

250 BAR COMPRESSED NATURAL GAS LABORATORY



Highlights

- ◆ Quality and Reliability Evaluation of Coriolis Mass Flow Meters
- ◆ Model approval of CNG meters and dispensers
- ◆ High Pressure calibration of Industrial Custody Transfer meters

Auto and Natural Gas Scenario in India

Increased concern on the environmental pollution caused by conventional diesel/petrol fuels has caused the emergence of Compressed Natural Gas (CNG), as an environmental friendly and clean fuel. Auto fuel Policy introduced by MoPNG aims to address the issues of vehicle emission, vehicle technology and auto fuel quality. The use of CNG and LPG would be increased in pollution affected cities and there is a continuous growth of CNG filling stations in India.

Cost of Metering Errors

The cost of the fuel is charged based on mass measurements made by Coriolis mass flow meters. OIML R139 recommendations stipulate an error limit of 1.5% on the dispensed quantity, which is in the range 2 - 100 kg. An error of about 1.5% could produce a revenue loss or gain of 1.5 % of total transactions.

Model Approval as per OIML R139

CNG dispensers used for dispensing the fuel to the automobiles should be type approved for their performance as per OIML139 norms. The constituent elements of a measuring system and the subsystems for e.g meter, transducer, electronic calculator (including the indicating device), ancillary devices providing or memorizing measurements results, self-service device shall undergo separate model approval as required.

1. Accuracy Tests at Constant Flow rates

Constant flow rates and vessel volume to be used for testing are defined in OIML R139. Each test is repeated 3 times and accuracies are determined.

2. Banking Accuracy Tests

These tests are performed at various pressured banks.

3. Endurance Test

Endurance Test shall involve at least 5000 deliveries performed in less than six months preferably at site. The measured volume for each delivery shall be 20 times the minimum measured quantity at least and the deliveries may be simulated. After the endurance cycles, tests are performed at least 3 times, and mean initial/final intrinsic errors are calculated. The deviation shall remain within specified limit.

4. Testing the Gas Influence Factors

Tests should be carried out at the limits of the meter's field of operation, i.e. at the limits of possible pressure, temperature and density for the gas for 3 times each..

Table below gives the limits of errors for flow rate performance tests.

Metrological performance requirements for CNG meters and dispensers

	Parameter	Maximum Permissible Error
1	Type Approval - Meter alone	<1%
2	Type Approval - Dispenser	<1.5 %
3	Initial Verification or subsequent verification, Meter (Lab)	<1%
4	Initial Verification or subsequent verification, System (Lab)	<1.5 %
5	Initial Verification or subsequent verification, System ,site	2%
6	Minimum Measured Quantity	Twice Type Approval
7	Repeatability Error	<0.6%
8	Error shift after endurance test	< 1 %

5. Influence and disturbance performance tests for type approval of CNG dispensers

For undertaking Model Approval / Pattern Approval Testing of CNG meters/Dispensers as per the norms specified under OIML, extensive tests need to be carried out for accuracy and performance verification. A series of Environmental tests are mandatory as per OIML to assess the performance of the system under influence and disturbance factors

FCRI services to CNG Automobile Industry

A typical CNG dispensing station and dispenser calibration is shown in the schematic (Fig.1). It consists of low pressure gas supply, multistage compressor, CNG storage cascades and dispenser. Depending on the banking of the dispensers, flow rate will vary over a wide range. Mass flow meter of the dispenser must have the capability to ensure sufficient accuracy over the flow rate range it experiences.

FCRI carries out accuracy testing of CNG dispenser using the existing installation set up with master mass meter. Master prover has a calibrated coriolis mass flow meter modified as portable proving unit. Site verification is conducted by filling 8-10 buses/autos/cars. Amount of gas filled depends on the initial pressure of the cylinder of the vehicle.

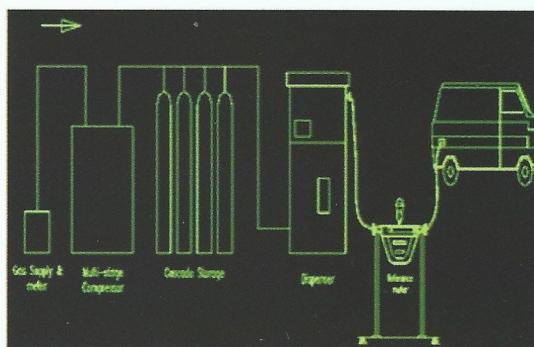


Fig.1 Scheme of CNG dispenser calibration at site

250 bar Compressed Natural Gas Laboratory

The new 250 bar facility is capable of evaluating and testing metering technologies for high pressure compressed natural gas applications, type test dispensers and mass flow meters. The facility consists of major components such as booster compressor, piping components, control components, storage cascades, weigh and buffer tanks and precision electronic mass comparator.

Specifications of the facility

Medium	: Compressed Natural Gas
Pressure	: Upto 200 bar
Reference System	: Gravimetric
Storage Volume	: 18 m ³

Test Line Size	: Up to 1 1/2"
Flow rate	: 4500 kg/h
Uncertainty	: 0.1%
Weigh Vessel	: 1 m ³ approx.

Clean dry CNG stored in cascades is used as test media. Gas drawn from Weigh/buffer tanks (pressure variation 200-25 bar) by booster type reciprocating compressor is compressed to the storage pressure of 250 bar and stored in cascades. The pressure to the test loop can be regulated to the required levels either in cascades or with multiple sets of pressure regulators while testing 2-3 bank dispensers. Mass flow rates are monitored using coriolis meters and a set of 7 critical flow venturi nozzles of different capacities control the mass flow rates through the loop. Actual mass flow rates are determined using electronic balance. Pressures /Temperatures are measured at upstream/downstream of nozzles and also at the inlet of the compressor. The facility is extensively instrumented and remotely operated valves are controlled by an online real time PC based GE Fanuc SCADA System

Fig. 2 shows the scheme of lab test of dispensers. The errors so determined must lie within the specified limits of the system. Master meters are calibrated at FCRI, prior to the site testing. Performance of the meter should be within the specified levels.



Fig.2 CNG dispenser under test in laboratory