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RESEARCH ARTICLE

AN INNOVATIVE CONCEPT, METHOD FOR WET CALIBRATION of PRIMARY & INTERFACE LEVEL - OF MUTIPLE, MULTIBRAND LEVEL DEVICES

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ABSTRACT

Precise Measurement of Level is often Critical for Inventory, Custody Transfer, Process efficiency, Consistent supply etc. In order to ensure Accurate & Reliable Measurements, Calibration of Level devices by Dynamic WET Calibration is Imperative. Compared to Primary Level measurements in liquids, the detection and measurement of Interface Level has its own particular challenges. Ideally, an Interface would be a clear separation between two media with different densities. This Article / Paper emphasises on an Innovative Method for Primary and Interface Level WET Calibration of Multi Type / Multi Brand Level Devices, mounted in a Specially Designed Universal Platform / Level Calibration Rig. This method efficiently works on the basic principle of Physics, cascaded with latest measurement techniques.

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INTRODUCTION

LEVEL, like Temperature, Pressure, Flow etc., is also an Important Process Parameter. Unfortunately, Periodic Calibration of Level (Measuring & Controlling) Devices had NOT Received its Due Importance. This is Presumably Attributable to the Fact that Appropriate Rigs / Systems for (Periodic) Calibration of the Multitude of Level Devices Deployed in the Process Industries are Not Available. Process Industries Typically Install Hundreds of Level Measuring & Controlling Devices — Multiple Types (Like e.g.: Float, Capacitance, Ultrasonic, Magnetostrictive, Radar etc.) & MultiBrand (Like e.g.: Magnetrol, Vega, ABB- K Tek etc.) (Refer Figure 1). Globally, An Universal Platform - Calibration Rig / System - which can accept such Diverse (MultiType / MultiBrand) Level Devices - to enable Perform WET Calibration - is NOT Available, Constraining Industrial users to Ignore Periodic Calibration of their Level Devices.Most Manufacturers of Level Devices 'Calibrate ' these employing 'DRY" Calibration Techniques — Using Linear Dimension Measurement of Length / Height, to correlate this with the Analog / Digital Outputs of their Level Devices.

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WET Calibration — Close to Dynamic Process Conditions - with Devices physically in Contact with Liquid Media — is a Rare Process Adopted by the Manufacturers (of Level Devices). In CRITICAL Process Applications, such WET Calibration - as against DRY Calibration - of Level Devices deployed had Proved to be Effective & Reliable. An INNOVATIVE CONCEPT Methodology — an UNIVERSAL PALTFORM /RIG — that Enables Perform WET Calibration — Not Only of PRIMARY Level (using WATER Media) but Also of INTERFACE Level (of Chosen Liquids) — in a Laboratory Environment - of Multiple Types / Multi Brands Level Devices is elaborated below. This Calibration Methodology can be extended for Measuring SPANS, Typically up to 5000 mm& can be Designed / Adopted to Suit / Mount Most Popular Types of Level Devices, Including: Capacitance, Float, Ultrasonic, Magnetic, and Magnetostrictive & Radar. Calibration Accuracies - in Comparison Mode - as High as 0.01 % / 1.25mm Min. — can be achieved. By Cascading Techniques, Using a Single REFERENCE Sensor, this Rig can be extended to Accept: Short Stem - Side or Top Mounted, Devices with In Built Chambers etc. The Major Modules of the RIG will Include : a Large Diameter (to Suit — Typically 500 / 600 mm Dia) Main Chamber, Height Typically 2000 mm (Can be Extended up to 5000 mm), Top Lid Designed to Mount Multiple (2 or 3) Devices, Reference Probe of High Accuracy (Typically Magnetostictive, with 0.01 % FS

Accuracy), Control (LOOP) System (Consisting of Pumps, Control Valves, Solenoid Valves, Connecting Pipes, Drain Tank cum Reservoir etc.), Control Console (Monitor, Indicators, PC, Software etc.).In the Event of INTERFACE Level Calibration :1 or 2 Auxiliary Overhead Tanks to Hold Chosen Interface Liquids, Solenoid Valves, Drain Tanks & Pumping System — are to be Included (Refer Figure 2).

Figure 1. Multiple Types of Level Devices

Calibration Methodology

Primary level: REFERENCE Sensor of Appropriate Span & Accuracy &Unit Under Test (UUT) are Mounted on Top of the MAIN Chamber. Control Algorithm enables Water in Reservoir to be pumped into the Chamber until SET Level is reached. Outputs of Reference Sensor & UUT are then compared to realise the Calibration Error. Calibration can be performed in Multiple Points over the Span.

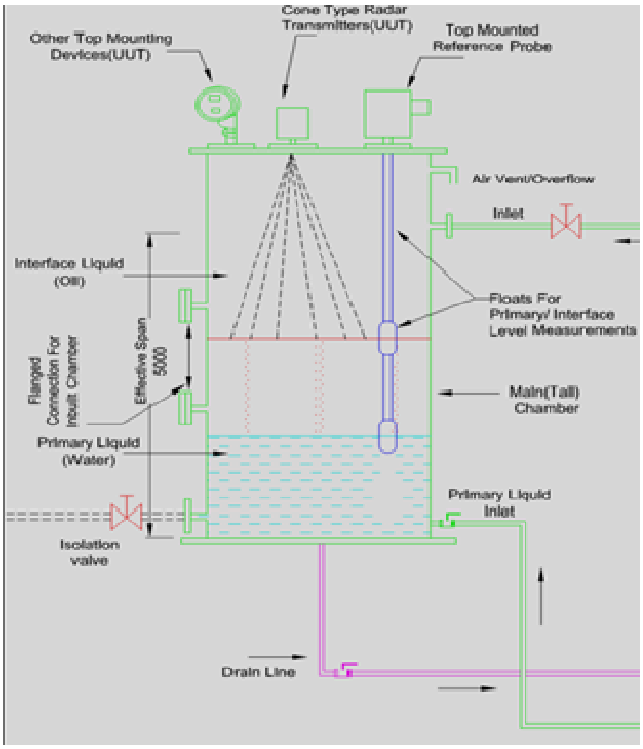

Figure 2. Major modules of Rig

Secondary (interface) level: In this Case the REFERENCE Sensor needs to have 2 FLOATS (Magnetostrictive) or suitable to Detect 2 Different Specific Gravity Bands - One for Primary & the Second for Interface. With Support from the Control Circuit, After Stabilising the Primary Level at any One Point, Appropriate Interface Liquid Stored in the Overhead Tank is Drained to Predetermined Level over the Primary Liquid. The Interface Level then is Measured by Reference Sensor (Second Float) & Compared with UUT Interface Reading, to Derive Error.

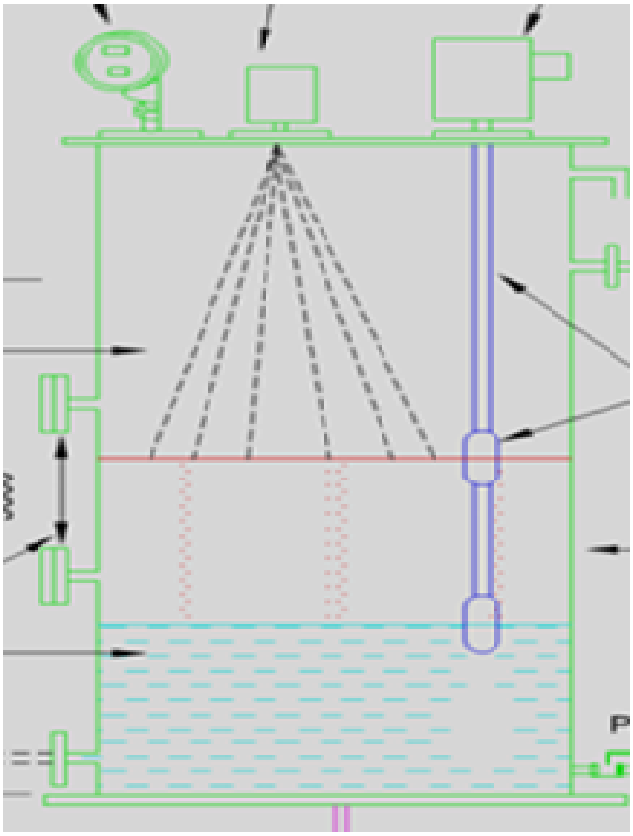

Figure 3. Cone type RADAR level device Installedin Rig

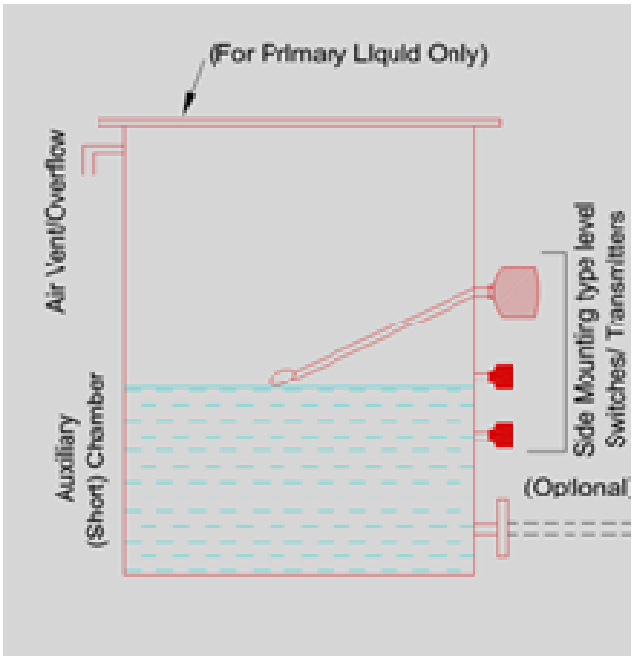

Figure 4. Short Span Tank for calibration of side mounted level devices

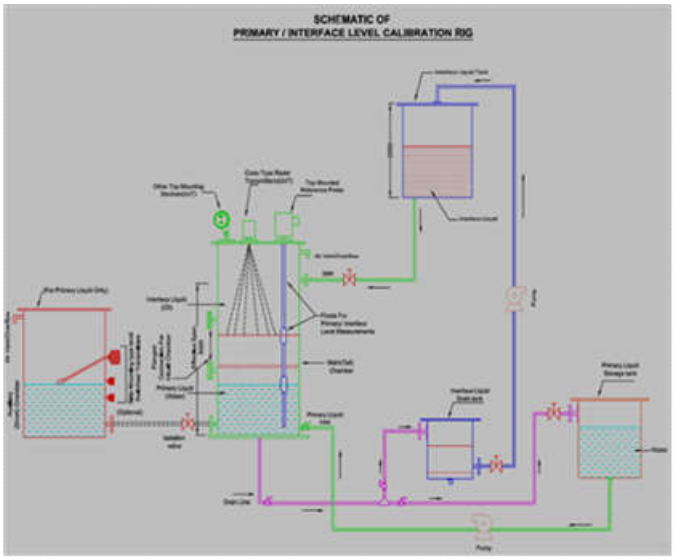

Figure 5. Schematic of Primary/Interface level calibration Rig

This Rig Allows the Option to:

— Keep Primary Level Constant & Raise Only Interface Level to Various Spans (points)

— Or Keep Interface Level Constant but Raise Only the Primary Level to Various Spans (points)

Once Interface Calibration is completed, the Interface Liquid can be drained by Lowering the Primary Liquid to Zero Level &Interface Liquid is then pumped back to the overhead Interface LiquidTank. Alternatively Interface Liquid can also be drained from Top, by raising the Primary Liquid to the outlet point.

The Large Diameter of Main Tank Allows CONE Type RADAR Devices to be calibrated, allowing Obstructions in the Cone to be avoided (Refer Figure 3).

By Adding an Interconnected (at Bottom, with Isolation Valve) Short Span Tank, SIDE Mounted (Float Type Switches etc.) Devices can also be calibrated, still employing the same Reference Sensor but only for Primary Level. However during INTERFACE Level calibration, this Short Span Tank needs to be Isolated (Refer Figure 4).

Reference : Instrumentation Reference Book Fourth Edition by Walt Boyes

The Limitation of this Universal Rig is the Maximum SPAN, which (presently) cannot exceed 5000 mm because Rigid Stem (Reference) Level Sensors are at Present available only up to 5000 mm.

Level Probes Beyond this Span are Calibrated Only Up to this Maximum Span & Extrapolated for Higher Spans.

By Designing the Top Mounting Flanges Appropriately, Level Probes of Any Dia (including Chain & Pulley Type) can be accommodated.

The Present Design Allows for One Ref. Sensor with Maximum 2 UUTs (Including Radar) or up to 3 or 4 UUTs (With Radar Devices excluded).

In Short this RIG is Totally Customisable to suit Available Devices (Refer Figure 5).

This Innovative Concept Methodology- based on State of the Art Technology - is Proven / Tried out & found to be Reliable.

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