

<b>BROOKHAVEN NATIONAL LABORATORY</b> Safety & Health Services Division		NUMBER <b>IH96500</b>
		REVISION <b>Final Rev5</b>
SUBJECT: <b>INDUSTRIAL HYGIENE GROUP</b> Standard Operating Procedure: Field Procedure		DATE <b>11/02/05</b>
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INSTRUMENT OPERATION: <b>Bruel &amp; Kjaer Type 2236</b> <b>As a Precision Sound Level Meter and Octave Band Analyzer</b>		

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### **1.0 Purpose/Scope**

This procedure provides a standardized method for the operation of the Bruel & Kjaer (B & K) Type 2236 Precision Sound Level Meter and Analyzer. It should be used in conjunction with the SBMS Subject Area *Noise and Hearing Conservation* and IH SOP IH96200 *Noise Measurement Principles: Area Surveys*.

The B&K 2236 provides a method for easy and accurate surveys of workplace noise exposures. This area survey meter should be used to determine the baseline noise levels and area noise levels. Its use is designed for conducting noise surveys to determine the need for area warning posting, locate problem-noise sources, and measuring the effectiveness of engineering controls.

The B&K 2236 can be used as a screening tool to determine the need for personal monitoring and to sketch isometric lines for control area delineation. Generally, employee exposure assessments should be made with a noise dosimeter. However this area survey meter can be used in limited situations for exposure assessments, such as for operations that are of short duration and involve limited employee movement. This allows the meter to measure the actual employee exposure. In these cases, the meter reading must be observed over the entire time of exposure.

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## 2.0 Responsibilities

- 2.1 Personnel that perform exposure monitoring with this instrument are responsible to follow all steps in this procedure.
- 2.2 The data collected using this meter must have an appropriate evaluation of the hazard and risk by a cognizant Industrial Hygiene professional.

## 3.0 Definitions

- 3.1 *Decibel (dB):* A non-dimensional unit used to express sound pressure levels. It is the log of the ratio of the measured sound pressure level to a reference level.
  - 3.1.1 *dBA:* A sound pressure level in decibels made on the A-scale of a sound level meter. This unit of measure approximates the response of the human ear.
  - 3.1.2 *dB C:* Sound pressure based on a nearly flat, non-weighted scale.
- 3.2 *Frequency:* The number of cycles completed by a periodic quantity in a unit time. Unit, hertz (Hz) measures cycles per second.
- 3.3 *Impulse or Impact Noise Levels:* Variations in noise levels that involve peak levels spaced at periods of greater than one per second. Where the intervals are less than one second, it should be considered a continuous noise source.
- 3.4 *Occupational Exposure Limit:* The maximum time weighted average (TWA) exposure permitted for employee exposure, based on the less of the OSHA Permissible Exposure Limits (PEL) or ACGIH Threshold Limit Value (TLV). See IH96200.

## 4.0 Prerequisites

### 4.1 **Training prior to using this meter:**

- 4.1.1 Use of the B&K 2236 shall be limited to persons who act under the direction of a competent hazard assessment person and have demonstrated the competency to satisfactorily use the meter, as evidenced by experience and training, to meet the criteria set by BNL. Refer to Section 7 *Implementation and Training*.
- 4.1.2 Other appropriate training for other hazards in the area to be entered may be needed. Check with ESH coordinator or FS Representative for the facility.

### 4.2 **Area Access:**

- 4.2.1 Contact the appropriate Facility Support Representative or Technician to obtain

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- approval to enter radiological areas.
- 4.2.2 Verify with the appropriate Facility Support Representative or Technician if a Work Permit or Radiological Work Permit is needed or is in effect. If so, review and sign the permit.
- 4.2.3 Use appropriate PPE for area

## 5.0 Precautions

### 5.1 Hazard Determination:

- 5.1.1 The operation of this meter does not cause exposure to any chemical, physical, or radiological hazards. The meter design does not cause significant ergonomic concerns in routine use. The meter does not generate Hazardous Waste.
- 5.1.2 By its very nature, the B&K 2236 meter may be used in areas where excessive noise levels exist or are suspected to be present. Exposures to noise levels above the PEL and/or TLV may cause temporary or permanent hearing loss.

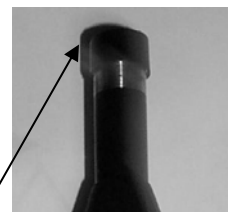
### 5.2 Personal Protective Equipment:

- 5.2.1 In areas where noise levels exceed the *Occupational Exposure Limit (OEL)*, hearing protection should be worn. The hearing protection should be able to reduce the noise levels below the OEL. See IH96200 for guidance on PPE selection.
- 5.2.2 Additional PPE: Other appropriate PPE for the area being entered. Check with your ES&H representative.

## 6.0 Procedure

**Equipment:** (Pictured in Appendix 8.1)

- 6.1.1 Meter Body
- 6.1.2 Microphone
- 6.1.3 Batteries (4 AA, alkaline)
- 6.1.4 Windscreen (foam ball cover for microphone)
- 6.1.5 Random Incidence Ring (black plastic ring for microphone)
- 6.1.6 Calibrator (Type 4231)



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**Operation of the B&K 2236** (picture of meter and description of controls and displays is contained in Appendix 9.1.)




6.1 **Turning Power On:** press the  button.

#### 6.2 **Battery Check**

- 6.2.1 Observe the battery symbol on the screen, if the battery is low, the symbol will be unfilled and flashing. If flashing, replace the batteries.
- 6.2.2 To observe the actual battery status, press *<Edit>*, then *<OK>*. Press *<OK>* to clear this screen. (Fresh batteries equal 6 V, replace when 3.9 or less.)

6.3 **Warm-up:** A warm-up is not required for this meter.

#### 6.4 **Calibration:**


- 6.4.1 Press *<SHOW>* on the B&K 2236 meter.
- 6.4.2 Put the meter into the “dBA” scale.
- 6.4.3 Press  *Parameter* on the B&K 2236 meter to move to the calibration screen.
- 6.4.4 Press *<EDIT>* on the B&K 2236 meter.
- 6.4.5 On the B&K 2236 meter, set the “calibration level” to **94.0dB** using  or  *Parameter*.
- 6.4.6 Remove the **Random Incidence Ring** from the microphone.
- 6.4.7 Put the meter microphone into the calibrator opening.
- 6.4.8 Press the *<On/Off>* button on the calibrator.
- 6.4.9 Press *<OK>* on the B&K 2236 meter (meter display reads *Checking...*).
- 6.4.10 Press *<OK>* on the B&K 2236 meter in response to question on new factor [typical factor is in the range of 1.6 +/- 0.4] (meters display reads *In progress...* then *Completed*).
- 6.4.11 Press *<OK>* on the B&K 2236 meter to return to the main screen.
- 6.4.12 Press *<OK>* on the B&K 2236 meter to return to main screen.
- 6.4.13 Turn off calibrator by pressing the *<On/Off>* button on the calibrator.
- 6.4.14 Record results on the sample form.



#### 6.5 **Operation:**

Typical Display Screen:

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Filter Center Frequency	40  120	Range (+ indicates over-range)
	31.5 Hz <input type="checkbox"/> OVL	Battery Status
Pause	Pause <b>02:00:00</b>	Overload
Time Weighting (F/S/I)	<b>F MaxL 83.6 dBA</b>	Elapsed Time
	Response Current Level	Frequency Weighting (dBA, C or L)

**6.5.1 Setting up the meter response:** After calibration, the meter will be ready to take measurements as a sound pressure level meter operating in any of the following response parameters: SPL, Leq, SEL, LEPd, L10, L50, L90, Ovl, MaxL, MinL, MaxP, Peak.

**Response:** Use the *Parameter* ▼ ▲ to select the desired setting. (For routine exposure monitoring choose **SPL** which links automatically to dBA.)

<b>SPL</b>	Maximum RMS level in 1sec interval (dBA)	<b>Leq</b>	Equivalent continuous sound level (dBA) (3dB exchange rate)
<b>MaxP</b>	(dBL)	<b>LAV4</b>	Equivalent continuous sound level with Exchange Rate of 4dB (ANSI S1.25) <small>L<sub>DOD</sub></small>
<b>MaxL</b>	Maximum SPL since last reset (dBL)	<b>LAV5</b>	Equivalent continuous sound level with Exchange Rate of 5dB (ANSI S1.25) <small>L<sub>OSHA</sub></small>
<b>MinL</b>	Minimum SPL since last reset (dBA)	<b>Lim</b>	Equivalent continuous impulse level(dBA)
<b>Peak</b>	Maximum Peak level in 1 sec interval (dBL)	<b>LEPd</b>	Daily Personal Noise Exposure Level (dBA)
<b>SEL</b>	Sound Exposure Level IEC 804 (dBA)	<b>L10</b>	Level exceeded 10% of measurement time (dBA)
<b>IEL</b>	Impulse Sound Exposure Level (dBA)	<b>L50</b>	Level exceeded 50% of measurement time (dBA)
<b>OVL</b>	Input signal overloading instrument % A	<b>L90</b>	Level exceeded 90% of measurement time (dBA)

**Frequency:** Use the *Frequency Wt.* ▼ ▲ to choose 31.5, 63, 125, 250, 500, 1K, 2K, 4K, 8K, or (Blank). (For routine exposure monitoring choose **BLANK** which automatically averages all frequencies.)

**Response Speed:** Use the *F/S/I* button to choose Fast, Slow, or Impulse response speed. (For routine exposure monitoring choose **Fast**.)

**6.5.2 Operator Position:** Preferably the operator should be further from the sound source than the microphone and positioned as to reduce reflection of the sound to the meter. Hold the meter at arms length.

- DO NOT stand between the sound source and microphone.

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- DO NOT place the hand within 12 cm (5 inches) of the microphone.
- The microphone can be a “random-incidence-response type” or a “free field response type” depending on the presence or absence of the **Random Incidence Ring**.

6.5.3 Place the meter in “dBA” and “Slow” response when making measurements for comparison with occupational exposure levels.

6.5.4 **Random-incidence-response.** Put the Random Incidence ring on the microphone. Do not point the meter at the source, hold it at a 70-90 degree angle, i.e., take the measurement so that the path from the noise source to the microphone is along a 70<sup>0</sup> to 90<sup>0</sup>. This setting is used for ANSI measurements. Do not use the meter if the ring is missing.

**Free Field:** When the Random Incidence ring from the microphone, the meter is then omni-directional. This setting is used for IIEC-ISO measurements. BNL does not use this setting for compliance testing

6.5.5 Take measurements at ear level of employee (sitting, standing or bending) to estimate personal exposures and to locate isometric lines of noise intensity on a sketch for defining area levels.

6.5.6 For maximum confidence in the exposure assessment, also take readings near the source and in areas that have low noise levels (background) to verify that the meter response matches these higher and lower sound pressure levels.

6.5.7 **Using the data logger:**

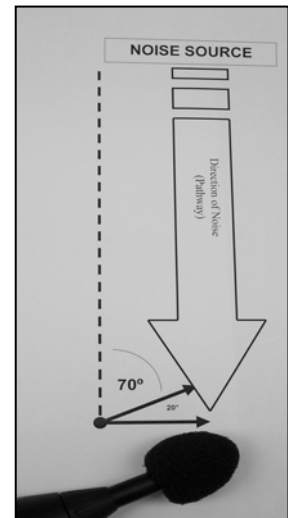
6.5.7.1 **Clearing old data:** To clear previously stored data, press the *<Reset>* button. Answer the Erase question by pressing the *<OK>* button. (Hint: If correctly reset, the display *Elapsed Time* should be reset.)

6.5.7.2 Press *<Show>*

6.5.7.3 Press *<Edit>*

6.5.7.4 Press *Parameter* ▼ ▲ until “to log – every 1 s” appears.

6.5.7.5 Meter Displays “Warning, this will erase logged results Erase



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*No/OK?* “ Press <OK> (displays *Erasing logged data...*”. then “*to log – every 1s*”.

6.5.7.6 Press <OK>. Meter starts new set of logging data.

#### 6.5.8 Downloading data:

6.5.8.1 Connect the meter to Serial Printer via the Serial Interface socket using a 9 pole Cable. Set baud rate at 9600.

6.5.8.2 Press <Data>.

6.5.8.3 Press <OK>.

6.6 **Octave Band Analysis:** Use the *Frequency Wt.* ▼ ▲ to move through each frequency and record the corresponding frequency Band and SPL on an *Octave Band Analysis* data form.

#### 6.7 Recording readings:

6.7.1 Use the BNL Direct Reading Sampling Instrument Form to record readings (see the IH web page for the most recent version).

6.7.2 Return meter and original sampling form to the SHSD IH Laboratory daily or at the end of each project as agreed to by the IH Laboratory Technician.

6.7.3 Send a copy of any hazard evaluation report written on the survey to the IH Laboratory and the Occupational Medicine Clinic.

6.7.4 Perform a post calibration. Record on form.

## 7.0 Training and Implementation

7.1 Training prior to using this meter includes a demonstration of proper operation of the instrument based on training, education, and experience. All persons must have met the qualification criteria for IH96 Noise Assessor set in *IH50300 BNL IH Program and IH Group Training & Qualification Matrix*.

7.2 Personnel are to document their training using Attachment 9.5, the Job Performance Measure Completion Certificate. Qualification on this JPM is required on a 3 year basis, providing the professional is monitoring noise sources frequently.

7.3 A baseline audiogram may be needed if the duration of exposure to the person performing the survey will be in excess of the OSHA Permissible Exposure Limits (PEL) or ACGIH Threshold Limit Value (TLV) (which ever is less). See IH96200.

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7.4 Other appropriate training for the area to be entered (check with ESH coordinator or FS Representative for the facility).

## 8.0 References

- 8.1 B&K 2236 Precision Sound-Level Meter and Analyzer Instruction Manual.
- 8.2 BNL SBMS Subject Area *Noise and Hearing Conservation*.
- 8.3 OSHA Noise/Hearing Conservation 29CFR1910.95.

## 9.0 Attachments

- 9.1 Photo of meter and parts
- 9.2 Theory of Operation
- 9.3 Short List of Operating Instructions
- 9.4 Area Survey Form
- 9.5 Meter Operation Qualification form- Job Performance Measure

## 10.0 Documentation

Document Development and Revision Control Tracking		
<b>PREPARED BY:</b> <i>(Signature and date on file)</i> <b>R. Selvey Author</b> <b>Date 03/09/01</b>	<b>REVIEWED BY:</b> <i>(Signature and date on file)</i> <b>R. Wilson SHSD IH Group</b> <b>Date 03/09/01</b>	<b>APPROVED BY:</b> <i>(Signature and date on file)</i> <b>R. Selvey SHSD IH Group Leader</b> <b>Date 03/13/01</b>
ESH Coordinator/ Date: <i>none</i>	Work Coordinator/ Date: <i>none</i>	SHSD Manager / Date <i>none</i>
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RCD Facility Support Procedure Committee Review 03/09/01	Environ. Compliance Rep. / Date: <i>none</i>	Effective Date: <b>03/13/01</b>
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: 11/02/05 Hard Copy files updated: 11/02/05

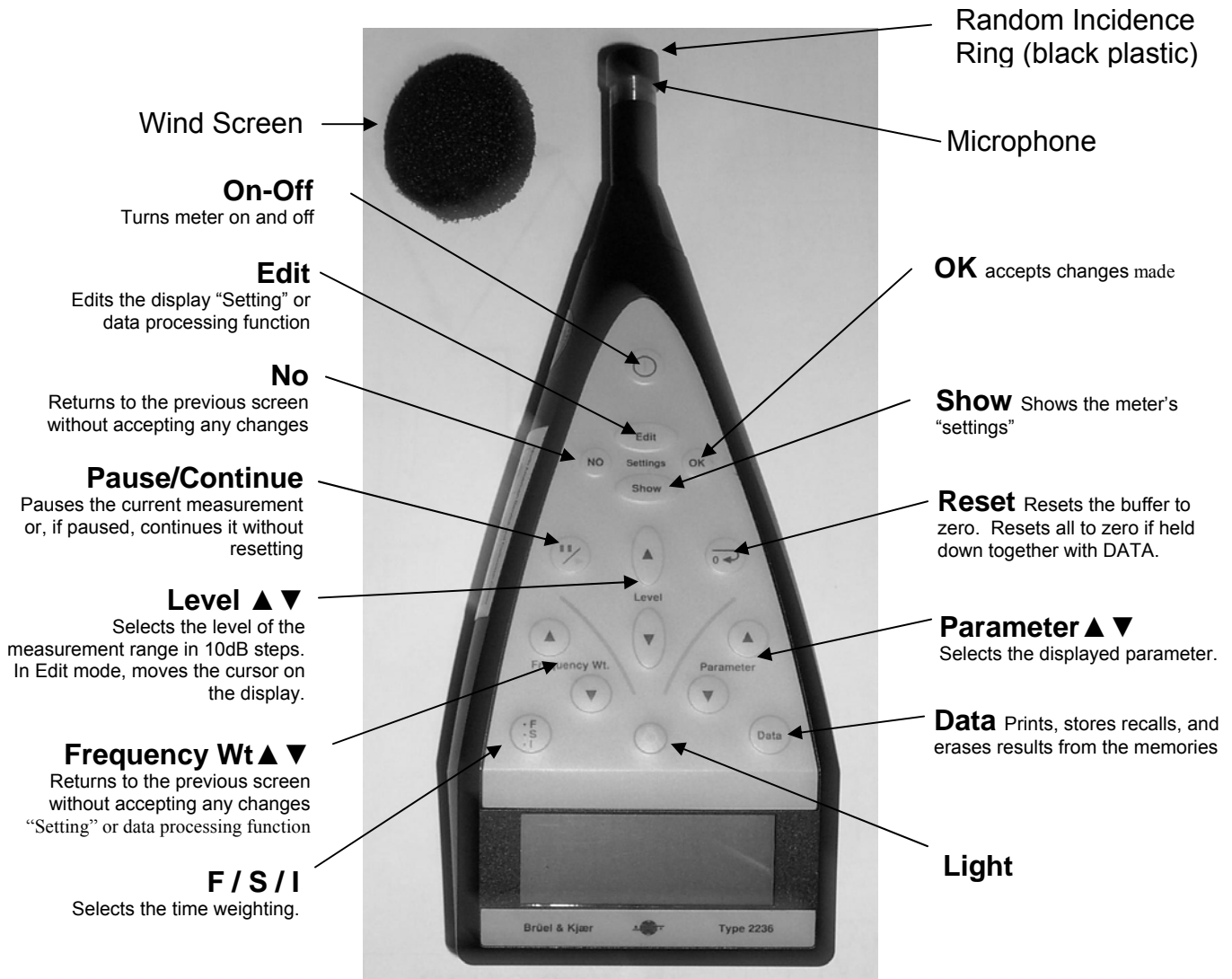


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Revision Log		
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input checked="" type="checkbox"/> Periodic review <input type="checkbox"/> Clarify/enhance procedural controls Changed resulting from: <input 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 to include RCD Facility Support Procedure Committee Review comments.		
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(signature on file) R. Selvey 04/12/04 SME Reviewer/Date:	Reviewer/Date:	Reviewer/Date:
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(signature/date on file) R. Selvey 11/02/05 SME Reviewer/Date:	SME Reviewer/Date:	SME Reviewer/Date:

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### Attachment 9.1 Photo of the Meter and Parts



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## Attachment 9.2 Theory of Operation

The B&K 2236 is a precision sound level meter which incorporates octave-band filters from 31.5 Hz to 16 kHz, A, B, C and Flat weighting networks, as well as FAST, SLOW, IMPACT and IMPULSE detector response.

- A reading can be captured on the digital display at the precise instant required while the analog meter continues to track the incoming noise level
- The digital display can be used in the continuous mode or it can be operated to capture and hold the maximum level encountered. This is extremely useful when measuring sounds of short duration or vehicle “passerby” sounds.
- In the maximum mode, the digital display will be updated by the highest sound level. The display can be reset by pressing a button.
- In the peak (impact) or impulse modes, the peak detector can be reset by the press of a button. This allows other readings to be taken without waiting for the peak detector to decay.


Weighting Networks. The meter contains three weighting networks, A, B, C, which shape the noise to discriminate against the frequency components of the measured noise.

- *A Network*: Simulates subjective responses to noise. Generally used in noise surveys to locate noise hazards. The A Network discriminates the low frequencies quite severely. Most regulations require that noise be measured on the A-weighting scale.
- *B Network*: Moderately discriminates (filters) against low frequencies
- *C Network*: Barely discriminates (filters) against low frequencies.

If measured sound levels of noise are much higher on the C-weighting than on the A-weighting, much of the noise is contributed by the low frequencies.

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### Attachment 9.3 Short Operating Instructions

Step	User Action	Digital Display
1 <b>Power On</b>	press the  button.	Main screen.
2 <b>Battery Check</b>	Check for battery symbol on the screen, if the battery is low, the symbol will be unfilled and flashing. If flashing, replace the batteries. For battery status, press <EDIT>, then <OK>. Press <OK> to clear this screen. (Fresh batteries equal 6 V, replace when 3.9 or less.)	
3 <b>Calibration</b>	Press <SHOW> Press <i>Parameter</i> ▲	Calibration screen
	Press <EDIT>, set the “calibration level“ to <b>94.0dB</b> using ▲ or ▼ <i>Parameter</i> .	
	Remove the <b>Random Incidence Ring</b> . Put the meter microphone into the calibrator opening. Press the <On/Off> button on the calibrator.	
	Press <OK> then <OK>	Cal factor displayed <i>In progress...</i> then <i>Completed</i> .
	Press <OK>	Returns to main screen.
4 <b>Set the meter response:</b>	Use <i>Parameter</i> ▼ ▲ to select the desired setting. (For routine exposure monitoring choose <b>SPL</b> which links automatically to dBA.)	Applicable section of main screen changes
	Use <i>Frequency Wt.</i> ▼ ▲ to band. (For routine exposure monitoring choose <b>BLANK</b> which automatically averages all frequencies.)	
	Use <i>F/S/I</i> button to choose Fast, Slow, or Impulse response speed. (For routine exposure monitoring choose <b>Fast</b> .)	
5 <b>Operator Position</b>	Stand at the same distance from sound source as the microphone. Hold Meter at arms length.	Main Screen
6 <b>Octave Band Analysis:</b>	Use <i>Frequency Wt.</i> ▼ ▲ to move through each frequency and record the corresponding frequency Band and SPL on an <i>Octave Band Analysis</i> data form.	Applicable section of main screen changes

DATE:

SURVEYOR(S):

**I. AREA INFORMATION**

DEPT:

BLDG:

ROOM:

SOURCE:

ENGINEERING CONTROLS:

**II. EMPLOYEE INFORMATION**

FIRST NAME:

LAST NAME:

BNL #:

DEPT:

BLDG:

JOB TITLE:

EXPOSURE DURATION (HRS):

EXPOSURE (TIMES PER DAY):

EXPOSURE (DAYS PER YR):

JOB PERFORMED:

PPE USED:

**III. SURVEY INSTRUMENT INFORMATION**

INSTRUMENT:

MODEL:

SERIAL#:

FACTORY CALIBRATION DATE:

PRE-CAL:

BY:

POST CAL:

BY:

BATTERY CHECK (Y/N):

125 250 500 1000 2000

125 250 500 1000 2000

CALIBRATOR SERIAL #:

dBA

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dBA

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dBC

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dBC

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**IV. SAMPLING INFORMATION & RESULTS**

Response:  FAST  SLOW

WIND SCREEN: Y N

TIME	LOCATION OF SAMPLE READING	SPL READING		COMMENTS, SPECIAL CONDITIONS, and/or STATUS OF SOURCE
		dBA	dBC	

\_\_\_\_\_ Additional Data on back of form

**V. CONCLUSIONS & RECOMMENDATIONS**

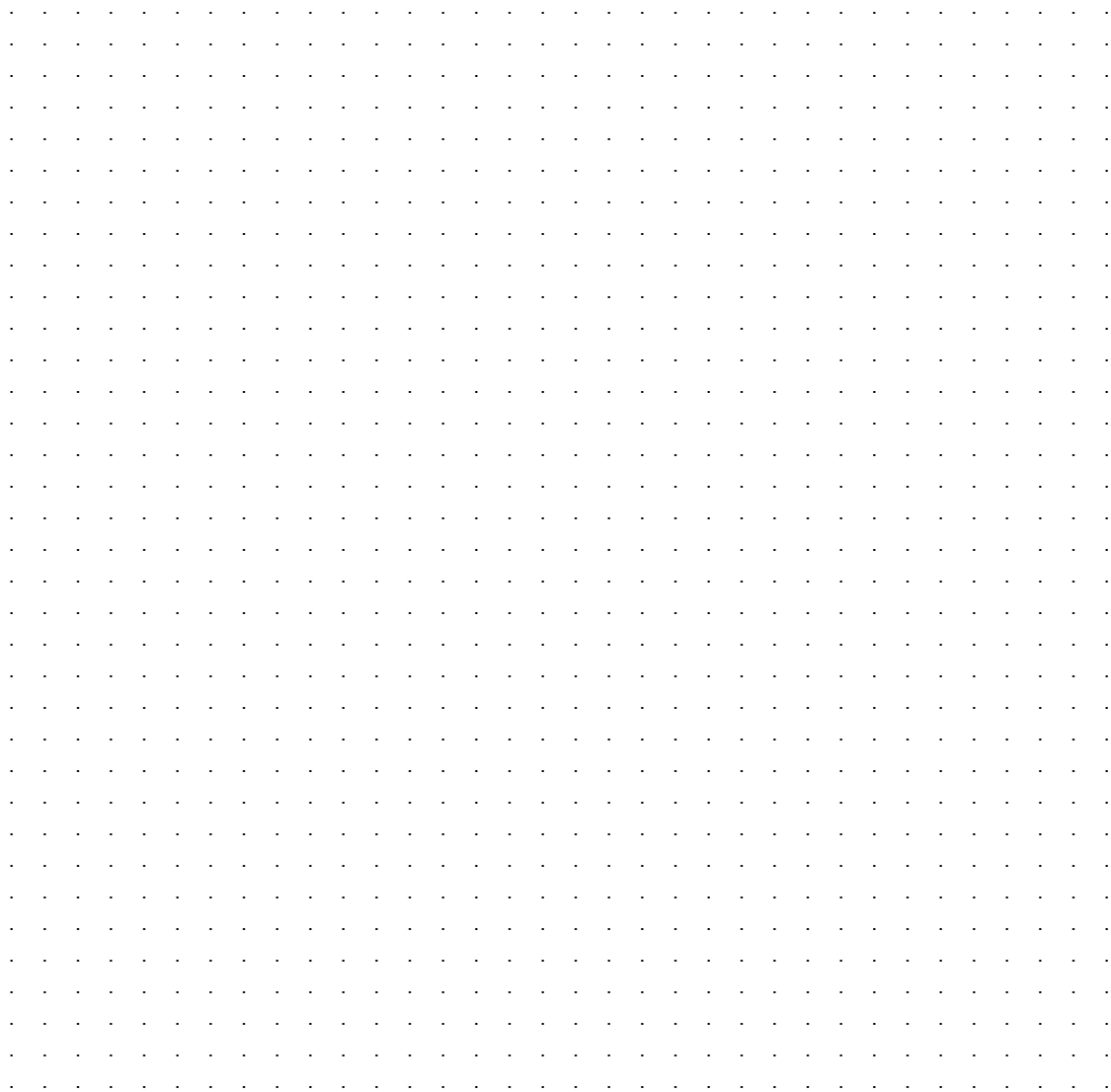
**IV. SAMPLING INFORMATION & RESULTS (continued)**

Response: \_\_\_FAST \_\_\_SLOW

WIND SCREEN: Y N

TIME	LOCATION OF SAMPLE READING	SPL READING		COMMENTS, SPECIAL CONDITIONS, and/or STATUS OF SOURCE
		dBA	dBC	

SKETCH OF SAMPLING AREA (OPTIONAL)



## Noise and Hearing Conservation *Operation of the Bruel & Kjaer Type 2236 Meter*

### Job Performance Measure (JPM) Completion Certificate

Candidate's Name	Life Number:	Qualification Number: <b>HP-IHP- 96500</b>
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### Practical Skill Evaluation: Demonstration of Evaluation Methodology by Oral Exam

Criteria	Qualifying Performance Standard	Unsat.	Recov.	Satisf.
<b>1. Hazard Analysis</b>	Understands the need to perform a hazard analysis of the area and potential exposure to the self as sampler and workers in the area.			
<b>2. Personal Protective Equipment</b>	Understands the need to be aware of the potential surface contamination, airborne levels of contaminants, radiological hazards, and noise hazard. Knows how to determine the need for PPE.			
<b>3. Sampling Equipment</b>	Knows where equipment needed for the procedure is located and how to properly sign it out.			
<b>6. Operating Parameters</b>	Knows the theory to establish operating parameters (safety envelope) for the equipment.			
<b>7. Documentation</b>	Demonstrates correctly filling out IH monitoring forms.			

### IH Noise Meter Operation - Practical Skill Evaluation: Demonstration of Methodology

Criteria	Qualifying Performance Standard	Unsat.	Recov.	Satisf.
<b>1. Turning the Meter On and Off</b>	Demonstrates correctly activating the meter and turning it off			
<b>2. Calibration of the Meter</b>	Demonstrates correctly calibrating/bump checking the meter			
<b>3. Clearing Stored data</b>	Demonstrates the correctly to erase stored data			
<b>4. Operation of taking a reading</b>	Demonstrates correctly hold the meter, and the correct settings			
<b>5. Downloading stored data</b>	Demonstrates correctly extracting stored data from the meter to paper printout and electronic storage.			
<b>6. Clearing data after downloading</b>	Demonstrates correctly for removing stored data for the next user.			

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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