



TECHNICAL ASSESSMENT

INQUIRY OF ULTRA-LOW FLOW RATES RELATIVE TO BUBBLE TESTING, AER DIRECTIVES 20 AND 87 SCVF DETECTION

BACKGROUND:

Recent testing observations from several hundred SCVF tests over the past 12-months have detected what is proven to be a "false positive" SCVF, which could be mistaken as an actual SCVF.

Before the invention of the Ventbuster®, low emission volumes could never be accurately measured. A SCVF reported as "TSTM" must be evaluated via a "bubble-test" protocol outlined in well abandonment directives. The proof for a negative SCVF test is when no bubbles are seen over a 10-minute duration. Contrarily, positive gas flow from a SCV may still exist because of the induced water back-pressure, flawed testing techniques and predisposed human interpretation. The bubble test is essentially a block-and-bleed technique, attempting to verify that migrating gases are present. The 'shut-in then flow' methodology is employed with PD or DP gas meters in an attempt to estimate immeasurable, low gas flow volumes. The Ventbuster® is the only continuous, low-flow gas meter that can accurately measure and record these low-flow SCVF emissions.

Industry asked us to formulate a 'one bubble in 10-minute' equivalent flowrate and illustrate this on our Dashboard and PDF reports. Under laboratory conditions, with gas flowing through the Ventbuster®, we concluded that this volumetric equivalent was 0.0029 m³/day. Below this flow rate, we could not manifest a bubble in one-inch of water over the 10-minute duration. As such, on the Ventbuster® Dashboard, we state an "AER Directive 20 Flow Limit (0.0029 m³/day).

Note that this volume of 0.0029 m³/day is deemed a guide and is not meant to supersede current Regulations.

VENTBUSTER ACCURACY:

- All Ventbuster® Units are calibrated against a NIST Standard by the manufacturer. The meter flow accuracy is rated at < 1.0% of Full Scale at the time of manufacturing and commercial release.
- Contrastingly, the manufacturer sees a higher error of flow accuracy of 1.0 to 10.0% at extremely low flow ranges below 10.0 ml/minute.
 - This would mean that a maximum 10% error at 10 ml/minute (0.014 m³/day) flow would result in a flow rate reading variance of only 1.0 ml/minute (0.0014 m³/day).
- After over a year of field utilization, Ventbuster® Units routinely demonstrate a variance between <1.0 and 2.0% Full Scale upon manufacturer's verification.

VENTBUSTER

INSTRUMENTS

- An example of a subject Ventbuster® in this application, VB100-0031, was verified by the manufacturer on September 24, 2020, with the following results:
 - At 4.0 ml/minute test flow, the Ventbuster® measured 4.1 ml/minute at room temperature (3% error - Ventbuster® Unit set in low-flow mode).
 - At 10.0 ml/minute test flow, the Ventbuster® measured 10.5 ml/minute at room temperature (5% error - Ventbuster® Unit set in low-flow mode).
- The maximum pressure rating of the Ventbuster® flow sensor is 10.0 MPa, and the Ventbuster® device has an operating pressure rating of up to 7.0 MPa. Adjustable pressure relief is designed into the unit per AER Directive 20.
- **Pressure calibration by the manufacturer tolerates +/- 5.0 kPag variance over the entire pressure range of the Ventbuster® Unit. Therefore, pressure ranges from - 5.0 kPag to + 5.0 kPag are essentially considered a “nil” pressure reading.**
- To obtain the most accurate results, it is recommended that the operating manual and quick start guide be followed carefully to ensure that secondary environmental conditions have been understood and mitigation measures are in place to ensure the test's integrity.

VENTBUSTER® FIELD TESTING AND OBSERVATIONS:

After deploying the Ventbuster® onto hundreds of wells, we have discovered that with the sensitivity and accuracy in measuring continuous, ultra-low emission volumes, various ambient and environmental field influences play a role in altering true SCVF readings, inducing false SCVF vent flow readings. These influences are:

- Barometric pressure changes which may induce or negate ultra-low flow volumes over a timeline,
- Barometric pressure changes which can cause small variances in flowing vent pressures,
- Solar heating and ambient cooling of the SCV assembly piping causes expansion and contraction of the air/gas within the plumbing, inducing small flows or a vacuum,
- Wind passing across the exhaust of the SCV, depending on wind speed, can produce a low-pressure venturi effect, drawing gas volumes out of the vent,
- Relative atmospheric humidity can induce gas flow from the vent assembly,
- Some in the industry have speculated that tidal forces come into play which may induce gas flow from the vent assembly,
- The same holds for bubble testing; ambient temperature and pressure changes or environmental conditions affect the bubble rate.

Further to the laboratory testing to manifest bubbles in a cup, we have conducted comparative field trials with Ventbuster® and a vessel with one inch of water on SCV assemblies. Intriguingly, we discovered differing rates of ultra-low flow in the field would not always manifest bubbles in a cup.

Our field trials have observed that there were never any gas bubbles observed without a shut-in pressure build-up recorded after the low or ultra-low flow rate event. Conversely, with a positive shut-in pressure build-up recorded after the flow event, gas bubbles were always observed.

OPINION:

Since the Ventbuster® is a continuous flow through the metering device, artificial back pressure or shutting in the meter (block-and-bleed) is not needed to induced flow, and we now can observe for the first time, the actual characteristics of the dynamic vent flow emissions and its relationship to actual thermogenic gas migration and outside or secondary flow inducements.

As such, Ventbuster Instruments Inc. concludes that the lack of a positive shut-in pressure build-up test proves that no thermogenic gases are continuing to flow because there is no energy to drive the source gas vertically up the wellbore. These ultra-low gas flows are a manifestation of environmental or ambient influences.



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