
**Fire protection — Automatic nozzle
systems —**

**Part 14:
Requirements and test methods for
water spray nozzles**

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*, Subcommittee SC 5, *Fixed firefighting systems using water*.

A list of all parts in the ISO 6182 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

These nozzles are intended for application of hazards involving: exposure protection; the extinguishment or control of fires including flammable liquids hazards; conveyor openings; oil cooled transformers; dryers; and other hazards.

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Fire protection — Automatic nozzle systems —

Part 14:

Requirements and test methods for water spray nozzles

1 Scope

This document specifies performance requirements, methods of test, and marking requirements for open water spray nozzles. This document is not applicable to open sprinklers or open water mist nozzles.

Factors of installation, such as nozzle spacing, design densities, wind and hot gas velocities, are not intended to be addressed by this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 49, *Malleable cast iron fittings threaded to ISO 7-1*

ISO 65, *Carbon steel tubes suitable for screwing in accordance with ISO 7-1*

ASTM G36, *Standard Practice for Evaluating Stress-Corrosion-Cracking Resistance of Metals and Alloys in a Boiling Magnesium Chloride Solution*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

water spray nozzle

water discharge device that, when discharging water under pressure, will distribute the water in a specific directional pattern

Note 1 to entry: Some devices utilize deflector plates or swirl chambers.

3.2

open water spray nozzle

water spray nozzle (3.1) that has no heat responsive element and discharges water after the water spray system is actuated

3.3

coated nozzle

water spray nozzle (3.1) that has a factory-applied coating for corrosion protection

Note 1 to entry: For the purposes of this document, the term 'coated nozzle' does not include coatings intended for aesthetic purposes.

4 Product consistency

It shall be the responsibility of the manufacturer to implement a quality control programme to ensure that production continuously meets the requirements of this document.

5 Product assembly

5.1 Design features

All nozzles shall be designed and manufactured in such a way that they cannot be readily adjusted, dismantled or reassembled.

5.2 Materials of construction

Nozzles shall be constructed of corrosion resistant metallic materials. Nozzles made of brass, bronze or stainless steel are deemed to satisfy this requirement.

6 Requirements

6.1 Dimensions

6.1.1 Orifice size

6.1.1.1 Except as permitted in 6.1.1.2, all nozzles shall be constructed so that a sphere of diameter 5 mm can pass through each water passage in the nozzle.

6.1.1.2 Nozzles having orifices smaller than a nominal 5 mm diameter are permitted if the orifices are protected with a strainer in the system or in each nozzle. The maximum dimension of an opening in the strainer shall not exceed 80 % of the smallest water passageway being protected and the total open area of the strainer shall not be less than 150 % of the total nozzle orifice area.

NOTE If there is no risk of corrosion or water deposits, then an orifice less than 5 mm can be used without a strainer. See the manufacturer's installation instruction requirements in [Clause 9](#).

6.1.2 Nominal thread sizes

Nominal thread sizes shall be suitable for fittings threaded in accordance with ISO 7-1. The dimensions of all threaded connections should conform to International Standards where applied or shall conform to national standards where International Standards are not applicable.

6.2 Flow constant (see [7.2](#))

The flow constant, K , for nozzles is given by the formula:

$$K = \frac{q}{\sqrt{10p}}$$

where

p is the pressure, expressed in megapascals;

q is the flow rate, expressed in litres per minute;

K-factor for nozzles shall be in accordance with the manufacturer's design and installation instructions when determined by the test method given in 7.2. Each flow constant K (calculated), shall be within $\pm 5\%$ of the manufacturer's value, for nozzles having a nominal k-factor of 40 or larger, and $\pm 10\%$ of the manufacturer's value for nozzles having a nominal k-factor less than 40.

6.3 Spray angle (see 7.3)

When tested as described in 7.3.1 through 7.3.3, a spray nozzle shall produce a spray angle within $\pm 10^\circ$ of the manufacturer's published water discharge angles. Other methods of determining nozzle spray angle shall be permitted to be used provided the same level of accuracy is maintained.

6.4 Stress corrosion (see 7.4)

6.4.1 Stress corrosion for copper alloy parts (see 7.4.1)

When tested in accordance with 7.4.1, each nozzle shall show no cracks, delamination or degradation which could affect its ability to satisfy other requirements of this document.

6.4.2 Stress corrosion for stainless steel parts (see 7.4.2)

When tested in accordance with 7.4.2, each nozzle shall show no cracks, delamination or degradation which could affect its ability to satisfy other requirements of this document.

NOTE In some countries, this test is not mandatory.

6.5 Coated nozzles (see 7.5)

6.5.1 Evaporation of wax and bitumen (see 7.5.1)

Waxes and bitumens used for coating nozzles shall not contain volatile matter in sufficient quantities to cause shrinkage, hardening, cracking or flaking of the applied coating. The loss in mass shall not exceed 5 % of that of the original sample when tested by the method in 7.5.1.

6.5.2 Resistance to low temperatures (see 7.5.2)

All coatings used for nozzles shall not crack or flake when subjected to low temperatures by the method in 7.5.2.

6.5.3 Resistance to high temperature (see 7.5.3)

Coated nozzles shall withstand exposure to increased ambient temperatures without evidence of cracking, flaking, delamination, deformation or melting of the coating, when tested by the method specified in 7.5.3.

6.6 Resistance to heat (see 7.6)

Nozzles shall be resistant to high temperatures when tested in accordance with 7.6. After exposure, the nozzle shall not fracture or break. If visual deformation is observed in the water discharge path, it shall meet the requirements of 6.2. If the nozzle is deformed, spray angle testing shall be conducted in accordance with 6.3.

6.7 Vibration (see 7.7)

Nozzles having multiple components shall be able to withstand the effects of vibration without deterioration when tested in accordance with 7.7. After the vibration test of 7.7, nozzles shall show no visible deterioration or loosening of components.

6.8 Impact (see 7.8)

Nozzles shall have adequate strength to withstand impacts associated with handling, transport and installation without deterioration of performance. After the impact test of 7.8.1; these nozzles shall show no fracture. If the nozzle is deformed, spray angle and strength testing shall be conducted in accordance with 6.3 and 6.9.

6.9 Strength of water dispersing components (see 7.9)

The nozzle shall not show any signs of visible deterioration or loosening of components after the test specified in 7.9. If damage is noted, spray angle testing shall be conducted in accordance with 6.3.

7 Methods of test

The following tests shall be carried out for each type of nozzle. Before testing, precise drawings of parts and the assembly shall be submitted together with the appropriate specifications. Tests shall be conducted at a room temperature of $20\text{ °C} \pm 10\text{ °C}$, unless other temperatures are indicated. Nozzles shall be tested with all the components required by their design and installation instructions. Unless otherwise stated, the tolerances given in Annex A shall apply.

7.1 Preliminary examination

The construction shall be examined to ensure that it complies with the requirements of Clause 5.

7.1.1 Visual examination

Before testing, nozzles shall be examined visually with respect to the following points:

- a) marking,
- b) conformity of the nozzles with the manufacturer's drawings and specification,
- c) obvious defects.

7.2 Water flow constant (see 6.2)

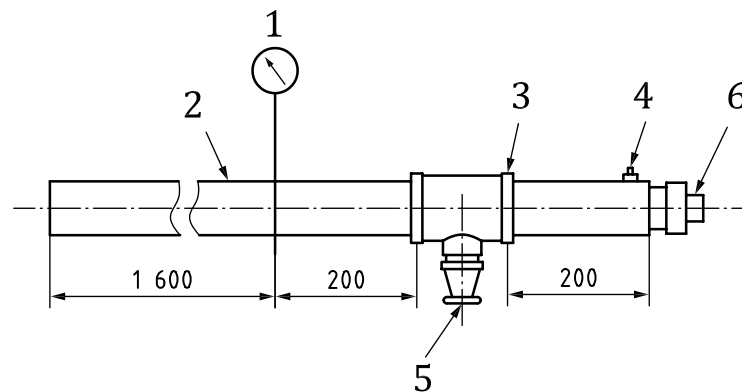
The nozzle shall be mounted with a pressure gauge on a supply pipe as shown in Figure 1.

Four nozzles shall be tested. The frame arms and deflector of nozzles may be removed to facilitate testing provided this does not impact the flow constant.

The water flow shall be measured by use of a flowmeter or by collection and measurement of the water discharge by weight or volume at pressures from minimum discharge pressure to the maximum discharge pressure referenced in the manufacturer's installation instructions. In one series of tests, the pressure shall be increased at intervals of 0,1 MPa (1 bar), and, in the other series, the pressure shall be decreased from the maximum discharge pressure at intervals of 0,1 MPa (1 bar) to the minimum discharge pressure.

The K-factor shall be calculated for each flowing pressure and the K-factor shall be averaged for each series of readings. Each calculated K-factor shall be within the limits specified in 6.2. During the test, pressures shall be corrected for differences in height between the gauge and the outlet orifice of the nozzle.

Dimensions in millimetres

**Key**

- 1 pressure gauge
- 2 steel tube, nominal internal diameter 40 mm, medium mass (in accordance with ISO 65)
- 3 tee fitting, see 7.3.2 (in accordance with ISO 49)
- 4 air bleed valve
- 5 nozzle
- 6 plug or cap

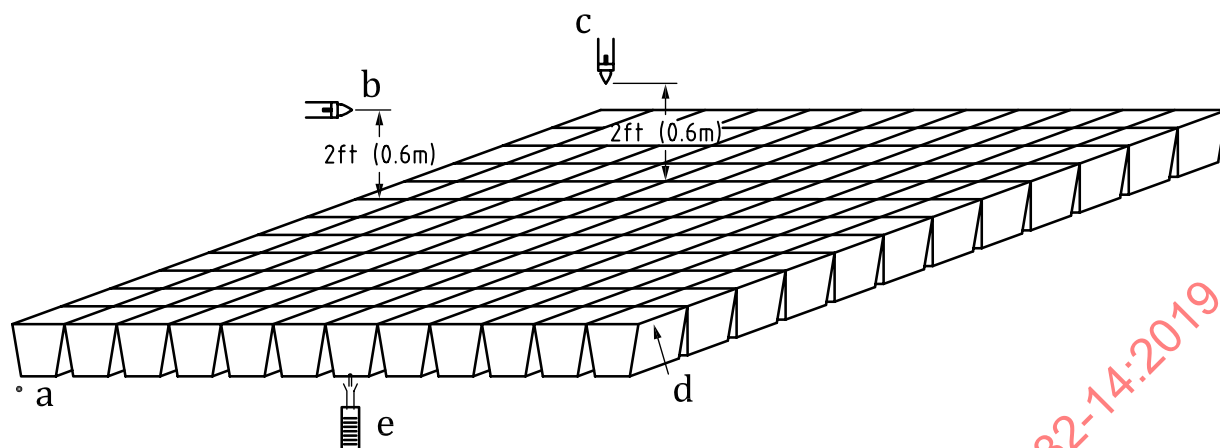
Accuracy: pressure gauge $\pm 2\%$ **Figure 1 — Typical water flow test apparatus****7.3 Spray angle tests (see 6.3)**

7.3.1 For a nozzle intended to be installed at various orientation positions, the nozzle shall be tested at 0° (vertically downward) using the test method described in 7.3.2 and in positions indicated in the manufacturer's installation instructions using the test method described in 7.3.3. A sidewall nozzle shall be tested at 90° using the test method described in 7.3.2.

7.3.2 A water spray nozzle is to be supplied with water at the minimum and maximum discharge pressure, through a tee fitting. The outlet of the tee fitting is to be the same size as the inlet for nozzles with nominal inlet sizes of 25 mm and smaller. Tee fittings are to be the same size as the nozzle inlet for nozzles with inlets larger than a nominal 25 mm. The nozzle is to be positioned at distances of 0,6 m and at a maximum installation height, as referenced in the manufacturer's installation instructions, above an array of 300 mm by 300 mm square collection pans as shown in Figure 2. Water is to be collected in a large enough area such that at least one row of perimeter collection pans has no pans with more than a trace amount of water collected after 10 min of discharge. After a minimum 10 min discharge, the water collection is to be measured. The spray angle is to be determined and compared to the manufacturer's installation instructions.

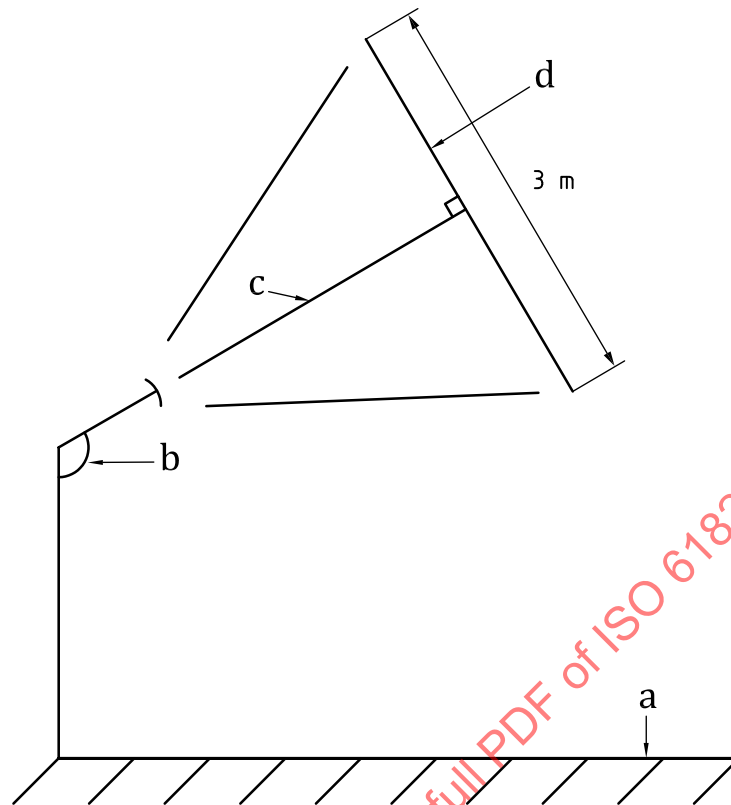
7.3.3 A nozzle is to be supplied with water at the minimum and maximum discharge pressure, through a tee fitting. The outlet is to be the same size as the inlet for nozzles. The nozzle is to be positioned at distances of 0,6 m from a 3 m by 3 m dry surface (plane of protection), with the plane of protection positioned perpendicular to the line between the nozzle and this plane, as shown in Figure 3 in positions as described in the manufacturer's installation instructions. Water from the nozzle is to be discharged for at least 30 s or the time required to exhibit a characteristic spray angle. The spray angle, as determined by visually observing the wetted surface of the plane, is to be compared to the manufacturer's installation instructions. The nozzle is then to be positioned 3 m or the maximum distance specified in

the manufacturer's instructions from the plane of protection, whichever is less, and observations made for impingement of water on the plane of protection.



- a Not to scale.
- b 90° orientation sidewall type.
- c Vertical downward orientation.
- d 300 m × 300 m (typical)
- e Typical collection method for each pan.

Figure 2 — Collection pan array

**Key**

- a Floor.
- b Nozzle orientation angle.
- c Spray pattern.
- d Plane of protection.

Figure 3 — Nozzle orientation**7.4 Stress corrosion tests (see 6.4)****7.4.1 Stress corrosion test with aqueous ammonia solution (see 6.4.1)**

Five nozzles shall be subjected to the following aqueous ammonia test.

Degrease the samples to be tested and then expose them for 10 d to a moist ammonia-air mixture in a glass container.

An aqueous ammonia solution, having a density of $0,94 \text{ g/cm}^3$, shall be maintained in the bottom of the container, approximately 40 mm below the bottom of the samples. A volume of aqueous ammonia solution corresponding to $0,01 \text{ ml/cm}^3$ of the volume of the container will give approximately the following atmospheric concentrations: 35 % ammonia, 5 % water vapour and 60 % air.

The moist ammonia-air mixture shall be maintained as closely as possible at atmospheric pressure, with the temperature maintained at $(34 \pm 2) ^\circ\text{C}$. Provision shall be made for venting the chamber via a capillary tube to avoid the build-up of pressure. Specimens shall be shielded from condensate drippage. The glass container shall be placed in an enclosure which shall be heated uniformly to prevent condensate on the test sample.

Nozzles showing cracking or delamination shall not show evidence of separation of permanently attached parts when subjected to the water flow at the rated pressure for 30 min.

7.4.2 Stress corrosion test with a boiling magnesium chloride solution (see 6.4.2)

7.4.2.1 Four sets of uncoated or unplated stainless steel components and four previously untested nozzles shall be degreased and then exposed to a boiling magnesium chloride solution for a period of 150 (+12, -0) hours as described below, and in accordance with ASTM G36. Special fixtures or elevated temperature operating elements may be employed to simulate assembly loading on parts, where appropriate and necessary.

7.4.2.2 Samples are to be placed in a flask fitted with a wet condenser. The flask shall be filled approximately one-half full with magnesium chloride solution, placed on a thermostatically-controlled electrically-heated mantle, and maintained at a boiling temperature of $150\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.

NOTE The nominal weight of magnesium chloride is 42 to 44 % in order to achieve the boiling temperature.

7.4.2.3 Following exposure, the samples shall be removed and rinsed in potable water. Following a 2- to 4-day drying period, visual examination of the samples shall be made.

7.4.2.4 The stainless steel components that show no evidence of cracking, delamination, or degradation shall not need further testing. Stainless steel components showing stress corrosion cracking or delamination shall not show evidence of separation of permanently attached parts when subjected to the water flow at rated pressure for 30 min.

7.5 Tests for nozzle coatings (see 6.5)

7.5.1 Evaporation test (see 6.5.1)

A 50 cm³ sample of wax or bitumen shall be placed in a metal or glass cylindrical container, having a flat bottom, an internal diameter of 55 mm and an internal height of 35 mm. The container, without lid, shall be placed in an automatically controlled electric, constant ambient temperature oven with air circulation. The temperature in the oven shall be controlled at 16 °C below the nominal release temperature of the nozzle, but at not less than 50 °C. The sample shall be weighed before and after 90 d exposure to determine any loss of volatile matter; the sample shall meet the requirements of 6.5.1.

7.5.2 Low-temperature test (see 6.5.2)

Five nozzles, coated by normal production methods, whether with wax, bitumen or a metallic coating, shall be subjected to a temperature of -10 °C for a period of 24 h. On removal from the low temperature cabinet, the nozzles shall be allowed to return to normal ambient temperature for at least 30 min before examination of the coating to the requirements of 6.5.2.

7.5.3 High-temperature test (see 6.5.3)

Twelve wax-coated nozzles shall be exposed to a constant temperature of 38 °C for low temperature wax and 66 °C for high temperature wax.

The test shall be conducted for 90 d. On removal from the exposure, the nozzles shall be allowed to return to normal ambient temperature for at least 30 min before examination of the coating to the requirements of 6.5.3.

7.6 Resistance to heat test (see 6.6)

One nozzle body shall be heated in an oven at $770\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$ for a period of 15 min, with the nozzle on its inlet thread. The nozzle body shall then be removed, holding it by the threaded inlet, and shall be promptly immersed in a water bath at a temperature of approximately 15 °C.

NOTE In some countries, 650 °C is used instead of 770 °C for this test.

7.7 Vibration test (see 6.7)

7.7.1 Five nozzles shall be fixed vertically to a vibration table. They shall be subjected at room temperature to sinusoidal vibrations. The direction of vibration shall be along the axis of the connecting thread.

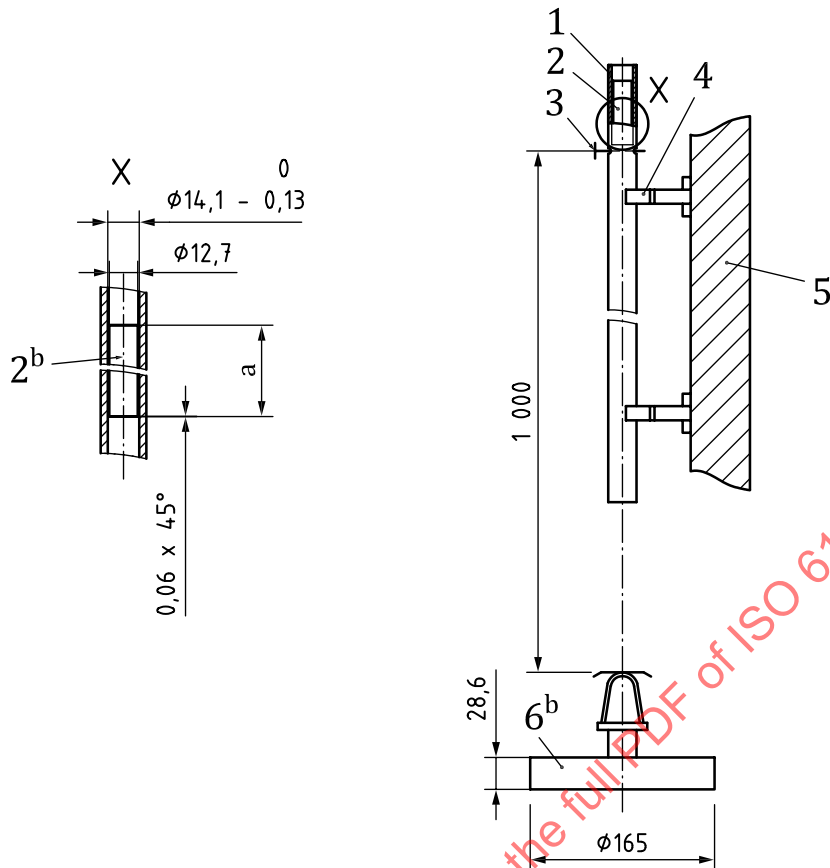
7.7.2 The nozzles shall be vibrated continuously from 5 Hz to 40 Hz at a maximum rate of 5 min/octave and an amplitude of 1 mm (1/2 peak to peak value). If one or more resonant points are detected, the nozzles, after coming to 40 Hz, shall be vibrated at each of these resonant frequencies for 120 h per number of resonances. If no resonances are detected, the vibration from 5 Hz to 40 Hz shall be continued for 120 h.

7.7.3 After vibration, each nozzle shall be visually observed for evidence of deterioration or loosening of components.

7.8 Impact test (see 6.8)

7.8.1 Five nozzles shall be impact-tested by dropping a weight onto the deflector or discharge end of the nozzle along the axial centre line of the waterway. The mass equivalent to that of the tested nozzle shall be dropped from a height of 1 m (see [Figure 4](#)). The dropped weight shall be prevented from impacting more than once upon each sample.

After the impact test, each nozzle shall meet the requirements of [6.8](#).



Key

- 1 cold drawn seamless steel tubing
- 2 mass
- 3 latching pin
- 4 adjustable brackets (2)
- 5 rigid support
- 6 nozzle support
- a Length to be determined (length of required mass).
- b Cold finished steel.

Figure 4 — Impact test apparatus

7.9 Strength of water dispersing components test (see 6.9)

The strength of the water dispersing components shall be verified using 3 nozzles at a pressure not less than the maximum rated pressure plus 0,17 MPa (1,7 bar). The water shall be allowed to flow at a residual pressure equal to not less than the rated pressure plus 0,17 MPa (1,7 bar) for a period of 30 min.

8 Marking

8.1 Nozzles

Each nozzle complying with the requirements of this document shall be marked as follows:

- a) identification of manufacturer, such as trademark, manufacturer's name, or identifying symbol;
- b) identification of model;