



**International  
Standard**

**ISO 24163-2**

**Clamp-in tyre valves for tyre  
pressure monitoring systems —**

**Part 2:  
Test methods and performance**

*Valves à visser pour système de contrôle de la pression des  
pneus —*

*Partie 2: Méthodes d'essai et exigences de performance*

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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)).

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This document was prepared by Technical Committee ISO/TC 31, *Tyres, rims and valves*, Subcommittee SC 9, *Valves for tube and tubeless tyres*.

A list of all parts in the ISO 24163 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](http://www.iso.org/members.html).

# Clamp-in tyre valves for tyre pressure monitoring systems —

## Part 2: Test methods and performance

### 1 Scope

This document specifies test methods for clamp-in tyre valves for tyre pressure monitoring systems (TPMSs).

These methods are defined to determine the minimum level of performance requested.

This document applies to the tyre valve assembled on the rim hole with diameter of 11,3 mm for passenger cars or for light duty vehicles.

### 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 3877-2, *Tyres, valves and tubes — List of equivalent terms — Part 2: Tyre valves*

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 9413, *Tyre valves — Dimensions and designation*

ISO 14960-2, *Tubeless tyres — Valves and components — Part 2: Clamp-in tubeless tyre valve-test method*

ISO 24163-1, *Tyre valves — Clamp-in tyre valves for tyre pressure monitoring systems — Part 1: Definition, types, dimensions and valve interface*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3877-2, ISO 9413, ISO 24163-1, ISO 14960-2 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

##### **clamp-in tyre valve**

valve for tubeless tyre, designed to be used with a valve core, a cap, an O-ring or a rubber grommet and to be fixed with a hex nut and potentially a ring washer

#### 3.2

##### **tyre pressure monitoring system**

##### **TPMS**

system which directly monitors the tyre pressure and which alerts in case of under pressure

**3.3 valve assembly**

clamp-in tyre pressure monitoring system (TPMS) (3.2) valve (with a valve core, a cap, a nut, an O-ring or a rubber grommet and potentially a washer) fixed on the test fixture

**4 Test fixture and valve hole dimensions**

For each test, the material and the test fixture should be representative of the actual rim.

Break both edges on both sides of the valve hole either by a 45° chamfer or a radius from 0,3 mm to 0,4 mm. Emery cloth or suitable tooling is recommended. The material of rim or fixture shall be aluminium alloy or steel.

Unless otherwise stated, for all the tests, the conditions in Table 1 shall be applied for the installation of the valve.

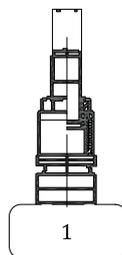
**Table 1 — Test Fixture**

Test	Nominal hole diameter 11,3 mm	
	Test hole diameter mm	Test plate thickness mm
Valve to rim seal leakage tests (see 5.5)	Specific fixture, see 5.5	
Over torque nut test (see 5.6.1)	11,7 <sup>+0</sup> <sub>-0,05</sub>	3,5 ± 0,05
High pressure test (see 5.6.2)	11,7 <sup>+0</sup> <sub>-0,05</sub>	3,5 ± 0,05
Radial force resistance (see 5.6.3)	11,3 <sup>+0,05</sup> <sub>-0</sub>	3,5 ± 0,05
Ozone test (see 5.7.1)	Ozone test on seal alone: Specific fixture, see 5.7.1 Ozone test on complete valve assembly: 11,3 <sup>+0,05</sup> <sub>-0</sub>	Ozone test on seal alone: Specific fixture, see 5.7.1 Ozone test on complete valve assembly: 3,5 ± 0,05
Neutral salt spray test (see 5.7.2)	11,3 <sup>+0,05</sup> <sub>-0</sub>	3,5 ± 0,05

As described in ISO 9413 and ISO 24163-1, several types of clamp-in valves exist.

Furthermore, several types of tyre pressure monitoring systems (TPMSs) exist and this document does not consider the attachment system between valve and sensor housing.

In this document a simplified illustration of a TPMS clamp-in valve is used (Figure 1).



**Key**

1 TPMS

**Figure 1 — Simplified representation of a TPMS clamp-in valve**

## 5 Test methods and performance requirements

### 5.1 General

#### 5.1.1 Appearance

If not otherwise defined between customer and supplier:

- Valve external aspect: no visible valve crack, spot or scratch is allowed. No visible defect of the anodizing layer is allowed. No deep marks coming from shocks or machining are allowed. All these defects can be judged with naked eye at 1 m distance in final configuration (valve assembled on rim).
- Sealing element aspect shall be uniform; no bubble, no rubber lack, no visible crack or any other defect that will affect the performance is allowed.
- No oil, grease, corrosion or other substance that will affect the performance is allowed.

Prior to performing any test, check the quality of the samples.

#### 5.1.2 Operating pressure

All pressures mentioned in this document are gauge pressures.

Nominal operating pressure: 0 kPa to 830 kPa (refer to the valve manufacturer indication).

Maximal operating pressure: 1 400 kPa. This maximal operating pressure can be replaced for each test by the real maximal operating pressure according to the valve's specification pressure.

#### 5.1.3 Installation procedure

Unless otherwise stated, for all the tests, the installation procedures and torques of the components (valve core, nut, cap) defined in ISO 24163-1 are applicable.

Each of the following tests shall be performed on unused valve assembly.

#### 5.1.4 Samples

It is recommended to test the minimum quantity to be representative of the design (usually at least 5 samples).

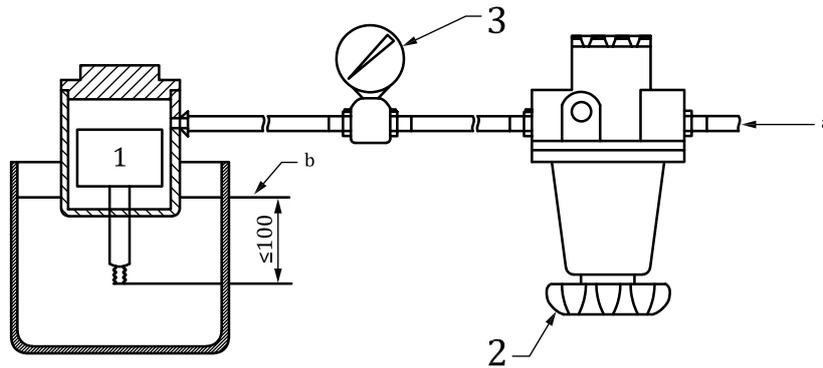
### 5.2 Leakage test method

For each required leakage test in this document:

- a) Immerse the valve assembly vertically not more than 100 mm below the surface of the water. The valve mouth should be positioned down to test for valve core leakage (see [Figure 2](#)), and the valve mouth should be positioned up to test for valve to rim leakage (see [Figure 3](#)).
- b) Use the liquid, temperature, pressure and time described in each test procedure.
- c) Before starting the test to check for leakage, twist the test fixture several times in the water bath to remove bubbles stuck on valve and nut (wait for surface stabilization).
- d) During the test, observe the bubbles in order to evaluate the leakage:
  - The leakage limit is 0,2 cm<sup>3</sup>/min, which is equivalent to around 14 bubbles/min with a diameter of about 3 mm or to one bubble/min with a diameter of approximatively 7 mm.
  - No bubbles during 1 min is also considered as acceptable.

- e) If the leakage exceeds the limit, perform the test again to confirm the defect. Perform the test a minimum of 24 h after seal assembly onto the valve in order to take in account the seal relaxation effect.

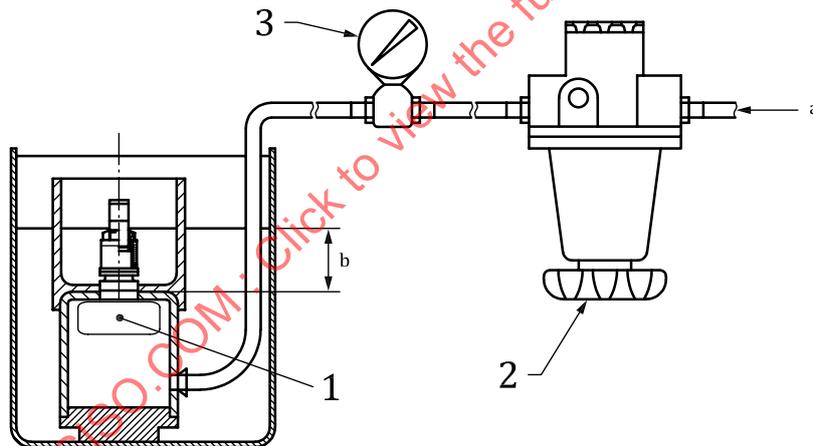
Dimensions in millimetres



**Key**

- 1 TPMS
- 2 regulator
- 3 gauge
- a Air supply.
- b Liquid level.

**Figure 2 — Valve core leakage test set-up**



**Key**

- 1 TPMS
- 2 regulator
- 3 gauge
- a Air supply.
- b Liquid level (100 mm maximum).

**Figure 3 — Valve to rim leakage test set-up**

## 5.3 Valve core tests

### 5.3.1 Valve core specification for leakage tests

Valve cores installed in clamp-in valve assemblies shall have:

- a pin height tolerance between  $-0,90$  mm and  $+0,25$  mm, relative to the valve mouth;
- a standard torque of:
  - $0,34$  Nm to  $0,56$  Nm with metallic sealing;
  - $0,23$  Nm to  $0,56$  Nm for non-metallic gasket.

The valve core leakage tests shall be conducted with a valve without cap.

### 5.3.2 Valve core room temperature leakage test

#### 5.3.2.1 Test procedure

- a) Immerse the valve assembly vertically in clean water at  $23\text{ °C} \pm 5\text{ °C}$  not more than 100 mm below the surface of the water (see [Figure 2](#)).
- b) Check for leakage of the cup gasket seal using a pressure of  $35\text{ kPa} \pm 5\text{ kPa}$  for 1 min.
- c) Then check for leakage of the barrel seal using the maximal operating pressure  $\pm 15\text{ kPa}$  for 1 min as defined in [5.1.2](#).

#### 5.3.2.2 Performance requirement

The leak rate shall not be greater than  $0,2\text{ cm}^3/\text{min}$ .

### 5.3.3 Valve core low temperature leakage test

#### 5.3.3.1 Test procedure

- a) Depress and release the valve core pin once after a minimum exposure period of 24 h at  $-40\text{ °C} \pm 3\text{ °C}$ ; maintain pressure at  $180\text{ kPa} \pm 15\text{ kPa}$ .
- b) Immerse the valve assembly vertically in ethanol or methanol at  $-40\text{ °C} \pm 3\text{ °C}$  not more than 100 mm below the surface (see [Figure 2](#)).
- c) Check for leakage using a pressure of  $180\text{ kPa} \pm 15\text{ kPa}$  for 1 min.
- d) Then, check for leakage using the maximal operating pressure  $\pm 15\text{ kPa}$  for 1 min as defined in [5.1.2](#).

#### 5.3.3.2 Performance requirement

The leak rate shall not be greater than  $0,2\text{ cm}^3/\text{min}$ .

### 5.3.4 Valve core high temperature leakage test

#### 5.3.4.1 Test procedure

- a) Depress and release the valve core pin once after a minimum exposure period of 48 h at  $100\text{ °C} \pm 3\text{ °C}$ ; maintain pressure at the maximal operating pressure  $\pm 15\text{ kPa}$  as defined in [5.1.2](#).
- b) Immerse the valve assembly vertically in clean water at  $66\text{ °C} \pm 3\text{ °C}$  not more than 100 mm below the surface (See [Figure 2](#)).

- c) Check for leakage using the maximal operating pressure  $\pm 15$  kPa for 1 min as defined in [5.1.2](#).

#### 5.3.4.2 Performance requirement

The leak rate shall not be greater than  $0,2 \text{ cm}^3/\text{min}$ .

#### 5.3.5 Valve core over torque resistance test

##### 5.3.5.1 Test procedure

With a calibrated torque wrench, torque the core on the valve twice the maximum specified torque. Remove the core and examine for separation of the swivel from the barrel, and of the barrel gasket from the barrel.

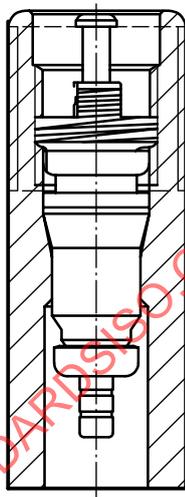
##### 5.3.5.2 Performance requirement

The core shall come out of the valve without separation.

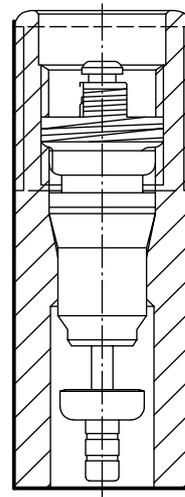
#### 5.3.6 Valve core endurance test

##### 5.3.6.1 Test procedure

- With the valve pressurized at the maximal operating pressure  $\pm 15$  kPa as defined in [5.1.2](#), depress the valve core pin to its maximum travel 120 times in  $10 \text{ min} \pm 3 \text{ min}$  (see [Figure 4](#)).
- After the endurance test, immerse the valve assembly vertically in clean water at  $23 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$  not more than 100 mm below the surface of the water (see [Figure 2](#)).
- Check for leakage using the maximal operating pressure  $\pm 15$  kPa for 1 min as defined in [5.1.2](#).



a) Valve core in closed position



b) Valve core pin depressed to its maximum travel

Figure 4 — Valve core endurance test position

##### 5.3.6.2 Performance requirement

The leak rate shall not be greater than  $0,2 \text{ cm}^3/\text{min}$ .

### 5.3.7 Valve core air flow rate test

#### 5.3.7.1 Test procedure

If the presence of the TPMS sensor housing influences the test condition or the test result, this test shall be performed with the TPMS sensor housing attached.

Depress the valve core pin by  $2 \text{ mm} \pm 0,5 \text{ mm}$  from the closed position (see [Figure 5](#)).

Measure the air flow through the tyre valve with 690 kPa pressure applied (see [Figure 6](#)).

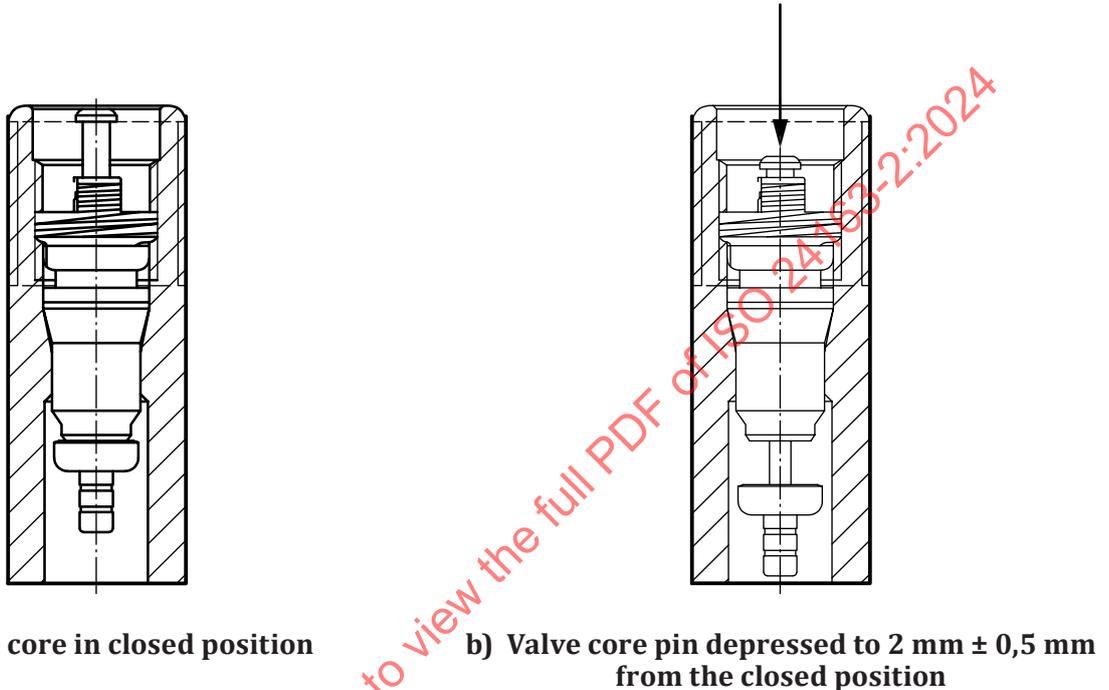


Figure 5 — Valve core air flow rate position

#### 5.3.7.2 Performance requirement

The air flow rate shall be greater than or equal to 100 l/min.

### 5.4 Valve cap seal

#### 5.4.1 Room temperature test (optional, for sealing caps only)

##### 5.4.1.1 Test procedure

- Screw the cap with a sealing gasket at 0,15 Nm to 0,20 Nm torque on a valve without a valve core.
- Immerse the valve assembly vertically in clean water at  $23 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$  not more than 100 mm below the surface of the water (see [Figure 2](#)).
- Check for leakage using the maximum pressure indicated by valve or cap manufacturer.

##### 5.4.1.2 Performance requirement

The leak rate shall not be greater than  $0,2 \text{ cm}^3/\text{min}$ .

## 5.5 Valve to rim seal

### 5.5.1 Valve to rim seal leakage test — General

For each tested valve assembly, two trials shall be performed with different installation parameters in accordance with [Table 2](#).

Minimum and maximum values are according to ISO 9413 for the particular valve being tested.

**Table 2 — Installation parameters for temperature leakage test**

Trial	Factor		
	Rim hole diameter mm	Rim thickness mm	Installation torque (valve nut) Nm
A	Maximum $\begin{matrix} +0 \\ -0,05 \end{matrix}$ 11,7 $\begin{matrix} +0 \\ -0,05 \end{matrix}$	Minimum $\pm 0,05$	Minimum $\pm 5 \%$
B	Minimum $\begin{matrix} +0,05 \\ 0 \end{matrix}$ 11,3 $\begin{matrix} +0,05 \\ -0 \end{matrix}$	Maximum $\pm 0,05$	Maximum $\pm 5 \%$

### 5.5.2 Valve to rim seal low temperature leakage test

#### 5.5.2.1 Test procedure

- Subject the valves to  $-40 \text{ °C} \pm 3 \text{ °C}$  for 24 h at  $180 \text{ kPa} \pm 15 \text{ kPa}$ .
- Immerse the valve assembly vertically in ethanol or methanol at  $-40 \text{ °C} \pm 3 \text{ °C}$  not more than 100 mm below the surface (see [Figure 3](#)).
- Check for leakage using a pressure of  $180 \text{ kPa} \pm 15 \text{ kPa}$  for 1 min.
- Then, check for leakage using the maximal operating pressure  $\pm 15 \text{ kPa}$  for 1 min as defined in [5.1.2](#).

#### 5.5.2.2 Performance requirement

The leak rate shall not be greater than  $0,2 \text{ cm}^3/\text{min}$ .

### 5.5.3 Valve to rim seal high temperature leakage test

#### 5.5.3.1 Test procedure

- Subject the valves to  $100 \text{ °C} \pm 3 \text{ °C}$  for 72 h at the maximal operating pressure  $\pm 15 \text{ kPa}$  as defined in [5.1.2](#).
- Check for leakage with  $66 \text{ °C} \pm 3 \text{ °C}$  clean water at not more than 100 mm above the valve mouth (see [Figure 3](#)).
- Check for leakage using the maximal operating pressure  $\pm 15 \text{ kPa}$  for 1 min as defined in [5.1.2](#).

#### 5.5.3.2 Performance requirement

The leak rate shall not be greater than  $0,2 \text{ cm}^3/\text{min}$ .

#### 5.5.4 Valve to rim seal peak temperature leakage test

##### 5.5.4.1 Test procedure

- a) Subject the valves to  $135\text{ °C} \pm 3\text{ °C}$  for 1 h at the maximal operating pressure  $\pm 15\text{ kPa}$  as defined in [5.1.2](#).
- b) Submerge the fixture in water at  $66\text{ °C} \pm 3\text{ °C}$  and check for leakage at the valve core and seal/rim interface.
- c) Check for leakage using the maximal operating pressure  $\pm 15\text{ kPa}$  for 1 min as defined in [5.1.2](#).

##### 5.5.4.2 Performance requirement

The leak rate shall not be greater than  $0,2\text{ cm}^3/\text{min}$ .

#### 5.6 Valve mechanical resistance

##### 5.6.1 Over torque nut test

###### 5.6.1.1 Test procedure

Using a calibrated torque wrench, tighten the hex nut on the valve with a torque of two times the maximum installation torque given in ISO 24163-1, then unscrew immediately.

###### 5.6.1.2 Performance requirement

No crack or rupture initiating point visible to the naked eye of either the nut or the valve (or washer if present) is permitted.

##### 5.6.2 High pressure test

###### 5.6.2.1 Test procedure

- a) At  $23\text{ °C} \pm 5\text{ °C}$ , apply 3 times the maximal operating pressure  $\pm 15\text{ kPa}$  as defined in [5.1.2](#) to the valve assembly with a representative time of real inflation process. In case the representative time of real inflation pressure is unknown,  $1\text{ min} \pm 5\text{ s}$  can be used.
- b) Maintain this pressure for 3 min.

###### 5.6.2.2 Performance requirement

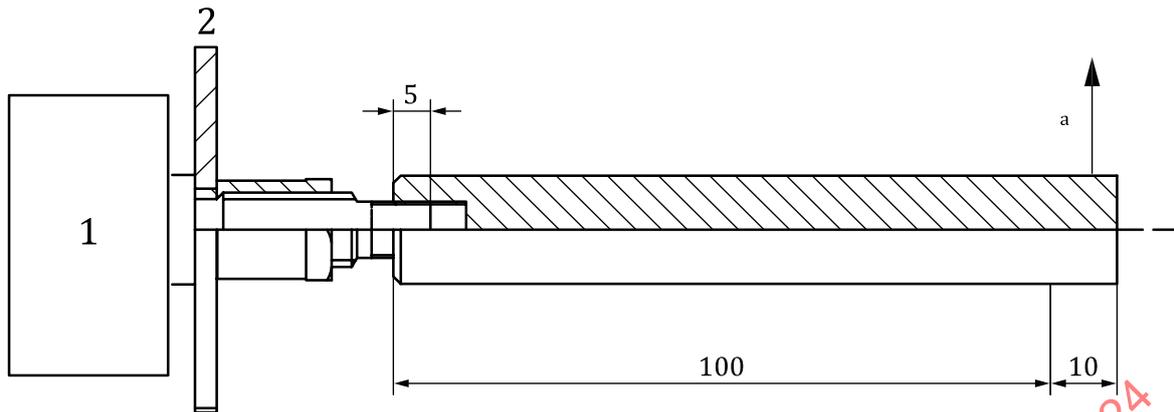
The valve shall not burst.

##### 5.6.3 Radial force resistance (nose resistance)

###### 5.6.3.1 Test procedure with a dynamometer

For this test, a valve core shall be assembled in the valve.

- a) At room temperature, mount the complete valve on a fix plate.
- b) Screw a rigid extension arm of 100 mm minimum length on the valve mouth. The arm shall be screwed on by  $5\text{ mm} \pm 1\text{ mm}$  on the threading of the nose of the valve and shall remain hanging on.
- c) Push at the extremity of the extension arm with a speed of minimum  $10\text{ mm}/\text{min}$ . The force shall be applied at a maximum of 10 mm from the end of the extension arm. The applied load shall be perpendicular to the extension arm and shall be recorded using a dynamometer (see [Figure 6](#)).

**Key**

- 1 TPMS
- 2 fix plate
- a Force rate (mm/min).

**Figure 6 — Radial force resistance set-up with a dynamometer**

**5.6.3.2 Performance requirement**

There shall be no breakage visible to the naked eye until a minimal force of 80 N.

**5.6.3.3 Alternative test procedure with a weight**

For this test, a valve core shall be assembled in the valve.

- a) At room temperature, mount the complete valve on a fix plate.
- b) Screw a rigid extension arm of 100 mm minimum length on the valve mouth. The arm shall be screwed on by  $5 \text{ mm} \pm 1 \text{ mm}$  on the threading of the nose of the valve and shall remain hanging on.
- c) Apply a static force of 80 N (a metal weight with fixed weight is suggested) at a maximum of 10 mm from the end of the extension arm (see [Figure 7](#)). The applied force shall be perpendicular to the extension arm.
- d) Apply the force during 60 s, then remove the force.
- e) Observe the valve assembly after the test.