TCVN VIETNAM NATIONAL STANDARDS

TCVN 6102: 1996
ISO 7202: 1987

FIRE PROTECTION - FIRE EXTINGUISHING MEDIA - POWDER

(This English version is for reference only)

HA NOI – 2008

Foreword

TCVN 6102: 1996 was identical to ISO 7202:1987.

TCVN 6102: 1996 was prepared by Technical Committee TCVN/TC 21 *Equipment for fire protection and fire fighting*, proposed by Directorate for Standards, Metrology and Quality, and approved by Ministry of Science and Technology.

This standard was transferred in 2008 from Vietnam Standard into Vietnam National Standard under the same identifier number, as stipulated in Section 1, Article 69 of the Law on Standards and Technical Regulations and in Point a, Section 1, Article 6 of Decree No 127/2007/ND-CP of the Government dated 01 August 2007 detailing the implementation of a number of articles of the Law on Standards and Technical Regulation.

Introduction

1. This standard is one of a series giving specifications for fire extinguishing media in common use and which are in need of specification for fire fighting purposes. These specifications are designed to establish that the medium in question has at least a minimum useful fire extinguishing capability and can therefore be reasonably sold for fire extinguishing purposes.

2. Requirements for media used in particular equipment will form the subject of future standards.

3. Annexes A and B provide important information on, and give recommendations relating to, the use of extinguishing powders, and they should be read carefully by all concerned with the use of extinguishing powders. They do not, however, form part of the specification.

Fire protection equipment - Fire extinguishing media - Powder

1. Scope

This standard specifies requirements for the chemical and physical properties, and for minimum performance in defined test methods, of fire extinguishing powders suitable for use against fires of classes A, B and C. Requirements are also given for the information and data to be declared by the manufacturer.

Extinguishing powders specifically designed for the control and extinction of class D (metal) fires do not fall within the scope of this standard.

NOTE — The classification of fires is given in TCVN 4878:1989 (ISO 3941).

2. Normative references

ISO 2591, Test sieving.

ISO 3130, Wood — Determination of moisture content for physical and mechanical tests.

ISO 3310-1, Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth.

ISO 3941, Classification of fires.

ISO 4788, Laboratory glassware — Graduated measuring cylinders.

3. Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1. Extinguishing powder: An extinguishing medium com- posed of finely divided solid chemical products consisting of one or more principal components, which are combined with additives to improve its characteristics.

When it is useful to indicate the class of fire for which a particular powder is designed, capital letters may be added before the term. The letters used in this standard are those defined in TCVN 4878:1989 (ISO 3941).

Example: "BC" powder is designed to extinguish class B (liquids or liquefiable solids) and class C (gases) fires; "ABC" powder is designed to extinguish class A (solids which form glowing embers), class B and class C fires.

3.2. Batch: For the purposes of acceptance and verification testing by an inspecting authority, a batch of powder is a single charge of material in the processing equipment that has been made homogeneous by subjection to the same unit and physical processing.

3.3. Lot: A lot contains one or more batches but not more than 25T of powder**,** manufactured to the same formulation by the same manufacturing process and under the same environ- mental conditions.

NOTE: Any substantial change in production personnel, manufacturing process, source of raw materials, or change in environmental conditions may justify identifying the material as a different lot.

3.4. Characterization statement:

Information and data declared by the manufacturer regarding the chemical and physical properties of the powder.

4. Sampling

Samples for testing in accordance with this standard shall be taken using a method which will provide a sample which is as representative as possible.

When sampling a lot, not less than 12 kg of material shall be taken at random from a batch. For batch testing, not less than 2,5 kg selected from a container shall be taken at random. Suitably identified samples shall be stored in individual, clean, dry, airtight, non-reactive containers.

For relatively small quantities, a 25 mm metal sampling tube shall be inserted to the full depth of the extinguishing powder container at no fewer than five locations.

In addition to these samples, an inspecting authority may require additional samples for verification testing.

In order to avoid any risk of condensation, it is essential that the temperature of the powder in its original container is not lower than the ambient air temperature when the sample is being taken. Sample containers should not be opened until temperature equilibrium with the laboratory air has been reached.

5. Characterization statement and requirements

5.1. General

The manufacturer shall declare, on demand, the information and data specified in 5.2 to 5.5. The manufacturer should conduct statistical measurements to ensure that the values declared correspond to the mean values of the range of values inherent to the manufacturing process.

NOTE: The characterization statement is primarily for identification and information purposes and to provide the reference values for the tolerance requirements of 5.2, 5.3 and 5.4, but particular attention is drawn to 5.5.

5.2 Bulk density

The bulk density of the powder shall be determined in accordance with 12.1. The bulk density shall be within ± 0,10 g/ml of the value declared by the manufacturer.

5.3 Sieve analysis

When tested using the method specified in 12.2.1 or 12.2.2, the quantity retained on the 40 µm sieve and on the 63 µm sieve shall not differ from the declared value by more than ± 10 % of the total mass of the sample, and the quantity retained on the 125µm sieve shall not differ from the declared value by more than ± 5 % of the total mass of the sample. The test method shall be declared with the results.

5.4 Chemical content

The declared chemical content of the extinguishing powder need not include constituents making up less than 10 % by mass of the extinguishing powder. However, the chemical content declared shall cover more than 75 % *(m/m)* of the total composition of the extinguishing powder. The allowed tolerance shall not exceed ± 10 % of the declared value for constituents comprising less than 50 %*(m/m)* of the extinguishing powder, and ± 5 % of the declared value for a constituent comprising more than 50 % *(m/m)* of the extinguishing powder.

NOTE: For example, a constituent with a declared value of 40 % will have tolerance limits of 36 % and 44 % and a constituent with a declared value of 80 % will have tolerance limits of 76 % and 84%.

5.5 Toxicity

It is most important that under normal conditions of use the various materials and additives used to produce extinguishing powders shall be generally recognized as being non-toxic to humans.

6 Fire test performance

6.1 Class A

Extinguishing powders claimed by the manufacturer to be suitable for class A fires shall extinguish the test fire described in 12.3.2 in two out of a set of three tests.

6.2 Class B

Extinguishing powders claimed by the manufacturer to be suitable for class B fires shall extinguish the test fire described in 12.3.3 in two out of a set of three tests.

6.3 Class C

Any powder meeting the requirements of 6.2 shall, in addition, be deemed to possess the potential for achieving an adequate performance on class C fires.

7 Discharge performance

When discharged from an extinguisher as described in 12.4 not less than 85 % of the powder shall be discharged.

8 Resistance to caking and lumping

The resistance of the powder to caking and lumping shall be determined using the method specified in 12.5. The penetration of the needle shall be more than 15 mm.

9 Water repellency

There shall be no visually observable absorption of the water droplets by the powder when specified in 12.6.

10 Resistance to extreme low temperature

When tested using the method specified in 12.7, all the powder shall fall to the stoppered end of the test tube within 5s.

11 Electrical insulation value

The powder shall have a dielectric strength of not less than 5 kV, when measured using the method specified in 12.8.

12 Test methods

12.1 Bulk density (see 5.2)

Place 100 ± 0,1g of the powder in a clean, dry 250 ml stoppered glass measuring cylinder, conforming to ISO 4788, having an approximate height of 320 mm and an approximate internal diameter of 40 mm. Secure the stopper in the cylinder. Rotate the cylinder end over end for ten complete revolutions, at approximately 1 revolution every 2 s. Immediately after the ten revolutions have been completed, set the cylinder upright on a level surface and allow the powder to settle for 1 80 s. Read off the volume occupied by the powder. Calculate the bulk density from the following equation:

$$d_k = \frac{m}{v}$$

where

m is the mass of the powder (i.e. 100 g):

V is the volume occupied by the powder.

NOTES

1) Electrostatic phenomena may cause difficulty in testing powders containing stearates. The problem is reduced by prior testing of a siliconized powder.

2) After long-term storage the bulk density may increase.

12.2 Sieve analysis (see 5.3)

NOTE: The two methods specified in 12.2.1 and 12.2.2 may give slightly differing results.

12.2.1 Method 1

12.2.1.1 Apparatus

The apparatus shall comprise the following items:

a) Nest of sieves, having a nominal diameter of 200 mm and nominal sizes of 125 µm, 63 µm and 40 µm, conforming to ISO 3310-1, a lid and a collecting pan with the 125 p.m sieve as the top sieve with the lid placed on top and the 40 p.m sieve as the bottom sieve with the collecting pan placed underneath.

b) Sieve-shaking device, capable of moving the nest in a horizontal ellipse with an impact from the bottom to the top of the nest at every ninth pass.

12.2.1.2 Procedure

Accurately weigh to ± 0,02 g approximately 20 g of the powder into the top sieve. Assemble on the shaking device and shake for 10 min. Weigh the quantity of powder retained on each sieve and report as cumulative percentage of the original sample mass retained.

12.2.2 Method 2

12.2.2.1 Apparatus

The apparatus shall comprise the following items:

a) Three sieves, as described in 12.2.1.1.

b) Air-jet sieving device, which provides an air flow from above to below the sieve with a reverse air-jet from a rotating arm beneath the sieve (see figure 1).

12.2.2.2 Procedure

Carry out three tests using the 125 µm, 63 µm and the 40 µm sieves in turn.

Follow the air-jet sieving device manufacturer's instructions. Use a 20 g sample of powder and sieve for 5 min. Report as percentage retained on each sieve.

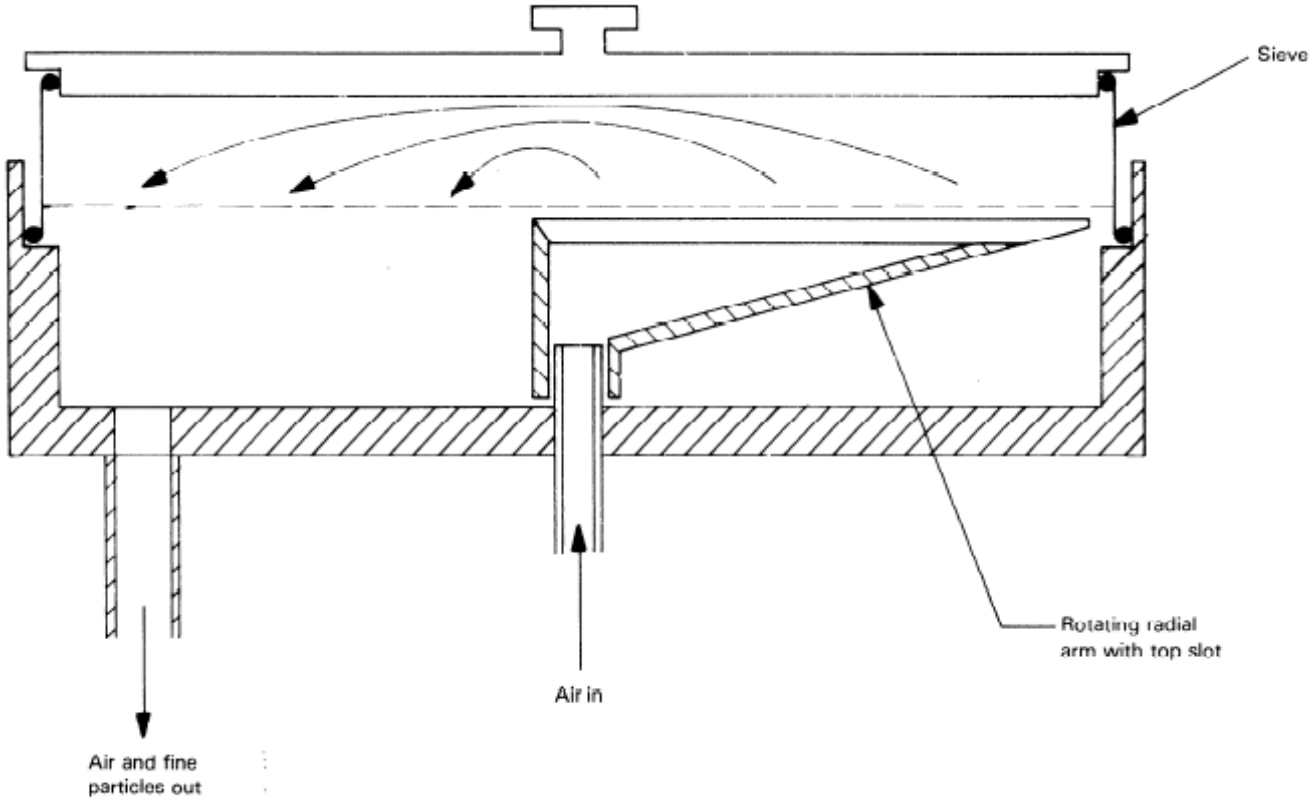


Figure 1 — Air-jet sieving device

12.3 Qualification tests

12.3.1 General

Carry out the tests of 12.3.2 and 12.3.3 at an ambient temperature of not less than 0 °C and not more than 30°C using 3 kg of the extinguishing powder charged into an extinguisher having a nominal capacity of 3 kg, following the procedure recommended by the extinguisher manufacturer. The extinguisher shall conform to an appropriate national standard.

Use extinguishers of identical design when testing the same powder for class A (12.3.2) and class B (12.3.3) performance.

Before testing, store extinguishers in the normal operating position for not less than 24h at a temperature of 20 ± 5°C and maintain at this temperature until tested.

The operator of the extinguisher shall be protected against heat. A wide-brimmed hat, with a heat-resistant face-guard, a long coat and gloves of heat-resistant cloth are recommended.

CAUTION: Attention is drawn to the necessity for taking precautions to safeguard the health of personnel conducting the tests against the risk of fire and inhalation of smoke and any toxic products of combustion.

12.3.2 Class A fire test (see 6.1)

12.3.2.1 Location and ambient conditions

Carry out the test indoors in a test chamber, sheltered from draughts, which does not impede the natural development of the test fire or effective fire fighting.

12.3.2.2 Test fire construction

The test fire shall consist of a crib of wooden sticks constructed on two 63 mm x 38 mm angle irons, or other similar and appropriate supports, placed on concrete blocks, so that the height of the supports above the floor is 405 mm. The sticks forming the outside edges of the crib shall be stapled or nailed together to provide strength.

Use wood sticks of species, sub-species or hybrids of the genera *Pinus, Picea,* or *Abies,*or the species *Cyptomeria Japonica* in the form of sticks of square cross-section with sides of 38^{+3}_{-1} mm, 651 ± 10 mm long, with a moisture content of 9 % to 13 % (m/m) and specific mass of 500kg/m^3 ± 50 kg/m^3.

Stack the wooden sticks in 13 layers with 6 sticks in each layer. Stack each layer of sticks at right angles to the layer below. Stack individual sticks on each layer with even spacing and in the form of a square with sides equal to the stick length (see figure 2).

NOTES: Determine the moisture content of the sticks using commercially available instruments which measure electrical conductivity between needle probes pushed into the sticks. Some variation in reading may be obtained due to structural variation of the timber and the direction of the grain. In cases of doubt, calibrate the instrument by determination of moisture content in accordance with ISO 3130.

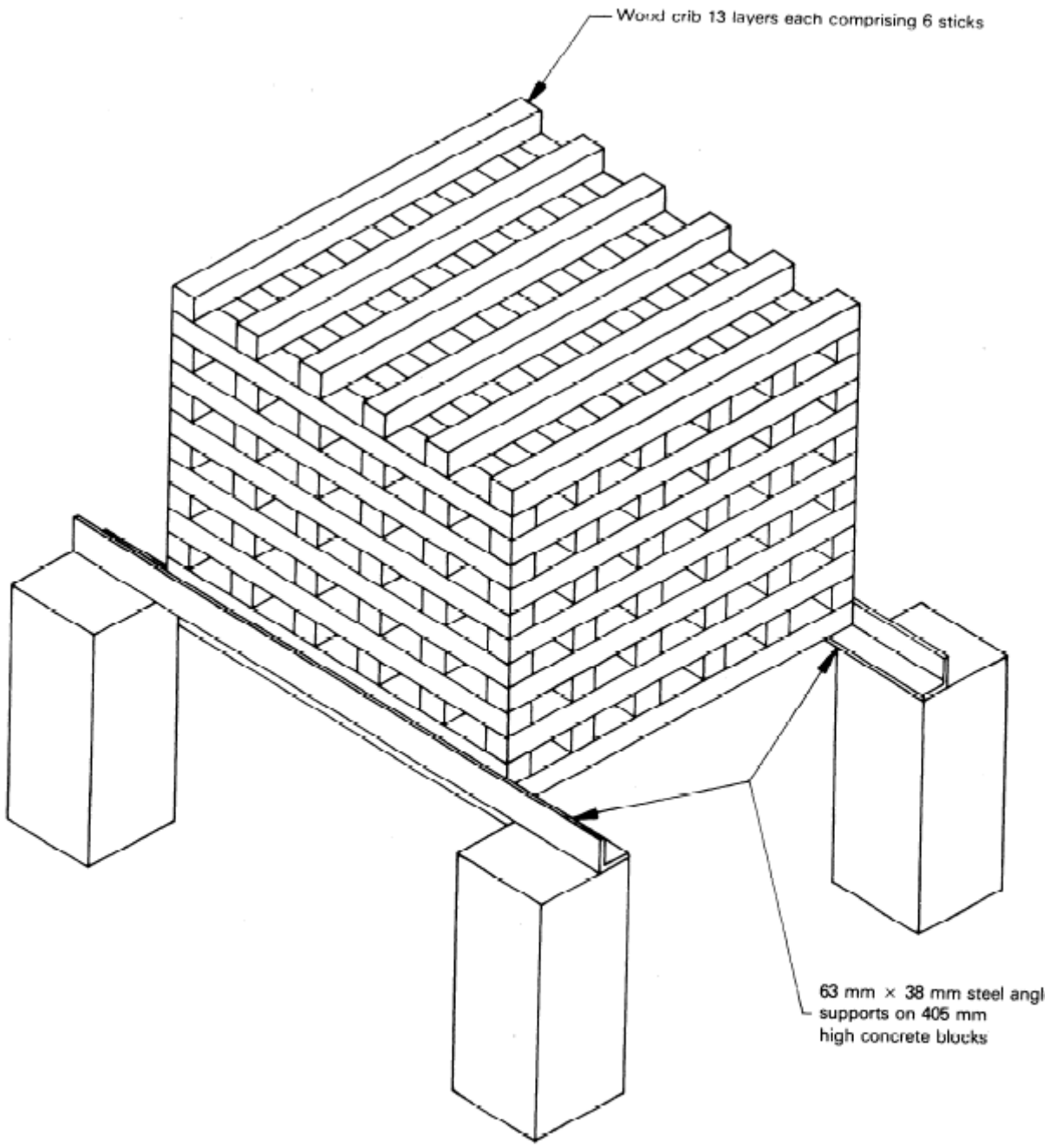


Figure 2 – Typical set-up for class A test fire

12.3.2.3 Ignition

Place a lighting tray, 686 mm x 686 mm x 102 mm deep, centrally and symmetrically under the crib. Pour 3,8l of fuel (as defined in 12.3.3.2) into the tray. Ignite the fuel. Remove the tray once the liquid fuel has been consumed. Allow the crib to burn until the sticks in the top row have unburnt core diameters of 19 to 25 mm[1)] before applying the extinguisher to the fire.

12.3.2.4 Application of the extinguisher

Apply the discharge of the extinguisher to the test fire, initially to the front and from a distance of not less than 1,8 m. Reduce the distance of attack and apply the discharge to the top, bottom, front or either side but not the back of the crib, at will. Maintain all devices for controlling the flow of the powder in the position for maximum discharge.

12.3.2.5 Condition for successful extinction

For the test to be successful, all flames shall be extinguished, and the crib shall be in a state which will not be subject to self- ignition or continue to smoulder under the conditions of the test for a period of 15 mm.

12.3.3 Class B fire test (see 6.2)

12.3.3.1 Location and ambient conditions

Carry out the test indoors or outdoors, when the wind speed is not less than 1 m/s and not more than 3 m/s.

12.3.3.2 Fuel and tray

Use 55l of an aliphatic hydrocarbon liquid fuel having an initial boiling point not less than 88°C and final boiling point not more than 105 °C.

Use a fire tray of welded steel 2,5 mm thick, having a diameter of 1,48 m and 150 mm deep, providing a fuel surface area of 1,73 m^2.

12.3.3.3 Tray arrangement

Set the base of the tray horizontal and level with the surrounding ground. Add the fuel. To obviate the effects of any distortion of the tray, add additional fuel so that there is a minimum depth of 15 mm at all points of the tray, but with a depth not exceeding 50 mm at any point on the periphery of the tray.

12.3.3.4 Application of the extinguisher

[1)] This will take 6 to 10 mm. Determine the exact time by a preliminary test making adjustments as necessary. Where continuous monitoring of the mass of the crib is undertaken, it is possible to relate the time to a reduction of mass of the crib to 60 %, say, of the initial mass.

Ignite the fuel and allow it to burn freely for a minimum of 60s. Apply the extinguisher to the fire, initially with no part of the operator's body nearer than 1,5 m to the tray. The operator may move around the fire at any distance to obtain the best result. Discharge the extinguisher either continuously or in successive bursts at will. At no time may the operator step onto or into the tray.

12.3.3.5 Condition for successful extinction

The test is successful if all flames are extinguished.

12.4 Discharge performance test (see clause 7)

12.4.1 Apparatus

12.4.1.1 Test extinguisher

An extinguisher of the following specifications shall be used:

nominal capacity: 2,25 kg

expellent gas (CO_2) : 40 g

container internal length : 375 mm

container internal diameter: 90 mm

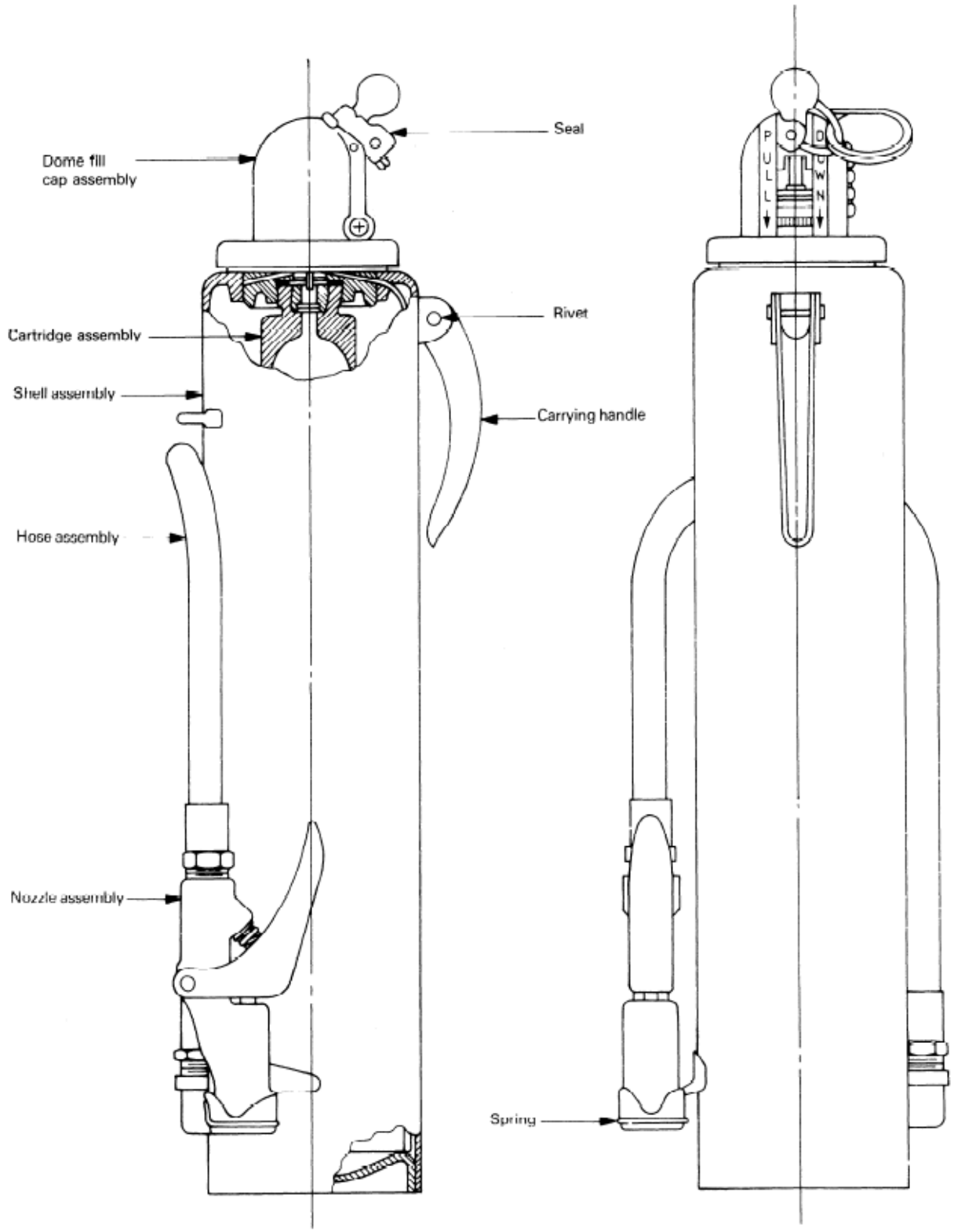
discharge hose internal diameter: 10 mm

discharge nozzle diameter: 4,25 mm

The extinguisher shall be as shown in figures 3, 4 and 5.

12.4.1.2 Impact machine, which submits the charged extinguisher to repetitive shock pulses by dropping it from a height of 25mm ± 1,5 mm onto a solid surface.

The dropping operation shall be guided and have acceleration approaching free fall.



NOTE – ANSUL Model A.5 extinguisher has been found to meet these requirements.

Figure 3 – Cartridge extinguisher for packed powder discharge

Dimensions in millimetres

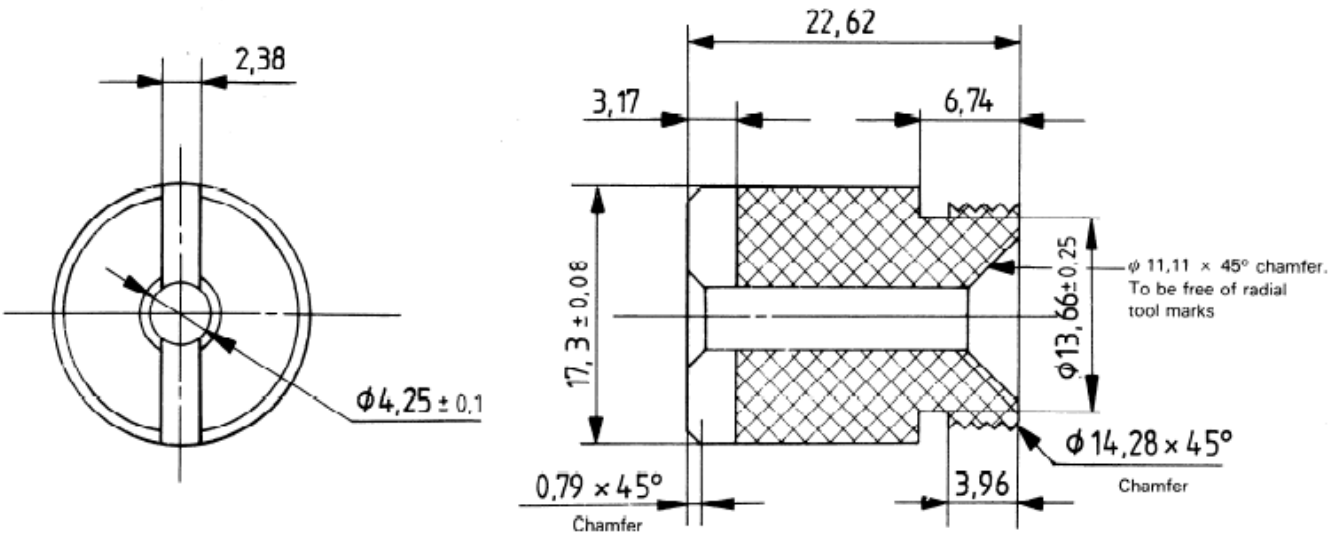
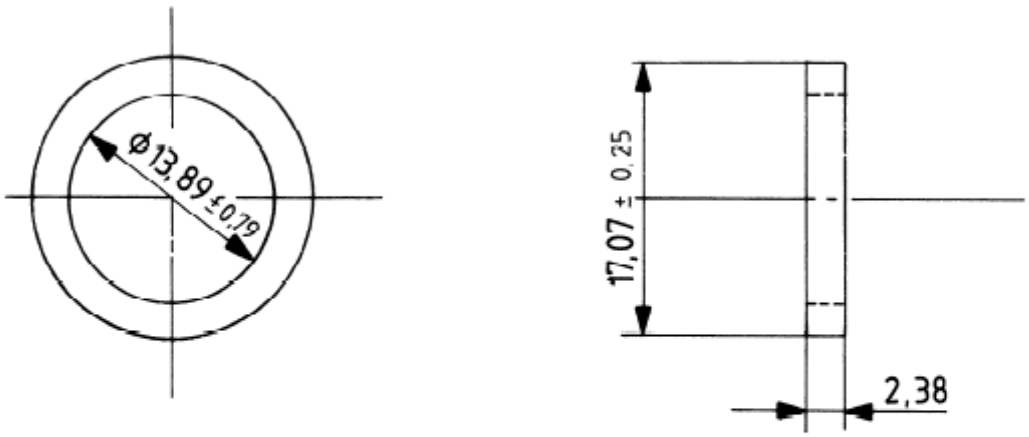


Figure 4 — Nozzle tip for cartridge extinguisher illustrated in figure 3

Dimensions in millimetres



Material : neoprene, durometer 50 ± 5

Figure 5 — Nozzle tip gasket for cartridge extinguisher illustrated in figure 3

12.4.2 Procedure

Charge the extinguisher with 2250 x d_k ±10 g (the initial mass, m_1) of the powder to be tested, where d_k is the bulk density of the powder as determined using the method specified in 12.1.

Assemble the uncharged carbon dioxide cartridge to the extinguisher head, and fix the head in turn tightly to the extinguisher. Position the extinguisher on the impact machine (see 12.4.1.2) and impact the extinguisher at a rate of 25 times per minute for a total of 250 times (i.e. at a frequency of 0,417 Hz for 10 min). After the impact operation has been completed, loosen the head and place the extinguisher in a conditioning oven at 49 ± 1 °C for 8 h.

Remove the extinguisher from the oven and immediately replace the uncharged cartridge with a fully charged cartridge containing 40 ± 4 g of carbon dioxide. Secure the extinguisher head and puncture the cartridge. After 5s to allow for pressurization, discharge the contents of the extinguisher as quickly as possible. Weigh the extinguisher (to give the final mass, m_2). The percentage of powder discharged is given by the following formula:

$$\frac{m_1 - m_2}{m_1} x100$$

where

m_1 is the initial mass;

m_2 is the final mass.

Report the mean of three tests as the percentage of powder discharged.

12.5 Test for resistance to caking and lumping (see clause 8)

12.5.1 Apparatus

The penetration apparatus consists of a penetrometer with a needle in a holder (spindle) able to move vertically without measurable friction, and capable of indicating the depth of penetration to the nearest 0,1 mm. The mass of the spindle shall be 47,5g ± 0,05g, and the total mass of needle and spindle assembly 50,00g ± 0,05 g.

The needle shall be made of fully hardened and tempered stainless steel. It shall be approximately 50 mm in length and 1 ,00 to 1 ,02 mm in diameter, symmetrically tapered at one end by grinding to a cone having an angle between 8,7° and 9,7° over the entire cone length. The cone shall be coaxial with the straight body of the needle. The total axial variation of the intersection between the conical and straight surfaces shall not exceed 0,2 mm. The truncated tip of the cone shall be within the diameter limits of 0,14 and 0,16 mm and square to the needle axis within 2°. The entire edge of the truncated surface at the

tip shall be sharp and free of burrs. The surface roughness height of the tapered cone surface shall be 0,2mμ to 0,3mμ arithmetic average.

The needle shall be mounted in a stainless steel ferrule, the exposed length being between 40 and 45 mm. The ferrule shall be 3,2 ± 0,05 mm in diameter and 38 ± 1 mm in length. The needle shall be rigidly mounted in the ferrule. The mass of the ferrule needle assembly shall be 2,50 ± 0,05 g.

NOTE: A suitable penetrometer is described in ISO 2137.

12.5.2 Sample preparation

Place two 125 g samples of powder in each of two nickel crucible-shaped cups of 100 ml capacity, 64 mm high and 60 mm in diameter at the rim. Vibrate on a sieve-shaker using a suitable holder until there is no further increase in bulk density, but in any event for not less than 5 min.

Place the samples in a moving air-stream humidifier at 21 ± 3 °C and 78 % relative humidity for 24h, followed by 24h in a drying oven at 48 ± 3°C.

NOTE: Stagnant air conditions found in the usual saturated solution desiccator compartments may not give consistent results and precautions shall be taken to ensure air circulation if a desiccator is used as the humidifier. A 250 mm diameter desiccator with a saturated NH_4CI solution in the lower compartment may be used in this determination. During the test, circulate air at 5 l/mm. Presaturate the air by bubbling through a saturated NH_4CI solution and introduce into the desiccator through a centre tube, having an internal diameter of 6 mm, terminating 20 mm above the centre hole in the desiccator plate. Check the relative humidity of the exit air stream from time to time using some convenient means.

12.5.3 Procedure

Follow the manufacturer's instructions for operating the penetration apparatus. Take three readings on each of the two samples. Determine the mean and report as the penetration.

12.6 Water repellency test (see clause 9)

Place an excess of powder in a Petri dish, approximately 70 mm in diameter. Smooth the surface over using a pallet knife. On three different areas of the powder surface, place a drop (approximately 0,3 ml) of distilled water. Place the Petri dish over saturated sodium chloride solution at 20 ± 5°C (giving approximately 75% relative humidity) in a desiccator for 60 min. Remove the Petri dish from the desiccator.

Tilt the Petri dish gradually so as to allow the drops to roll away. Adequate water repellency is indicated by the absence of visually observable absorption of water by the powder.

12.7 Low temperature test (see clause 10)

Place approximately 20g of the powder in a clean, dry, stoppered glass test tube, approximately 20 mm x

150 mm. Place the tube in a cold cabinet at -55 °C for 1h. Remove the tube and invert it without removing the stopper. Adequate cold resistance is indicated by all the powder falling to the stoppered end within 5 s.

12.8 Electrical insulation test (see clause 11)

12.8.1 Apparatus

Test cup, generally as illustrated in figure 6, fitted with rigidly mounted electrodes with parallel faces, and with axes in a coincident horizontal line constructed so that no part of it shall be less than 13 mm from any part of the test electrode discs, and made of a material of high dielectric strength resistant to the absorption of moisture.

The top end of the cup shall be not less than 32 mm above the top of the electrodes. The cup shall be designed to permit easy removal of the electrodes for cleaning and polishing, to withstand the test procedure of 12.8.2 and to permit easy adjustment of the gap spacing. The electrodes shall be polished brass discs, 25 mm in diameter and at least 3 mm thick with square edges. The spacing between the electrodes shall be 2,5 ± 0,01 mm.

Step-up transformer, energized from a suitable low voltage source with output voltage continuously variable to more than 5 kV.

12.8.2 Procedure

Fill the test cup with extinguishing powder and compact it by dropping the cup 500 times at a frequency of 1 Hz through a height of 15 mm. The impact machine of 12.4.1.2 may conveniently be used. The cup may, if desired, be clamped in a suitable protective casing during this procedure. Using the transformer, apply an electrical potential to the electrodes, increasing the potential at a uniform rate until breakdown occurs as indicated by a continuous discharge across the gap between the electrodes. Record the voltage as the dielectric breakdown strength.

13 Marking and packaging

Whenever possible, the manufacturer or supplier shall provide, marked on each separate package (or on a label firmly attached to the package), the following information:

a) the commercial name of the product followed by the words “Fire extinguishing powder”;

b) a brief statement, e.g. “Conforms to TCVN... , suitable for class A, B and C fires”, to indicate the manufacturer’s claim that the product complies with this standard and the classes of fire for which the product is suitable;

c) the year of manufacture;

d) any essential recommendations regarding conditions of storage;

e) the name and address of the person or body who accepts to endorse full responsibility of the product's conformity to this standard - this may be the manufacturer, distributor or other supplier;

f) the warning statement "Ensure compatibility between this product and the equipment in use".

NOTE- Extinguishing powders should be packaged in containers which are essentially moisture and impact-resistant. The supplier should ensure that every consignment is packed in such a way as to preserve its essential characteristics when stored and handled in accordance with the manufacturer's recommendations.

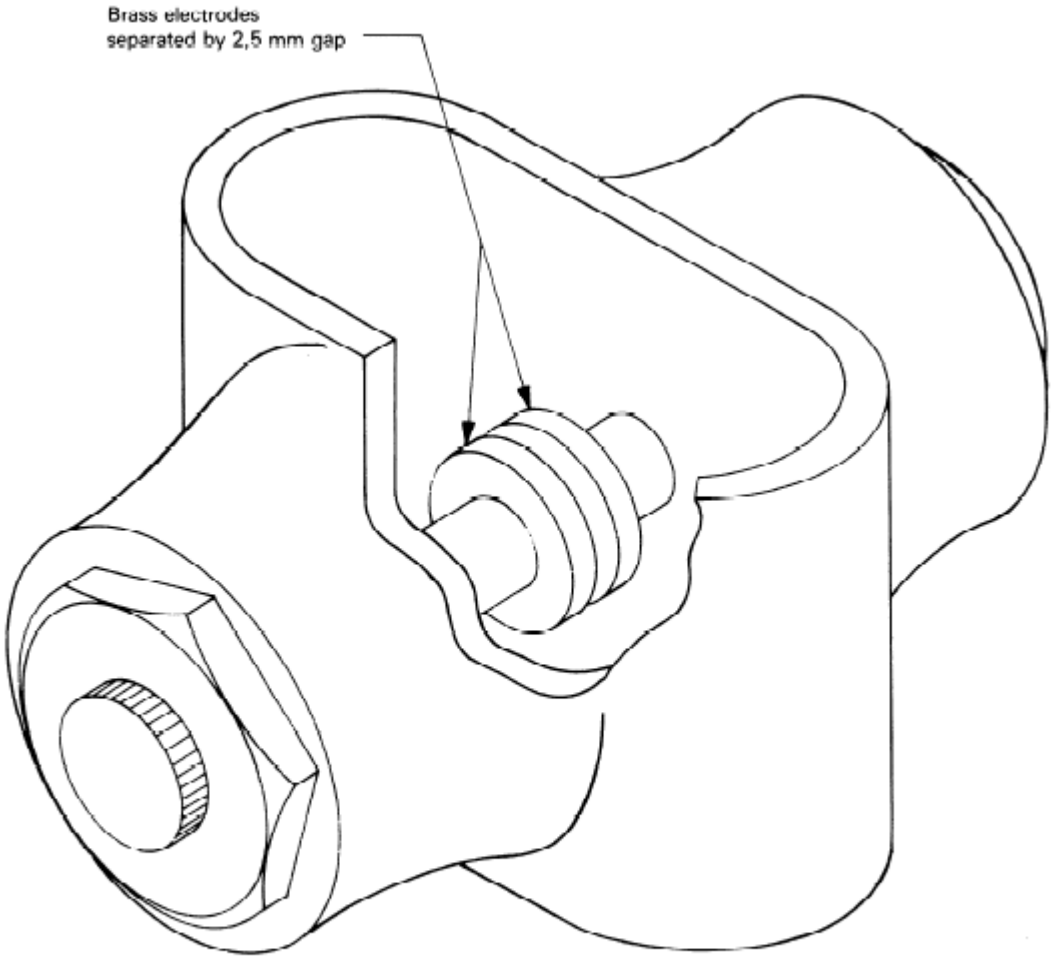


Figure 6 — Electrical conductivity test cup

Annex A

(normative)

Compatibility between extinguishing powders and foams

Under some circumstances, incompatibility between extinguishing powders and foams may exist. The user should ensure that any combination of extinguishing powder and foam which may be used does not lead to an unacceptable loss of efficiency caused by an unfavourable interaction of the chosen media, when applied simultaneously or successively.

Annex B

(normative)

Suitability and equivalence of extinguishing powders in equipment

This standard does not provide an assessment of the performance of an extinguishing powder in a particular piece of equipment nor does it attempt to compare the performance of different extinguishing powders.

The tests specified in clause 6 only establish whether or not the powder is above a minimum acceptable quality, and it not suggested that the tests can be used to compare the potential fire extinguishing performance of different powders.

It is important that a powder complying with the requirements of this standard shall also be tested for correct function in the particular equipment in which it is to be used, as specified in the appropriate national or other standard.