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Air Sterilizer

KOA AS 01 : 2011

The Korea Ozone Association

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Korea Ozone Association Type Approval and Standards Review Committee

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Contents

Korean Ozone Society Standard

KO A AS 01 : 2011

Air Sterilizer

1. Scope

This standard covers electrical appliances that are installed in living environments (residential, commercial, etc.) and industrial environments. It applies to the safety and performance of the air sterilizer which reduces bacteria, yeast bacteria, odorous substances and similar.

2. Citing Standard

The following cited standards are essential for this standard to be applied. The citation appears with the issue year. Those for which no publication year is indicated refer to the latest edition (including all postscripts).

KS A 0006, Standard atmospheric conditions for testing
KS C IEC 60335-1 : 2004, Safety of household and similar electrical appliances – Part 1: General Requirements
KS C IEC 60335-2-65 : 2009, Safety of household and similar electrical appliances – Part 2: Safety of air cleaners individual requirements
KS C IEC 61058-1 : 2002, Switches for appliances – Part 1: General requirements
KS C CISPR 14-1, Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission
KS C CISPR 14-2, Requirements for household appliances, electric tools and similar apparatus – Part 2: Electromagnetic Immunity
KS I ISO 16000-6: 2004, Indoor air – Part 6: Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, thermal desorption and gas chromatography using MS/FID
KS X ISO / IEC 28360: 2007, Information technology – Office equipment – Determination of chemical emission rates from electronic equipment
Indoor Air Quality Process Test Standard (Ministry of Environment, No. 2010-24)

3. Terms and Definitions

For the purposes of this standard, the following terms and definitions apply.

3.1

Air Sterilizer

A device that reduces airborne bacteria and odorous substances in indoor air to a certain level or less.

3.2

Sterilization

The airborne bacteria in the indoor air are killed or inactivated to be reduced to a certain level or less.

3.3

Air Filtration

Airborne bacteria in the indoor air are physically (mechanically) separated and collected by a filter and reduced to a certain level or less.

3.4

Deodorization
It is to reduce indoor odor substances to a certain level or less by oxidation, neutralization, decomposition and adsorption action.

3.5
Hazardous Substances
Airborne germs, volatile organic compounds, aldehydes and odor causing substances in indoor air.

3.6
Purification
The contaminated air is removed through an artificial operation.

3.7
Cleaning Agent
High-voltage discharge of ultraviolet rays, activated by a method such as plasma or incineration and oxygen, to generate a substance such as ions, ozone, radicals and other ionic compounds to remove pollutants.

3.8
Standby Power
It is only connected to the external power source, and does not perform the main function, or it waits for an external ON signal. State power consumption.

3.9
Off Mode
The state in which the power supply is off.

3.10
Airborne Bacteria
Microorganisms floating in indoor air

3.11
Test Strain
The test strain for the performance test of floating bacteria was Staphylococcus epidermidis (ATCC 12228™).

Note The ATCC is the /International Center for Biological Resources (www.atcc.org).

3.12
Negative Control
In sterile conditions the growth of bacteria on the culture medium will be not be observed.

3.13
Positive Control
The growth of bacteria on the culture medium will be observed within 24 hours.

3.14

Medium
It is usually a nutrient agar or a nutrient broth.

3.15
Buffer
Refers to a solution of PBS (phosphate buffered saline)

3.16
Collision Method
It is a method of collecting the sample by colliding the airborne bacteria in the indoor air with the medium.

3.17
Cleaning Method
It is a method to attach floating bacteria to the surface of the liquid or to suck it into the liquid.

3.18
Initial Value Measurement
Before evaluating the removal performance of airborne bacteria, the bacterial value was measured at 1 hour after the injection of the bacteria in the test chamber

3.19
Removal Measure
To evaluate the removal performance of airborne bacteria, after the test specimen is run for 60 minutes, turn off the power immediately and measure the bacterial value.

3.20
Background Test
Without operating the equipment under test (EUT) in the chamber, a test is carried out 1 hour after strain injection and at the end of 2 hours the amount of the strain is tested.

3.21
Preliminary Tests
Based on initial values, the range of colonies should be above the reference value (88 cfu / m^3). This test confirms if the large value is achieved.

3.22
Natural Reduction Rate
This is the rate at which the test specimen reducing naturally over time, and applies to the initial value correction of the EUT.

3.23
Release Test Chamber
This is a chamber for testing the amount of analyte released from the EUT.

3.24
Load Factor
The ratio of the volume of the EUT to the volume of the unloaded test chamber.

3.25

Flow Speed
Air velocity (m/s) measured in a no-load test chamber

3.26
Emission
The amount (μg) of the specific analyte released per hour of the EUT.

3.27
Total Volatile Organic Compounds (TVOC)
The concentration of the volatile organic compounds and the area of the unknown substance were measured using a toluene reaction coefficient. A sum.

3.28
Volatile Organic Compounds (VOCs)
It is a compound eluting between n-Hexane and n-Hexadecane in a non-polar GC-column.

3.29
Air Flow In Test Chamber
By operating the fan air is agitated generating a flow of air within the test chamber.

3.30
Standby Power
It is only connected to the external power source, and does not perform the main function, or it waits for an external ON signal. State power consumption.

3.31
Purification method

3.31.1
Suction
The forced air blowing device draws the contaminated room air into the purifier, physically collecting dust, floating bacteria and odorous substances, or purifying pollutants using a cleaning agent and discharging the pollutants to the outside of the apparatus. At this time, the cleaning agent is not discharged to the outside of the apparatus.

3.31.2
Release Formula
The purifying agent generated from the purifying device is discharged to the outside of the apparatus to sterilize the floating bacteria, and remove or reduce pollutants. The discharge formula can be classified into high pressure discharge, ultraviolet rays, and plasma depending on the generation method of the cleaning agent.

3.31.3
Complex Type
The combined type is a combination of the inhalation type and the release type.

3.31.4
Other Methods
The polluted room air is purified by a method other than the above-mentioned method (for example, water washing, incineration, etc.).

4 Performance

4.1 Safety Performance

4.1.1 General Requirements

The general requirements for air sterilizers is to be in accordance with the third section of KS C IEC 603.35-1.

4.1.2 Shock Protection For Live Parts

The protection against electric shock to live parts is in accordance with section 8 of IEC 60335-1.

a) In order to prevent all access to live parts during cleaning or maintenance.
   i) If the secondary circuit is not powered through an independent transformer, disconnect it from all poles.
   ii) It shall have a contact separation which provides full disconnection in accordance with IEC 61058-1: 2002.
   iii) Shall be protected against accidental operation.
b) Compliance is checked by inspection and measurement and by test finger.

4.1.3 Input Power and Current

Input power and current are in accordance with section 10 of IEC 60335-1.

4.1.4 Temperature Rise

The temperature rise in normal use is in accordance with section 11 of IEC 60335-1.

4.1.5 Insulation Performance

Insulation performance test shall be carried out as follows:

a) Leakage current and dielectric strength test in operation is in accordance with section 13 of KS C IEC 60335-1.
b) Moisture resistance test According to section 15 of IEC 60335-1.
c) Leakage current and dielectric strength test according to section 16 of IEC 60335-1.

4.1.6 Overload Protection of Transformers and Related Circuits

4.1.7 Abnormal Operation

Abnormal operation is to comply with section 19 of IEC 60335-1.

4.1.8 Stability and Mechanical Hazards

Stability and mechanical hazards are to comply with section 20 of IEC 60335-1.

4.1.9 Mechanical Strength

The mechanical strength is to comply with section 21 of IEC 60335-1.

4.1.10 Structure

The structure is to comply with section 22 of IEC 60335-2-65, and additionally:

a) It shall be constructed so that during sterilization, light rays other than visible light do not leak directly to the outside under normal use conditions.

b) The appliance shall not have any openings that allow small objects to penetrate the bottom of the appliance and reach the live parts.

   Compliance is checked by inspection and by measuring the distance between the live parts through the support surface and the hole. This distance shall be at least 6 mm. However, if a leg is attached to the appliance, this distance is increased to 10 mm for the appliance installed on the table and to 20 mm for the appliance installed on the floor.

c) An interlock device connected the input circuit must be installed to prevent access to live parts during user maintenance and prevent accidental operation.

4.1.11 Ground Connection

Grounding connection is in accordance with section 27 of IEC 60335-1.

4.1.12 Creepage Distance, Clearance Distance and Insulation Distance

Creepage distances, clearances and insulation distances shall be in accordance with section 29 of IEC 60335-1.

4.1.13 Heat Resistance, Fire Resistance and Tracking Resistance

Heat resistance, fire resistance and tracking resistance are in accordance with IEC 60335-1.

4.1.14 Corrosion Resistance

Corrosion resistance is in accordance with 31 of IEC 60335-1.

4.1.15 Standby Power

The power consumption per hour when the power is turned off should be 1 W or less.

4.1.16 Electromagnetic Compatibility (EMC) Performance

Electromagnetic Interference (EMI) during the performance test, is in accordance with KS C CISPR 14-1,
The EMS shall be in accordance with KS C CISPR 14-2.

4.2 Product Performance

4.2.1 Release of Harmful Substances

The material emitted from the EUT itself must meet the values in Table 1 (see 4.3.1).

Table 1 – Release of Hazardous Substances

Substance	Hourly Discharge (Mg)
Particulate matter	< 4.0
Total Volatile Organic Compounds	< 18.0
Acetaldehyde	< 1.8
Formaldehyde	< 1.8

4.2.2 Remove harmful substances

Airborne bacteria removal rates and hazardous materials deodorization rates shall meet Table 2 and Table 3 (see 4.3.2).

Table 2 - Removal Rate of Airborne Bacteria

	Removal Rate (%)
Sterilization	> 80
Eradication	> 90

Table 3 – Deodorization Rate of Harmful Substances

	Deodorization Rate (%)
Ammonia	> 30
Acetic acid	> 30
Toluene	> 30
Acetaldehyde	> 30
Formaldehyde	> 30

4.2.3 Ozone Release

The ozone release shall not exceed an 8-hour average of 0.05×10^{-6}, and an 8-hour maximum of 0.1×10^{-6} (article 4.3.3).

4.2.4 Energy Consumption Efficiency

The energy consumption efficiency of the air sterilizer is determined by the ratio of the airborne bacteria removal rate to the power consumption as follows:

$$E_p = \frac{B_p}{S_w}$$

Where

E_p : Energy consumption efficiency (%)

B_p: Removal rate of floating bacteria (%)

S_w : Power consumption (W)

5 Release of Harmful Substances

5.1 Test Chamber

Test chamber performance requirements.

a) The loading rate of the test chamber shall, in principle, be in the range of 1: 4 to 1: 100, depending on the specimen. However, if it is difficult to determine the size of the test chamber, a smaller size release chamber shall be used. Interior wall material should be made of stainless steel.
b) The wall and bottom surfaces inside the chamber, the power supply line, and the sensor line could affect the concentration of the substance to be measured and should be treated to minimize impact.
c) Release test chamber internal conditions shall be maintained as follows:
    1. Temperature: (23 ± 2) ° C
    2. Relative humidity: (50 ± 5) %
    3. Number of ventilation:
        a. Release test chamber > 5 ㎥: 1 ~ 2 times per hour, relative tolerance is ± 0.5%
        b. Release test chamber ≤ 5 ㎥: 1 to 5 times per hour, relative tolerance is ± 0.5%
    4. Air flow rate: (0.1 to 0.3) m / s
    5. Sample air volume: less than 80% of the inlet air flow into the test chamber
d) The initial state of the emission test chamber shall meet the following in terms of the number of times of ventilation per hour:
    1. Dust: Less than 10 ㎍ / ㎥
    2. VOCs and formaldehyde: less than 2 ㎍ / ㎥
    3. Total Volatile Organic Compound (TVOC): less than 20 ㎍ / ㎥

5.2 Test Procedure

This is the test method for releasing hazardous substances.

a) Before the EUT is operated, confirm that the condition is met as stipulated in 5.1d)
b) The test specimens shall be placed in the center of the test chamber without power supply and maintained for more than 3 times of ventilation.
   In order to prevent contamination, test samples should be installed as soon as possible.
   Immediately after discharge, the test chamber shall be released. In addition, at the same time as the test sample is installed, the temperature and humidity of the chamber shall be measured, and all subsequent measurement procedures shall be such that there is no opening or closing of the chamber.
c) After the power supply is connected, the EUT shall be operated under the maximum load condition and maintained until the measurement is completed.
d) Measurements shall be made at the exit of the emission test chamber.

5.3 Test Method

5.3.1 Volatile Organic Compounds (VOCs) and Carbonyl Compounds

The measurement of the volatile organic compound and the carbonyl compound is as follows:

a) Measurements of the total volatile organic compounds (TVOC), acetaldehyde and formaldehyde emissions must be completed from the start of ventilation 3 until the end of the ventilation 4.
b) Volatile organic compounds are sampled and analyzed using Tenax TA after pretreatment according to ISO 16000-6. In the case of formaldehyde, DNPH cartridges should be used as adsorbents.
c) In the case of volatile organic compounds, two samples should be sampled. For formaldehyde, one sample should be sampled.
d) The collected volatile organic compound adsorption tubes were analyzed using ATD-GC / MS and GC-FID. Well-controlled programming and column bleeding is adjusted so that the n-C16 is eluted before the baseline becomes higher.
e) DNPH cartridges for formaldehyde analysis are analyzed by HPLC after elution with acetonitrile.
f) The qualitative volatile organic compounds should be quantified using the absolute reaction coefficient determined by the calibration curve. Unknown volatile organic compounds should be quantified using toluene equivalent as the relative reaction coefficient.

g) The total volatile organic compound value is eluted between n-hexane and n-hexadecane, and the release should be calculated by summing the concentrations of the qualitative and the unknown substances.

5.3.2 Particulate Matter

Relating to particulate matter measurement.

a) Dust emission measurements shall be maintained from the start of ventilation three times after the start of operation of the EUT until four times of ventilation is completed and the sampling period should be able to detect particulate matter of at least 5 μg / m^3.
b) In the measurement of particulate matter, an analytical balance having a weighing accuracy of 1 μg or more is placed in a temperature and humidity control room. The room, such as glass fiber padding of 0.7 μg pores, should be kept in the air control room for 48 hours.
c) The unused baseline and the measurement area are weighed before and after the sampling, and the measurement area is calibrated by correcting the measurement area with the mass difference of the reference area.

5.3 Others

Calculation of the measurement results and other details are in accordance with ISO / IEC 28360.

6 Airborne Bacteria Removal

6.1 General Information

General information about the performance of floating bacteria.

a) The test method is to measure the number of airborne bacteria amongst the microbial substances present in the standardized test chamber. The impact method is the main test method, but the cleaning method can be used if necessary.
b) The built-in disinfection method of the air sterilizer includes ultraviolet (UV), accelerated oxidation (AOP), photodecomposition, ion cluster, silver nano, plasma and photo catalyst – a mixture of these, or equivalent methods to remove airborne bacteria will apply.
c) Appropriate positive and negative controls should be used in the test.
d) The test shall be conducted on finished products.
e) When producing the medium, operate aseptically.
f) Materials and tools that are not required to be sterilized shall be those recommended by the manufacturer.
g) The tweezers, spoons, media and lids used in the test are sterilized by flame sterilization or high pressure steam every time.
h) The results of quantitative airborne bacteria measurement should be presented in appropriate units according to the method used.
i) If the growth of bacterium is recognized in the negative control medium, all tests shall be re-executed from the beginning and when the development of the bacteria is not recognized, the test is carried out.
j) The test shall be conducted at the airflow level recommended by the sponsor (manufacturer).

6.2 Test Chamber

The test chamber shall be equipped with a HEPA filter unit to remove particles from inside the test chamber which can affect the test, and an air conditioning unit capable of controlling the temperature and humidity of the air inside the test chamber. An agitating fan is installed to maintain the airflow in the test chamber at a speed of 1 m/s or higher and the air must be sterilized by an ultraviolet lamp or the like.

6.3 Test Environment

According to KS A 0006, the temperature shall be (23 ± 2) ° C and relative humidity (50 ± 5) %. The volume shall be within (60 ± 0.5) ㎥.

6.4 Testing Equipment

The test equipment is to have the same or equivalent standard as Table 4.

Table 4 – Test Facility

Product Name	Recommended Dimensions	Remarks
Microbial Sampler	100 L/min	
Autoclave	120 ℃, (15~20) min	
Water bath	30 ℃ ~ 100 ℃	
Incubator	30 ℃ ~ 100 ℃	
Low Temperature Incubator	10 ℃ ~ 40 ℃	
Clean Room	-	
Petri Dish	90mm x 15mm	
Test Chamber	60 ㎥ ± 5 ㎥	
Electronic Balance	< 0.0001 g	
Liquid Nitrogen Storage Container	20 L inside and outside	
High-Speed Centrifuge	100 r/rpm ~ 10,000 r/rpm	
Centrifugal Separator	10 r/min ~ 1,000 r/rpm	
Particle Counter	0.3 ㎛ ~ 10㎛	
Microscope	x 1000	
Homogenizer	-	
Water Purification System	> 18 MΩ	
Colony Counter	-	For colony counting
Aseptic Box	-	
pH Meter	-	
Nebulizer	< 5 ㎛	

6.5 Test Methods

The buffer solution for the test is as follows.

6.5.1 Buffer Preparation

Phosphate buffer (pH 7.2) and peptone salt buffer (pH 7.0) are prepared according to the following procedure.

a) Phosphate buffer (pH 7.2) – Dissolve 34 g of potassium dihydrogen phosphate in about 500 ml of water. For a sodium hydroxide solution, add about 175 ml to adjust the pH to 7.1-7.3 and add water to make 1000 ml. After high pressure steam sterilization, keep refrigerated. When used, this solution is diluted 800 times and sterilized at 121 ° C for 15 to 20 minutes.

b) Peptone salt buffer (pH 7.0) – 3.56 g of potassium dihydrogen phosphate, 18.23 g of sodium mono hydrogen phosphate, 4.30 g of sodium chloride and 1.0 g of peptone was dissolved in 1 000 ml of water, heated and sterilized at 121 ° C for 15 to 20 minutes. Adjust the pH to 6.9 ~ 7.1. If necessary, a surfactant such as polyoxyethlene sorbitan fatty acid ester 20 or 80 may be added in an amount of 0.1 to 1.0%.

6.5.2 Production of Medium

a) 5.0 g of Nutrient Broth peptone and 3.0 g of beef extract are dissolved in 1 000 ml of distilled water. Adjust to 7.0 ~ 7.4 and sterilize at 121 ℃ for 15 minutes.

b) Nutrient Agar 15 g of purified agar is added to 1 000 ml of ordinary medium, heated and dissolved, and distilled water. (6.8 ± 0.2) and sterilized at 121 ° C for 15 minutes.

6.5.3 Test Strain

Staphylococcus epidermidis (ATCC 12228) is used as the strain.

6.5.4 Test Procedure

The test procedure is carried out in the following order.

a) Operate the HEPA filter unit in operation mode for about 1 hour to remove microorganisms and dust inside the chamber. At the same time, the ultraviolet lamp is turned on and sterilizes residual microorganisms and fine dust. At this time, since the residual microorganisms and fine dust may cause errors, the degree of cleanliness should be kept constant below class 5,000.
b) While turning on the HEPA filter unit and the UV lamp and operating the auxiliary fan, about 1 x 10^5 cfu of the test strain is sprayed using a Nebulizer and allowed to stand for one hour and then the initial value is measured.
c) When the EUT is tested, the EUT is operated. During the base test, the removal value shall be measured when the EUT is not running.
d) After completion of the test, sterilize the inside of the chamber with an ultraviolet lamp (40 W, 4) while operating the internal stirring fan to remove the microorganisms.
e) Sufficiently introduce outside air and maintain cleanliness in the test chamber.

6.5.5 Preliminary Examination

Perform preliminary tests if necessary.

a) Ensure that the initial values performed in the blank test and in the test of the EUT are in the appropriate range.
b) The steps are as follows: the primary background test, the specimen test, and the secondary background test.
c) If the range of colonies obtained through preliminary test satisfies the standard value, it can be used as the initial value.

6.5.6 How to Install the EUT

Stand type equipment should be installed on the floor surface of the test chamber, whilst table-mounted equipment should be installed 1.2m above the floor. Wall-mounted or ceiling-mounted equipment should be mounted 1.8m from the floor and an interval of 0.1 to 0.2m from the wall.

6.5.7 Sampling

Samples are taken in the following order.

a) Allow the air to come into contact with the medium using a medium suitable for the measurement method and suction pump.
b) The lid of the sampler is sterilized by autoclaving. After disinfection with 70% alcohol as needed, it will be completely moisture free.
c) Sampling takes place at the centre of the chamber and at a height of 1.2 from the bottom.
d) The initial value at the end of the one hour after the injection of the strain is measured, and the EUT is immediately operated to remove the airborne bacteria in the chamber. During this time, access is prohibited.
e) The sample volume at the initial measurement shall be 100L and adjusted to the initial value range.
f) The removal value (measured value 2 hours after strain injection) is measured immediately after the EUT is run for 60 minutes. At this time, power off the EUT.

6.5.8 Results Calculated

The removal rate is calculated in accordance with 6.5.13 using the removal values obtained from the operation of the EUT and the initial values calibrated through two or more background tests.

6.5.9 Cultivation and Management of Strain

The medium is incubated for the 24 hours under aerobic conditions (32-35). Since a single strain is used, there is no fear that the bacteria will multiply. The incubation temperature and storage method should be managed according to the method provided by the strain bank.

6.5.10 Colony Count Concentration

The number of bacterial colonies is counted using the colony count conversion table, and the number of colonies obtained here is divided by the amount of collected air to calculate the number of colonies per unit volume (cfu / m^3). The colony count conversion table is used for each sampling device (air sampler). Use the colony count conversion table presented.

6.5.11 Natural Reduction Rate

The natural reduction rate is given by the following formula:

$$B_i = \left(1 - \frac{C_t}{C_i}\right) \times 100$$

Where

B_i : Natural reduction rate

C_t : Measured value at 2 hours after the injection of the strain

C_i : Measured value at 1 hour after the injection of the strain

6.5.12 Initial Value Correction

The correction of the initial value is given by the following equation:

$$S_c = \left(1 - \frac{B_i}{100}\right) \times P_t$$

Where

S_c : Initial value correction (cfu / m^3)

B_i : Natural reduction rate

P_t : Initial value when testing the EUT

However, the sampling error of the natural reduction rate should be within the tolerance ± 2% at the confidence level of 95%.

6.5.13 Calculate removal rate

The rate of removal of airborne bacteria by the EUT is given by the following formula.

$$N_i = \left(1 - \frac{S_c}{C_i}\right) \times 100$$

Where

N_i : Airborne bacteria removal rate

S_c : Initial value correction (cfu / m^3)

C_i : Measured value at 1 hour after the injection of the strain

6.5.14 Quality control (QA/QC)

Results should be carefully reviewed and recorded to ensure reliability and objectivity of measurement results and to identify trends. In particular, for the reliability of the test, the error range of the natural reduction rate should always be recorded and corrected.

6.5.15 Sample Collection Record

The sampling record shall be as follows:

a) Collection method
b) Important information about measuring equipment and observations
c) Date and time of sampling, time, duration and temperature / humidity conditions

6.5.16 Sample culture record

Sample culture record is as follows.

a) Culture conditions, storage method and incubation time
b) Variables that can affect the outcome of the harvesting method
c) Appropriate unit markings
d) The name of the person responsible for measurement and culture.

6.6 Deodorization of harmful substances

6.6.1 General Information

The EUT must be supplied with the instructions and should be checked for proper operation before starting the test.

6.6.2 Environmental condition

Unless otherwise specified, it shall be 23 ° C grade 2 • 55% grade 15 according to KS A 0006.

6.6.3 Operating Conditions

The EUT shall be operated at rated air flow with all additional functions turned off. However, when the manufacturer requests to turn on and operate a specific additional function, it operates with rated air volume with the additional function turned on

6.6.4 Test Methods

6.6.4.1 Gas to be Tested

The following five types of hazardous gases are to be tested:

a) Ammonia
b) Acetic acid
c) Toluene
d) Acetaldehyde
e) Formaldehyde

6.6.4.2 Test Chamber

The test chamber shall be a closed vessel (material: glass or acrylic resin) of (4.0 ± 0.1) m3 or more. The EUT is installed in the center of the test chamber. Table mounted equipment shall be installed at a height of 0.75 m above the floor. To uniformly distribute the gas to be teste, a stirring fan is installed inside the chamber.

6.6.4.3 Gas Supply Device

The gas supply apparatus to be tested supplies a certain amount of gas into the test chamber by using a gas tank or a gas generating apparatus so that it can be mixed and diluted, and constitutes a supply line for arbitrarily adjusting the gas concentration in the test chamber.

6.6.4.4 Gas Meter

The gas meter to be tested shall be of FT-IR or higher.

6.6.4.5 Measuring Conditions

The measurement conditions are as follows:

a) The gas to be tested is precisely adjusted by the needle valve and injected in a certain amount.
b) Stop the operation of the EUT when injecting the gas to be tested.
c) The test equipment shall be turned on and off without opening the test chamber door.
d) The agitating fan is continuously operated but stopped during the product test operation.

6.6.4.6 Initial gas concentration measurement

The initial gas concentration is measured after 2 to 5 minutes from the injection of a certain amount of gas. The initial concentration of each test gas shall be 10×10^{-6} and the tolerance of the concentration shall be ± 10%.

6.6.4.7 Operating gas concentration measurement

The operating gas concentration measurement shall be as follows.

a) Run the EUT for 120 minutes at rated air flow rate.
b) Stop the operation of the EUT and measure the concentration of the residual gas.

6.6.4.8 Calculating the removal rate

After n minutes from the start of operation of the EUT, the calculation of the removal capacity of each contaminant gas shall be as follows:

$$N_{i,n} = \left(1 - \frac{C_{i,n}}{C_{i,0}}\right) \times 100$$

Where

$N_{i,n}$: Removal ability of pollutant gas (%)

$C_{i,n}$: Concentration of gas after n minutes of operation (10^{-6})

$C_{i,0}$: Concentration of initial gas before operation (10^{-6})

7 Ozone Release

7.1 Test Environment

According to KS A 0006, the temperature shall be (23 ± 2) ° C and relative humidity (50 ± 5) %.

7.2 Test Method

7.2.1 Test Chamber

The test chamber has a volume of 27 m^3. The inner wall material shall be made of polyethylene sheet or stainless steel. However, if the processing capacity of the EUT differs from the chamber volume, the chamber volume should be increased or decreased according to the manufacturer's request.

In addition, EUTs having the processing capacity of more than the chamber volume can be tested by making a simple chamber. This will be under sealed conditions, providing the manufacturer does not allow for any ventilation.

7.2.2 EUT Installation

The EUT shall be installed at a height of 0.75 m from the center of the test chamber or from the center of the wall. If it is a stand type, install it in the center of the chamber. The number of times of ventilation varies depending on the place of use proposed by the manufacturer.

7.2.3 Measurement of Ozone Emission Concentration

The concentration of ozone emitted from the EUT can be measured by ultraviolet spectrophotometry (No. 2010-24) or by using an ozone concentration analyzer which is equivalent thereto.

The position of the ozone sampling tube should be set to the direction perpendicular to the air flow at a point 0.5 m from the horizontal position of the EUT in the case of ceiling-mounted and wall-mounted type, and 0.05 m from the horizontal position of the EUT in the case of stand-type. The tube for sampling ozone is made of Teflon and the outer diameter is 6.35 mm. The length of the tube shall not exceed 4 m.

8 Noise Test

The test method is as follows:

a) Noise test is performed in the anechoic room by installing the air sterilizer on the pedestal without resonance and echo, and operating at the rated frequency and rated voltage according to the rated voltage.

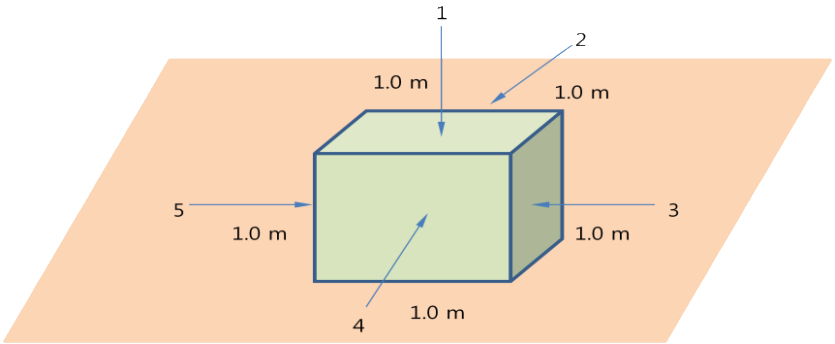
b) Measure the equivalent noise level for 30 seconds in the manner specified in KS A 0701 using the characteristics of the A / D conversion circuit A with the sound level specified in KS C 1502 or KS C 1505 as the noise of the measuring point in the appropriate figure. However, if there is an influence of wind in the wind direction, measure it so that it is not affected.

c) Noise is measured at a distance of 1.0 m from the center of the front, back, left, and right sides of the floor, and the average of the measurements is obtained (see Figure 1).

d) The stand-type noise measurement location measures the noise at a distance of 1.0 m from the frontal and anechoic floor (see Figure 2).

e) The wall-mounted noise measurement location measures noise at a distance of 1.0 m from the front and anechoic floor (see Figure 3).

f) The ceiling embedded noise measurement location measures the noise at the highest noise level in a plane 1.4 m below the EUT (see Figure 4).



Key

1	Upper surface portion
2	Rear surface
3	Right side portion
4	Front part
5	Left side surface

Figure 1 - Noise measurement position of floor type

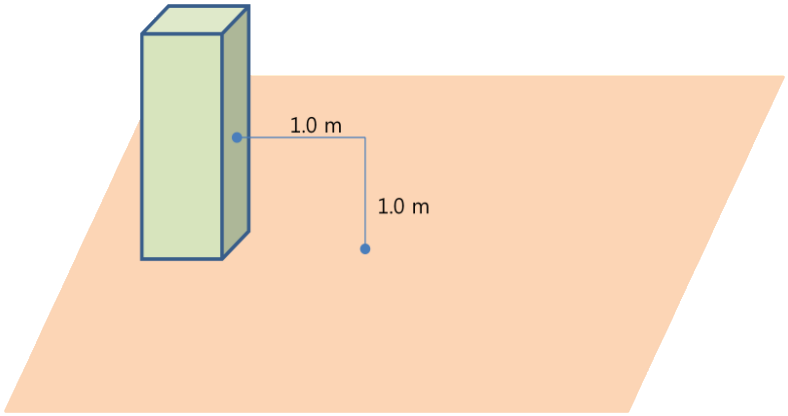


Figure 2 - Standing noise measurement location

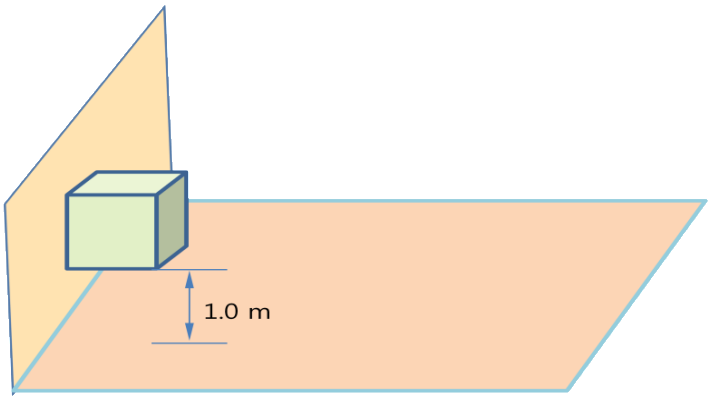
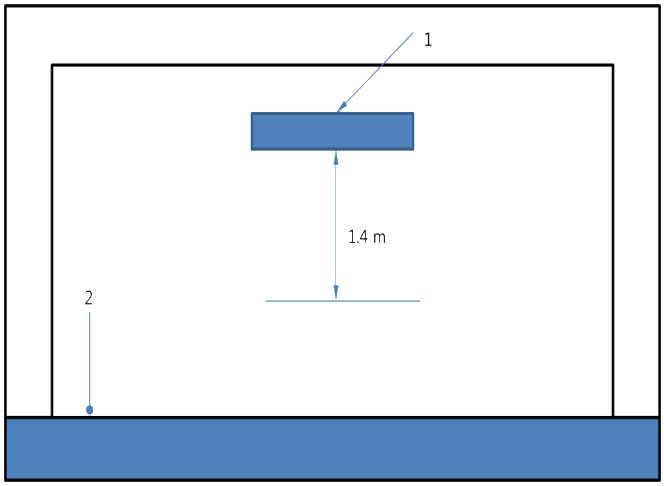


Figure 3 - Wall-mounted noise measurement location



Key

1. Air sterilizer
2. Anechoic floor

Figure 4 - Location of ceiling embedded noise measurement

9 Display

Each product or minimum unit package should be marked as follows in a way that cannot be easily deleted in easy-to-see places. However, precautions for use may be displayed separately from the product or package manuals.

a) Model name
b) Rated voltage (V)
c) Rated frequency (Hz)
d) Measured power consumption (W)
e) Standard use area
f) Year of manufacture
g) Manufacturer's name or its abbreviation
h) Importer's name (import only)
i) Country of manufacture
j) Address and phone number
k) Precautions for use (e.g. safety distance)
l) Energy consumption efficiency

Association Standard	Air Sterilizer
Publish and Issue	Korea Ozone Association Building 130-504 Seoul National University, Gwanak-gu, Seoul, 151-741 ☎ (02)874－0824 ☎ (02)874－0817 http://www.koa.pe.kr

MRSA Test Results from Korea Test Institute (KTL)

Independent test report conducted by KTL following the KOA AS 01 test standard for Air Sterilization Technology.
The object of the report is to show:

A) The reduction of microbial airborne contamination risk, in this case MRSA, by showing a timed reduction of airborne pathogens in a life size chamber of 60M3
B) The ability of Radic8 technology to reduce other air pollutants within healthcare settings, creating a safer and healthier indoor environment.

Description		Contents	Remarks
Test Code		KOA AS 01	
Airborne Bacteria Sterilization Performance	Test Chamber	60±0.5 m^3	
	Test Strain	Staphylococcus epidermidis (ATCC 12228)	
	Incubating Time	24 Hours	
	Removal Rate Calculation Formula	$N_i=(1-S_c/C_i) \times 100$	
	Test Laboratory	Korea Test Institute (KTL)	
Hazardous Gas Removal Performance	Test Chamber	4.0±0.1 m^3	
	Measuring Instrument	FT-IR	
	Test Gases	5 kinds of Gases (Toluene, Ammonia, Acetaldehyde, Formaldehyde, Acetic Acid)	
	Measuring Time	120 Minutes	
	Removal Rate Calculation Formula	$\eta_{i,n} = 1 - C_{i,n}/C_{i,o} \times 100$	
	Test Laboratory	Korea Test Institute (KTL)	
Ozone Emission Test	Test Chamber	27 m^3	
	Measuring Instrument	Ozone Concentration Analyzer	
	Measuring Method	Real-time Continuous Measurement	
	Test Laboratory	Korea Basic Electric Power Research Institute	
Noise Measure Test	Test Chamber	Anechoic Room	
	Measuring Position	1m Height	
	Calculation Method	The average value of the front portion, the rear portion, the left and right side portions, the rear portion	
	Test Laboratory	Korea Test Institute (KTL)	

Description		Limit of KOA AS 01	Test Results of VIRUSKILLERS			Remarks
			VK-BLUE	VK-001 and VK-002	VK-102 and VK-102	
Release of Harmful Substances	Particulate matter	4.0 under	0.052	0.083	0.083	mg/hr
	TVOC's	18.0 under	0.276	0.088	0.088	
	Acetaldehyde	1.8 under	0.037	0.024	0.024	
	Formaldehyde	1.8 under	0.184	0.063	0.063	
Airborne Bacteria Removal Rate		**80% over**	**96.3 %**	**99.1%**	**99.4%**	60 min
Harmful Gas Deodorization Rate	Ammonia	30% over	63%	81%	79%	120 min
	Acetic Acid	30% over	100%	100%	100%	
	Toluene	30% over	100%	100%	100%	
	Acetaldehyde	30% over	88%	100%	100%	
	Formaldehyde	30% over	71%	82%	95%	
Ozone Release		0.05×10^{-6} under	-0.02ppm (Below "0" means no detection)	-0.016ppm (Below "0" means no detection)	-0.014ppm (Below "0" means no detection)	8 hr
Noise		50 dB	46.1dB	46.5dB	47.7dB	

Results

This test report clearly displays a good reduction to the risk of airborne disease transmission and an impressive reduction in air common indoor air pollutants, creating a safer and healthier healing environment.
NOTE: The Raidc8 technology range has a certified destruction rate of all respiratory viruses of 99.9999% on a single air exchange. The above microbial reduction is an indicator of air exchanges through the Radic8 technology and we can safely estimate that all airborne pathogens would have a similar result.