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**Protective clothing—Gloves and
arm guards protecting against cuts
and stabs by hand knives—
Part 1 : Chain-mail gloves and arm
guards**

ICS 13.340.40; 13.340.99

Reference number : JIS T 8121-1 : 2006 (E)

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Health, Labour and Welfare and the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal of establishing a Japanese Industrial Standard from Japan Society Appliances Association (JSAA)/ Japanese Standards Association (JSA) with a draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

This part of **JIS T 8121** has been made based on **ISO 13999-1 : 1999** *Protective clothing—Gloves and arm guards protecting against cuts and stabs by hand knives—Part 1: Chain-mail gloves and arm guards* for the purposes of making it easier to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Ministers and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

JIS T 8121 consists of the following 2 parts under the general title “*Protective clothing—Gloves and guards protecting against cuts and stabs by hand knives*”:

Part 1 Chain-mail gloves and arm guards

Part 3: Impact cut test for fabric, leather and other materials

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Contents

	Page
Introduction	1
1 Scope	1
2 Normative reference	2
3 Terms and definitions	2
4 Requirements	3
4.1 Dimensions of the protective surface areas of gloves and arm guards....	3
4.2 Construction	5
4.3 Tensile strength	6
4.4 Penetration resistance	6
4.5 Properties of materials	6
5 Test apparatus	6
5.1 Visual examination	6
5.2 Tolerances	7
5.3 Tensile strength testing apparatus	7
5.4 Penetration testing apparatus	7
5.5 Gauges of interstices	8
5.6 Blunt probe	8
5.7 Test arms for measuring the compressed length of cuffs and forearm guards	8
6 Procedures	8
6.1 Visual examination	8
6.2 Dimensions and mass determination	9
6.3 Testing the dimensions of interstices	10
6.4 Tensile strength testing	11
6.5 Penetration testing	11
6.6 Testing the physical stability of plastics arm guards at cleaning temperatures	12

7	Marking	12
8	Information for users and instructions for use	12
9	Pictograms.....	13
Annex A (normative)	Colour codes of selected glove sizes	20
Annex B (informative)	Hand and arm sizes, protective glove and arm guard sizes.....	25
Annex C (informative)	Advice on the selection of plastics for use in arm guards.....	36
Annex D (informative)	Selection and fitting of gloves and arm guards to provide comfort and protection.....	38

Protective clothing—Gloves and arm guards protecting against cuts and stabs by hand knives—

Part 1: Chain-mail gloves and arm guards

Introduction This Japanese Industrial Standard has been prepared based on the first edition of **ISO 13999-1** *Protective clothing—Gloves and arm guards protecting against cuts and stabs by hand knives—Part 1: Chain-mail gloves and arm guards* published in 1999 without modifying the technical contents.

The portions underlined with dots are the matters not stated in the original International Standard.

Chain-mail gloves and metal or plastic arm guards that offer some protection against stabs are used in those aspects of work where a knife is moved towards the user's hand and forearm. Protective gloves and arm guards against stabs may also offer adequate protection for those working with hand knives in the plastics, leather, textile and paper industries, when laying flooring and similar tasks.

It should be noted that the tests specified in this part of **JIS T 8121** are designed to be severe, and in some cases destructive, in order to adequately test the products. The requirements in this part of **JIS T 8121** based on these tests do not imply that, in normal use, knives will penetrate gloves or arm guards by significant distances.

It has been assumed in the drawing of this part of **JIS T 8121** that the execution of its provisions is entrusted to appropriately qualified and experienced people, for whose guidance it has been prepared. The apparatus described should only be used by competent persons and requires safeguards to prevent, as far as is reasonably practicable, injury to the operator and other persons.

1 Scope This part of **JIS T 8121** specifies requirements for the design, penetration resistance, ergonomic characteristics, straps, weight, material, marking and instructions for use, of gloves and arm guards. It also specifies the appropriate test methods.

- a) This part of **JIS T 8121** applies to protective chain-mail gloves and to metal and plastics arm guards for use with hand knives.

Remarks : The International Standard corresponding to this part of **JIS T 8121** is as follows.

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21**.

ISO 13999-1 : 1999 *Protective clothing—Gloves and arm guards protecting against cuts and stabs by hand knives—Part 1: Chain-mail gloves and arm guards* (IDT)

2 Normative reference The following standard contains provisions which, through reference in this text, constitute provisions of this part of **JIS T 8121**. If the indication of the year of coming into effect is given to the referred standard, only the edition of the indicated year constitutes the provision of this Standard but the revision and amendment made thereafter do not apply.

JIS T 8120:2006 *Protective clothing—Aprons, trousers and vests protecting against cuts and stabs by hand knives*

NOTE : **ISO 13998:2003** *Protective clothing—Aprons, trousers and vests protecting against cuts and stabs by hand knives* is equivalent to the said standard.

3 Terms and definitions For the purposes of this part of **JIS T 8121**, the following terms and definitions apply.

3.1 Anatomical terms Defined terms and symbols are illustrated in figure 1.

3.1.1 digit one of the terminal divisions of the hand

NOTE : These are numbered from (1) the thumb to (5) the little finger in figure 1 and the numbers are used to denote the appropriate digits in this part of **JIS T 8121**.

3.1.2 wrist radio-carpal joint

NOTE : To obtain the surface marking of the wrist level, place the hand and forearm, fully relaxed, on a flat surface with the palm upwards. A finger tip is pressed firmly in the direction of the arrow in figure 1, to palpate the styloid process of the ulna, which is located towards the dorsal surface of the hand. Mark the transverse level of the palpated ulnar styloid process. A plane 10 mm proximal to this level is the plane of the wrist. Note that skin creases are not an adequate guide to the level of the wrist.

3.2 Clothing Defined terms and symbols are illustrated in figure 2.

3.2.1 glove hand covering for the whole hand that has protective material extending to the wrist and covers each digit separately [see figure 2 a)]

3.2.2 short-cuff glove glove with protective material continuous with it of length *A* proximal to the wrist [see figure 2 b)]

3.2.3 long-cuff glove glove with a permanently attached stiff but flexible cuff of length *B*, covering the forearm to a point which is at a distance *C* from the upper arm surface when the elbow is flexed at 90° [see figure 2 c)]

NOTE : The term “gauntlet” is deprecated. This is an inexact synonym of “long-cuff glove”.

3.2.4 arm guard protective device covering the forearm

NOTE : It may be permanently attached to or held in place by a glove with a special short cuff of length *D* [see figure 2 d)] while both are used. It

extends to a point which is at distance C from the upper arm surface when the elbow is flexed at 90° .

3.2.5 arm guard and glove assembly arm guard correctly attached to or correctly worn with a compatible glove with a total length B from the wrist [see figures 2 c) and 2 d)]

3.2.6 long arm guard protective device that covers the forearm and extends onto the upper arm

NOTE : It may be secured to the body or to clothing so that it remains in place during use [see figure 2 e)].

4 Requirements

4.1 Dimensions of the protective surface areas of gloves and arm guards

4.1.1 General The coverage provided by gloves shall be assessed in accordance with **6.1.4**.

For details of dimensions, sizing and fitting of gloves and arm guards, see Annexes A, B and D.

4.1.2 Gloves A five-finger glove shall be designed to provide protection to all of the hand up to the wrist. The coverage shall be continuous except for a slit on the ulnar surface of the palm to aid putting on and taking off the glove. When the wrist strap is adjusted as in use the slit shall be closed by overlapping chain-mail.

4.1.3 Short-cuff gloves Short-cuff gloves shall be designed to provide continuous protection from the finger tips to a length A [see figure 2 b)] at least 75 mm proximal to the wrist. The cuff shall either be stiffened so that it has a minimum compressed length of 75 mm and so that the difference between its compressed and extended length is less than 20 mm when measured in accordance with **6.2.2**, or shall be attached to the upper body or arm or to clothing so that the minimum required coverage is maintained in use.

4.1.4 Long-cuff gloves Long-cuff gloves shall be designed to provide continuous protection from the finger tips to the wrist and up the forearm. The proximal end of the protection should be at a distance C [see figures 2 c) and 2 d)] of not more than 75 mm from the upper arm surface when the elbow is flexed at 90° (see Annex B).

Long-cuff glove cuffs shall either be stiffened so that at least the minimum coverage is provided when the cuff is compressed and measured in accordance with **6.2.2**, or shall be attached to the upper body or to the arm or to clothing so that the minimum required coverage is maintained in use.

4.1.5 Glove sizes Gloves shall be marked with their size based on the hand size they are designed to fit, or with the colour-coded strap appropriate to the dimensions of the glove as given in Annexes A and B.

4.1.6 Arm guard and glove assemblies The coverage provided by arm guards and arm guard and glove assemblies shall be assessed in accordance with **6.1.4**.

4.1.6.1 Coverage with rigid arm guards Arm guards shall be designed to provide continuous protection to the hand and forearm: the arm guard covers the forearm from the cuff of a compatible glove. The proximal end of the protection shall be at a distance C [see figures 2 c) and 2 d)] which should not be less than 45 mm or more than 75 mm from the upper arm surface when the elbow is flexed at 90° (see Annex B). The arm guard shall be attached to, or held in place by, the cuff of the glove.

4.1.6.2 Coverage by chain-mail arm guards Chain-mail arm guards shall either be stiffened so that at least the minimum coverage is provided when the guard is compressed and measured in accordance with **6.2.2**, or shall be attached to the upper body or to the arm or to clothing so that the minimum required coverage is maintained in use.

4.1.6.3 Coverage and attachment of long arm guards Long arm guards shall be designed to provide continuous protection of the hand and forearm. The straps or fixing of the proximal end of the arm protector, when correctly adjusted, shall not allow it to slide down to expose the forearm.

4.1.6.4 Cuffs The overlap of the protection provided by the cuff of the glove and the arm guard shall be at least 8 mm. The cuff of a compatible glove shall be of stiffened chain-mail with a compressed length D [see figure 2 d)] of not less than 30 mm. The difference in extended and compressed lengths of the cuff shall not be more than 20 mm when tested according to **6.2.2**.

NOTE : If the stiffening is only at the sides of the wrist, flexing of the wrist will not be impeded.

4.1.6.5 Shape of arm guards made of plastics or other rigid material Arm guards made from plastics or other smooth materials shall be so designed at their proximal end to stop the knife blade. An example of the shape is given in figure 3. The dimensions shall be:

$$6 \text{ mm} < l_1 < 15 \text{ mm}$$

$$2 \text{ mm} < l_2 < 6 \text{ mm}$$

$$l_3 > 1.5 \text{ mm}$$

The protection shall extend for at least 300° around the circumference of the arm guard. The arm guard shall be designed so that the arc without the protection can only be worn on the outside of the forearm directed towards the point of the elbow.

Information : This means that the arm guard protects the anterior (palm) side of the forearm.

Arm guards formed of a rolled-up sheet of rigid material with an overlapping longitudinal junction shall have an overlap of their free edges of at least 30 mm for the whole length of the arm guard.

4.1.6.6 Arm guard and long cuff sizes Arm guards sizes are their minimum or compressed length in millimetres (see **6.2.2**).

See Annex B for information on sizes of arms and of arm guards and long cuffs.

4.2 Construction

4.2.1 Chain-mail gloves Chain-mail shall be made from rings with an internal diameter no greater than 3.2 mm. Chain-mail sheet shall have four rings passing through each ring.

4.2.2 Dimensions of interstices The dimensions of interstices between chain-mail or any other components of the protective surface of gloves and arm guards shall be such that the 6.0 mm wide gauge number 1 described in **5.5** is unable to pass through them when applied as described in **6.3**.

The dimensions of interstices between chain-mail rings or any other components of the protective surface of gloves and arm guards shall be such that the 4.0 mm wide gauge number 2 described in **5.5** is unable to pass through them when applied as described in **6.3** except at the positions listed below.

Sites where the 4.0 mm gauge number 2 is permitted to pass through the protective material are:

- a) at not more than three points in each crotch between digits two and three, three and four, and, four and five; probe number 2 shall not pass through at any point in the crotch between digits one and two;
- b) at not more than eight points on the seam on the lateral and medial surfaces of each digit and over the tip of the digit.

Possible sites where the 4.0 mm probe penetrates the glove surface are shown in figure 4.

4.2.3 Straps Gloves shall have adjustable wrist straps at least 18 mm wide. The length of straps shall be continuously adjustable. They shall be secured by a quick release closure, for example a spring-loaded stud fastener. The fixed part of the closure shall be on the strap on the back of the wrist within 10 mm of the centre (i.e. in the centre of the dimension $l_{10} \pm 10$ mm, as in Annex A table 1 and Annex A figure 1). It shall not be possible to remove straps from gloves or arm guards when the straps are fastened. Straps shall be attached to cuffs or shall pass through loops. It shall not be possible to remove closures from straps except by intent.

Any straps on arm guards shall be of similar construction. See also advice in Annex D about avoiding long free ends on the straps.

NOTE : The force required to open the fastener should be greater than any accidental force that is likely to be applied during the work for which the glove is designed.

4.2.4 Mass Gloves and arm guards shall be constructed of material with a mass per area of less than 4 kg/m². Testing shall be in accordance with **6.2.3**.

4.3 Tensile strength

4.3.1 Chain-mail When tested in accordance with **6.4.1**, no ring, link or plate shall break or open when a force of 100 N is applied.

4.3.2 Attachment of arm guards Arm guards shall be securely held in place when worn with a compatible glove. This attachment shall withstand a force of 150 N on the arm guard directed towards the elbow as described in **6.4.2**.

If attachment is by studs or similar discrete fasteners, at least five shall be used. They shall be distributed approximately evenly around the circumference of the junction.

4.4 Penetration resistance

4.4.1 General Penetration resistance of a glove or assembly shall be provided over the whole protective surface, including any junction between a glove and its cuff or attached arm guard.

4.4.2 Chain-mail gloves cuffs and chain-mail arm guards and those including metal plates Protection shall be provided over the whole protective surface including any junction to another component or material. Testing shall be conducted in accordance with **6.5.1**. The mean penetration shall not exceed 10 mm and no single penetration shall exceed 17 mm.

4.4.3 Rigid arm guards made of plastics or metal Testing shall be conducted in accordance with **6.5.2**. The mean penetration shall not exceed 12 mm and no single penetration shall exceed 15 mm.

4.4.4 Rigid arm guard attachment Testing of the region of attachment of the cuff of a compatible glove to the arm guard shall be in accordance with the principles in **6.5.2**. The mean penetration shall not exceed 12 mm and no single penetration shall exceed 15 mm.

4.5 Properties of materials

4.5.1 General The protective clothing shall not be constructed of materials that are known to cause short- or long-term injury to normal users. The protective clothing shall not have injurious rough or sharp surfaces. It shall not lose its protective properties during its normal service life when cleaned and sterilized according to the manufacturer's instructions.

4.5.2 Cleaning temperature stability The maximum cleaning temperature that does not harm the item shall be supplied with it. If this temperature is below 82 °C it shall be marked on the item. The testing of the stability of plastic arm guards is described in **6.6**. No dimension shall have changed by more than 10 %, nor shall any dimension fall outside the range given in **4.1.6.5** after testing.

5 Test apparatus

5.1 Visual examination Visual examinations should be made by a competent person with such light sources and magnification aids as are necessary.

5.2 Tolerances Unless specified, all dimensions are centre values with a tolerance of $\pm 2\%$.

5.3 Tensile strength testing apparatus Tensile strength testing apparatus shall be as described in **JIS T 8120**, except that the metal rods to be placed in the rings shall be (1.2 ± 0.1) mm unless narrower rods are required to pass through the rings, and the force to be exerted shall be up to 100 N.

5.4 Penetration testing apparatus

5.4.1 General Penetration testing apparatus shall be as described in **JIS T 8120** with the addition of components to support small chain-mail samples and rigid arm guards as given in **5.4.2** and **5.4.3**.

5.4.2 Chain-mail samples Rectangular samples of glove chain-mail or arm guard chain-mail shall be cut (120 ± 10) mm $\times$ (120 ± 10) mm. Rigid steel rods are passed through the rings on each side of the sample, leaving approximately 10 mm (three or four rings) unsupported at the ends of each side.

The sample placed on the flesh simulant is tensioned by four 400 g weights. One is attached to the centre of each side by clips and string which is arranged to fall approximately 30° to the horizontal and pass over a hoop of internal diameter not less than 800 mm, to the weight. The outer surface of the glove or arm guard material shall be placed upwards.

Samples of the following types representing all the construction features of the test item are to be tested:

- a) four-ring interlock flat chain-mail;
- b) samples of four-ring interlock flat chain-mail joined by a seam across the middle of the sample; samples of every seam type present in the glove or arm guard shall be tested; the seams shall not include points at which the 4.0 mm probe is able to pass through the chain-mail;
- c) samples of chain-mail in which the rings are coated or surrounded by a plastics matrix that impedes their independent movement.

5.4.3 Support for rigid arm guards Plastics or other rigid arm guards shall be filled with uncooked long-grain polished rice in polythene bags. The rice shall be shaken and vibrated into place. The bags shall be taped into place and the guards shall be taped tightly around the bags, so that no movement occurs during testing. The filled arm guard shall be pressed into the flesh simulant so that its lower surface is fully supported. It shall be taped down by adhesive tape across the tray as shown in figure 5.

If the rice is not sufficiently tightly packed, the impact energy is absorbed elastically in deformation of the whole guard. The knife and block may even rebound as the arm guard returns to its resting shape. It is important that the rice be tightly packed to avoid this happening.

5.5 Gauges of interstices The gauges for interstices shall be made of steel (1 ± 0.05) mm thick. Gauge number 1 shall be (6 ± 0.1) mm wide over a length of not less than 50 mm. The end of a gauge shall taper with $(60 \pm 5)^\circ$ included angle as shown in figure 6. Gauge number 2 shall be the same as gauge number 1 except that its width shall be (4 ± 0.05) mm. The gauges shall be supported in handles or otherwise so that the force that can be exerted along the long axis of the gauge is limited to (10 ± 0.5) N.

5.6 Blunt probe The blunt probe for checking the coverage provided by test items in 6.1.4 shall have a smooth approximately hemispherical end on a (6 ± 0.5) mm diameter metal shaft.

5.7 Test arms for measuring the compressed length of cuffs and forearm guards The test arms shall be made of hard polished material such as varnished wood, metal or hard plastic. The dimensions shall be accordance to table 1. The shape is shown in figure 7.

Table 1 Test arm dimensions

Unit: mm

Dimensions ^{a)}	Test arm number			
	1	2	3	4
l_1	Dimension to be measured when cuff of the glove or arm guard is not fully extended (see figure 7)			
l_2	60	60	60	60
l_3	100	100	100	100
l_4	60	60	60	60
l_5	20	20	20	20
l_6	15	15	15	15
d_1	80	85	92	100
d_2	80	85	92	100
d_3	50	56	63	70
d_4	45	50	55	60
d_5	45	50	55	60
D_6	75	80	85	90
Note ^{a)} Dimensions are shown on figure 7.				

6 Procedures

6.1 Visual examination

6.1.1 Chain-mail Examine the entire surface of the mail for missing rings, unclosed rings and rough welds which could abrade a user's skin. Examine all seams and the interlocking of rings within them. Test by hand to determine whether fittings have sharp edges, that the fasteners are easy to use and secure, and that there

are no long free ends of straps when the glove is worn. Where chain-mail is possibly joined within an opaque strap or fitting, expose the chain-mail and examine as above. Report findings.

6.1.2 Rigid arm guards Examine the whole surface, edges and fittings. Determine whether there are sharp edges, surface crazing or small cracks at edges and around fitment holes. Determine if the whole shape is appropriate. Report findings.

6.1.3 Assembly Examine the attachment of the arm guard to a compatible glove. Determine the orientation of any openings between them and the compatibility of the assembly. Determine whether unexpected detachment could occur in use. Report findings.

6.1.4 Examination of coverage The test item shall be put on and correctly adjusted on a subject of the appropriate dimensions determined from the manufacturer's information for users. The relevant requirements in **4.1.2**, **4.1.3**, **4.1.4**, **4.1.6.1**, **4.1.6.2**, **4.1.6.3** and **4.1.6.4** for coverage of the hand, wrist and forearm shall be tested by inspection, measurement and the attempted insertion of a non-injurious blunt probe described in **5.6**.

The probe shall be applied to every slit, opening or overlap found. The probe shall be angled at 0° to 45° with the underlying skin at any angle between directly up the arm and 90° across the arm from the medial to the lateral side. The probe shall be gently moved around with a maximum force of 4 N. Varying its angle of approach to ascertain whether it can pass through the test item. Every penetration shall be recorded as a gap in the coverage. Report findings.

6.2 Dimensions and mass determination

6.2.1 Measurement of glove dimensions Lay the glove flat and insert appropriate gauges (see Annex A) into the digits to measure their length. Measure the remaining dimensions specified. Make allowances where the glove is curved (see Annex A). Check the correspondence of the results to the claimed size and marking. Report findings.

6.2.2 Measurement of compressed and extended lengths of cuffs, cuffs and arm guards, and arm guards Measure the maximum length (extended length) of a cuff and arm guard, or arm guard, when it is suspended by its distal end and hanging freely under its own weight. The dimensions to be measured shall correspond to the appropriate dimensions *A*, *B* or *D* shown in figure 2. The measurement shall be made five times. Between measurements, the test item shall be lifted from below to compress it, and it shall be gently released to hang freely again before the next measurement is made.

Measure the compressed length of the same item on a test arm as described in **5.7**. Choose the appropriate test arm according to the manufacturer's size marked on the test item. The test item should fit loosely about the test arm. A smaller size test arm should be used if the fit is not loose, and a larger one should be used if the looseness is far in excess of what would be acceptable in the normal use of the test item. Table 2 is a guide to the selection of test arms.