Verification of fuel dispensing pumps

Every measuring instrument should be accurate and correct to be permitted for use in any commercial transaction, particularly at the Point Of Sale. The measuring instrument may be accurate but may not be correct. To be accurate, the instrument must meet the applicable tolerance limit (MPE) and some metrological requirements. It should pass some specific performance tests. To be correct, measuring instrument, should not only be accurate, it should meet some specific legal requirements also - type (design) or model approval, appropriate class for usage, descriptive markings, proper maintenance etc.

1. Definitions.

1.1 Fuel dispensing pump

A dispensing pump is a measuring instrument used in conjunction with a storage tank for effecting delivery of liquid products by specified volume. The instrument should be able to measure continuously, memorize and display the volume of liquid passing through the measuring unit.

1.2 Adjusting Device

Device incorporated in the meter, that only allows shifting of the error curve generally parallel to itself, with a view to bringing errors within the maximum permissible errors. This device may be either mechanical or electronic.

1.3 Indicating Device

Part of the meter that displays the measurement results.

1.4 Measuring Device

Part of the meter converting the flow, the volume or the mass of the liquid to be measured into signals, representing volume or mass, destined for the calculator. It consists of a meter sensor and a transducer.

2. Metrological Requirements.

(a) A dispensing shall essentially consist of:

- Suitable casing or housing
- Pumping unit
- Metering unit
- Register for quantities and sales.
- Flexible hose with nozzle

(b) Every dispensing pump shall be provided with indicator to display all possible deliveries. Any other counting or totalizing device that may be provided shall be so arranged as to avoid any possibility of confusion with the individual sales indicator.

(c)Main ancillary devices are:

- zero-setting device,
- repeating indicating device,
- printing device,
- memory device,
- price indicating device,
- totalizing indicating device,
- correction device,
- conversion device,
- pre-setting device,
- self-service device.

3.0 Visual examination

- Make and Model of the dispensing pump
- Serial number
- Sight glass
- Certificate number of pattern approval.
- Stamping or sealing mechanism

4.0 Determination of MPE

The maximum permissible error for dispensing pumps is based on standard test measures, maximum permissible errors. The MPE of standard test measure is ± 0.05% of the nominal capacity.

5.0 **Test Procedure**

5.1 Equipment

- Thermometer with accuracy of 0.2 ^{o}C or better
- Standard capacity measure (depends on flow rate of fuel dispenser)
- The measure should be suitable for deliveries greater than three times the minimum measured quantity specified for the dispenser.

For dispensers greater than 60 L/min use a measure with a volume equivalent to at least 1 min delivery for both maximum and minimum flow rate.

NOTE: It is essential that all working standard volume measures be conditioned (wetted and drained) before being used. This procedure is only needed on the initial test run, and is not required on subsequent deliveries as long as the measure remains conditioned

5.2 The following series of test procedures determine if the performance of a fuel dispenser meets requirements and whether the dispenser requires adjustment or service.

5.2.1. Checking Facility for Electronic Indicating Devices

The checking facility for an electronic indicating device shall provide visual checking of the entire display, which shall meet the following description

- displaying all the elements (see all segment showing number eight are visible);
- displaying zeros
- Remove the nozzle from its hang-up position and check that the display test is performed and display segments are not faulty.

Determine whether the dispenser has passed or failed.

5.2.2 Mechanical Reset Mechanism

For mechanical indicating devices, there shall be no residual volume indication after return to zero. Likewise, there is no residual price indication after return to zero.

5.2.2.1 Electronic Reset Mechanism

For electronic indicating devices, the price/volume indication after return to zero shall be zero without any ambiguity.

5.2.3. Price Computing

The price indicated shall be equal to the price calculated from the volume and unit price.

This test can be done at any time during a test delivery, e.g. accuracy test or nozzle shut off test.

- Reset the dispenser to zero.
- Make a delivery of a convenient volume.
- Calculate the total price from the unit price and total volume indicated.
- Compare this calculated price with all displays.

Determine whether the dispenser has passed or failed.

5.2.4 Nozzle Cut-off

Where the hose is fitted with an automatic cut-off nozzle the nozzle should cut off automatically when the sensing port of the nozzle comes in contact with liquid or foam.

This test can be done during accuracy testing.

- Make a delivery at normal flow rate.
- Allow the sensing port of the nozzle to come in contact with liquid or foam.
- Ensure the nozzle cuts off.
- Repeat steps 1 to 3 twice more.

Determine whether the dispenser has passed or failed.

6.0 Accuracy Test

The following series of test procedures are for determination of fuel dispenser accuracy.

- After wetting standard capacity measure, record the internal temperature (t_r).
- Measure and record the temperature of the fuel delivered by dispensing pump at β the point of discharge (t_m).
- Measure and record the temperature of the fuel in standard capacity measure (t_s) after delivery.
- Record the volume reading indicated by the fuel dispensing pump (V_m).
- Record the volume measured in the standard capacity measure (V_s).

- Determine temperature correction of the standard capacity measure in % (E_β) **$E_\beta = \beta\ (t_r - t_s) \times 100$**
- Determine temperature correction of the test fuel in % (E_α). **$E_\alpha = \alpha\ (t_s - t_m) \times 100$**
- Determine uncorrected error E' in % **$E' = [(V_m - V_s) / V_s] \times 100$**
- Determine error of fuel dispensing pump **E** in %. **$E = E' + E_\alpha + E_\beta$**

Notes: α: Refer to OIML R 63 or ISO 91-1 for petroleum products.
β: 33 ´ 10^{-6} °C^{-1} for mild steel, 51 x 10^{-6} °C^{-1} for stainless steel
54 x10^{-6} °C^{-1} for Brass.

where

E is the fuel dispenser error, in %
E' is the uncorrected error, in %
E_β is the temperature correction for the standard capacity measure (%)
E_α is the temperature correction for the test fuel (%)
V_m is the volume indicated by the fuel dispensing pump, in L
V_s is the volume measured in the standard capacity measure, in L
t_s is the average fuel temperature in the standard capacity measure, in °C
t_m is the average fuel temperature in the dispensing pump, in °C
t_r is the reference temperature of the standard capacity measure, in °C
α is the cubic expansion coefficient of the test fuel due to temperature, in °C^{-1}
β is the cubic expansion coefficient of the standard capacity measure due to temperature, in °C^{-1}

Check if *E* is within ±*MPE* then fuel Dispensing pump *Passed*

TEST REPORT FOR DISPENSING PUMP

Company responsible for service station: ..... Date:.....

Name of service station : ....

Address:..... ...

Location:.....

General Examination:

Type of Pump…… Model : …….....

Serial Number…… Last Verification …….

Local Identification: .....

Sealing Mechanism (Provide/not Provide)……

Product …….... Meter Flow rate…….....

Initial Meter Reading: ..... Final Meter Reading: .....

Visual Examination:

(a) ……

(b) ……

(c) ……

☐ **Passed** ☐ **Failed**

On Verification when new or after repair (MPE is ±0.05% of norminal Capacity) ☐

On Re-verification (MPE is ±0.1% of norminal Capacity) ☐

	Test Flow rate		Slow rate			Normal rate			Fast rate		
s/no	**Item**	**units**									
1.	Temperature of standard capacity measure (tr)	**^{o}C**									
	Average Temperature of standard capacity measure (tr)	**^{o}C**									
2.	Fuel temperature in standard measure (ts)	**^{o}C**									
	Average Temperature of standard capacity measure (ts)	**^{o}C**									
3.	volume measured in standard capacity measure (Vs)	**L**									
	Average Volume of standard capacity measure (Vs)	**L**									
4.	fuel temperature in the dispensing pump (tm).	**^{o}C**									
	average fuel temperature in the dispensing pump(tm).	**^{o}C**									
5.	volume indicated by the fuel dispensing pump (Vm)	**L**									
	Average volume indicated by the fuel dispensing pump (Vm)	**L**									
6.	Cubic expansion coefficient of the test fuel (α) in $^{o}C^{-1}$										
7.	Cubic expansion coefficient of the standard capacity measure (β) in $^{o}C^{-1}$										
8.	Uncorrected Error E'	**%**									
9.	Temp. correction for test fuel E_{α}	**%**									
10.	Temp. correction for standard measure E_{β}	**%**									
11.	Meter error E	**%**									

Notes: $E = E' + E_{\alpha} + E_{\beta}$ $\quad E' = [(V_m - V_s) / V_s] \times 100$

$E_{\beta} = \beta (t_r - t_s) \times 100$ $\quad E_{\alpha} = \alpha (t_s - t_m) \times 100$

Check if *E* is within ±*MPE* then fuel Dispensing pump *Passed.*

Decision: ***(a) Pump sealed and stamped***
Certificate of correctness No: ..... issued.
(b)Pump rejected for repairs
Rejection Note No: ..... issued.
(**c**) **Pump Condemned**
Condemnation Note No: ..... issued.

..... **.....**
Name of Inspector **Inspector Signature**

..... **.....**
Name of Owner/user **Signature of Owner/User**