

INSTRUCTION MANUAL

Pistonphone

NC-72A



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

Organization of this manual

This manual describes the features and operation of the Pistonphone NC-72A. The manual contains the following sections.

Outline

Gives basic information on the unit.

NC-72A Main Unit External View

Contains drawings that show the pistonphone from all sides.

Accessories External View

Contains drawings that show the supplied accessories.

Names of Parts and Functions

Identifies and explains all parts of the unit.

Operation

Explains how to insert batteries, how to use the supplied adapters, and how to calibrate a sound pressure measurement system (sound level meter).

Reference

Explains output level differences and compensation according to atmospheric pressure and microphone combinations, and explains the influence of radio frequency fields.

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.



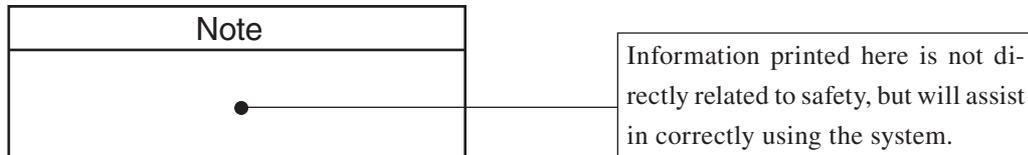
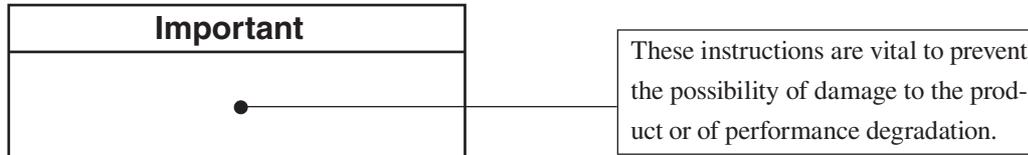
The product described in this manual is in conformity with the following European standards;

EN60942:2003 EN61326:1997

* All company names and product names mentioned in this manual are usually trademarks or registered trademarks of their respective owners.

FOR SAFETY

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



Precautions

- Read the documentation carefully, and operate the unit only as described in this manual.
- Do not use or store the unit in locations which may be
 - subject to splashes of water
 - subject to high levels of dust
 - subject to direct sunlight
 - subject to vibrations or shock
 - subject to air with high salt or sulphur content, to gases, or are in the vicinity of any substances that may adversely affect the unit
 - outside of the specified temperature and humidity range
 - subject to drastic temperature changes and to condensation
- To prevent the risk of battery fluid leakage, remove the batteries from the unit when not using it.
- This product does not require lubrication. Do not apply oil or similar to any part of the unit.

- Do not try to disassemble or modify the unit.
- In case of malfunction, contact the supplier.
- During operation, sound other than the 250 Hz tone may be heard, but this does not affect the performance of the unit.
- The NC-72A is a precision product. Always handle it carefully and do not subject it to shocks.
- In order to maintain continued preciseness, have the unit checked and serviced once per year. Contact the supplier for the check.
- When mounting and dismounting the microphone of the sound pressure measurement system (sound level meter), do not rotate the microphone or pistonphone. Otherwise the protective grid of the microphone may become loose or detached, causing damage to the microphone diaphragm.

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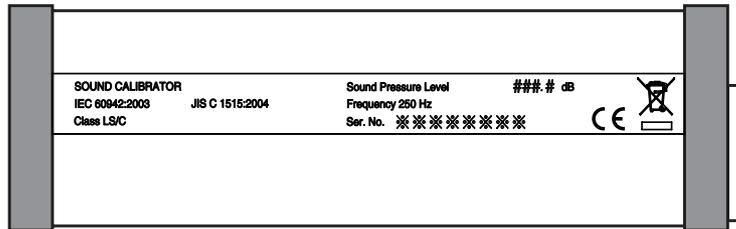
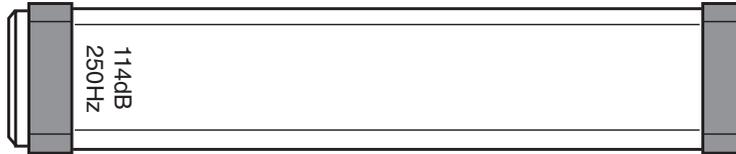
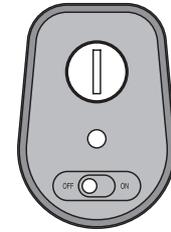
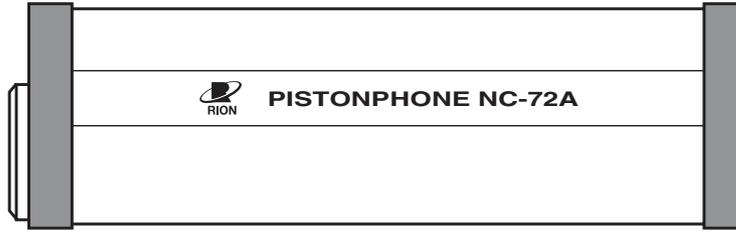
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Outline

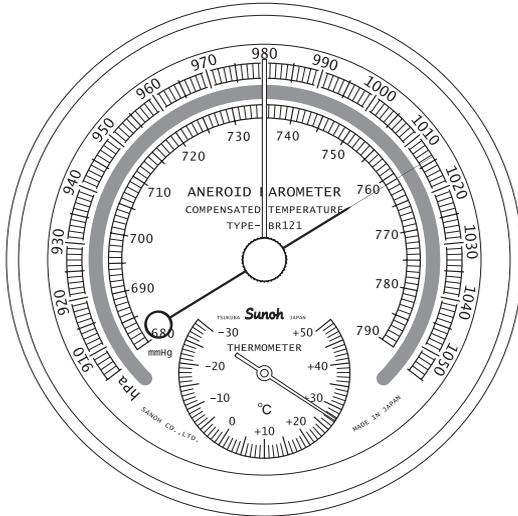
The pistonphone NC-72A is a sound calibrator that conforms to IEC 60942:2003 (JIS C 1515:2004) class LS/C specifications.

It uses a purely mechanical sound source with very low time-based variations which is capable of producing a sound of constant pressure and frequency unaffected by environmental changes (however, compensation of the output sound pressure level for static [atmospheric] pressure changes is required). The NC-72A is suitable for use in research institutions as calibration sound source for maintenance and management of acoustic measurement systems.

NC-72A Main Unit External View



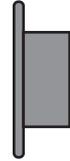
Accessories External View



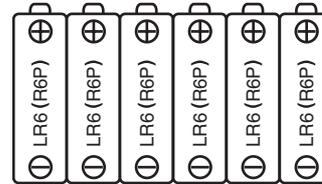
Barometer



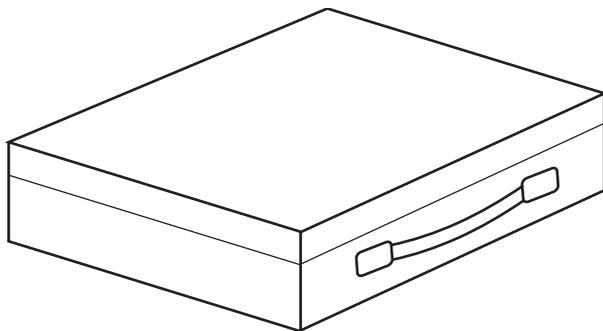
1/2-inch adapter



1/4-inch adapter



Six IEC LR6 (size AA) batteries



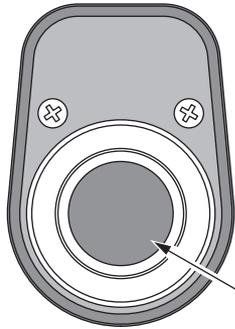
Carrying case



Instruction manual (this document)

Names of Parts and Functions

Coupler



Coupler Insert the microphone of the sound pressure measurement system (sound level meter) here.

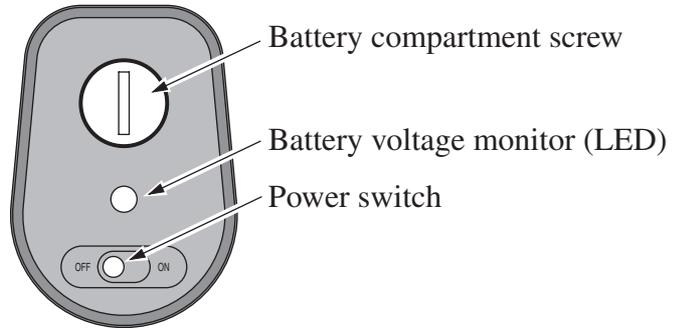
Use the 1/2-inch or 1/4-inch adapter as required to match the microphone dimensions.

Important

The coupler section also contains the piston part that generates sound pressure. If a foreign object enters the coupler, correct sound pressure and frequency are not assured.

- Never insert finger or any kind of stick into the coupler.
- Protect the coupler from any metallic or other foreign matter and from water, oil, or any other kind of liquid.
- Protect the coupler from dust and other contamination.

Power supply section



Battery compartment screw

Turn this screw to open the cover for battery replacement.

Battery voltage monitor (LED)

Enables to visually check the state of the batteries.

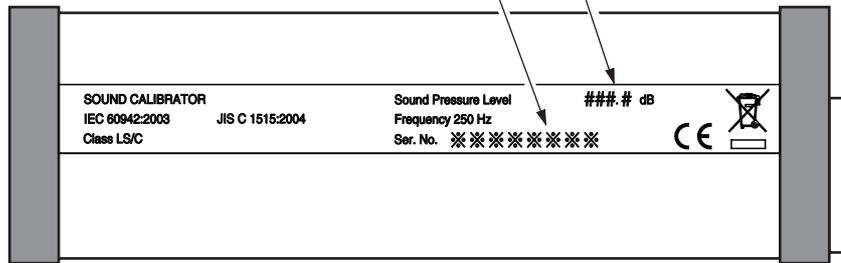
Power switch

Turns the unit on and off.

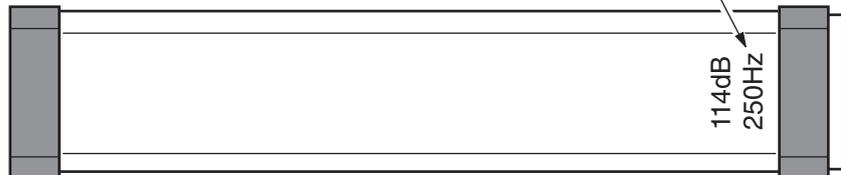
Side view and top view

Sound pressure level indication
(Specified sound pressure level at reference conditions)

Serial number

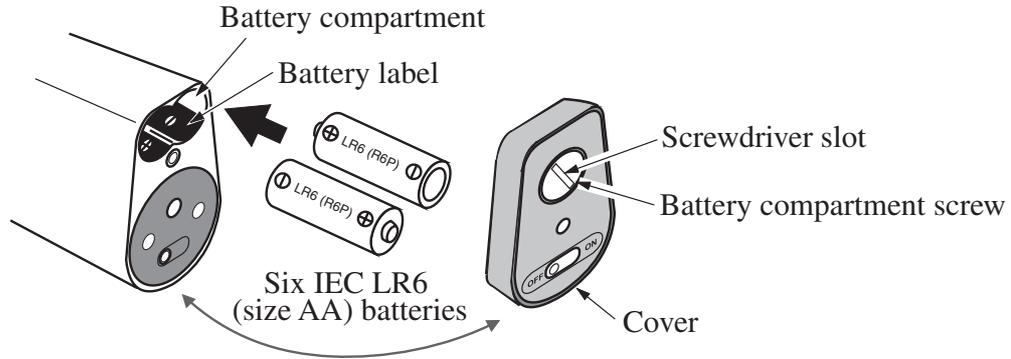


Nominal sound pressure level }
Nominal frequency }

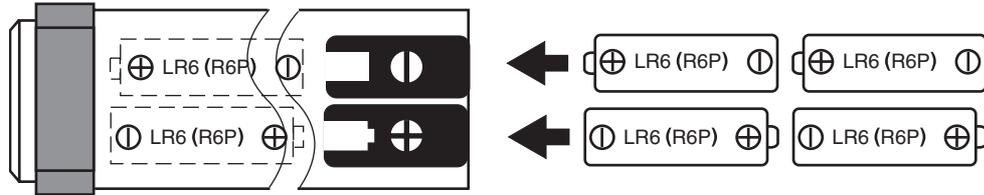


Operation

Inserting the batteries



1. Remove the cover from the unit.
Insert a flatblade screwdriver in the slot of the battery compartment screw and turn it counterclockwise to remove the cover. Make sure not to turn the screw too much to prevent it from coming off.
2. Insert six fresh IEC LR6 (size AA) batteries into the battery compartment, with correct +, - orientation as shown on page 9. The label in the battery compartment also indicates the polarity.
3. Press the cover against the unit and turn the battery compartment screw clockwise with the flatblade screwdriver until the screw is tight.



Important

- Make sure to insert batteries with correct +, - orientation as shown above. (The label in the battery compartment also indicates the polarity.)
- A total of six batteries are required.
- Do not mix old and new batteries.
- Do not mix different battery types.
- To prevent the risk of battery fluid leakage that can cause corrosion and damage, be sure to remove the batteries from the unit when not using it.
- Dispose of used batteries in accordance with local laws and regulations.
- Do not charge or dismantle a battery, do not throw a battery into a fire, and do not short-circuit a battery. Otherwise fluid leakage may occur or the battery may explode.

Checking the battery voltage

The constant sound pressure generator in the unit uses an electronically controlled motor to drive a piston and create an accurate sinusoidal wave. Frequency precision is within $\pm 1\%$ provided that the battery voltage is between 7 and 10 volts. The battery voltage monitor (LED) allows the operator to check the state of the batteries, in order to assure correct performance.

Lit	Flashing	Off
		
Battery voltage normal	Battery voltage low (Unit can still be used)	Unit cannot be used

When turning power to the unit on, use the battery voltage monitor (LED) to check the state of the batteries.

If the battery voltage monitor (LED) is off, the batteries must be replaced. If the battery voltage monitor (LED) is flashing, the batteries will have to be replaced soon. For information of how to replace the batteries, see pages 8 to 9.

Battery life at room temperature (approx. 23°C) is about 2 hours of continuous use with manganese batteries (R6P) or about 13 hours of continuous use with alkaline batteries (LR6).

Sound pressure measurement system (sound level meter) calibration

1. Verify that the power switch of the pistonphone is off.
2. Set the frequency weighting of the sound pressure measurement system (sound level meter) to "Z" or "C".
3. Select the measurement range of the sound pressure measurement system (sound level meter) so that 114 dB can be measured.
4. Carefully insert the microphone of the sound pressure measurement system (sound level meter) fully into the coupler of the pistonphone.

Important

When inserting the microphone into the pistonphone, always proceed very slowly and carefully, to avoid the possibility of damage to the microphone diaphragm caused by abrupt changes in air pressure.

Also, do not rotate the microphone or the pistonphone while inserting. Otherwise the protective grid of the microphone may become loose or detached, causing damage to the microphone diaphragm.

5. After inserting the microphone into the pistonphone, wait at least 1 minute.

Note

If calibration is performed immediately after inserting the microphone, correct results can not be achieved due to the change in air pressure. You must wait about 1 minute until the pressure inside the microphone stabilizes. The exact amount of required time is vary depending on the microphone. Refer to the documentation of the microphone or the sound pressure measurement system (sound level meter) for more information.

6. When the indication of the sound pressure measurement system (sound level meter) has stabilized, read the indicated value.
7. Turn the power to the pistonphone on.
Wait until the indication of the sound pressure measurement system (sound level meter) has stabilized. Then read the indicated value. Verify that the value is at least 30 dB higher than the value obtained in step 6.

Important

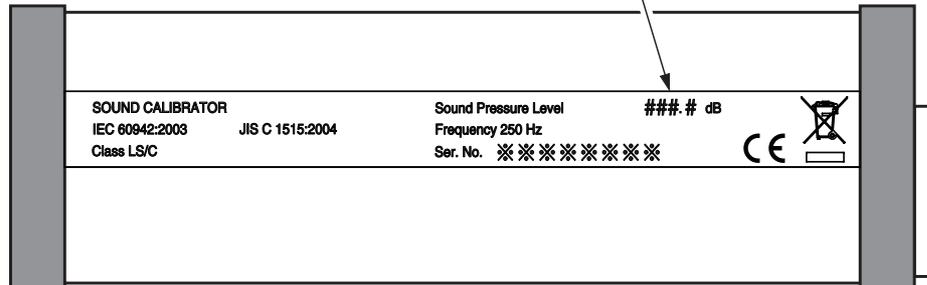
If the difference in readings is less than 30 dB, correct calibration will not be possible, due to the influence of background noise.

8. Adjust the sound pressure measurement system (sound level meter) so that it reads 114 dB*.

* The precise output sound pressure level (specified sound pressure level for specific microphones) is given in the supplied calibration chart.

At this time, compensation for the microphone effective load volume and static (atmospheric) pressure is required. For details, see the "Reference" section (pages 16 to 25).

Sound pressure level indication
(Specified sound pressure level at reference conditions)



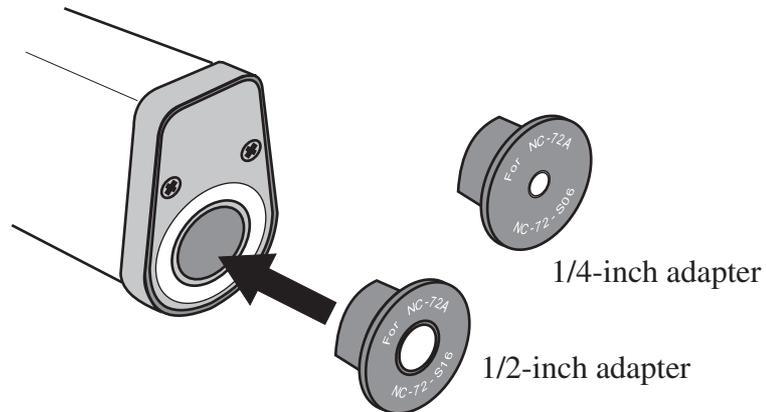
9. When level adjustment is completed, turn the power to the pistonphone off.
10. Carefully and slowly remove the microphone of the sound pressure measurement system (sound level meter) from the pistonphone.

Important
<p>When removing the microphone from the pistonphone, always proceed very slowly and carefully, to avoid the possibility of damage to the microphone diaphragm caused by abrupt changes in air pressure.</p> <p>Also, do not rotate the microphone or the pistonphone while removing. Otherwise the protective grid of the microphone may become loose or detached, causing damage to the microphone diaphragm.</p>

Using the microphone adapters

When the external diameter of the microphone is 1/2 inch or 1/4 inch, use the supplied 1/2-inch or 1/4-inch adapter.

- Insert the adapter fully into the coupler. Otherwise correct calibration is not possible.
- After use, be sure to remove the adapter from the coupler.



Reference

Output sound pressure level compensation

The output sound pressure level generated by the pistonphone depends on a certain extent on the static (atmospheric) pressure and on the effective load volume that is applied due to the mounting of the microphone (this will differ according to the microphone type).

When performing calibration, compensation for these two quantities must be provided to determine the exact output sound pressure level.

Change of output sound pressure level according to static (atmospheric) pressure

The sound pressure p (N/m²) produced by the pistonphone changes at a rate proportional to the static (atmospheric) pressure. To determine the exact output sound pressure level, the static pressure at the time of use should be measured, and compensation according to the specified sound pressure level data given in the calibration chart should be applied.

$$p = \gamma \times P \times \frac{2 \times A_p \times S}{V \times \sqrt{2}} \dots \dots \dots \text{Equation 1}$$

- γ : Specific heat ratio of air 1.402
- P : Static pressure Pa
- S : Piston cross section m²
- A_p : Cam stroke m
- V : Coupler volume m³

The output sound pressure level L (dB) is expressed by equation 2.

$$\text{Output sound pressure level } L \text{ (dB)} = 10 \times \log_{10} \frac{p^2}{p_0^2} \dots\dots\dots \text{Equation 2}$$

p_0 : Reference sound pressure 2×10^{-5} Pa

The output sound pressure level L (dB) with compensation for static (atmospheric) pressure is expressed by equation 3.

$$\text{Output sound pressure level } L \text{ (dB)} = L_s + 20 \times \log_{10} \frac{P_a}{P_o} \dots\dots\dots \text{Equation 3}$$

P_a : Static pressure at time of use kPa

P_o : Reference static pressure 101.325 kPa (reference conditions)

L_s : Specified sound pressure level for microphone in use
dB

Output sound pressure level compensation using supplied barometer

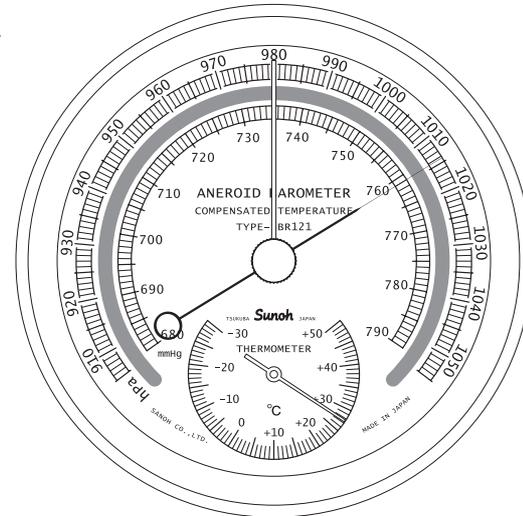
The barometer supplied with this unit is a Class LS/C device that can be used to provide compensation of the sound pressure level for a static (atmospheric) pressure range of 905 hPa to 1055 hPa (90.5 kPa to 105.5 kPa).

Place the barometer on a level horizontal surface and lightly tap it with your fingertip to stabilize the needle.

When using the pistonphone, read the current static (atmospheric) pressure from the scale of the barometer and insert the value into Equation 3 (page 17) to calculate the output sound pressure level with compensation.

Note

The barometer is a precision mechanical instrument. Do not tap it too forcefully, and make sure not to drop it.



Microphone effective load volume and output sound pressure level change

Depending on the microphone type, there will be a slight difference in output sound pressure level inside the coupler of the pistonphone. This is due to differences in the microphone prechamber volume and diaphragm equivalent volume, which cause a difference in the total volume of the coupler. (For information on the specified sound pressure level for various microphone types, see the supplied calibration chart.)

For microphones not listed in the calibration chart, the output sound pressure level from the load volume (prechamber volume + diaphragm equivalent volume) can be calculated by using the equation given below (approximate value).

1-inch microphone

Output sound pressure level L (dB) = $114.00^* + (V_L - 960) \times (-0.00041)$

V_L (mm³): Microphone dependent load volume (prechamber volume + diaphragm equivalent volume)

1/2-inch microphone

Output sound pressure level L (dB) = $114.00^* + ((V_L + 909) - 960) \times (-0.00041)$

* Use the specified sound pressure level (effective load volume 960 mm³ (reference conditions)) given in the supplied calibration chart or the sound pressure level indication value specified on the side of the pistonphone.

Output sound pressure level change according to effective load volume (compensation values)

(All compensation values in the table below apply to the microphone with grid attached.)

Microphone type	Change (compensation value, dB)	Remarks
UC-25	-0.08	1-inch microphone
UC-27	-0.03	
UC-34	-0.10	
UC-26	-0.13	1/2-inch microphone Using 1/2-inch adapter (NC-72-S16)
UC-28	-0.09	
UC-30	-0.09	
UC-31	-0.06	
UC-33P	-0.07	
UC-52	-0.03	
UC-53A	-0.09	
UC-57	-0.06	
UC-59	-0.07	
MS-10	-0.09	
MS-11	-0.09	
UC-29	+0.01	1/4-inch microphone Using 1/4-inch adapter (NC-72-S06)
UC-54	+0.01	

Change for other brand microphones (compensation value, for reference)

Microphone type	Change (compensation value, dB)	Remarks
Tokyo Riko MR-103	+0.24	1-inch microphone
Tokyo Riko MR-103 without grid	+0.12	
B&K 4160 without grid	+0.12	
B&K 4180	0.00	1/2-inch microphone Using 1/2-inch adapter (NC-72-S16)

Output sound pressure level compensation (example)

In actual use, the output sound pressure level generated by the pistonphone is calculated by applying compensation for the microphone effective load volume (differs according to microphone type) and the static (atmospheric) pressure. The output sound pressure level L (dB) is therefore obtained as follows.

1. When specified sound pressure level L_s (as per calibration chart) is known

$$\text{Output sound pressure level } L \text{ (dB)} = L_s + 20 \times \log_{10} \frac{P_a}{101.325}$$

P_a : Static pressure at time of use (kPa)

Static pressure used for reference:

101.325 kPa

Example: Output sound pressure level L with UC-59

Specified sound pressure level L_s : 113.98 dB (example, as per calibration chart)

Static pressure at time of use P_a : 98.83 kPa (example, measured with barometer at time of use)

$$L = 113.98 + 20 \times \log_{10} \frac{98.83}{101.325} = \mathbf{113.76 \text{ dB}}$$

2. When compensation value C_v for effective load volume of microphone is known

$$\text{Output sound pressure level } L \text{ (dB)} = L_0 + C_v + 20 \times \log_{10} \frac{P_a}{101.325}$$

L_0 : Specified sound pressure level at reference conditions (as per calibration chart, dB)

P_a : Static pressure at time of use (kPa)

Static pressure used for reference:

101.325 kPa

Example: Output sound pressure level L with UC-59

Specified sound pressure level L_s at reference conditions:

114.05 dB (example, as per calibration chart)

Static pressure at time of use P_a : 98.83 kPa (example, measured with barometer at time of use)

Compensation value for effective load volume of microphone C_v :

-0.07 dB (as per table on page 20)

$$L = 114.05 + (-0.07) + 20 \times \log_{10} \frac{98.83}{101.325} = \mathbf{113.76 \text{ dB}}$$

3. When effective load volume of microphone is known

1-inch microphone

Output sound pressure level L (dB)

$$= L_0 + (-0.00041 \times (V_L - 960)) + 20 \times \log_{10} \frac{P_a}{101.325}$$

1/2-inch or 1/4-inch microphone

Output sound pressure level L (dB)

$$= L_0 + (-0.00041 \times (V_L + V_A - 960)) + 20 \times \log_{10} \frac{P_a}{101.325}$$

L_0 : Specified sound pressure level at reference conditions (as per calibration chart, dB)

P_a : Static pressure at time of use (kPa)

V_L : Effective load volume of microphone in use (mm³)

V_A : Effective load volume with 1/2-inch adapter or 1/4-inch adapter

Load volume with 1/2-inch adapter: 909 mm³

Load volume with 1/4-inch adapter: 832 mm³

Effective load volume of microphone at reference conditions:

960 mm³

Static pressure used for reference: 101.325 kPa

Output sound pressure level change according to microphone effective load volume:

-0.00041 dB/mm³

Example: Output sound pressure level L for 1/2-inch microphone with known effective load volume

Specified sound pressure level L_s at reference conditions:

114.05 dB (example, as per calibration chart)

Static pressure at time of use P_a :

98.8 kPa (example, measured with barometer at time of use)

Microphone effective load volume V_L :

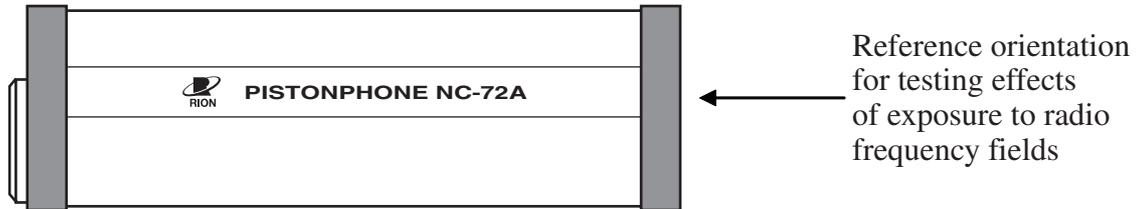
224 mm³ (example, according to catalog data for microphone)

$$L = 114.05 + (-0.00041 \times (224 + 909 - 960)) + 20 \times \log_{10} \frac{98.8}{101.325} = \mathbf{113.76 \text{ dB}}$$

Electromagnetic Compatibility

Reference orientation for testing effects of exposure to radio frequency fields:

Opposite side of microphone insertion opening (see illustration below)



Radio frequency emissions

Electric field strength of radio frequency emissions produced by the unit (quasi-peak value at a distance of 10 m)

Frequency range 30 MHz to 230 MHz: 30 dB (reference 1 $\mu\text{V/m}$) or less

Frequency range 230 MHz to 1 GHz: 37 dB (reference 1 $\mu\text{V/m}$) or less

The configuration for greatest radio frequency emissions:
power ON

Immunity to electrostatic discharges

No malfunction after the following electrostatic discharge tests

- Contact discharge: up to ± 4 kV (versus ground potential)
- Air discharge: up to ± 8 kV (versus ground potential)

Immunity to power frequency and radio frequency fields

Output sound pressure level deviation when placed under the influence of power frequency and radio frequency fields as specified below:

±0.3 dB or less

- Root-mean-square electric field strength up to 10 V/m (non-modulated), frequency range 26 MHz to 1 GHz, 900 Hz sinusoidal wave, 80% amplitude modulation
- Root-mean-square magnetic field strength up to 80 A/m, frequency 50 Hz and 60 Hz

The configuration that produce minimum immunity (maximum susceptibility) to power frequency and radio frequency fields:

power ON

Specifications

Applicable standards IEC 60942:2003 (JIS C 1515:2004) "Electroacoustics - Sound Calibrators" Class LS/C
(Class LS/C when using supplied barometer)

Specified microphones

1-inch microphones

- IEC 61094-1 Type LS1P compliant microphones
- IEC 61094-4 Type WS1P/F/D compliant microphones
- UC-25, UC-27, UC-34

1/2-inch microphones (using 1/2-inch adapter NC-72-S16)

- IEC 61094-1 Type LS2aP compliant microphones
- IEC 61094-4 Type WS2P/F/D compliant microphones
- UC-26, UC-28, UC-30, UC-31, UC-33P, UC-52, UC-53A, UC-57, UC-59, MS-10, MS-11

1/4-inch microphones (using 1/4-inch adapter NC-72-S06)

- IEC 61094-4 Type WS3P/F/D compliant microphones
- UC-29, UC-54

Reference conditions

Ambient temperature

23°C

Static (atmospheric) pressure

101.325 kPa

Relative humidity 50% RH

Microphone effective load volume

960 mm³ (total coupler volume 21245 mm³ (representative value))

Nominal sound pressure level

114 dB

Specified sound pressure level

As noted in supplied calibration chart (114.0 ±0.2 dB (at reference conditions))

Specified sound pressure level tolerance limit

±0.15 dB

Sound pressure level stabilization interval

After power-on: 5 s or less

After microphone insertion: 30 s or less

Sound pressure level stability (short-term fluctuations)

±0.05 dB (within rated ambient conditions for use)

(20 s, time weighting F (IEC 61672-1: 2002, JIS C 1509-1:2005))

Nominal frequency	250 Hz
Specified frequency	As noted in supplied calibration chart
Specified frequency tolerance limit	within $\pm 1.0\%$ (at reference conditions)
Frequency stabilization interval	After power-on: 5 s or less
Frequency stability	$\pm 1.0\%$ (within rated ambient conditions for use) (20 s, time window 1 s)
THD (total harmonic distortion) of output sound pressure tolerance limit	2.5% or less (20 Hz to 20 kHz, within rated ambient conditions for use)
Influence of static (atmospheric) pressure, ambient temperature and humidity (at conditions given below)	
Sound pressure level (deviation from value for reference conditions)	within ± 0.2 dB
Frequency (deviation from value for reference conditions)	within $\pm 1.0\%$
Rated ambient conditions	
Ambient temperature:	+16°C to +30°C
Static pressure:	65 kPa to 108 kPa
Relative humidity:	25% to 90% RH

1/2-inch adapter (supplied)

Model NC-72-S16

Load volume 909 mm³ (representative value)

1/4-inch adapter (supplied)

Model NC-72-S06

Load volume 832 mm³ (representative value)

Sound pressure level variation caused by microphone effective load volume variation

-0.00041 dB/mm³ (representative value)

Power supply Six IEC LR6 (size AA) alkaline batteries

Power supply voltage Nominal: 9.0 V, Max. 9.9 V, Min: 7.0 V

Deviation from specified sound pressure level within rated power supply voltage range

Within 0.1 dB referenced to specified sound pressure level at nominal power supply voltage (at reference conditions)

Battery life 13 hours (using six LR6 batteries, at reference conditions)

Battery voltage indication

LED lit: Possible to use (voltage normal)

LED flashing: Possible to use (voltage low)

LED off: Not possible to use

Ambient temperature for storage

-20°C to +60°C (no condensation)

Ambient conditions for use

Ambient temperature

-10°C to +55°C

Static (atmospheric) pressure

65 kPa to 108 kPa

Relative humidity 10% to 90% (no condensation)

Permissible ambient sound level

94 dB or less

Electromagnetic compatibility

EN 60942:2003 (JIS C 1515:2004, IEC 60942:2003), EN 61326:1997

Dimensions

Approx. 44 (W) mm × 62 (H) mm × 170 (D) mm

Weight

approx. 740 g (including batteries)

Output sound pressure level compensation for static (atmospheric) pressure

The output sound pressure generated by the NC-72A changes at a rate proportional to the static (atmospheric) pressure (See "Reference" section on page 17). To determine the exact output sound pressure level, the static pressure at the time of use should be measured, and compensation according to the specified sound pressure level data given in the calibration chart should be applied.

Specifications of supplied barometer (compliance with class LS/C)

Measurement range

905 hPa to 1055 hPa (90.5 kPa to 105.5 kPa)

Ambient conditions for use

+16°C to +30°C

Dimensions

135 (dia.) mm × 45 (H) mm

Weight

345 g

Supplied accessories

Carrying case	NC-72-053	1
1/2-inch adapter	NC-72-S16	1
1/4-inch adapter	NC-72-S06	1
Barometer		1
IEC LR6 (size AA) alkaline battery		6
Instruction manual		1
Calibration chart		1
Inspection certificate		1

