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Environmental Programs Directorate

Standard Operating Procedure

for **AIRNET—USING THE BELL PROVER TO
CALIBRATE AIR FLOW CALIBRATORS**

APPROVAL SIGNATURES:

Subject Matter Expert:	Organization	Signature	Date
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1.0 PURPOSE AND SCOPE

This standard operating procedure (SOP) states the responsibilities and describes the use of the bell prover apparatus to calibrate the flow calibrators used to measure filter sample flow on AIRNET stations for the Los Alamos National Laboratory (LANL) Waste and Environmental Services division.

All WES participants shall implement this procedure when calibrating flow calibrators used to measure filter sample flow on AIRNET stations, by using the bell prover apparatus.

2.0 BACKGROUND AND PRECAUTIONS

2.1 Background

The bell prover device provides a physical measurement for actual volume at the same altitude as the samplers and thus allows an accurate process to ensure calibration of the air flow measuring instruments.

The bell prover is a large open-bottomed drum of known dimensions that is suspended in a ring of mineral oil (which provides an airtight seal around the edges) over an outlet pipe. As the drum falls a known distance, a known volume is displaced through an outlet pipe. A scale on the side shows the flow rate in cubic feet per minute (CFM).

2.2 Precautions

None

3.0 EQUIPMENT AND TOOLS

Before using the bell prover ensure it has been in the raised position (between 0.5 and 1.0 on the scale) for at least 24 hours to allow the air in the bell to reach room temperature. Prior to use assemble the following:

- Bell prover
- AIRNET airflow calibrator
- Air flow control valve
- Connecting hoses
- Calculator
- Stopwatch

After use, and while not in use, leave bell in raised position.

4.0 STEP-BY-STEP PROCESS DESCRIPTION

4.1 Using the Bell Prover Apparatus

Worker	1.	<p>Ensure the bell is in the raised position, about 0.5 on the scale, before beginning. The bell must be kept in the raised position for at least 24 hours before use to allow the bell and the air inside to reach room temperature.</p> <p>To raise the bell do the following:</p> <ul style="list-style-type: none"> • While holding the handle on the chain, open the rotary valve (on left in picture in Attachment 1) and pull down on the chain. • Bell has slight damage on the bottom edge that prevents accurate readings below ~0.5 on the scale. Always start at 1 CFM. <p>NOTE: Do not let the bell fall to its lowest level while the pump is running; oil can be sucked into the lower inner chamber and go up the piping into the pump.</p>
	2.	Hook up hoses, calibrator, and pump as shown in first picture in Attachment 1.

- Worker
3. Remove hose from calibrator intake.
 4. Close bypass valve (on right in second picture in Attachment 1).
 5. Turn on pump and set the flow control valve between calibrator and pump to desired flow rate as read on calibrator scale.
 6. Turn off pump.
 7. Reconnect hose from bell prover to calibrator intake.
 8. Open bypass valve (on right in second picture in Attachment 1).
 9. Start vacuum pump.
 10. Close rotary valve to begin dropping the bell.
 11. Start stopwatch when scale on bell prover reads 1.0 ft³.
 12. Stop stopwatch when scale reads 4.0 or 5.0 ft³
 - **WARNING:** Turn off pump before bell falls much past 5.0 ft³ to avoid pulling oil into the calibrator and pump.
 13. Steps to measure flow from the bell prover:
 - Subtract the initial bell prover Reading from the Final bell prover reading and document on the "Calibration Using the Bell Prover" form, (Attachment 2).
 - Convert run time to minutes and hundredths of a minute: e.g. 36.6 sec = 36.6/60 = 0.61 min.
 - Divide the total cubic feet of air by the minutes to calculate the flow in CFM.
 - Record all calculations on the form "Calibration Using the Bell Prover" (Attachment 2)
 14. **For 4.0 CFM flow only:** If the calculated flow is not the same as the indicated flow, remove the hose from the calibrator intake. Close the bypass valve, and start the pump. Turn the calibration adjustment screw on the air flow calibrator so that it reads the calculated flow. After making this adjustment, turn the flow control valve so the air flow calibrator reads 4.0 CFM, and repeat steps 6 through 13.

If the calibration adjustment screw is turned during this step, at the completion of the calibration, place a drop of Loctite® on the threads of the screw to keep it from moving during use.
 15. Check the linearity of the calibration by repeating steps 2 through 13 for indicated flows at 2.0, 3.0 and 5.0 CFM. Additional flow values may be used if desired.

If the calibrator is not reading linearly (i.e., it reads correctly at 4.0 CFM, but is off by more than 0.2 CFM at other flow rates), remove the meter from service affixing a "do not use" sticker.

If the meter is reading linearly, place a sticker on the calibrator that indicates the date the calibration was performed, and the date the calibration will expire.
 16. When done using the bell prover restore it to the raised position (between 0.5 and 1.0 on the scale).

4.2 Calibration of the Bell Prover

1. The Bell Prover requires a certification by the manufacturer every 5 years. This effort must be coordinated through the LANL Standards and Calibration Laboratory well in advance of the expiration date.

4.3 Records Management

Worker 1. Maintain and submit records and/or documents generated to the Records Processing Facility according to EP-DIR-SOP-4004, Records Transmittal and Retrieval Process.

5.0 DEFINITIONS

N/A

6.0 PROCESS FLOW CHART

N/A

7.0 ATTACHMENTS

Attachment 1 Set Up of Bell Prover Apparatus and Pump (1 page)

Attachment 2 Form for Calibration Using the Bell Prover (1 page)

8.0 REVISION HISTORY

Revision No. <i>[Enter current revision number, beginning with Rev.0]</i>	Effective Date <i>[DCC inserts effective date for revision]</i>	Description of Changes <i>[List specific changes made since the previous revision]</i>
0	08/13/03	New document.
1	12/14/04	Add attachment form for recording data, replace Hazard Control Plan with Hazard Review.
0	4/2/2009	New document number and reformatted for WES division. Formerly ENV-MAQ-255.

[If you have read and understand the preceding document, click here to receive EDS credit.](#)

ATTACHMENT 1

SOP-5157-1

Set-Up of Bell Prover Apparatus and Pump

Records Use only



Connection of the hoses from the bell prover to the pump



Valves on Bell Prover.

Open the relief valve on the left to raise the bell; use a wrench on the bypass valve on the right

