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Title: **Terms and Conditions for the Approval of Coriolis Liquid Meters**

Effective Date: **2012-12-01**

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Revision: **1**

1.0 Application

These terms and conditions apply to Coriolis metering assemblies and to metering installations used in trade¹.

2.0 Definitions

In this document:

Coriolis Metering Assembly – means a device that measures the mass flow rate of a fluid by means of the interaction between the fluid flowing in oscillating tubes in order to determine the quantity of a liquid in units of mass or in units of volume derived from the measured density and mass of the liquid; (*ensemble de mesurage à effet de Coriolis*)

Metering Installation – means a Coriolis metering assembly, register and all other equipment necessary for the proper operation of the Coriolis metering assembly, and includes the piping, pump, valves and reservoir; (*installation de mesure*)

Minimum Measured Quantity – means the smallest quantity specified by the manufacturer for which a Coriolis metering assembly is capable of measuring within the applicable prescribed limit of error; (*quantité minimale mesurée*)

Minimum Specified Quantity Deviation (E_{min}) – means the absolute value of the limit of error for the minimum measured quantity; (*Écart de la quantité minimale spécifiée (E_{min})*)

Non-resettable Register – means a register that is intended for long-term use without being reset to zero; (*enregistreur sans remise à zéro*)

Register – means a primary display unit that incorporates electronic components to process signals from a Coriolis metering assembly and performs metrological functions in order to display a measured quantity; (*enregistreur*)

Registration – means a displayed or printed value; (*indication*)

Regulations – means the *Weights and Measures Regulations*. (*Règlement*)

All other words and expressions used in these terms and conditions have the same meaning as in the Regulations.

¹ The requirements of these terms and conditions were included in draft specifications related to Coriolis liquid meters and into mass flow meters.

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3.0 Design, Composition and Construction

3.1 Controls and Interlocks

3.1.1 (1) A register, other than a non-resettable register, that incorporates an electronic display shall:

(a) automatically supply electrical power to all display segments for at least 0.5 seconds and cut the power for at least 0.5 seconds after the register is reset to zero and before the next delivery is started, to allow an operator to detect any fault in a segment or in a circuit of the segment; or

(b) incorporate an automatic self-testing system that checks the operation of all display segments prior to starting a delivery and, where a fault is detected, prevents the delivery.

(2) Subsection (1) does not apply to secondary registers that display the same information as the primary register.

3.1.2 A register shall be designed so that the unit price cannot be changed while the register is computing the total price for a delivery.

3.1.3 The quantity and, where applicable, the unit price and the total price shall remain displayed for at least five minutes after a delivery unless:

(a) the next transaction is initiated; or

(b) the current transaction is finalized.

3.1.4 Where a metering installation incorporates a selective means of adjustment that permits a Coriolis metering assembly to accurately measure different liquids or permits the register to be used with different Coriolis metering assemblies, the selection of the liquids or Coriolis metering assembly shall be interlocked so that:

(a) the adjustment selection corresponds to the liquid or Coriolis metering assembly selected; and

(b) the unit price, where applicable, corresponds to the unit price of the liquid selected.

3.1.5 (1) In order to mask the effect of hose expansion on the registrations of a register, displayed values may be suppressed in a register up to a value equal to three times the applicable minimum increment of registration set out in 3.2.

(2) The minimum measured quantity for a metering installation with a rated maximum flow not greater than 90 kg or 90 litres per minute and which is intended to measure automotive or petroleum liquids in retail trade shall not exceed 5 kg or 5 litres.

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3.2 Registrations

3.2.1 (1) Every registration of a metering installation other than a registration of a non-resettable register shall have at least the following number of digits and not more than the following values as minimum increments of registration:

(a) four digits and 0.001 kg or 0.001 litres, in the case of registers intended for use with Coriolis metering assemblies designed for a maximum flow rate of 5 kg or 5 litres or less per minute;

(b) five digits and 0.001 kg or 0.001 litres, in the case of registers intended for use with Coriolis metering assemblies designed for a maximum flow rate of more than 5 kg or 5 litres per minute but not more than 20 kg or 20 litres per minute;

(c) five digits and 0.01 kg or 0.01 litres, in the case of registers intended for use with Coriolis metering assemblies designed for a maximum flow rate of more than 20 kg or 20 litres per minute but not more than 115 kg or 115 litres per minute;

(d) five digits and 0.1 kg or 0.1 litres, in the case of registers intended for use with Coriolis metering assemblies designed for a maximum flow rate of more than 115 kg or 115 litres per minute but not more than 500 kg or 500 litres per minute; and

(e) five digits and 1.0 kg or 1.0 litre, in the case of registers intended for use with Coriolis metering assemblies designed for a maximum flow rate of more than 500 kg or 500 litres per minute.

(2) For applications where the minimum delivery is always greater than 25,000 kg or 25,000 litres, the registration shall have a minimum of six digits and not more 10 kg or 10 litres for the minimum increment of registration.

3.2.2 Every means of registration of the total price by a metering installation shall have sufficient digits to enable the total price computed to be registered to the nearest cent when the metering installation is adjusted to the highest unit price and registers the largest volume the register is capable of registering.

3.2.3 A non-resettable register that is intended for use with a Coriolis metering assembly such as a pipeline Coriolis metering assembly shall be designed so that no registration is repeated when the Coriolis metering assembly operates continuously at its maximum rated capacity for a period of 90 days.

3.2.4 A non-resettable register that operates from the main power supply and that is exposed to ambient temperatures within the operating range of the register shall, in the event of a power outage, continue to function for a period of at least:

(a) 24 hours, where a back-up power supply that automatically recharges on restoration of power is used; or

(b) seven days, where any other type of back-up power supply is used.

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3.2.5 (1) A non-resettable register that obtains its power supply from a power source that must periodically be replaced, such as a battery, shall indicate low power at least 90 days before power failure.

(2) The replacement of a power source referred to in subsection (1) shall not alter any of the metrological parameters programmed in the register.

3.2.6 A register, other than a non-resettable register, that operates from the main power supply shall, in the event of a power outage:

(a) continue to operate in accordance with the applicable performance terms and conditions for the period set out in 3.2.4; or

(b) retain all of the metrological parameters programmed in the register for the period set out in 3.2.4 and be capable of displaying on demand the quantity and, where provided, unit price and total price, at any time up to 15 minutes after the power outage.

3.2.7 Except for metering installations in a continuous flow measurement application, a register shall be provided with a means for returning the quantity indication to zero either automatically or manually.

3.2.8 A register intended for use in a metering installation that measures the flow of liquid in the forward and reverse directions shall be designed to continuously indicate the direction of flow.

3.2.9 (1) Registrations of quantities for use in trade shall be indicated in units of mass or volume as prescribed in schedule I of the *Weights and Measures Act*.

(2) Indications of mass shall be derived on the basis of apparent mass versus a density of 8000 kg/m³ except in the case of the measurement of compressed liquefied gases where indications are in terms of mass.

(3) Metering installations which may provide supplementary registrations of density shall be in units of mass divided by volume.

3.3 Provision for Sealing

3.3.1 Adequate provision shall be made for sealing the access to the means of adjustment, including configuration adjustments of the metering installation by either physical or electronic means.

3.4 Means of Adjustment

3.4.1 Suitable adjustments shall be provided by a metering installation to:

(a) change the ratio of the indicated mass quantity to that of the actual measured quantity other than by liquid bypass of the Coriolis metering assembly;

(b) zero the mass measuring function under conditions of no liquid flow; and

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(c) permit the calibration of the density function when the Coriolis metering assembly measures volume.

3.5 Information to Be Marked

3.5.1 A Coriolis metering assembly shall be marked with the following information in addition to that prescribed in section 21 of the Regulations:

- (a) accuracy class;
- (b) minimum and maximum mass flow rates;
- (c) maximum working pressure;
- (d) liquid operating temperature range, if other than -30 °C to + 50 °C;
- (e) minimum measured quantity; and
- (f) special applications or limitations, as applicable.

4.0 Performance

4.1 Accuracy Classes

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4.1.1 Coriolis metering assemblies shall be classified as indicated in Column I of Table 1.

Table 1 - Accuracy Classes for Coriolis Liquid Meter Applications			
Column I	Column II	Column III	Column IV
Accuracy Class	Application or Commodity Measured	Acceptance Limits of Error	In-Service Limits of Error
0.3	All other liquid applications not shown in the table	±0.2%	±0.3%
0.5	Retail motor fuel dispensers (<90 lpm), heated products (>50 °C)	±0.3%	±0.5%
1.0	Compressed liquefied gases, including anhydrous ammonia and liquefied petroleum gas	±0.6%	±1.0%
2.5	Cryogenic liquids and liquefied gases not shown in this table, including carbon dioxide and liquefied natural gas	±1.5%	±2.5%

4.2 Limits of Error

4.2.1 When a Coriolis metering assembly is evaluated for approval pursuant to section 3 of the *Weights and Measures Act* the limits of error applicable to any known test quantity greater than or equal to the approved minimum measured quantity are:

- (a) as set out in column III of Table 1, for the applicable accuracy class, for any test carried out using any single rated liquid, at any one normal liquid temperature, at any single rated liquid pressure and at all rated flow rates; and
 - (b) as set out in column IV of Table 1, for the applicable accuracy class, for any test carried out on any two or more liquids, without adjustment of the metering installation when changing liquids, at all normal liquid temperatures, at all rated liquid pressures and at all rated flow rates.
- 4.2.2** (1) For inspection purposes, other than approval, the limit of error applicable to any known test quantity greater than or equal to the minimum measured quantity is set out in column IV of Table 1 for the applicable accuracy class.

(2) Whatever the measured quantity may be, the minimum specified quantity deviation (E_{min}) that may be applied as a limit of error is defined by the following formula:

$$E_{min} = LOE \times MMQ \times 2$$

Where: LOE is the applicable limit of error from Table 1
MMQ is the minimum measured quantity

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4.2.3 The ratio of maximum to minimum flow rates specified by a Coriolis metering assembly manufacturer shall be 5 to 1 or greater. In the case of a Coriolis metering assembly of accuracy class 1 or 2.5, the ratio of the maximum to minimum flow rates shall be 3 to 1 or greater.

4.2.4 For three consecutive performance tests conducted at similar flow rates, quantities and conditions of liquid temperature and pressure, the spread between the largest and smallest error indications for any quantity greater than or equal to five times the minimum measured quantity shall not exceed:

(a) 2/5 of the applicable limit of error for approval tests conducted under laboratory conditions; or

(b) 2/5 of the in-service limit of error.

4.3 Influence Factors

4.3.1 (1) Measurement errors shall remain within the limit of error applicable to any known test quantity greater than the minimum measured quantity under the influence of such disturbances as electromagnetic or radio frequency interference, power reduction, voltage spikes, electrostatic discharge, or other disturbance which may be encountered in use. The metering installation shall:

(a) be capable of interrupting the measurement upon detection of an out of tolerance error condition, cause the liquid flow to stop, notify the operator of an error condition and measured quantity at the time of interruption; or

(b) be designed so that it automatically causes the liquid flow to stop where, if during a delivery, a signal processing error exists where the resulting measurement error exceeds the limit of error applicable to any known test quantity greater than the minimum measured quantity.

4.3.2 For approval evaluation purposes:

(a) during an operational durability test, the permissible difference in the indicated error before and after the delivery of a quantity of product, equivalent to 100 hours of operation at 80% of the maximum rated flow rate, and without adjustment shall not exceed the limit of error of the known test quantity, as set out in column III of Table 1 for the applicable accuracy class.

(b) in addition to subsection (a), the durability test for mobile metering installations shall include an in-service test simulating actual conditions of use for a minimum of 20,000 km. The permissible difference in the indicated error before and after the in-service test, without adjustment to the metering installation, shall not vary from the first test by more than the applicable in-service limit of error.

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4.3.3 A register and all ancillary equipment shall remain within the applicable limits of error when tested under the following conditions:

(a) an ambient temperature in the range of -30 °C to +40 °C, except a register and all ancillary equipment designed for use in a temperature-controlled environment, which shall be tested over the range of ambient temperatures specified by the manufacturer and marked on the nameplate of the register; and

(b) a relative humidity in the range of 10 to 95 percent.

4.3.4 (1) A register and all ancillary equipment that operate from the main power supply shall remain within the applicable limits of error when tested with voltages from 90 to 110 percent of the nominal voltage.

(2) For the purposes of subsection (1), where a range of input voltages is specified by the manufacturer, the nominal voltage shall be the midpoint of the range.

4.3.5 Where a control console for motor fuel dispensers is used with a register so that a person can preset the quantity of liquid to be delivered, the dispenser shall deliver a quantity of liquid that is not less than the preset quantity and that does not exceed the preset quantity by more than five times the applicable minimum increment of registration set out in section 3.2.

4.3.6 Where a control console for motor fuel dispensers is used with a register so that a person can preset the money value of the liquid to be delivered, the dispenser shall stop the flow of liquid so that the money value registered at the dispenser is not less than the preset value and does not exceed the preset value by more than an amount rounded up to the nearest cent, equal to five times the applicable minimum increment of registration set out in section 3.2.

5.0 Installation and Use

5.1 General

5.1.1 A Coriolis metering assembly shall be installed in accordance with the manufacturer's recommendations and with any conditions or limitations set out in the Notice of Approval for the Coriolis metering assembly.

5.1.2 A metering installation shall be equipped with an effective vapour elimination mechanism or other effective and automatic means to prevent the measurement of vapour or air that may result in a measurement error exceeding the applicable limit of error.

5.1.3 During any metered delivery of liquefied petroleum gas and other liquids from a supplier's tank to a receiving container, there shall be no vapour return line from the receiving container to the supplier's tank.

5.1.4 A metering installation shall be equipped with an automatic means to stop the flow of product.

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5.1.5 (1) In a metering installation equipped with a programmable or adjustable low-flow cut-off feature, the metering installation shall be equipped with flow control valves which prevent the flow of product and stop the register from indicating product flow whenever the product flow rate is less than the programmed low-flow cut-off value.

(2) When the metering installation is equipped with a programmable or adjustable low-flow cut-off feature, the low-flow cut-off value shall not be set to flow rates higher than 10 percent of the applicable defined minimum flow rate of the Coriolis metering assembly.

5.1.6 Notwithstanding section 277 of the *Weights and Measures Regulations*, metering installations employing Coriolis metering assemblies do not require a screen, strainer, integral filter or other means to prevent foreign matter from passing through the meter.

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