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中华人民共和国国家标准

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呼吸防护用品的选择、使用与维护

Selection, use and maintenance of respiratory protective equipment

This Standard English translation is for SAC use only.
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Preface

The respirator selection principle and basic requirements set in this Standard are in accordance to GB 11651-1989 Selection Rules of Articles for Labor Protection Use, and this Standard provides detailed method for selection, use and maintenance methods of respirator.

In this standard, the Appendixes B and G are normative, and Appendixes A, C, D, E, F and H are informative.

This standard is proposed by the State Administration of Work Safety,.

This standard is under the supervision of the China National Standardization Technical Committee for Personal Protective Equipment.

This standard is prepared by the 3M China Limited, Wuhan Safety Engineering Institute and the Research Institute of Chemical Defence.

This standard is written by Yao Hong, She Qi-yuan, Ding Song-tao, Li Xiao-yin, Liu Jiang-ge, Nai Fang and Li Qin-hua.

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Introduction

The current national Standards related to respirators are all of technical performance for each type. It is realised that without a guidance of selection, use and maintenance of respirators, the technical performance Standards alone are not capable of assuring their proper use.

ISO has not yet a standard of the selection, use and maintenance of respirators.

This Standard is established on the basis of current technical specification Standard and appliacations of respirators in China. The British Standard BS 4275:1997 Guide to implementing an effective respiratory protective device programme, the Amirican standards ANSI Z88.2 –1992 American national standard for respiratory protection and OSHA CFR 1910.134 Respiraotry protection standard, the Australia and New Zealand standard of AS/NZS 1715:1994 The selection, maintenance and use of respiratory protection equipment, the Singapore standard CP 74: 1998 Code of Practice for Selection, use and maintenance of respiraotory protective devices, etc. are refered together with other current related Standards in China. The Immidiatly Dangerous to Life or Health (IDLH) concentrations provided in the NIOSH DHHS Publication No. 90-117 NIOSH Pocket Guide to Chemical Harzards are normative refered and regarded as one of the factors to determine the hazard level of hazardous atmospheres in this Standard.

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Selection, use and maintenance of respiratory protection equipment

1 Scope

This Standard sets out the principles for respiratory protection and makes recommendations for the selection, use and maintenance of respiratory protection equipment.

This Standards applies to protection of the body against atmospheres deficient in oxygen or against harmful substances which could enter the body through the respiratory system, or both.

This Standard does not deal with the problems connected with diving and underwater breathing, the use of respirators in aircraft, or the use of life support respirators for medical or resuscitation purposes.

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/T 2891-1995 Performance test methods for facepiece of filter type respirator

GB 3836.1 Electrical apparatus for explosive gas atmospheres - Part 1: general requirements

GB 3836.2 Electrical apparatus for explosive gas atmospheres - Part 2: flameproof enclosure ‘d’

GB 3836.4 Electrical apparatus for explosive gas atmospheres Instrinsically safety circuits and electrical apparatus ‘i’

GB 8958 Safey regulation for working under hardous condition of the oxygen deficiency

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

3.1.1 Respiratory protective equipment (respirator)

a respiratory protective device which is designed to prevent the deficency of oxygen or inhalation of contaminated air, or both.

3.1.2 Air-purifying respirator

a device in which ambient air is passed through an filter element that removes the contaminanct(s) through adsorption, absorbtion, catalization or filtration before being inhaled.

[GB/T 12903-91，defination 4.1.1]

3.1.3 Self-inhalation air-purifying respirator

an air-purifying respirator that the ambient air is inhaled and forced through the filter element to the inlet covering by the wearer to overcome the airflow resistance.

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3.1.4 **Powered air-purifying respirator (PAPR)**

an air-purifying respirator that the ambient air is forced through the filter element to the inlet covering by power (e.g. electrical blower or manual blower) to overcome the airflow resistance.

3.1.5 **Tight-fitting facepiece**

a respiratory inlet convering that is designed to form a complete seal with the face. Tight-fitting facepeice includes half facepiece and full facepiece.

3.1.6 **Atmosphere-supplying respirator**

a respirator which isolates the ambient atmosphere from respirator wearer's respiratory system and supply respirable air through air-line or air-hose, or by self-contained air source.

[GB/T 12903-91，defination 4.1.2]

3.1.7 **Supplied air respirator**

an atmosphere-supplying respirator of which respirable air is supplied by air-line or air-hose.

[GB/T 12903-91，defination 4.2.1.1]

3.1.8 **Self-contained breathing apparatus**

an atmosphere-supplying respirator that compressed air cylinder, compressed oxygen cylinder or oxygen generator is worked as respirable air source and is carried by the respirator wearer.

[GB/T 12903-91，defination 4.1.2.2]

3.1.9 **Negative pressure respirator**

a respirator in which the air pressure inside the respiratory inlet covering is negative during inhalation whith respect to the ambient air pressure.

[GB 16556-1996，defination 3.2]

3.1.10 **Positive pressure respirator**

a respirator in which the pressure inside the respiratory inlet convering is normally positive with respect to ambient air pressure.

[GB 165 56-1996，defination 3.3]

3.1.11 **Loose-fitting facepiece**

a respiratory inlet covering that applies to positive pressure respirators and is designed to form a partial seal with the face.

3.1.12 **Hood**

a respiratory inlet covering that applies to positive pressure respirators and is designed to completely cover head and neck, and may also cover portions of shoulder or in conjuction with protective clothing.

3.1.13 **Escape type respirator**

a respirator desigined to be used only during escape from hazardous atmoshperes.

3.1.14 **Airborne contaminant**

any gaseous or particle substance that does not exist in normal air, or the concentration exceeds its range in normal air.

3.1.15 **Particle** (aerosol)

airborne solid, liquid or solid and liquid particlulates, such as dust, fume, mist and microorganisms.

3.1.16 **Dust**

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

3.1.17 **Fume**

solid areosol formed by condensation of a gas or vapor. Fumes generally have a smaller particle size when compared to dusts.

3.1.18 **Mist**

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An areosol composed of liquid particles.

3.1.19 **Low boiling point organic compound**

organic compound of which boiling point is not higher than 65°C.

3.1.20 **Hazardous atmosphere**

an atmosphere that contains contaminants(s) in excess of the occupational exposure limit or that is oxygen deficient.

3.1.21 **Immediately dangerous to life or health concentration**

The concentration of a contaminant reaches to such a level that it poses an immediated threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a hazardous atmosphere.

3.1.22 **Filter element**

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

For example: canister, cartridge or filter.

3.1.23 **End-of-service-life indicator**

a system that warns the user of the approach of the end of adequate respiratory protection.

3.1.24 **Face-seal-check**

a quick check conducted by the respirator wearer to ensure that the respirator is fitting each time it is donned.

3.1.25 **Fit test**

A method to evaluate the fit of a respiraotr on an individual. Fit test includes qulitative fit test and quantitative fit test.

3.1.26 **Qualitative fit test**

a fit test giving pass/fail results and relying on the subject's response to a test agent.

3.1.27 **Quantitative fit test**

a fit test giving numerical fit factor results and not relying on the subject's response to a test agent.

3.1.28 **Fit factor**

a direct result of a quantitative fit test that estimates the ratio of the concentration of the test agent in ambient air to its concetnration leaking inside the respirator while the subjuect is performing certain exercises which simulate the task.

3.1.29 **Assigned protection factor**

the contaminant concentraion level to be expected reduced by respiratory protection provided by a properly functioning respirator or a class of respirators that has proper fit and properly used by the wearers.

3.1.30 **Hazard factor**

a round-off number obtained by dividing the concentration of a contaminant by its occupational exposure limit.

3.2 Abbreviations

For purpose of this Standard, the following abbreviations apply.

APF Assigned Protection Factor

IDLH Immediately Dangerous Life and Health

SCBA self-contained breathing apparatus

4 Selection of respirators

4.1 General requirement

4.1.1 No person should be exposed without suitable protection to an atmoshphere that is or may be harmful to health.

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4.1.2 The risk of existance of a hazardous atmophere should be assessed in reference to the occupational exposure limits (OELs) (elements which should be considered in a risk assessment refer to Appendex A), and the nature and hazard level of the hazardous atmosphere could be identified.

4.1.3 Appropriate engineering control measures should be taken as far as feasible. When effective engineering controls are not feasible, or can not eliminate respiratory hazard, or while they are being implemented, suitable respirator shall be selected in accordance with this standard 4.2, 4.3 and 4.4. The respiratory types are provided in Table 1. The respirator selection procedure is shown in Figure 1.

Table 1 Types of respirators

Air-purifying			Atmosphere-supplying			
Self-inhalation		Powered air-purifying	Air-supplying		Self-contained breathing apparatus	
Half facepiece	Full facepiece		Positive-pressure	Nagative-pressure	Positive-pressure	Nagative-pressure

4.1.4 The selected respirator should be certified by the administration and comply with liable standards.

4.1.5 The manufacturer's instructions and application requirements should be observed when selecting respirators.

4.1.6 In any workplace where respirators are necessary to protect the health of the employee, the employer shall establish and implement a respiratory protection program.

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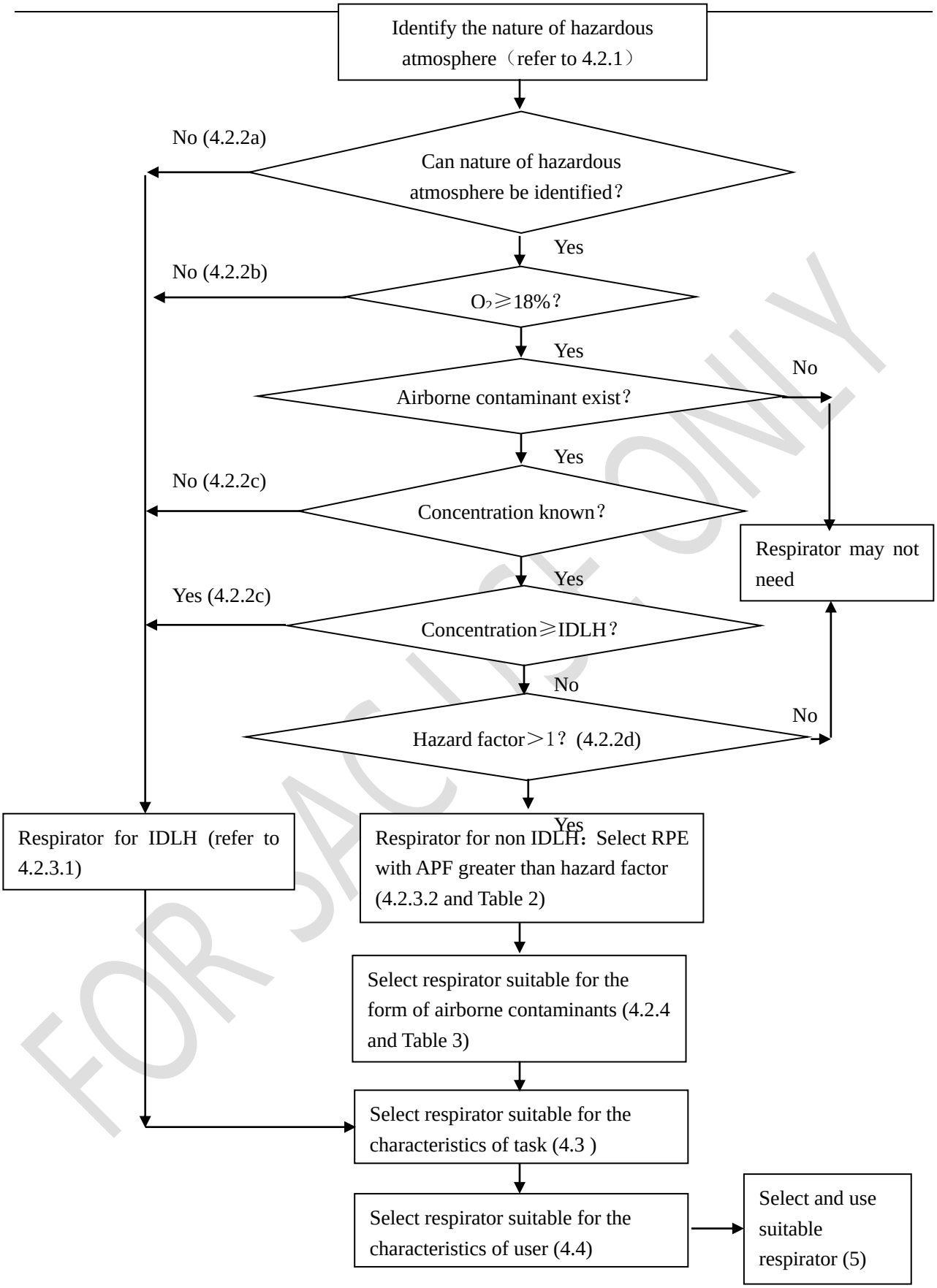

Figur 1. Respirator selection procedures

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4.2 Select respirator according to hazardous atmosphere

4.2.1 Identify the nature of hazardous atmosphere

The nature of hazardous atmosphere should be identified:

a) Whether the nature of the hazardous atmosphere can be identified;
b) Whether it is deficient of oxygen and oxygen concentration;
c) Whether airborne contaminant exist and its concentration;
d) The physical forms of airborne contaminant, whether it is particle, gas, vapor or their combination, and:
   1) in the case of particle, whether it is solid, liquid, and possible particle size distribution, its boiling point and vapor pressure, whether volatile at operation temperature, whether it is radio active, whether it is oil, whether there is liable OEL and IDLH concentration (see Appendix B), whether can also be absorbed through skin, whether it is allergenic, whether it is irritant or corrosive to skin and eyes, etc；
   2) in the case of gas or vapor, whether there is an adequacy of warning (refer to Appendix C), whether there is liable OEL and IDLH concentration (see Appendix B), whether it can also be absorbed through skin, whether it is allergenic, whether is irritant or corrosive to skin and eyes, etc.

4.2.2 Determine hazard level

The hazard level of hazardous atmosphere should be determined:

a) When the nature of hazardous atmosphere is unknown, it should be treated as IDLH atmosphere;
b) When it is deficient of oxygen or unable to determine, it should be treated as IDLH atmosphere;
c) When the airborne contaminant concentration reaches IDLH concentration, it should be treated as IDLH atmosphere;
d) When the airborne contaminant concentration is below IDLH, the Equation 1 should be used for calculating its hazard factor. When there is more than one airborne contaminant exist in the workplace, the hazard factor for each contaminant should be calculated separately and the factor of greatest value should be used for respirator selection.

$$\text{Hazard factor} = \frac{\text{Airborne contaminant concentration}}{\text{OEL}} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (1)$$

4.2.3 Select respirator according to hazard level

4.2.3.1 Respirators suitable for IDLH atmospheres

For IDLH atmospheres, the suitable respirators are:

a) A full facepiece positive pressure SCBA;
b) A combination of full facepiece or hood with positive pressure supplied air respirator with auxiliary escape respirator, which is suitable to the nature of the IDLH atmosphere involved.

Note: The auxiliary escape respirator should be suitable to the nature of IDLH atmosphere involved. For example, when in the case of the nature of hazardous atmosphere is unknown, oxygen deficiency, deficient of oxygen is unknown, the auxiliary escape respirator should be capable of providing respirable air to the user; and when in the case of airborne contaminant concentration reaches IDLH level, the auxiliary escape respirator should be suitable for the nature and concentration level of the contaminant(s) involved.

4.2.3.2 Respirators suitable for non-IDLH atmospheres

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For non-ILDH atmospheres, the suitable typies of respirator should have an APF greater than the hazard factor. The APFs of each type of respirator are shown in Table 2.

Table 2. APF of each type of respirator

Type of respirator	Type of facepiece	Possitive pressure	Negative pressure
Self-inhalation air-purifying	Half facepiece	N/A	10
	Full facepiece		100
Powered air-purifying	Half facepiece	50	N/A
	Full facepiece	>200 ～ <1000	
	Loose-fitting facepiece	25	
	Hood	>200 ～ <1000	
Supplied air	Half facepiece	50	10
	Full facepiece	1000	100
	Loose-fitting facepiec	25	N/A
	hood	1000	
SCBA	Half facepiece	>1000	10
	Full facepiece		100

4.2.4 Select suitable respirator according to the form of airborne contaminant

4.2.4.1 Respirators suitable for particles

Respirators suitable for particles are atmosphere-supplying respirators, or air-purifying respirators (see Table 3) to which additional attentions should be paid:

a) Particle respirator does not suitable for volatile particles protection, the selected respirator should have combined filter element which can remove both particle and its volatile;
b) The selected particle respirator should have filter element suitable for the particle size encountered;
c) When the particle is liquid or oil, the filter element should be suitable;
d) When the particle is radioactive, the filter element selected should be of the highest filter efficiency.

4.2.4.2 Respirators suitable for gases and vapors

Respirators suitable for gases and vapors are atmosphere-supplying respirators, or air-purifying respirators (see Table 3) to which additional attentions should be paid as followed:

a) The selected filter element should be suitable for the nature of gas or vapor involved. When filter element is not yet be covered by the current related Standards, the manufacturer's instruction should be observed.
b) When the gases or vapors encountered do not have adequacy of warning, the atmosphere-supplying respirators or respirators with end-of-service-time indicator are preferred.

4.2.4.3 Respirators suitable for combination of particle and gas or vapor

The respirators suitable for combination of particle and gas or vapor are atmosphere-suplying respirator, or air-purifying respirators with suitable filter element for the nature of the contaminants involed (see Table 3).

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Table 3.Suitable respirators for each type of hazardous atmosphere

Hazardous atmosphere				Type of respirator																							
				Atmosphere-supplying									Air-purifying														
				SCBA				Supplied air					Powered air-purifying									Self-inhalation air-purifying					
				Positive pressure		Negative pressure		Positive pressure			Negative pressure		G/V			Particle			Combined			G/V		Particle		Combined	
				H	F	H	F	H	T	L	H	F	H	T	L	H	T	L	H	T	L	H	F	H	F	H	F
O_2 concentration unknown					✓																						
O_2<18%					✓																						
Air contaminant & concentration unknown					✓																						
Oxygen efficient and air contaminants known	IDLH atmosphere				✓				⊙																		
	G/V	Hazard factor	<10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓			✓	✓
			<25	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓				✓	✓	✓		✓				✓
			<50	✓	✓		✓	✓	✓			✓	✓	✓					✓	✓			✓				✓
			<100	✓	✓		✓		✓			✓		✓						✓			✓				✓
			<1000	✓	✓				✓					✓						✓							
			>1000	✓	✓																						
	Particles		<10	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
			<25	✓	✓		✓	✓	✓	✓		✓				✓	✓	✓	✓	✓	✓				✓		✓
			<50	✓	✓		✓	✓	✓			✓				✓	✓		✓	✓					✓		✓
			<100	✓	✓		✓		✓			✓					✓			✓					✓		✓
			<1000	✓	✓				✓								✓			✓							
			>1000	✓	✓																						
	Combination of G/V & particles		<10	✓	✓	✓	✓	✓	✓	✓	✓	✓							✓	✓	✓					✓	✓
			<25	✓	✓		✓	✓	✓	✓		✓							✓	✓	✓						✓
			<50	✓	✓		✓	✓	✓			✓							✓	✓							✓
			<100	✓	✓		✓		✓			✓								✓							✓
			<1000	✓	✓				✓											✓							
			>1000	✓	✓																						

Note 1: ✓ means can be selected, ⊙ means when comply to 4.2.3.1b) of this Standard, can be selected.

Note 2: H means half facepiece, F means full facepiece, T means full facepiece or hood, L means loose fitting facepiece

注 3: Examples of respirator selection refer to Appendix D.

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4.3 Select respirators suitable for the specific task

After having selected suitable respirator according to 4.2 of this Standard, it is also important to consider the characteristics of task:

a) When airborne contaminant is irritant or corrosive to skin or eyes, or can be absorbed through skin, full facepiece should be selected, and other approprate personal protection equpmement should be provided. When other personal protection equipment is needed together with respirator, they should match to each other.
b) When there is a predicable emergency situation, escape-only respirators suitable for the nature of the emergency, or respirators complying with 4.2.3.1 of this Standard should be selected.
c) In the selection of respirators for use in atmospheres potentially explosive, considerations should be given to the selection of equipment complying with the requirements set in GB 3836.1、GB 3836.2 and GB 3836.4. The oxygen supplying SCBA should not be selected.
d) When contemplating supplied air respirators, consideration should be given to the problems that may be presented by the air-hose or airline which limiting the distance between the task and a source of respirable air. In addition, such air-hoses or airlines may be a source of danger to others working in the area and may them be damaged or severed through accident. Possible preventive measures should be considered and provided.
e) In high-temperature, low-temperature or high-humidity environments, or where organic solvent or other corrosive substances exist in the workplace, the respirators specially designed for that kind of situations are preferred.
f) When the work rate is high and respirator is supposed to be used for extended periods, consideration should be given to selection of respirator with lower breathing resistance, e.g. supplied air or powered air-purifying respirators.
g) When there is a need of clear vision, considerations should be given to selecting a facepiece with better visual field.
h) When precise communication is important, considerations should be given to selecting a facepiece with appropriate speech transmission facilities.

4.4 Select respirators considering user's characteristics

4.4.1 Facial characteristics

When half facepiece or full facepiece is contemplated, additional attentions should be paid to:

a) the fit between user's face and face seal of the respirator. If the manufacturer or distributor of the respirator may provid fit test to the users, it is helpful to the selection of fitted facepiece. Available fit test methods refer to Appendix E.
b) facial hair that potentially cause leakage between face and facial seal of respirator. The male users should have daily shave and facial hair should be prevented to come between face and facial seal.
c) facial characteristics, such scars, hollow temples, very prominent cheekbones, deep skin creases, a misshapen nose, etc. that may cause facepiece sealing problems. Facepiece which do not depend on facial seal are preferred.

4.4.2 Comfort

The effects of the working environment upon the user should be investigated to determin whether the respirator wearer will be subject to adverse effects from hazardous physical factors (such high-temperature), and to select suitable respirator design that may mitigate such hazards and increase comfort, for example, to select supplied air respirator having air cooling effect.

4.4.3 Wearing corrective lenses

When a respirator wearer must wear corrective lenses, it should be fitted to provide good version and should

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be worn in such a manner as not to interfere with the seal of the respirator. Manufactureres of respirator may provide kits for installing eyeglasses in their facepiece. These glasses of lenses should be mounted strictly in accordance with instructions to ensure proper fitting.

4.4.4 Some physical conditions that un-suitable for respirator using.

For wearers having cardiac and respiratory system disease history, or strict psychological stress to confined space and extra breathing burden, consultation should be made by industrial hygienst on their ability to use respirator.

Medical evaluation of wearer's ablility of using respirator refers to Appendix F.

5 Use of respirator

5.1 General requirements

5.1.1 The protective performance of any respirator has limitation, it is essential that users are adequately informed about these limitation.

5.1.2 Before using any respirator, the manufacturer's instruction should be read and understood by the user and kept followed in accordance.

5.1.3 The user of respirator should be trained of adequate use. For persons who working in or visitting an area where escape-only respirators are equipped, they should be trained for adequate use of escape-only respirator. The use of SCBA should be limited to those who have received specified training.

5.1.4 Before use of respirator, inspection should be performed for the intigrality of the respirator construction, the suitibility of the filter to the airborne contaminants involed , air flow rate of powered air-purifying respirator, air volume in the cylinder, etc. When there is mulfuction, the respirator should be repairied and can be used only after the mulfuction has been eliminated.

5.1.5 Before entering a hazardous atmosphere, the respirator should done first. In the case of tight-fitting facepiece is used, face-seal-check should be formored and face seal must be achieved. Face-seal-check methods see Appendix G.

5.1.6 A respirator must be worn whenever the person is exposed to the hazardous atmosphere.

5.1.7 Escape-only respirator alone can only be used for escaping from a hazadous atmosphere, not for entering.

5.1.8 Whenever experiences odor, cough, irritant, nausea or other bad feeling, the wearer must leave the hazardous atmosphere immediately. Inspection should be given to the function of the respirator. If no mulfuction exists, filter element should be replaced.

5.1.9 When the filter elements is parallel, e.g. dual cartridges respirator, the cartridges should be replaced at the same time.

5.1.10 When a new filter element expired in a short time, investigation should be made for its suitibility.

5.1.11 Excepting to those universal parts, it is not allowed to construct a respirator with parts from differenct manufacturers when no permission is abtained from the manufacturers.

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5.1.12 Medical evaluation should be provided to the wearers of respirator, and their ability of respirator using should be assessed. Medical assessment method refers to Appendix F.

5.2 Respirator use in IDLH atmosphere

5.2.1 When entering an oxygen deficient atmosphere, the use of respirator should comply with the requirements set in GB 8958.

5.2.2 For working in an IDLH atmosphere, when working area or space is allowed, it is suggested that at least two persons should enter at the same time equiping with life line. At least one assistant as suitabaly trained and equipped for entering should be standing by, in continuous inspection of the persons entered and keep effective communication with them.

5.3 Low-temperature environment

5.3.1 The lense of full facepiece should be treated for anti-fogging.

5.3.2 The respirable air or oxygen supplied by supplied air respirator or SCBA should be dry.

5.3.3 User of SCBA should be familiar with the operation instruction under low-temperature environment.

5.4 Filter replacement of air-purifying respirator

5.4.1 Filter replacement for particle respirator

The breathing resistance of the filter will progressively increase in use as it becomes choked with trapped particules and eventually becomes so high that the filter must be replaced. The time taken for this condition to develop will vary according to the characteristics of the filter, and the type, size and concentration of the particles. Normally, the filter should be repaced when:

a) the increased breathing resistance becomes evident for the self-inhalation air-purifying respirator;
b) in the case of electrical powered air-purifying respirator, it is ensured that the battery is properly charged and no defects are noted, the flow rate is below the manufacturer's specified minimu.
c) the increased filtering resistance becomes evident for mechanical powered air-purifying respirator.

5.4.2 Filter replacement of gas or vapor respirators

The service life of gas or vapor filter element will vary depending on the nature and concentraion of gas or vapor in the environment, the humidity, and the work rate of the wearer. The method to judge when filter elements should be replaced are as followed:

a) When the user experiences odor or irritant, the filter should be replaced at once.

Note: There is limitation of depending on wearer's sensitive to the odor or irritant of the airborn contaminants to detect the end of service time of gas or vapor filters (refers to Appendix C)。

b) For routine operation, it is suggested to replace the filter elements according to an time talbe of filter replacement established according to experiences, experiment data or other objective methods.
c) To note using period after each use will to help determing when the filter element should be replaced.
d) The service life of normal organic vapor filter element will be reduced when it is applied for the removing of low boiling point organic vapors. The filters should be replaced after each use. For other organic vapors, when the time period between two times use is longer than several days or several weeks, consideration should be give to replace the filters when reuse the respirator.

5.5 Use of supplied air respirator

5.5.1 The air quality of air sourse should be evaluated before use. The air should not be oxygen deficient, the concentraion of airborne contaminants can not over the current OELs or liable supplied air quality standard.

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5.5.2 The connecters of air-lines or air-hoses should not match to the other non-respirable air lines used in the same workplace.

5.5.3 Measures shall be taken to avoid interruption between supply-air respirator's air-line and other objects in the workplace, the air-line should not under compression and rolling.

6 Maintenance of respirator

6.1 Inspection and maintenance of respirator

6.1.1 Inspection and maintenance should only be carried out by a competent person in accordance with the manufacturer's instructions. When there is doubt, manufacturer should be consulted for instruction.

6.1.2 Inspection and servicing should be carried out periodicaly.

6.1.3 Immediately after use, used and partial used cylinders or other containers of compressed air or oxygen on SCBA should be replaced by fully charged cylinders, and the absorbents shall be renewed. It is prohibited to replace an air cylinder with an oxygen cylinder, and vice versa.

6.1.4 The air or oxygen cylinders should be periodicaly tested in acrredited testing organizations.

6.1.5 For the lubrication of high-pressure air or oxygen equipment, only special lubricants suitable can be used.

6.1.6 The respirator users shall not be allowed to re-fill sobents to canisters or cartridges. By any means the respirator users shall not be allowed to extent the service life of any expired filter elements .

6.2 Cleaning and disinfection

6.2.1 Respirators assigned as personal use shall be cleaned and disinfected regularly. For respirator not assigned for personal use, after each use, the facepiece shall be cleaned and disinfected.

6.2.2 It is prohibited to wash filter elements. For replacable filter, the filter elements should be removed before cleaning.

6.2.3 When cleaning the facepiece, disembling those parts that is suggested in the manufacturer's instruction, washing with neutrol detergent in warm water using a soft brush, thoroughly rinsing in clean water, and then have them air-dried in a clean place where direct sun-light should be avoided.

6.2.4 Disinfection may be achieved by using a broad-spectrum disinfectant. The choice of disinfectant should be made after enquiring of the respirator manufacturer and industrial hygenist. Such enquires should also assist where it is required to protection against the transmission of a specific pathogen. With all disinfectants, particular attention should be paid to the manufacturer's instructions regarding their use, e.g. dilution, temperature, exposure time.

6.3 Storage of respirator

6.3.1 Respirators should be kept clean and dry, and away from oil and exposure to direct sunlight and corrosive atmospheres.

6.3.2 When the use of respirators is infrequent, it is desirable to enclose facepieces to protect them from dust and corrosive atmospheres. Facepieces should be stored in such a way that they are not subject to distortion.

6.3.3 Gas or vapor filter elements should be stored in sealed containers.。

6.3.4 Respirators provided for emergency and rescue work should be at locations where they are readily available but adequately stored, secured and supervised, and unauthorized relocation is prevented.

7 Respiratory protection program

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7.1 General requirements

7.1.1 In any workplace where respirators are necessary to protect the health of the workers, the employer should establish and implement a written respiratory protection program. All the procedures of respirator selection, use, and maintenance should be incorperated into internal management systme and be recorded.

7.1.2 An individual at the administrative level shall be assigned as responsible for the respiratory protection program. He or she shall have been trained and qualified to the responsibility, and have suitable authority and resources to performe the programe.

7.1.3 The programe should be updated when there is a change in the workplace which could possiblly affect the use of respirator.

7.1.4 The effectiveness of respiratory protection program should be evaluated periodicaly. Adjustment, as appropriate, should be made to reflect the evaluation result. The evaluation methods refer to Appendix H.

7.2 Content of respiratory protection program

A respiratory protection program should include:

a) The name of the person assigned to responsible for the program, his or her authority and responsibility; the liability of other internal related departments.
b) Procedures of respirator selection in accordance to this Standard.
c) The basis for selecting a specific type of respirator.
d) Provisions for determining whether respirator user is physically and psychologically suitable for respirator using, which may include fit test, medical evaluation, etc.
e) Provisions for issuing respirators to users for routine, rescue and emergency use.
f) Provisions for periodic inspection, servicing, cleaning and disinfection, storage and dispose of respirators.
g) A respirator users training program that complies with the requirements set in 7.3 of this Standard.
h) A periodic evaluation by the administrator of the program to assure its continued functioning and effectiveness.

7.3 Information provided in the respiratory protection training

The information provided in the respiratory protection training should cover:

a) Nature and hazard level of the hazardous atmosphere. Nature and toxicity of airborne contaminant(s).
b) Engineering control measures provided in the workplace and its effect.
c) The necessity that respiratory protection is needed.
d) The applicable legal requirements related to respirator use.
e) Reasons that a certain type of respirators are selected with specific functions.
f) Functionality, use method and limitation of the selected respirator.
g) The importance of fit of tight-fitting facepiece and fit-test method.
h) How to assess when the filter should be replaced and the replace method.
i) How to carry out routine respirator maintain, inspection and storage.
j) How to response to emergency and how to use escape-only respirator.

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Annex A

（Informative）

Elements which should be considered in a risk assessment

See Figure A.1 for elements that should be considered in a risk assessment.

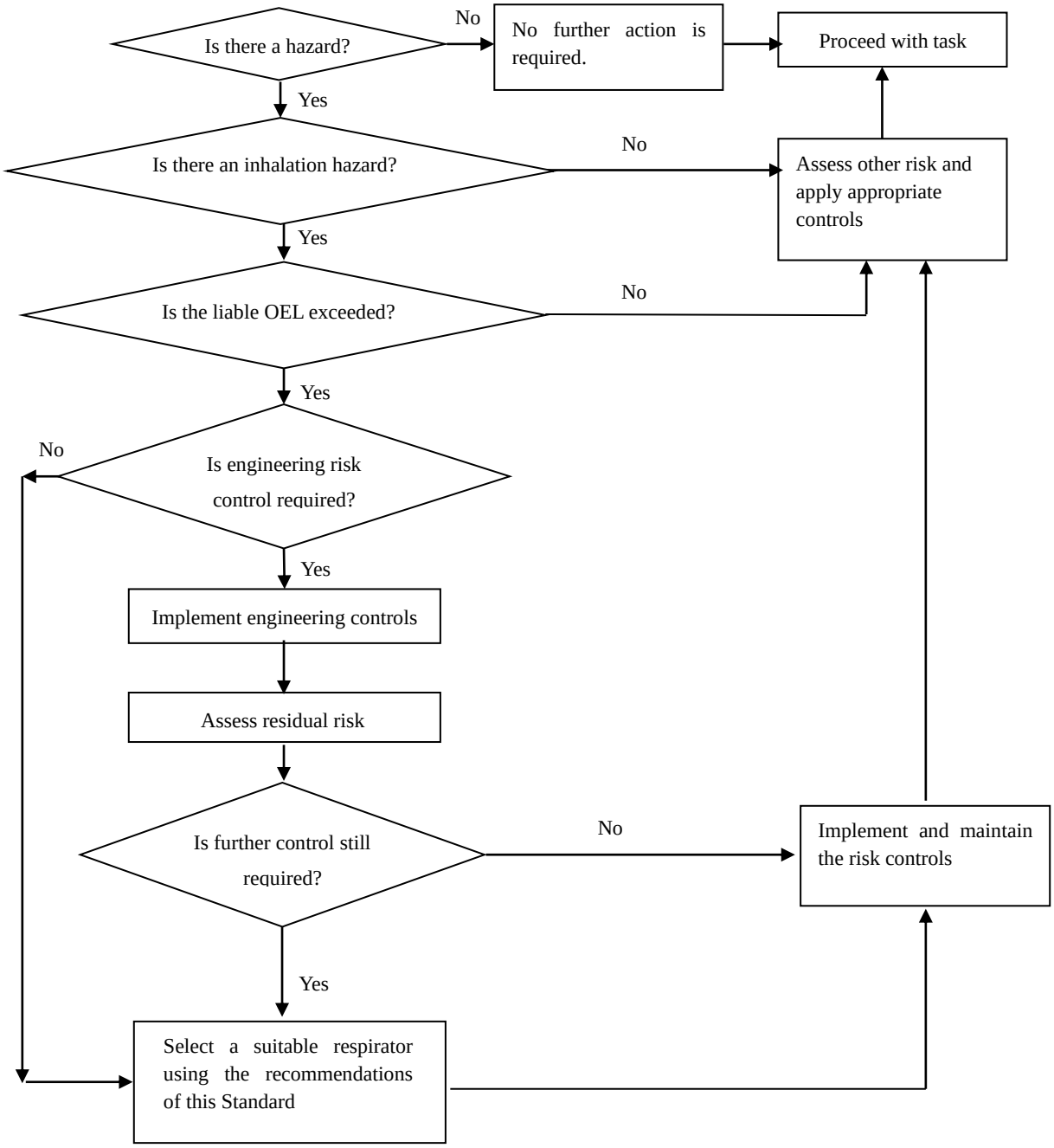

Figure A.1 Elements to be considered in risk assessment

Annex B

（Normative）

IDLH concentrations

IDLH concentrations provided in this Annex are taken from NIOSH DHHS Publication No.90-117, see Table B.1.

Table B.1 IDLH concentrations

Ser.	Name of contaminant in Chinese	Name of contaminant in English	IDLH[a] ppm	Unit conversion ratio from ppm into mg/m^3 [b] （20℃）	IDLH[c] mg/m^3 （20℃）
1	乙醛	acetaldehyde, acetic aldehyde	10 000	1.83	18 000
2	乙酸，醋酸	acetic acid	1 000	2.50	2 500
3	乙酸酐,醋酸酐	acetic anhydride	1 000	4.24	4 200
4	丙酮，阿西通	acetone	20 000	2.42	48 000
5	乙腈，甲基氰	acetonitrile, methyl cyanide	4 000	1.71	6 800
6	四溴乙烷	Acetylene tetrabromide, tetra-bromoethane	10	14.37	140
7	丙烯醛	acrolein, allyl aldehyde	5	2.33	10
8	丙烯腈，乙烯基腈	acrylonitrile, vinyl cyanide	500	2.21	1 100
9	艾氏剂	aldrin			100
10	烯丙醇	allyl alcohol	150	2.42	360
11	烯丙基氯	allyl chloride	300	3.18	950
12	缩水甘油烯丙醚	allyl glycidyl ether	270	4.75	1 300
13	2-氨基吡啶	2-aminopyridine	5	3.91	20
14	氨	ammonia	500	0.71	360
15	硫酸铵	ammonium sulfamate			5 000
16	乙酸戊酯	n-Amyl acetate	4 000	5.41	22 000
17	乙酸仲戊酯	sec-amyl acetate	9 000	5.41	49 000
18	苯胺	aminobenzene	100	3.87	390
19	茴香胺(所有异构体)	Anisidine (all isomers)			50
20	锑及其化合物	antimony & its compounds (as Sb)			80
21	安妥	ANTU, alpha-naphthyl thiocarbamide			100
22	砷(无机化合物，除砷化三氢)	arsenic (elemental & inorganic compounds (except arsine) as As)			100
23	砷化三氢，胂烷	arsine	6	3.24	20
24	甲基谷硫磷，益棉磷	azinphos-methyl			20
25	钡（可溶化合物）	barium (soluble compounds, as Ba)			1 100
26	苯	benzene	3 000	3.25	9 800

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Table B.1 (Continued)

Ser.	Name of contaminant in Chinese	Name of contaminant in English	IDLH[a] ppm	Unit conversion ratio from ppm into mg/m^3 [b] (20℃)	IDLH[c] mg/m^3 (20℃)
27	过氧化(二)苯甲酰	benzoyl peroxide			7 000
28	氯化苄	benzyl chloride	10	5.26	53
29	铍及其化合物	beryllium & its compounds (as Be)			10
30	三氟化硼	boron trifluoride	100	2.82	280
31	溴	Bromine	10	6.64	66
32	1,3-丁二烯,联乙烯	1,3-Butadiene	20 000	2.25	45 000
33	2-丁酮,甲基乙基酮	2-butanone, methyl ethyl ketone	3 000	3.00	9 000
34	2-丁氧基乙醇	2-Butoxyethanol	700	4.91	3 400
35	乙酸丁酯(所有异构体)	butyl acetate(all isomers)	10 000	4.83	48 000
36	丁醇	n-butyl alcohol, 1-butanol	8 000	3.08	25 000
37	2-丁醇,仲丁醇	2-butyl alcohol, sec-butyl alcohol	10 000	3.08	31 000
38	叔丁醇	tert-butyl alcohol, trimethyl carbinol	8 000	3.08	25 000
39	丁胺,1-氨基丁烷	butylamine, 1-aminobutane	2 000	3.04	6 100
40	叔丁基铬酸酯	tert-butyl chromate			30
41	缩水甘油丁醚	n-butyl glycidyl ether	3 500	5.41	19 000
42	正丁硫醇	butyl mercaptan, n-butanethiol	2 500	3.75	9 400
43	对位叔丁基甲苯	p-tert-Butyltoluene	1 000	6.16	6 200
44	镉 粉尘/烟	cadmium, elemental & compounds (as Cd)			50(尘) 9(烟)
45	砷酸钙	calcium arsenate (as As)			100
46	樟脑(人造)	camphor(synthetic), 2-camphanone			200
47	西维因	carbaryl (Sevin™)			600
48	二氧化碳	carbon dioxide	50 000	1.83	92 000
49	二硫化碳	carbon disulfide	500	3.16	1 600
50	一氧化碳	carbon monoxide	1 500	1.16	1 700
51	四氯化碳	carbon tetrachloride, tetrachloromethane	300	6.39	1 900
52	氯丹	Chlordane			500
53	氯化莰烯	Chlorinated camphene			200
54	氯	Chlorine	30	2.95	88
55	二氧化氯	chlorine dioxide	10	2.81	28
56	三氟化氯	chlorine trifluoride	20	3.85	77
57	氯乙醛	chloroacetaldehyde	100	3.26	330

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Table B.1 (Continued)

Ser.	Name of contaminant in Chinese	Name of contaminant in English	IDLH[a] ppm	Unit conversion ratio from ppm into mg/m^3 [b] (20℃)	IDLH[c] mg/m^3 (20℃)
58	氯乙酰苯，催泪剂	α－chloroacetophenone			100
59	氯苯	chlorobenzene, monochlorobenzene	2 400	4.68	11 000
60	邻氯苄亚甲基丙二腈	o-chlorobenzylidene malononitrile			2
61	氯溴甲烷	chlorobromomethane	5 000	5.38	27 000
62	氯二苯(42%氯)	chlorodiphenyl (42% chlorine)			10
63	氯二苯(54%氯)	chlorodiphenyl (54% chlorine)			5
64	三氯甲烷，氯仿	chloroform, trichloromethane	1 000	4.96	5 000
65	1-氯-1-硝基丙烷	1-chloro-1-nitropropane	2 000	5.14	10 000
66	硝基三氯代甲烷，氯化苦	chloropicrin, nitrotrichloromethane	4	6.83	30
67	2-氯代-1,3-丁二烯	β－chloroprene	400	3.68	1 500
68	铬酸和铬酸盐	chromic acid and chromates (as CrO_3)			30
69	煤焦油沥青挥发物	coal tar pitch volatiles (as benzene soluble fraction)			700
70	钴金属，尘和烟	Cobalt metal, dust, and fume (as Co)			20
71	除莠剂	Crag™ herbicide, sesone			5 000
72	甲酚	cresol (all isomers)	250	4.50	1 100
73	巴豆醛	crotonaldehyde	400	2.91	1 200
74	异丙苯	cumene, isopropyl benzene,	8 000	5.00	40 000
75	氰化物	cyanides (as CN)			50
76	环己烷	cyclohexane, hexahydrobenzene	10 000	3.50	35 000
77	环己醇	cyclohexanol	3 500	4.17	14 000
78	环己酮	cyclohexanone	5 000	4.08	20 000
79	环己烯	cyclohexene, tetrahydrobenzene	10 000	3.42	34 000
80	1,3-环戊二烯	1,3-cyclopentadiene	2 000	2.75	5 500
81	2,4-二氯苯氧基乙酸	2,4-dichlorophenoxyacetic acid			500
82	十硼烷,十硼氢	decaborane			100
83	内吸磷	demetone			20
84	二丙酮醇	diacetone alcohol	2 100	4.83	10 000
85	重氮甲烷	diazomethane	2	1.75	4

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Table B.1 (continued)

Ser.	Name of Contaminant in Chinese	Name of contaminant in English	IDLH[a] ppm	Unit conversion ratio from ppm into mg/m^3 [b] (20℃)	IDLH[c] mg/m^3 (20℃)
86	乙硼烷,硼烷	diborane, boroethane	40	1.15	46
87	二丁基磷酸酯	Dibutyl phosphate	125	8.47	1 000
88	邻苯二甲酸二丁酯	dibutylphthalate, DBP			9 300
89	1,1-二氯-1-硝基乙烷	1,1-dichloro-1-nitroethane	150	5.98	900
90	1,2-二氯苯	1,2-dichlorobenzene, o-dichlorobenzene	1 000	6.11	6 100
91	1,4-二氯苯	1,4-dichlorobenzene, p-dichlorobenzene	1 000	6.11	6 100
92	二氯二氟甲烷, 氟里昂 12	dichlorodifluoromethane, Freon™ 12	50 000	5.03	250 000
93	1,1-二氯乙烷	1,1-dichloroethane, ethylidene chloride	4 000	4.12	16 000
94	1,2-二氯乙烯(顺式)	1,2-dichloroethylene	4 000	4.03	16 000
95	二氯乙醚	dichloroethyl ether, bis-(2-chloroethyl) ether	250	5.94	1 500
96	一氟二氯甲烷, 氟里昂 21	dichloromonofluoromethane, Freon™ 21	50 000	4.28	210 000
97	1,1-二氯-1-硝基甲烷	1,1-dichloro-1-nitroethane	150	5.98	900
98	二氯四氟乙烷	dichlorotetrafluoroethane, Freon™ 114	50 000	7.10	360 000
99	敌敌畏	dichlorvos, DDVP			200
100	狄氏剂	Dieldrin			450
101	二乙胺	diethylamine	2 000	3.04	6 100
102	2-二乙基乙醇胺	2-diethylaminoethanol	500	4.87	2 400
103	氟里昂 12B2	difluorodibromomethane, Freon™ 12B2	2 500	8.72	22 000
104	二缩水甘油醚	diglycidyl ether	25	5.41	140
105	二异丁基甲酮	diisobutyl ketone	2 000	5.92	12 000
106	二异丙胺	diisopropylamine	1 000	4.21	4 200
107	二甲基乙酰胺	dimethyl acetamide	400	3.62	1 400
108	二甲胺(无水)	dimethylamine	2 000	1.87	3 700
109	二甲基苯胺	dimethylaniline	100	5.04	500
110	磷酸二甲基-1,2-二溴-2,2-二氯乙酯	dimethyl-1,2-dibromo-2,2-dichlorethyl phosphate			1 800
111	二甲基甲酰胺	dimethylformamide	3 500	3.04	11 000
112	1,1-二甲肼	1,1-dimethylhydrazine	50	2.50	120
113	邻苯二甲酸二甲酯	dimethylphthalate			9 300

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Table B.1 (Continued)

Ser.	Name of contaminant in Chinese	Name of contaminant in English	IDLH[a] ppm	Unit conversion ratio from ppm into mg/m^3 [b] (20℃)	IDLH[c] mg/m^3 (20℃)
114	硫酸甲酯	dimethyl sulfate	10	5.24	52
115	二硝基苯(所有异构体)	Dinitrobenzene(all isomers)			200
116	邻二硝基甲酚	dinitro-o-cresol			5
117	二硝基甲苯	dinitrotoluene			200
118	二氧杂环己烷	dioxane	2 000	3.66	7 300
119	联苯	diphenyl			300
120	异狄氏剂	endrin			2 000
121	表氯醇	epichlorohydrin	250	3.85	960
122	苯硫磷	EPN, o-ethyl o-p-nitrophenyl benzenephosphonothioate			50
123	乙醇胺	ethanolamine	1 000	2.54	2 500
124	乙二醇甲醚	2-ethoxyethanol, ethylene glycol monoethyl ether	6 000	3.75	22 000
125	乙酸乙二醇甲醚	2-ethoxyethly acetate, ethylene glycol monoethyl ether acetate, Cellosove™ acetate	2 500	5.49	14 000
126	乙酸乙酯	ethyl acetate, acetic ester	10 000	3.66	37 000
127	丙烯酸乙酯	ethyl acrylate	2 000	4.16	8 300
128	乙胺	ethylamine, aminoethane	4 000	1.87	7 500
129	乙苯	ethyl benzene	2 000	4.41	8 800
130	溴乙烷	ethyl bromide	3 500	4.53	16 000
131	3-庚酮,乙基正丁基甲酮	ethyl butyl ketone, 3-heptanone,	3 000	4.75	14 000
132	氯乙烷	ethyl chloride	20 000	2.68	54 000
133	乙烯氯乙醇	ethylene chlorohydrin	10	3.35	34
134	乙二胺	ethylenediamine, 1,2-diaminoethane	2 000	2.50	5 000
135	二溴化乙烯	ethylene dibromide	400	7.81	3 100
136	1,2-二氯化乙烯	ethylene dichloride, 1,2-dichloroethane	1 000	4.11	4 100
137	乙二醇二硝酸酯	ethylene glycol dinitrate EGDN			500
138	吖丙啶,氮丙环	ethyleneimine	100	1.79	180
139	环氧乙烷,乙撑氧	ethylene oxide	800	1.83	1 500
140	乙醚	ethyl ether	19 000	3.08	58 000
141	甲酸乙酯	ethyl formate	8 000	3.08	25 000

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Table B.1 (Continued)

Ser.	Name of contaminant in Chinese	Name of contaminant in English	IDLH[a] ppm	Unit conversion ratio from ppm into mg/m^3[b] (20℃)	IDLH[c] mg/m^3 (20℃)
142	乙硫醇	ethyl mercaptan, thanethiol	2 500	2.58	6 400
143	N-乙基吗啉	N-ethylmorpholine	2 000	4.79	9 600
144	正硅酸乙酯	ethyl silicate	1 000	8.66	8 700
145	氟化物	fluorides (as F)			500
146	氟	fluorine	25	1.58	40
147	三氯氟甲烷，氟里昂 11	Fluorotrichloromethane, Freon™ 11	10 000	5.71	57 000
148	甲醛	formaldehyde	30	1.23	37
149	甲酸	formic acid	30	1.91	57
150	呋喃甲醛，糠醛	Furfural, 2-furaldehyde	250	3.99	1 000
151	糠醇	furfuryl alcohol	250	4.08	1 000
152	缩水甘油	glycidol	500	3.08	1 500
153	七氯	heptachlor			700
154	正庚烷	n-heptane	5 000	4.17	21 000
155	六氯乙烷	hexachloroethane	300	10.0	3 000
156	六氯萘	hexachloronaphthalene			2
157	己烷	n-hexane	5 000	3.58	18 000
158	2-己酮	2-hexanone	5 000	4.17	21 000
159	异己酮	hexone	3 000	4.17	12 000
160	2-醋酸己酯	sec-hexyl acetate	4 000	5.99	24 000
161	无水肼	hydrazine (anhydrous)	80	1.33	110
162	氢溴酸，溴化氢	hydrogen bromide, hydrobromic acid	50	3.36	170
163	盐酸,氯化氢	hydrogen chloride, hydrochloric acid	100	1.52	150
164	氢氰酸，氰化氢	hydrogen cyanide, hydrocyanic acid	50	1.12	56
165	氢氟酸，氟化氢	hydrogen fluoride, hydrofluoric acid	30	0.83	25
166	过氧化氢	hydrogen peroxide	75	1.41	100
167	硒化氢	hydrogen selenide	2	3.37	7
168	硫化氢	hydrogen sulfide	300	1.42	430
169	碘	iodine	10	10.00	100
170	乙酸异戊酯	isoamyl acetate, banana oil	3 000	5.41	16 000
171	异戊醇	isoamyl alcohol, 3-methyl-1-butanol	10 000	3.67	37 000
172	乙酸异丁酯	isobutyl acetate	7 500	4.83	36 000

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Table B.1 (Continued)

Ser.	Name of contaminant in Chinese	Name of contaminant in English	IDLH[a] ppm	Unit conversion ratio from ppm into mg/m^3 [b] (20℃)	IDLH[c] mg/m^3 (20℃)
173	异丁醇	isobutyl alcohol, 2-methyl -1-propanol	8 000	3.08	25 000
174	异佛尔酮	Isophorone	800	5.74	4 600
175	乙酸异丙酯	isopropyl acetate	16 000	4.25	68 000
176	异丙醇	isopropyl alcohol	12 000	2.50	30 000
177	异丙胺	Isopropylamine	4 000	2.46	9 800
178	异丙醚	isopropyl ether, diisopropyl ether	10 000	4.25	42 000
179	缩水甘油异丙醚	isopropyl glycidyl ether	1 000	4.83	4 800
180	铅	lead, elemental & inorganic compounds (as Pb)			700
181	六氯化苯, 林丹	Lindane			1 000
182	氢化锂	lithium hydride			55
183	液化石油气	liquefied petroleum gas, LPG, compressed petroleum gas	19 000	1.80	34 000
184	马拉硫磷	Malathion			5 000
185	汞蒸气	mercury vapor			28
186	汞(有机金属的)烷基化合物(Hg)	mercury (organo) alkyl compounds (as Hg)			10
187	异亚丙基丙酮	mesityl oxide	5 000	4.08	20 000
188	乙酸甲酯	methyl acetate, acetic acid, methyl ester	10 000	3.08	31 000
189	丙炔,甲基乙炔	methyl acetylene	15 000	1.67	25 000
190	丙炔与丙二烯的混合物	methyl acetylene propadiene mixure	15 000	1.67	25 000
191	丙烯酸甲酯	methyl acrylate	1 000	3.58	3 600
192	甲缩醛	Methylal	15 000	3.16	47 000
193	甲醇	methyl alcohol, methanol	25 000	1.33	33 000
194	甲胺	methylamine	100	1.29	130
195	2-庚酮,甲基戊基甲酮	methyl (n-amyl) ketone, 2-heptanone,	4 000	4.75	19 000
196	溴甲烷, 甲基溴	methyl bromide	2 000	3.95	7 900
197	乙二醇甲醚	methyl cellosolve™, ethylene glycol monomethyl ether	2 000	3.16	6 300
198	乙酸乙二醇甲醚	methyl cellosolve™ acetate, ethylene glycol monomethyl ether acetate	4 000	4.91	20 000

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Table B.1 (Continued)

Ser.	Name of contaminant in Chinese	Name of contaminant in English	IDLH[a] ppm	Unit conversion ratio from ppm into mg/m^3 [b] (20℃)	IDLH[c] mg/m^3 (20℃)
199	氯甲烷，甲基氯	methyl chloride, chloromethane	10 000	2.10	21 000
200	三氯乙烷	methyl chloroform	1 000	5.55	5 600
201	甲基环己烷	methylcyclohexane	10 000	4.08	41 000
202	甲基环己醇	methylcyclohexanol	10 000	4.75	48 000
203	o-甲基环己酮	o-methylcyclohexanone	2 500	4.66	12 000
204	异氰酸二苯甲酯	methylene bisphenyl isocyanate			100
205	二氯甲烷	methylene chloride, dichloromethane	5 000	3.53	18 000
206	甲酸甲酯	methyl formate	5 000	2.50	12 000
207	乙基戊基甲酮	5-Methyl-3-heptanone, ethyl amyl ketone	3 000	5.33	16 000
208	甲基肼	methyl hydrazine	50	1.92	96
209	碘甲烷	methyl iodide	800	5.90	4 700
210	甲基异丁基甲醇	methyl isobutyl carbinol	2 000	4.25	8 500
211	甲基异氰酸酯	methyl isocyanate	20	2.37	47
212	甲硫醇	methyl mercaptan	400	2.00	800
213	异丁烯烯酸甲酯	methyl methacrylate	4 000	4.16	17 000
214	甲基苯乙烯	α-methyl styrene	5 000	4.91	24 000
215	甲基苯胺	monomethyl aniline, methyl aniline, MA	100	4.46	450
216	吗啉	morpholine	8 000	3.62	29 000
217	石脑油(煤焦油)	naphtha (coal tar)	10 000	4.57	46 000
218	萘	naphthalene	500	5.00	2 500
219	羰基镍	nickel carbonyl (as Ni)	7	7.10	50
220	尼古丁	nicotine			35
221	硝酸	nitric acid	100	2.62	260
222	一氧化氮	nitric oxide, nitrogen monoxide	100	1.25	120
223	对硝基苯胺,4-硝基苯胺	p-nitroaniline, 4-nitroaniline			300
224	硝基苯，密斑油	nitrobenzene, oil of mirbane	200	5.12	1 000
225	4-硝基氯苯	p-nitrochlorobenzene,p-chloronitrobenzene			1 000
226	硝基乙烷	nitroethane	1 000	3.12	3 100

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Table B.1 (Continued)

Ser.	Name of contaminant in Chinese	Name of contaminant in English	IDLH[a] ppm	Unit conversion ratio from ppm into mg/m^3[b] (20℃)	IDLH[c] mg/m^3 (20℃)
227	二氧化氮	nitrogen dioxide, dinitrogen tetroxide	50	1.91	96
228	三氟化氮	nitrogen trifluoride	2 000	2.95	5 900
229	硝化甘油	nitroglycerine, glyceryl trinitrate			500
230	硝基甲烷	nitromethane	1 000	2.54	2 500
231	硝基丙烷(所有异构体)	Nitropropane (all isomers)	2 300	3.70	8 500
232	硝基甲苯(所有异构体)	Nitrotoluene (all isomers)	200	5.70	1 100
233	辛烷	octane	5 000	4.75	24 000
234	四氧化锇	osmium tetroxide (as Os)			1
235	草酸	oxalic acid			500
236	二氟化氧	oxygen difluoride	0.5	2.24	1
237	臭氧	ozone	10	2.00	20
238	百草枯	paraquat			1.5
239	硫磷	parathion			20
240	五硼烷	pentaborane	3	2.62	8
241	五氯苯酚	pentachlorophenol			150
242	n-戊烷	n-pentane	15 000	3.00	45 000
243	2-戊酮	2-pentanone, methyl propyl ketone	5 000	3.58	18 000
244	全氯甲硫醇	perchloromethyl mercaptan	10	7.73	77
245	氟化高氯氧	perchloryl fluoride	385	4.26	1 600
246	汽油馏分(石脑油)	Petroleum distillates (naphtha)	10 000	4.11	41 000
247	苯酚	phenol, carbolic acid	250	3.80	950
248	苯肼,苯基联胺	phenylhydrazine, hydrazionbenzene	295	4.49	1 300
249	速灭磷	Phosdrin™	4	9.32	40
250	光气	Phosgene, carbonyl chloride	2	4.11	8
251	磷化氢,磷烷	Phosphine, hydrogen phosphide,	200	1.41	280
252	磷酸	phosphoric acid			10 000
253	五氯化磷	phosphorus pentachloride			200
254	五硫化二磷	phosphorus pentasulfide			750

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Table B.1 (Continued)

Ser.	Name of contaminant in Chinese	Name of contaminant in Englsih	IDLH[a] ppm	Unit conversion ratio from ppm into mg/m^3 [b] (20℃)	IDLH[c] mg/m^3 (20℃)
255	三氯化磷	phosphorus trichloride	50	5.71	280
256	邻苯二甲酸酐	phthalic anhydride			10 000
257	苦味酸	picric acid			100
258	杀鼠酮，鼠完	pindone			200
259	丙烷	propane	20 000	1.83	37 000
260	乙酸丙酯	n-propyl acetate, acetic acid, n-propyl ester	8 000	4.25	34 000
261	1-丙醇,正丙醇	n-propyl alcohol, 1-propanol	4 000	2.50	10 000
262	二氯丙烯	propylene dichloride	2 000	4.70	9 400
263	丙烯亚胺	propylene imine	500	2.37	1 200
264	环氧丙烷	propylene oxide	2 000	2.42	4 800
265	硝酸丙酯	n-propyl nitrate	2 000	4.37	8 700
266	除虫菊	pyrethrum			5 000
267	吡啶	pyridine	3 600	3.29	12 000
268	对苯醌	quinone			300
269	皮蝇磷	ronnel			5 000
270	六氟化硒	selenium hexafluoride (as Se)	5	8.02	40
271	氟代乙酸钠	sodium fluoroacetate			5
272	氢氧化钠	sodium hydroxide, caustic soda			250
273	锑化氢	stibine	40	5.19	210
274	干洗溶剂汽油	stoddard solvent			29 500
275	马钱子碱，士的宁	strychnine			3
276	苯乙烯	styrene	5 000	4.33	22 000
277	二氧化硫	sulfur dioxide	100	2.66	270
278	硫酸	sulfuric acid			80
279	一氯化硫	sulfur monochloride	10	5.61	56
280	五氟化硫	sulfur pentafluoride	1	10.56	10
281	磺酰氯	sulfuryl fluoride	1 000	4.24	4 200
282	四乙基二硫代焦磷酸酯，二硫代焦磷酸四乙酯	TEDP, tetraethyl dithionopyrophosphate			35
283	六氟化碲	tellurium hexafluoride (as Te)	1	10.04	10
284	特普,四乙基焦磷酸酯	TEPP, tetraethyl pyrophosphate			10
285	氟里昂 112	1,1,2,2-tetrachloro-1,2-difluoroethane, Freon™ 112	15 000	8.47	130 000

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Table B.1 (Continued)

Ser.	Name of contaminant in Chinese	Name of contaminant in English	IDLH[a] ppm	Unit conversion ratio from ppm into mg/m^3 [b] (20℃)	IDLH[c] mg/m^3 (20℃)
286	氟里昂 112a	1,1,2,2-tetrachloro-2,2-difluoroethane, Freon™ 112a	15 000	8.47	130 000
287	1,1,2,2-四氯乙烷	1,1,2,2-tetrachloroethane, acetylene tetrachloride	150	7.00	1 000
288	四氯乙烯	tetrachloroethene	500	6.89	3 400
289	四乙基铅	tetraethyl lead (as Pb)			40
290	四氢呋喃	tetrahydrofuran	20 000	3.00	60 000
291	四甲基铅	tetramethyl lead as Pb			40
292	四甲基琥珀腈	tetramethyl succinonitrile	5	6.00	30
293	四硝基甲烷	tetranitromethane	5	8.15	40
294	铊(可溶化合物,Tl)	Thallium (soluble compounds, as Tl)			20
295	二硫四甲秋兰姆	thiram			1 500
296	锡	Tin (inorganic compounds except oxides,as Sn)			400
297	甲苯	Toluene, methyl benzene,	2 000	3.83	7 700
298	2,4-二异氰酸甲苯酯	toluene-2,4- diisocyanate	10	7.24	72
299	2-甲苯胺	o-toluidine, 2-toluidine	100	4.46	450
300	磷酸三丁酯	tributyl phosphate	125	11.07	1 400
301	1,1,2-三氯乙烷	1,1,2-trichloroethane	500	5.55	2 800
302	三氯乙烯	trichloroethylene	1 000	5.46	5 500
303	1,2,3-三氯丙烷	1,2,3-trichloropropane	1 000	6.13	6 100
304	氟里昂 113	1,1,2-trichloro-1,2,2-trifluoroethane, Freon™ 113	4 500	7.79	35 000
305	三乙胺	triethylamine, N,N-diethylethamine	1 000	4.21	4 200
306	三氟溴甲烷	trifluorobromomethane	50 000	6.19	310 000
307	三甲苯磷酸甲酯	triorthocresyl phosphate, TCP, TOCP			40
308	松节油	turpentine	1 500	5.65	8 500
309	铀(不可溶化合物,U)	uranium (insoluble compounds, as U)			30
310	铀(可溶化合物,U)	uranium (soluble compounds, as U)			20

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Table B.1 (Continued)

Ser.	Name of contaminant in Chinese	Name of contaminant in English	IDLH[a] ppm	Unit conversion ratio from ppm into mg/m^3 [b] (20℃)	IDLH[c] mg/m^3 (20℃)
311	五氧化二钒(呼吸性粉尘或烟)	vanadium pentoxide(respirable dust or fume,as V_2O_5)			70
312	乙烯基甲苯	vinyl toluene	5 000	4.91	24 000
313	丙酮苄羟基香豆素,杀鼠灵	warfarin			350
314	二甲苯(所有异构体)	Xylene(all isomers)	1 000	4.41	4 400
315	二甲代苯胺	xylidine	150	5.04	760
316	氯化锌烟	zinc chloride fume			4 800
317	锆化合物 (Zr)	zirconium compounds (as Zr)			500

a. The units of gaseous and liquid contaminants' IDLH concentration in NIOSH DHHS publication No.90-117 IDLH are in ppm.

b. For gaseous or liquid contaminant IDLH concentrations taken from NIOSH DHHS Publication No.90-117, a conversion ratio from ppm into mg/m^3 is generated under a condition of 20℃ and one atmospheric pressure.

c. IDLH concentration in mg/m^3 after unit conversion.

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Appendix C

（Informative）

Warning give by the airborne contaminants

C.1 Limitations of odors as a warning of end of filter service life

The limitations of odors as a warning of end of filter service life:

a) There is considerable variation between individuals, with some persons being unable to detect contaminants by smell, e.g. hydrogen cyanide has a characteristic almond odor that is not detectable by some people.
b) The smell in an individual may be considerably diminished temporarily by a cold in the nose or other inflammatory conditions of the nasal passages.
c) The odor of a contaminant may be masked by other smells.
d) The smell fails to detect high concentrations of many contaminants if such concentrations have been built up gradually, e.g. hydrogen sulfide. A person working in a situation where a dangerous concentration of a contaminant has developed slowly may not detect any odor; yet a person entering the situation from outside could be aware of a very strong odor.
e) The threshold of odor for some substances exceeds the level at which such substances may be considered hazardous. Thus, by the time the contaminant can be smelt, the user may already have been exposed to a hazardous situation.
f) Some gases have no odor and therefore are not detectable by this means.
g) Some gases have very objectionable odors at very low concentrations but do not represent a health hazard at these concentrations.

C.2 Limitations of irritant action as a warning of end of filter service life

Some contaminants, because of their local irritant action on the upper respiratory tract or eyes, will give an early indication if present in harmful amounts. The warning sensation experienced, although perhaps centered in the nose, is not a smell, but a discomfort, a feeling of burning of irritation. But with some contaminants, the warning may be insufficient to protect a person who is willing to endure considerable discomfort.

C.3 Threshold of odor of some airborne contaminants

Odor threshold values are provided in some reference manuals. For the same substance odor threshold values from different current sources can vary over several oders of magnitude possibly due to the differences in measurement methods and human olfactory response.

Note: The odor threshold values of some of the most popular airborne contaminants can refer to references [18] and [19].

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Appendix D
（Informative）
Respiratory selection examples

D.1 Example 1

D.1.1 Job description

A painter carrying out brush painting and exposed to turpentine.

D1.2 Hazardous atmosphere identification and evaluation

The oxygen content in the atmosphere is normal. The painter exposed to 2 150 mg/m^3 turpentine. The OEL of turpentine is 300 mg/m^3, its IDLH concentration of turpentine is 8 500 mg/m^3. Turpentine is an irritant and has good warning properties. Its odor threshold is 280 mg/m^3 to 1 130 mg/m^3. Its boiling point is 150 ℃ to 170 ℃, it is not a low boiling point organic compound.

D.1.3 Hazard level determination

The oxygen is efficient. Turpentine exposure concentration is below IDLH concentration. It is a non-IDLH atmosphere.

The concentration of turpentine is over the applicable OLE, the hazard factor is:

$$\text{Hazard factor} = \frac{\text{Turpentine concentration}}{\text{OLE}} = \frac{2\ 150\ \text{mg/m}^3}{300\ \text{mg/m}^3} \approx 7$$

D.1.4 Respirator selection according to hazard level and the form of the contaminant

Since the hazard factor is lower than 10, and turpentine has good warning properties, a self-inhalation air-purifying of half face respirator is recommended in the Table 3. Since turpentine is an irritant, a full facepiece should be selected instead.

As turpentine is an organic vapor, certified organic vapor cartridges can be used. The duration of cartridge use may depend on the service life information provided by the manufacturer, the warning property of turpentine may help wearer to determine when to replace the cartridges, too.

$$\text{Predicted exposure concentration} = \frac{\text{Turpentine concentration}}{\text{APF of respirator selected}} = \frac{2\ 150\ \text{mg/m}^3}{100} = 21.5\ \text{mg/m}^3$$

If the half facepiece fits the painter, the predicted exposure concentration will be 21.5 mg/m^3. It is lower than the OEL.

D.2 Example 2

D.2.1 Job description

A worker is painting in a storage tank (4 m in diameter with a height of 2 m) without forced ventilation. The duration of the operation is estimated to be one hour. Xylene is used as the paint solvent. The temperature inside the tank is 20 ℃.

D.2.2 Hazardous atmosphere identification and evaluation

The oxygen concentration in the tank is normal. The applicable OEL of Xylene is 100 mg/m^3, its IDLH concentration is 4 400 mg/m^3 and it produces irritation to eyes and nose at around 880 mg/m^3.

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The space of the tank is small and poorly ventilated, in which the concentration of Xylene may increase quickly. The vapor pressure of Xylene is 9 mmHg at 20 ℃, and the possible saturation vapor concentration may reach as high as 53 000 mg/m^3, exceeding IDLH concentration.

D.2.3 Hazard level determination

There is no oxygen deficiency and Xylene concentration exceeded IDLH concentration. It is an IDLH atmosphere.

D.2.4 Respirator selection according to hazard level and the form of the air contaminant

Since Xylene is an irritant, eye protection is required. Accordance to Table 3, a full facepiece positive pressure SCBA with at least one hour service life is recommended. Since air-hose will not interfere with the work activities in such a tank, a full facepiece positive pressure supplied air respirator with escape SCBA or an escape type air-purifying respirator suitable to the Xylene and its concentration level is also suitable.

$$\text{Predicted exposure concentration} = \frac{\text{xylene concentration}}{\text{APF of respirator selected}} = \frac{53\ 000\ \text{mg/m}^3}{1\ 000} = 53\ \text{mg/m}^3$$

If the full facepiece fits the worker, the worker's predicted exposure concentration is 53 mg/m^3, lower than OEL.

D.3 Example 3

D.3.1 Job description

Workers in a lead acid battery factory are exposed to 0.2 mg/m^3 of lead in the form of oxide dust.

D.3.2 Hazardous atmosphere identification and evaluation

The oxygen concentration in the workplace is normal. The OEL of lead dust is 0.05 mg/m^3. Its IDLH concentration is 700 mg/m^3.

D.3.3 Hazard level determination

There is no oxygen deficiency. The lead dust concentration is lower than IDLH concentration, but has exceeded OEL. The hazard factor is:

$$\text{Hazard factor} = \frac{\text{Lead dust concentration}}{\text{OLE}} = \frac{0.2\ \text{mg/m}^3}{0.05\ \text{mg/m}^3} = 4$$

D.3.4 Respirator selection according to hazard level and the form of the air contaminant

Lead dust is not irritant. According to Table 3, a half facepiece self-inhalation air-purifying respirator is appropriated. Particle filter element should be suitable to lead dust.

$$\text{Predicted exposure concentration} = \frac{\text{Lead dust concentration}}{\text{APF of respirator selected}} = \frac{0.2\ \text{mg/m}^3}{10} = 0.02\ \text{mg/m}^3$$

If the half facepieces fit the workers, the workers' predicted exposure concentration is 0.02 mg/m^3, lower than OEL.

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Appendix E
（Informative）
Fit test

E.1 General rule

Fit test is suitable for tight-fitting facepiece respirators. The test subjects shall be those actual wearers of the respirator, the purpose is to inspect the face seal between the wearer’s face and the face seal of a specific model of respirator, in order to make sure the respirator wearer is able to obtain adequate protection against the hazardous environment.

Fit test shall be performed whenever a new model of respirator is to be selected. For respirators under use, fit test is suggested to be performed at regular intervals.

Fit test methods are classified into qualitative fit test and quantitative fit test, some of the popular used fit test methods are recommended in this Annex. The administrator of the respiratory protection program should select suitable fit test method for respirator wearers by considering factors such as the type of the respirator, protection objects, required protective performance, technical capability, characteristics of the wearer, etc. Other types of validated fit test methods are also acceptable for use.

No matter what a fit test method is to be used, when to perform fit test, all male test subjects shall have clean shave, and all test subjects should adequately don the respirator and use the respirator. The respirator harness (e.g. head harness) shall be adjusted into such a way that neither too tight nor too loose for proper comfort, otherwise it shall not be benefit to adequate face seal achievement.

E.2 Qualitative fit test

E.2.1 Theory of qualitative fit test

The qualitative fit test agents shall be materials of non-toxic or low toxicity, either gaseous, vapor or particle materials, which is dispersible in a test hood. After adequately don the respirator, the test subject shall be allowed to enter the test hood and to perform simulative exercises. The test subject shall use his/her sense of taste or odor, or the irritation sensed by eyes, mouth or nose mucous membranes caused by the test agents to detect the leakage and to determine the respirator fit. An easy-to-make fit test hood is shown in Fig. E.1 as qualitative fit test facility, it should be put in a well-ventilated area.

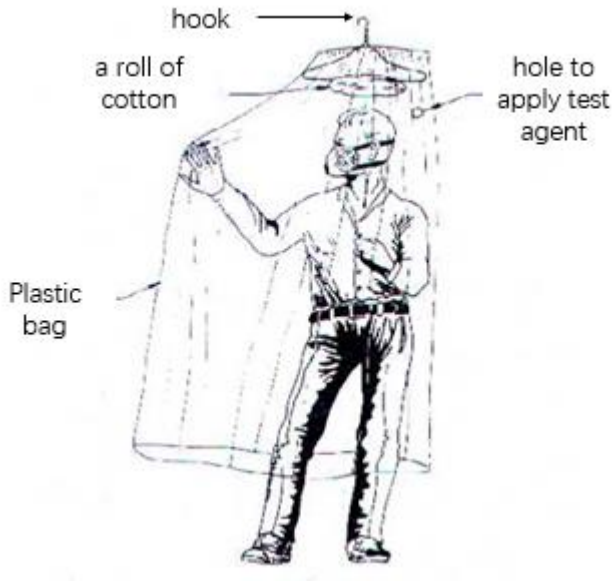


Fig. E.1 An easy-to-make qualitative fit test hood

E.2.2 Qualitative fit evaluation and its limitation

If test subject can taste, smell or sense the irritation of the test agent, it means the test agent has leakaged into the respirator facepiece. If situations such as incorrect respirator wearing method, malfunction of the respirator, expired filter element or unsuitable fit test protocol could be eliminated, it can be determined that the test subject may not fit that specific model of respirator, and another size or model of respirator should be selected instead, and fit test shall be repeated.

The qualitative fit test evaluation depends on subjective feeling of the individual. Such an evaluation could be disabled by the insensitive of the test subject or noncooperation of the test subject.

E.2.3 Isoamyl acetate qualitative fit test protocol

E.2.3.1 This protocol is suitable for gas or vapor respirators using organic vapor filter. If it is to be used to fit test particulate respirators, the respirator must be equipped with an organic vapor filter.

E.2.3.2 Before fit testing, each test subject should perform odor threshold screening using method described as below:

- Two 1 liter glass jars are required. Bring 500 ml newly prepare isoamyl acetate (IAA) stock solution with a volume fraction of 1×10^{-6} into one jar as odor threshold screening solution, bring 500 ml pure water into the another jar, both of the jar shall be tightly covered with lid, and the jar and jar lid should be labeled with number for identification.
- In a well-ventilated room or area, to let the test subject opening the lid of the two jar separately and to smell.
- If the test subject can correctively identify banana oil smell of the jar containing the IAA solution, the test subject is suitable to be fit tested using this protocol. Otherwise, the test subject can not use this protocol for fit testing.

E.2.3.3 Test procedure

The test procedures are as followed:

a) Put a roll of cotton at the top of the test hood (as shown in Fig. E.1). Use a dropper with scale to get 0.75 ml pure IAA, and to apply the IAA to the cotton roll.

b) At a location away from the test hood, let the test subject don the respirator and perform face-seal-check and pass the check.

c) Let test subject entering into the test hood, performing the exercise activities described below, each activity should last for 60 s.

   1) Normal breathing;

   2) Deep breathing to simulate heavy working load;

   3) Move head from side to side, the moving range shall simulate that of during work;

   4) Move head up and down, the moving range shall simulate that of during work;

   5) Talking or reading loudly enough to be heard by nearby people;

   6) Other activities as needed to be designed according to work operation character.

d) During the testing, if the test subject can sense the odor of the test agent, it means leakage. The test subject should re-adjust the facepiece or change another size of respirator to repeat the fit test. If leakage persists, it can be determined that the test subject can't fit that respirator.

e) If the test subject failed the fit test, another suitable type of respirator can be selected and fit tested, or to select a suitable type of respirator without fit test need.

E.2.4 Saccharin qualitative fit test protocol

E.2.4.1 This protocol is suitable for fit test of respirators using particle filter.

E.2.4.2 Before performing this fit test, the test subject should stop eating, drinking beverage (water is allowed), smoking, chewing gum for at least 10 min. As the first step, the test subject shall be screened using sensitive test method described below:

- Prepare 0.83 g/ml Saccharin water solution as fit test solution stock. Dilute the fit test solution by 100 times as sensitive test solution and take a little into a hand nebulizer.
- Let the test subject enter the test hood without wearing respirator and breathing through mouth only. Through the hole on the hood (see Fig. E.1), squeeze the nebulizer to generate test agent mist inside the test hood and record how many times squeeze have been made when the test subject can taste the sweetness of test agent.
- If the test subject can't taste the test agent after 30 times squeeze of the hand nebulizer, it means this fit test protocol is not suitable for this test subject.

E.2.4.3 Test procedure

Fit test procedure shall be performed after the sweet taste subsided in the mouth of test subject who has passed the sensitive screening. The fit test procedure is below:

a) At a location away from the test hood, let the test subject don the respirator and perform face-seal-check and pass the check.

b) Ask the test subject enter the test hood, get some fit test solution into the hand nebulizer and use it to generate test agent mist through the hole on the hood, the squeeze times of the nebulizer shall be equal to that of in sensitive screening, followed by half times squeeze after every 30 s;

c) Ask the test subject to perform the exercise activities described in E.2.3.3. 3c) 1) to 6), each activity should last for 60 s;

d) During the test, if the test subject tastes the sweetness of the test agent, it means leakage. The test subject should re-adjust the facepiece or change another size of respirator to repeat the fit test. If leakage persists, it can be determined that the test subject can't fit that respirator.

e) If the test subject failed the fit test, another suitable type of respirator can be selected and fit tested, or to select a suitable type of respirator without fit test need.

E.2.5 Irritant smoke qualitative fit test protocol

E.2.5.1 This protocol is suitable for fit test of full facepiece used with atmosphere supplying respirator or air-purifying respirator using high efficiency particle filter.

E.2.5.2 This method uses irritant test agents (e.g. zinc tetrachloride or titanium tetrachloride) to generate irritant smoke that can irritate eyes, skin and mucous membrane. This character is utilized in this test method as an indication of respirator leakage. Before fit test, the test subject should be informed about the symptom of irritant reaction and how to react when leakage (e.g. withdraw from the test hood as soon as possible and remove the facepiece at a well-ventilated area, use clean water to wash face, etc.).

E.2.5.3 This test protocol normally does not need sensitive screening of the test subjects.

E.2.5.4 Test procedures are as followed:

a) Ask the test subject don the respirator and perform face-seal-check and pass the check.

b) Broke the top end of ampoule which contains the irritate agent solution, let an air follow of 200 ml/min passing over the ampoule to bring the irritant smoke into the test hood.

c) Ask the test subject entering the test hood, and to perform the exercise activities described in E.2.3.3. 3c) 1) to 6), each activity should last for 60 s;

d) During the test, if the test subject sense the irritation, it means leakage. The test subject should re-adjust the facepiece or change another size of respirator to repeat the fit test. If leakage persists, it can be determined that the test subject can't fit that respirator.

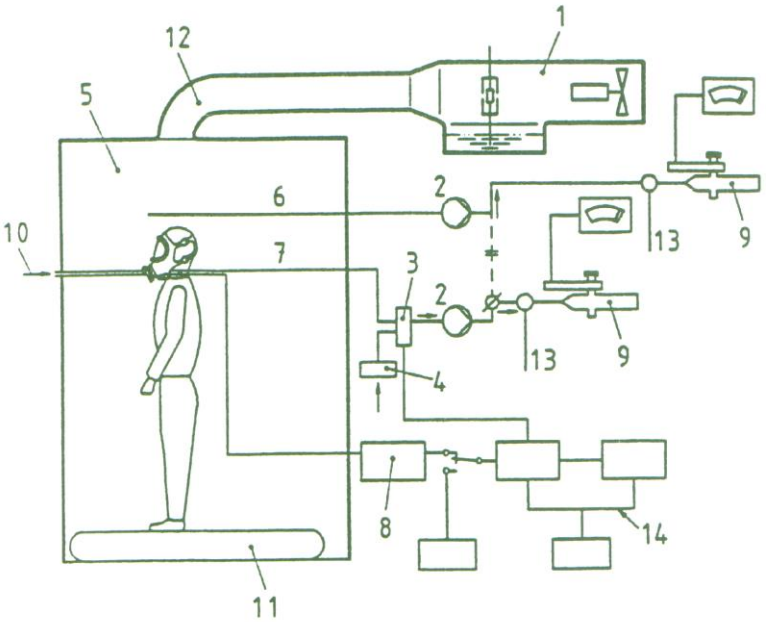
e) If the test subject failed the fit test, another suitable type of respirator can be selected and fit tested, or to select a suitable type of respirator without fit test need.

E.3 Quantitative fit test

E.3.1 Theory of quantitative fit test

Quantitative fit test is objective test method, it does not rely on individual's subjective sense or evaluation. The test agents can be used are materials of non-toxic or low toxicity, such as particles (e.g. sodium chloride, dioctyl phthalate (DOP) etc.) or gas (e.g. sulfur hexafluoride). The test subject is asked to don respirator adequately and enter a test chamber filled with test agent to perform simulated activities, during which test instrument is used to quantitively measure the test agent concentration inside the test chamber and inside the respirator facepiece that leaks into the facepiece. The ratio of test agent concentration inside the test chamber

to that of inside the facepiece is calculated to obtain fit factor as quantitative evaluation of the fit of the selected respirator. An illustration of a quantitative fit test system using sodium chloride is shown in Fig E.2.



1——sodium chloride particle generator
2——pump
3——switch valve
4——filter
5——test chamber
6——sampling from test chamber
7——sampling from respirator facepiece
8——manometer
9——photometer
10——reference fresh air simulator
11——tread mill
12——air inlet and air deflector
13——make up air
14——pulse sampling connector

Fig E.2 Illustration of quantitative fit test system using sodium chloride

E.3.2 General requirement

E.3.2.1 This method is suitable for fit testing on respirators using high efficiency particle filter that is suitable for the test agent. In case of high filter efficiency filter is not in place, measures should be taken to have the test subject breathing the clean air coming from the outside of the test chamber.

E.3.2.2 A sampling hole shall be needed on the facepiece in order to arrange the breathing air sampling from inside of the facepiece near mouth and nose. It is best to make use the element parts of the facepiece (e.g. drinking tube) as sample hole to avoid hole puncture to be made on facepiece.

E.3.2.3 The test chamber shall be tight seal, having a space big enough for test subject performing simulative exercises.

E.3.2.4 The test instrument should be able testing fit factors as high as 2 000, capable of simultaneously measurement and record of the concentration of test agent leaks inside the facepiece along with breathing cycles.

E.3.2.5 The leakage factor test method described in GB/T2891-1995 3.1 can also be used, the reciprocal of the leakage factor can be regarded as fit factor.

E. 3.2.6 Running quantitative fit test needs professional technical equipment, testing condition and operator, the test cost is higher. It is normally not suitable for respirator users to conduct this kind of test. When such a fit test method is on demand, the respirator manufacturers shall be consulted, and the test shall be performed in professional testing organizations.

E.3.2.7 Quantitative fit test evaluation

When the obtained fit factor is not smaller than 10 times of the APF of the related type of respirator (see Table 2), or not smaller than a fit factor required for that respirator defined by the manufacturer, it can be evaluated as pass.

In case of fit test is failed, when situations such as incorrect respirator wearing method, malfunction of the respirator, expired filter element could be eliminated, it can be determined that the test subject may not fit that specific model of respirator, and another size or model of respirator should be selected instead, and fit test shall be repeated.

E.3.4. Quantitative fit test protocol

The quantitative fit test protocol is below:

a) Before testing, the test agent particles or gas should be generated and directed into the test chamber until a stable concentration is reached; during the test, the test agent concentration should be stable and under control with a variation level not higher than 10%;

b) Checking the test instrument according to related specific technical requirements to make sure it is in normal working condition;

c) Ask the test subject don the respirator, perform the face-seal-check and pass the check; then ask the test subject enter test chamber, then connect the facepiece sampling tube.

d) Turn on the tread mill and adjust the walking speed to 6 km/h;

e) The test subject shall perform the exercises described in E.2.3.3. 3c) 1) to 6), each exercise should last for 60 s

f) The test agent concentration inside and outside the facepiece should be measured and recorded continually.

E.3.5 Fit factor calculation

E.3.5.1 Fit factor of each exercise activity

For each exercise activity, the mean of the pulse peak concentration of the test agent shall be calculated as the leakage concentration, and the corresponding mean concentration in the test chamber shall be regarded as test chamber concentration of the test agent. Use Equation (E.1) to calculate the fit factors for each of the activities.

$$ff_i = \frac{C_o}{C_i} \qquad \text{(E. 1)}$$

In (E.1):

ff_i —— the fit factor the activity of No. i;

C_0—— the test agent concentration inside the test chamber

C_i—— the test agent concentration inside the facepiece during the No. i exercise activity

E.3.5.2 The overall fit factor

The overall fit factor shall be calculated using Equation (E.2).

$$ff = \frac{n}{\sum (1/ff_i)} \quad \text{.....} \quad (E.2)$$

In (E.2):

ff ——the overall fit factor;

n ——the number of the activities performed by the test subject.

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Appendix F

（Informative）

Medical evaluation of respirator wearers

F.1 Physiological considerations

Carrying heavy respirators, for example, SCBA and other equipment in addition to a heavy workload may impose stress on the cardiopulmonary system. Intense ambient heat (e.g. during fire fighting) could be an additional stress on the heart. Persons with severe lung diseases may experience difficulty with breathing against the additional resistance of a respirator.

F.2 Psychological considerations

Full facepiece respirators especially with full body protection may give rise to feelings of anxiety and isolation in some people, making it difficult for them to perform their work satisfactorily.

F.3 Suggested medical evaluation method

A medical history and at least a limited physical examination by a physician are recommended. In particular, the cardiopulmonary system should be evaluated. A previous history of respirator usage should also be elicited.

Chest x-ray, spirometry and exercise stress tests with ECG monitoring may be considered in persons using SCBA, when extremely stressful work conditions are expected.

The respirator user should be observed during a trial period to evaluate any potential anxiety or claustrophobic reaction during the use of the respirator during training.

The examination is suggested to be carried out prior to the issue of respirators and periodically. For workers above 45 years of age and who are carrying out strenuous work with SCBA, annual examinations are recommended.

F.4 Medical conditions that may limit respirator usage

There is a great variation in the type of respirators, work conditions and workers' health status. As such, these medical conditions may not be absolute contraindications but should be considered together with other relevant factors and the workers' particular situation. Many impaired workers would be able to work safety while wearing respirators if they could control their own work pace, including having sufficient time to rest. Come of these medical conditions are:

- moderate or severe pulmonary disease
- angina pectoris, significant arrhythmias, recent myocardial infarction
- symptomatic or uncontrolled hypertension
- claustrophobia / anxiety reaction
- history of spontaneous pneumothorax

It should be noted that mild to moderated impairment of lung function would not preclude the using of respirators in most cases.

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Appendix G
（Normative）
Face-seal-check

G.1 General rule

The wearer of a tight-fitting respirator needs to perform face-seal-check to determine adequate seal between face and the facepiece is achieved each time the respirator is put on. If adequate seal could not be achieved, the hazardous environment should not be entered.

G.2 Negative pressure face-seal-check

G.2.1 Negative pressure face-seal-check for disposable respirator facepiece

Using both hands, or an air-tight material (e.g. a plastic bag), to cover the facepiece, then inhale sharply. The facepiece shall collapse slightly if good seal is achieved. If air leakage is sensed around face seal or nose clip, the wearer shall re-adjust the facepiece position, head band and nose clip until no leakage can be detected.

G.2.2 Negative pressure face-seal-check for elastic rubber material facepiece

Close off the inlet of the filter by covering with the palm of the hand(s) (see Fig. G.1) or by bending the inlet air-line to stop air flow, inhale gently so the facepiece collapse slightly, and hold the breath for seconds. If the facepiece remains in its slightly collapsed condition, the tightness of the respirator is considered satisfactory. Otherwise the respirator position and head harness shall be readjusted until adequate seal can be achieved.

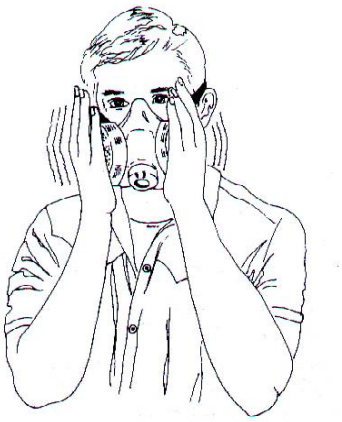

Figure G.1 Negative pressure face-seal-check

G.3 Positive pressure face-seal-check

G.3.1 Positive pressure face-seal-check of disposiable respirator facepiece

Using both hands, or an air-tight material (e.g. a plastic bag), to cover the facepiece, then exhale sharply. Without adequate seal, the air leakage shall be detected around the facesearl and the wearer shall re-adjust the facepiece position, head band and nose clip until no leakage can be detected.

G.3.2 Positive pressure face-seal-check for elastic rubber material facepiece

Close off the exhalation valve and exhale gently into the facepiece. The face seal is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at

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the seal. For some respirators this method requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replacing it after the test. In this case, the positive pressure face-seal-check is not suggested as a frequent used method.

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Appendix H

（Informative）

Checklist for respiratory protection program

H.1 General requirements

The effectiveness of respiratory protection program should be evaluated periodicaly, normaly annually. when there is a change in the workplace which could possiblly affect the use of respirator, the programe should be updated to make it suitable to the new condition. Adjustment, as appropriate, should be make to reflect the evaluation result.

H.2 Inspection of respiratory protection program

Inspection include two parts – program administration and program operation.

H.2.1 Inspection of program administration

The inspection contents see Table H.1.

Table H.1 Inspection of program administration

Ser.	Inspection content	Inspection result		
		Yes	No	Note
1	Is there a written respiratory protection prgrame?			
2	Is program responsibility vested in one individual who is knowledgeable and who can coordinated all aspects of the programe?			
3	Can peasible engineering controls or work practices eliminate the need for respirators?			
4	Does the programe include the following activities?			
4.1	Monitoring of airborne contaminant level			
4.2	Respirator selection			
4.3	Medical fitness to use respirators			
4.4	Issuing of respirators			
4.5	Field inpection of respirator use			
4.6	Training			
4.7	Maintenance, storage, repair and inspection of respirators			
4.8	Medical surveilance (where applicable)			
5	Is the programe reviewed regularly?			
Note: It is appropriate to tick or mark each checking point, or to use rating method.				

H.2.2 Inspection of program operation

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The inspection contents see Table H.2.

Table H.2 Inspection of program operation

Ser.	Inspection contents	Inspection result		
		Yes	No	Note
1	Monitoring of airborne contaminant concentration			
	Are nature and hazard level of atmosphere and form of airborne contaminant properly identified?			
2	Selection of respirator			
2.1	Are respirators selected suitable for the nature and hazard level of atmosphere and the form of airborne contaminant?			
2.2	Are respirators selected have liable certification?			
3	Has a medical evaluation of the prospective user been madetodetermine physical and psychological ability to use the selected respirator?			
4	Where practical, have users of tight-fitting facepieces passed qualitative or quantitative fit test?			
5	Respirator use in the workplace			
5.1	Are respirators being worn correctly?			
5.2	have users of tight-fitting facepiece conducted face-seal-check before entering hazardous atmophere?			
5.3	Are workers wearing respirators all the time while in thework place?			
5.4	In the case of air-purfying respirators are used, are expired filter elements been replaced timly.			
6	Training			
6.1	Do workers understand of the nature and hazard level of exposed hazardous atmosphere?			
6.2	Are users trained in proper respirator use, maintenance, clean and inspection?			
7	Maintenance of respirator			
7.1	Are respirators stored ina manner so as to protect them from dirt, dust, sunlight, moisture or damaging chemicales?			
7.2	Are respirators inspected befor and after each use and during cleaning?			
7.3	Are respirators designated as emergency use inspected at regular interval?			
7.4	Are replacement parts used in repairement of the manufacturer of the respirator?			
8	Special use conditions			
8.1	Is the procedure of use respirator in IDLH atmosphere complies to liable regulation and standard?			
8.2	Is the procedure of use respirator in confined space complies to liable regulation and standard?			
9	Are the users on a regular medical surveilance program (where applicable)?			
Note: It is appropriate to tick or mark each checking point, or to use rating method.				

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