Nagman
Instruments & Electronics Private Limited
Chennai, India

TECHNICAL PRESENTATION – FLOW METER CALIBRATION SYSTEM

by
G Rajabaskaran
Vice Chairman
Brief about Nagman

► Nagman is an ISO 90001:2008 certified company and serving the global market since 1972

► Our calibration lab is accredited to NABL for Thermal, Mechanical, Electrical and Flow Parameters in accordance with IEC/ISO 17025:2005

► We provide complete solutions to Calibration needs and offer consultancy services.

► We have Ability in Design, Manufacturing, testing, Supply, Installation & Commissioning and Maintenance under one roof.
A. Portable Calibrators – Temperature / Pressure / Signal
B. Dead Weight Tester / Comparator
C. Test Benches / Work Stations
D. Flow Meters & Water Meters Calibration System
E. Level Calibration System
F. Domestic Gas Meter Calibration System (Bell Prover)
G. Process Flow Meters
H. Level Transmitters / Devices
I. Calibration Services - ISO 17025 accredited
It is the method of calibrating flow meters using PROCESS MEDIA under clear environmental conditions.
Why Flow Meter Calibration

- Flow meters readings tend to drift due to changes in Temperature, Pressure and Harsh Environmental conditions.

- Meters used in Custody transfer application should be precise.

- Quality systems viz..ISO / TS/TQM demands periodical calibration

- For the Safety and Security of the personnel.

Recommended calibration frequency is atleast once in a year
Techniques of Fluid Flow – WET calibration

Comparative Method

WET CALIBRATION

Volumetric Method

Gravimetric Method

 KNOWLEDGE IS WEALTH   12/20/2017   NAGMAN
A. Comparison Method

Desired flow rate is set using the pumps (VFDs) and throttle valves. The volume & flow rate of UUT is compared with the reference meter to estimate the accuracy of UUT. The accuracy of the system depends on the accuracy of the Master meter.

Typical Calibrated accuracy of Master 0.2% (Achievable Up to 0.05% )
Pre fabricated volume tank is used as a Master reference. Water is getting diverted between Sump and collection tank for precise volume measurement. UUT reading is compared with volume of water collected in the tank. Typical calibrated accuracy of Master is 0.1%.
C. *Gravimetric Method*

High resolution weighing scale is used as a reference. After setting the required flow rate, the diverter is activated to collect the water in the collection tank to measure the mass of water using the weighing scale. Water density is also measured through a high accuracy density meter. Both Mass of water and Density are used to calculate the volume which is compared with the reading of UUT.

Uncertainties (CMC) up to 0.05%
Typical Flow meter calibration Systems

**NABL** accredited as per **ISO 17025**

<table>
<thead>
<tr>
<th>Method</th>
<th>Gravimetric</th>
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<tbody>
<tr>
<td>Flow range</td>
<td>up to 6000 LPM</td>
</tr>
<tr>
<td>Meter Sizes</td>
<td>DN 6 to DN 150</td>
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<tr>
<td>Flow control</td>
<td>Semi Automatic</td>
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<tr>
<th>Method</th>
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</thead>
<tbody>
<tr>
<td>Flow range</td>
<td>up to 25,000 LPM</td>
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<td>Meter Sizes</td>
<td>DN 6 to DN 400</td>
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<td>Flow control</td>
<td>Fully Automatic</td>
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</table>
Salient Features of the system

► Water Media Calibration with “Correction Factors” for other Liquids

► Calibration of Multiple UUT’s Simultaneously

► Effortless / Ergonomic Clamping / Mounting System – Manual / Pneumatic / Hydraulic / Electrical Actuators

► Adjustable Flow Rate over the Span

► Sizes: DN 6 to DN 400

► Flow Rates: 1 LPM up to 25,000 LPM

► No. of Lines: 1, 2 or 3 to suit
Display / Control Console: Flow Rate, Total Flow, Start / Stop Timer etc.,

Fully Automatic System with pre loaded FLOCAL software, PLC & HMI mounted on electronic console

Flow setting through high accuracy EMF meters

Four Stainless Steel Tanks of Nominal volumes 150 Ltrs., 600 Ltrs., 6000 Ltrs. & 12000 Ltrs.

Fine Flow control through Electrically Operated Flow Control Valves


High resolution weighing scales as a MASTER reference
Key Modules of FLOCAL System

- Storage Tank / Water Reservoir
- Pumps for water Supply
- Variable Frequency Drives (VFDs) for Flow Control
- Water Filter (Off Line)
- Test Bed
  - On/Off Valves
  - Clamping Systems
  - Adaptors & Spacers
  - Flow Straighteners
  - Pressure Measurement Devices (inlet / outlet)
  - Temperature Measurement Devices (inlet / outlet)
Key Modules - contd

- Electro Magnetic Flow Meters (Flow Setting / Reference Device)
- Weighing Scales With Collection Tanks
- Diverter System
- Automatic Read out System - Optical Heads (or) Digital Cameras
- Electronic Control Console, PLC, HMI, SCADA
- FLOCAL Software
- Computer System
Types of Flow Meters that can be Calibrated

- Variable Area Flow Meter (Rota Meter)
- Turbine / Impeller
- Positive Displacement
- Vortex
- Electro-Magnetic
- Coriolis / Thermal Mass
- Ultrasonic
- Primary Flow Elements
Flow Calibration System can operate without the availability of an external water supply source (Except for Topping up once in a way) Using only the water in the Storage Tank / Water Reservoir & on Recirculation Mode.
PUMPS & VFD

Adequate No. of Pumps provided to suit required Flow Rate. Pumps are mounted with frequency Drives (VFD) to control complete water circulation between the Reservoir / Storage Tank & Collection tanks.
TURBULENCE EFFECT

Designed with the ‘Objective’ of minimizing the Turbulence created by Water Flow from the Pump discharge by passing through a 3 level perforated Sheet filter Embedded inside the tank (Air Vent / Bleeder Valve provided)

Flow Straightener

Flow straightener is used inside the pipe line to avoid turbulence and obtain better Reynolds number.
Headers are provided at inlet / outlet of the test bed to minimize the turbulence of water flow.
WATER FILTER ( Off line)

Water filter provided on the Test lines to prevent clogging and unacceptable impact on the measurement results and the meters.
Flow Meters of Sizes up to DN 400 can be tested at the same bench.

Multiple flow meters of smaller sizes can be tested.

1/2/3 or more Test lines can be designed to suit the Meter Sizes.
COMPARISON METHOD

Accuracy
- 0.2%
- 0.1%
- 0.05%

Mass Flow Meter

Electro Magnetic

Master / Reference

Key Modules – contd…

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Key Modules – contd...

Volumetric Method

Pre Calibrated Graduated Tank

0.1 % accuracy
Master / Reference - contd

Gravimetric Method

High Resolution Weighing Scale

Multiple scales w.r.t flow range

System Uncertainty (CMC) – 0.05%
Key Modules – contd…

Pressure Transmitters at the up / down stream of the test lines.

Two Temperature Transmitters at the inlet and collection tank
Manually (or) Actuated valves – Based on Customer Request

- For Water Supply
- For Testing Lines
- For Flow Reference / Setting Devices
- Drain Lines
Clamping System

High quality Pneumatic (or) Hydraulic clamping system to clamp UUT’s.

Air compressor with 6 bar pressure for pneumatic system.
Adaptors / Spacers / Blanks will be provided for Matching / connecting Various Sizes of Meters.

High Quality supports for the Pipe line UUTs & Master Meters.

High resolution digital cameras & optical sensors used for automatic capturing of Data from UUT.
Flow Diverter will enable divert Flow into Collection Tanks/Reservoir (Storage Tank) for Flying Start/Stop Operation without disturbing the Flow Rate.

Flow Diverter in Operation - Video
Collection Tanks ……of capacities up to 12,000 Liters will be provided to collect the water flow during Campaign & These Collection Tanks will be placed on Matching Precision Weighing Scales up to 12,000kg – used as ‘MASTERS’
Electronic Console
To display Rate of flow, start / stop timer, selection of valves for UUT, selection of Master meters, VFD control knob (Flow Rate Control), temperature indicator, pumps on/off control through which the entire calibration process / operation can be performed.

SCADA SYSTEM

Key Modules – contd…
Some typical Systems
PICs Arabia – Saudi Arabia

Gravimetric System

Fully Automatic Flow Control

DN 15 to DN 250

High Resolution Weighing Scales
BPCL – Mumbai, India

Comparison System

Manual Flow Control

DN 8 to DN 80

Reference Mass F/M – 0.1% acc
Comparison System ; Manual Flow Control ; DN 15 to DN 250

Reference Electro Magnetic F/M – 0.2% acc
Mobile Flow Calibration System – ARIL - Kenya

Comparison System

Manual Flow Control

DN 6 to DN 100

Reference Electro Magnetic
F/M – 0.2% acc
Mobile Flow Calibration System – SKID Mounted

- Gravimetric System
- Manual Flow Control
- DN 6 to DN 80
- Reference High Resolution Weighing Scale
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<th>Job No.</th>
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<tr>
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Customer Name and Address  
M/s. Indian Oil Corporation Limited,  
(Refineries Division), P.O.Barauni Oil Refinery,  
Begusari - 851114.

Customer Reference  
PO.No: RBRM151041/24753096 Dated 05.05.2016

Details of the Instrument

| Location | - |
| Description | Mass Flowmeter |
| Make | Nagman |
| Model | NAGMASS 25- LZYN-25Y1U2S4.0 |
| Serial number | LN160101 |
| Identification Number | - |
| Size | DN 25 |
| Flow Range | 8000 kg/h |
| Resolution | 0.01 kg |
| Accuracy | ± 0.1% |
| Calibration Procedure | ISO 4185-1980 (CFC-FL/W1/F-02) |
| Equipment received on | 09.06.2016 |
| Condition of the equipment on receipt | Good |
| Date of calibration | 13.06.2016 |
| Date of next calibration suggested | 13.06.2017 |

Calibration environments

| Temperature | 31.5°C |
| Relative humidity | 61% RH |

Standard Instrument Details

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The Standards used are traceable to National / International Standards
**CALIBRATION DATA**

**Flow Element**  Mass Flowmeter  **Calibration Fluid**  : Water

**Size**  DN 25  **Flow Range**  8000 kg/h

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<th>W2</th>
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<th>Wa kg</th>
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<th>Dev in Wt %</th>
<th>Exp.Unc ± %</th>
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