INSTRUCTION MANUAL

Sound Level Meter

NL-26

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Organization of this manual

This manual describes the functions and operation of the Sound Level Meter NL-26. This manual is divided into the following sections.

Outline

Gives basic information on configuration and features of the unit.

Controls and Functions

Briefly explains the function of the operation keys, connectors, and other parts of the unit.

Preparations

Describes how to turn the unit on, check for proper operation, make settings, etc.

Measurement

Describes how to make measurements.

Technical notes

Gives background information about sound level meter functions, frequency weighting characteristics, time weighting characteristics and other technical aspects relating to measurement.

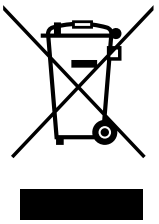
Description for IEC 61672-1

Explains how to perform the IEC 61672-1.

Specifications

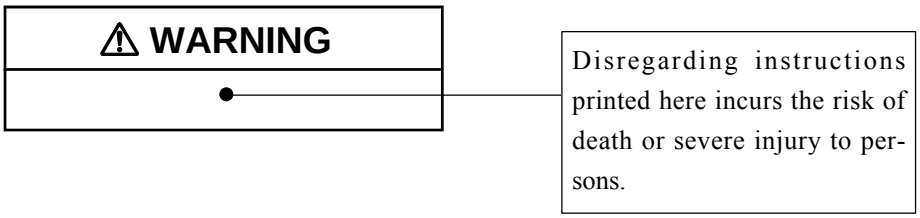
Lists the technical specifications of the unit.

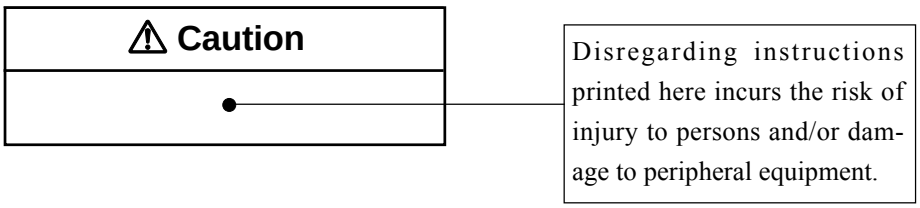
To conform to the EU requirement of the Directive 2002/96/EC on Waste Electrical and Electronic Equipment, the symbol mark on the right is shown on the instrument.

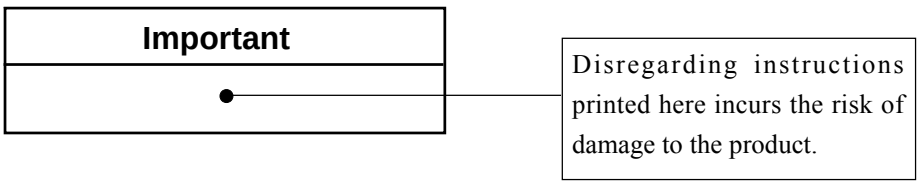


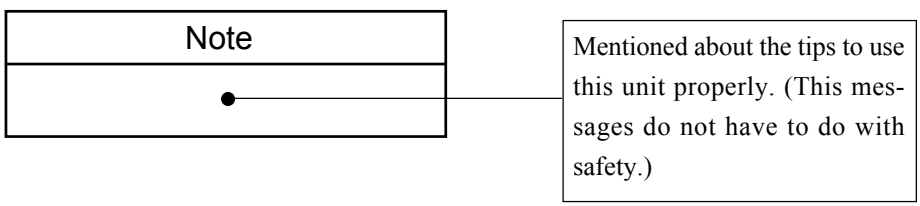
FOR SAFETY

In this manual, important safety instructions are specially marked as shown below. To prevent the risk of death or injury to persons and severe damage to the unit or peripheral equipment, make sure that all instructions are fully understood and observed.









Precautions

- Operate the unit only as described in this manual.
- Do not touch any parts of the unit other than necessary for operation.
- Do not drop the unit. Protect it from shocks and vibration.
- The permissible ambient temperature range for operation of the unit is -10 to +50ºC. Relative humidity must be between 10% and 90%.
  Do not use or store the unit in locations which may be subject to water, direct sunlight, high temperatures or humidity. Also protect the unit from air with high salt or sulphur content, gases or the influence of chemicals.
- Do not forget to turn the unit off after use. Remove the batteries if the unit is not to be used for some time.
- When disconnecting cables, always hold the plug and do not pull the cable.
- To clean the unit, use only a dry cloth or a cloth lightly moistened with water. Do not use chemical cleaning cloths, solvents or alcohol-based cleaners to prevent the possibility of deformation and discoloring.
- Do not insert any objects such as pins, metal scraps, conducting plastic etc. into any opening on the unit.
- Do not disassemble the unit or attempt internal alterations.
- In case of malfunction, do not attempt any repairs. Note the condition of the unit clearly and contact the supplier.
- When removing the miniature screwdriver from the case, always grasp the handle of the driver. Proceed with care, because the tip of the driver is sharp and pointed.
- When disposing of the unit or the batteries, follow national and local regulations regarding waste disposal.

Contents

Outline

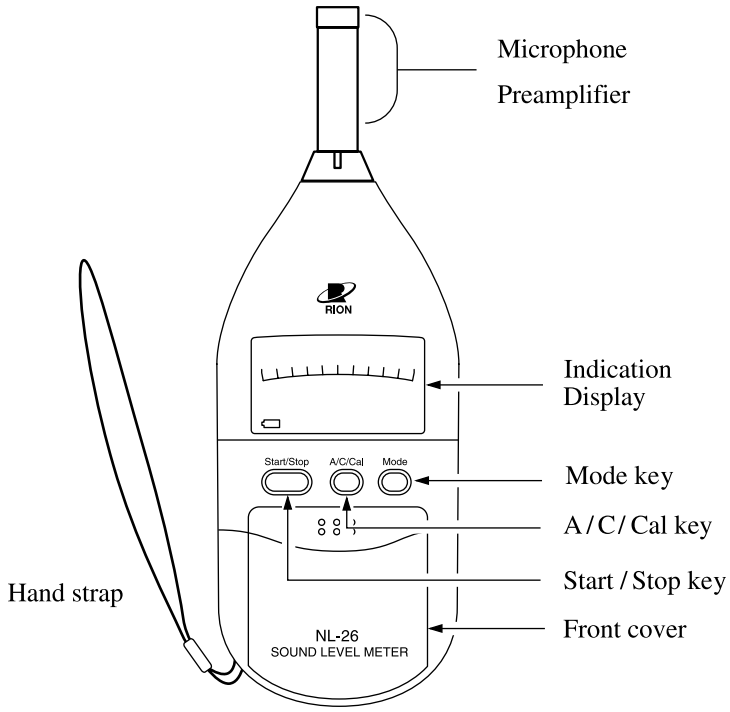
The NL-26 is a sound level meter that complies with two major standards: IEC 61672-1:2002 Class 2 and JIS C 1509-1 Class 2. Its hand-held and lightweight design makes the unit ideal for applications where portability is important. The NL-26 will serve not only as a general-purpose sound level meter but also for environmental measurements, engine noise measurements in car servicing facilities, and many other purposes.

Features

- Comes on with A weighting and Fast mode enabled, allowing it to be used immediately after power-on.
- Single measurement range extends from 30 to 137 dB. No need for cumbersome range selection to accommodate different measurement requirements.
- Extremely portable thanks to small size and light weight.
- Only three key switches make operation simple and straightforward.
- Specially developed LCD panel features easy-to-read numeric indication and a bar graph that visually shows the change in sound levels.
- A quick guide for Fast/Slow selection and measurement time setting is printed inside the front cover, for easy reference in the field.
- Operates continuously for up to 20 hours on two size AA batteries (alkaline batteries).
- Besides sound level measurement, the unit also has functions for measuring maximum level, equivalent continuous sound pressure level, and sound exposure level.

Controls and Functions

Front Panel



Microphone / preamplifier

Microphone and preamplifier are integrated in a single enclosure. An extension cable cannot be used.

Mode key

This key switches the sound level display and various processing functions. Holding down the key somewhat longer activates the mode for setting the time weighting (dynamic) characteristics (Fast / Slow) and the measurement time. (For details, see "Setting the time weighting (dynamic) characteristics (Fast / Slow) and measurement time" on page 14.)

A / C / Cal key

This key selects the frequency weighting characteristics and the calibration mode. At power-on, the "A" position is selected. Pressing the key once switches to "C" and pressing it once more switches to "Cal". The next key press switches back to "A" frequency weighting. In the "Cal" (calibration) mode, a 1 kHz sine wave signal is produced internally by the unit.

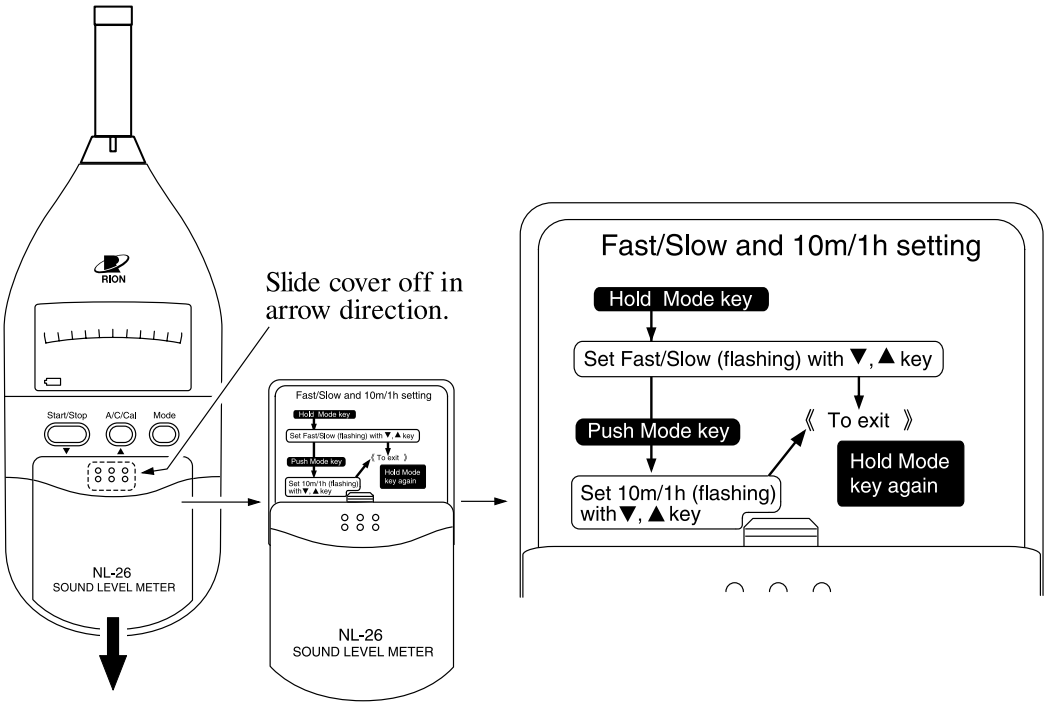
Start / Stop key

Pressing this key initiates or terminates the various measurement (or processing) functions.

Front cover

Inside this cover you will find step instruction for setting the time weighting (dynamic) characteristics (Fast / Slow) and the measurement time (see illustration below).

Note
Protective film The unit is shipped with a transparent film covering the explanation of time weighting characteristics and measurement time setting. If desired, you may peel off this film.

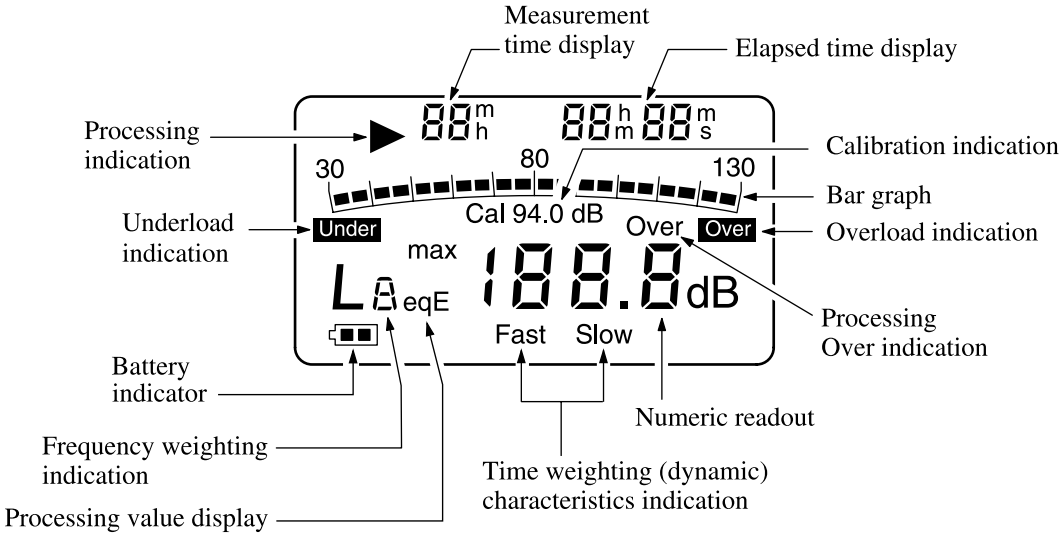


Hand strap

The strap should be used to safely carry the unit when making measurements (see page 13).

Indication display

The illustration below shows all indication fields and symbols on the LCD panel. In actual operation, not all of these will be visible at the same time.



Measurement time display

Shows the selected measurement time setting.

Elapsed time display

Shows the elapsed time during measurement in seconds.

Calibration indication

This indication appears when the calibration mode for calibration or checking has been activated with the A / C / Cal key.

Bar graph

Shows the sound level in graphical form.

Overload indication

Indicates that an excessive sound level signal was detected.

Processing Over indication

If an excessive sound level signal is detected during processing, this Over indication is shown until the start of the next processing cycle.

Numeric readout

Shows the measured sound level or processing result in numeric form.

Time weighting (dynamic) characteristics indication

Shows the selected time weighting characteristics.

Processing value display

Various processing values as switched by the Mode key can be shown here.

Frequency weighting indication

Shows the selected frequency weighting characteristics.

Battery indicator

This indicator lets you check the battery status. When the indicator starts to flash, replace the batteries, as described on page 9.

Underload indication

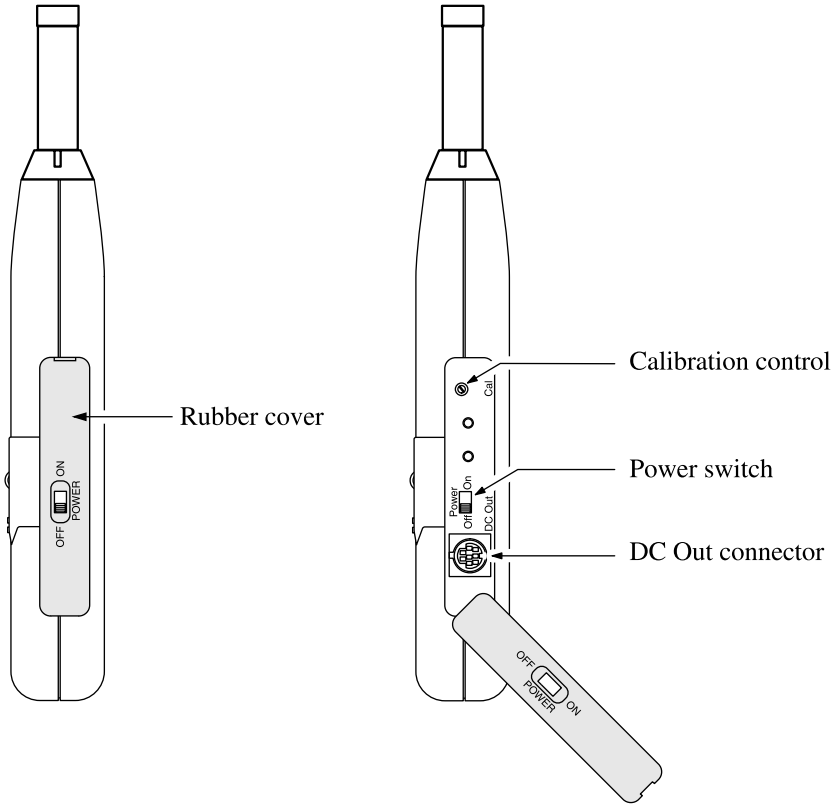
Indicates that an under-range sound level signal was detected.

Processing indication

When you press the Start / Stop key, this symbol starts to flash.

Note
About the Over indication This is displayed when excessive signal level has been detected. In such a case, the measurement range was exceeded and the indicated value may not be correct.

Side View



Rubber cover

This cover protects the calibration control and DC Out connector. Removing the cover gives access to these parts, as shown in the above illustration.

Calibration control

During calibration (see page 10).

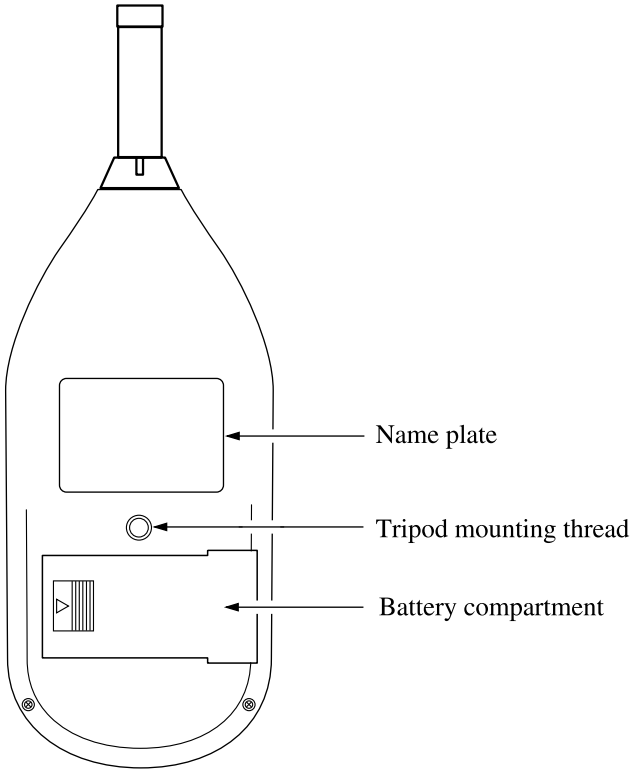
Power switch

Serves to turn the unit on and off.

DC Out connector

A DC signal corresponding to the sound level is available at this output. The signal after frequency weighting, time weighting, and logarithmic compression is output here.

Rear View



Tripod mounting thread

The unit can be mounted on a camera tripod using this thread.

Battery compartment

Two size AA batteries (IEC R6P or LR6) are inserted here (see page 8).

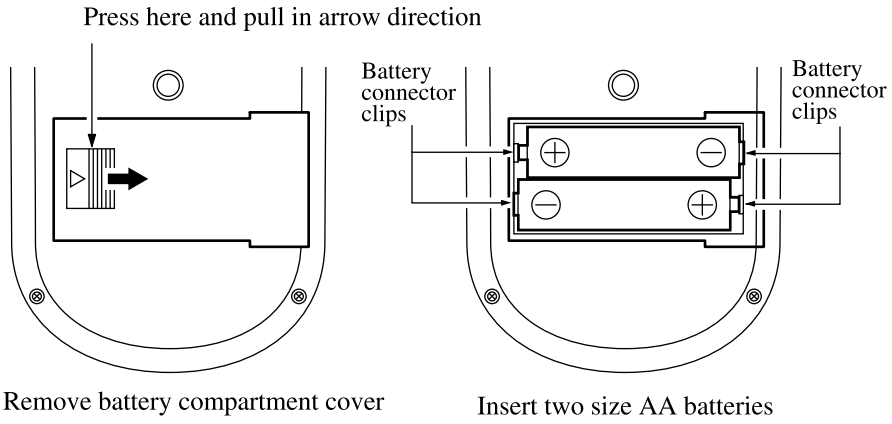
Preparations

Power Supply

⚠ Caution
Make sure that the power switch is set to "Off" before performing the following steps.

Inserting the Batteries

1. Remove the cover of the battery compartment on the rear of the unit.
2. Insert two size AA batteries (IEC R6P or LR6). Take care to establish correct polarity as indicated in the compartment.
3. Replace the cover of the battery compartment.



Important
● Take care not to reverse the (+) and (-) polarity when inserting the batteries. If batteries are inserted with wrong polarity, the unit will not operate. ● Always use two identical batteries, and replace batteries only as a set. Mixing battery types or old and new batteries can lead to damage. ● Remove the batteries from the unit when it is not used.

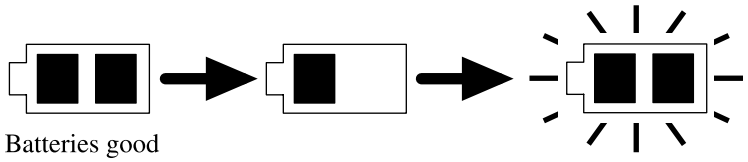
Note
The battery life will differ depending on ambient conditions. At 23ºC, a set of R6P (manganese) batteries will last for about 7 hours of continuous operation, and a set of LR6 (alkaline) batteries for about 20 hours.

Note
Do not subject the battery connector clips to strong force or stress. Otherwise insufficient spring force can lead to loss of proper battery contact.

Note
If symptoms such as abnormal screen indication or momentary interruption of power occur, you should have the unit checked and repaired as necessary.

Battery indicator

Check this indication before starting to use the unit. The number of black segments decreases as the battery capacity decreases. When the indication starts to flash, correct measurement is no longer possible. Replace the batteries.



Batteries good

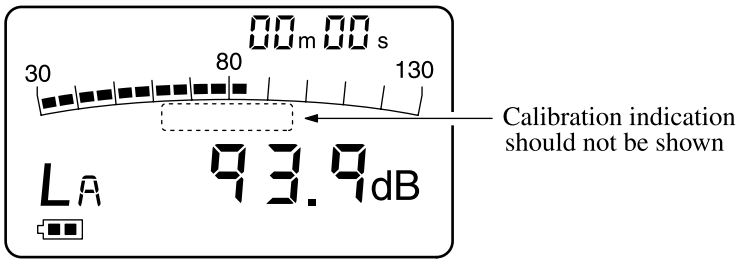
Flashing
Replace batteries

Calibration

Before starting a measurement, you should calibrate the unit as follows, using the sound calibrator NC-74.

Acoustic calibration with sound calibrator NC-74

1. Turn power to the sound calibrator NC-74 off.
2. Turn the power switch of the NL-26 on.
3. Verify that the display indication is for A-weighted sound level L_A.
4. Mount the 1/2 inch adapter on the coupler of the sound calibrator NC-74.
5. Insert the microphone very carefully and slowly all the way into the coupler.
6. Turn power to the sound calibrator NC-74 on.
7. Adjust the Cal control to obtain an L_A reading of 93.9 dB.



Display during calibration with Sound Calibrator NC-74

Note
The NC-74 is designed to produce 94.0 dB under certain conditions, but when used for sound level meter calibration, the exact value will differ for various models, depending on sound field compensation and other factors. For the NL-26, use a target reading value of 93.9 dB.

8. Turn power to the sound calibrator NC-74 off.
9. Remove the microphone very carefully and slowly from the coupler.

Note
For details on operation of the sound calibrator NC-74, please refer to its documentation.
The sound calibrator NC-74 automatically compensates for sound pressure variations caused by fluctuations in atmospheric pressure.
Change the position of the Cal control only when performing calibration with the sound calibrator NC-74. If the control was accidentally moved at another time, correct measurement may not be possible. Perform calibration again.

Calibration Signal Output

The calibration signal can be used to calibrate external equipment. To activate this signal, select the calibration signal output mode with the A / C / Cal key. The "Cal 94.0 dB" indication appears. To turn the signal off and return to normal measurement mode, press the A / C / Cal key again.

Calibration of external equipment

1. Select the calibration signal output mode with the A / C / Cal key.
2. Verify that the "Cal 94.0 dB" indication is shown.
3. Use the voltage output cable CC-26 (option) to connect the output connector of the NL-26 to the signal input connector of the external equipment. (NL-26 are equipped only with DC output.)
4. The numeric indication on the display of the NL-26 corresponds to the calibration signal voltage. Calibrate the external equipment based on this indication. (To perform calibration, use an appropriate feature of the external equipment, such as input signal level control or marker function.)
5. Press the A / C / Cal key to turn calibration signal output off.

Note
Do not use the Cal control on the NL-26 when performing calibration of external equipment. If the control was accidentally moved, correct measurement will be impaired, and calibration of the external equipment will also be wrong. For information on what to do in such a case, refer to the note in the preceding section (Sound Level Meter Calibration).

Factory default position of Cal control

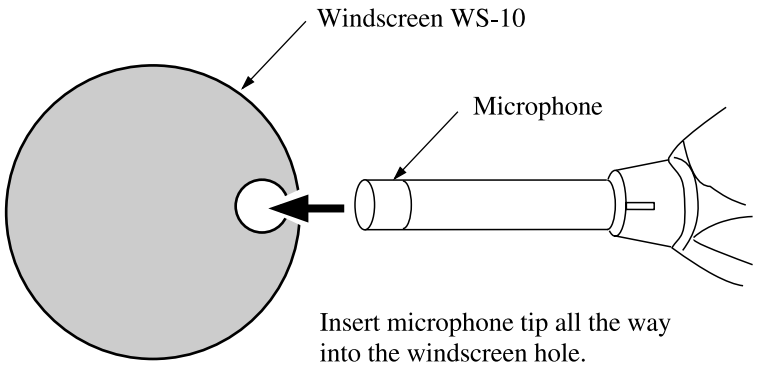
With the calibration signal output mode (Cal) is activated, the numeric indication of the NL-26 shows"94.0 dB" when the Cal control is in the factory default position.

Using a windscreen

During outdoor measurements on windy days or when measuring ventilation equipment, wind impact on the microphone can falsify measurement results.

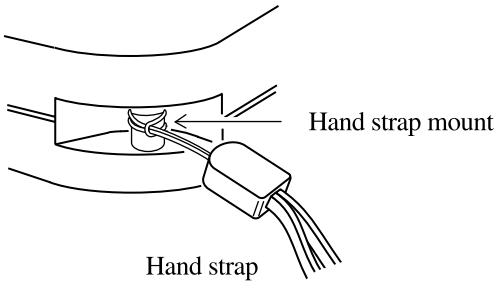
In such cases, the supplied windscreen WS-10 can be used to reduce the influence of wind noise. The windscreen attenuates wind noise by about 25 dB for sound level measurement (frequency weighting A) and 15 dB for sound pressure level measurement (frequency weighting C).

The influence of the windscreen on the acoustical properties of the microphone is within ±1.0 dB up to 8 kHz.



Hand strap

Attach the hand strap as shown below.
When holding the unit in your hand, pass this strap around your wrist to guard against dropping it.



Attaching the hand strap

Setting the time weighting characteristics F (Fast) / S (Slow) and measurement time

Proceed as follows to set the time weighting characteristics F (Fast) / S (Slow) and the measurement time.

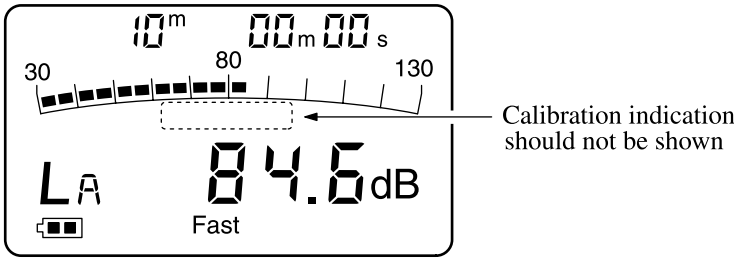
1. Verify that the Cal indication is not shown.
2. Hold down the Mode key somewhat longer.
3. The "Fast" or "Slow" indication flashes. This shows that the unit is in the condition for selecting the time weighting characteristics and for setting the measurement time. In this condition, the ▲ and ▼ keys change the time weighting characteristics setting to Fast or Slow.
4. When you press the Mode key in the condition of step 3, the measurement time indication starts to flash. The ▲ and ▼ keys now change the measurement time setting.
5. To terminate the setting, hold down the Mode key once more.

Measurement

When power to the unit is turned on, the following settings are selected: "A" weighting, Fast, measurement time 10 minutes

Sound level (L_A, L_C) measurement

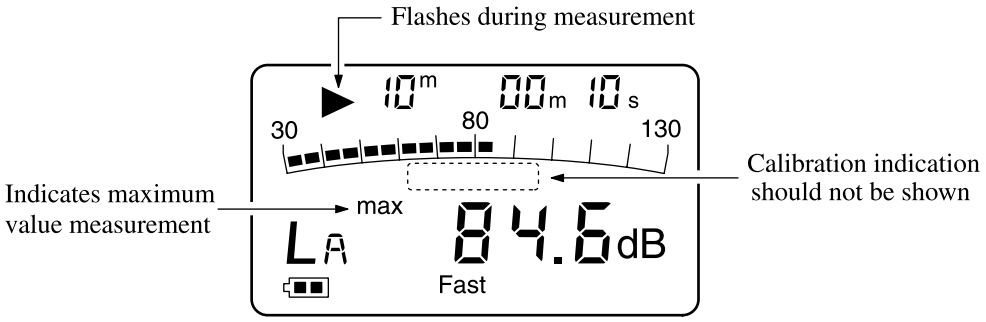
1. Verify that the Cal indication is not shown.
2. Use the A / C / Cal key to select "A" or "C". For normal sound level measurements, select "A" weighting.
3. Verify that the display does not show L_{max}, L_{eq}, or L_E. If any of these indications is shown, use the Mode key to turn it off.
4. Set the time weighting characteristics to "Fast" or "Slow". For details, see "Setting the time weighting characteristics (Fast / Slow) and measurement time" on page 14.
5. The sound level is shown, with the reading being updated every second.



Sound level measurement display example

Maximum level (L_{max}) measurement

1. Verify that the Cal indication is not shown.
2. Use the A / C / Cal key to select "A" or "C". For normal sound level measurements, select "A" weighting.
3. Use the Mode key to select the "L_{max}" indication.
4. Set the time weighting characteristics to "Fast" or "Slow". For details, see "Setting the time weighting characteristics (Fast / Slow) and measurement time" on page 14.
5. Set the measurement time to "5 m", "10 m" or "1 h". If the intended measurement time is less than 5 minutes, either setting can be selected. The maximum measurement time is one hour ("1 h" setting).
6. Press the Start / Stop key to start the measurement. The ▶ symbol starts to flash, and the maximum level value is held on the display.



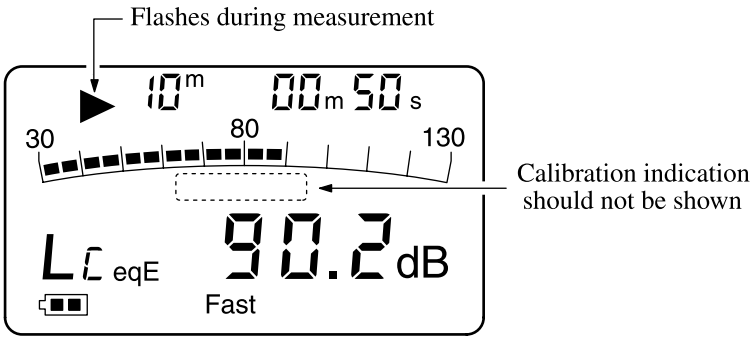
Measurement display example

7. To terminate the maximum level measurement, press the Start / Stop key once more. If the Start / Stop key is not pressed, the measurement will stop automatically after 5 minutes ("5 m" setting), 10 minutes ("10 m" setting) or one hour ("1 h" setting). When measurement terminates, the ▶ symbol goes out, and the maximum level value that was determined during the measurement is held until the next measurement.

Note
You can select either 5 minutes ("5 m"), 10 minutes ("10 m") or one hour ("1 h") for the measurement, but you can also terminate the measurement at any time with the Start / Stop key. The point at which the measurement is stopped becomes the actual measurement time.
The bar graph always shows the instantaneous sound level.

Equivalent continuous sound level (L_{eq}) and Sound exposure level (L_E) measurement

1. Verify that the Cal indication is not shown.
2. Use the A / C / Cal key to select "A" or "C". For normal sound level measurements, select "A" weighting.
3. Use the Mode key to select the "L_{eq}" indication for equivalent continuous sound pressure level measurement or the "L_E" indication for sound exposure level measurement.
4. Set the measurement time to "5 m" (5 minutes), "10 m" (10 minutes) or "1 h" (1 hour).
5. Press the Start / Stop key to start the measurement. The ▶ symbol starts to flash, and the measurement begins.



Measurement display example

6. To terminate the measurement, press the Start / Stop key once more. If the Start / Stop key is not pressed, the measurement will stop automatically after 5 minutes ("5 m" setting), 10 minutes ("10 m" setting) or one hour ("1 h" setting). When measurement terminates, the ▶ symbol goes out, and the measurement result is held until the next measurement.

Note
You can select either 5 minutes ("5 m"), 10 minutes ("10 m") or one hour ("1 h") for the measurement, but you can also terminate the measurement at any time with the Start / Stop key. The point at which the measurement is stopped becomes the actual measurement time.
Because the NL-26 carries out L_{eq} and L_E processing using a sound pressure waveform obtained with high-speed sampling (20.8 μs), the time weighting (dynamic) characteristics setting has no influence. Therefore the measurement result will be the same regardless of whether "Fast" or "Slow" is selected. For details regarding the processing principles, refer to pages 24 to 25.

Technical notes

Influence of Background Noise

When measuring a certain sound in a certain location, all other sounds present at that location except the measurement target sound are background noise (also called ambient noise or dark noise). Since the sound level meter will display the combination of target sound and background noise, the amount of background noise must be taken into consideration when determining the level of the target sound.

If the difference between the meter reading in absence of the target sound and the reading with the target sound is more than 10 dB, the influence of background noise is small and may be disregarded. If the difference is less than 10 dB, the values shown in the table below may be used for compensation, to estimate the level of the target sound.

Background noise compensation

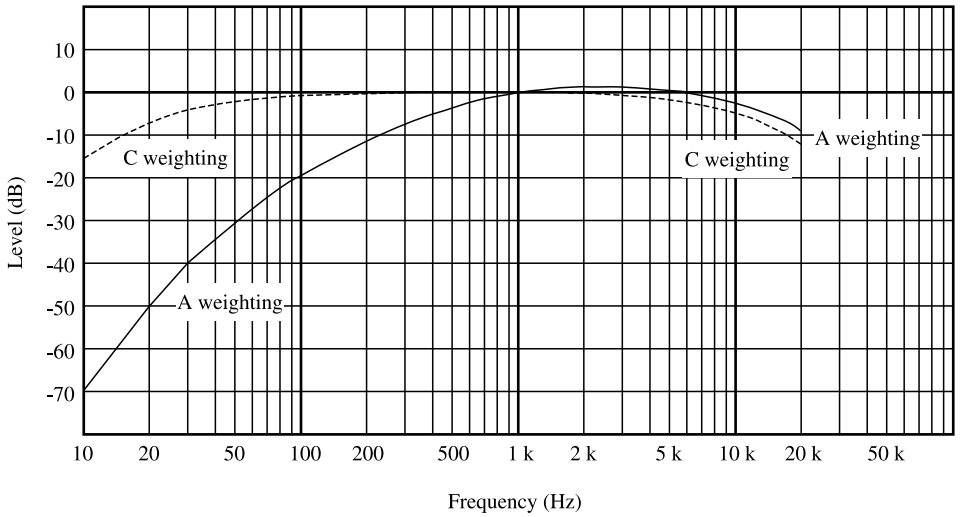
Display reading difference with and without target sound (dB)	4	5	6	7	8	9
Compensation value (dB)	-2		-1			

If for example the measured sound level when operating a machine is 70 dB, and the background noise level when the machine is not operating is 63 dB, the compensation value for the difference of 7 dB is -1 dB. Therefore the sound level of the machine can be taken to be 70 dB + (-1 dB) = 69 dB.

The above principle for compensating the influence of the background noise assumes that both the background noise and the target sound are approximately constant. If the background noise fluctuates, and especially if it is close in level to the target sound, compensation is difficult and will often be meaningless.

Frequency weighting characteristics

Frequency weighting in the Sound Level Meter NL-26 is achieved by a frequency compensation circuit for A and C. The electrical characteristics of the frequency compensation circuit are shown below.



Frequency weighting characteristics

The volume impression (loudness) of a sound depends not only on the sound pressure level, but also on the frequency. At high or low frequencies, a sound is felt to be less loud than a sound of equal level in the midrange. The "A" weighting curve compensates for this effect and produces measurement results which are close to the actual impression of loudness. For this reason, this type of frequency weighting is widely used for purposes such as sound level evaluation.

The "C" weighting curve produces almost flat response, but with a roll-off below 31.5 Hz and above 8 kHz. This is suitable for sound pressure level measurements in situations with unwanted low-frequency or high-frequency components.

Time weighting characteristics

During sound level measurements, the level often fluctuates drastically, which would make it difficult to evaluate readings if some kind of averaging is not applied. Sound level meters therefore provide the capability for index weighting (index averaging) using the rms circuit. These weighting characteristics are called the time weighting (dynamic) characteristics.

Major time weighting (dynamic) characteristics settings are Fast (F characteristics) and Slow (S characteristics). The time range that is considered for averaging is narrow in the "Fast" setting and wide in the "Slow" setting. In the "Fast" setting, the instantaneous level has a larger bearing on the displayed value than in the "Slow" setting. From the point of view of the measurement objective, the "Fast" setting is more suitable to situations with swiftly changing sound level, whereas the "Slow" setting yields a more broadly averaged picture.

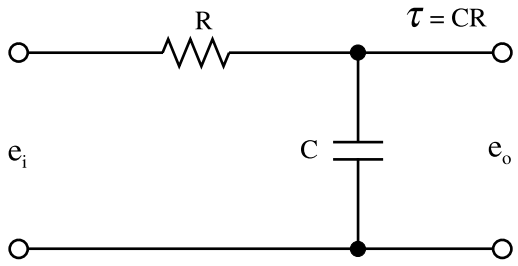
The "Fast" setting is more commonly used, and sound pressure level values given without other indication are usually made with "Fast" characteristics.

The "Slow" time weighting setting is suitable for measuring the average of sound with fairly constant levels. For example, in Japan aircraft noise and high-speed train noise is usually transient noise with high fluctuation, but in Japan, the "Slow" setting is used to determine the maximum level for each noise event.

Relation between time weighting (dynamic) characteristics and time constant

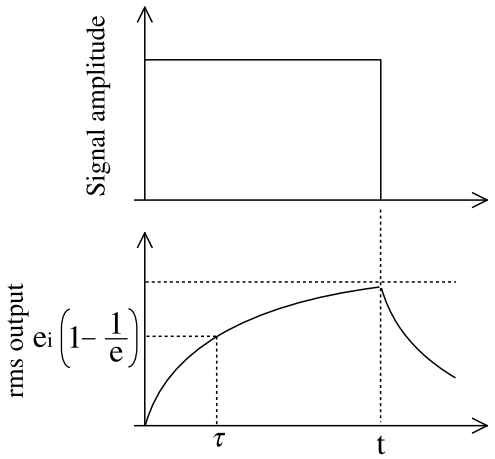
Time weighting characteristics	Time constant	
	Rise time	Fall time
F (Fast)	125 ms	125 ms
S (Slow)	1 s	1 s

The time constant circuit of the sound level meter performs exponential averaging on the square of the sound pressure signal. The equivalent circuit is shown below. τ is the time constant, which equals CR.



Equivalent electrical circuit

The response of the exponential averaging circuit to a single burst signal is shown below.



Burst signal response

e_i: Input voltage (proportional to square of sound pressure)
e_o: Output voltage
e: Natural logarithm base
τ: Time constant
t: Time

L_{Aeq} (Equivalent continuous sound level)

For a sound level signal that changes over time, the L_{Aeq} (equivalent sound level) is a constant sound level that has the same energy as the actually measured signal in the measurement interval. It is defined by the following equation.

$$L_{AeqT} = 20 \log_{10} \left\{ \left[\left(\frac{1}{T} \right) \int_{t_1}^{t_2} p_A^2 (t) \, dt \right]^{1/2} / p_0 \right\}$$

t: Time integral variable for period from time t_1 to t_2

T: Time when $T = t_2 - t_1$

$p_A(t)$: A-weighted instantaneous sound pressure at time t

p_0: Reference sound pressure 20 μPa (2×10^{-5} N / m^2)

In the NL-26, digital processing based on the following equation is used to determine L_{Aeq}.

$$L_{Aeq} = 20 \log_{10} \left\{ \left(\frac{1}{N} \sum_{i=1}^{N} p_A^2 (i) \right)^{1/2} / p_0 \right\}$$

N: Number of samples

In the NL-26, the sampling interval is 20.8 μs (48000 samples per second).

L_{AE} (Sound exposure level)

The L_{AE} (single-event sound exposure level) is a constant 1 second sound level having the same energy as a single-event sound level measured with A weighting. It is defined by the following equation.

$$L_{AE} = 10 \log_{10} \left\{ \left[\int_{t_1}^{t_2} p_A^2 (t)\, dt \right] \Big/ p_0^2 T_0 \right\} = L_{Aeq} + 10 \log_{10} (T / T_0)$$

t: Time integral variable for period from time t_1 to t_2
T: Time when $T = t_2 - t_1$
$p_A(t)$: A-weighted instantaneous sound pressure at time t
p_0: Reference sound pressure 20 μPa (2×10^{-5} N / m^2)
T_0: Reference time 1 second

In the NL-26, digital processing based on the following equation is used to determine L_{AE}.

$$L_{AE} = 10 \log_{10} \frac{1}{N_0} \sum_{i=1}^{N} \frac{p_A^2 (i)}{{p_0}^2}$$

N_0: Number of samples per second

In the NL-26, the sampling interval is 20.8 μs (48000 samples per second).

L_{Amax} (Maximum sound level)

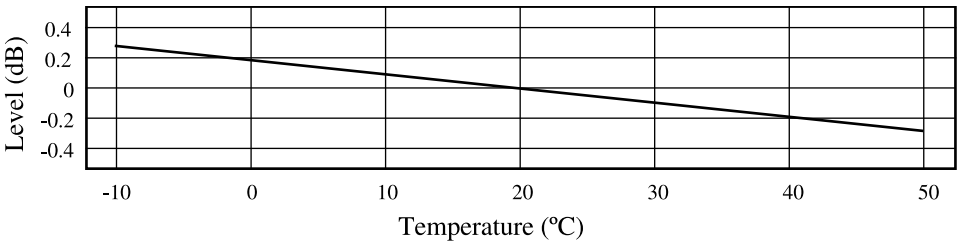
This is the maximum sound level encountered during a measurement. In the NL-26, the sampling interval is 20.8 μs, and the maximum value since the start of the measurement is retained. Therefore the L_{Amax} reading up to the current point can be displayed already during measurement. However, the display is updated only every second.

Microphone Specifications

Model:	UC-52
Nominal diameter:	1 / 2 inch
Sensitivity:	-33 dB (0 dB = 1 V / Pa)
Frequency response:	20 to 8000 Hz
Capacitance:	19 pF
Diaphragm type:	Titan alloy film
Temperature coefficient:	-0.008 dB / ºC (at 250 Hz)
Humidity-dependent sensitivity change:	
	0.1 dB or less
	(at 250 Hz, RH below 95%, no condensation)
Dimensions:	13.2 dia. ×12 mm

Thermal Characteristics

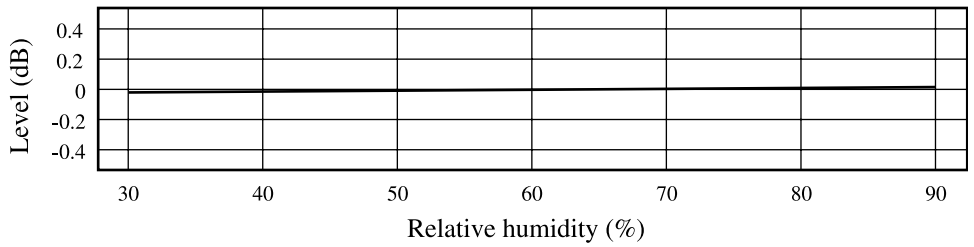
The thermal characteristics of a microphone indicate how sensitivity changes at various temperatures. This is influenced by the choice of materials and the design of the microphone. Normally, materials with a linear expansion coefficient are used. The diagrams below show the thermal characteristics of the microphone UC-52.



Thermal characteristics (at 250 Hz)

Humidity Characteristics

The humidity characteristics of a microphone indicate how sensitivity changes at various humidity levels. The diagrams below show the microphone UC-52.



Humidity characteristics (at 250 Hz)

Description for IEC 61672-1

9.2.1 General	
a) Type & Classification	Group X and Class 2
b) Configuration for normal mode of operation (Including windscreen)	See chapter of "Controls and Functions" and "Preparations".
c) Microphone	UC-52
d) Inapplicable	-
e) Inapplicable	-
9.2.2 Design features	
a) Acoustical quantities (measurement functions)	L_p, L_{eq}, L_{max}, L_E
b) Directional response and Free-field response	Fig. 1-1, 1-2, Tab. 1-1, 1-2
c) Frequency weighting characteristics	A, C
d) Time weighting characteristics	F, S
e) Measurement range (A-weighted, at 1 kHz)	Tab. 2
f) Operation of the level range control	There is no level range controls.
g) Display device	See paragraph of "Front panel" in "Controls and Functions". Cycle of display. Numerical value: 1 sec. Bar graph: 0.1 sec.
h) Total range	30 to 137 dB
i) Measurement range (L_{Cpeak})	Tab. 2
j) Inapplicable	-
k) Inapplicable	-
9.2.3 Power Supply	
a) Power supply: battery type & nominal battery life	R6P × 2 : > 7 hours LR6 × 2 : > 20 hours
b) Power supply: method of checking batteries	See paragraph of "Power Supply" in "Preparations".
c) Inapplicable	-
d) Inapplicable	-
9.2.4 Adjustments to indicated levels	
a) Sound calibrator model	NC-74 (RION)
b) Calibration check frequency	1 kHz
c) Calibration procedure	See paragraph of "Calibration" in "Preparations".
d) Microphone response & Body reflection	Fig. 2-1, 2-2

9.2.5 Operating the sound level meter	
a) Reference direction of incidence	Fig. 4
b) Procedures for measuring sound	See paragraph of "Sound level (L_A, L_C) measurement" in "Measurement". About influence of operator, see Fig. 5.
c) Procedure for selecting the level range	See paragraph of "Front panel" in "Controls and Functions".
d) Procedure for measuring low-level sound fields	See paragraph of "Influence of Background Noise" in "Technical notes".
e) Warming-up time	< 5 s
f) Settling time for valid readings	< 1 s
g) Time pre-set procedure	10 min. and 1 hour About procedure, see paragraph of "Setting the time weighting characteristics F (Fast)/ S (Slow) and measurement time" in "Preparations".
h) Minimum and maximum integration time	Minimum time: 1sec. Maximum time: 1 hour.
i) Operation of hold feature	See paragraph of "Maximum level (L_{Amax}) measurement" in "Measurement".
j) Operation of reset facility Nominal delay time	Measured value and Over indicator are reset at the time of a next measurement start. < 1 s
k) Overload and under range indicators	See paragraph of "Front panel" in "Controls and Functions".
l) Inapplicable	-
m) Inapplicable	-
n) Recommended cable length and type	CC-26 is recommended for standard conformity.
o) Self-generated noise (Specification)	A: < 22 dB (L_{Aeq}, 30 s) C: < 55 dB (L_{Cpeak}, 30 s)
p) DC output	Frequency weighting: A or C Voltage: 2.5 V (at 130 dB), 0.25 V/ 10 dB Output impedance: approx. 50 Ω Load impedance: > 10 kΩ

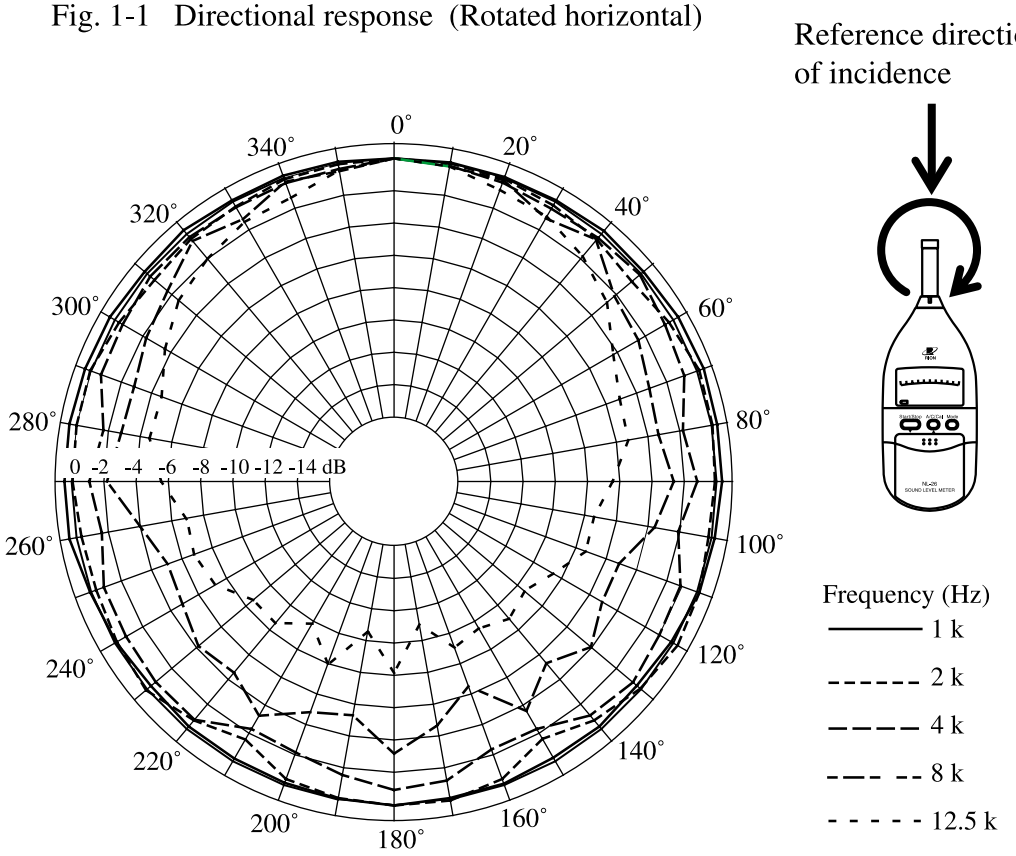
9.2.6 Accessories	
a) Influence of accessories (windscreen)	Fig. 6-1 to 6-4 Cannot complete IEC 61672-1 with windscreen.
b) Inapplicable	-
c) Inapplicable	-
d) Information of auxiliary devices	See paragraph of "Side view" in "Controls and Functions".
9.2.7 Influence of variations in environmental conditions	
a) Inapplicable	-
b) Degradation in performance or loss of functionality due to electrostatic discharges	Measured value may be influenced. However, it is temporary.
c) Statement of conforming to the basic statement	Tab. 3

9.3 The instruction manual shall contain the following information for testing, as appropriate to a sound level meter	
a) Reference sound pressure level	94 dB
b) Reference level range	30 to 130 dB range
c) Microphone reference point	Center point on diaphragm
d) Frequency response adjustment data for periodic testing	Tab. 4
e) A-weighted sound levels at upper and lower limit of each level range	Tab. 5
f) Starting point	Tab. 5
g) Electrical impedance for microphone substitution	dummy microphone capacitance : 19 pF (tolerance: within ±1.0 pF)
h) Self-generated noise (Typical value)	For microphone UC-52 (-30 dB (ref. 1 V/Pa)) A: Typ. 20 dB (L_{Aeq}) C: Typ. 43 dB (L_{Cpeak}) For dummy microphone A: Typ. 18 dB (L_{Aeq}) C: Typ. 39 dB (L_{Cpeak})
i) Highest sound pressure level Input voltage	150 dB 12 Vp-p
j) Maximum supply voltage Minimum supply voltage	3.5 V 1.8 V
k) Inapplicable	-
l) Time interval for stabilization	For temperature: < 1 hour For humidity: < 1 hour For static pressure: < 5 min.
m) Inapplicable	-
n) Setting and configuration for greatest RF emissions	Any setting and configuration is same.
o) Mode of operation with minimum immunity to RF fields Mode of operation with minimum immunity to a.c power fields	Fig. 7 Any setting and configuration is same.

Directional Characteristics

The directional characteristics of a microphone is a measure of its differing sensitivity for sound waves arriving from various angles. Since the prepolarized condenser microphone used in the NL-26 is a pressure-sensitive type, it should be equally sensitive in all directions. However, refraction and cavity effects cause a certain microphone directional response at high frequencies. The diagram below shows the directional response of the NL-26.

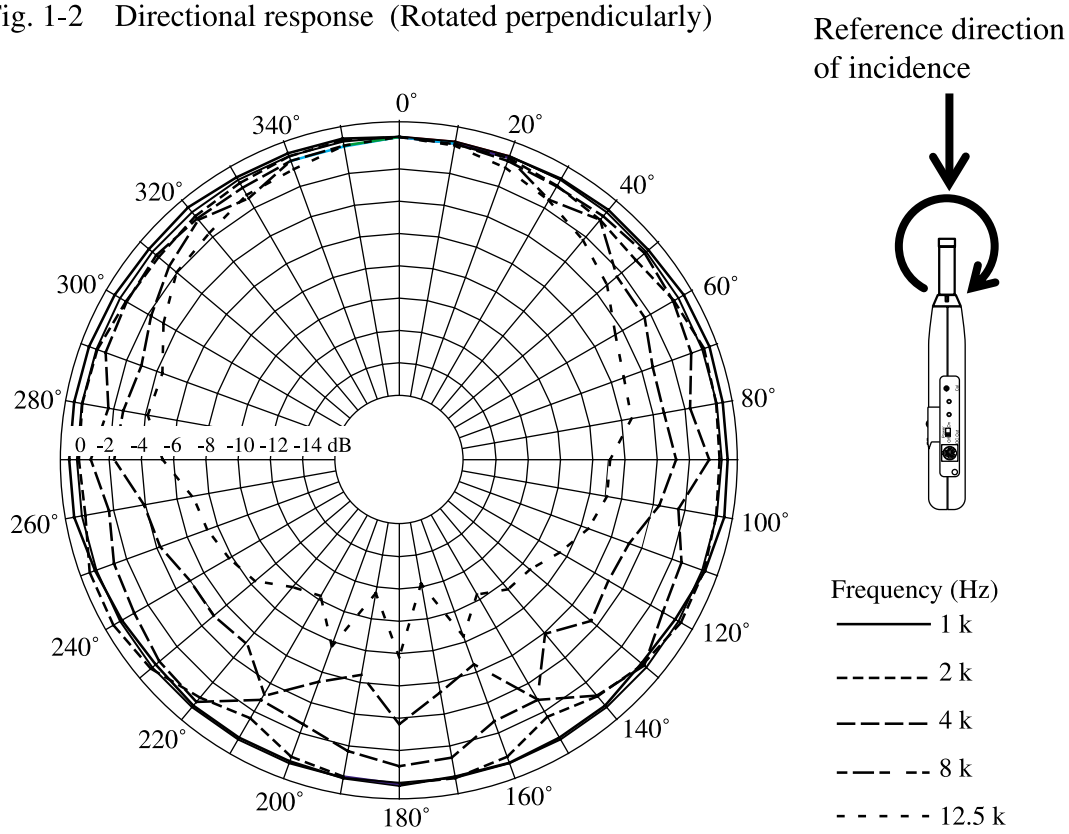
Fig. 1-1 Directional response (Rotated horizontal)



Tab. 1-1 Directional response (Rotated horizontal)

angle	Frequency (Hz)					angle	Frequency (Hz)				
	1 k	2 k	4 k	8 k	12.5 k		1 k	2 k	4 k	8 k	12.5 k
0°	0.0	0.0	0.0	0.0	0.0	180°	0.1	0.1	-0.9	-3.2	-8.2
10°	0.1	0.0	-0.2	-0.2	-0.2	190°	-0.1	-0.1	-1.6	-5.3	-10.5
20°	0.1	-0.1	-0.3	-0.2	-0.8	200°	-0.2	-0.4	-2.2	-4.8	-8.0
30°	0.1	-0.3	-0.5	-1.2	-1.1	210°	-0.2	-1.6	-2.3	-3.3	-9.8
40°	0.3	-0.5	-0.3	-0.5	-1.8	220°	-0.2	-0.7	-0.8	-4.6	-8.6
50°	0.2	-0.8	-0.1	-2.2	-2.8	230°	-0.3	0.1	-0.7	-4.2	-8.6
60°	0.4	-0.3	-0.6	-2.5	-4.3	240°	-0.1	-0.2	-0.8	-4.9	-7.2
70°	0.5	0.2	-0.9	-3.2	-5.1	250°	0.1	-0.4	-0.9	-5.1	-6.8
80°	0.4	0.1	-1.8	-3.4	-5.3	260°	0.5	-0.3	-1.6	-4.0	-6.8
90°	0.4	-0.1	-1.2	-2.7	-6.5	270°	0.5	-0.1	-1.1	-2.2	-5.6
100°	0.2	-0.2	-2.1	-3.6	-7.4	280°	0.5	-0.0	-1.7	-2.8	-4.6
110°	0.2	0.2	-1.1	-5.2	-7.4	290°	0.4	0.1	-0.7	-2.9	-4.7
120°	-0.2	0.3	-1.0	-5.1	-8.6	300°	0.4	-0.3	-0.6	-2.3	-3.6
130°	-0.4	-0.1	-0.7	-4.1	-9.1	310°	0.2	-0.6	-0.3	-1.7	-2.6
140°	-0.2	-0.7	-1.1	-5.3	-8.9	320°	0.3	-0.4	-0.3	-0.6	-2.0
150°	-0.3	-1.6	-2.3	-3.6	-9.5	330°	0.1	-0.4	-0.4	-1.3	-1.5
160°	-0.1	-0.4	-2.4	-6.5	-8.1	340°	0.2	-0.1	-0.4	-0.3	-1.3
170°	-0.1	0.1	-1.2	-4.7	-11.0	350°	0.1	-0.1	-0.4	-0.5	-0.5

Fig. 1-2 Directional response (Rotated perpendicularly)



Tab. 1-2 Directional response (Rotated perpendicularly)

angle	Frequency (Hz)					angle	Frequency (Hz)				
	1 k	2 k	4 k	8 k	12.5 k		1 k	2 k	4 k	8 k	12.5 k
0°	0.0	0.0	0.0	0.0	0.0	180°	0.2	0.1	-1.0	-3.6	-7.8
10°	0.0	-0.1	-0.1	-0.2	-0.3	190°	0.1	-0.1	-1.7	-6.5	-11.6
20°	0.0	-0.1	-0.3	-0.1	-0.8	200°	-0.1	-0.4	-2.6	-5.4	-7.8
30°	0.1	-0.4	-0.5	-1.4	-1.5	210°	-0.1	-1.5	-2.8	-3.1	-10.3
40°	0.2	-0.6	-0.3	-0.6	-2.3	220°	-0.1	-0.8	-0.4	-5.1	-9.7
50°	0.2	-0.8	-0.1	-2.4	-3.2	230°	-0.3	0.2	-0.6	-5.0	-8.3
60°	0.4	-0.3	-0.4	-2.4	-4.5	240°	-0.1	0.5	-1.0	-5.0	-7.8
70°	0.5	0.2	-0.7	-3.3	-5.2	250°	0.1	0.5	-1.2	-4.2	-7.2
80°	0.4	0.0	-1.7	-3.3	-5.4	260°	0.5	-0.2	-1.7	-3.9	-6.9
90°	0.4	-0.1	-0.8	-2.8	-6.9	270°	0.5	-0.1	-0.9	-2.3	-5.3
100°	0.5	0.0	-2.4	-3.6	-6.9	280°	0.5	0.0	-1.7	-2.6	-4.2
110°	0.2	0.2	-1.4	-4.8	-7.5	290°	0.5	-0.1	-0.6	-3.0	-4.4
120°	-0.2	0.2	-1.1	-5.0	-8.5	300°	0.4	-0.4	-0.5	-2.2	-3.1
130°	-0.4	-0.3	-0.2	-4.5	-9.4	310°	0.3	-0.5	-0.3	-1.4	-2.0
140°	-0.1	-0.9	-0.9	-5.9	-9.5	320°	0.4	-0.3	-0.5	-0.6	-1.7
150°	-0.1	-1.6	-2.8	-2.9	-10.4	330°	0.2	-0.2	-0.6	-1.3	-1.1
160°	0.0	-0.4	-2.8	-6.3	-8.4	340°	0.2	0.0	-0.3	-0.3	-0.9
170°	-0.1	0.1	-1.3	-5.4	-12.2	350°	0.2	0.1	-0.3	-0.3	-0.3

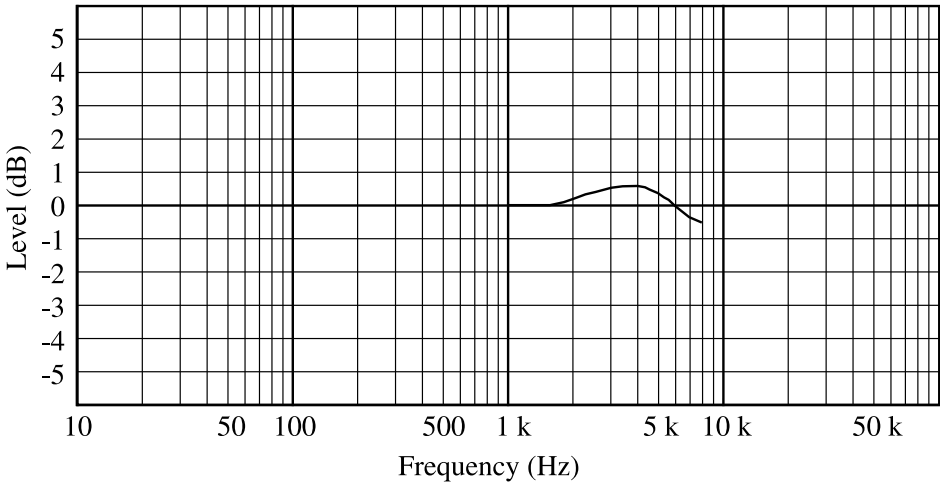
Measurement range

Tab. 2 Measurement range

Level range		L_A (dB)	L_C (dB)
30～130 dB	Upper limit	137	137
	Lower limit	30	36

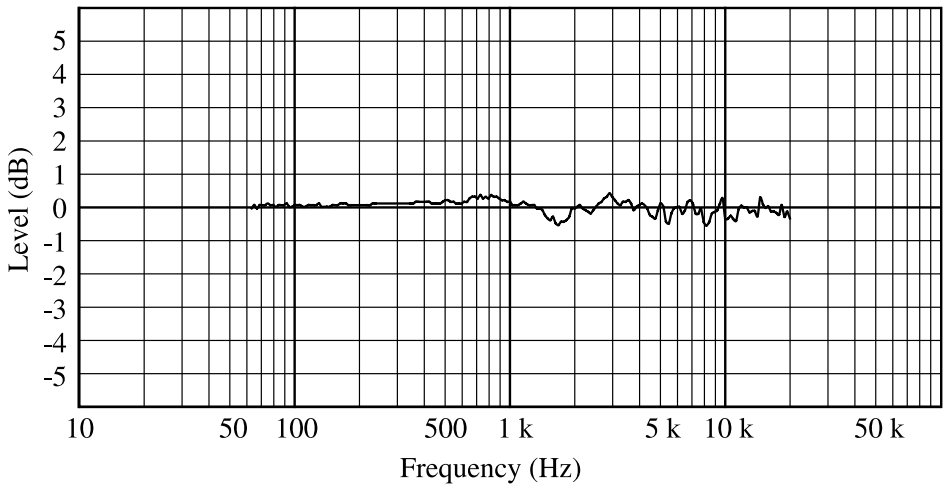
Free field microphone response

Fig. 2-1 Frequency response sample of microphone UC-52



Body reflection

Fig. 2-2 Body reflection



Random incidence response

Fig. 3 Random incidence response

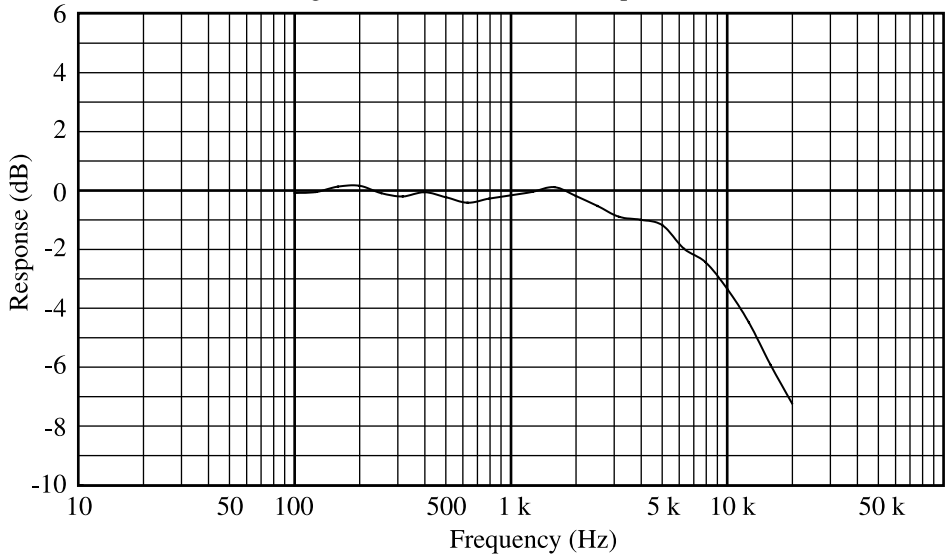
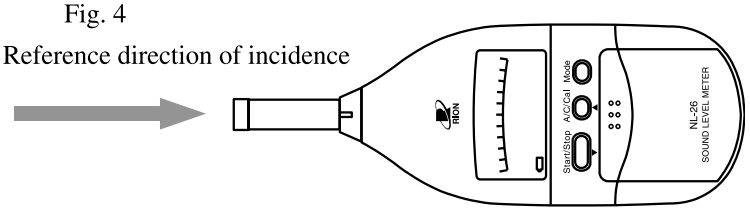
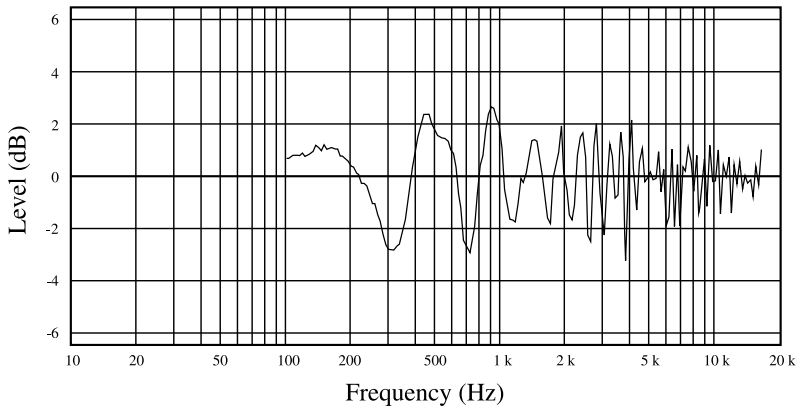


Fig. 4
Reference direction of incidence

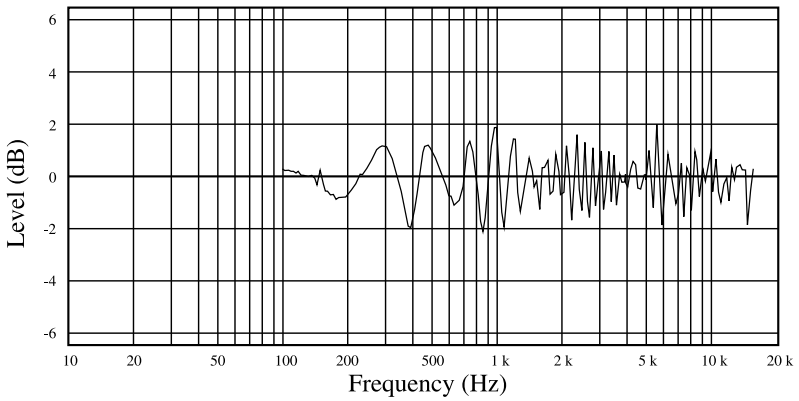


The NL-26 is designed to minimize reflections caused by the body of the unit. The charts below show the influence of the operator on the measurement.

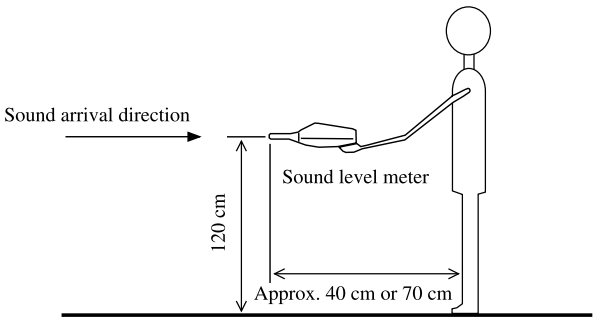
Fig. 5



Acoustical influence of sound level meter body (the distance from the top of the microphone to the operator is approx. 40 cm)



Acoustical influence of sound level meter body (the distance from the top of the microphone to the operator is approx. 70 cm)



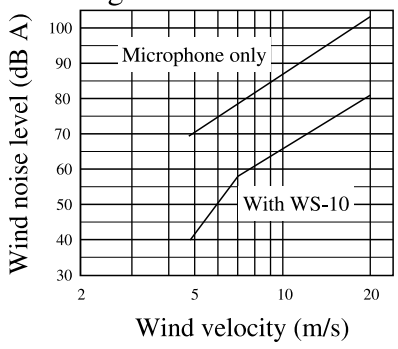
Measurement conditions for acoustical influence of operator

Influence of Windscreen

During outdoor measurements or measurement of ventilation devices, wind noise can falsify measurement results. To counter such problems, the supplied windscreen WS-10 should be mounted on the microphone. The characteristics of the WS-10 are shown below. The attenuation of wind noise produced by the windscreen is about 25 dB with frequency weighting A and 15 dB with frequency weighting C.

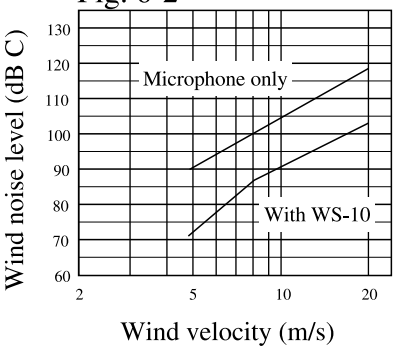
The influence of the windscreen WS-10 on the acoustic performance of the microphone is within ±1.0 dB up to 12.5 kHz, as shown in the diagram on the next page.

Fig. 6-1



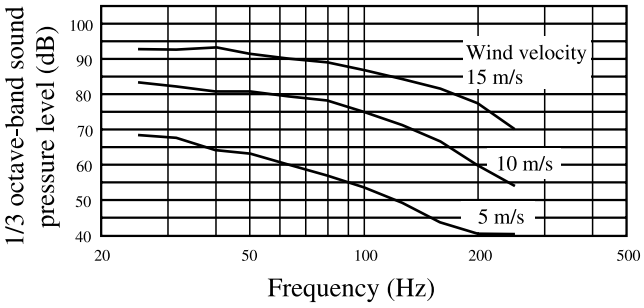
Frequency weighting A

Fig. 6-2



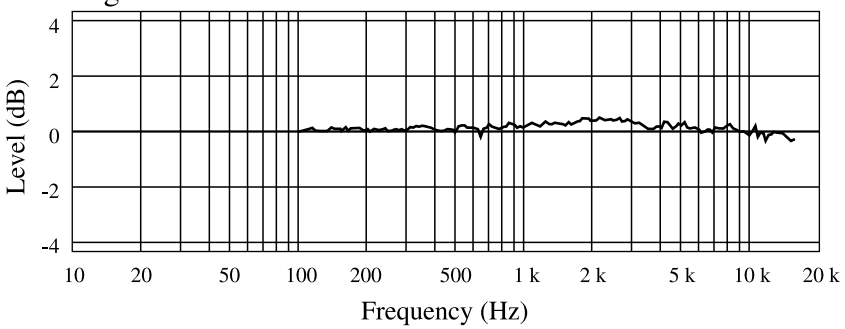
Frequency weighting C

Fig. 6-3



Frequency response of wind noise measured with windscreen WS-10 mounted on microphone

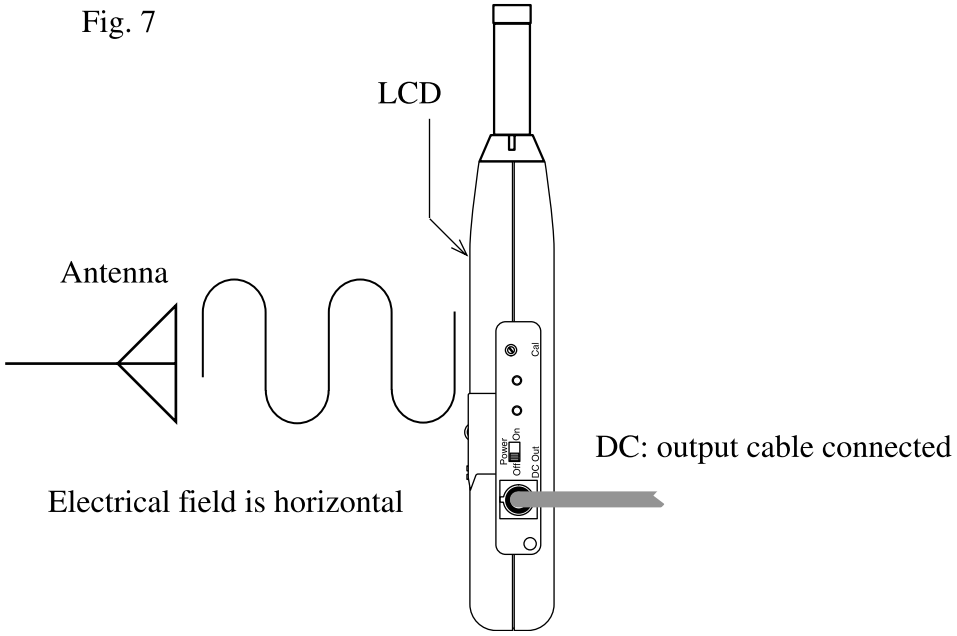
Fig. 6-4



Influence of windscreen WS-10 on acoustical properties of microphone (referred to microphone response without windscreen)

The greatest susceptibility configuration for radio frequency fields

Fig. 7



Statement of conforming to the statement

Tab. 3

Immunity (Radio frequency field)	The specification of IEC 61672-1 Class 2 is satisfied
Immunity (a.c power frequency field)	The specification of IEC 61672-1 Class 2 is satisfied
Emission	The specification of IEC 61672-1 Class 2 is satisfied

Frequency response adjustment data for periodic test

Tab. 4 Adjustment data for calibrated sound calibrator

Frequency (Hz)	Correction (dB)
125	0.0
1000	+0.2

Frequency (Hz)	Correction (dB)
4 k	+1.3
8 k	+3.2

The lower and upper limits of linear operating range

Tab. 5 The lower and upper limits of the liner operating range

		31.5 Hz	1 kHz	4 kHz	8 kHz	12.5 kHz
130 to 30 dB	Upper limit	97.0	137.0	137.0	135.0	132.0
	Starting point	54.0	94.0	94.0	94.0	94.0
	Lower limit	30.0	30.0	30.0	30.0	30.0

Specifications

Applicable standards	IEC 61672-1:2002 Class 2 JIS C 1509-1:2005 Class2
	IEC 60651 and IEC 60804 was withdrawn and replaced by IEC 61672-1:2002.
	JIS C 1502 was withdrawn and replaced by JIS C 1509-1.
Measurement functions	
	Sound level L_p Equivalent continuous sound level L_{eq} Sound exposure level L_E Maximum Sound level L_{max}
Measurement time	5 minutes*, 10 minutes and 1 hour (can be arbitrarily stopped during the measurement time) (* The "5 minutes" measurement time setting has been added in NL-26 whose serial number starts from 00742508.)
Measurement level range	
	30 to 137 dB
Noise floor	A weighting: 24 dB or less Typically 21 dB C weighting: 30 dB or less Typically 27 dB
Linearity range	107 dB
Reference sound pressure level	
	94 dB
Reference frequency	1000 Hz
Reference level range	30 to 130 dB (no range switching)
Frequency range	20 to 8000 Hz
Frequency weighting	A and C
Time weighting	F (Fast) and S (Slow)
Acoustic calibration	using sound calibrator NC-74

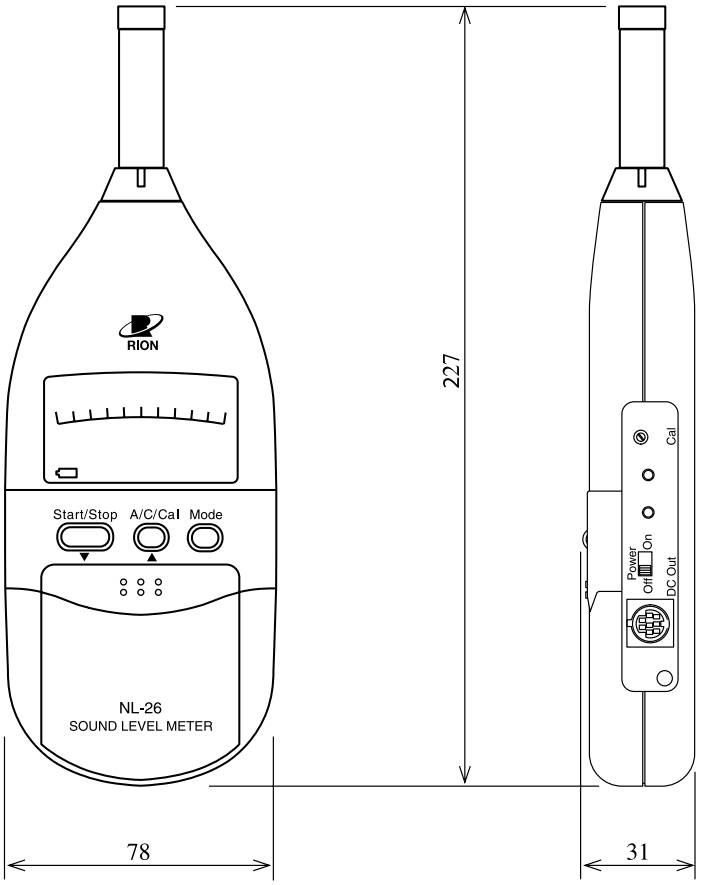
Microphone	1 / 2-inch prepolarized condenser type
	Model: UC-52
	Sensitivity: -33 dB (0 dB = 1 V / Pa)
Display	LCD
Numeric readout	resolution 0.1 dB, display update cycle 1 s
Bar graph	resolution 5 dB, scale range 100 dB, display update cycle 0.1 s
Warning indications	
Over (overload):	appears when level exceeds +7 dB from scale upper limit
Under (underload):	appears when level falls below -0.5 dB from scale lower limit
Battery capacity	3-stage indicator
Output	DC output connector
Output voltage:	2.5 V (at 130 dB), 0.25 V / 10 dB
Output impedance:	approx. 50 Ω
Load impedance:	10 kΩ or more
Power requirements	Two size AA batteries (IEC R6P or LR6; manganese or alkaline)
Battery life	Manganese batteries (R6P): approx. 7 hours continuous operation (at 23ºC) Alkaline batteries (LR6): approx. 20 hours continuous operation (at 23ºC) Battery life is 20% shorter when DC output is used or during Cal On.
Ambient conditions for operation	
	-10 to +50ºC, 10 to 90% RH (no condensation)
Dimensions	227 (length) × 78 (width) × 31 (thickness) mm
Weight	Approx. 240 g (including two batteries, R6P)

Supplied accessories

Windscreen	WS-10	1
Batteries	IEC R6P	2
Miniature screwdriver	D-62	1
Carrying case		1
Hand strap		1
Instruction Manual		1
Inspection certificate		1

Optional equipment

DC output cable	CC-26
Sound calibrator	NC-74



Unit: mm

Dimensional drawing of Sound Level Meter NL-26

No. 38142 06-11