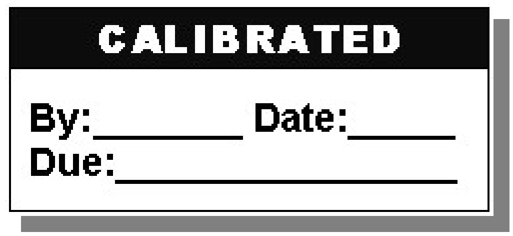
Contents



1.0 Purpose & Scope

This document describes the BNL SHSD Industrial Hygiene Group (IHG) calibration and testing laboratory operations. The procedure

- defines the roles of the IH laboratory personnel.
- establishes IHG policy on the frequency and mechanism for calibration and repair of IHG instrumentation.
- provides standardized methods of calibration for sampling equipment used in integrated sampling with media.
- provides standardized methods of calibration for meters such as the *Scott Scout®* Multi-Gas Monitor, Miran Sapphire, Portable Gas Chromatograph, TVA-1000, etc.
- documents a procedure to safely remove the cylinder valve from empty calibration gas cylinders.

2.0 Responsibilities

2.1 This procedure is administered through the SHSD Industrial Hygiene Manager who assigns staff to serve as *IH Lab Members*.

2.2 The *SHSD IH Lab Members* are responsible to follow this procedure and the meter's manufacturer's operating manual instruction on meter calibration.

3.0 Definitions

Calibration: A set of operations which establish the relationship between values indicated by a measuring instrument and the corresponding standard or known values (derived from a standard).

Calibration Certificate: A document/record that records the results of a calibration.

Equipment Custodian: A person designated by the IH Group Leader or Program Administrator to process equipment for maintenance and calibration in accordance with this procedure.

In-Line: Refers to the scenario when sampling medium (such as a filter cassette or sorbent tube cassette) is connected to the sampling device (air-sampling pump) via a piece of flexible tubing.

Media: Equipment designed to collect particulate, gases, and vapors onto a surface or into a liquid. The most common sampling media include sorbent tubes, filter cassettes, and culture plates.

Sampling Device: Devices designed to bring sample air to the media. The most common sampling devices include vacuum pumps, cyclones and impingers.

Traceable: A measurement that can be related to an appropriate intrinsic, national or international standard through an unbroken chain of comparisons.

Verification: Checking that the deviations between values indicated by a measuring instrument and corresponding known values are consistently smaller than the limits of permissible error in the specification of the measuring equipment.

4.0 Prerequisites

4.1 Calibrations should be done as soon before and after sampling as possible, but in all cases within 24 hours of sampling (exception is line voltage powered pumps). Post calibration must be done prior to recharging battery-operated pumps.

4.2 To insure that the calibrator makes accurate measurements, the calibrator should be calibrated by a NIST traceable source or primary standard annually.

5.0 Precautions

5.1 **Hazard assessment:** The actual task of calibrations typically does not cause significant employee health risks. (Note: some impinger solutions and calibration gases are hazardous.) But by its very nature, this SOP may be performed with chemicals, and these hazards must be assessed on a case-by-case basis.

The removing of a cylinder valve may pose significant employee health risks from sudden pressure release. This SOP may be performed on cylinders that pose chemical health hazards. The hazards must be assessed on a case-by-case basis. Do not perform cylinder valve removal until a competent individual has assessed the hazards of the cylinder and determined valve removal can be done safely. This tool is to be used only on Cylinders that are empty and have not pressure.

5.2 **Personal Protective Equipment:** The use of personal protective equipment to protect personnel handling IHG instrumentation during preparation for calibration and maintenance is not typically required.

Calibrations may involve use of hazardous gases. Inhalation of toxic gases or oxygen deficient atmospheres can have significant health consequences. Some calibration gases may be flammable. A hazard evaluation by a cognizant ESH professional has resulted in the requirement to conduct calibration within the laboratory hood. This control measure prevents significant worker exposure.

If it is necessary to handle equipment with potential surface contamination, at a minimum, disposable gloves must be used when contacting the exposed surfaces. Do all handling of contaminated equipment within a laboratory hood.

Hand: No hand protection is typically necessary.
Body: No body protection is typically necessary. If contact of the body with contaminated surfaces is anticipated, a disposable suit should be used. Acceptable chemical protective equipment materials include: Tyvek®, KleenGuard®, and cotton. Disposable garments must be discarded as hazardous waste if contact with contamination has occurred. If personal clothing items become contaminated, they must be surrender for BNL cleaning or disposal.
Foot: No foot protection is necessary.
Respiratory: Under normal use, respiratory protection is not required.
Eye: Safety Glasses with side shields are required in laboratories. When hazardous chemicals can significantly injure the eyes, safety glasses with side shields must be used.

5.3 **Radiation Contamination:** It is possible that sample might be collected from radiological contamination areas. Samples from these areas must be analyzed for the radiation hazard before it can be submitted to the SHSD IH Laboratory for analysis. At no time will the SHSD IH Laboratory accept a sample with radiation contamination above permissible limits for the general public.

It is possible that some equipment may have been taken into areas with radiological contamination. The IHG person handling equipment must verify from RCD that the equipment has been analyzed for the radiological hazard and are at radiological contamination levels below the permissible release limits to the general public.

5.4 **Work Planning:** Work permits are not required in performing this procedure.

5.5 **Environmental Impact and Waste Disposal:** Calibrations can generate environmental emissions, but not hazardous waste. Calibration gases are vented from Building 120 via the lab hood exhaust stack. Any unused gases that are to be discarded must be disposed of in accordance with Waste Management Division directions and procedures.

The venting of the remaining gas in a calibration gas cylinder is done in the hood. It has insignificant adverse impact on the environment due to the very low concentration of contaminants in the calibration gas cylinders (typically low parts per million concentrations). This process does not create waste for disposal. The empty, valve removed, and air or inert gas purged cylinders are considered scrap metal and can be placed into metal recycling dumpsters.

5.6 **Job Risk Assessment:** Consult the *Job Risk Assessment* SHSD-JRA-03 for the risk analysis of this operation based on the hazards and controls of this SOP.

6.0 Procedure

6.1 **Maintenance of Exposure Monitoring Equipment records:** The IH Group maintains records of sampling equipment operating manuals, calibration data and maintenance records.

6.2 **Calibration and Maintenance of Exposure Monitoring Equipment:** The IH Group develops and revises Standard Operating Procedure for IH equipment, meters and dosimeters and maintains the equipment in a state of readiness for use by qualified surveyors from BNL organizations that perform exposure assessments.

6.2.1 Portable test equipment used in this program will be calibrated on a basis of the manufacturer's recommendations.

6.2.2 The IH group provides some equipment calibration by equipment owned by other organizations. Example: calibration with NIST traceable standards for gas detection meters.

6.2.3 The IH Laboratory members also send certain equipment to Original Equipment Manufacturer (OEM) or approved vendors for calibration.

6.3 **Establishing the Frequency of calibration.** The calibration frequency is determined by the IH Group based on the following hierarchy of references (based on DOE O 414.1A):

6.3.1 Manufacturer's recommendation as stated in the instruments *Operation Manual* or *Owner's Instruction Manual.*

6.3.2 Manufacturer's recommendation as stated in other means of communication with BNL, such as memorandum, e-mails, or documented phone conversations.

6.3.3 Other engineering/scientific standards specifically referring to a particular type of instrumentation.

6.3.4 IHG determination of calibration needs based on experience with the equipment or recommendations by other sources.

6.4 **Calibration Procedures:** This SOP provides generic calibration procedure methodology in Attachment 9.1 to 9.5 and recording forms in Attachments 9.7 to 9.9.

6.5 **Calibration by off-site vendors, suppliers, or original equipment manufacturer:** Equipment that is to be calibrated by a vendor or original equipment manufacturer will include are requirement for "as found" and "As left" calibration with the purchase requisition initiating the calibration.

6.6 **Documenting Calibration Status:** The on-going calibration status of each IHG electronic instrument requiring periodic calibration is to be marked on the meter by a label on the meter that indicates "calibrated" and the due date for next calibration.

6.6.1 For meters calibrated by vendors, a label may have been placed on the meter. IHG will add any of the following missing information on an auxiliary label: company name performing calibration, date of calibration, and expiration or due date.

6.6.2 The sticker used by IHG for "in-house" calibration contains the following wording:

CALIBRATED
BY______ DATE_____ DUE_______________

6.6.3 For equipment that is out of service and has expired on the acceptable calibration interval, but is being held in reserve as a potential replacement, a label with the following wording shall be prominently placed on the equipment:

6.7 Log the date of calibration in the IHG Intellitrack® database.

6.8 **Maintenance of Instruments:** The IHG policy on routine maintenance for equipment:

- Sampling Pumps: Repair and routine replacement of expendable parts such as diaphragms and batteries shall be done as needed when instruments fail to calibrate or fails operate within required parameters.
- Meters and Instruments:
  - Off-site Calibration- Meters receive routine maintenance during their periodic calibration by off-site vendors.
  - On-site Calibration- Meters calibrated by IHG will receive maintenance or repair if they fail to calibrate within specifications or fail to operate within typical parameters.
- Damage or abuse: When IHG meters show signs of damage or abuse they will be repaired by IHG or the manufacturer as needed.
- If a calibration is “out of tolerance”, The IH Group will investigate the reason for the status of the meter and the impact on data recently collected with the meter.

6.9 **IH sample processing for analysis.** The IH Lab members maintain and distribute copies of field sampling sheets and laboratory analysis reports.

6.10 **Cylinder Gas inlet valve removal:** To eliminate generating hazardous waste from spent calibration gas cylinder, the IH group will purge the cylinder with air to render them as scrap metal. See Attachment 9.5

7.0 Implementation & training

7.1 Personnel performing roles in the IH laboratory are to be qualified per the IH Manager via the Qualification Record in Attachment 9.11 Job Performance Measure.

8.0 References

8.1 DOE Order 414.1A.

8.2 Numerous manufacturers' operation manuals were reviewed in the creation of *BNL Instrument Calibration Frequency Policy* (see sample in *Attachment 9.2)* References to manufacturers are included in Attachment 9.2.

8.3 SBMS Subject Area *Calibration*.

8.4 ANSI/NCSL Z540-1-1994: *Calibration Laboratories and Measuring and Test Equipment- General Requirements.*

8.5 ANSI/ISO/IEC *17025 General requirements for the competence of testing and calibration laboratories, 2nd edition, 2005.*

8.6 Gary O. Nelson, Gas Mixtures: Preparation and Control, Lewis Publishers, 1(992).

8.7 Gary O. Nelson, Controlled Test Atmospheres, Lawrence Radiation Laboratory, UC Livermore (1971).

8.8 *Air Liquide*™ Cylinder Valve Removal Tool *Instruction Sheet*; PN 608; Rev Date 12/97.

9.0 Attachments

9.1 Calibration Standard Preparation Methods
9.2 Environmental Evaluation of Meter Calibration with Standard Gas Mixtures
9.3 Adsorbent/Adsorbent Media Calibration
9.4 Direct Reading Meter Calibration
9.5 Cylinder Valve Removing Tool Procedure
9.6 Document Control of Instrument Manuals
9.7 Multiple Gas Meter Calibration & Maintenance Record
9.8 Single Gas/.Vapor Calibration Record.
9.9 Bump Test Record
9.10Sample of BNL Instrument Calibration Frequency Policy
9.11Qualification Certificate- Job Performance Measure

10.0 Documentation

Document Development and Revision Control Tracking

Prepared By: *(signature/date on file)* R. Selvey 11/04/08 Certified Industrial Hygienist	Reviewed By / Date: *(signature/date on file)* J. Peters 11/04/08 Certified Industrial Hygienist	Approved By / Date: *(signature/date on file)* R. Selvey 12/19/08 Industrial Hygienist Manager
ESH Coordinator/ Date: *none*	Work Coordinator/ Date: *none*	SHSD Manager / Date *none*
QA Representative / Date: *none*	Training Coordinator / Date: *none*	Filing Code: **IH52**
Facility Support Rep. / Date: *none*	Environ. Compliance Rep. / Date: *none*	Effective Date: **01/26/09**
ISM Review - Hazard Categorization ☐ High ☒ Moderate ☒ Low/Skill of the craft	Validation: ☐ Formal Walkthrough ☐ Desk Top Review ☐ SME Review Name / Date:	Implementation: Training Completed: n/a Procedure posted on Web: 01/26/09 Hard Copy files updated: 01/26/09 Document Control on forms: 01/26/09

Revision Log

Purpose: ☐ Temporary Change ☐ Change in Scope ☐ Periodic review ☐ Clarify/enhance procedural controls
Changed resulting from: ☐ Environmental impacts ☐ Federal, State and/or Local requirements ☐ Corrective/preventive actions to non-conformances ☒ none of the above
Section/page and Description of change: Rev1- Merged this procedure with IH51650 Air Sampling Pump Calibration for the *DryCal Defender & DC Lite;* IH51660 Instrument Calibration and Maintenance Program; IH51675 Instrument Manual Documentation Control; IH51900 Calibration Method for Chemical, and Monitors/Meters and IH51910 Cylinder Valve Removal Technique.
Reviewer/Date: R. Selvey 09/18/09

Attachment 9.1

Calibration Standard Preparation Methods

Principles:
There are several methods for making accurate gas/vapor samples. The methods used at BNL are:

- Static bag mixture [used for TVA1000, and other small flow rate meters];
- Closed loop system [used for Miran Sapphire];
- Syringe pump injection into a flowing stream of air (dynamic) [rarely used- not described below. BNL owns a *Harvard Apparatus* Microliter Syringe Pump that can be used for this technique];
- Permeation tubes into a flowing stream of air (dynamic) [rarely used- not described below]. Permeation tubes are purchased tubes with a certificate of calibration containing volatile chemicals in tubes. The chemicals will permeate ("leak") through the walls of the tube at a rate that is controlled by the temperature. The permeation tube is placed in a temperature controlled glass chamber through which a controlled flowrate of the diluting gas is passed. The constant leakage of chemical into the constant flow of gas produces a constant concentration. BNL owns a MAST® apparatus for controlled heating and airflow though permeation tubes. The concentration can be varied by changing the flowrate of the carrier gas, or by changing the temperature of the chamber.

The methods for delivering known volumes of diluting air or nitrogen at BNL are:

- Gas syringes (i.e., Tracor Atlas cylinder) is used for bag mixtures. This 10 Liter syringe is filled to the mark from a second bag containing clean air or nitrogen, from a known clean air source, or from room air (drawn in through a charcoal filter if suspected to contain contaminants.)
- Air from a pressure pump or Compressed air cylinder with Stopwatch and flowmeter. The gas source is connected to a flowmeter and adjusted to the desired value. The total pump time needed to deliver the required volume of air is calculated. The flow is connected to the sample bag and the stopwatch is started. The flow rate is re-measured. At the end of this filling time, the bag is disconnected.

Tubing and gas sample bags must be compatible with the chemicals being handled. Compatibility involves three considerations:
Reactivity: **V**apor does not react chemically with the material. An example of an incompatibility is Ozone's reaction with many plastics and oils and processing chemicals from manufacturing.

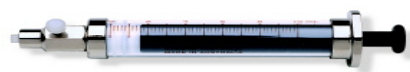
Permeation: Vapor should not leak out through the material. Polyethylene, in particular, is permeable to many gases and in general should not be used.

Absorption: **T**he tubing or bag does not absorb the vapor from the sample.

Method 1. Static Bag Mixture in a Tedlar® Bag: The liquid is measured with a microliter syringe and injected into a sample bag. The bag is then inflated with a known volume of air. To calculate the correct amount of liquid to inject, you must know the molecular weight of the liquid, its density, the final volume of the dilution to be made, and the final concentration desired.

Applicability: This method can make from 1 liter to 40 liter of gas/vapor in air/nitrogen mixtures in the range of 1ppm to % mixtures. It is useful for calibration of monitors/meters that draw air in the cc/min to low liter/minute rate. Examples are the TVA-1000, Scott Scout, TLV Sniffer, H-Nu PID, and GasTech GC.

Equipment:



- 10 L Tedlar® Bag;
- 10 microliter gas tight syringe,
- Tubing (Teflon, silicone or Tygon®)
- 50-500 milliliter gas tight syringe
- Model 722K 10 L piston cylinder from *Houston Tracor Atlas, Inc*. or 500 cc syringe from *Precision Sampling Corp.* or Air from a pressure pump or Compressed air cylinder with Stopwatch and flowmeter.

For concentrations of 100 ppm or more, the Tedlar bag standard can be prepared at the desired concentration. For lower concentrations, make a 1000- 10,000 ppm stock sample in a 4-10 liter bag. Make dilutions for final concentrations from 0.1 -100 ppm by withdrawing known volumes of the stock, injecting it into a sample bag, and filling the bag with a known volume of dilution air.

The large-volume Tracor Atlas 722K syringe is useful for measuring diluting gases, but should never be used for contact with chemicals, for two reasons:
1.) The cylinder could become contaminated and
2.) The syringe uses a thin layer of silicone oil inside the barrel to aid plunger movement. Silicone oil will efficiently absorb many chemicals from the vapor phase, reducing the final concentration.

An alternative to using the Tracor cylinder is to use a calibrated sampling pump to deliver a known flow rate for a measured time period into the Tedlar bag.

The chemical should be introduced into the Tedlar bag via a syringe needle through the septum. It may be necessary to apply heat from a hair dryer, heat lamp or heat gun to volatilize the liquid within the bag. Do not overfill the bag. Mix the diluting air and the chemical gas or vapor within the bag by squeezing one end of the partially filled bag, then the opposite end, over and over in a "shifting, needing" action.

The formula to calculate the desired amount of chemical and dilution air is:

$$\text{ul of analyte} = \frac{\text{ppm desired} \times \text{mol. weight} \times \text{volume of air (liters)}}{24450 \times \text{liquid density at 20C (g/ml)}}$$

An example:
Preparation of a 5000 ppm Methylene Chloride in air bag standard:

mw = 84.9   density = 1.327 g/ml at 20C

$$\text{Microliters of MC} = \frac{5000 \text{ ppm} \times 84.9 \times 10 \text{ liters}}{24470 \times 1.327} = 131 \text{ ul}$$

Method 2. Closed loop system

This method is used to calibrate instruments that have a fast air flow sampling that would consume Static bag mixtures before stable reading could be obtained. The Miran Sapphire at 14 liter/minute requires a closed loop calibration. In this system, a known amount of gas/liquid is injected into the septum of a diaphragm pump connected via Teflon® tubing to the inlet and outlet of the Sapphire. The internal volume of the Sapphire is 2.23 L. The internal volume of the pump is 0.01 L and the tubing is 0.002 L. Total volume of the closed loop is 2.242 L.

The formula to calculate the desired amount of chemical and dilution air is:

$$\text{ul of analyte} = \frac{\text{ppm desired} \times \text{mol. weight} \times 2.242 \text{ (liters)}}{24470 \times \text{liquid density at 20C (g/ml)}}$$

An example:
Prepare a 75 ppm Acetone in air bag standard:
mw = 58.08   density = 0.79 g/ml at 20C

$$\text{Microliters of Acetone} = \frac{75 \text{ ppm} \times 58.08 \times 2.242 \text{ liters}}{24470 \times 0.79} = 0.51 \text{ ul}$$

Attachment 9.2

Environmental Evaluation of Meter Calibration with Standard Gas Mixtures

Operation Description: 10-50 cc of a mixed gas is presented to a meter's detector via pressure in the cal gas cylinder. This test is done to establish that the meter responds to the calibrated gas's known concentration correctly. Additionally, the gas is used for daily "Bump tests" in which a small amount of gas (1-2 cc) is sent to the detector to verify the meter response.

Typical gas mixtures are not hazardous at the concentrations released to the environment. Examples are:

- 25 – 50 ppm Carbon Monoxide in Air
- 5 ppm Hydrogen Sulfide in Air

Frequency of Operation: (Calibration) 2-3 times per month.

Frequency of Operation: (Bump Test) 6-10 times per month.

Environmental impact:

The operation is done in a non-HEPA lab hood in Building 120-, Room 1-19. The hood is exhausted at 30' above building height.

- Gas mixture cylinders are used until empty. Empty cylinders are opened, vented in a hood to expel contents, purged with compressed air, and cylinder is recycled as metal scrap. Purged cylinders are taken to Building T-87 with a completed *Process Knowledge Form* for recycling. SOP for Cylinder Valve Removal is finalized as IH75190.
- Mercury is used to bump test the mercury meter. No mercury is consumed, as only the head space of a bottle is needed.
- Some chemicals may be used to create static bag mixtures of chemicals in air. Examples of chemicals used in the past have been carbon monoxide, benzene, and formaldehyde. In these cases, Tedlar bags are used to make mixtures of known concentration. At the completion of testing, these bag mixtures are exhausted up the hood. Concentrations are typically 1-100 ppm in air; volume is 1 to 10 liters of mix.

Waste Disposal:

- Convert the cylinders are converted to scrap metal by removing the valve and purging with room air within the lab hood. The empty, purged cylinders are taken to PPM for disposal as scrap metal.
- Bag standards are vented into the lab hood.

Attachment 9.3

Adsorbent and Absorbent Media Sampling Calibration

Sample Pump (a vacuum creating device such as):

- High volume air pump for environmental work area sampling (such as the Gast® DOL-101-AA).
- Personal air-sampling pumps (such as the SKC-224-43XR or the Low flow pump 222-3-Low flow) for breathing zone sampling.

Sample Media (any of these depending on the contaminant)

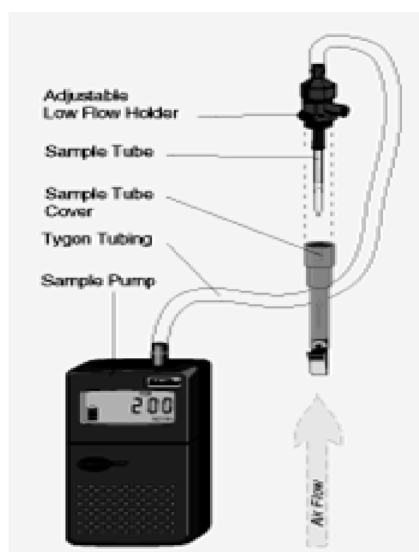
- Cassettes (such as 37mm or 25 mm filter media)
- Various sorbent tubes
- Culture media for microbial impaction samplers

Tubing (for connection between the calibrator, sampling media and the pumps). Typical tubing is 0.25" ID PVC (Tygon®) tubing.

Calibrator: Bios International, Inc. Defender, DC-Lite, or eqivalent.

Calibration Labels, from BNL PPM Stock or equivalent.

1. Plug in the calibrator twenty minutes prior to use to ensure or operate with meter running off the charger.
2. Prior to calibrating any air-sampling pump, verify the operability of all sampling pumps and the Defender or DC-Lite.
3. Fully charge the pump unit according to the instrument manual.
4. Remove both inlet and outlet caps on cassettes or break off tips of tubes. Remove the end plugs from filter cassettes or break off the ends of glass tubes before attaching to the sampling hose.
5. Use the actual media to be sent to the field for tubes and filters. Use a representative agar plate for culture plate samplers.
6. Let the pump run for at least five minutes before calibrating (to stabilize flow rate).
7. Attach the media and sampling device to the calibrator as per Attachment 9.1.



Pre-calibration: Power on and start the Calibrator:

Defender: Press [Power] until the light comes on in the piston area. Then choose "measure" and [enter] and then "continuous" and [enter].
DC-Lite: Press [on], then press and hold [Read] until the piston activates.

1. Let the calibrator run through a minimum of 10 reading to ensure that the calibrator and pump have stabilized.
2. Record the average of the readings on the IH75140 Air Sampling form.
3. The calibrator will shut off automatically after use.
4. Send sample media attached to pump, a blank set of media, and sample data sheets to the field with the sampler.
5. Do not accept media and sampling devices from the field which has the potential for surface contamination. Reject suspect sample equipment until an investigation of the surface contamination is done and the equipment is verified to be clean or has been decontaminated.

Post Calibration: Flow Measurement with DryCal (Done after field exposure-)

1. Verify the samples are not contaminated by questioning the person taking the samples. Do not accept contaminated samples without permission of the IH Group Leader.
2. If the difference between the pre- and post- calibration is more than 5%, reject the sampling media until an evaluation of the data by the IH Manager or designee.

Handling the sample(s) after Post-Calibration

1. Remove the sample media from the sample hose and replace end plugs on cassettes, put caps on tubes, or plates on culture media.
2. Place cassettes or tubes in a tamper proof bag. Place all paper work with samples.
3. Follow the SHSD Chain of Custody Procedure to process the sample for analysis.
4. Store and ship media per the sampling method requirements (e.g. refrigeration, ambient light protection in foil, etc).
5. Clean surfaces all pumps and hoses as needed.

Attachment 9.4

Direct Reading Meter Calibration

Equipment:
- Meter & Sample Probe
- Calibration gas or vapor, generated by either:
- Cylinder of NIST traceable gas of known concentration;
- Static bag mixture of vapor/gas (Tedlar Bag, microliter gas tight syringe, 10 L gas syringe or calibrated air pump; or
- Closed loop system, (re-circulating air pump, microliter gas tight syringe, appropriate tubing and connectors to meter)

Method:
1. Refer to Attachment 9.1 for methods of creating known concentrations of gases or vapors if a calibration gas cylinder is not used.
2. Turn the meter on as per the meter's instruction manual or meter's IH SOP. Allow the meter to warm up for the period specified in the manual or SOP.
3. Within the hood, attach the meter probe to the calibration gas cylinder or source of calibration gas/vapor.
4. Turn on the flow of calibration gas cylinder or start the source.
5. Observe the meters readout and record readings for the sensor(s) during calibration.
6. The alarm points on multiple gas meters should be verified during calibration of the instrument. if the meter fails to alarm when exposed to gas at the alarm concentration, record the condition on the calibration record.
7. Record reading on Attachment 9.xx (Multiple Gas Meter Calibration & Maintenance Record) or Attachment 9xx (Single Gas/Vapor Calibration Record).
8. Attach a calibration sticker as per this SOP Section 6.

Attachment 9.5

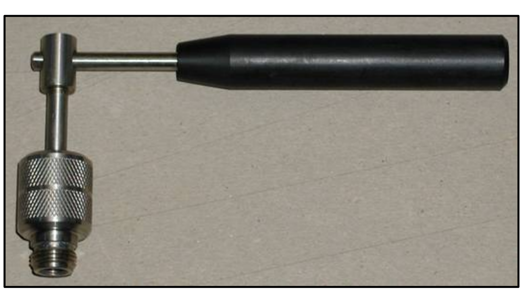
Cylinder Valve Removing Tool Safety Reminders

Precautions:

- This operation must be done in a functioning laboratory hood to vent any calibration gas away from the breathing zone of the worker.
- Never attempt valve removal on a cylinder that is not EMPTY. Vent the remaining gas into the hood until the cylinder is completely empty.
- Never attempt valve removal on a cylinder that is damaged.
- Never attempt valve removal on a cylinder that contains a flammable concentration.
- Never attempt valve removal on a cylinder that contains a corrosive or irritant gas without the prior review of the cylinder content and approval of the operation by the IH Group Leader.
- Do not use the tool if it fails to engage properly with the cylinder threads, otherwise injury may occur.
- Do not use wrenches or pliers to attach the tool to a cylinder. Hand tight only.
- Do not use the tool if it fails to engage properly with the cylinder threads, otherwise injury may occur.
- Do not use wrenches or pliers to attach the tool to a cylinder. Hand tight only.
- Always wear safety glasses when using these tools.

Equipment:

- Laboratory Hood
- Ring Stand
- Compressed Gas source and thin tubing for purging the container after valve removal, either compressed air, compressed nitrogen, or air from a pump.
- ***Air Liquide*™ Cylinder Valve Removal Tool Model RC10** for use with calibration gas cylinders with external threads.
- ***Air Liquide*™ Cylinder Valve Removal Model RC600** for use with calibration gas cylinders with internal threads.



Method:

1. Perform the removal operation in an operating lab hood.
2. Secure the cylinder to a ring stand within the hood to safely hold the cylinder upright during the operation.
3. Cylinders must be EMPTY <u>before</u> using the valve removing tool. Cylinders with gas content must be relieved of all pressure prior to valve removal. Attach a gas cylinder regulator to gas cylinder, open regulator valve to release residual gas that may be left in the cylinder. When the cylinder is completely empty, remove the regulator.
4. Determine cylinder type and applicable tool to use (internal or external thread). There are two cylinder valve removing tool models: Model RC10 for use with calibration gas cylinders with external threads and Model RC600 for use with calibration gas cylinders with internal threads.
5. Prepare the tool for use by making sure the center punch is retracted completely into the body of the tool before beginning. Turning it counter clockwise until it stops retracts the center punch.
6. Lower the hood sash to place the Plexiglas® of the sash between the cylinder valve and the worker's eyes.
7. Screw the tool on the cylinder as you would a regulator. Once the tool is connected to the cylinder, slowly turn the handle clockwise until you have reached the end of its travel. The cylinder valve is pushed into the cylinder (you may hear when the valve falls into the cylinder).
8. If venting occurs during this procedure, pause to allow gas pressure to dissipate. Both tools are designed with gas relief ports in the event the cylinders contain residual gas.
9. Retract and remove the tool by turning counter clockwise. There will be a visible hole in the cylinder where the valve used to be.
10. Remove the tool from the cylinder by unscrewing it.
11. When the contents of the cylinder previously contained a concentration above the TLV or PEL: Connect a thin tube to a compressed nitrogen source or an air pump. Insert the tube into the cylinder hole. In a lab hood, purge the cylinder until the remaining contents is fully expelled from the cylinder by purging 10 times the cylinder volume.
12. Deface the cylinder content label and replace with a label "EMPTY.
13. Remove CMS Barcode label and fill out the *CMS Deletion* form to record the disposal of empty cylinders.
14. Place the empty cylinder in a metal recycling bin or dumpster.

Attachment 9.6

Document Control of Instrument Manuals

1. **Determining documentation to maintain:** Maintain Instrument Manuals (Operating Manuals or Instructions) for all active equipment and out-of-service equipment that are used or have been used to measure compliance with Occupational Exposure Levels.

2. **Creating a "controlled document":** For current equipment, obtain or make an electronic version (such as a PDF file) of the Instrument Manual. The electronic version serves as the official copy and is to be maintained on the SHSD IH Group's web site with its redundancy and back-up mechanisms.

3. **Archiving "hard copies" of current instruments:** For actively used equipment, the IH Group will maintain the original paper copy of the instrument manual (or a print-out of the manual if received from the manufacturer as an electronic copy).

4. **Archiving "hard copies" of out-of-service instrument:** For equipment that was formerly used but is no longer in service, the IH Group will maintain a paper copy of the instrument manual.

5. **Copies of manuals for loan:** Maintain at least one copy of the instrument manual in a location that can be signed out by BNL personnel for reference and training.

Multi-gas Monitor
Calibration & Maintenance Record

Calibration by:	Calibration date:	Next Due:
Instrument Name ☐ **Scott Scout, Model SCT, Serial Number:** ☐**6375,** ☐**6376,** ☐**7014,** ☐**7078;** ☐________ ☐ **Crowcon, Model Triple Plus+IR, Serial Number:** ☐**2560025445,** ☐ ______________ ☐ ______________________ Model:__________ Serial Number:__________		Customer Group:

Sample

See SHSD SOP Web Page for a blank form

Calibration Readings				
	Concentration	As Found	As Left	Pass/Fail
☒ Oxygen (O2)	20.9%	20.9 %	20.9 %	☒Pass ☐Fail
☒ LEL	32%	31 %	32%	☒Pass ☐Fail
☒ Carbon Monoxide (CO)	50 ppm	15 ppm	n/a ppm	☐Pass ☒Fail
☒ Hydrogen Sulfide (H2S)	25 ppm	26 ppm	25ppm	☒Pass ☐Fail
☐ Sulfur Dioxide (SO2)			ppm	☐Pass ☐Fail
☐ Nitrogen Dioxide (NO2)			ppm	☐Pass ☐Fail
☐ Nitrous Oxide (NO)			ppm	☐Pass ☐Fail
☐ Hydrogen Cyanide (HCN)				☐Pass ☐Fail
☐ Hydrogen Chloride (HCl)				☐Pass ☐Fail
☐				☐Pass ☐Fail
☐				☐Pass ☐Fail

Problems During Calibration: The carbon monoxide sensor failed to record the correct value and could not be set to an appropriate level. Meter failed calibration on this sensor. A new sensor has been ordered from the supplier.

Maintenance & Service Record			
Repairs: Date: By:	none where needed		
New Sensors Replacement Date: By:	☐ Oxygen (O2)	☐ LEL	☐ Carbon Monoxide
	☐ Hydrogen Sulfide	☐ Sulfur Dioxide	☐ Nitrogen Dioxide
	☐ Nitrous Oxide	☐ Other:	
Battery Replacement: Date: 8/12/05 By: John Doe	The battery was tested on a Volt-Ohm meter and found to be acceptable. The meters BAT indicator showed the battery level was acceptable. No changes were needed.		
Comments:	None		

Single Gas/Vapor Calibration Record

Calibration by:	Calibration date:	Next Due:
Instrument Name ☐ **Scott Scout, Model SCT, Serial Number: ☐6375, ☐6376, ☐7014, ☐7078; ☐** ____________ ☐ **Crowcon, Model Triple Plus+IR, Serial Number: ☐2560025445, ☐** ________________ ☐ ______________________________ Model:_____________ Serial Number:_____________		Customer Group:

Calibration Readings			
Contaminant	Calculated/Known Concentration	As Found	As Left
Acetone	500 ppm	456 ppm	500 ppm
"	100 ppm	87 ppm	99.5 ppm
"	50 ppm	43 ppm	50 ppm
"	10 ppm	7 ppm	10 ppm
"	1 ppm	None detected ~~ppm~~	1 ppm
~~---~~	~~ppm~~	~~ppm~~	~~ppm~~
~~---~~			~~ppm~~
~~---~~			~~ppm~~
Recor			
Comments/ Problems During Calibration			

Sample

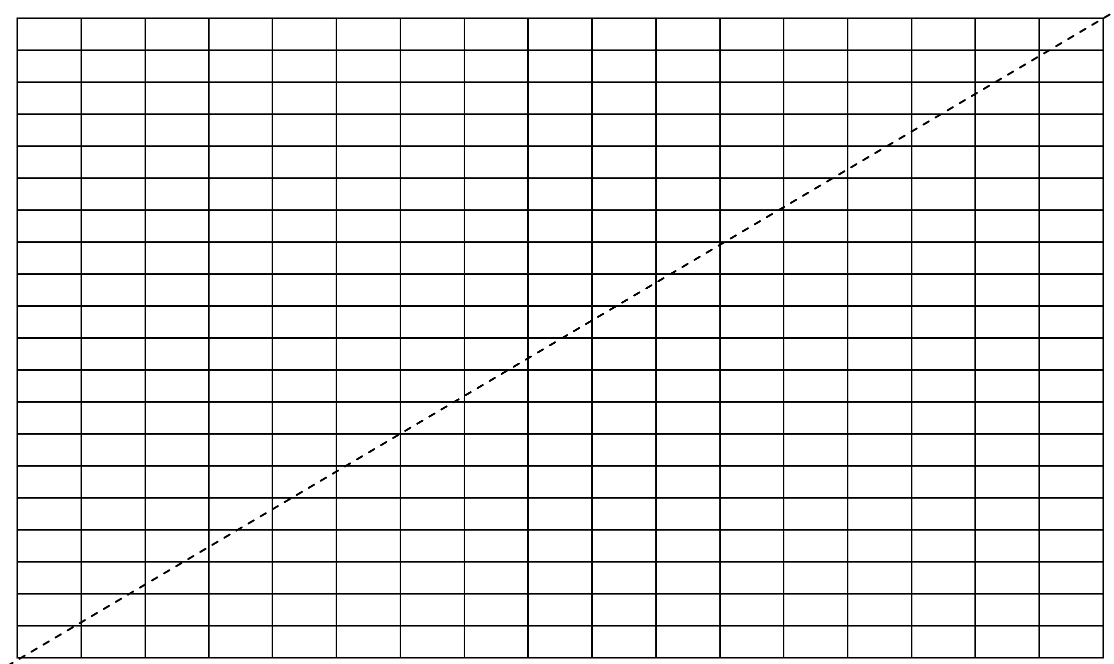
See SHSD SOP Web Page for a blank form

Maintenance & Service Record	
Repairs: Date: By:	n/a
New Sensors Replacement Date: By:	n/a
Battery Replacement: Date: 02/23/06 By: J. Doe	The battery was tested on a Volt-Ohm meter and found to be acceptable. The meters BAT indicator showed the battery level was acceptable. No changes were needed.
Comments:	

Single Gas/Vapor Calibration Record

Plot of Known to Measured Concentration

Known or Calculated Concentration of Standard



Concentration measured by Meter/Monitor

Details and Diagram of the Gas/Vapor Generation System
Diagram of System:
System Descriptions:

BROOKHAVEN NATIONAL LABORATORY

IH5110 Attachment 9.9
Meter Bump Test Record

Bump test by:	Signature:	Date:

Instrument Name

☐ **Scott Scout, Model SCT, Serial Number: ☐6375, ☐6376, ☐7014, ☐7078; ☐__________**

☐ **Crowcon, Model Triple Plus+IR, Serial Number: ☐2560025445,** ☐________________

☐ ______________________________ Model:______________ Serial Number:______________

Pre-Test Checklist	Pass/Fail
Calibration Date is within 3 months	☐Pass ☐Fail
Battery indicates charged and functional	☐Pass ☐Fail
Zero Sensor- sensors zeroed properly	☐Pass ☐Fail
Leak Check	☐Pass ☐Fail
Bump Test (see results below)	☐Pass ☐Fail

Sample

See SHSD SOP Web Page for a blank form

Test Parameter	Standard Concentration	Measured Value	Pass/Fail
☐ Oxygen (O2)	%	%	☐Pass ☐Fail
☐ LEL	% of LEL	% of LEL	☐Pass ☐Fail
☐ Carbon Monoxide (CO)	ppm	ppm	☐Pass ☐Fail
☐ Hydrogen Sulfide (H2S)	ppm	ppm	☐Pass ☐Fail
☐ Sulfur Dioxide (SO2)	ppm	ppm	☐Pass ☐Fail
☐ Nitrogen Dioxide (NO2)	ppm	ppm	☐Pass ☐Fail
☐ Nitrous Oxide (NO)	ppm	ppm	☐Pass ☐Fail
☐ Hydrogen Cyanide (HCN)	ppm	ppm	☐Pass ☐Fail
☐ Hydrogen Chloride (HCl)	ppm	ppm	☐Pass ☐Fail
☐			☐Pass ☐Fail
☐			☐Pass ☐Fail

IH51100 Attachemt 9.10 Sample of BNL Meter Calibration Policy

Mfgr.	Meter (Active)	Manufacturer &Address/Phone	Manufacturer Calibration Frequency Recommendation	BNL Calibration Frequency Policy	BNL Calibration Mechanism
Alnor	**Swinging Vane Anemometer** Models: 6000P	Alnor 7555 N. Linden Ave. Skokie, IL 60097 312-677-3500	**Not required** Manual Date: 11/77 6270 Page: 13	**None required** Calibration only after damage.	Offsite vendor
Ametek	**Chatillon®** **DFE Series Digital Force Gauge**	Ametek TCI Division Chatillon Systems 8600 Somerset Drive Largo, FL 33773 (800) 527-9999	**No recommendation stated** Manual Date: NC002775 Issue 1 Dec 2004 Page: 1-8	**Every two years at the factory**	Ametek or authorized distributor.
Arizona	**Jerome Mercury Vapor Analyzer** Model: **Jerome 431-X**	Arizona Instrument 4114 East Wood Street Phoenix, AZ 85040-1941 (602) 470-1414 (800) 235-3360 FAX: (602) 470-1888	**Annually** Manual Date: July, 1996 Page: 12	**Annual**	Offsite Vendor
ATI	**Photometer** **Model 2H and2NH**	Air Technologies intl 11403 Cronrdige drive Owings Mills, MD 21117 (410) 363-9696 www.atitest.com	[illegible] Page: 28	**[illegible]ual**	ATI Factory Maintenance and Calibration
Bios	**Defender 500** **Model 717-510M**	Bios International Corp. 230 W. Parkway Unit 1 Pompton Plains, NJ 07444 800-663-4977	**Annually** Manual Date: 2006 Page: 13,14	**Annual**	Offsite Vendor
Bios	**Dry Cal Calibrator** Model: BIOS DC-1	Bios International Corp. 230 W. Parkway Unit 1 Pompton Plains, NJ 07444 800-663-4977	**No recalibration required** Manual Date: 2/5/97 Page: section 2.0	**None- Primary Standard**	IHG with Soap Film Flow Meter or Off-site Vendor
Bios	**Dry Cal Calibrator** Model: BIOS DC-2	Bios International Corp. 230 W. Parkway Unit 1 Pompton Plains, NJ 07444 800-663-4977	**No recalibration required** Manual Date: Page: section	**None - Primary Standard**	IHG with Soap Film Flow Meter or Off-site Vendor

Sample
Current Version maintained by SHSD IH Lab Group in file IH51

BROOKHAVEN NATIONAL LABORATORY

Safety and Health Services Division
Industrial Hygiene Group

IH51100 Attachment 9.11

IH-IHP-51100

IH Laboratory Personnel

Job Performance Measure- Qualification Certificate

Candidate's Name (Print):	BNL#	Date of Qualification

Performance Measures

Topic	Criteria	Qualification Status		
		Unsatis factory	Recove red	Satisf actory
Calibration	Knowledgeable in the calibration of IH equipment via SHSD procedures or off-site vendors.	--	--	--
	Knows how to properly determine the calibration frequency and how to process equipment for calibration from the proper source.			
Sampling & Measuring Equipment Preparation	Demonstrates knowledge of the equipment needed for the analysis and how to prepare. Shows how to perform the pre-use setup/calibration to access potential exposure to the worker. Has high level of knowledge of regulatory requirements and techniques to access compliance.	--	--	--
Measurement of flow	Knows how to properly measure the flowrate of the sampling equipment,			
Cylinder Valve Removal	Demonstrates the proper set up of the cylinder removal tool.			
Instrument Manuals	o Is knowledgeable on how to maintain at least one copy of the instrument manual in a location that can be signed out by BNL personnel for reference and training. o Knows to maintain the original paper copy of the instrument manual (or a print-out of the manual if received from the manufacturer as an electronic copy) in the proper file location. o Knows to maintain a paper copy of the instrument manual for out-of service meters/equipment.			
Calibration Record Management	Demonstrates knowledge of the location and technique for storage and retrieval of sampling forms and the databases used to store and track records.			
Risk Assessment	Understand the risk assessment and controls described in Job Risk Assessment SHSD-JRA-03.			

I accept the responsibility for performing the tasks as demonstrated within this JPM and the corresponding SOP.

Candidate Signature:	Date:

I certify the candidate has satisfactorily performed each of the above listed steps and is capable of performing the task unsupervised.

Evaluator Signature:	Date: