

User Information Sheet 09

Formerly LPGA Technical Memorandum NO.77 – April 2003

Selection and Operation of Coriolis Meters for Proving LPG Metering Equipment by Volume

1. Introduction

Coriolis meters have become widely used for checking LPG metering equipment (both for dispensers and on tankers) by volume. They have the advantage of being portable, easy to operate and the production of results is straightforward.

To operate as a proving meter the repeatability of the results needs to be within 0.2% of the volume being measured. This can only be achieved by:

- careful selection of the components;
- correct preparation of the equipment and procedures on site;
- appropriate assessment of the results.

Factors affecting the results may include:

- pressure and temperature of the liquid;
- changes in ambient conditions;
- the flow rate;
- the flow range of both the meter being checked and the Coriolis meter;
- the pressure drop across the meter;
- the return path back to the vessel;
- initial meter set up.

2. Selection of Equipment

The selection of a Coriolis meter needs to take into account that the equipment:

- is to be used to compare the Coriolis meter volume readings with those of other meters;
- is for use with LPG at temperatures of -20 °C to 50 °C;
- is for use with LPG at pressures of up to 25 bar;
- is going to be used in an outside environment;
- will be moved from site to site, probably several times a day;

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- should be suitable for operation in a Zone 2 area as defined in the Dangerous Substances and Explosive Atmospheres Regulations 2002 and meet the requirements of Equipment Group II, Category 3, “G” of the Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996.

Electrical circuits and equipment should be suitably documented. In particular the documentation should indicate the power and earthing requirements of the equipment when in service.

If the meter is sensitive to change in pressure and/or temperature of the LPG, then it requires automatic pressure/temperature correction.

3. Equipment Preparation

It is essential that the meter is rigidly supported on the inlet and outlet pipework by brackets on either side of the meter securely mounted to a rigid frame in accordance with the manufacturers instructions. If the frame is fitted with wheels these need to be off the ground during measurement. If the framework is fitted with legs these must be locked in the down position.

- This is important to prevent vibration in the supports which could affect the readings, especially at low flows.

“Bent tube” meters should have the bent tubes in the vertically down position.

To prevent compression and expansion at the inlet and outlet of the meter generating hydraulic noise straight sections of pipework of the same nominal inlet diameter as the meter should be fitted to the meter inlet and outlet. The length of pipe on the inlet should not be less than 10 times the diameter and that on the outlet not less than 5 times the diameter.

Provision for pressure indication should be included in the inlet pipework to the meter. Suitable bleed/purge points should be considered.

If the instrument is not fitted with a temperature indicator then a temperature indicator should be included in the pipework adjacent to the meter.

Meter tubes should be suitably protected from changes in external conditions during use (e.g. sunlight, rain) by appropriate covers.

The inlet and outlet meter pipework should be fitted with suitable self-sealing couplings and/or isolation valves. Isolation valves should be ball valves of the full bore design to ensure no compression or expansion of LPG.

No pressure control valves should be fitted between the inlet connection and the meter inlet.

The outlet of the meter should be fitted with both a valve for flow rate control and an isolation valve. Control valves selected to give minimum pressure drop when fully open.

Any hoses fitted should comply with the requirements of Code of Practice 19 Part 1 for the hose dilation figure and with Code of Practice 14 for the working pressure.

Where multiple transmitters are available it is essential that the correct transmitter is connected to the matched flowmeter.

The transmitter should be set and sealed so that the meter parameters cannot be adjusted between periodic proving of the Coriolis meter.

Provision should be made for a suitable high quality earth between the meter wiring, the transmitter and the equipment being tested.

4. Setting up the Meter Parameters

After final assembly of the meter and transmitter the manufacturer should set up the transmitter with appropriate parameters for use on LPG.

Consideration should be given to setting limits on density readings to prevent measurement of any slug flow (Mixture of LPG liquid and vapour).

5. Proving the Meter

To confirm correct operation the Coriolis meter should be checked on a proving rig at a set period of not less than 12 months. The method needs to be acceptable to NWML and be traceable back to a National Standard.

6. Personnel

Only personnel who have been suitably trained should operate the equipment. When work is to be carried out on petrol forecourts the personnel should also be suitably trained to work in such a location.

7. Automatic recording

Some procedures include provision for recording some or all of the following parameters.

- flowrate;
- total volume;
- total mass;
- pressure;
- temperature;
- density.

The equipment should be set up to reflect individual procedures.

The Coriolis supplier should confirm that making recordings does not affect the reading from the meter.

8. Typical Operating Procedure

Note 1: The following detail typical measurement procedures, alternative procedures may be used providing they can be shown to have the same level of repeatability and accuracy.

Note 2: Safety Procedures, Work Instructions and Risk Assessments to meet the duties of the Health and Safety at Work Etc Act 1974, the Management of Health and Safety at Work Regulations 1999, the Provision and Use of Work Equipment Regulations 1998 and the Dangerous Substances and Explosive Atmospheres Regulations 2002 must be established before any work commences.

- Set up Coriolis meter on level firm ground;
- if transmitter is separate connect to meter;
- at this stage do not turn on;
- fit any pressure and temperature sensor;
- connect metering system outlet to Coriolis meter inlet;
- connect Coriolis meter outlet to metering system return or directly back to vessel;
- note metering system totaliser reading;
- pressurise pipework and check that there are no leaks;
- turn on power to transmitter and Coriolis meter and wait for the manufacturer's stabilisation period, usually 15 or 20 minutes after the power has been turned on;
- run 100 litres through meter;
- run liquid through the system until temperature of LPG going through Coriolis meter is steady within $\pm 0,5$ °C;
- close Coriolis meter outlet valve;
- carry out any sensor checks/system zeroing required by the manufacturer;

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- (n) zero the metering system and transmitter;
- (o) open Coriolis meter outlet valve and note static pressure;
- (p) start metering system at full flow;
- (q) note flow-rate and pressure;
- (r) run 50 litres liquid through the system, then close the Coriolis meter return valve;
record:
 - metering system reading;
 - Coriolis meter transmitter reading both volume and mass;
 - temperature;
 - product density (if available).
- (s) repeat test;
- (t) for “low” flow test adjust flow to between 10 and 15 litres per minute using the second valve on the meter outlet and run a volume not less than 25 litres through the system, recording the same items as in (r);
- (u) repeat test;
- (v) for “medium” flow test adjust flow to between half way between low and full flow using the second valve on the meter outlet and run a volume not less than 25 litres through the system, recording the same items as in (r);
- (w) repeat test;
- (x) results are considered acceptable providing the metering system reading and the flowmeter reading are within $\pm 1\%$ on all tests and within 1% at each flowrate;
- (y) close vapour return valve (which should be on the metering system side of the return pipework and confirm that the metering system does not allow flow), re-open return valve;
- (z) note metering system totaliser figure;
- (aa) turn off power to Coriolis meter and recording instrument;
- (bb) if necessary purge the Coriolis meter with nitrogen and depressurise;
- (cc) disconnect metering system nozzle from Coriolis meter inlet, position in metering system nozzle holder;
- (dd) disconnect Coriolis meter outlet from metering system return.

On satisfactory completion:

- mechanical parts of the dispenser that can be adjusted should be suitably sealed by lead seal;
- a report detailing the results and confirmation of the procedure followed should be prepared for the owner of the installation.