

# **INSTRUCTION MANUAL**

Sound Level Meter

**NL-51**



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<http://www.rion.co.jp/english/>



## Organization of this manual

This manual describes the functions and operation of the Sound Level Meter NL-51. The 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, 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**

Gives requested-informations by IEC 61672-1:2002.

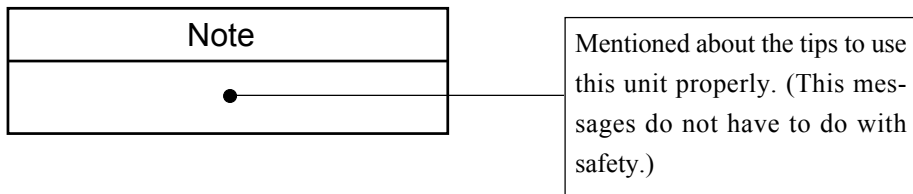
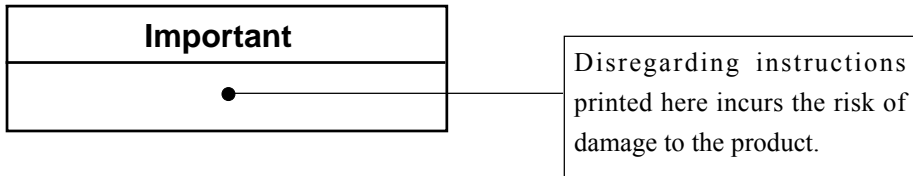
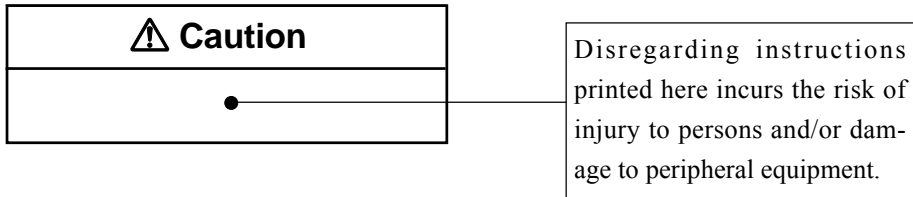
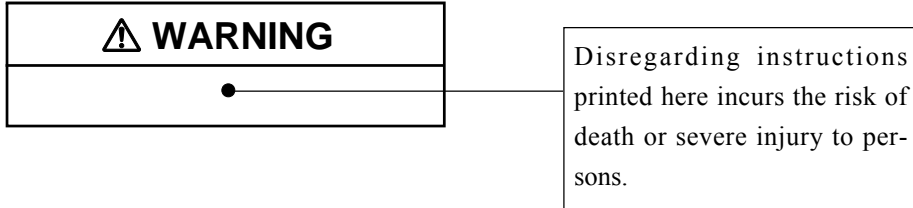
### **Specifications**

Lists the technical specifications of the unit.



## 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 +50°C. 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.
- If the unit has ceased to operate normally, 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

FOR SAFETY .....	iii
Precautions .....	v
Outline .....	1
Controls and Functions .....	2
Front Panel .....	2
Side View .....	6
Rear View .....	7
Preparations .....	8
Power Supply .....	8
Sound Level Meter Calibration .....	10
Calibration Signal Output .....	12
Using a windscreen .....	13
Hand strap .....	13
Measurement .....	14
A-weighted sound level ( $L_A$ ) measurement .....	14
Processing value ( $L_{Aeq}$ , $L_{Amax}$ , $L_{Cpeak}$ ) measurement .....	15
Technical notes .....	18
Influence of Background Noise .....	18
Frequency weighting characteristics .....	19
Time weighting (dynamic) .....	20
$L_{Aeq}$ (A-weighted equivalent continuous sound level) .....	22
$L_{Amax}$ (A-weighted maximum sound level) .....	23
$L_{Cpeak}$ (C-weighted peak sound level) .....	23
Microphone Specifications .....	24
Thermal Characteristics .....	25
Humidity Characteristics .....	25



Description for IEC 61672-1 .....	26
Directional Characteristics .....	30
Measurement range .....	33
Free field microphone response .....	34
Body reflection .....	34
Random incidence response compensation .....	35
Influence of Operator .....	36
Influence of Windscreen .....	37
The greatest susceptibility configuration	
for radio frequency fields .....	38
Statement of conforming to the basic statement .....	39
Frequency response adjustment data for periodic test .....	39
The lower and upper limits of the linear operating range	
(A-weighted sound level) .....	39
Specifications .....	40



# Outline

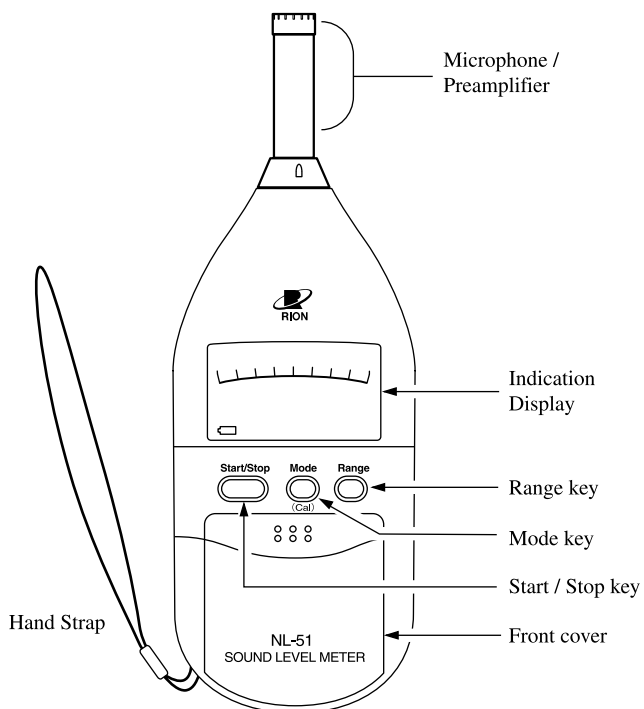
The NL-51 is a sound level meter compliant with the IEC 61672-1: 2002 Class 1 standard. The unit is compact and lightweight, making it ideal for use in the field.

## Features

- Simultaneously measures A-weighted sound level, A-weighted equivalent continuous sound level, A-weighted maximum sound level, and C-weighted peak sound level.
- Immediately ready for measurement after power-on. Only level range adjustment is required.
- Wide dynamic range (80 dB) eliminates the need for frequent level range switching.
- Only three ergonomic and well thought-out key switches make the unit easy and intuitive to operate. A guide to switch operation is printed inside the front cover, for quick reference in the field.
- Custom type LCD features easy-to-read numeric indication and bar graph display that shows level fluctuations at a glance.
- Light weight of only about 245 grams including batteries ensures easy portability.
- Approx. 16 hours continuous measurement are possible with two size AA batteries (IEC LR6 :alkaline batteries).

# Controls and Functions

## Front Panel



### Microphone / preamplifier

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

### Range key

This key selects the level range. After power-on, the level range is always set to 30 to 110 dB. Pressing the key toggles between the 30 to 110 dB and 60 to 140 dB settings.

### Mode key

This key switches the A-weighted sound level display and various processing functions. Holding down the key for 3 seconds or more activates the calibration signal output mode (Cal). In this mode, a 1 kHz sine wave signal is generated internally and supplied at the output, for calibration of external equipment.

## Start / Stop key

Pressing this key initiates or terminates the measurement processing functions.

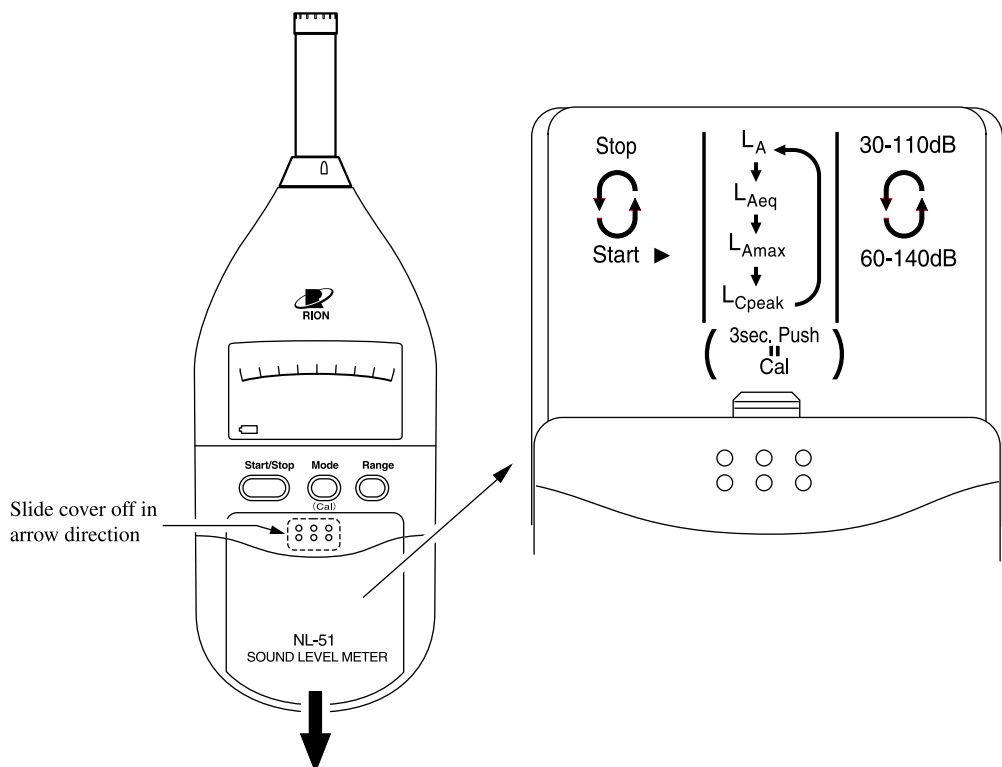
## Front cover

Inside this cover you will find step instruction for setting key switch (see illustration below).

### Note

#### Protective film

The unit is shipped with a transparent film covering the explanation of key switch setting. If desired, you may peel off this film.

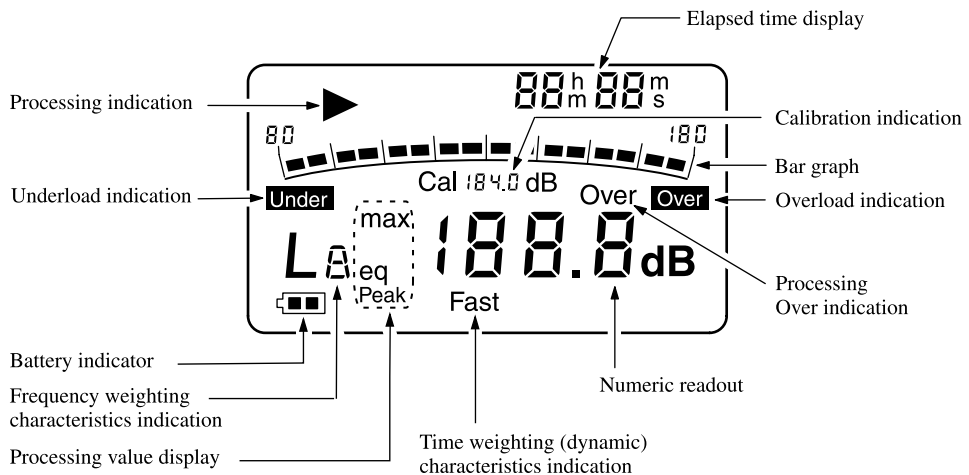


## Hand strap

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.



## Elapsed time display

Shows the elapsed time during measurement in seconds.

## Calibration indication

This indication appears when the Mode key was pressed for 3 seconds or more, for calibration of external equipment.

## Bar graph

Always indicates the A-weighted sound level  $L_A$ .

## 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

For A-weighted sound level  $L_A$  and A-weighted maximum sound level  $L_{Amax}$ , the indication "Fast" is shown here.

### Processing value display

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

### Frequency weighting characteristics indication

Shows the frequency weighting characteristics for each measurement.

### 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

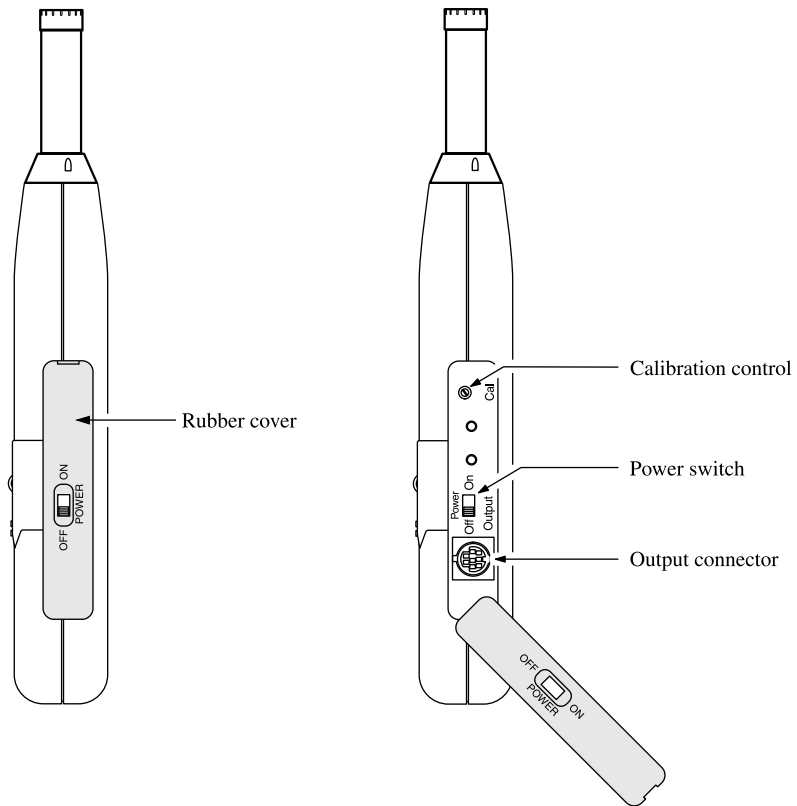
Indicates that an under-range sound level signal was detected.

### Processing indication

When this symbol flashes, a measurement is in progress.

<b>Note</b>
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. (Set the level range to 60 to 140 dB.)

## Side View



### Rubber cover

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

### Calibration control

This control serves for calibration of the unit.

### Power switch

Serves to turn the unit on and off.

### Output connector

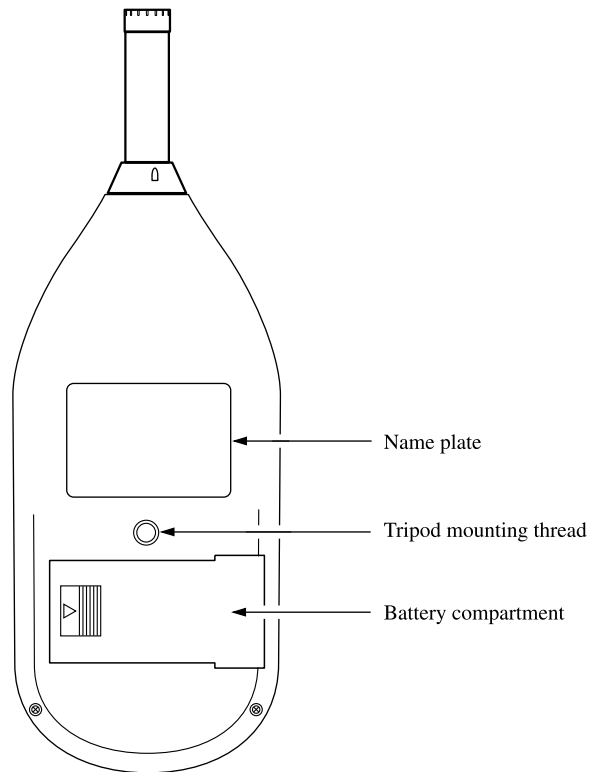
This connector provides an AC output signal. The signal is proportional to the sound pressure as picked up by the microphone. The signal has flat characteristics (not subject to frequency weighting or time weighting).

#### Note

This signal is not A-weighting. Be careful to connect it to the level recorder and so on.



## 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

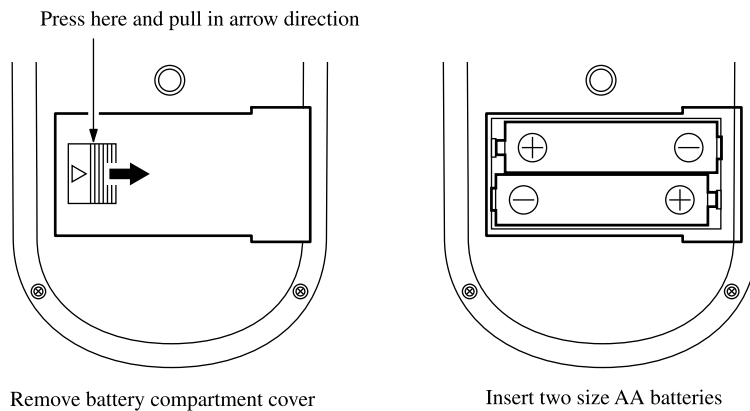
## Power Supply

### Important

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.

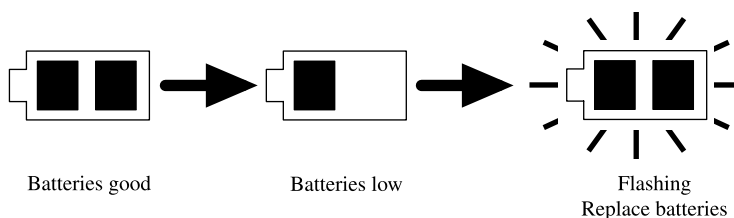
**Note**

The battery life will differ depending on ambient conditions.

At 23°C, a set of R6P (manganese) batteries will last for about 6 hours of continuous operation, and a set of LR6 (alkaline) batteries for about 16 hours.

**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.

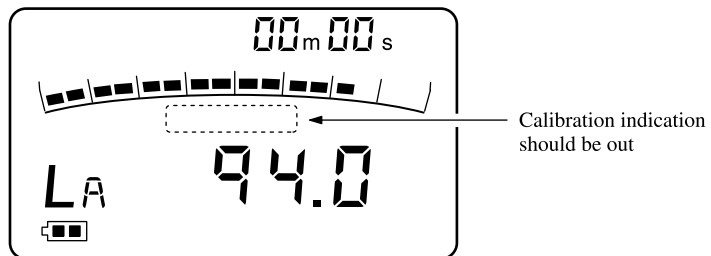


## Sound Level Meter Calibration

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-51 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 Calibration control to obtain an  $L_A$  reading of 94.0 dB.



Display during calibration with  
Sound Calibrator NC-74

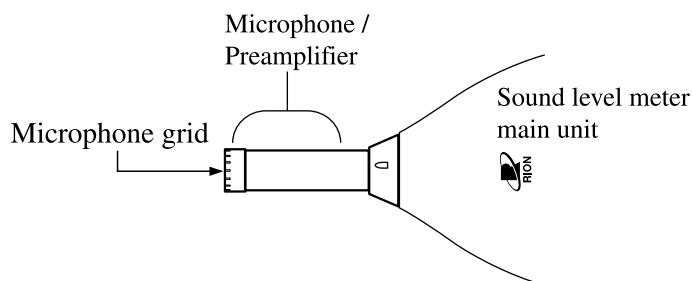
8. Turn power to the sound calibrator NC-74 off.
9. Remove the microphone very carefully and slowly from the coupler.

**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 Calibration 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.

**Microphone grid****Important**

Never remove the microphone grid, because this can lead to damage.

Before using the microphone and before putting it away, always check that the microphone grid has not become loose. If this has happened, refasten the microphone grid firmly and then use or store the microphone.

## Calibration Signal Output

The calibration signal can be used to calibrate external equipment. To activate this signal, press and hold the Mode key for 3 seconds or more. To turn the signal off and return to normal measurement mode, press the Mode key again.

### Calibration of external equipment

1. Press and hold the Mode key for 3 seconds or more to activate the calibration signal.
2. Verify that the Cal indication is shown.
3. Use the output cable CC-51 (option) to connect the Output connector of the NL-51 to the signal input connector of the external equipment.
4. The numeric indication on the display of the NL-51 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 an input signal level control or marker function.)
5. Press the Mode key to turn calibration signal output off.

Note
Do not use the Calibration control on the NL-51 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 (page 10).

### Factory default position of Cal control

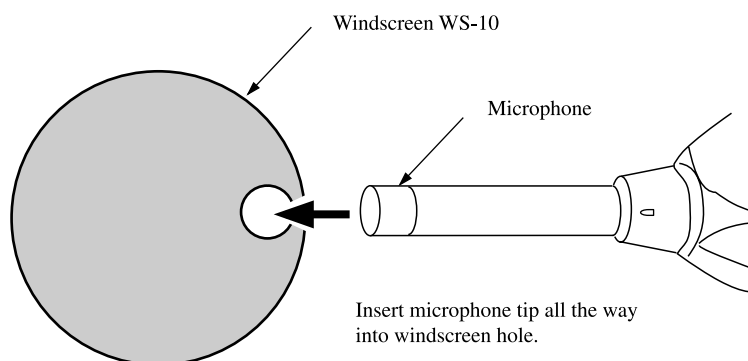
With the 30 to 110 dB level range selected and the calibration signal output mode (Cal) is activated, the numeric indication of the NL-51 shows "104.0 dB" when the Cal control is in the factory default position.

## 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).

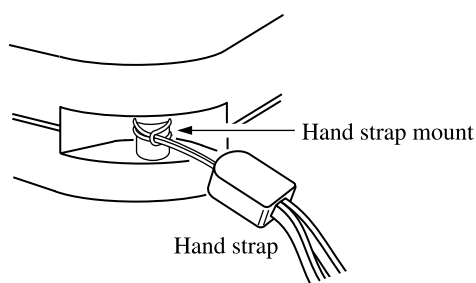
The influence of the windscreen on the acoustical properties of the microphone is within  $\pm 1.0$  dB up to 12.5 kHz.



## 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

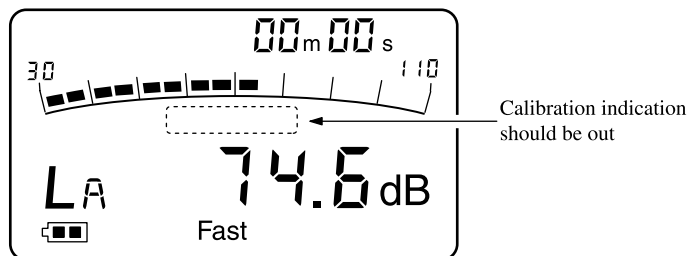
# Measurement

After power-on, the unit selects the 30 to 110 dB level range by default and displays the A-weighted sound level. Provided that level calibration has been performed properly, all that is needed for measurement is selecting the level range as necessary.

The A-weighted sound level  $L_A$  display can always be shown, with the display being updated every second. To display other values (A-weighted equivalent continuous sound level, A-weighted maximum sound level, C-weighted peak sound level), it is necessary to initiate the measurement by pressing the Start / Stop key. These three values are called processing values. While a measurement is in progress, the processing value up to that point is shown. When the measurement is finished, the final result is shown. (The A-weighted sound level  $L_A$  can be displayed at any time.)

## A-weighted sound level ( $L_A$ ) measurement

1. Verify that the Cal indication is not shown. (In calibration signal output mode, the A-weighted sound level reading is not available.)
2. Use the Range key to select the level range as necessary.
3. Use the Mode key to select A-weighted sound level  $L_A$ .
4. The A-weighted sound level  $L_A$  is shown, with the display being updated every second.



A-weighted Sound level :  $L_A$  measurement display example



## Processing value ( $L_{Aeq}$ , $L_{Amax}$ , $L_{Cpeak}$ ) measurement

The A-weighted equivalent continuous sound level  $L_{Aeq}$ , A-weighted maximum sound level  $L_{Amax}$ , and C-weighted peak sound level  $L_{Cpeak}$  are measured simultaneously. While a measurement is in progress, the processing value up to that point can be shown. Use the Mode key to select the desired value.

To stop the measurement at any time, press the Start / Stop key. If the Start / Stop key is not pressed, the measurement will stop automatically after one hour has elapsed.

1. Verify that the Cal indication is not shown. (In calibration signal output mode, measurement is not possible.)
2. Use the Range key to select the level range as necessary.
3. Use the Mode key to select the desired processing value.
4. Press the Start / Stop key to initiate the measurement.

When the measurement starts, the ► symbol flashes to indicate that a measurement is in progress. Regardless of which value is selected for display, all three values are calculated simultaneously. The Mode key can be used to switch between the values at any time.

5. To stop the measurement, press the Start / Stop key. If the Start / Stop key is not pressed, the measurement will be terminated automatically after one hour.

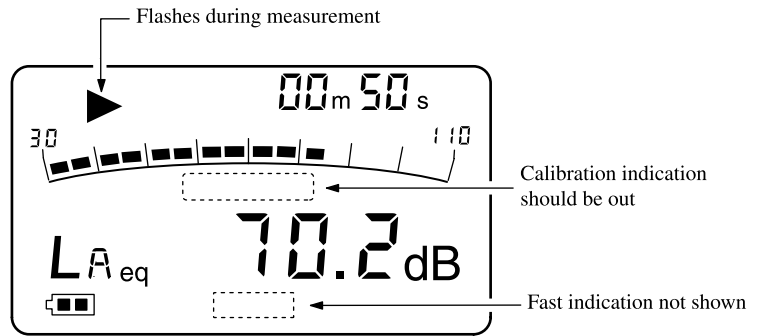
When measurement processing is completed, the ► symbol goes out. The measurement result is maintained until the start of the next measurement.

**Note**

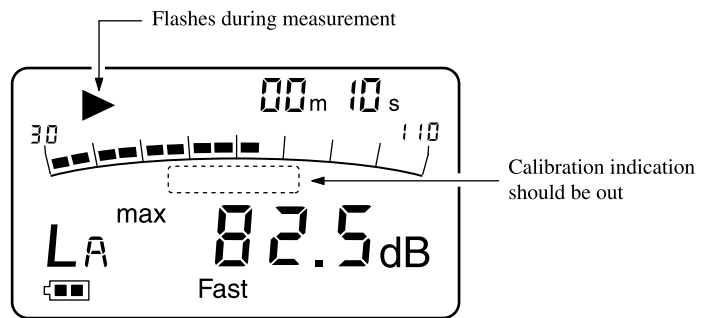
You can stop the measurement with the Start / Stop key at any point within one hour. When one hour has elapsed, the measurement will be stopped automatically. The actual duration of the processing measurement is always the time shown on the elapsed time display.

The bar graph always shows the A-weighted sound level.

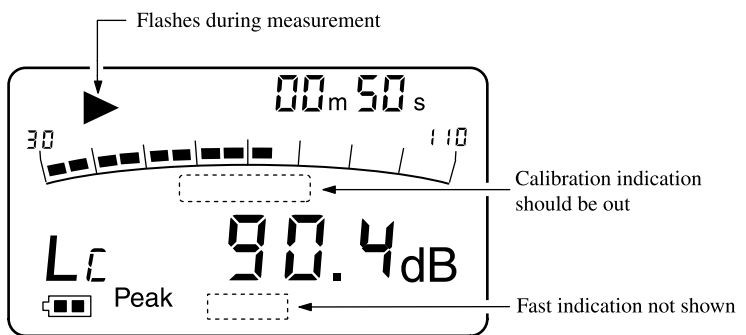
$L_{Aeq}$  and  $L_{Cpeak}$  are calculated using high-speed sampling (20.8  $\mu$ s). Therefore the time weighting (dynamic) characteristics have no influence on the result, and no time weighting indication is shown on the display. For details regarding the processing principles, refer to pages 22 to 23.



A-weighted equivalent continuous Sound level :  $L_{Aeq}$  measurement display



A-weighted maximum Sound level :  $L_{Amax}$  measurement display example



C-weighted peak sound level :  $L_{Cpeak}$  measurement display example

# 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

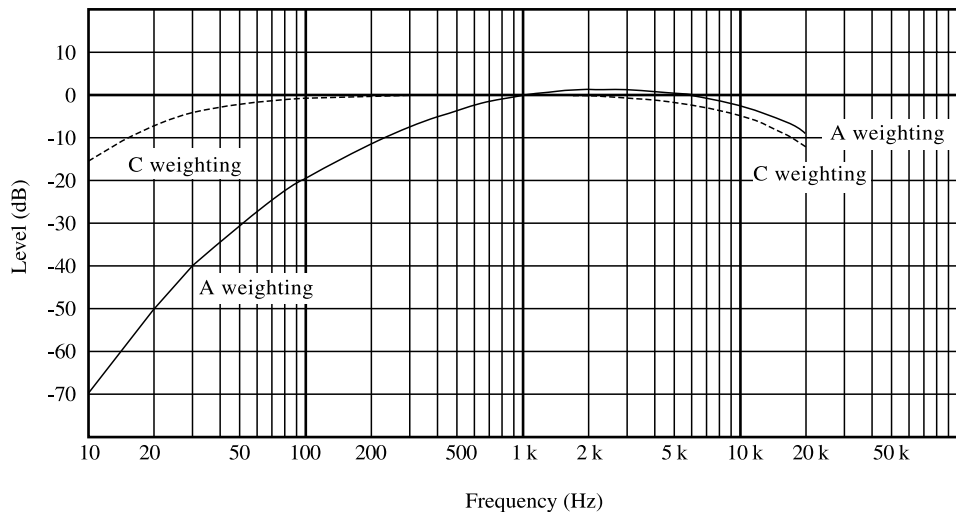
Display reading difference with and without target sound (dB)	4	5	6	7	8	9
Compensation value (dB)	-2		-1			

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  $70 \text{ dB} + (-1 \text{ dB}) = 69 \text{ dB}$ .

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-51 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.

The NL-51 normally uses only A-weighting, but C-weighting is used for  $L_{Cpeak}$ .

## Time weighting (dynamic)

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.

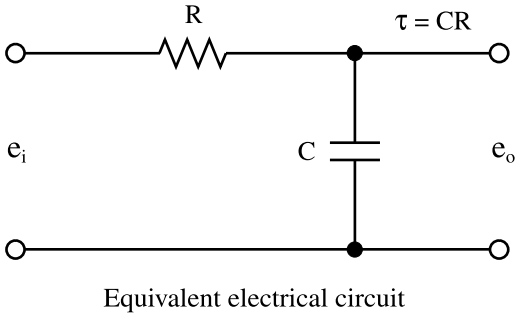
The "Slow" time weighting setting is suitable for measuring the average of sound with fairly constant levels. For example, in Japan aircraft noise and high-speed train noise is usually transient noise with high fluctuation, but in Japan, the "Slow" setting is used to determine the maximum level for each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

The NL-51 uses only the Fast time weighting characteristics.

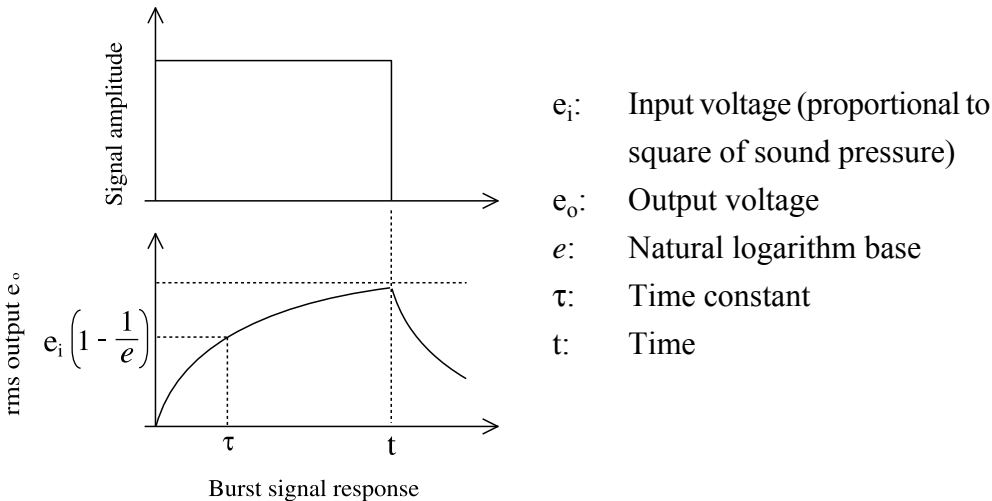
Relation between time weighting (dynamic) characteristics and time constant

Time weighting characteristics	Time constant	
	Rise time	Fall time
Fast	125 ms	125 ms
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.  $\tau$  is the time constant, which equals CR.



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



## $L_{Aeq}$ (A-weighted equivalent continuous sound level)

For a sound level signal that changes over time, the  $L_{Aeq}$  (A-weighted equivalent continuous 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.

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

$t$ : 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  $\mu\text{Pa}$  ( $2 \times 10^{-5} \text{ N / m}^2$ )

In the NL-51, 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-51, the sampling interval is 20.8  $\mu\text{s}$  (48000 samples per second).



## **$L_{Amax}$ (A-weighted maximum sound level)**

This is the maximum A-weighted sound level encountered during a measurement.

In the NL-51, the sampling interval is 20.8  $\mu$ s, 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.

## **$L_{Cpeak}$ (C-weighted peak sound level)**

This is the maximum C-weighted peak sound pressure level encountered during a measurement.

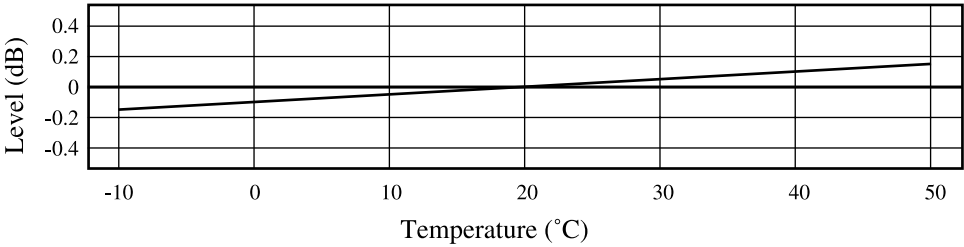
In the NL-51, the sampling interval is 20.8  $\mu$ s, and the maximum value since the start of the measurement is retained. Therefore the  $L_{Cpeak}$  reading up to the current point can be displayed already during measurement. However, the display is updated only every second.

## Microphone Specifications

Model:	UC-53A
Nominal diameter:	1 / 2 inch
Sensitivity:	-28 dB (0 dB = 1 V / Pa at 1000 Hz)
Frequency response:	10 to 20000 Hz
Capacitance:	12 pF
Diaphragm type:	Titanium alloy film
Temperature coefficient:	+0.005 dB / °C (at 250 Hz)
Humidity-dependent sensitivity change:	0.1 dB or less (at 250 Hz, RH below 95%, no condensation)
Dimensions:	13.2 dia. × 12.9 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.

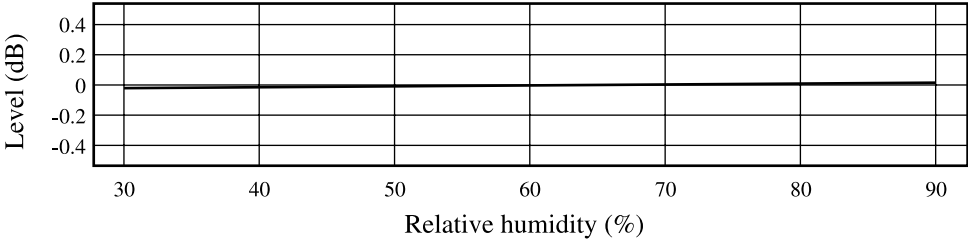


Thermal characteristics (at 250 Hz)

### Humidity Characteristics

The humidity characteristics of a microphone indicate how sensitivity changes at various humidity levels.

The diagrams below show the microphone UC-53A.



Humidity characteristics (at 250 Hz)

# Description for IEC 61672-1

<b>9.2.1 General</b>	
a) Type & Classification	Group X and Class 1
b) Configuration for normal mode of operation (Including windscreen)	See chapter of "Controls and Functions" and "Preparations".
c) Microphone	UC-53A
d) Inapplicable	-
e) Inapplicable	-
<b>9.2.2 Design features</b>	
a) Acoustical quantities (measurement functions)	$L_A, L_{Aeq}, L_{Amax}, L_{Cpeak}$
b) Directional response and Free-field response	Fig. 1-1, 1-2, Tab. 1-1, 1-2
c) Frequency weighting characteristics	A (RMS, $L_{eq}$ ), C ( $L_{peak}$ )
d) Time weighting characteristics	F
e) Measurement range (A-weighted, at 1 kHz)	Tab. 2
f) Operation of the level range control	See paragraph of "Front panel" in "Controls and Functions".
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 140 dB
i) Measurement range ( $L_{Cpeak}$ )	Tab. 2
j) Inapplicable	-
k) Inapplicable	-
<b>9.2.3 Power Supply</b>	
a) Power supply: battery type & nominal battery life	R6P × 2 : > 6 hours LR6 × 2 : > 16 hours
b) Power supply: method of checking batteries	See paragraph of "Power Supply" in "Preparations".
c) Inapplicable	-
d) Inapplicable	-
<b>9.2.4 Adjustments to indicated levels</b>	
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 "A-weighted sound level ( $L_A$ ) measurement" in "Measurement". About influence of operator, see Fig. 5-1, 5-2.
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	Fixed in 1 hour
h) Minimum and maximum integration time	Minimum: 1 sec. Maximum: 1 hour.
i) Operation of hold feature	See paragraph of "Processing value ( $L_{Aeq}$ , $L_{Amax}$ , $L_{Cpeak}$ ) 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-51 is recommended for standard conformity.
o) Self-generated noise (Specification)	A: < 22 dB ( $L_{Aeq}$ , 30s)
p) AC output	Frequency weighting: FLAT Voltage: Full scale 1 Vrms Output impedance: < 600 $\Omega$ Load impedance: > 10 k $\Omega$

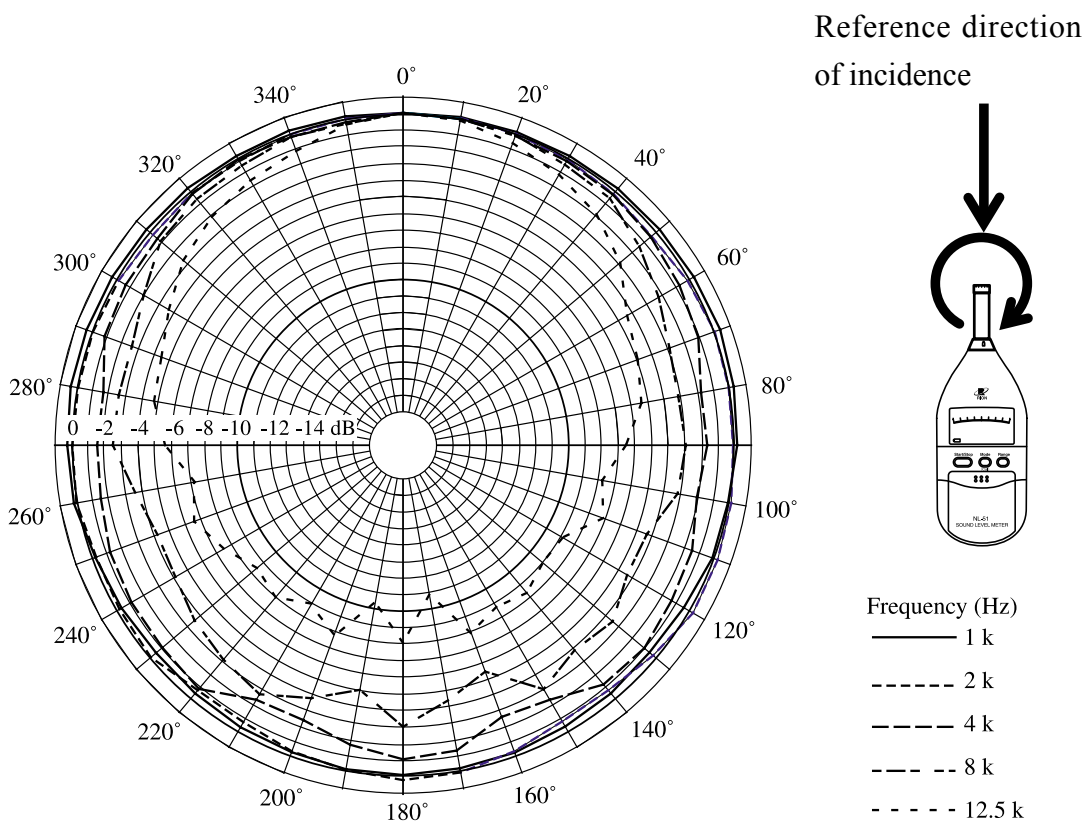
9.2.6 Accessories	
a) Influence of accessories (windscreen)	Fig. 6-1 to 6-4
	Cannot complete IEC 61672-1 with windscreen.
b) Inapplicable	-
c) Inapplicable	-
d) Information of auxiliary devices	See paragraph of "Side view" in "Controls and Functions".
9.2.7 Influence of variations in environmental conditions	
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 110 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 : 12 pF (tolerance: within $\pm 1.0$ pF)
h) Self-generated noise (Typical value)	For microphone UC-53A (-27 dB (ref. 1 V/Pa)) A: Typ. 17 dB ( $L_{Aeq}$ ) For dummy microphone A: Typ. 15 dB ( $L_{Aeq}$ )
i) Highest sound pressure level Input voltage	150 dB 12 V <sub>p-p</sub>
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	Fig. 7
Mode of operation with minimum immunity to a.c power fields	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-51 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 microphone UC-53A.

Fig. 1-1 Directional response (Rotated horizontal)

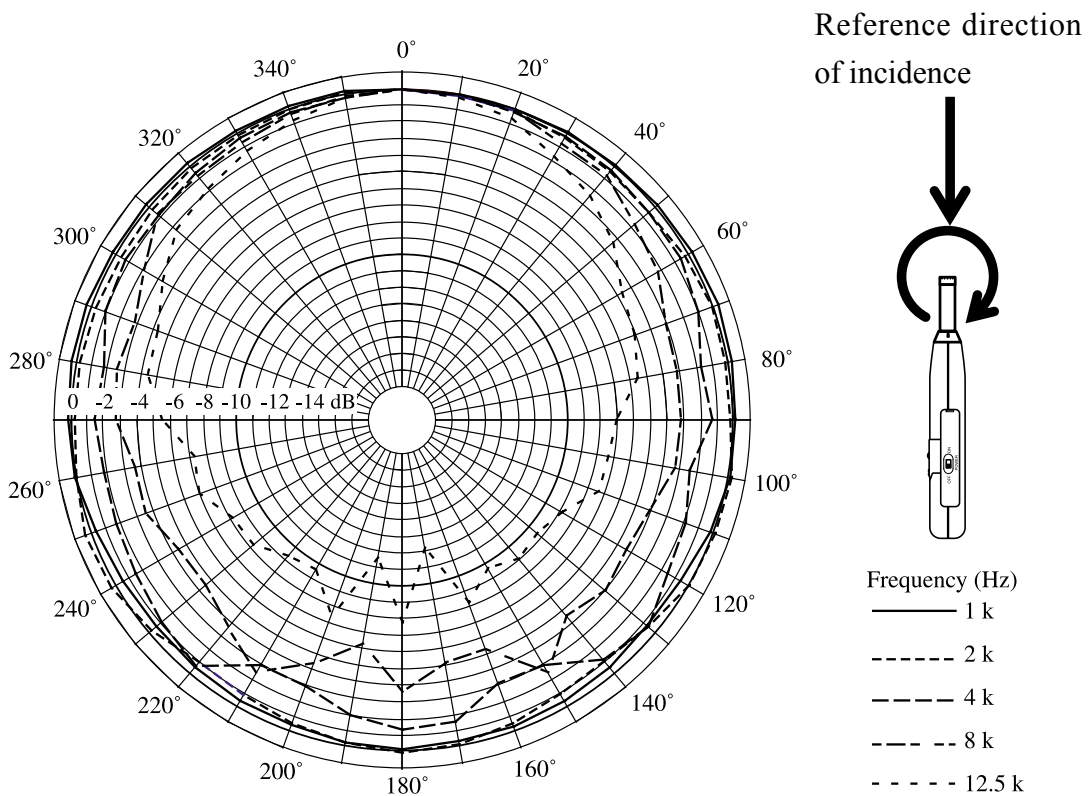




Tab.1-1 Directional response (Rotated horizontal)

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°	-0.2	0.2	-1.1	-3.1	-8.1
10°	0.1	0.0	-0.1	-0.1	-0.2	190°	-0.2	-0.2	-1.7	-5.1	-10.4
20°	0.1	-0.1	-0.2	-0.2	-0.7	200°	-0.4	-0.4	-2.4	-3.8	-7.8
30°	0.1	-0.2	-0.3	-0.5	-1.2	210°	-0.4	-0.8	-2.3	-2.7	-9.0
40°	0.2	-0.3	-0.3	-0.6	-1.9	220°	-0.5	-0.8	-0.9	-3.2	-8.1
50°	0.2	-0.5	-0.5	-1.4	-2.9	230°	-0.6	-0.2	-1.1	-3.6	-8.5
60°	0.3	-0.2	-0.8	-2.2	-4.4	240°	-0.4	-0.3	-1.1	-4.2	-7.5
70°	0.4	0.0	-1.1	-2.9	-5.0	250°	-0.3	-0.3	-1.2	-4.3	-6.6
80°	0.3	-0.1	-1.8	-3.2	-5.4	260°	0.2	0.0	-1.5	-3.6	-7.2
90°	0.2	-0.1	-1.7	-3.0	-6.6	270°	0.3	-0.1	-1.6	-2.5	-5.7
100°	-0.1	0.1	-2.0	-3.2	-7.8	280°	0.4	-0.1	-1.7	-2.6	-4.8
110°	-0.2	0.2	-1.5	-4.4	-7.2	290°	0.3	-0.1	-0.9	-2.6	-4.5
120°	-0.5	0.2	-1.3	-4.4	-8.9	300°	0.3	-0.2	-0.7	-2.0	-3.7
130°	-0.6	-0.3	-1.0	-3.5	-9.0	310°	0.2	-0.3	-0.7	-0.9	-2.7
140°	-0.5	-0.8	-1.2	-3.9	-8.4	320°	0.2	-0.2	-0.3	-0.7	-2.1
150°	-0.5	-0.8	-2.3	-3.1	-8.8	330°	0.1	-0.3	-0.2	-0.6	-1.6
160°	-0.3	-0.4	-2.6	-5.5	-7.9	340°	0.2	-0.1	-0.3	-0.3	-1.2
170°	-0.3	0.0	-1.4	-4.4	-10.9	350°	0.1	-0.1	-0.3	-0.4	-0.4

Fig. 1-2 Directional response (Rotated horizontal)



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°	0.0	0.2	-1.2	-3.5	-7.7
10°	0.0	-0.1	0.0	0.0	-0.2	190°	-0.1	-0.1	-1.8	-6.2	-11.5
20°	0.0	-0.1	-0.2	-0.1	-0.6	200°	-0.3	-0.4	-2.8	-4.4	-7.6
30°	0.1	-0.3	-0.2	-0.7	-1.6	210°	-0.3	-0.7	-2.8	-2.5	-9.5
40°	0.1	-0.4	-0.3	-0.7	-2.3	220°	-0.4	-0.8	-0.5	-3.7	-9.2
50°	0.2	-0.5	-0.5	-1.6	-3.3	230°	-0.5	-0.1	-0.9	-4.4	-8.2
60°	0.3	-0.2	-0.5	-2.1	-4.6	240°	-0.4	0.4	-1.3	-4.3	-8.1
70°	0.4	0.0	-0.9	-3.0	-5.0	250°	-0.2	0.5	-1.5	-3.4	-7.0
80°	0.3	-0.1	-1.6	-3.1	-5.5	260°	0.2	0.1	-1.6	-3.5	-7.3
90°	0.2	-0.1	-1.2	-3.1	-7.0	270°	0.3	-0.1	-1.3	-2.6	-5.4
100°	0.2	0.3	-2.3	-3.2	-7.3	280°	0.4	-0.1	-1.6	-2.4	-4.3
110°	-0.1	0.2	-1.7	-4.0	-7.3	290°	0.4	-0.2	-0.8	-2.7	-4.2
120°	-0.5	0.1	-1.4	-4.3	-8.8	300°	0.3	-0.3	-0.6	-1.9	-3.2
130°	-0.6	-0.5	-0.5	-3.9	-9.3	310°	0.3	-0.2	-0.7	-0.6	-2.1
140°	-0.4	-0.9	-1.0	-4.5	-9.0	320°	0.3	-0.1	-0.5	-0.7	-1.7
150°	-0.3	-0.8	-2.8	-2.3	-9.6	330°	0.2	-0.1	-0.3	-0.6	-1.2
160°	-0.2	-0.4	-3.0	-5.3	-8.2	340°	0.2	0.0	-0.2	-0.3	-0.7
170°	-0.2	0.0	-1.4	-5.1	-12.1	350°	0.2	0.1	-0.2	-0.1	-0.2

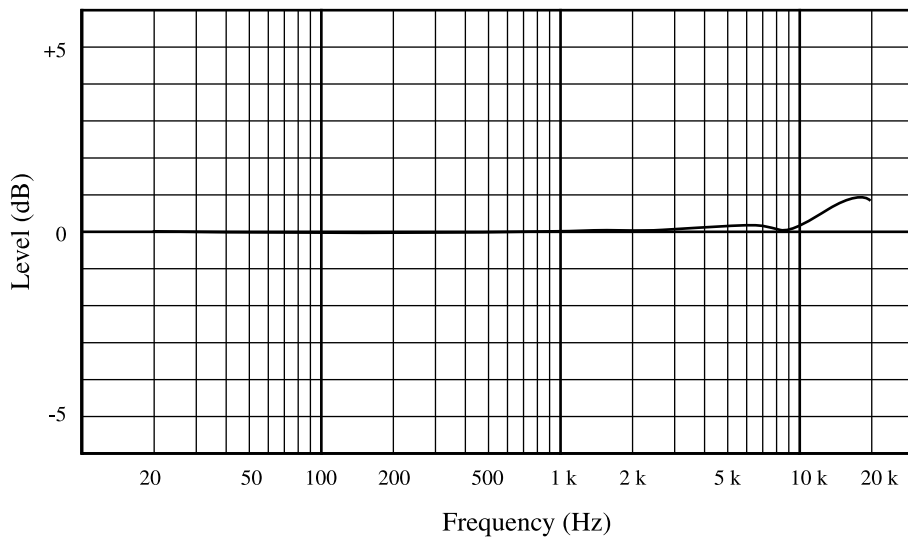
## Measurement range

Tab. 2 Measurement range

Level range		$L_A$ (dB)	$L_{Cpeak}$ (dB)
30 to 110 dB	Upper limit	110	113
	Lower limit	30	60
60 to 140 dB	Upper limit	140	143
	Lower limit	60	80

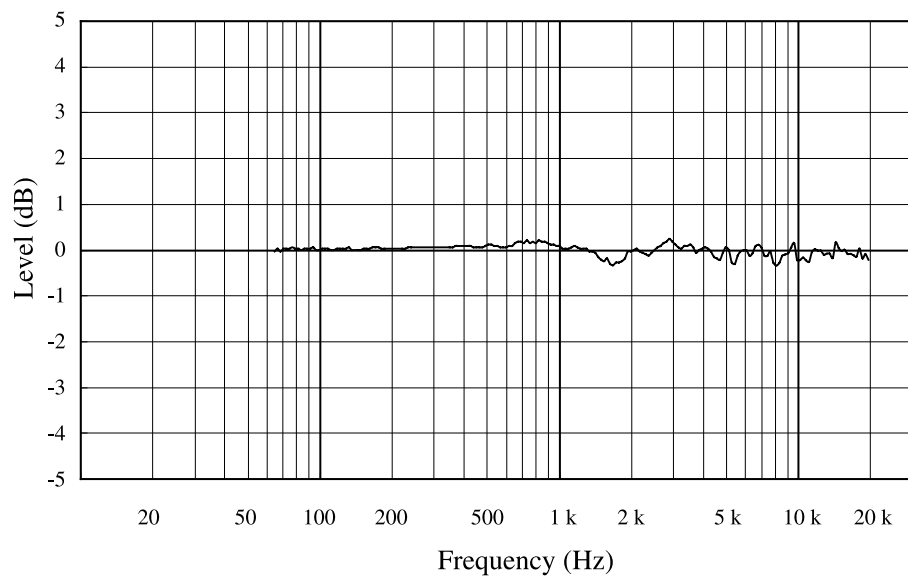
## Free field microphone response

Fig. 2-1 Frequency response sample of microphone UC-53A



## Body reflection

Fig. 2-2 Body reflection



## Random incidence response compensation

Fig. 3 Random incidence response compensation

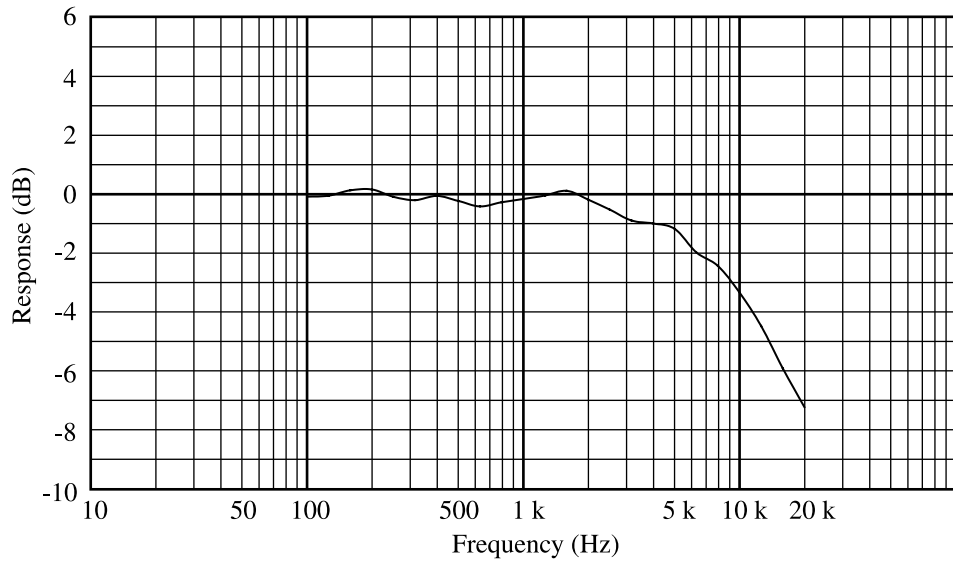
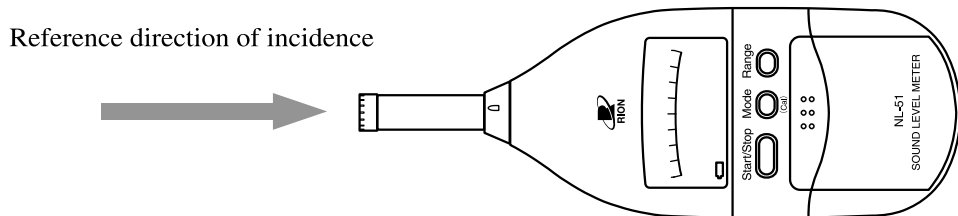


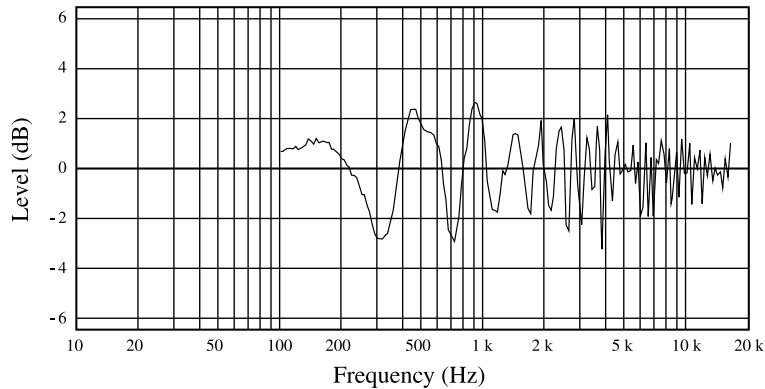
Fig. 4



## Influence of Operator

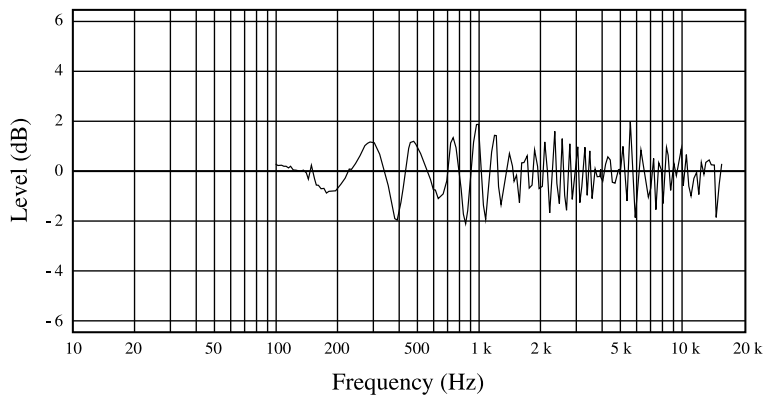
The NL-51 is designed to minimize reflections caused by the body of the unit. The charts below show the influence of the operator on the measurement.

Fig. 5-1

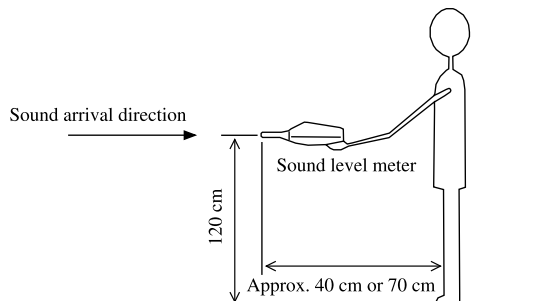


Acoustical influence of sound level meter body (the distance from the top of the microphone to the operator is approx. 40 cm)

Fig. 5-2



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  $\pm 1.0$  dB up to 12.5 kHz, as shown in the diagram on the next page.

Fig. 6-1

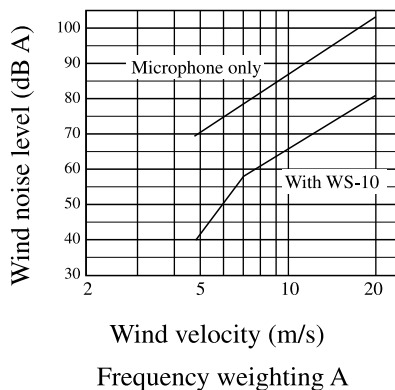


Fig. 6-2

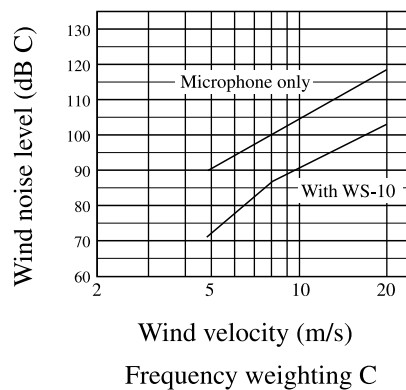
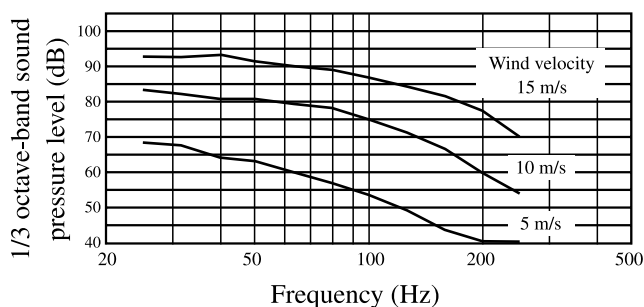
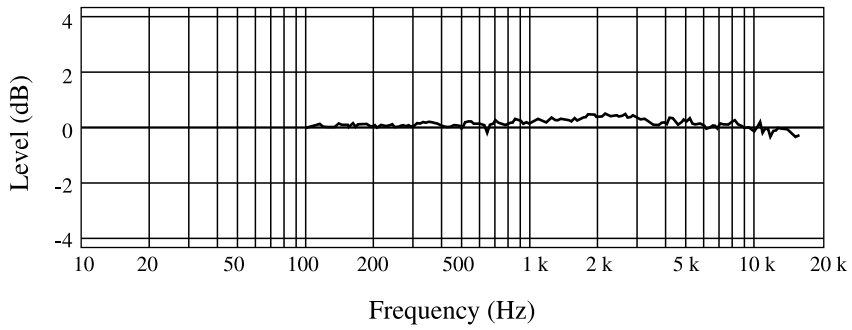


Fig. 6-3



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

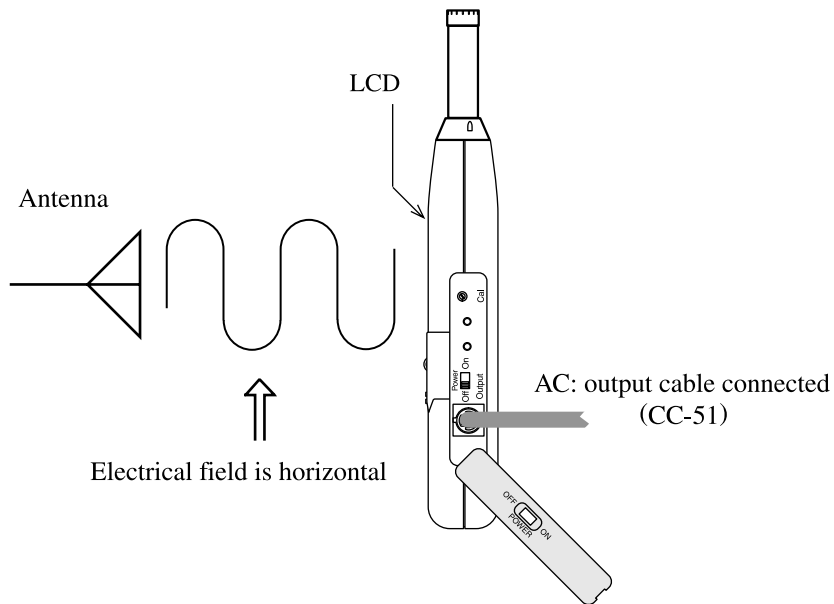
Fig. 6-4



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 basic statement

Tab. 3 Statement of conforming to the basic statement

Immunity (Radio frequency field)	The specification of IEC 61672-1:2002 Class 1 is satisfied
Immunity (a.c power frequency field)	The specification of IEC 61672-1:2002 Class 1 is satisfied
Emission	The specification of IEC 61672-1:2002 Class 1 is satisfied

## Frequency response adjustment data for periodic test

Tab. 4 Adjustment data for electrostatic actuator

Frequency (Hz)	Correction (dB)	Frequency (Hz)	Correction (dB)
250	0.0	2.5 k	0.2
315	0.0	3.15 k	0.4
400	-0.1	4 k	0.9
500	-0.1	5 k	1.3
630	-0.1	6.3 k	2.4
800	0.0	8 k	3.1
1000	0.0	10 k	5.2
1.25 k	0.0	12.5 k	7.4
1.6 k	0.1	16 k	8.9
2 k	0.1	20 k	11.1

## The lower and upper limits of the linear operating range (A-weighted sound level)

Tab. 5 The lower and upper limits of the linear operating range (A-weighted sound level)

		Frequency (Hz)				
		31.5 Hz	1000 Hz	4 kHz	8 kHz	12.5 kHz
30 to 110 dB	Upper limit	70.0	110.0	111.0	108.0	105.0
	Starting point	54.0	94.0	94.0	94.0	94.0
	Lower limit	30.0	30.0	30.0	30.0	30.0
60 to 140 dB	Upper limit	100.0	140.0	141.0	138.0	135.0
	Starting point	84.0	124.0	124.0	124.0	124.0
	Lower limit	60.0	60.0	60.0	60.0	60.0

# Specifications

Applicable standards	IEC 61672-1: 2002 Class 1 IEC 60651: 1979 Type 1 * IEC 60804: 2000 Type 1 * * IEC 60651: 1979 Type 1 and IEC 60804: 2000 Type 1 have been superseded by IEC 61672-1: 2002 Class 1 and have become invalid as of 2003.
Measurement functions	A-weighted sound level $L_A$ A-weighted equivalent continuous sound level $L_{Aeq}$ A-weighted maximum sound level $L_{Amax}$ C-weighted peak sound level $L_{Cpeak}$
Measurement time	1 hour max. (stop at any time possible)
Measurement level range	A-weighting: 30 to 140 dB(Total range) C-weighting ( $L_{Cpeak}$ only): 60 to 143 dB
Linearity range	80 dB
Noise floor (measured with 12 pF dummy microphone)	A-weighting: 22 dB or less
Reference sound pressure level	94 dB
Reference frequency	1000 Hz
Reference level range	30 to 110 dB
Level range switching	30 to 110 dB (default) 60 to 140 dB
Frequency range	20 to 12500 Hz
Frequency weighting	A or C characteristics (C-weighting for $L_{Cpeak}$ only)
Time weighting (dynamic characteristics)	F (Fast) only
Sound calibration	With sound calibrator NC-74
Microphone	1 / 2-inch electret condenser type Model: UC-53A Sensitivity: -28 dB (0 dB = 1 V / Pa)

Calibration signal output	Internal signal generator (1 kHz sine wave) for electrical calibration of external equipment
Display	LCD
Numeric readout	Resolution 0.1 dB, display update cycle 1 s
Bar graph	Resolution 5 dB, scale range 80 dB, display update cycle 0.1 s
Warning indicators	
Over (Overload):	Appears from +0.3 dB of upper scale limit
Over (Processing overload):	Appears when overload condition was detected during $L_{Aeq}$ , $L_{Amax}$ , and $L_{Cpeak}$ processing. Retained until start of next measurement.
Under (Underload):	Appears from -0.5 dB of lower scale limit
Elapsed measurement time	00 m 00 s to 60 m 00 s, 1-second increments
Battery capacity	3-stage indicator (2 segments lit → 1 segment lit → 2 segments flashing)
Output connector	AC output (Flat characteristics)
Output voltage:	1 V <sub>rms</sub> (full-scale) ±5% (no-load condition)
Output impedance:	600 Ω ±5% max.
Load impedance:	10 kΩ or more
Power requirements	Two size AA batteries (IEC R6P or LR6; manganese or alkaline batteries)
Battery life	Manganese batteries (R6P): approx. 6 hours continuous operation (at 23°C) Alkaline batteries (LR6): approx. 16 hours continuous operation (at 23°C)

Battery life will be about 20 percent shorter in calibration signal output condition (Cal).

Ambient conditions for operation

-10 to +50°C, 10 to 90% RH (no condensation)

Dimensions

227 (length) × 78 (width) × 31 (thickness) mm

Weight

Main unit only:

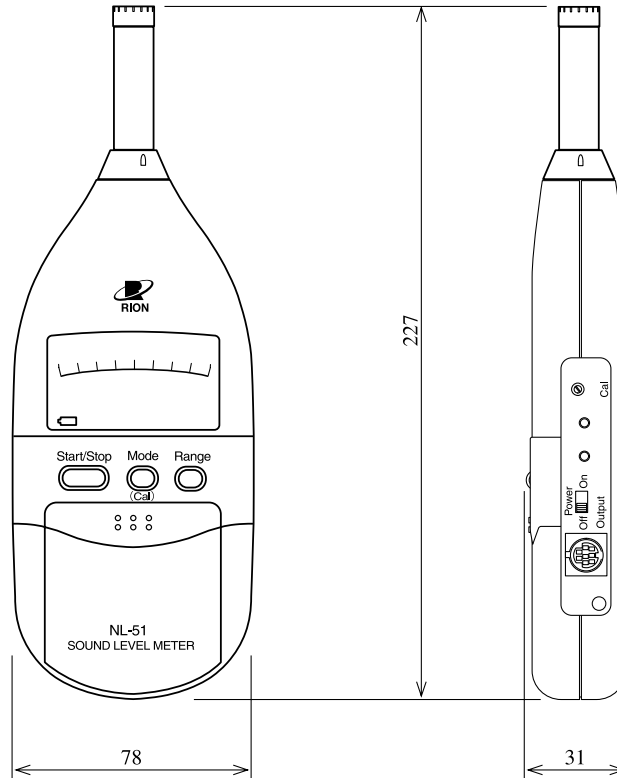
approx. 200 g (245 g including 2 IEC LR6 batteries)

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

Output cable	CC-51
Sound calibrator	NC-74



Unit: mm

Dimensional drawing of Sound Level Meter NL-51



