USING THE BELL PROVER TO CALIBRATE FLOW CALIBRATORS

Purpose

This Meteorology and Air Quality Group (MAQ) procedure describes the use of the bell prover apparatus to calibrate the flow calibrators used to measure filter sample flow on AIRNET stations.

Scope

This procedure applies to the AIRNET personnel who are assigned to calibrate the flow calibrators used to measure filter sample flow on AIRNET stations.

In this procedure

This procedure addresses the following major topics:

Signatures

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04/11/05

General information about this procedure

Attachments

This procedure has the following attachments:

Number	Attachment Title	No. of pages
1	Hazard Review	2
2	Set up of Bell Prover Apparatus and Pump	1
3	Calibration Using the Bell Prover	1

History of revision

This table lists the revision history and effective dates of this procedure.

Revision	Date	Description Of Changes
0	8/13/03	New document.
1	12/14/04	Add attachment form for recording data, replace HCP with HR.

Who requires training to this procedure?

The following personnel require training before implementing this procedure:

- AIRNET personnel assigned to calibrate flow calibrators

Training method

The training method for this procedure is **on-the-job** training by a previously-trained individual and is documented in accordance with the procedure for training (MAQ-024).

Prerequisites

In addition to training to this procedure, the following training is also required prior to performing this procedure:

- MAQ-011, “Logbook Use and Control”
- First Aid
- Cardiopulmonary Resuscitation (CPR)

General information, continued

Definitions specific to this procedure

None.

References

The following documents are referenced in this procedure:

- MAQ-024, "Personnel Training"

Note

Actions specified within this procedure, unless preceded with "should" or "may," are to be considered mandatory guidance (i.e., "shall").

Using the bell prover apparatus

Background

The calibrators used to measure and set the flow through the AIRNET filters were formerly calibrated by the manufacturer. Questions were raised about the calibration corrections used to correct for actual flow at the altitude of Los Alamos, and some inconsistencies were observed between instruments. The bell prover device provides a physical measurement for actual volume at the same altitude as the samplers and is thus a more accurate process to assure calibration of the flow measuring instruments.

Description

A large open-bottom drum of known dimensions 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 in CFM (via scale on side), a known volume of air is displaced out the outlet pipe.

Safety considerations

The bell prover apparatus sits inside a large catch can that serves as secondary containment for any oil leaking out. The apparatus holds about 20 to 25 gallons of oil. An MSDS for the oil is located near the apparatus (MSDS #7292. NFPA Health rating: 0. Flammability: 1. Reactivity: 0).

The apparatus has no significant hazards associated with it. Use common sense to avoid pinches, etc.

When not in use

Leave bell in raised position (between 0.5 and 1 on scale) when not in use. It must be kept in raised position at least 24 hours before use to allow air in the bell to equilibrate with room temperature.

Equipment needed

Set up equipment as shown in Attachment 2.

In addition to the equipment set up, the following is needed:

- Calculator
- Stopwatch
- Logbook or form (attachment 3) to record data

Using the bell prover apparatus, continued

Raising the bell

Before each run, raise the bell to a position on the scale reading about 0.5: While holding the handle on the chain, open the rotary valve (on left in picture in Attachment 2) and pull down on the chain.

NOTE: Bell has slight damage on bottom edge that prevents accurate readings below about 0.5 on the scale. So always start at 1 CFM.

WARNING

Do not let the bell fall to its lowest level when the pump is running – oil can be sucked into the lower inner chamber and eventually up the piping into the pump.

Steps to measure flow

To measure the flow with the bell prover, perform the following steps:

Step	Action
1	Hook up hoses, calibrator, and pump as shown in first picture in Attachment 2.
2	Remove hose from calibrator intake.
3	Close bypass valve (on right in second picture in Attachment 2).
4	Turn on pump and set the valve between calibrator and pump (red handle in first picture in Attachment 2) to desired flow rate as read on calibrator scale.
5	Turn off pump.
6	Reconnect hose from bell prover to calibrator intake.
7	Open bypass valve (on right in second picture in Attachment 2) and start vacuum pump.
8	Start stopwatch when scale on bell prover reads 1.0 or 2.0 cubic feet.
9	Stop stopwatch when scale reads 4.0 or 5.0 cubic feet.
10	**WARNING**: Turn off pump before bell falls all the way to bottom.
11	Calculate the flow rate: Flow (CFM) = volume (CF) / time (sec) x 60 (sec/min)
12	Mark the scale on the calibrator for the calculated flow rate.
13	Raise the bell (see block at top of page) and repeat the process (steps 2 – 12) for a different flow rate: • Use 0.2 CFM increments between 2.0 to 5.0 CFM. • Use 0.5 CFM increments between 0 to 2.0 and 5.0 to 6.0 CFM.
14	Record the readings and all calculations in a logbook. Note the identification numbers of the calibrators. Make entries in accordance with procedure MAQ-011.

Records resulting from this procedure

Records

The following records generated as a result of this procedure are to be submitted **within 3 weeks** as records to the records coordinator:

- Entries in logbook (made in accordance with MAQ-011)
- Form “Calibration Using the Bell Prover” (attachment 3)
- Copies of logbook pages showing calibration calculations

HAZARD REVIEW

Work tasks/Steps	**Hazards, Concerns, and Potential accidents; Likelihood/ Severity**	**Controls, Preventive Measures** *(e.g., safety equipment, administrative controls, etc.)*	**Hazard Level** *from IMP 300-00-00 Hazard Grading Matrix*
Use Bell Prover according to steps in this procedure (MAQ-255).	Oil in bell prover apparatus – spills could create slip hazards or health hazard. improbable / moderate = minimal	Catch pan as secondary containment is in place under the apparatus. An MSDS for the oil is located in the room (MSDS #7292. NFPA Health rating: 0. Flammability: 1. Reactivity: 0). Fire extinguisher is located in the room.	Low
Same as above.	Abrasions, bruises, or pinches from moving and handling equipment. occasional / moderate = low	Use common sense to avoid these injuries. Work carefully, always use proper tool for the job.	Low

Wastes or residual materials resulting from process

None.

Emergency actions to take in event of control failure

For all injuries, provide first aid and see that injured person is taken to Occupational Medicine (only if immediate medical attention is not required) or the hospital. Notify supervisor and group office as soon as possible.

ATTACHMENT 2

SET UP OF BELL PROVER APPARATUS AND PUMP

Connection of hoses from bell prover to pump.

Valves on Bell Prover. Open relief valve on left to raise bell. Use wrench on bypass valve on right.

Meteorology and Air Quality Group

Calibration Using the Bell Prover

This form is from MAQ-255

Calibrator SN:	***Description:***
Bell Prover SN:	***Date calibrated:***

Calibrator reading	Beginning Bell Prover reading	Ending Bell Prover reading	Cubic Feet	Time	Actual CFM

Tested by:

Signature _____ Name (print) _____ Date _____