

*Simpson*

**Simpson Model 884-2  
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) 588-3947.

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.

## NOTES

# Contents

1. INTRODUCTION .....	7
1.1 General Description .....	7
1.2 Specifications .....	7
1.3 Items And Accessories Furnished With Instrument .....	9
1.4 Available Accessories .....	9
2. INSTALLATION .....	9
2.1 Unpacking And Inspection .....	9
2.2 Shipping .....	10
2.3 Service .....	10
2.4 Battery Installation Or Replacement .....	10
2.5 Installation .....	10
2.5.1 Tripod or Strap Mounting .....	10
2.5.2 Accuracy Of A Measurement .....	10
2.6 Care .....	10
3. APPLICATION .....	11
3.1 Decibel Scale .....	11
3.2 Measurement And Exposure Standards .....	11
3.3 Sound Fields .....	12
3.3.1 Free Field .....	12
3.3.2 Reverberant Field .....	12
3.3.3 Semi-Reverberant Field .....	13
3.4 Microphone Orientation .....	13
3.5 Effect Of Operator's Presence .....	13
3.6 Windscreen .....	14
3.6.1 Loss of System Sensitivity Due to Windscreen .....	14
3.7 Meter Fluctuations .....	14
3.8 Background Noise .....	14
3.9 Dual Sound Sources .....	15
4. OPERATING INSTRUCTIONS .....	16
4.1 Precautions .....	16
4.2 Operational Items And Features .....	16
4.3 Sound Level Measurements .....	18
4.4 Use With Auxiliary Equipment .....	18

## NOTES

## NOTES

# 1. INTRODUCTION

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## 1.1 General Description

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The Simpson 884-2 Sound Level Meter (hereafter referred to as the 884-2 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 884-2 meets the requirements of the American National Standards Institute (ANSI) Standard Specification S1.4 - 1983 for "Type S2A 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 884-2 can be hand-held for rapid testing or mounted on a tripod for measurements over extended periods of time. 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 884-2 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. Fast or slow meter response is switch selectable.

The 884-2 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

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The specifications for the 884-2 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 350V, 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 S2A instrument.  |
| <b>4. Weighting:</b>         | Conforms to the A-weighting characteristic specified in ANSI S1.4-1983. The "External Filter" jack may be used to obtain a flat response.  |
| <b>5. Meter:</b>             | Taut-band 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 specification for a Type S2A instrument.  |
| <b>6. Speed of Response:</b> |  |
| <b>Types of response:</b>    | Selectable "Slow" or "Fast" modes provide the  |

- response times required by the ANSI specification for a Type S2A 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 tuned 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 tuned 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. Screwdriver adjustable from the side of the case.
9. **Output Connections:** This Instrument is provided 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 KV 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 KV 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).
- dB Output:** Provides logarithmic output of +1.50 V DC, at a meter reading of +10 dB, into a 100 KV 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 is  $-10^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ .
  - Storage Temperature:**  $-40^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$  with the battery removed.
- 12. Temperature Influence:** Typically  $0.015\text{ dB}/^{\circ}\text{C}$  at 1kHz.
- 13. Operating Humidity:** 0 to 90% relative humidity (non-condensing) for a reading change of  $< 0.5\text{ dB}$ .
- 14. Warm-up Time:** Approx. 30 seconds.

### 1.3 Items And Accessories Furnished With Instrument

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All items required to operate the 884-2 are furnished with each Instrument, and are listed in Table 1-2.

*Table 1-2. Accessories Furnished with Instrument*

Qty.	Description	Part Number
1	9-volt battery NEDA	1604A*
1	Operator's Manual	6-115307

\*Available from local retail stores.

### 1.4 Available Accessories

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*Table 1-3. Available Accessories*

Description	Part/Catalog Number
Screwdriver	5-116470
Windscreen	00197
Calibrator, 890-2	12890
Package Case	10-866065
Adapter, Microphone to Tripod	00184
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 884-2. 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 signs 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 the Operator's Manual in its entirety. Become familiar with the Instrument in the manual, then proceed to check the electrical performance as soon as possible. Save the shipping carton and packing materials for future storing or shipping of the Instrument.

## **2.2 Shipping**

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Pack the Instrument carefully and ship it prepaid to the proper destination. Insure 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 884-2 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 a 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 884-2 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 Accuracy Of A Measurement**

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**

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- a. 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.
- b. 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.
- c. Whenever the Instrument is not in use, set the range switch to the OFF position.
- d. 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.
- e. Verify Instrument calibration with a 890-2 Acoustical Calibrator.
- f. It is recommended that the Instrument be returned to the factory annually (sooner if required) for a complete overall check, adjustment, and calibration.
- g. When the Instrument is not in use store it in a room free from temperature extremes, dust, corrosive fumes, mechanical vibration or 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 884-2 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

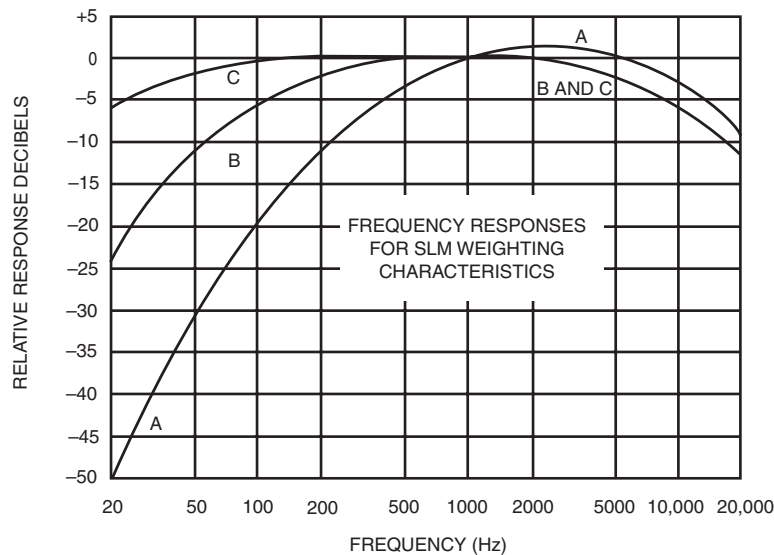


Figure 3-1. A, B, and C Weighted Responses of the Sound Level Meter

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 latest available documents and information.

The specification for a Type S2A instrument takes into account the average response of the human ear which varies as a function of the intensity of sound. It groups 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 in 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*

<b>Duration per Day In Hours</b>	<b>Sound Level, dB(A) SLOW Response</b>
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**

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#### **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 most common 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 884-2 this angle is  $70^\circ$  (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 ( $70^\circ$ ) 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.

## 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  $70^\circ$  with the incoming sound wave. Do not point the Instrument toward a source of noise other than the one being measured.

The 884-2 (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  $45^\circ$  to  $70^\circ$  with respect to the horizon. This allows the operator to step back several feet or completely away and still be able to make measurements.

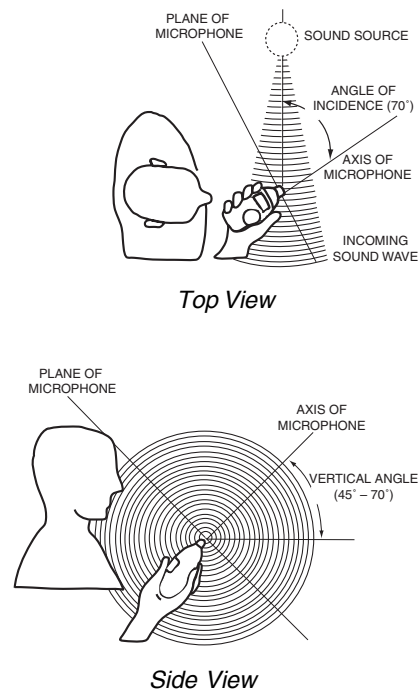


Figure 3-2. Orientation of Microphone and Operator with respect to Incoming and Sound Waves

### 3.6 Windscreen

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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.

**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.

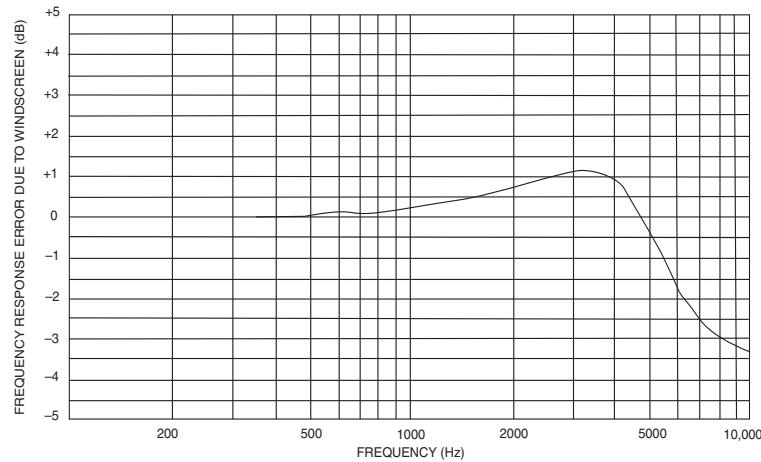


Figure 3-3. Loss of System Sensitivity Due to Windscreen

#### 3.6.1 Loss of System Sensitivity Due to Windscreen

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 Background Noise

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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 approxi-

mation 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.

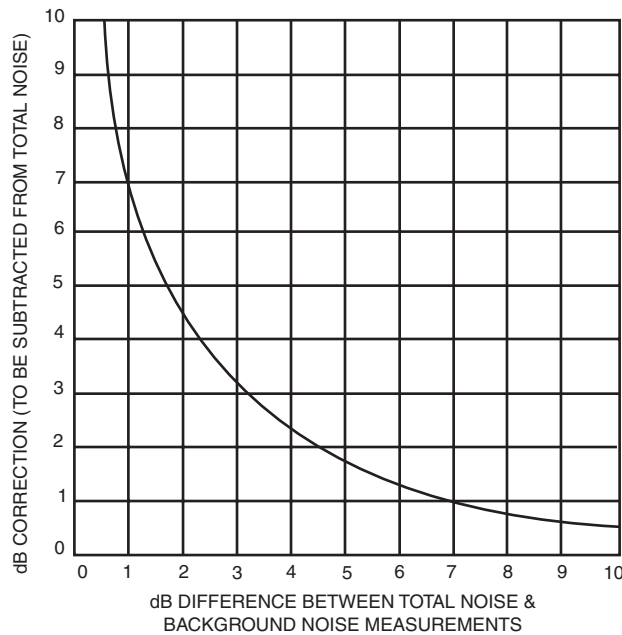


Figure 3-4. Background Noise Correction

### 3.9 Dual Sound Sources

When separate measurements are made on two sound sources, the combined effect cannot be predicated 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, 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

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This section contains the instructions required for the operation of the 884-2 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 Act of 1970, noise that measures above 115 dBA is automatically "too high" for any length of exposure approximately over one second.

### 4.1 Precautions

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

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All items and features used to operate the 884-2 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. With the range switch set to the "OSHA" position, the dB level is read on the red arc displaying the OSHA range. 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 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. **SLOW/FAST**



- Slide Switch:** This slide switch is used to select the response time of the meter circuit as defined in Table 1-1.
- 3. BATT TEST** A momentary push-button switch used to check the condition of the battery.
- 4. Microphone** A condenser type microphone that converts sound energy vibrations into electrical signals.
- 5. 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 of 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.
- 6. Meter:** A 0-100  $\mu$ A DC full scale, taut-band movement contains a dB scale 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.

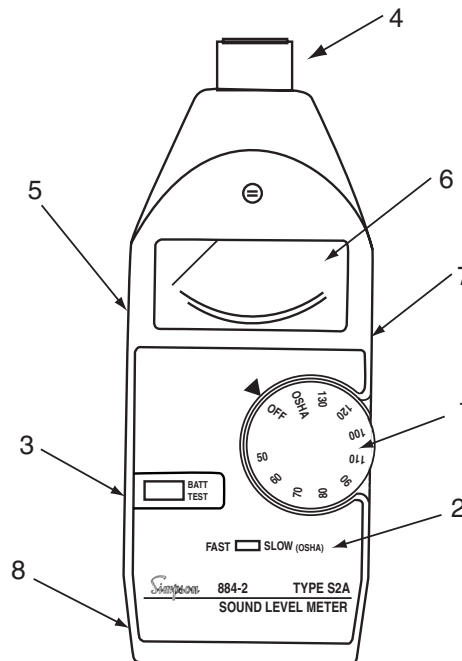


Figure 4-1. Operational Items and Features

7. **Calibration Adjustment:** This screwdriver adjustment, located under a metal cap on the side of the Instrument, is used to calibrate the 884-2. The Simpson Sound Level Calibrator, Model 890-2, is designed to calibrate the 884-2. The calibration procedures are contained in the operator's manual for the 890-2.
8. **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 884-2:

- 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 and the range switch to OSHA. 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. 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 884-2 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 884-2 with this filter.

Non-Linear Distortion: At frequencies from 30 Hz to 50 Hz, the AC output will have observable distortion with levels exceeding 0 dB on any meter range.

## NOTES

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