

REGULATIONS AND STANDARDS OF RESPIRATORS IN JAPAN

YOSHIMI MATSUMURA, PH. D

DEPARTMENT OF ENVIRONMENTAL HYGIENE, NATIONAL INSTITUTE OF INDUSTRIAL HEALTH
21-1, 6 CHOME, NAGAO, TAMA-KU, KAWASAKI-214, JAPAN

Structures and properties of most kinds of respirators in Japanese market are summed in Japanese Industrial Standards (JIS). These Standards show the minimum requirements for the construction elements and whole structures and the functional criteria as well as the testing methods to prove them. Government Regulations of respirators cover only four kinds of respirators, but the objective respirators are certified by national approval tests in conformity with the Regulations.

However, the developments of new kinds of respirators and new testing methods induce the changes of concepts on respirators in Japan. Relating to this circumstance, some of the Standards early established and newly established are not necessarily consistent with each other in the classification of respirators, functional criteria and in the testing methods of properties. Governmental Regulations also show different concepts on some properties of respirators. Revisions of some Standards and Regulations are in progress, and consequently, some part of this review would not hold true a year later.

Japanese Industrial Standards of Respirators

In this chapter, all of Japanese Industrial Standards on respirators are glanced over. Classifications, main construction elements and important functional criteria of the respirators defined by each JIS are briefly described. However, the attendant construction elements such as head harness, nose cup and eyepiece, and criteria for breathing resistance, weight, visual field, dead space, operating pressures of valves, air tightness etc. are omitted.

All of the Japanese Industrial Standards in respirators are listed in Table I. There are also some respirators still undefined by JIS, such as used by firefighters, powered gas masks and special type respirators for farmers against both of mist and particles.

JIS T 8151 Dust Respirators

Classification Two types and three grades shown in Table II.

Special grade respirators should have the dust collection efficiency of 99.5% or more, 1st grade ones 95% or more and 2nd grade 85% or more, when tested against the air flow of 30 l/min with quartz particles smaller than $2\mu\text{m}$ at the concentration of $30 \pm 5 \text{ mg/cu.m}$ as test contaminant.

However, this classification is not adjusted to the Government Regulation for dust respirators (also JIS T 8160).

Construction elements Respirator has one or two dust filter units and a facepiece with exhalation valve. Breathing hose for only front or back mounted type. **Functional requirements** The wearer inhales through the filter units and exhales only through the exhalation valve to ambient atmosphere. But the 2nd grade respirators may release partial exhalation air through the filter units.

JIS T 8160 Respirators for Particulates

Classification Two types and two grades are shown in Table III.

The SS grade should have the leakage rate less than 0.1% and the S grade less than 1.0% when tested in use of a respirable dummy head against standard NaCl aerosol as test contaminant.

Construction elements Respirator is composed of filter units and facepiece with inhalation valve and exhalation valve. Breathing hose is included only in front or back mounted type respirators.

Functional requirements The ambient air cleaned through filter, should be inhaled through breathing hose (only in front or back mounted type) and through inhalation valve and should be exhaled through exhalation valve. Facepiece must be designed to permit

the wearer to easily test fitness by himself. The increase of inhalation resistance of filter due to the humidity of inhaled air should be within certain limits.

JIST 8158 Disposable Dust Respirators

Classification One class.

Construction elements Filter for particles and head band.

Functional requirements The ambient air cleaned by filter should be inhaled, and the leakage rate should not increase during single use within the pre-

scribed duration. The dust collection efficiency determined against quartz particles as test contaminant should be 90% or more, and the leakage rate determined by man-test with 10 test panels should be less than 10% for the 9th best panel among the 10. The increase in inhalation resistance due to the accumulation of quartz on the filter and due to moisture should be within certain criteria.

JIS T 8157 Powered Dust Respirators

Classification The respirators of this kind are divided into 3 types, i.e., facepiece type, faceshield type and hood type. Each type includes 1st grade and 2nd

Table I Yoshimi Matsumura

Japanese Industrial Standards (JIS) of Respirators

Code No.	Kind of Respirator	Established	Revised	Affirmed
T 8151	Dust Respirators	1950	1972	1979
T 8160	Respirators for Particulates	1985		
T 8158	Disposable Dust Respirators	1984		
T 8157	Powered Dust Respirators *	1982		
T 8152	Gas Masks	1972	1981	1986
T 8153	Supplied Air Respirators	1983		
T 8155	Self-Contained Breathing Apparatus (Compressed Air Type)	1971	1983	
T 8156	Oxygen-Generating Closed Circuit Breathing Apparatus (Chlorate Candle Type) *	1981		
M 7600	Compressed Oxygen Open Circuit Self-Contained Breathing Apparatus	1987		
M 7601	Compressed Oxygen Closed Circuit Self-Contained Breathing Apparatus	1987		
M 7611	Self Rescuer for Carbon Monoxide	1985		
M 7651	Oxygen Generating Type Self Rescuers*	1984		
M 7623	Escape Breathing Apparatus for Miners	1987		
T 8159	Leakage Rate Testing Method for Facepieces of Respirators	1983		
T 8150	Guidance for Selection, Use and Maintenance of Respiratory Protective Equipments	1985		
T 8001	Glossary of Terms Relating to Respiratory Protective Equipments	1985		

* Standards with this mark are being revised.

Table n Yoshimi Matsumura			
Classification of Dust Respirators			
Type	Grade		
Front or back mounted	Special	1st	
Chin-style	Special	1st	2nd

grade which correspond to the protection factor higher than 99.0 and 95.0 respectively at the lowest air flow rate for normal operation. The protection factor should be determined on respirable dummy head against fume as test contaminant.

Construction elements A powered blower, breathing hose, battery, filter unit and air flow rate indicator to show the lower limit of air flow, and a full face type facepiece with exhalation valve, faceshield or hood for the corresponding type respectively.

Functional requirements (Facepiece type) The ambient air should be sent into facepiece through filter and breathing hose by a powered blower and exhalation and excess air should be released through exhalation valve. When the blower stops, inhalation must be kept by user's own respiration through filter and breathing hose.

(Faceshield and hood types) The ambient air should be sent into faceshield or into hood by a powered blower through filter and breathing hose. The exhalation and excess air should be released through the space between wearer's face and shield or hood.

The air flow rate indicator should show the decrease of air supply below the published necessary lower limit of air flow. The powered blower should generate enough air and air pressure with electric source of 24V.

JIST 8152 Gas Masks

Classification Gas masks are classified into 3 types depending on the sizes of canned adsorbents, i.e., front or back mounted type canister, chin-style canister and chemical cartridge. Gas masks are classified also into 3 types depending on the types of facepieces, i.e., full facepiece, half mask and mouthpiece. The front or back mounted type canisters are divided into 9 divisions by the kinds of objective gases. Chin-style canisters are divided into 8 divisions and chemical cartridges into 6 divisions. They are shown in Table IV.

Construction elements (Front or back mounted type gas mask) Facepiece with inhalation valve and exhalation valve, breathing hose and canister.

(Chin-style gas mask) Facepiece with inhalation valve and exhalation valve and directly connected canister.

(Chemical cartridge respirator) Facepiece or mouthpiece with inhalation valve and exhalation valve and chemical cartridge.

Functional requirements Facepiece should have the structure permitting the wearer to test qualitative fitness by himself by negative pressure method, positive pressure method or by isoamylacetate method.

The service life of canister or cartridge should be longer than the criteria for each type and each division, which should be determined against the test air flow at rate of 30l/m, 20°C and 50% of relative humidity containing definite test contaminant. The card showing breakthrough time curve in relation with the test contaminant concentration and the card to record the used times should be attached to each canister or cartridge.

The dust collection efficiency of dust filter included in canister and cartridge should be tested against tobacco smoke of 100-200 mg/cu.m as test contaminant

Table III Yoshimi Matsumura			
Classification of Respirators for Particulates			
Type	Facepiece	Grade	
Front or back mounted	Full facepiece	SS	S
	Half mask		
Chin style	Full facepiece	SS	S
	Half mask		

Table IV Yoshimi Matsumura
Division of Canisters and Cartridges of Gas Masks

Division of canister and cartridge according to objective gas	Test gas	Front or back mounted	Chin-style	Chemical cartridge
Halogen gases	Chlorine	0	0	0
Acidic gases	Hydrogen chloride	0	0	0
Organic vapors	Carbon tetrachloride	0	0	0
Carbon monoxide	Carbon monoxide	0	0	
Carbon monoxide & organic vapors	Carbon monoxide & carbon tetrachloride	0		
Ammonia	Ammonia	0	0	0
Sulfur dioxide	Sulfur dioxide	0	0	0
Hydrogen cyanide	Hydrogen cyanide	0	0	
Hydrogen sulfide	Hydrogen sulfide	0	0	0

and be higher than 95% for front or back mounted canister, 80% for chin style canister and 60% for chemical cartridge.

JIS T 8153 Supplied Air Respirator

Classification Hose masks and air-line respirators are included in this JIS. Hose masks are divided into 2 types, i.e., with blower (powered and manual) and without blower. Air-line respirators are divided into 3 types, i.e., constant-flow type, demand type and pressure-demand type. They are shown in Table V.

Construction elements (Hose mask without blower) Facepiece with exhalation valve and breathing hose with larger diameter than 19 mm and longer than 10m.

(Hose mask with powered or manual blower) Facepiece with exhalation valve, breathing hose, breathing bag or air flow controller and powered or manual blower with dust filter. Facepiece can be replaced by faceshield or hood.

(Constant-flow type air-line respirator) Facepiece with exhalation valve, breathing hose, flow rate controller, medium pressure hose and filter for dust and fume. Air is supplied from compressed air line.

(Demand type and pressure-demand type air-line respirator) Facepiece with demand or pressure-demand valve, breathing hose, air supply valve, flow rate controller, pressure reducing valve and medium pressure valve. Some respirators of this type are accompanied with small compressed air cylinder which is used when air supply from compressor stops.

Functional requirements The criteria for leakage rate of facepiece shown in Table VI should be proved against NaCl aerosol as test contaminant on ten test panels by the method described in JIS 8159.

Protection factors of faceshield and hood should be tested on dummy head with breathing simulator, but test contaminant is not defined. The operations of air supply valve, air-tightness of exhalation valve, the ability of blower and others should be in compliance with this JIS.

JIS T 8155 Self-Contained Breathing Apparatus - Compressed Air Type

Classification The respirators covered by this JIS are classified into the following four types.

- (1) Atmospheric pressure - demand type
- (2) Atmospheric pressure - pressure-demand type

Table V Yoshimi Matsumura
Supplied-Air Respirators

Kind	Type	Facepiece etc.
Hose mask	Natural inspiration	Facepiece
	Blower-Powered	Facepiece, Faceshield, Hood
	Blower-Manual	Facepiece
Air-line respirators	Constant flow type	Facepiece, Faceshield, Hood
	Demand type	Facepiece
	Pressure demand type	Facepiece

Table VI Yoshimi Matsumura
Leakage Rate of Facepiece, Faceshield and Hood

Kind	Type	Leakage rate
Hose mask	Natural inspiration	Less than 0.3%
	Blower-Powered	Less than 1%
	Blower-Manual	Less than 1%
Air-line respirators	Constant flow type	Less than 3%
	Demand type	Less than 0.3%
	Pressure demand type	Less than 0.3%

(3) Dual atmospheric and high pressure use - demand type

(4) Dual atmospheric and high pressure use - pressure-demand type

Construction elements Facepiece of full face type or halfmask, air supply valve of demand type or pressure demand type, exhalation valve, by-pass valve, air supply hose, pressure reducing valve, warning device for lower limit of compressed air pressure, pressure gauge and compressed air cylinder. By-pass valve and warning device are not the unavoidable elements.

Functional requirements Leakage rate of facepiece should be lower than 0.1% for full facepiece and lower than 0.3% for halfmask when tested by man-test on 10 panels against NaCl aerosol by the method described in JIS T 8159.

JIS T 8156 Oxygen-Generating Closed Circuit Breathing Apparatus - Chlorate Candle Type

Classification Three classes of the following candles are included.

- (1) Type CC-20: Oxygen generating time longer than 20 minutes.
- (2) Type CC-30: Oxygen generating time longer than 30 minutes.
- (3) Type CC-40: Oxygen generating time longer than 40 minutes.

Construction elements Facepiece with inhalation exhalation valves, candle, breathing hose, exhalation hose, breathing bag and canister to adsorb CO₂. Warning system for the lower limit of oxygen generating rate and automatic exhaust valve to release excess oxygen are provided.

Functional requirements Carbon dioxide concentration in inhaled air should be kept below 3% during the nominal oxygen generating time. The temperature of inhaled air should be kept within 8°C difference from that of exhaled air.

Initial oxygen generating rate should be more than 2.5l for initial 30 seconds and more than 40l for initial 60 secs. The oxygen generating rate during the service time should be more than 2.5l/min.

Automatic exhaust valve should operate at 20 - 50 mmH₂O.

Warning system should operate at the decrease of oxygen generating rate by 1.0 - 1.5l/min.

Air tightness of facepiece, the concentrations of carbon monoxide and chlorine in generated oxygen and inhalation resistance should be proved in compliance with criteria.

JISM 7600 Compressed Oxygen Open Circuit Self-Contained Breathing Apparatus

Classification Four types of breathing apparatus with different oxygen contents are included.

- (1) Type 0-600: more than 600l
- (2) Type 0-900: more than 900l
- (3) Type 0-1200: more than 1200l
- (4) Type 0-1600: more than 1600l

Construction elements Facepiece of full face types and half mask with demand valve and exhalation valve, connecting hose and oxygen cylinder. Reducing valve, warning system for the lower limit of oxygen pressure in cylinder and by-pass valve for releasing oxygen independently from the operation of demand valve are included in some.

Functional requirements Leakage rate of full face type facepiece tested by man-test on ten test panels and NaCl aerosol according to the method described in JIS T 8159 should be less than 0.1% and that of half mask should be less than 0.3%. Air tightness of facepiece and the other parts under high, medium, and low pressures should be proved. Operations of demand valve, by-pass valve and warning system should be proved for the nominal criteria.

JIS M 7601 Compressed Oxygen Closed Circuit Self-Contained Breathing Apparatus

Classification This breathing apparatus is classified into two types with different oxygen supply rates, i.e., constant supply type with more rapid rate than 2.5l/min and constant/demand dual supply type with more rapid rate than 2.5l/min. It is also classified into three types with different inhalation valves, i.e., con-

stant/demand dual type (oxygen supply rate more than 30l/min), one step demand type (oxygen supply rate more than 2.5l/min) and two step demand type (oxygen supply rate of 1st valve more than 2.5l/min and 2nd valve more than 30l/min).

Construction elements Full facepiece or mouthpiece with inhalation valve and exhalation valve, demand valve or constant valve for oxygen supply from cylinder, breathing hose, breathing bag, exhalation hose, cleaning canister to remove CO₂, compressed oxygen cylinder with reducing valve and pressure gauge. Manual exhaust valve, automatic exhaust valve, by-pass valve to supply oxygen from cylinder and warning system for the lower limit of oxygen content in cylinder are equipped to some.

Functional requirements Air tightness of each part at high pressure, medium pressure and low pressure should be proved.

Air tightness of facepiece on a dummy head should be tested using ammonia and any leakage should not be observed. CO₂ concentration in inhaled air should be kept below 3% during operation. Temperature of inhaled air should not rise higher than 6°C over the exhaled air temperature.

Protection factor determined on 10 test panels with NaCl aerosol by the method described in JIS T 8159 should be less than 0.1 for full facepiece, but no definite criteria is given for mouthpiece. Operation of demand valve, automatic exhaust valve, by-pass valve and warning system should start at the nominal pressures respectively.

JIS M 7611 SelfRescuer for Carbon Monoxide

Classification One type of mouth piece and directly connected canister.

Construction elements Canister for carbon monoxide, mouthpiece with nose clip and heat exchanger.

Functional requirements Air tightness of mouthpiece connected with canister should be proved at 100 mmH₂O inside pressure, or at 150 mmH₂O inside pressure in the immersed state in water at 50 cm depth. No leakage should be observed. CO concentration in the test air stream after passing the canister should be kept below 500 ppm and total amount of penetrated CO should be below 385 ml during continuous 90 min, test of passing the CO test gas at 0.25% and 1.5% at flow rate of 100l/min on breathing simulator.

The ability of canister to remove CO should be proved after the preconditioning of canister at 15°C, at -20°C and at 70°C and after vibration and shock are given.

JISM 7651 Oxygen Generating Type Self Rescuers

Classification Rescuers of this type are divided into two types according to the chemical reactions adopted to generate oxygen, i.e., K type adopting potassium superoxide and C type adopting sodium chlorate (chlorate candle). Each type is divided into 4 grades according to the length of service time, i.e., 5 min., 10 min., 20 min. and 30 min.

Construction elements (K-type) Half mask or mouthpiece, oxygen generating canister, breathing bag and breathing hose. Initial oxygen generator and exhalation valve on facepiece or mouthpiece if necessary.

(C-type) Half mask or mouthpiece, candle, breathing bag, breathing hose, and cleaning canister to remove CO₂. Exhalation valve on facepiece or mouthpiece if necessary.

Functional requirements Oxygen generating rate should be 1.2l/min in average and not less than 0.8l/min. Initial oxygen generating rate, if the initial generator is equipped, should be more than 2.5l/min for initial 30 sec and more than 30l in total for initial 60 sec. When initial oxygen generator is not equipped, contained oxygen should be more than 2.5l for the use at the start.

JIS M 7623 Escape Breathing Apparatus for Miners

Classification Only one type containing 300 l oxygen. **Construction elements** Mouthpiece with nose clip, demand valve, high pressure O₂ cylinder, exhalation valve, resistance valve, breathing bag and breathing hose.

Functional requirements Oxygen is supplied from cylinder through demand valve and breathing hose. The exhalation is released through resistance valve into breathing bag and excess exhalation is exhausted through exhalation valve. The exhaled air into breathing bag is mixed with newly generated oxygen from cylinder and again inhaled by the wearer.

Air tightness of O₂ cylinder, demand valve and the parts at low pressure should be proved at definite conditions.

JIS T 8159 Leakage Rate Testing Method for Facepieces of Respirators

Testing method of leakage rate of facepiece on 10 test panels is described. NaCl aerosol is used as test contaminant of particles but the test contaminants of gases and vapors are not defined. The test panels should be chosen by mouth width or face width and face length to comply with Table VII.

Test panels putting on the respirators perform up and down steps at 20 cm high at the rate of 15 steps per minute. After more than 3 minutes from the start of steps, the air inside the facepiece is sampled for more than 1 minute at the smaller rate than 5l/min. During the test, the inhalation should be supplied through high efficiency particle filter or from clean air outside the test chamber into the facepiece. Exhalation should be exhausted to outside the chamber.

The leakage rate for each test panel is obtained by the following equation (1) and the average leakage rate for 10 panels by the equation (2). The grade of facepieces is determined by the average leakage rate as shown in Table 8.

$l_i = C_i/C_o$ where l_i is the individual leakage rate (%) on one panel, C_i is the concentration of test contaminant inside the facepiece and C_o is the concentration of test contaminant of the air in the test chamber.

$$L = (l_2 + l_3 + \dots + l_9)/8 \quad (2)$$

where L is the average leakage rate (%) and $l_2 \sim l_9$ are the individual leakage rates on panels except the highest and the lowest leakage rates observed.

Table VII Yoshimi Matsumura
Dimensions of Faces for Test Panels
for The Determination of Leakage Rate

Face length (cm)	14.5		1	1	
	13.5	1	1	1	
	12.5	1	1	1	
	11.5	1	1		
10.5					
		3.5	4.5	5.5	6.5
		Mouth width (cm)			

(A) 10 Test Panels

Face length (cm)	15.5		1	1	
	14.5	2	10	2	
	13.5	1	* 5	1	
	12.5	1	1		
	11.5				
		12.5	13.5	14.5	15.5
		Face width (cm)			

(B) 25 Test Panels

Table VIII Yoshimi Matsumura

Grade of Facepiece Determined by Leakage Rate

Grade	Leakage rate	
	Full face type	Half mask
AAA	Less than 0.03%	
AA	0.03% - 0.1%	
A	0.1% - 0.3%	Less than 3%
B	0.3% - 1%	0.3% - 1%
C	1% - 3%	1% - 3%
D	More than 3%	More than 3%

pirators, supplied air respirators, self-contained breathing apparatus (compressed air type), oxygen-generating closed circuit breathing apparatus (chlorate candle type), compressed oxygen open circuit self-contained breathing apparatus and compressed oxygen closed circuit self-contained breathing apparatus in compliance with the corresponding JIS for industrial purposes, though they are not certified by the Ministry of Labour.

The respirators used for escape from fires include oxygen-generating closed-circuit breathing apparatus (chlorate candle type) and simpler respirators to remove CO which must be certified in compliance with the Criteria of Fire Defence Board. However, the respirators used by firemen are not supervised by Government, and they are certified by Local Fire Defence

Table IX Yoshimi Matsumura

Regulations of Respirators

Name of Regulation	Competent Authority
Regulation of Dust Respirators	Ministry of Labour*
Regulation of Gas Masks	Ministry of Labour
Criteria of Disposable Dust Respirators	Ministry of Labour*
Criteria of Respirators for Escape from Fire	Fire Defence Board

* Regulations with this mark are being revised.

JIS T 8150 Guidance for Selection, Use and Maintenance of Respiratory Protective Equipments

JIS T 8001 Glossary of Terms Relating to Respiratory Protective Equipments

Regulations of Respirators

Dust respirators and gas masks used by the workers in industrial workshops must be the certified ones in compliance with the corresponding Governmental Regulations respectively, and they are submitted to national approval tests performed by the Ministry of Labour. Disposable dust respirators are also permitted to use in industrial workshops of which the report on the structure and properties showing the self certification in compliance with the Government Criteria must be submitted to the Ministry of Labour. The Ministry of Labour permits to use powered dust res-

Board.

The respirators used for escape from accidents in mines are supervised by the Ministry of International Trade and Industry. They are compressed oxygen open circuit self-contained breathing apparatus, compressed oxygen closed circuit self-contained breathing apparatus, self rescuer for CO, oxygen generating type self rescuers and escape breathing apparatus for miners. They are certified by the Ministry of International Trade and Industry in compliance with the corresponding JIS.

Table IX shows the Regulations and the Criteria issued by the competent authorities.

Government Regulations and Criteria are abstracted below.

Regulation of Dust Respirators

Classification One class of filter with dust collection efficiency of 95% or more. Two types of filter unit,

Table X Yoshimi Matsumura

Test Items for Certification of Dust Respirators According to Regulation

(Materials)

Heat resistance (Whole respirator)	$70 \pm 2^\circ\text{C}$, 6 h
Cold resistance (Whole respirator)	$-20 \pm 2^\circ\text{C}$, 3 h
Chemical resistance (Whole except filter)	5 wt.% NaCl soln, $40 \pm 2^\circ\text{C}$
	1 wt.% H_2SO_4 soln, $40 \pm 2^\circ\text{C}$
	1 wt.% HNO_3 soln, $40 \pm 2^\circ\text{C}$
	1 wt.% NaOH soln, $30 \pm 2^\circ\text{C}$
Extension ratio (Head harness)	1 kg weight
Extension resistance (Head harness)	20 cm/min
Extension resistance (Head harness fastener)	10 kg, 5 kg
Extension resistance (Breathing hose)	10 kg
Extension resistance (Breathing hose mount)	10 kg

(Structures)

Not easily breakable	
Exchangeable parts (Filter, Inhalation valve, Exhalation valve, Head harness)	
Structures permitting the wearer to test fitness any time.	
Dead space	280 cu.cm or less in full face type facepiece 180 cu.cm or less in half mask
Visual field	Full face type (Horizontal direction) 80° (Upward direction) 50° (Downward direction) 40° Half maks (Downward direction) 60° or (45° Downward direction) 60°
Filtration efficiency	95% or more against quartz particles suspended at 30 ± 5 mg/cu.m in air stream of 30 l/min.
Inhalation resistance	8 mmH ₂ O or less at 40 l/min.
Exhalation resistance	8 mmH ₂ O or less at 40 l/min.
Inhalation resistance increase	16 mmH ₂ O or less at 40 l/min accumulation of 100 mg quartz particles on filter.
Operational leakage of exhalation valve	
For this test, exhalation valve is put on respirable dummy facepiece, and quartz particles in dummy facepiece is measured at operational state.	

i.e., front or back mounted type and chin-style. Facepieces have also two types of full facepiece and half mask.

Construction elements Filter units and facepiece with exhalation valve. Breathing hose and inhalation valve attached to facepiece are added to front or back mounted type.

Functional requirements Filter unit, head harness,

inhalation valve and exhalation valve must be renewable. Facepiece must have the structure permitting the wearer to test fitness by himself. Eyepiece of full facepiece must be kept from moisture. Exhalation must be exhausted through exhalation valve.

The test items for dust respirators for national approval tests are summarized in Table X.

Regulation for Gas Masks

Classification The types of gas masks are classified by the kinds of facepieces, the sizes of cans and by the kinds of objective gases as shown in Table XI.

Construction elements The same with those described in JIS T 8152.

Functional requirements Canisters and cartridges should show the service lives longer than the prescribed times against the test air streams of 20°C, 50% of relative humidity and 30 l/min containing the test contaminants at prescribed concentrations. The filtration efficiency of front or back mounted canister, chin-style canister and cartridge for sulfur dioxide and sulfur should be tested against tobacco smoke and show 95%, 80% and 60% or more respectively. Air tightness of facepiece, breathing hose, canister and cartridge, air tightness of exhalation valve at operational state, inhalation resistances of inhalation valve, canister and cartridge and exhalation resistance of exhalation valve should be within the criteria.

Criteria of Disposable Dust Respirators

Classification No classification.

Construction elements Filter in the form of facepiece and elastic head band.

Functional requirements Filtration efficiency determined against quartz particles suspended in an air stream of 40 l/min should be 90% or more. Leakage

rate should be determined on 10 test panels against NaCl aerosol and the 9th best leakage rate among the observed 10 should be less than 10%. Inhalation resistance, inhalation resistance increase due to the accumulation of quartz of 100 mg, and inhalation resistance of wet filter should be in compliance with the criteria. Dead space value of the respirator should be noted in the report.

Criteria of Respirators Used for Escape from Fires - Oxygen Generating Type

Classification 3 classes according to the time of generating oxygen, i.e., more than 20 min, between 10 min and 20 min and between 3 min and 10 min.

Construction elements No description.

Functional requirements Protection factor measured on respirable dummy head against air borne SF_6 at 10 - 20 ppm concentration should be more than 50 (excellent), between 10 and 50 (very good) or should be between 5 and 10 (good). The respirators with protection factor less than 5 is not allowable. Man test on 25 panels may replace the above test on dummy head, and the 24th best protection factor among the observed 25 data is taken for the certification.

The CO_2 concentration, O_2 concentration and temperature of inhaled air should be measured along the time course on the respirator put on a respirable dummy head and should clear the criteria. The con-

Table XI Yoshimi Matsumura
Classification of Gas Masks According to Regulation

Division of canister and cartridge according to objective gas	Test gas	Front or back mounted	Chin- style	Chemical cartridge
Halogen gases	Chlorine	O	O	O
Organic vapors	Carbon tetrachloride	O	O	O
Carbon monoxide	Carbon monoxide	O		
Ammonia	Ammonia	O	O	O
Sulfur dioxide	Sulfur dioxide	O	O	O

Facepieces of full face type and half mask are allowable for every division. Mouth piece is not allowable.

Table XII Yoshimi Matsumura

Application of Leakage Rate Test on Man Panels

T 8158	Disposable Dust Respirators
T 8153	Supplied-Air Respirators
T 8155	Self-Contained Breathing Apparatus(Compressed Air Type)
M 7600	Compressed Oxygen Open Circuit Self-Contained Breathing Apparatus
M 7601	Compressed Oxygen Closed Circuit Self-Contained Breathing Apparatus
	Government Criteria of Disposable Dust Respirators
	Government Criteria of Respirators for Escape from Fires
	Chemical Filter for Carbon Monoxide

centrations of CO, NO₂, HCN and SO₂ in the inhaled air should be lower than definite levels. Protection from hot air and heat radiation, visual field and air tightness of eyepiece should be proved in compliance with the criteria.

Criteria of Respirators for Escape from Fires - Chemical Filter for Carbon Monoxide

Classification No classification.

Construction elements No description.

Functional requirements Protection factors determined on 10 test panels against NaCl aerosol should be 7% or more for all of the 10 panels.

Filtration efficiency determined against the mixture of wood smoke and CO is measured at 30l/min at the same time with the inhalation resistance measurement. The life time of the respirator must be longer than 3 min when measured on the above items. The protection of eye should be proved.

Applications of New Test Methods to Respirators

The Regulations and Standards show many methods to measure the properties of respirators. They include traditional and newly established methods. Among them, leakage rate test on man panels and the determination of protection factor in use of dummy head are adopted in the Standards listed in Table XII

and 13.

Definite Uses of Respirators in Industries and Mines

The uses of respirators in industrial workshops are prescribed by the Occupational Safety and Health Laws, and the definite kinds of respirators to be used are indicated by the Ordinance to prevent occupational diseases and accidents, and also by the Administrative Guidance Circulars.

In Japan, working area in industrial workshops must be kept at lower concentrations of hazardous materials than the administrative levels, and the air quality is assured by the periodical working environment measurements and the examinations on running states of ventilation systems. So, workers do not use respirators for usual work. Respirators are used by the workers engaged by such works as temporary works, works in tanks or in such places where ventilation systems can not be settled, or in accidents. Exceptionally, workers engaged in hand-works generating dusts or handling very hazardous materials such as tetraethyllead must put on prescribed respirators by Ordinances or Administrative Guidance Circulars issued by the Ministry of Labour as shown in Table XIV, and Table XV shows those for miners prescribed by the Ministry of International Trade and Industries.

For hazardous dusts such as mineral dusts, chemi-

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Application of Protection Factor Determination on Respirable Dummy Head

T 8157	Powered Dust Respirators
	Government Criteria of Respirators for Escape from Fires
	Oxygen Generating Type

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Definite Uses of Respirators for Specified Works

Objected materials	Kinds of respirators
Hazardous dust	Dust respirators Powered dust respirators Disposable dust respirators
Organic solvent (General)	Gas masks for organic vapors Supplied air respirators
Organic solvent (CS_2)	Effective respirators
Lead	Effective respirators
Tetra ethyl lead	Gas masks for organic vapors Supplied air respirators
Specified chemical substances (General)	Effective respirators
Specified chemical substances (Asbestos-Spraying)	Supplied air respirators Self-contained breathing apparatus
Specified chemical substances (Asbestos more than 2 fibers/cu.cm)	Dust respirators
Specified chemical substances (Methyl bromide & hydrogen cyanide)	Supplied air respirators Self-contained breathing apparatus Gas masks (Front-or-back mounted type)
High pressure	Effective respirators
Radioactive substances	Effective respirators Supplied air respirators Self-contained breathing apparatus
Oxygen deficiency (General)	Self-contained breathing apparatus Supplied air respirators
Oxygen deficiency (Fron)	Oxygen breathing apparatus Self-contained breathing apparatus Supplied air respirators Oxygen breathing apparatus

Table XV Yoshimi Matsumura

Definite Uses of Respirators in Mines

Purpose	Kinds of respirators
Escape	Self Rescuer for Carbon Monoxide Oxygen-Generating Type Closed Circuit Breathing Apparatus (Chlorate Candle Type) Escape Breathing Apparatus for Miners
Rescue	Compressed Oxygen Closed Circuit Self-Contained Breathing Apparatus Compressed Oxygen Open Circuit Self-Contained Breathing Apparatus

cal particles such as dyes, metal compounds and fumes generated in such circumstances prescribed in Ordinances or Administrative Guidance Circulars, certified dust respirators can be used. Powered dust respirators in compliance with JIS T 8158 can be used in the same occasions except for highly hazardous particles such as radioactive particles, arsenic compounds and lead compounds. Disposable respirators can be used in temporary works for the same particles as objected by dust respirators except highly hazardous ones like radioactive particles and lead compounds.

For toxic gases and vapors, for oxygen deficiency and for high pressure works, the suitable respirators are indicated. The respirators used in these cases must be the certified ones in conformity with Regulations, but those respirators undefined by Regulations are accepted when they are in compliance with JIS.