Rack-mounted meters, pump supplied

Category: Volume
Part: 2-IPO
Section: 2
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Purpose
This inspection procedure outline (IPO) defines the minimum tests which must be performed to ensure that basic volumetric measuring devices comply with the legislation.

Application
Fixed metering systems (e.g., loading rack meters) used for the measurement of petroleum products which are liquid at ambient temperature and pressure (e.g., herbicides or pesticides, chemical liquid products, heated bunker oil or liquid asphalt). These metering systems are typically used to load or unload tanker trucks, railway tank cars, ships, etc.

Equipment
Appropriate volumetric proving standards, thermometer (0.1 °C).

Note: All proving standards must be verified and designated as a local standard by Measurement Canada. Mobile prover standards require recertification every four years. When selecting the appropriate capacity of proving standard, a minimum test volume should normally equal or exceed a one-minute run at maximum operating rate. Consult bulletin V-24 for additional information.

Requirements

Use
- Device and major components are approved for trade use: ..... Notice of approval (NOA), Weights and Measures Act, section 8
- Device and components are suitable for the actual use: .................... NOA, R-271, R.272
- Device has been initially inspected and is appropriately marked: R-29, bulletins V-08 and V-09
- Flow rates are within approved range: ..................................................NOA, R.290
- Automatic temperature compensation (ATC) seasonal and partial conversion: Bulletin V-19
- The use of actual product densities is authorized for determining volume correction factors (VCFs) under certain conditions: ..................................................Bulletin V-18
- Manual correction of volume to 15 °C is prohibited: ...............................Bulletin V-15
Visual examination (marking and labelling)

- Device is marked with the required information (manufacturer’s name, model and serial number, approval number(s), maximum and minimum flow rates, volume corrected to 15 °C, etc.): ................................................................. NOA, R.21
- Markings are appropriate and permanent (if applicable): ........................................... R.18
- Marking plate is permanently affixed to the device: .............................................. R.18
- Initial inspection marks (steel die or approved label): .............................................. R.29
- Units of measurement and, if applicable, the £ per litre or $ per litre face plate markings are appropriate (location, size, appropriate decimal and number of places): .......... R.135, R.136, R.137
- Marking of multiple outlet systems (if applicable): ..................................................... R.282
- Marking device usage restriction (if applicable): ....................................................... NOA, R.70

Note: The requirement of SVM.2-15 for marking test thermal wells is no longer applied.

Visual examination (printers, tickets, consoles)

- Tickets are appropriate to the printing device: ......................................................... R.149
- Information is printed as required: R.129, R.295, SVM.1-27, SVM.2-14 and bulletin V-20
- Quantity printed with adequate number of digits and decimals: ...................... R.126, bulletin V-07

Note: A clear message must be printed on the ticket if a delivery is done when the meter is in the testing or calibration mode.

Visual examination (seals)

- Calibration adjustments of the meter are sealed: ....................................................... R.235
- Pulse processing adjustments are sealed: ............................................................ SVM.1-8, SVM.1-9
- ATC adjustments are accessible and sealable: ..................................................... SVM.2-7
- Sealing ATC sensor and well assemblies: .............................................................. SVM.2-10
- Sealing flow control valve (if applicable): ............................................................... R.280

Note: Calibration and settings of metrological functions must not be accessible through external devices without breaking seals or without being logged (event logger) as prescribed. The device must not operate normally if left in calibration mode.

Note: The NOA must be consulted for special sealing provisions.

Visual examination (installation – general)

- Device is installed in accordance with restrictions and conditions listed in the NOA and in accordance with the manufacturer’s instructions: .............................. NOA, R.68, R.69, R.70
• Device is adequately secured, protected against abnormal environmental factors, is connected to an adequate and compatible electrical supply as prescribed by the manufacturer and attached components do not adversely affect its performance: .R.124, R.141, R.142

• Primary register is positioned for customer view (if applicable): ...............R.143, R.144

• Minimum graduation is in compliance with requirements: ............R.68(2), R.126, SVM.1-20

• Increments of registration (displayed and printed): ........................................Bulletin V-07

• Means of registration of total price – sufficient number of digits: ..................SVM.1-21

• System designed to allow for testing and inspection: .....................................R.284

• Blending metering systems – if one meter is equipped with ATC, all meters must be so equipped: .............................................................................................................SVM.1-2

Visual examination (settings)

• Multiple products or meters – Selection of unit price and adjustment are interlocked: SVM.1-16

• Register used with more than one meter or liquid prevents the delivery of more than one liquid at a time: ...........................................................................................................SVM.1-18

• Multi products ATC – Selection of coefficient of expansion or density is interlocked: SVM.2-12

• Adjacent linearization factors must not deviate by more than 0.25%: .............SVM.1-10

• Means of adjustments set both gross and net registrations: ..................SVM.2-28

Note: If the linearization factors are interpolated between entered values, the 0.25% restriction between adjacent factors is not applicable.

Note: If the lowest and the highest linearization factor set values exceed 0.25%, additional tests at mid-flow range may be warranted.

Note: The piping of a multi-product / multiple meter system must be equipped with the necessary automatic solenoid valves or other means interfaced with the electronic register to make the interlocking system operational as prescribed by the requirements.

Note: The requirements in this section are of particular importance for systems that are interfaced with computers that perform net quantity calculation.

Visual examination (upstream and downstream piping and hoses)

• Short and unencumbered suction piping: .............................................................R.273

• Piping and accessories are installed so as to minimize the passage of air or vapour: R.274

• Adequate vapour prevention and elimination system is in place, and the vapour eliminator has not been obstructed (if applicable): .................R.276, R.279, bulletin V-21

• Filter, strainer or other required equipment is located immediately upstream from the meter: .............................................................................................................R.277, NOA
• Sealed flow control valve (if necessary): ................................................................. R.280
• Check valve or other approved means installed to keep the system primed and prevent back flow (if necessary): .............................................................. R.280, R-28, SVM.1-34
• All product is delivered downstream from the transfer point and is retained upstream from the transfer point. Piping and hose downstream from the meter can be readily inspected: ................................................................. R.282, R.289
• Multiple outlet systems comply with installation and marking requirements: .......... R.282
• Quick-acting valve installed near outlet for inspection purposes: ...................... R.283
• Automatic means (e.g., solenoid valve) to stop liquid flow if missing pulses are detected: ........................................................................................................ SVM.1-37
• Automatic valve having throttling effect is located downstream from the meter: .. R.285
• Spring-loaded anti-drain valve installed at the outlet end of delivery hose: .......... R.286
• ATC temperature sensor and test well are installed within one metre of the meter (if applicable); no components are installed between the ATC sensor and the meter: ........................................................................ SVM.2-23, SVM.2-25
• Test thermal well is installed adjacent to the sensor and so that it will retain thermal conducting fluid during a test (if applicable): ...................................................... SVM.2-24
• ATC requirements for blending metering systems composed of more than one meter – all meters must be equipped with ATC: ............................................................ SVM.2-27

Note: Piping, valves and other components must be examined for leakage. Particular attention must be paid when examining suction piping. For safety and accuracy, any leakage should be corrected before inspection.

Performance

• Certified volumetric provers and measures are required to be wet and dripped in accordance with their certificate of calibration: ...................................................... STP-22
• Volume correction for the expansion or contraction of the prover shell needs to be calculated into the observed volume reading: ...................................................... STP-23
• In-service limits of error apply to tests performed in the field: ..... Bulletins V-03 and V-23
• Return-to-zero test (mechanical registers): ............................................................. STP-1
• Interlock test: ............................................................................................................. STP-2
• Segment test (electronic register): ........................................................................... STP-3
• Slow flow test: .......................................................................................................... STP-4
• Fast flow test: ........................................................................................................... STP-5
• Intermediate flow test: ............................................................................................ STP-6
• Repeatability test: .................................................................................................... STP-7
• Agreement between registrations test: ...................................................................... STP-9
• Computed value test: ............................................................................................ STP-10
• Hose expansion test (if applicable): ................................................................. STP-12
• Delivery cross-over test (if applicable): ...................................................... STP-15
• ATC test (if applicable): ................................................................................ STP-18
• ATC temperature sensor failure test (if applicable): ...................................... STP-19
• Electromagnetic interference and radio frequency interference susceptibility test (if applicable): ................................................................. STP-20

Note: Annotate inspection certificate with products measured during the test and which may be measured for trade use. Ensure programmed calibration factors are applied to appropriate products or product groups.

Meters used to measure more than one liquid must be tested on the highest and lowest grades in terms of viscosity. A meter with a single calibration setting (K factor) that is used to measure several grades of a product must be capable of performing within tolerances on all grades. Meter(s) equipped with a register having multiple settings for multiple liquids must be interlocked so that the adjustment selection corresponds to the liquid or meter selected. See specific requirements in specifications SVM 1-16, SVM 1-18, SVM 1-38 and SVM 2-12. Where it is not possible to test meters with all products, the register must employ the factor for a more viscous product in place of the products not tested. This ensures that the customer receives at least the amount of product purported.

Particular products and metering systems

Coriolis effect mass flow meter – Specific requirements

Identify units of measure (mass or volume) to select correct procedures and equipment.

• General requirements: .................................................................................... STP-42
• Gravimetric testing/volume indicating: ....................................................... STP-27
• Gravimetric testing/mass indicating: .............................................................. STP-43

Low-flow cut-off

• During initial configuration, low-flow cut-off (LFCO) should be disabled to check suitability of the initial factory applied zero offset.
• LFCO configuration only need be checked if initial configuration parameters have been changed.
• During subsequent examinations, LFCO must be limited to no more than 10% of minimum meter flow rate.
• System must stop flow when actual flow rate is below LFCO.
Initial configuration and examination

- Damping factor set to NOA or manufacturer's recommendations: ..........................STP-42
- Determine minimum measured quantity (MMQ): ........................................STP-27 or STP-43
- Check $E_{\text{min}}$ suitability ($E_{\text{min}} = \text{LOE}\% \times \text{MMQ} \times 2$): ...........................STP-27 or STP-43
- Limit of error (LOE) applicable at 5 $\times$ MMQ or greater (unique to mass flow meters): .............................Section 4.2 of the Terms and Conditions for the Approval of Coriolis Liquid Meters
- Determine minimum test quantity: .............................STP-27, STP-43 or applicable worksheet

Note: Due to the complex format of the uncertainty worksheet, inspectors will typically not have direct access to it. Therefore, STP-27 tables will be applicable unless the Volumetric Specialist has authorized a different value (likely as determined from the uncertainty worksheet).

Note: STP-27 tables should take precedence over the uncertainty worksheet. In most cases, the numbers will be comparable, but concessions were made in the STP tables in order to facilitate the use of standard test equipment already in use. Specifically, there are reduced volumes required for liquid petroleum gas proving with the existing gravimetric provers.

Pipe or piston prover

These standards may be used to test vehicle-mounted meters. Please refer to Measurement Canada’s pipe prover training module for complete pipe prover operating procedures.

Metering systems that use the same pump and lines to load and unload products

This type of systems is found in smaller plants located in the country where product is received through tanker trucks, ships and railcars. No measurement takes place when the system is used in unloading mode. It is imperative that these systems be designed to prevent pockets of air or gas which may be trapped in the piping and prevent this air or gas from being measured by the meter when in loading mode.

The examination of the piping configuration, valves and air eliminator is particularly important. Two-way three-port valves or interlocked valves must be installed to prevent the use of the meter when the system unloads product. An efficient air elimination system must be used. In order to evaluate the efficiency of the air prevention / elimination system, the following test must be performed in addition to the standard tests described above: Out of product test to verify the efficiency of the air prevention / elimination system: STP-8
Unloading metering systems

These systems are dedicated to the measurement of liquids when tanker trucks, railway tank cars or ships are unloaded to the plant reservoirs. The suction line must be as short and direct as possible, and the metering system located at a level lower than the source (tank car outlet, etc.). The system must be designed and operated so that a fixed transfer point is established. Automatic components such as low-level cut-off valves must be installed as necessary to ensure a consistent transfer point and accurate measurement. The system must be provided with an efficient air / gas elimination system. The system must be equipped with a pressure gauge located at the inlet of the pump. Some systems, in accordance with the NOA, may incorporate the design of air eliminator which is installed upstream of the pump. In order to evaluate the constancy of the transfer point and the efficiency of the air / gas elimination system, the following tests must be performed in addition to the standard tests described above:

- Vacuum test to ensure there is no leak on the suction line: ..................................STP-29
- Out of product test to evaluate the efficiency of the air elimination system: ............STP-8

Blending systems

These systems may be composed of two or more measuring chambers used to measure a particular grade of product that is blended downstream from the meters. Pulsers feed an approved multi-channel register that integrates the information and displays the total quantity of the blend. When possible, test each meter separately. As a minimum, a slow and a fast test must be performed on each meter. The following test must be performed in addition to the standard test:

- Product blend test: ................................................................................................ STP-16

Blending systems may be composed of two separate meters that have each their own register. Products are blended by means of a blending valve on the downstream side of the meters. The system must be provided with facilities that allow for testing each meter separately.

Blending systems may be composed of a single meter that measures different blends or grades of liquids. The blend ratio is ensured by one or more blending valves located upstream from the meter. One of the critical points in these systems is the capability of the meter to measure accurately all possible blends having different viscosities and densities. The meter must be tested with the two products that present the extremes in terms of viscosities and densities.

When a meter of a blending system is equipped with ATC, all meters must be equipped with ATC. See SVM 2-27.

Bunker oil or asphalt metering system

Only pipe proving and gravimetric means of testing are acceptable means when certifying metering systems for bunker oil or asphalt products.
Herbicides, fertilizers and chemical metering systems
Some of these products require the use of stainless steel provers or pipe provers. All the above standard tests must be performed. The device owner must be consulted and must provide assistance regarding the cleaning of the prover and the safe handling and disposal of product. Some systems may incorporate a design of air eliminator or deaerator which is installed upstream of the pump. In order to evaluate the efficiency of the air prevention / elimination system, the following test must be performed in addition to the standard tests described above:

- Vacuum test to ensure there is no leak on the suction line: ................................. STP-29

Engine oils and other lubricants
As for blending systems, certain meters can be used to measure several grades of lubricants. In this case, they must be tested for accuracy with the two grades that represent the extremes in terms of viscosities and densities. They must perform within the applicable tolerances. Meters equipped with a register having multiple settings for multiple liquids must be interlocked so that the adjustment selection corresponds to the liquid or meter selected.

See specific requirements in specifications SVM 1-16, SVM 1-18, SVM 1-38 and SVM 2-12.

- See specific requirements in standard test procedures: ........................................ STP-25.

Volumetric testing of lubricating oil meters
Volumetric testing requires the prover to be fully drained, flushed and cleaned with solvent. The prover must also be wet and dripped between each test. The operator must take all necessary precautions to avoid contamination. The device owner must be made aware of the flushing solvent in use and if not acceptable must provide an alternate agent. Arrangements must be made with the device owner for the safe disposal of the solvent. Field tests are performed using the product currently measured by the meter.

Lubricant meters may be tested using the gravimetric test procedure STP-27.
Revisions

Revision 2
The purpose of this revision was to add specific tests applicable to Coriolis effect mass flow meters. The format of the document was also changed. Device types and sub-types were removed from the document.

Revision 1
The procedure which utilized open provers to conduct tests of heated petroleum products such as Bunker or Asphalt is no longer condoned and subsequently revoked under that section. A notice instructing the use of closed system proving techniques replaced this procedure. Reference to a previously revoked procedure, STP-38, was removed from the Herbicides, Fertilizers and Chemical Metering Systems section and new instruction was included when air eliminators are found to be installed upstream of the pump. The title was also revised to include the two new device type codes (52.12 and 52.13).