C
Disables and enables multi-point calibration.

Setup disables multi-point calibration during normal deliveries. Used when proving and setting multi-point calibrations.

Applied enables multi-point calibration.

Linearization Prover Qty: (FE) C
The metered volume of the prover after a calibration delivery. When the prover volume is entered, the LCR 600 will prompt you to select a linearization point number and a flow rate. After these values are entered, the LCR 600 will assign the error accordingly. See calibration instructions.

BEGIN CALIBRATION DELIVERY
Starts a calibration delivery.

Point #: (FE) C
The fields under **Point #:** are used to calibrate the meter/register at up to 10 different flow rates for each product type/calibration.

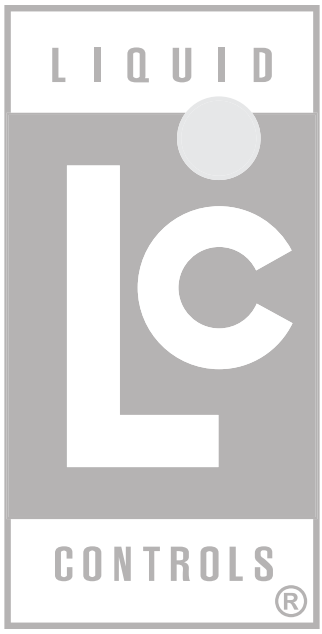
Flow Rate: (FE) C
The flow rate at which the calibration point was measured.

Percent Error: (FE) C
This field contains the percent difference between the register volume and the prover volume.

Percent Error = [(Prover Qty. - Meter Qty.) ÷ Prover Qty.] x 100

Field Type
FE - Field Edit Box
LB - List Box

Security Clearance
L - Locked
U - Unlocked
C - Weights & Measures Calibration
P - Stop/Pause
F - Factory


LIQUID
CONTROLS

Point-of-Sale (POS) Overview

The LCR 600 POS upgrade enables the LCR 600 to deliver fuel and print delivery tickets with prices, taxes, and discounts. At the delivery site, drivers can add miscellaneous charges to the delivery total, make preset deliveries according to price, and print a priced delivery ticket. To do this, prices, discounts, taxes, and charges need to be loaded into the LCR 600. Once these are loaded, they can be combined into “products”. “Products” are created to match the needs of your customers. Since customers require, for example, different tax structures, a “product” can be created that suits any type of customer you have. The LCR 600 can hold up to 100 “product” configurations.

CALIBRATION AND PRODUCT TERMINOLOGY

Previous LectroCount models used the terms **`Product Code`**, **`Product Name`**, *and* **`Product Type`** *for calibration purposes. The LCR 600 has redefined these terms for the POS application and replaced them in the calibration setup with* **`Calibration Code`**, **`Calibration Name`**, *and* **`Calibration Type`**. *A “product” on the LCR 600 is the combination of a price, a tax, discounts, and a calibration.*

POS SETUP OVERVIEW

The LCR 600 POS was designed to be flexible during setup and easy to use at the delivery site. When a driver reaches a delivery site, he simply selects the preprogrammed “product” that matches that customer’s price, tax, and discount requirements. After delivering the customer’s fuel, the LCR 600 prints a perfectly priced ticket. A copy of the ticket can be given to the customer and another copy can be held for the drivers delivery records.

In the LCR 600 POS, a “product” is the combination of a calibration, a tax structure, a cash discount, a volume discount, and a price. Often, a specific combination of these characteristics will apply to more than one customer; therefore, a driver can use one preprogrammed product for many customers. Before the products can be programmed, four of the five characteristics—calibration, tax category, cash discount, an volume discount—must be programmed. 16 structures can be programmed for each characteristic. Tax structure, cash and volume discounts, and additional charges are programmed in the Setup POS screens. Calibrations are defined in the Calibration Setup screens. The price is entered alphanumerically in the Setup POS screen. LCR 600 POS also provides a Miscellaneous Charges screen where any additional products or services can be loaded into the LCR 600. Drivers can add any of these products or services to the delivery ticket during delivery.



For typical deliveries, drivers will select the correct POS product for the customer, begin the delivery, add any miscellaneous charges, finish the delivery, and give a copy of the priced and taxed ticket to the customer. Certain LCR 600 security settings (at the top of the Setup POS screen) allow drivers to edit the price and discounts of the product; however, the taxing and calibration characteristics of the product can only be changed in the Setup POS screens.

PERMIAN GLOBAL, INC. AND MANTICORE FUELS, LLC EXHIBIT 1013, Page 50

Tax Categories

You can setup 16 different tax categories (or tax structures) in the LCR 600 POS. Each tax category has ten blank lines where you can enter taxes and build a tax structure. The LCR 600 will apply a tax as either a percent of the delivery total, a numerical quantity applied per unit delivered, or a percent tax on other taxes. When a tax category is completed, it can be added to a product in the Setup POS screen, and when that product is selected for a delivery, the LCR 600 will apply the tax category to the delivery total and print a short summary of the taxation on the delivery ticket.

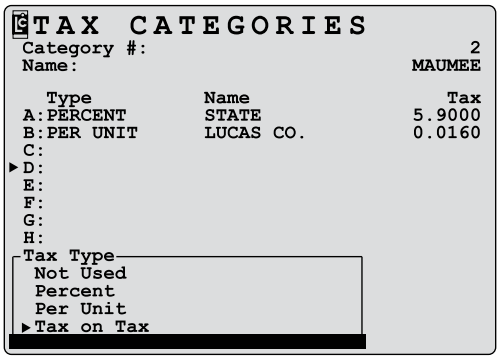
Be careful. **Category** *#s can be overwritten. Don't accidentally overwrite a* **Category** *# currently in use.*

To setup a tax category:

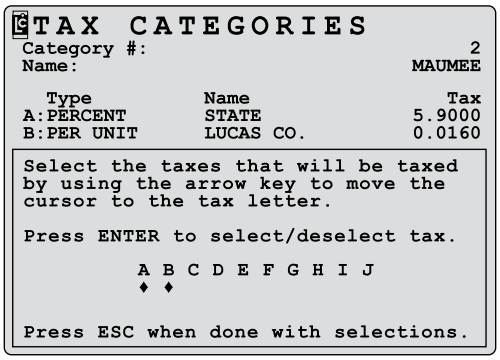
1. Navigate to the Tax Categories screen in the Setup POS application.
2. Select a category number (1-16) from the **Category #:** field.
3. Enter a name for the category number in the **Name**: field.
4. Move the pointer ▶ to **A:** field and press enter. The LCR 600 will bring up the **Tax Type** list box (followed by the **Tax Header Text** field edit box and the **Tax Value** field edit box).
5. Select the tax type from the **Tax Type** list box. The LCR 600 will then bring up the **Tax Header Text** field edit box.

5a. If **Tax on Tax** is selected from the **Tax Type** list box, a window will appear on the screen asking you to select which taxes should receive the **Tax on Tax**. The letter of the fields receiving the will be displayed in the **Type** column.

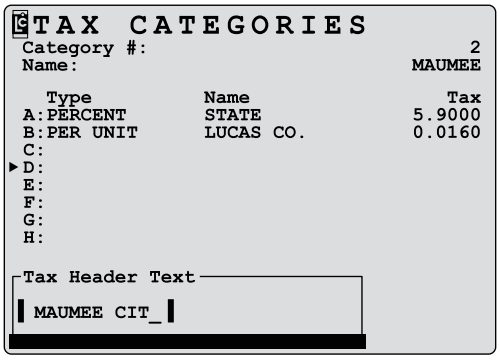
6. Enter a name for the tax type in the **Tax Header Text**. The LCR 600 will then bring up the **Tax Value** field edit box.
7. Enter the value of the tax in the **Tax Value** field edit box.
8. Move the pointer ▶ to **B:** and press enter. Repeat steps 5 to 7.
9. Complete the lettered fields until you have built your entire tax structure.



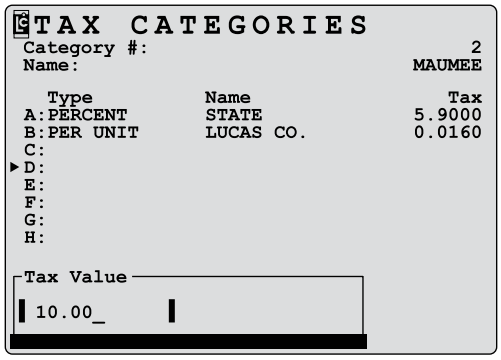
Tax Type List Box



Tax on Tax - Application to Other Taxes



Tax Header Text Field Edit Box



Tax Value List Box

TAX TYPES

Not Used typically used to erase an existing tax line item.
Percent a percentage, the **Tax Value**, of the delivery subtotal added to the total.
Per Unit a fixed amount, the **Tax Value**, charged per unit of delivered product.
Tax on Tax a percentage, the **Tax Value**, of the delivery subtotal and other selected taxes added to the total.

TAX CATEGORIES

Category #: (LB) C - U - L
The active tax category number. Enter an unused number to create a new tax category or the number of an existing tax category to edit.

Name: (FE) C - U
The name or description of the selected tax category.

Type: (Tax Type) (FE) C - U
The type of tax to apply to the tax value. There are four options:

Not Used typically used to erase an existing tax line item.

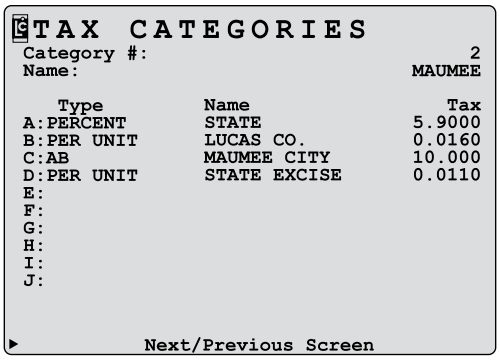
Percent a percentage, the **Tax Value**, of the delivery subtotal added to the total.

Per Unit a fixed amount, the **Tax Value**, charged per unit of delivered product.

Tax on Tax a percentage, the **Tax Value**, of the delivery subtotal and other selected taxes added to the total.

Name: (Tax Header Text) (FE) C - U
A name or description of the type of tax.

Tax: (Tax Value) (FE) C - U
The value applied according to the type of tax.



Security Clearance
- L - Locked
- U - Unlocked
- C - Weights & Measures Calibration
- P - Stop/Pause
- F - Factory

Field Type
- **FE - Field Edit Box**
- **LB - List Box**

PURCHASE QTY			171.45	GALLONS
SUBTOTAL	@	2.3990	$ 411.91	
STATE	:	5.9000%	$ 24.30	
LUCAS CO.	:	0.0160	$ 2.75	
CITY	:	10.0000%	$ 43.90	
STATE EXCISE	:	0.0110	$ 1.89	

Tax Section of Delivery Ticket

Cash Discounting

Like the tax categories, the LCR 600 has 16 different cash discounting categories where discounts based on early payment can be outlined. Each cash discounting category has three blank lines where an early payment time period (entered as days from delivery) and a discount (entered as either a percentage of the delivery or a dollar amount per unit) can be entered. When the cash discounting category is completed, it can be added to a product, and when that product is selected for a delivery, the LCR 600 will calculate the discounted price and print them on the delivery ticket.

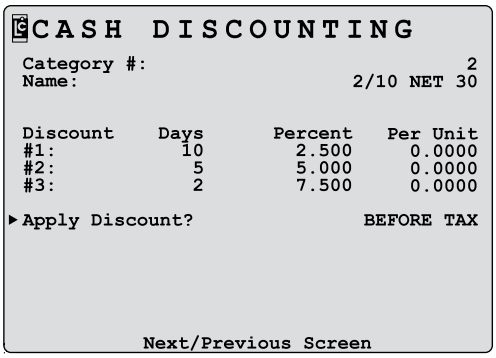
To setup cash discounting:

1. Navigate to the Cash Discounting screen in the Setup POS application.
2. Select a category number (1-16) from the **Category #:** field.
3. Name the cash discount in the **Name:** field.
4. Move the pointer ▶ to the **#1:** field and press enter. The LCR 600 will bring up the **Cash Discount Days** field edit box. Enter the number of days after the delivery the discount will remain valid.
5. The LCR 600 will then bring up the **Percent Cash Discount** field edit box. If you want to offer a discount based on a percentage of the total delivery charge, enter the percentage.
6. The LCR 600 will then bring up the **Per Unit Cash Discount** field edit box. If you want to offer a discount based on a per unit of the total delivery volume, enter the amount.
7. Move the pointer ▶ to the **#2:** and/or the **#3:** field and press enter. Repeat steps 4 to 6, if you want to offer additional discounts for longer or shorter periods of time.
8. Move the pointer ▶ to the **Apply Discount** field and select **After Tax** or **Before Tax**.

Be careful. **Category** *#s can be overwritten. Don't accidentally overwrite a* **Category** *# currently in use.*

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CASH DISCOUNTING



Category #: (LB) C - U - L
The active cash discount category number. Enter an unused number to create a new cash discount or the number of an existing cash discount category to edit.

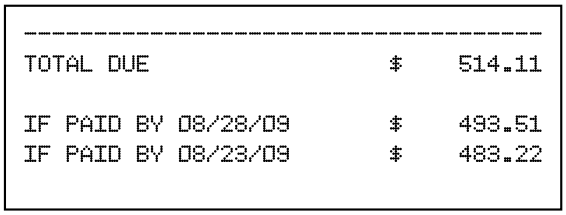
Name: (FE) C - U
The name or description of the selected cash discount category.

Discount: *Display Only*
One of three available levels of cash discounts.

Days: (FE) C - U
The maximum number of days after delivery in which the percent or per unit discount is valid.

Percent: (FE) C - U
The discount, if paid within the allotted days, in percentage of the subtotal.

Per Unit: (FE) C - U
The discount, if paid within the allotted days, in per unit of the volume.



Cash Discount Section of Delivery Ticket

Apply Discount?: (LB) C - U
Determines when the discount value is applied: **BEFORE TAX** or **AFTER TAX.**

Field Type
FE - Field Edit Box
LB - List Box

Security Clearance
L - Locked
U - Unlocked
C - Weights & Measures Calibration
P - Stop/Pause
F - Factory

Volume Discounting

The LCR 600 has 16 different volume discounting categories where discounts based on the delivery volume can be outlined. Each volume discounting category has three blank lines where a volume and a discount (entered as either a percentage of the delivery or a cash amount per unit) can be entered. When the volume discounting category is completed, it can be added to a product, and when that product is selected for a delivery, the LCR 600 will calculate the discounted prices and print them on the delivery ticket.

To setup volume discounting:

1. Navigate to the Volume Discounting screen in the Setup POS application.
2. Select a category number (1-16) from the **Category #:** field.
3. Name the volume discount in the **Name:** field.
4. Move the pointer ▶ to the **#1:** field and press enter. The LCR 600 will bring up the **Discount Volume** field edit box. Enter the delivery volume needed to obtain the discount.
5. The LCR 600 will then bring up the **Percent Volume Discount** field edit box. If you want to offer the discount as a percentage of the total delivery charge, enter the percentage.
6. The LCR 600 will then bring up the **Per Unit Volume Discount** field edit box. If you want to offer the discount as a cash amount per unit of the delivery volume, enter the amount.
7. Move the pointer ▶ to the **#2:** and/or the **#3:** field and press enter. Repeat steps 4 to 6 if you want to offer additional discounts for larger or smaller volumes.

Be careful. **Category** *#s can be overwritten. Don't accidentally overwrite a* **Category** *# currently in use.*

VOLUME DISCOUNTING

Category #: (LB) C - U - L
The active volume discount category number. Enter an unused number to create a new cash discount or an existing volume discount category number to edit.

Name: (FE) C - U
The name or description of the selected cash discount category.

Discount: *Display Only*
One of three available levels of volume discounts.

Volume: (FE) C - U
The minimum volume necessary to receive the percent or per unit discount.

Percent: (FE) C - U
The discount, if paid within the allotted days, in percentage of the subtotal.

Per Unit: (FE) C - U
The discount, if paid within the allotted days, in per unit of the volume.

Apply Discount?: (LB) C - U
Determines when the discount value is applied: **BEFORE TAX** or **AFTER TAX.**

```
VOLUME DISCOUNTING
 Category #:                          1
 Name:                        TEST VOL

 Discount   Volume     Percent    Per Unit
▸#1:          15.0       1.235      0.0000
 #2:          35.0       2.999      0.0000
 #3:           0.0       0.000      0.1100

 Apply Discount?            BEFORE TAX

          Next/Previous Screen
```

Field Type
FE - Field Edit Box
LB - List Box

Security Clearance
L - Locked
U - Unlocked
C - Weights & Measures Calibration
P - Stop/Pause
F - Factory

```
STATE EXCISE : 0.0110    $      1.89
VOLUME DISCOUNT          $     -3.09
-------------------------------------
```

Volume Discount Section of Delivery Ticket

Miscellaneous Charges

The Miscellaneous Charges screen is a list of any additional services or products your company offers. There are 16 possible miscellaneous charges that can be programmed into the LCR 600 POS. Drivers can select the charges from the list during deliveries, and the LCR 600 will add the charge to the delivery total and print each miscellaneous charge onto the delivery ticket.

```
-------------------------------------
  1 FILTER  @   30.0000   $     30.00
  1 LATE DEL@   75.0000   $     75.00
                     TAX $      8.57
-------------------------------------
```

Miscellaneous Charges Section of Delivery Ticket

To create a miscellaneous charge:

1. Navigate to the Misc Charges screen in the Setup POS application.
2. Move the pointer ▶ to the a blank field and press **ENTER**. The LCR 600 will bring up the **Misc Charge Name** field edit box. Enter the name of the charge. *Only eight characters are allowed, so you might need to abbreviate.*
3. The LCR 600 will then bring up the **Misc Charge Tax Category** list box. Select the tax category that applies to the charge.
4. The LCR 600 will then bring up the **Misc Charge Unit Price** field edit box. Enter the amount of the product or service.
5. Move the pointer ▶ to other blank fields and repeat steps 2 to 4 until all possible miscellaneous charges are on the list.

```
DELIVERY SETUP      1
 Gross Quantity:          34.1 GALLONS
 2  PD1   DIESEL NET       DISTALLATE
 Product #:   PD4       DIESEL NET   4
 Gross Preset:             0.0 GALLONS
 Price Preset              $     0.00
 Price/Unit:               $   3.8900
 Tax Code:                    DARK CO.
 Volume Discount:                    1
 Cash Discount:          EARLY PAYMENT

 Auxiliary 1 Output:  ON DURING DELIVERY
 Auxiliary 2 Output:   FLOW DIRECTION
 Toggle Flow Rate:                 0.0
 Preset Type:                    CLEAR
 No-Flow Timer:                    180
 Add Miscellaneous Charges
▸          Next/Previous Screen
```

```
                          34.1
                       GALLONS
 2   PD1   DIESEL          DISTALLATE
 Product #:   P4       DIESEL NET   4
 Gross Preset:             0.0 GALLONS
 Price Preset:             $     0.00
 Price/Unit:               $   3.8900
 Total Price Including Tax:  $ 155.60

 Flow Rate:      35.8 GALLONS PER MINUTE
 Add Miscellaneous Charges
▸          Next/Previous Screen
```

Add Miscellaneous Charges at the Bottom of Delivery Setup 1 and the POS Delivery Screen

PERMIAN GLOBAL, INC. AND MANTICORE FUELS, LLC EXHIBIT 1013, Page 54

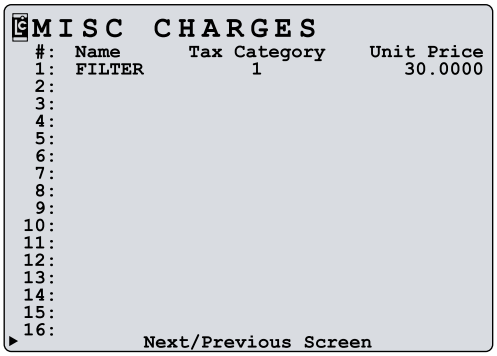
MISC CHARGES

Name: (FE) C - U
The name or description of the selected cash discount category.

Tax Category: (LB) C - U
The tax category applied to the miscellaneous charge. Choices include tax categories 1 through 16, no tax, same tax as product.

1 through **16** • **None** • **Same as Product**

Unit Price: (FE) C - U
The price per unit of the miscellaneous charge.



Setup POS (Creating Products)

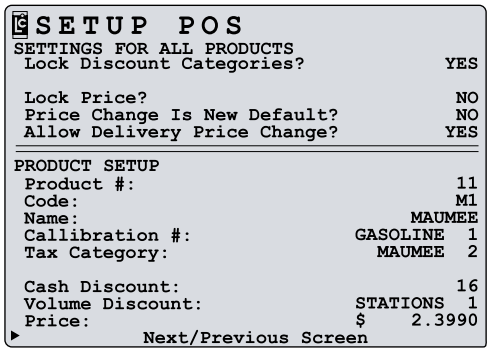
After the tax structures and discounts are entered, you can begin creating products. A product is a unique combination of a calibration, a tax structure, a volume discount, a cash discount, and a price. On the setup POS screen, under **PRODUCT SETUP**, the fields below the double line allow you to name the product and assign a calibration a tax structure, discounts, and a price. The LCR 600 provides for 100 different products. All 100 products are all available for selection in the delivery screens.

To create a product:

1. Move the pointer ▶ to the **Product #:** field and press **ENTER**. Enter a number between 1-100. Make sure the number has not been used for a previous product.
2. Move the pointer ▶ to the **Code**: field and press **ENTER**. Enter a code unique to this product.
3. Move the pointer ▶ to the **Name**: field and press **ENTER**. Enter a name unique to the product.
4. Move the pointer ▶ to the **Calibration #**: field and press **ENTER**. Enter the number of the calibration used to prove the product.
5. Move the pointer ▶ to the **Tax Category**: field and press **ENTER**. Select one of the preset tax categories for the product.
6. Move the pointer ▶ to the **Cash Discount**: field and press **ENTER**. Select one of the preset cash discounts for the product.
7. Move the pointer ▶ to the **Volume Discount**: field and press **ENTER**. Select one of the preset volume discounts for the product.
8. Move the pointer ▶ to the **Price**: field and press **ENTER**. Enter the price of the product.

Be careful. **Product** *#s can be overwritten. Don't accidentally overwrite a* **Product** *# currently in use.*

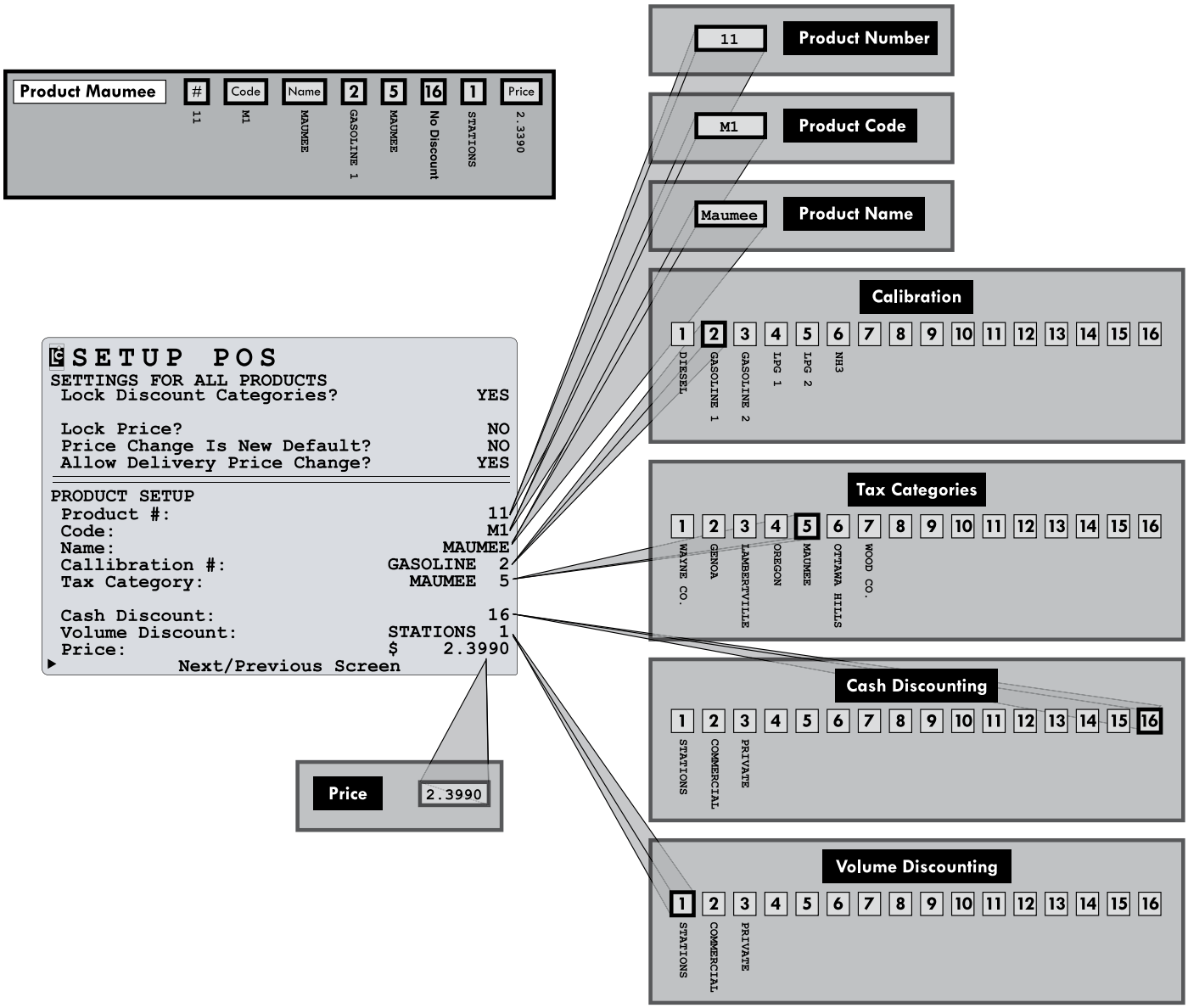
Code *#s are often the same as codes employed by company's office records.*



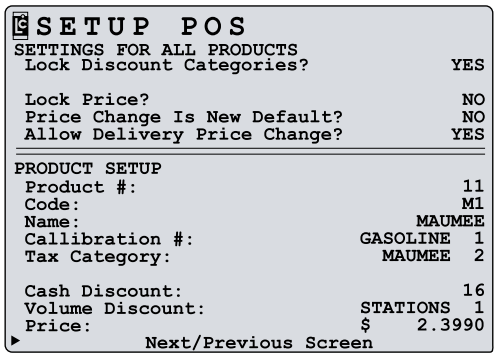
No Discounts?

If you don't want to apply a cash discount, volume discount or a tax structures to a product, select a number that has not been programmed with a discount or a tax. See Cash Discounting on page 44.

Setup POS (Creating Products)



SETUP POS



Lock Discount Categories?: (LB) C - U
Allows or prevents access to the **Volume Discount:** and **Tax Discount:** fields in the POS Delivery Setup 1 screen. If **NO** is selected, the fields default to the values assigned to the product in Setup POS.

Lock Price?: (LB) C - U
Allows or prevents access to the **Price:** field in the POS Delivery Setup 1 screen. If **NO** is selected, the field defaults to the value assigned to the product in Setup POS.

Price Change Is New Default?: (LB) C - U
If **YES** is selected, any price change in the POS Delivery Setup 1 screen will become the default price for all subsequent deliveries. If **NO** is selected, the default price will revert to the value assigned in Setup POS. The **Lock Price?:** setting must be **NO** to activate this setting.

Allow Delivery Price Change?: (LB) C
Allows or prevents a price change while a delivery is active. If **YES** is selected, operators can change the price by turning the selector switch to STOP and changing the value in the **Price:** field. This is not allowed in most regions. Consult your local authorities for regulations.

Product #: (FE) C - U - L
The active product number. Enter an unused number to create a new product or an existing product number to edit.

Code: (FE) C - U
The code of the active product number.

Name: (FE) C - U
The name of the active product number.

Calibration #: (LB) C - U
The calibration selected for the active product number.

Tax Category: (LB) C - U
The tax category selected for the active product number.

Cash Discount: (LB) C - U
The cash discount selected for the active product number.

Volume Discount: (LB) C - U
The volume discount selected for the active product number.

Price: (FE) C - U
The price for the active product number.

Security Clearance
- L - Locked
- U - Unlocked
- C - Weights & Measures Calibration
- P - Stop/Pause
- F - Factory

Field Type
- **FE - Field Edit Box**
- **LB - List Box**

Operation Overview

After setting up the LCR 600 to your specifications, the selector switch faceplate must be fastened and sealed before the LCR 600 is ready for everyday use. While the faceplate is on, the calibration position is not accessible. Still, the LCR 600 can perform all necessary delivery functions including: beginning deliveries, pausing deliveries, ending and printing delivery tickets, setting and making preset deliveries, printing duplicate tickets, printing diagnostic tickets, ending shifts, and printing shift tickets.

Making a Delivery

Making a delivery with the LCR 600 is a simple matter of turning the selector switch to RUN, taking the nozzle to the fueling point, and filling the tank. When the selector switch is turned to RUN, the LCR 600 opens the control valve, product flows through the meter (if the system pump is on), and the LCR 600 displays the delivery volume as it increases. When the delivery is completed, turn the switch to PRINT to print the delivery ticket and close the control valve. If you have an Epson slip printer, make sure the printer has a new delivery ticket loaded in the printer for each delivery. Epson roll printers do not require paper replacement until the paper roll runs out.

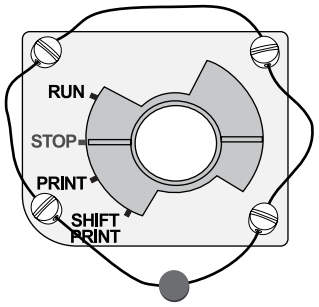
The LCR 600 will not begin a delivery without a ticket engaged in the slip printer.

To make a delivery with an Epson slip printer:

1. Press RELEASE on the printer. Insert a blank delivery ticket.
2. Press FORWARD on the printer to engage the ticket.
3. Turn the LCR 600 selector switch to RUN.
4. Take the nozzle to the fueling point and fill the tank.
5. Turn the LCR 600 selector switch to PRINT to print a delivery ticket.
6. When the ticket finishes printing, press RELEASE on the printer. Remove the ticket.
7. Insert a blank delivery ticket and press FORWARD on the printer to engage the new ticket

To make a delivery with an Epson roll printer:

1. Check for paper in the roll printer.
2. Turn the LCR 600 selector switch to RUN.
4. Take the nozzle to the fueling point and fill the tank.
5. Turn the LCR 600 selector switch to PRINT to print a record of the delivery.



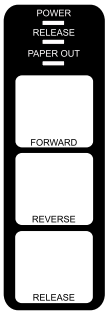
POSITIONS ON THE SELECTOR SWITCH

RUN - opens the control valve to begin a delivery

STOP - closes the control valve to pause a delivery

PRINT - ends a delivery and prints a delivery ticket

SHIFT PRINT - ends a shift, prints a shift ticket, and resets shift data in the LCR 600



SLIP PRINTER BUTTONS AND INDICATOR LIGHTS

POWER *light* - light indicates power is on

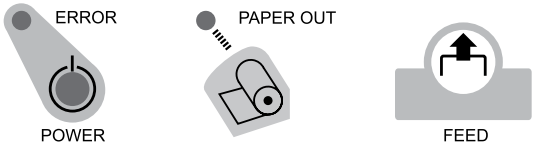
RELEASE *light*- light indicates ticket can be removed

PAPER OUT *light*- light indicates no paper in printer

FORWARD *button* - moves paper forward

REVERSE *button*- moves paper backward

RELEASE *button*- release ticket for removal



ROLL PRINTER BUTTONS AND INDICATOR LIGHTS

ERROR *light*- light indicates printer unable to print (see printer manual

POWER *light* - light indicates power is on

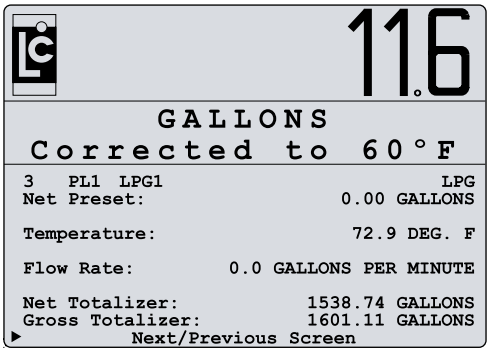
PAPER OUT *light*- light indicates no paper in printer

FEED *button* - moves paper forward

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Delivery Screens

After switching the selector switch to RUN, one of four delivery screens will appear on the screen—Detailed Pump & Print, Volume and Preset, Aviation, and POS Delivery. Most fields in the delivery screens are display only. Without the LCR 600 POS upgrade, the only editable fields are the preset fields. With the POS upgrade, the POS Delivery screen contains editable fields that effect the pricing configuration printed on the delivery ticket. To change the delivery screen, use the **Delivery Screen** field on the System Setup 2 screen.



DETAILED PUMP & PRINT

DETAILED PUMP & PRINT

Calibration details - *Display Only*
The calibration number, calibration code, calibration name, and calibration type of the active calibration

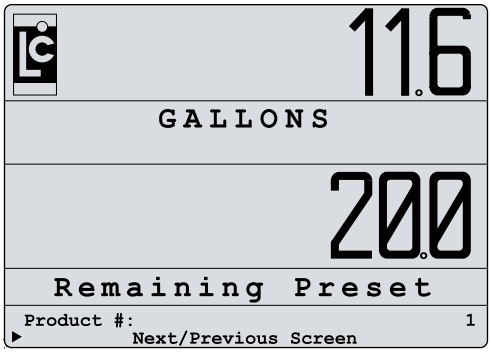
Net Preset: (FE) U - L - P
Preset value according to net volume. *This field will be named* **Gross Preset** *when the active calibration is not temperature compensated.*

Temperature: *Display only*
The current temperature reading of the RTD temperature probe.

Flow Rate: *Display Only*
The current flow rate through the meter.

Net Totalizer: *Display only*
Net volume delivered by the LCR 600. In the calibration position, the field can be set to any positive value. The value resets after a clear all. *This field only appears when the calibration is temperature compensated.*

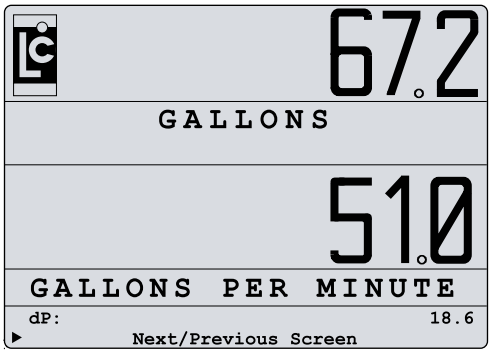
Gross Totalizer: *Display only*
Gross volume delivered by the LCR 600. In the calibration position, the field can be set to any positive value. The value resets after a clear all.



VOLUME AND PRESET

VOLUME AND PRESET

Product #: *Display only*
The active product number.



AVIATION

AVIATION

ΔP: *Display only*
The current differential pressure. Field only shown if the LCR 600 is connected to a ΔP transducer.

Delivery Screens (continued)

POS DELIVERY

`Product #:` (FE) C - U - L
The active product number. Select the field to change the product for the next delivery.

`Gross Preset:` (FE) U - L - P
Preset value according to gross volume. *This field will be* **`Net Preset`** *when the active product is temperature compensated.* See preset directions on pg. 46.

`Price Preset:` (FE) U - L - P
Preset value according to gross volume. See preset directions below.

`Total Price Excluding Tax:` *Display Only*
The total price according to the current volume and price per unit

`Flow Rate:` *Display Only*
The current flow rate through the meter.

`Add Miscellaneous Charges` U - L - P
Opens the Add Miscellaneous Charges screen where you can select products and services and add their price to the total.

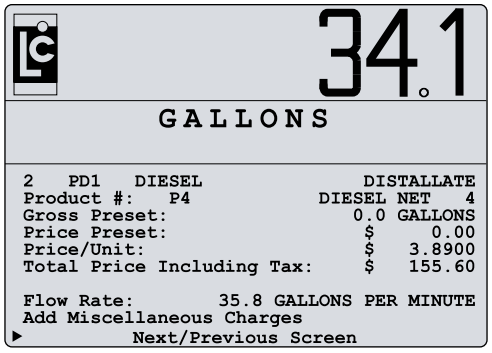
To add a miscellaneous charge to a delivery:

1. Turn the selector switch to RUN to start a delivery.
2. Turn the selector switch to STOP to pause the delivery.
3. Move the pointer ▶ to the **`Add Miscellaneous Charges`** field and press **ENTER**.
4. Move the pointer ▶ to a charge, press **ENTER**, enter an amount into the filed box, and press **ENTER**.
5. Move the pointer ▶ to **`Next/Previous Screen`** and press **ENTER**.
6. Turn the selector switch to RUN to resume the delivery.

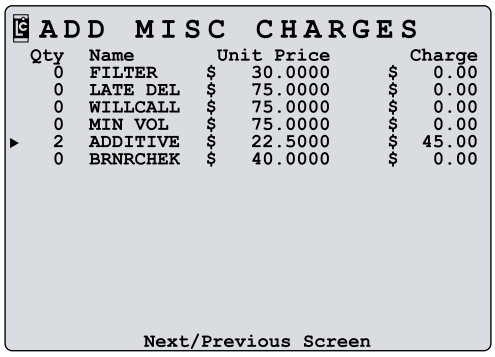
Preset Deliveries

A preset delivery automatically closes the control valve and ends a delivery when the LCR 600 reaches a predetermined volume. Preset volumes can be entered before in the **`Gross Preset`**, **`Net Preset`**, or **`Price Preset`** (POS upgrade only) fields. When the selector switch is turned to RUN and the nozzle opened, the LCR 600 will automatically end the delivery volume reaches the preset volume.

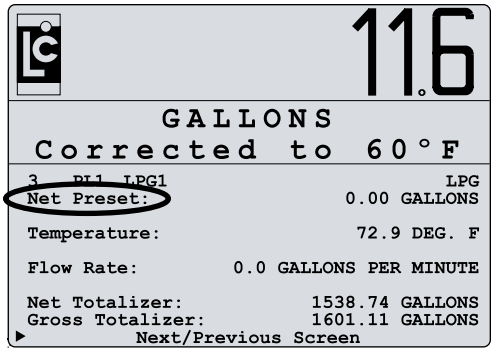
The location of preset fields varies according to the type delivery screen activated. There are preset fields on the Detailed Pump & Print delivery screen, Detailed POS delivery screen, the Delivery Setup 1 screen, and the Delivery Setup 1 (POS).



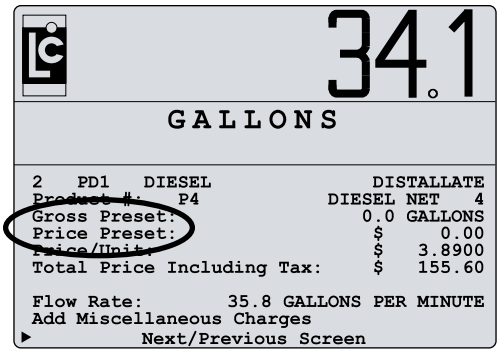
POS Delivery Screen



Add Miscellaneous Charges Screen

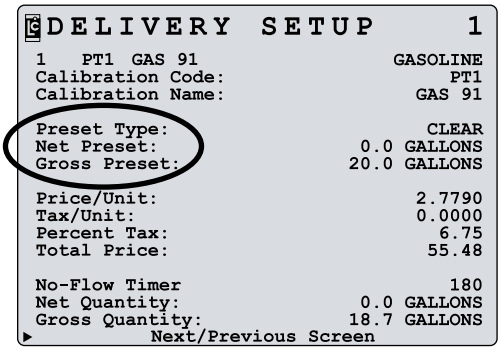


Detailed Pump & Print Preset Field

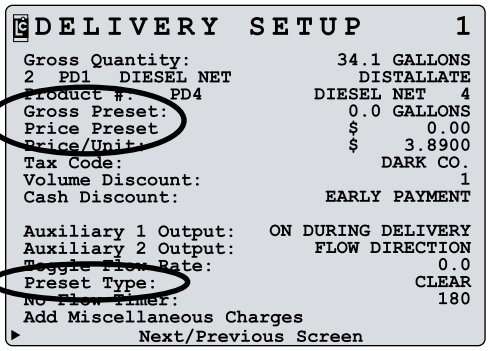


POS Delivery Preset Fields

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Delivery Setup 1 Preset Fields



Delivery Setup 1 (POS) Preset Fields

What's in a Price Preset?

LCR 600 price presets add taxes into the total preset value but it does not account for discounts or miscellaneous charges. The LCR 600 will deliver the volume as close to the price as possible without exceeding the preset price

GROSS, NET, AND PRICE PRESETS

The LCR 600 will deliver gross and net presets. LCR 600s with the POS upgrade will deliver price presets as well. If the active calibration is not temperature compensated, the LCR 600 will only deliver gross volume presets. If the active calibration is temperature compensated, both gross and net presets can be delivered (depending on system settings).

PRESET TYPES

The LCR 600 provides four settings for preset deliveries. The **Preset Type** field is on the Delivery Setup 1 screen for the base and POS LCR 600 software.

Clear resets the preset values to 0 after the current delivery is ended.

Retain maintains the preset values to be used again on the next delivery.

Multiple allows more than one preset to be run before a delivery ticket is printed. Delivery ticket printed with PRINT command.

Inventory maintains the remaining preset amount between deliveries. *This option is typically used to indicate the remaining volume in the vehicle tank*.

S1 CLOSE

The **S1 Close** field sets the duration, in volume, of the dwell flow before the end of a preset delivery. For example, if the S1 close value is two gallons and the preset volume is 20 gallons, the dwell flow will begin 18 gallons into the delivery. A dwell flow slows the flow rate before the end of a delivery to lessen the hydraulic shock incurred upon shut off. The **S1 Close** field is on the Calibration Setup 1 screen.

Packing the Hose

To comply with Weights & Measures requirements, it is necessary to start and stop each delivery with a fully packed hose. Normally, this will be the case. However, there are times where the hose is not fully packed (e. g., after a preset delivery). In those instances, the hose must be packed and the register zeroed before making the next delivery.

To pack the hose:

1. Turn the selector switch to RUN—do not open the hose nozzle. The display will reset and the solenoid will open the valve, packing the hose.
2. When the display has stopped incrementing, the hose is packed.
3. Turn the selector switch to STOP. This will de-energize the solenoid and close the valve.
4. Turn the selector switch back to RUN. The display will reset to zero, and the solenoid will energize again and open the valve. *If more than one gallon or five litres register on the LCR 600, the display will not zero out.*
5. Open the hose nozzle and begin the delivery.

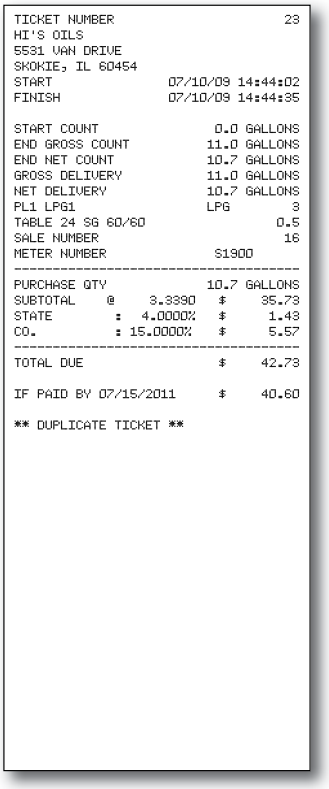
This procedure will not work for an empty or dry hose. If more than 1 gallon or 5 litres of liquid is required to pack the hose, a delivery ticket must be printed.

The selector switch can only be turned to STOP one time per delivery, at the start of the delivery, to pack the hose.

Duplicate Delivery Tickets

To print a duplicate delivery ticket:

1. Press RELEASE on the printer. Insert a blank delivery ticket.
2. Press FORWARD on the printer to engage the ticket.
3. Turn the LCR 600 selector switch to PRINT and then to STOP.
4. When the ticket finishes printing, press RELEASE on the printer. Remove the ticket.
5. Insert a blank delivery ticket and press FORWARD on the printer to engage the new ticket



```
TICKET NUMBER                        23
HI'S OILS
5531 VAN DRIVE
SKOKIE, IL 60454
START                07/10/09 14:44:02
FINISH               07/10/09 14:44:35

START COUNT                0.0 GALLONS
END GROSS COUNT           11.0 GALLONS
END NET COUNT             10.7 GALLONS
GROSS DELIVERY            11.0 GALLONS
NET DELIVERY              10.7 GALLONS
PL1 LPG1                  LPG         3
TABLE 24 SG 60/60                   0.5
SALE NUMBER                          16
METER NUMBER               S1900
----------------------------------------
PURCHASE QTY              10.7 GALLONS
SUBTOTAL    @     3.3390   $     35.73
STATE       :   4.0000%    $      1.43
CO.         :  15.0000%    $      5.57
----------------------------------------
TOTAL DUE                  $     42.73

IF PAID BY 07/15/2011      $     40.60

** DUPLICATE TICKET **
```

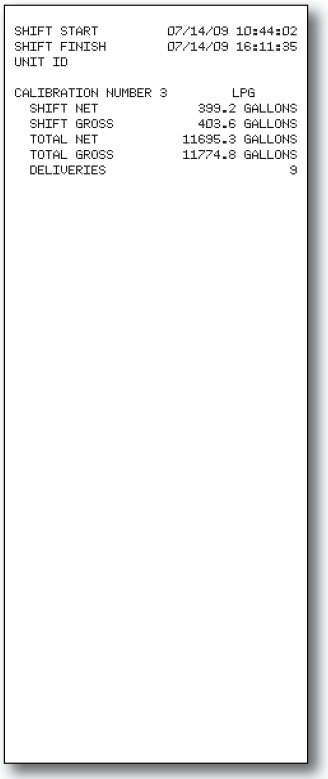
Duplicate Delivery Ticket

Shift Tickets

To print a shift ticket:

1. Press RELEASE on the printer. Insert a blank delivery ticket.
2. Press FORWARD on the printer to engage the ticket.
3. Turn the LCR 600 selector switch to SHIFT PRINT.
4. When the ticket finishes printing, press RELEASE on the printer. Remove the ticket.
5. Insert a blank delivery ticket and press FORWARD on the printer to engage the new ticket

Shift tickets can run over the length of a standard slip printer ticket especially if more than one product was delivered during the shift. Two tickets may be required. When the printer stops printing, replace the ticket and press **ENTER** *on the LCR 600.*



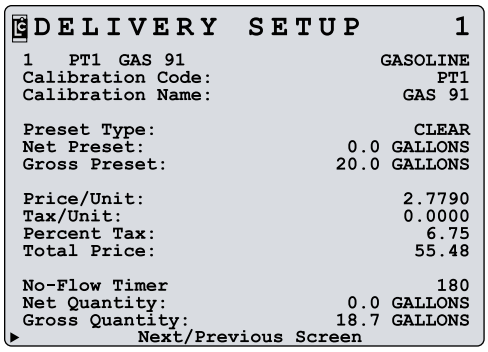
```
SHIFT START          07/14/09 10:44:02
SHIFT FINISH         07/14/09 16:11:35
UNIT ID

CALIBRATION NUMBER 3          LPG
  SHIFT NET             399.2 GALLONS
  SHIFT GROSS           403.6 GALLONS
  TOTAL NET           11695.3 GALLONS
  TOTAL GROSS         11774.8 GALLONS
  DELIVERIES                        9
```

Shift Ticket

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DELIVERY SETUP 1



Product & Calibration details (FE) U - L
C1 PT1 GAS 91 Gasoline
The calibration number, calibration code, calibration name and calibration type of the active calibration

Calibration Code: (FE) U - L
The code assigned to the active calibration. Often, this code corresponds with an office code.

Calibration Name: (FE) U - L
The text designation of the active calibration.

Preset Type: (LB) U
Provides four options for handling preset deliveries.

Clear resets the preset values to 0 after the current delivery is ended.

Retain maintains the preset values to be used again on the next delivery.

Multiple allows more than one preset to be run before a delivery ticket is printed. Delivery ticket printed with PRINT command.

Inventory maintains the remaining preset amount between deliveries. Typically used to indicate the remaining volume in the vehicle tank.

Net Preset: (FE) U - L - P
Preset value according to net volume.

Gross Preset: (FE) U - L - P
Preset value according to gross volume.

Price/Unit: (FE) U - L - P
The active price per unit of measure.

Tax/Unit: (FE) U - L
The active tax per unit of measure.

Percent Tax: (FE) U - L
The percentage of the total price added to the total price as a tax.

Total Price: *Display Only*
The total price of the active delivery.

Field Type
FE - Field Edit Box
LB - List Box

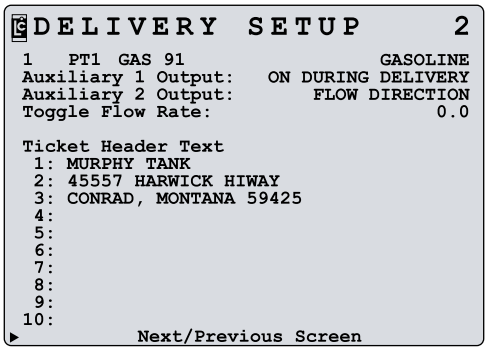
Security Clearance
L - Locked
U - Unlocked
C - Weights & Measures Calibration
P - Stop/Pause
F - Factory

No-Flow Timer: (FE) U - L
The amount of time until the LCR 600 ends a delivery and prints a ticket after it senses that no product is flowing through the meter. The time can be set from 0 to 3600 seconds. If the time is set as 0, the feature is deactivated and the message “Multiple Deliveries at One Site” will be printed on the delivery ticket. If the value is greater than 180, the message “Multiple Deliveries at One Site” will be printed on the delivery ticket. The No-Flow Timer protects product from being delivered to unauthorized locations sometimes referred to as “riding the ticket”. Increasing the value allow fuelers to deliver fuel to more than one tank (or fueling point) at a single site and print one ticket that includes every tank at that site. The No-Flow Timer is not active in the calibration mode.

Net Quantity: *Display Only*
The net quantity of the active delivery.

Gross Quantity: *Display Only*
The gross quantity of the active delivery.

DELIVERY SETUP 2



Calibration details - *Display Only*
The calibration number, calibration code, calibration name and calibration type of the active calibration

Auxiliary 1 Output: (LB) U
Determines when to activate the Auxiliary 1 component. Common Auxiliary 1 components are pump controls, additive injectors, and alarms. The value of this field is unique to each product. The options include:

Off

On

On During Delivery

Monitor Flow Rate activates Auxiliary 1 at the beginning of the delivery and deactivates at 40 units/time flowrate

Toggle Flow Rate activates Auxiliary 1 at flowrate designated in the **Toggle Flow Rate** field

Auxiliary 2 Output: (LB) U
Determines when to activate the Auxiliary 2 component. Common Auxiliary 2 components are pump controls, additive injectors, and alarms. The value of this field is unique to each product. The options include:

Field Type
FE - Field Edit Box
LB - List Box

Off

On

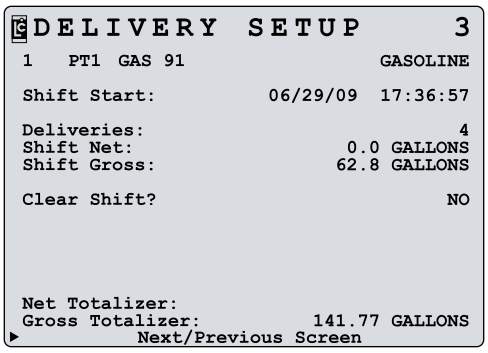
On During Delivery

Flow Direction activates Auxiliary 2 according to the Flow Direction field on the System Setup 1 screen

Toggle Flow Rate: (FE) U
The flow rate value at which Auxiliary 1 activates in the **Toggle Flow Rate:** mode. Auxiliary 1 remains activated above the set flow rate value and deactivates when the flow rate falls below the value. A common output is an air operated valve (AOV) on the pump. When the flow rate value is attained, the AOV is activated switching the pump from low bypass pressure mode to full flow fuel mode (high bypass pressure). When the flow rate falls below the set value, the AOV deactivates and the pump returns to low flow. Another possible output is the engine throttle—to increase and decrease the RPM of the pump shaft. In applications such as these, the flow rate value in this field should be below the low flow rate with a fully open nozzle or the output will never turn on. Another application of this field is to set the value as a maximum flow rate at which a valve should be closed. On fuel delivery trucks, flow valves often activate an internal switch at approximately 18 GPM (68 LPM). The value of this field is unique to each product.

Ticket Header Text: (FE) U *(Lines 11 and 12 are Weights & Measures protected)*
Supplies 10 lines where you can enter text for the ticket header. Every delivery ticket printed by the LCR 600 will print this text at the top of every ticket. Lines 11 and 12 must be edited in General Setup 2 while in the calibration position.

DELIVERY SETUP 3



Calibration details - *Display Only*
The calibration number, calibration code, calibration name and calibration type of the active calibration.

Shift Start: *Display Only*
Date and time when the active shift started.

Deliveries: *Display Only*
Number of deliveries for the active shift.

Shift Net: *Display Only*
Net volume delivered during the active shift.

Shift Gross: *Display Only*
Gross volume delivered during the active shift.

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DELIVERY SETUP 3 (continued)

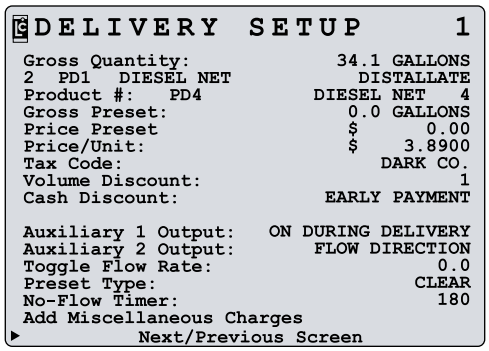
Clear Shift: (LB) U
Resets active shift data.

Net Totalizer: *Display Only*
Net volume delivered by the LCR 600. Can only be reset in calibration position or with a clear all.

Gross Quantity: *Display Only*
Gross volume delivered by the LCR 600. Can only be reset in calibration position or with a clear all.

DELIVERY SETUP 1 (POS)

Delivery Setup screen for LCR 600's with the POS upgrade



Gross Quantity: *Display Only*
The quantity according to gross volume. *This field will be* **Net Quantity** *when the active product is temperature compensated.* See preset directions on pg. 46.

Calibration details - *Display Only*
The calibration number, calibration code, calibration name, and calibration type of the active calibration.

Product #: (FE) U - L
The product code, product name, and product number of the active product.

Gross Preset: (FE) U - L - P
Preset value according to gross volume. *This field will be* **Net Preset** *when the active product is temperature compensated.* See preset directions on pg. 46.

Price Preset: (FE) U - L - P
Preset value according to price.

Price/Unit: *Display Only*
The active price per unit of measure. This field can be locked in the Setup POS screen **Lock Price?** field.

Tax Code: *Display Only*
The tax code designated to the active product.

Volume Discount: *Display Only*
The volume discount designated to the active product. This field can be locked in the Setup POS screen **Lock Discount Categories?** field.

Cash Discount: *Display Only*
The cash discount designated to the active product. This field can be locked in the Setup POS screen **Lock Discount Categories?** field.

Auxiliary 1 Output: (LB) U - L
Determines when to activate the Auxiliary 1 component. Common Auxiliary 1 components are pump controls, additive injectors, and alarms. The options include:

Off

On

On During Delivery

Monitor Flowrate activates Auxiliary 1 at the beginning of the delivery. Auxiliary 1 stays active below a 40 units/time flowrate and deactivates over 40 units/time flowrate

DELIVERY SETUP 1 (POS) (continued)

Auxiliary 2 Output: (LB) U - L
Determines when to activate the Auxiliary 2 component. Common Auxiliary 2 components are pump controls, additive injectors, and alarms. The options include:

Off

On

On During Delivery

Flow Direction activates Auxiliary 2 according to the Flow Direction field on the System Setup 1 screen

Toggle Flow Rate: (FE) U - L
The flow rate value at which Auxiliary 1 activates in the **Toggle Flow Rate:** mode. Auxiliary 1 remains activated above the set flow rate value and deactivates when the flow rate falls below the value. A common output is an air operated valve (AOV) on the pump. When the flow rate value is attained, the AOV is activated switching the pump from low bypass pressure mode to full flow fuel mode (high bypass pressure). When the flow rate falls below the set value, the AOV deactivates and the pump returns to low flow. Another possible output is the engine throttle—to increase and decrease the RPM of the pump shaft. In applications such as these, the flow rate value in this field should be below the low flow rate with a fully open nozzle or the output will never turn on. Another application of this field is to set the value as a maximum flow rate at which a valve should be closed. On fuel delivery trucks, flow valves often activate an internal switch at approximately 18 GPM (68 LPM).

Preset Type: (LB) U - L
Provides four options for handling preset deliveries.

Clear resets the preset values to 0 after the current delivery is ended.

Retain maintains the preset values to be used again on the next delivery.

Multiple allows more than one preset to be run before a delivery ticket is printed. Delivery ticket printed with PRINT command.

Inventory maintains the remaining preset amount between deliveries. Typically used to indicate the remaining volume in the vehicle tank.

No-Flow Timer: (FE) U - L
The amount of time until the LCR 600 ends a delivery and prints a ticket after it senses that no product is flowing through the meter. The time can be set from 0 to 3600 seconds. If the time is set as 0, the feature is deactivated and the message “Multiple Deliveries at One Site” will be printed on the delivery ticket. If the value is greater than 180, the message “Multiple Deliveries at One Site” will be printed on the delivery ticket. The No-Flow Timer protects product from being delivered to unauthorized locations sometimes referred to as “riding the ticket”. Increasing the value allow fuelers to deliver fuel to more than one tank (or fueling point) at a single site and print one ticket that includes every tank at that site. The No-Flow Timer is not active in the calibration mode.

Add Miscellaneous Charges: S
Opens the Miscellaneous Charges list box.

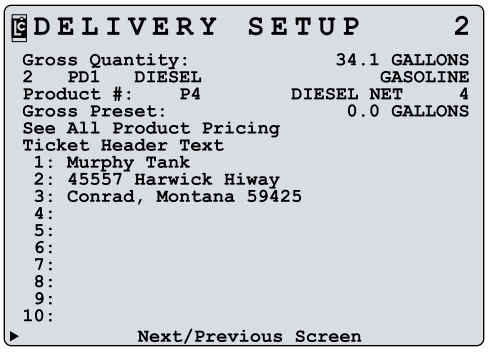
Security Clearance
L - Locked
U - Unlocked
C - Weights & Measures Calibration
P - Stop/Pause
F - Factory

Field Type
FE - Field Edit Box
LB - List Box

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DELIVERY SETUP 2 (POS)

Delivery Setup screen for LCR 600's with the POS upgrade



Gross Quantity: *Display Only*
The quantity according to gross volume. *This field will be* **Net Quantity** *when the active product is temperature compensated.* See preset directions on pg. 46.

Calibration details - *Display Only*
The calibration number, calibration code, calibration name, and calibration type of the active calibration.

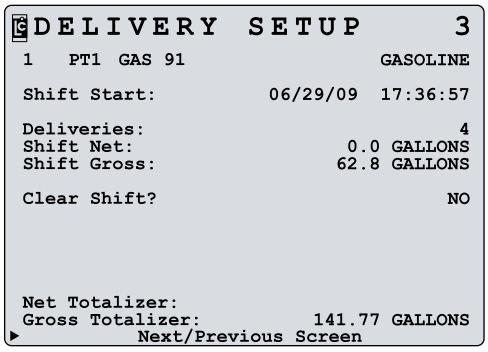
Product #: (FE) U - L
The product code, product name, and product number of the active product.

Set All Product Pricing: U - L - P
Opens the Product Price Entry Screen where the prices for all products can be changed.

Ticket Header Text: (FE) U
Supplies 12 lines where you can enter text for the ticket header. Every delivery ticket printed by the LCR 600 will print this text at the top of every ticket.

DELIVERY SETUP 3 (POS)

Delivery Setup screen for LCR 600's with the POS upgrade



Product & Calibration details (FE) U - L
C1 PT1 GAS 91 Gasoline
The calibration number, calibration code, calibration name and calibration type of the active calibration

Shift Start: *Display Only*
Date and time when the active shift started.

Deliveries: *Display Only*
Number of deliveries for the active shift.

Shift Net: *Display Only*
Net volume delivered during the active shift.

Shift Gross: *Display Only*
Gross volume delivered during the active shift.

Clear Shift: (LB) U - L
Resets active shift data.

Net Totalizer: *Display Only*
Net volume delivered by the LCR 600. Can only be reset in calibration position or with a clear all.

Gross Quantity: *Display Only*
Gross volume delivered by the LCR 600. Can only be reset in calibration position or with a clear all.

Security Clearance
- L - Locked
- U - Unlocked
- C - Weights & Measures Calibration
- P - Stop/Pause
- F - Factory

Field Type
- **FE - Field Edit Box**
- **LB - List Box**

Diagnostics and Troubleshooting Overview

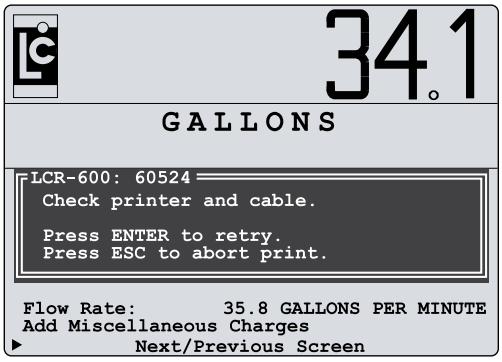
The LCR 600 provides tools for diagnosing and troubleshooting itself as well as other aspects of the meter system. The three main diagnostic tools are error messages, diagnostic and status screens, and diagnostic tickets. Error messages will pop up on the LCR 600 when the register can not continue its current function without an adjustment in the current settings. The diagnostic and status screens provide a detailed account of the status of the LCR 600. Diagnostic tickets provide a rundown of calibration data, system identification information, temperature probe data, error messages, and other useful bits of information. These three tools can help you pinpoint any issues occurring within the system and the LCR 600 and maintain an accurate, efficient, and safe fluid measurement system.

Error Messages

The LCR 600 identifies entry errors and system errors as soon as they occur. When an error occurs, a shaded box with a short description of the error will appear on the display. The error might also include additional instructions or options. If necessary, the additional options will give you the opportunity to open the diagnostic screens. In many error cases, you will also want to print a diagnostic ticket (see page 63). The list below explains LCR 600's error messages and possible corrective actions. If the suggestions listed are not successful, consult the troubleshooting section. If the troubleshooting tips do not help, call an authorized Liquid Controls service provider.

DELIVERY ERROR MESSAGES

These messages may be displayed when the LCR 600 is attempting to start, in the midst, or finishing a delivery.



Delivery ticket pending
A new delivery was attempted but the previous delivery ticket was not printed in its entirety. Turn the selector switch to the PRINT position. Once the previous delivery ticket is printed, a new delivery can begin.

Check printer and cable
The printer is not responding. The most common cause is no ticket in the printer. Epson slip printers have a built in photo eye to detect if a ticket is in position. Other causes include faulty data cable or power cable and LCR 600 circuit board failure.

ROM CHECKSUM ERROR
The program memory space of the LCR 600 has been corrupted. If this error occurs, the unit must be reflashed with the control software before any deliveries can be made. Flash instructions are available on the www.lcmeter.com website.

TEMPERATURE ERROR
The temperature circuit returned an error or the temperature calibration data is in error. Check the temperature probe and its connections. A broken temperature probe wire is the most common cause of this error. See the troubleshooting section for more information (see page 65).

VCF DOMAIN ERROR
The calculated temperature falls outside the allowable range for the current compensation parameter. Verify that the product compensation type is correct on the Calibration Setup 2 screen (See page 35).

PULSER FAILURE
The number of pulser faults exceeds the allowable amount. Pulser faults typically occur in high vibration environments or when the flow rate is highly throttled. The LCR 600 allows a maximum of five times the number of pulses required for the least significant displayed digit or 0.1% of the pulses generated for the current delivery. This equation can not be altered. Liquid Controls is not responsible for pulser failures caused by excessive system vibrations. See the troubleshooting section for more information (see page 66).

METER CALIB ERROR
The product selected for delivery has not been calibrated. Select a calibrated product.

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NO FLOW STOP ERROR
The no flow timer expired and terminated the delivery. This is not an error condition. See the Delivery Setup 1 to change the no flow timer.

POWER FAIL ERROR
The delivery ended due to a loss of input voltage. Check the power supply and wiring to the LCR 600. Check the in-line fuse. See the troubleshooting section for more information (see page 65).

PRESET ERROR
When accessing a preset field, a flash memory error was detected.

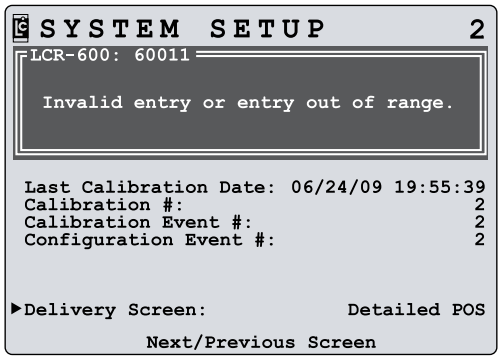
TERMINAL NOT CONNECTED
A terminal connection was disconnected during a delivery. Check the cables and connectors for broken wires and loose connections.

DATA ACCESS ERROR
A flash memory error occurred.

INIT WARNING
This message appears when **No-Flow Timer** or the **Ticket Required?** fields return an error. If this error occurs, the delivery can continue but default values **180** and **Yes** are used.

RUN TIME ERROR MESSAGES

These messages may be displayed if an error occurs while the system is running.



Invalid entry or entry out of range
The value entered into the field edit box is outside of the range specified for the field. Reenter the value.

FLASH CRC FAILURE
The CRC stored with an LCR 600 data block indicates the data or CRC has been corrupted. A rebuild operation could possibly fix the problem. If not, try a clear all (Call Liquid Controls for clear all instructions). If that does not work, hardware may be at fault and the unit should be returned to Liquid Controls for more analysis. Before starting a clear all operation, print a calibration ticket.

FLASH WRITE FAILURE
A failure detected while a data block was being written to the flash memory. See Flash CRC Failure above for corrective actions

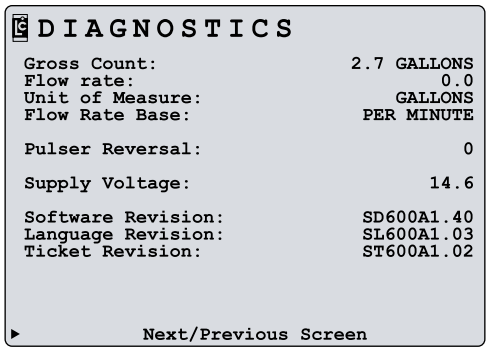
FLASH NOT INITIALIZED
The selector switch was not in the CALIBRATION position when a **Clear All** or **Rebuild** was attempted.

Invalid entry or entry out of range
The data entered was not within the required range limits for the specific field.

Duplicate flow rates not allowed
This message only appears when setting up multi-point calibration. When calibrating a multi-point meter, each linearization point must have a unique flow rate. This message is displayed if a duplicate flow rate is entered.

Adjacent linearization points out of 0.25% range
This message only appears when setting up multi-point calibration. When calibrating a multi-point meter, adjacent linearization points must be within a 0.25% correction of each other. To avoid this error, select an additional flow rate and correction factor between the two points. More than one additional point may be required.

DIAGNOSTICS



Gross Count: *Display Only*
The gross volume of the active delivery.

Flow Rate: *Display Only*
The current flow rate of the active delivery.

Unit of Measure: (LB) C
The unit of flow measurement.

Gallons • Litres • Cubic M • Lbs (pounds) • Kgs • Barrels • Other

Flow Rate Base: (LB) C
The time unit of the flow rate.

Per Second • Per Minute • Per Hour

Field Type
FE - Field Edit Box
LB - List Box

Pulser Reversals: *Display Only*
The number of pulser reversal occurrences.

Supply Voltage: *Display Only*
The current voltage being supplied to the LCR 600.

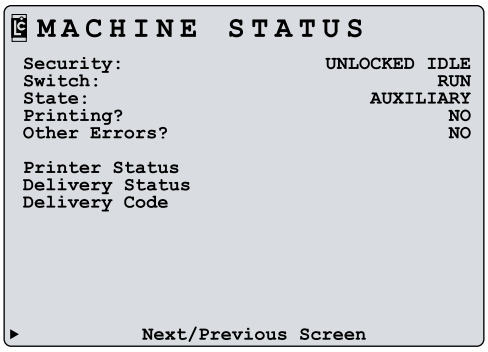
Software Revision: *Display Only*
The current version of LCR 600 software installed.

Language Revision: *Display Only*
The current version of language software installed on the LCR 600.

Ticket Revision: *Display Only*
The current version of ticket revision software installed on the LCR 600.

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MACHINE STATUS



Security: *Display Only*
A description of the active security level.

Idle • Unlocked Idle • Delivery Paused • Delivery Active • W&M Idle • Factory Idle

Switch: *Display Only*
The position of the selector switch.

Run • Stop • Print • Shift Print • Calibrate

State: *Display Only*
The current processing activity of the LCR 600.

Run • Stop • End Delivery • Auxiliary • Shift • Calibrate • Waiting for No-Flow • Unknown

Printing? *Display Only*
Is the printer currently printing?

Other Errors? *Display Only*
Are there any other errors being reported by the LCR?

Printer Status C - U - L - P
Select this field to open the Printer Status screen. Pg. 58.

Delivery Status C - U - L - P
Select this field to open the Delivery Status screen. Pg. 59.

Delivery Code C - U - L - P
Select this field to open the Delivery Code screen. Pg. 60.

Security Clearance
L - Locked
U - Unlocked
C - Weights & Measures Calibration
P - Stop/Pause
F - Factory

PRINTER STATUS

Delivery Ticket? *Display Only*
Has a delivery ticket been requested?

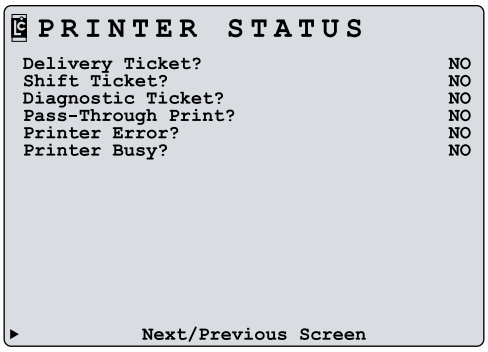
Shift Ticket? *Display Only*
Has a shift ticket been requested?

Diagnostic Ticket? *Display Only*
Has a diagnostic ticket been requested?

Pass-Through Print? *Display Only*
Is text from the host in the LCR print buffer?

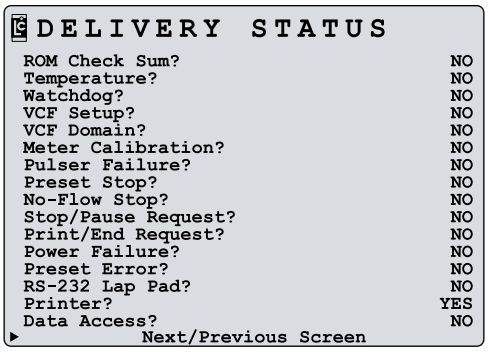
Printer Error? *Display Only*
Has an error been detected with the printer?

Printer Busy? *Display Only*
Has the print processor began to print a ticket?



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DELIVERY STATUS



ROM Check Sum? *Display Only*
Has a delivery not started due to the checksum of the LectroCount program code space failing?

Temperature? *Display Only*
Has the current delivery not started (or was terminated) due to an error with the temperature reading hardware?

Watchdog? *Display Only*
Was the processor reset due to a LectroCount watchdog time out error?

VCF Setup? *Display Only*
Was there an error setting up the volume compensation factor for the current product?

VCF Domain? *Display Only*
Did the temperature of the product go outside the valid range for the compensation type of the product?

Meter Calibration? *Display Only*
Did an error occur while setting up the meter calibration for the current delivery?

Pulser Failure? *Display Only*
Did the current delivery terminate due to too many pulser faults?

Preset Stop? *Display Only*
Was the gross or net preset volume reached?

No-Flow Stop? *Display Only*
Was the current delivery stopped due to no-flow being detected through the meter for a specified amount of time?

Stop/Pause Request? *Display Only*
Was a stop activated by the selector switch during an active delivery?

Print/End Request? *Display Only*
Was a print activated by the selector switch during an active delivery?

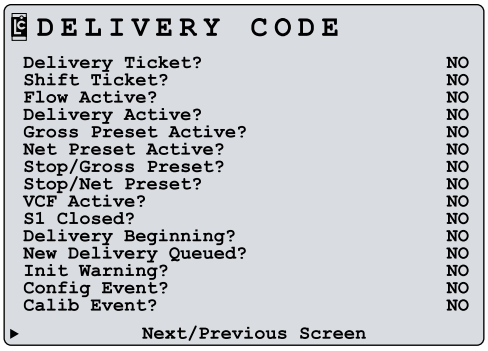
Power Failure? *Display Only*
Did a delivery end due to a power fail condition for more than 15 seconds?

Preset Error? *Display Only*
Did a delivery end due to an error condition while attempting to set up a gross or net preset?

Printer? *Display Only*
Does the current delivery require a printed ticket but the printer is off-line or busy?

Data Access? *Display Only*
Did a data access error occur during the delivery which was critical to the delivery?

DELIVERY CODE



Delivery Ticket? *Display Only*
Is a delivery ticket is pending?
A new delivery cannot be started until this field is cleared by successfully printing the last delivery ticket.

Shift Ticket? *Display Only*
Has a shift ticket been requested and waiting to be printed?

Flow Active? *Display Only*
Is the flow active during a delivery?
This field changes with the **Delivery Active?** *field, but it also turns off when a delivery is paused and turned on when the delivery is resumed.*

Delivery Active? *Display Only*
Is a delivery active?

Gross Preset Active? *Display Only*
Is the current delivery a gross preset?

Net Preset Active? *Display Only*
Is the current delivery a net preset?

Stop/Gross Preset? *Display Only*
Has the current delivery been stopped by reaching a gross preset value?

Stop/Net Preset? *Display Only*
Has the current delivery been stopped by reaching a net preset value?

VCF Active? *Display Only*
Is the volume of the current delivery compensated according to temperature?

S1 Closed? *Display Only*
Is the S1 solenoid closed?
During preset deliveries, the S1 solenoid should be open at full product flow and closed at dwell flow.

Delivery Beginning? *Display Only*
Is a delivery in the process of being started?

New Delivery Queued? *Display Only*
Has a new delivery has been queued in the LCR 600?

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Diagnostic Tickets and Error Message Examples

To print a diagnostic ticket:

1. Press RELEASE on the printer. Insert a blank delivery ticket.
2. Press FORWARD on the printer to engage the ticket.
3. Turn the LCR 600 selector switch to SHIFT PRINT for less than 2 seconds and turn the switch to PRINT.
4. When the ticket finishes printing, press RELEASE on the printer. Remove the ticket.
5. Insert a blank delivery ticket and press FORWARD on the printer to engage the new ticket

Diagnostic tickets can run over the length of a standard slip printer ticket. Two tickets may be required. When the printer stops printing, replace the ticket and press **ENTER** *on the LCR 600.*

```
CALIBRATION TICKET #                28
CALIBRATION EVENT #                  2
CONFIGURATION EVENT #               17
CALIBRATION DAT     07/13/11 15:02:54
METER IDENTIFIER             S1900
SERIAL NUMBER                9230055
CALIBRATION NUMBER 1         GASOLINE
  COMP TYPE                 NONE
  NONE                      ----------
  PULSES              33.1996 GALLONS
CALIBRATION NUMBER 2        DISTALLATE
  COMP TYPE                 NONE
  NONE                      ----------
  PULSES             553.3996 GALLONS
CALIBRATION NUMBER 3        LPG
  COMP TYPE                 NONE
  NONE                      ----------
  PULSES             242.9572 GALLONS
  RATE     %ERROR   RATE    %ERROR
   60.00   -0.122   40.00   -0.300
   20.00   -0.451
CALIBRATION NUMBER 4
  COMP TYPE                 NONE
  NONE                      ----------
  PULSES               0.0000 GALLONS
CALIBRATION NUMBER 5
  COMP TYPE                 NONE
  NONE                      ----------
  PULSES               0.0000 GALLONS
CALIBRATION NUMBER 6
  COMP TYPE                 NONE
  NONE                      ----------
  PULSES               0.0000 GALLONS
CALIBRATION NUMBER 7
  COMP TYPE                 NONE
  NONE                      ----------
  PULSES               0.0000 GALLONS
CALIBRATION NUMBER 8
  COMP TYPE                 NONE
  NONE                      ----------
  PULSES               0.0000 GALLONS
CALIBRATION NUMBER 9
  COMP TYPE                 NONE
  NONE                      ----------
  PULSES               0.0000 GALLONS
```

Diagnostic Ticket (Calibration Ticket)

```
CALIBRATION NUMBER 10
  COMP TYPE                 NONE
  NONE                      ----------
  PULSES               0.0000 GALLONS
CALIBRATION NUMBER 11
  COMP TYPE                 NONE
  NONE                      ----------
  PULSES               0.0000 GALLONS
CALIBRATION NUMBER 12
  COMP TYPE                 NONE
  NONE                      ----------
  PULSES               0.0000 GALLONS
CALIBRATION NUMBER 13
  COMP TYPE                 NONE
  NONE                      ----------
  PULSES               0.0000 GALLONS
CALIBRATION NUMBER 14
  COMP TYPE                 NONE
  NONE                      ----------
  PULSES               0.0000 GALLONS
CALIBRATION NUMBER 15
  COMP TYPE                 NONE
  NONE                      ----------
  PULSES               0.0000 GALLONS
CALIBRATION NUMBER 16
  COMP TYPE                 NONE
  NONE                      ----------
  PULSES               0.0000 GALLONS
FIRMWARE                     SD600v1.00
                             SL600v1.00
                             SL600v1.00
TEMPERATURE                71.96 DEG. F
ADC OFFSET               -124.57 DEG. C
ADC SLOPE                 0.0155   /BIT
TEMP ZERO                   0.00 DEG. F
PULSER FAULTS                      0
LAST GROSS                 16.9 GALLONS
LAST NET                    0.0 GALLONS
```

Diagnostic Ticket (Calibration Ticket) continued

Troubleshooting the LCR 600

The troubleshooting section of this manual covers the common problem situations. Call your local authorized Liquid Controls service provider or the Liquid Controls electronics service department if the troubleshooting section does not address the situation.

When troubleshooting the LCR 600 follow these guidelines:

- Check for proper operating voltages before changing the circuit board. If the circuit board needs to be changed, be sure to remove all power to the LCR 600.
- The error message or a diagnostic ticket will contain an error message that can be useful in troubleshooting. Examine the diagnostic screens on the LCR 600 or the diagnostic ticket to make sure all set-up fields are accurate, e.g. pulses per unit volume, temperature coefficient and base temperature. Print a diagnostic ticket by moving the red selector switch to “SHIFT PRINT” for less than two seconds.
- Never remove a terminal block or jumper with the power on.
- Never install a terminal block or jumper with the power on.
- Never force a terminal block into its location.
- Never exchange or reposition terminal blocks on the circuit board.
- In case of a major problem such as a burned or water-damaged circuit board, evaluate possible causes before replacing it and turning the power back on.
- Isolate the problem before changing the circuit board.
- Return faulty circuit boards with the proper forms, concisely completed.

PROBLEM	PROBABLE CAUSE	SOLUTION
Unit will not power up or no display.	1. Inadequate supply voltage. +9 to 28VDC is required for operation.	1. With the key in the accessory position, check the battery voltage to the circuit board at J6. Use terminal #11 as positive and terminal #12 as DC ground. While the LCR 600 will power-up at +9VDC, it is recommended that the input be at least +12.6VDC. 2. Check the 7.5A, in-line fuse (PN 70985) for continuity. It is located on the accessory power line. Replace if necessary.
Unit blows 7.5A fuse.	1. +12VDC Battery line is shorted to ground.	1. For safety reasons, remove the 7.5A in-line fuse from the accessory power cable. 2. Remove the J6 terminal block. Inspect for stray wire stands and visible shorts. 3. Using a multimeter, take a reading across terminal 11 and terminal 12 on the J6 terminal block. The terminals should be open. If the multimeter shows a short, replace the power cable (PN 81512). 4. Inspect the power cable for damaged insulation that could cause a short between the wire and the chassis (or other nearby metal). If the cable is damaged, replace it. 5. Replace the 7.5A fuse (PN 70985) and re-install the J6 connector. 6. If the 7.5A fuse blows again, replace the LCR 600 circuit board.

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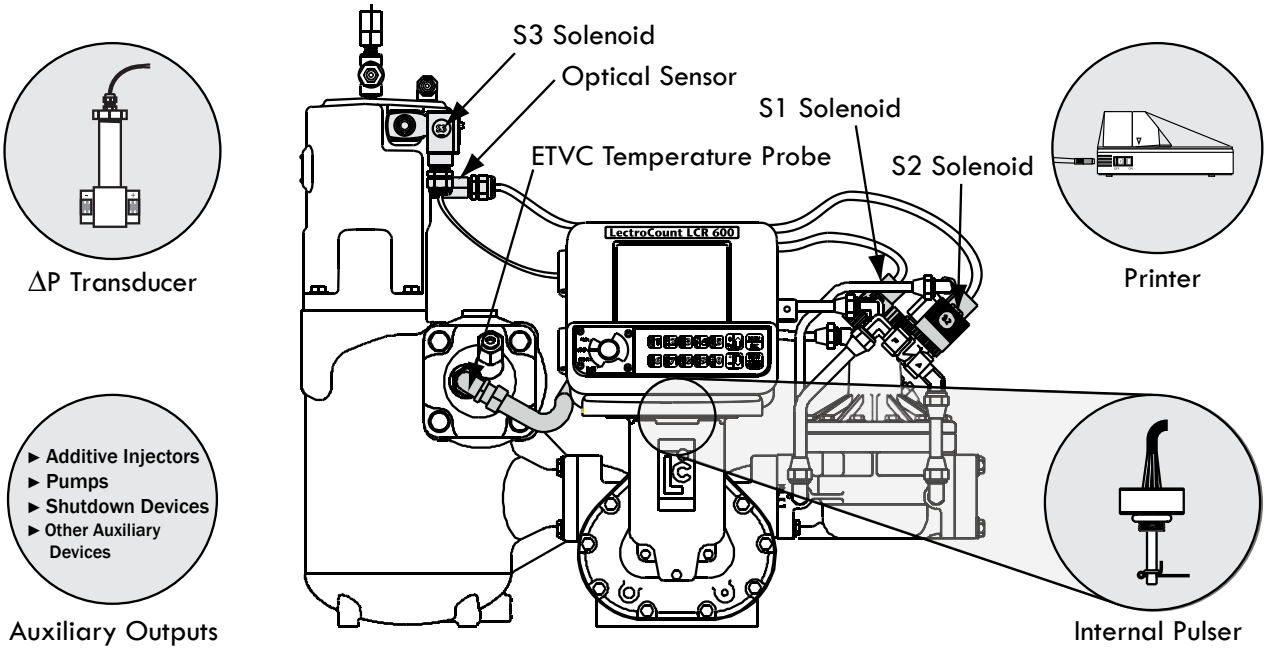
PROBLEM	PROBABLE CAUSE	SOLUTION
"Power Failure" appears diagnostic ticket or LCR 600 shuts down unexpectedly.	1. Power to LCR 600 interrupted during delivery. 2. Static discharge.	1. Check accessory power cable for damage. Ensure that the power, common and ground wires (11, 12 and 13) on power connector J6 are secure. 2. Turn on all truck accessories (head lamps, 2-way radio, heater, etc.). Engage the hose reel and monitor the DV voltage at J6 using terminal 11 as positive and terminal 12 as ground. If the voltage drops below +10VDC, the truck electrical system may not 3. Verify proper grounding of the LCR 600. Refer to the installation manual for proper grounding procedures.
Epson printer release light flashes.	1. Low voltage to the Epson printer.	1. Check the battery voltage for a minimum of +12.6VDC. 2. Under extreme cold conditions, the printer may not operate. Warm up the cab of the vehicle. 3. If the release light continues to flash, replace the Epson 295 Printer (PN E49001).
No power indicator lights to the Epson printer.	1. No power to the Epson printer.	1. Verify that the power switch is in the ON position. This switch is located on the left-hand side of the Epson 295 printer. 2. Check the printer power cable (PN 825001) to ensure that it is seated in the port properly. If the problem persists, replace the power cable. If the problem continues replace the Epson printer (PN E49001).
"Temperature Error" appears on diagnostic ticket or on the LCR 600.	1. Open or shorted circuit between the RTD probe and LCR 600.	1. Remove terminal block J14 from the circuit board. On the terminal block, measure and record the resistance between the following pins: TERMINAL # — CONTINUITY J14 #20 to #22 — 100Ω ±20Ω J14 #20 to #23 — 100Ω ±20Ω J14 #21 to #22 — 100Ω ±20Ω J14 #21 to #23 — 100Ω ±20Ω 2. If the readings are not within the above tolerances, replace the RTD probe (PN 71130).
Product flow does not register on LCR 600 display.	1. Pulser shaft is not turning with product flow. 2. Pulser failure.	1. Manually spin the pulser shaft and monitor the LCR 600 display. 2. If the LCR 600 display counter increments, this may indicate a mechanical problem. Contact your local Liquid Controls distributor or the Liquid Controls service department for assistance. 3. If the LCR 600 display counter does not increment, see "Pulser Failure" in the following troubleshooting section.

PROBLEM	PROBABLE CAUSE	SOLUTION
"Pulser Failure" appears on the diagnostic ticket or on the LCR 600 display.	1. Missing pulse counts. 2. Excessive reversals. ***Pulser faults generally occur in a high vibration environment. Liquid Controls is not responsible for pulser failures caused by excessive system vibrations.***	1. Using a multimeter, measure the following DC voltages on terminal block J8, while J8 is connected to the circuit board. Use terminal 37 as ground reference. TERMINAL # VOLTAGE J8 #32 +5 VDC J8 #33 0 or +5VDC J8 #34 0 or +5VDC 2. If the terminals show the preceding voltages, check for loose pulser wiring connections. If no loose connections are found, replace the encoder harness. (PN 81584 – for Series E2611X and E2612X) (PN 81412 – for Series E2605X and E2606X) or (Hard wires for POD pulser.) TERMINAL # VOLTAGE J8 #32 0 VDC J8 #33 +1-3VDC J8 #34 +1-3VDC 4. If the LCR 600 still shows a pulser failure, insert a ticket into the Epson printer and begin a delivery. With product flowing through the meter, measure the following DC voltages on the terminal block. TERMINAL # VOLTAGE J8 #32 0 VDC J8 #33 +1-3VDC J8 #34 +1-3VDC 5. If the voltages shown below are observed, ensure that the pulser shaft is rotating. Look for any mechanical problems that may cause either the meter or the pulser shaft to lock up. If the Lap Pad continues to indicate a pulser failure, replace the pulser (Part # 81582 for Series E2611X and E2612X) (Part # 81170 for Series E2605X and E2606X) or (Part # 81159 for POD pulser) TERMINAL # VOLTAGE J8 #32 +5 VDC J8 #33 0 or +5VDC J8 #34 0 or +5VDC

PROBLEM	PROBABLE CAUSE	SOLUTION
Valve will not open.	1. Solenoids are inactive or inoperative. 2. Foreign debris in system.	1. Insert a delivery ticket into the Epson printer and start a delivery. 2. Move the selector switch from RUN to STOP and back to RUN. Listen for an audible clicking sound from the solenoids. 3. If there is an audible click from the solenoid (but still no flow), this may be an indication of a mechanical problem with the main valve or its associated components. Contact your local Liquid Controls distributor or the Liquid Controls service department for assistance. 4. If there is no audible click from the solenoid, check the voltage to pin #s 14, 15, 16 and 17 of terminal block J13. While still in RUN mode, use a multimeter to measure the following DC voltages on the circuit board. Use J8 pin #38 as a ground. TERMINAL # — VOLTAGE J13 #14 — 12.0VDC ±1.5VDC J13 #15 — 1.0VDC ± 0.5VDC J13 #17 — 12.0VDC ±1.5VDC J13 #18 — 1.0VDC ±0.5VDC 5. If the above voltages are correct, this may be an indication of a problem with the valve or its associated components. Contact your local Liquid Controls distributor or the Liquid Controls service department for assistance. 6. If the above voltage are incorrect, replace the solenoids (PN varies depending on system). If the valve problem persists, replace the LCR 600 circuit board (PN 84040).

LectroCount LCR 600 Fields for Inputs/Outputs			
Input/Output Component	Related Settings and Fields	Screen Locations	Selector Switch Commands
ETVC Probe	Temperature:	Delivery - System Setup 2	
	Temperature Offset: Temperature Offset:	System Setup 2	
	Compensation Type: Delivery Ticket - Shift Ticket Compensation Parameter: Delivery Ticket - Shift Ticket Base Temperature: Delivery Ticket - Shift Ticket	Calibration 2	
S1 Solenoid	Net Preset: Gross Preset: Price Preset:	Delivery - Delivery Setup 1	RUN, STOP, PRINT
	S1 Close:	Calibration Setup 1	
	No-Flow Timer:	Delivery Setup 1	
S2 Solenoid	Net Preset: Gross Preset: Price Preset:	Delivery - Delivery Setup 1	
	S1 Close:	Calibration Setup 1	
S3 Solenoid	No Related Fields		
Optical Sensor	No Related Fields		
DP Transducer	dP Shutdown Value:	System Setup 1	
Injector, Pump, Shutdown Device, etc..	Auxiliary 1 Output: Auxiliary 2 Output: Toggle Flow Rate:	Delivery Setup 1 or 2	
Internal Pulser	Flow Rate:	Delivery	
	Pulse Output Edge: Pulse Output Freq:	General Setup 1	
	Pulses/Unit <k-Factor>: Prover Quantity:	Calibration Setup 1	

LectroCount LCR 600 Input and Output Devices



LectroCount LCR 600 Fields for Inputs/Outputs			
Input/Output Component	Related Settings and Fields	Screen Locations	Selector Switch Commands
PRINTER The type(s) of ticket that prints the field value is indicated to the right of the field.	Product #: Delivery Ticket -Shift Ticket Code: (Product) Delivery Ticket -Shift Ticket Name: (Product) Delivery Ticket -Shift Ticket	Delivery - Delivery Setup 1 to 3 - Setup POS	PRINT, SHIFT PRINT
	Net Totalizer: Shift Ticket Gross Totalizer: Shift Ticket	Delivery - Calibration Setup 1 - Delivery Setup 3	
	Price/Unit: Delivery Ticket	Delivery - Delivery Setup 1 - Setup POS	
	Add Miscellaneous Charges Delivery Ticket Total Price: Delivery Ticket	Delivery - Delivery Setup 1	
	Tax/Unit: Delivery Ticket (no POS) Tax Code: Delivery Ticket Volume Discount: Delivery Ticket Cash Discount: Delivery Ticket Percent Tax: Delivery Ticket (no POS)	Delivery Setup 1 - Setup POS	
	Ticket Header Text Delivery Ticket - Shift Ticket	Delivery Setup 2 - General Setup 1	
	Shift Start: Shift Ticket Deliveries: Shift Ticket Shift Net: Shift Ticket Shift Gross: Shift Ticket	Delivery Setup 3	
	Unit ID: Shift Ticket - Delivery Ticket (ST203) Date Format: All Tickets Date: All Tickets Time: All Tickets Sale #: All Tickets Ticket #: All Tickets Print Gross and Parameter? Volume Corrected Messages?	General Setup 1	
	Date Format: All Tickets Date: All Tickets	General Setup 1 - Security - Advanced Features	
	Meter ID: Calibration Ticket - Delivery Ticket Decimal Digits: Residual Processing: Printer: Ticket Required?	System Setup 1	
	Unit of Measure: All Tickets	System Setup 1 - Diagnostics	
	Calibration Event: Calibration Ticket Configuration Event: Calibration Ticket RTD Offset: Calibration Ticket RTD Slope: Calibration Ticket	System Setup 2	
	Calibration #: Calibration Ticket	System Setup 2 - Calibration 1 - Setup POS - Advanced Features	
	Calibration Code: All Tickets Calibration Name: All Tickets Calibration Type: Calibration Ticket	Calibration 1	
	Compensation Type: Delivery Ticket - Shift Ticket Compensation Parameter: Delivery Ticket - Shift Ticket Base Temperature: Delivery Ticket - Shift Ticket Temperature: Calibration Ticket Auxiliary Quantity: All Tickets Auxiliary Unit of Measure: All Tickets	Calibration 2	
	Software Revision: Calibration Ticket Language Revision: Calibration Ticket Ticket Revision: Calibration Ticket	Diagnostics	
	LCR Serial ID: Calibration Ticket	Advanced Features	
	No Flow Timer	Delivery Setup 1	

LIQUID CONTROLS GROUP

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https://web.archive.org/web/20140521011059/http://www.lcmeter.com/en/Literature/Documents/Specifications/ES100-30%20(LCR%20600).pdf

LectroCount LCR 600™ Electronic Register

Full Screen Electronic Registration with POS Capabilities



Benefits

- Proven long service life
- Increased accuracy with multi-point calibration
- Reliable in harsh environments
- Reduced delivery times and billing errors with priced and taxed delivery tickets with POS
- Reduce time to post and shorten cash cycle with POS
- Industry-specific applications: POS and FlightConnect

Features

- Weights & Measures custody transfer (product delivery and ticket generation)
- Metrological data collection
- 16 product calibrations *with POS*
- Multi-point and Single-point calibration
- Four delivery screens
- Volume, flow rate, and other key values visible during delivery
- Printed shift and diagnostic tickets
- Cash and volume discounting *with POS*
- Multiple, complex tax structures *with POS*
- Priced and taxed delivery tickets *with POS*
- Miscellaneous charges *with POS*
- In-field configuration and setup
- Delivery quantity and totalizer
- Security settings
- No-flow timer
- Two auxiliary outputs (settings include: *On*, *Off*, *On During Delivery*, *Monitor Flow Rate*, *Toggle Flowrate*, and *Flow Direction*)
- RS232/RS485 communication
- Electronic temperature volume compensation (ETVC)
- Electronic presetting by volume and price *price presetting with POS only*
- Electronic valve control
- Electronic air or vapor elimination
- NEMA 4X enclosure
- -40 to 158 °F (-40 to 70 °C) temperature range
- Available in Class I, Div 2 enclosure, Groups C & D
- Easy-to-use RUN, STOP, PRINT, SHIFT PRINT red rotary selector switch and alphanumeric keypad
- Compatible with most flowmeters (accepts input from PD, Amplified Turbine, Electromagnetic and Mass flowmeters)

General Information

Liquid Controls' LectroCount LCR 600 is a microprocessor-based electronic meter register. Its primary functions include configuring the meter system to the properties of the metered liquid, interfacing with the electronic components of the meter system (and external components such as pumps, injectors, and shutdown devices), and performing Weights & Measures approved custody transfer actions.

The LCR 600 is equipped with a large display, user-friendly interface, increased functionality and a large platform that can hold industry specific custody transfer applications, such as Point-of-Sale (POS), for customer-direct fuel delivery, and FlightConnect, for aviation fueling.

The LCR 600 can control a meter system as a stand-alone unit, or it can be used as a slave to a host controller such as a process controller or an in-cab data management system. It is a self-contained unit. All operation, setup, and configuration functions can be carried out using the red selector switch and the alphanumeric keypad. No lap pads, personal computers, or other data entry devices are required.

LectroCount LCR 600 Electronic Register

Specifications

Materials of Construction
Aluminum Alloy ADC12
Corro-Coat PE 74-141 Polyester Powder Coat

Weight
8.75 lbs (4 kg)

Display Elements
Liquid crystal display, 320 X 240 pixels

Cable Entry
½" NPT (5)
¾" NPT (2)

Temperature Rating
-40 to 158 °F (-40 to 70 °C)

Input Voltage
9 to 28 VDC, 4.5 A maximum (including solenoid valves and display heater)

Pulse Output
5 to 28 V peak to peak, 7500 Hz maximum

Scale Pulse Output
150 mA sinking capability

Electrical Protection
7.5 A Fuse

Communications
RS-232: EIA-232E standard
RS-485: SAE J1708 standard

Auxiliary 1 Output
1 A sinking capability

Auxiliary 2 Output
150 mA sinking capability

Solenoid 1 Output
10.2 to 27.2 VDC
1 A maximum

Solenoid 2 Output
10.2 to 27.2 VDC
1 A maximum

Solenoid 3 Output
10.2 to 27.2 VDC
1 A maximum

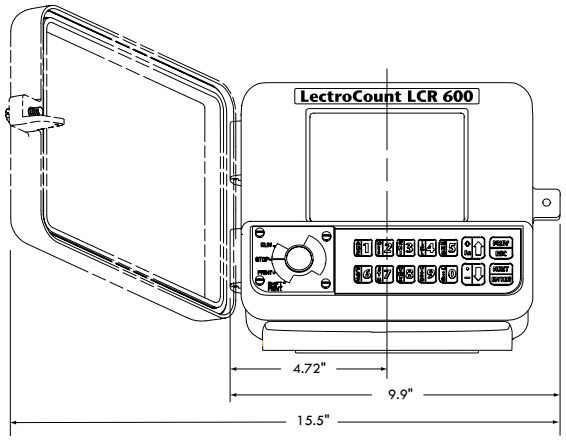
Optical Sensor
10 to 28 VDC
0.5 A maximum

RTD Temperature Probe
4 wire platinum sensor
100 Ω resistance at 0 ºC
138.5 Ω resistance at 100 ºC

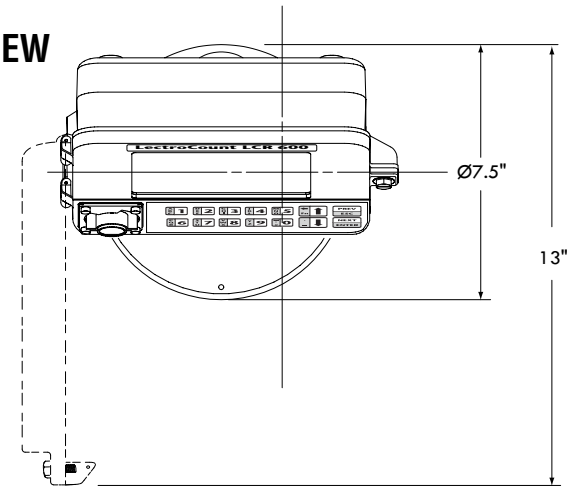
Remote Electronic Display
1 A sinking capability

Dimensions

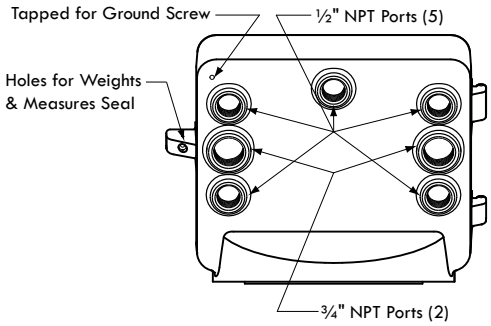
FRONT VIEW



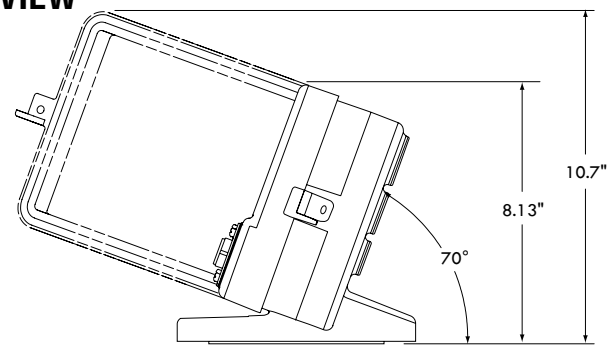
TOP VIEW



REAR VIEW



SIDE VIEW



Consult the factory when certified engineering drawings are required.
Dimensions shown are not suitable for construction or modifications

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Liquid Controls
105 Albrecht Dr.
Lake Bluff, IL 60044

https://web.archive.org/web/20150501023438/http://www.lcmeter.com/en/Literature/Documents/Installation/Meters/M100-20%20(MS%20Meters).pdf

Installation & Parts Manual

MS-Series Spherical Two-Case Meters

LIQUID CONTROLS
A Unit of IDEX Corporation

IDEX CORPORATION



Installation: M100-20

www.lcmeter.com

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Publication Updates and Translations

The most current English versions of all Liquid Controls publications are available on our website, **www.lcmeter.com**. It is the responsibility of the Local Distributor to provide the most current version of LC Manuals, Instructions, and Specification Sheets in the required language of the country, or the language of the end user to which the products are shipping . If there are questions about the language of any LC Manuals, Instructions, or Specification Sheets, please contact your Local Distributor.

⚠ *WARNING*

- Before using this product, read and understand the instructions.
- Save these instructions for future reference.
- All work must be performed by qualified personnel trained in the proper application, installation, and maintenance of equipment and/or systems in accordance with all applicable codes and ordinances.
- Failure to follow the instructions set forth in this publication could result in property damage, personal injury, or death from fire and/or explosion, or other hazards that may be associated with this type of equipment.

Please have the following information available when making inquiries, ordering replacement parts, or scheduling service. If a specific meter accessory is involved, please provide the model and serial number of the meter in question (see page 5).

Meter Serial Number _____

Full Service Distributor _____

Full Service Distributor Phone Number _____

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NOTICE:
This manual provides warnings and procedures that are intended to inform the owner/operator of the hazards present when using the Liquid Controls Meter on LPG and other products. The reading of these warnings and the avoidance of such hazards is strictly in the hands of the owner/operator of the equipment. Neglect of that responsibility is not within the control of the manufacturer of the meter.

SAFETY PROCEDURES:
Remember to relieve internal pressure before disassembly or inspection of the strainer, vapor eliminator, valves, POD pulser, and the front or rear covers. See "Meter Maintenance" on Page 15 for the steps to relieve internal pressure in your system.

BE PREPARED:
- Make sure that all necessary safety precautions have been taken. Provide for proper ventilation, temperature control, fire prevention, evacuation, and fire management.
- Provide easy access to the appropriate fire extinguishers for your product. Consult with your local fire department, state, and local codes to make sure that you are adequately prepared.
- Read this manual as well as all the literature provided in your "Owner's Information Packet". If you have any questions, consult your full-service distributor or call the Service Department at Liquid Controls.

IN THE EVENT OF A GAS LEAK:
In the event of a large gas leak:
Evacuate the area and notify the fire department.

In the event of a small, contained gas leak:
1. Stop the leak.
2. Prevent accidental ignition.
3. Prevent entrance of gas into other portions of the building. Some gases, such as LPG, seek lower levels, while other gases seek higher levels.
4. Evacuate all people from the danger zone.
5. See that the gas is dispersed before resuming business and operating motors. If in doubt, notify your local fire department.

IN THE EVENT OF A GAS FIRE:
In the event of large fires or fires that are spreading:
1. Evacuate the building and notify your local fire department.
2. Stop the leakage only if the equipment can safely be reached.

In the event of small, contained fires that you can safely control:
1. Stop the leakage only if the equipment can safely be reached.
2. Use the appropriate extinguisher: Class B fire extinguisher, water, fog, etc., depending on the materials. If in doubt, call your local fire department.

⚠ *WARNING*

All internal pressures must be relieved before disassembly of the meter, strainer, vapor eliminator, any valves in the system, the pulse output device, or the front and rear covers. **LINE PRESSURE MUST BE 0.0 PSI.** See "Meter Maintenance" on Page 15 for the procedures to relieve internal

How LC Meters Work

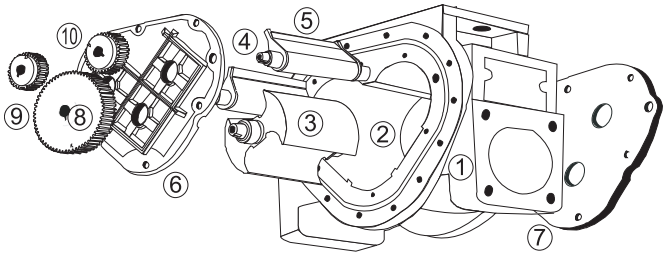
Liquid Controls MS-Series meters are positive displacement flowmeters. They are designed for liquid measurement in both custody transfer and process control applications. Because of their simple design, they are easy to maintain, and can easily be adapted to a variety of systems.

The meter element (1) is designed with three cylindrical bores (2). A Blocking rotor (3) and two Displacement rotors (4,5) turn in a synchronized relationship within the bores. The three rotors are supported by bearing plates (6,7). The ends of the rotors protrude through the bearing plates. Blocking rotor gear (8) is placed on the end of the blocking rotor (3). Displacement rotor gears (9,10) are placed on the ends of the displacement rotors (4,5). These gears create the synchronized timed relationship between the three rotors.

As fluid moves through the meter element, the rotor assembly turns. The liquid is segmented into uniform sections by the turning rotors. Fluid displacement happens simultaneously. As fluid enters, another portion of the fluid is being partitioned and measured. At the same time, the fluid ahead of it is being displaced out of the meter and into the discharge line. Since the volume of the bores is known, and the same amount of fluid passes through the meter during each revolution of the blocking rotor, the exact volume of liquid that has passed through the meter can be determined.

This true rotary motion is transmitted through either the pulse output device (POD) to the encoder, or the face gear and drive shaft to the counter/register. True rotary motion output means consistent accuracy since the register indication is in precise agreement with the actual volume throughput at any given instant.

At any position in the cycle, the meter body, the blocking rotor, and at least one of the displacement rotors form a continuous capillary seal between the un-metered upstream product and the metered downstream product.



Capillary seals mean no metal-to-metal contact within the metering element. This means no wear. No wear means no increase in slippage, and no increase in slippage means no deterioration in accuracy.

Throughout the metering element, the mating surfaces are either flat surfaces or cylindrical faces and sections that are accurately machined. These relatively simple machining operations, plus the fact that there is no oscillating or reciprocating motion within the device, permit extremely close and consistent tolerances within the LC meter.

The product flowing through the meter exerts a dynamic force that is at right angles to the faces of the displacement rotors. The meter is designed so that the rotor shafts are always in a horizontal plane. These two facts result in no axial thrust. Therefore, with no need for thrust washers or thrust bearings, the rotors automatically seek the center of the stream between the two bearing plates eliminating wear between the ends of the rotors and the bearing plates.

Liquid Controls meters are made of a variety of materials to suit a variety of products. Because of our no-wear design, capillary seals, and unique rotary metering, LC meters provide unequalled accuracy, long operating life, and unusual dependability.



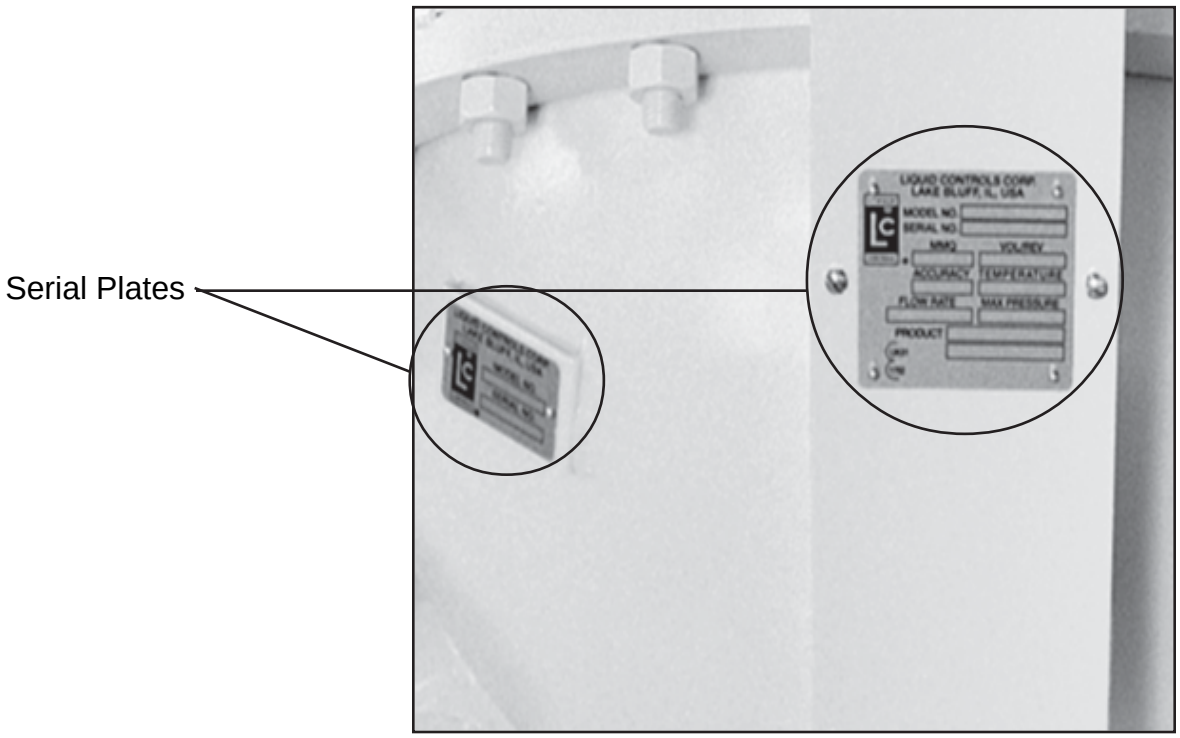
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Is all the documentation included with the meter? LC meters come in many variations. The information sent depends on the accessories ordered with the meter. Make an inventory of the "Owner's Information Packet". First, find the LC packing slip with the computer printout. Locate the serial number and the meter model number on this printout. Cross-reference the packing slip with the actual meter serial numbers.

Included in the "Owner's Information Packet" are the following:

- Installation, Operation & Parts Manuals (for all elements supplied such as LectroCount Register, Valves, Air Eliminators, etc.)
- Bill of Materials

Record the meter serial number in the space provided on Page 2 of this manual. This page also provides a space for the full-service distributor's name and telephone number, if applicable. Fill in this information and keep it handy. The meter serial number and model number will be required when calling for service or parts. See "How to Order Replacement Parts" on Page 35 in this manual.



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Installation Requirements

⚠ *WARNING*

All internal pressures must be relieved before disassembly of the meter, strainer, vapor eliminator, any valves in the system, the pulse output device, or the front and rear covers. **LINE PRESSURE MUST BE 0.0 PSI.** See "Meter Maintenance" on Page 15 for the procedures to relieve internal pressure.

- Make sure that all necessary safety precautions have been taken. Provide for proper ventilation, temperature control, fire prevention, evacuation, and fire management.
- Provide easy access to the appropriate fire extinguishers for the product. Consult with the local fire department and state and local codes to make sure that you are adequately prepared.
- Read this manual as well as the literature provided in the "Owner's Information Packet". If there are any questions, consult with the full-service distributor or call the Service Department at Liquid Controls.
- Install the meter and accessories in conformance with all applicable federal, state, local, construction, electrical, and safety codes.
- Class 10 meters for LPG must be installed in accordance with the requirements of ANSI-NFPA 58 in addition to all other state and local codes.
- Before shipment, protective thread caps were placed in all meter and accessory openings. They should remain in place until ready to attach piping.
- Prior to meter installation, the entire piping system should be thoroughly flushed of all debris, with a liquid that is compatible with the construction of the meter.
- Keep all external surfaces of the meter clean.
- The meter must always be securely bolted to a platform or supporting member, regardless of the mounting position of the meter. **Never "hang" a meter on the connecting pipe**.
- Prevent pipe strain or stress from occurring when making meter or accessory repairs. Pipe strain and stress occur when the pipes are not supported or are not aligned correctly to the meter. **The weight of the pipes must always be supported independent of the meter.** This means that the meter and accessories can easily be removed without affecting the pipes or the pipe alignment. Never leave any of the pipes hanging.
- Apply pipe compound to male threads only.
- Install the meter down stream of the pump.
- Position the meter with service in mind. Provide ample work space. Removing covers can be difficult when work space is not available. Always supply a platform or support for the meter mounting.
- A meter is metallurgically designed to be physically compatible with a given type of liquid, as originally specified by the customer, and as indicated on the Serial Number Plate. A meter should not be used with a liquid different from the liquid originally specified, unless the physical characteristics and pH rating are similar and the application has been checked with Liquid Controls Sales or Engineering.

NOTE: Always request up-to-date, engineering approved, dimensional drawings before starting any construction. Do not rely on catalog pictures or drawings which are for reference only. After receiving prints, check to see that all equipment ordered is shown and that any extra pressure taps, plugs, etc. are noted and their size specified.

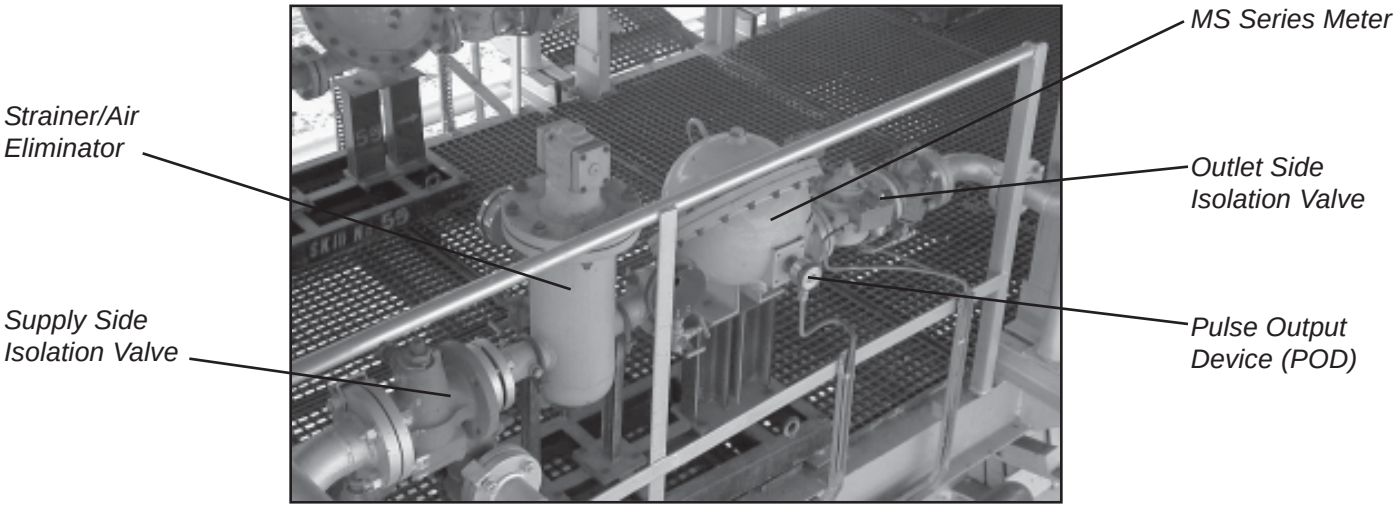
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Flowmeters must be installed properly if accuracy and repeatability of measurements are to be sustained over long periods of time. The system in which the meters are to be used must have provisions for controlling flow, transitional, and no flow conditions. Pressure, both hydrostatic and hydrodynamic, must be an integral part of the variables controlled in the flowing system. Systems in which meters are to be installed must be designed to eliminate transient pressure conditions, eliminate thermally induced pressure increases, and to exclude air or vapor.

The complete system must be kept full of product at all times. The photograph below is a typical fuel delivery gantry designed for loading rail tank wagons. This particular gantry has provisions for loading 152 rail tank wagons at one time. Four different fuels are supplied to the gantry through 16 inch pipe lines which are approximately ½ mile long. The pumps are centrifugal type and are located between 100 and 300 yards from the storage tanks.



The next photograph shows a typical gantry position. From left to right, there is a supply line attached to an isolation valve, a second isolation valve and piping leading vertically to the loading arm. The meter is equipped with a dual channel, quadrature pulse transmitter connected directly to a batch controller. The batch controller provides preset batch capability, flow rate control, and slow flow start and stop. There is one batch controller for each metering position.



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Design For Calibration

Field calibration of meters is essential. Calibration conducted during meter production is to confirm the meter is capable of attaining the required accuracy/linearity and repeatability.

Typically, the meter characteristics are:

Mechanical Registration
- Repeatability: Capable of .02% or better at any flow rate over entire range
- Linearity: ± .125% over a 5:1 range
- Linearity: ± .22% over a 10:1 range
- Linearity: ± .5% over a 40:1 range

Electronic Registration
- Repeatability: Capable of .02% or better at any flow rate over entire range
- Linearity: ± .1% over a 5:1 range
- Linearity: ± .1% over a 10:1 range
- Linearity: ± .15% over a 40:1 range

The meters are normally tested against a master meter that has been proven against a Weights & Measures certified, volumetric prover.



Volumetric Prover

The pictures below show a properly configured meter installation and mobile master prover. The prover connections are at the right. The two valves to the left of the meter are for connecting the volumetric prover or master meter to be used for calibration. The valve mounted in the vertical line between the two horizontally mounted valves is a double-block, bleed valve used to ensure there is no leakage through the valve during calibration.



Proper Meter Installation

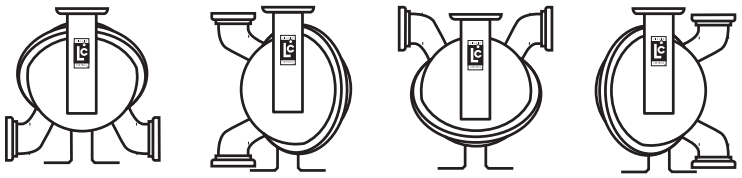


Mobile Master Proving Trolley

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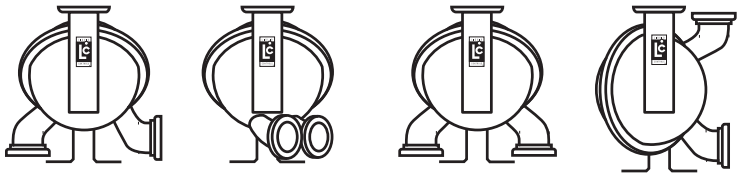
Design for Standard Mounting Arrangements
(straight through flow)

Regardless of meter mounting configuration, accessories such as the air/vapor eliminator must always be mounted in a vertical orientation to permit proper operation of the float-actuated apparatus.



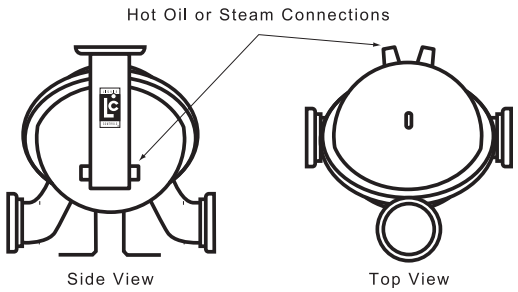
Design for Special Mounting Arrangements

Special flange arrangements are available as shown. Contact the factory for details or additional information.



Design for Hot Oil/Steam Jacket Options

Heating a meter can be accomplished by hot oil/steam jacketing the meter's rear cover and/or packing gland boss. A heat jacketed meter does not preclude the necessity for insulating the meter and surrounding piping.



Design for Ensuring the System Remains Full of Product

The first consideration is merely filling the piping for the first time. The filling of the system must take place slowly in order to avoid pressure "spikes" or transients caused by rapid acceleration or deceleration of the liquid. Under gravity flow conditions, pressure transients in orders of magnitude larger than the available head pressure are possible.

At this time, air must be removed from the system. Make sure that a positive head condition is always present in the system (which should be designed into the system). Air or vapor in the system contributes to error in measurements while metering. Once air is removed from the system, ensure that the system design does not allow for air to re-enter the system once it is full of product.

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Design for Thermal Shock or Expansion

Temperature considerations in system design should not be ignored. Care must be taken in the design so that zones are not created where fluid can be trapped or locked between two closed valves. For every 1°F increase in temperature, pressure in the trapped zone will increase by an amount depending on the product in the system (70 psi for LPG). A few degrees increase in ambient temperature may create a serious problem if thermal expansion pressure relief is not included in regions where the product may be trapped. Typically, the pressure setting in a thermal relief valve is set approximately 10% higher than the nominal operating pressure.

Design for Proper Flow Control

The example on Page 7 shows 152 meters monitoring the delivery of 4 different products. Thirty eight meters are used for delivery of HSD. Assume that one (1) pump is selected to supply product to the meters. Each meter measures 375 gallons per minute (GPM). The total flow capacity of the pump must be:

38 X 375 GPM or 14,250 GPM.

Once the system is in operation, product flows through the first meter when the control valve is opened. If the flow rate is not regulated, 14,250 GPM attempts to flow through the meter. The resulting overspeed will immediately damage the meter. It is critically important that a each meter location be equipped with a digital or hydraulic flow rate controller. These valves must be downstream of the meter to ensure that the meter remains full of product at all times.

Control must also be used when beginning or stopping flow. Proper control will minimize or eliminate transient pressure conditions brought on by rapid velocity changes in the system.

Commissioning

Once the metering system is installed, it is ready for commissioning. Filling the system the first time requires care and time. Ensure that the isolation valve on the inlet side of the meter is closed. Pressure the header by starting the pump. At the meter position to be commissioned, “crack” or slightly open the inlet isolation valve until flow into the meter can be heard. Allow the inlet side to remain in this slightly opened position until flow stops.

At this time, “crack” or loosen the pipe plug on top of the meter case to allow air to bleed out. Once the air is eliminated and product is present, fully tighten the plug. Open the inlet side isolation valve completely. The system must be kept full of fluid to avoid damage to the meter. If air is allowed inside the metering element, significant damage can occur as this air expands or compresses due to system flow and pressure conditions. In extreme cases, the presence of air can cause catastrophic failure of the measuring element as a result of liquid velocities and transient pressure spikes that can bend or break critical measuring elements. The rate at which the system is filled and pressurized must be controlled to eliminate the possibility of creating any pressure transients from excessive liquid velocity. Once the meter and system are filled, pressurized, and free of air, flow may begin.

Care must be taken during the initial flow condition to prevent damage to the meter or strainer due to foreign debris in the piping system. Foreign particles not removed during flushing and hydrotesting will collect in the strainer basket. Monitor the strainer differential pressure for the first month of operation. Clean the strainer basket if needed. Examine the strainer basket carefully and replace if damaged.

Assure that the thermal relief valves are installed and functioning properly.

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The meter must remain full of product at all times. An easy way to accomplish this is to put the meter assembly in the line below the piping center-line (a sump position). This requires adding elbows and flanges prior to installing the meter. The meter should be installed with a bypass loop, below the pipe center-line, with block valves upstream and downstream. A block valve should be located in the mainstream, labeled as the bypass valve. **A word of caution:** any portion of pipe system that might isolate or block flow should be provided with a pressure relief to prevent damage from thermal expansion. There are excellent benefits to this type of installation. First, the meter is kept full. Second, this type of installation allows the meter to be isolated for servicing and calibration while continuing flow through the bypass valve.

Upstream lines must be maintained full to prevent air from entering the meter. If the upstream or inlet lines are constructed in a manner which allows reverse flow, foot valves or back checks must be installed.
NOTE: Use soft seats, not cast iron swing checks.

Every meter should be calibrated under actual service and installation conditions per the API Manual of Petroleum Measurement Standards:

Chapter 4: Proving Systems
Chapter 5: Metering
Chapter 6: Metering Assemblies
Chapter 11 Section 2.3: Water Calibration of Volumetric Provers
Chapter 12 Section 2: Calculation of Petroleum Quantities

These chapters of the API Manual of Petroleum Measurement Standards supersede the API Standard 1101.

Provide a means of conveniently diverting liquid for calibration purposes.

Give careful attention to your system's pumping equipment and piping because of their influence on liquid being measured as it enters the meter assembly. Systems should be made free of conditions that cause or introduce entrained air or vapor.

Follow the manufacturer's recommendations fully when installing pumps. Give particular attention to factors like: use of foot valves, pipe size to the inlet and conformance to net positive suction head (NPSH) conditions when suction pumping is required. Following the manufacturer's recommendations will minimize air and vapor elimination problems.

For all products, it is desirable to use flooded suctions and piping sized larger than the normal pump size.

Hydraulic shock is harmful to all components of an operating system including valves, the meter and the pump. In particular, meters must be afforded protection from shock because of their need to measure with high precision. Generally the best protection is prevention, which can be readily accomplished by adjusting valve closing rates in such a manner that shock does not occur. Shock pressure and system pressure are independent of each other.

Thermal expansion like hydraulic shock is a phenomenon that can easily damage meters and systems in general. Care should be taken in designing the system to include pressure relief valves in any portion or branch of the system that might be closed off by closure of operating valves or block valves. Note that 1°F is equivalent to an increase amount depending on the product in the system (70 psi for LPG).

⚠ *WARNING*

Under normal operation, do not expose any portion of the LP-Gas system to pressures in excess of rated working pressures without an automatic safety valve to vent the over pressure discharge to a place of safety away from the operator and other people. Failure to provide such a safety relief may result in leakage or rupture of one or more of the components in the system. This can result in injury or death from the gas, a fire, or pieces of flying debris from the rupture.

When a Back Check Valve is used, an automatic safety valve must be installed to prevent pressure buildup (thermal expansion) in excess of rated working pressure in the meter housing. One automatic safety valve should be installed in each meter. Remove the pipe plug from the front cover or rear cover and insert the appropriate automatic safety valve.

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Meter Start Up and Operation

Prior to meter start up, use extreme caution. Make sure that:

1. The meter is properly secured
2. All connections are tight
3. All valves are in the closed position

Placing your meter in operation:
Check to determine that all fittings and flanges are tight and liquid lines are closed.

Open the vapor line to the meter. Using vapor pressure only, check each joint with a liquid soap solution to see that no leaks go undetected. When all joints have been checked, admit liquid SLOWLY to avoid operation on vapor at speeds greater than the maximum indicated on the serial number plate and to insure that cover cavities do not contain vapor which can be compressed. Proper slow filling can be done by throttling the system with a valve at the meter OUTLET.

With the valve(s) open between the tank and the meter, go to the valve located down stream of the meter. Open the down stream valve slowly until the meter's register/ counter starts to move. Do not run the meter any faster than 25% of its maximum rated flow during start-up. Once the product is flowing out the end of your system, the outlet valve can be opened all the way provided that the system is designed not to exceed the flow rate marked on the meter.

NOTE: If the valves are not manual, consult the valve manufacturer for slow flow start-up.

Filling the system with a pump:
Consult the pump manufacturer for proper pump priming. Once the pump is primed with product, proceed.

NOTE: Make sure that your pump can operate against a dead head pressure. If NOT, consult the factory for assistance.

Never operate the meter or system when partially filled with liquid, or with pockets of compressed air or vapor present. If these conditions cannot be avoided, air and vapor elimination systems may be required. If you cannot fill the meter slowly by gravity or by using a valve to throttle back the flow, consult the factory.

- Do not operate the meter at a pressure exceeding that marked on the Serial Number Plate. Under any and all pressure producing circumstances, for instance, thermal expansion and hydraulic shock, the working pressure must not exceed the indicated maximum.

- If the meter is operated at a rate greater than the maximum recommended GPM, excessive wear and premature failure may occur.

The meter can be calibrated for flows below minimum ratings if the flow remains constant and varies within narrow limits or if the product is viscous. A meter should never be run beyond the maximum flow rate determined for that class meter and/or liquid measured.

Electronic Registration

Liquid Controls' family of LectroCount® electronic registers provide near-perfect metering accuracy over a full range of flow rates and deliver enhanced functions including: automated data collection (i.e., date, time, product, delivery quantity and more), on-site ticket generation, meter linearization, electronic temperature volume compensation, real-time communication capabilities (RF, GPS, CDPD), improved security and more.



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Reversing the Meter Registration

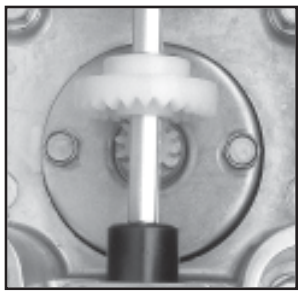
The direction of flow is specified by the customer when the meter is ordered. The standard direction of flow is from left to right when facing the front of the meter. A red, pressure sensitive label indicating the inlet is affixed to the meter at the time of shipment.

If the meter is equipped with a strainer and/or valve, the strainer and/or valve **MUST** be moved when reversing the direction of flow through the meter. **The strainer should always be located on the inlet side of the meter.** When the meter is equipped with a valve, it is moved to the outlet side of the meter. Some repositioning of the valve components may be required. See the Valve Manual in the Owner's Information Packet.

When the meter is first installed, check the register. If the register counts **DOWN** (numbers decrease) the direction of registration must be reversed by either reversing the position of the adjuster drive gear or by reprogramming the direction of flow using the Lap Pad (for LectroCount electronic registration). Consult the LectroCount Operation Manual provided in the Owner's Information Packet.

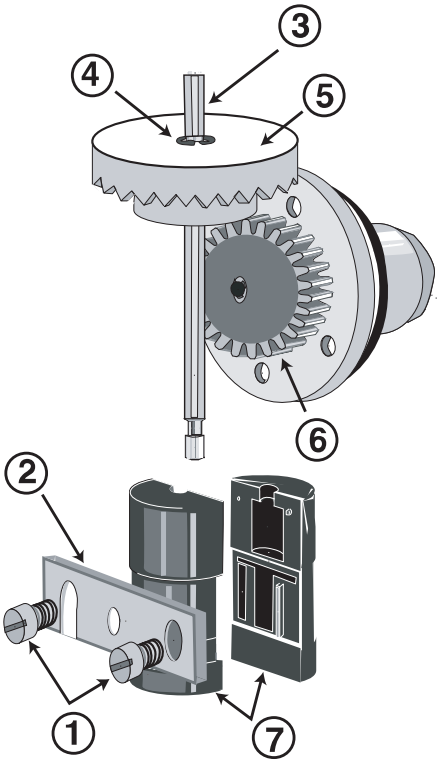
Reversing the drive to the register is accomplished by reversing the position of the adjuster drive gear relative to the pinion gear of the packing gland.

Adjuster drive gear engaged from the top.



Adjuster drive gear engaged from the bottom.





1. See Meter Maintenance on Page 15 and "Servicing the Drive Components" on Page 17, for instructions on removing the dust cover.
2. Remove the retaining spring screw(s) (1) with a standard screwdriver.
3. Remove the retaining spring (2).
4. Remove the drive shaft (3) mounted with the adjuster driver gear assembly (4, Retaining Ring) (5, Adjuster Drive Gear).
5. Remove the retaining ring (4) with a screwdriver or pliers.
6. Remove the adjuster driver gear (5) and turn it 180° so that it is upside down from the original installed position. The bushing (7) supports the adjuster drive gear in the lower position. The retaining ring (4) supports the adjuster drive gear in the upper position.
7. Reassemble the parts in reverse order. Make sure that the adjuster driver gear meshes with the packing gland's pinion gear (6) without being too tight. Make sure there is a little play in the gear teeth. The retaining ring (4) should be placed in the grove provided on the drive shaft (3) regardless of the adjuster drive gear position. The packing gland pinion gear to adjuster drive gear ratio is either 1:1 or 2:1. In the 2:1 ration, the pinion of the packing gland is smaller in diameter.

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Setting the Standard Adjuster

Note: These instructions apply to meters equipped with mechanical output accessories only. If the meter is equipped with an electrical output assembly, refer to the accessory manual, such as the Pulser Manual or LectroCount Manual in your Owner's Information Packet.

1. See Meter Maintenance on Page 15, and "Servicing the Drive Components" on Page 17, to remove the dust cover.

2. Check meter registration by delivering product to a reliable, accurate prover. Perform multiple delivery tests to verify the meter repeatability.

3. Record the setting indicated on the adjuster.

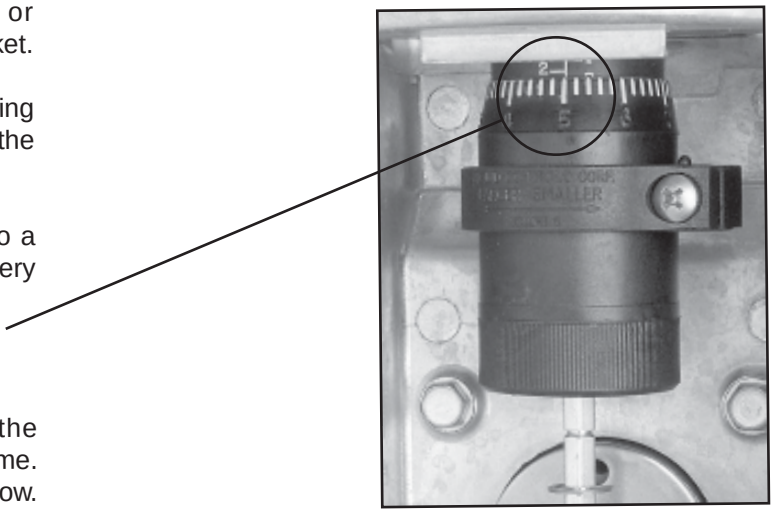
4. Note the volume in the prover. Calculate the difference between the counter and prover volume. Multiply the result by 100. Refer to the formula below.

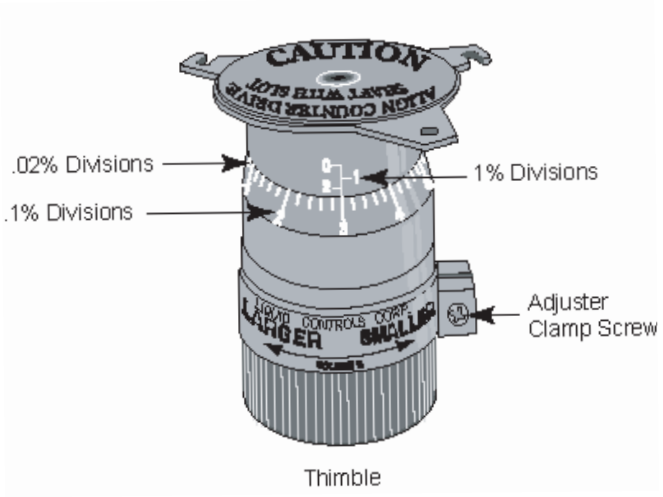
5. Loosen the adjuster clamp screw.

6. When the prover volume is less than the meter counter volume, add the percentage to the original adjuster setting by turning the thimble towards the arrow marked LARGER (volume). Correct the original setting by approaching the number desired from the next larger number. For example, a desired adjuster setting is "3.4". Turn the adjuster thimble to the left to number "4", then to the right to obtain the "3.4" setting.

7. When the prover volume is more than the meter counter volume, subtract the percentage from the original adjuster setting by turning the thimble in the direction of the arrow marked SMALLER (volume).

8. Retighten the adjuster clamp screw. Run product through the meter to allow the adjuster to take set. Then make several prover runs to check for accuracy and repeatability.





$$\% \text{ CORRECTION} = \frac{\text{VOLUME IN PROVER - VOLUME ON METER COUNTER}}{\text{VOLUME IN PROVER}} \times 100$$

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⚠ WARNING

RELIEVING INTERNAL PRESSURE

All internal pressure must be relieved to zero before disassembly or inspection of the strainers, air eliminators, valves, the pulse output device (POD), or the front and rear covers.

Serious injury or death from fire or explosion could result from maintenance of an improperly depressurized and evacuated system.

Procedure for Non-LPG Meters

1. Turn off pump pressure.
2. Close valves before and after the meter.
3. Remove pressure by cracking open the drain plugs until pressure is relieved. Then open the drain plugs completely and drain the meter.

Procedure for LPG System Meters

1. Close the belly valve of the supply tank.
2. Close the valve on vapor return line.
3. Close the manual valve in the supply line on the inlet side of the meter. If no manual valve exists on the inlet side, consult the dispenser manufacturer for procedures to depressurize the system.
4. Slowly open the valve/nozzle at the end of the supply line.
5. After product has bled off, close the valve/nozzle at the end of the supply line.
6. Open the bleed valves located on the strainer cover and meter cover (if equipped) to relieve pressure in the system. Product will drain from the meter system.
   Caution: If the systems contains a Back Check Valve, pressure inside the meter housing MUST be relieved by opening the bleed valve in the meter cover (if equipped) or by loosening one of the pipe plugs in the meter cover. This procedure must be done for each meter.
7. As product is bleeding from the bleed valve, slowly reopen and close the valve/nozzle on the discharge line. Repeat this step until the product stops draining from the bleed valve and discharge line valve/nozzle.

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Meter Maintenance

Prevent pipe strain or stress from occurring when making meter or accessory repairs. Pipe strain and stress occur when the pipes are not supported or are not aligned correctly to the meter. The weight of the pipes must always be supported independent of the meter. This means that the meter and accessories can easily be removed without affecting the pipes or the pipe alignment. Never leave any of the pipes hanging.

Seasonal meter storage. If the meter is used for seasonal work, at the end of each season the meter should be removed from the system and thoroughly flushed with a compatible liquid. This includes removing the drain on the front and rear covers. Then flush the product from the front and rear covers. If flushing with water is preferred, extra care should be taken to drain the meter completely and to dry all internal parts. Immediate refilling with a compatible liquid (or oil misting) is essential to prevent corrosion as well as ice damage to parts from moisture that was overlooked after flushing and drying.

Do not mar or scratch any of the precision machined surfaces by prying or sanding parts.

Torque specifications. All fasteners such as screws and bolts should be torqued to proper specification. See the "Torque Chart" on Page 31 of this manual.

Stone the machined surfaces when reassembling the meter to assure that the machined surfaces are free of burrs and mars.

Repair pulled threads with threaded insert fasteners. These can be used in many instances. Contact your full-service distributor for advice if this occurs.

Coating threads. When removing and replacing bolts and castings in a meter, always coat the threads with anti-seize.

Removing flange seals. When removing the flange assembly, always carefully remove the O-ring seal. Make sure that the flange surface is clean. Discard and replace the old O-Ring seal if it is nicked or scratched in any way. If it is undamaged, it can be reused.

Examine all fasteners. Make sure fasteners are not bent, rusted, or have pulled threads. The threads should all appear evenly placed. If the bolts are bent, check the housing and bearing plate for flatness. Use a straight edge to determine flatness.

Look for gaps. When disassembling a meter, use a feeler gauge to check for gaps between the bearing plate and housing. If you do find gaps, check the bearing plates for flatness with a straight edge. Gaps can be caused by shock problems that must be resolved. Contact your full-service distributor or the Service Department at Liquid Controls for assistance if this occurs.

Check the O-Rings. O-Rings should be smooth. Cracked or worn O-Rings should be replaced. However, a more serious problem of shock may have occurred if the O-Rings look nibbled. Shock problems must be verified and resolved. Contact your full-service distributor or the Service Department at Liquid Controls for assistance if this occurs.

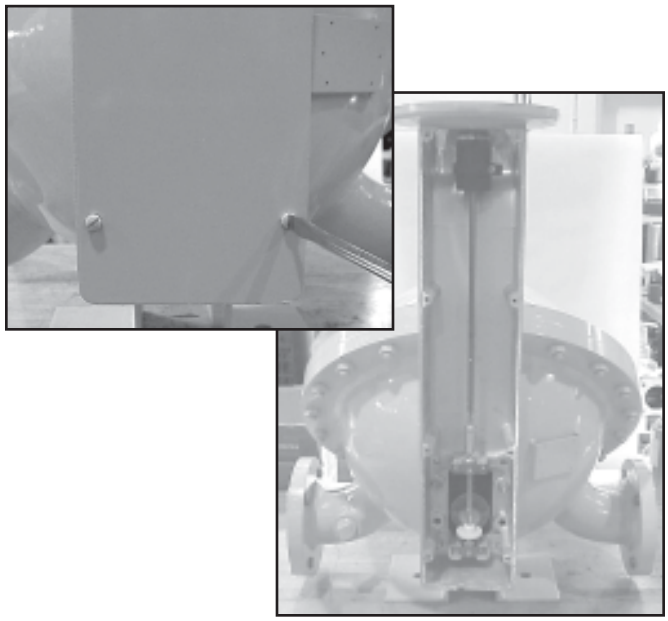
Check the bearing plates. Check the bearing plates for flatness. Use a straight edge. Warped bearing plates can be caused by shock problems that must be resolved. Contact your full-service distributor or the Service Department at Liquid Controls for assistance if this occurs.

Weights & Measures. Check with the regulatory agency that governs Weights & Measures in your area. Removing a seal wire may require Weights & Measures recalibration.

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Removing the Dust Cover

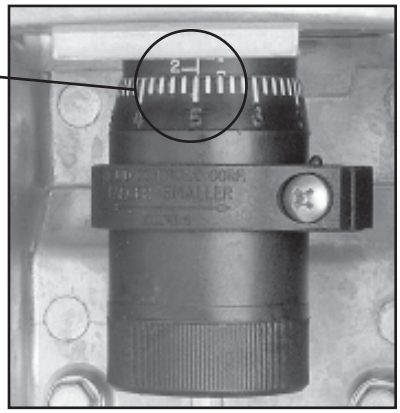
1. Cut the dust cover seal wire (if present) with a side cutters. Remove the dust cover screws with a flat blade screwdriver. Remove the dust cover.



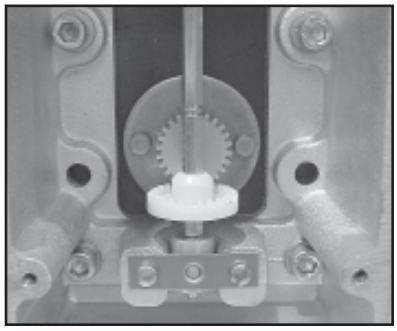
NOTE: See Relieving Internal Pressure and Weights & Measures in the Meter Maintenance section on Page 15 of this manual.

Removing the Adjuster and Adjuster Drive Assembly

2. Record the Adjuster Micrometer setting.



3. Carefully note the adjuster drive gear position. The gear engages the packing gland pinion from below (shown) or above. The gear must be reinstalled in its original position or the register counter will run backwards.

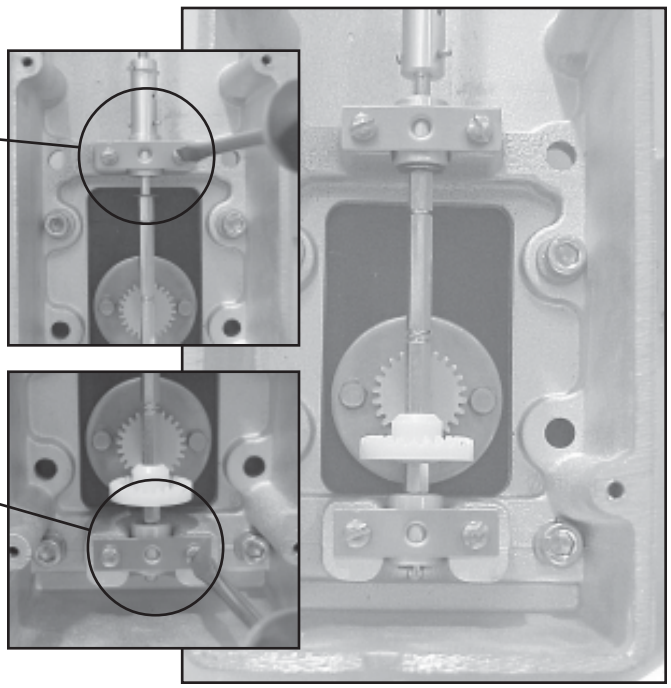


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Removing the Adjuster and Adjuster Drive Assembly (Continued)

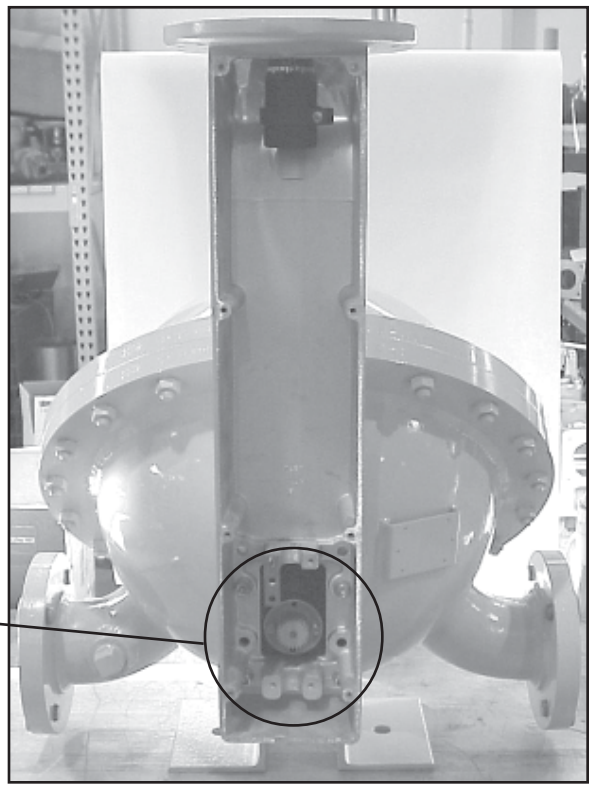
4. Use a flat blade screwdriver to remove the two screws of the upper retaining spring.

5. Use a flat blade screwdriver to remove the two screws of the lower retaining spring.



6. Remove the drive assembly.

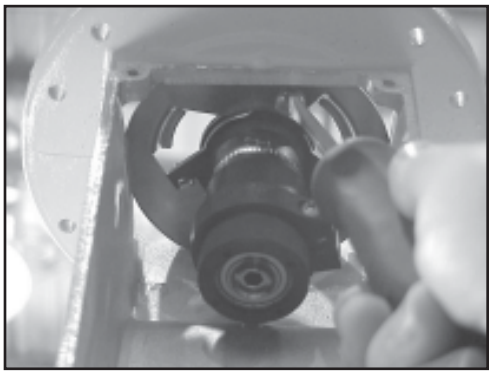
If there is a need to remove the entire counter adapter assembly, remove the 4 screws located at the bottom end of the assembly.



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Removing the Adjuster and Adjuster Drive Assembly (Continued)

7. Remove the Adjuster assembly by removing the single screw holding it in place. The adjuster can then be rotated clockwise and removed from below.



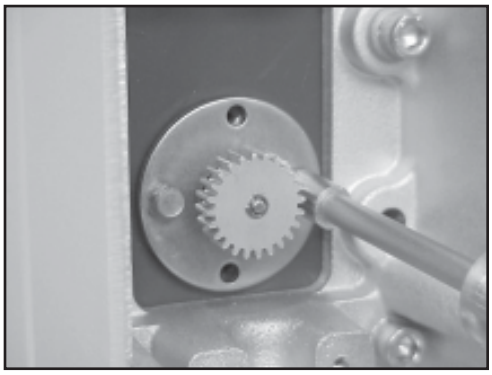
Removing the Packing Gland

⚠ *WARNING*

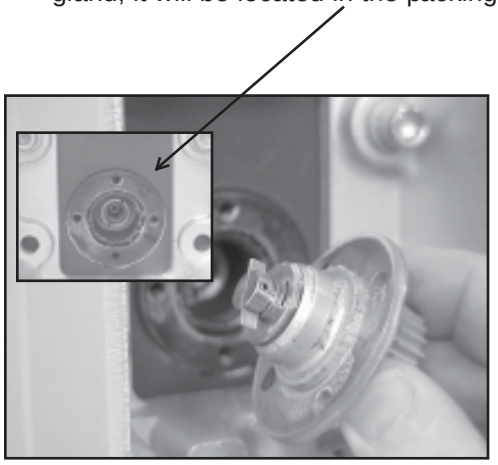
All internal pressures must be relieved before disassembly of the meter, strainer, vapor eliminator, any valves in the system, the pulse output device, or the front and rear covers. **LINE PRESSURE MUST BE 0.0 PSI.** See “Meter Maintenance” on Page 15 for the procedures to relieve internal pressure.

8. Remove the two packing gland retaining plate screws with a 5/16” socket and ratchet driver extension or 5/16” nut driver.

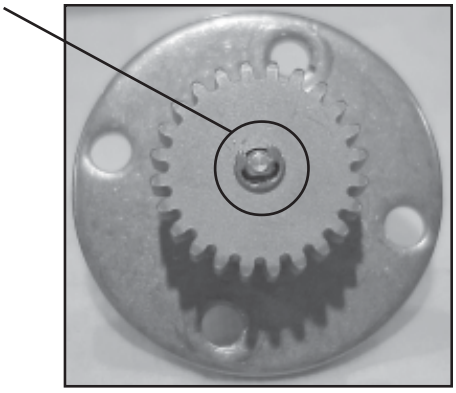
   NOTE: It is not necessary to completely remove the stack from the meter to service the packing gland.



9. Pull out the packing gland. There is an O-Ring for the packing gland which may not come out with the packing gland. If it does not come off with the packing gland, it will be located in the packing gland well.



The packing gland may be taken apart by removing the retaining ring from the gear end of the assembly.

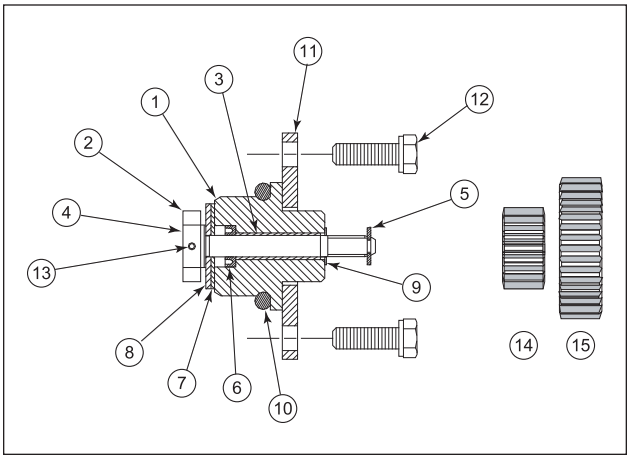


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Servicing the Drive Components

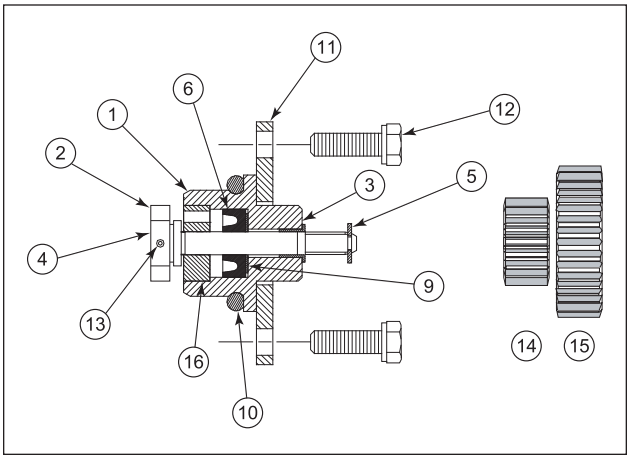
Standard Packing Gland

1. Housing
2. Drive Blade
3. Bushing
4. Shaft
5. Retaining Clip
6. “U” Cup
7. Rulon Thrust Washer
8. Stainless Steel Thrust Washer
9. Nylon Washer
10. O-Ring
11. Retaining Plate
12. Retaining Plate Screws (2)
13. Roll Pin
14. Output Gear 1:2
15. Output Gear 1:1



LPG Packing Gland

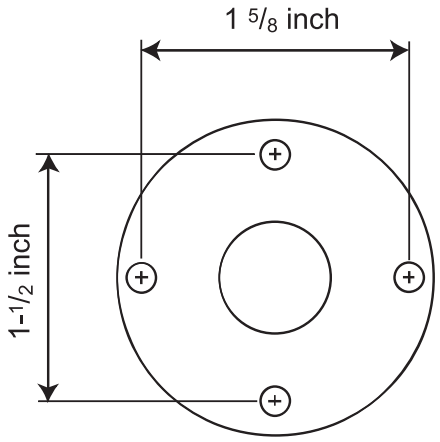
1. Housing
2. Drive Blade
3. Bushing
4. Shaft
5. Retaining Clip
6. “U” Cup
9. Stainless Steel Washer
10. O-Ring
11. Retaining Plate
12. Retaining Plate Screws (2)
13. Roll Pin
14. Output Gear 1:2
15. Output Gear 1:1
16. Carbon Guide Bearing



The Retaining Plate

The retaining plate has four holes”
Two that are drilled 1.5” on center
Two that are drilled 1.625” on center.

Turn the retaining plate until the holes match up with the threads to determine which orientation is correct for the meter being serviced.



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Tools:
Torque Chart
Wrench & Socket Size Chart
Counter bracket wrench or socket
Drain plug wrench
Cover socket or open end/box end wrench
Standard screwdrivers (2)
Spare displacement rotor gear
Bearing plate wrench
Plastic or rubber mallet
Emery cloth
Wire brush

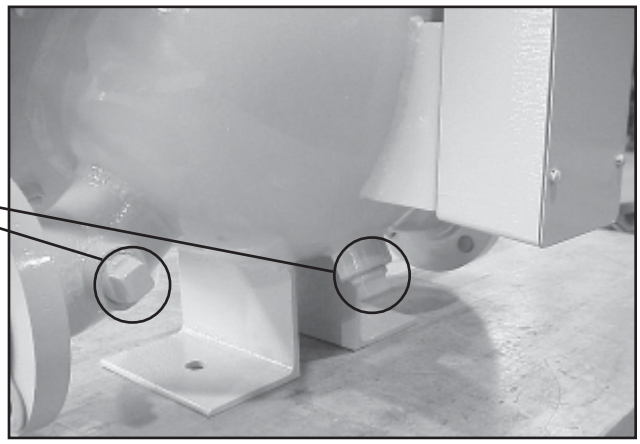
(See Pages 31 & 32 for the Torque and Wrench & Socket Size Charts)

⚠ *WARNING*

All internal pressures must be relieved before disassembly of the meter, strainer, vapor eliminator, any valves in the system, the pulse output device, or the front and rear covers. **LINE PRESSURE MUST BE 0.0 PSI.** See "Meter Maintenance" on Page 15 for the procedures to relieve internal pressure.

Draining Fluid from the Meter

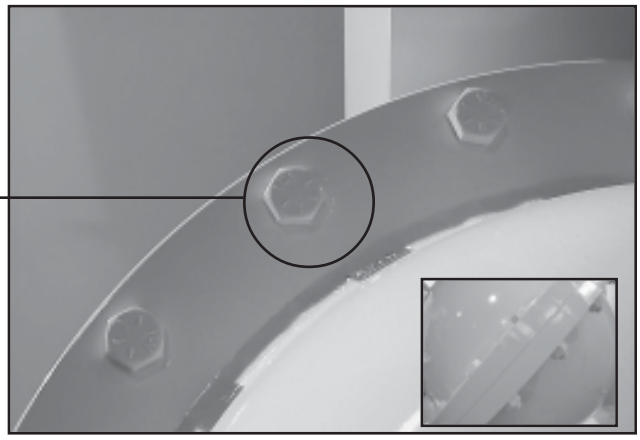
1. After the internal pressure has be relieved, open the drain plugs located at the bottom of the weldment assembly and discharge arm to drain all fluid from the weldment assembly.



Opening the Weldment Assembly

2. Once the system has been completely drained, the weldment assembly may be opened by removing the cover screws and bolts that are located around the rim of the enclosure.

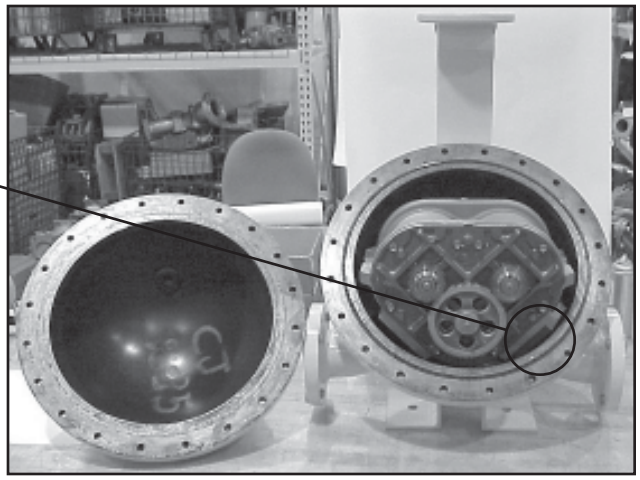
   The number of bolts may vary between the different meter sizes.



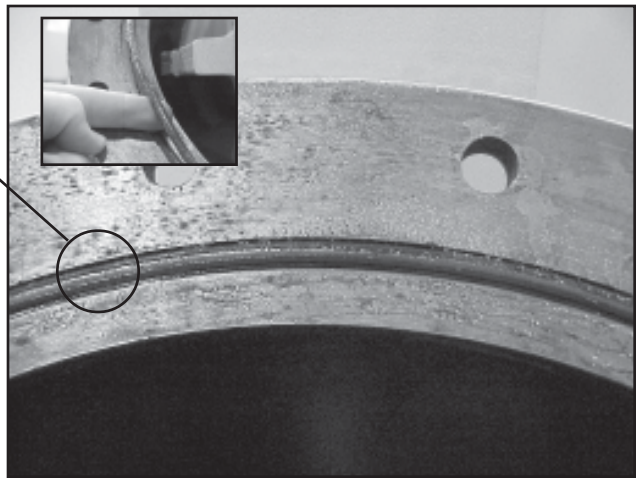
Disassembling the Meter

3. When all the screws and bolts have been removed, remove the weldment cover. This exposes the inside of the weldment assembly and provides access to the meter assembly. The meter assembly is held in place by 4 bolts on the inlet side of the meter. This can be either side of the meter depending on the direction of flow.

   Access to these four bolts is gained by removing the front bearing plate of the meter housing.



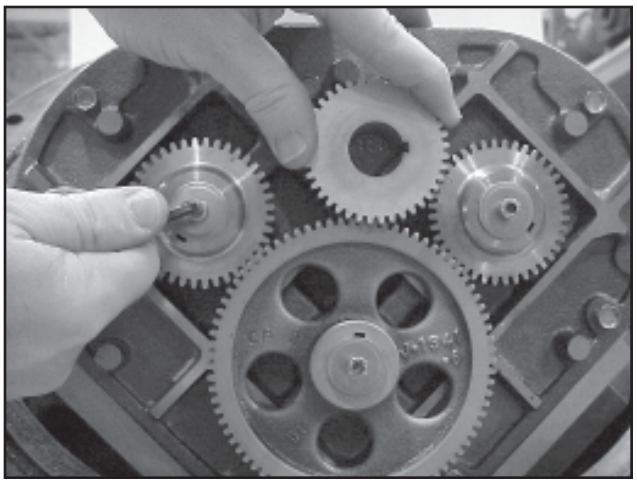
4. Remove the O-Ring from the weldment assembly. Undamaged O-Rings may be reused.



Removing the Rotor Gears

5. Hold a spare displacement rotor gear between the right displacement rotor gear and the blocking rotor gear to keep them from turning. If a spare gear is not available, use a shop rag between the gear teeth. Use the rotor gear allen key to loosen the rotor gear screw by turning it counter-clockwise. Do not remove the screw completely.

   NOTE: Do not use a metallic tool for locking the gears as this will likely result in damage to the gear teeth.



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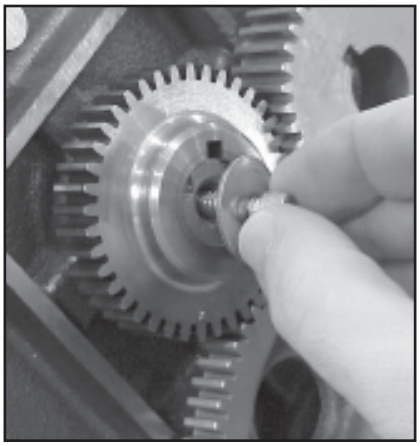
6. Keeping the spare displacement gear between the right rotor gear and blocking gear, use the allen wrench to loosen the screw of the right rotor gear assembly.

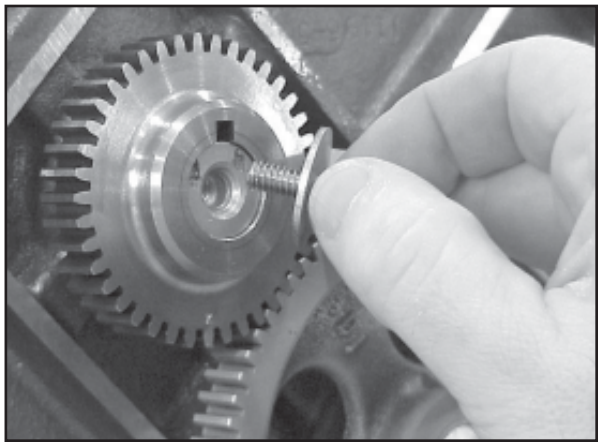


7. To loosen the screw of the blocking rotor gear, move the spare displacement rotor gear to between the left rotor gear and the blocking rotor gear to prevent the gears from moving.

   Once all the screws are loose, remove the screws and washers completely from each of the 3 gear assemblies.







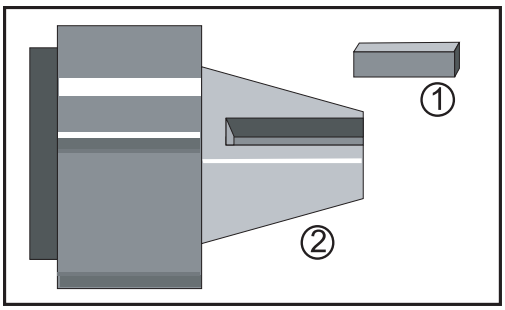
PERMIAN GLOBAL, INC. AND MANTICORE FUELS, LLC EXHIBIT 1013, Page 109

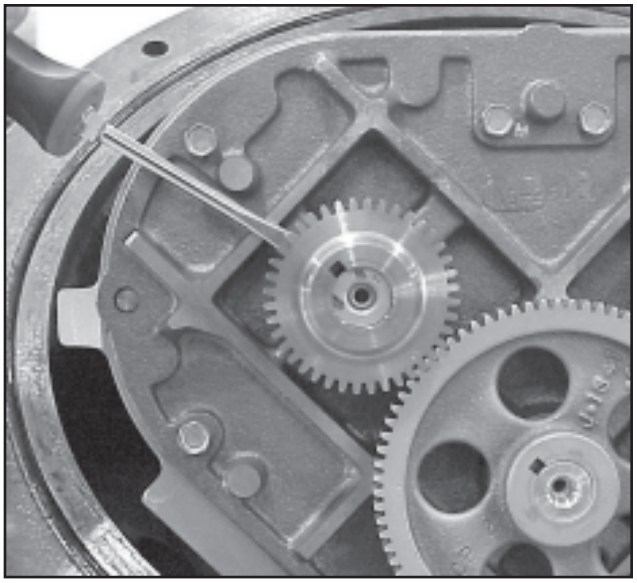
Disassembling the Meter

Removing the Rotor Gears

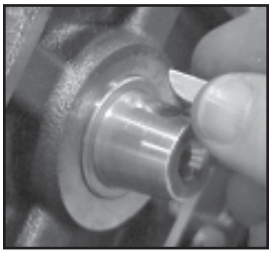
8. Using one or two flat blade screwdrivers, gently pry the gear off its rotor tapered end. Do this for each of the gears.

   As the rotor gear comes off, remove the key (1) from the rotor keyway (2). Save the key to use when reassembling.



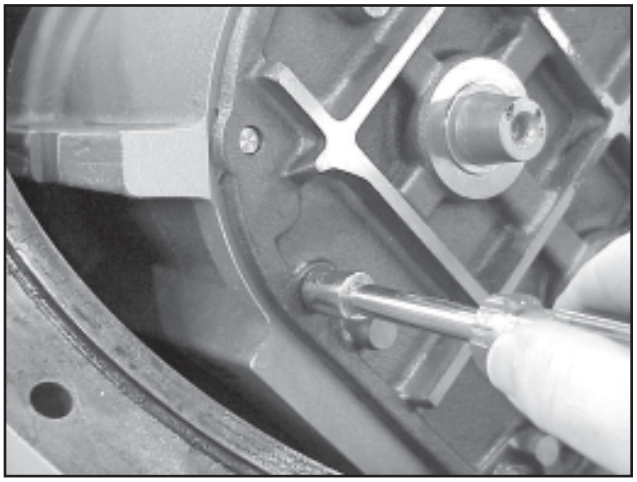






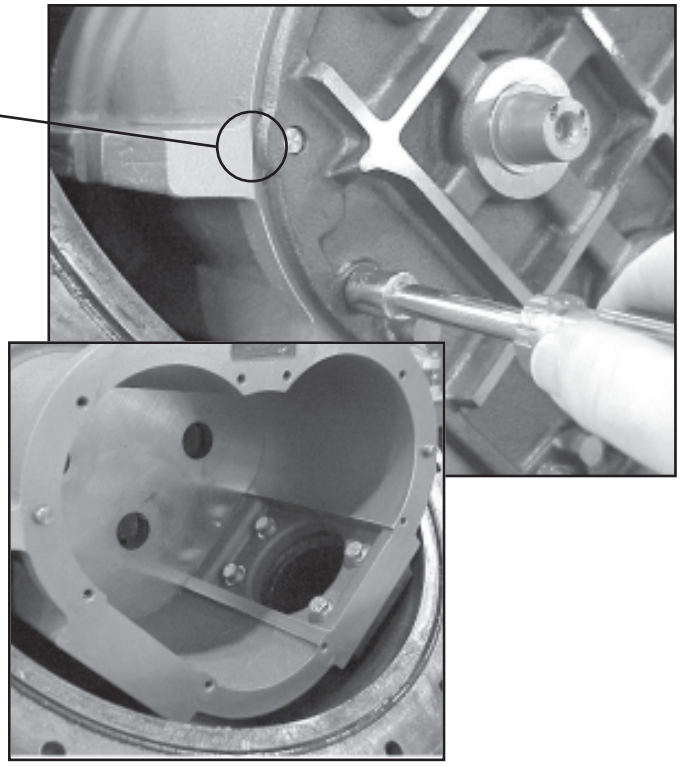
Removing the Bearing Plates and Rotors

9. Use the bearing plate wrench or nut driver to remove the screws that hold the front bearing plate to the meter housing. The number of screws varies between the different meter sizes.



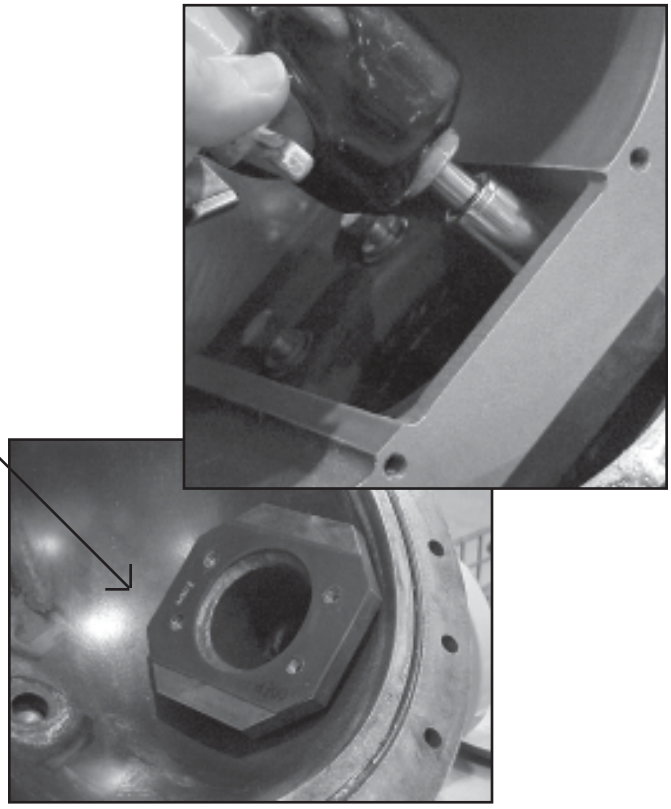
PERMIAN GLOBAL INC. AND MANTICORE FUELS, LLC EXHIBIT 1013, Page 110

10. When all the bolts are removed, insert a screwdriver into each of the two notches near the dowel pins. Be careful not to mar any of the surfaces. Gently pry the front bearing plate off the dowel pins. Remove the front bearing plate and rotor assemblies by pulling a rotor straight out from the housing. Be careful not to mar any of the surfaces.



Removing the Meter Housing Assembly

11. The meter housing assembly is held in place by four bolts. Remove these using an impact or socket wrench. There is a flat gasket between the meter housing and the weldment housing. Inspect this gasket for damage and replace as needed.

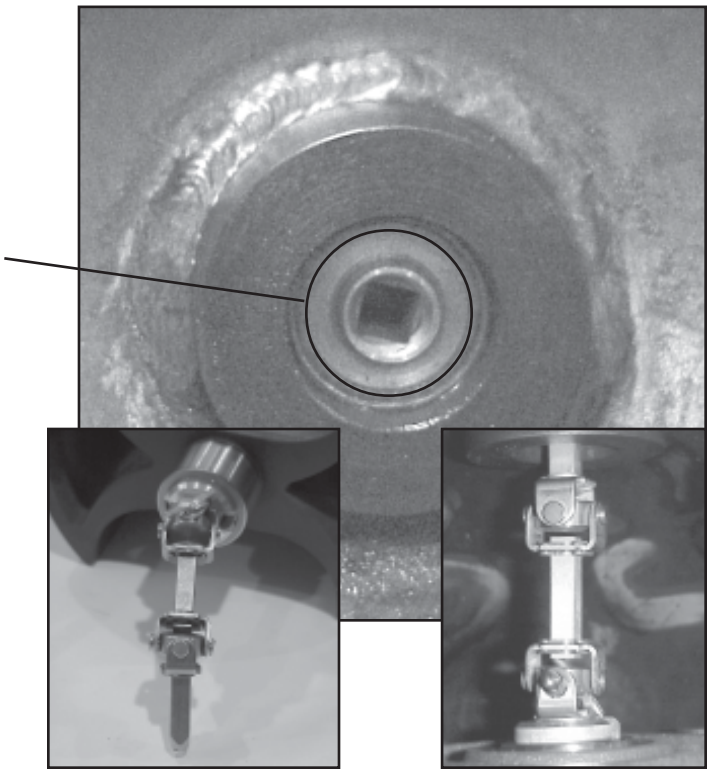


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Disassembling the Meter

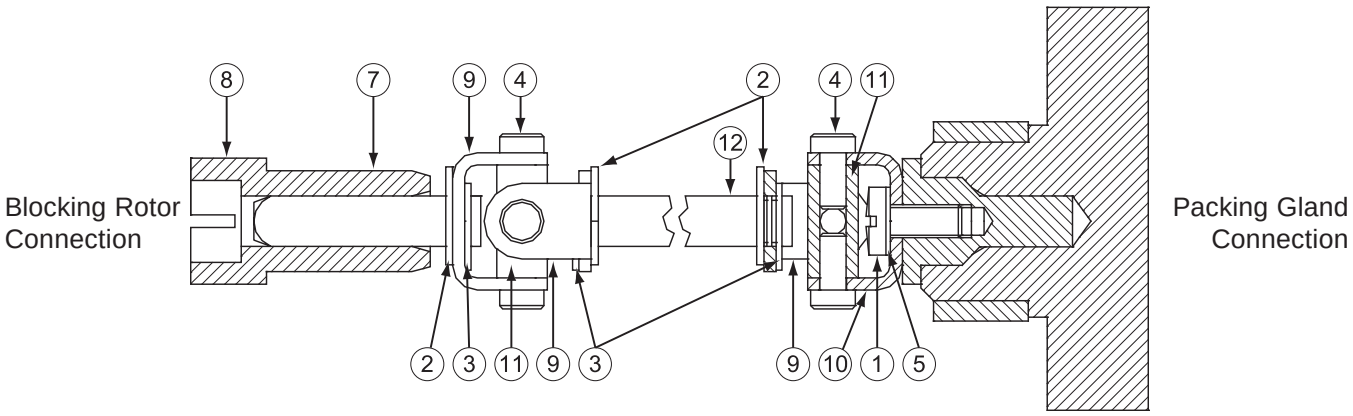
Universal Joint Assembly

12. The Universal Joint is an extension used to connect the blocking rotor of the meter to the packing gland. When the blocking rotor rotates, the Universal Joint causes the packing gland to rotate which drives the register. This assembly extends through the back of the meter and into the weldment wall through the drive coupling bearing.



Universal Joint Components

1. Screw, #8-32
2. Retaining Ring (3)
3. Retaining Ring (3)
4. U-Joint Pin (8)
5. Lock Washer
6. Coupling
7. Drive Coupling
8. Driver Packing
9. U-Joint Bracket
10. Coupling
11. Trunnion



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Tools:

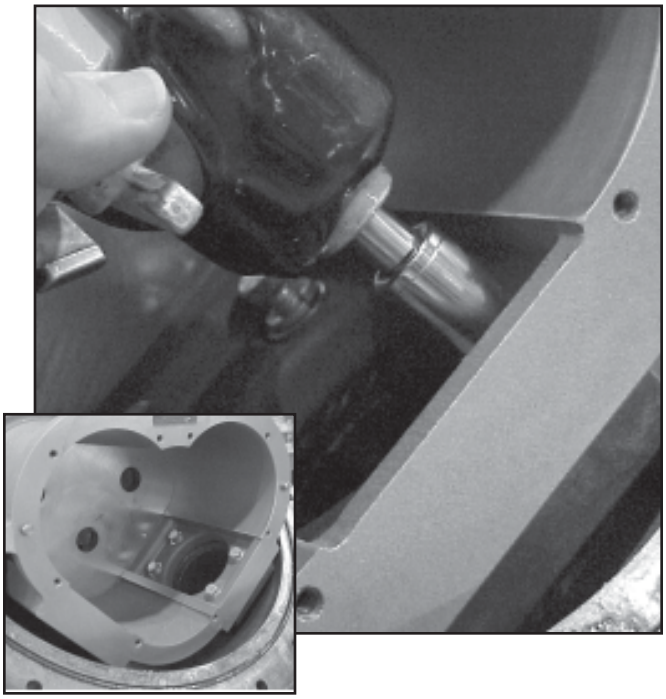
Cover socket or open end/box end wrench
Spare displacement rotor gear or shop rag
Rotor gear wrench or socket
Bearing plate wrench or socket

NOTE: The principles of meter disassembly and reassembly are the same for all Liquid Controls meters. Although your meter may look slightly different than those pictured, the steps are the same, except as noted.

(See Pages 31 & 32 for the Torque and Wrench & Socket Size Charts)

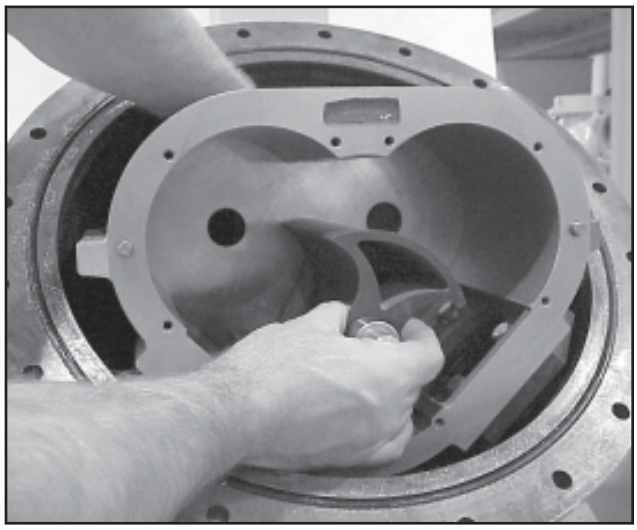
Installing the Meter

1. Place the flat gasket in the lower weldment and line up the bolt holes. Position the meter housing in the weldment lower hemisphere and secure using the four bolts. Use care not to damage the flat gasket. Use an impact driver or socket to tighten bolts.



Assembling the Meter

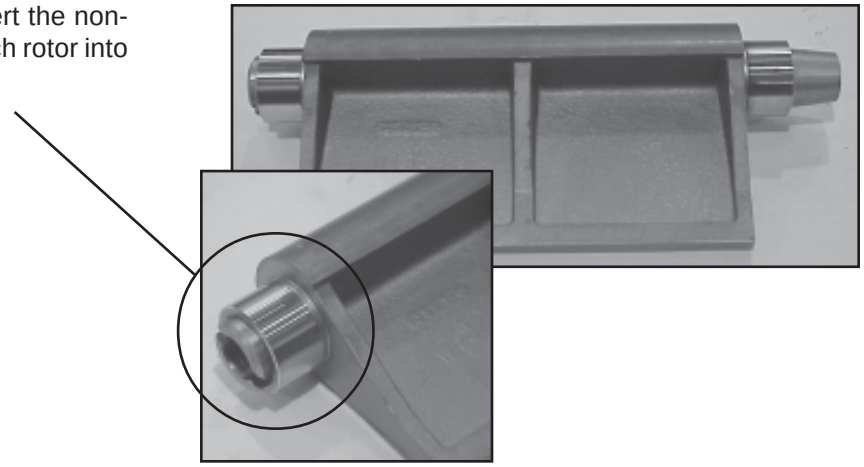
2. Install the blocking rotor. It will be necessary to guide the universal joint assembly into the drive coupling bearing and packing gland by reaching behind the meter element.



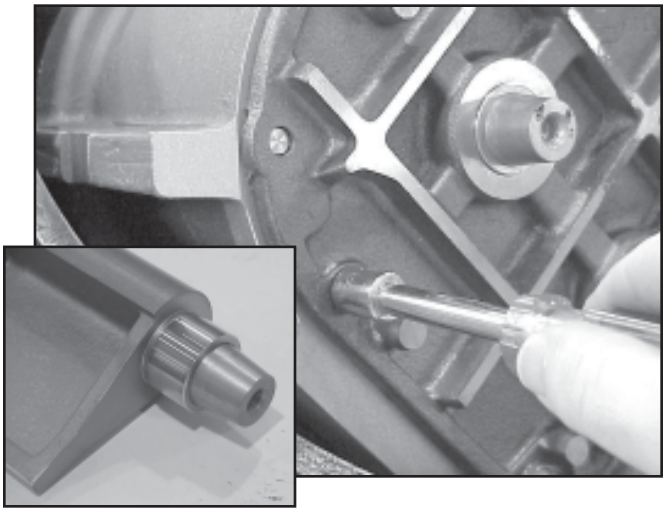
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Reassembling the Meter

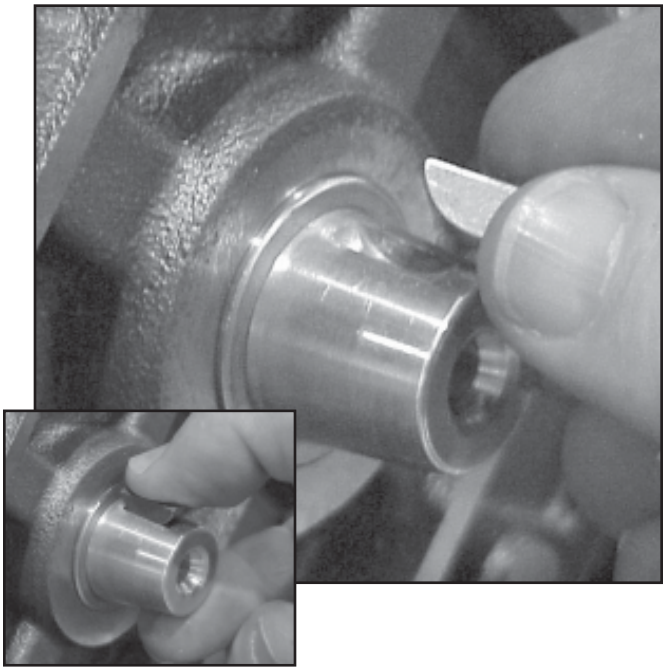
3. Install the two displacement rotors. Insert the non-tapered ends into the housing. Place each rotor into its respective bore on the bearing plate.



4. Install the bearing plate cover over the three tapered ends and fasten it with the bearing plate screws. Use the bearing plate wrench. The number of screws varies between different meter sizes.



5. Install the rotor keys. The rotor key is a small wedge of metal. Position the keys in each one of the three rotors. Press the keys into the rotor keyways.

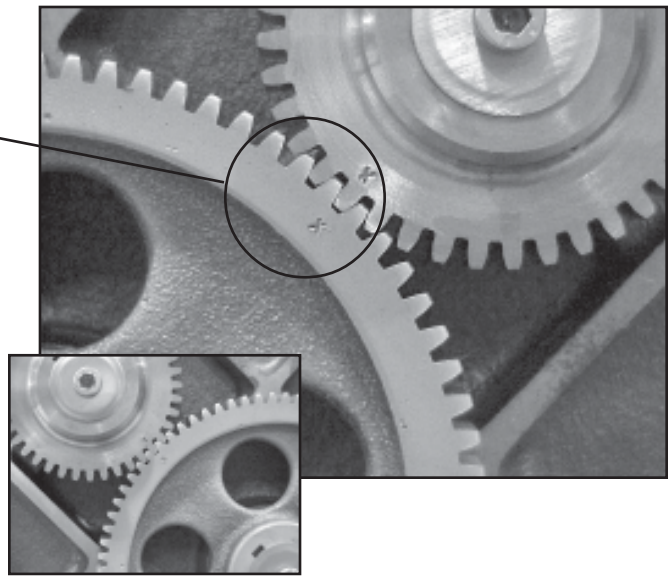


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Rotor Gear Timing

6. Slide the blocking rotor gear on its tapered rotor end. Slide the right displacement rotor gear on its tapered rotor end so that the timing marks line up between the two gears.

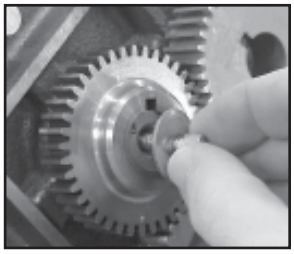
   HINT: Before placing the right displacement rotor gear on its end, hold the right rotor gear in position. Turn the blocking rotor gear. Line up the timing marks before placing the right displacement rotor gear on its tapered end.



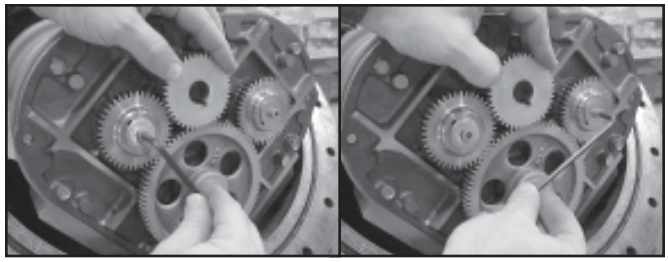
7. Slide the left displacement rotor gear on its tapered rotor end so that its timing mark lines up with the blocking rotor gear.

8. Insert the rotor gear screw and flat washer into each of the rotor gears and finger tighten.



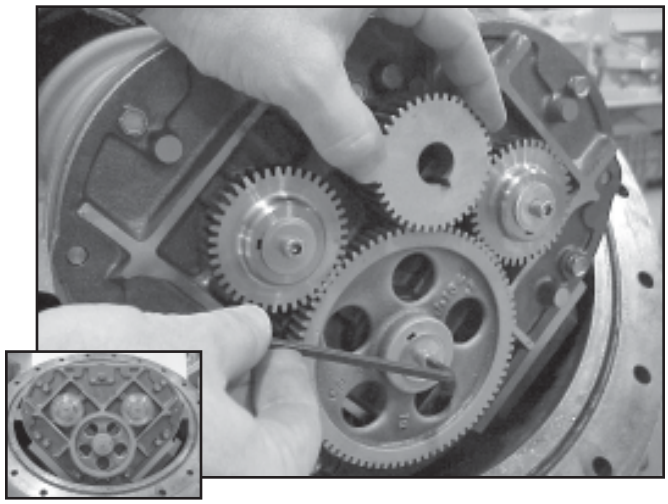


9. Position the spare displacement rotor gear between the left displacement rotor and the blocking rotor gear to prevent the gears from moving. If a replacement gear is not available, use a shop rag between the teeth of the gears. Tighten the screws of the displacement rotor gears to the torque specification listed in the Torque Chart.



10. Position the spare displacement rotor gear between the right displacement rotor and the blocking rotor gear to prevent the gears from moving. Tighten the screw of the blocking rotor gear to the torque specification listed in the Torque Chart.

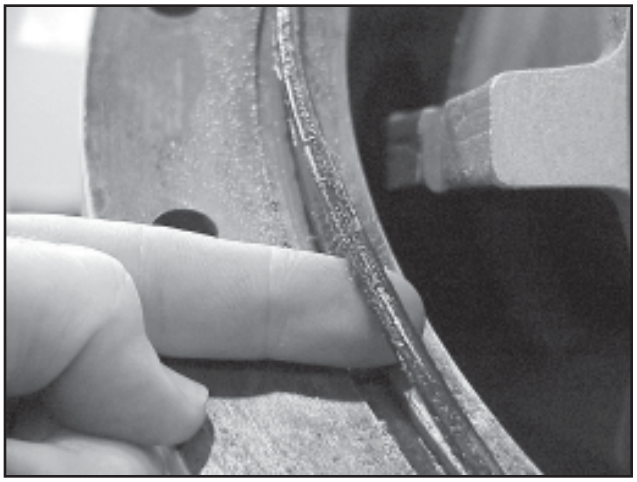
11. Rotate the gears to make sure that the rotors turn freely. Burrs, foreign material, or marred surfaces can restrict the rotor movements. It may be necessary to remove the gears and rotors and deburr or clean the surfaces again.



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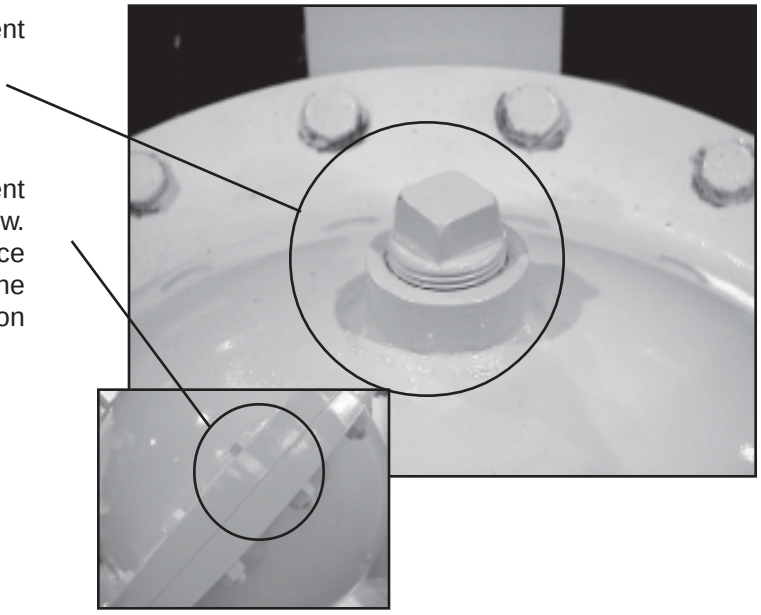
Reassembling the Weldment Assembly

12. Install a new O-Ring in the groove around the weldment base assembly if required.

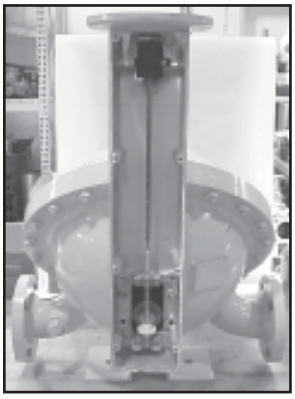


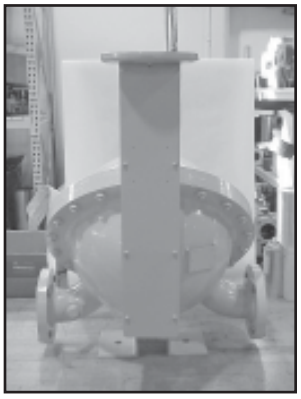
13. Position the weldment cover on top of the weldment base so that the cover vent plug is on top.

Install the screws around the rim of the weldment cover. Attach the nuts to the back of each screw. Begin by hand-tightening each of the screws. Once this is complete, tighten the nuts and bolts to the proper torque following the tightening sequence on Page 31.



14. To complete the reassembly, reinstall the adjuster and drive components. When this is complete, reinstall the dust cover.





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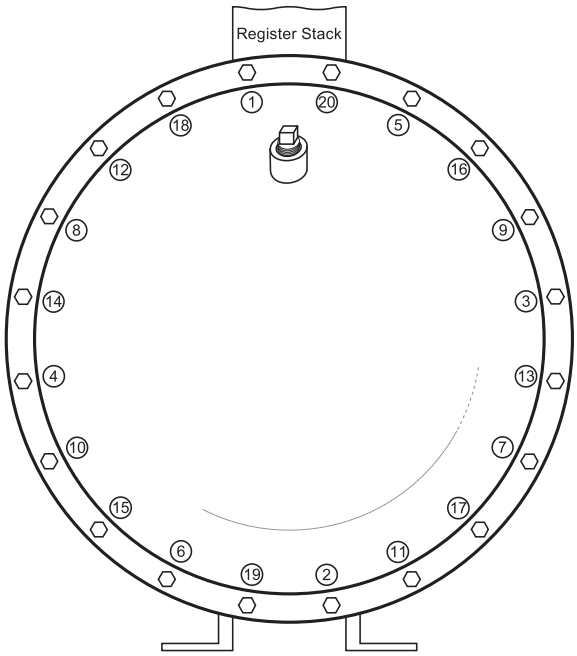
Bolt Tightening Sequence

When placing the weldment cover on the weldment base, it is important that the bolts are tightened in a sequence which reduces the risk of leaking when the system is put back in service. The number of bolts will vary depending on the size of the meter. The general pattern should be followed as pictured.

It is important to ensure that the O-Ring does not get pinched during this process.

Tighten the bolts following the pattern to 50% of the nominal torque. When all the bolts are torqued to 50%, they should then be torqued to the proper setting following the same pattern. Follow the torque specifications listed.

When replacing fastener elements, it is recommended to use compatible components.



WRENCH/SOCKET USED								
Meter Model	Meter Element				Weldment Assembly			
	Dust Cover Screws	Counter Bracket Screws	Bearing Plate Screws	Rotor Gear Screws	Element Mounting Bolts	Drain Plug	Cover Vent Plug	Weldment Cover
MS-7 MSB-7	slotted screwdriver	1/4" Allen wrench	7/16" wrench/ socket	3/8" wrench/ socket	1/4" Allen wrench	13/16" 4-point socket	9/16 4-point socket	3/4" wrench/ socket
MSA-7 MSAA-7	slotted screwdriver	1/4" Allen wrench	7/16" wrench/ socket	3/8" wrench/ socket	1/4" Allen wrench	13/16" 4-point socket	9/16 4-point socket	9/16" wrench/ socket
MSC-7	slotted screwdriver	1/4" Allen wrench	7/16" wrench/ socket	3/8" wrench/ socket	1/4" Allen wrench	13/16" 4-point socket	9/16 4-point socket	15/16" wrench/ socket
MS-15 MSA-15 MSAA-15	slotted screwdriver	1/4" Allen wrench	7/16" wrench/ socket	3/16" Allen wrench	1/4" Allen wrench	13/16" 4-point socket	13/16" 4-point socket	9/16" wrench/ socket
MSB-15 MSC-15	slotted screwdriver	1/4" Allen wrench	7/16" wrench/ socket	3/16" Allen wrench	1/4" Allen wrench	13/16" 4-point socket	13/16" 4-point socket	1-5/16" wrench/ socket
MS-30 MSA-30 MSAA-30 MS-40	slotted screwdriver	1/4" Allen wrench	7/16" wrench/ socket	3/16" Allen wrench	9/16" wrench/ socket	13/16" 4-point socket	13/16" 4-point socket	3/4" wrench/ socket
MSB-30 MSC-30	slotted screwdriver	1/4" Allen wrench	7/16" wrench/ socket	3/16" Allen wrench	9/16" wrench/ socket	13/16" 4-point socket	13/16" 4-point socket	1-5/8 wrench/ socket
MS-75 MSA-75 MSAA-75 MSB-75 MSC-75	slotted screwdriver	1/4" Allen wrench	1/2" wrench/ socket	9/16" wrench/ socket	15/16" wrench/ socket	13/16" 4-point socket	13/16" 4-point socket	15/16" wrench/ socket
MS-120 MSA-120 MSAA-120	slotted screwdriver	1/4" Allen wrench	1/2" wrench/ socket	9/16" wrench/ socket	15/16" wrench/ socket	13/16" 4-point socket	13/16" 4-point socket	1-1/8" wrench/ socket

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Fastener and Torque Chart

FASTENERS USED								
Meter Model	Meter Element				Weldment Assembly			
	Dust Cover Screws	Counter Bracket Screws	Bearing Plate Screws	Rotor Gear Screws	Element Mounting Bolts	Drain Plug	Cover Vent Plug	Weldment Cover
MS-7 MSB-7	(6) #10-24 x .38 FLSTR HD SLOT.	(4) .312-18x1 HX. HD. SS.	(10) .250-20x.75 HX. HD. SS	(3) #10-24x.625 HX. HD. SS.	(4) .312-18x.75 HX. SCK. HD	(1) 1"-11.5 NPT SQ. HD.	(2) .500-14 NPT SQ. HD.	(12) .500-13x1.75 HX. HD. GR 5
MSA-7 MSAA-7	(6) #10-24 x .38 FLSTR HD SLOT.	(4) .312-18x1 HX. HD. SS.	(10) .250-20x.75 HX. HD. SS	(3) #10-24x.625 HX. HD. SS.	(4) .312-18x.75 HX. SCK. HD	(1) 1"-11.5 NPT SQ. HD.	(2) .500-14 NPT SQ. HD.	(16) .375-16x1.75 HX. HD. GR 5
MSC-7	(6) #10-24 x .38 FLSTR HD SLOT.	(4) .312-18x1 HX. HD. SS.	(10) .250-20x.75 HX. HD. SS	(3) #10-24x.625 HX. HD. SS.	(4) .312-18x.75 HX. SCK. HD	(1) 1"-11.5 NPT SQ. HD.	(2) .500-14 NPT SQ. HD.	(20) .625-11x2.5 HX. HD. GR 5
MS-15 MSA-15 MSAA-15	(6) #10-24 x .38 FLSTR HD SLOT.	(4) .312-18x1 HX. HD. SS.	(12) .250-20x.75 HX. HD. SS	(3) .250-20x.75 SCK. HD. SS	(4) .312-18x1.25 HX. SCK. HD.	(2) 1"-11.5 NPT SQ. HD.	(1) 1"-11.5 NPT SQ. HD.	(16) .375-11x2.5 HX. HD. GR 5
MSB-15 MSC-15	(6) #10-24 x .38 FLSTR HD SLOT.	(4) .312-18x1 HX. HD. SS.	(12) .250-20x.75 HX. HD. SS	(3) .250-20x.75 SCK. HD. SS	(4) .312-18x1.25 HX. SCK. HD.	(3) 1"-11.5 NPT SQ. HD.	(1) 1"-11.5 NPT SQ. HD.	(24) .875-9x5 HX. HD. GR 5
MS-30 MSA-30 MSAA-30 MS-40	(6) #10-24 x .38 FLSTR HD SLOT.	(4) .312-18x1 HX. HD. SS.	(16) .250-20x1 HX. HD. SS	(3) .250-20x.75 SCK. HD. SS	(4) .375-16x1.25 HX. HD. GR8	(3) 1"-11.5 NPT SQ. HD.	(1) 1"-11.5 NPT SQ. HD.	(20) .500-13x3 HX. HD. GR 8
MSB-30 MSC-30	(6) #10-24 x .38 FLSTR HD SLOT.	(4) .312-18x1 HX. HD. SS.	(16) .250-20x1 HX. HD. SS	(3) .250-20x.75 SCK. HD. SS	(4) .375-16x1.25 HX. HD. GR8	(3) 1"-11.5 NPT SQ. HD.	(1) 1"-11.5 NPT SQ. HD.	(28) 1"-8x7 GR B7 STUD
MS-75 MSA-75 MSAA-75 MSB-75 MSC-75	(6) #10-24 x .38 FLSTR HD SLOT.	(4) .312-18x1 HX. HD. SS.	(20) .312-18x1 HX. HD. SS	(3) .375-16x1.25 HX. HD. SS.	(4) .625-11x2.5 HX. HD. GR 5	(3) 1"-11.5 NPT SQ. HD.	(1) 1"-11.5 NPT SQ. HD.	(24) .625-11x4 HX. HD. GR5
MS-120 MSA-120 MSAA-120	(6) #10-24 x .38 FLSTR HD SLOT.	(4) .312-18x1 HX. HD. SS.	(20) .312-18x1 HX. HD. SS	(3) .375-16x1.25 HX. HD. SS.	(4) .625-11x2.5 HX. HD. GR 5	(3) 1"-11.5 NPT SQ. HD.	(1) 1"-11.5 NPT SQ. HD.	(24) .750-10x3 HX. HD. GR 5

Torque Chart

Torque Ref. #	Bolt Size	Inch-Pounds	Newton-Meter
		NOMINAL*	NOMINAL*
1	#8 (.164) - 32 UNC-2A	42	4.8
2	#10 (.190) - 24 UNC-2A	63	7.1

NOTE: ASTM A574 socket Head Cap Screw - Low Alloy Steel: quenched & tempered.

Torque Ref. #	Bolt Size	Grade 5		Grade 8	
		Foot-Pounds	Newton-Meter	Foot-Pounds	Newton-Meter
		NOMINAL*	NOMINAL*	NOMINAL*	NOMINAL*
3	1/4" (.250) - 20 UNC-2A	7.3	9.9	---	---
4	5/16" (.3125) - 18 UNC-2A	15.3	20.7	---	---
5	3/8" (.375) - 16 UNC-2A	27	37	---	---
6	7/16" (.4375) - 14 UNC-2A	43	58	---	---
7	1/2" (.500) - 13 UNC-2A	66	90	112	152
8	5/8" (.625) - 11 UNC-2A	132	179	222	301
9	3/4" (.750) - 10 UNC-2A	233	316	395	535

**Torque Tolerance is ± 10%*

PERMIAN GLOBAL INC. AND MANTICORE FUELS, LLC EXHIBIT 1013, Page 118

Identification of Bolt Grades

Grade 0, 1, & 2
(No Markings)



Grade 3
2 radial dashes, 180º apart



Grade 5
3 radial dashes, 120º apart



Grade 6
4 radial dashes, 90º apart



Grade 7
5 radial dashes, 72º apart



Grade 8
6 radial dashes, 60º apart

Troubleshooting

Problem: Leakage past the packing gland drive shaft housing from internal metering chamber.

Probable Cause: Internal seal of the packing gland assembly is worn. Replace packing gland and O-Ring seal.

Operating Note: Two common causes of packing gland leakage are thermal expansion and hydraulic shock. If two valves in a piping system (on either side of the meter) are closed at one time, and if the temperature rises as little as 1ºF in the system, it could result in a rise in pressure (70 psi for every 1°F) within the system that would exceed the working pressure rating of the meter. To avoid this hazard caused by thermal expansion, a pressure-relief valve must be installed in the system. Hydraulic shock occurs when a large volume (mass) of liquid is moving through a pipe line at some flow rate and a valve is suddenly closed. When the flow is stopped, the entire mass of liquid in the piping system acts as a battering ram causing a shock effect within the meter. The greater the mass, length of line, and/or velocity, the greater the hydraulic shock. Since the valve is usually located at the meter outlet, the meter housing, packing gland and the meter internal components receive the full impact of such hydraulic shock. To prevent this hazard, a slow closing, two-stage valve should be used with the meter. On those systems where mass length of line, etc. are of such magnitude as to preclude elimination of hydraulic shock with the use of a two-stage valve, an impact absorbing or cushioning device should be used.

Problem: Leakage from the cover gasket.

Probable Cause: Gasket has been damaged due to shock pressure, thermal expansion, or cover bolts that have not been sufficiently tightened.

Problem: Breaking teeth on rotor timing gears.

Probable Cause:
1. Starting or stopping flow in the meter too rapidly.
2. Pump bypass not adjusted properly.
3. Shock due to start-up of an empty system. When liquid is introduced, shock can occur if not started slowly.

PERMIAN GLOBAL, INC. AND MANTICORE FUELS, LLC EXHIBIT 1013, Page 119

Troubleshooting

Problem: Product flows through the meter but the register does not operate.

Probable Cause:
1. Check the packing gland and gear train.
2. If all meter parts are moving, the problem is in the register. Faulty registers should be checked and repaired by a trained technician.
3. Remove the register from the meter. If all meter parts are moving but the output of adjuster assembly is not, adjuster is worn and must be replaced.
4. If totalizer numbers (small numbers) on the meter are recording, but the large numbers are not moving, the register needs repair.
5. The packing gland gear is not turning. The drive blade may be sheared. Replace the packing gland. This may be caused by starting the flow too rapidly.

Problem: Product flows through meter but register does not record correctly.

Probable Cause:
1. Adjuster not properly calibrated.
2. Incorrect gear plate or gear ratio has been installed.
3. Meter is damaged.
4. There is air in the system

Problem: No flow through meter.

Probable Cause:
1. Faulty pump.
2. Valve not open or not functioning.
3. Meter “frozen” due to buildup of chemical “salts” or foreign material inside the metering chamber. To correct, clean the meter and inspect for damage.

Problem: Meter runs too slowly.

Probable Cause:
1. Valve internal mechanism faulty. Valve does not open fully.
2. Meter gears or rotors partially “salted” enough to slow up rotation of parts. To correct, clean the meter.
3. The strainer basket is partially clogged.

Problem: The meter counts down (the numbers decrease).

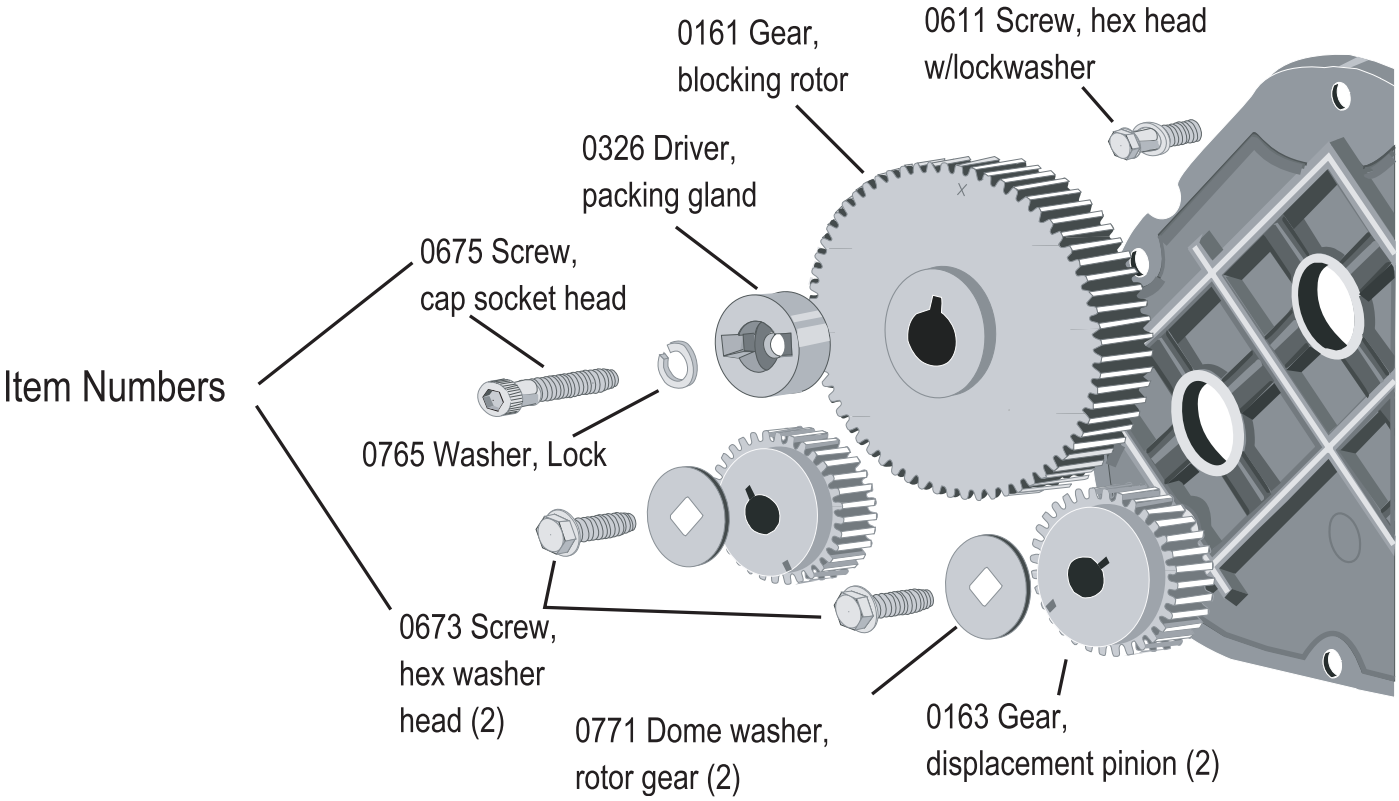
Probable Cause: It is necessary to reverse the direction of flow by reversing the adjuster drive gear. See Meter Start Up & Operation on Page 12 of this manual.

PERMIAN GLOBAL, INC. AND MANTICORE FUELS, LLC EXHIBIT 1013, Page 120

1. Refer to the exploded drawings of the meter on Pages 36-39. Find the four digit item number for the part you want to order.

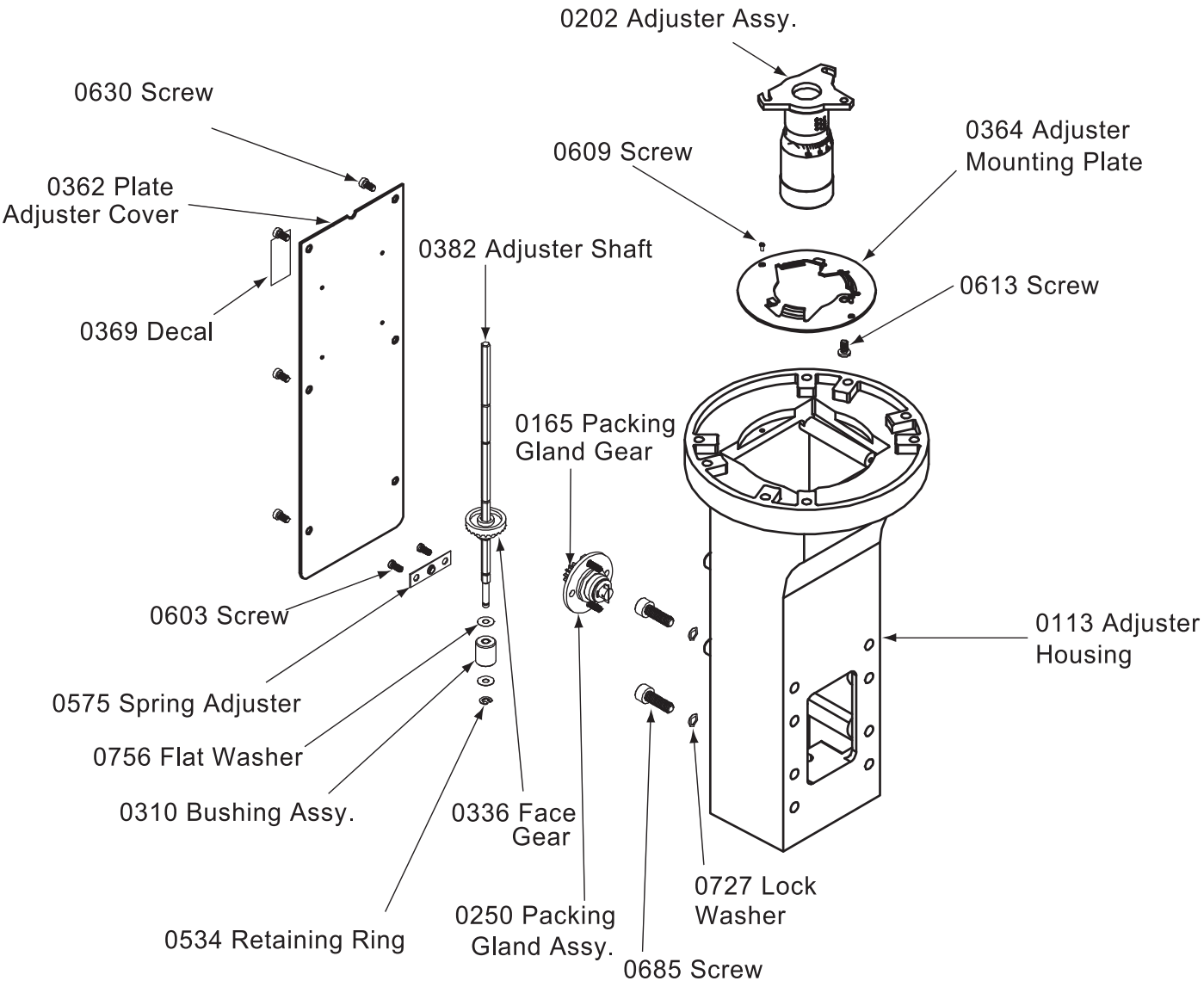
2. Find the computer printout titled Bill of Materials that has been inserted in the red Owner's Information Packet. Look up the item number on the Bill of Materials. The Bill of Materials shows each item number with a corresponding part number. Find the corresponding part number for the item you want to order. The part number represents an individual piece, a kit, or a complete assembly.

3. Inform your distributor of the part number that you need. The part number is the only number that allows the distributor to find the correct component for your meter.



PERMIAN GLOBAL, INC. AND MANTICORE FUELS, LLC EXHIBIT 1013, Page 121

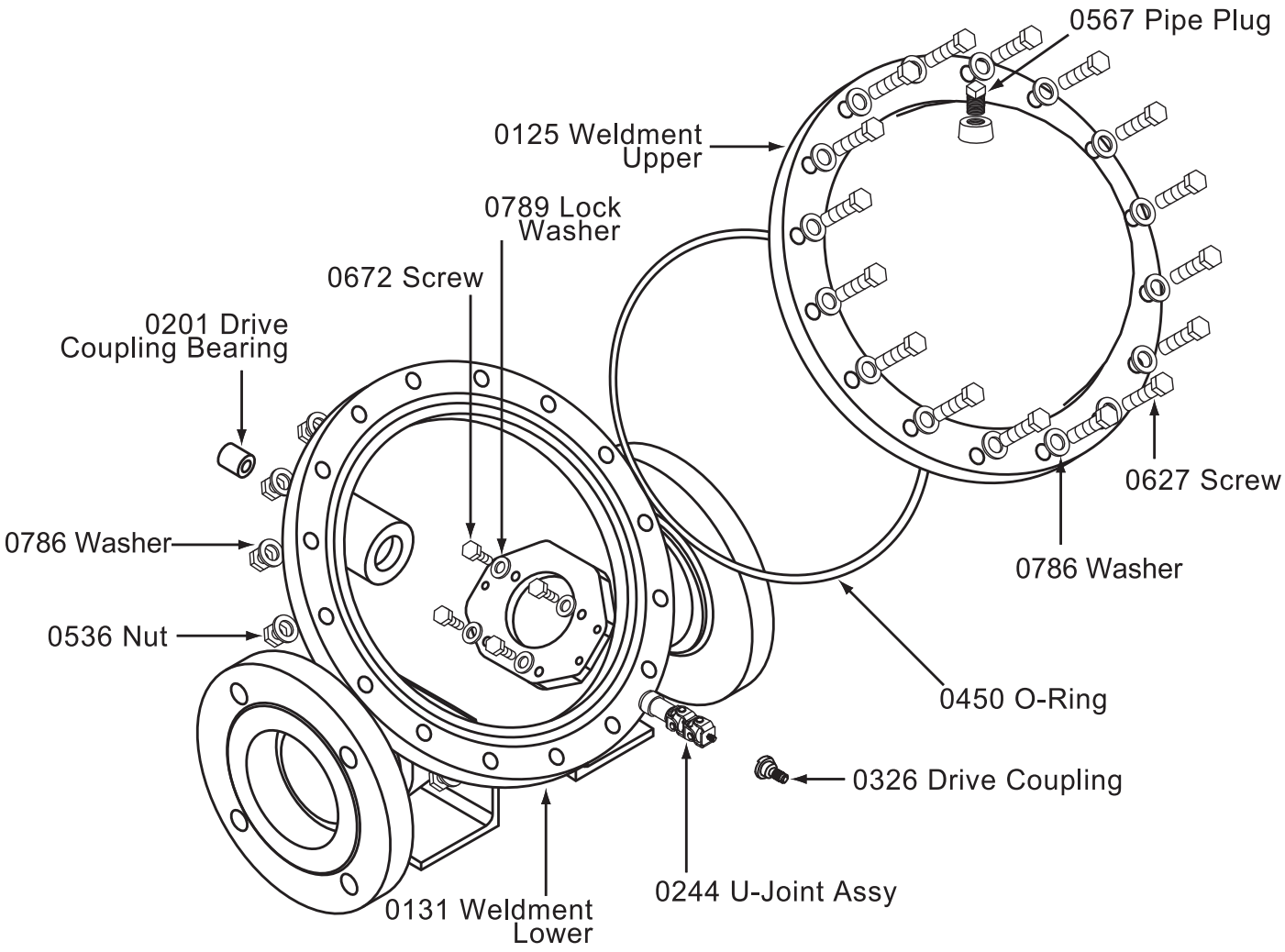
Adjuster Housing Assembly



NOTE: Numbers shown are **ITEM** numbers, not Part Numbers. Refer to the Bill of Materials supplied in the red Owner's Information Packet to locate the **PART NUMBER** associated with these **ITEM NUMBERS**.

PERMIAN GLOBAL, INC. AND MANTICORE FUELS, LLC EXHIBIT 1013, Page 122

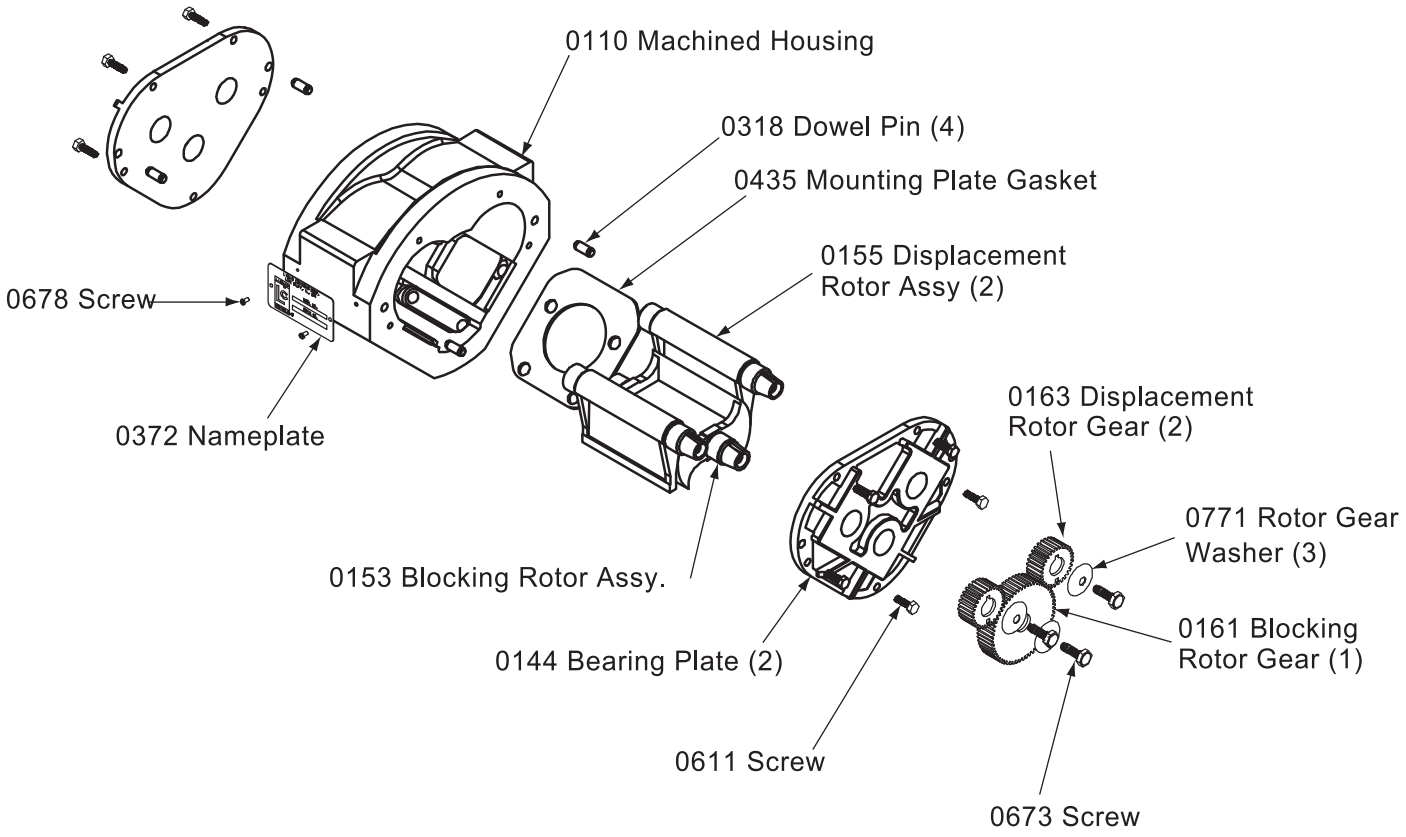
Weldment Assembly



NOTE: Numbers shown are **ITEM** numbers, not Part Numbers. Refer to the Bill of Materials supplied in the red Owner's Information Packet to locate the **PART NUMBER** associated with these **ITEM NUMBERS**.

PERMIAN GLOBAL, INC. AND MANTICORE FUELS, LLC EXHIBIT 1013, Page 123

Meter Element Assembly



NOTE: Numbers shown are **ITEM** numbers, not Part Numbers. Refer to the Bill of Materials supplied in the red Owner's Information Packet to locate the **PART NUMBER** associated with these **ITEM NUMBERS**.

PERMIAN GLOBAL, INC. AND MANTICORE FUELS, LLC EXHIBIT 1013, Page 124

shown are **ITEM** numbers, not Part Numbers. Refer to the Bill of Materials supplied in the red formation Packet to locate the **PART NUMBER** associated with these **ITEM NUMBERS**.

PERMIAN GLOBAL, INC. AND MANTICORE FUELS, LLC EXHIBIT 1013, Page 125

LIQUID CONTROLS GROUP

CORKEN · FAURE HERMAN · LIQUID CONTROLS · SAMPI · SPONSLER · TOPTECH SYSTEMS

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LIQUID CONTROLS INDIA
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ISO 9001 DNV CERTIFICATED FIRM Certificate No. 08732
ISO 14001 DNV CERTIFICATED FIRM Certificate No. 05049

https://web.archive.org/web/20151010104600/http://www.lcmeter.com/en/Literature/Documents/Overviews/E100-10%20Electronics%20Overview.pdf

LIQUID CONTROLS



Electronic Registers and Data Management Systems







Practical Electronic Flowmeter Systems

Liquid Controls electronic flowmeter systems are designed to meet and exceed the increasing demands of today's custody transfer and inventory control operations. Liquid Controls' (LC) has been manufacturing flowmeters and flowmeter accessories for more than 60 years. In that time, LC has built a reputation for reliable positive displacement flowmeter systems that sustain their outstanding accuracy, even in the harshest of environments.

More than 30 years ago, in order to enhance the capabilities of the LC positive displacement meter, Liquid Controls began designing and developing electronic registers and data processors for flowmeter systems. Since then, LC has consistently produced leading edge electronics for flowmeter systems, pioneering a number of advances in flowmeter data processing and Weights & Measures-approved electronic registration.

Today, LC electronic flowmeter systems measure with near-perfect accuracy over a full range of flow rates and throughout a wide range of viscosities. They are easy to use and maintain their high performance in harsh fixed-site and vehicle-mounted environments. LC electronic flowmeter systems streamline dataflow between the flowmeter and your office network, increase the security of your inventory, and promote a safer work environment for your employees.

Liquid Controls remains committed to providing straightforward, practical solutions to the challenges you face today and generating innovative opportunities to help you build your future.

Applications

Tank wagons and transports

LPG bobtails

Aviation refuelers

Hydrant carts

Load Racks

Fixed Installations

Bulk Plants & Terminals



M-80 with LectroCount LCR 600

The Advantages of Liquid Controls Electronics

IMPROVED EFFICIENCY
- Electronic presetting
- No more hand written tickets
- Reduced delivery time

SUPERIOR ACCURACY
- Multi-point calibration

INCREASED PROFITABILITY
- No more manual pricing errors
- Streamlined office operations

AUTOMATIC DATA COLLECTION

IMPROVED SECURITY AND AUDIT TRAILS

LectroCount® LCR-II™

The LectroCount LCR-II is the electronic register of choice for those who have experienced its performance in the field. The LCR-II earned its sterling reputation because of its simple design and sturdy construction, which provide easy operation and longevity in the most challenging environments.



Flowrate Screen

Temperature rating

-40 to 158 °F (-40 to 70 °C)

Input Voltage

9 to 28 VDC, 4.5 A maximum *including solenoid valves*

Communications

RS-232: *EIA-232E standard*
RS-485: *SAE J1708 standard*

Inputs

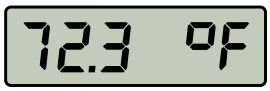
Electronic temperature volume compensation RTD probe, Optical air/vapor elimination sensor

Outputs

Scaled Pulse: *150mA sinking capability*
Auxiliary 1: *1 A sinking capability*
Auxiliary 2: *150 mA sinking capability*
External display: *1 A sinking capability*
Solenoid (3): *10.2 to 27.2 VDC, 1 A maximum*

Features

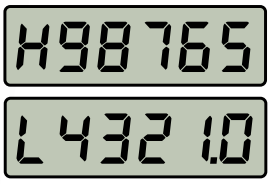
- Simple 'Pump & Print' delivery system
- Weights & Measures custody transfer (product delivery and ticket generation)
- Metrological data collection
- Four product calibrations
- Multi-point and Single-point Calibration
- Printed delivery, shift, and diagnostic tickets
- Security settings
- Two auxiliary programmable outputs
- No-flow timer
- Electronic temperature volume compensation (ETVC) *optional*
- Electronic presetting by volume
- Electronic valve control
- Electronic air or vapor elimination
- 10-digit totalizer
- NEMA 4X enclosure
- Available in Class I, Div 1 or Div 2 enclosure, Groups C & D



Temperature Screen



Preset Screen



10-digit Totalizer Screen



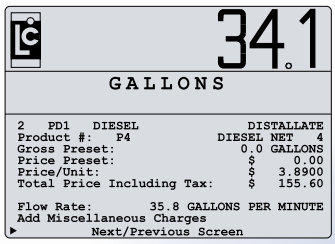
Class I Division 1 Enclosure

- Proven long service life
- Increased accuracy with multi-point calibration
- Simple operation
- Reliable in harsh environments
- Improved efficiency relative to mechanical systems

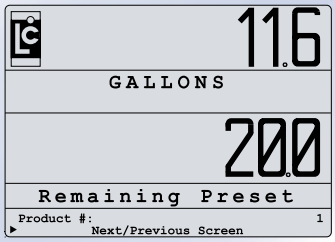


LectroCount LCR 600™

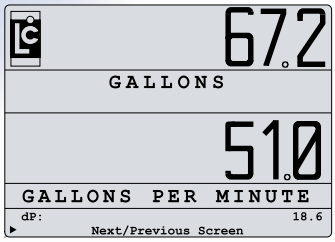
The LectroCount LCR 600 marks the next evolution of Liquid Controls electronic registers, providing a large display, user-friendly interface, and increased functionality. The LCR 600 is a flexible computing platform that can be supplied standard or with industry-specific custody transfer applications, such as Point-of-Sale (POS), for customer-direct fuel delivery, and FlightConnect, for aviation fueling.



POS Delivery Screen



Preset Delivery Screen



Flowrate Delivery Screen

Temperature rating

-40 to 158 °F (-40 to 70 °C)

Input Voltage

9 to 28 VDC, 4.5 A maximum *including solenoid valves and display heater*

Communications

RS-232: *EIA-232E standard*
RS-485: *SAE J1708 standard*

Inputs

Electronic temperature volume compensation RTD probe, Optical air/vapor elimination sensor

Outputs

Scaled Pulse: *150mA sinking capability*
Auxiliary 1: *1 A sinking capability*
Auxiliary 2: *150 mA sinking capability*
External display: *1 A sinking capability*
Solenoid (3): *10.2 to 27.2 VDC, 1 A maximum*

Features

- Point-of-Sale (POS) and FlightConnect upgrades *optional*
- Customized pricing, taxes, discounts, and miscellaneous charges *with POS upgrade*
- Simple 'Pump & Print' delivery system
- Weights & Measures custody transfer (product delivery and ticket generation)
- 16 product calibrations *POS only*
- Multi-point and Single-point Calibration
- Four delivery screens
- Volume, flow rate, and other key values visible during delivery
- Printed shift and diagnostic tickets
- In-field configuration and setup
- Two auxiliary programmable outputs
- No-flow timer
- Electronic temperature volume compensation (ETVC)
- Electronic presetting by volume and price *price presetting with POS upgrade*
- Electronic valve control
- Electronic air or vapor elimination
- NEMA 4X enclosure

- Proven long service life
- Increased accuracy with multi-point calibration
- Reliable in harsh environments
- Reduced delivery times and billing errors with priced and taxed delivery tickets *with POS*
- Reduce time to post and shorten cash cycle *with POS*
- Industry-specific applications: POS and FlightConnect



DMS™

The DMS is an in-cab data management system designed for fuel delivery vehicles. After each delivery, the DMS gathers the metrological data from the electronic register, combines it with customer and transaction data, and transfers a complete record of delivery activity to your office computer. There are three types of application software available for the DMS, each one tailored to the intricacies of a specific fueling application: DMS Delivery for customer-direct, point-of-sale fuel delivery, EZConnect for fleet fueling, and FlightConnect for aviation fueling.

Temperature rating

-22 to 158 °F (-30 to 70 °C)

Operating voltage

+9 to 30 VDC

Power Consumption

5 A maximum
60 W maximum, *intermittent*

Display

LCD, dot matrix, 240 x 64 pixels, backlit, 5.2" W, 1.55" H, 8 rows, 30 characters per row

Features

- Simultaneously manage deliveries from up to three meter systems
- Two auxiliary ports for custom devices
- Three programmable outputs for injectors, warning lamps, and other devices
- Software designed to specific applications available: customer-direct fueling, fleet fueling, and aviation refueling
- Rugged construction provides longevity and operation in extreme environments
- Data transfer via RF, cellular, or USB
- Two support software programs preinstalled
- Controls all LectroCount register functions and settings







- Flexible and expandable customization fits your unique needs
- Identify and prevent theft
- Reliable operation in harsh environments
- Captures analytical data that can lead to fleet management improvement



LectroCount Systems: Features Table

	 LCR-II	 LCR 600	 DMS & LCR-II
Weights & Measures Approval	✓	✓	✓
Weights & Measures Security	✓	✓	✓
Pump & Print	✓	✓	✓
POS (Point of Sale)		✓	✓
DMS Delivery			✓
EZConnect			✓
FlightConnect		✓	✓
Diagnostics	✓	✓	✓
Shift Tickets	✓	✓	✓
Single-point Calibration	✓	✓	✓
Multi-point Calibration	✓	✓	✓
4 Product Calibrations	✓		✓
16 Product Calibrations		✓	
Volumetric Presetting	✓	✓	✓
Price Presetting		✓	✓
Valve Control	✓	✓	✓
Wireless Communication		✓	✓
Electronic Air and Vapor Elimination	✓	✓	✓
Differential Pressure Shutdown	✓	✓	✓
Low Flow Auxiliary Output	✓	✓	✓
No-flow Timer	✓	✓	✓
Integrated Keypad Controls		✓	



MS-30 with F-Series Strainer and Division 1 LCR-II



M-7 Meter with Optical Air Eliminator, High Capacity Strainer, E-7 Valve, and LectroCount LCR-II

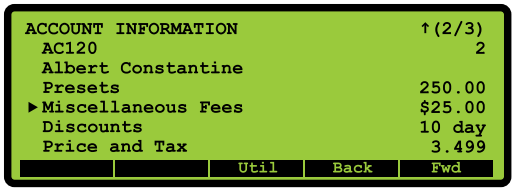
DMS Delivery™

Versatile Point-of-Sale Fueling

DMS Delivery accelerates the efficiency of fuel delivery operations—at the fueling point and in the office. DMS Delivery is a point-of-sale application that provides complete pricing and taxing at the fueling point and a versatile data management and transfer system.

DMS combines metrological, customer, and transaction data, prints a priced and taxed ticket, and transfers the data back to the office. Discounts, taxes, pricing, and miscellaneous charges are easily customized and applied to the customer in the database or at fueling point.

DMS Delivery is ideal for fuel delivery operations with large customer bases and complex billing structures.



DMS Delivery

- Shorten fueling times
- Increase operational efficiency
- Reduce processing time and data entry errors
- Avoid inventory reconciliation errors and rework
- Reduce transaction cycle time

Main Functions

- Account management
- Operational data management
- Delivery data tracking
- Data entry interface
- File conversions
- Security settings for fueling access and system configuration
- Print ticket configuration
- Customer equipment identification
- Delivery start and stop

Delivery

DMS Delivery Office Software







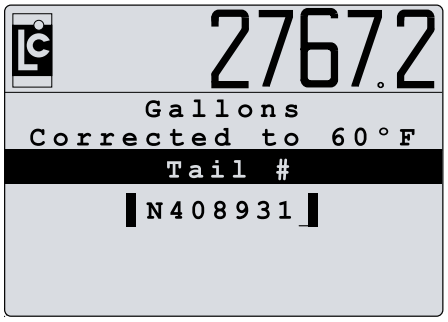
FlightConnect™

Efficient, Automated Aviation Fueling

FlightConnect is an automated, easy-to-use data capture and management system that streamlines into-plane fueling operations. FlightConnect collects the details of each fueling and delivers them, wirelessly, to the doorstep of your back office software.

FlightConnect eliminates the need for hand-written tickets at the gate or at the plane as well as the majority of manual data entry required in the office. Fuelers simply enter the plane details into their LCR 600 register or DMS, and when the fueling is complete, FlightConnect prints a ticket of the fueling details and wirelessly sends all of the data to your office computer. There, the data is organized and formatted by FlightConnect's office software so it can be easily imported into your fuel management or POS system. FlightConnect's office software also features a dispatching tool that wirelessly sends fueling assignments to fuelers on the tarmac.

FlightConnect is ideal for commercial or fixed-based operations. It is available on the LectroCount LCR 600 and the DMS and operates seamlessly in a mixed environment of refuellers, hydrant trucks and hydrant carts.



LectroCount LCR 600 FlightConnect

- Reduce processing time and data entry errors
- Print on-site delivery summaries
- Dispatch fueling assignments wirelessly
- Avoid inventory reconciliation errors and rework
- Reduce transaction cycle time
- Shorten fueling times
- Increase operational efficiency

Data Fields

- Tail number
- Fueling date and time
- Fuel type
- Gallons delivered
- Airport ID
- Fueler ID
- Aircraft type
- Gate number
- Origin
- Destination
- Requested volume
- User-defined fields
- Maximum ΔP reading





FlightConnect

FlightConnect Office Software

EZConnect™

Fleet Fueling Made Simple

EZConnect simplifies fuel delivery and streamlines accounting procedures for fleet fueling operations. Using a handheld reader, it identifies vehicles and equipment at the fueling site, automatically verifies the customer and the type of fuel required, records the delivery data, and transfers the delivery data into an office computer.

EZConnect can practically eliminate misfuelings. Before allowing a delivery, fuelers must use the EZConnect Button Reader to identify the vehicle or piece of equipment. EZConnect then pulls the vehicle's data from the database, verifies the correct fuel type, makes the delivery, prints a delivery ticket, and records the delivery data. No handwritten tickets are required and delivery data is electronically transferred into the office computer, decreasing fueling times and accounting inaccuracies significantly.

EZConnect is ideal for fueling ground support equipment at an airport, construction sites, or any other fleet fueling application.



EZConnect Fill Vehicles Screen

Main Functions

- Account management
- Operational data management
- Delivery data tracking
- Data entry interface
- File conversions
- Security settings for fueling access and system configuration
- Print ticket configuration
- Equipment identification
- Delivery start and stop

- Prevent misfuelings
- Deliver to multiple customers without stopping or changing accounts
- Prevent fuel theft
- Print on-site delivery summaries
- Shorten fueling times
- Reduce billing errors
- Simplify accounting
- Reduce time to post and shorten cash cycle
- Improve preventative maintenance
- Audit fleet performance according to fuel burn and fuel consumption



EZCONNECT

EZConnect Office Software

Electronic Accessories

POD (Pulse Output Device)

The POD converts the rotary motion of Liquid Controls flowmeters into a high resolution, unscaled pulse stream. The POD's pulse stream is accepted by LectroCount registers and a wide variety of other electronic monitoring devices and control equipment.



XL LED Remote Display

Perfect for aviation refuelers, load racks, and other applications in vast spaces where long-distance viewing is necessary, the six 2¼" high digits, each consisting of 18 red LED lights, are discernible from up to 250 feet away.



Differential Pressure (ΔP) Transducer

The ΔP transducer is a safety shutdown device and a maintenance tool for aviation refueling systems. The ΔP transducer, in conjunction with a LectroCount register and a solenoid operated valve, stops deliveries when the differential pressure (ΔP = pressure drop) across a full flow fuel monitor or filter separator meets a preprogrammed differential pressure shutdown value, eliminating the risk of tainted fuel deliveries and meter damage. Maximum differential pressure (across the full flow fuel monitor or filter separator) and the corresponding flow rate are printed on the ticket

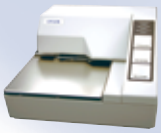


Printers

Epson slip printers and Epson roll printers are industry standards for mobile and stationary flowmeter systems. Epson printers provide multiple copies of delivery tickets, diagnostic tickets, calibration reports, and shift tickets.



Epson Roll Printer



Epson Slip Printer

EZCommand™

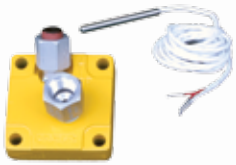
EZCommand is a user-friendly Windows®-based interface that saves and distributes LectroCount register settings and updates. It is a simple way to coordinate configurations and setups across your entire fleet.



Electronic Accessories

Electronic Temperature Volume Compensation (ETVC)

The ETVC kit all but eliminates the effect of product temperature change on the delivered volume. The platinum RTD probe sends two temperature readings per second back to the LectroCount register. It is accurate to 0.45 °F over the operating temperature range of -40 to 158 °F. Features include field programming for base temperature and a coefficient of expansion (or API) table.



Electronic Valves

LectroCount registers can controls a number of different types of solenoid control valves. Ask your Liquid Controls representative which valve is right for your application.



E-7 Valve



Block Valve



500 Series Valve

Optical Air and Vapor Eliminators

Optical air and vapor eliminators detect and eliminate air or vapor from the system before it reaches the flowmeter's measuring chamber. Optical air and vapor eliminators have no internal moving parts, so maintenance costs and downtime are minimal.



Optical Vapor Eliminator



Optical Air Eliminator

Dual Meter Module (cab mounted)

The dual meter module permits sequential operation and control of two flowmeter systems with LectroCount registers. The dual meter module reduces the size and cost of dual meter installations.



Lap Pad (cab mounted)

The lap pad is a valuable tool for the set up and calibration LectroCount registers, especially the LCR-II. It has a large, tactile, alpha-numeric keyboard and a dual line, backlit display.



SCAMP™

SCAMP is an advanced electronic flowmeter signal conditioner that converts the output signal from the flowmeter into a volumetric unit of measure. Features include temperature correction to delivered volume measurements (API standard or programmable coefficient of expansion) and multi-point calibration.





Liquid Controls - A Tradition of Excellence

Over fifty years ago, Liquid Controls set a new standard of excellence in engineering by building the finest flow meter products possible. The very first Liquid Controls meters metered aviation fuel for the United States Air Force, and it wasn't long until the Liquid Controls name became synonymous with dependability and accuracy. With years of constant innovation in flow meter technology,a flourishing worldwide distribution network and an ever-expanding industry base, Liquid Controls remains a premier name for controlling and measuring high-value liquids and gases.

The professionals at the Liquid Controls are driven to bring you products that perform efficiently and accurately with minimum maintenance for years to come. Delivering everything you'd expect from the very best—that's our goal.

Your Customers—Our Customers

Liquid Controls is part of IDEX Energy & Fuels. The IDEX Corporation is a diversified, engineered products company. IDEX leverages the resources of high quality, similar-profile businesses to innovate solutions that bring real and lasting value to you, our customer. At Liquid Controls and IDEX, the voice of our customers is our driving force. With your guidance, we will ensure that the quality of our existing products endures and we will continue to develop new products and services that best meet your customers' needs.

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