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Challenges to Calibrate “on-site” a 212 Bbls Prover by Water-Draw Method
Introduction

Have you ever asked how accurate these scales?
But in Crude Oil Market

- The first question came from the customer is your Measurements System Accurate?
- Prove it?
- The Custody Transfer Metering system has Prover
- **What is a Prover?**
  - A Prover is a device with a precise calibrated volume determine from international test measures.
- **What is a Prove?**
  - A prove is a procedure that validate measurement system (Meters) against a known calibrated volume (Prover)
What Proves the Prover?

Hierarchy of how users flowmeter gets certified and referenced to Original Kilogram in France.

Water-Draw Method

[Diagram showing steps: Original Kilogram → Metrology Lab → Test Measures → Field Prover → Meters]
Why it is important?

\[
\text{Meter Factor} = \frac{\text{Prover Volume}}{\text{Meter Volume}}
\]

\[
\text{Gross Standard Volume (60F)} = \text{Indicated volume (60F)} \times \text{Meter Factor}
\]
How it is performed?

Fresh Water → Pump

Test Measures

The Calibrated Volume

A

B

Prover
How it is performed?

• Isolate the prover and verify leaks on the 4-way valve.
• Clean the Prover and prepare it for Fresh Water.
• Validate the Detector Switches
• Validate the Sphere size and % inflation.
• Venting the System
• At least 3 consecutive calibration runs, that meet all the repeatability criteria
• Runs must be preformed on different flow rates (fast/slow/fast or slow/fast/slow)
• The corrected volumes of three or more consecutive round trip runs shall agree within a range of 0.020%
Why it is a Challenge to Calibrate 212 Bbls?

Prover Base Volume is 212 Bbls = 8904 U.S Gallon  “Can = 100 Gallon”

it was required 90 cans per volume
Why it is a Challenge to Calibrate 212 Bbls?

Meeting all the calibration criteria required;

• Minimum of 3 consecutive runs on different flow rates. Volumetric quantity required:

  - Volume 1
  - Volume 2
  - Volume 3

• with 0.020% Repeatability which is 1.8 gallon.
V-21 Calibration

- Since Factory Water Draw on 2001 this activity has not performed on-site. Only master meter method was performed frequently to validate/calibrate the Metering Skid.
- On 2017, EOM&M decided to calibrate the prover on the 2 volumes (A-C & B-D) considering:
  - Each run lasted minimum of 16 hr. (per-run and run)
  - Ambient temperature challenge.
  - Location “Inside Ahmadi Refinery”
  - Preparation/set-up and Cleaning the prover.
V-21 Calibration
Calibrate the First Volume A & C

On-Site Observation;

Issue: The Sphere was not able to move due to flow rate limitations.

*Solution*: Have bigger Pump that required different hoses and generator.

Issue: The First 4 consecutive run were out of repeatability and we suspect Sphere.

*Solution*: Check the Sphere.

Issue: Repeatability was not achieved after 5 runs.

*Solution*: fixing back the old Detector Switches which were removed.

*Repeatability achieved.*

*The activity took 11 runs which were performed in 24 days since start.*
Calibrate the Second Volume B & D

On-Site Observation

Issue: After three runs, Repeatability was not achieved and we notice that water color has been little change.

Solution: Take Sphere out and re-fill the system with new fresh water.

Issue: Over head Crane got unavailable due to electrical motor failure

Solution: Job postponed until fixing the issue.

Issue: Repeatability was out achieved, due 4-way valve leaking. “1 littler in 5 hr.”

Solution: Inspect 4-way valve and replace the Slips.
Calibrate the Second Volume B & D

On-Site Observation

Issue: After removing the rust and clean the it, valve was still passing.

*Solution: By-Pass 4-way valve by spading it and utilize the drain point to run the flow.*

*Issue:* four runs were done and different result were obtained

*Solution:* Remove the Air.

*Repeatability achieved.*

*This activity took 9 runs which were performed in 17 days since fixing the overhead crane.*
Water-Draw Results

The Difference in historical volume compared to 2017 results.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Year</th>
<th>Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master Meter</td>
<td>2015</td>
<td>0.0279%</td>
</tr>
<tr>
<td>Master Meter</td>
<td>2014</td>
<td>0.0110%</td>
</tr>
<tr>
<td>Water Draw</td>
<td>2001</td>
<td>0.0036%</td>
</tr>
</tbody>
</table>

Why it is important?
Conclusion

Lessons Learnt:

• Sometimes one problem has a multiple reasons, so be always prepared.
• Water-Draw on site is never be easy.
• Think Out of the Box to solve the issues.

KOC Benefits:

• Improves the Measurements Systems Accuracy
• Improves KOC revenue “changing in fourth decimal will be highly appreciated if your dispatch X,XXX,XXX bbls/day
THANK YOU
Sphere Inflation

The Sphere should be inflated 2% to 5% to prevent the system from any passing and in case of Over-inflation, the sphere will stuck and stop the movements.
Sphere Inflation
Original Kilogram

The international prototype kilogram is a cylinder of platinum and platinum-iridium alloy, which is kept at the International Bureau of Weights and Measures (BIPM) near Paris and this is the reference to all weight measurement.
Test Measure

Calibrated volume

Picture Ref: Certified Calibrations, Inc.
Why it is important?

Meter Factor = (Prover Volume/Meter Volume)

Gross Standard Volume (60F) = Indicated volume(60F) * Meter Factor
Inspect 4-way valve

Rust was on the valve and due to that minor passing was happened; the valve was cleaned and observed Slips were in good conditions.
Error

We Believed that While swapping the hoses; the air was entering the system.
Avoid the Air

Swapping the hoses inside the water