

*Simpson*<sup>®</sup>

**Simpson Model 886-2  
Sound Level Meter  
OPERATOR'S MANUAL**




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**About this Manual**

To the best of our knowledge and at the time written, the information contained in this document is technically correct and the procedures accurate and adequate to operate this instrument in compliance with its original advertised specifications.

**Notes and Safety Information**

This Operator's Manual contains warning symbols which alert the user to check for hazardous conditions. These appear throughout this manual where applicable, and are defined below. To ensure the safety of operating performance of this instrument, these instructions must be adhered to.

 Warning, refer to accompanying documents.

 Caution, risk of electric shock. 

This instrument is designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely before making any measurements. Failure to follow directions can result in a serious or fatal accident.

**Technical Assistance**

SIMPSON ELECTRIC COMPANY offers assistance Monday through Friday 8:00 am to 4:30 pm Central Time. To receive assistance contact Technical Support or Customer Service at (715) 588-3311.

Internet: <http://www.simpsonelectric.com>

**Warranty and Returns**

SIMPSON ELECTRIC COMPANY warrants each instrument and other articles manufactured by it to be free from defects in material and workmanship under normal use and service, its obligation under this warranty being limited to making good at its factory or other article of equipment which shall within one (1) year after delivery of such instrument or other article of equipment to the original purchaser be returned intact to it, or to one of its authorized service centers, with transportation charges prepaid, and which its examination shall disclose to its satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on its part, and SIMPSON ELECTRIC COMPANY neither assumes nor authorizes any other persons to assume for it any other liability in connection with the sales of its products.

This warranty shall not apply to any instrument or other article of equipment which shall have been repaired or altered outside the SIMPSON ELECTRIC COMPANY factory or authorized service centers, nor which has been subject to misuse, negligence or accident, incorrect wiring by others, or installation or use not in accord with instructions furnished by the manufacturer.

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switch to 120, and depress "C" weighting button. Check peak reading on meter dial. A reading of 125 dB approximates an impulse noise of 140 dB, which is the upper limit established by the Walsh-Healy Act.

- f. When not in use return the range switch to the OFF position and store the Sound Level Meter in a safe place.

#### **4.4 Use With Auxiliary Equipment**

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The 886-2 is equipped with three outputs intended to be used with auxiliary equipment such as a chart recorder, oscilloscope or the Simpson 898 Octave Band Filter. These jacks are designed to give the operator more detailed and comprehensive sound analysis study. The larger of the three jacks is designed to be used with the Simpson 898 Octave Band filter. The operator's manual for the Model 898 describes how to use the 886-2 with this filter.

Non-Linear Distortion: When using "A" weighting at frequencies from 30 Hz to 50 Hz, the AC output will have observable distortion with levels exceeding 0 dB on any meter range. For "B" and "C" weighting, the AC output remains linear at levels up to +10 dB on any meter range and at any specification frequency.

- whenever the microphone is changed. The microphone can be detached easily by first pressing the microphone retaining latch.
- 6. **Output Jacks:**
    - Decibel Output Jack:** A logarithmic output of 1.50 V DC is equivalent to meter reading of +10 dB looking into 100 K $\Omega$  load. The recommended plug for this jack is a Switchcraft #850.
    - RMS Output Jack:** A weighted or non-weighted output of 1.00 V RMS is equivalent to a meter reading of +10 dB looking into a 100 K $\Omega$  load. The recommended plug for this jack is a Switchcraft #850.
    - External Filter Jack:** A non-weighted (flat response) output of 120 millivolts RMS is equivalent to a meter reading of +10 dB looking into 100 K $\Omega$  load. The recommended plug for this jack is a Switchcraft #750.
  - 7. **Meter:** A 0-100 $\mu$ A DC full scale, taut-band movement with end markings of -10 dB and +10 dB and 1 dB divisions starting from -5 dB. The upper end of the scale includes a BATT OK section.
  - 8. **Calibration Adjustment:** This screwdriver adjustment, located under a metal cap on the side of the Instrument, is used to calibrate the 886-2. The Simpson Model 890-2 Sound Level Calibrator, is designed to calibrate the 886-2. The calibration procedures are contained in the operator's manual for the 890-2.
  - 9. **Battery Compartment:** The battery compartment, which is totally separated from the electronics, houses the battery

### 4.3 Sound Level Measurements

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- To obtain sound level measurements with the 886-2.
- a. Turn on the Instrument and select the desired measurement range. To ensure accurate results, check the battery every time sound level measurements are made.
  - b. When the Instrument is hand-held, orientate the microphone approximately 45° to 70° with respect to the horizontal plane and at an angle of 70° with respect to incoming sound waves.
  - c. For OSHA compliance measurement set FAST/SLOW switch to SLOW, the range switch to OSHA, and depress "A" weighting push-button. Read exact dB(A) on red OSHA arc.
  - d. For other applications, select the desired range, weighting, and response. If the meter fluctuations are in excess of 3 dB set the response to SLOW position.

**NOTE:** With the range switch set to any of the other ranges (black numerals), the black indicator, and the switch position corresponds to zero (0) indication. For example, if switch is set to 90, and the indication is 5, add 5 to 90 to obtain 95 dB level.

- e. To conduct impact noise checks, set FAST/SLOW switch to FAST, dB range

corresponds to either 130, 120, 110, 100, 90, 80, 70, 60, or 50 dB as determined by the position of the range switch. An indication other than zero (0) must be added to the range selected to obtain final level indication. For example, if the range switch is set to the 110 position, and the indication is +5, the sound level is 115 dB.

**2. A, B and C Weighting Switches:**

These push-button switches are used to select the frequency response of the Instrument in accordance with A, B and C weighting requirements of the ANSI Standard Specification for a Type 2 Sound Level Meter.

**3. SLOW/FAST Slide Switch:**

This slide switch is used to select the response time of the meter circuit as defined in Table 1-1.

**4. BATT TEST:**

A momentary push-button switch used to check the condition of the battery.

**5. Microphone:**

A condenser type microphone that converts sound energy vibrations into electrical signals. Microphones are not interchangeable, therefore, the Instrument must be recalibrated

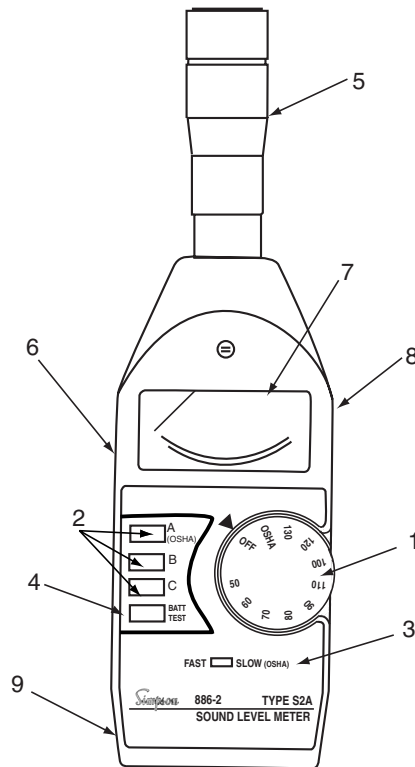


Figure 4-1. Operational Items And Features

# 1. INTRODUCTION

## 1.1 General Description

The Simpson 886-2 Sound Level Meter (hereafter referred to as the 886-2 or the Instrument) is a portable, general purpose sound level instrument, capable of accurate sound level measurements over a range of 40 to 140 dB. This encompasses the noise level of a quiet residence to that beyond the threshold of pain. This dB range is compatible with current Federal, State, and local noise ordinance requirements; including safety and environmental noise checks.

The 886-2 meets the requirements of the American National Standards Institute (ANSI) Standard Specification S1.4 - 1983 for "Type 2 General Purpose Sound Level Meters and the International Electro-Technical Commission (IEC) 651." It can be used by industry to measure noise levels to comply with Occupational Safety and Health Act of 1970 (OSHA) and the Walsh-Healy Act, except for direct measurement of impact (impulse) noise.

The 886-2 can be hand-held for rapid testing or mounted on a tripod for measurements over extended periods of time. The microphone is detachable and can be extended from its case by use of an optional 25-foot microphone extension cable. The meter case is constructed of high-impact molded plastic, especially contoured at the microphone end to minimize reflections of the sound energy field being measured.

The 886-2 is equipped with a range selector switch which references the 0 dB point of the indicating instrument to the range selected. For example, when the range switch is set to 70, the zero (0) mark on the black arc is equal to 70 dB. Push-button switches provide quick, direct selection of "A", "B" or "C" weighting networks and a battery check function. Fast or slow meter response is switch selectable.

The 886-2 offers three outputs which are proportional to the sound level input; a RMS output, a dB output, and an external filter output that is compatible with the Simpson 898 Octave Band Filter.

## 1.2 Specifications

The specifications for the 886-2 are listed in Table 1-1.

Table 1-1. Specifications

- |                        |   |
|------------------------|---|
| <b>1. Microphone:</b>  | The microphone is a condenser type with the size as type L per ANSI S1.12 - 1967. The nominal electrical impedance is 350 Ω, 20% @ 23°C. The microphone is omnidirectional; its angle of incidence which approximates random incidence response is 70°. |
| <b>2. Sound Level:</b> | Measurement Ranges: 40 dB to 140 dB. Zero (0) dB reference is 20 μPascals. Maximum SPL: 140 dB SPL for linearity within 1 dB.   |
| <b>3. Accuracy:</b>    | Meets ANSI S1.4 - 1983 for a Type 2 instrument.   |
| <b>4. Weighting:</b>   | Three selectable networks modify overall frequency response to meet the ANSI specification for the A, B, or C weighting curves for a Type 2 instrument. The "External Filter" jack may be used to obtain a flat response.                               |

- 5. Meter:** Pivot and Jewel movement with 2-1/2" dial having end markings of -10 dB and +10 dB, and fifteen 1 dB scale markings. From -5 dB to +10 dB the accuracy and scale markings comply with the ANSI specification for a Type 2 instrument.
- 6. Speed of Response:** Types of response: Selectable "Slow" or "Fast" response times meet the exponential-time-averaging characteristic required by the ANSI specification for a Type 2 instrument.
- SLOW Response:** Response to a 500 millisecond tone burst of 1000 Hz is nominally 2.5 dB down from a reference steady state signal at the same level and frequency. Overshoot response to a suddenly applied steady state signal is less than 0.5 dB. When an applied signal is turned off, the decay rate is less than 3 seconds per 10 dB.
- FAST Response:** Response to a 200 millisecond tone burst of 1000 Hz is nominally 2.0 dB down from a reference steady state signal at the same level and frequency. Overshoot response to a suddenly applied steady state signal is less than 0.5 dB. When an applied signal is turned off, the decay rate is less than 0.5 seconds per 10 dB.
- 7. Linearity:** Primary indicator range is from 0 dB to +10 dB on each range. Overall indicator range is -5 dB to +10 dB. The dedicated "OSHA" range primary indication is +105 dB to +115 dB, with an overall indication of +100 dB to +115 dB. Within these limits, the primary indicator accuracy is .1 dB and the overall accuracy is 1.5 dB.
- 8. Calibration:** Recommended calibration frequency is 1000 Hz at sound pressure levels of either 94 dB on the 90 dB range, or 114 dB on the 110 dB range. Calibration is screwdriver adjustable from side of case.
- 9. Output Connections:** This Instrument is equipped with three outputs: External Filter, RMS Output, and dB Output.
- External Filter:** Provides non-weighted (flat response) output of 120 mV RMS, at meter reading of +10 dB, into a 100 K $\Omega$  load; a lower impedance may affect the meter reading. This output is not affected by the "Fast-Slow" setting. The recommended plug is Switchcraft's #750 (0.141" diameter).
- RMS Output:** Provides weighted or non-weighted output of 1.00 V RMS, at a meter reading of +10 dB, into a 100 K $\Omega$  load; a lower impedance will not affect the meter reading. This output is not affected by the "Fast-Slow" setting. The recommended plug is Switchcraft's #850 (0.097" diameter).

Act of 1970, noise that measures above 115 dB(A) is automatically "too high" for any length of exposure approximately over one second.

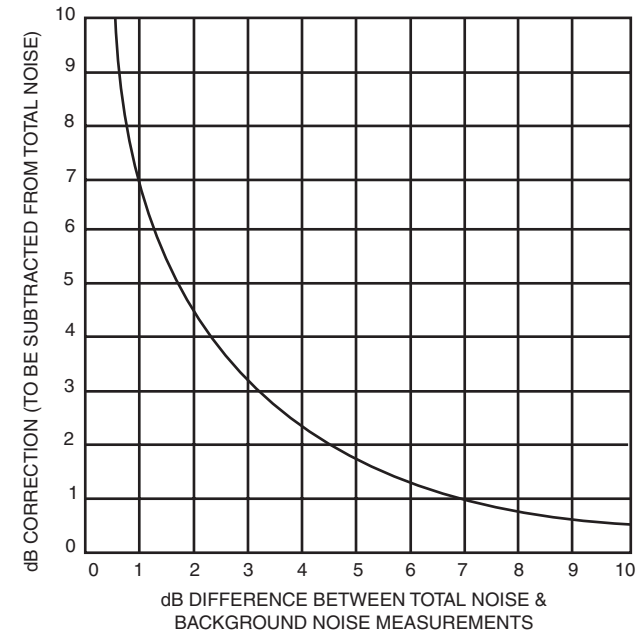


Figure 3-4. Background Noise Correction

## 4.1 Precautions

Read Section 3 before performing measurements. This section contains important information on terminology, standards, techniques, and precautions pertinent to sound and noise measurements.

Use the 890-2 Calibrator to check the calibration of the Sound Level Meter periodically, especially if the Instrument has been subjected to severe mechanical shock or environmental extremes.

## 4.2 Operational Items And Features

All items and features used to operate the 886-2 are described in Table 4-1 and illustrated in Figure 4-1.

Table 4-1. Operational Items And Features

- 1. Range Switch:** This eleven position rotary switch is used to turn the Instrument on and to select the desired measurement range. The range is indicated by the arrowhead. When the range switch is set to the "OSHA" position, the dB level is read on the red arc displaying the OSHA level. With the range switch set to one of the other dB ranges, the black arc is used. A zero (0) indication on the black arc

### 3.10 Background Noise

Ideally, any sound source being measured should be isolated from effects due to extraneous or background noise. If the background noise is 10 dB or more below the sound source level desired, the effect from the background noise can be considered negligible. In instances where the ratio is less than 10 dB, an approximation can be made using Figure 3-4 and measurements of the background noise alone and the sound source with the background noise. Simply take the difference between these measurements and locate this difference value of the abscissa of Figure 3-4. Move in a vertical direction from this point to the intersect of the curve and then horizontally to the corresponding ordinate point. This ordinate point indicates a value to be subtracted from the total or sound source with background noise measurement. The difference obtained represents the sound source level. It should be noted that a difference of 3 dB or less between sound source and background noise will provide only an indication of this sound source level, not an accurate measurement.

### 3.11 Dual Sound Sources

When separate measurements are made on two sound sources, the combined effect cannot be found by direct addition. For example: If two machines are emitting equal noise levels of 80 dB, the combined level will be 83 dB, not 160 dB. If the level of one source is 10 dB or greater than the other, then the lower level source can be disregarded as it will be "masked" by the higher level source. Information listed in Table 3-2 can be used for calculating the combined effect of the two sources. If more than two sound levels are involved, combine the highest two first, then combine the total with the next highest remaining sound level. Continue this procedure until all noteworthy levels are combined.

Table 3-2. Combining Noise Sources

Difference Between Levels in dB	No. Of dB to be Added to Higher Level
0	3.0
2	2.1
4	1.5
6	1.0
8	0.6
10	0.4

## 4. OPERATING INSTRUCTIONS

This section contains instructions required for the operation of the 886-2 Sound Level Meter. Follow these instructions carefully to obtain accurate and useful data.



If noise levels exceed 115 dB(A) (SLOW response) immediate use of protective ear muffs or plugs is required. According to the Occupational Safety and Health

#### dB Output:

Provides logarithmic output of +1.50 V DC, at a meter reading of +10 dB, into a 100 KΩ load; a lower impedance will not affect the meter reading. The response time of this output is set by the "Fast-Slow" setting. The exponential-time-averaging time constant is per ANSI S1.4 - 1983, paragraphs 6.2 and 6.3: Slow is 1000 milliseconds, and Fast is 125 milliseconds. The recommended plug is Switchcraft's #850 (0.097" diameter).

#### 10. Power Requirements:

One 9-volt alkaline battery, NEDA 1604A (or equal) will typically provide 40 hours of continuous operation.

#### 11. Temperature Range:

**Operating Temperature:** -10°C to +50°C.

**Storage Temperature:** -40°C to +60°C with the battery removed.

#### 12. Temperature influence:

Typically 0.015 dB/°C at 1kHz.

#### 13. Operating Humidity:

0 to 90% relative humidity (non-condensing) for a reading change of < 0.5 dB.

#### 14. Warm-up Time:

Approx. 30 seconds.

### 1.3 Items Furnished With The Instrument

All items required to operate the 886-2 are furnished with each Instrument, and are listed in Table 1-2.

Table 1-2.

Quantity	Description	Part Number
1	9-volt battery NEDA	1604A*
1	Operator's Manual	6-115308

\*Available from local retail stores.

### 1.4 Available Accessories

Available accessories are listed in Table 1-3.

Table 1-3.

Description	Part/Catalog Number
Screwdriver	5-116470
Windscreen	00197
Calibrator, 890-2	12890
Package Case	10-866065
Adapter, Microphone to Tripod	00184
Microphone Extension Cable	00198
Microphone Assembly	00183
898 Octave Band Filter Set	02231

## 2. INSTALLATION

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This section contains information and instructions for the packaging and shipping of the 886-2. Included are procedures for unpacking and inspection, service, shipping, battery installation, installation and care.

### 2.1 Unpacking And Inspection

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Examine the shipping carton for obvious sign of damage. If shipping carton is in good condition, inspect the Instrument for possible damage incurred during shipment. If damaged, notify the carrier and supplier and do not attempt further use of the Instrument. If the Instrument appears to be in good condition, read Operator's Manual in its entirety. Become familiar with the Instrument as instructed in the manual, then proceed to check the electrical performance as soon as possible.

### 2.2 Shipping

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Pack the Instrument carefully and ship it prepaid to the proper destination. Insure the Instrument. Save the shipping carton and packing materials for future storing or shipping of the Instrument.

### 2.3 Service

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This Instrument contains no operator serviceable parts, except for the battery. Refer all service requests to the Simpson factory. If the Instrument is covered by warranty, include the model number, serial number, and date of purchase.

### 2.4 Battery Installation Or Replacement

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The 886-2 is powered by a 9-volt alkaline battery. The battery is packaged separately. To install or replace the battery:

- a. Turn the range switch to the "OFF" position.
- b. Using the screwdriver or coin, loosen the two screws located on the battery cover access compartment and remove the cover.
- c. Install or replace the battery with the connector on the left side of the Instrument. Route the cable between the battery and upper wall of the battery compartment.

### 2.5 Installation

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The Instrument, when in operation, may be either hand-held or mounted on a tripod. The physical position of the Instrument does not affect the accuracy.

#### 2.5.1 Tripod or Strap Mounting

The 886-2 can be attached to any commercial, photography-type tripod having a standard 1/4-20" mounting screw. The mounting screw is aligned with the threaded insert in the case and finger-tightened. A camera-type carrying strap can be attached to the threaded insert. Carry the Instrument with the strap around the wrist to prevent accidental dropping.

#### 2.5.2 Remote Microphone Mounting

A remote cable and microphone adapter can be used to mount the microphone to

**NOTE:** When making out-of-doors measurements, it is usually preferable to point the microphone upward (to avoid interference from reflected high frequencies) and as far from the body as is convenient.

Grease and dirt on the windscreen will affect sound level measurements. To check for dirt or grease on the windscreen, measure the level of continuous noise indoors with or without the windscreen in place. To clean the windscreen, wash with a mild detergent. Thoroughly rinse and dry before placing over microphone.

### 3.7 Meter Fluctuations

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If the meter indication fluctuates more than 3 dB, set the meter response switch of the Instrument to the SLOW position unless otherwise specified in the applicable specification. Then if the fluctuations are less than 6 dB, record a value of 3 dB less than maximum indication. Infrequent, high peaks customarily are disregarded. (When making noise survey measurements record the highest peak.)

**NOTE:** As pointed out in Table 3-1, applicable standards require SLOW meter response when making noise surveys.

### 3.8 Selecting A Weighting Characteristic

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The weighting characteristic must be selected according to individual application requirements. Noise codes and sound test procedures frequently specify the one to be used. For example: "A" weighting often is employed for measurement of speech interference by office and plant noise. Federal regulations such as the Walsh-Healy Act require use of the "A" response for all tests. When a standard test procedure is not involved, data can be taken with each of the three characteristics and thereby provide information on overall frequency content.

**NOTE:** If the weighting is not specified, common practice is to assume "A" weighting (ANSI S1.4-1983). Be sure to indicate the weighting used on all recorded data.

### 3.9 Impact Noise

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Impact (impulse) noise refers to noise impulses of less than 1 second duration, occurring once or at intervals greater than 1 second, such as gunshots or drop-hammers. Impulse noise measurements are made with an impulse noise meter such as the Simpson 899.

Impulse noise measurements can also be made using an oscilloscope and the 886-2. The oscilloscope is connected to the RMS output jack and calibrated, using a steady sound source and correlating the scope deflection with the indication on the sound level meter.

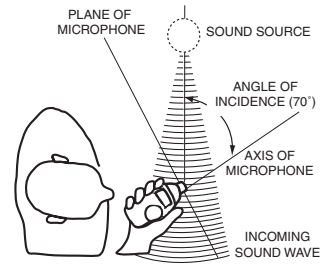
A rough check of impulse noise having a duration greater than 5 milliseconds can be made with a sound level meter. It is set on "C" weighting, "FAST" meter response, and range switch in the 120 or 130 position. An indication of 125 dB is approximately equivalent to an actual impulse noise of 140 dB (limit established by the Walsh-Healy Act).

**NOTE:** Impulse noises having durations longer than 50 milliseconds and peak levels of 140 dB will give readings higher than 125 dB. The Simpson 899 Impulse Sound Level Meter may be used to take measurements such as these.

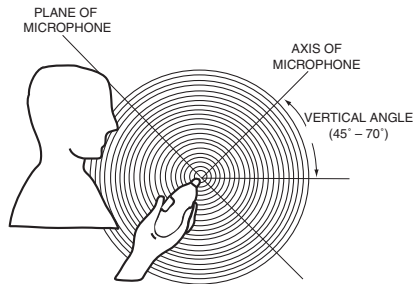
### 3.5 Effect Of Operator's Presence

When sound is coming mainly from one direction, the reading might be affected by the relative positions of the microphone and operator. For example, if the operator and microphone are in line and facing the sound source, there can be a marked increase in response at high frequencies because the operator will act as a reflector and produce errors of several dB at frequencies above 100 Hz. A more uniform frequency response is obtained with the Instrument extended as far as conveniently possible in front of the operator, and the axis of the microphone oriented to form an angle of incidence of 70° with the incoming sound wave. Do not point the Instrument toward a source of noise other than the one being measured.

The 886-2 (or its microphone) can be mounted on a tripod for further reduction in the effects of the operator's presence. A practical arrangement is to tilt the microphone axis at an angle of approximately 45° to 70° with respect to the horizon. This allows the operator to step several feet back or completely away and still be able to make measurements.



Top View



Side View

Figure 3-2. Orientation of Microphone and Operator with respect to incoming Sound Waves.

### 3.6 Windscreen

When making measurements where wind is present, a low frequency interference can be introduced by air passing across the microphone. Try to make measurements where wind is not present; if this is not practical a windscreen should be employed. When using this screen, indicated wind noise will be attenuated approximately 20 dB. The loss of system sensitivity occurring with use of the windscreen is shown in Figure 3-3.

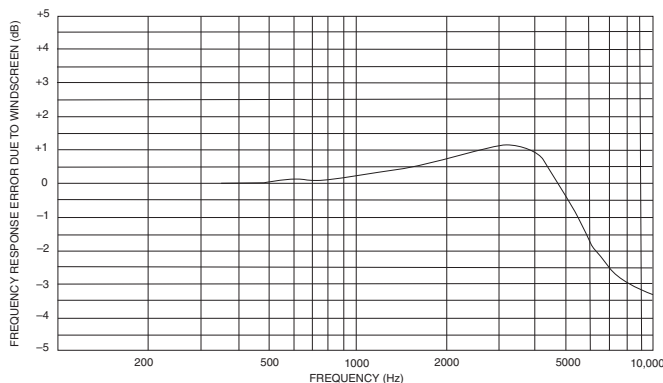


Figure 3-3. Loss Of System Sensitivity Due To Windscreen

any commercial, photography-type tripod for remote operation of the microphone.

**NOTE:** The accuracy of a measurement will be affected by several factors, one of which is the position of the microphone with respect to the sound source. Read Section 3 carefully for general background information. (See Section 4 for operating instructions for obtaining correct data from the measurements)

### 2.6 Care

- Immediately clean any spilled materials from the Instrument and wipe dry. If spillage is corrosive, use a suitable cleaner to remove it and to neutralize corrosive action.
- To protect the microphone, keep sharp objects away from the top. Never rest the unit on the microphone. If the microphone is detached, always lay it on its side.
- Whenever the Instrument is not in use, set the range switch to the OFF position.
- Avoid prolonged exposure or usage in areas subject to temperature and humidity extremes, vibration, mechanical shock, dust, corrosive fumes, and strong electrostatic and electromagnetic interference.
- Verify Instrument calibration with a 890-2 Acoustical Calibrator.
- It is recommended that the Instrument be returned to factory annually (sooner if required) for a complete overall check, adjustment, and calibration.
- When the Instrument is not in use store it in a room free from temperature extremes, dust, corrosive fumes, mechanical vibration and shock. If storage time is expected to exceed 30 days, remove the battery.

## 3. APPLICATION

This section contains basic information required for effective application of the 886-2 Sound Level Meter, and must be understood before attempting to operate the Instrument for the first time.

### 3.1 Decibel Scale

The human ear has a mid-frequency dynamic sound sensitivity range of greater than one million to one, from the lowest level that can be detected to the highest that can be tolerated without pain. Because of the large ratio of value involved, a linear meter scale marked in pressure units becomes impractical. A scale based on logarithms, called a decibel (dB) scale, is used. This scale expresses the ratio between the sound pressure level being measured and a reference. This simplifies notation and manipulation by reducing large ratios into smaller convenient numbers. For example, a million-to-one pressure ratio can be expressed on a 0 to 120 dB scale.

### 3.2 Measurement And Exposure Standards

The American National Standards Institute (ANSI), in collaboration with scientific and engineering societies, has established a standard, S1.4-1983, for conformance of all approved sound level meters. Federal, state and local governments

also have defined allowable noise (undesirable sound energy) level exposure limits for persons in industrial environments. Selected and applicable parts of those currently in force are cited in this manual. Standards and government regulatory laws are subject to modification or expansion. Check for the latest available documents and information.

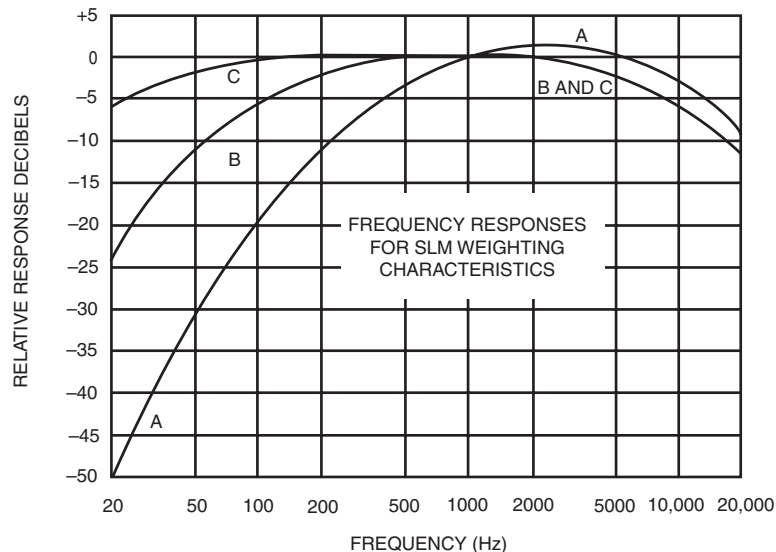


Figure 3-1. A, B and C Weighted Responses of the Sound Level Meter

The specification for a Type 2 instrument takes into account the average response of the human ear which varies as a function of the intensity of sound. It grounds intensity into three weighting curves; "A", "B" and "C". The "A" weighted curve more closely corresponds to the human ear at the low sound levels.

As indicated in Figure 3-1, the "B" and "C" weighting curves include more of the low frequency information. Thus, at any level, measurements taken with various weightings can be compared in determining the frequency content of the noise. This is done by indicating the level dB, accompanied by the weighting letter notation "A", "B" or "C", preferable in parenthesis; e.g., the 100 dB (A), etc.

The allowable employee noise level exposure limits are established by the Occupational Safety and Health Act of 1970 (OSHA), the Walsh-Healy Act (Federal Register, Volume 34, No. 96) and paragraph 1910.95 of the Occupational Safety and Health Standards (Federal Register, Vol. 36, No. 105, May 29, 1971) and the OSHA Hearing Conservation Program Amendment, Federal-Register Vol 46, No. 162, August 21, 1981. Table 3-1 summarizes these limits.

\*Table 3-1. Permissible Noise Exposure Limits

Duration per day in hours	Sound level, dB(A) SLOW response
32	80
16	85
8	90
6	92
4	95
3	97
2	100
1-1/2	102
1	105
1/2	110
1/4 or less	115

\*From Federal Register, Vol. 46, No. 162, August 21, 1981.

### 3.3 Sound Fields

#### 3.3.1 Free Field

A free field contains no reflecting objects. Ideally it prevails around a point sound source located in free space. However, it can be considered to exist whenever the sound level being measured is caused mainly by sound waves coming directly from the sound source. This can occur even if there are reflecting objects, if measurements are made close to the sound source.

#### 3.3.2 Reverberant Field

A reverberant field contains reflecting objects and the sound level being measured is caused mainly by reflections of the sound source. This usually occurs at a moderate distance from the sound source.

#### 3.3.3 Semi-Reverberant Field

This field is encountered most commonly and exists whenever the sound level being measured contains a significant amount of both reflected and direct sound waves.

### 3.4 Microphone Orientation

- When making measurements in a free or semi-reverberant field, orient the microphone so that the angle of incidence, formed by incoming sound waves and axis of the microphone, is equal to the random incidence angle of the microphone. For the 886-2 this angle is 70° (refer to Figure 3-2).
- When making measurements in a reverberant field, orientation of the microphone is not critical. However, it is recommended, where possible, that the operator use the same orientation (70°) as for the free or semi-reverberant field.
- Vertical orientation of the microphone is not critical except where it is in line with a second sound source or a high-amplitude reflection of a sound source. It usually is invalidated by a second sound source, or by a nearby reflecting surface.
- When evaluating a particular sound source, avoid holding the microphone in such a way that the reading is invalidated by a second sound source, or by the proximity of a nearby reflecting surface.