

GENERAL DESCRIPTION

The Quest CA-15B Sound Calibrator is a five-frequency, self-contained field calibrator that quickly and precisely verifies the accuracy of sound measuring instruments and the sensitivity of microphones. The unit generates a reference sound pressure level of precisely 110 dB at five ANSI preferred frequencies of 125, 250, 600, 1000, and 2000 Hertz.

The Calibrator is operated by a single 9-volt transistor battery, and with its small size is fully portable. The unit is primarily intended as a field instrument for on-the-spot accuracy checks of sound level meters, octave band filter sets, noise dosimeters and other instruments with microphone-type inputs.

The CA-15B consists of a switchable oscillator to provide the five stable frequencies, an amplifier stage, magnetic acoustic transducer with microphone coupler, and a battery check circuit to insure accurate stable performance. The coupler directly accepts a standard 1-1/8 inch diameter microphone. A separate adaptor is also provided to accommodate a 15/16 (one inch) diameter microphone. Adaptors for certain smaller microphones are available. Regulation of the output is inherently provided against battery drain by the solid state integrated circuitry.

SPECIFICATIONS

OUTPUT FREQUENCY: Switch selectable. 125, 250, 500, 1000, and 2000 Hz, $\pm 3\%$ accuracy.

OUTPUT AMPLITUDE: Sound Pressure Level of 110 dB, ref. $20\mu\text{N}/\text{m}^2$. ($20\mu\text{Pa}$)

ACCURACY: ± 0.4 dB at 23°C and 760 mm Hg.

DISTORTION: Less than 1%.

ELECTRICAL OUTPUT: Jack output, 1.0V rms AC nominal $\pm 10\%$. For connection use a Switchcraft type 780 Tini-plug or equivalent.

TEMPERATURE: -10 to 50°C operating. Coefficient of SPL is 0 to $.015$ dB/ $^\circ\text{C}$, -40 to $+65^\circ\text{C}$ storage (battery removed).

ALTITUDE EFFECTS: See diagram, page 9. HUMIDITY: 0 to 95% RH, operating.

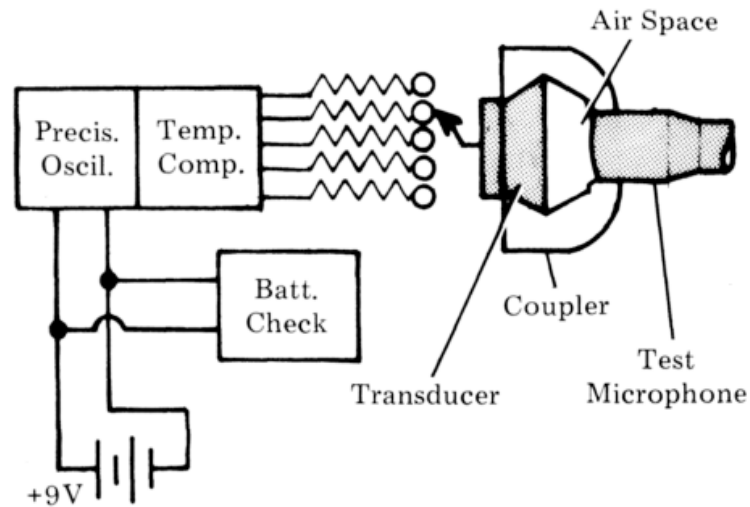
POWER: Battery-operated; 9 volt standard transistor battery, NEDA 1604, Burgess 2U6, Eveready 216 or equivalent. Battery life: approximately 50 hours operation with intermittent use. Battery life is affected by temperature. Consult manufacturer's data for specific battery used, 8 ma. drain.

CONSTRUCTION: Solid state integrated circuitry in rugged aluminum housing.

SIZE AND WEIGHT: 4.4 inch x 2-3/8 inch diameter. 14 ounces.

PRINCIPLES OF OPERATION

The following block diagram of the CA-15B depicts the basic operation of the instrument.



Block Diagram of CA-15B Calibrator

The battery check circuit continuously monitors battery output. When the voltage falls below that required for optimum performance, the voltage is removed from the oscillator circuit, and no sound output is generated. The oscillator is a temperature-stabilized Weinbridge oscillator with matched thick film resistor networks to change frequency. Individual output adjustments are provided to allow proper adjustment of the output for each frequency.

GENERAL OPERATING PROCEDURE

The CA-15B Calibrator is designed to check the accuracy of many types of sound instruments in addition to Quest manufactured equipment. Quest instruments commonly use the standard 1-1/8 inch diameter ceramic microphone which fits directly into the calibrator coupler cavity. For other microphones with smaller diameters, an adaptor must be used. The next most common size microphone is the 1-inch (actually 15/16 inch). When testing an instrument with a 1-inch microphone, the adaptor ring (furnished) must first be inserted in the coupler. This keeps a close tolerance fit around the microphone head. Be sure the microphone fits down inside the adaptor and rests on the lower rim. This rim supports the microphone and forms the necessary inner seal.

Use the following procedure to calibrate any sound instrument with the CA-15B.

1. Set Calibrator OFF-FREQUENCY switch to desired frequency (the preferred test frequency is 1000 Hz). The selected tone can be heard when holding the calibrator near the ear.
2. There is no external battery indicator on the Calibrator. The electronics are designed with an internal sensor whereby the tone will be cut off completely if the battery is too weak to maintain the accurate output. Therefore, if the tone is heard, the output is accurate and proper.
3. (Skip this step if the instrument to be measured has a 1-1/8 inch diameter microphone.) Insert the proper sized microphone adaptor, inner rim down, into the calibrator coupler cavity.

4. Carefully insert the microphone of the meter to be measured into the calibrator coupler. Be sure microphone is down inside the coupler resting on the lower coupler rim.

CAUTION

Rapid insertion or withdrawal of the microphone may damage the microphone or the transducer in the coupler because of the rapid change in pressure on the diaphragms.

5. Proceed to verify the instrument accuracy by comparing the known output level of the calibrator to the instrument reading. Adjust instrument as necessary. (See Tables 1, 2 and 3 and the altitude curve for corrections to the indicated sound pressure levels.)

6. When calibration has been made, carefully remove the microphone and move calibrator switch to OFF.

CALIBRATING SOUND LEVEL METERS

Most Sound Level Meters (in the U.S.) are usually adjusted to have flat response to free field random incidence sound. To determine what the sound level meter should read when calibrated with the CA-15B one must account for the difference between microphone free field random incidence response and the pressure response within the calibrator coupler. Calibrating with the CA-15B or most any other closed coupler system produces a pressure type characteristic. Therefore, the value of 110 dB SPL is nominal and actually may vary slightly for each frequency and microphone type. THE PREFERRED TEST FREQUENCY FOR CALIBRATION IS 1000 HZ.

The air volume of the coupler cavity is nominally 6cc with the Shure 1-1/8 inch microphone inserted. The sound pressure level (SPL) produced on each frequency range is 110 dB flat response when using the standard WE 640AA microphone or the B&K 4144 and 4160 condenser microphones. Other microphones including the Shure 401 (used on Quest meters and certain Gen-Rad meters) produce slightly different SPL readings as shown in Table 1 .

Table 1. Microphone Correction Chart

The SPL values shown are flat response sound level meter readings for the various microphones listed, to obtain a free field random incidence SPL of 110dB when using the CA-15B Calibrator.

Microphone (with grid)	Dia. (Inches)	Quest Adaptor	Sound Pressure Level (dB)				
			125Hz	250Hz	500Hz	1000Hz	2000Hz
WE 640AA	.936	58-929	110.1	110.1	110.2	110.3	110.5
B&K 4144	.936	58-929	110.0	110.0	110.0	110.0	110.0
B&K 4133	.52	58-928	110.0	110.0	110.0	110.0	110.0
B&K 4165	.52	58-928	110.0	110.0	110.0	110.0	110.0
GR P ₃ , P ₄ (Shure)	1.125	NONE	109.8	109.9	110.0	110.0	110.2
GR P ₅ , P ₆	.936	58-929	110.1	110.2	110.2	110.2	110.3
GR 1961	.936	58-929	110.2	110.3	110.2	110.3	110.4
GR 1962	.50	58-927	109.7	109.8	109.8	109.8	109.8
Quest 1830	.50	58-927	109.9	109.9	110.0	110.0	109.9
Quest 401	1.125	NONE	109.8	109.9	110.0	110.0	110.2
Quest 7046/ 47	.52	58-928	110.0	110.0	110.0	110.0	110.0
Quest 7013	.52	58-928	110.0	110.0	110.0	110.0	110.0
Quest 7023	.936	58-929	110.0	110.0	110.0	110.0	110.0

**Table 2. A, B and C Scale Weighting Correction Chart
(Per ANSI Standard S1.4-1971)**

The values shown are deviations from the flat response readings (Table 1) when the meter being tested is set for A, B and C Scale weighting.

Weighting	Sound Pressure Level Deviation (dB)				
	125Hz	250Hz	500Hz	1000Hz	2000Hz
A	-16.1	-8.6	-3.2	0	+1.2
B	- 4.2	-1.3	-0.3	0	-0.1
C	- 0.2	0	0	0	-0.2

Table 3. Design Center Readings Equivalent to Free Field Random Incidence SPL of 110 dB

The values shown have been combined from Tables 1 and 2. They are the actual readings on Quest sound level meters using the Shure 401 microphone, 1-1/8 inch in diameter, to indicate a free field random incidence SPL of 110 dB for the given weighting and frequency.

Weighting	Actual Reading on Quest Sound Level Meter Using Shure Type 401 Microphone				
	125Hz	250Hz	500Hz	1000Hz	2000Hz
A	93.7	101.3	106.8	110.0	111.4
B	105.6	108.6	109.7	110.0	110.1
C	109.6	109.9	110.0	110.0	110.0

ALTITUDE EFFECTS

Most acoustic calibrators including the CA-15B are affected by altitude or atmospheric pressure changes. The transducer diaphragm within the calibrator creates the sound as it vibrates against the air. When the air is thinner (at higher elevations) a slightly different sound level is produced by the calibrator.

The CA-15B is set at the laboratory to emit 110dB at sea level (760 mm Hg). The curves on page 9 show the variation in calibrator output (dB) for each frequency at altitudes up to 12,000 feet.

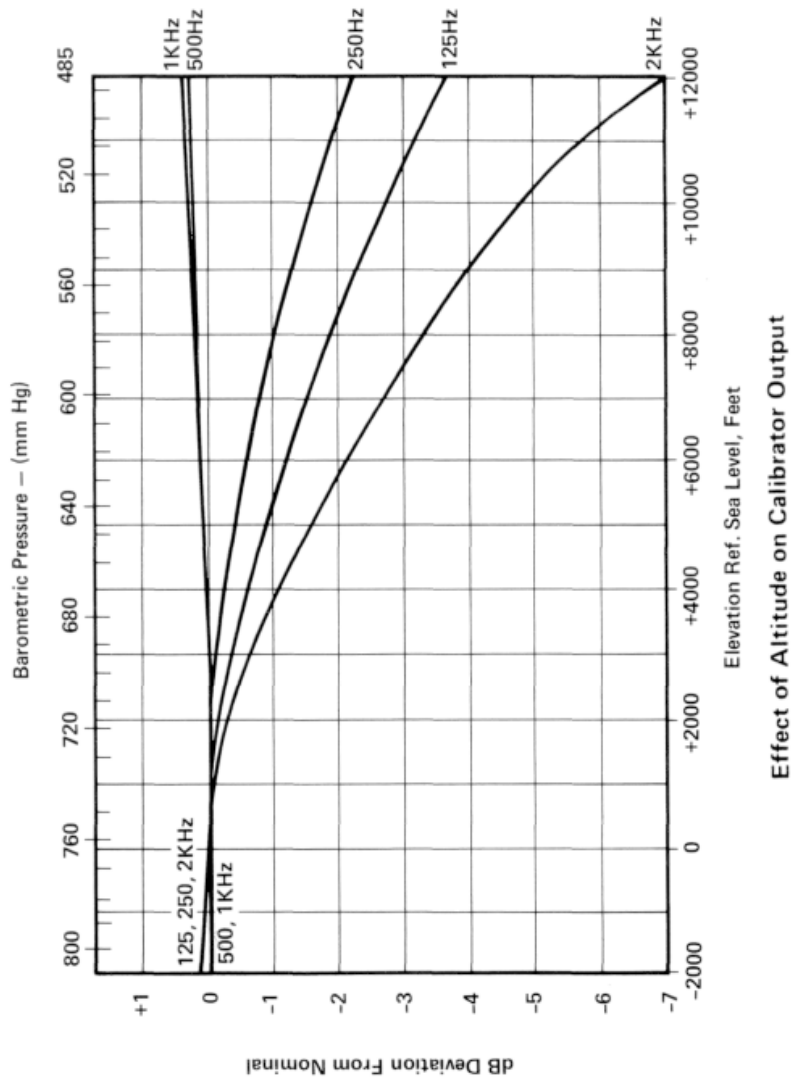
EXAMPLE OF CALIBRATING A SOUND LEVEL METER WITH THE CA-15B CALIBRATOR

Assume you are using a Quest meter with the 401 microphone, 1-1/8 inch diameter, in Denver, Colorado (elevation 5200 ft.) and you wish to calibrate the meter for "A" scale at 500 Hz:

1. From the altitude curves note that at 5200 ft. and 500 Hz the calibrator actually produces 110.1 dB, which is .1 dB more than the standard 110 dB.

2. From Table 3 note that the design center reading for "A" scale at 500 Hz is 106.8 dB. The correct meter reading for the given conditions is thus 106.9 dB (106.8 plus .1).

3. Set the calibrator switch to 500 Hz and insert the meter microphone in the calibrator coupler. Adjust the



meter to give a reading of 106.9 dB. It is now calibrated to read the actual free field random incidence sound pressure level for the given conditions.

CALIBRATING A NOISE DOSIMETER

Noise dosimeters are generally set to read with "A" scale weighting. Since the dosimeter is a type of noise accumulator it integrates noise level over time. Therefore, any calibration of the dosimeter must require a time measured reading. Again, you are concerned with how the dosimeter performs in a free field random incidence condition. As such, the microphone correction, the "A" scale weighting value, and the altitude correction must be applied to the 110dB output of the calibrator. This net dB level is then used to calculate the exposure over the time period of measurement. The noise dosimeter manual should give calibration readings of dB vs. time.

CHECKING AN OCTAVE BAND FILTER SET

The filter set of an Octave Band Analyzer can easily be checked by the CA-15B for insertion loss and slope of the filter skirt (roll-off) above and below the center band

frequency. Proceed as follows:

1. Set the Sound Level Meter to Flat Response (LINEar or "C" scale).
2. Read and calibrate the meter for 110dB from the calibrator using one of the frequencies, say 1000 Hz.
3. Switch the unit to EXTernal (engage the filter set) with the filter switch set at the same frequency as the calibrator (1000 Hz).
4. Note the difference in reading between step 2 and step 3. This is the insertion loss of the filter; it should be within ± 1 dB.
5. With the calibrator still at the same frequency (1000 Hz), switch the filter set down one octave to 500 Hz. The meter reading should drop by at least 15dB for ANSI Class II filters. This is a measure of the sharpness of the filter skirt.
6. Next switch the filter to the higher band (2000 Hz). Here also the meter reading should drop by 15dB or more. This is a measure of the sharpness of the other side of the filter skirt.
7. Comparing step 5 with step 6 gives an indication of filter balance or tuning around the center frequency.
8. Repeat the above for each of the five calibrator frequencies checking the filter at the center frequency, and then at each side band or filter skirt.

BATTERY CHECK AND REPLACEMENT

The CA-15B Calibrator has only one 9 volt transistor battery as its power source. Note there is no external indication of battery condition. The unit is designed with special electronic sensing circuitry which detects the battery condition continuously, and permits the unit to function so long as the battery is strong enough to produce an accurate calibrated sound source. When the battery becomes too weak, the unit will shut off its sound completely. Therefore, whenever no sound is heard with the unit switched ON, replace the battery.

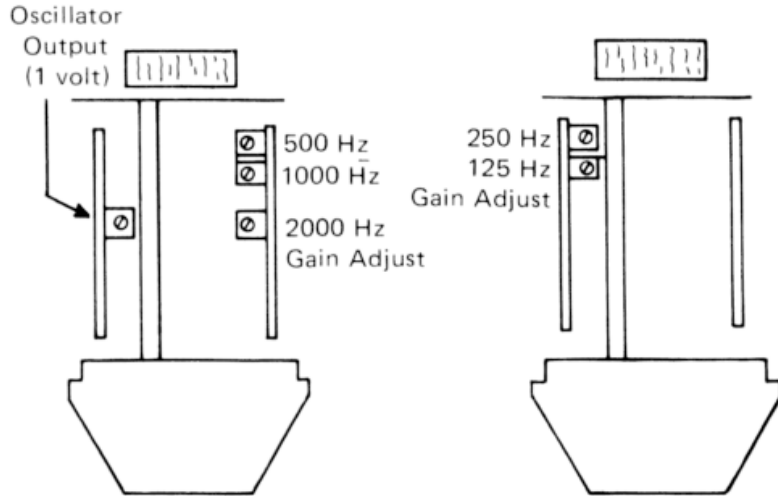
To replace the battery, first be sure the calibrator is turned off. Then grasp transducer (silver) end in one hand and middle of the cylinder sleeve in the other. Turn sleeve counterclockwise about 7 turns and slide sleeve off. Note that it is not necessary to remove the label plate. The threads have a special anti-seize compound applied during manufacture; take care not to get it on your hands or clothing. Carefully unsnap battery connector and remove weak battery. Replace with a fresh one and, observing polarity, snap connector on. Carefully replace cover so as not to pinch wires.

CA-15B CALIBRATION

The CA-15B Calibrator was precisely calibrated in the Quest laboratory with special acoustical instrumentation traceable to the U.S. Bureau of Standards. The

CA-15B is very stable; but since it is used to calibrate other equipment, it should be periodically checked with laboratory standards. It is recommended that the calibrator be returned to the factory at least once each year for recalibration, or whenever there is a question about its accuracy.

The following diagram shows the CA-15B Calibrator with cylinder sleeve removed. Control potentiometers are indicated for adjusting dB levels of each frequency. These "pots" are for precise laboratory calibration only, and should not otherwise be adjusted.



CA-15B CALIBRATOR dB ADJUSTMENT CONTROL

Service Policy

The Quest product you have purchased is one of the finest acoustic instruments available. It is backed by our full one-year warranty which seeks complete customer satisfaction. This is your assurance that you can expect prompt courteous service for your equipment from the entire Quest service organization.

Should your Quest equipment need to be returned for repair or recalibration, please contact the Service Department at (800) 245-0779 (USA) or Fax (262) 567-4047 for a Return Authorization Number. The RA number is valid for 30 days, and must be shown on the shipping label and purchase order/cover letter. If you are unable to return instruments in that time call for a new RA number. Send it prepaid and properly packed in the original shipping carton directly to Quest Technologies, 1060 Corporate Center Drive, Oconomowoc, WI 53066 U.S.A.

Repair or replacement work done under warranty will be performed free of charge, and the instrument will be returned to you prepaid. Your copy or a photocopy of the Quest Registration Card will serve as proof of warranty should the factory require this information.

If for any reason you should find it necessary to contact the factory regarding service or shipping damage, please direct your calls or letters to the attention of the Service Manager, Quest Technologies, (262) 567-9157 or (800) 245-0779. Office hours are from 7 AM to 6 PM (Central Standard Time) Monday through Friday.

For service or recalibration outside the U.S.A., please contact your local Quest Dealer or fax Quest U.S.A. at 1-262-567-4047.