FIGURE 1. The Type 559-A Noise Meter is a complete, portable instrument containing the pickup unit and spare for all batteries.

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USES -- Inexpensive noise-measuring equipment is needed by manufacturers of machinery to ascertain the amount of disturbance caused by their products. Such equipment is also widely used by acoustic engineers and manufacturers of soundproofing materials to demonstrate the effectiveness of sound-proof installations.

The Type 559-A Noise Meter has been developed particularly to meet these needs. It is well adapted to practically all problems where comparative measurements of over-all noise are required.

ADVANTAGES -- The General Radio Type 559-A Noise Meter is mounted in a compact, oak carrying case which also accommodates the dynamic noise-pickup unit and all tubes and batteries. It is merely necessary to set the instrument in any desired location, turn on the switch and read the noise level directly from the panel meter and attenuator. The performance compares favorably with instruments costing several times as much.

 Provision is made on the noise meter panel so that by removing a 4-terminal plug, the 600-ohm input circuit may be opened, allowing the connection of an external microphone or a filter for suppressing certain frequencies.

PRINCIPLE OF OPERATION -- Figures 1 and 2 show, respectively, the appearance and method of operation of this new noise meter. It contains a special dynamic noise-pickup unit which is similar in construction to the usual permanent-magnet dynamic speaker and which is much more sensitive and rugged than the usual microphone.

An impedance matching transformer associated with the noise-pickup steps up the impedance to 600 ohms. Normally this transformer operates into a frequency-weighting network and transformer, across the output of which there is a calibrated step-by-step attenuator to adjust the input level to the amplifier.

For the measurement of extremely high levels, a second attenuator of the T-pad constant-impedance type is inserted at the input of the frequency-weighting network. This additional attenuator is snapped in and out of the circuit by means of a toggle switch on the panel. Since all attenuators precede the first amplifier tube, the amplifier always operates at approximately the same level, and accordingly no error is introduced due to possible non-linearity. The output from the amplifier actuates a meter on the panel.

The noise meter is calibrated directly.
GENERAL RADIO COMPANY

in decibels above the normal threshold of hearing at 1000 cycles, and covers the range from +30 to +146 decibels. Expressed in decibels above one millibar, which is also frequently used as a reference level, this represents +23 to +139 decibels.

The frequency response characteristic of the noise meter amplifier, including the frequency-weighting network, closely resembles the response of the human ear. When the self-contained dynamic pickup is used, the over-all characteristic, including the pickup, follows the same curve quite closely through the important part of the noise spectrum. If a high-quality condenser microphone with a suitable pre-amplifier is used with the noise meter, the net characteristic will be an almost ideal approximation of the normal ear characteristic. Such precision is, however, seldom required.

PART 2

INSTALLATION OF TUBES AND BATTERIES

TUBES REQUIRED
1 RCA-32, CX-32, or equivalent.
1 RCA-33, CX-33, or equivalent.

BATTERIES REQUIRED
3 Burgess Type 5308, 45-volt, B-batteries or equivalent.
1 Burgess Type 5540, 7-1/2-volt, C-battery or equivalent.
2 Burgess No. 6A or Eveready No. 6, 1.5-volt, dry cells or equivalent.

INSTALLATION OF BATTERIES -- A compartment is provided in the noise meter cabinet for holding all necessary batteries. The three B-batteries go in the larger section of the compartment, which is toward the right, as the noise meter is viewed from the front. The two dry cells should be placed in the narrow section of the compartment, which is next to the sound pickup unit. The C-battery should be placed in the metal strip in the right-hand end of the cabinet, above the B-batteries. The photograph in the cover of the instrument and in Figure 3 shows the exact arrangement of the batteries. A piece of sponge rubber is provided and should be placed between the dry cells and the B-batteries so that they will fit tightly. If necessary, place a piece of corrugated cardboard behind the dry cells to keep them from moving.

CONNECTIONS TO BATTERIES -- Spade-tipped color-coded leads are provided for all battery connections. The color code is as follows:

Red.............A+ (2 #6 cells in series)
Black...........A-
Slate........B+ 135 volts
Blue-Red.......B+ 45 volts
Blue...........B+ 22.5 volts
Yellow.......B-
Green........C+
Brown........C- 1.5 volts
Orange.........C- 6 volts

INSTALLATION OF TUBES -- Before placing the tubes in the sockets, be sure that the "ON-OFF" switch is in the "OFF" position and the rheostat marked "SET TO 2 VOLTS" is turned as far in a counterclockwise direction as it will go. The 32-type tube should be placed in the left-hand socket, as the meter is viewed from the front, and connection made to the cap of the tube with the shielded grid lead provided. The 33-type tube should be placed in the right-hand socket. The lid of the instrument should be closed and kept closed whenever measurements are being made.

REPLACEMENT OF BATTERIES AND TUBES -- The two dry cells in the noise meter should be replaced whenever it is impossible to obtain a filament voltage of 2 volts. The B-batteries should be replaced when the panel voltmeter indicates a total plate voltage of 120 volts or less. The C-battery should preferably be changed each time the B-batteries are replaced.
NORMAL OPERATION -- Before turning the noise meter on, the switch marked "DECIBELS" should be set on the point marked "90." The toggle switch marked "0" and "50 DB." should be set in the "0" position. The scale plug on the upper left-hand corner of the panel should be securely in place. Snap the "ON-OFF" switch to the "ON" position and adjust the filament rheostat (marked "SET TO 2 VOLTS") so that the panel voltmeter reads 2 volts. A check may now be made on the B-voltage by pressing the small button on the voltmeter. The total B-voltage should be approximately 135 volts with new batteries.

Unless the instrument is in a very noisy location, the panel meter marked "DECIBELS" will probably not show any deflection with the attenuator set as described above. The attenuator setting (knob marked "DECIBELS") should not be reduced step by step until a deflection is obtained upon the meter marked "DECIBELS." The sum of the attenuator reading and the meter reading will indicate the level in decibels above the threshold of hearing.

MEASUREMENT OF VERY LOUD SOUNDS -- When very loud sounds are being measured, it will sometimes be found that the meter will go off scale, even with the "DECIBELS" switch at the point marked "90." When this is the case, the small switch in the left-hand lower corner of the panel should be snapped to the position marked "50 DB." The step-by-step attenuator switch may then be reduced until a suitable deflection is obtained on the meter. The total level under these conditions is obtained by adding 50 decibels to the sum of the switch and meter readings.

DIRECTIONAL CHARACTERISTICS -- Since the noise pickup unit of the instrument is in the left-hand end of the cabinet, the
noise meter will naturally be more sensitive to sounds coming from that direction. Advantage can be taken of this characteristic by aiming the noise pickup at the source of sound when the noise generated by some particular machine is being measured. If the total noise in any room or location is being measured, however, readings of the noise meter should be taken with the instrument in several locations and pointing in several directions. An average of these readings may be considered as the average noise level in the location.

PART 4

OPERATING CHARACTERISTICS

FREQUENCY CHARACTERISTIC—The over-all frequency characteristic of the noise meter has been adjusted to approximate that of the human ear at a volume level corresponding to about 40 decibels above the threshold of hearing at 1000 cycles. Curve A in Figure 4 shows the approximate over-all characteristic of the instrument from the input at the terminals marked "X" (see Figure 2) through to the indicating meter. The curve marked "B" shows the approximate over-all frequency characteristic, including the self-contained dynamic pickup.

REFERENCE LEVEL — The Type 559-A Noise Meter is calibrated to read directly in decibels above the reference level of the average threshold of hearing at 1000 cycles. This represents a reference level of about 0.4-0.5 millibars. This means that the Type 559-A Noise Meter reads about 7 decibels higher than similar instruments calibrated with a reference level of 1 millibar.

USE OF FILTERS OR ADDITIONAL ATTENUATORS—If it is desired, filters may be used with the noise meter to minimize or eliminate certain frequency ranges from its readings. If the four-prong plug in the upper left-hand corner of the front panel is removed, two pairs of terminals will be exposed. The two marked "M" are the output terminals of the dynamic pickup unit. The two marked "X" are the input to the noise meter attenuator and amplifier. Any 600-ohm filter having the desired characteristic may be connected in the circuit at this point. The General Radio Type 330 Filters can be supplied having the following characteristics: (See the General Radio catalog for additional data.)

<table>
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<th>Type</th>
<th>Theoretical Cut-Off Frequency</th>
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<tr>
<td>330-A</td>
<td>500 cycles</td>
</tr>
<tr>
<td>330-E</td>
<td>1000 &quot;</td>
</tr>
<tr>
<td>330-J</td>
<td>2000 &quot;</td>
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The approximate characteristics of these filters are shown in Figure 5.

USE OF EXTERNAL MICROPHONE—If desired, an external microphone can be used with the Type 559-A Noise Meter. Such a microphone should have an output impedance of approximately 600 ohms, or an impedance matching transformer should be used, and connection should be made directly to the terminals marked "X". A high-quality condenser microphone with suitable pre-amplifier will be found very satisfactory for noise measurements where a high degree of

![Figure 4](image-url)

FIGURE 4. Approximate over-all frequency characteristics of the Type 559-A Noise Meter.
accuracy and an especially smooth frequency characteristic are required.

CALIBRATION OF EXTERNAL MICROPHONE: When using an external microphone it is desirable to calibrate it in terms of the internal dynamic noise pickup so that readings will be comparable. To do this, a source (such as an oscillator and loudspeaker) which will give an audio-frequency tone of about 1000 cycles per second is required. This tone should be measured using the dynamic pickup unit. The external microphone may then be plugged into the noise meter and the reading noted. If the external microphone gives a reading \( N \) decibels higher than the dynamic pickup, \( N \) should be subtracted from the readings of the noise meter when using the external microphone. Similarly, if the external microphone reads \( N \) decibels lower than the dynamic pickup, \( N \) should be added to the noise meter readings when using the external microphone.

In making this calibration, it is advisable to place the external microphone in the same plane with respect to the audio wave as the dynamic pickup unit and to make the measurement in a room which is fairly "dead" acoustically.

PART 5

READJUSTMENT OF CALIBRATION

Before shipment, each Type 559-A Noise Meter is calibrated with the particular tubes supplied. This calibration may be checked at any time by the customer and readjusted if necessary.

If for any reason the tubes are changed, particularly the 32-type tube, it is a good idea to check the calibration. Although the calibration will be found to hold quite closely for the average run of 32-type tubes, occasionally a tube will be found which will shift the sensitivity by as much as 6 decibels.

FIGURE 5. Attenuation characteristics of General Radio Type 330 Filter Sections.

FIGURE 6. Calibration Circuit.
The procedure is very simple. A 600-ohm resistor and a source of about 2 to 3 volts, r.m.s., at 1000 cycles are required.

The apparatus is connected to the noise meter as shown in Figure 6 and a 1000-cycle voltage \$V\$ applied to the noise meter through the 600-ohm resistor. The noise meter should then read +60 decibels. The average value for \$V\$ is about 2.35 volts. The exact value for each particular noise meter will be found on a label in the cover.

If, when the proper \$V\$ is applied, the instrument does not read 60 decibels, the calibration adjustment should be turned, by means of a screwdriver, until the proper reading is obtained. The location of this calibration adjustment is shown on Figure 3 and on the diagram in the noise meter lid.

Of course, this method of calibration does not take into account the noise-pickup unit. The sensitivity of this, however, will not shift appreciably if the unit is not dropped or misused.

CAUTION: Do not allow any magnetic material, such as screwdrivers, etc., to come into contact with the large permanent magnet.

![Wiring Diagram of Type 559A Noise Meter]

**FIGURE 7. Wiring Diagram.**