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GB 2626—2019
Replacement of GB 2626-2006

呼吸防护——自吸过滤式防颗粒物呼吸器

Respiratory protection —— Non-powered air-purifying particle respirator

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CONTENT

Preface

This standard was developed according to GB/T 1.1-2009.

This standard replaces GB 2626-2006 .

The major changes between this standard and GB2 626-2006 are:

——The name of standard was changed from “Respiratory protective equipment – Non-powered air-purifying particle respriator” to “Respiratory protection – Non-powered air-purifying particle respirator”.

——Defination of “fume”, “mist” and “micro-orgainism” were deleted while “penetration”, “ user seal check”, “assigned protection factor”, “count medium diameter”, “ mass medium diameter”, “aerodynimic particle size”, and “mass medium aerodynamic diameter” seven new definations were added (see clause 3.14 and 3.19 to 3.24).

——The requirement to overall inhalation resistance and exhalation resistance of different types respirators were changed (see clause 5.5).

——Evaluation method of exhalation valve leakage was changed (see clause 5.6.1 and 6.7).

——Replaced the name of “valve cover” with “valve protection” (see 5.6.2 and 6.8).

——The requirements of visual field of all types respirators were changed (see claused 5.8).

——The requirements and test methods to filters that to be claimed by the manufacturer as washable/disinfectable were added (see clause 5.14.1, 5.16 and 6.2.3).

——Practical performance evaluation requirements and test method were added (see clause 5.15 and 6.16).

——Extra requirements were added to information supplied by manufactuer about how to evaluate filter using time, and use limitation to products that are not flame resistant (see clause 5.16).

——To the part of efficiency test method, a particle size conversion calculation method was added for particles used in filter efficiency test (see Annex B), together with extra requirements to filter efficiency test equipment resolution (see clause 6.3.2), the evaluation method for end of aerosl loading test (see clause 6.3.4.4, 6.3.4.5, 6.3.4.6 and Annex C), and aerosol loading amount (see clause 6.3.3) .

——To the part of leakage test method, extra requirements were added for sample check beforehand (see clause 6.4.1.4) and test equpiment precision (see 6.4.2.4), also provided leakage calculation equation for subjects (see Equation (5)).

——An illustration figur was added to show dummy head breathing tube construction for breathing resistance and dead space test (see Fig. 4).

——To part of breathing resistance test, extra requirements were added for air-tight seal between respirator mask and test dummy head must be achieved (see clause 6.5.4 and 6.6.4), and the specification of micromanometer was adjusted (see 6.5.2.3).

——The illustration figur for dead space test method was changed (see Fig. 6).

——In the handband strength test method, extra requirement was added for head band pulling dirction that shall be in accordance to its normall using condition (see 6.11.3).

Note: The major differences from the previouse version standard was amended (see Annex E).

This standard is proposed by Ministry of Emergency Management of the People's Republic of China.

This standard is under the supervision of the China National Standardization Technical Committee for Personal Protective Equipment (SAC/TC 112).

This standard was developed by the Sinosteel Wuhan Safety & Environment Protection Research Institute Co., Ltd., Research Institute of Chemical Defense and 3M Company China Ltd.

This standard is written by Cheng Jun, Ding Song-tao, Yang Xiao-bing, Yao Hong, Zhou Xiao-ping, Cai Xia-lin, Zhang Shou-xin, Yu Jing-jing.

This standard was published in 1981 for the first time. It was upgraded as GB/T 2626-1992 in 1992, and upgraded as GB 2626-2006 in 2006.

Respiratory protection — Non-powered air-purifying particle respirator

1 Scope

This Standard sets out the classification and designation, technical requirements, test methods and marking for non-powered air-purifying particle respirator.

This Standard applies to non-powered air-purifying respirators against particles.

This Standard does not apply to respirators against gas and vapors and oxygen deficiency, does not apply to respirators used for the purposes of underwater operation, escape and fire fighting.

2 Nominative references

The following normative documents contain provisions which, through reference in this Standard, constitute provisions of this part of the Standard. For dated references, subsequent amendments to , or revisions of, any of these publications do not apply. However, parties to agreements based on this part of the Standard are encouraged to investigated the possibility of applying the most recent edition of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

GB 2890-2009 Respiratory protection - Non-powered air-purifying gas and vapor respirator

GB/T 5703 Basic Humen Body Measurments Used for Technical Design

GB/T 10586 Technical Condition of Humid and Heat Tester

GB/T 10589 Technical Condition of Low Temperature Tester

GB/T 11158 Technical Condition of High Temperature Tester

GB/T 18664-2002 Selection, Use and Maintenance of Respiratory Protective Equipment

GB/T 23465-2009 Respiratory protectice equipment - Practical performance evaluation methods

3 Terms and definitions

For purpose of this Standard, the following terms and definations apply.

3. 1

Particle

Airborne solid, liquid or solid and liquid particlulates, such as dust, fume, mist and micro-organisms.

[Modify GB/T 18664-2002,Terms 3.1.15]

3. 2

dust

An solid aerosol consisting of mechanically produced particles derived from breaking up of larger particles.

[GB/T 18664—2002，Terms 3.1.16]

3. 3

non-powered air-purifying respirator

An air-purifying respirator that the resistance of the airflow passing through the elements is overcame by wear's breath.

[GB 18664-2002，Terms 3.1.3]

3. 4

tight-fitting face piece

A respiratory inlet convering that is designed to form a complete seal with the face to cover mouth and nose, or to form a complete seal with head and face to cover eyes, mouth and nose.

Note: Tight-fitting facepeice includes half facepiece and full facepiece.

[modify GB 18664-2002，Terms 3.1.5]

3. 5

half facepiece

A type of tight-fitting facepiece that can cover mouth and nose, or mouth, nose and chin.

Note: Half facepeice includes disposable facepiece and replacable half facepiece.

3. 6

full face piece

A type of tight-fitting facepice that can cover mouth, nose, eyes and chin.

3. 7

disposable facepiece

A type of half facepice that is mainly constructed by filter material, may have exhalation valve.

3. 8

replaceable facepiece

A facepiece constructed with replaceable single or multi-filters, may have exhalation valve and/or breath hose.

3. 9

inhalation valve

Non-return valve which allows breathable gas to enter the facepiece and prevents exhaled air from leaving via the inlet path.

[GB 2890-2009, Terms 3.6]

3. 10

exhalation valve

Non-return valve which allows the escape of exhaled and excess air from the facepiece.

[GB 2890-2009, Terms 3.7]

3. 11

breathing hose

A flexible and air-tight hose connected to the facepiece through which breathable gas enters.

3. 12

filter element

A component of air-purifying respirators through which inhaled air passes and which removes particles or certain gases, or both.

For example: canister, cartridge or filter.

[GB/T 18664-2002，Terms 3.1.22]

3. 13

filter efficiency

The level that filter elements filter the particles at specific test condition~~, expressed in mass fraction~~.

3. 14

penetration

The level that particles penetrating the filter element at specific test condition.

Note: penetration = 100% - filter efficiency

3. 15

total inward leakage，

TIL

The ratio of concentration of the simulative agent leaking into the facepiece from all sourses including filter or device with that of outside the facepiece when measured under specifice test atmosphere in laboratory.

Total inward leakage = $C_i / C_0 \times 100\%$ …… (1)

In Equation (1):

C_i :concentration of the simulative agent inside the facepiece;

C_0 :concentration of the simulative agent outside the facepiece.

3. 16

inward leakage,

IL

The ratio of concentration of the simulative agent into the facepice from all sources excluding filters of the divece with that of outside the facepiece when measured under specifice test atmosphere in laboratory.

Inward leakage = $C_i / C_0 \times 100\%$ …… (2)

In Equation (2):

C_i :concentration of the simulative agent inside the facepiece;

C_0 :concentration of the simulative agent outside the facepiece.

3. 17

dead space

The volume fraction of carbon dioxide rebreathed from the previously exhaled gas in inhalation air

3. 18

head harness

Means of holding a facepiece in place on the head.

3. 19

User face-seal check

Action conducted by the respriator wearer to determine if the respriator is properly sealed on the face.

3. 20

Assigned protection factor

APF

The expected workplace level of respiratory protection that would be provided by a properly functioning respirator or a class of respirators to properly fitted and trained users.

Note: amend 3.1.29 in GB/T 18664-2002.

3. 21

count median diameter

CMD

Particle size of a particle distribution for which one-half the total number of particles are larger and one-half are smaller.

3. 22

mass median diameter

MMD

Particle size of a particle distribution of which half the mass is contributed by particles greater than MMD and half by particles smaler than MMD.

3. 23

aerodynamic diameter

Diameter of a unit density sphere having the same settling velocity as the particle in question.

3. 24

mass median aerodynamic diameter

MMAD

Point in an aerodynamic particle size distribution where half of the mass lies in particles with a diameter smaller than the MMAD and half in particles with diameter greater than the MMAD.

4 Classification and designation

4. 1 Type of facepiece

There are 3 types facepieces, they are disposable facepiece, replacable half facepiece and full facepiece.

4. 2 Type of filter element

There are 2 types filter element, they are type KN and type KP.

KN Filter elements are suitable for particles free of oil only, KP filter elements are suitable for both oil and non-oil particles.

4. 3 Classification of filter elements

According to the filter efficiency level, filter element calssification are defined in Table 1.

Table 1 Classification of filter elements

Type of filter element	Typy of facepice		
	Disposable facepiece	Replacable half facepice	Full facepice
Type KN	KN90 KN95 KN100	KN90 KN95 KN100	KN95 KN100
Type KP	KP90 KP95 KP100	KP90 KP95 KP100	KP95 KP100

4. 4 Designation

The disposable facepiece and filter elements of replacable facepieces meeting this standard shall be designated in such a way that combines both the number of publication of this standard and the classification.

Example 1：the designation of KN90 filter element is GB 2626-2019 KN90.

Example 2：the designation of KP100 filter element is GB 2626-2019 KP100.

5 Technical requirement

5. 1 Basic requirement

Materials and sturcture of the device shall meet below requirements. Inspection shall be done in accordance to 6.1, and evaluation shall be conducted in accordance to 6.16.

a) The requirements for the materials used on the device include:

1) Parts that may directly contact wearer's face shall not be harmful to skin;

2) Filter material shall not be harmful to people;

3) shall have enough mechanical strength and, during normal use, shall not tear and have deformation that may affect protective effectiveness;

4) shall not cause apparent pain or irritation when in use.

b) The structure of the device shall be designed in such a way that:

1) structural disaggregation shall not likely occur, and the design, components and assembly shall not be harmful to the user.

2) The desigen of head harness shall be elastic or self-adjustable and facilitate for donning and doffing and be able to fix the facepiece on wearer's face securely without apparent pressure and hurt feeling. The head harness used on replacable half facepiece and full facepiece shall be replacable;

3) if same size and model device facepiece is provided with different donning manner, it shall be tested as different products;

Note: different donning manner of same facepiece may effect face seal status.

4) shall not affect visual field significantly;

5) the visor of full facepiece shall not fog and affecting vision when in use;

6) replacable filter elements, valves and head harness shall be facilitating for replacement and facial seal check when in use;

Note: see Annex G of GB/T 18664-2002 for user seal check.

7) breathig hose shall not limit head and body movement, shall not affect face seal or limit and block air flow;

8) exhalation valve shall be protected from front direction with such a design that either a dedicated valve protective conponent or other conponent(s) with said function are acceptable.

9) Disposable facepiece shall provide proper face seal, shall not deform during normal use.

10) conponents of replaceable facepiece (exept filter element) shall be washable.

5. 2 Visual inspection

Testing shall be done in accordance with 6.1.

No visual damage, deformation and any other apparent defects shall be ovserved. Components and structure shall endure possible temperature, humid and mechanical impact in normal use condition. After temperature and humidity conditioning and mechemical strength conditioning in accordance to 6.2, no disaggregation, damage and deformation shall be observed. Visual inspection shall also inspect marking and information supplied by the manufacturer.

5. 3 Filter efficiency

Sodium chloride (NaCl) testing particles shall be used for type KN filter elelments, and dioctyl phthalate (DOP) test particles or other oil particles with equivalent property (e.g. paraffin oil) for type KP filter elements.

Testing shall be done in accordance with 6.3.

During the whole testing procedure, each sample shall meet the filter efficiency requirements defined in Table 2.

Table 2. Filter efficiency

Type & classification of filter	Testing with NaCl	Testing with oil particles
KN90	≥90.0%	N/A
KN95	≥95.0%	
KN100	≥99.97%	
KP90	N/A	≥90.0%
KP95		≥95.0%
KP100		≥99.97%

5. 4 Leakage

5.4.1 TIL of disposable face piece

Testing shall be done in accordace with 6.4.

The TIL of disposible facepiece shall meet the requirements definded in Table 3.

Table 3 TIL of disposable facepiece

Filter classes	At least 46 out of the 50 individual exercises TIL results (i.e. 10 subjects ×5 exercises) shall	At least 8 out of the 10 individual wearer arithmetic means of the TIL results shall
KN90 or KP90	＜13%	＜10%
KN95 or KP95	＜11%	＜8%
KN100 or KP100	＜5%	＜2%

5.4.2 IL of replaceable half facepiece

Testing shall be done in accordace with 6.4. At least 46 out of the 50 individual exercises IL results (i.e. 10 subjects ×5 exercises) shall less than 5%, and at least 8 out of the 10 individual wearer arithmetic means of the IL results shall less than 2%.

5.4.3 IL of full facepiece

Testing shall be done in accordace with 6.4. Each of individual exercise IL results (i.e. 10 subjects ×5 exercises) shall be less than 0.05%。

5. 5 Breathing resistance

Testing shall be done in accordance with 6.5 and 6.6.

All types of device shall meet requirements of breathing resistance defined in Table 4.

Table 4 Requirements to breathing resistance

Type of facepiece	Inhalation (Pa)			Exhalation (Pa)
	KN90/KP90	KN95/KP95	KN100/KP100	
Disposable, w/o valve	≤170	≤210	≤250	Same as inhalation
Disposable, w/ valve	≤210	≤250	≤300	≤150
Replaceable Half facepiece and full facepiece w/ filter element(s) in place	≤250	≤300	≤350	

5. 6 Exhalation valve

5.6.1 Exhalation valve leakage

This requirement is only suitable for half facepiece. Exhalation valve shall meet requiremwnts set as followed:

Testing shall be done in accordance with 6.7, the allowable leakage air flowrate of exhalation valve of each respirator shall not be greater than 30 ml/min; where multiple exhalation valves are in use, the allowable leakage air flowrate shall be averaged, i.e. if two exhalation valves are used on the respirator, the allowable leakage air flowrate of each of the valve shall not be greater than 15 ml/min.

5.6.2 Exhalation valve protection

Testing shall be done in accordance with 6.8.

When the exhalation valve protection is applyied an axile pulling force defined in Table 5, no glide, break and deform shall be observed.

Table 5 Axle pulling force applying to exhalation valve protection

Type of facepiece	Disposible facepiece	Replacable facepiece
Pulling force	10 N，lasting for 10 s	50 N，lasting for 10 s

5. 7 Dead space

Testing shall be done in accordance with 6.9.

The average test result of dead space shall not larger than 1%.

5. 8 Visual field

Testing shall be done in accordance with 6.10.

The visual field of the device shall meet the requirements defined in Table 6.

Table 6. Visual field

Visual field	Type of facepiece		
	Half facepiece	full facepiece	
		Single visor	Twin visor
Down direction	≥35°	≥35°	≥35°
total	N/A	≥70%	≥65%
overlapped	≥65%	≥55%	≥24%

5. 9 Head harness

Testing shall be done in accordance with 6.11.

Each head band, buckle and any adjusting components shall be tested by applying pulling force required in Table 7. No glide or break shall be observed.

Table 7 Pulling force applying to head harness

Type of facepiece	Disposible facepiece	Half facepiece	Full facepiece
Pulling force	10 N，lasting for 10 s	50 N，lasting for 10 s	150 N，lasting for 10 s

5. 10 Connection and connector

Testing shall be done in accordance with 6.12.

Each connection or connector between replacable filter element to facepiece, or each connection or conncector between air hose and replacable filter element and facepiece shall be tested by applying axile pulling forc requried in Table 8. No glide, break or deformation shall be observed.

Table 8 Axle pulling force applying to connection or connector

Type of facepiece	Replacable halfpiece	Full facepiece
Pulling force	50 N，lasting for 10 s	250 N，lasting for 10 s

5. 11 Visor

5.11.1 Test shall be conducted on full facepiece.

5.11.2 Testing shall be done in accordance with 6.13. No damage or crake shall be observed on each sample. Then all the samples shall be subject to airtightness test in accordance 6.14 and all the samples shall meet the requirements set in 5.12.

5.11.3 Testing accordance to 6.16, the visor shall not cause visual deformantion.

5.11.4 If visor is used with cover film for transparent maintenance, or is designed with anti-fogging application, the anti-fogging agent shall be be known as harmful substance to human; when used with cover film or anti-fogging agent, sight deformation and blur shall not be caused, and the anti-fogging agent shall not cause irritation and other discomfort to user. Tesing shall be conducted accordance 6.1 and 6.16.

5. 12 Air tightness

Testing shall be done in accordance with 6.14.

When tested under required condition, the decrease of negative pressue in each of the full facepiece during 60 s time period shall not be larger than 100 Pa.

5. 13 Flammability

5.13.1 If the device is not designed flame resistant, the requirements set in 5.16 c)1) shall be met.

5.13.2 If the device is designed to be flame resistant, testing shall be done in accordance with 6.15 to each component. The sample shall not continue to burn for more than 5 s after removal from the flame.

5. 14 Cleaning and disinfecting

5.14.1 If it is claimed that the filter element(s) are subject to cleaning and/or disinfection for reuse, requirements set in 5.16 d) shall be met, and the filter element(s) shall be tested to meet 5.3 filter efficiency, 5.4 leakage and 5.5 breathing resistance requirements after being washed or disinfected in accordance with the methods recommended by the manufacturer. The method provided by the manufacture for user to determine whether the washed or disinfected filter may be continually effective for reuse shall be correct and effective.

5.14.2 The reusable facepiece material shall withstand cleaning or disinfecting treatment recommended by the manufacturer. Each sample shall meet the requirements set in 5.4 after cleaning and disinfecting treatment.

5. 15 Practical performance

Test shall be done in accordance with 6.16 under simulated testing condiction, the device shall be evaluated for satisfaction to such kind of requirements as 5.1 b) and 5.11 that may not be suitable for test methods other than subjective evaluation.

If the device may not pass the evaluation, the detailed test methods shall be described by the evaluation laboratory to facilitate any duplicated testing that to be conducted in other laboratories.

5. 16 Information supplied by the manufacturer

Inspection shall be done in accordance with 6.1.

GB/T 18664-2002 shall be consulted for the appropriateness of the information supplied by the manufactuer.

The information supplied by the manufacturer shall:

a) be supplied to the smallest distribution package;

b) be provided with Chinese;

c) contain all information necessary for the user that shall include:

1) application scope and limitations, which shall include (but not limited to) applicable particle type (e.g. whether oil), respirator assigned protection factor, and/or other unsuitable application environments; if the product is designed not flame resistant, the statement shall be provided as ”this device shall not be suitable for application in working places with fire and flame (e.g. welding, metallurgy, etc.)”.

2) use method for replaceable filter elements with full facepiece or half facepiece, and to provide indication to multi-filters;

3) assembling for replaceable facepiece;

4) check prior to use;

5) methods of donning and conducting wearer face seal check;

6) method to evaluate end of service of disposable facepiece;

7) suggestion about when filter and face piece replacement for replaceable face piece respirator;

8) maintenance method (such as cleaning and disinfecting), if applicable;

9) storage;

10) meaning of any symbol or mark used;

d) if it is claimed that the filter element(s) are subject to wash and/or disinfection for reuse, information shall include:

1) the specific type/scope of particle that is applicable;

2) the maximum times that the filter(s) shall be allowed for wash and/or disinfection;

3) method to evaluate whether filter element(s) is continually effective after wash/disinfect or need replace.

e) warnings to problems that to be likely encountered, such as:

1) user face fit with respirator facepiece;

2) leakage caused by facial hair under the face seal;

3) air quality (contaminants, oxygen deficiency, etc.);

f) information supplied shall be precise, illustrations, part numbers, marking shall be added if helpful.

5. 17 Package

Inspection shall be done in accordance with 6.1.

The sales package shall be protective agains mechanical impact and contaminant prior to use.

6 Testing

6. 1 Visual inspection

According to the technical requirements (refer to Annex A), each sample shall be visual inspected prior to subsequent testing.

6. 2 Conditioning

6.2.1 Temperature and humidity conditioning

6.2.1.1 Sample quantity and requirements

Total 2 samples as received shall be needed; or the quantity specified in other testing.

6.2.1.2 Test equipment

Test equipments shall meet requirements as followed:

a) High temperature tester: technical performance shall meet GB/T 11158;

b) Low temperature tester: technical performance shall meet GB/T 10589;

c) Humid and heat tester: technical performance shall meet GB/T 10586.

6.2.1.3 Test procedure

Remove the sample from its original package, then expose the samples to the followeing cycle:

a) for (24±1) h to an atmosphere of (38±2.5)℃ and (85±5)% relative humidity;

b) for (24±1) h to a dry atmosphere of (70±3)℃;

c) for (24±1) h to an atmosphere of (-30±3)℃.

The conditioning shall be carried out in a manner which ensures that no thermal shock occurs. Samples shall be allowed to return to room temperature for at least 4 h prior to subsequent testing.

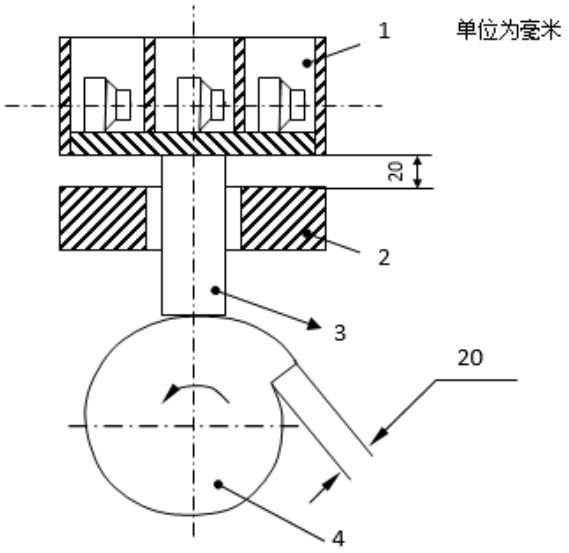
6.2.2 Mechanical strength conditioning

6.2.2.1 Sample quantity and requirement

This test shall be suitable for replacable filter elements only. Total 2 samples as received shall be needed; or the quantity required in other testing.

6.2.2.2 Test equipment

The apparatus as shown schematically in Figure 1, that consists of a steel case which is fixed on a vertically moving piston, capable of being lifted up 20 mm by a rotating cam and dropping down onto a steel plate under its own mass as the cam rotates. The mass of the steel case shall be more than 10 kg, the weight of the steel plate onto which the steel case falls shall be at least 10 times the weight of the steel case. The rotating fequency of the rotating cam shall be (100±5) r/min.



1——steel case　　3——piston

2——steel plate　　4——rotating cam

Figure 1 Testing equipment of mechanical strength conditioning

6.2.2.3 Test procedure

Remove the sample from its original package. Unencapsulated filter(s) shall be tested in the smallest commercially available package.

The samples shall be placed on their sides in the steel case so that they do not touch each other during the test, allowing 6 mm horizontal movement and free vertical movement.

Testing shall last about 20 min.

Then the samples shall be tested in the subsequent testing.

6.2.3 Wash and / or disinfection conditioning

6.2.3.1 Sample quantity and requirement

This test shall be suitable for filter element(s) that is claimed to be subject to wash and/or disinfection for reuse only. The quantity required in other testing.

6.2.3.2 Test procedure

The samples shall be washed/disinfected in accordance to method provided in information supplied by manufacturer. After each time wash and/or disinfection, the samples shall be completely dried and then be evaluated for continue effectivemess using the method provided by manufacturer. The evaluation results shall be recorded. Continue to conduct next round wash and/or disinfection conditioning procedure until the maximum allowable treatment times provided by manufacturer is reached.

6. 3 Filter efficiency

6.3.1 Sample quantity and requirement

A total of 20 samples of disposable facepiece or 20 samples of replaceable filter elements shall be needed, the filter adaptor (if used) shall be included. If disposable facepiece have multi sizes, at least 5 samples for each size shall be needed. 5 samples shall be after 6.2.1 conditioning, another 5 shall be after 6.2.2 conditioning (if applicable), and the rest shall be as received. If the device is claimed to meet requirements set in 5.14.1, at least 5 samples shall be after 6.2.3 conditioning. All samples after conditioning shall be kept in an air tight container and tested within 10 h.

6.3.2 Test equipment

6.3.2.1 NaCl particle filter efficiency test system

The main technical condition of the system shall include:

a) be able to generate NaCl test particle at a concentration not greater than 200 mg/m^3 with a particle size distribution as count medium diameter（CMD）of (0.075±0.020) μm and a standard geometric diviation not exceeding 1.86；

Note: using converting methods provided in Annex B will convert above metioned CMD into a MMAD of around 0.3 μm.

b) be able to detect the concentration in the range of (0.001～200) mg/m^3 with a precision of 1％ or 0.001 mg/m^3;

c) be able to test at an airflow rate in the range of (30～100) L/min with a precision of 2％；

d) be able to test filter efficiency in the range of 0～99.999％, with a resolution of at least 0.003%；

e) be able to neutralize the testing particles.

6.3.2.2 Oil particle filter efficiency test system

The main technical condition of the system shall include:

a) Be able to generate DOP or other suitable oil (such as paraffine oil) testing particles at a concentration in a range of (50～200) mg/m^3 with a particle size distribution as CMD of (0.185±0.020) μm and a standard geometric diviation not exceeding 1.60；

Note 1: using converting methods provided in Annex B will convert above metioned CMD into a MMAD of around 0.3 μm.

Note 2: the suitable replacement of DOP shall be validated oil substances with test results equivalent to that of using DOP.

b) be able to detect the concentration in the range of (0.001～200) mg/m^3 with a precision of 1％ or 0.001 mg/m^3；

c) be able to test at an airflow rate in the range of (30～100) L/min with a precision of 2％；

d) be able to test filter efficiency in the range of 0～99.999％, with a resolution of at least 0.003%.

6.3.2.3 Test condition

Type KN filter elements shll be tested at a temperature of(25±5)℃ and relative humidity of (30±10)％，and the NaCl testing particle concentration shall not exceed 200 mg/m^3.

Type KP filter elements shall be tested at a temperature of (25±5)℃，and the oil testing particle concentration shall not exceed 200 mg/m^3。

Test air flow rate is (85.0±4.0) L/min. Where multi-filters are in use, the test airflow rate shall be averagely divided. For example, filter elements use in pair shall be tested at an airflow rate of（42.5±2.0）L/min, but if the filter element may also be used as single, the test airflow rate shall be (85.0±4.0) L/min.

6.3.3 Requirement to loading quantity

6.3.3.1 During test procedure of filter efficiency, filter element shall be persistently loaded with aerosol and the loading quantity for each respirator shall be (200±5) mg as general requirement. When multiple filter elements are in use, the aerosol loading quantity shall be averaged, e.g. if two parallel filters are in use, each filter element shall be loaded with (100±5) mg; for three parallel filters design, each filter element shall be loaded with (66.7±5) mg; when each filter element may be used as the single filter of the respirator, the loading quantity shall be (200±5) mg.

6.3.3.2 For KP type filter element, when the general loading quantity requirement is met and at the same time the circumstances described in 6.3.4.6 has occurred, loading test procedure shall be extended with the maximum loading quantity applied, which will be two times the general loading quantity defined in 6.3.3.1, i.e. (400±5) mg. When multiple filter elements are in use, the loading quantity shall be averaged and the maximum loading quantity for each filter element shall be twice of that defined in 6.3.3.1.

6.3.4 Test procedure

6.3.4.1 Adjusting the test system to the required conditions.

6.3.4.2 Fixing the disposible facepiece or filter element onto the test equipment using suitable fixture in an air-tight manner, the filter adapter and sealant conponent(if applciable) shall be included. If the filter element and the facepiece are not separatable (e.g. disposable mask), seal the exhalation valve.

6.3.4.3 Start the test, recording the filter efficiency continually. When filter efficiency is below the limit for that filter class, the test shall be stopped immediately, and it shall be regarded as fail.

6.3.4.4 For KN type of filter element, during aerosol loading, if filter efficiency is below the limit for that filter class, the test shall be stopped, otherwise the loading shall be continuted untill the general loading quantity requirement set in clause 6.3.3.1 is met, during which if filter efficiency is never dropped below than the limit of that filter class, it shall be regarded as pass.

6.3.4.5 For KN type of filter element, if the filter efficiency test curves are consistently showing a same trend with a minimum filter efficiency point, and afterwards the filter efficiency will be steadly increasing, the loading test shall be allowed to stop earlier before the general loading quantity requirement set in clause 6.3.3.1 is met. When the minimum filter efficiency point is shown not less than the limit for that filter class, and it shall be regarded as pass.

6.3.4.6 For KP type of filter element, if the filter efficiency is decreasing when the general loading quantity requriement set in 6.3.3.1 is met, the test shall be continued. When filter efficiency is below the limit of that class before the maximum loading quantity required in 6.3.3.2 is met, the test shall be stopped immediately, otherwise the loading test shall be continuted and using the bandwidth to review the decreasing trend according to the method provided in Annex C. If the bandwidth is not greater than the bandwidth limit (BL) set in Table 9, the filter efficiency may be regarded as discreasing stops and the minimum filter efficiency of the sample is obtained, the test is allowed to stop. If the minimum filter efficiency is not lower than the limit of that class, it shall be regarded as pass. When the maximum loading quantity set in 6.3.3.2 is met and the filter efficiency has never shown lower than the limit, it shall be also regarded as pass.

Table 9 Bandwidth limit (BL) of KP type filter elements

Limit used to evaluate whether filter efficiency continue decrease durng loading	Classes of KP type filter element		
	KP90	KP95	KP100
BL	0.20%	0.10%	0.004%

6.3.4.7 The minimum filter efficiency of each sample shall be reported.

6. 4 Leakage

6.4.1 Sample quantity and requirement

6.4.1.1 For disposible facepiece, a total of 10 sampels are needed. If device have different sizes, at least two samples of each size shall be provided. 5 samples shall be as received, and 5 after conditioning in accordance to 6.2.1; if the device is claimed to meet requirement set in clause 5.14.1, 5 samples shall be after conditioning in accordance to 6.2.1 and the other 5 samples after conditioning in accordance to 6.2.3. Afterwards, all samples shall be handled in accrodance with 6.4.1.4 (if applicable).

6.4.1.2 For replaceable facepiece, a total of 2 sampels are needed, of which one as received, and the other one after conditioning in accordance to 6.2.1; if product is claimed to meet requirement set in clause 5.14.1, one sample shall be after conditioning in accordance to 6.2.1 and the other one after conditioning in accordance to 6.2.3. If device has different sizes, at least two samples of each size shall be provided, one of which as received or after conditioning in accordance to 6.2.3 (if applicable), the other one after conditioning in accordance with 6.2.1. Afterwards, all samples shall be handled in accrodance with 6.4.1.4.

6.4.1.3 Breathing hose shall be tested as part of facepiece, if any.

6.4.1.4 According to product user instruction, if respirator conponent(s) are designed to be dissembled/re-assembled or replaceable by the respirator users for wash or maintenance purposes (e.g. inhalation valve, exhalation valve or replaceable filter element(s)), prior to leakage test, all of those conponents shall be dessembled and re-assembled by experienced laboratory test person in a manner that is fully in accordance to the product user instruction, then the device shall be provided to the test subject for leakage test.

6.4.2 Test equipment

6.4.2.1 The leakage test apparatus is shown schematically in Figure 2.

6.4.2.2 The test chamber shall be a close room with an observation window and a space size big enough for the individual finishing the required exercises. The simulative agents shall be designed to enter the top of the room through a flow distributor, and it shall be directed downwards and expelled via exhaust.

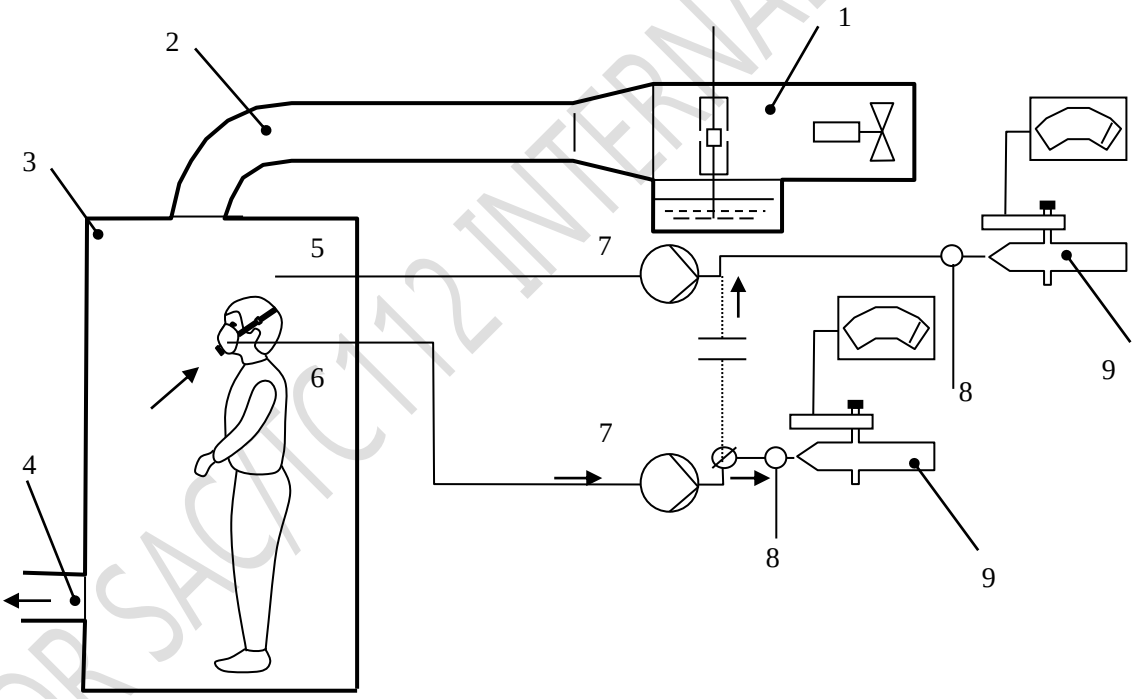
6.4.2.3 The generator of the simulative agents shall meet either of the requirements listed as followed:

1) When using NaCl particles：the generation volume shall be around 100 L/min and the concentration shall be (4～12) mg/m^3 with an aerodynamic particle size distribution of the range of 0.02μm to 2μm and a mass medium diameter of around 0.6μm, and the variation of the concentration within the chamber shall not be greater than 10%.

2) When using oil particles: the oil particles shall not be harmful to health, corn oil or paraffine oil may be regarded as options. The generation volume shall be around 100 L/min and the concentration shall be (20～30) mg/m^3 with an aerodynamic particle size distribution of the range of 0.02μm to 2μm and a mass medium diameter of around 0.3μm, and the variation of the concentration within the chamber shall not be greater than 10%. This method shall not be used for TIL testing of disposible facepiece with type KN filter.

6.4.2.4 The particle detector shall be able to test particle concentration in the range of (0.001～200) mg/m^3 with a precision of 1％ or 0.001 mg/m^3, and a responding time not greater than 500 ms。

6.4.2.5 The sampling pump shall be adjustable in the range of (0.50～4) L/min.



1——atomizer；
2——ducting and baffle；
3——test chamber；
4——exhaust
5——chamber sample；
6——facepiece sample；
7——pump；
8——dilution air；
9——particle detector

Figure 2 TIL and IL test system

6.4.3 Test condition

6.4.3.1 Prior to the test, there shall be an inspection to ensure that the samples are in good working condition and can be used without hazard. Inspection shall be done in accordance with 6.1.

6.4.3.2 For the test, persons shall be selected who are familiar with using such of similar devices. 10 clean-shaven persons shall be selected covering the spectrum of facial characteristics and gender of typical users excluding significant abnormalities. The faces of the 10 subjects shall be recorded with face length and width measured in accordance with GB/T 5703.

6.4.3.3 Sampling airflow rate shall be controlled within (1～2) L/min.

6.4.3.4 The chamber sample shall be collected at a position near the area of subject's head movements, and face piece sample probe shall be positioned in such a way that is as near to the central line of the wearer's mouth as possible. The connection between sample tube and the probe shall be air-tight.

6.4.3.5 Ask the test subjects to read the manufacturer's fitting information and when the face piece is manufactured in more than one size, ask the test subject to select the size deemed by him or her to be the most appropriated. The test subjects shall also understand the test requirements and procedure.

6.4.3.6 In IL test, the original filter elements used on replaceable facepieces shall be replaced by minimum KP100 filter element(s) with similar breathing resistance.

6.4.4 Test procedure

Prepare the samples and install the sample probe, do best to position the sample probe as near to the centrl line of the wear's mouth. With disposable mask, measures shall be takent to make sure sampling tuble will not distirb the mask position on the face during the test. Fix KP100 filter element(s) if applicable. Exame the test system to make sure it is in good working condition.

Direct the test particle into the test chamber and allow concentration reach the requried level.

Ask the test subject don the facepiece in a clean air environment, conduct the wearer face seal check. Then connect the sampling tube to the probe and particle detector. Test the concentration inside the facepiece when outside the test chamber. Record 5 results and use the arithmetic average as the background concetration.

Ask the test subject enter the test chamber, connect the testig tube to the particle detector without particle pollution. Ask the test subject to perform the following exercises:

1)Head still without talking for 2 min；

2) turning head from side to side (approx. 15 times) as if inspecting the walls of the chamber for 2 min；

3) moving the head up and down (approx. 15 times), as if inspecting the roof and floor for 2 min；

4) reciting an agreed text (e.g. counting numbers) out or talking aloud for 2 min；

5) head still without talking for 2 min.

Record test concentrations both in the test chamber and facepiece at the same time. Normally only record the last 100 s time period of each exercise and avoid the time period between the exercises. Record 5 results for each exercise and use the arithmetic average as the result of that exercise.

During the test, the subject is allowed to adjust the facepiece when there is a need and the test shall be done again for that exercise.

For replaceable facepiece sample, after each use, the sample shall be washed or disinfected in accordance with the method recommended by the manfuacturer. Then the sample shall be provided to the next test subject.

When NaCl particle is used in the test, the disposeable mask total inward leakage (TIL) of each exercise and the inward leakage (IL) of each exercise for replacable mask shall be calculated with Equation (3):

$$TIL_{ex}\,(IL_{ex}) = \frac{(C - C_a)1.7}{C_0} \times 100\% \quad \cdots\cdots\cdots\cdots\cdots\cdots (3)$$

in Equation (3)：

C ——particle concentration inside the facepiece during each exercise, in mg/m^3;

C_a ——background particle concentration inside the facepiece, in mg/m^3;

C_0 ——particle concentration inside the test chamber during each exercise, in mg/m^3.

1.7——coefficient used for NaCl particles concentration correction inside the respriator mask due to NaCl particles lost in test subject's respiratory duct and resulting in lowered concentration.

When oil particle is used in the test, the disposeable mask total inward leakage (TIL) of each exercise and the inward leakage (IL) of each exercise for replacable mask shall be calculated with Equation (4):

$$TIL_{ex}\,(IL_{ex}) = \frac{C - C_a}{C_0} \times 100\% \quad \cdots\cdots\cdots\cdots\cdots\cdots (4)$$

In Equation (4):

C ——particle concentration inside the facepiece during each exercise, in mg/m^3;

C_a ——background particle concentration inside the facepiece, in mg/m^3;

C_0 ——particle concentration inside the test chamber during each exercise, in mg/m^3.

The overal TIL or the overal IL of each test subject shall be calculated with Euquation (5):

$$Overal\ TIL_{subject}\,(Overal\ IL_{subject}) = \frac{1}{5}\sum TIL_{ex}\,(IL_{ex}) \cdots\cdots\cdots\cdots (5)$$

6.4.5 Test report

Test report shall included contents as followed:

a) The arithmetic average of each exercise of each test subject of TIL or IL.

b) The calculated overal TIL or IL of each test subject.

6. 5 Inhalation resistance

6.5.1 Sample quantity and requirement

A total of four samples shall be needed, of which two samples as received, and rest two samples after conditioning in accordance with 6.2.1; if the device is claimed to meet requirement set in clause 5.14.1, two samples shall be after conditioning in accordance to 6.2.1 and the other two samples after conditioning in accordance to 6.2.3. If the device have different sizes, at least two samples of each size shall be provided, of which one as received or after conditioning in accordance to 6.2.3 (if applicable), the other one after conditioning in accordance with 6.2.1.

6.5.2 Test equipment

6.5.2.1 The breathing resistance test apparatus is shown schematically in Figure 3.

6.5.2.2 Airflow meter shall be able to measure the airflow in the range of (0～100) L/min with a precision of 3%.

6.5.2.3 Micro-pressure meter shall be able to measure the pressure in the range of (– 1 000～1 000) Pa with a precision of 1 % and resolution of 0.1 Pa.

6.5.2.4 Test dummy heads shall have a breathing duct installed at the position of mouth, see illustration Fig. 4. The major measurements of the 3 sizes (big, medium and small) dummy head shall see to Annex D

6.5.3 Test condition

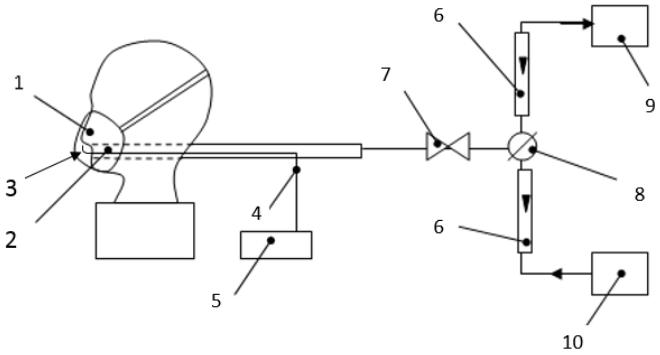
6.5.3.1 If applicable, the test shall be done with the replaceable filter element(s) and breathing hose installed.

6.5.3.2 The airflow rate shall be maintained at (85±1) L/min.

6.5.4 Test procedure

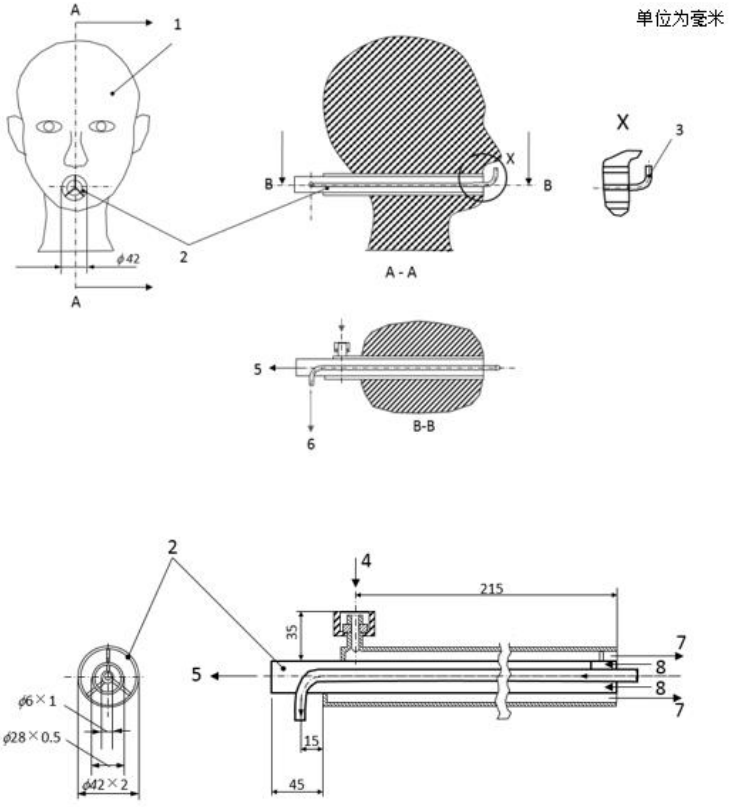
Exame the test system to make sure it is in good working condition and there is no leakage. Adjust the airflow rate at (85.0±1.0) L/min, and record the initial system resistance, regarded as “0”.

Fix the facepiece on the matchable dummy head, and adjusting the position the head harness, appropriated measures shall be taken (e.g. using sealant) to make sure an air-tight face seal is achieved between the facepiece and the dummy head without facepiece deformance and reduce of respirator’s effective filtering area. Re-adjust the airflow rate to the (85.0±1.0) L/min and record the maximum inhalation resistance.



1——test sample;
2——breathing duct of the dummy head;
3——accessory as pressure probe inside facepiece;
4——pressure detection tube;
5——micro-pressure meter;
6——airflow meter;
7——airflow adjusting valve;
8——switch;
9——vacuum pump (for inhalation resistance test);
10——air pump (for exhalation resistance test)

Figure 3 test system of breathing resistance



1——dummy head;
2——breathing duct built inside the dummy head;
3——accessory used in breathing resistance test as probe of pressure inside the facepiece;
4——inlet of exhalation, connected to breathing machine for dead space test;
5——outlet of inhalation, conntected to breathing machine for dead space test;
6——connector for micro-pressure meter in breathing resistance test, or for CO_2 analyzer (inhale) in dead space test;
7——exhale;

8——inhale.

Fig. 4 illustration of breathing duct of dummy head used for breathing resistance and dead space test

6. 6 Exhalation resistance

6.6.1 Sample quantity and requirement

Same as 6.5.1.

6.6.2 Test equipment

Same as 6.5.2

6.6.3 Test condition

Same as 6.5.3.

6.6.4 Test procedure

Exame the test system to make sure it is in good working condition and there is no leakage. Adjust the airflow rate at (85.0±1.0) L/min, and record the initial system resistance, regarded as “0”.

Fix the facepiece on the matchable dummy head, and adjusting the position the head harness, and appropriated measures shall be taken (e.g. using sealant) to make sure an air-tight face seal is achieved between the facepiece and the dummy head without facepiece deformance and reduce of respirator’s effective filtering area. Re-adjust the airflow rate to the (85.0±1.0) L/min and record the maximum exhalation resistance.

6. 7 Exhalation valve leakage

6.7.1 Sample quantity and requirement

A total of 4 respirators shall be needed, of which 2 as received, 2 after conditioning in accrodance with 6.2.1.

6.7.2 Test condition

6.7.2.1 Test condition shall be normal room temperature and atmospheric pressure, the relative humidity shall be less than 75%.

6.7.2.2 The sample shall include a part of face piece that is connected to the exhalation valve. The valve shall be clean and dry. Measures shall be taken to make sure the valve sample shall be free of debris or pollution when collected from disposable facepiece (e.g. cutting facepiece to produce the valve sample).

6.7.3 Test equipment

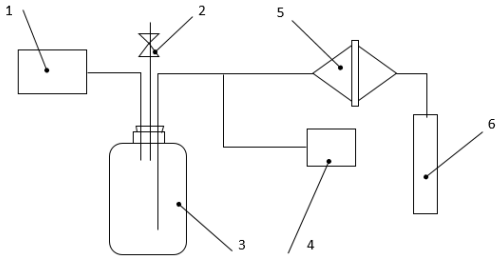
The test system is shown schematically in Figure 5. The requirements shall be:

a) A vacuum pump shall have an airflow volume of around 2 L/min.

b) A buffer with a capacity not less than 5L.

c) A micro-pressure meter shall be able to test the pressure in the range of (-1 000～0) Pa with a precision of 1 % and resolution of 1 Pa.

d) An airflow meter shall be able to measure the airflow in the range of (0～100) ml/min with a precision of 1 % and resolution of 0.1 ml/min.



1——vacuum pump
2——adjustment switch
3——buffer
4——micro-pressure meter
5——exhalation valve fixture
6——air flow meter

Fig 5. Exhalation valve leakage test system

6.7.4 Test procedure

Inspect the test system and sample fixture, making sure no air leakage existed.

Use appropriated method (e.g. use sealant), fix the sample on the test fixture in an air-tight manner. Turn on the vacuum pump, adjusting the switch to have valve sample subject to -249 Pa pressure, and test the valve leakage air flowrate.

6. 8 Exhalation valve protection

6.8.1 Sample quantity and requirement

A total of 3 respirators as received shall be needed.

6.8.2 Test equipment

6.8.2.1 A pulling force tester shall be capable in the range of (0～1 000) N with a precision of 1％. Or use standard weight to apply a pulling force as required in Table 5.

6.8.2.2 A fixture that shall have an appropriate structure and clamp force.

6.8.2.3 A timer with a precision of 0.1 s shall be needed.

6.8.3 Test procedure

Clamp the exhalation valve protection component and facepiece body (as near to the connection location as feasible) separately. Apply axile pulling force as required in Table 5, or by hanging standard weight to apply an axile pulling force as requried in Table 5. Record whether there is any break, glide and deformation observed.

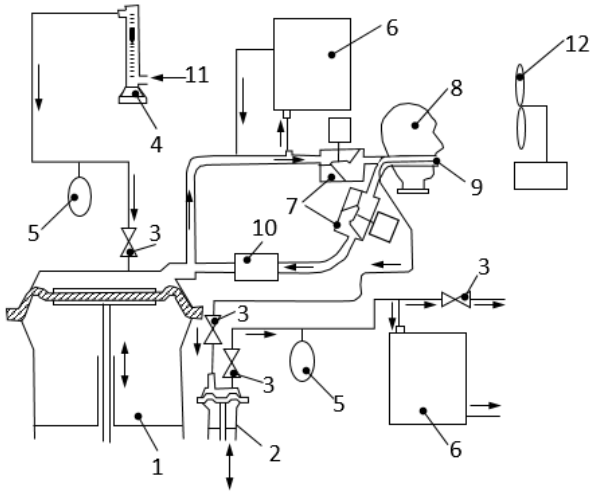
6. 9 Dead space

6.9.1 Sample quantity and requirement

Total 3 disposible facepieces are need, all as received. One half facepiece or full facepiece is needed, or 1 sample for each size, all as received.

6.9.2 Test equipment

6.9.2.1 Dead space (CO_2 content in inhalation air) test equipment is shown in Figure 6. Exept the breathing simulator, the total dead space of the test equiment air track shall not be greater than 2 000 ml.



1——breath simulator;
2——auxiliary lung;
3——non-return valve;
4——flowmeter;
5——compensator;
6——carbon dioxide analyzer;
7——solenoid valve;
8——dummy head;
9——sampling tube for inhalation air;
10——carbon dioxide absorber;
11——carbon dioxide;
12——fan.

Figure 6. Scheme of typical test system of dead space

6.9.2.2 Dummy head shall be same as 6.5.2.4.

6.9.2.3 Breath simulator breath frequency shall be adjusted to 20 strokes/min, tidal air volume shall be in the range of (0.5～3.0) L/stroke.

6.9.2.4 CO_2 supply: CO_2 volume fraction shall be (5.0±0.1) %

6.9.2.5 CO_2 Flow meter shall have a test range not lower than 40 L/min with a precision of 1 L/min.

6.9.2.6 CO_2 analyzer shall have a test range not lower than 12% as volum fraction, with a precision not lower than 0.1% (volum fraction).

6.9.2.7 Air velocity tester, fan, etc.

6.9.3 Test condition

6.9.3.1 Test shall be done in room temperature with a range of (16～32) ℃.

6.9.3.2 Set the breathing simulator breath frequency at 20 stroke/min and tidal volume of 1.5L.

6.9.3.3 Suitable air ventilation measure shall be taken, to make sure CO_2 concentration in test environment shall not be over 0.1%, the location of the environment test shall be around 1m from the front of the sample.

6.9.3.4 If testing on disposable respirator, a fan shall be used to blow air from the side of the sample. At the front of the sample, the passing air velocity shall be 0.5 m/s.

6.9.4 Test procedure

Inspect the test system, making sure it is good working condition. Suitable measures shall be taken to fit the sample on the dummy head in an airtight manner without sample deformation.

Turn on the dead space test system, continually monitoring and recording CO_2 concentration in inhalation air and environment air, until a stable value is reached.

Three disposible respiartors shall be tested, each sample shall be tested once. In case of half and full facepiece, each sample shall be tested 3 times.

The test shall be effective only when the CO_2 concentration in environment is not over 0.1% (volum fraction), and test value shall be deducted by the CO_2 concentration in environment. The test result of CO_2 concentration in inhaltion shall be the arithmetic avarage of 3 test value.

6. 10 Visual field

Testing shall be done in accordance with GB 2890-2009 Clause 6.8.

6. 11 Head harness

6.11.1 Sample quantity and requirement

A total of 2 samples shall be needed, of which 1 as received, another 1 after conditioning in accordance with 6.2.1.

6.11.2 Test equipment

6.11.2.1 A pulling force tester shall be capable in the range of (0～1 000) N with a precision of 1%. Or use standard weight to apply a pulling force as required in Table 7.

6.11.2.2 A fixture that shall have an appropriate structure and clamp force.

6.11.2.3 A timer with a precision of 0.1 s shall be needed.

6.11.3 Test procedure

Clamp the head harness (not the free end) and facepiece body (as near the connection part of the head harness as feasible) separately. Apply axile pulling force as required in Table 7, or by hanging standard weight to apply an axile pulling force as requried in Table 7. Record whether any break or glide is observed.

Testing shall be done to each head harness connection part and results shall be recorded.

6. 12 Connection and connector

6.12.1 Sample quantity and requirement

A total of 2 samples shall be needed, one as received, the other one after conditioning in accordance to 6.2.1.

6.12.2 Test equipment

6.12.2.1 A pulling force tester shall be capable in the range of (0～1 000) N with a precision of 1%, or use standard weight to apply a pulling force as required in Table 8.

6.12.2.2 A fixture that shall have an appropriate structure and clamp force.

6.12.2.3 A timer with a precision of 0.1 s shall be needed.

6.12.3 Test procedure

Clamp the connecting component and facepiece body (as near the connection part as feasilbe) separately. Apply the pulling force required in Table 8, or by hanging standard weight to apply an axile pulling force as requried in Table 8. Record whether there is any break, glide or deformation observed.

Testing shall be done to each connection part and results shall be recorded.

6. 13 Visor

6.13.1 Sample quantity and requirement

A total of 5 samples shall be needed, all as receive.

6.13.2 Test equipment

6.13.2.1 Test dummy heads: the major measurements of the 3 sizes dummy (big, medium and small) shall see to Annex D.

6.13.2.2 A steel ball having a diameter of 22 mm, a mass of (45±1) g and a smooth surface.

6.13.3 Test procedure

Fix the facepiece on the matchable dummy head and adjust the position. Orientating the dummy head in such a way to let the visor facing up, and secure the position of the dummy head. Let the steel ball dropping from a hight of 1.3 m freely on the center of the visor. Record whether there is any damage or crack observed.

Each visor sample shall be tested and results shall be recorded.

6. 14 Airtightness

6.14.1 Sample quantity and requirement

All the received samples, or the samples required in other testing.

6.14.2 Test equipment

6.14.2.1 Dummy head: same as 6.5.2.4.

6.14.2.2 A micro-pressure meter shall be able to test the pressure in the range of (0～2 000) Pa with a precision of 1 % and resolution of at least 1 Pa.

6.14.2.3 A timer shall be able to measure the time with a precision of 0.1 s.

6.14.2.4 A vacuum pump shall have an airflow volume of around 2 L/min.

6.14.3 Test procedure

Fix the facepiece on the matchable dummy head, seal the inhalation valves and moisten the exhalation valves. Pump the air to reach a negative pressure of 1 000 Pa. Stop air pumping and begin to record the time at the same time. Observe and record the decrease value of pressure within 60 s.

6. 15 Flammability

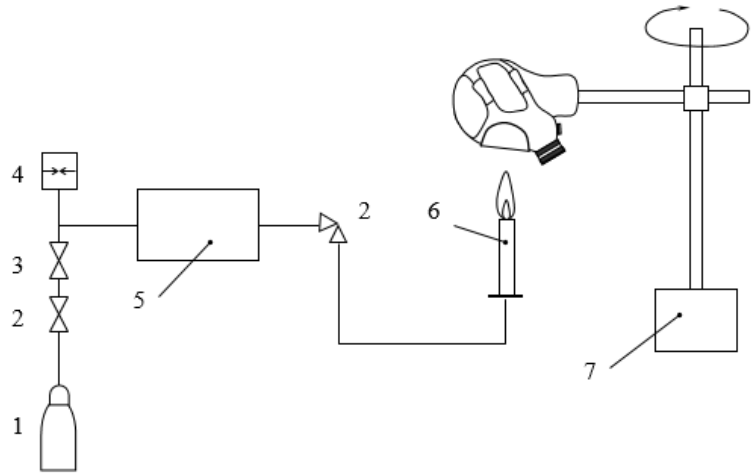
6.15.1 Sample quantity and requirement

A total of 4 disposible facepieces shall be needed, of which 2 as received, 2 after conditioning in accordance with 6.2.1.

A total of 3 replacable half facepiece or full facepieces shall be needed, of which 1 as received, and 2 after conditioning in accordance with 6.2.1.

6.15.2 Test equipment

The test apparatus is shown schemically in Figur 7. The test system includes a metallic dummy head fixed on a stand which is motorized to be able to move linear or horizonatal circle with a linear speed, measured at the tip of the nose, of (60±5) mm/s. The hight of the head shall be adjustable and it shall be arranged to pass over a propane burner, the position of which can be adjusted. By means of a suitable gauge to measure the height and a 1.5 mm diameter thermocouple probe to measure the flame temperature.



1——propan cylinder
2——valve；
3——pressure reducer；
4——presure gauge；
5——flame arrester
6——burner
7——rotation motor and speed control

Figure 7. Flammability test system

6.15.3 Test procedure

Fix the facepiece on the dummy head. Adjust the height of the head to make sure the distance between the top of the burner, and the lowest part of the facepiece (when positioned directly over the burner) shall be set to (20±2) mm, then turn the dummy head away form the area adjaceent to the burner.

Turn on the propane gas burner and make the adjustment to set the flame height to (40±4) mm, and the temperature of the flame measured at a height of (20±2) mm above the burner tip shall be (800±50)℃.

The head is set in motion and the effect of passing the facepiece once through the flame shall be recorded.

The test shall be repeated to enable an assessment to be made of all material on the exterior of the device. Any one component shall be passed through the flame once only.

6. 16 Practical performance

6.16.1 Basic requirements

Prior to the test the device shall be evaluated by all laboratory test methods (exepte flammablity required in clause 6.15) in order to make sure not hazardous to test subjects.

6.16.2 Theory

Test subjects shall don the device and conduct simulative exercise and to provide subjective evaluation.

6.16.3 Sample quantity and requirement

Total two samples shall be needed, of which one as received, the other one after conditioning in accordance to clause 6.2.1. Inspect the samples in accordance to clause 6.1, making sure the samples are in good working condition. Each test subject shall use one sample.

6.16.4 Test subject requirement

Total two test subjects are needed and subjec to meeting the requirements provided in GB/T 23465-2009 clause 4.2.

6.16.5 Test condition

Test shall be conducted in an envrionment of (16～32) ℃ and (30～80)% humidity. The test condition shall be recorded in the test report.

6.16.6 Test procedure

Test shall follow the procedure set in GB/T 23465-2009 clause 5.5. Test subjects shall use the device in such a manner that is accordance to the user instruction provided by the manufacturer. If respirator conponent(s) are designed to be dissembled/re-assembled or replaceable by the respirator user for wash or maintenance purposes (e.g. inhalation valve, exhalation valve, head band or replaceable filter element(s)), prior to practical performance evaluation, all those conponents shall be dessembled and re-assembled by the test subject in a manner that is fully in accordance to the product user manual. The test subjects shall conduct the required exercises within the required time period according to the requirements set for non-powered air-purifying respriators provided in GB/T 23465-2009 Table 2.

6.16.7 Test report

Each test subject shall provide subjective evaluation according to requirements provided in GB/T 23465-2009 chapter 6 and Table 3, together with the clause of 5.15 of this standard.

The test reprort shall meet requirements provided in GB/T 23465-2009 chapter 7.

7 Marking

7.1 Marking on the device

Marking on the device shall include:

a) Name, trademark or other means of identification of the manufacturer or supplier;

b) Model or size (if applicable);

c) The number and year of publication of this standard, filter classification on each filter element. Filter classification shall be marked in a way of combining both number of this standard and filter type and class, for example, GB 2626-2019 KN90, or GB 2626-2019 KP100.

7.2 Marking on packaging

The following information shall be clearly and durable marked on the smallest commercially available packaging or legible through it if the packaging is transparent：

a) The name, trademark or other means of identification of the manufacturer or supplier;

b) Type of facepiece, model and size (if applicable);

c) The number and year of publication of this standard, filter classification on each filter element. Filter classification shall be marked in a way of combining both number of the standard and filter type and class, for example, GB 2626-2019 KN90, or GB 2626-2019 KP100.

d) The product license number or approval information (if applicable);

e) Manufacture date (at least with year and month) or lot number, and shelf life (at least with year);

f) The sentence “see information supplied by the manufacturer”;

g) The manufacturer’s recommended conditions of storage (at least the temperature and humidity).

Annex A

（Informative）

Summary of requirements and test

This Annex summarizes the requirements and test in Table A.1.

Table A.1 Summary of technical requirements, sample and test

Requirement content	Requirement clause	No. of Samples			Sampel condioning	Test clause
		Disposible facepiece	Replacable half facepiece	Full facepiece		
General requirements	5.1	All	All	All	As received	6.1, 6.16
Visual inspection	5.2	2	2	2	T.C.(2), M.S.(2)	6.1,6.2
Filter efficiency	5.3 & Table 2	20, minimum 5 for each size if applicable.	20 filter elements.	20 filter elements	T.C./M.S.(5) , Wash(5,if applicable), rest A.R	6.3
Leakage	5.4 & Table 3	10, minimum 2 for each size if applicable	2, 2 for each size if applicable	2, 2 for each size if applicable	T.C./M.S(half number) ,A.R or Wash (if applciable) (half number); then handle the sample(disemble/re-assemble) according to 6.4.1.4.	6.4
Inhalation resistance	5.5 & Table 4	4, 2 for each size if applicable	4, 2 for each size if applicable	4,2 for each size if applicable	A.R or wash(if applicable) (half number), T.C. (half number)	6.5
Exhalation resistance	5.5 & Table 4	4, 2 for each size if applicable	4, 2 for each size if applicable	4, 2 for each size if applicable	A.R or wash (if applicable) (half number), T.C. (half number)	6.6
Exhalation valve leakage	5.6.1	Samples from 4 respirators	Samples from 4 respirators	N/A	A.R (half number), T.C. (half number)	6.7
Exhalation valve protection	5.6.2 & Table 5	3	3	3	A.R.	6.8
Dead space	5.7	3	1	1	A.R.	6.9
Visual field	5.8 & Table 6	1	1	1	A.R.	6.10
Head harness	5.9 & Table 7	2	2	2	A.R.(1), T.C.(1)	6.11
Connection and connector	5.10 & Table 8	N/A	2	2	A.R.(1), T.C.(1)	6.12
visor	5.11	N/A	N/A	5	A.R.	6.13, 6.14, 6.1 & 6.16(if applicable)

airtightness	5.12	N/A	N/A	All	A.R	6.14
flammability	5.13	4	3	3	For disposible facepice：A.R.(2)，T.C.(2); for half and full facepiece: A.R (1), T.C.(2)	6.15
Wash &/disinfection	5.14	If applicable: included in 5.3 filter efficiency, 5.4 leakage and 5.5 inhalation resistance	If applicable: included in 5.3 filter efficiency, 5.4 leakage and 5.5 inhalation resistance	If applicable: included in 5.3 filter efficiency, 5.4 leakage and 5.5 inhalation resistance	Conditioned in accordance with user manual with method and maximum allowable treatment times.	6.4 or 6.2.3, 6.3, 6.4 and 6.5 (if applicable)
Pracitcal performance	5.15	2	2	2	A.R.(1), T.C/M.S. and Wash(if applicable) (1). Prior to test, samples passed all tests (except 6.15 flammability)	6.16
Information supplied by the manufacturer	5.16	all	all	all	A.R	6.1, 6.16
Package	5.17	all	all	all	A.R	6.1
Marking	7	all	all	all	A.R	6.1

Note:

A.R.: as received

T.C.:temperature and humidity conditioned

M.S.:mechanical strength conditioned

Annex B

(Informative)

Calculation method of conversion CMD into MMAD

B.1 Converting CMD into MMD

Use Equation (B.1) to convert CMD into MMD:

$$D_{MMD} = D_{CMD} \exp(3\ln^2\sigma_g) \quad \text{(B.1)}$$

In Equation (B.1):

D_{MMD} ——mass median diameter of the particles, μm;

D_{CMD} ——count median diameter of the particles, μm;

σ_g ——geometric standard deviation of the particle distribution.

According to 6.3.2.1 a), the CMD of NaCl particles shall be (0.075 ± 0.020) μm, a particle distribution in a range of 0.055 μm～0.095 μm with a geometric standard deviation of not larger than 1.86; and according to 6.3.2.2 a), the CMD of DOP or the equivalent oil particles shall be (0.185 ± 0.020) μm, a distribution in a range of 0.165 μm～0.205 μm with a geometric standard deviation of not larger than 1.60. Bring those separately into Equation (B.1) to obtain:

$$D_{MMD,NaCl} = (0.055\sim0.095)\exp(3\ln^2 1.86) = (0.175\sim0.302) \quad \text{(B.2)}$$

In Equation (B.2):

$D_{MMD.NaCl}$ ——MMD of NaCl particles defined in 6.3.2.1 a), in μm;

$$D_{MMD,DOP} = (0.165\sim0.205)\exp(3\ln^2 1.60) = (0.320\sim0.398) \quad \text{(B.3)}$$

In Equation (B.3):

$D_{MMD,DOP}$ ——MMD of DOP or the equivalent oil particles defined in 6.3.2.2 a), in μm.

B.2 Converting MMD into MMAD

Use Equation (B.4) to convert MMD into MMAD:

$$D_{MMAD} = D_{MMD}\left(\frac{\rho_p}{\rho_0\chi}\right)^{\frac{1}{2}} \quad \text{(B.4)}$$

In Equation (B.4):

D_{MMAD} ——mass median aerodynamic diameter of the particles, in μm;

D_{MMD} ——mass demian diameter of the particles, in μm;

ρ_p ——density of the particles, in kg/m^3;

ρ_0 ——density of the standard spherical particle which is water, in 1 000 kg/m^3;

χ ——aerodynamic coefficient of particle shape, provided in Table 1.

Table B.1 Aerodynamic coefficient of some typical particles (χ)

Classified basing on geometrical shape or type of dust	χ
spherical	1.00
cubic	1.08
coal dust	1.05～1.11
quartz dust	1.36

sand dust	1.57
talc dust	1.88
Note: Data used in this Table come from Aerosol Technology: Properties, Behavior, and Measurement of Airborne Particles, 2nd Edition, Table 3.2. See reference [5].	

B.3 The MMAD of NaCl particles defined in this standard

The density of NaCl is 2 200 kg/m^3, the geometrical shape of NaCl particles is close to cubic. According Table B.1, the χ of NaCl particles shall be 1.08. Bring the $D_{MMD,NaCl}$ obtained from Equation (B.2) into Equation (B.4) to obtain:

$$D_{MMAD,NaCl} = (0.175 \sim 0.302)[2200/(1000 \times 1.08)]^{1/2} = (0.249 \sim 0.430) \quad \text{(B.5)}$$

In Equation (B.5):

$D_{MMAD,NaCl}$——the MMAD of NaCl particles defined in this standard 6.3.2.1 a), in μm.

B.4 The MMAD of DOP or the equivalent oil particles defined in this standard

The density of DOP is 985 kg/m^3, the geometrical shape of DOP particles is spherical. According Table B.1, the χ of DOP particles shall be 1. Bring the $D_{MMAD,DOP}$ obtained from Equation (B.3) into Equation (B.4) to obtain:

$$D_{MMAD,DOP} = (0.320 \sim 0.398)[985/(1000 \times 1)]^{1/2} = (0.318 \sim 0.395) \quad \text{(B.6)}$$

In Equation (B.6):

$D_{MMAD,DOP}$ ——the MMAD of DOP particles defined in this standard 6.3.2.2 a), in μm.

Annex C

(Normative)

Method to evaluate KP type filter efficiency decrease under loading

C.1 Basic theory

The filter efficiency decreases (or filter penetration increase) trend under loading condition will be affected by test equipment resolution and efficiency limit criteria. If the resolution of a test equipment is X%, it will be not possible for the test equipment to distinguish between two filter elements that have 0.000% and X% penetration. It is required in clause 6.3.2.2 b) of this standard that, the test equipment of filter efficiency shall have a precision of 1%, when a filter element having penetration Y is tested repeatedly, the penetration test result shall be variable in a range of (Y - 1%×Y) and (Y +1%×Y), and the maximum difference between the test result readings will be 2%Y, or 0.02Y.

Taking the above mentioned two factors into consideration, a method could be developed to evaluate penetration increase trend in loading test by using bandwidth limit (as BL).

C.2 Calculation of bandwidth limit

Different filter efficiency test equipment has different resolution. Using the real resolution specification of each test equipment, Equation (C.1) shall be used to calculate bandwidth limits of different classes of KP filter elements. Equation (C.1) is shown below:

$$BL_{KP100}\ (BL_{KP95} \text{ or } BL_{KP90}) = R + 0.02 \times P \quad \text{(C.1)}$$

In which:

BL_{KP100} ——— Bandwidth limit of KP100 filter element;

BL_{KP95} ——— Bandwidth limit of KP95 filter element;

BL_{KP90} ——— Bandwidth limit of KP90 filter element;

R ——— Resolution of the test equipment;

0.02 ——— two time of test equipment precision required in clause 6.3.2.2 b);

P ——— the maximum allowable value of penetration of each class KP filter element, 0.03% of KP100, 5.0% ofr KP95 and 10.0% for KP90.

C.3 Application of bandwidth limit for evaluation of KP filter efficiency decrease trend

When the general loading quantity requirements set in 6.3.3.1 is met for KP type filter, starting with the first reading cross the loading quantity limit and count the first 5 readings (see the five A shown in Fig. C.1). If the difference between the maximum and minimum of these 5 readings (i.e. the bandwidth) is larger than the BL obtained from Equation (C.1), or, one of the five readings is a new maximum penetration value (shown as A1 in Fig. C.1), it shall be believed that the filter efficiency is decreasing and loading shall be continued. Using same method to obtain bandwidth from every new five readings followed (shown as B, C and D in Fig.C.1). In case of the bandwidth is not larger than the BL from Equation (C.1) (such as the five C readings in Fig. C.1) but a new maximum penetration is appeared (point C4 in Fig.C.1), it shall be regarded as filter efficiency is still

decreasing, and loading shall not stop. When bandwidth is not greater than the BL and at the same time no new maximum penetration reading appeared, it may be regarded as filter efficiency decrease is stopped (see the five D points in Fig. C.1).

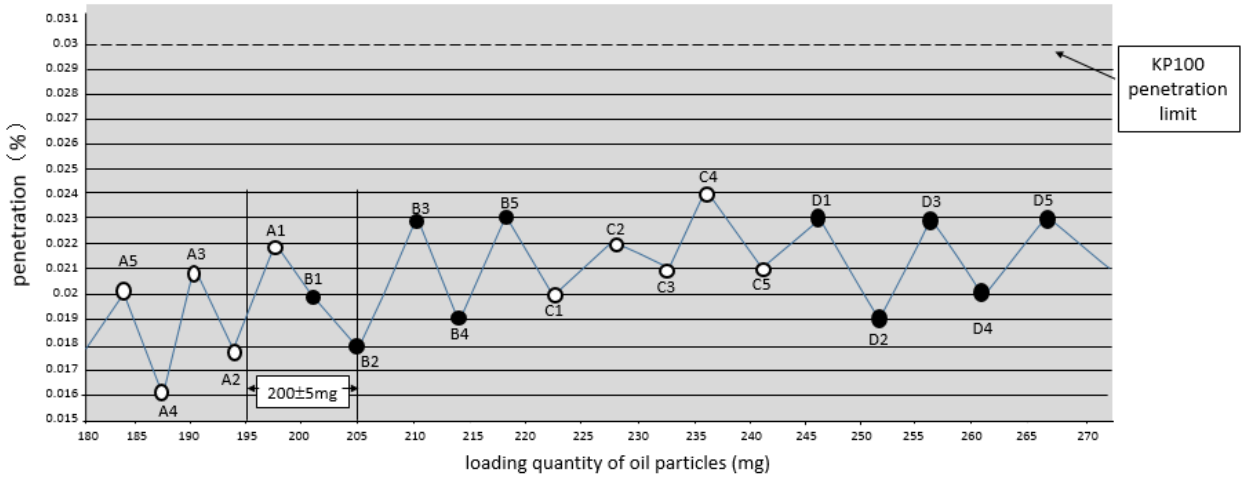


Fig C.1 Illustration of KP100 filter efficiency decrease trend evaluation with a BL=0.004%

Annex D

(Informative)

Summary of requirements and test

The key measurements of dummy heads used in this standard are provided in Table D.1.

Table D.1 Key measurements of dummy heads (in mm)

Measures	Small size	Medium size	Large size
Facial length	113	122	131
Facial width	136	145	154
Distance between pupils	57.0	62.5	68.0

Annex E
（Informative）

Comparison between GB 2626-2006 and GB 2626-2019

The major technical content differences between this standard with the previous version GB 2626-2006 are summarized in Table E.1.

Table E.1 Major differences between GB 2626-2019 and GB 2626-2006

Ser	Parts that have differences	GB 2626-2006	GB 2626-2019
1	Name of standard	Respiratory protective equipment – non-powered air-purifying particle respirator	Respiratory protection – non-powered air-purifying particle respirator
2	Terms and definitions	Previouse Clause 3.3、3.4、3.5.	The terms of fume, mist and micro-organisms are deleted, news terms of 3.14 and 3.19 to 3.24 are added.
3	Basic requirement	Previouse claus 5.1, as “general requirement”.	Now as cluase 5.1. The name of the clause is changed into “basic requiement”; The requirement of materials are amended; new requriements for different facepiece sizes and different head harness design, valve protection and washable conponents of replaceable facepiecespecific are added; the description of “service life” is adjusted into “normal use”.
4	Test method of particle filter efficiency: resolution of the test equipment	Previouse clause 6.3.2. No requirement.	Now as clause 6.3.2. Required as ≤ 0.003%。
5	Test method of particle filter efficiency: methods to convert particle size	Previouse clause 6.3.2. Did not provided	Now as clause 6.3.2 and Annex B. Provided.
6	Test method of particle filter efficiency: method to determine end of loading test for KP type filters.	Previouse clause 6.3.3. Provided, not very specific.	Now as clause 6.3.3 and clause 6.3.4. Provided with extra requirements of maximum aerosol loading amount limit, bandwidth limits and evaluation methods described in norminative Anenx C.
7	Test method of leakage	Previous clause 6.4. The leakage caused by respirator component parts dessemble/reassemble were not taken into consideration.	Now as cluase 6.4. New requirements are provided. If respirator component parts are replaceable or dessemble for the purpose of clean or maintenance, the test samples shall be dessembled and reassembled before leakage test.

Table E.1 Major differences between GB2626-201X and GB2626-2006(continued)

Ser.	Parts that have difference	GB2626-2006	GB2626-2019
8	Test method of breathing resistance	Previous clause 6.5 & 6.6. The seal between sample and dummy head was not required as air-tight manner. The requirement of construction of breathing ducts inside the dummy head was not provided.	Now as clause 6.5 and 6.6. An air-tightness requirement is added for the seal between facepiece sample and the dumny head, and it is requried to record the maximum breathing resistance as the test result. Fig.4 is added to provide detail requirement to breathing duct construction and measurements.
9	Technical requirement of inhalation resistance (Pa)	Previouse clause 5.5. ≤350 for all type of respirator of all classes	Now as clause 5.5. For disposable mask without exhalation valve: KN90/KP90：≤170；KN95/KP95：≤210 KN100/KP100：≤250 For disposable mask with exhalation valve: KN90/KP90：≤210；KN95/KP95：≤250； KN100/KP100：≤300 For replacable half mask and full face mask: KN90/KP90：≤250；N95/KP95：≤300； KN100/KP100：≤350
10	Technical requirement of exhalation resistance (Pa)	Previouse clause 5.5 ≤250 for all type of respirator of all classes	Now as clause 5.5 ≤150 for all type of respirator facepiece with exhalation valve. For disposable facepiece without exhalation valve, same as inhalation resistance.
11	Technical requirement of exhalation valve leakage and test method	Previouse clause 5.6.1 and 6.7. The situation of one facepiece having multi exhalation valve was not taken into consideration. The valve was not required to be sealed on the test fixture in an air-tightness manner, and it was tested horizontally, not a normall using condition.	Now as clause 5.6.1 and 6.7. New requriement is added for one facepiece has multi exhalation valves. The valve shall be tested vertically and sealed on the test fixture in an air-tightness manner. The test method is replaced by a new one to test valve leakage air flow under 249 Pa negative pressure and it is required to be not greater than 30 ml/min.
12	Technical requirement of exhalation valve protection	Previouse clause 5.6.2 Previous name was “exhalation valve cover”.	Now as clause 5.6.2 and 5.1b). The name is changed into “exhalation valve protection”. New requirement is added for exhalation valve protection design.
13	Test mthod of dead space	Previouse clause 6.9 and Fig. 5 Error found in Fig 5 for test equipment illustration.	Now as clause 6.9 and Fig. 7 Illuratraion figure is corrected.

Table E.1 Major differences between GB2626-201X and GB2626-2006(continued)

Ser.	Parts that have differences	GB 2626-2006	GB 2626-2019
14	Technical requirements to half facepiece visual field.	Previouse clause 5.8 & Table 5. Down direction ≥60°	Now as clause 5.8 and Table 6 Requirements are changed to be same as that of GB 2890-2009 for half facepiece: Overlapped ≥65%, down direction ≥35°
15	Technical requirements of full facepiece visual field	Previouse clasue 5.8 & Table 5 Single visor: total ≥70%, overlapped ≥80% Twin visor: total ≥70%, overlapped ≥20%	Now as clause 5.8 & Talbe 6. Requirements are changed to be same as that of GB2890-2009 for full facepiece： Single visor: total ≥70%, overlapped ≥55%, down direction ≥35° Twin visor: total ≥65%, overlapped ≥24%, down direction ≥35°
16	Technical requirement of full facepiece visor	Previouse clause 5.11 Visual disformation caused by visor was not considered, and no requirement provided for application of anti-fogging agent and visor cover film .	Now as clause 5.11. The visual disformation, hazy, irritating or orther discomfort cuased by visor, or by anti-fogging agent(if applicable) and visor cover film shall be evaluated in practical performance test described in cluase 6.16.
17	Flammability	Previouse clause 5.13. It was a mandatory requirement for all types products.	Now as cluase 5.13 and 5.16c)1) In case of product is not designed flamme resistant, requirements are added in the inforamtion provided by the manfuacturer to include such a statement provided in clause 5.16 c) 1) as: “this device shall not be suitable for application in working places with fire and flame (e.g. welding, metallurgy, etc.)”.
18	Cleaning and disinfection	Previouse clasue 5.14. The situation of products having statements that filter elements are washable and/or disinfectable were not taken into consideration.	Now clause 5.14、5.16d) and 6.2.3. It is allowed for filter elements being designed washable and/or disinfectable for reuse, requirements are add in the information provided by the manufacturer to include the particle characteristic or scope that is applicable, the maximum times of washing and/or disinfecing for reuse, and methods for user to determine whether the filter element can be reused. During sample conditioning described in clause 6.2.3, samples shall be washed and/or disinfected as such according to the user instruction provided by the manfuacturer before filter efficiency (clause 5.3) , leakage (clause 5.4) and inhalation resistance (clause 5.5) evaluation.

Table E.1 Major differences between GB2626-201X and GB2626-2006(continued)

Ser.	Parts that have differences	GB2626-2006	GB2626-2019
19	Information provided by the manufacturer	Previouse clause 5.15.	Now as clause 5.16. Requirements are added for specific content of respirator application scope and limit, product change or replacemnt, flammability, washing and/or disinfection.
20	Practical performance	Not required.	Now as clause 5.15 and 6.16. For basic techncial requriements provided in clause 5.1 and 5.11, requirements are added to adopt GB/T 23465-2009 for practical performance evaluation.
21	Test method of head hearness.	Previouse clause 6.11.3.	Now as clause 6.11.3. Requirement is added that the head harness shall be pulled in the same direction of normall use condition.

Reference:

[1] ISO 16900-2 Respiratory protective devices – Methods of test and test equipment – Part 2. Determination of breathing resistance, 2009-07-15.

[2] ISO 16972-2010 Respiratory protective devices – Terms, definations, graphial symbols and units of measurement.

[3] EN 136:1998,Respiratory protective devices – Full face masks - Requirements, testing, marking, CEN.

[4]EN 149:2001,Respiratory protective devices – Filtering half masks to protect against particles – Requirements, testing, marking, CEN.

[5] William C. Hinds, Aerosol Technology: properties, behavior and measurement of airborn particles, 2nd Edition, A Wiley-Interscience Publication, John Wiley & Sons, Inc.1999. ISBN 0-471-19410-7.

[6] US CDC, Procedure No. TEB-APR-STP-0051 Revision 2.1, Date: 20 August 2012, Determination of Particulate Filter Efficiency Level for P100 Series Filters against Liquid Particulates for Non-powered, Air-Purifying Respirators Standard testing Procedure(STP).
http://www.cdc.gov/niosh/npptl/stps/pdfs/TEB-APR-STP-0051

[7] US CDC,Procedure No. TEB-APR-STP-0053 Revision 2.1 Date: 20 August 2012. Determination of Particulate Filter Efficiency Level for P95 Series Filters against Liquid Particulates for Non-powered, Air-Purifying Respirators Standard testing Procedure(STP). http://www.cdc.gov/niosh/npptl/stps/pdfs/TEB-APR-STP-0053