Process Flow Meter Calibration System

NagendranVenkatraman, RajabaskaranGanapathy
Nagman Instruments & Electronics Private Ltd., Chennai – 600 123, India.

Abstract— *Precise (Liquid) Flow Measurement is Vital in Processesto Ensure Product Reliability to Achieve Reliable & Accurate Flow Measurements, Periodic 'Calibration' of the Flow Meters is Essential.Typical Calibration Modes include 'Comparison' (with Respect to a Pre-calibrated Master Flow Meter) & 'Gravimetric/Volumetric' (Deriving Flow Volume after Density Correction from the Mass of Liquid Flown - in a Pre Set Time Period - into Collection Tanks Mounted on Precision Weigh Scales). Article Briefly Explains the Methodology & Modules ofa Typical 'Gravimetric / Volumetric' Flow Meter Calibration System.*

Keywords - *Liquid Flow Calibration, Flow Meter, Calibration Methods.*

I. INTRODUCTION

This Article Purports to Describe in Brief, an Innovative/Hi-tech Process Liquid Flow Calibration System to Calibrate Flow Meters of Larger Sizes (up to DN 300) with enhanced System Features & Facilities.

II. WHY CALIBRATE FLOW METERS?

Flow Meter measures the rate of Flow of Fluid which passes through it. Flow Meters are used in wide variety of Applications where Accurate Flow Measurements are critical in various Sectors like Energy, Power, Refineries, Utilities, Water Management, Aerospace, Pharmaceutical Industry etc.

In Critical Applications like Custody Transfer, Inventory & Process Efficiency, it is important to Calibrate the Flow Meters to enable make reliable Measurements. Regular Calibrations assure you that the Flow Meter's Measurements are as accurate as their specifications.

Even the most rugged Flow Meters can fall out of Calibration with performance degradation over time - even corrosion or dirt within the media that flows through can shift the Accuracy of the Flow Meters.

This Process Flow Meter Calibration System (Operable in Automatic/Semi-automatic/Manual Mode) is designed for Calibrating the "Accuracy of Measurements" of varieties of Flow Meters (Coriolis Mass, Electromagnetic, Ultrasonic, Venturi, Orifice Plate, Turbine Flow Meters etc.) typically in sizes from DN 15 to DN 300 through Gravimetric/Volumetric Method. Calibration thro' Comparison Methods also are achievable with this System.

The System's Pump House accommodates an array of pumps from Very Low (1 M^3/hr) to Very High (600 M^3/hr x 2 Nos.) Flow Volume, with Frequency Converters (VFD's) which control the complete water circulation between the Storage Reservoir & Collection Tanks.

System's Test Bed will have Multiple (Three/Four) Test Lines to accommodate/mount 'Units Under Test' (UUT). Each Test Line is fitted with a Calibrated & Certified 'Electromagnetic' Flow Meter which serves as Flow Setting Device (Master). One or more of Flow Meters (UUT's) (Depending on the Sizes & Types of Flow Meters) can be Mounted & Calibrated at a time.

3 or 4 Stainless Steel Tanks of Nominal Volumes from 150Litresupto12000LitresareMountedonMatching Weighing Scales/Load Cells. Pressure Measurement devices are installed at both Upstream/Downstream of the test line to measure the Inlet/Outlet Pressure of Water. Temperature Sensors with Transmitters are fitted in Each Collection/Weighing Tanks to measure the Temperature of Water collected.

AnOpen Type Flow 'Diverter 'System enables Diversion of Flow into Collection Tanks or to Water Reservoir per Flying Start/Stop Operation, without disturbing the Flow Rate. Precise Flow Control is achieved by employing VFD's (Connected to Pumps/PLCs) & Electrically Operated Flow Control Valves. Very huge (Preferably Underground) Water Reservoir, with a capacity of 30,000/50,000 Litres will Serve as uninterrupted Water source for performing flow Calibration thro' recycling.

System's Control Panel is designed in such a way to perform multiple tasks & to mount the Weighing Indicators & Multiple Control Switches/Knobs etc. Control Console is also equipped with a Mounted PC with preloaded Software - to handle/operate the process and Display the parameters like Flow Rate/Total Volume, Temperature & Pressure readings. Control Console is equipped with precise PLC system to take care of the Automation Process of the System & is loaded with Appropriate Software which generates Calibration Report.

Fig 1 : 3D Drawing of Flow Meter Calibration System for covering Meter Sizes upto DN 300.

III. MAJOR MODULES OF THE SYSTEM :

Water Reservoir (Underground?), Pump House with 3 or 4 Pumps, Headers/Test Bed with 3 or 4 Lines, Clamping System, Master Flow Meters, Space for Units Under Test (UUTs),Control Valves, Spacers/ Adapters/ Blanks, Diverter Systems/Collection Tanks Mounted on Precision Weighing Scales, Drain/Bypass Lines, Temperature/Pressure Measuring Devices, Density Measuring Device, Off Line Filter, Control Console (to House On Off Switches, VFD Control for Pups, Weight Indicators, Rate of Flow/Total Flow Indicators, Precision Timer, Temperature/Pressure Indicators etc.), PC (with Preloaded Software)& Printer.

IV. OTHER SALIENT FEATURES :

3 Modes of Operation :Manual/Semi-Automatic/Automatic.

CMCs/Uncertainties Achievable:Gravimetric Method: Around 0.07%;Com parison Method: Around0.25%.

Media of Operation: Water (Correction Factors for other Process Fluids).

With this System,Typically, Gravimetric Calibration can be performed upto 12,000 Liters volume on the basis of 1 minute (60 seconds) campaign (i.e. Flow Rate 12,000 LPM). For volume higher than 12,000 Liters (for eg. Flow rates higher than 12,000 liters/minute) Gravimetric Calibration Campaign time will be varied according to the set flow rate.

Comparison Calibration can be Performed upto 20000 LPM thro' Bye Pass Mode.

ACKNOWLEDGEMENT

REFERENCES
[1] Industrial Flow Measurement by David W. Spitzer

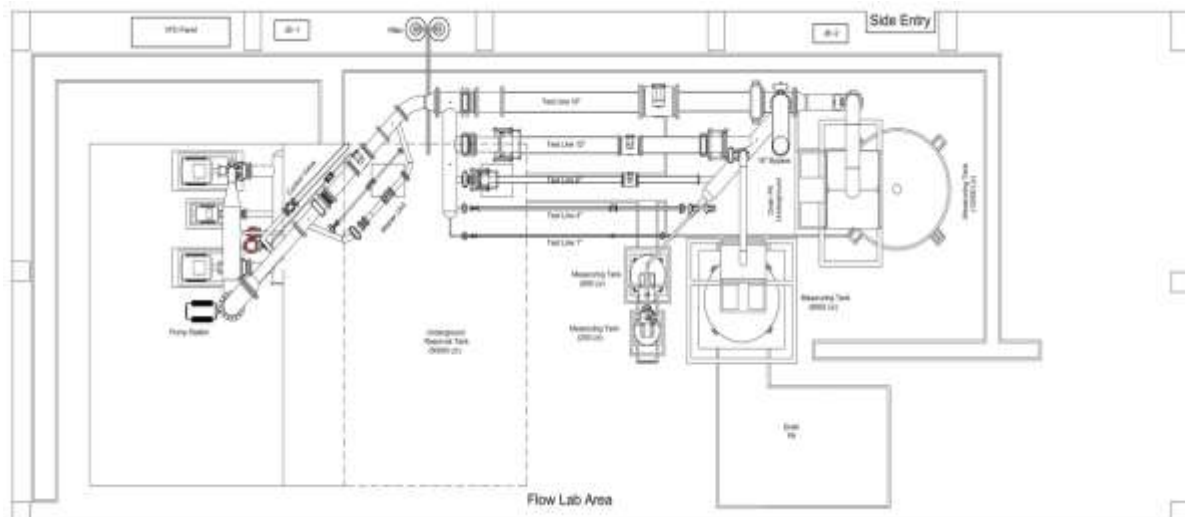[2] Flow Rate Calibration Methods: ISO 4185, VDI/VDE 2641

Fig 2 : 2D Schematic Drawing of Flow Meter Calibration System Setup