



**International  
Standard**

**ISO 22760-9**

**Road vehicles — Dimethyl ether  
(DME) fuel system components —**

**Part 9:  
Pressure relief device (PRD)**

*Véhicules routiers — Composants des systèmes de combustible  
Diméthyle Ether (DME) —*

*Partie 9: Dispositif de limitation de pression*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be subject to patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html)

This document was prepared by Technical Committee ISO/TC 22, *Road Vehicles*, Subcommittee SC 41, *Specific aspects for gaseous fuels*.

A list of all parts of the ISO 22760 series of international standards 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](http://www.iso.org/members.html).

# Road vehicles — Dimethyl ether (DME) fuel system components —

## Part 9: Pressure relief device (PRD)

### 1 Scope

This document specifies definitions of and general requirements to a pressure relief device for limiting internal pressure of dimethyl (DME) fuel containers intended for use on the types of motor vehicles as defined in ISO 3833. It also provides general design principles and specifies requirements for instructions and marking.

This document is applicable to vehicles using gaseous fuels in accordance with ISO 16861. It is not applicable to the following:

- a) fuel containers for any application other than as noted above;
- b) stationary, ship, railroad vehicle or aircraft DME engine installations;
- c) fuel container mounting hardware;
- d) electronic fuel management.

NOTE 1 It is recognized that miscellaneous component properties not specifically addressed herein can be examined for compliance with the criteria of any applicable part of the ISO 20760 series, including subjecting the component to appropriate functional tests.

NOTE 2 All pressures referred to in this document are gauge pressures unless otherwise specified.

### 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 22760-1, *Road vehicles — Dimethyl ether (DME) fuel system components — Part 1: General requirements and definitions*

ISO 22760-2, *Road vehicles — Dimethyl ether (DME) fuel system components — Part 2: Performance and general test methods*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 22760-1 and the following apply.

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

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

### 3.1

#### **rupture pressure**

activation pressure

inlet pressure specified by the pressure relief device (PRD) manufacturer, at which the PRD is designed to activate to permit the flow to its outlet in order to discharge the fuel container pressure

### 3.2

#### **activation temperature**

temperature of the pressure relief device (PRD) specified by its manufacturer, at which the PRD is designed to activate to permit the flow to its outlet in order to discharge the fuel container pressure

## 4 Marking

Marking of the component shall provide sufficient information to allow the following to be traced:

- a) the manufacturer's or agent's name, trademark or symbol;
- b) the model designation (part number);
- c) the working pressure;
- d) the yield or activation temperature and/or pressure in accordance with [Annex A](#).

The following additional marking entries are recommended:

- the direction of flow (when necessary for correct installation);
- the type of fuel;
- electrical ratings (if applicable);
- the symbol of the certification agency;
- the type approval number;
- the serial number or date code;
- a reference to this document.

NOTE This information can be provided by a suitable identification code on at least one part of the component when it consists of more than one part.

## 5 Design and assembly

The PRD shall comply with the applicable provisions of ISO 22760-1 and ISO 22760-2, and pass the tests specified in [Clause 6](#).

## 6 Tests

### 6.1 Applicability

The required tests are indicated in [Table 1](#).

Table 1 — Applicable tests

Test	Applicable	Test procedure as required by ISO 22760-2	Specific test requirements of this document
Hydrostatic strength	X		X (See <a href="#">6.2</a> )
Leakage	X		X (See <a href="#">6.3</a> )
Excess torque resistance	X	X	
Bending moment	X <sup>a</sup>		X (See <a href="#">6.4</a> )
Continued operation	X		X (See <a href="#">6.5</a> )
Corrosion resistance	X	X	
Vibration resistance	X	X	
Brass material compatibility	X	X	
Oxygen ageing	X	X	
Non-metallic material immersion	X	X	
Ozone ageing	X	X	
Creep	X	X	
Resistance to dry heat	X	X	
Accelerated life	X		X (See <a href="#">6.6</a> )
Benchtop activation	X		X (See <a href="#">6.7</a> )
Thermal cycling	X		X (See <a href="#">6.8</a> )
Condensate corrosion resistance	X		X (See <a href="#">6.9</a> )
Flow capacity	X		X (See <a href="#">6.10</a> )

<sup>a</sup> Depends on the type of device.

## 6.2 Hydrostatic strength

Test the PRD according to the procedure for testing hydrostatic strength specified in ISO 22760-2. The test pressure shall be 2,25 times the working pressure.

## 6.3 Leakage

Test the PRD at the temperatures and pressures given in [Table 2](#). For other test conditions and requirements, refer to ISO 22760-2.

Table 2 — Test temperatures and pressures

Temperature °C (±5 °C)	Pressure Factor × working pressure (WP)	
	First test	Second test
-40 or -20	0,75 × WP	0,025 × WP
20	0,025 × WP	2,25 × WP
85	0,05 × WP	

## 6.4 Bending moment

The purpose of this test is to confirm sufficient strength of stand-alone, externally threaded PRD designs. Test the PRD according to the corresponding procedure given in ISO 22760-2.

## 6.5 Continued operation

### 6.5.1 Test procedure

- a) Randomly select five test specimens.
- b) Cycle the PRD according to [Table 3](#), at between 10 % and 100 % of the working pressure, using water for the hydraulic medium. The maximum allowed frequency is 10 cycles per minute.

**Table 3 — Test temperatures and cycles**

Temperature of hydraulic medium, (°C)	No. of cycles
82 or higher	2 000
57 ± 2	18 000

### 6.5.2 Requirements

Upon test completion, there shall be no extrusion of the fusible material from the PRD. The PRD shall comply with the requirements of [6.3](#) and [6.7](#). The rupture pressure shall be >75 % and <105 % of the rupture pressure of a PRD not subjected to any previous testing.

## 6.6 Accelerated life

### 6.6.1 General

Fusible materials employed in PRDs can creep and flow within the operating temperature range of DME vehicle fuel containers. Accelerated-life testing is performed to verify that the rate of creep is sufficiently low in order for the device to perform reliably for at least one year at 82 °C and for at least 20 years at 57 °C. Accelerated-life testing shall be performed on new PRD designs or designs in which the fusible material or device activation mechanism is modified. For devices not using fusible materials that can creep, testing and analysis shall still be performed to verify that the device will perform reliably for at least one year at 82 °C and at least 20 years at 57 °C.

### 6.6.2 Test procedure

- a) Place the test specimens in an oven or liquid bath, holding the specimens' temperature to within ±1 °C of the target test temperature ( $T_L$ ) throughout the test.
- b) Elevate the pressure at PRD inlet to 100 % of the working pressure and hold this constant to within ±0,7 bar until activation. The pressure supply may be located outside the controlled temperature oven or bath. Limit the volume of liquid or gas to prevent damage to the test apparatus upon activation and venting.

Each device may be pressurized individually or through a manifold system. If a manifold system is used, each pressure connection shall include a check valve to prevent pressure depletion of the system if one specimen fails.

### 6.6.3 Accelerated-life test temperature

The accelerated-life test temperature,  $T_L$ , is given in °C by the formula:

$$T_L = 12,88 \times T_f^{0,420}$$

where  $T_f$  is the manufacturer's specified activation temperature, expressed in °C.

## 6.6.4 Requirements

**6.6.4.1** Three PRDs shall be tested at the manufacturer's specified activation temperature to verify that they activate in less than 10 h.

**6.6.4.2** Five PRDs shall be tested at their accelerated-life test temperature. The time-to-activation for accelerated-life test devices shall exceed 500 h.

## 6.7 Benchtop activation

### 6.7.1 General

The purpose of the benchtop-activation test is to demonstrate that a PRD will activate consistently throughout its life.

Test two PRDs without subjecting them to other tests (unless noted otherwise) in order to establish a baseline time to activation. The PRDs that have undergone the tests of 6.5 and 6.9 shall be tested according to 6.7 and meet the requirements of 6.7.2, as applicable. Test thermally-activated PRDs in accordance with 6.7.2.

### 6.7.2 Thermally-activated PRDs

#### 6.7.2.1 Test setup

The test setup shall include either an oven or a burner with chimney capable of maintaining a gas temperature at  $600\text{ °C} \pm 10\text{ °C}$  in the test area into which the PRD is inserted during the test. The PRD shall not be exposed directly to the burner flame.

#### 6.7.2.2 Test procedure

- a) Pressurize the PRD to 25 % of working pressure or 2 MPa, whichever is less. The temperature in the test area shall remain within the acceptable range (see 6.7.2.1) for 2 min prior to executing step b).
- b) Insert the PRD in the test area and record the time-to-activation,  $T$ .

#### 6.7.2.3 Requirements

PRDs that have been subjected to tests as per 6.5, 6.8, 6.9, and the corrosion-resistance and vibration-resistance tests of ISO 22760-2, shall have their time to activation,  $T$ , meeting the following requirements (where  $t$ , in minutes, is the time-to-activation of PRDs which have not been subjected to those tests):

$$T \leq 5 \cdot t$$

$$T \leq t + 4 \text{ min}$$

## 6.8 Thermal cycling

### 6.8.1 Test procedure

Thermally cycle the PRD between  $-20\text{ °C}$  or  $-40\text{ °C}$  (or lower) as applicable and  $82\text{ °C}$  or higher, as follows:

- a) Place a depressurized PRD in a cold fluid bath maintained at  $-20\text{ °C}$  or  $-40\text{ °C}$  (or lower) as applicable, for a period of 2 h or more. Then transfer the device to a fluid bath maintained at  $82\text{ °C}$  or higher within 5 min of removing it from the cold bath.
- b) Leave the depressurized PRD in the fluid bath maintained at  $82\text{ °C}$  or higher for a period of 2 h or more. Then, transfer the device to the cold fluid bath as per step a) within 5 min of removing it from the hot bath.

- c) Repeat steps a) and b) until a total of 15 thermal cycles have been achieved.
- d) Then, with the PRD conditioned for a period of 2 h or more in the cold fluid bath as per step a), cycle the PRD between no more than 10 % and no less than 100 % of the working pressure for a total of 100 cycles.

## 6.8.2 Requirements

At the completion of the test, the PRD shall meet all the requirements of [6.3](#) and [6.7](#).

## 6.9 Condensate corrosion resistance

### 6.9.1 Test procedure

- a) Fill the outlet port of the PRD with the test solution specified in [6.9.2](#) and seal the port.
- b) Soak the device for 100 h at  $21\text{ °C} \pm 2\text{ °C}$ .
- c) Empty the solution from the PRD and reseal the outlet port, then heat the device for an additional 100 h at  $82\text{ °C}$  or higher.

At the end of this test, the PRD shall meet all the requirements of [6.3](#) and [6.7](#).

### 6.9.2 Test solution

The test solution, by volume percentage, shall consist of:

- Stoddard solvent, 84,8 %
- benzene, 10,0 %
- phosphate ester compressor oil, 2,5 %
- water, 1,5 %
- methanol, 1,0 %
- mercaptan, 0,2 %.

## 6.10 Flow capacity

### 6.10.1 General

Three random samples of the PRD shall be tested for flow capacity. In preparation for flow-testing, one device shall be made to activate by temperature, another by pressure and the third by a combination of temperature and pressure.

After activation, and without cleaning, removing parts or reconditioning, each PRD shall be subjected to a flow test wherein the amount of air released by the device is measured. The rated flow capacity of the device shall be the average flow obtained with the three samples, provided the individual flows are not less than 90 % of the highest flow recorded. If the latter condition is not met, the test shall be restarted with three other PRD samples.

### 6.10.2 Test procedure

- a) Conduct flow testing with the inlet air pressure being within 0,8 MPa (8 bar) to 0,9 MPa (9 bar) range.
- b) Measure the temperature.
- c) Correct the calculation of flow rate to 0,7 MPa (7 bar) absolute and  $15\text{ °C}$ .

The PRD conditioned as per [6.10.1](#) shall be tested to establish its flow capacity in m<sup>3</sup>/h (normal conditions) of DME vapour or air with an accuracy of ±10 %. One acceptable method is to measure the temperature and pressure of a known volume of compressed air or gas, both before and after conducting a flow test, and measure the time during flow.

## 7 Production batch inspection and acceptance testing

The PRD manufacturer shall institute, in addition to the tests required by this document, a continuous production batch inspection and acceptance testing that ensure consistent safety-related performance of the final product over its time in production.

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