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# The smartest way which you can control, Contact ART Plus





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Technical Service	
Construction SMART CITY	
corresponding to fine dust	

#### Main Business



Evaluation system for 'measurement accuracy' and 'reduction efficiency' of particle & gaseous substances

Design SMART CITY corresponding to fine dust, Annual technical service for system check & calibrations

#### Carry out government R&D project and relevant standard technology research

#### Patents & Awards







#### **Company History**

2016	2017	2018	2019	2020	2021
<ul> <li>03. Established ART Plus Co., Ltd.</li> <li>11. Recognized as an affiliated research institute</li> </ul>	<ul> <li>05. Signed MOU for technology exchange with The Nelson Mandela African Institution of Science and Technology (NM-AIST)</li> <li>11. • Awarded of 'Group achievement award' by NASA</li> <li>• Korea Electronics Technology Institute, Constructing China Network and Market Research Service for Air Purifier by SMEs in Gwangju</li> </ul>	<ul> <li>02. Signed MOU for technology exchange with the Center for Chemical and Packaging (BBKK)</li> <li>03. Acquired ISO 9001, 14001 quality environment management system certification</li> <li>11. Selected as a promising small business in Gyeonggi-do</li> <li>12. Selected as a frontier venture company by the Technology Guarantee Fund</li> </ul>	<ul> <li>03. Private procurement project to improve indoor air quality in Medan, Indonesia (R.P.M. Plus project, Saint Yosep School)</li> <li>05. Awarded Korea green energy company grand prize</li> <li>07. Korean Association for Particle and Aerosol Research, Invitation to major institutions in Indonesia (Ministry of Industry Indonesia, National Standardization Agency of Indonesia, National research institute of Indonesia and etc.)</li> <li>08. Signed MOU for technology exchange with Indonesia's Medan City Research Institute for Standardization and Industrial Terrain (BIM)</li> </ul>	<ul> <li>02. Signed MOU for standards and test methods development with The National Standardization Agency of Indonesia (BSN)</li> <li>12. Awarded the Minister of Small and Medium Venture Business Award for excellent venture business in Gyeonggi-do</li> </ul>	<ul> <li>04. Korean Agency for Technology and Standards, Feasibility Study on Building a Testing &amp; Certification Infrastructure for Fine Dust- Blocking Products in Indonesia</li> <li>06. Awarded the Ministry of Foreign Affair for 'TOP company for K-Corporate Sustainable Management'</li> </ul>

10. Korea Trade-Investment Promotion Agency, Relocation of air filter performance evaluation equipment for vehicles in Tanzania (Global CSR project)

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## Air Filter Performance Evaluation System

Air filter performance evaluation system is a device that measures particle concentration upstream and downstream of test filter while generating particles to pass through the test filter to determine collection efficiency. System includes wind tunnel, generator, neutralizer, measurement device, control board, and program. Types of test procedures, generators, and measurement devices used are different depending on the type of filters, and likewise the statistically figures also differ by the measurement values. Therefore, it is critical to design and manufacture according to the standards. As for the test materials, KCl, NaCl, DOP, Paraffin Oil and others can be used. Test procedures include PSE(Particle Size, Efficiency), Pressure Loss, MERV(Minimum Efficiency Reporting Value), MPPS(Most Penetrating Particle Size). System is differed by the type of filter and standards required for the evaluation.



## **Features**

- Provide reliability of measurement results by optimizing air velocity uniformity, particle concentration, and space uniformity for each systems
- Emergency stop button is available in case emergency situation occurs
- Easily place and remove test filter for user convenience
- Prevent user operated errors in measurement results and test procedures by automating data collection, storage, and statistical processing during system operation
- Provide timely updates to meet changes in related regulations and/or test standards
- Chemically resistant sealants are used to connect in between ducts to prevent damage by the test material specified in the related standards / applied to corrosion resistance material product (Cabin air filter for Gas)

#### **Applications**

Model	Evaluations	Applications
CF-2010W	ISO 11155-1 (Particle)	Road vehicles
CF-1916W	ISO 11155-2 (Gas)	- Air filters for passenger compartments
MF-1712W	ISO 16890, ASHRAE 52.2	Ventilation / Air conditioner
HF-1710W	EN1822-4 HEPA / Medium filter collection efficiency	Semiconductor and high-tech industrial
HF-1711W	KS B6740, KS B 6141, KS B 9325	process Air cleaners
LF-1918W	KACA Air cleaner fine dust maintain capacity test (proposed)	Air filter for air cleaner life expectancy (life-span) evaluation
BF-1713W	Bacterial material collection efficiency	Medical, phamaceutical, animal testing, specific purpose construction ventilation, and air cleaners

#### Cabin Air Filter Particle Efficiency Performance Evaluation Tester (CF-2010W)



Classification	Specification	
Flow range	150 ~ 680 CMH	
Testing filter cross sectional areas	300 x 600 mm	
Flow rate uniformity	± 10%	
Particle uniformity	± 10% (@ 0.3 ~ 5.0 µm), ± 20% (@ 5.0 ~ 10 µm)	
Upstream and downstream correlation ratio	0.7 ~ 1.6	
Pressure loss measurement range	~1,000Pa	
Transfer system size	2,100 x 1,700 x 3,600 mm	
Test particles	ISO A2 Fine Dust, KCl	
Type of test	Pressure loss, efficiency test, filter dust capacity	
Related regulations	KS R ISO 11155-1, ISO/TS 11155-1, DIN 71460-1, SPS-KACA014-144	
Testing filter	Cabin air filter	
Control system	Operation program and KIOSK	
Main components	Optical particle counter, Large particle generator, Dust generator, Neutralizer	



## Cabin Air Filter Gas Efficiency Performance Evaluation Tester (CF-1916W)



Classification	Specification
Flow range	150 ~ 680 CMH
Testing filter cross sectional areas	300 x 600 mm
Flow rate uniformity	± 10%
Gas concentration uniformity	± 5%
Transfer system size	3,102 x 1,630 x 3,450 mm
Test gas	N-butane, Toluene SO2 (Option: NO2, Acetaldehyde)
Type of test	Pressure loss, Filtration efficiency, Capacity determination
Related regulations	KS R ISO 11155-2, ISO/TS 11155-2, DIN 71460-2, SPS-KACA014-144
Testing filter	Cabin air filter
Control system	Operation program and KIOSK
Main components	Gas analyzer (N-butane, Toluene, SO₂), Gas generator

## High Performance Air Filter Leak Rate Performance Evaluation Tester (HF-1710W)



High Performance Air Filter Particle Efficiency Performance Evaluation Tester (HF-1711W)



Classification	Specification	
Surface speed	0.485 m/s	
Flow rate uniformity	CV 10%	
Particle uniformity	CV 15%	
Transfer system size	4,000 x 8,000 x 2,000 mm	
Test particles	NaCl, KCl, PSL, DOP, DEHS	
Scanning probe	Area : 9 ± 1 cm <sup>2</sup> (30 x 30 mm) Accuracy : 1 mm Position : 10 ~ 50 mm Movement speed(X,Y,Z) : 10 cm/s or less	
Test cross- section	< 1,830 x 1,220 mm	
Materials	Electrical conductor of STS 304 or higher	
Observation window	Uninterrupted processed Resin series	
Related regulations	EN 1822-4, KS B6740 : 2015	
Testing filter	HEPA filter, ULPA filter	
Control system	Operation program and KIOSK	
Main components	Optical particle counter, Particle generator, Neutralizer, Clean air supply, Diffusion dryer	

Classification	Specification	
Surface speed	0.5 ~ 3.0 m/s	
Testing filter cross sectional areas	610 × 610 mm	
Flow rate uniformity	CV 10%	
Particle uniformity	CV 15%	
Transfer system size	1,584 x 11,500 x 1,780 mm	
Туре	Horizontal straight wind tunnel consisting of a square section duct	
Test particles	KCl or DOP	
Subject mounting part	Duct moving guide and applying pneumatic cylinder	
Materials	Electrical conductor of STS 304 or higher	
Observation window	Uninterrupted processed resin series, equipped with LED lighting	
Related regulations	KS B 6740 : 2015, KS B 6141 : 2020, KS B 9325 : 2011(Type 1)	
Testing filter	HEPA filter (H13 or higher)	
Control system	Operation program and KIOSK	
Main components	Optical particle counter, Particle generator, Dilutor, Clean air supply	

Medium Performance Air Filter Particle Air Filter Life Efficiency Performance Evaluation Tester (LF-1918W) (MF-1712W)



Classification	Specification	
Surface speed	0.5 ~ 3.8 m/s	
Testing filter cross sectional areas	610 × 610 mm	
Flow rate uniformity	CV 10%	
Particle uniformity	CV 15%	
Transfer system size	2,249 x 12,000 x 2,600 mm	
Test particles	KCI, ASHRAE DUST	
Flow inlet and outlet in the wind tunnel	High performance filter (H13 or higher)	
Subject mounting part	Duct moving guide and applying pneumatic cylinder	
Materials	Electrical conductor of STS 304 or higher	
Observation window	Uninterrupted processed resin series, equipped with LED lighting	
Related regulations	ANSI/ASHRAE 52.2, ISO 16890	
Testing filter	(For ventilation/air conditioning) Medium performance air filter	
Control system	Operation program and KIOSK	
Main components	Optical particle counter, Large particle generator, Dust generator, Neutralizer	



# Air Filter Lifespan Evaluation Tester (LF-1918W)



Classification	Specification	
Airflow volume	150 ~ 680m³/h(± 3%)	
Testing filter cross sectional areas	610 × 610 mm (Filter bank under test)	
Flow rate uniformity	± 10%	
Particle uniformity	± 10% (@ 0.3 ~ 5.0 μm), ± 20% (@ 5.0 ~ 10 μm)	
Туре	Top-down type vertical wind tunnel	
Transfer system size	2,400 x 2,400 x 2,100 mm	
Test particle	Dust (powder form)	
Materials	Electrical conductor of STS 304 or higher	
Observation window	Uninterruptible acrylic	
Type of test	Fine-dust reduction durability of air filter	
Related regulations	SPS-KACA 002-132;2021	
Test filter	Air filter for air cleaner device (purifier)	
Control system	Operation program and KIOSK	
Main components	Optical particle counter, KCl generator, Dust generator, Neutralizer, Dilutor, Clean air supply (Option: Environmental control system, IPA Conditioner)	

## Air Filter Bacterial Filtration Efficiency **Performance Evaluation Tester** (BF-1713W)



## **IPA Conditioner (Elimination of** electrostatic effect of air filter, AIC-1998)



Classification	Specification	Cla
Surface speed	0.5 ~ 3.0 m/s	S
Testing filter cross sectional areas	610 × 610 mm	0
Flow rate uniformity	CV 10%	
Particle uniformity	CV 15%	Inte
Туре	Horizontal straight wind tunnel composed of squre cross-section duct	Char
Transfer system size	1,854 x 11,500 x 1,780 mm	IPA
Test particles	Staphylococcus aureus	
Subject mounting part	Duct moving guide and applying pneumatic cylinder	Dar
Materials	Electrical conductor of STS 304 or higher	Ai
Observation window	Uninterrupted processed resin series, equipped with LED lighting	V
Related regulations	ASTM F2101-14	Com
Testing filter	(For ventilation/air conditioning) Medium performance air filter	IP
Control system	Operation program and KIOSK	Ex
Main components	Optical particle counter, large particle generator, dust generator, neutralizer	re

Classification	Specification	
Size(WDH)	1,668 X 805 X 1,724 mm	
Component	<ul> <li>Touch panel PC (control and S/W) Airtight damper</li> <li>IPA generation chamber &amp; filter mount chamber</li> </ul>	
Internal volume	Approx. 0.98m <sup>3</sup>	
Chamber material	Stainless Steel (internal)	
IPA generation type	Evaporative in chamber Dualization of IPA generation chamber and filter mount chamber (Space separation using dampers)	
Damper works	Pneumatic Actuator	
Airtightness	< 15 Pa within 1 min	
Ventilation	> 3.5 air exchange/hr. Blower (Supply type) Automatic (can be manual)	
Compressed air	> 4 bar (recommended)	
IPA drainage	Automatic drainage (can be manual)	
Exhaust port	Φ 50mm	
Related regulations	ISO 16890-4, SPS-KACA002-132:2021	

# Dust Sensor(PM-2.5) Performance Evaluation System

Dust sensor performance evaluation system evaluates measurement accuracy and reproducibility of dust sensor by placing dust sensor in certain volume of space(chamber) where particle concentration uniformity is secured and test material or test particle with known size distribution is injected and comparing with reference equipment. System includes test chamber, particle generator, measurement instrument, and operating program. The generator is capable of providing two types of conditions. One type is maintaining constant concentration of test particle and evaluating measurement accuracy of dust sensor. Another type is reducing concentration of test particle uniformly to simultaneously evaluate dust sensor measurement accuracy and reactivity according to the particle concentration changes. User can select test types according to the purpose of the test.

#### **Features**

- Secure particle concentration uniformity in chamber by optimized mixing column and generating system
- Minimize test measurement uncertainty
- Maintain chamber door in lock until test is completed or user decides to end the test to prevent accidents
- Capable of identifying test progress status via warning lights installed outside of test chamber
- Improve user convenience and efficiency by minimizing concentration adjustment time in test concentration sections
- Besides test procedures of initially implemented requirement, provide access to set test concentration and test time to provide expandibility as device for fine dust concentration environment research and creating environment
- Automatic test operation and test report storage
- System stand alone control and remote control via external PC

#### **Applications**

Model	Туре	
ADT-1782 (ADT-1786)	Batch type	<ul> <li>Optimized for dust</li> <li>Capable of providin mass production f</li> <li>Average aerosol complete</li> </ul>
ADT-1783	Continuous flow type	<ul> <li>Optimized to deter specific conditions</li> <li>Complies to SPS-C</li> <li>Average aerosol complexity</li> </ul>
ADT-1785	Changes in temperature and humidity environmental conditions	<ul> <li>Optimized to determ</li> <li>Capable of testing</li> <li>Average aerosol comparison</li> </ul>
ADT-1983	Batch type	<ul> <li>Used for determining</li> <li>Exclusively for the repeatability test p</li> <li>Average aerosol comparison</li> </ul>
ADF-2090	Portable (On-site evaluation)	<ul> <li>Possible on-site in</li> <li>Enable to check w as notification(201</li> </ul>





c.	voto m	footuroc	•	honofite
- 5	vstem	reatures	8	benefits
_				

- sensor development and performance research ng customized system for fine dust product for facility oncentration deviation < ±15 %
- rmine dust sensor performance evaluation and
- s coincide
- CKACA 0027-7269 dust sensor test evaluation standard oncentration deviation < ±15 %
- nine dust sensor performance evaluation and reliability evaluation at the following condition:  $-40^{\circ}$  ~  $85^{\circ}$ ,  $15^{\circ}$  ~  $85^{\circ}$ 
  - (@25℃, non-condensing)
- oncentration deviation < ±15 %
- ng performance class of fine dust for simple measuring device Ministry of Environment 'notification(2019-14)' rocedure
- oncentration deviation < ±10 %
- nspection of Fine dust (PM-2.5) sensor hether maintaining quality of performance level (class) 19-14) of Korean Ministry of Environment

## General-type Dust Sensor (PM-2.5) Performance Evaluation Tester (ADT-1782)



## Mass Production-type Dust Sensor Performance Evaluation Tester (ADT-1786)



Classification	Specification	Classification	Specification
External size (WDH)	1,600 x 1,400 x 2,400 mm	External size (WDH)	1,900 x 1,650 x 2,200 mm
Internal size (WDH)	1,000 x 1,000 x 1,000 mm	Internal size (WDH)	1,300 x 1,300 x 1,000 mm
Test particles	KCl, smoke, dust (User selected)	Test particles	KCl, Smoke, Dust (User selected)
Control concentration range	10~500 μg/m³	Control concentration range	10~500 μg/m³
Test particle concentration uniformity	± 15 % (@50~500 μg/m³), ± 5 μg/m³ (@<50 μg/m³)	Test particle concentration uniformity	± 15 % (@50~500 μg/m³), ± 5 μg/m³ (@<50 μg/m³)
Test particle concentration maintained accuracy	± 10 % (@50~500 μg/m³), ± 5 μg/m³ (@<50 μg/m³)	Test particle concentration maintained accuracy	± 10 % (@50~500 μg/m³), ± 5 μg/m³ (@<50 μg/m³)
Chamber materials	STS 304, Anti static materials	Chamber materials	STS 304, Anti static materials
Power	220 VAC, 60 Hz	Display	Touch panel & LCD monitor (User selection)
Control system	Operation program and KIOSK	Power	220 VAC, 60 Hz
		Control system	Operation program (Exclude control sensor and communications)

## Part-type Dust Sensor (PM-2.5) Performance Evaluation Tester (ADT-1783)



#### Environmental control system

Classification	
Test room size (WDH)	5,000 x 3,050 x 3,400
Temp./Humid. (accuracy)	18 ~ 28 ℃ (±1.5 ℃), 4
Power	3 Phase, 380 VAC 60

#### Test chamber

Classification	
Size(WDH)	Test section : 470 x
Weight	200 kg
Airflow in the chamber	< 0.1 ± 0.05 m/s
Generated particle	KCI
Generated particles size	~ 10 µm
Particle generation type	Continuous concen
Particle generation concentration	~ 1,000 µg/m³
Accuracy of particle concentration change	When fitting a curve
Particle distribution uniformity	< ±15 %
Mass concentration measurement range	0.1 ~ 5,000 μg/m <sup>3</sup>
Particle measurement range	0.25~32 µm, 0~3,00
Display	Count concentration
Control system	Operation program
Related regulations	SPS-C KACA 0027-



#### Specification

0 mm (Include HVAC)

40 ~ 70 % (@18 ℃ ~ 28 ℃ ±5 %)

0Hz 24 Kw/h (Safety Factor 30 %)

#### Specification

: 470 x 400 mm / External : 1,600 x 1,000 x 2,900 mm

tration change, exponential dacay or linear dacay

ve, the residual value is 0.8 or more

00,000#/liter

on + PM-10, PM-2.5, PM-1

and KIOSK

-7269

.

## Automotive Part-type(Reliability evaluation) Dust Sensor (PM-2.5) Performance Evaluation Tester for Automobile Parts (ADT-1785)

Classification	Specification
Chamber size (WDH)	Test section : 600 x 600 x 600 mm External : 1,600 x 2,800 x 2,300 mm
Test particles	KCl, Cigarette smoke, dust(User optional)
Control concentration range	10~500 μg/m <sup>3</sup>
Test particle concentration uniformity	± 15 % (@50~500 μg/m³), ± 5 μg/m³ (@<50 μg/m³)
Test particle concentration maintained accuracy	± 10 % (@50~500 μg/m³), ± 5 μg/m³ (@<50 μg/m³)
Materials	STS 304, Anti Static Materials
Temp.	-40 ~ 85 ℃ (±2 ℃)
Humid.	30 ~ 85 % (±5 %) @ 25 ℃, Non-Condensing
Weight	Approx. 500 kg
Control system	Operation program and KIOSK
Related regulations	Satisfying ES (Engineering Standard) for 'H' automotive company in Korea

#### • Dust Sensor for Equivalent Verification for Outdoor

- Outdoor test room and equivalency evaluation system is based on 'Air pollution monitoring network installations and operation guidelines' and National Institute of Environmental Research (NIER) affiliated organization of Ministry of Environment 'Installation and operation guidelines for air pollution monitoring stations'
- Measuring equipment for equivalence evaluation is 'type approved' by the Ministry of Environment(Class I, Class II)
- The outdoor test building is constructed in the same way as the installation method of the NIER's "Atmospheric monitoring network" (National Institute of Environmental Research)
- Automatic weighing system minimizes 'Measurement uncertainty by precisely controlling temp./humid. and removing static electricity and particles inside', 'Data processing of more than 100 no. of filters', 'Accommodates more than 100 no. of filters simultaneously', and 'Possible to process large amounts of data'
- Components : Automatic weighing system, ultra fine dust sample collector (sampler type and beta-ray type), precision scale, flow calibration device, outdoor test room and equivalency test facility, spare equipment and accessories

## • Dust Sensor (PM-2.5) for Repeatability Verification for Indoor

- Chamber large enough to evaluate all 'simplified fine-dust analyzers' sold in South Korea. (simple measuring device) sampling flow rate: less than 16.7 L/min)
- Related standard : Ministry of Environment 'Notification 2019-24'

Classification	
External size(WDH)	2,300 x 1,700 x 2,400 mm
Internal size(WDH)	4.1 m <sup>3</sup> (1,600 x 1,600 x 1,600mm
Particle distribution uniformity	± 10 % (Difference in particle cor by four of the test surface and 5
particle concentration control range and accuracy	0 ~ 100 $\mu g/m^3$ (based on PM-2.5
Background concentration in chamber	2 µg/m³ (up to 30 min)
Particle mixing device	Geometric standard deviation :
Test particle size range	0.1~10µm
Test particle concentration range	0.1~10,000µg/m³
Particle concentration measurement method	Optical scattering
Mass concentration display resolution	0.1µg/m³
Particle concentration measuring flow rate	5 L/min, 1.2 L/min (User selecta
Maximum sampling flow rate of the test object	~16.7 L/min
Test progress indicator	Damper with lighting fixtures fo
Control system	Operation program & KIOSK





#### Specification

n) The length of each side can be adjusted within 30%

oncentration at the center point of each quadrant divided measuring points at the center point of the test surface)

5), set concentration value  $\pm$  10 % or  $\pm$  5  $\mu$ g/m<sup>3</sup>

1.4 ~2.0

table)

or recognizing test conditions

## SMART CHECK (ADF-2090, Dust sensor (PM-2.5) (simple measuring device/sensor) performance field inspection equipment)

ART Plus SMART CHECK (Dust sensor (PM-2.5) (simple measuring device/sensor) performance field inspection equipment (model. ADF-2090)) is a device that provides capability to verify measurement accuracy and sensitivity for simplified fine dust analyzers to quickly confirm that the analyzer is maintaining the quality within the measurement accuracy of initially received class.



\* The others("Portable case", and "Support tripod") optional, but "Particle counter", and "Aluminum Table", and etc. in the picture just for the information

Classification	Specification
Particle supply method	fluidized bed generator
Generated particle flow rate	2 ±15 % L/min
Particle generation concentration	<ul> <li>Elapsed time of occurrence 1-10 min. : 45~55 μg/m<sup>3</sup></li> <li>Elapsed time of occurrence 11~20 min. : 20~30 μg/m<sup>3</sup></li> <li>(A basis of PM-2.5, adjustable concentration according to test fine dust mixing ratio)</li> </ul>
Size(WDH)	230 x 280 x 550 mm
Screen Layout	5.0 inch Touch Panel
Weight(kg)	Performance check equipment body 10kg or less
Power	Using portable battery (12V DC, 4A)
Operating time	6 hours
Option	Battery : ADF-63501 Support tripod : ADF-63502 Customized test material discharge port (Made to order) : ADF-63503 Portable case : ADF-63504 Test material (Dust) 1 pack [10 bottles] : ADF-63505 USB cable for battery charging : ADF-63506
EMC No.	R-R-hnd-ADF-2090

#### • ADF-2090 Test result



<Inspected test equipment generation
concentration & reproducibility test results>

# Simplified Gas Sensor Performance Evaluation Tester

The simplified gas sensor is used in various environmental fields due to its advantage of being able to collect data at a low cost. Since a relatively simple measurement method was applied, it is difficult to determine whether traceability with the National Reference Measurement System level, ART Plus's 'Simplified gas sensor tester' is a device that can super easily check the main performance of gas sensors

Classification	
Test chamber configuration	Double chamber system
Chamber material	<ul><li>inner chamber : Stainl</li><li>outer chamber : Stainl</li></ul>
Gas generation	Supply quantitative refer
Measuring gas	NO, NO2, SO2, CO, O3, H2S
Gas concentration dilution ratio	Interlocking with referen dilution ratio
Zero air generator	<ul> <li>Flow rate : Operate in concentration : SO2 &lt; 0</li> <li>NH3 &lt; 0.1 ppb, 03</li> <li>CO2 &lt; 1ppm, other</li> <li>Zero Air purity : ≥ 99.9</li> </ul>
Reference gas meter	Equipment that meets th
Temp. Humid. range, and accuracy	• Temp. range, and accu • Humid. range, and acc
Evaluation items	Measurement accuracy, coefficient (R2), zero drif concentration limit, and
etc.	Consultation is required interfering gas impact ev





#### Specification

```
(inner chamber & outer chamber)
```

```
less steel coated teflon, and stainless steel
less steel (≥ strength of SUS304)
```

rence gas

```
S, NH3, CO2, VOC
```

nce gas meter, and applying dynamic gas concentration

```
onjunction with the condition below limit of reference gas meter
0.1 ppb, H<sub>2</sub>S < 0.1 ppb, NO < 0.1 ppb, NO<sub>2</sub> < 0.1 ppb,
<sup>13</sup> < 0.4 ppb, CO < 20 ppb, Hydrocarbons < 5 ppb,
er gases can be added
299%
```

he MoE's 'type approval', and equity test standards (Optional)

```
uracy : -30~80℃, ±2℃
curacy : 10~80% R.H. ±5%
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relative precision, relative accuracy, repeatability, linear ft, environmental reliability, data acquisition rate, measured etc

when adding evaluation items or adding conditions for valuation

# Mask Performance Evaluation system

The mask performance evaluation system of ART Plus is divided into health (KF), medical (ASTM), and industrial (EN) depending on standard of masks.

Each system is designed and manufactured in accordance with the certification standards, and is used as a test criteria equipment in Korea Conformity Laboratories (KCL), P&C Labs, Busan Techno Park, Gyeong-buk Techno Park, KOTITI Testing & Research Institute, and FITI Testing & Research Institute.

#### Applied standards & test regulations

: Ministry of Food and Drug Safety (MFDS) 'Guideline for Health Mask Standards' MFDS Notification No. 2020-85, No. 2021-14 of 'Quasi-Drug criteria and Test Methods' MFDS's Guideline for 'Permission Review of Medical respiratory protective Equipment'

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## Health Mask Performance Evaluation

MFDS's mandatory test list for health mask

Classification	Test sample	Test criteria	Remark
BFE	Non-woven	≥95% (@0.3um)	'Permission', or 'Declaration' submission
Breathing resistance		$\leq$ 60, 70, 100 Pa	
PFE	-	≥80,94,99%	
Tensile strength		$\geq$ 10N	
Appearance, shape, purity	Mask (product)	Refer to the standard test method for quasi-drugs	
Leakage rate		≤ 25.0, 11.0, 5.0 %	Submit only at the time of 'initial' product approval

#### Mask Inhalation Resistance Evaluation Tester (ARE-1651)



Specification
Guideline test head for reference criteria for health masks
~120 Pa
30 L/min
60 sec /1 time
Raw data (1 time/1 sec) and average value
0~40°C
40~70%RH
KF 80, 94, 99 Mask Inhalation Resistance Tester
12.1" TFT XGA LED Panel
Windows 10
system memory (~4GB) DDR9 1066 SDRAM
USB x2, Ethernet x1
340 x 540 x 700 (Including Head)
Approx. 35kg

## Leak Rate Performance Evaluation Tester (AML-1652)



Classification Aerosol measureme device Aerosol generator

Test room

Test chamber environment Test char environm

Software

Others

#### AML-1652 Software Program

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	the first set	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1		
Å	AML-1652		-	
	activity of a	41341 -< 11.6 8 9	19.34	
		*1.1.43 2.5cp =2c0.	*****	
	(1.00) <b>(</b> .00)	5.46.	1.4	
No.	. Details			
1	Testing Chamber			
2	Clean Air Supply Tube			
3	Mask inside Concentration Sampling (Connected	Mask inside Concentration Sampling (Connected to Downstream)		
4	Differential Pressure Sensor: Measuring B	Differential Pressure Sensor: Measuring Breathing Pattern		
5	HEPA Filter	HEPA Filter		
6	Solenoid Valve for Inhalation			
7	Solenoid Valve for Exhalation			
8	Measurement (Photometer)			
9	Sampling Pump for Photometer			
10	Chamber Concentration Sampling (Connected to Upstream)			
11	NaCl Generator			
12	Controlled Air Supply Duct	Controlled Air Supply Duct		



	Specification
nt	Laser photometer
	Aerosol concentration : 8 $\pm$ 4mg/m <sup>3</sup> Particle size range : 0.02~2 $\mu$ m Mass median diameter : 0.6 $\mu$ m(measured by SMPS)
	(Option) Temp. & RH range : $25 \pm 2.5^{\circ}$ , $50 \pm 5^{\circ}$ Air supply & Exhaust : HEPA filter unit
ess	ISO class 7(10,000 class)
nber nent	Up to 30 times per hour or continuous cycle
	Particle concentration measurement cycle: 1 time/0.1 second, measuring instrument measurement and control, ventilator, valve opening and closing control, mask leakage rate automatic calculation and determination, screen display and storage
	Inhalation/Exhalation time count & Hardware control





## Medical Mask Performance Evaluation System

A medical mask is a product used to prevent the intrusion or infection of certain disease from unexpected viruses or bacteria, etc. in hospitals. Therefore, in order to prove the purpose of use as a medical respirator, all of the performance tests below must be performed.

ART Plus's medical mask performance evaluation equipment (smART) is a measuring equipment designed in accordance with ASTM F2100-11 of ASTM International, a global organization that develops and publishes technical standards for medical products, materials, systems, and services. The performance of medical masks can be tested according to the five evaluation criteria required by the standard. Korean MFDS's Guideline for Permission Review of 'Medical Respiratory Protective Equipment' operates in the same way as FDA, ASTM, NIOSH, and therefore respond to MFDS's Guideline through smART series,

### MFDS's mandatory test list for medical respiratory protective equipment

Test item	Test criteria	Compulsory Test (FDA or NIOSH, select 1)		Remarks	
(Regulation)		FDA NIOSH			
Differential Pressure (MIL-M-36954C)	< 5 (or 6) mmH <sub>2</sub> O/cm <sup>2</sup>	Differential Inhalation & exhalation pressure Resistance test		Breathability	
Bacterial Filtration Efficiency (ASTM F2101:BFE)	≥ 95% @ 3 µm or ≥ 98% @ 3 µm	© - (		Determination of the proportion of bacteria larger than 3 µm with Staphylococcus aureus	
Particle Filtration Efficiency (ASTM F2299:PFE)	≥ 95% @ 0.1µm or ≥ 98% @ 0.1µm	o -		Measure proportion of particles larger than 1 µm filtered by the mask into the latex aerosol	
Synthetic Blood Penetration Resistance Tester (ASTM F1862)	80(or 120, 160) mmHg	Ø		Assess the penetration resistance of the mask with a smaill amount of artificial blood (~2ml)	
Flammability (16 CFR Part 1610)	Class1 or Class 2	0		Measure combustion maintenance time by touching a 16 mm flame for 1 sec.	
Dust Filtration Efficiency	≥95% (NaCl)	- ©		Average particle size 0.3 µm, 85ℓ /min	
Biological safety	-	0		Confirmation of biological safety for human contact	

## smART Flammability Tester (MDF-2034)



Classification	Specification
Contact time resolution	1 second
Combustion time measurement resolution	0.1 second
Specimen target size	50 x 150 mm
Specimen fixed angle	45 degrees
Touch panel PC	10.4" TFT LCD
Size(WDH)	400 x 380 x 640 mm
Operating software	Contact time control, combustion duration monitoring
Related regulations	US 16 CFR 1610



# smART Synthetic Blood Penetration Resistance Tester (MBP-2038)



Classification	Specification
Blood spraying distance	300 ± 10 mm
Blood spraying speed	450, 550, 635 cm/s
Blood spraying time	0.80, 0.66, 0.57 sec
Blood spraying pressure	10.6, 16, 21.3 kPa
Nozzle	ID 0.84 mm x L 12.7 mm
2-axis motor electric control	2-axis motor electric control
Control pressure range	Using electric regulator
Touch panel PC	10.4"TFT LCD
Size(WDH)	860 x 620 x 600 mm
Material	Steel case, powder coated
Blood collected part	Polycarbonate (PC)
Synthetic blood storage tank	STS 304
Main air pressure range	4.5 ~ 5.5 bar
Water tank pressure range	0 ~ 1 bar
Control system	<ul> <li>Spray distance controlable</li> <li>Blood spraying speed and time control, and monitoring</li> <li>Automatic pressure control using electric regulator</li> <li>Nozzle zero control and position information storage</li> <li>Synthetic blood storage tank water level monitoring/drain function</li> </ul>
Related regulations	MFDS's Guideline for permission review of 'Medical respiratory protective equipment', and ASTM F1862

## smART Particle Filtration Efficiency(PFE) Measurement Tester (PFE-2037)



## smART Mask Differential Pressure Tester (MDP-2030)



## Bacterial Filtration Efficiency Evaluation Tester (BFET-1853) (for Health & Medical)



Classification	Specification
Test flow rate	28.3 ℓ /min
Test sample	Mask, Filter media
Filter efficiency	-99.999999%
Particle efficiency	50% @ 0.1µm, 100% @ 0.15µm
Test particle	Sampling flow : 28.3 LPM Particle dilution ratio 1:10
Particle measurement range	0.1~10µm
Test particle concentration	103#/cm³ or less
Correlation ratio of test particle (Upstream/ downstream)	99~101%
Automatic control device and operating software	<ul> <li>Test flow control and monitoring</li> <li>Generator, instrument power and operation control</li> <li>Instrument measurement data collection and storage</li> <li>Real-time monitoring of test status and system environment (flow, temperature, humidity)</li> <li>Built-in relevant prescriptive test protocols for performing automated tests</li> <li>Statistical processing of result data according to domestic and international applicable regulations and test methods</li> </ul>
Optional	<ul> <li>Particle Dilutor (Dilution ratio 1:10)</li> <li>Applied when testing at concentration higher than the particle measurement limit</li> </ul>
Related regulations	MFDS's Guideline for Permission Review of 'Medical Respiratory Protective Equipment', and ASTM F2299

Classification	Specification		
Flow	8 LPM		
Test area	2.5 cm dia.		
Differential pressure measurement	Manometer		
Weight	< 7 kg		
Related regulations	MFDS's Guideline for Permission Review of 'Medical Respiratory Protective Equipment', and MIL-M-3695 4C 4.4.1.2		

Classification	
Bacteria generating device part	Generation method : N Average particle diame Concentration level(Ch Pressure control rang Mixing flow control rang Feeding speed range :
Bacteria collected device part	6-stage type (Andersen Flow rate : 28.3 ℓ /min (
Medical mask jig	Keep sealed(0.1#/cm <sup>3</sup>
Medical mask fixing method	Compression and hold
Test air flow control	Supply through clean a
Device for collected residual bacteria	Collected cooling cond
Cooling water supply(8L)	Temperature range : - External size : 400 x 70
HHood system : Built-in HEPA filter	External size : 1,800 x Internal size : 1,500 x &
Control system and program	<ul> <li>Automatic control : g</li> <li>Test flow meter mor</li> <li>Built-in test protoco</li> <li>Storage of test cham (preventing arbitrary</li> <li>Control hardware</li> </ul>
Related regulations	MFDS's Guideline for F Equipment', and ASTM
Others, user options	Test environment cont



#### Specification

Nebulizing neter : 3.0 ± 0.3 µm (ASTM F2101-14) Challenge level) : 2,200 ± 500 CFU (ASTM F2101-14) ge : 0 ~ 2.0 bar ange : 0 ~ 30 lpm • : 0 ~ 23.4 ml/min

n type cascade impactor) Sample measuring range : 0.85 ~ 10  $\mu{\rm m}$  (1 CFM)

<sup>3</sup> or less)

ding device using compressed air

air inlet, automatic control method

densation

-20 ~ 40 ℃ 700 x 720 mm(WDH)

generator operation, test flow

nitoring

ol according to standards and regulations and automatic test mber environment data and measured raw data γ modification)

Permission Review of 'Medical Respiratory Protective M F2101-14

ntrol system and laboratory equipment

## smART Cough Droplet Simulating Environment Virus Filter Tester (VF-2021TS)



- By Patent 'no. 10-2128994', bacterial spray nozzle and bacterial aerosol supply device using the same
- Design considering safety of user from viruses and particles
- ► Install UV light inside the virus test hood system
- After completion of test, the test chamber and system can be cleaned and sterilized by distilled water and ethanol
- ▶ In case of emergency, press the EMO switch to cut power
- Design a system to apply with the standards of <Standards and Test Methods for Quasi-Drugs> announced by the Ministry of Food and Drug Safety and <ASTM F2101-14>
- Measured values of the equipment are automatically processed to prevent data loss and errors due to user error or manual measurement.
- The operating device of the equipment performs test automatically, minimizing the uncertainty and error caused by the user's hand-operating.
- Evaluate blocking performance of masks and mask media during 'sneezing'
- Fill the virus using the test virus 'buffer container'.
- Supply the virus filled in the buffer container at the aerosol chamber under 'sneezing' conditions.
- Designed to allow horizontal movement in consideration of the ease of mounting and dismounting each component

#### Display of VF-2021TS Program



Classification		Specification
Virus apporation controllor	Pressure control range	0~2bar
virus generation controller	Supply flow	0~23.4 ml/min
Virus transfer	Chamber size and material	Ø 80mm, Length 600mm, Quartz
test chamber	Clean air supply part	HEPA filter(efficiency of 99.97%)
	Test filter media holder	100mm X 100mm
	Mask jig	For finished mask products
Test filter holder	Keep sealed	$\leq$ 0.1/cm <sup>3</sup> (Ø 0.3 $\mu$ m Particle criteria)
& mask jig	Automatic opening and closing, and keeping sealed	Linear Motion Guide & Pneumatic cylinder
	Pressure loss measurement mode	Test filter media and test mask
	Simulation method	Cylinder and piston
Speezing droplet	Cylinder volume	≥3L
generation simulation	Administration time	min 0.5s
system	Piston driving device	Thrust $\geq$ 550N, loss rate $\leq$ 0.1mm
	Discharge air cleaner	HEPA filter (efficiency of 99.97%)
	Container volume and material	$\geq$ 3L, STS
Virus buffer container	Virus generation nozzle	Glass nebulizer
	Vacuum booster	Suction pump and pressure gauge
	Туре	6-stage Andersen type Inertial Cascade Impactor
	Collected particle size range	0.85~10 μm
Virus collected part	Working flow	28.3 LPM
	Longitudinal detachment method	Linear motion guide & Pneumatic cylinder
Virus condensatio		Isolation two flow condenser
virus condensatio	on removal system	chiller and cooling water circulation system
Test flow control	Control range	28.3L/m ±5%
	Automatic control items	Generator operation, test flow
Control unit	Precise control items	Time of occurrence and flow rate of sneezing droplet generation simulation system
	Monitoring	Test flow
		Built-in test protocol and automatic test progress
Operating	g program	Raw data storage and random modification preventing function
		Test environmental conditions measurement and data collection



# Industrial Respirator (half-type mask) Performance Evaluation System (EN-149)

Korean Ministry of Employment and Labor manages 'safety certification regulations', separately 'Protective equipment safety certification notice' to prevent particles from entering body through respiratory tract of workers at workplace.

Korean regulations were established based on European EN regulation, and ART Plus's performance evaluation system for industrial masks (Half-mask) was designed as EN-149 standards

#### EN149 required test list

Classification		Test contents		
	Exhaust flow	Before testing, sample treatment with continuous exhalation flow rate (300 $\ell$ /min)		
	Auxiliary lung	Sample treatment under respiratory operating conditions (25 breaths/min@2 $\ell$ )		
Test pre-treatment	Mechanical strength	Sample treatment under respiratory operating conditions (25 breaths/min@2 $\ell$ )		
	Temp.	Sample treatment to be maintained at –30°C, 70°C for 24 hrs		
Leakage		After supplying 2% NaCl aqueous solution with an average particle diameter of 0.6 $\mu$ m into the test chamber, if concentration of the hydrogen flame spectrometer is maintained at 8±4mg/m <sup>3</sup> , the test subject wearing mask moves on Treadmill at a speed of 6km/h calculating the leakage rate value according to the results of 5 different exercises while walking		
PFE		At test flow rate of 95 $\ell$ /min using each particle generator; average particle size of Paraffin oil of 0.4 $\mu$ m was set at a constance concentration (20±5mg/m <sup>3</sup> ), and maintaining average particle diameter of 0.6 $\mu$ m of sodium chloride (NaCl) at a constance concentration (8±4mg/m <sup>3</sup> ), then comparison of before and after 'Particle Passage' of mask to calculate the "Collection Efficiency"		
Breathing resistance		Measure resistance of mask according to inhalation/exhalation flow at 30, 95ℓ/min exhalation flow. During exhaust test, fix Sheffield head in 5 directions		
CO <sub>2</sub> content of the inhalation air		Evaluation of concentration of CO <sub>2</sub> inside Mask		
Clogging		Differential pressure measurement of mask when test dust concentration is reached		
Flammability		Check whether mask burns after passing through flame		
Strength of attachment of exhalation valve housing (tensile strength)		After fixing to exhalation valve of mask, apply a force of 10N to check whether it is separated		

Mask Inhalation and Exhlation Resistance Evaluation Tester (MBR-2031)



Pressure expression unit

Classification

Test head

Test flow

Flow control

Related regulations

CO<sub>2</sub> Concentration Evaluation Tester Inside the Face (MCD-2032)

Breathing Simulator

Classification

Test head

Auxiliary lung device

CO<sub>2</sub> analyzer

Automatic control device and software

Related regulations



#### Specification

Sheffield head

Inhalation: 30 and 95 LPM (2 test modes) Exhalation : 160 LPM

mbar or Pa Print and save after automatic processing with 3 significant digits or more

Flow control By mode (inhalation and exhalation), + 5% of set flow rate

Ministry of Employment and Labor 'Safety certification notice' annex 4 dust mask performance criteria, MFDS's Guideline for permission review of 'medical respiratory protective equipment', and EN 149

#### Specification

Sheffield head

Simulated breathing device : Piston & Cylinder Volume : 2.0±0.1 liters Operating cycle : 25 times per minute Device drive : linear motor or stepping motor

Auxiliary lung device : piston & cylinder Auxiliary lung volume : within 5% of the volume of the breathing simulator The volume of the  $CO_2$  analyzer duct from the synthetic lung should be within 2,000 ml

Low concentration, high concentration (2 ch)

Built-in test procedure and user arbitrary operation mode simulated breathing device operation control, synthetic lung operation control CO2 concentration control and flow control Display and automatically save test results

Ministry of Employment and Labor 'Safety certification notice' annex 4 dust mask performance criteria, EN 149

## Clogging Tester (MCT-2033)



#### Mask Artificial Lug Preconditioning Tester (MLP-2035)



Classification	Specification	Cla
Test chamber cross-sectional area	650x650 mm	Т
Test chamber length	5100 mm or more	Si
Test air flow	More than 60 CMH	d
Test head	Sheffield head	
Simulated breathing device	Simulated breathing device : Piston &Cylinder Volume : 2.0±0.1 liters Operating cycle : 25 times per minute Device drive : linear motor or stepping motor	F cor co
Temperature and humidity control device	37+2°C, Relative humidity more than 95%	re
Test particle generator	Test particle: dolomite Test particle generation amount : 400± 100mg/m³	Mas (MD
Particle counter	Particle concentration measurement range : 0.001~400mg/m <sup>3</sup> Particle size measurement range : 0.1~10µm	
Particle collected device	Open face type 37mm diameter filter used Sampling flow : 2 LPM	
Automatic control device and software	<ul> <li>Built-in test procedure and user arbitrary operation mode</li> <li>Simulated breathing device operation control, test air flow control</li> <li>Test particle generation and particle concentration measurement</li> <li>Display and automatically save test results</li> </ul>	Cla E CAM
Related EN 149		Tes
no ou lotiono		

Classification	Specification			
Test head	Sheffield head			
Simulated breathing device	Simulated breathing device : Piston & Cylinder Simulated breathing device volume : 2.0+0.1 liters Simulated breathing device operation cycle : 25 times per minute Simulated breathing device drive : linear motor or stepping motor			
Humidity control device	Humidity control unit temperature : 37+2°C Humidity control range : Relative humidity more than 95%			
condensate	Equipped with trap device			
Related regulations	EN 149			

#### sk Durability Preconditioning Tester )T-2037)



Classification	Specifications
Excitation method	Up and down reciprocating motion and drop collision using CAM and piston
CAM	Designed so that the maximum travel distance of the piston is 20mm
CAM rotation speed	100 revolutions per minute or more
Test duration	More than 20 minutes
Related regulations	EN 149

# Air Cleaner Performance Evaluation System

<SPS KACA002 132; Air purifier Group Test Standard;2021> has been revised. The existing air purifier performance evaluation method evaluated only the test items for 'dust collection efficiency', and 'deodorization' but in this revision it is added 'Fine-dust removal efficiency/Reduction durability test', 'Toxic gas purification ability test/harmful gas for filters used in air purifiers reduction life-span test', and 'Flow test', which was originally abolished in 2016. In addition, the national standard (KS C 9326) for the 'Large-capacity air purifier performance test method' was newly enacted and announced in Mar. 2021.

Model	AK6001	AK6008	AK6030	AK6050	AK6180
Chamber size	1m <sup>3</sup> ±0.1m <sup>3</sup> (1.0×1.0×1.0)	8m <sup>3</sup> ±0.5m <sup>3</sup> (2.0×2.0×2.0)	30m <sup>3</sup> ±1.5m <sup>3</sup> (3.5×3.5×2.5)	50m <sup>3</sup> ±1.5m <sup>3</sup> (4.5×4.5×2.5)	180m <sup>3</sup> ±1m <sup>3</sup>
(WDH)	Rectangular, or cube shape, Depth(D) is within 85~100% of Width (W)				Rectangular, D <w *="" 2<="" td=""></w>
	-	Purifying at (Polydisp Fine-dust reduct	Fine-dust removal ability (Potassium Chloride)		
Test items (Test sample))	Tox (Ammoni Toxic gas rea Tox (Ammonia, toluene,	xic gas purification ability nia, toluene, and formaldehyde) eduction durability (Formaldehyde) - xic gas removal efficiency e, formaldehyde, acetic acid, acetaldehyde)			-
	-	-	Ozone generation concentration	-	Ozone generation concentration
	Rated flow	Rated flow volume, fine-dust sensor for air purifier, and noise			
Air tightness	Particle concentr	Particle concentration after 20 min is 90% or more of initial concentration for part			ticle size of 0.3 $\mu$ m
Temp./ Humid.	23 ± 3 ℃ (± 1 ℃), 50 ± 10 % R.H ± 5% R.H (average during 20 min)				Temp. 20±5℃, atmospheric pressure 760±20mmHg
Chamber material	Well, ceiling, and floor: uninterruptible panel, STS304, 310, 316 or glass Surface in chamber: Uninterruptible				lass
Applicable regulations	SPS-KACA002-132;2021, KS C 9304; 10.2, KS A ISO 1996-2; 8, SPS-C KACA 0027-7269 (According to Client's requirements, can supply chambers which meet related standard such as GB, AHAM, JEM)			KS C 9326	

regulations



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Air Cleaner Performance Evaluation Syste

• Air Cleaner Device Fine-dust Removal Efficiency Test programme



• Air Cleaner Device Toxic Gas Removal Efficiency Performance Evaluation System



• Air Cleaner Device Toxic Gas Removal Efficiency Test programme



• Life Assessment for Gas Removal System



• Life Assessment for Gas Removal Test programme

## Generators

### Large Particle Generator (AKG-1791)



Classification	
Operating type (mode of operation)	Micro spray nozzle
Particle Source	KCl or NaCl in aque
Particle supply method	Peristaltic pump, S
Occurrence particle size range	0.1~10 µm
Generated particles flow rate	50~55 lpm (nomina
Control pressure	4 bar or less
Particle concentration	PM concentration : Max. number conce
Power	220 VAC , 6A
Other components	HEPA filter. Heater

Model	AKG-1791	AKG-1791M	AKG-1791A
Usage	Dust sensor(PM-2.5)	Dust sensor(PM-2.5)	Medium performance air filter performance evaluation
Special note	Use alone	Use with particle mixing chamber	Use alone
Size (WDH,mm)	• Controller : 400x600x350 • Column : Ø200, 512H	<ul> <li>Controller : 400x600x350</li> <li>Column&amp;Mixing chamber</li> <li>: 500 x 396 x 850, Ø220</li> </ul>	• Controller : 400x600x350 • Column : Ø305, 1462H
Photo			





#### Specification

eous solution, other types of particles soluble in water

Supply flow control possible (~1.2ml/min)

al). 100 L/min

: ~ 8,000 μg/m<sup>3</sup> (PM-10, KCl criteria) centration : Approx. 10^7#/cc

#### r & Ionizer





#### Gas Generator (GGA-1895)



Model	GGA-1895	GGA-1895S	
Generator quantity	5EA	1EA	
Gas type	Acetic acid, acetaldehyde, ammonia, formaldehyde, toluene		
Gas generation method	Bubbling method		
Generated concentration	~ 100ppm @ 30m³ test chamber		
Generated time	~ 30min		
Generated flow	~ 20/min		
Constant temperature bath	1 continuous heating water tank 2 (parallel arrangement) Temperature control : (room temperature +5)~ 60℃		
Size[W×D×H]	1,050 × 800 ×	× 1,450 mm	
Material	STS, Tempered glass		
Chamber ventilation	Carbon filter & Blower		
Control system	Control board and operating software (including touch function)		

#### Gas requirements for each regulation

	GB				KACA		
Gas type	Formaldehyde	Toluene	Acetic acid	Acetaldehyde	Ammonia	Formaldehyde	Toluene
concentration [ppm]	1	1	10	10	10	10	10
Standard	GB/T 18801-2015			SF	PS-KACA002-1	32	

## Bacteria Generator (ABG-1771A)

- Bacterial aerosol spray in live state
- Occurrence amount and size control
- Conforms to the Korean Air Cleaning Association SPS-KACA402-1566, China GB 21551.3:2010 standard
- Can be used for chamber test for air cleaner performance evaluation and wind tunnel test device for air filter performance evaluation

Classification	Specification
Operating type	Phase 2 spray nozzle
Bacteria supplying method	Peristaltic pump, ~ 2 ml/min
Bacteria outbreak concentration	> 5 x 10 <sup>4</sup> CFU/m <sup>3</sup>
Control pressure rang	0 ~ 2 atm.
Control flow range (Sheath Air)	0 ~ 50 lpm
Size (WDH, mm)	Controller_400 x 475 x 400. Column_φ 150, 500 H
Weight (kg)	20 (Include column and control box)

## NaCl Generator (ML-1691, for mask leakage performance evaluation)



## Classification

Generation type

- Particle size distribu
- Average particle siz distribution

Generation particle concentration

Generation flow rat

Cigarette Smoke	
Generator (FSQ-003)	







	Specification
	Impulse spraying using multi-channel orifices
ion	0.02 ~ 2.0 μm
e	0.6 µm (Mass Median Diameter, MMD)
9	$8 \pm 4 \text{ mg/m}^3$
е	3 ~12 LPM

Classification	Specification
Flow range	1 ~ 5 L/min
Duration of each smoke occurrence	40~50s
Power	AC, Single-phase 220V/50Hz
Maximum output	100W (Including smoke ignition generator output)
Weight	7kg
External size (DWH)	360×270×400 mm

## Construction SMART CITY corresponding to 'FINE-DUST'



#### **Design SMART CITY**

• SMART CITY design to correspond to FINE -DUST considering characteristics of FINE -DUST concentration distribution after analyzing "humanities environment "(society, culture, transportation, communication, etc.) and "natural environment" (temperature/ humidity, wind direction, wind speed, flow, etc.) of regional characteristics,

#### Develop big data platform corresponding to FINE-DUST

- Develop FINE-DUST information platform that citizens can feel and participate (activities)
- Construct operating system corresponding to intelligent FINE-DUST based on big-data

#### ₽ ∎ **Construct FINE-DUST information** collection/reduction system

- Construct FINE-DUST measurement network according to regional characteristics
- Selective construct reduction devices according to regional characteristics, and reduction environment



#### Education/Training programme

- Atmospheric environment technology expert man-power
- SMART CITY corresponding to FINE-DUST (Big-data + Atmospheric environment technology + ICT)

## **SMART CITY Implementation** corresponding to intelligent (AI) FINE-DUST based on Big-data • Information collection-analysis-management, Deep-learning, prediction, reduction operation • Regional government specialized information utilization and provision service

- FINE-DUST collection information
- Public information (GIS, Meteorological, Climate, Specialized information
- ✓ Education programe
- Community characteristics
- Social & Culture information
- Reduction activity information
- Meteorological climate environment collection information
- User information. etc.



## Project Design, Project Operating and management, System making, Big-data, and big-data platform constructing

- "Accomplishment of building up project for '20-'21 FINE-DUST clean specialized cluster in Bucheon"
- Project Management/ "FINE-DUST notification service in our neighborhood"



#### Analyzing Big-data

#### ALGORITHM corresponding to big-data based FINE -DUST

- User requirements analysis design
- Public information-collected information analysis statistical function
- Providing distribution of dominant FINE-DUST generate area
- FINE-DUST flow analysis using wind direction/speed, temperature, humidity, and fine dust concentration
- FINE-DUST diffusion prediction model according to conditions (season, temperature, and humidity, and wind direction/speed)
- Data control between FINE-DUST AQ monitoring networks

#### AQ Monitoring networking



- Design and manufacture of System corresponding to FINE-DUST optimized for regional pollution/climate/weather/ geographic environment
- Constructing Integrated system operated systematic procedure-base such as 'collection-analysis-reduction-utilization'



FINF-DUST reductior service (Subway)



Big-data based system corresponding to FINE-DUST

#### PLATFORM corresponding to FINE-DUST

#### Citizen Participant Portal

- Notification of FINE-DUST information in the area of use
- Expression of participation function that can utilize FINE-DUST information
- Providing information on main policies and local conditions related to FINE-DUST

#### Administration Operation Portals

- Operation/Management of Smart city corresponding to FINE-DUST
- Managing of Collected information AQ monitoring information
- Remote operation of Reduction device, display device, alarm device