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Testing methods for flammability of textiles

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Contents

	Page
Introduction	1
1 Scope	1
2 Normative references	2
3 Definitions	2
4 Rounding method for numerical values	2
5 Classification of test	3
6 Classification method for flammability	4
7 Sampling and preparation of sample	5
8 Testing method	6
8.1 Method A (combustion test)	6
8.2 Method B (surface combustion test)	13
8.3 Method C (combustion rate test)	15
8.4 Method D (flame contact test)	18
8.5 Method E (oxygen index method test)	20
9 Recording method	25
Annex 1(normative) Burning behaviour of textile fabrics and textile products — Vocabulary	30
Annex 2 (normative) Textile floor coverings — Burning behaviour — Tablet test at ambient temperature	35
Annex 3 (normative) Textile fabrics — Burning behaviour — Determina- tion of ease of ignition of vertically oriented specimens	40
Annex 3-A (normative) Type and construction of burner	47
Annex 3-B (informative) Worked example for ease of ignition test	49
Annex 3-C (informative) Experimental techniques	51
Annex 4 (normative) Textile fabrics — Burning behaviour — Measurement of flame spread properties of vertically oriented speci- mens	52
Annex 4-A (normative) Type and construction of burner	59
Annex 4-B (informative) Experimental techniques	61
Annex 5 (normative) Textiles — Determination of surface burning time of fabrics	62

Annex 5-A (normative)	Type and construction of burner	67
Annex 5-B (normative)	Burning device for raising surface fibres of fabric specimen	69
Annex 6 (normative)	Textiles — Commercial laundering procedure for textile fabrics prior to flammability testing	70
Annex 6-A (informative)	Parameters for typical washing machines	75
Annex 7 (normative)	Textiles — Domestic laundering procedures for textile fabrics prior to flammability testing	76
Annex 7-A (normative)	Preparation of artificial hard water	80
Annex 7-B (informative)	Composition of detergent	81
Annex 7-C (informative)	Parameters for typical washing machines	82
Annex 8 (informative)	Testing method for flammability in vertical — Vertical burner method	83
Annex 9 (informative)	Testing method for surface flammability — 45° methenamine tablet method	86

Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of International Trade and Industry through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law.

Consequently JIS L 1091: 1992 is replaced with this Standard.

The revision this time is to correspond to **ISO 6925** *Textile floor coverings—Burning behaviour—Tablet test at ambient temperature*, **ISO 4880** *Burning behaviour of textiles and textile products—Vocabulary*, **ISO 6940** *Textile fabrics—Burning behaviour—Determination of ease of ignition of vertically oriented specimens* (including Amendment 1:1993), **ISO 6941** *Textile fabrics—Burning behaviour—Measurement of flame spread properties of vertically oriented specimens* (including Amendment 1:1992), **ISO 10047** *Textiles—Determination of surface burning time of fabrics*, **ISO 10528** *Textiles—Commercial laundering procedure for textile fabrics prior to flammability testing*; and **ISO/FDIS 12138** *Textiles—Domestic laundering procedures for textile fabrics prior to flammability testing*.

Testing methods for flammability of textiles

Introduction This Japanese Industrial Standard has been prepared so that the corresponding International Standards of **ISO 6925** *Textile floor coverings — Burning behaviour — Tablet test at ambient temperature* published in 1982, **ISO 4880** *Burning behaviour of textiles and textile products — Vocabulary* published in 1997, **ISO 6940** *Textile fabrics — Burning behaviour — Determination of ease of ignition of vertically oriented specimens* published in 1984 (including Amendment 1: 1993), **ISO 6941** *Textile fabrics — Burning behaviour — Measurement of flame spread properties of vertically oriented specimens* published in 1984 (including Amendment 1: 1992), **ISO 10047** *Textiles — Determination of surface burning time of fabrics* published in 1993, **ISO 10528** *Textiles — Commercial laundering procedure for textile fabrics prior to flammability testing* published in 1995 and **ISO/FDIS 12138** *Textiles — Domestic laundering procedures for textile fabrics prior to flammability testing* published in 1996 are translated without any modifications of the technical contents so as to be Annexes, in addition to the items specified in the existing JIS.

1 Scope This Standard specifies the testing methods for the flammability of textile products.

NOTES 1 The unit and numerical values given in { } in this Standard are based on the traditional units and are the reference values.

2 The International Standards corresponding to this Standard are as follows.

ISO 4880: 1997 *Burning behaviour of textiles and textile products—Vocabulary*

ISO 6925: 1982 *Textile floor coverings — Burning behaviour — Tablet test at ambient temperature*

ISO 6940: 1984 *Textile fabrics — Burning behaviour — Determination of ease of ignition of vertically oriented specimens* [Amendment 1: 1993]

ISO 6941: 1984 *Textile fabrics — Burning behaviour — Measurement of flame spread properties of vertically oriented specimens* [Amendment 1: 1992]

ISO 10047: 1993 *Textiles — Determination of surface burning time of fabrics*

ISO 10528: 1995 *Textiles — Commercial laundering procedure for textile fabrics prior to flammability testing*

ISO/FDIS 12138: 1996 *Textiles — Domestic laundering procedures for textile fabrics prior to flammability testing*

2 Normative references The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

- JIS A 5430 *Fiber reinforced cement boards*
- JIS G 4309 *Stainless steel wires*
- JIS K 0101 *Testing methods for industrial water*
- JIS K 1101 *Oxygen*
- JIS K 1107 *High purity nitrogen*
- JIS K 1521 *Perchloroethylene*
- JIS K 2240 *Liquefied petroleum gases*
- JIS K 8101 *Ethanol (99.5) (Reagent)*
- JIS L 0860 *Test methods for colour fastness to dry cleaning*
- JIS L 1018 *Test methods for knitted fabrics*
- JIS L 2101 *Cotton sewing thread*
- JIS Z 8401 *Guide to the rounding of numbers*

3 Definitions For the purposes of this Standard, the following definitions shall apply.

- a) afterflame time the length of time for which the specimen continues to flame from the completion of heating under the specified test condition
- b) afterglow time the length of time for which the glowing continues after the completion of heating or after cessation of flaming of specimen under the specified test condition
- c) heating time the length of time from the ignition of ignition source to the stop of fuel supply
- d) burned area the total area of destroyed part due to combustion or pyrolysis under the specified test condition
- e) burned length the maximum length of destroyed part due to combustion or pyrolysis under the specified test condition
- f) oxygen index the numerical value of minimum oxygen concentration expressed by the volume percentage of oxygen required for continuing the combustion of material

NOTE : In addition, definitions of principle terms used in Annex 2 to Annex 7 are specified in Annex 1 (ISO 4880).

4 Rounding method for numerical values The test result shall be rounded off ac-

according to JIS Z 8401 for obtaining the specified numerical values.

5 Classification of test There are five types of the following in this test corresponding to the item for measurement, and any one of the methods shall be selected and carried out depending on the purpose of test or the type of textile products.

a) **Method A (combustion test)** This method is to measure the spread degree of combustion (burned area and burned length) and the afterflame and afterglow times, and there are 4 types of the following depending on the mounting position of specimen, the size of ignition source and the like.

- 1) **Method A-1 (45° micro burner method)** This method is suitable for the thin (450 g/m² or under in mass) textile products (curtains, etc.).
- 2) **Method A-2 (45° Meckel burner method)** This method is suitable for the thick (exceeding 450 g/m² in mass) textile products (curtains, etc.).
- 3) **Method A-3 (horizontal method)** This method is suitable for the textile products for special use (sheet, etc.).
- 4) **Method A-4 (vertical method)** This method is suitable for the textile products for special use (nightwear, etc.).

Information : Method A-4 specifies the method in which the tip of Bunsen burner is inclined to vertical direction by 25° as the ignition source. The method to use a vertical burner is specified in Annex 8 as the different method.

b) **Method B (surface combustion test)** This method is to measure the spread degree of combustion on the surface of sample and suitable for the thick textile products (textile floor covering, etc.).

Information: Method B specifies the method in which an air-mixed burner is used as the ignition source. The method to use methenamine tablet is specified in Annex 9 as the different method.

c) **Method C (combustion rate test)** This method is to measure the quickness degree of combustion of the sample and suitable for the thin textile products (scarves, clothes and the like).

d) **Method D (flame contact test)** This method is to measure the number of times of flame contact until the specimen is molten and completely burned by heating, and suitable for the textile products molten by heating.

e) **Method E (oxygen index method test)** This method is to measure the flammability by oxygen index and there are 3 methods of the following depending on the supporting method of specimen.

- 1) **No. E-1** This method is suitable for the case where a heat-melting type fabric, etc. are wound in a twisted form so that the specimen stands upright, then tested.
- 2) **No. E-2** This method is suitable for the case where the specimen is mounted on a

U-shaped holder, then tested.

- 3) No. E-3 This method is suitable for the case where glass fibres are sewn on to a specimen such as a heat-melting type fabric, etc. and the specimen is mounted on a U-shaped holder, then tested.

NOTE : In addition, an adequate method is selected from Annex 2 (ISO 6925), Annex 3 (ISO 6940), Annex 4 (ISO 6941) or Annex 5 (ISO 10047) for the testing.

6 Classification method for flammability The flammability shall be classified as table 1 to table 4 from the test result of each measurement item for the respective testing methods in clause 5.

Table 1 Method A-1

Division	Heating for 1 min				After 3 s from flaming		
	Burned area cm ²	Afterflame time s	Afterflame time + af- terglow time* s	Burned length cm	Burned area cm ²	Afterflame time s	Afterflame time + af- terglow time* s
1	Over 45	Over 3	Over 5	Over20	Over45	Over 10	Over 15
2	45 max.	3 max.	5 max.		45 max.	10 max.	15 max.
3	30 max.			20 max.	30 max.	3 max.	5 max.

Table 2 Method A-2

Division	Heating for 2 min				After 6 s from flaming		
	Burned area	After-flame time	Afterflame time + afterglow time* s	Burned length	Burned area	Afterflame time	Afterflame time + afterglow time” s
	cm ²	s		cm	cm ²	s	
1	Over 60	Over 5	Over 20	Over 20	Over 60	Over 20	Over 30
2	60 max.	5 max.	20 max.		60 max.	20 max.	30 max.
3	40 max.			20 max.	40 max.	5 max.	20 max.

Table 3 Method B

Division	Burned length cm	Afterflame time s
1	Over 10	Over 20
2	10 max.	20 max.

Table 4 Method D

Division	Number of flame contacts
1	2 max.
2	3 min.

7 Sampling and preparation of sample The sampling shall be at random. In the case of fabric, it shall be sampled from the part excluding each one-tenth of whole width from the selvages on both sides and 1 m or over from the end. The sample shall be treated according to the determined laundering method⁽¹⁾, then the following test shall be carried out. This treatment may be omitted for the product for which this laundering method is not required.

The sample shall be left in a thermostatic dryer at $50\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 24 h as it is. For the sample without the possibility of being influenced by heat, this may be substituted with the treatment that the sample shall be left in a thermostatic dryer at $105\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 1 h as it is. Next, it shall be left in a desiccator containing silica gel for 2 h or longer as it is.

The sheet for construction work or others used outdoors shall be immersed in warm water at $50\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 30 min prior to the drying in the thermostatic dryer.

Only for method C (combustion rate test), the specimen shall be mounted on the holder, left in thermostatic dryer at $105\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 30 min as it is, then left in the desiccator containing silica gel for 15 min as it is. As occasion demands, the test may also be carried out on the sample on which the dry cleaning has been treated.

Note ⁽¹⁾ Laundering method The specimen shall be the size required for each testing method, hemmed for avoiding fray and laundered according to the following method.

a) In the case of laundering by water washing, it shall be in accordance with either of the following.

1) Carry out continuously 5 times according to the method F-2 in **8.58.4 b) 6.2)** of JIS L 1018, provided that the laundering temperature shall be $60\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ and the laundering time shall be 15 min. The sample thrown into the cylinder shall be adjusted to 800 g in mass including the ballast.

If necessary, measure the hardness of water according to **15.1** of JIS K 0101 and use that of $5\text{ mgCaCO}_3/\text{L}$ or under in concentration converted to calcium carbonate. In this case, the purport shall be appended to the test result.

2) Carry out continuously twice according to the method D in **8.58.4 b) 4)** of JIS L 1018, provided that it shall be immersed in boiling water solution (bath ratio 50 : 1) for 30 min.

b) In the case of dry cleaning, it shall be as follows.

Carry out laundering for 15 min according to the method E-2 in **8.58.4 b) 5.2)** of JIS L 1018, then carry out rinsing twice with sufficient amount of perchloroethylene. After draining the solution, carry out the drying operation continuously five times by the method not so as to be unnaturally "wrinkled" by such as air-drying or warm wind at $65\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. The sample thrown into the cylinder shall be adjusted to 300 g in mass including the ballast. For the perchloroethylene of treatment solution, use the solution prepared so that 1 g of anionic surface active agent of dioctyl sulfo

succinate ester of 60 % or over in purity and 3.5 % or under in alcohol insoluble content, 1 g of non-ionic surface active agent specified in JIS L 0860 and 0.1 ml of water to 100 ml of perchloroethylene specified in JIS K 1521 are mixed.

- NOTES
- 1 When the properties of both surfaces of sample are different, both surfaces shall be tested, provided that for the thick textile products such as the textile floor covering, etc. used in horizontal condition with surface upside, only the surface shall be tested.
 - 2 As the weave, density or material differs depending on the part of the sample, the test shall be carried out on each part.
 - 3 When the laundering treatment is required in Annex 2 to Annex 5, it shall be in accordance with Annex 6 (ISO 10528) or Annex 7 (ISO/FDIS 12138).

8 Testing method

8.1 Method A (combustion test)

8.1.1 Method A-1 (45° micro burner method) and method A-2 (45° Meckel burner method)

a) Apparatus and materials

- 1) Combustion test box That shown in figure 1.1 to figure 1.3.
- 2) Specimen holding frame That shown in figure 1.4 to figure 1.6 capable of holding the specimen completely (hereafter, referred to as the “holding frame”).
- 3) Electric spark generator
- 4) Micro burner That shown in figure 1.7 and the primary air introduction port is not provided.
- 5) Meckel burner That shown in figure 1.8 and the primary air introduction port is not provided.
- 6) Thermostatic dryer That capable of adjusting at the specified temperature.
- 7) Desiccator
- 8) Stopwatch That graduated in 0.2 s.
- 9) Fuel Liquefied petroleum gas of Class 2 No. 4 specified in JIS K 2240 (butane and butylene as the main component).
- 10) Silica **gel**

Unit : mm

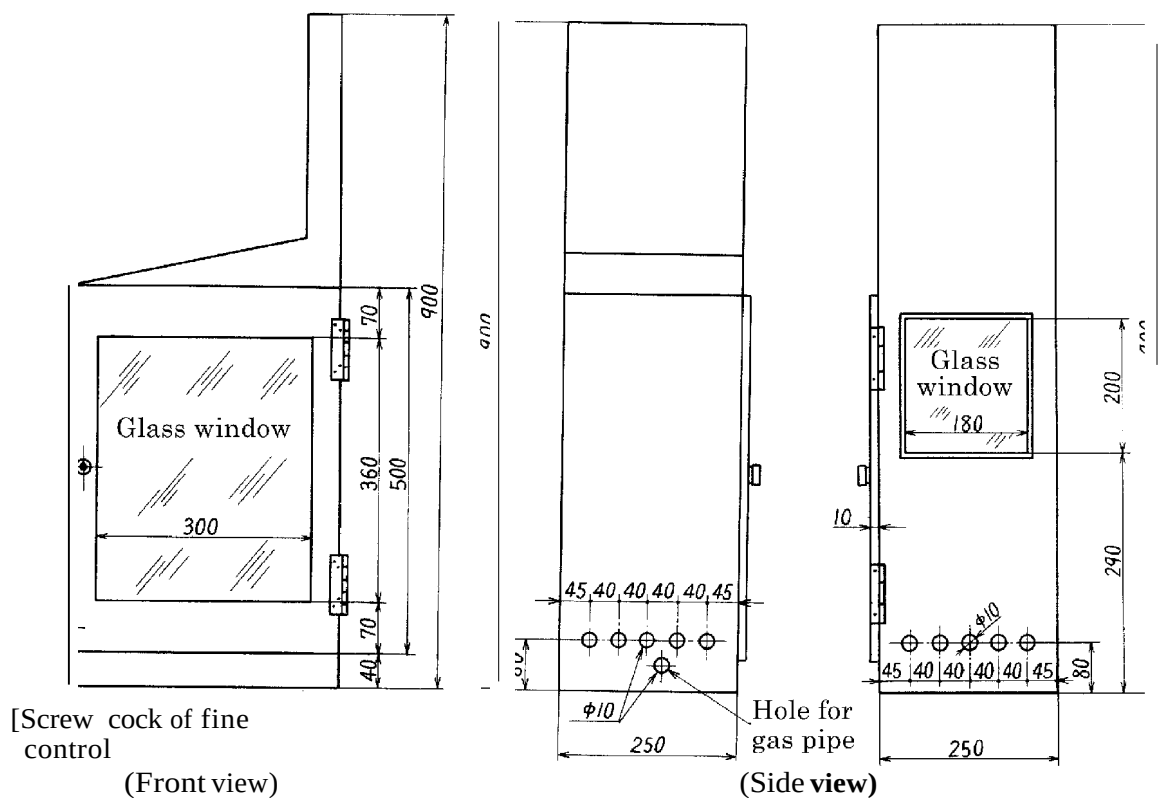


Figure 1.1 Combustion test box

Unit : mm

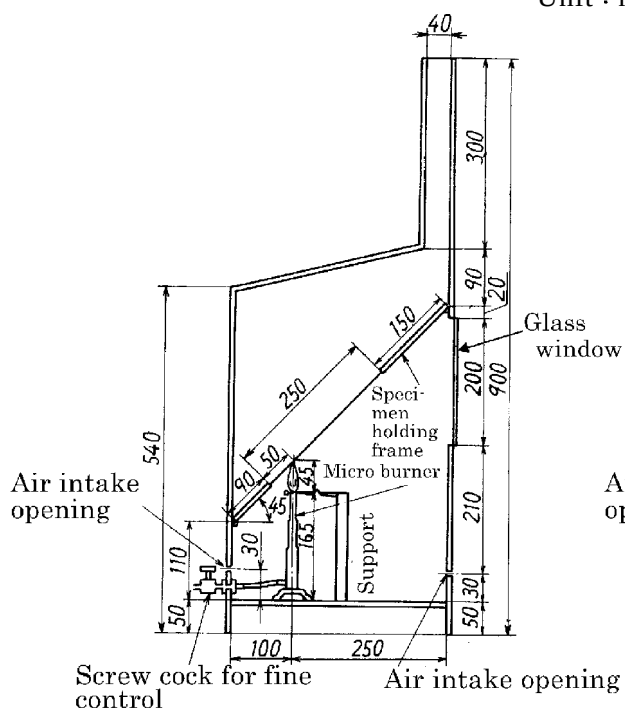


Figure 1.2 Combustion test box
(micro burner method)

Unit : mm

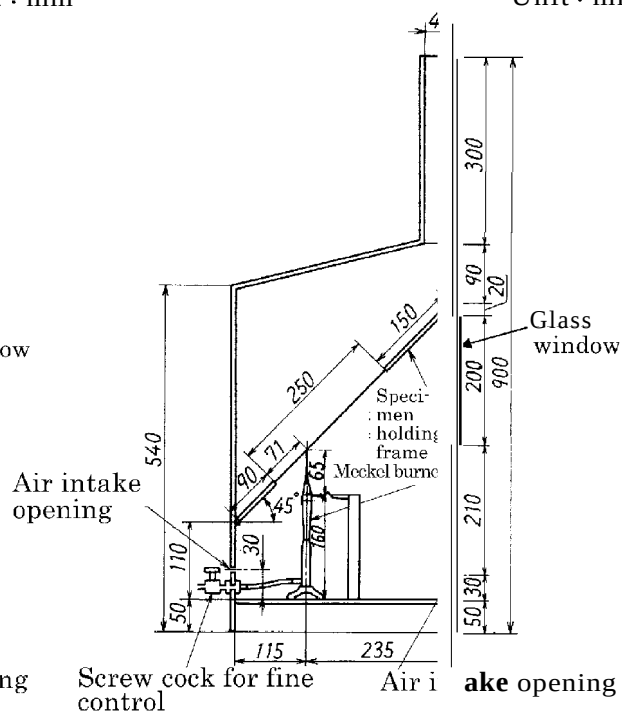


Figure 1.3 Combustion test box
(Meckel burner method)

Unit : mm

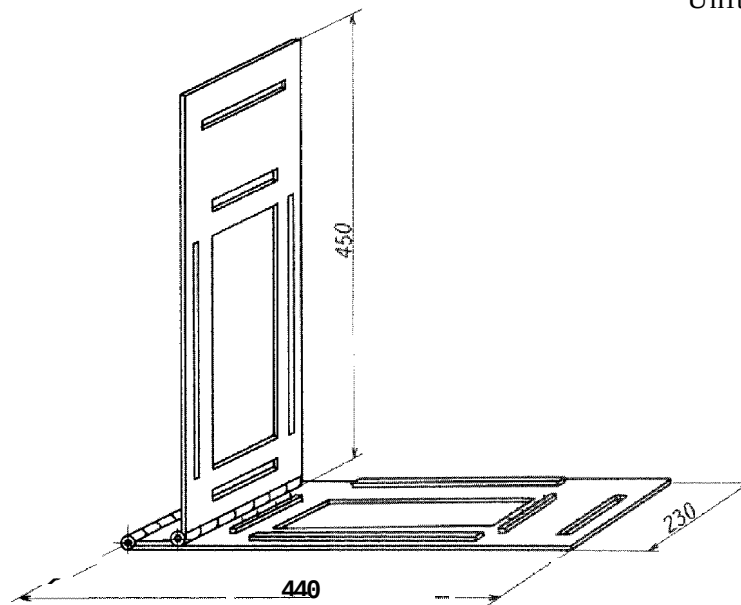


Figure 1.4 Specimen holding frame

Unit : mm

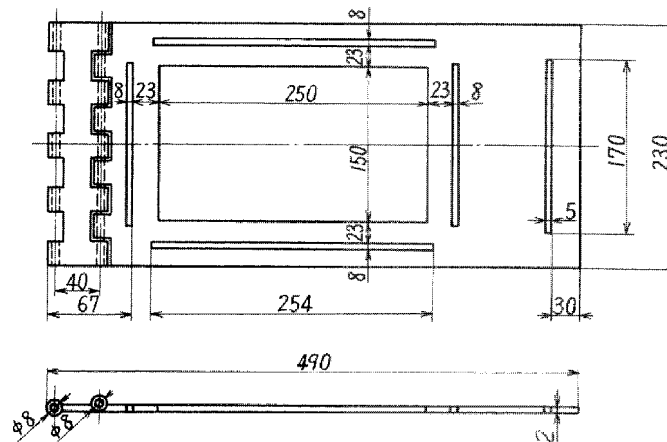


Figure 1.5 Upper part

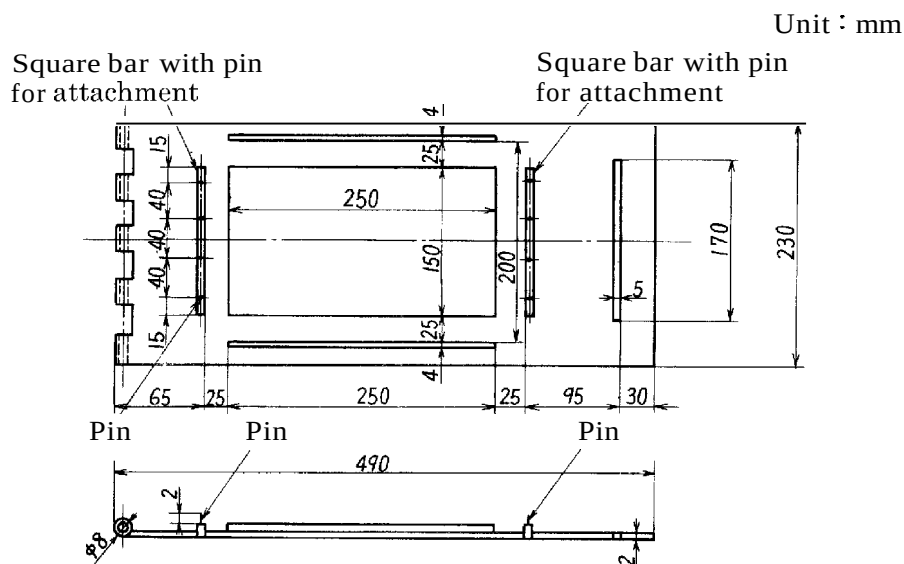


Figure 1.6 Lower part

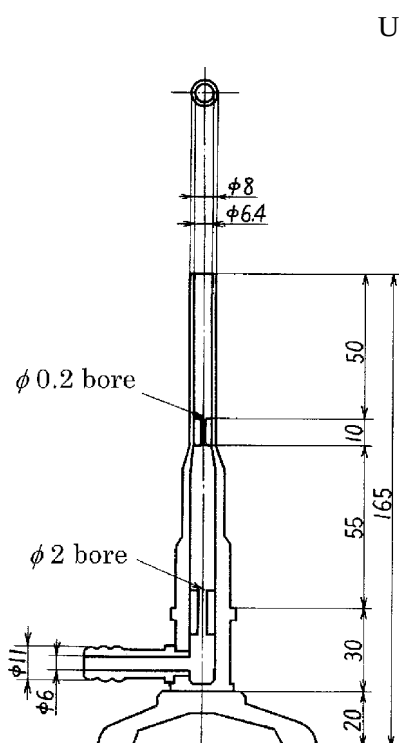


Figure 1.7 Micro burner

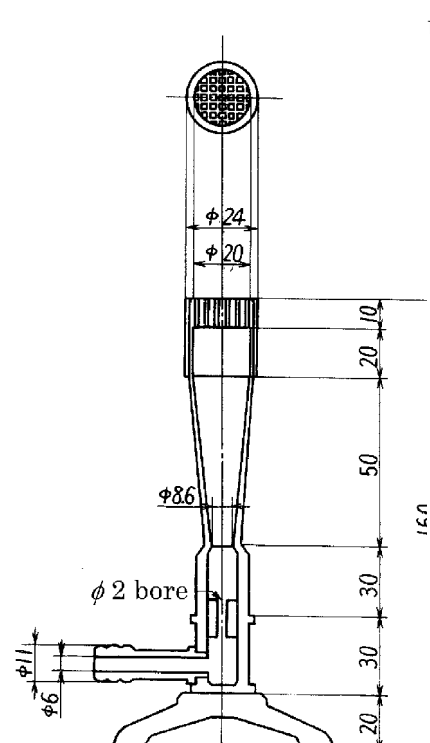


Figure 1.8 Meckel burner

- b) Operation Take three sheets of specimen of about 350 mm × 250 mm in size for lengthwise and widthwise respectively in both method A-1 and method A-2. Place a burner on a prescribed position of the combustion test box (see figure 1.2 and figure 1.3) and adjust the length of flame so as to be 45 mm for method A-1 and 65 mm for method A-2 under the condition where the holding frame is not mounted. Take out each specimen from the desiccator and put it quickly on the supporting frame so as not to be loosened. Mount this to the combustion test box. heat it for 1 min in

method **A-1** or 2 min in method **A-2**, and measure the afterflame time (s) and the afterglow time (s). Next, detach the specimen from the holding frame and measure the burned area (cm²) up to the place of integer by using a planimeter, etc. For the specimen flamed during heating for 1 min in method A-1 or 2 min in method **A-2**, carry out the test on another two sheets in lengthwise and widthwise respectively so as that flame is removed in 3 s after flamed for method A-1 or in 6 s after flamed for method **A-2**, and measure in the same way. In this case, append the heating time. Furthermore, for the specimen which shrinks when it is contacted to flame, put the rectangular part in 263 mm × 158 mm of specimen into the rectangular part in 250 mm × 150 mm of the inside of specimen holding frame and fix so that the length and width are corresponded respectively (it is loosened by 5 %), heat it for 1 min in method A-1 or 2 min in method **A-2**, and measure the burned length (cm). For the test result, express the maximum burned area (cm²), the maximum afterflame time (s), afterglow time (s) and the burned length (cm) up to the place of integer.

8.1.2 Method **A-3** (horizontal method)

a) Apparatus and materials

- 1) Specimen holder That shown in figure 2.
- 2) Cup for combustion A circular-flat bottomed vessel of 15.9 mm in inside diameter and 7.1 mm in height moulded from brass plate of 0.8 mm in thickness.
- 3) **Cork** stand That shown in figure 2.
- 4) Pipette That graduated in 0.1 mm.
- 5) Scale That graduated in 1 mm.
- 6) Ethanol That of Class 1 specified in JIS K 8101.
- 7) Thermostatic dryer That capable of adjusting at the specified temperature.
- 8) Desiccator
- 9) Silica gel

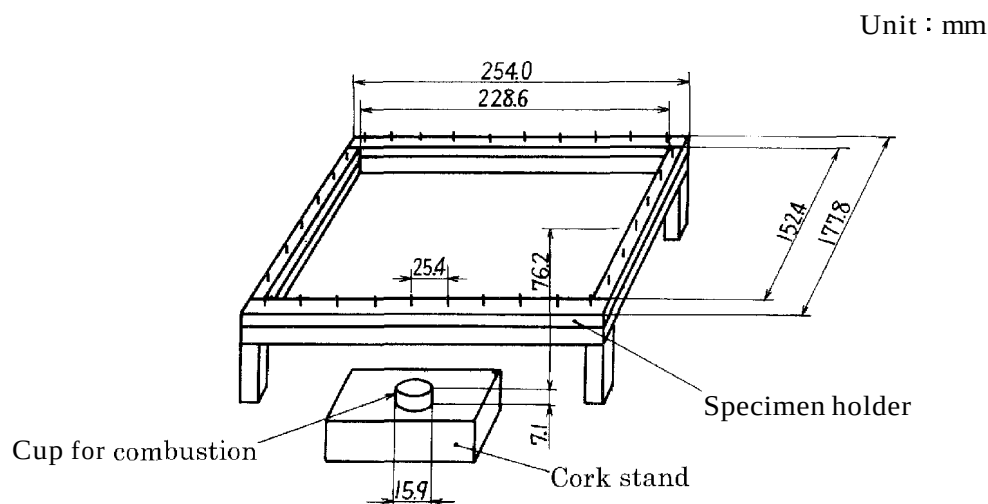


Figure 2 Apparatus for combustion

- b) **Operation** Take five sheets of specimen of about 180 mm × 250 mm in size. Take out each specimen from the desiccator and mount it quickly to the specimen holder horizontally. Place a cup for combustion on the cork stand (when carrying out continuously, use the cup completely cooled down to the room temperature) and adjust so that the distance between the central part of specimen and the edge of vessel becomes 76.2 mm. Next, inject ethanol of 0.3 ml into cup by using a pipette and ignite it under the windless condition. After ethanol is completely burned, take out the specimen from the specimen holder and measure the burned length (cm). Express the test result by the mean value of five sheets.

8.1.3 Method A-4 (vertical method)

a) Apparatus and materials

- 1) **Combustion test box** That shown in figure 3.1 and of 329 mm in width, 329 mm in depth and 762 mm in height for the inside dimension.
- 2) **Specimen holder** That shown in figure 3.2 and made of stainless steel (2 mm in thickness).
- 3) **Bunsen burner** A pipe of 11 mm in inside diameter and the tip part shall be inclined by 25° to vertical direction. An operation rod shall be mounted so that the tip of burner can be quickly moved to the prescribed position.
- 4) **Load** That of 0.54 N {54.4 gf}, 1.12 N {113.4 gf}, 2.23 N {226.8 gf} and 3.34 N {340.2 gf}.
- 5) **Scale** That graduated in 1 mm.
- 6) **Fuel** Methane gas of 97 % or over in purity.
- 7) **Thermostatic dryer** That capable of adjusting at the specified temperature.
- 8) **Desiccator**
- 9) **Silica gel**

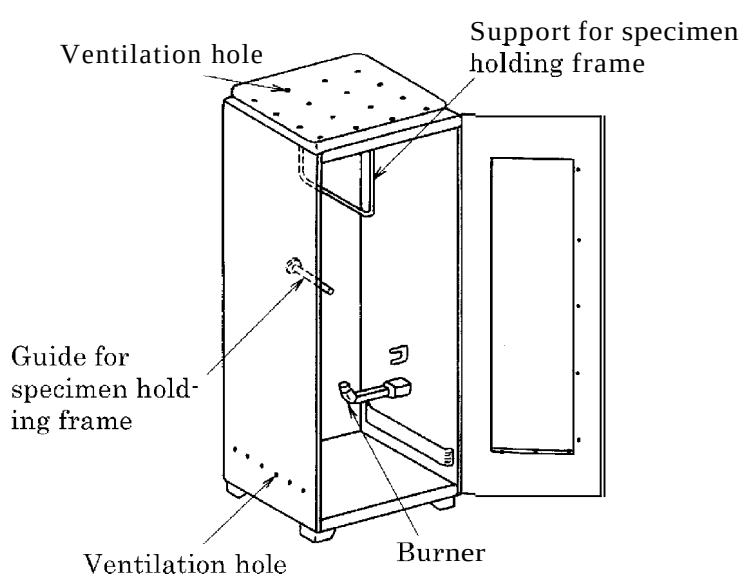


Figure 3.1 Combustion test box

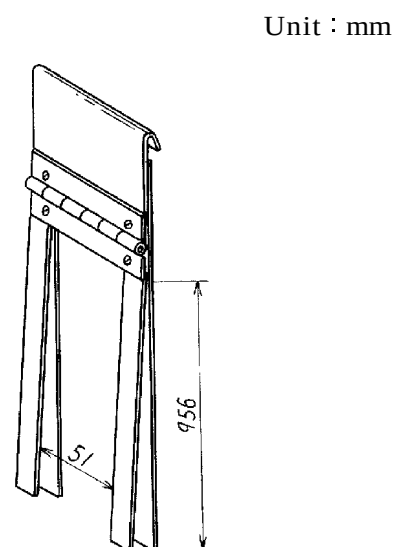


Figure 3.2 Specimen holder

- b) **Operation** Take five sheets of specimen of about 89 mm × 254 mm in size for lengthwise and widthwise respectively. Place a burner in the combustion test box (see figure 3.1) and adjust the length of flame so as to be 38 mm under the condition where the specimen holder is not mounted. Take out each specimen from the desiccator, put it quickly on the specimen holder (see figure 3.2), adjust the specimen holder so that the lower end of specimen becomes 17 mm of height from the opening of burner and close the glass door. Next, operate the burner from the outside of box with the operating rod so that the flame hits the centre of width of the specimen. Remove the flame after heating for 3 s and carry out the test. Next, detach the specimen from the specimen holder and measure the burned length (cm) according to the following method. Mount a load shown in table 5 to one side of the part left unburned of the lower end of specimen and gently raise the other side (see figure 3.3). As the result, measure the length from the lower end of specimen to the tip of torn part and take it as the burned length.

Express the test result by the mean value of five sheets of lengthwise and widthwise, respectively.

Table 5 Load

Mass of fabric g/m ²	Load N {gf}
Under 101	0.54 { 54.4}
101 or over to and excl. 207	1.12 {113.4}
338 or over	3.34 {340.2}

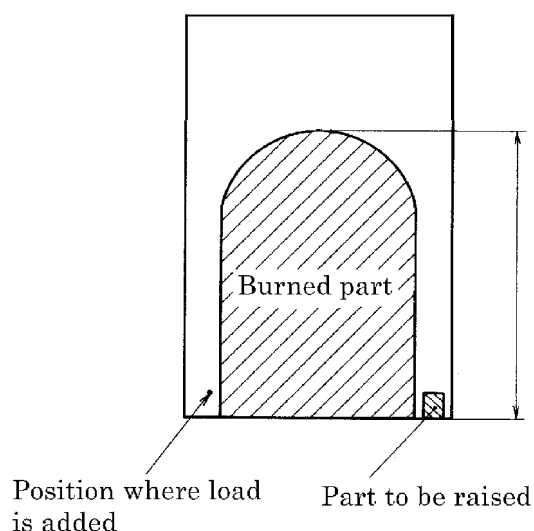


Figure 3.3 Measuring method of burned length

8.2 Method B (surface combustion test)

a) Apparatus and materials

- 1) Combustion test box That shown in figure 4.1.
- 2) Specimen pressing frame That made of stainless steel as shown in figure 4.2 (hereafter, referred to as “pressing frame”).
- 3) Perlite board The autoclaved board 0.8 perlite board (0.8PA) of 8 mm in thickness specified in JIS A 5430 as shown in figure 4.3 or the fire resistant thermal insulating board.
- 4) Electric spark generator That shown in figure 4.5.
- 5) Burner That shown in figure 4.4 to figure 4.8.
- 6) Thermostatic dryer That capable of adjusting at the specified temperature.
- 7) Scale That graduated in 1 mm.
- 8) Stopwatch That graduated in 0.1 s.
- 9) Fuel Liquefied petroleum gas of Class 2 No. 4 specified in JIS K 2240 (butane and butylene as the main component).
- 10) Desiccator
- 11) Brush That adequate for piling the specimen surface.
- 12) Silica gel

- b) Operation Take three sheets of specimen⁽²⁾ of 220 mm × 400 mm in size for lengthwise and widthwise respectively⁽³⁾. Make a burner to be in vertical condition and adjust the length of flame so as to be 24 mm by controlling the pressure of fuel at 3.92 kPa (400 mm H₂O). Take out each specimen from the desiccator and put it quickly on the perlite board whose temperature is same as the room temperature in laboratory, press the periphery with a pressing frame so as to be still, and fix it in a combustion test box as figure 4.1. Make the burner to be horizontal, heat it for 30 s as keeping the tip away by 1 mm from the surface of specimen, and measure the afterflame time (s). Next, detach the specimen from the pressing frame and measure the burned length (cm) by using a scale. Express the test result by the maximum value among the measured values.

Notes ⁽²⁾ If necessary, the surface is piled by brushing.

⁽³⁾ When the specimen cannot be taken to the specified size, the size as it is may be applicable.

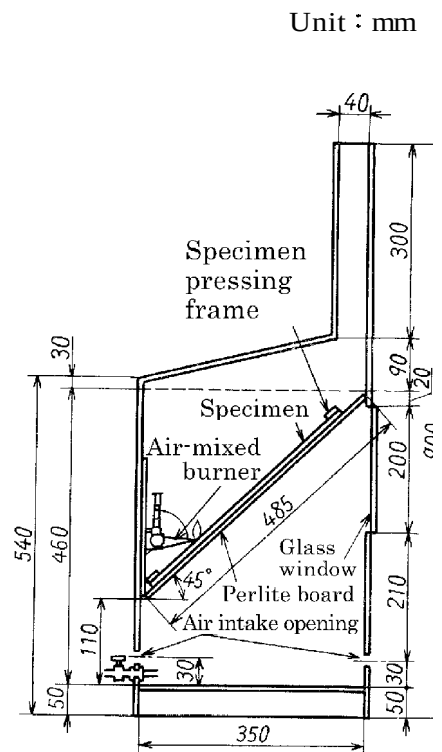


Figure 4.1 Combustion test box

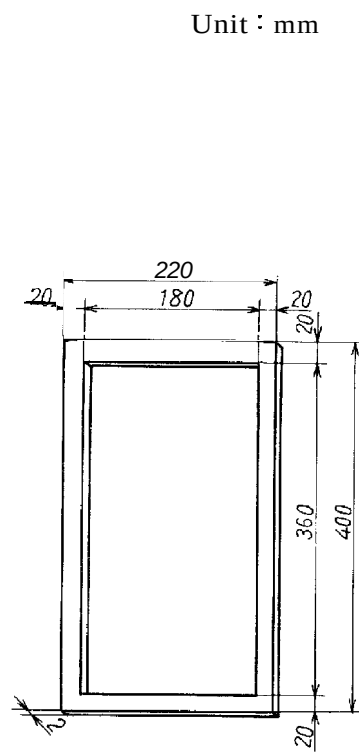


Figure 4.2 Specimen pressing frame

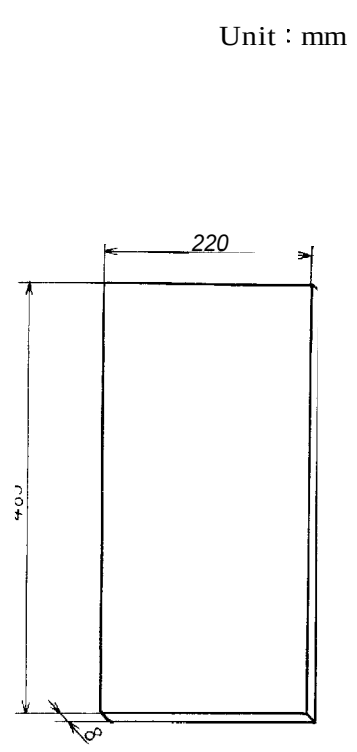


Figure 4.3 Perlite board

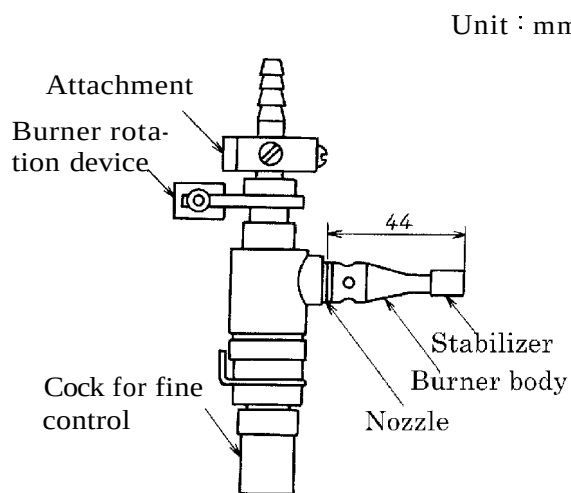


Figure 4.4 Construction of burner

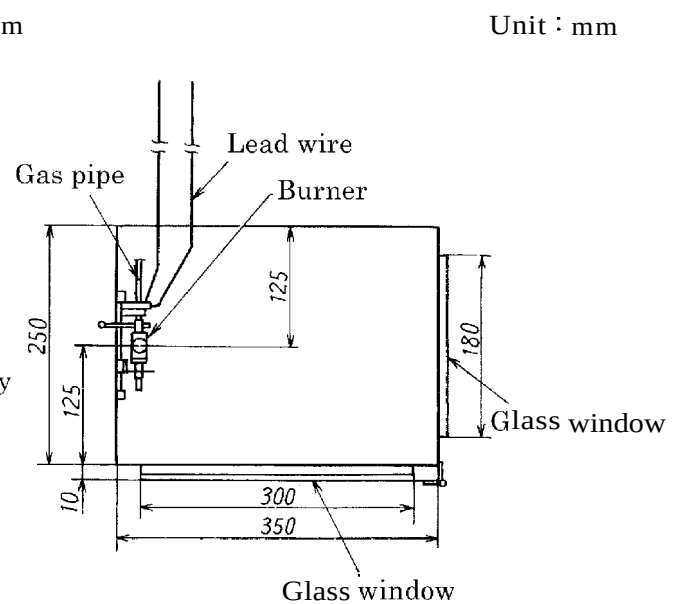


Figure 4.5 Burner attachment and electric spark generator

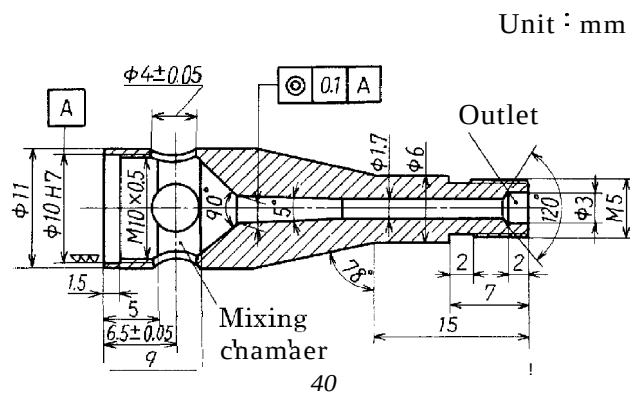


Figure 4.6 Burner body

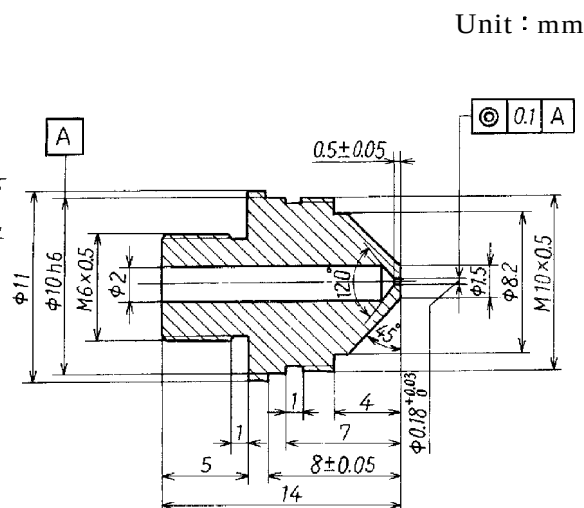


Figure 4.7 Nozzle

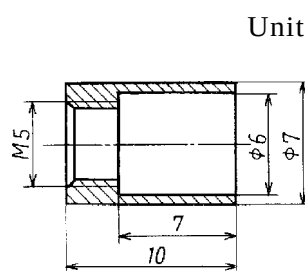


Figure 4.8 Stabilizer

8.3 Method C (combustion rate test)

a) Apparatus and materials

- 1) Flammability tester That shown in figure 5.1 to figure 5.3.
- 2) Stopwatch That graduated in 0.2 s.
- 3) Thermostatic dryer That capable of adjusting at the specified temperature.
- 4) Desiccator
- 5) Brush That adequate for piling the specimen surface.
- 6) Fuel Liquefied petroleum gas of Class 2 No. 4 specified in JIS K 2240 (butane and butylene as the main component).
- 7) Set yarn White mercerized yarn, soft finished 120 dtex {No.50} of JIS L 2101.
- 8) Silica gel

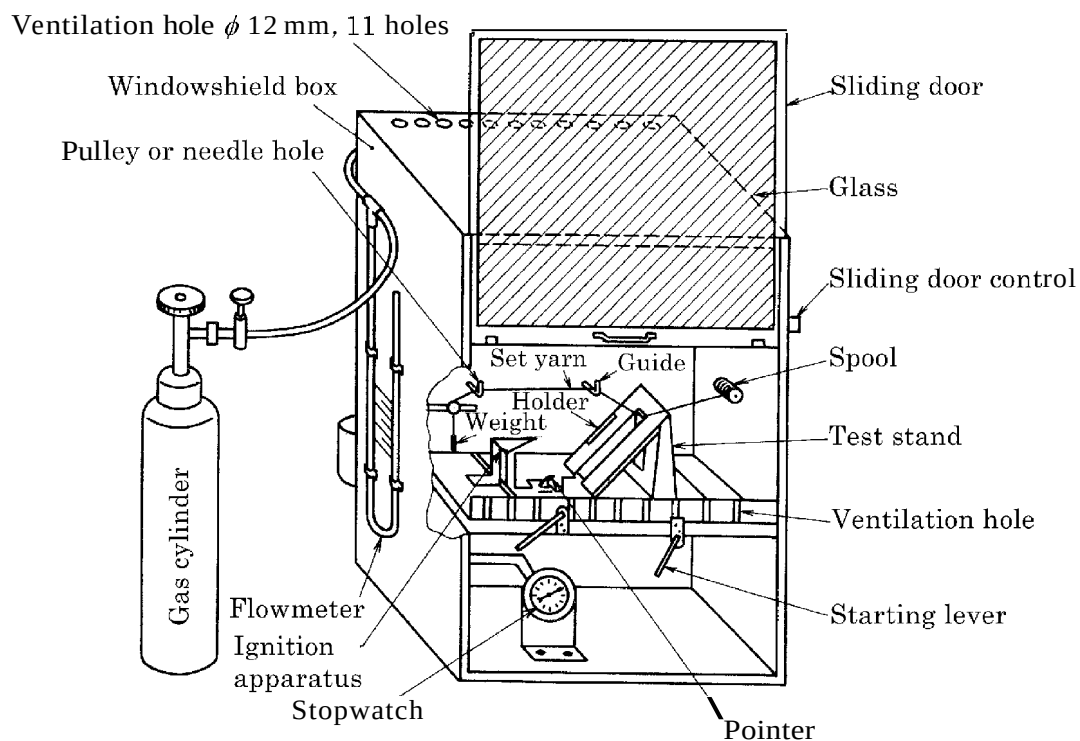


Figure 5.1 Flammability tester

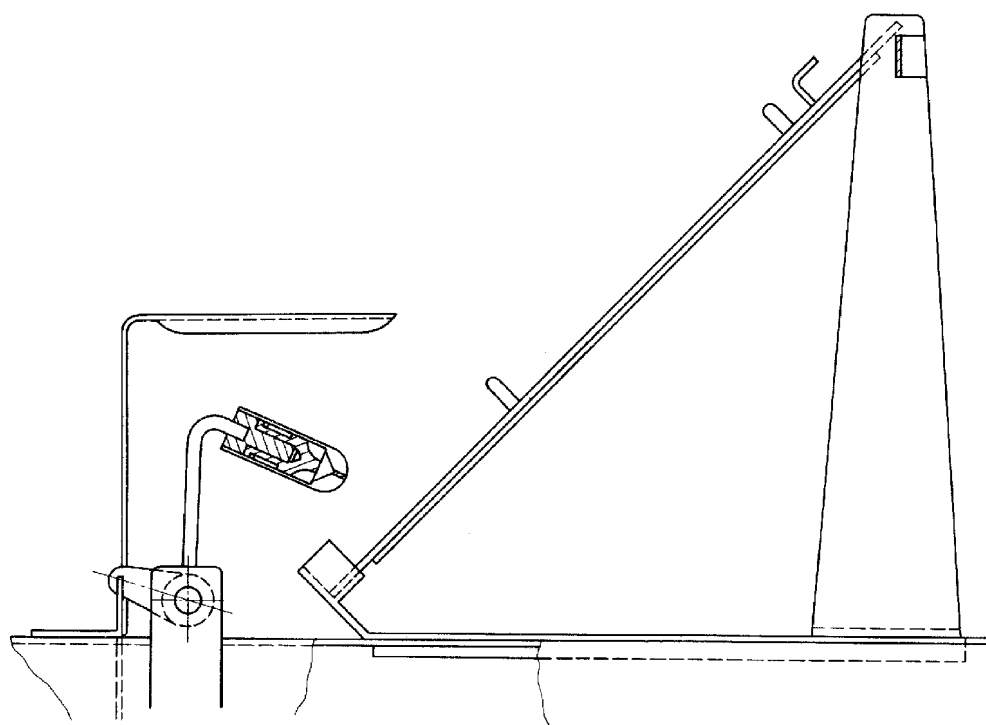


Figure 5.2 Ignition apparatus

Unit : mm

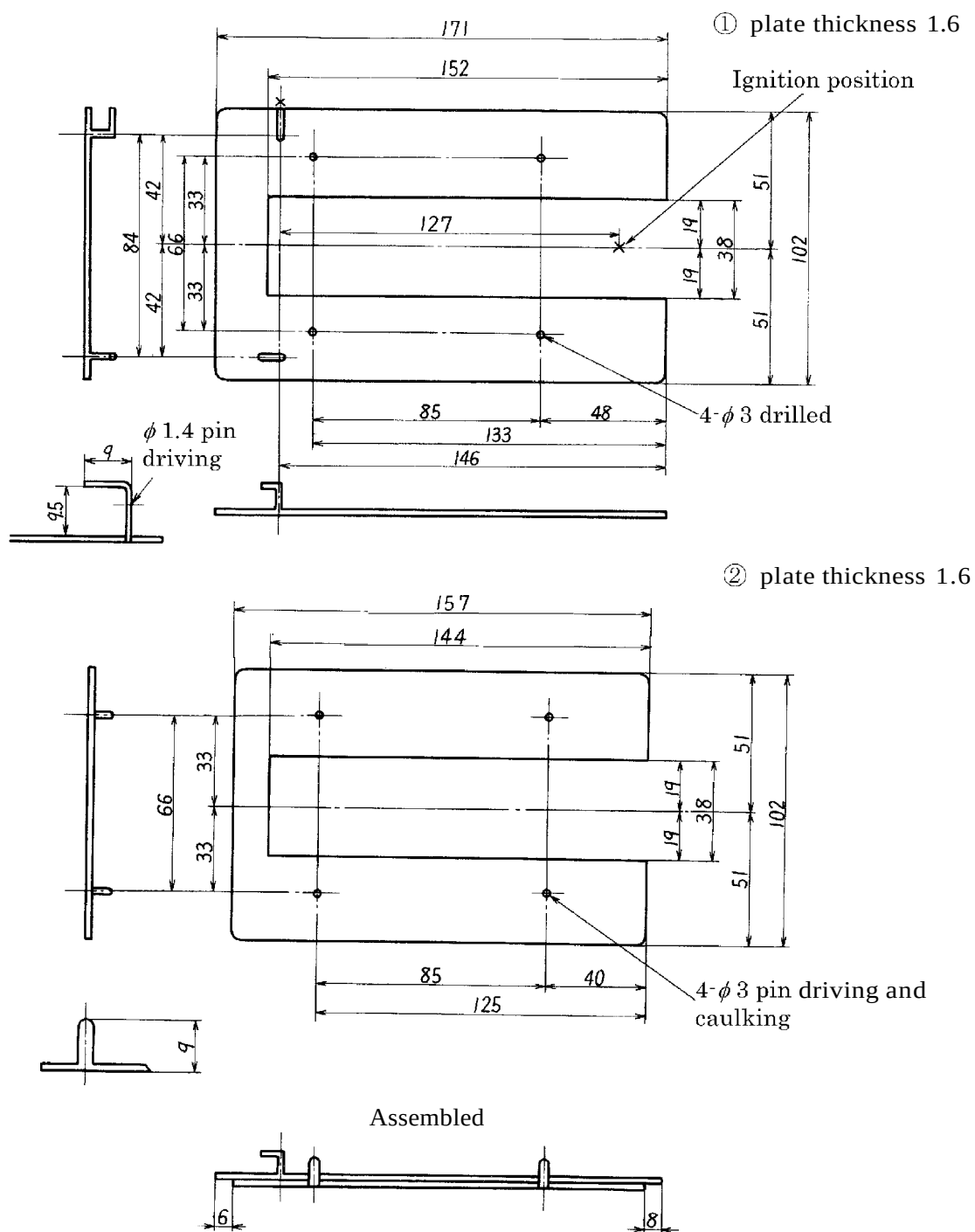


Figure 5.3 Specimen holder

- b) Operation Take five sheets of specimen of about 50 mm × 150 mm in size for lengthwise and widthwise respectively. Mount a preliminary specimen to the flammability tester (see figure 5.1) and adjust so that the lower surface of specimen is contacted to the tip of pointer. Adjust the length of flame so as to be 16 mm and set the stopwatch at zero. Next, take out quickly the specimen mounted to the

specimen holder from the desiccator, replace it with a preliminary specimen, place it on the regular position of the test stand in tester, stretch a set yarn at the prescribed place, mount a weight to its end, close the door, pull the starting lever to the right side and release it. The stopwatch is started corresponding to this and flame is contacted to the specimen for 1 s. In this case, the time in which the specimen is taken out from the desiccator and contacted to flame shall be within 30 s. When the set yarn stretched at the upper part of specimen is burnt and the weight falls, the stopwatch will be stopped. Measure the time (s) indicated by the stopwatch at this time, and take it as the combustion rate. When any one of five specimens is not flamed or the combustion is stopped until the flame reaches the set yarn, carry out the same test about five more specimens. Express the test result by the mean value (to the nearest 0.1 s) of the all measured values in lengthwise and widthwise (excluding the specimens not flamed or those of which the combustion is stopped before the flame reaches the set yarn.).

8.4 Method D (flame contact test)

a) Apparatus and materials

- 1) Combustion test box That shown in figure 6.1. The dimension shall be in accordance with figure 1.1.
- 2) Micro burner and flame contact burner The micro burner shall be that shown in figure 1.7. The flame contact burner shown in figure 6.2 may be used.
- 3) Thermostatic dryer That capable of adjusting at the specified temperature.
- 4) Desiccator
- 5) Specimen holding coil That made of rigid stainless steel wire of 0.5 mm in diameter specified in JIS G 4309, and be 10 mm in inside diameter, 2 mm interval between mutual wires and 150 mm in length (see figure 6.2).
- 6) Fuel Liquefied petroleum gas of Class 2 No. 4 specified in JIS K 2240 (butane and butylene as the main component).
- 7) Silica gel

Unit : mm

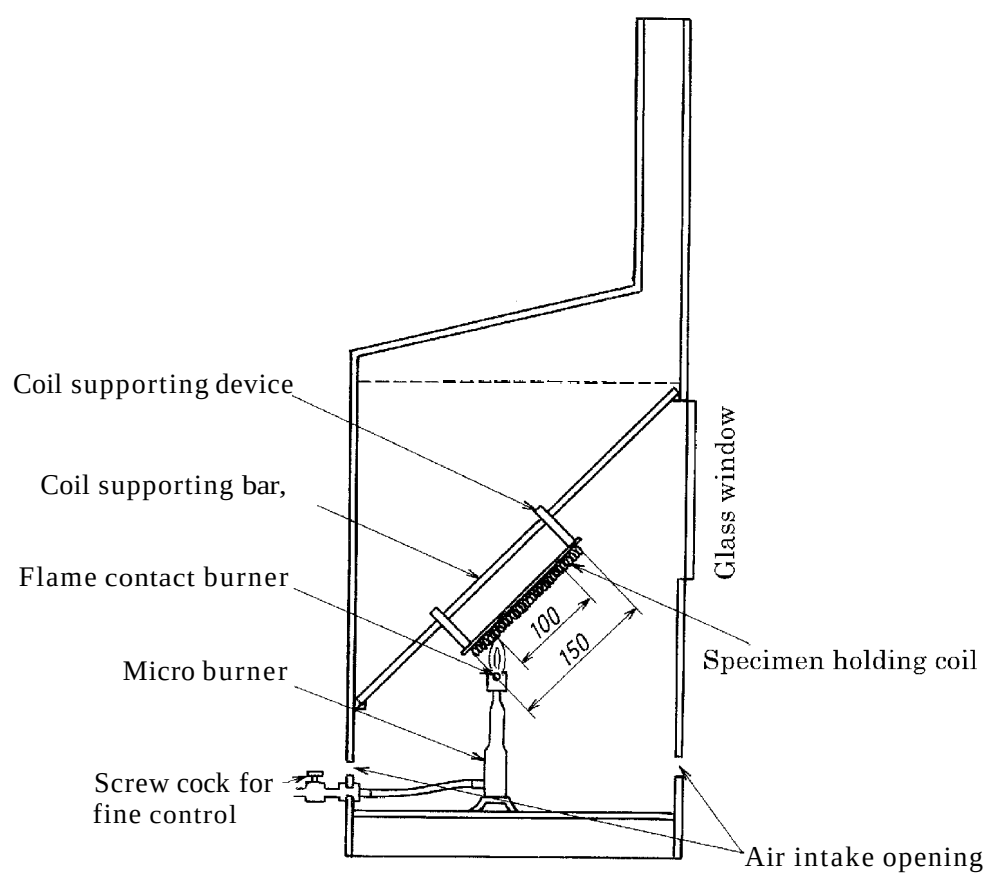


Figure 6.1 Combustion test box

Unit : mm

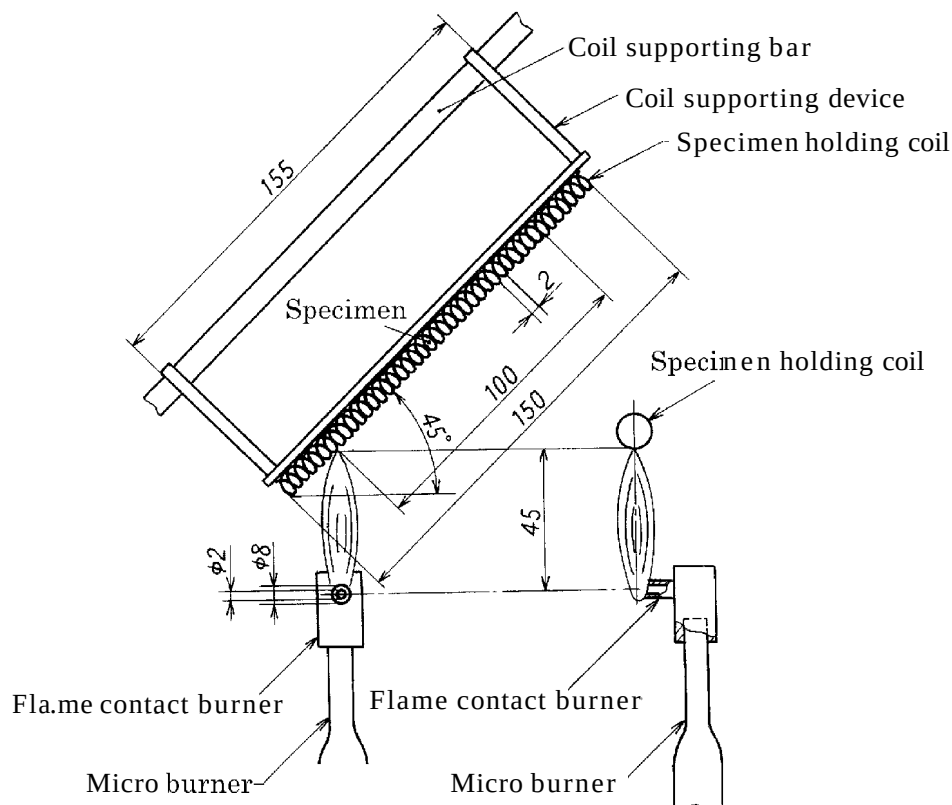


Figure 6.2 Specimen holding coil

- b) Operation The size of a specimen shall be 100 mm in width and 1 g in mass. When the length exceeds 200 mm, however, make it 200 mm and take five sheets of specimen for lengthwise and widthwise respectively. Adjust the length of flame of burner so as to be 45 mm under the condition where a specimen holding coil is not mounted. Take out each specimen from the desiccator, round it quickly so as to be 100 mm in width, insert it into the centre of the specimen holding coil and keep it by the inclination of 45°. Adjust the flame of burner at the position contacted to the lowest end of specimen in the specimen supporting coil (see figure 6.2) and heat it until the combustion of specimen is stopped as melting. Adjust it over again at the position where the flame is contacted to the lowest end of residual specimen, carry out the same test as the previous test and repeat this operation until the place of 90 mm from the lower end of specimen is molten to be burnt. The test result shall be expressed by the minimum number of times of flame contact during the test of five sheets of lengthwise and widthwise, respectively.

8.5 Method E (oxygen index method test)

a) Apparatus and materials

- 1) Testing apparatus The testing apparatus shall consist of a combustion part, a gas supply part, a measurement part and an igniter as shown in figure 7.1 and

satisfy the following various conditions.

- 1.1) Combustion part The combustion part shall consist of a combustion cylinder and a specimen holder.

The combustion cylinder shall be made of heat resistant glass with 75 mm^{+3}_0 mm in inside diameter, $450\text{ mm} \pm 5\text{ mm}$ in height and uniformly filled with the glass particle of $4\text{ mm} \pm 1\text{ mm}$ in diameter in thickness of $100\text{ mm} \pm 5\text{ mm}$ from the bottom. A metal net shall be placed above the glass particles because the carbide and the like of specimen fall during the test. The flow speed of mixed gas in cylinder shall be $40\text{ mm/s} \pm 10\text{ mm/s}$. The specimen holder shall be so constructed as to be capable of supporting the specimen vertically at the central part of bottom of the combustion cylinder.

- 1.2) Gas supply part The gas supply part shall consist of oxygen and nitrogen cylinders, pressure gauges, pressure controllers, valves and hoses.

The oxygen to be used shall be the one specified in JIS K 1101 or at least equal to it in quality and the nitrogen shall be the one of Class 2 specified in JIS K 1107 or at least equal to it in quality.

- 1.3) Measurement part The measurement part shall consist of an oxygen flowmeter (0.1 L/min in minimum graduation with flow rate control valve), a nitrogen flowmeter (0.1 L/min in minimum graduation with flow rate control valve), a gas mixer, pressure gauges, pressure controllers, purifiers and an inspecting valve. Each flowmeter shall be calibrated once a year.

- 1.4) Igniter The igniter shall be constructed so as to be about 3 mm in inside diameter of the tip, capable of controlling the flame to a prescribed length, inserted from the upper of combustion cylinder so as to ignite the specimen easily. For the heat source, the liquefied petroleum gas of Class 1 No. 1 of JIS K 2240 shall be used in principle.

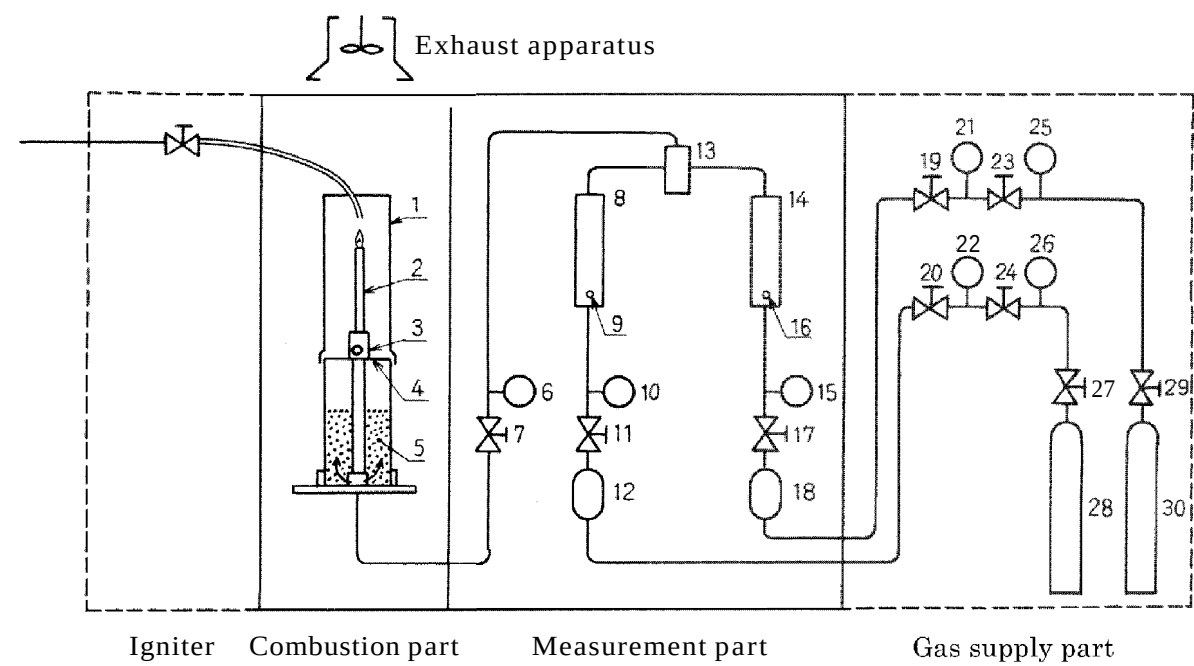
- 2) U-shaped holder The U-shaped holder shall be the holder of aluminium to be used when tested by No. E-2 and No. E-3, and the shape and dimensions thereof shall be as shown in figure 7.2.

- 3) Stopwatch That graduated in 0.2 s.

- 4) Silica gel

- 5) Thermostatic dryer That of capable of adjusting at the specified temperature.

- 6) Desiccator



Designation of testing apparatus

No.	Designation	No.	Designation
1	Combustion cylinder	12, 18	Purifier
2	Sample	13	Gas mixer
3	Specimen support	14	Oxygen flowmeter
4	Metal net	16	Oxygen pressure gauge
5	Glass particles	17	Oxygen pressure controller
6	Leak inspecting pressure gauge	19, 20, 27, 29	Valve
7	Shut valve	21, 22	Supply pressure gauge
8	Nitrogen flowmeter	23, 24	Pressure controller
9, 15	Valve for fine control	25, 26	Main pressure gauge
10	Nitrogen pressure gauge	28	Nitrogen gas cylinder
11	Nitrogen pressure controller	30	Oxygen gas cylinder

Figure 7.1 Testing apparatus

Unit : mm

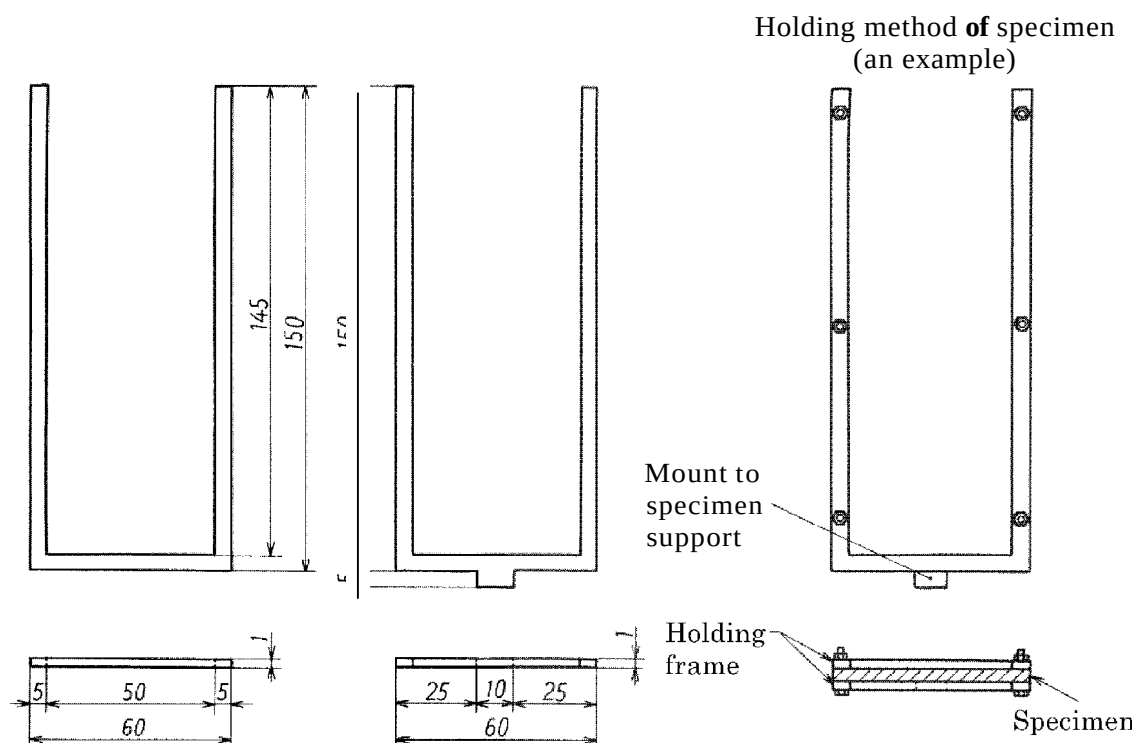


Figure 7.2 U-shaped holder

- b) Operation The shape and dimensions of specimen shall be as shown in table 6. For the specimen of No. E-1, as shown in figure 7.3, the specimen is densely wound up in a twisted form by making a wire, etc. of 0.8 mm to 0.9 mm in diameter to be a core and the length is made to be 80 mm to 100 mm, then the wire is pulled out. For the specimen of No. E-3, one of the three of glass fibres⁽⁴⁾ is sewn on to the centre of specimen and the rest of two are sewn on to right and left at intervals of 10 mm as shown in figure 7.5. On this occasion, the number of sewing stitches shall be 4 to 5 per 10 mm.

The specimen of ten sheets or more should be prepared.

Before the test is started, it shall be confirmed that there is no leakage at connection parts by operating the inspecting valve of the apparatus. Next, the confirmation of apparatus shall be carried out by using a collation specimen⁽⁵⁾.

For the specimen of No. E-1, mount vertically to the specimen support so that the upper end part is positioned at 100 mm or over of distance from the upper end part of the combustion cylinder. For the specimens of No. E-2 and No. E-3, place the specimen between two holding frames of the U-shaped holder as shown in figure 7.2, fix the upper end part and the lower end part, or several places if necessary, by using screws, card fastening clips and the like, then mount it vertically to the specimen holder so that the upper end part of specimen is positioned at 100 mm or over of distance from the upper end part of the combustion cylinder.

Select the presumed oxygen concentration of sample and set the apparatus by selecting the corresponding oxygen flow rate and nitrogen flow rate from attached table 1 beforehand. When the presumed oxygen concentration of sample is unknown, ignite the specimen in air, examine the combustion condition; and when the specimen burns quickly at this time, it is recommended to start from 18 % in oxygen concentration. When the specimen is not ignited, it is recommended to start from about 25 % in oxygen concentration or over. When changing the concentration, determine the ratio of flow rate of oxygen and nitrogen according to attached table 1. However, confirm that the total flow rate in combustion cylinder is 11.4 L/min, and the equilibrium of the ratio is maintained continuously.

When the tip of igniter is turned upward, adjust the length of flame to 15 mm to 20 mm.

Open the oxygen and nitrogen flow rate control valves to release the gas into the combustion cylinder for about 30 s, and ignite the upper end of specimen. In this case, confirm that the upper end part of specimen is wholly flamed and burnt in flame-form, remove the flame of igniter, then immediately start the measurement of the burning time as well as the burned length.

Repeat the following operation of 1) or 2) and determine the minimum oxygen flow rate required for the continuous combustion of the specimen for 3 min or longer in burning time or that for 50 mm or longer in burned length after ignition, and the nitrogen flow rate of this time. Do not change the flow rate during combustion.

- 1) When the burning time of specimen exceeds 3 min, or when the burned length exceeds 50 mm, the oxygen concentration is too high in any case, therefore it shall be gradually reduced.
- 2) When it goes out soon after flamed or it goes out for under 3 min in burning time or under 50 mm in burned length, the oxygen concentration is too low in any case, therefore it shall be gradually raised.

Table 6 Division according to supporting method of specimen

Supporting method of specimen		Shape, dimensions of specimen		Application
Division	Symbol			
Case where test is carried out so that specimen is made to be stood alone	No. E-1	Length"	150 mm	Case where the test is carried out so that thin material, heat-melting type fabric, etc. are wound
		Width"	20 mm	
		Thickness	Thickness of sample	
Case where test is carried out so that specimen is mounted to U-shaped holder	No. E-2	Length	150 mm	Case where the test is carried out so that glass fibres are sewn on to specimen such as heat-melting type fabric
	No. E-3	Width	60 mm	
		Thickness	Thickness of sample	

Note * In principle.