LPG Liquid-Measuring Devices
Part 5: Test

NIST Weights and Measures Division

LPG Short Course

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LPG Meter Test - Overview

- Describe procedures for conducting performance tests specified in the EPOs
- Understand the purpose of testing the performance of LPG liquid-measuring systems
- Analyze and interpret test results

Normal Test ("Fast Test")

- Conducted at maximum discharge flow rate developed under the conditions of installation
  - Maximum discharge rate of installation can't exceed rated maximum discharge rate
- Tests at flow rates down to and including one-half the sum of the maximum discharge flow rate and rated minimum discharge flow rate are "normal" tests
  - Example:
    - Max Installation Flow Rate = 60 gal per min
    - Rated Min Flow Rate = 20 gal per min
    - Breakpoint (60 + 20)/2 = 40 gal per min

Handbook 44 References: N.4.1.

Special Test ("Slow Test")

- Conducted to develop operating characteristics of the device & any accessories
  - Examines meter performance at slower flow rates
  - Coupled with results of normal test, *provides an indication of meter condition*
  - Includes any test other than that in N.4.1.
- Always conducted with automatic temperature compensator deactivated
- Regulate flow by manipulating prover inlet valve

Handbook 44 References: N.4.2.

Repeatability (N.4.1.2., T.3.)

- Tests conducted at approximately same rate & draft size
- All other conditions of the test are the same
- Minimum of three consecutive drafts
- The range of tests (spread) shall not exceed 40 percent of the absolute value of the maintenance tolerance.
  - For example, on 100-gal test draft:
    - 0.40 x 231 cu in = 92.4 cu in
- Each individual test must be within applicable tolerance

Test Draft Size (N.3.)

- Test draft size must be equal to the amount delivered by the device in one minute at its normal discharge rate.

Testing - Overview

- Wet prover once for each meter tested
- Accuracy tests include at least 3 test drafts:
  - 2 Normal Tests (at maximum flow rate)
    - 1 with ATC activated
    - 1 with ATC deactivated
  - 1 Special Test (at a flow rate at or near minimum flow rate marked on device)
    - ATC deactivated
- Repeatability Tests for any result close to or outside of tolerance

Nontemperature-Compensated Meters

- First Run:
  - Normal Test, Full Flow
    - Record temperature at meter at 1/3 and 2/3 prover capacity
    - Normal tolerance applies
- Second Run:
  - Normal Test, Full Flow (Repeated)
    - Record temperature at meter at 1/3 and 2/3 prover capacity
  - Normal tolerance applies
- Third Run:
  - Special Test, Slow Flow
    - Special tolerance applies

Temperature-Compensated Meters

- First Run:
  - Normal Test, Full Flow
    - Normal tolerance applies
- Second Run:
  - Normal Test, Full Flow – ATC Deactivated
    - Normal tolerance applies
  - Difference between 1st and 2nd run cannot exceed ATC Tolerance (T.4.)
- Third Run:
  - Special Test, Slow Flow – ATC Deactivated
    - Special tolerance applies

Information Recorded at the End of the First Draft

- actual discharge rate
- temperature of product at meter at 1/3 and 2/3 prover capacity (will be 60 °F for ATC runs)
- temperature of prover immediately after delivery
- pressure in metering system tank and in prover immediately after delivery
- prover reading, nearest 0.05 gal
- register reading to nearest 1/10 of quantity interval (e.g., 0.1 gallon if in whole gallons; 0.01 gallon if in 0.1 gallons)

Three Corrections to Make

- 1) Product Temperature
- 2) Prover Pressure
- 3) Prover Temperature

#1: Correction for Product Temperature

- For change in product volume between meter and prover due to temperature differential

- Compensated (ATC-activated) drafts:
  - Use Table 4 (ASTM Table 24) to correct prover volume to 60 °F

- Uncompensated drafts:
  - Use Table 2 to correct for difference between prover & meter

#2: Correction for Prover Pressure

- For expansion/contraction of prover caused by pressure
- Use table prepared when prover was calibrated (Table 1)

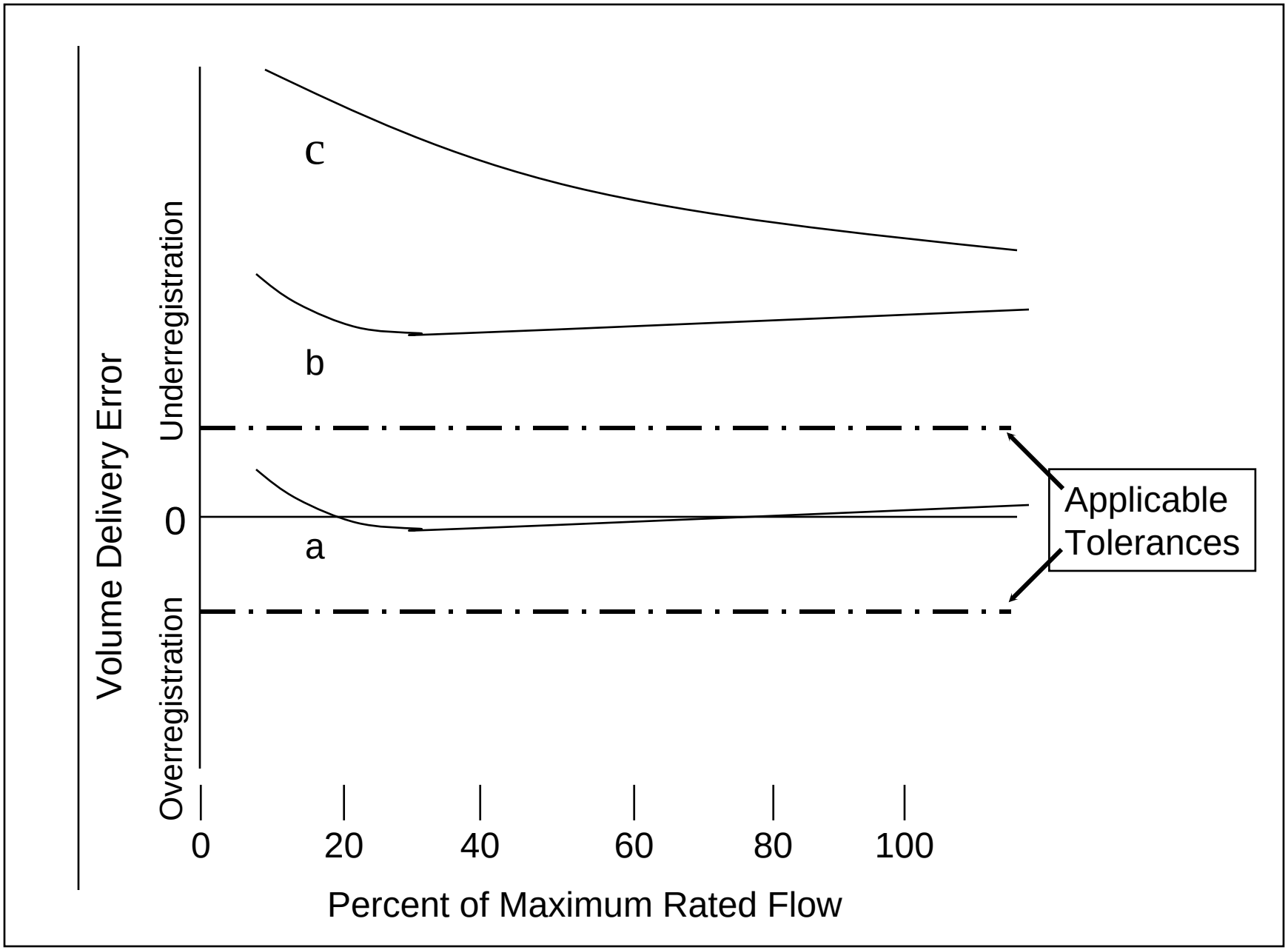
#3: Correction for Prover Temperature

- For thermal expansion/contraction of prover caused by temperature
- If low-carbon steel, use Table 3
- If prover is of different material, use a table with appropriate values or use coefficient of expansion marked on prover

Concluding the Test

- have operator reactivate ATC
- seal meter
- disconnect prover
- if no more tests at this location, bleed hoses
- after meter and prover are secure, proceed to “Post-Test Tasks”

Typical meter performance curve



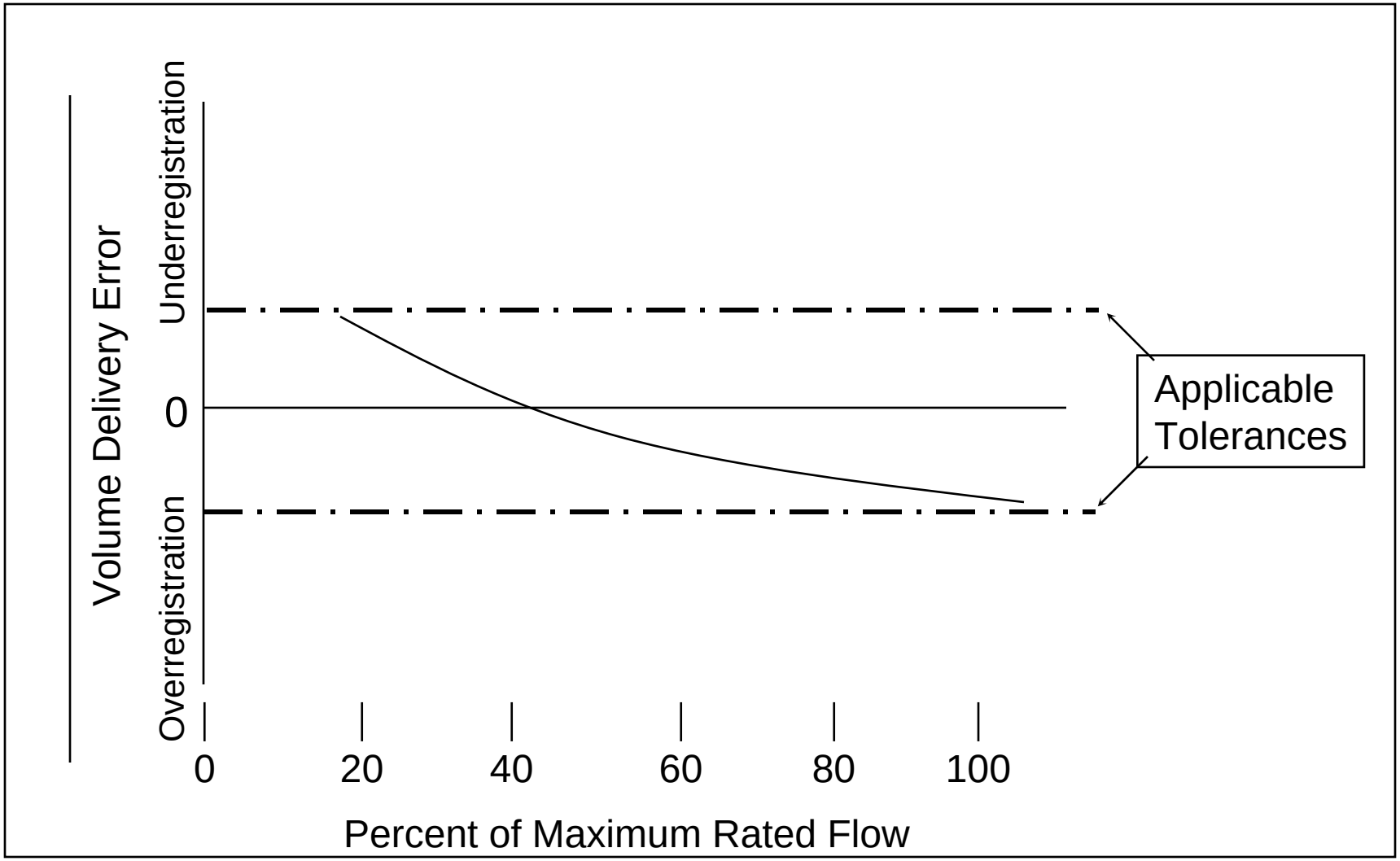
Meter Performance Curves

- curve “a” is a new or recently adjusted meter
- curve “b” is a meter that is out of tolerance, but that can be adjusted
- curve “c” is a badly worn meter
  - simply readjusting will not correct
  - readjusting meter may bring the meter within tolerance, but…..recall G-UR.4.1.

G-UR.4.1.
Maintenance of Equipment

- Equipment must be maintained in proper operating condition
- Equipment in service at a single place of business found to be in error predominantly in a direction favorable to the device user shall not be considered “maintained in a proper operating condition.”

Badly Worn Meter



General Post-Test Tasks

- Install security seals on equipment as appropriate
- Record audit trail information, if equipped
- Record final totalizer readings
- Evaluate results
- Determine appropriate compliance action
- Notify owner/operator
- Mark device to indicate disposition
- Complete & submit report form and other paperwork

Security Means

- Check for/apply physical security seal to meter & temperature compensator (G-UR.4.5., S.2.2., S.2.6.2.)
  - e.g., lead-and-wire, plastic wire, etc.
- Record audit trail information, if device is equipped (G-S.8.)
  - Record event counter information
  - Review event logger, if equipped
  - Retain information and compare it with audit trail information on future inspections

Test - Overview

- Wet prover
- Normal Test
  - Run 2 normal tests
- Special Test
- Repeatability Test
- Corrections
  - Product temperature
  - Prover pressure
  - Prover temperature
- Evaluate results
- Post test tasks