

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division	NUMBER IH51660
	REVISION FINAL Rev9
INDUSTRIAL HYGIENE GROUP Standard Operating Procedure	DATE 06/06/07
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SUBJECT: Instrument Calibration and Maintenance Program	

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CALIBRATED	
By: _____	Date: _____
Due: _____	

1.0 Purpose & Scope

This document describes the SHSD Industrial Hygiene Group (IHG) *Calibration and Maintenance Schedule policy* for direct reading instrument and air sampling pumps. Its purpose is to establish IHG policy on the frequency and mechanism for calibration and repair of IHG instrumentation.

The goal of the procedure is to provide a uniform protocol for preserving IHG instrumentation in a manner that will result in accurate, precise, and reliable readings from the instruments.

Procedures for maintenance and/or calibration of individual pieces of equipment are documented in separate SOPs within the IHG's written documentation.

2.0 Responsibilities

- 2.1 **Program Administration:** This procedure is administered through the SHSD Industrial Hygiene Group. Members of the SHSD Industrial Hygiene Group are required to follow this procedure.

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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.

Program Administrator: A person designated by the IH Group Leader to administer this procedure and associated sampling equipment management.

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 **Training prior to using this procedure:** Demonstration of proper operation of the procedure per Section 7 for qualification requirements.

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.

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.

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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 surrendered 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:** This sampling does not have adverse impact on the environment or create waste for disposal.

- 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

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- 6.1 **Equipment:** Calibration Labels, from BNL PPM Stock or equivalent. See Section 6.6 for wording.
- 6.2 **Determining the frequency of calibration.** Refer to [BNL Instrument Calibration Frequency Policy](#) (see sample in [Attachment 9.2](#)) to this procedure for a list of IHG instrumentation and the IHG determined calibration frequency. Calibrations are to be completed within the frequency listed in [BNL Instrument Calibration Frequency Policy](#) or the equipment must be removed from service.
- 6.3 **Establishing the Frequency of calibration.** The calibration frequency listed in [BNL Instrument Calibration Frequency Policy](#) is determined by the Program Administrator 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 does not provide specific calibration procedure methodology. Follow IH Group written procedures specific to instruments that IHG performs calibrations "in-house" for the methodology for calibration.
- 6.5 **Calibration by off-site vendors, suppliers, or original equipment manufacturer:** Equipment that is to be calibrated by an vendor or original equipment manufacturer will include the inclusion of [Attachment 9.3 Scope of Work](#) with the purchase requisition initiating the calibration.
- 6.6 **Documenting Calibration Status:** The on-going calibration status of each IHG electronic instrument (other than sampling pumps) must be marked on the meter by means of a label on the meter. The label must, at a minimum, indicate that the meter is "calibrated" and show the date of expiration.
- 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.

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6.6.2 The sticker used by IHG for “in-house” calibration must contain at least 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:



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

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

6.7.1 **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.

6.7.2 **Meters and Instruments:**

6.7.2.1 **Off-site Calibration-** Meters receive routine maintenance during their periodic calibration by off-site vendors.

6.7.2.2 **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.

6.7.3 **Damage or abuse:** When IHG meters show signs of damage or abuse they will be repaired by IHG or the manufacturer as needed.

6.8 When equipment is sent off site for calibration, it is recommended to request an “As Found” calibration report, when available. This report is in addition to the *Calibration Certificate* which is required. See Scope of work in Attachment 9.3

6.9 The *Equipment Custodian, IH Manager, or IH Laboratory Supervisor* is to review (*verification*) incoming calibration results and “as found” reports. The reviewer is to

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document needed action if an “out of tolerance” condition was found in equipment returning from calibration.

7.0 Implementation and Training

7.1 Qualification Criteria: Only individuals who have demonstrated knowledge of this procedure to the satisfaction of the IH Group Leader, the Program Administrator, or their designee will be qualified to perform any activities described in this procedure. The qualification criteria to conduct work following this procedure are:

- 7.1.1 Specific knowledge of this procedure shown by an ability to answer questions on procedure.
- 7.1.2 Personnel shall be re-qualified at a frequency not to exceed three years.
- 7.1.3 If significant and substantive changes to the procedure are made, all qualified *Equipment Custodians* will be notified of the changes.
- 7.1.4 Personnel performing maintenance on energized electrical meters or pumps in a condition that potentially exposes them to the energy source (meets definitions of “hot work”) must meet all BNL training and medical approval requirements.

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*.

9.0 Attachments

- 9.1 Equipment Custodian Qualification form
- 9.2 Sample of [BNL Instrument Calibration Frequency Policy](#)
- 9.3 Statement of Work for Calibration of Equipment

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10.0 Documentation

Document Development and Revision Control Tracking		
PREPARED BY: <i>(signature and date on file)</i> R. Selvey <i>(signature and date on file)</i> D. Wadman Date: 02/14/01	REVIEWED BY: <i>(signature and date on file)</i> R. Wilson <i>(signature and date on file)</i> J. Peters Date: 02/15/01	APPROVED BY: <i>(signature and date on file)</i> R. Selvey IH Group Leader Date: 03/07/01
ESH Coordinator/ Date: <i>none</i>	Work Coordinator/ Date: <i>none</i>	SHSD Manager / Date <i>none</i>
QA Representative / Date: <i>none</i>	Training Coordinator / Date: <i>none</i>	Filing Code: IH52
Facility Support Rep. / Date: <i>none</i>	Environ. Compliance Rep. / Date: <i>none</i>	Effective Date: 03/18/03
ISM Review - Hazard Categorization <input type="checkbox"/> High <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> Low/Skill of the craft	Validation: <input type="checkbox"/> Formal Walkthrough <input type="checkbox"/> Desk Top Review <input type="checkbox"/> SME Review Name / Date:	Implementation: Training Completed: Tracked in BTMS Procedure posted on Web: 06/06/07 Hard Copy files updated: 06/06/07 Document Control: 06/06/07

Revision Log		
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input type="checkbox"/> Periodic review <input checked="" type="checkbox"/> Clarify/enhance procedural controls		
Changed resulting from: <input type="checkbox"/> Environmental impacts <input type="checkbox"/> Federal, State and/or Local requirements <input type="checkbox"/> Corrective/preventive actions to non-conformances <input checked="" type="checkbox"/> none of the above		
Section/page and Description of change: Renumbered from IH60660 to 51660 to correct clerical mistake.		
R. Selvey (Signature and date on file) SME Reviewer/Date: 04/24/01	Reviewer/Date:	Reviewer/Date:
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input checked="" type="checkbox"/> Periodic review <input checked="" type="checkbox"/> Clarify/enhance procedural controls		
Changed resulting from: <input type="checkbox"/> Environmental impacts <input type="checkbox"/> Federal, State and/or Local requirements <input type="checkbox"/> Corrective/preventive actions to non-conformances <input checked="" type="checkbox"/> none of the above		
Section/page and Description of change: Revised Table to add new instruments and revise policy on some meters		
R. Selvey (Signature and date on file) SME Reviewer/Date: 01/29/02	SME Reviewer/Date:	SME Reviewer/Date:
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input type="checkbox"/> Periodic review <input checked="" type="checkbox"/> Clarify/enhance procedural controls		
Changed resulting from: <input type="checkbox"/> Environmental impacts <input type="checkbox"/> Federal, State and/or Local requirements <input type="checkbox"/> Corrective/preventive actions to non-conformances <input checked="" type="checkbox"/> none of the above		
Section/page and Description of change: Revised Section 7 and Attachment 9.1 to add new instruments and revise policy on some meters. Added "IHG" changes to policy.		
R. Selvey (Signature and date on file) SME Reviewer/Date: 03/17/03	SME Reviewer/Date:	SME Reviewer/Date:

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Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input checked="" type="checkbox"/> Periodic review <input type="checkbox"/> Clarify/enhance procedural controls Changed resulting from: <input type="checkbox"/> Environmental impacts <input type="checkbox"/> Federal, State and/or Local requirements <input type="checkbox"/> Corrective/preventive actions to non-conformances <input checked="" type="checkbox"/> none of the above Section/page and Description of change: Revised Attachment 9.1 to add new instruments and revise policy on some meters.		
R. Selvey (Signature and date on file) SME Reviewer/Date: 12/13/04	SME Reviewer/Date:	SME Reviewer/Date:
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input checked="" type="checkbox"/> Periodic review <input checked="" type="checkbox"/> Clarify/enhance procedural controls Changed resulting from: <input type="checkbox"/> Environmental impacts <input type="checkbox"/> Federal, State and/or Local requirements <input type="checkbox"/> Corrective/preventive actions to non-conformances <input checked="" type="checkbox"/> none of the above Section/page and Description of change: Change to format of Section 10. Added Attachment 9.1 JPM Qualification Form. Update Attachment 9.2 with Quest 2100 and Quest DLX dosimeter.		
R. Selvey 6/28/06 (signature/date on file) SME Reviewer/Date:	SME Reviewer/Date:	SME Reviewer/Date:
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input type="checkbox"/> Periodic review <input type="checkbox"/> Clarify/enhance procedural controls Changed resulting from: <input type="checkbox"/> Environmental impacts <input type="checkbox"/> Federal, State and/or Local requirements <input type="checkbox"/> Corrective/preventive actions to non-conformances <input checked="" type="checkbox"/> none of the above Section/page and Description of change: Update Attachment 9.2 with TSI Particle Counter and Chatillon Force Gauge		
R. Selvey (signature/date on file) SME Reviewer/Date: 07/07/06	SME Reviewer/Date:	SME Reviewer/Date:
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input checked="" type="checkbox"/> Periodic review <input type="checkbox"/> Clarify/enhance procedural controls Changed resulting from: <input type="checkbox"/> Environmental impacts <input type="checkbox"/> Federal, State and/or Local requirements <input type="checkbox"/> Corrective/preventive actions to non-conformances <input checked="" type="checkbox"/> none of the above Section/page and Description of change: Update the Section 5 Precautions and added JRA link. Moved Attachment 9.2 to a controlled document and changed the attachment to an "example".		
R. Selvey (signature/date on file) SME Reviewer/Date: 04/26/07	SME Reviewer/Date:	SME Reviewer/Date:
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input type="checkbox"/> Periodic review <input checked="" type="checkbox"/> Clarify/enhance procedural controls Changed resulting from: <input type="checkbox"/> Environmental impacts <input type="checkbox"/> Federal, State and/or Local requirements <input checked="" type="checkbox"/> Corrective/preventive actions to non-conformances <input type="checkbox"/> none of the above Section/page and Description of change: Corrected error referring to "Attachment 9.2" as "Attachment 9.1" throughout the document and inserted a hyperlink to the web address of Attachment 9.2 Added Step 6.7 to recommend an "As Found" report on off-site calibrations, when available. Added Step 6.8 to require a review of the calibration results and document needed actions if an "out of tolerance" condition was found in equipment returning from calibration. Added <i>SBMS Calibration</i> as a reference in Section 8.		
R. Selvey (signature/date on file) SME Reviewer/Date: 05/08/07	SME Reviewer/Date:	SME Reviewer/Date:
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input checked="" type="checkbox"/> Periodic review <input type="checkbox"/> Clarify/enhance procedural controls Changed resulting from: <input type="checkbox"/> Environmental impacts <input type="checkbox"/> Federal, State and/or Local requirements <input checked="" type="checkbox"/> Corrective/preventive actions to non-conformances <input type="checkbox"/> none of the above Section/page and Description of change: Added definitions for calibration, certificate and traceable in Section 3. Minor text revisions for clarity in several steps in Section 6. Step 6.5 was added. Added references to the two ANSI calibration standards in Section 8. Added Attachment 9.3 to serve as exhibit on future Purchase Requisitions to ensure "as found" calibration data is provided.		
R. Selvey (signature/date on file) SME Reviewer/Date: 06/06/07	SME Reviewer/Date:	SME Reviewer/Date:

**Equipment Custodian
Job Performance Measure (JPM) Completion Certificate**

Candidate's Name	Life Number:
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Practical Skill Evaluation: Demonstration of Evaluation Methodology by Oral Exam

Criteria	Qualifying Performance Standard	Unsat.	Recov.	Satisf.
1. Sampling Equipment	Knows where equipment needed for the procedure is located and how to instruct others to properly sign it out.			
2. Pre-Testing Inspection	Verifies the equipment to be used is operational and calibrated. .			
3. Calibration	Knows how to properly determine the calibration frequency and how to process equipment for calibration from the proper source.			
4. Documentation	Demonstrates correctly filling out IH equipment calibration and maintenance forms. And how and where to properly store records.			

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

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

Evaluator Signature:	Date:
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IHS1660 Attachment 9.2 BNL Instrument Calibration Frequency Policy

Date: 07/08/06 (1)

Meter	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	Recommendation Reference: Not required Operation Manual Manual Date: 11/77 6270 Page: 13	None Calibration only after damage.	If needed due to damage: RCD IC wind tunnel or Offsite vendor
Alnor Compuflo Air Velocity Meter Models: 8500D-11	Alnor 7555 N. Linden Ave. Skokie, IL 60097 312-677-3500	Recommendation Reference: No recommendation stated Operation Manual Manual Date: 11/77 6270 Page: 13	Out of service , held as back-up for TSI anemometers, if used Annual	RCD IC wind tunnel or Offsite vendor
Arizona-Jerome Mercury Vapor Analyzer Model: Jerome 431-X	Arizona-Jerome 431-X (602) 470-1888 FAX: (602) 470-1888	Recommendation Reference: As per user set intervals Operation Manual Manual Date: 5/95, Rev. 2 Pages: 5-9 & 8-2	Out of Service [Annual (minimum), target goal is Quarterly] Out of Service [Before each use]	Offsite Vendor
Bacharach Sentinel Personal Gas Monitor Model: Sentinel 44T & 44	Bacharach 625 Alpha Drive Pittsburgh, PA 15238-2878 Phone: (412) 963-2000	Recommendation Reference: As per user set intervals Operation Manual Manual Date: 5/95, Rev. 2 Pages: 5-9 & 8-2	Out of Service [Annual (minimum), target goal is Quarterly] Out of Service [Before each use]	IHG single point calibration with standard gas for each sensor IHG bump check with gas for each sensor to be measured in field.
Bios Dry Cal Calibrator Model: BIOS DC-1	Bios International Corp. 230 W. Parkway Unit 1 Pompton Plains, NJ 07444 800-663-4977	Recommendation Reference: No recalibration required Operation Manual Manual Date: 2/5/97 Page: section 2.0	None	IHG with Soap Film Flow Meter multipoint calibration 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	Recommendation Reference: No recalibration required Operation Manual Manual Date: Page: section	Annual	IHG with Soap Film Flow Meter multipoint calibration or Off-site Vendor

SAMPLE
See SHSD SOP page for the most recent version of this List of Equipment

Statement of Work for Calibration of BNL Equipment

Description of Service: The Contractor shall furnish the services of trained personnel, equipment, and supplies to perform calibration, i.e. a set of operations which establish the relationship between values indicated by the BNL equipment and a corresponding standard or known value.

Calibration: The Contractor shall perform a calibration using traceable standard(s). The calibration shall evaluate the: before “as found” value/status, adjusted value/status (if necessary), and “as returned” value/status. If needed, the meter is to be adjusted (+/-) to meet the manufacturer’s specifications or contractor’s tolerance.

Preventive maintenance and repair: If required, repair is to proceed only after notification of BNL of the needed action(s) and authorization by BNL. Preventive maintenance (replacement of parts, disassembling, cleaning, etc.) shall be performed in accordance with the manufacturer's specifications, if not covered by the purchase order, is to proceed only after notification of BNL.

SAMPLE
See SHSD SOP web page for the most recent version of this Attachment

Applicable Requirements: The Contractor must meet the requirements of ANSI/NCSL Z540-1-1994: *Calibration Laboratories and Measuring and Test Equipment - General Requirements* or ANSI/ISO/IEC 17025- 2005: *General requirements for the competence of testing and calibration laboratories*.

Calibration Certificate: The Contractor shall submit a certificate that the equipment has been calibrated and is ready for use. The certificate shall contain (at least) the following items:

- A title (such as, “Calibration Report,” “Calibration Certificate”),
- Name and address of the calibration facility,
- Description of equipment calibrated, including Manufacturer, Model Number, Serial Number,
- Identification of procedure &/or standards used to calibrate the equipment,
- Before date (i.e., “as found”) and after data (i.e. “as returned”) taken with respect to Manufacturer’s specifications or Contractor’s Tolerance (+/-),
- Statement of the status of equipment with respect to Manufacturer’s Tolerance or Contractor’s Tolerance (i.e. “Pass/Fail”),
- Date of calibration, and
- Signature and title, or an equivalent identification, of person performing the calibration.

Equipment Labeling: The Contractor shall affix a label to the calibrated equipment, which indicates, (at least):

- Contractor’s name,
- Date of calibration, and
- Next due date of calibration (based on the manufacturer’s recommendations).