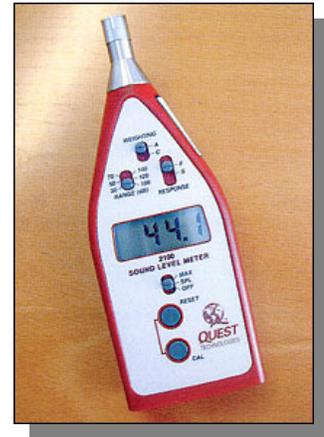


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1.0 Purpose/Scope

This procedure provides a standardized method for the operation of the Quest 1100/2100 Sound Level Meter. It should be used in conjunction with the SBMS Subject Area Noise & Hearing Conservation and IH SOP IH96200 *Noise Measurement Principles: Area Surveys*.

The Quest SLM 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 posting area warning, locating problem-noise sources, and measuring the effectiveness of engineering controls.

The Quest SLM 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 Use of the Quest SLM 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 meeting the standardized BNL Industrial Hygiene qualification criteria. See Section 7 for qualification requirements.
- 2.2 Personnel that perform exposure monitoring with this instrument are responsible to follow all steps in this procedure.
- 2.3 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 *dBC*: Sound pressure based on a nearly flat scale.
- 3.2 *Frequency*: The number of cycles completed by a periodic quantity in time. Unit, hertz (Hz) measures cycles per second; perceived as the “pitch” of the sound.
- 3.3 *Sound Pressure Level (SPL)*: the quantity measured with a sound level meter; the intensity or perceived “loudness” of the sound.
- 3.4 *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.
- 3.5 *Occupational Exposure Limit*: The maximum time weighted average (TWA) exposure permitted for an employee, based on the lesser of the OSHA Permissible Exposure Limit (PEL: 90 dBA) or ACGIH Threshold Limit Value (TLV: 85 dBA). Also used for determining necessary actions by the employer is the OSHA Action Level of 85 dBA. See IH96200.

4.0 Prerequisites

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4.1 **Training prior to using this meter:** See Section 7 for qualification requirements.

4.2 **Area Access:**

- 4.2.1 Contact the appropriate Facility Support Representative or Technician to obtain 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 or wear hearing protection when levels are unknown.

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 Quest SLM may be used in areas where excessive noise levels exist or are suspected to be present. Exposures to noise levels above the PEL, TLV or Action Level may cause temporary or permanent hearing loss.

5.2 **Personal Protective Equipment:**

- 5.2.1 In areas where noise levels exceed, or are expected to 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 Coordinator or Facility Support representative.

6.0 **Procedure**

6.1 **Equipment:**

- Type 2 SLM with RF shielded case

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- Calibrator (Type QC-10/20)
- Batteries (9 volt alkaline)
- Windscreen (foam ball cover for microphone)

6.2 **Operation of the Quest SLM** (picture of meter, calibrator and description of controls and displays is contained in Attachment 9.1.)

Switches & Buttons

Weighting	Range	Response	Power	Buttons
A	70 – 140	F (Fast)	Max	Reset
C	50 – 120	S (Slow)	SPL	Cal
	30 -100		Off	

Display Readings

Low Bat	Low battery power
+	Over ranged the meter, move to the next higher Range
Ur	Under range, move to the next lower range
numeric	A valid sound pressure level

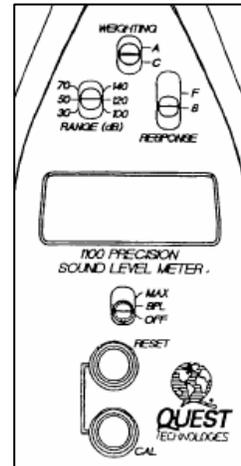
6.2.1 **Turning Power On:** Slide the center switch from **Off** to **SPL** for the calibration check.

6.2.2 **Battery Check:** If power is low, **LOBAT** is indicated on the display. Change the batteries.

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

6.2.4 **Calibration:**

- Remove the microphone cover. Place the black adapter ring into the calibrator.
- For maximum accuracy the instrument should be calibrated at the temperature of the measured environment.
- Slowly insert the Quest SLM microphone into the coupler in the QC-10 (calibrator) and ensure the calibrator is seated squarely with the adapter and microphone or significant error may result.



QUEST TECHNOLOGIES

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- Slide the **RANGE** switch to 50-120 and **WEIGHTING** switch to A.
- Slide the **RESPONSE** switch to **S (slow)** to switch the instrument on.
- Move the switch on the Calibrator to the **SPL** position. Allow 15 seconds for the output to stabilize. If no sound is apparent after 15 seconds or the **LOBAT** light is lit change the battery.
- Press the **CAL** button and CAL will appear on the display followed by moving dashes. After about 2 seconds the display will show either a **P** for pass or an **F** for fail. If the calibration fails, check settings and repeat procedure. If it continues to fail, return to the IH lab and do not use for surveys. (Acceptable readings are +/- 0.5 dB from the calibrator value.)
- For post-calibration, if significant change has occurred (the unit fails), the data is suspect and you must notify the IH lab manager as well as the IH professional.
- Turn off the calibrator and remove the microphone from the calibrator.
- Record results on the sample form.
- **Note:** there is an automatic shut off on the calibrator that turns the unit off after 2 minutes. To restart the calibrator, turn the power off and back on.

6.2.5 **Operation: Setting up the meter:** After calibration, the meter will be ready to take measurements as a sound pressure level meter.

- Use the **WEIGHTING** switch to set A weighting.
- Use the **RANGE** switch to select the appropriate range (50-120).
- Use the **RESPONSE** switch to select the response time.
- **S** (slow) is normally selected. It is used for compliance surveys.
- Use the sliding switch to select **SPL** or **MAX** modes.
 - **SPL** displays the current reading and changes at a rate determined by the RESPONSE setting.
 - **MAX** holds and displays the maximum reading. The reading is not stored so returning to **SPL** mode erases the previous Max level.
- When a '+' sign appears it means the reading is over the range and the next range should be selected.

6.2.6 **Operator Position:** Hold the instrument and **point the microphone directly**

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at the suspected noise source (0° Free Field microphone). Record readings as necessary.

- 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.
- DO NOT place your hand within 12 cm (5 inches) of the microphone.
- Take measurements at ear level of employee (sitting, standing or bending) to estimate personal exposures. Take measurements at various locations around the noise source to locate isometric lines of noise intensity on a sketch for defining area levels. Include, at a minimum: immediately adjacent to the source; any area with potential worker exposure; and to delineate the 85 dBA boundary.
- 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.

6.2.7 Recording readings:

6.2.7.1 Use the BNL Direct Reading Sampling Instrument Form to record readings (see the IH web page for the most recent version: IH96200 *Noise Measurement Principles: Area Surveys*. Record SPL readings at key points such as ear level of employee (sitting, standing or bending), immediately adjacent to the source, any area with potential worker exposure, at the 85 dBA boundary, and in an area that has low noise levels (background).

6.2.7.2 Create a plot of the noise level on a map of the room/area. Record measurements around the noise source to locate isometric lines of noise intensity. Indicate the noise level: at the source, any area with potential worker exposure, and the 85 dBA boundary.

6.2.8 End of Monitoring:

6.2.8.1 Perform a post calibration as per step 6.2.4. Record on form.

6.2.8.2 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

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Technician.

6.2.8.3 Send a copy of any hazard evaluation report written on the survey to the IH Laboratory and others as required in the SOP IH60500 Hazard Assessment Planning and Reporting.

7.0 Implementation and Training

- 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 9.4, the Job Performance Measure Completion Certificate. Qualification on this JPM is required on a 3 year basis, providing the professional/technician 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.
- 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 Quest 1100/2100 Sound Level Meter Operator's Manual.
- 8.2 Quest QC-10/20 Sound Calibrator Operator's Manual
- 8.3 BNL SBMS Subject Area Noise & Hearing Conservation.
- 8.4 OSHA Noise/Hearing Conservation 29 CFR 1910.95.

9.0 Attachments

- 9.1 Photo of meter and parts
- 9.2 Theory of Operation

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- 9.3 Short List of Operating Instructions Attachment
- 9.4 Job Performance Measure Completion Certificate

10.0 Documentation

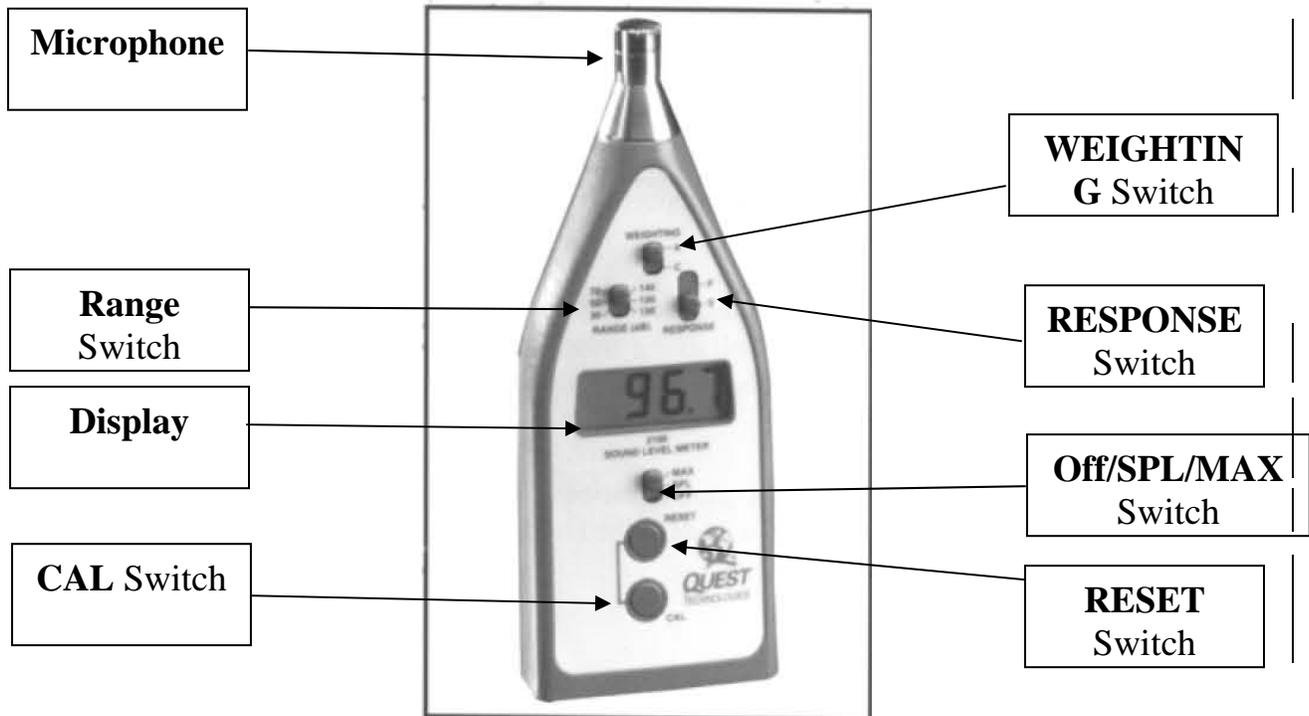
Document Development and Revision Control Tracking		
PREPARED BY: <i>(Signature and date on file)</i> J. Peters SHSD IH Group Date 04/17/06	REVIEWED BY: <i>(Signature and date on file)</i> R. Selvey SHSD IH Group Leader Date 04/19/06	APPROVED BY: <i>(Signature and date on file)</i> R. Selvey SHSD IH Group Leader Date 04/20/06
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: IH52.05
Facility Support Rep. / Date: <i>None</i>	Environ. Compliance Rep. / Date: <i>none</i>	Effective Date: 04/20/06
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 checked="" type="checkbox"/> Desk Top Review <input type="checkbox"/> SME Review Name / Date:	IMPLEMENTATION: Training Completed: as per BTMS Procedure posted on Web: 04/20/06 Hard Copy files updated: 04/20/06

Revision Log		
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 type="checkbox"/> none of the above		
<i>(signature/date on file)</i> SME Reviewer/Date:	SME Reviewer/Date:	SME Reviewer/Date:

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Attachment 9.1 Photo of the Meter and Parts



Quest 2100 SLM

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Quest QC-10 Calibrator

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Attachment 9.2

Theory of Operation

The Quest SLM is a precision sound level meter which incorporates A and C weighting networks, as well as FAST and SLOW detector response.

- Readings are displayed on the digital readout and can be logged by this instrument.
- 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.

Weighting Networks. The meter contains two weighting networks, A & 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.
- *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.

The meter response time and internal averaging to noise is set with the **RESPONSE** and the **MODE** settings.

Response Settings

- **S** (slow) is normally selected. It is used for slowly varying noise.
- **F** (fast) is used for comparatively stable noise.

Mode Settings

- **MAX** holds and displays the maximum reading. The reading is not stored so returning to **SPL** mode erases the previous Max level.
- **SPL** displays the current reading and changes at a rate determined by the RESPONSE setting.

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Attachment 9.3

Short Operating Instructions

	Step	User Action
1	Power On	Slide switch from Off to SPL .
2	Battery Check	If batteries are low LO BAT appears on the screen. Replace with 1 9 volt alkaline battery.
3	Calibration	Set the instrument to read sound pressure level <ul style="list-style-type: none"> • SPL • Slow response • A weighting. Place the microphone into the calibrator coupler Turn the calibrator on and read the meter. Press and briefly hold the CAL button until dashes appear in the display. When P appears the unit has passed calibration. Record on the field sheet. Turn off the calibrator; remove the microphone and replace the windscreen.
4	Set the meter response:	For typical survey work: <ul style="list-style-type: none"> • set the meter to SPL (sound pressure level) • Weighting A • Range 50-120 • Response to S (slow)
5	Record Measurements	Point the meter at the noise source (free field microphone) and collect readings at various points as required by the type of survey to be conducted.
6	Post-calibration	Repeat calibration and record on field sheet.

Noise and Hearing Conservation
Operation of the Quest 2100 SPL Meter

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. Hazard Analysis	Understands the need to perform a hazard analysis of the area and potential exposure to the self as sampler and workers in the area.			
2. Personal Protective Equipment	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.			
3. Sampling Equipment	Knows where equipment needed for the procedure is located and how to properly sign it out.			
6. Operating Parameters	Knows the theory to establish operating parameters (safety envelope) for the equipment.			
7. Documentation	Demonstrates correctly filling out IH monitoring forms.			

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

Criteria	Qualifying Performance Standard	Unsat.	Recov.	Satisf.
1. Turning the Meter On and Off	Demonstrates correctly activating the meter and turning it off			
2. Calibration of the Meter	Demonstrates correctly calibrating/bump checking the meter. Correctly demonstrates actions when calibration (pre or post) is not within limits.			
3. Operation of taking a reading	Demonstrates how to correctly hold the meter, and the correct settings			
4. Required Data Gathering	Demonstrates knowledge of correct data to collect for each survey			

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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