

# **PROTECTIVE CLOTHING FOR RESCUE TEAMS FOR PROTECTION AGAINST CHEMICALS**

**CFASDM 003 : 2013**

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**DELIBERATED BY  
THE COUNCIL OF FIRE APPLIANCES STANDARD  
FOR DISASTER MANAGEMENT**

## FOREWORD

This standard has been established by the Council of Fire Appliances Standard for Disaster Management (CFASDM) for which the Fire Equipment and Safety Center of Japan (FESC) acts as the Secretariat regarding the performance and testing methods for highly advanced fire equipment used by the rescue teams of fire departments at the time of special types of disasters, such as terrorism, as well as large-scale disasters, such as volcanic eruptions.

This standard has been established with reference to the relevant **ISO**, **EN** (European standards), **NFPA** (National Fire Protection Association), **JIS** and other standards. Whenever these standards are revised, this standard will accordingly be reviewed and revised if necessary.

It must be reminded that parts of this standard may infringe a patent with technical properties, patent on application after its laid-open disclosure, utility model patent or application for the registration of a utility model after its laid-open disclosure. Neither the Council of Fire Appliances Standard for Disaster Management nor the Fire Equipment and Safety Center of Japan shall be held responsible for the non-confirmation of such patent with technical properties, patent on application after its laid-open disclosure, utility model patent or application for the registration of a utility model after its laid-open disclosure.

This **CFASDM 003 standard** has the following annex.

Annex (Reference): Guidelines for the Selection of Chemical Protective Clothing

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## Protective Clothing for Rescue Teams for Protection Against Chemicals

### 1. Scope of Application

This standard stipulates the minimum requirements regarding the structural requirements and performance requirements for protective clothing for protection against chemicals (hereinafter referred to as "chemical protective clothing), excluding respiratory devices, to be used by rescue teams at the time of a special kind of disaster or large-scale disaster.

Rescue team members responding to an emergency situation could encounter a significant risk when dealing with hazardous substances. Accordingly, it is essential for rescue team members to conduct risk assessment regarding whether or not the chemical protective clothing worn by them is suitable for the intended purpose of use and perceived threat, to undergo training on the selection, use, care and maintenance of such clothing and to understand the limitations of such clothing.

This standard does not intend to restrict the stipulation of more stringent conditions than those stipulated by this standard by the competent agency, users or manufacturers.

**Notes 1** : This standard does not assume the use of chemical protective clothing in such situations as exposure to radiation, fierce fire, ignition by a chemical or high risk of explosion.

**Notes 2** : This standard does not intend to stipulate fire protective clothing.

**Notes 3** : This standard does not intend to stipulate the uniform usage of protective clothing as disaster situations are diverse.

### 2. Normative References

The standards listed below shall form part of this standard when cited in this standard. When a cited standard is accompanied by the year of effectuation, the version established in that year alone shall form part of this standard and the provision of subsequent revisions and supplementary provisions shall not form part of this standard. In the case of those normative references without the year of effectuation, the latest revisions (including supplementary provisions) shall form part of this standard when cited.

**JIS K6404-4** : 1999 Testing methods for rubber or plastics-coated fabrics - Part 4  
Determination of tear resistance

**Note** Corresponding international standard :

**ISO/DIS 4674-1** : 1998 Rubber or plastics-coated fabrics - Determination of tear resistance - Part 1 : Constant rate of tear method

**JIS R6253** : 1999 Waterproof abrasive papers

**JIS T8005** : 2005 Protective clothing - General requirements

**Note** Corresponding international standard :

**ISO 13688** : 1998 Protective clothing - General requirements (MOD)

**JIS T8030** : 2005 Protective clothing - Protection against chemicals - Determination of resistance of protective clothing materials to permeation by liquids and gases

**Note** Corresponding international standard :

**ISO 6529** : 2001 Protective clothing - Protection against chemicals - Determination of resistance of protective clothing materials to permeation by liquids and gases (MOD)

**JIS T8031** : 2005 Clothing for protection against chemicals - Determination of the resistance of protective clothing materials to penetration by liquids under pressure

**Note** Corresponding international standard :

**ISO 13994** : 1998 Clothing for protection against chemicals - Determination of the resistance of protective clothing materials to penetration by liquids under pressure (MOD)

**JIS T8032** : 2005 Protective clothing - Protection against gaseous and liquid chemicals - Determination of resistance of protective clothing to penetration by liquids and gases

**Note** Corresponding international standard :

**ISO 17491** : 2002 Protective clothing - Protection against gaseous and liquid chemicals - Determination of resistance of protective clothing to penetration by liquids and gases (MOD)

**JIS T8051** : 2006 Protective clothing - Mechanical properties - Determination of resistance to puncture

**Note** Corresponding international standard :

**ISO 13996** : 1999 Protective clothing - Mechanical properties - Determination of resistance to puncture (IDT)

**JIS T8052** : 2006 Protective clothing - Mechanical properties - Determination of resistance to cutting by sharp objects

**Note** Corresponding international standard :

**ISO 13997** : 1999 Protective clothing - Mechanical properties - Determination of resistance to cutting by sharp objects (MOD)

**JIS T8101** Protective footwear

**JIS T8115** : 2005 Protective clothing for protection against chemicals - Classification, labelling and performance requirements

**Note** Corresponding international standard :

**ISO FDIS 16602** : 2004 Protective clothing for protection against chemicals - Classification, labelling and performance requirements (MOD)

**JIS T8116** : 2005 Protective gloves for use against chemicals

**JIS T8117** : 2005 Protective boots for use against chemicals

**JIS T8153** Supplied-air respirators

**JIS Z9101** Safety colours and safety signs - Design principles for safety signs in workplaces and public areas

**ISO/DIS 22613** : 2004 Protective clothing - General test methods and performance requirements for hand-protection

### 3. Definitions

The principal terms used in this standard are defined as follows.

- a) **Hazardous area (contaminated area)** : An area to which a hazardous material has leaked or an area where the risk to human life is high.
- b) **Quasi-hazardous area (including decontamination zone)** : An area where contamination is controlled to a certain extent.
- c) **Warning area**: An area demarked by rope or similar at the site of a disaster which is also subject to an evacuation order issued to residents, etc. and also to restricted entry and exit (excluding hazardous area and quasi-hazardous area).
- d) **Hazardous materials** : Solid, liquid or gaseous substances or their mixtures which have a harmful impact on the human body through respiration, ingestion or absorption through contact with the skin.
- e) **Gases** : Collective term for gaseous substances (equal to or above the critical temperature) and vaporous substances (less than the critical temperature).
- f) **Chemical protective clothing** : An individual garment or combined assembly of garments worn to prevent exposure to or contact with hazardous materials.

**Note :** In this standard, a visor, gloves and boots used simultaneously with the clothing are included in this definition of chemical protective clothing as components of such clothing.

- g) Garment :** An individual component (of chemical protective clothing); garments protect the relevant parts of the human body from chemicals when worn.
- h) Chemical protective clothing materials :** Materials used for the main body of chemical protective clothing.
- i) Full body chemical protective clothing :** Chemical protective clothing which protects the whole or greater part of the human body.
- j) Gas-tight chemical protective clothing :** A full body chemical protective clothing which has the function of maintaining the inside of the clothing in a gas-tight state and a structure which prevents the incursion of chemicals inside the clothing.
- k) Non-gas-tight chemical protective clothing :** A full body chemical protective clothing which has a structure of preventing both direct exposure to and contact of the skin with chemicals and the incursion of chemicals inside the clothing.
- l) Gas-tight chemical protective clothing with internal self-contained breathing apparatus (Type 1a) :** A gas-tight chemical protective clothing to which self-contained breathing apparatus is mounted inside the clothing.
- m) Gas-tight chemical protective clothing with external self-contained breathing apparatus (Type 1b) :** A gas-tight chemical protective clothing to which self-contained breathing apparatus is mounted outside the clothing.
- n) Spray-tight (non-gas-tight) chemical protective clothing (Type 4) :** A full body chemical protective clothing with spray-tight connections between different parts of the clothing, and to gloves and boots to protect the wearer against liquid chemicals.

**Example :** one-piece coverall or two-piece suit

- o) Mist-tight (non-gas-tight) chemical protective clothing (Type 6) :** A full body chemical protective clothing with mist-tight connections between different parts of the clothing, and to gloves and boots to provide limited protection of the wearer against liquid chemicals.

**Example :** one-piece overall or two-piece suit

- p) Seam :** A permanent junction between pieces of material.
- q) Assemblage :** A permanent fastening between garments or between a chemical protective clothing and such accessories as a hood, gloves or footwear.
- r) Joint :** A non-permanent junction between garments or between a chemical protective clothing and such accessories as a hood, gloves or footwear.

- s) Connection** : Collective term for assemblage and joint.
- t) Visor** : A window-like component of the hood for chemical protective clothing to ensure the field of vision of the wearer : sometimes called an eyepiece.
- u) Face-piece** : Part of self-contained breathing apparatus or supplied air respirator to protect the respiratory organs; can be a full face-piece or half face-piece.
- v) Gloves** : A component of chemical protective clothing to protect the fingers and wrists.
- w) Boots** : A component of chemical protective clothing to protect the legs, ankles and lower limbs.
- x) Bootees** : Sock-like extended part of chemical protective clothing.
- Note** : A different material from that used for chemical protective clothing may be used for bootees.
- y) Permeation** : The process by which a chemical moves through a material on a molecular level.
- Permeation involves:
- sorption of the molecules of the chemicals into the contacted (outside) surface of a material:
  - diffusion of the sorbed molecules in the material, and;
  - desorption of the molecules from the opposite (inner) surface of the material
- z) Penetration** : The process by which a chemical moves through porous materials, seams, pinholes or other imperfection in a material on non-molecular level.
- aa) Calibrated stain** : The area formed on clothing when test liquid of a specified quantity is dropped on the clothing for the absorbability test to check the penetration resistance of finished chemical protective clothing.
- bb) Shelf life** : The serviceable life of chemical protective clothing which is stored with the utmost care and maintenance, but never used in either a real situation or drill.
- cc) Limited use** : Serviceability for the period up to decontamination or disposal due to the adherence of chemical contaminants is required, including single use or re-use with some restrictions.
- dd) Reusable** : Use more than once on the condition that the performance required by this standard is met after proper decontamination.



## **4. Types**

The types of chemical protective clothing for rescue teams based on the level of protection are listed below. At each level, products are categorised as either those for limited use or those which are re-usable and manufacturers must designate their products as either category.

### **4.1 Level A Chemical Protective Clothing**

Protective clothing to be worn by those working in a hazardous area (contaminated area) where a high level of respiratory protection as well as skin and eye protection are required.

### **4.2 Level B Chemical Protective Clothing**

Protective clothing to be worn by those working in a hazardous area (contaminated area) where the required level of respiratory protection is equivalent to Level A chemical protective clothing but the level of skin and eye protection may be lower than that of Level A chemical protective clothing.

### **4.3 Level C Chemical Protective Clothing**

Protective clothing to be worn by those working in a quasi-hazardous area (including a decontamination zone) where the required level of skin protection is equivalent to Level B chemical protective clothing but the level of respiratory protection may be lower than that of Level B chemical protective clothing.

### **4.4 Level D Chemical Protective Clothing**

Protective clothing to be worn by those working in a warning area where respiratory protection is unnecessary but the minimum skin protection is required.

## **5. Structure**

The structure of protective clothing for rescue teams for protection against chemicals shall meet the following requirements.

### **5.1 Level A Chemical Protective Clothing**

The structure of Level A chemical protective clothing shall meet the following requirements.

- a) Level A chemical protective clothing shall be composed of either a gas-tight chemical protective clothing with internal self-contained breathing apparatus (Type 1a) or a gas-tight chemical protective clothing with external self-contained breathing apparatus (Type 1b), gloves and boots.

**Note :** Level A chemical protective clothing may be composed of a gas-tight chemical protective clothing and an overall which is worn over the gas-tight chemical protective clothing to meet the performance required by this standard.

- b) The knee areas and back of a gas-tight chemical protective clothing which is not worn together with an overall shall be reinforced when protection of the protective clothing from physical damage is judged to be necessary.
- c) A supplied air respiratory protective device for rescue teams shall be mounted to Level A chemical protective clothing for rescue teams as a respiratory protective device. A self-contained breathing apparatus approved by CFASDM 002 should be used.
- d) The hood of a gas-tight chemical protective clothing with internal self-contained breathing apparatus (Type 1a) shall have a separate visor from the face-piece of a respiratory protective device.
- e) The exhalation valve of Level A chemical protective clothing shall have a protective cover, etc. made of the same material as that of the clothing or a material with the same performance or higher than that of the same material.
- f) A gas-tight chemical protective clothing which is not chemical protective clothing with integral boots shall have bootees.
- g) The structure of a gas-tight chemical protective clothing which is not chemical protective clothing with integral boots shall not allow the incursion of hazardous liquids and/or solids into the boots.

**Example :** A flap or similar may be attached to each boot.

## 5.2 Level B Chemical Protective Clothing

The structure of Level B chemical protective clothing shall meet the following requirements.

- a) Level B chemical protective clothing shall be composed of a spray-tight chemical protective clothing (Type 4), gloves and boots.

**Note :** Level B chemical protective clothing may be composed of a spray-tight chemical protective clothing (Type 4) and an overall which is worn over the spray-tight chemical protective clothing (Type 4) to meet the performance required by this standard.

- b) The knee areas of a spray-tight chemical protective clothing (Type 4) which is not worn together with an overall shall be reinforced when protection of the protective clothing from physical damage is judged to be necessary.

- c) A supplied air respiratory protective device for rescue teams shall be mounted to Level B chemical protective clothing for rescue teams as a respiratory protective device. A self-contained breathing apparatus approved by CFASDM 002 should be used.

**Note :** A air purifying respiratory protective device for rescue teams may be used depending on the situation. An air purifying respiratory protective device for rescue teams approved by CFASDM 001 should be used.

- d) A spray-tight chemical protective clothing (Type 4) which is not chemical protective clothing with integral boots should have bootees.
- e) The structure of a spray-tight chemical protective clothing (Type 4) which is not chemical protective clothing with integral boots shall not allow the incursion of hazardous liquids and/or solids into the boots.

**Example :** A flap or similar may be attached to each boot.

### 5.3 Level C Chemical Protective Clothing

The structure of Level C chemical protective clothing shall meet the following requirements.

- a) Level C chemical protective clothing shall be composed of a spray-tight chemical protective clothing (Type 4), gloves and boots.

**Note 1 :** Level C chemical protective clothing may be composed of a spray-tight chemical protective clothing (Type 4) and an overall which is worn over the spray-tight chemical protective clothing (Type 4) to meet the performance required by this standard.

**Note 2 :** A mist-tight chemical protective clothing (Type 6) may be used depending on the situation.

- b) A air purifying respiratory protective device for rescue teams shall be mounted to Level C chemical protective clothing for rescue teams as a respiratory protective device. An air purifying respiratory protective device for rescue teams approved by CFASDM 001 should be recommended.
- c) A spray-type chemical protective clothing (Type 4) which is not chemical protective clothing with integral boots should have bootees.
- d) The structure of a spray-tight chemical protective clothing (Type 4) which is not chemical protective clothing with integral boots shall not allow the incursion of hazardous liquids and/or solids into the boots.

**Example :** A flap or similar may be attached to each boot.

## 5.4 Level D Chemical Protective Clothing

The structure of Level D chemical protective clothing shall meet the following requirements.

- a) Level D chemical protective clothing shall be composed of a mist-tight chemical protective clothing (Type 6), gloves and boots.

**Note :** The gloves and boots of Level D chemical protective clothing may be other than the gloves referred to in **6.3.4** and boots referred to in **6.3.5** depending on the situation.

## 6. Performance and Test Methods

The performance of and test methods for protective clothing for rescue teams for protection against chemicals shall meet the following requirements.

### 6.1 Finished Chemical Protective Clothing

Finished chemical protective clothing shall meet the performance described in **6.1.1** through **6.1.10** by conducting the tests shown in **Table 1**.

**Table 1 Test Items for Finished Chemical Protective Clothing**

Test Item	Type			
	Level A Chemical Protective Clothing		Level B & C Chemical Protective Clothing	Level D Chemical Protective Clothing
	Type 1a Gas-Tight CPC	Type 1b Gas-Tight CPC	Type 4 Spray-tight CPC	Type 6 Mist-tight CPC
6.1.1 Leak tightness	O	O		
6.1.2 Inward leakage	O <sup>(1)</sup>	O <sup>(1)(2)</sup>		
6.1.3 Liquid penetration resistance (Spray test : Method D)			O	
6.1.4 Mist penetration resistance (Spray test : Method F)				O
6.1.5 Practical performance	O	O	O	O
6.1.6 Face-piece	O	O		
6.1.7 Lifeline attached to self-contained breathing apparatus	O			
6.1.8 External ventilation hose		O <sup>(3)</sup>		
6.1.9 Exhaust assemblage	O	O <sup>(4)</sup>		
6.1.10 Pressure in chemical protective clothing	O	O <sup>(5)</sup>		

#### Notes

- (1) Gas-tight chemical protective clothing to be worn at chemical/biological terrorism incidents shall be tested.
- (2) Inward leakage test is required for Type 1b chemical protective clothing when the face-piece is not permanently attached.
- (3) The performance of external ventilation hose shall be tested with a gas-tight chemical protective clothing with external self-contained breathing apparatus (Type 1b) which is equipped with an external ventilation hose.
- (4) Type 1b chemical protective clothing shall be fitted with an exhaust assemblage if the exhalation valve of the respiratory protective equipment is not free to discharge directly to atmosphere, or where supplementary air for ventilation is supplied to the clothing.
- (5) Type 1b chemical protective clothing shall only be tested when an exhaust assemblage is fitted.

### 6.1.1 Leak-tightness

The leak-tightness shall be tested using either **Method A1** or **Method A2** in **JIS T8032** and the pressure drop after the passing of the stipulated test pressure load time shall be 20% or lower. Two specimens shall be tested.

### 6.1.2 Inward leakage

The inward leakage shall be 0.05% or lower when two specimens worn by different test subjects are tested using either **Method B1** or **Method B2** in **JIS T8032**.

- a) The inward leakage of Type 1a and Type 1b gas-tight chemical protective clothing to be worn at chemical/biological terrorism incidents shall be 0.02% or lower.
- b) In the case of a gas-tight chemical protective clothing with external self-contained breathing apparatus (Type 1b) where the face-piece is connected to chemical protective clothing, the inward leakage shall also be measured inside the face-piece.

### 6.1.3 Liquid penetration resistance (Spray test : Method D)

In regard to a spray-tight chemical protective clothing (Type 4), when the penetration resistance to liquid is tested for a duration of five (5) minutes using **Method D2** in **JIS T8032** by different test subjects after the preconditioning referred to in **6.1.5 - Practical Performance Test**, the penetration shall not be three times the calibrated stain area or larger. Two specimens shall be tested.

**Note :** A spray-tight chemical protective clothing (Type 4) to be worn at a chemical/biological terrorism incident shall not show any signs of penetration when tested using **Method D1** in **JIS T8032**.

### 6.1.4 Mist penetration resistance (Spray test : Method F)

In regard to a mist-tight chemical protective clothing (Type 6), when the resistance to mist penetration is tested with different test subjects by means of exposure lasting for one (1) minute using **Method F** in **JIS T8032** after the preconditioning referred to in **6.1.5 - Practical Performance Test**, the penetration shall not be three times the calibrated stain area or larger. Two specimens shall be tested.

### 6.1.5 Practical Performance

The practical performance of chemical protective clothing shall meet the following criteria when one piece of chemical protective clothing after the preconditioning referred to in **5.2** of **JIS T8115** is tested by Sequences **A** and **B** in **Annex A** of **JIS T8115**.

- a) The chemical protective clothing shall not restrict any work of the test subject in test movements.
- b) When a test subject with normal eyesight wears the chemical protective clothing, the visor of the chemical protective clothing shall allow the reading of a safety sign of 10 cm in height and 8 cm in width from a distance of 6 m as stipulated by **JIS Z9101**.
- c) Chemical protective clothing equipped with a visor shall not disrupt the peripheral vision of the test subject in test movements.
- d) A gas-tight chemical protective clothing shall undergo the post-practical performance test and leak-tightness test using **Method A1** in **JIS T8032** and shall not have a pressure drop of 20% or more after passing of the stipulated test pressure load time of four (4) minutes.

**Note :** The leak-tightness test in the post-practical performance test may be conducted under different conditions depending on the purpose of use of the gas-tight chemical protective clothing.

### 6.1.6 Face-piece

The face-piece shall meet the following performance requirements stipulated by **5.11** of **JIS T8115**.

- a) The face-piece used by a gas-tight chemical protective clothing shall meet the performance of **a)** in **6.3.1** - (Face-piece, etc.) of **JIS T8153**.
- b) An integral full face-piece of a gas-tight chemical protective clothing shall not impair close contact with the face and other functions during the test referred to in **6.1.5**.
- c) A gas-tight chemical protective clothing with a connected full face-piece in non-permanent manner shall not show any penetration which is three times the calibrated stain area or larger when tested using **Method C** of **JIS T8032** after preconditioning of the joint in the manner stipulated by **5.2** of **JIS T8115**. Two specimens shall be tested.

### 6.1.7 Lifeline Attached to Self-Contained Breathing Apparatus

When a lifeline is to be attached to self-contained breathing apparatus, the said lifeline shall meet the following performance stipulated by **5.12** of **JIS T8115**. Two specimens shall be tested.

- a) In the case of a gas-tight chemical protective clothing with internal self-contained breathing apparatus (Type 1a) to which a lifeline is to be attached, the lifeline and the connection shall be

evaluated during the period of the test referred to in **6.1.5** so that the execution of the work by the test subject shall not be restricted.

- b) When the strength of the attachment of the lifeline in accordance with **Annex B** of **JIS T8115** is tested, the said attachment shall not separate from the chemical protective clothing with a force of 1,000 N or less.

### **6.1.8 External Ventilation Hose**

A gas-tight chemical protective clothing with external self-contained breathing apparatus (Type 1b) with which breathing air is taken inside for ventilation shall meet the following performance stipulated by **5.14** of **JIS T8115**. Two specimens shall be tested.

#### **a) External Ventilation Hose**

The external ventilation hose of a gas-tight chemical protective clothing with external breathing apparatus (Type 1b) shall be evaluated during the period of the test referred to in **6.1.5** so as to ensure the execution of all types of work by the worker as well as sufficient elasticity to allow free movement of the head. The connection between the chemical protective clothing and external ventilation hose shall pass the damage inspection after an axial tensile test with a force of 250 N. One specimen each shall be tested before and after the preconditioning referred to in **5.2** of **JIS T8115**.

#### **b) Collapse Resistance of External Ventilation Hose**

In regard to the collapse resistance of an external ventilation hose, the reduce of the air flow rate and permanent deformation of the diameter after the test conducted with the following conditions conducted after the preconditioning referred to in **5.2** of **JIS T8115** shall be not more than 5% and not more than 20% respectively.

- 1) **Apparatus** : Two metal plates with dimensions of 100 mm by 100 mm or 100 mm in diameter and a minimum thickness of 10 mm shall be used with one being fixed and the other being movable.
- 2) **Procedure** : The central section of the hose shall be clamped by the two plates and air shall be fed through the hose at the manufacturer's design air flow rate or 120 litres/min (whichever is the lower) to measure the actual flow rate. This shall be followed by the application of force of  $50 \pm 2.5$  N to the plates to measure changes of the air flow rate.

### 6.1.9 Exhaust Assemblage

The exhaust assemblage shall meet the following performance stipulated by **5.16** of **JIS T8115**.

- a) A gas-tight chemical protective clothing with internal self-contained breathing apparatus (Type 1a) shall be fitted with an exhaust assemblage consisting of one or more exhalation valves.
- b) A gas-tight chemical protective clothing with external self-contained breathing apparatus (Type 1b) shall be fitted with an exhaust assemblage when the exhalation valve of the respiratory protective device has a structure which does not allow the direct discharge of air to the outside or where ventilation air is supplied to inside the clothing. Two specimens shall be tested in accordance with **Annex D** of **JIS T8115** and the change of the pressure shall be less than 0.1 kPa per minute.

### 6.1.10 Pressure Inside Protective Clothing

The pressure inside protective clothing shall meet the following performance stipulated by **5.17** of **JIS T8115**.

- a) The pressure inside chemical protective clothing in the case of a gas-tight s chemical protective clothing with internal self-contained breathing apparatus (Type 1a) shall not exceed 1.0 kPa when tested in accordance with **Annex C** of **JIS T8115**. The pressure drop in the leak-gas-tightness test after the internal pressure test of the chemical protective clothing shall not be 20% or more after the passing of the test pressure load time. Two specimens shall be tested after the preconditioning referred to in **5.2** of **JIS T8115**.
- b) In the case of a gas-tight chemical protective clothing with external self-contained breathing apparatus (Type 1b), only those fitted with an exhaust assemblage shall be tested.



## 6.2 Materials for Chemical Protective Clothing

The materials for chemical protective clothing shall meet the performance shown in **Table 2**.

**Table 2 Test Items and Performance for Classification of Chemical Protective Clothing Materials**

	Type					
	Level A Chemical Protective Clothing		Level B and Level C Chemical Protective Clothing		Level D Chemical Protective Clothing	
	Limited Use	Reusable	Limited Use	Reusable	Limited Use	Reusable
6.2.1 Permeation resistance	Class 3 > 60 mins	Class 3 > 60 mins				
6.2.2 Resistance to penetration by liquid under pressure			Class 3 > 14 kPa	Class 3 > 14 kPa		
6.2.3 Liquid penetration resistance					Class 1 < 10%	Class 1 < 10%
6.2.4 Liquid repellency					Class 1 > 80%	Class 1 > 80%
6.2.5 Tensile strength (Strip method)	Class 4 > 250 N	Class 6 > 1,000 N	Class 2 > 60 N	Class 4 > 250 N	Class 1 > 30 N	Class 3 < 100 N
6.2.6 Tear strength (Trapezoid method)	Class 3 > 40 N	Class 3 > 40 N	Class 2 > 20 N	Class 3 > 40 N	Class 1 > 10 N	Class 2 > 20 N
6.2.7 Puncture resistance	Class 2 > 10 N	Class 3 > 50 N	Class 2 > 10 N	Class 3 > 50 N	Class 1 > 5 N	Class 2 > 10 N
6.2.8 Abrasion resistance <sup>(1)</sup>	Class 4 > 1,000 cycles	Class 6 > 2,000 cycles	Class 2 > 100 Cycles	Class 4 > 1,000 cycles	Class 1 > 10 cycles	Class 3 > 500 cycles
6.2.9 Flex cracking resistance <sup>(1)</sup>	Class 1 > 1,000 cycles	Class 4 > 15,000 cycles	Class 1 > 1,000 cycles	Class 4 > 15,000 cycles	Class 1 > 1,000 cycles	Class 3 > 5,000 cycles
6.2.10 Resistance to flame	Class 1 or higher	Class 1 or higher				

### Note

- <sup>(1)</sup> Both the abrasion resistance and flex cracking resistance are evaluated at the end point indicating the expected performance of the material. Damage to the material of a gas-tight chemical protective clothing (Type 1) is evaluated based on its pass or failure in the material test piece leakage test. Damage to the material of a spray-tight chemical protective clothing (Type 4) is evaluated visually.

### 6.2.1 Permeation Resistance

The permeation resistance shall be tested in the following manner.

- a) In regard to the permeation resistance of materials for Level A chemical protective clothing, the performance stipulated by **6.5** of **JIS T8115** shall be tested for the recommended test chemicals listed in **Table 3**. The test results for those recommended test chemicals marked with an asterisk (\*) shall meet the Class 3 performance in **Table 2**. The test results shall be reported in the manner described in **9-c**).

### Notes

1. The permeation resistance shall be tested in accordance with **JIS T8030**.

2. When Level A chemical protective clothing consists of multiple layers, the chemical protective layer shall be tested. However, tightly adhered multiple layers shall be deemed to constitute a single layer.
  3. The results of tests on chemicals other than the recommended test chemicals listed in **Table 3** may be reported in the manner described in **9-c)** as additional information.
- b) Gas-tight chemical protective clothing and spray-tight chemical protective clothing to be worn at the time of chemical/biological terrorism incidents shall undergo an additional test using  $\beta$ -chloroethyl ethyl sulphide [CAS : 693-07-2] and the expected performance for the permeation resistance shall be met.

**Note :** "CAS" numbers are the registry numbers of chemicals in the database provided by the Chemical Abstracts Service (CAS ON-LINE) of the American Chemical Society.

- 1) The permeation resistance test using  $\beta$ -chloroethyl ethyl sulphide shall be conducted in the following manner.
  - 1.1) A test piece of 15 mm x 15 mm shall be cut out and detector paper (10 mm x 10 mm) designated by a test laboratory which is stipulated separately from this standard shall be placed under the test piece. These shall then be placed on a glass plate and the four sides of the test piece shall be sealed by paraffin or similar.
  - 1.2) 0.02 ml of  $\beta$ -chloroethyl ethyl sulphide shall be dripped on to the test piece.
  - 1.3) The test piece shall be placed in a level position inside a thermostatic chamber of  $30 \pm 1^\circ\text{C}$  and any discolouration of the detector paper shall be examined thirty (30) minutes later.
  - 1.4) A test piece showing no clear discolouration of the detector paper shall be judged to have passed the test.

**Table 3 Recommended List of Test Chemicals for Permeation Resistance Test**

Recommended liquid test chemicals	<ul style="list-style-type: none"> <li>* Aceton (2-propanon) [CAS : 67-64-1]</li> <li>Acetonitrile (cyanomethane) [CAS : 75-05-8]</li> <li>Carbon disulphide [CAS : 75-15-0]</li> <li>Dichloromethane (methylene chloride) [CAS : 75-09-2]</li> <li>Diethylamine [CAS : 109-89-7]</li> <li>Ethyl acetate [CAS : 141-78-6]</li> <li>n-hexane [CAS : 110-54-3]</li> <li>Methanol (methyl alcohol; carbinol) [CAS : 67-56-1]</li> <li>* Sodium hydroxide (30 mass %), <math>\rho = 1.33</math> kg/L [CAS : 1310-73-2]</li> <li>* Sulphuric acid (96 mass %), <math>\rho = 1.83</math> kg/L ~ 1.84 kg/L [CAS : 7664-93-9]</li> <li>Tetrahydrofuran (THF; 1, 4-epoxybutane) [CAS : 109-99-9]</li> <li>* Toluene (toluol) [CAS : 108-88-3]</li> </ul>
Recommended gaseous test chemicals	<ul style="list-style-type: none"> <li>* Ammonia, anhydrous (99.99%) [CAS : 7664-41-7]</li> <li>* Chlorine (99.5%) [CAS : 7782-50-5]</li> <li>* Hydrogen chloride (99.0%) (hydrochloric acid) [CAS : 7647-01-0]</li> </ul>

### 6.2.2 Resistance to Penetration by Liquid Under Pressure

In regard to the resistance to penetration by liquid under pressure for materials for Level B and Level C chemical protective clothing, when the performance stipulated by **6.6** of **JIS T8115** is tested using the recommended test chemicals listed in **Table 4**, the test results at least those recommended test chemicals marked with an asterisk (\*) shall meet the relevant class shown in **Table 2**. The test results shall be reported in the manner described in **9-c**).

#### Notes

1. The resistance to penetration by liquid under pressure shall be tested in accordance with **JIS T8031**.
2. When Level B or Level C chemical protective clothing consists of multiple layers, the chemical protective layer shall be tested. However, tightly adhered multiple layers shall be deemed to constitute a single layer.
3. The results of tests on chemicals other than the recommended test chemicals listed in **Table 4** may be reported in the manner described in **9-c**) as additional information.

**Table 4 Recommended List of Test Chemicals for Test on Resistance to Penetration by Liquid Under Pressure**

<p>* Acetone (2-propanon) [CAS : 67-64-1]          Acetonitrile (cyanomethane) [CAS : 75-05-08]          Ethyl acetate [CAS : 141-78-6]          n-hexane [CAS : 110-54-3]</p> <p>* Sodium hydroxide (30 mass %), <math>\rho = 1.33</math> kg/L [CAS : 1310-73-2]          * Sulphuric acid (96 mass %), <math>\rho = 1.83</math> kg/L ~ 1.84 kg/L [CAS : 7664-93-9]          Tetrahydrofuran (THF; 1, 4-epoxybutane) [CAS : 109-99-9]</p>
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### 6.2.3 Liquid Penetration Resistance

In regard to the liquid penetration resistance of material for Level D chemical protective clothing, when the performance stipulated by **6.8** of **JIS T8115** is tested using the recommended-test chemicals listed in **Table 5**, at least those recommended test chemicals marked with an asterisk (\*) shall meet the relevant class shown in **Table 2**. The test results shall be reported in the manner described in **9-c)**.

#### Notes

1. The liquid penetration resistance shall be tested in accordance with **Annex 2** of **JIS T8115**.
2. The results of tests on chemicals other than the recommended test chemicals listed in **Table 5** may be reported in the manner described in **9-c)** as additional information.

### 6.2.4 Liquid Repellency

In regard to the liquid repellency of material for Level D chemical protective clothing, when the performance stipulated by **6.8** of **JIS T8115** is tested using the recommended test chemicals listed in **Table 5**, at least those recommended test chemicals marked with an asterisk (\*) shall meet the relevant class shown in **Table 2**. The test results shall be reported in the manner described in **9-c)**.

#### Notes

1. The liquid repellency shall be tested in accordance with **Annex 2** of **JIS T8115**.
2. The results of tests on chemicals other than the recommended test chemicals listed in **Table 5** may be reported in the manner described in **9-c)** as additional information.

**Table 5 Recommended List of Test Chemicals  
for Liquid Penetration Resistance Test and Liquid Repellency Test**

* Sodium hydroxide (10% aqueous solution) [CAS : 1310-73-2]
* Sulphuric acid (30% aqueous solution) [CAS : 7664-93-9]
n-butanol [CAS : 71-36-3]
Paraxylene [CAS : 106-42-3]

### 6.2.5 Tensile Strength

In regard to the tensile strength, the relevant class shown in **Table 2** shall be met for the performance stipulated by **6.10** of **JIS T8115**.

**Note :** The tensile strength shall be tested in accordance with **Annex 3** of **JIS T8115**.

### 6.2.6 Tear Strength

In regard to the tear strength, the relevant class shown in **Table 2** shall be met for the performance stipulated by **6.11** of **JIS T8115**.

**Note :** The tear strength shall be tested in accordance with **Annex 4** of **JIS T8115**.

### 6.2.7 Puncture Resistance

In regard to the puncture resistance, the relevant class shown in **Table 2** shall be met for the performance stipulated by **6.12** of **JIS T8115**.

**Note :** The puncture resistance shall be tested in accordance with **JIS T8051**.

### 6.2.8 Abrasion Resistance

In regard to the abrasion resistance, the performance stipulated by **6.13** of **JIS T8115** shall meet the relevant class shown in **Table 2**.

#### Notes

1. The abrasion resistance shall be tested in accordance with **Annex 6** of **JIS T8115** using the P320-Cw class abrasive paper stipulated by **JIS R6253**.
2. The materials for a gas-tight chemical protective clothing (Type 1) shall be tested in accordance with **Annex G** of **JIS T8115** and damage shall be judged to have occurred when the difference between non-abraded material and abraded material exceeds 0.1 kPa in one (1) minute. In the case of the materials for a spray-tight chemical protective clothing

(Type 4), judgement on the damage shall be based on the number of abrasion cycles which has resulted in abnormality causing concern in regard to the penetration of chemicals which can significantly affect the performance of the chemical protective clothing.

### **6.2.9 Flex Cracking Resistance**

In regard to the flex cracking resistance, the performance stipulated by **6.14** of **JIS T8115** shall meet the relevant class shown in **Table 2**.

#### **Notes**

1. The flex cracking resistance shall be tested in accordance with **Annex 7** of **JIS T8115**.
2. When the low temperature test is conducted, the test temperature shall be -30°C. The pass level shall be 200 or more flexing cycles without causing damage.
3. The materials of a gas-tight chemical protective clothing (Type 1) shall be tested in accordance with **Annex G** of **JIS T8115** and damage shall be judged to have occurred when the difference between unflexed material and flexed material exceeds 0.1 kPa for one (1) minute. In the case of the materials for a spray-tight chemical protective clothing (Type 4), judgement on the damage shall be based on the number of flexing cycles which has resulted in abnormality causing concern in regard to the penetration of chemicals which can significantly affect the performance of the chemical protective clothing.

### **6.2.10 Resistance to Flame**

In regard to the resistance to flame, the performance stipulated by **6.15** of **JIS T8115** shall meet one of the classes shown in **Table 6**.

#### **Notes**

1. Three test pieces shall be tested. Based on the judgement that no damage has been caused to these test pieces, the original material shall be classified in a suitable class shown in **Table 6**.
2. The materials of a gas-tight chemical protective clothing (Type 1) shall be tested in accordance with **Annex G** of **JIS T8115** and damage shall be judged to have occurred when the difference between unexposed material and exposed material exceeds 0.1 kPa for one (1) minute.

**Table 6 Classification of Resistance to Flame**

Class	Exposure Time of Test Piece	Observed Ignition Performance
1	Test piece is held in flame for five (5) seconds	No formation of molten droplets. Burning does not continue for more than five (5) seconds following removal from flame.
2	Test piece is held in flames for one (1) second	
3	Test piece is passed through flames	

### 6.3 Other Performance Requirements

Protective clothing for rescue teams for protection against chemicals shall meet the other performance requirements stipulated by **6.3.1 through 6.3.5**.

**Note :** Classification of the performance level shall be based on **Table 7**.

**Table 7 Other Test Items and Performance for Classification**

	Type					
	Level A Chemical Protective Clothing		Level B and Level C Chemical Protective Clothing		Level D Chemical Protective Clothing	
	Limited Use	Reusable	Limited Use	Reusable	Limited Use	Reusable
6.3.1.2 Seam strength	Class 5 > 300 N	Class 5 > 300 N	Class 2 > 50 N	Class 4 > 125 N	Class 1 > 30 N	Class 3 > 75 N
6.3.1.3 Permeation resistance of seams	Class 3 > 60 min	Class 3 > 60 min				
6.3.1.4 Resistance of seams to penetration by liquid under pressure			Class 3 > 14 kPa	Class 3 > 14 kPa		
6.3.2.2 Permeation resistance of visor material	Class 3 > 60 min	Class 3 > 60 min				
6.3.2.3 Resistance of visor material to penetration by liquid under pressure			Class 3 > 14 kPa	Class 3 > 14 kPa		
6.3.4.3 Permeation resistance of glove material	Class 3 > 60 min	Class 3 > 60 min				
6.3.4.4 Resistance of glove material to penetration by liquid under pressure			Class 3 > 14 kPa	Class 3 > 14 kPa		
6.3.4.5 a) Cut resistance of glove material	Class 1 ≥ 200 g	Class 2 ≥ 500 g	Class 1 ≥ 200 g	Class 2 ≥ 500 g		
6.3.4.5 b) Puncture resistance of glove material	Class 1 ≥ 20 N	Class 2 ≥ 60 N	Class 1 ≥ 20 N	Class 2 ≥ 60 N		
6.3.4.5 c) Abrasion resistance of glove material	Class 1 ≥ 100 cycles	Class 2 ≥ 500 cycles	Class 1 ≥ 100 cycles	Class 2 ≥ 500 cycles		
6.3.4.5 d) Tear resistance of glove material	Class 1 ≥ 10 N	Class 2 ≥ 25 N	Class 1 ≥ 10 N	Class 2 ≥ 25 N		
6.3.5.2 Permeation resistance of boot material	Class 3 > 60 min	Class 3 > 60 min				
6.3.5.3 Resistance of boot material to penetration by liquid under pressure			Class 3 > 14 kPa	Class 3 > 14 kPa		

### 6.3.1 Seams

The seams of chemical protective clothing shall meet the relevant classes in **Table 7** for the performance stipulated by **7.5.2** through **7.5.4** of **JIS T8115**.

#### 6.3.1.1 General

The seams in this standard include permanent connections between the materials and visor in addition to permanent connections between materials.

#### 6.3.1.2 Seam Strength

All types of straight seams shall be tested in accordance with **Annex 8** of **JIS T8115** and the lowest measured seam strength shall still satisfy the relevant class shown in **Table 7**.

#### 6.3.1.3 Permeation Resistance of Seams

- a) In regard to the permeation resistance of the seams of Level A chemical protective clothing, the performance stipulated by **7.5.3** of **JIS T8115** shall be tested with the recommended test chemicals listed in **Table 3**. The test results for at least those recommended test chemicals marked with an asterisk (\*) shall meet the Class 3 performance in **Table 7**. The test results shall be reported in the manner described in **9-c**).

#### Notes

1. The permeation resistance shall be tested in accordance with **JIS T8030**.
  2. When Level A chemical protective clothing consists of multiple layers, the seams of the chemical protective layer shall be tested. However, tightly adhered multiple layers shall be deemed to constitute a single layer.
  3. The results of tests on chemicals other than the recommended test chemicals listed in **Table 3** may be reported in the manner described in **9-c**) as additional information.
- b) The seams of a gas-tight chemical protective clothing and spray-tight chemical protective clothing to be worn at the time of a chemical/biological terrorism incident shall undergo an additional test using  $\beta$ -chloroethyl ethyl sulphide [CAS : 693-07-2] and the expected performance for the permeation resistance shall be met.



#### **6.3.1.4 Resistance of Seams to Penetration by Liquid Under Pressure**

In regard to the resistance of seams to penetration by liquid under pressure of Level B and Level C chemical protective clothing, the performance stipulated by **7.5.4** of **JIS T8115** shall be tested with the recommended test chemicals listed in **Table 4**. The test results for at least those chemicals marked with an asterisk (\*) shall meet the Class 3 performance in **Table 7**. The test results shall be reported in the manner described in **9-c**).

#### **Notes**

1. The resistance to penetration by liquid under pressure shall be tested in accordance with **JIS T8031**.
2. When Level B or Level C chemical protective clothing consists of multiple layers, the seams of the chemical protective layer shall be tested. However, tightly adhered multiple layers shall be deemed to constitute a single layer.
3. The results of tests on chemicals other than the recommended test chemicals listed in **Table 4** may be reported in the manner described in **9-c**) as additional information.

#### **6.3.2 Visor**

The visor shall meet the following performance requirements.

##### **6.3.2.1 Physical Resistance Properties of Visor Materials**

- a) The visor materials for chemical protective clothing shall meet the performance requirements regarding distortion of the vision, field of vision and impact resistance stipulated by **7.6.3** through **7.6.4** of **JIS T8115**.
- b) The visor materials for Level A chemical protective clothing shall meet the resistance to flame performance stipulated by **6.2.10**.

##### **6.3.2.2 Permeation Resistance of Visor Materials**

- a) In regard to the permeation resistance of the visor materials for Level A chemical protective clothing, when the performance stipulated by **7.6.2** of **JIS T8115** is tested with the recommended test chemicals listed in **Table 3**, the test results for at least those recommended test chemicals marked with an asterisk (\*) shall meet the relevant class shown in **Table 7**. The test results shall be reported in the manner described in **9-c**).

### Notes

1. The permeation resistance shall be tested in accordance with **JIS T8030**.
  2. The results of tests on chemicals other than the recommended test chemicals listed in **Table 3** may be reported in the manner described in **9-c)** as additional information.
- b) The visor for a gas-tight chemical protective clothing and spray-tight chemical protective clothing to be worn at the time of a chemical/biological terrorism incident shall undergo an additional test using  $\beta$ -chloroethyl ethyl sulphide [CAS : 693-07-2] and the expected performance for the permeation resistance shall be met.

#### 6.3.2.3 Resistance of Visor Materials to Penetration by Liquid Under Pressure

In regard to the resistance of the visor materials for Level B and Level C chemical protective clothing to penetration by liquid under pressure, when the performance stipulated by **6.6** of **JIS T8115** is tested with the recommended test chemicals listed in **Table 4**, the test results of at least those recommended test chemicals marked with an asterisk (\*) shall meet the relevant class shown in **Table 7**. The test results shall be reported in the manner described in **9-c)**.

### Notes

1. The resistance to penetration by liquid under pressure shall be tested in accordance with **JIS T8031**.
2. The results of tests on chemicals other than the recommended test chemicals listed in **Table 4** may be reported in the manner described in **9-c)** as additional information.

#### 6.3.3 Face-piece of Respiratory Protective Device

In the case of a gas-tight chemical protective clothing with external self-contained breathing apparatus (Type 1b) of which the structure uses the face-piece as the primary barrier between the external environment and the wearer, the face contact area and eyepiece of the face-piece shall be evaluated as additional materials for chemical protective clothing and the permeation resistance performance stipulated by **6.2.1-a)** shall be met.

#### 6.3.4 Gloves

Gloves shall be the chemical protective gloves stipulated by **JIS T8116** and the following additional performance requirements shall be met.

#### **6.3.4.1 Leak Tightness of Glove Connections**

When gloves are connected to Level A chemical protective clothing, the finished chemical protective clothing with connected gloves shall meet the leak-tightness stipulated by **6.1.1**.

#### **6.3.4.2 Strength of Glove Connections**

The strength of the connections of gloves to chemical protective clothing shall be tested in accordance with **Annex B** of **JIS T8115** and these connections shall not be destroyed or split with a stress of 100 N or less.

#### **6.3.4.3 Permeation Resistance of Glove Materials**

- a) In regard to the permeation resistance of the glove materials for a Level A outfit, the performance stipulated by **7.7** of **JIS T8115** shall be tested with the recommended test chemicals listed in **Table 3**. The test results for at least those recommended test chemicals marked with an asterisk (\*) shall meet the relevant class shown in **Table 7**. The test results shall be reported in the manner described in **9-c**).

##### **Notes**

1. The permeation resistance shall be tested in accordance with **JIS T8030**.
  2. The results of tests on chemicals other than the recommended test chemicals listed in **Table 3** may be reported in the manner described in **9-c**) as additional information.
- b) The glove materials for a gas-tight chemical protective clothing and spray-tight chemical protective clothing to be worn at the time of a chemical/biological terrorism incident shall undergo an additional test using  $\beta$ -chloroethyl ethyl sulphide [CAS : 693-07-2] and the expected performance for the permeation resistance shall be met.

#### **6.3.4.4 Resistance of Glove Materials to Penetration by Liquid Under Pressure**

In regard to the resistance of the glove materials for Level B and Level C chemical protective clothing to penetration by liquid under pressure, the performance stipulated by **6.6** of **JIS T8115** shall be tested with the recommended test chemicals listed in **Table 4** and the test results for at least those recommended test chemicals marked with an asterisk (\*) shall meet the relevant class shown in **Table 7**. The test results shall be reported in the manner described in **9-c**).

## Notes

1. The resistance to penetration by liquid under pressure shall be tested in accordance with **JIS T8031**.
2. The results of tests on chemicals other than the recommended test chemicals listed in **Table 4** may be reported in the manner described in **9-c)** as additional information.

### 6.3.4.5 Physical Resistance Properties of Glove Materials

The glove materials for chemical protective clothing shall meet the values shown in **Table 7** regarding the following performance requirements.

#### a) Cut Resistance

The cut resistance of the glove materials shall be tested using the method stipulated by **JIS T8052** where the blade is moved by a stroke length of 20 mm.

#### b) Puncture Resistance

The puncture resistance of the glove materials shall be tested in accordance with **JIS T8051**.

#### c) Abrasion Resistance

The abrasion resistance of the glove materials shall be tested in accordance with **Annex 6** of **JIS T8115** using the P120-Cw class abrasion paper stipulated by **JIS R6253**.

#### d) Tear Resistance

The tear resistance of the glove materials shall be tested in accordance with **Method A2** of **JIS K6404-4** under the conditions stipulated by **Annex I** of **ISO/DIS 22613** : 2004.

### 6.3.5 Boots

Boots shall be the chemical protective boots stipulated by **JIS T8117** and the following additional performance requirements shall be met.

#### 6.3.5.1 General Performance of Boots

Boots shall meet the performance of all-rubber protective footwear stipulated by **JIS T8101**.

### 6.3.5.2 Permeation Resistance of Boot Material

- a) In regard to the permeation resistance of the boot materials for Level A chemical protective clothing, when the performance stipulated by **7.8** of **JIS T8155** is tested with the recommended test chemicals listed in **Table 3**, the test results for at least those recommended test chemicals marked with an asterisk (\*) shall meet the relevant class shown in **Table 7**. The test results shall be reported in the manner described in **9-c**).

#### Notes

1. The permeation resistance shall be tested in accordance with **JIS T8030**.
  2. The results of tests on chemicals other than the recommended test chemicals listed in **Table 3** may be reported in the manner described in **9-c**) as additional information.
- b) The boot materials for a gas-tight chemical protective clothing and spray-tight chemical protective clothing to be worn at the time of a chemical/biological terrorism incident shall undergo an additional test using  $\beta$ -chloroethyl ethyl sulphide [CAS : 693-07-2) and the expected performance for the permeation resistance shall be met.

### 6.3.5.3 Resistance of Boot Materials to Penetration by Liquid Under Pressure

In regard to the resistance of the boot materials for Level B and Level C chemical protective clothing to penetration by liquid under pressure, when the performance stipulated by **6.6** of **JIS T8115** is tested with the recommended test chemicals listed in **Table 4**, the test results of at least those recommended test chemicals marked with an asterisk (\*) shall meet the relevant class shown in **Table 7**. The test results shall be reported in the manner described in **9-c**).

#### Notes

1. The resistance to penetration by liquid under pressure shall be tested in accordance with **JIS T8031**.
2. The results of tests on chemicals other than the recommended test chemicals listed in **Table 4** may be reported in the manner described in **9-c**) as additional information.

### 6.3.5.4 Strength of Connections of Boots

The strength of the connecting part of boots attached to chemical protective clothing shall be tested in accordance with **Annex B** of **JIS T8115** and the connections shall not be destroyed or split by stress of 100 N or less.

### 6.3.5.5 Performance of Bootees

Bootees attached to chemical protective clothing shall meet all the performance requirements for chemical protective clothing stipulated by **6.2** except for resistance to flame in **6.2.10**.

## 7. Inspection

The following items shall be inspected and the inspection results shall comply with the requirements under the individual items of **6**.

### Notes

1. The leak-tightness inspection shall be 100% inspection.
2. The resistance to liquid penetration and resistance to mist penetration shall be inspected by means of sampling inspection.
  - a) Leak-tightness
  - b) Resistance to liquid penetration (spray test : Method D)
  - c) Resistance to mist penetration (spray test : Method F)

## 8. Labelling

All items of protective clothing for rescue teams for protection against chemicals shall include a label that shall be permanently attached to the chemical protective clothing in a conspicuous location and include at least the following information in Japanese.

**Note :** In the case of non-integral gloves and boots to the main body of protective clothing, the individual indications of **a), b), e) and k)** listed below shall be sufficient.

- a) Name of standard (Protective Clothing for Rescue Teams for Protection Against Chemicals: CFASDM 003) and year of establishment of the said standard
- b) Model number (number given by a certification body which is stipulated separately from this standard)
- c) Type [for example, Level A chemical protective clothing for rescue teams (Type 1a); Level B/C chemical protective clothing for rescue teams (Type 4)]
- d) Name of product and product number
- e) Name of manufacturer or its code
- f) Category of limited use product or reusable product

- g) Whether or not the performance requirements for chemical protective clothing for chemical/biological terrorism incidents are met
- h) Special performance (for example, low temperature capability or resistance to flame capability)
- i) Year of manufacture or its code
- j) Manufacturing lot number or tracking number
- k) Size
  - 1) The sizes of chemical protective clothing shall be within the range of sizes stipulated by **JIS T8005**.
  - 2) The sizes of gloves shall be those stipulated by **5.2 of JIS T8116**.
  - 3) The sizes of boots shall be those stipulated by **5.2 of JIS T8117**.
- l) Clear statement or a pictogram indicating the need to read the instructions for use. However, indication by means of a pictogram is voluntary.

## 9. Instructions for Use

The manufacturer shall provide instructions with every chemical protective clothing or shall alternatively provide instructions with at least every commercial packaging unit in Japanese. The instructions shall contain the information given on the label and at least the following information, as applicable:

### a) Pre-Use Information

- 1) Safety considerations (limitations of use)
- 2) Handling cautions
- 3) Indication of corresponding use of chemical protective clothing [for example, Level A chemical protective clothing for rescue teams (Type 1a) or Level B/C chemical protective clothing for rescue teams (Type 4)]
- 4) Category of limited use product or reusable product
- 5) Principle materials or their common names for chemical protective clothing, visor, gloves and boots
- 6) Type of supplied air respiratory protective device which is simultaneously used in the case of a gas-tight chemical protective clothing with external self-contained breathing apparatus (Type 1b)
- 7) Types of gloves and boots simultaneously used
- 8) Closure lubricants, if applicable
- 9) Anti-fog agents or procedures for visor

- 10) Size
- 11) Fitting adjustment method when worn
- 12) Inspection frequency and details
- 13) Donning and doffing procedures
- 14) Storage method and shelf life
- 15) Warranty information

**b) Post-Use Information**

- 1) Cleaning method and warning not to use chemical protective clothing which has not been thoroughly cleaned and dried
- 2) Decontamination method
- 3) Maintenance criteria and repair methods
- 4) Disposal criteria and considerations

**c) Test Results**

**1) Test Data on Chemicals**

The test data on chemicals in terms of the permeation resistance, resistance to penetration by liquid under pressure, liquid penetration resistance and liquid repellency shall be shown in the form of a table, etc. for each tested material or seam.

1.1) For the permeation resistance, the average normalised breakthrough detection time and performance class for each test chemical shall be stated.

**Note :** Reporting of the minimum normalised breakthrough chemical protective clothing, maximum permeation rate and steady state permeation rate shall be optional.

1.2) For the resistance to penetration by liquid under pressure, the average penetration pressure and performance class for each test chemical shall be stated.

1.3) For the liquid penetration resistance, the average penetration index and performance class for each test chemical shall be stated.

1.4) For the repellency, the average repellency index and performance class for each test chemical shall be stated.

**2) Other Test Data**

Although it is desirable for the instruction for use to contain the results of all other tests stipulated by this standard, the reporting of such test results shall be optional.



## **Annex (informative) : Guidelines for the Selection of Chemical Protective Clothing**

This Annex has been prepared as an abridged version of **ISO/CD 20512.1:2004 Annex A (ISO/CD 20513.1:2004 Annex B** with the same contents) and presents the guidelines for the selection of Level A chemical protective clothing and Level B chemical protective clothing in this standard.

The test chemicals used to determine pass or failure differ between this standard and **ISO/CD 20512.1:2004** or **ISO/CD 20513.1:2004**. In the case of the permeation resistance test on protective clothing to be worn at the time of a chemical terrorism incident, it is decided to conduct the test using pseudo agents stipulated by the Defense Agency as the test using real sarin and mustard gas cannot be conducted in Japan. This standard does not demand a test on the resistance to penetration by a virus under pressure regarding the protective clothing to be worn at the time of a biological terrorism incident. For this reason, sufficient caution must be called for in regard to the limitation of use in the guidelines.

### **1. Risk Assessment**

#### **1.1 Recommended Process**

A proper response to chemicals requires identification of the hazard at the site of the subject disaster so that the level of the necessary protection can be judged. For this purpose, risk assessment as well as hazard assessment must be conducted. The recommended steps of the risk assessment process are described below.

- 1) Define the response environment and associated tasks to be evaluated.
- 2) Identify the hazards associated with each work task.
- 3) Determine each affected body area or body system.
- 4) Estimate the likelihood of employee exposure to identified hazards.
- 5) Estimate the possible consequences of exposure to identified hazards.

#### **1.2 Identification of Hazard**

For the identification of the hazard to which exposure may occur, the following aspects of the work place must be considered.

- a) Checking of Potential or Actual Chemical Hazards
  - 1) Identify specific chemicals involved in the response.
  - 2) For overlapping tasks, identify the chemicals and their effects.

- 3) Note the temperature of chemicals to which contact will take place.

**b) Physical Properties of Chemicals**

- 1) Identify as a solid, liquid or gas.
- 2) List the material's vapour pressure.
- 3) If a mixture is present, determine the properties of the major components.

**c) Chemical Contact Periods**

- 1) Determine if contact with the chemical(s) will be as solids, liquids, vapours or gas.
- 2) Note how long the chemical protective clothing will be in direct contact with the chemicals (seconds, minutes, hours or days).
- 3) Determine if the contact is routine, intermittent or infrequent/unplanned.
- 4) Note if the chemical protective clothing is simply for splash protection and if the wearer can change quickly.

**d) Types of Potential Risk**

- 1) Determine the type of chemical contact expected under emergency conditions (e.g. pressurised spray accident).
- 2) Note the physical hazards that will impact the integrity of the clothing to keep chemicals out (tearing, cut, puncture or abrasion risks).
- 3) Attention to other types of hazards, including the following :
  - 3.1) Other physical hazards (e.g. flying debris, slippery surfaces)
  - 3.2) Environmental hazards (e.g. extremes of cold or heat, noise, lighting)
  - 3.3) Biological hazards (e.g. airborne or liquid-borne pathogens)
  - 3.4) Thermal hazards (e.g. contact with hot surfaces, radiant heat)
  - 3.5) Electrical hazards
  - 3.6) Radiation hazards
- 4) Hazard originating from the site environment (examples : drowning and falling)
- 5) Hazard originating from the chemical protective clothing itself
  - 5.1) Creation of particles or static electricity that can damage sensitive environments
  - 5.2) Allergic or other skin reactions from non-biocompatible materials
  - 5.3) Retention of contamination for continued exposure

- 5.4) Reduced mobility and hand function or impaired communication and vision for diminished productivity or propensity to accidents
- 5.5) Lack of ankle or back support increasing the opportunity for strains and sprains
- 5.6) Heat stress from use in warm environments

### **1.3 Estimation of Likelihood of Exposure**

The presence of chemicals does not necessarily lead to exposure. Estimation of the likelihood of exposure should be based on the results of prior analysis.

### **1.4 Determination of Risk**

Hazard assessment can clarify the entire picture of a hazard, parts of the body likely to be affected, likelihood of exposure and probable consequences of exposure. It is necessary to conduct risk assessment to determine which hazard carries the largest risk so that appropriate chemical protective clothing can be selected.

## **2. Selection of Gas-Tight Chemical protective clothing (Type 1)**

On the following occasions, the wearing of a gas-tight suit is preferable.

- a) The chemical substance has been identified and requires the highest level of protection for skin, eyes and the respiratory system based on either :
  - 1) measured (or potential for) high concentration of atmospheric vapours, gases or particulates;  
or
  - 2) Site operations and work functions involving a high potential for splash, immersion or exposure to unexpected vapours, gases or particulates of materials that are harmful to skin or capable of being absorbed through intact skin.
- b) Substances with a high degree of hazard to the skin are known or suspected to be present and skin contact is possible.
- c) Operations must be conducted in confined, poorly ventilated areas until the absence of conditions requiring this level of protection is determined.

### 3. Selection of Spray-Tight Chemical protective clothing (Type 4)

On the following occasions, the wearing of a spray-tight suit is preferable.

- a) The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection but less skin protection. This involves atmospheres :
  - 1) with IDLH (Immediately Dangerous to Life or Health) concentrations of specific substances that do not represent a severe skin hazard; or
  - 2) that do not meet the criteria for use of air-purifying respirators.

**Note :** Here, Level B chemical protective clothing should be selected. Level C chemical protective clothing cannot be selected.

- b) The presence of incompletely identified vapours or gases is indicated by a direct-reading organic vapour detection instrument but vapours and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through intact skin.
- c) There are no vapour or gas hazards that are present; the primary hazard is contact with chemicals or materials in liquid form via spray or splashes.

### 4. Other Items Used Simultaneously

The use of the following items is recommended.

- a) Hard hat
- b) Two-way radio communications
- c) Coveralls (to wear under the chemical resistant clothing)
- d) Disposable boot covers

## Protective Clothing for Rescue Teams for Protection Against Chemicals

### Explanations

The explanations given here regard the matters stipulated or described in the body text and Annex, matters described as references and related matters and do not constitute part of the standard.

#### 1. Key Points of the Standard

The purpose of the establishment of this standard and the formulation policies are explained below.

##### 1.1 Purpose

The purpose of this standard is to stipulate the minimum structural requirements and performance requirements for chemical protective clothing to be used by rescue team members at the time of special kinds of disasters, including chemical/biological terrorism incidents, and large-scale disasters.

##### 1.2 Formulation Policies

- a) The standard is based on the relevant **JIS** standards, **ISO/CD 20512.1:2004** Hazardous Materials Response Equipment - Spray-Tight, Liquid Splash Protective Ensembles (Type 4) and **ISO/CD 20513.1:2004** Hazardous Materials Response Personal Protective Equipment - Gas-Tight Vapour-Protective Ensembles for Emergency Response Teams (Type 1) (hereinafter referred to as " Draft **ISO** standards), both of which are current under deliberation by **ISO/TC94/SC14** (Fire-Fighter's Personal Equipment), while incorporating the relevant **EN** standard, **NFPA** standard and other domestic specifications.
- b) This standard does not intend to exclude products conforming to overseas standards (**EN** or **NFPA**).

##### 1.3 Purpose of Revision

The original edition of this standard was established in 2004. The decision to publish the second edition was for the principal purpose of revising the normative references because of the facts that protective clothing-related **JIS** standards which were being deliberated in 2004 were gradually established and that the draft **ISO** standards, which formed the basis of the work, were formalised as formal drafts **ISO/CD 20512.1:2004** and **ISO/CD 20513.1:2004** of the Committee in the subsequent years.

## 2. Contents of Stipulated Items

The contents of the stipulated items are explained below. To assist understanding of this standard, Sections 3 and 4 of the explanations offer a summary of **ISO 11613:1999 Annex F** - Risk Assessment and an example of the guidelines for the setting up of a warning area, etc. respectively.

### 2.1 Scope of Application

The purpose of this standard is to "stipulate the minimum structural requirements and performance requirements for chemical protective clothing to be used by rescue team members at the time of special kinds of disasters, including chemical/biological terrorism incidents, and large-scale disasters". Accordingly, users must be reminded to pay careful attention to the following issues.

- a) This standard stipulates the minimum structural requirements, performance requirements and others for chemical protective clothing to be used by rescue teams at the time of special kinds of disasters or large-scale disasters. For this reason, ordinary citizens with insufficient education and training are the subject persons of this standard.
- b) The chemical protective clothing referred to in this standard aims at achieving protection against chemicals and does not aim at protecting the wearer from exposure to radiation and other types of hazards. Particular attention should be paid to the fact that the resistance to flames in this standard is designed to provide a very limited level of protection for the purpose of evacuation at the time of a fire involving a chemical (flash fire).
- c) It is assumed that the required equipment in a hazardous area differs for chemical terrorism and biological terrorism. For this reason, the administration of this standard in a uniform manner is unnecessary.

### 2.2 Normative References

This standard cites the **JIS** standards which are consistent with the relevant **ISO** standards so that the performance requirements, etc. are consistent with the relevant **ISO** standards.

### 2.3 Definitions

In addition to citing the terms used in the **JIS** standards, the necessary terms are defined.

## **2.4 Types**

For the types of chemical protective clothing, the concept of a level of protection corresponding to a specific environment and purpose of use is adopted to determine types corresponding to the required levels of protection. The assumed areas and environment for use are explained next.

### **2.4.1 Level A Chemical Protective Clothing**

#### **a) Areas for Use**

Hazardous areas (contaminated areas) where a subject substance has been identified and a high level of respiratory protection as well as skin and eye protection are required.

#### **b) Environment for Use**

- 1) There is a possibility of exposure to a subject substance leading to instant death or a serious medical condition or significant loss of the evacuation capacity.
- 2) There is concern that a subject substance has a high vapour pressure, high skin toxicity and/or carcinogenic properties.
- 3) When work is conducted in a place with insufficient ventilation.

### **2.4.2 Level B Chemical Protective Clothing**

#### **a) Areas for Use**

Hazardous areas (contaminated areas) where the required level of respiratory protection is roughly equivalent to that of Level A chemical protective clothing but the level of skin and eye protection can be lower than that of Level A chemical protective clothing.

#### **b) Environment for Use**

- 1) When none of Items **1)** through **3)** in **2.4.1-b)** are applicable.
- 2) When the composition and concentration of a subject substance are incompatible with the conditions of use for the filter of the gas mask.
- 3) When there is no hazard originating from vapour or gas and the main hazard is posed by a spray or splash state liquid chemical or other substances.

### **2.4.3 Level C Chemical Protective Clothing**

#### **a) Areas for Use**

Quasi-hazardous areas (including decontamination zones) where the required level of skin protection is roughly equivalent to that of Level B chemical protective clothing but the level of respiratory protection can be lower than that of Level B chemical protective clothing.

#### **b) Environment for Use**

When the composition and concentration of the hazardous substance in air have been identified and are found to be compatible with the conditions of use for the filter of the gas mask.

### **2.4.4 Level D Chemical Protective Clothing**

#### **a) Areas for Use**

Warning areas where respiratory protection is not required but the minimum level of skin protection is required.

#### **b) Environment for Use**

- 1) When there is no hazardous substance in the atmosphere
- 2) When the risk of contact or unforeseeable contact with a hazardous material has been eliminated.

## **2.5 Structure**

- a) It is decided for the purpose of this standard that the performance of the visor, gloves and boots which are simultaneously used with a chemical protective clothing shall be evaluated as integral components of chemical protective clothing based on the concept of level protection. Three types of attachment of gloves or boots to a suit are assumed : permanent connection of gloves or boots to a chemical protective clothing (assemblage method), non-permanent connection (joint method) and close contact of gloves or boots to a suit. The expression "simultaneously used" is used as a general reference to all of these three attachment methods.
- b) This standard permits the use of an outer garment along with Level A, Level B or Level C chemical protective clothing to meet the required performance. As the main purpose of protection by protective clothing is protection against chemicals, this standard holds that the performance relating to physical resistance and resistance to flames other than the performance relating to protection against chemicals can be supplemented by an outer



garment. However, the requirements under this standard can only be met when chemical protective clothing and an outer garment are simultaneously worn in an appropriate manner.

- c) The standard configuration and assumed areas for use are shown in the table below in correspondence with individual types of chemical protective clothing.

**Explanations Table 1 Standard Configuration and Assumed Areas of Use of Chemical Protective Clothing**

	Level A Chemical Protective Clothing	Level B Chemical Protective Clothing	Level C Chemical Protective Clothing	Level D Chemical Protective Clothing
Type of chemical protective clothing	Gas-tight chemical protective clothing with internal self-contained breathing apparatus (Type 1a) or gas-tight chemical protective clothing with external self-contained breathing apparatus (Type 1b)	Spray-tight chemical protective clothing (Type 4)	Spray-tight chemical protective clothing (Type 4)	Mist-tight chemical protective clothing (Type 6)
Type of respiratory protective device	Supplied air respiratory protective device for rescue teams	Supplied air respiratory protective device for rescue teams or air purifying respiratory protective device for rescue teams	Air purifying respiratory protective device for rescue teams	
Gloves	Protective gloves against chemicals	Protective gloves against chemicals	Protective gloves against chemicals	Protective gloves against chemicals or other gloves
Boots	Protective boots against chemicals	Protective boots against chemicals	Protective boots against chemicals	Protective boots against chemicals or other footwear
Assumed areas for use	Hazardous areas (contaminated areas)	Hazardous areas (contaminated areas)	Quasi-hazardous areas (including decontamination zones)	Warning areas

**d) Types of Chemical Protective Clothing Stipulated by ISO**

The ISO classifies chemical protective clothing into 11 types and stipulates the performance requirements for each type. For reference, Explanations **Table 2** lists the chemical protective clothing stipulated by **JIS T8115**.

**Note :** This standard adopts four different types of chemical protective clothing for rescue teams : gas-tight chemical protective clothing with internal self-contained breathing apparatus (Type 1a), gas-tight chemical protective clothing with external self-contained breathing apparatus (Type 1b), spray-tight chemical protective clothing (Type 4) and mist-tight chemical protective clothing (Type 6). The provisions of this standard regarding a gas-tight chemical protective clothing with internal self-contained breathing apparatus (Type 1a), gas-tight chemical

protective clothing with external self-contained breathing apparatus (Type 1b) and spray-tight chemical protective clothing (Type 4) are generally compatible with the provisions of the Draft ISO standards, **EN 943-2**, **NFPA 1991**, **NFPA 1992** and **NFPA 1994**.

**Explanations Table 2 Types of Chemical Protective Clothing Stipulated by ISO**

Full body chemical protective clothing	Gas-Tight chemical protective clothing	Gas-tight chemical protective clothing with internal self-contained breathing apparatus (Type 1a)	Gas-tight chemical protective clothing with which self-contained breathing apparatus is mounted inside the suit
		Gas-tight chemical protective clothing with external self-contained breathing apparatus (Type 1b)	Gas-tight chemical protective clothing with which self-contained breathing apparatus is mounted outside the suit
		Supplied air gas-tight chemical protective clothing (Type 1C)	Gas-tight chemical protective clothing with which breathable air is supplied from outside the suit via a hose
	Non Gas-Tight chemical protective clothing	Non gas-tight chemical protective clothing for protection against gas (Type 2)	Non gas-tight full body chemical protective clothing with a structure where breathing air is supplied from outside to maintain the positive air pressure inside the suit
		Liquid-tight chemical protective clothing (Type 3)	Full body chemical protective clothing with a structure where the areas between the different parts of the clothing and between the clothing and gloves as well as footwear are connected to protect the wearer from jets of liquid chemicals
		Spray-tight chemical protective clothing (Type 4)	Full body chemical protective clothing with a structure where the areas between the different parts of the clothing and between the clothing and gloves as well as footwear are connected to protect the wearer from the spray of liquid chemicals
		Particulate-tight chemical protective clothing (Type 5)	Full body chemical protective clothing with a structure where the areas between the different parts of the clothing and between the clothing and gloves as well as footwear are connected to protect the wearer from air-borne solid particulates
		Mist-tight chemical protective clothing (Type 6)	Full body chemical protective clothing with a structure where the areas between the different parts of the clothing and between the clothing and gloves as well as footwear are connected to protect the wearer from liquid mist
	Partial Body chemical protective clothing		Liquid-tight partial body chemical protective clothing (Type 3p)
		Spray-tight partial body chemical protective clothing (Type 4p)	Spray-tight chemical protective clothing which protects part of the body
		Mist-tight partial body chemical protective clothing (Type 6p)	Mist-tight chemical protective clothing which protects part of the body

## **2.6 Performance and Test Method**

### **2.6.1 Finished Chemical Protective Clothing**

#### **2.6.1.1 Leak-tightness**

The test on leak-tightness is required for every type of gas-tight chemical protective clothing. The inside of chemical protective clothing is constantly pressurised at a certain level and the leak-tightness of the entire chemical protective clothing is checked based on a stipulated limit for pressure drop after a certain length of time. The test method and judgement criteria are compatible with the provisions of **JIS T8115** so that any of the Draft **ISO** standards, **EN 943-2** and **NFPA 1994** can be used.

#### **2.6.1.2 Inward leakage**

The test on the inward leakage is required for gas-tight chemical protective clothing to be worn at the time of chemical/biological terrorism incidents and gas-tight chemical protective clothing with external self-contained breathing apparatus (Type 1b) where the mask, of which the face-piece acts as the visor for the chemical protective clothing, is attached externally. After a pre-determined exercise by a person wearing an actual chemical protective clothing, the inflow quantity of contaminants in the environment to the chemical protective clothing is measured. In the case of a chemical protective clothing with external self-contained breathing apparatus (Type 1b) where the mask, of which the face-piece acts as the visor for the chemical protective clothing, is attached externally, this standard demands the test on the leakage rate inside the suit in consideration of absorption by the skin in addition to the test on the inward leakage inside the face-piece. Apart from this additional demand, the test method and judgement criteria are compatible with **JIS T8115**, the Draft **ISO** standards and **EN 943-1**. In regard to chemical protective clothing to be used at the time of chemical/biological terrorism incidents, **Method B1** is adopted as an additional test method under the provision of **a)**.

#### **2.6.1.3 Liquid penetration resistance (Spray test : Method D)**

This test is required for spray-tight chemical protective clothing (Type 4). The actual chemical protective clothing is worn by a person and liquid chemicals are sprayed on to the clothing to check for any penetration of the liquid behind the clothing via the connections, etc. The test method and judgement criteria are compatible with **JIS T8115** and the Draft **ISO** standards. In regard to chemical protective clothing to be used at the time of chemical/biological terrorism incidents, it is stipulated that a spray-tight chemical protective clothing "shall not show any signs of penetration" in the accompanying **Note**.

#### **2.6.1.4 Mist penetration resistance**

This test is required for mist-tight chemical protective clothing (Type 6). The actual chemical protective clothing is worn by a person and liquid chemicals are sprayed on to the clothing to check for any penetration of the liquid behind the clothing via the connections, etc. Compared to the Method D spray test, the test flow rate is lower and the surface tension of the liquid is greater. The test method and judgement criteria are compatible with **JIS T8115**.

#### **2.6.1.5 Practical Performance**

This test is required for all types of chemical protective clothing. The actual chemical protective clothing is worn by a person and, after certain exercises and work, the degree of any impairment to work, etc., field of vision and leak-tightness of the chemical protective clothing after work are checked. There are major discrepancies regarding the test method and judgement criteria between **JIS T8115/EN 943-1/NFPA 1994** and the Draft **ISO** standards/**EN 943-2**. The deliberations for this standard have found that the conditions stipulated by the Draft **ISO** standards and **EN 943-2** are too severe. Accordingly, it is decided to adopt the conditions adopted by **JIS T8115**. As the use of protective clothing for rescue teams for protection against chemicals cannot specify the use environment, it is decided that the test on the practical performance should be conducted after the execution of thermal preconditioning. Accordingly, although **JIS T8115** stipulates that the test shall be conducted with one piece of chemical protective clothing prior to thermal preconditioning and with another piece after thermal preconditioning, this standard only requires the test on one piece after thermal preconditioning. For reference, the relevant sections of the Draft **ISO** standards are cited below.

The difference between the Draft **ISO** standards and **EN 943-2** is that while the Draft **ISO** standards stipulate a walking speed of a constant 5 km/hr, **EN 943-2** adopts a constant walking speed of 6 km/hr.

##### **a) Practical Performance Test Model**

- 1) Test Conditions** : Temperature of  $20 \pm 5^{\circ}\text{C}$ ; relative humidity of less than 60%; ambient noise level of 75 dBA or lower
- 2) Procedure** : The test must complete the following steps within thirty (30) minutes.
  - 2.1) Walking on a flat surface at a constant speed of 5 km/hr for 5 min**
  - 2.2) Climbing up a ladder (total vertical distance : 20 m)**

- 2.3) Lifting up and down of a work tool weighing 25 kg 10 times each from the top of a work table with the upward and downward movements being vertically made involving a height of 1.8 m
- 2.4) Walking with a bent posture on a flat surface with a head clearance of  $1.3 \pm 0.2$  m (total distance : 200 m)
- 2.5) Crawling on a flat surface with a head clearance of  $0.70 \pm 0.05$  m (total distance : 10 m)
- 2.6) Extension of a 15 m long fire hose and rewinding
- 2.7) Walking on a flat surface at a constant speed of 6 km/hr for the remaining time if all of the above steps have been completed within thirty (30) minutes

**b) Practical Performance Test Method in Cold Environment**

- 1) Test Conditions : Temperature of  $-15 \pm 3^{\circ}\text{C}$
- 2) Procedure : The test must complete the following steps within thirty (30) minutes.
  - 2.1) Walking on a flat surface at a constant speed of 5 km/hr for 5 min
  - 2.2) Crawling on a flat surface with a head clearance of  $0.70 \pm 0.05$  m (total distance : 10 m)
  - 2.3) Lifting up and down of a work tool weighing 25 kg 10 times each from the top of a work table with the upward and downward movements being vertically made involving a height of 1.8 m
  - 2.4) Walking on a flat surface at a constant speed of 6 km/hr for the remaining time if all of the above steps have been completed within thirty (30) minutes

**2.6.1.6 Face-piece**

The performance and requirements of a gas-tight chemical protective clothing are stipulated regarding the basic matters for the face-piece which is integral or connected to chemical protective clothing. The test method and judgement criteria are based on **JIS T8115** and the Draft **ISO** standards.

**2.6.1.7 Lifeline Attached to Self-Contained Breathing Apparatus**

This test is required for a gas-tight chemical protective clothing with internal self-mounted breathing apparatus (Type 1a) to which a lifeline is attached. The test is designed to check the impacts of the practical performance test on the lifeline to be attached to the self-contained breathing apparatus and the connection as well as strength of the attachment. The test method and judgement criteria are equivalent to those of **JIS T8115**, the Draft **ISO** standards, **EN 943-1** and **NFPA 1994**.

### **2.6.1.8 External Ventilation Hose**

This test is required for a gas-tight chemical protective clothing with external self-contained breathing apparatus (Type 1b) equipped with an external ventilation hose. The test is designed to check the impacts of the practical performance test on the external ventilation hose, strength of the connection with the chemical protective clothing and resistance of the hose against collapse. The test method and judgement criteria are equivalent to those of **JIS T8115**, the Draft **ISO** standards and **EN 943-1**.

### **2.6.1.9 Exhaust Assemblage**

This section stipulates the fitting conditions for an exhaust assemblage for a gas-tight suit with externally mounted self-contained breathing apparatus (Type 1b) and the leak-tightness of the exhaust assemblage. The test method and judgement criteria are equivalent to those of **JIS T8115**, the Draft **ISO** standards and **EN 943-1**.

### **2.6.1.10 Pressure Inside Protective Clothing**

This test is required for a gas-tight chemical protective clothing with internal self-contained breathing apparatus (Type 1a) and a gas-tight chemical protective clothing with external self-contained breathing apparatus (Type 1b) equipped with an exhaust assemblage. The test is designed to check the upper limit of the allowable pressure inside chemical protective clothing and the leak-tightness after the internal pressure test for chemical protective clothing. The test method and judgement criteria are equivalent to those of **JIS T8115**, the Draft **ISO** standards and **NFPA 1994**.

## **2.6.2 Materials for Chemical Protective Clothing**

Of the various performance requirements of chemical protective clothing materials, the performance requirements of **EN 943-2** which have already been established as the performance requirements for Level A chemical protective clothing are adopted for the physical resistance properties. This leads to a situation of reversal where some of the required performance levels of Level B and Level C chemical protective clothing stipulated by the Draft **ISO** standards regarding the physical resistance properties are higher than those of Level A chemical protective clothing. To resolve this situation, the required performance levels of **EN 943-2** are adopted for the tear strength and puncture resistance rather than those of the Draft **ISO** standards.

### 2.6.2.1 Permeation Resistance

- a) The required minimum performance level for the permeation resistance of the materials for Level A chemical protective clothing against the recommended test chemicals is one class higher than the minimum required level of **EN 943-2** to match sixty (60) minutes which is the minimum required level of the Draft **ISO** standards. This level of performance requirement is compatible with the required level for the mask. No minimum requirement level is stipulated for the materials for Level B, Level C and Level D chemical protective clothing because **JIS T8115** does not require permeation resistance for Type 4 and Type 6 suits.
- b) The types of recommended test chemicals in the original edition have now been revised to match the 15 test chemicals adopted by **JIS T8115**, the Draft **ISO** standards and **EN 943-2**. Meanwhile, **NFPA 1991** stipulates 21 standard test chemicals. While the minimum average normalized breakthrough time (permeation resistance) is equally sixty (60) minutes, only seven standard test chemicals designated in the original edition are used for the judgement on pass or failure, differing from the Draft **ISO** standards which demand a Class 3 performance for all 15 test chemicals. It is, however, decided that test shall be conducted for all 15 test chemicals and that the test results shall be reported in the instruction for use. These arrangements aim at improving the convenience for users. The seven test chemicals used to provide the judgement criteria are selected based on the domestic production volume and occupational exposure limits.
- c) Because of the decisions explained in a) and b), the performance of chemical protective clothing which passes this standard is not necessarily equal to that of international standards (draft) and overseas standards. It is essential that users of chemical protective clothing meeting the requirements of this standard pay careful attention to this fact.
- d) The level of permeation resistance of gas-tight chemical protective clothing and spray-tight chemical protective clothing to be worn at the time of chemical/biological terrorism incidents to  $\beta$ -chloroethyl ethyl sulphate is made identical to the level required of the face-piece under the "Standard for Air Purifying Respiratory Protective Devices for Rescue Teams (CFASDM 001:2004)" and the "Standard for Supplied Air Respiratory Protective Devices for Rescue Teams (CFASDM 002:2004)".

#### Notes

1. This requirement is compatible with Chemical Protective Clothing Type 4 (**DSP L4311**) of the Defence Agency specifications.
2. Both the Draft **ISO** standards and **NFPA 1994** demand the permeation resistance test using real chemical terrorism agents. However, as it is impossible to conduct tests using real chemical terrorism agents in Japan, the Defence Agency specifications are adopted as alternatives. Explanations **Table 3** lists the recommended test chemicals stipulated as

chemical terrorism-related agents by **NFPA 1994**. The agents stipulated by the Draft **ISO** standards are marked with an O.

**Explanations Table 3 Chemical Terrorism-Related Chemicals and Their Permeation Resistance Performance**

	Standard Test Chemical	Permeation Resistance Performance	Draft ISO Standards
Liquid Chemical Terrorism Agents	Distilled sulphur mustard [HD; bis (beta-chloroethyl) sulphide] CAS 505-60-2; 32 ± 1°C	Average cumulative permeation mass per hour ≤ 4.0 µg/cm <sup>2</sup>	O
	Lewisite [L; 2-chlorovinyl-dichloro-arsine] CAS 541-25-3; 32 ± 1°C		X
	Sarin [GB; isopropyl methane-fluorophosphate] CAS 107-44-8; 32 ± 1°C (90 V ± 1°C)	Average cumulative permeation mass per hour ≤ 1.25 µg/cm <sup>2</sup>	O
	V agent [VX; O-ethyl S-diisopropylamino-ethyl methyl phosphorothiolate] CAS 50782-69-9; 32 ± 1°C		O
Liquid Toxic Industrial Chemical	Dimethyl sulphate [DMA; sulphuric acid dimethyl ester] CAS 77-78-1; 32 ± 1°C	Average breakthrough time ≥ 60 min	O
Gaseous Toxic Industrial Chemicals	Ammonia [CAS 7664-41-7]; 32 ± 1°C		X
	Chlorine [Cl <sub>2</sub> ; CAS 7782-50-5]; 32 ± 1°C		X
	Cyanogen chloride [CK; CAS 506-77-4]; 32 ± 1°C		O
	Carbonyl chloride [CG; phosgen; CAS 75-44-5]; 32 ± 1°C		O
	Hydrogen cyanide [AC; HCN; CAS 74-90-8]; 32 ± 1°C	O	

### 2.6.2.2 Resistance to Penetration by Liquid Under Pressure

- a) The minimum performance level regarding the resistance of Level B or Level C chemical protective clothing materials to penetration by liquid under pressure using a recommended test chemical is set at equivalent to that of the Draft **ISO** standards. In the case of Level A chemical protective clothing materials, it is decided that the minimum required performance level is not set up under this test item because of the existence of a minimum required level for the permeation resistance. In the case of Level D chemical protective clothing, it is decided that the minimum required level is not set up as **JIS T8115** does not require resistance to penetration by liquid under pressure for Type 6 chemical protective clothing.
- b) The number of the recommended test chemicals in the original edition has been revised to seven (7) to match the number adopted by the Draft **ISO** standards. The level of concentration differs between this standard and the Draft **ISO** standards because of the selection of seven chemicals from the recommended test chemicals for the permeation resistance test. **NFPA 1992** also stipulates a similar seven chemicals. While the stipulated load pressures are similar (14 KPa and 13.8 KPa), this standard differs from the Draft **ISO** standards in that it only uses three (3) recommended test chemicals designated in the original edition to determine whether chemical protective clothing materials pass or fail this standard compared to the demand of the Draft **ISO**



standards where a Class 3 performance is demanded for all seven test chemicals. It is, however, decided that test shall be conducted for all seven test chemicals and that the test results shall be reported in the instruction for use. These arrangements aim at improving the convenience for users. The three test chemicals used to provide the judgement criteria are selected based on the domestic production volume and occupational exposure limits.

- c) Because of the decisions explained in a) and b), the performance of chemical protective clothing which passes this standard is not necessarily equal to that of international standards (draft) and overseas standards. It is essential that users of chemical protective clothing meeting the requirements of this standard pay careful attention to this fact.
- d) The Draft **ISO** standards demand that Level A and Level B chemical protective clothing materials to deal with biological terrorism undergo the test in accordance with **ISO/DIS 16604** (Clothing for protection against contact with blood and body fluids - Determination of resistance of protective clothing materials to penetration by blood-borne pathogens - Test method using Phi-X 174 bacteriophage). The required performance level is that no viral penetration shall occur under a pressure of 28 kPa for Level A chemical protective clothing or 14 kPa for Level B chemical protective clothing. However, the relevant sections of the Draft **ISO** standards are not incorporated in this standard because of the facts that the required performance of Level A chemical protective clothing is met by the leak-tightness test and permeation resistance test and that the required performance of Level B chemical protective clothing is similarly met by the test on resistance to penetration by liquid (spray test : Method D) and the test on resistance to penetration by liquid under pressure.

### 2.6.2.3 Liquid Penetration Resistance

- a) For Level A chemical protective clothing materials, it is decided not to set up a minimum required level under this test item because of the existence of a minimum required level for the permeation resistance. Similarly, it is decided not to set up a minimum required level under this test for Level B and Level C chemical protective clothing materials as there is a minimum required level for the resistance to penetration by liquid under pressure.
- b) The number of recommended test chemicals in the original edition has been revised to four to match **JIS T8115** and **EN 943-1**. Two recommended test chemicals designated in the original edition are designated as the recommended test chemicals to be used to determine the pass or failure of materials under this standard. Meanwhile, the test itself shall be conducted with all four test chemicals and the test results shall be reported in the instruction for use. These arrangements aim at improving the convenience for users. The two test chemicals used to provide the judgement criteria are selected based on the domestic production volume and occupational exposure limits.

- c) **JIS T8115** demands that at least one recommended test chemical out of four shall meet the Class 3 performance (less than 1%) while this standard demands that the Class 1 performance (less than 10%) is demanded against two recommended test chemicals. Accordingly, the performance of protective clothing materials which pass this standard cannot be necessarily said to be equivalent to that under **JIS T8115**. It is, therefore, essential that users of this standard pay careful attention to this fact.

#### 2.6.2.4 Liquid Repellency

- a) For Level A chemical protective clothing materials, it is decided not to set up a minimum required level under this test item because of the existence of a minimum required level for the permeation resistance. Similarly, it is decided not to set up a minimum required level under this test for Level B and Level C chemical protective clothing materials as there is a minimum required level for the resistance to penetration by liquid under pressure.
- b) The number of recommended test chemicals in the original edition has been revised to four to match **JIS T8115** and **EN 943-1**. Two recommended test chemicals designated in the original edition are designated as the recommended test chemicals to be used to determine the pass or failure of materials under this standard. Meanwhile, the test itself shall be conducted with all four test chemicals and the test results shall be reported in the instruction for use. These arrangements aim at improving the convenience for users. The two test chemicals used to provide the judgement criteria are selected based on the domestic production volume and occupational exposure limits.
- c) **JIS T8115** demands that at least one recommended-test chemical out of four shall meet the Class 3 performance (less than 1%) while this standard demands that the Class 1 performance (less than 10%) is demanded against two recommended test chemicals. Accordingly, the performance of protective clothing materials which pass this standard cannot be necessarily said to be equivalent to that under **JIS T8115**. It is, therefore, essential that users of this standard pay careful attention to this fact.

#### 2.6.2.5 Tensile Strength

The tensile strength required of the materials for Level A chemical protective clothing is set at equivalent to the minimum required level of **EN 943-2** for both limited use and reusable types. In the case of the materials for Level B and Level C chemical protective clothing, the required level in this standard is set at equivalent to the minimum required level in the Draft **ISO** standards because of the absence of a relevant provision of **EN 943-2**. In the case of the materials for Level D chemical protective clothing, as the required strength is not as high as that of the materials for Level B and Level C chemical protective clothing of both limited use and reusable types, the minimum required

level for limited use or reusable type clothing is set at one class lower than the corresponding class required of the materials for Level B and Level C chemical protective clothing.

#### **2.6.2.6 Tear Strength**

The tear strength required of the materials for Level A chemical protective clothing is set at equivalent to the minimum required level of **EN 943-2** for both limited use and reusable types. In the case of the materials for Level B and Level C chemical protective clothing for which **EN 943-2** does not have any relevant provisions, the minimum required level for the limited use type is set at equivalent to the minimum required level of the Draft **ISO** standards while the minimum required level for the reusable type is set at equivalent to the minimum required level for the materials for the reusable type of Level A chemical protective clothing. In the case of the materials for Level D chemical protective clothing, as the required strength is not as high as that for the materials for Level B and Level C chemical protective clothing of both the limited use and reusable types, the minimum required level for limited use or reusable types is set at one class lower than the corresponding class required of the materials for Level B and Level C chemical protective clothing.

#### **2.6.2.7 Puncture Resistance**

The puncture resistance required of the materials for Level A chemical protective clothing is set at equivalent to the minimum required level of **EN 943-2** for both limited use and reusable types. In the case of the materials for Level B and Level C chemical protective clothing for which **EN 943-2** does not have any relevant provisions, the minimum required level for the limited use type is set at equivalent to the minimum required level of the Draft **ISO** standards while the minimum required level for the reusable type is set at equivalent to the minimum required level for the materials for the reusable type of Level A chemical protective clothing. In the case of the materials for Level D chemical protective clothing, as the required strength is not as high as that for the materials for Level B and Level C chemical protective clothing of both the limited use and reusable types, the minimum required level for limited use or reusable types is set at one class lower than the corresponding class required of the materials for Level B and Level C chemical protective clothing.

#### **2.6.2.8 Abrasion Resistance**

The abrasion resistance required of the materials for Level A chemical protective clothing is set at equivalent to the minimum required level of **EN 943-2** for both limited use and reusable types. In the case of the materials for Level B and Level C chemical protective clothing, the required level in this standard is set at equivalent to the minimum required level in the Draft **ISO** standards because of the absence of a relevant provision of **EN 943-2**. In the case of the materials for Level D chemical

protective clothing, as the required strength is not as high as that of the materials for Level B and Level C chemical protective clothing of both limited use and reusable types, the minimum required level for limited use or reusable type clothing is set at one class lower than the corresponding class required of the materials for Level B and Level C chemical protective clothing.

However, in regard to the abrasive paper to be used for the abrasion resistance test, the abrasive paper indicated in **Annex F** of **JIS T8115** is not available in Japan and it is decided to use P320-Cw abrasive paper stipulated by **JIS R6253** in view of the nearest proximity of this paper to that stipulated by **JIS T8115**.

### **2.6.2.9 Flex Cracking Resistance**

The flex cracking resistance required of the materials for Level A chemical protective clothing is set at equivalent to the minimum required level of **EN 943-2** for both limited use and reusable types. In the case of the materials for Level B and Level C chemical protective clothing for which **EN 943-2** does not provide any relevant provisions, the minimum required level for the reusable type is set at equivalent to the minimum required level of the Draft **ISO** standards while the minimum required level for the limited use type is set at equivalent to that for the materials for limited use type Level A chemical protective clothing. In the case of the materials for Level D chemical protective clothing, as the required level of resistance is not as high as that for the materials for Level B and Level C chemical protective clothing of both the limited use and reusable types, the minimum required level for limited use or reusable types is set at one class lower than the corresponding class required of the materials for Level B and Level C chemical protective clothing. However, the minimum required level for the limited use type is set at Class 1 as the minimum required level for the materials for limited use type Level B and Level C chemical protective clothing is already Class 1.

### **2.6.2.10 Resistance to Flames**

There is no presupposition that the chemical protective clothing stipulated by this standard is to be used for fire-fighting activities. For this reason, resistance to flames is not required. However, it is decided to require the minimum required level of Class 1 of **EN 943-2** to be met as the minimum required level only required of the materials for Level A chemical protective clothing to be used in hazardous areas as the performance for protection against chance exposure to flames and not to require such performance of the materials for chemical protective clothing of other levels. The reason why only Level A chemical protective clothing is required to meet the minimum performance level is to eliminate the risk associated with the use of Level A chemical protective clothing as this clothing may be worn when the hazard level is unknown. As chemical protective clothing of other levels is worn

when the hazard level is known to a certain extent, resistance to flames is not included in this standard as a performance requirement of chemical protective clothing other than Level A clothing.

### **2.6.3 Other Performance Requirements**

#### **2.6.3.1 Seams**

It is decided that the scope of the seams include the permanent connections between the materials and visor in addition to the permanent connections between the materials. This is because of the fact that connections between the visor and the materials of a protective clothing are required to have the same performance as the principal body of a protective clothing.

##### **a) Seam Strength**

In the case of Level A chemical protective clothing, the required seam strength is decided to be equivalent to the minimum required level of **EN 943-2** for both limited use and reusable types. In the case of Level B and Level C chemical protective clothing for which **EN 943-2** does not provide any relevant provisions, the required seam strength is decided to be equivalent to the minimum required level in the Draft **ISO** standards. In the case of Level D chemical protective clothing, as the required seam strength is not as high as that for the materials for both limited use and reusable types of Level B and Level C chemical protective clothing, the minimum required level is set at one class lower for the corresponding type of Level B and Level C chemical protective clothing.

##### **b) Permeation Resistance of Seams**

The required permeation resistance level of the seams is set at equivalent to the corresponding minimum required level of the materials.

##### **c) Resistance of Seams to Penetration by Liquid Under Pressure**

As the resistance performance of the seams to penetration by liquid under pressure should essentially be equivalent to the level required of the materials, it is set at equivalent to the minimum required level of the materials. In the Draft **ISO** standards and **NFPA 1992**, 100% isopropanol and 97% sulphuric acid are stipulated as the recommended test chemicals.

#### **2.6.3.2 Visor**

##### **a) Physical Resistance Properties of Visor Materials**

The required physical resistance properties of the visor materials are set to be compatible with those of **JIS T8115** and the Draft **ISO** standards.

**b) Permeation Resistance of Visor Materials**

The required permeation resistance level of the visor materials is set at equivalent to the corresponding minimum required level of the materials.

**c) Resistance of Visor Materials to Penetration by Liquid Under Pressure**

The required resistance level of the visor materials to penetration by liquid under pressure is set at equivalent to the corresponding minimum required level of the materials.

**2.6.3.3 Face-piece of Respiratory Protective Device**

Because the face contact area and eyepiece of the face-piece of the mask for a gas-tight chemical protective clothing with external self-contained breathing apparatus (Type 1b) where the face-piece of the mask is mounted externally are in contact with the external air, the required permeation resistance performance of this face contact area and eyepiece is set at equivalent to the corresponding minimum required level of the materials.

**2.6.3.4 Gloves**

Gloves are to be the chemical protective gloves stipulated by **JIS T8116** with additional performance requirements.

**a) Strength of Glove Connections**

The strength of the glove connections is set at equivalent to the corresponding minimum required level of the Draft **ISO** standards and **EN 943-1**.

**b) Permeation Resistance of Glove Materials**

The required permeation resistance level of the glove materials is set at equivalent to the corresponding minimum required level of the materials.

**c) Resistance of Glove Materials to Penetration by Liquid Under Pressure**

The required resistance level of the glove materials to penetration by liquid under pressure is set at equivalent to the corresponding minimum required level of the materials.

**d) Physical Resistance Properties of Glove Materials**

The required physical resistance properties of the glove materials are set at equivalent to the corresponding minimum required levels of the Draft **ISO** standards. Because of this, it is decided that the tear strength test shall be conducted using **Method A2** in **JIS K6404-4**, i.e. trouser tear method, under the conditions set forth in **Annex I** of **ISO/DIS 22613:2004**. In regard to the

abrasive paper to be used for the abrasion resistance test, the abrasive paper indicated in **Annex H** of **ISO DIS 22613** as designated by the Draft **ISO** standards is unavailable in Japan and it is decided to use P120-Cw abrasive paper stipulated by **JIS R6253** in view of the nearest proximity of this paper to that designated by the Draft **ISO** standards.

### **2.6.3.5 Boots**

Boots are to be the chemical protective boots stipulated by **JIS T8117** with additional performance requirements.

#### **a) Permeation Resistance of Boot Materials**

The required permeation resistance level of the boot materials is set at equivalent to the corresponding minimum required level of the materials.

#### **b) Resistance of Boot Materials to Penetration by Liquid Under Pressure**

The required resistance level of the boot materials to penetration by liquid under pressure is set at equivalent to the corresponding minimum required level of the materials.

#### **c) Strength of Boot Connections**

The strength of the boot connections is set at equivalent to the corresponding minimum required level in the Draft **ISO** standards and **EN 943-1**.

## **2.7 Inspection**

In principle, inspection means a test conducted by a test laboratory for each manufacturing lot or shipping lot regarding a product for which type approval is made by the said test laboratory.

- a) Among the various performance requirements of finished chemical protective clothing, the most basic performance issues of leak-tightness, liquid penetration resistance and mist penetration resistance are stipulated in this standard as inspection items. In relation to the 100% inspection for leak-tightness, there was an opinion favouring sampling inspection in view of the fact that this inspection is voluntarily conducted by manufacturers. However, it is decided that 100% inspection is required under this standard because of the prospective use of Level A chemical protective clothing in an environment with the highest risk.

## **2.8 Labelling**

The labelling items basically follow those in **JIS T8115**. Some items are added, including the category of limited use products or reusable products and whether or not the performance

requirements for chemical protective clothing for chemical/biological terrorism incidents are met. Moreover, "the manufacturing lot number or tracking number" which was to be included in the instruction for use in the original edition has been transferred to the list of required labelling in the body text from the viewpoint of improving convenience for users.

- a) In the case of imported goods, writing of the indications in Japanese is a compulsory requirement as indications in the original language alone could lead to erroneous use.

## 2.9 Instructions for use

It is decided that the contents of the instructions for use section shall follow the corresponding section of **JIS T8115**.

- a) As in the case of **8** - Labelling, writing in Japanese is a compulsory requirement.
- b) The writing of information on chemical tests for protective clothing materials in the instructions for use which was voluntary in the original edition has now become a compulsory requirement. The contents of this information are identical to those of **JIS T8115** : 2005. Because of this change, it is now possible to select a type of protective clothing to match the purpose of use and also to compare different types of protective clothing. It is important to improve the performance of materials in the coming years by means of promoting material tests using many chemicals while the recommended test chemicals set the minimum requirement. For a similar reason, it is desirable for the results of tests other than those stipulated by this standard to be reported in the instructions for use, etc.

## 3. Risk Assessment

This section is a summary of **Annex F** of **ISO 11613** : 1999 and intends to explain the concept of risk assessment for fire-fighting (rescue) activities.

### 3.1 General

Personal protective equipment (chemical protective clothing) is only one part of an effective system for fire-fighting (rescue) personnel safety. Well trained, closely supervised and properly staff fire departments are equally essential elements to minimise the operational risk. Regardless of the location, the primary goals of fire-fighting and rescue work are the control of an emergency as quickly as possible and, at the same time, the implementation of steps to minimise the eventual damage to and loss of materials and people. In order of priority, the objectives of rescue team members reaching the scene of an incident are to :

- a) save lives and prevent or minimise injury;



- b) prevent or minimise damage to property;
- c) prevent or minimise damage to the environment.

The role of protective clothing for rescue team members for protection against chemicals is not only to protect the rescue team members but also to enable the rescue team members to achieve these objectives.

### **3.2 General Approach to Conduct Risk Assessment**

The main items of the risk assessment process are explained next.

#### **a) Risk Identification**

Risk identification means the listing of potential problems and hazards for rescue operation. Some examples of useful sources of information are listed below.

- 1) List of the risks to which members are or may be exposed
- 2) Records of previous accidents, illnesses and injuries, both locally and nationally
- 3) Facility and apparatus surveys and inspections, etc.

#### **b) Risk Evaluation**

Risk evaluation evaluates each item using the following questions.

- 1) What is the level or potential severity of the occurrence? (weighting of an incident)
- 2) What is the potential frequency or likelihood of the occurrence? (estimation of the probability of occurrence)
- 3) What are the potential consequences of the occurrence? (estimation of the spread of impact)

#### **c) Risk Control**

Once the risk has been identified and evaluated, the control for each risk should be implemented and documented. In order of preference, the two primary risk control methods are as follows.

- 1) Where possible, total elimination and/or avoidance of the risk or an activity which presents a risk
- 2) Where it is impossible or impractical to avoid or eliminate the risk, steps should be taken to control the risk, such as the use of more appropriate and high performance personal protection equipment.

### **3.3 Recommended Factors for Identification and Evaluation of Risks for Rescue Team Members**

In the use of chemical protective clothing, the following factors must be considered from the viewpoint of risk assessment.

- a) Level of training and experience of rescue team members
- b) Level of fitness and health of rescue team members
- c) Function of rescue team members at the scene of an incident
- d) Environmental conditions at the scene of an incident
- e) Specific hazards to be faced at the scene of an incident
- f) Known limitations of the protective clothing and other personal protection equipment for rescue team members
- g) Type and application of command system at the scene of an incident

### **3.4 Other Considerations**

Some examples of other considerations are listed below.

- a) Possible occurrence of flash-over
- b) Planned deployment of disaster prevention activities in correspondence with the community disposition towards disaster prevention
- c) Building construction
- d) Recommendation of the provision of higher level protective clothing for "interior attack teams"
- e) Heat stress through the donning of protective clothing

## **4. Guidelines for Setting Up of Warning Area, etc.**

An example of the guidelines for the setting up of a warning area as well as hazardous area (contaminated area) and a quasi-hazardous area (decontamination zone) to be set up inside the said warning area and other relevant matters is given here.

### **4.1 Setting-Up of a Warning Area**

A warning area is set up in the following manner.

#### **4.1.1 Conditions**

A warning area shall be set up on any of the following occasions, taking the residual area of the hazardous material, topography and wind direction into consideration.

- a) When a hazardous material is detected
- b) When the composition and concentration of the hazardous material are unknown but odour, irritating odour or coloured gas is confirmed
- c) When there is a high probability of the presence of a hazardous material given the situation at the scene or problems which affect the physical condition of the residents, etc. are observed

#### **4.1.2 Geographical Scope, etc.**

The geographical scope of a warning area and the relevant matters are determined in the following manner.

##### **a) Geographical Scope**

- 1) A warning area should be determined as a circled area with its radius being determined as the cumulative distance of the distance to the furthest point where the hazardous material is confirmed or measured from the original site of the incident and extra distance for sufficient safety. However, a wider area should be covered in the leeward, taking the wind velocity into consideration.
- 2) When a hazardous material is neither detected nor measured, a warning area should be determined by the incident commander on a need basis in view of the reality of the disaster.
- 3) When buildings, expressways, underground facilities and other facilities exist near the site of an incident, these facilities should be included in the warning area.
- 4) A warning area should be set up using street blocks, buildings, land plots and others as units.

##### **b) Demarcation**

A warning area should be demarcated by ropes, markers, signboards and others for clear indication of its status.

##### **c) Collaboration**

When policemen arrive at the scene, their collaboration should be sought. By informing them of the geographical scope of and planned duration of the warning area, their collaboration for the evacuation of residents and others, prohibition or restriction of entry to the area, traffic control and other relevant matters should be sought.

#### **d) Review of Set Area**

The level of risk should be constantly reviewed and the geographical scope of the warning area should be extended or reduced based on the detection or measurement results of the hazardous material, wind direction, wind velocity, situation of dispersion and situation of damage.

#### **4.1.3 Control Measures, etc.**

- a) In principle, residents and others should be told to evacuate the area.
- b) The subject area for evacuation should be clearly instructed and the direction, destination and route for evacuation should be specified in view of the flow direction of the hazardous material due to the wind direction and other relevant factors.
- c) Guided evacuation should be conducted for residents in a high risk area and for vulnerable people to the disaster or when panic or a chaotic situation is anticipated.
- d) The command post and bases for support teams (triage post, emergency relief station and others) should be located in the warning area but outside either the hazardous area (contaminated area) or quasi-hazardous area (decontamination zone).

#### **4.2 Setting-Up of Hazardous Area**

A hazardous area should be set up within the warning area when the following criteria are met. In the hazardous area, fire-fighting activities should be strictly controlled, including restricted entry by fire-fighters and all other personnel.

##### **4.2.1 Setting-Up Criteria**

The setting-up criteria for a hazardous area are as follows.

- a) Area where a hazardous material is either confirmed or detected
- b) Area of which the designation as a hazardous area is judged to be necessary by the incident commander

##### **4.2.2 Setting-Up Procedure**

A hazardous area should be set up in the following manner.

###### **a) Geographical Scope**

A hazardous area should be set up using street blocks, buildings, land plots and others as units, taking the risk posed by the residence or drifting of the hazardous material into consideration.

**b) Demarcation and Notification**

A hazardous area should be set up and demarcated by ropes, markers, signboards and others and its existence should be notified to mobilised teams, facility managers and relevant local bodies.

**c) Review of Set Area**

The level of risk should be constantly reviewed and the geographical scope of the hazardous area should be extended or reduced based on the detection or measurement results of the hazardous material, wind direction, wind velocity, situation of dispersion and situation of damage.

**4.2.3 Control of Operations**

Operations inside the hazardous area should be controlled in the following manner.

- a) Prohibition of entry to the area by anyone who has not taken the body protection measure of wearing Level A chemical protective clothing (or Level B chemical protective clothing depending on the situation)
- b) Performance of operations by the minimum required staff strength (minimum : two team members)
- c) Commands provided by more than one commander with specified areas of command for each scene for effective control at the scene

**1) Advance Check**

Advance checking of the donning situation of a respiratory protective device and chemical protective clothing, physical condition of team members to enter the scene, routes for exit and other relevant matters

**2) Entry Control**

Control of entries by team and members (names of the team and its members, entry time and operation duration)

**3) Activity Control**

Control of the actual activities, including monitoring of the rescue activities, reserve team members ready to respond to any unexpected incident and securing of the means of communication with the team(s) in action

**4) Exit Control**

Control of the decontamination measures for exited team members, checking of their physical condition, checking of any adherence of the hazardous material and designation of the place and method to remove the body protective gear

#### **4.3 Setting-Up and Decontamination of Quasi-Hazardous Area (Including Decontaminated Zone)**

The setting-up and decontamination of a quasi-hazardous area (including decontamination zone) should be conducted in the following manner.

##### **a) Setting-Up**

A quasi-hazardous area (including decontamination zone) shall be set up outside the warning area for the decontamination of team members operating inside the hazardous area, equipment used and contaminated injured or sick people.

##### **b) Decontamination**

Team members operating inside the hazardous area and the equipment used by them must be properly decontaminated in the quasi-hazardous area to ensure safety, including prevention of the spread of the contaminated area and the prevention of secondary contamination.

**Note :** When sufficient decontamination of equipment, etc. cannot be conducted, the equipment should be sealed inside an impermeable container or bag for removal.

##### **c) Emergency Transportation**

People rescued from the hazardous area who require medical help should be washed and decontaminated by a shower, etc. and their clothes changed in the quasi-hazardous area, followed by their emergency transportation.

##### **d) Drainage**

Contaminated water due to a decontamination measure should, in principle, be rendered harmless by a neutralisation measure and should then be discharged.

#### **4.4 Collaboration with Related Bodies**

The geographical scope of the warning area should be indicated to policemen in order to obtain their collaboration regarding control of the entry by people other than those involved in the emergency work.

#### **4.5 Notification of Control Measures to Residents and Others**

a) When a warning area is set up, it should be publicly and widely notified to residents and others.

**Note :** In the case of an emergency due to risk to human lives and/or the need to issue an evacuation order, a team or team members responsible for notification should be

designated with the indication of the priority issues and priority area so that public notification activities which correspond to a specific purpose can be swiftly and precisely implemented.

- b)** When the set warning area is extensive, a specific area(s) may be designated for the implementation of control measures by fire companies and voluntary fire companies and for the notification of evacuation.

**Note :** In this case, the mobilisation of the disaster prevention organizations of municipalities and local communities and the community wireless system should be considered.

- c)** Public notification activities should primarily feature the following matters and should be conducted in a manner which can be clearly understood by residents and others.

**1) Setting-up of the warning area**

1.1) Duration and geographical scope

1.2) Restrictions inside the area

**2) Exit (evacuation) order**

2.1) Geographical area subject to the exit (evacuation order)

2.2) Persons subject to the exit (evacuation) order

2.3) Destination(s) and method of exit (evacuation)

2.4) Measures to be taken by residents and others at the time of exit (evacuation)

**3) Prohibition or restriction of entry**

3.1) Geographical area where entry is prohibited or restricted

3.2) Persons to which entry to the area is prohibited or restricted

**4) Risks of hazardous materials**

4.1) Impacts on the human body

4.2) Measures to be taken when injured