

Automotive liquefied petroleum gas components — Other than containers

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee PVE/19, LPG containers and their associated fittings, which has the responsibility to:

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Foreword

This document (EN 12806:2003) has been prepared by Technical Committee CEN /TC 286, "Liquefied petroleum gas equipment and accessories", the secretariat of which is held by NSAI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2003, and conflicting national standards shall be withdrawn at the latest by October 2003.

Annexes A and B are informative.

Annexes C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S and T are normative.

This document includes a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies the general design and testing requirements for all components, in automotive Liquefied Petroleum Gas (LPG) propulsion systems, which have a working pressure equal to or greater than 20 kPa.

This European Standard also specifies the requirements for the Electric Control Unit (ECU), which is not subjected to pressure, and the gas-tight housing which has a working pressure below 20 kPa.

This European Standard excludes containers.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 549:1994, *Rubber materials for seals and diaphragms for gas appliances and gas equipment*.

EN 589, *Automotive fuels – LPG – Requirements and test methods*.

EN ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation (ISO 228-1:2000)*.

EN ISO 1307:1998, *Rubber and plastic hoses for general-purpose industrial applications – Bore diameters and tolerances, and tolerances on length (ISO 1307:1992)*.

EN ISO 1402, *Rubber and plastics hoses and hose assemblies – Hydrostatic testing (ISO 1402:1994)*.

EN ISO 4080, *Rubber and plastics hoses and hose assemblies - Determination of permeability to gas (ISO 4080:1991)*.

EN ISO 4672, *Rubber and plastics hoses -- Sub-ambient temperature flexibility tests (ISO 4672:1997)*.

EN 60068-2-52, *Environmental testing – Part 2. Tests – Test Kb: Salt mist, cyclic (sodium chloride solution) (IEC 60068-2-52:1996)*.

EN 60529:1991, *Degrees of protection provided by enclosures (IP code) (IEC 60529:1989)*.

ISO 37, *Rubber, vulcanized or thermoplastic - Determination of tensile stress-strain properties*.

ISO 188, *Rubber, vulcanized or thermoplastic - Accelerated ageing and heat-resistance tests*.

ISO 1431-1, *Rubber, vulcanized or thermoplastic - Resistance to ozone cracking – Part 1: Static strain test*.

ISO 1436-1, *Rubber hoses and hose assemblies - Wire-braid-reinforced hydraulic types – Specification – Part 1: Oil-based fluid applications*.

ISO 1817, *Rubber, vulcanized - Determination of the effect of liquids*.

ISO 6957, *Copper alloys - Ammonia test for stress corrosion resistance*.

ISO 9227, *Corrosion tests in artificial atmospheres - Salt spray tests*.

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

3.1.1

pressure

gauge pressure, unless otherwise stated

3.1.2

test pressure

pressure to which the component, or an assembly of components, is subjected during the test

3.1.3

design pressure

pressure on which the calculations are based

3.1.4

working pressure

pressure under normal operating conditions

3.1.5

automotive LPG system

assembly of components enabling a vehicle to use automotive LPG in its propulsion system

NOTE Components are defined in their specific annexes (see Table 1 and Table 2).

3.1.6

container

vessel used for the storage of automotive LPG

3.2 Abbreviations

ECU Electronic Control Unit

EMC Electromagnetic Compatibility

PRV Pressure Relief Valve

PRD Pressure Relief Device

STP Standard Temperature and Pressure [15,6 °C (288,7 K), 1,013 bar absolute (0,1013 MPa absolute)]

4 Technical requirements

4.1 General

Components shall be designed for use with automotive LPG as specified in EN 589.

The specific requirements for design and testing are detailed in the annexes (see Table 1 and Table 2).

If a device combines two or more functions of separate components, the relevant requirements for each component shall apply.

Table 1 — Annexes dealing with components fitted in or on the container

Component	Annex	Clause
80% stop valve	C	C.1
level indicator	C	C.2
Float	C	C.3
pressure relief valve	C	C.4
remote-controlled service valve with excess flow valve	C	C.5
excess flow valve	C	C.6
pressure relief device (PRD)	C	C.7
fuel pump	D	
gas-tight housing	E	
power supply bushing	F	
non-return valve	G	
multi-valve	H	
NOTE A fuel pump, multi-valve, gas-tight housing, power supply bushing and a non-return valve can be fitted if required for proper operation of the automotive LPG system.		

Table 2 — Annexes dealing with components not fitted in or on the container

Component	Annex
pressure regulator / vaporiser	I
shut-off valve	J
gas injection device or injector	K
gas mixing unit	K
gas dosage unit	L
flexible hoses and gas pipes	M
hydrostatic relief valve	N
LPG filter unit	O
pressure and/or temperature sensor	P
service coupling	Q
electronic control unit	R
fuel rail	S
filling unit	T

4.2 General design rules

4.2.1 Electrically operated devices containing LPG

Electrically operated devices containing LPG shall not produce sparks in the event of failure.

No current shall flow through LPG containing parts.

The electrical system shall be insulated from the body of the component and from the container.

The insulation resistance shall be greater than 10 MΩ.

The electrical enclosures of the LPG installation inside the boot and passenger compartment and in the LPG container shall comply with class IP 40 according to EN 60529:1991.

All other electrical enclosures shall comply with class IP 54 in accordance with EN 60529:1991.

Each electrically operated component shall comply with the relevant EMC requirements (see UN/ECE Regulation 10, 02 series of amendments or equivalent).

4.2.2 Remotely operated valves

Remotely operated valves, (e.g. 80% stop valve, service valve, shut-off valves), shall be of the “normally closed” type.

4.2.3 Heat exchanger materials

Materials shall be compatible with the heat exchange medium. The heat exchanger shall be designed to withstand a pressure of twice the maximum working pressure of the heat exchange medium.

4.2.4 Components containing high and low pressure parts

A component, containing both high pressure and low pressure parts, shall be designed to prevent pressure build up in the low-pressure part above the design pressure of that part of the component.

4.3 Materials

Materials in contact with LPG shall be LPG compatible.

Materials exposed to corrosive conditions shall be corrosion resistant or protected against corrosion.

The component manufacturer shall maintain records of and provide if requested:

- ¾ chemical analysis certificates,
- ¾ mechanical property data,
- ¾ results of metallurgical and mechanical tests and analysis,

for the materials used in construction of the parts subjected to pressure.

The component manufacturer shall maintain a system for the identification and tracing of materials used in the fabrication of parts under pressure.

NOTE For guidance on the choice of non-metallic materials, see EN ISO 11114-2.

4.4 Design temperature

The minimum design temperature shall be $-20\text{ }^{\circ}\text{C}$.

For extreme cold operating conditions, a minimum design temperature of $-40\text{ }^{\circ}\text{C}$ shall apply.

The maximum design temperature shall be:

- ¾ $65\text{ }^{\circ}\text{C}$ for components installed on the vehicle,
- ¾ $120\text{ }^{\circ}\text{C}$ for components installed in the engine compartment.

5 Classification of components

Components are classified according to their design pressure and function, see annex A:

- | | |
|----------|---|
| Class 1 | High pressure parts including pipes and fittings containing liquid LPG with a design pressure of 3 000 kPa, excluding valves and pressure relief devices. |
| Class 2 | Low pressure parts operating in the vapour phase including pipes and fittings with a design pressure of 450 kPa. |
| Class 2A | Low pressure parts operating in the vapour phase including pipes and fittings with a design pressure of 120 kPa. |
| Class 3 | Valves and pressure relief devices with a design pressure of 3 000 kPa. |

For a component consisting of several parts, each part shall be classified in its own class depending on the design pressure and function of that part.

6 Construction and workmanship

The manufacturer shall be able to demonstrate that the quality control system ensures that the component produced meets the requirements of this standard.

The manufacturer shall maintain records of the inspections that are carried out during production.

7 Tests

7.1 General

Components except flexible hoses shall be tested in accordance with Table 3.

Flexible hoses shall be tested in accordance with annex M.

Table 3 — Production and prototype tests

Test:	Class 1		Class 2/2A		Class 3		Clause
	Prototype	Production	Prototype	Production	Prototype	Production	
Overpressure	X		X		X		7.2
External leak ^f	X	X	X	X	X	X	7.3
Seat leak ^b	X	X	X	X	X	X	7.4
Operational ^b					X		7.5
Endurance					X		7.6
Vibration ^e					X		7.7
LPG compatibility ^a	X		X		X		7.8
Corrosion resistance ^c	X		X		X		7.9
Resistance to dry heat ^{a, f}	X				X		7.10
Ozone ageing ^{a, f}	X				X		7.11
Creep ^{a, d, f}	X				X		7.12
Temperature cycle ^a	X				X		7.13
^a Only applicable for rubber materials. ^b Only applicable for parts containing a valve. ^c Only applicable for metallic parts exposed to corrosive conditions. ^d Except for the 80% stop valve and excess flow valve as the permitted leak exceeds the requirements of this test. ^e Only applicable to the float operated 80% stop valve. ^f Only for parts having a sealing function							

Test pressure tolerances shall be 10% of the stated value with a maximum of 100 kPa.

Test temperature tolerances shall be:

$\frac{3}{4}$ - 5 °C for the minimum test temperature;

$\frac{3}{4}$ + 5 °C for the maximum test temperature;

$\frac{3}{4}$ ± 5 °C for 20 °C.

7.2 Overpressure test

7.2.1 General

The test pressure applied shall be 2,25 times the design pressure, unless otherwise stated in the specific component annex.

The test shall be performed at a temperature of 20 °C.

If an endurance test is required by Table 3, it shall be performed before the overpressure test.

7.2.2 Test procedure

The outlet of the component compartment to be tested shall be plugged. The level indicator and the float shall be tested installed in a pressure vessel.

The test medium shall be water or any suitable liquid.

The pressure shall be raised gradually.

The test pressure shall be maintained for at least one minute.

7.2.3 Interpretation of the test

The component shall pass the overpressure test without any visible evidence of rupture or permanent distortion.

7.2.4 Retesting

If the component fails the test, two additional samples shall be submitted to an overpressure test. If both samples pass the test, the test is successful.

If one or both fail the retest, the component design shall be rejected.

7.3 External leak tests

7.3.1 Prototype testing

7.3.1.1 General

An overpressure test, and an endurance test if required by Table 3, shall be performed before the external leak test.

7.3.1.2 Test procedure

The test shall be performed with air or nitrogen.

All components shall be tested at 20 kPa and at 1,5 times the design pressure at the following temperatures:

- a) 20 °C;
- b) the minimum design temperature;
- c) the maximum design temperature,
- d) or otherwise as required by the specific component annex.

Tests shall be carried out according to the following procedure:

- ¾ plug the outlet of the component;

- ¾ pressurise the component at the inlet;
- ¾ immerse the component in a suitable test liquid;
- ¾ maintain the test pressure for two minutes and determine the leak rate.

The components shall be preconditioned at the test temperature for at least 8 h.

7.3.1.3 Leak rate determination

The leak rate shall be determined according to the following method or any other equivalent method:

A graduated cylinder that is calibrated in cubic centimetres, filled with the test liquid, shall be placed inverted above the component.

At the end of the test period, the liquid displacement in the graduated cylinder is recorded.

The leakage rate is then calculated using the following formula:

$$V_l = V_t \frac{60}{t} \frac{273 P}{101,6 T}$$

where:

- V_l is the leakage rate, cm³/hour of air or nitrogen;
- V_t is the liquid displacement during the test in cm³;
- t is the time of test, minutes;
- P is the atmospheric pressure during test in kPa;
- T is the ambient temperature during test in K.

7.3.1.4 Test interpretation

The external leak rate shall be less than 15 cm³/hour, except for the gas-tight housing, for which a leak rate of 100 cm³/hour is allowed.

7.3.1.5 Retesting

If the component fails the test, two additional samples shall be submitted to an external leak test. If both samples pass the test, the test is successful.

If one or both fail the retest, the component shall be rejected.

7.3.2 Production testing

During production all components shall be tested in accordance with the procedure in 7.3.1.2, at 20 °C without preconditioning and at the design pressure. Components that fail the test shall be rejected.

7.4 Seat leak test

7.4.1 Prototype testing

7.4.1.1 General

An external leak test, and an endurance test if required by Table 3, shall be performed before the seat leak test.

7.4.1.2 Test procedure

The test shall be performed with air or nitrogen at 20 °C, at 20 kPa and at the design pressure unless otherwise stated in the specific component annex.

The components shall be preconditioned at 20 °C for at least 8 h.

The following procedure shall be applied:

- ¾ shut-off valves and pressure relief valves shall be pressurised at the inlet with the outlet open, non-return valves shall be pressurised at the outlet with the inlet open;
- ¾ pressurise the component, maintain the test pressure for two minutes and determine the leak rate in accordance with 7.3.1.3;
- ¾ in the case of an 80% stop valve and an excess flow valve, the pressure equalising bypass shall be blanked;

7.4.1.3 Test interpretation

Unless otherwise stated in the annex specific to the component, the seat of the component shall not leak more than:

- ¾ 15 cm³/hour for soft seated seals,
- ¾ 500 cm³/hour for metal to metal seats.

7.4.1.4 Retesting

If the component fails the test, two additional samples shall be submitted to a seat leak test. If both samples pass the test, the test is successful.

If one or both fail the retest, the component shall be rejected.

7.4.2 Production testing

During production all components shall be tested in accordance with the procedure in 7.4.1.2 at the design pressure without preconditioning. Components that fail the test shall be rejected.

7.5 Operational tests

7.5.1 Pressure relief valve and hydrostatic relief valve

7.5.1.1 General

Three pressure relief valves of each size, design, and setting shall be tested according to the following:

- ¾ test No. 1: start-to-discharge pressure and resealing pressure test;
- ¾ test No. 2: flow capacity test;
- ¾ repeat test No. 1, approximately one hour after the test No. 2.

Three hydrostatic relief valves of each size, design and setting shall be submitted to test No. 1.

7.5.1.2 Test No. 1

7.5.1.2.1 General

The same test procedure shall apply to a pressure relief valve and a hydrostatic relief valve



A minimum of two successive tests shall be performed on each of the three samples.

7.5.1.2.2 Test procedure

The test shall be performed with air or nitrogen at 20 °C. The pressure source shall be capable of maintaining a pressure of at least 500 kPa above the set pressure marked on the valve. A shut-off valve and a pressure gauge (having a pressure range of about twice the test pressure) shall be installed in the pressure supply pipe. The pressure gauge shall be installed in the pipe between the test valve and the shut-off valve. The start-to-discharge pressure and resealing pressure shall be observed, using a water seal not more than 100 mm in depth, and measured on the pressure gauge.

After recording the start-to-discharge pressure of the valve, increase the pressure sufficiently to ensure the valve lifts. Close the shut-off valve slowly, the pressure at which bubbles cease to emerge from the valve shall be recorded as the resealing pressure of the valve.

7.5.1.2.3 Test interpretation before the flow capacity test

The start-to-discharge pressure of each of the three samples of a pressure relief valve shall be within the tolerance of the set pressure (see C.4.3).

The resealing pressure of the sample shall be at least 90 % of the initially observed start-to-discharge pressure.

7.5.1.2.4 Test interpretation after the flow capacity test

The start-to-discharge pressure of a pressure relief valve shall be at least 85 % of the recorded start-to-discharge pressure during the test performed before the flow capacity test; the resealing pressure shall be at least 80 % of the resealing pressure recorded before the flow capacity test.

7.5.1.2.5 Retesting

If more than one valve fail the test, the component shall be rejected.

If one valve fails the test, two additional valves shall be submitted to test No. 1.

If both valves pass the retest, the test is successful.

If one or both fail the retest, the component shall be rejected.

7.5.1.3 Test No. 2

7.5.1.3.1 General

The flow capacity test on a pressure relief valve shall be carried out with a calibrated flowmeter. The flowmeter shall be connected to a source of air of adequate flow capacity and pressure.

The flowmeter shall be installed in accordance with the manufacturers' instructions.

7.5.1.3.2 Test procedure

The valve in the air-supply line shall be opened slowly until the flow rating pressure (120 % of the set pressure) is reached. The flow at this pressure is then recorded. The pressure is now decreased and the pressure at which there is no further discharge from the valve, is recorded. This is the blow-down pressure of the valve.

7.5.1.3.3 Test interpretation

The average flow capacity of the three pressure relief valves shall be recorded as the flow capacity of the valve of that specific size, design and setting. The recorded flow capacity shall be corrected to STP.

The flow capacity of any of the three samples of a pressure relief valve shall be at least 90 % of the highest observed capacity.

During the flow capacity tests on each valve there shall be no evidence of abnormal operating conditions.

The blow-down pressure of each valve shall be at least 65 % of the resealing pressure recorded during the start-to-discharge test performed before the flow capacity test.

7.5.1.3.4 Retesting

If more than one valve fail the test, the component shall be rejected.

If one valve fails the test, two additional valves shall be submitted to test No. 2.

If both valves pass the retest, the test is successful.

If one or both fail the retest, the component shall be rejected.

7.5.2 Excess flow valve

7.5.2.1 General

Three valves of each size and design shall be subjected to the test.

A valve intended to operate in the liquid phase shall be tested with water or any other suitable test liquid.

A valve intended for use in the vapour phase shall be tested with air or any other suitable test gas.

A valve intended for installation in one orientation shall be tested in that orientation only.

A valve not intended for installation in one orientation shall be tested in the vertical, inverted and horizontal orientation.

The flow through the excess flow valve shall be measured using a suitable flowmeter. The flow at the instant just before closing shall be recorded.

7.5.2.2 Test interpretation

The excess flow valves shall operate at the rated closing flow capacity specified by the manufacturer +10 % –20 %.

7.5.2.3 Retesting

If more than one valve fail the test, the component shall be rejected.

If one valve fails the test, two additional valves shall be submitted to the operational test procedure.

If both valves pass the retest, the test is successful.

If one or both fail the retest, the component shall be rejected.

7.5.3 80% stop valve

7.5.3.1 General

Three samples of each design of the 80 % stop valve shall be subjected to the following test.

7.5.3.2 Test procedure

The valve to be tested shall be installed in the normal operating orientation.

The valve shall be connected to a liquid supply source that is able to maintain a flow rate from 30 % to 130 % of the flowrate for which the 80 % stop valve is designed.

The rate at which the liquid level rises in the test vessel shall be equivalent to the rate at which the level rises in the type of container for which the valve is designed.

The level at which the 80 % stop valve closes shall be recorded.

The test shall be repeated 10 times at 0,3, 0,8 and 1,3 times the flow rate for which the 80 % stop valve is designed.

Alternative test methods are acceptable provided that they are equivalent.

7.5.3.3 Test interpretation

The maximum level at which any valve closes shall be 80 % of the volume of the smallest container for which the 80% stop valve is designed.

The difference between the highest and the lowest levels recorded for the smallest container for which the 80% stop valve is designed shall be:

- $\frac{3}{4}$ - 5% at 0,3 times the design flow rate;
- $\frac{3}{4}$ - 5% at 0,8 times the design flow rate
- $\frac{3}{4}$ - 10 % at 1,3 times the design flow rate.

7.5.3.4 Retesting

If more than one valve fail the test, the component shall be rejected.

If one valve fails the test, two additional valves shall be submitted to the operational test procedure.

If both valves pass the retest, the test is successful.

If one or both fail the retest, the component shall be rejected.

7.5.4 Fusible plug

7.5.4.1 Test procedure

The test shall be performed in the following manner:

- a) three fusible plugs shall be held at a controlled temperature of at least 90 °C and pressurised to the design pressure for 24 h;
- b) the fusible plugs shall be cooled to ambient temperature and inspected;
- c) the fusible plugs shall be gradually heated, the temperature at which the plug opens shall be recorded.

7.5.4.2 Test interpretation

After the test described in 7.5.4.1 b) there shall be no leakage or visible extension of any used fusible metal.

The recorded temperature at which the plug opens shall be between 110 °C and 130 °C.

7.5.4.3 Retesting

If more than one fusible plug fail the test, the component shall be rejected.

If one fusible plug fails the test, two additional fusible plugs shall be submitted to the operational test procedure.

If both fusible plugs pass the retest, the test is successful.

If one or both fail the retest, the component shall be rejected.

7.6 Endurance test

7.6.1 General

Three components shall be submitted to a test at the design pressure and at 20 °C unless otherwise stated in the specific component annex.

7.6.2 Test procedure

The component shall be installed in its normal operating orientation.

Shut-off valves and pressure relief valves shall be pressurised at the inlet with the outlet open, non-return valves shall be pressurised at the outlet with the inlet open.

Unless otherwise stated in the annex specific to the component, operate the device for 6 000 cycles at a maximum rate of 10 times per minute.

The temperature shall be kept constant during the test.

Subsequent to this cycle, the component shall be submitted to an external leak test and a seat leak test at 20 °C and at the design pressure. The function of the component shall be tested.

7.6.3 Test interpretation

A visual examination of the component shall be carried out.

There shall be no damage or wear of the component indicative of an early failure.

The component shall still comply with the design rules as stated in the specific component annexes.

Gaskets and seals, if fitted, shall be in the design position and shall not be damaged.

The component shall comply with the external and seat leak tests requirements at 20 °C.

7.6.4 Retesting

If more than one component fail the test, the component shall be rejected.

If one component fails the test, two additional components shall be submitted to the endurance test procedure.

If both components pass the retest, the test is successful.

If one or both fail the retest, the component shall be rejected.

7.7 Vibration test

7.7.1 General

To ensure that a float operated 80 % stop valve is constructed to withstand expected dynamic vibration stresses, two components shall be subjected to either the test described in 7.7.2.2 or in 7.7.2.3.

The test shall be carried out along each of the three dimensional axes of the component.

7.7.2 Test procedure

7.7.2.1 Equipment and mounting techniques

The component shall be attached to the vibration equipment by its normal mounting accessories, either directly to the vibration exciter or transmission table, or by means of a rigid fixture capable of transmitting the specified vibration conditions to the component.

When the component can be installed in more than one position, additional samples shall be tested to cover all mounting positions.

Equipment used to measure and/or record the acceleration level or amplitude level and the frequency shall have an accuracy of at least 10 %.

Procedure A or procedure B shall be used.

7.7.2.2 Procedure A

7.7.2.2.1 Resonance search

Resonant frequencies of the component shall be determined by varying the frequency of the applied vibration slowly through the specified vibration range, at reduced test levels, but with sufficient amplitude to excite the component.

NOTE The sinusoidal resonance search can be performed using the test level and cycling time as specified for the cycling test, provided the resonance search time is included in the time required for the sinusoidal cycling test.

7.7.2.2.2 Resonance dwell test

The component shall be vibrated for 30 min along each axis at the most severe resonant frequencies determined in the resonance search test.

The excitation level of the vibration exciter or transmission table shall be $1,5g$ ($14,7 \text{ m/s}^2$). If more than four significant resonant frequencies are found for any one axis, the four most severe resonant frequencies shall be chosen for this test.

If a change in the resonant frequency occurs during the test, each time of occurrence shall be recorded and the frequency shall be adjusted immediately to maintain the peak resonance condition. The final resonant frequency shall be recorded.

The total dwell test time shall be included in the required time for the sinusoidal cycling test.

7.7.2.2.3 Sinusoidal cycling test

The component fitted on the exciter or transmission table shall be sinusoidally vibrated for 3 h along each of its 3 dimensional axes, under the following conditions:

¾ an acceleration level of $1,5g$ ($14,7 \text{ m/s}^2$),

¾ a frequency range of 5 Hz to 200 Hz,

¾ a sweep time of 12 min.

The frequency of the applied vibration shall be swept logarithmically over the specified range.

NOTE The sweep time is the time required to pass the frequency range from 5 Hz. to 200 Hz. and back.

7.7.2.3 Procedure B

The test shall be performed on a sinusoidal vibrating bench, at a constant acceleration of $1,5g$ and, at frequencies ranging between 5 Hz and 200 Hz.

The test shall last 5 h for each of the dimensional axes of the component.

The frequency band shall be 5 Hz to 200 Hz.

The sweep time shall be 15 min.

NOTE The sweep time is the time required to pass the frequency range from 5 Hz. to 200 Hz. and back.

Alternatively, in case the test is not conducted by utilising a constant acceleration bench, the frequency band from 5 Hz to 200 Hz shall be subdivided into 11 semi-octave bands, each of them covered by a constant amplitude, so that the theoretical acceleration is between $1g$ and $2g$ ($g = 9,8 \text{ m/s}^2$). See Table 4.

Table 4 — Vibration amplitudes

Amplitude (crest value) mm	Frequency (for acceleration = $1g$) Hz	Frequency (for acceleration = $2g$) Hz
10	5	7
5	7	10
2,50	10	14
1,25	14	20
0,60	20	29
0,30	29	41
0,15	41	57
0,08	57	79
0,04	79	111
0,02	111	157
0,01	157	222

Each frequency band shall be covered in both directions in 2 min.

7.7.2.4 Subsequent testing

After the test, the component shall be subjected to the operational test in accordance with 7.5.3.2.

7.7.2.5. Test interpretation

After the test, the component shall show no mechanical failure.

The values of :

$\frac{3}{4}$ the filling level at the stop position and

$\frac{3}{4}$ the filling rate at the stop position,

shall not exceed the values before the vibration test by more than 1 %.

7.7.2.6. Retesting

If both components fail the test, the component shall be rejected.

If one component fails the test, two additional components shall be submitted to the vibration test.

If both components pass the retest, the test is successful.