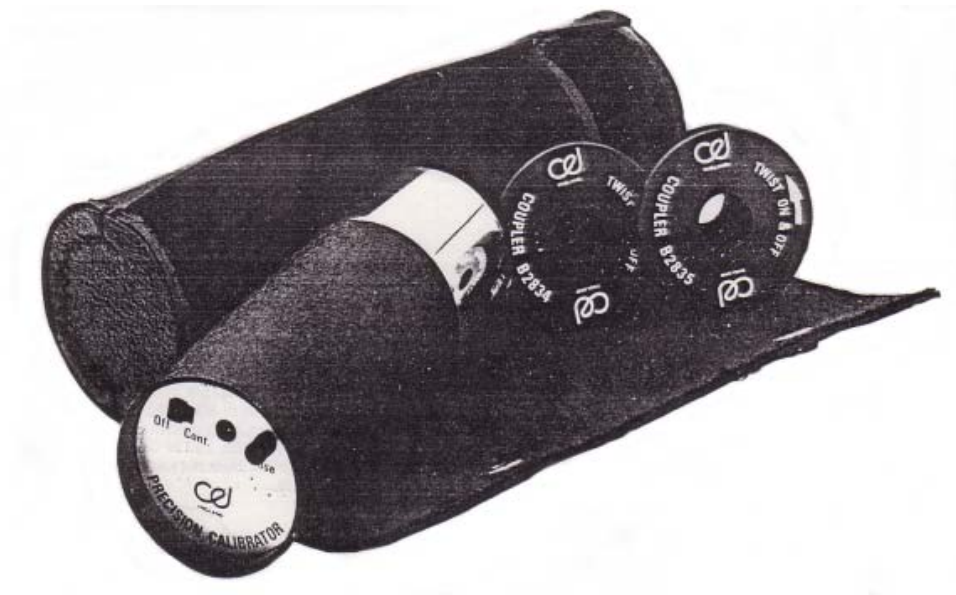


CEL-177 Precision Acoustic Calibrator



Handbook

Introduction

The CEL-177 is a convenient and accurate device that allows the accuracy of the CEL range of precision acoustic measuring instruments to be checked. It may also be used to calibrate sound level meters produced by other manufacturers as long as they are fitted with the industry standard dimension microphones. The CEL-177 incorporates a continuous sound source within a calibration cavity and tables are provided of the sound pressure level developed within the cavity when different types of microphone are introduced. To facilitate the calibration of noise dose rates the acoustic output provided may be 'gated' to provide an accurately known duration of calibration tone. The product of this level and time function may then be related to the noise dose count provided by these instruments. A calibrated voltage is also provided to allow vibration meters, or other electronic measurement equipment to be checked.

Description

The CEL-177 'Precision Acoustic Calibrator' contains a high stability low distortion sine wave oscillator, the amplitude and frequency of which is factory adjusted to produce the required level in the coupling cavity. The transducers are pre-aged and matched to the driving circuits to ensure the long term stability of the system. The frequency of operation is 1kHz. Pulses from the oscillator are also needed to drive the counter that provides the 66.5 sec gate for the dose meter calibration function. A single 9 V 6F22 type battery provides the power for the device.

Acoustic calibration is performed within a closed cavity within which the calibration pressure level is generated. Microphones to be calibrated are introduced into this cavity and are located against a shoulder and held in place by the 'O' rings. It is important to ensure that the microphone is correctly seated to avoid calibration errors. The calibration cavity is designed to accept 1 inch diameter microphones whilst a range of couplers are available in order to adapt it to accommodate smaller diameter types. Pressure equalisation is provided between the calibration cavity and atmosphere, however it is still recommended that the microphone is inserted and withdrawn slowly and a few seconds allowed for static pressures to equalise before readings are taken.

Schedule of Parts

The description CEL-177 refers to the following items and upon receipt they should be checked against this schedule:

CEL-177	Precision Acoustic Calibrator
CEL-2958	Leather case*
CEL-2835	1" to ½" coupler (13.7 mm)
6F22	9 V Battery
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Accessory items, for use with this calibrator, which must be specifically ordered and will be shown separately on delivery notes and invoices, include:

CEL-2834	1" to ½" coupler (12.7mm)
CEL-3379	Coupler (17mm)
RS591-089	Rechargeable battery
RS591-067	Battery Charger

* This item is not provided when the calibrator is provided as part of a sound level meter kit as it is then housed within the instrument's system case.

Preparation of the Instrument

In order to commission the calibrator it is only necessary to connect the battery. Although a battery is provided with the unit it is not connected in order to avoid accidental operation in transit and to prevent damage due to leakage. To connect the battery, first ensure that the unit is switched off and then the black sleeve should be unscrewed from the chromed head and carefully slid off. The battery may then be connected to the flying lead, ensuring correct polarity, and the battery located in the battery tray. It is held in position by the spring clip which should be biased away to allow insertion of the battery. On connecting the battery the calibrator may run for a few seconds but will then switch itself off.

Operation

The 'on-cont' switch selects the continuous tone whilst the 'Dose', button which when depressed with the 'on-cont' switch in the off position will cause the calibration tone to run for 65.5 seconds. If the dose button is depressed whilst the unit is switched to the 'on-cont' the 'off' position is overridden until the dose meter calibration cycle has timed out. The indicator lamp on the top face will light whenever the device is operated to signal that the battery is in good condition. Should this indicator fail to light the battery must be replaced.

The CEL-177 is suitable for calibrating any instrument that is fitted with the Industry standard 1" diameter microphone capsule whilst the couplers, shown below us available for use with smaller diameter microphones. This table also indicates some of the instruments that use these microphones.

Coupler Type	Nominal Microphone Diameter	Instrument Type
CEL-2834	12mm	CEL-183, 206, 210, 223
CEL-2835	13mm	CEL-175, 187, 314
CEL-3379	17mm	CEL-214, 228, 283

Calibration

The microphone to be calibrated should be slowly inserted into the cavity using a gentle screw action to ensure that it passes both 'O' rings and is correctly located against the shoulder in the base of the cavity. As the sound pressure level generated within the cavity is dependent upon its enclosed volume it is important to ensure that the microphone is correctly located within the cavity. For microphones having diameters of less than 1 inch the correct coupler should be selected and the coupler placed over the microphone, again ensuring that the microphone face locates against the shoulder in the coupler. The microphone and coupler assembly may then be inserted into the calibration cavity in the same manner as described above.

Having located the microphone within the cavity the instrument may then be calibrated. For

sound level calibration the unit should be switched to 'on-cont' and the measuring system adjusted to show 114 dB plus the sum of correction factors shown in tables 1 and 2. As mentioned earlier the sound pressure level generated is dependent upon the volume of the calibration cavity and this in turn is affected by the equivalent volume of the actual microphone being calibrated. Different types of microphone will, therefore, have a correction factor depending upon their equivalent volume.

Calibration of noise dose meters is carried out in a similar manner except that the 'dose' button is activated rather than selection of 'on-cont'. It is important to ensure that the dose meter was reset prior to calibration and that the 'dose' button is not depressed a second time as this will restart the counter and result in an error. The level that should be indicated by the dose meter at the end of the calibration cycle can be determined from:

$$\text{Noise dose count} = 2^n \times \frac{12.5 \times 65.5}{3600}$$

$$\text{Where } n = \left[\frac{\text{Calibrator level} - \text{criterion level}}{Q} \right]$$

Calibrator level - corrected sound pressure level developed within calibration cavity.

Criterion level - number of dB for which the dose meter will over 8 hours indicate 100% noise exposure.

Q - amplitude weighting function (i.e. the number of dB required to double the significance in resultant)

This formula has been evaluated for a number of CEL Noise Dose Meters and the results are given in table 3.

A calibrated 100mv output is provided via the 2.5m. sub miniature jack socket located on the calibrator top face. This is primarily intended for calibrating the CEL-3025 vibration attachment but may also be used for aligning other acoustic or electronic measurement systems. This voltage has a source impedance of approximately 100 ohms and due consideration must be given to this when loading the output.

In determining calibration accuracy the consideration should be given to the following:

Effect of battery voltage - Over the working battery range, as indicated by the indicator lamp, the sound pressure level is maintained within that indicated in Table 1 ± 0.2 dB. The frequency stability of the 1kHz tone and therefore the dose time are accurate to $\pm 0.5\%$.

Effect of temperature - For the temperature range 10°C to +30°C the variation in sound pressure level is less than ± 0.4 dB. Variation in frequency and dose time is better than $\pm 0.5\%$.

Effect of pressure - Normal variations of air pressure will have negligible effect but figure 2 shows the variations that may be expected if calibration is performed at high altitudes.

Care and Maintenance procedure.

The CEL-177 requires very little routine maintenance. If difficulty is experienced in inserting the microphone a small amount of silicone grease should be used on the O rings in the calibrator. Also, it is possible after a large number of insertions that the O rings lose some elasticity. Therefore, if the microphone is not firmly held in the cavity the O rings should be replaced.

To prevent damage by battery acid the battery should always be removed when storing the calibrator.

Manufacturer's Servicing And Warranty Arrangements

Each instrument has been carefully inspected and calibrated prior to dispatch from our factory in order to ensure its rigid conformity with the requirements of our specification. All technical information relating to individual instruments is filed under the instrument's serial number. It is important, therefore, to always quote this number in any correspondence with the manufacturers. The serial number is located on the back of the instrument. The manufacturers undertake to rectify any defect in the instrument that is directly attributable to faulty design or assembly and which becomes apparent during the first twelve months from the date of the initial calibration.

Many of the specialized components used in the instrument are subject to separate warranties by their actual manufacturers and in all cases

benefit of these undertakings will be passed onto the end user. However, Computer Engineering's (CEL's) liability is limited to items of their own manufacture and they do not accept liability for any loss resulting from the operation or interpretation of the results from this equipment.

In the event of a malfunction developing the instrument should be carefully packed and returned to either the manufacturer's agent in the territory or, in the case of domestic sales, to our Hitchin factory along with a detailed description of the fault. The necessary repairs will be undertaken and the instrument returned as soon as possible.

After the warranty has expired, except on approved accounts, service work is undertaken against quotation and all packing and transit costs are charged extra. In the case of sales in the UK, service contracts are available for the instruments and full details of these are available on request.

Specification

Sound pressure level	Nominally 114dB ± 0.4 dB (see also Figure 1)
Operating Mode	Continuous & Timed
Dose time	65.5 sec ± 0.5 sec
Frequency	1kHz $\pm 5\%$
Voltage	100 mV rms ± 1 mV
Dimensions	118mm x 45 mm (4.65" x 1.75")
Weight	7.92 ounces (225g)
Power Consumption	10 mA approx. 7V-10V
Temperature Range	10-30 °C (50-86 °F)

Microphone type	Coupler required	Correction to nominal level dB
CEL-186/2P	CEL-2835	-1.0
CEL-186/2PR	CEL-2835	-1.0
CEL-192F	CEL-2835	-1.0
CEL-190F	Not required	-1.0
Genrad 1961	Not required	0
Genrad 1962	CEL-2834	0
Knowles BL1803	CEL-2834	0
B&K 4133	CEL-2835	-1.0

Figure 1
 Microphone equivalent volume corrections to nominal output sound level

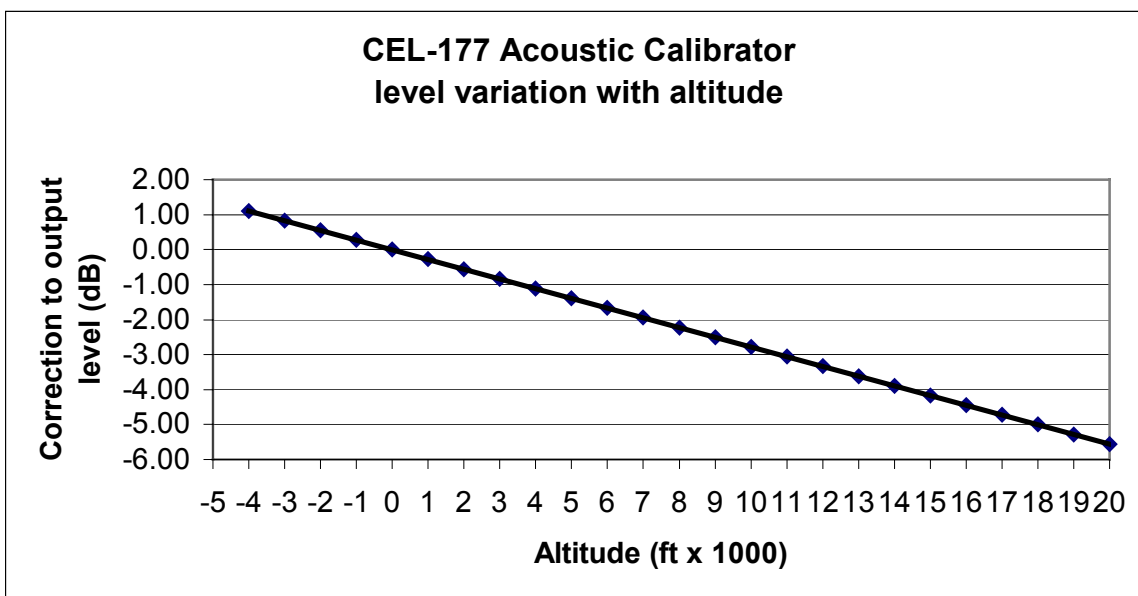


Figure 2
 Calibration corrections as a function of altitude relative to sea level

CEL Dosimeter model number	Dosimeter calibration count at nominal output 114 dB (includes coupler where used)
CEL-139D	58.2
CEL-172H & J	58.2
CEL-172K	184.8
CEL-172L	116.4
CEL-179H & J	46.2
CEL-179K	146.7
CEL-179L	92.4
CEL-180G	46.2
CEL-180J	146.7
CEL-180L	5.5
CEL-181G	58.2
CEL-181J	184.8
CEL-181L	6.3

Figure 3
 Dosimeter calibration settings using CEL-177 Acoustic Calibrator

Casella USA
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Calibration Certificate

CEL-177 serial number

Date

Inspector

CEL Instruments are manufactured and serviced by:

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In line with our policy of continual design improvement we reserve the right to amend any of the details in this handbook.

Issue 1

June 1986