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**Respiratory protection - Non-powered air-purifying gas
mask**

呼吸防护 自吸过滤式防毒面具

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Respiratory protection - Non-powered air-purifying gas mask

1 Scope

This document specifies the classification and sign, technical requirements, marking, packaging and information provided by the manufacturer of non-powered air-purifying gas masks; describes the test methods.

This document applies to gas masks based on the non-powered air-purifying principle.

This document does not apply to non-powered air-purifying gas masks, which are used in hypoxic environments, underwater operations, escape and firefighting hot zones.

2 Normative references

The contents of the following documents constitute essential provisions of this document through normative references in the text. Among them, for dated reference documents, only the version corresponding to the date applies to this document; for undated reference documents, the latest version (including all amendments) applies to this document.

GB/T 2428-1998 Head-face dimensions of adults

GB 2626-2019 Respiratory protection - Non-powered air-purifying particle respirator

GB/T 5703-2010 Basic human body measurements for technological design

GB/T 10586-2006 Specifications for damp heat chambers

GB/T 10589-2008 Specifications for low temperature test chambers

GB/T 11158-2008 Specifications for high temperature test chambers

GB/T 12903-2008 Personal protective equipment terminology

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

GB 30864-2014 Respiratory protection - Powered air-purifying respirator

Filters with the function of preventing particulate matter are divided into two categories: KN and KP, according to the different properties of protecting particulate matter. The category KN is only suitable for filtering non-oily particles; the category KP is suitable for filtering oily and non-oily particles.

4.3.2 Filter level

4.3.2.1 Filter protective time

Filters are divided into level 1, level 2, level 3 according to the different protective time and from low to high.

4.3.2.2 Particulate matter protection performance of combined filters

The particle protection performance of combined filters is divided into KN90, KP90, KN95, KP95, KN100, KP100 according to the type of protective particles and filtration efficiency.

4.3.3 Marking

The marking of the gas filter consists of the gas filter protection gas type, gas filter protective time level, particle protection performance level (when applicable). The particle protection performance level is marked on the anti-particulate matter component; the protective gas type and filter level are marked on the anti-toxic gas and/or vapor component, on the combined filter.

Example 1: Level 1 type A ordinary filter is marked as: A1.

Example 2: Level 2 multifunctional filter with protection against two types of gases, A and B, is marked as: A2B2.

Example 3: Level 1 type E KN95 integrated combined filter is marked as: E1KN95.

Example 4: Used to protect some special compounds marked as: SX-(protective gas name).

5 Technical requirements

5.1 Mask

5.1.1 General requirements for masks

The structure and design of the mask shall meet the following requirements, be inspected according to the method specified in 6.2, evaluated in 6.23:

- a) Mask materials shall be non-toxic, non-irritating, harmless to health;
- b) The surface of the metal material on the mask shall be subject to anti-corrosion

treatment;

- c) The edges of the mask shall be smooth, without obvious edges and burrs, or defects that affect air tightness;
- d) The mask shall fit tightly on the wearer's face without obvious tenderness; the fixing system of the mask shall be adjustable according to the wearer's needs;
- e) The mask shall enable the wearer to check the air tightness between the mask and the face at any time and conveniently, meanwhile perform air tightness inspection;
- f) The observation window of the mask shall see objects realistically; measures shall be taken to prevent lens fogging;
- g) The exhalation valve shall have exhalation valve protection devices or measures to protect it from damage; the exhalation valve shall be able to work normally;
- h) Replaceable parts on the mask shall be easy to replace;
- i) For a mask equipped with a breathing hose, the breathing hose shall not restrict head movement or the wearer's movements, shall not affect the tightness of the mask, shall not restrict or block the airflow.

5.1.2 Mask adaptability to high and low temperatures

When tested according to the method specified in 6.3, the mask shall have no obvious deformation; the connecting part shall be able to be connected to the gas filter (breathing hose), according to the method provided by the manufacturer.

5.1.3 Mask flammability

When tested according to the method specified in 6.4, each component exposed to the flame shall not burn after being removed from the flame; if burning, the afterburning time shall not exceed 5 s.

5.1.4 Mask exhalation valve

5.1.4.1 Mask exhalation valve protection device

When tested according to the method specified in 6.5, the exhalation valve protection device shall not slip, break or deform, when it withstands an axial tension of 50 N for 10 seconds.

5.1.4.2 Air tightness of mask exhalation valve

Only half masks are tested according to the method specified in 6.6. When the exhalation valve is depressurized to -1180 Pa, the time for the exhalation valve to return to normal pressure shall not be less than 20 s.

Only full-face masks are tested. The observation windows of full-face masks shall meet the following requirements:

- a) When tested according to the method of 6.11, the light transmittance (visible light transmittance) of the lens shall not be less than 85%;
- b) Test according to the method in 6.12. The lens shall not come into contact with the eyes of the headform and shall not fall off or break.

5.1.10 Bonding strength of mask and gas filter

Test according to the method in 6.13. The test results shall comply with the following requirements:

- a) The bonding force between the full mask and the filter joint shall not be less than 250 N; there shall be no obvious damage;
- b) The bonding force between the half mask and the filter joint shall not be less than 50 N; there shall be no obvious damage;
- c) For a full-face mask with a breathing hose, the binding force between the breathing hose and the full-face mask shall not be less than 50 N; there shall be no obvious damage.

5.1.11 Mask headband

Test according to the method in 6.14. The test results shall comply with the following requirements:

- a) The full mask's headband shall be able to withstand a pulling force of 150 N for 10 seconds; it shall not break;
- b) The half mask's headband shall be able to withstand a pulling force of 50 N for 10 seconds; it shall not break.

5.1.12 Overall air tightness of full mask

When tested according to the method in 6.15, the pressure change within each full mask within 60 seconds shall not be greater than 100 Pa.

5.1.13 Breathing hose

When tested according to the method of 6.16, the length of the breathing hose shall be 50 cm ~ 100 cm; when tested according to the method of 6.17, the pressure value inside the breathing hose shall not change within 15 seconds.

5.2 Filters

6 Test methods

6.1 Test samples and test conditions

The test sample shall conform to the description of the product label and be functionally valid. The total number of test samples shall be determined, according to the specific requirements of the test. See Appendix A for the number of individual test samples and pretreatment requirements.

The pretreatment method for each individual test sample is in accordance with Appendix B.

The main dimensions of the test headform, which is used in each individual test, are in accordance with Table C.1 in Appendix C.

6.2 Appearance inspection

Before laboratory performance testing, non-powered air-purifying gas masks shall be visually inspected, including inspection of their appearance, structure, information and markings provided by the manufacturer. According to the needs of each technical requirement, conduct visual appearance inspection of the samples, before and after laboratory performance testing; report the results.

6.3 Mask adaptability to high and low temperatures

It is carried out, according to the provisions of B.1.

6.4 Mask flammability

It is carried out in accordance with the provisions of 6.15 in GB 2626-2019.

6.5 Mask exhalation valve protection device

It is carried out in accordance with the provisions of 6.8 in GB 2626-2019.

6.6 Air tightness of mask exhalation valve

It is carried out in accordance with the provisions of D.1 of Appendix D.

6.7 Inward leakage

It is carried out in accordance with the provisions of D.2.

6.8 Mask dead space

It is carried out in accordance with the provisions of D.3.

6.9 Mask field of view

7.2.1 Sales packaging shall be able to protect the product from mechanical damage and contamination before use.

7.2.2 On the minimum sales package, it shall clearly and permanently mark in Chinese, at least the following information; OR these can be visible through transparent packaging:

- a) Name, trademark or other identification of the manufacturer or supplier;
- b) Gas filter marking;
- c) Mask type, model, size (if applicable);
- d) This document number implemented;
- e) Production date (at least year and month) or production batch number, shelf life (at least year);
- f) Storage conditions recommended by the manufacturer.

7.3 Information provided by the manufacturer

Each non-powered air-purifying gas mask (mask or gas filter) shall have an additional product description on the smallest package it is sold in, which can be provided to the end user in printed matter, albums, etc., which shall include but not be limited to the following:

- a) Product manufacturer's name, address, contact information;
- b) Applicable and non-applicable conditions;
- c) Wearing instructions;
- d) Conditions for use of filters and methods for judging failure;
- e) Instructions for use as multiple filters (when applicable);
- f) Description that it can be used as a split-type combined filter (when applicable);
- g) Detailed description of the type of protective gas (or vapor), including examples of gases;
- h) Instructions and recommendations for assembly, use, cleaning, disinfection;
- i) Storage conditions recommended by the manufacturer;
- j) Detailed description of accessories and spare parts used (if applicable);
- k) The split combined filter shall have guidance and recommendations on assembly

Appendix B

(Normative)

Pretreatment method

B.1 Mask pretreatment method

B.1.1 Equipment

Mask pretreatment equipment shall meet the following requirements:

- a) The technical performance of the high temperature test chamber shall comply with the requirements of GB/T 11158-2008;
- b) The technical performance of the low temperature test chamber shall comply with the requirements of GB/T 10589-2008;
- c) The technical performance of the damp heat test chamber shall comply with the requirements of GB/T 10586-2006.

B.1.2 Method

Take the sample out of the original packaging and subject it to the following conditions in order:

- a) Place in a high temperature test chamber at $(70 \pm 3) ^\circ\text{C}$ and relative humidity less than 20%, for (72 ± 3) h;
- b) Place in a damp heat test chamber at $(70 \pm 3) ^\circ\text{C}$ and relative humidity of 95% ~ 100%, for (72 ± 3) h;
- c) Place in a low temperature test chamber at $(-30 \pm 3) ^\circ\text{C}$, for (24 ± 1) h.

Before each step, follow-up testing shall be performed at least 4 hours after the sample temperature returns to room temperature.

Pretreatment shall ensure that the sample is not subjected to thermal shock.

B.2 Filter pretreatment method

B.2.1 Temperature pretreatment

B.2.1.1 Equipment

Filter pretreatment equipment shall meet the following requirements:

D.2.2.2 The concentration of particulate matter in the detection chamber shall be within the range of $100 \text{ mg/m}^3 \sim 200 \text{ mg/m}^3$.

D.2.2.3 The particle sampling flow rate shall be controlled at $1 \text{ L/min} \sim 2 \text{ L/min}$.

D.2.2.4 The filtration efficiency of the gas filter for oily particles is KP100. If the manufacturer does not have a gas filter, which has this oil mist filtration efficiency, it is allowed to use a KP100 level gas filter, which has equivalent resistance during the test; however, it shall be able to fit well with the mask.

D.2.2.5 The position of the sampling tube in the detection chamber shall be located in the movement area of the subject's head. The sampling tube shall be installed on the sample to be tested. The interface shall be kept airtight; the end of the tube shall be close to the mouth and nose area.

D.2.3 Test steps

Pour the oily particles into the detection chamber. Adjust the concentration to the test required concentration and make it stable. Start the air pump, to make the concentration reach the required C_0 . The subject wears the mask correctly. Performs a preliminary air tightness check, according to the usage method. Adjusts it appropriately. Connect the sampling tube to the photometer. Start the air pump. Measure the concentration of particulate matter in the mask, when the subject breathes in the air in the clean air area outside the detection chamber. Take 5 numbers. The average value is the background concentration C_a . Ask the subject to enter the detection chamber and complete the following actions in order, according to the instructions. Measure the concentration of particulate matter in the mask under each action. There are 5 data for each; the average value is used as the leakage concentration C of the action.

- a) Keep head still and don't speak for 2 minutes.
- b) Turn the head left and right to look at the left and right walls of the detection chamber (about 15 times) for 2 minutes.
- c) Look up and down at the top and ground of the detection chamber (about 15 times) for 2 minutes.
- d) Read a large paragraph of text aloud (such as counting numbers) or speak loudly, for 2 minutes.
- e) Keep head still and do not speak for 2 minutes.

When performing each action, the particle concentration in the detection chamber and the mask shall be detected simultaneously. Generally, only the area wherein last 100 seconds of the action occurs are measured, to avoid overlapping sections of detection actions.

D.3.2.1 Correctly wear the mask on the test headform. The mask shall be airtight and without deformation. When necessary, polyvinyl chloride (PVC) tape or other suitable sealant can be used, to seal the periphery of the mask with the test headform.

D.3.2.2 Adjust the ventilator to a respiratory frequency of 25 times/min and a respiratory tidal volume of 2 L/time.

D.3.2.3 The CO₂ shall be fed into the ventilator through a flow meter, compensation bag, one-way valve. To prevent the accumulation of CO₂, a CO₂ absorber shall be used in the inspiratory circuit, between the solenoid valve and the ventilator.

D.3.2.4 Continuously measure and record the CO₂ content in the inhaled gas. The test shall be carried out, until the CO₂ concentration reaches stability.

D.3.2.5 Detect the CO₂ concentration in the environment 1 m away from the nose of the test headform. When the CO₂ concentration in the inhaled gas reaches a stable level, the CO₂ concentration in the environment is measured immediately. The CO₂ concentration in the environment can also be measured from the sampling tube, after the CO₂ gas source is turned off. The test results are considered valid only when the CO₂ concentration in the environment is less than 0.1%.

D.3.3 Test results

The CO₂ concentration in the detection environment is subtracted from the measured value of the CO₂ content in the inhaled gas. The test sample shall be tested three times; the average value is the CO₂ content in the inhaled gas.

D.4 Field of view

D.4.1 Sample requirements

Install the filter provided by the manufacturer on the mask, according to the information provided by the manufacturer.

D.4.2 Test device

D.4.2.1 Perimeter

The specific requirements for perimetry are as follows:

- a) Semi-circular arc bow: It has a radius of 300 mm ~ 340 mm, which can rotate around the horizontal radius passing through its midpoint 0°. Starting from 0°, there is a scale on both sides every 5° extending to 90°. The arc bow is equipped with a sliding white sight mark;
- b) Recording device: The recording needle is linked to the visual target through a shaft wheel and other components; the orientation and angle of the visual target are correspondingly recorded on the visual field drawing;

c) Mount: It is used to support the semi-circular arc bow and fixed recording device.

D.4.2.2 Test headform

The field of view of the headform itself shall conform to the average field of view of Chinese adults. Small light bulbs are installed at the pupil positions of the two eyes. The distance between the pupils of the two eyes shall comply with the requirements of GB/T 2428-1998. The line connecting the vertices of the light bulb is (7 ± 0.5) mm behind the midpoint of the two eyes. The test headform shall be installed on the workbench, in such a position that the left and right eyes can be placed at the center of the semicircular arc bow and look directly at its "0" point.

D.4.2.3 The recording paper is used in conjunction with the recording device. It has the average visual field curve printed on it.

D.4.2.4 The accuracy of the integrator is 0.1 cm^2 .

D.4.3 Test conditions

The test shall be carried out in a dark room; the mask shall be worn correctly; the headband shall be adjusted appropriately; attention shall be paid to the left-right symmetry of the mask on the headform.

D.4.4 Test steps

Check whether the perimetry recording device and visual mark linkage work correctly. Calibrate it carefully. Install the recording paper correctly on the recording table. Wear the test mask on the test headform and adjust it correctly. It is not too loose or too tight. The mask shall not have visible deformation. Place the test headform wearing a mask on the seat, so that the left or right eye is at the center of the arc. Turn on the power of the light bulb of that eye. Starting from any vertical or horizontal direction, measure a point every $15^\circ \sim 30^\circ$, until all directions are measured. Move the headform to measure the other eye as described above; then remove the recording paper. Take off the mask. Readjust it. Repeat the measurement three times according to the above steps. Connect the points recorded on each recording paper into a closed curve, according to the visual field of the left and right eyes, respectively. Except for special points, it shall generally be naturally smooth.

D.4.5 Test results

D.4.5.1 Use an integrator to measure the area S_i of the binocular visual field map and the total visual field map, on each recording paper. Assume the corresponding average visual field map area S without wearing a mask, measure the visual field preservation rate τ .

$$\tau = \frac{\gamma \cdot S_i}{S} \times 100\% \quad \dots\dots\dots (D.3)$$

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