

EPO No. 25

Examination Procedure Outline for
Loading-Rack Meters

It is recommended that this outline be followed for examining loading-rack meters used to measure petroleum products sold at wholesale. The outline may be applied to devices with or without Automatic Temperature Compensating Systems. Non-retroactive and retroactive requirements are followed by the applicable date in parentheses.

SAFETY NOTES

When excerpting this Examination Procedure Outline for duplication, the "Safety Considerations" section and the "Glossary of Safety Key Phrases" should be duplicated and included with the outline.

The inspector is reminded of the importance of evaluating potential safety hazards prior to an inspection and taking adequate precautions to avoid personal injury or damage to the device. The inspector should read and be familiar with the introductory section on safety found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Clothing	Material Safety Data Sheets (MSDS)
Electrical Hazards	Nature of Product
Emergency Procedures	Personal Protection Equipment
Eye Protection	e.g., Safety Shoes
Fire Extinguisher	Safety Aprons, Respirators, Gloves, Barrier Cream, Etc., if deemed necessary.
First Aid Kit	Hard Hat -- for protection from overhang in rear of vehicle tank truck
Grounding	Safety Cones/Warning Signs
Ignition Sources	Static Discharge
Lifting	Support -- for prover
Location	Switch Loading
also: Wet/Slick Conditions	Obstructions and Overhead Hazards
Chemicals, Petroleum Products, And Hazardous Materials	

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Pretest Determinations:

Safety First !!!

Check the inspection site carefully for safety hazards and take appropriate precautions.

**Check to be certain that the ground surface of the inspection site is sufficiently strong and rigid to support the prover when it is filled with product
---don't forget to chock the wheels of the prover.**

Learn the nature of hazardous products used at or near the inspection site--obtain and read copies of MSD's.

Know emergency procedures and location and operation of fire extinguishers and emergency shut-offs.

Post safety cones/warning signs and be aware of vehicular and pedestrian traffic patterns.

Use caution moving around in wet, slippery areas and in climbing on prover, storage tanks, and vehicles.

Use personal protection equipment and clothing appropriate for the inspection site.

Be sure that a first aid kit is available and that the kit is appropriate for the type of inspection activity.

**H-44 General Code and
Liquid Measuring devices
Code References**

1. Prover must have valid calibration certificate and security seals must be intact on sight gauge.
2. Prover capacity must be sufficient to hold the amount of product that would be delivered by the meter to be tested during 1 minute of flow at its maximum discharge rate and in no case be less than 200 liters (50 gallons)N.3.5.
3. Prover and system design must be compatible (top loading/bottom loading).

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Pretest Determinations (cont.):

Be sure the prover is equipped with an explosion-proof motor.

Carefully inspect electrical supply lines for test equipment for wear or damage; correct potentially hazardous conditions before use; protect lines from damage during use.

4. Thermometers are to be accurate to within:
 - a. $\pm 0.5\text{ }^{\circ}\text{C}$, have a range of at least $0\text{ }^{\circ}\text{C}$ to $50\text{ }^{\circ}\text{C}$, and be divided in increments of no greater than $0.5\text{ }^{\circ}\text{C}$ for liquid-in-glass thermometers and $0.1\text{ }^{\circ}\text{C}$ for digital thermometers or
 - b. $\pm 1\text{ }^{\circ}\text{F}$, have a range of at least $0\text{ }^{\circ}\text{F}$ to $120\text{ }^{\circ}\text{F}$, and be divided in increments of no greater than $1\text{ }^{\circ}\text{F}$ for liquid-in-glass thermometers and $0.1\text{ }^{\circ}\text{F}$ for digital thermometers.

Thermometers may be of the partial immersion or digital type.
5. Inspect prover's interior surface for dents, product clingage, rust, water, or other foreign material.
6. Prover sight glass must be clean and fittings must not leak.
7. Available test fluid must be of the same general physical characteristics as that of the liquid to be commercially measured by the device N.1.1.
8. For top loading provers, the prover inlet must be lower than the outlet of the meter discharge line.
9. Determine applicable tolerance values:

Applicable requirements.....	G-T, T.1.
Basic values.....	T.2.3.3.
a. On normal tests:	
Acceptance tolerance	0.2 percent
Maintenance tolerance	0.3 percent
b. On special tests:	
Acceptance tolerance and maintenance tolerance	0.5 percent

Inspection:

1. Indicating and recording elements.

Design:

Device must be equipped with indicating elements and MAY be equipped with a recording element. S.1.1.

Units:

Units are to be in terms of liters, gallons, quarts, pints, or binary-sub-multiples or decimal subdivisions of the liter or gallon. S.1.2., S.1.2.3.(b)

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Inspection (cont.):

Readability:

Indicating and recording elements must be clear, definite, and easily read. G-S.5., S.1.4., S.1.5.

Required markings shall be distinct, easily readable, and of a permanent nature G-S.6.(1/1/77), G-S.7.

Values of intervals:

Values of the graduated intervals must be uniform throughout the series of indicating elements or, if equipped, recording elements. G-S.5.3.

For devices indicating or recording in more than one unit, the values must be appropriately identified. G-S.5.3.1. (1/1/90)

Advancement and return to zero: S.1.3.

Indicating and recording elements may only be **advanced** to zero by the mechanical operation of the device, UNLESS:

- a. Advancement can not be stopped until zero is reached, OR
- b. The indicating elements are automatically obscured until the elements reach a correct zero position.

Provision for sealing:

Provision must be made for sealing electronic adjustable components G-S.8. (1/1/90)

A security seal must be affixed to any adjustment mechanism designed to be sealed. G-UR.4.5.

2. Measuring elements.

Determine that system has an effective vapor elimination system and that vent lines are suitably rigid. S.2.1.

Verify that means are provided for determination of product temperature S.2.6. (1/1/85)

Determine that provision is made for applying security seals to the meter and to the automatic temperature compensating system, and that security seals are intact on both G-UR.4.5., S.2.2., S.2.7.3.

3. Marking.

Device is to be permanently marked with a make, model and serial number G-S.1.(a),
G-S.1.(c)(1/1/03),
G-S.1.(d)(1/1/68),
G-S.1.(e)(1/1/86),
G-S.1.(f)(1/1/01)

Inspection (cont.):

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All switches, lights, displays, pushbuttons, and other operational controls and features must be clearly and definitely identified. G-S.6. (1/1/77)

The limitation on a device's use shall be clearly and permanently marked on any device intended to measure accurately: S.4.1.

- a. only products having particular properties,
- b. only under specific installation conditions, or
- c. only when used in conjunction with specific accessory equipment.

Designed minimum and maximum discharge rates must be clearly and permanently marked on meter. Minimum discharge rate shall not exceed 20 percent of the maximum discharge rate..... S.4.3.1.

4. Installation.

Device must be readily accessible for purposes of testing. Assistance shall be provided by the firm if needed. G-UR.2.3., G-UR.4.4.

Examine discharge line and valves to insure that measured liquid cannot be diverted From the measuring chamber or discharge line and that any directional flow valves are automatic in operation. S.2.3., S.3.1.

No leaks should exist in the system on the outlet side of the meter..... G-UR.4.1., S.3.1.

Note: If leaks are detected on the inlet side of the meter, a notation should be made on the inspection report and the firm should be made aware of the location of the leak for purposes of safety.

Examine the system and any associated equipment to insure that the assembly, installation, and construction do not facilitate fraud..... G-S.2.

The details of the installation must be proper and must not adversely affect system performance. The actual maximum discharge rate must not exceed that specified by the manufacturer. G-UR.2.1., UR.2.1., UR.2.2.

5. Selection and use.

Device must be suitable for the service in which it is used with respect to the elements of design, including flow rate, computing capability, the details of its indicating and recording elements, and the value of its smallest unit and unit prices. Device must also be suitable for use in the environment in which it is installed. G-UR.1.1., G-UR.1.2

Device and any associated equipment are to be operated and maintained as intended by the manufacturer G-UR.3.1., G-UR.4.1.

Inspection (cont.):

If a device is equipped with a mechanical automatic temperature compensator, it shall be connected, operable, and in use at all times. UR.3.6.1.1.

6. Devices equipped with automatic temperature compensating systems.

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Provision must be made to deactivate the automatic temperature compensating system so that the meter may indicate and record, if equipped to record, in terms of the uncompensated volume. S.2.7.2.

Thermometer well must be provided for determination of the temperature of the liquid..... S.2.7.4.

Primary indicating and recording elements on devices equipped with automatic temperature compensating systems shall be marked to show that the volume delivered has been adjusted to 15.5 °C (60 °F)..... S.4.3.2.

Test Notes:

Wear appropriate personal protection equipment such as petroleum-resistant, non-skid safety shoes (to prevent possible injury from spills or slipping on slick surfaces), protective clothing, eye protection (to prevent injury from splashed product), and a hard hat (to prevent injury from overhangs and projections on vehicle tank truck).

Use proper grounding procedures!

Device operator should be present at all times during testing.

1. Check for the proper operation of the level indicators on the prover and level the prover.
2. Connect safety interlock and ground cable. If applicable, connect the vapor recovery hose.
3. Verify that all valves in the proving system are closed and that the prover pumping mechanism is functional.
4. Note the totalizer reading. Totalizer should be checked before and after each draft to determine its proper operation.

Test Notes (cont.):

5. Care should be exercised to insure that the temperature difference between product in the prover and in the meter is small. N.2.
6. For top-loading provers, take precautions to minimize splashing and to maintain the spout fill in a consistent position.
7. Examine printed tickets and invoices:

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- a. Print a ticket after each test draft, if device is so equipped..... G-S.5.6.
 - b. For devices of the computing type:
 - 1) Check price computations on indicator and on printed indications. S.1.7.2.
 - 2) On any printed ticket containing the total computed price, the total volume of the delivery and the price per gallon or liter shall be shown either machine printed or in clear handscript. UR.3.4.
 - c. Check all indicated and recorded values for proper comparability..... G-S.5.2.2.
 - d. For systems equipped with automatic temperature compensation, check invoices to determine if:
 - 1) deliveries which are adjusted to 15.5 °C (60 °F) show that the volume has been adjusted to 15.5 °C (60 °F)..... UR.3.6.1.2.(a)
 - 2) in the case of an electronic wholesale device equipped with an automatic temperature compensating system, the API gravity, specific gravity, or coefficient of expansion; product temperature; and gross reading are also indicated. UR.3.6.1.2.(b)
 - e. For devices with nonautomatic temperature compensating systems, check invoices to determine that: if the volume of the product delivered is adjusted to 15.5 °C (60 °F), this is stated on the invoice along with the product temperature used in making the adjustment..... UR.3.6.2.1., UR.3.6.2.2.
 - f. In addition to tickets printed during inspection and testing, several examples of actual used tickets are to be examined. This serves to verify the format of and information on actual printed tickets.
- 8. Prover readings are to be determined by reading the bottom of the meniscus for transparent liquids, and the top of the meniscus for opaque liquids.
 - 9. When monitoring drainage of the prover, one of the following methods should be followed depending on prover design. Precautions should be taken to insure that drainage procedure is followed in a consistent manner for each test.
 - a. If the prover has a lower neck equipped with a drain sight glass, close the drain valve prior to the liquid level reaching the zero mark indicator. After 30 seconds drain time, open the small drain-off valve and lower the liquid level to the zero mark. (Do not adjust the liquid level again,

Test Notes (cont.):

- even if continued drainage raises the liquid level above the zero mark before the test is started.)
 - b. If the prover is not equipped with a lower sight glass, leave the drain valve open until continuous flow ceases and dripping commences. Close drain valve after 30 seconds.
- 10. Temperature readings are to be taken to the nearest 0.25 °C or 0.5 °F or for digital thermometers, to the nearest increment. Take the temperature of the test liquid in the prover immediately following each

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accuracy test. For provers equipped with more than one thermometer, the temperature of the test liquid is the mathematical average of the individual readings.

A thermometer placed in the thermowell adjacent to the meter is to be used to determine meter temperature. Meter temperature is to be taken at 1/3 and 2/3 prover capacity during each delivery and averaged.

11. Automatic-stop-mechanism must stop flow within one-half the minimum interval indicated S.2.4.

Test Procedure:

Use proper lifting techniques to lift and move equipment!

Be aware of and attempt to eliminate potential ignition sources in or near the inspection site.

Be aware of vehicular and pedestrian traffic in the area.

1. Wet prover.
2. Empty prover. Allow a 30-second drain period each time the prover is emptied, using one of the methods outlined in the **Test Notes**. The amount of time between wetting the prover and the first test draft should be minimal.
3. Insert a meter ticket and set preset stop mechanism for the rated capacity of the prover.

Reset the meter to zero.
4. Start the pump, then open the prover delivery valve.

Test Procedures (cont.):

If any test result is close to or outside of applicable tolerance, then repeat the test.

If two consecutive tests are found to exceed applicable tolerance values, discontinue accuracy test and proceed to next portion of EPO.

For Repair Personnel:

Two test runs should be performed to insure repeatability. The difference between the high and low readings of these two consecutive runs should not exceed 0.05 percent of the prover's certified volume.

If test results exceed applicable tolerance values, the meter should be adjusted at this point. Repair

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personnel should follow company policy regarding adjustment of meter; for meters equipped with a temperature compensator, it may be necessary to first deactivate the temperature compensator prior to making any adjustment.

A check for the performance of the temperature sensor should be performed at the end of each accuracy test. Utilize the section at the end of each worksheet to analyze the performance of the sensor. Should a variation of 1 °C or 2 °F exist for two consecutive runs, the normal operating thermometer must be recalibrated against a National Institute of Standards and Technology traceable thermometer.

5. Accuracy tests.

a. Nontemperature-compensated meters.

Temperature corrections are to be made for accuracy tests to account for any difference between the temperature of the liquid passing through the meter and the liquid in the prover..... N.5.

1) Normal test--full flow..... N.4.1., N.4.1.1., N.4.1.2., T.2.3.

- a) Fill prover in a manner simulating actual use and determine actual flow rate. Test should be run at the maximum discharge rate anticipated under the conditions of the installation. Actual rate of flow should be within manufacturer's ratings of minimum and maximum flow..... G-UR.3.1., UR.2.2.
- b) Verify that all valves are closed and that prover remains level.
Examine prover piping to insure that there is no entrapment of air and that there are no leaks.
- c) Disconnect the bottom loading coupler or remove the loading spout from the liquid.

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Test Procedure (cont.):

- d) Allow time for product settling and foam dissipation prior to taking prover reading.
- e) Read the thermometers as described in **Test Notes**, and record the reading to the nearest 0.25 °C or 0.5 °F or for digital thermometers, to the nearest increment.
- f) For an analog device, record ending meter reading to the nearest 0.1 gallon. For a digital-indicating device, record the meter indication to the smallest quantity division available, e.g., test mode indication. Check totalizer against actual amount dispensed.
- g) Disconnect vapor recovery hose and then drain prover.
- h) Use appropriate worksheet to determine meter error.
- 2) Special test--slow flow..... N.4.2., N.4.2.4., T.2.3.
 - a) Reconnect vapor recovery hose, if applicable.
 - b) Fill prover at the minimum discharge rate marked on the device
 - c) Repeat steps (b) through (h) of part 5.a.(1) above.
- b. Temperature compensated meters.

For meters that indicate in "net" gallons. With temperature compensator activated:

 - 1) Normal test--full flow (do not deactivate temperature compensating system). N.4.1., N.4.1.1., N.4.1.2., T.2.3.
 - a) Fill prover as described in part 5.a.(1) above.
 - b) Obtain temperature of product at meter at 1/3 and 2/3 prover capacity. Determine the average.
 - c) Follow remaining steps in part 5.a.(1) above, using the worksheet for compensated meters to determine meter error.

Deactivate temperature compensator:

- 1) Normal test--full flow N.4.1., N.4.1.1., N.4.1.2., T.2.3.

Follow testing procedure described in part 5.a. above for normal test, uncompensated meters, determine meter error using worksheet for uncompensated meters.
- 2) Special test--slow flow..... N.4.2., N.4.2.4., T.2.3.

Follow testing procedure described in part 5.a.(2) above for special test,

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Test Procedure (cont.):

uncompensated meters. Determine meter error using worksheet for uncompensated meters.

Reactivate temperature compensator.

c. Temperature compensated meters.

For meters that indicate or record in "gross" gallons (uncompensated) and "net" gallons (compensated).

1) Accuracy of "gross" gallons is to be determined following the test procedure for non-temperature compensated meters in part 5.a.(1) and (2) above to perform both normal and special tests.

2) Accuracy of "net" gallons is to be determined as follows:

a) For each test run in part c.(1) above, obtain the temperature of product at meter at 1/3 and 2/3 capacity of prover.

b) Correct prover volume reading to 15.5 °C (60 °F), using the worksheet for compensated meters.

6. For automatic temperature compensating systems. The difference between the meter error for tests performed with and without the automatic temperature compensating system activated shall not exceed 0.2 percent for mechanical ATCS and 0.1 percent for electronic ATCS of the test draft. The results of each test shall be within applicable tolerances..... T.2.3.5.(1/1/88)

7. Security seal:

Adequate provision shall be made for applying a security seal..... S.2.2

Affix a security seal to the adjustment mechanism, as appropriate. G-UR.4.5.

8. For a wet-hose system, check the effectiveness of the anti-drain valve..... S.3.9.

9. For a dry-hose system, check for complete drainage of the hose. S.3.4.(b)

10. Radio Frequency Interference (RFI)/Electromagnetic Interference (EMI) (only if a problem is suspected). using only equipment on site in the vicinity of the metering system, perform a test for radio frequency/electromagnetic interference. Results of this test must indicate that use of such equipment does not adversely affect performance of the metering system..... G-N.2., G-UR.1.2., G-UR.3.2., G-UR.4.2.

Test Procedure (cont.):

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**Use extreme caution when switch-loading product!
Take precautions to isolate equipment when
transporting it to avoid exposure to hazardous fumes.**