LPG Liquid-Measuring Devices
Part 4: Test Notes

NIST Weights and Measures Division

LPG Short Course

May 2005

Test Notes - Overview

- Report Forms
- Test Equipment and Use
  - Test Measures & Provers
    - Design, use, maintenance, and proper reading
  - Understand special factors associated with testing LPG LMD's in the field
- Verify Operation of Totalizers
- Examine Printed and Displayed Indications

Why Use A Report Form ?

Purpose

- Primary Record
- Historical data record
- Comprehensive
- Clearly describes official action
- Guide to serviceperson
- Signature verifies receipt of information

Minimum Information

1) Device(s) examined

2) Findings of examination

3) Official disposition of device

4) Action taken as a result of that disposition

Basic Equipment

1) one or more dry chemical fire extinguishers
   - described in chapter 4
   - recommend one for flammable liquid and one for electrical fires
2) first aid kit
3) protective goggles and gauntlet gloves
4) caution signs
5) markers, safety cones
6) calibrated field standard prover of correct capacity for type of metering & standard fittings
7) heavy duty 3-wire, 100’ extension cord, 3-prong adaptor, size 10 neoprene
8) grounding cable

Basic Equipment (cont.)

9) complete set of adaptors for LPG fittings
   - Suggested list in APPENDIX B

10) matched & accurate liquid glass thermometers:
   - -30° F to 130° F
   - 1° F increments
   - at least 12” in length
   - accurate to within +/- 0.5° F
   - at least 6 thermometers at all times
   - important to be matched
   - 1° F difference can result in as much as 40 cubic inches of error in readings

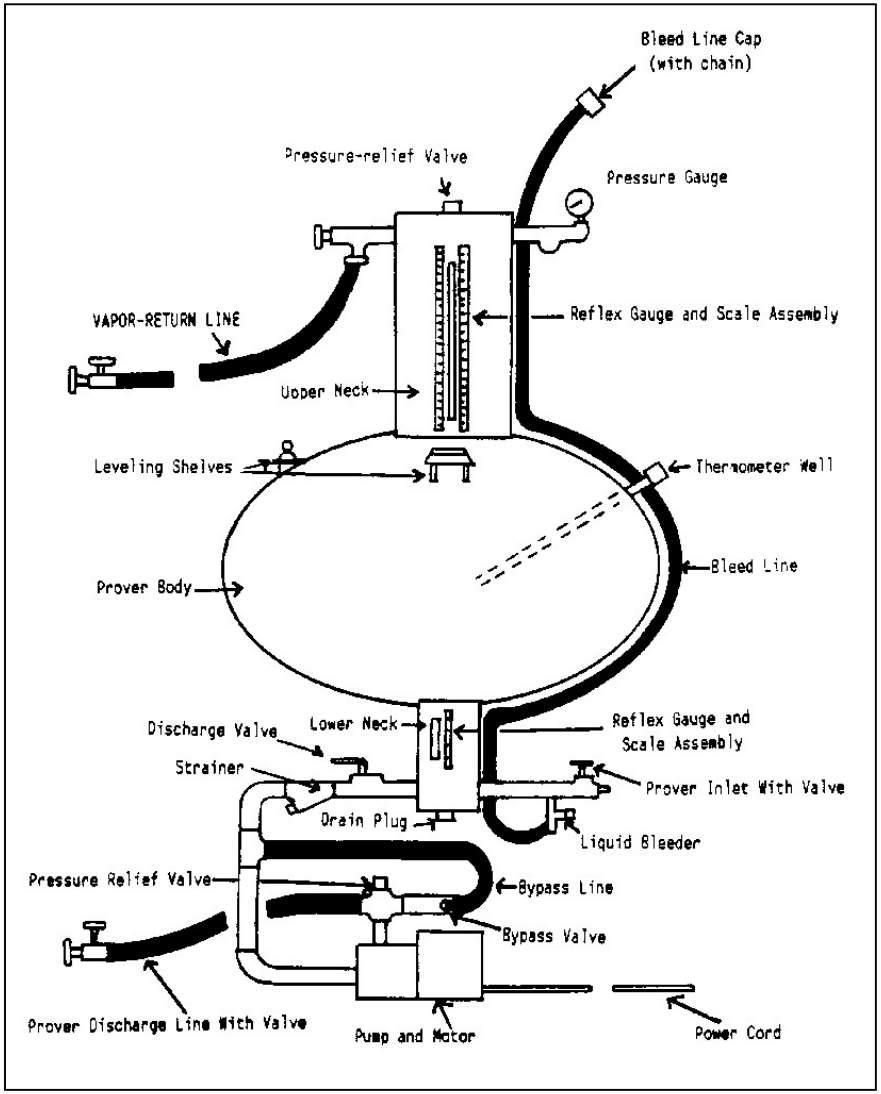
Basic Equipment (cont.)

11) ethylene glycol, bulb syringe
12) pipe joint compound
13) hand tools (not for repairs)
14) stop watch
15) temperature and pressure correction tables for prover
16) ASTM Table 24 for temperature corrections
17) NIST HB 44 and other applicable codes and regulations
18) report forms
19) lead and wire seals, tags, seals, etc.
20) equipment checklist and emergency numbers to keep with prover

Prover Design, Operation, Components

- NIST Handbook 105-4, Specifications & Tolerances for Test Measures
  - Size
  - Construction material
  - Physical properties
  - Accuracy requirements
  - Test methods
  - Uncertainties

LPG Liquid Prover



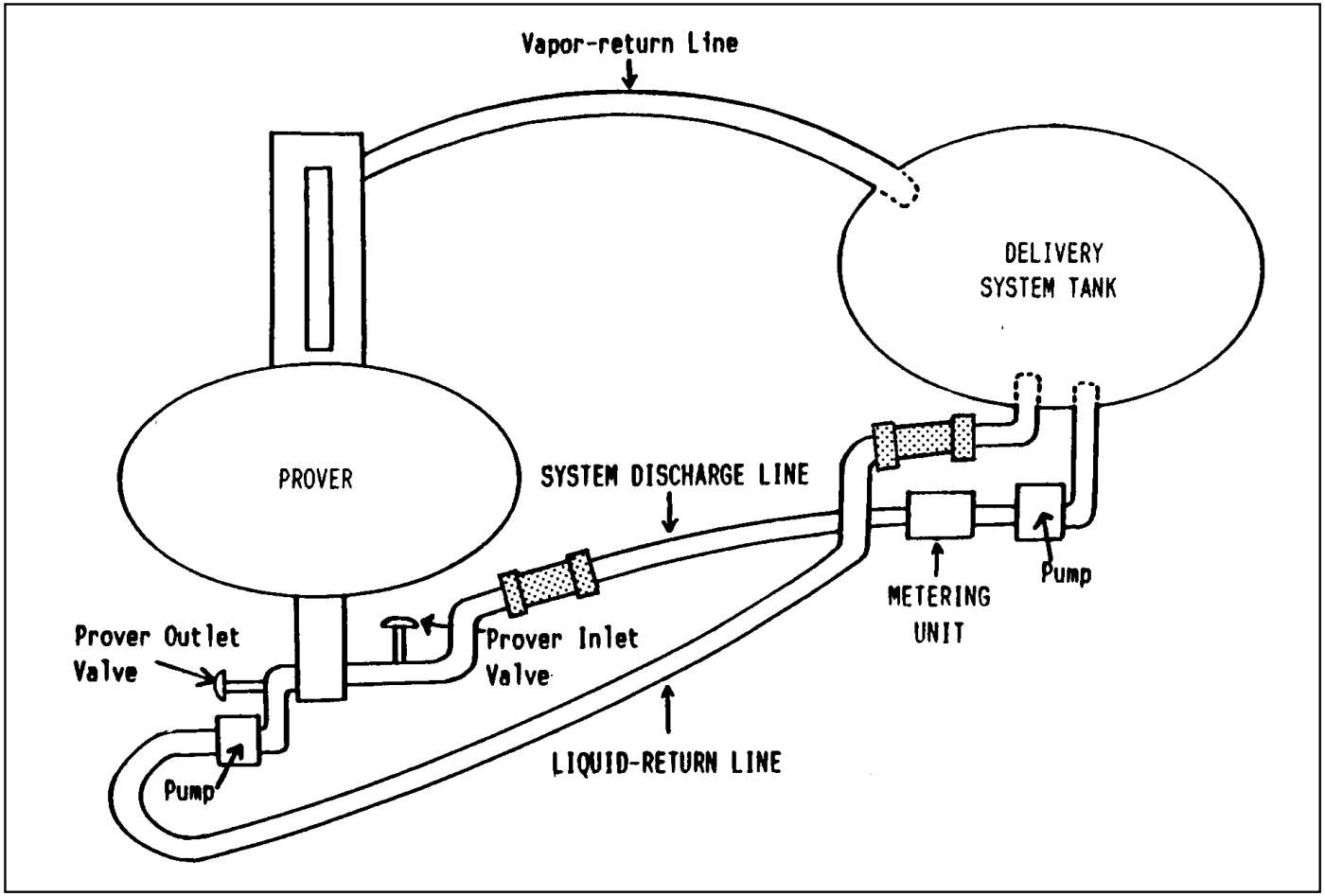
LPG Liquid Prover Setup -- Overview

- Three basic connections:
  1) liquid supply line from system tank to prover
  2) liquid return line from prover to system tank
  3) vapor return line from top of prover to top of vapor space of system tank

- Stationary or mounted on bed of a truck or trailer

- Must withstand working gauge pressures of at least 250 psi

LPG Liquid Prover Setup -- Overview

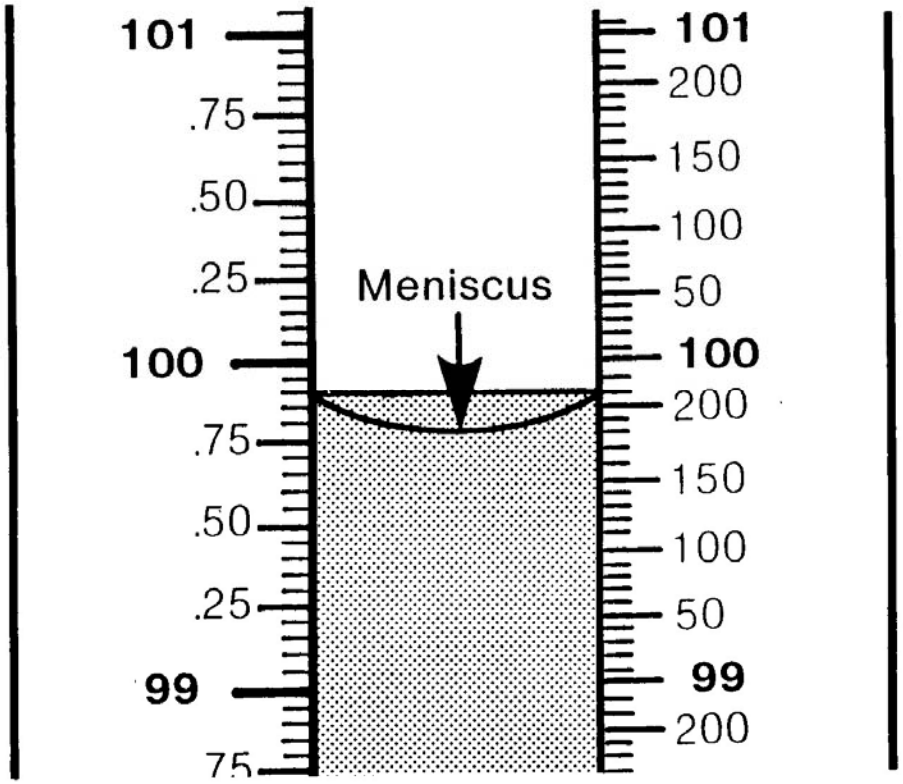


Vapor Return Line

- Opened after liquid discharge & return lines are connected
- Closed before taking reading
- Allows vapor initially in prover to be pushed back into system tank
- If vapor in prover were to remain, pressure from incoming liquid would cause condensation
- Necessary for testing; not possible to determine amount of product resulting from vapor condensation
- Commercial transaction: vapor in the receiving tank belongs to customer
- Spray fill tank design enables efficient delivery
- Promotes condensation
- Reduces pressure

Reading the Prover Gauge

- The capillary action of glass tube creates a curvature called the "meniscus"
  - Concave surface of liquid
  - Appears lens-shaped
- Read prover at <u>bottom</u> of meniscus



Reading the Prover

- If not exactly at zero, the value will be read as plus (above the zero line) or minus (below the zero line)
- If the reading is between graduations, round off to the “nearest” graduation.
- If the bottom of the meniscus is exactly in the middle of a graduation, read the value of the “even” numbered graduation.

Set-Up Procedures

- Have operator:
  - connect the system delivery hose to prover inlet line
  - connect vapor return line to system vapor connection
  - connect prover liquid return line to system liquid inlet
  - check for tight connections; valves & bleeders are closed
  - open vapor return line valves SLOWLY to avoid abrupt pressurization of prover
  - observe pressure gauges
  - install thermometers in (meter) and prover

Setting Up the Prover-- Procedures

- Remember: Safety First!!!

- position the prover:
  - away from source of ignition, on stable surface
  - near power source
  - be sure prover return pump operates before pumping product into prover
  - location should enable you to see meter, register, & prover indications as you operate the prover valves

- position fire extinguishers within easy reach
  Don't Leave Them in the Prover!!

Set-Up Procedures (cont.)

- chock and level prover trailer or vehicle
- check chocks and level again with product in the prover
- position caution signs and safety cones
- ground the prover to a suitable ground
- check fittings for adaptors required before proceeding
- note and record totalizer
- inspect temperature wells for dirt and debris
- clean & fill
- check prover & bleed valves
- be sure they are closed tight

Test Notes--
Wetting the Prover

- Wet prover, filling to nominal capacity
- Required at least once per meter
- Wetting of prover is very important:
  - be sure to adhere strictly to drain times
  - re-wet following long periods of non-use
    e.g., lunch break, meter adjustments, etc.

Test Notes--General (cont.)

- Prover readings corrected for expansion/contraction of the prover due to:
  - Pressurization
  - Thermal expansion or contraction of prover shell
  - Temperature difference between product at meter and at prover
- Primary indications and recording elements checked for comparability, legibility
- Computing devices for price computations...check after each draft
- Check totalizers after each draft

Handbook 44 References: N.5., G-S.5.6., S.1.1.6., UR.2.5., UR.2.6.

Test Notes-- Temperature and Pressure (N.5.)

- Temperature and pressure of product in prover and pressure at meter **recorded immediately** after each delivery
- No significant differences in pressure between prover and system under test
  - Should be no more than **5 psig**
  - > 5 psig may indicate an obstruction restricting flow
  - If restriction exists, can get some condensation which may affect the test results

Recorded Representations

- **G-S.5.6. Recorded Representations**
  - Requirements for indicating and recording elements also apply to printed values
  - Indications shall be recorded digitally
- **S.1.1.6. Printed Ticket (Issued by Computing Device)**
  - If total price is printed, volume and unit price must also be printed
- **UR.2.5. Ticket in Printing Device**
  - No ticket in printer until just before delivery
  - No ticked in device while vehicle is in motion
- **UR.2.6. Ticket Printer, Customer Ticket**
  - Vehicle-mounted systems must be equipped with a ticket printer
  - Copy of ticket must be left with customer at the time of delivery

Digital Indications & Recorded Representations (G-S.5.2.2.)

- Digital values of like value must agree
- Digital value coincides with associated analog value to nearest minimum graduation
- Digital value “rounds off”
- Digital zero must include all to the right and at least one place to the left of the decimal

Agreement Between Printed/Indicated Money

- $$$ indicated on device and
- $$$ indicated on ticket

  - **must agree exactly**

- Example:
  - $10.01 on indicator
  - $10.02 on ticket
  - Does **NOT** comply
  - must say $10.01 on ticket

Check Price Computations

- **G-S.5.5. Money Values, Mathematical Agreement (Computing Devices)**
  - Indicated and recorded money values in mathematical agreement with associated quantity to nearest 1 cent
  - Does not apply to certain operator-only auxiliary digital indications

- **S.1.1.5. Money Values, Mathematical Agreement (Computing Devices)**
  - Digital money-value indication and recorded money values in mathematical agreement with associated quantity to within one cent
  - Except stationary retail computing must comply with G-S.5.5.

Check Price Computations (cont.)

- **S.1.5.2. Stationary Devices, Money Value Computations**
  - Shall compute total sales price at any single-purchase unit price for which the product is offered for sale
    - Excludes fleet sales and other price contract sales
  - Analog money value indication shall not differ from the mathematically computed money value (quantity x unit price = sales price), by more than the values shown in Table 1

Table 1.
Money-Value Divisions and
Maximum Allowable Variations for Money-Value
Computations on Mechanical Analog Computers

Unit Price		Money Value Division	Maximum Allowable Variation	
From	To and including		Design Test	Field Test
0	0.25/liter or $1.00/gallon	1¢	± 1¢	± 1¢
0.25/liter or $1.00/gallon	0.75/liter or $3.00/gallon	1¢ or 2¢	± 1¢	± 2¢
0.75/liter or $3.00/gallon	2.50/liter or $10.00/gallon	1¢ or 2¢	± 1¢	± 2¢
0.75/liter or $3.00/gallon	2.50/liter or $10.00/gallon	5¢	± 2 1/2¢	± 5¢

Figure 7-10. LPG & AA/LMD Code, Table 1.

Price Computations – Summary, Digital Devices

Digital Devices:

- S.1.1.5.
  - indicated or recorded money value must agree with the mathematically computed value to within 1 cent
    - i.e., plus or minus one cent

- S.1.1.5; S.1.5.2.2.; G-S.5.5.:
  - stationary retail device must be to nearest cent
    - i.e., rounded to nearest cent

Price Computations – Summary, Analog Devices

Analog Devices:

- S.1.5.2.; S.1.5.2.1.
  - retail stationary analog indicated money value must not differ from mathematically computed money value by more than Table 1

Price Computations - Examples

- 152.7 gallons at $0.84/gallon
  = 152.7 x 0.84
  = $128.268

- digital stationary retail:
  - to nearest cent
  - must be $128.27

- other digital devices:
  - $128.27 is rounded value
  - within 1 cent (plus or minus)
  - must be $128.26 or 128.27 or $128.28

Price Computations -- Examples (cont.)

- 152.7 gallons at $0.84/gallon
  = 152.7 x 0.84
  = $128.268

- <u>analog:</u>
  - Table 1 says +/- 1 cent
  - can see between graduations
  - must be $128.258 or 128.278 or between these two values

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