BRITISH STANDARD

BS EN
12078:1998

Zero governors for gas burners and gas burning appliances

The European Standard EN 12078:1998 has the status of a British Standard

ICS 23.060.40

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National foreword

This British Standard is the English language version of EN 12078:1998.

The UK participation in its preparation was entrusted by Technical Committee GSE/22, Safety and control devices for gas governors and gas burning appliances, to Subcommittee GSE/22/19, Gas/air ratio controls, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled "International Standards Correspondence Index", or by using the "Find" facility of the BSI Standards Electronic Catalogue.

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Summary of pages

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English version

Zero governors for gas burners and gas burning appliances

Détendeurs à zéro pour brûleurs à gaz et appareils à gaz

Nulldruckregler für Gasbrenner und Gasgeräte

This European Standard was approved by CEN on 26 July 1998.

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European Committee for Standardization
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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 58, Safety and control devices for gas-burners and gas-burning appliances, the Secretariat of which is held by BSI.

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of an identical text or by endorsement, at the latest by February 1999, and conflicting national standards shall be withdrawn at the latest by February 1999.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this standard.

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, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Contents

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1 Scope

This standard specifies the safety, constructional and performance requirements for zero pressure governors, hereafter referred to as zero governors, intended for use with gas appliances. It also gives the test procedures for evaluating these requirements and information necessary for the purchaser and user.

This standard applies to zero governors for gas-burning appliances that may be used and tested independently of these appliances. These zero governors are suitable for one or more of the fuel gases of the 1st, 2nd and 3rd families, at inlet pressures up to and including 200 mbar.

This standard does not cover:

a) zero governors connected directly to distribution pipework or to a container that maintains a standard distribution pressure;

b) zero governors intended for gas appliances to be installed out-of-doors and exposed to the environment.

This standard covers type testing only.

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.

ISO 7-1:1994, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation.*

ISO 65:1981, *Carbon steel tubes suitable for screwing in accordance with ISO 7-1.*

ISO 68:1973, *ISO general purpose screw threads. Basic profile.*

ISO 228-1:1994, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation.*

ISO 262:1973, *ISO general purpose metric screw threads — Selected sizes for screws, bolts and nuts.*

ISO 274:1975, *Copper tubes of circular section — Dimensions.*

ISO 301:1981, *Zinc alloy ingots intended for casting.*

ISO 1817:1985, *Rubber, vulcanized — Determination of the effect of liquids.*

ISO 7005, *Metallic flanges.*

EN 60730-1:1995, *Automatic electrical controls for household and similar use — Part 1: General requirements.*

3 Definitions

For the purposes of this standard, the following definitions apply.

3.1

zero governor (atmospheric pressure regulator)

device which maintains the outlet pressure constant at a value equal to or close to atmospheric pressure independent of the variations in the inlet pressure and/or flow rate within defined limits

3.2 pressures

3.2.1

inlet pressure (p_1)

pressure at the inlet of the zero governor

3.2.2

outlet pressure (p_2)

pressure at the outlet of the zero governor

3.2.3

test pressure

pressure to be applied during a test

3.2.4

pressure drop

pressure difference between the inlet and the outlet pressure with the zero governor valve open to its fullest extent

3.2.5

maximum inlet pressure (p_{1max})

highest inlet pressure declared by the manufacturer

3.2.6

minimum inlet pressure (p_{1min})

lowest inlet pressure declared by the manufacturer

3.2.7

inlet pressure range

range of inlet pressures between the maximum and minimum values

3.2.8

setting point

this refers to the inlet and outlet pressures declared by the manufacturer, at which the zero governor is initially adjusted for test purposes (see **6.5.1** and **7.6.3**) at a declared flow rate. The respective pressures and flow rate are termed “inlet setting pressure”, “outlet setting pressure” and “setting flow rate”

3.3 flow rates

3.3.1

maximum flow rate (q_{max})

maximum rate, as a function of inlet and outlet pressures, declared by the manufacturer and expressed in m^3/h of air at standard conditions. For a non-adjustable zero governor there is only one maximum flow rate

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3.3.2

minimum flow rate (q_{min})

minimum rate, as a function of inlet and outlet pressures, declared by the manufacturer and expressed in m^3/h of air at standard conditions. For a non-adjustable zero governor there is only one minimum flow rate

3.3.3

flow rate range

range of flow rates between the maximum and minimum values

3.3.4

setting flow rate

see **3.2.8**

3.4 component parts

3.4.1

breather hole

orifice that allows atmospheric pressure to be maintained in a compartment of variable volume

3.4.2

diaphragm

flexible member which, under the influence of the forces arising from loading and pressure, operates the zero governor valve

3.5 performance terms

3.5.1

external leak-tightness (soundness)

leak-tightness of a gas-carrying compartment with respect to atmosphere

3.5.2

lock-up pressure

outlet pressure at which a zero governor closes when the outlet of the governor is sealed. The increase in outlet pressure is expressed in mbar

3.5.3

maximum ambient temperature

highest temperature of the surrounding air, declared by the manufacturer at which the zero governor may be operated

3.5.4

minimum ambient temperature

lowest temperature of the surrounding air, declared by the manufacturer at which the zero governor may be operated

3.5.5

mounting position

position declared by the manufacturer for mounting the zero governor

3.6

response time

the maximum time taken for the output to reach stable conditions in response to a change in inlet pressure

3.7 classification (see Table 3)

3.7.1

group 1

a zero governor for use in an appliance and/or installation where it is not subjected to bending stresses imposed by installation pipework, e.g. by the use of rigid adjacent supports

3.7.2

group 2

a zero governor for use in any situation, either internal or external to the appliance, typically without supports.

NOTE A zero governor which meets the requirements of group 2 also meets the requirements for group 1.

4 Units of measurement

4.1 All dimensions are given in millimetres.

4.2 All pressures are static pressures relative to atmospheric pressure and are expressed in millibars[1)].

4.3 Bending moment and torques are given in newton metres.

5 Construction requirements

5.1 General

5.1.1 Zero governors shall be designed, manufactured and assembled so that they function correctly when installed and used according to the manufacturer's instructions.

5.1.2 All parts of a zero governor shall be free from sharp edges and corners which might cause damage, injury or incorrect operation.

5.1.3 Holes for screws, pins, etc., which are used for the assembly of parts of the zero governor and for mounting, shall not penetrate gasways. The wall thickness between these holes and gasways shall be at least 1 mm.

5.1.4 Holes necessary in manufacture which connect gasways to atmosphere but which do not affect the operation of the zero governor shall be permanently sealed by metallic means. Suitable jointing compounds may additionally be used.

5.1.5 Closure parts, including those of measuring and test points, which may be dismantled for servicing, adjustment or conversion, shall be constructed such that leak-tightness in accordance with **7.3** is achieved by mechanical means (e.g. metal to metal joints, O-rings). This excludes all jointing compounds such as liquids, pastes and tapes.

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1) 1 mbar = 100 N/m^2 = 100 Pa.

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Jointing compounds, may be used for permanent assemblies and shall remain effective under normal operating conditions.

Closure parts not intended to be dismantled during servicing, adjustment or conversion shall be sealed by means which will show evidence of interference (e.g. lacquer).

5.1.6 Parts that require dismantling, e.g. for servicing, shall be capable of being dismantled and reassembled using commonly available tools and shall be constructed or marked such that incorrect assembly is impossible when following the manufacturer's instructions.

5.1.7 Screwed fastenings that may be removed during servicing shall have metric threads to ISO 68:1973 or ISO 262:1973.

Self-tapping screws that cut a thread and produce swarf shall not be used for connecting gas-carrying parts or parts that may be removed for servicing. Self-tapping screws that form a thread and do not produce swarf may be used provided they can be replaced by metric machine screws conforming to the above ISO standards.

5.1.8 The operation of moving parts (e.g. for diaphragms, bellows) shall not be impaired by other parts.

5.1.9 Breather holes shall be designed so that, when the diaphragm is damaged, either:

a) when tested in accordance with **7.3.3**, the flow of air through the hole shall not exceed 70 dm^3/h at the maximum inlet pressure; or

b) they shall have a connection for a suitable vent pipe, in which case the installation and operating instructions shall state that the breather should be vented to a safe place.

For maximum inlet pressures up to 30 mbar, requirement a) above shall be deemed to be met with a breather hole of diameter not greater than 0,7 mm.

If compliance with a) is by the use of a leakage rate limiter, it shall be able to withstand three times the maximum inlet pressure.

If a safety diaphragm is used as a leakage rate limiter, it shall not take the place of the working diaphragm in the event of a fault.

Breather holes shall be protected against blockage or shall be located so that they do not easily become blocked. They shall be arranged such that the diaphragm cannot be damaged by any instrument inserted through the breather hole.

5.1.10 Sealing caps, if used, shall be capable of removal and replacement with commonly available tools and shall be capable of being sealed (e.g. by lacquer). A sealing cap shall not hinder adjustment within the whole range declared by the manufacturer.

5.1.11 The outlet pressure adjustment shall be readily accessible to authorized persons. Adjustment by unauthorized persons shall be discouraged by provisions for sealing or the need for special tools.

5.2 Materials

5.2.1 *General material requirements*

The quality and dimensions of materials used and the method of assembling the various parts shall be such that the construction and performance characteristics are safe and the performance characteristics do not alter significantly during a reasonable life when the zero governor is installed, used and serviced in accordance with the manufacturer's instructions.

5.2.2 *Solder*

Soldering or other processes where the jointing material has a melting point below 450 °C after application shall not be used for joining gas-carrying parts except for additional sealing.

5.2.3 *Zinc alloys*

Zinc alloys shall only be used for gas-carrying parts if of quality ZnA14 to ISO 301:1981 and if the parts will not be exposed to a temperature higher than 80 °C. For main inlet and outlet threaded connections only external threads conforming to ISO 228-1:1994 are permitted if these connections are made of zinc alloy.

5.2.4 *Housing*

Parts of the housing that directly or indirectly separate a gas-carrying part from atmosphere shall be such that, on fracture of non-metallic parts other than O rings, seals, gaskets and diaphragms, no more than 30 dm^3/h of air escapes when tested in accordance with **7.3.2**.

5.2.5 *Resistance to corrosion and surface protection*

All springs and any part in contact with gas or the surrounding atmosphere, shall be manufactured from corrosion-resistant materials or shall be suitably protected. The corrosion protection for springs and other moving parts shall not be impaired by any movement.

5.2.6 *Impregnation*

A production-line treatment such as impregnation may be carried out using an appropriate procedure, e.g. vacuum or internal pressure, using appropriate sealing materials.

5.3 Connections

5.3.1 *General*

Equivalent connection sizes are given in Table 1.

5.3.2 *Threads*

5.3.2.1 If the inlet or outlet connection of a zero governor is a pipe thread, it shall be to ISO 7-1:1994 or ISO 228-1:1994 and shall be chosen from the series given in Table 1.

5.3.2.2 It shall easily be possible to apply the necessary forces when making any gas connection e.g. by suitable spanner flats for commonly available tools.

5.3.2.3 For connections intended to be made without threaded pipes but with union joints, the union joints shall be made available or full details supplied with the device if the threads do not conform to ISO 7-1:1994 or ISO 228-1:1994.

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Table 1 — Connection sizes

Nominal size DN	Designation of thread to ISO 7 1:1994 or ISO 228-1:1994	Nominal size of flanges to ISO 7005	Outside diameter of tubes for compression fittings range, mm
6	1/8	6	2 ≤ 5
8	1/4	8	6 ≤ 8
10	3/8	10	10 ≤ 12
15	1/2	15	14 ≤ 16
20	3/4	20	18 ≤ 22
25	1	25	25 ≤ 28
32	1 1/4	32	30 ≤ 32
40	1 1/2	40	35 ≤ 40
50	2	50	42 ≤ 50
65	2 1/2	65	—
80	3	80	—
100	—	100	—
125	—	125	—
150	—	150	—

5.3.3 *Flanges*

Where flanges are used, they shall be suitable for connection to flanges to ISO 7005 PN6 or PN16, or suitable adaptors shall be supplied to ensure connection to standard flanges or threads, or full details of mating parts shall be made available upon request.

5.3.4 *Compression fittings*

Compression fittings shall be suitable for use with pipe of outside diameters according to Table 2 of ISO 274:1975. It shall not be necessary for the installer to form the tubes before connection is made. The olives shall be appropriate to the tubes for which they are intended. Non-symmetrical olives may be used provided that they cannot be fitted incorrectly.

5.4 Seals for glands for moving parts

Seals for moving parts which pass through the body to atmosphere and seals for the closure member shall only be made of solid material (e.g. synthetic materials with adequate mechanical support and stability) of a type which does not deform permanently (e.g. no sealing paste).

Manually adjustable packing glands shall not be used for sealing moving parts.

NOTE An adjustable gland set by the manufacturer and protected against further adjustment and which need not be readjusted is considered to be non-adjustable.

Bellows shall not be used as sole sealing element against atmosphere.

5.5 Pressure test nipples

Pressure test nipples, where fitted, shall have an external diameter of $(9^{\ 0}_{-0,5})$ mm and a useful length of at least 10 mm for connection to tubing. The area of the hole shall not be greater than that of a 1 mm diameter hole.

6 Performance requirements

6.1 General

6.1.1 *Mounting position*

The performance of the zero governor shall be satisfactory in all mounting positions declared by the manufacturer.

6.1.2 *Ambient temperature range*

Zero governors shall operate correctly within the ambient temperature range declared by the manufacturer. The maximum ambient temperature shall be at least 60 °C and the minimum ambient temperature at most 0 °C.

6.2 External leak-tightness

Zero governors shall be leak-tight. They are considered to be leak-tight if the leakage rate does not exceed the value given in Table 2 when tested in accordance with **7.3.1**.

Closure parts (see **5.1.5**) shall remain leak-tight after having been dismantled and re-assembled five times.

Table 2 — Maximum external leakage rates

Nominal size (inlet) DN	Maximum external leakage rate (in cm^3/h of air)
DN < 10	20
10 ≤ DN ≤ 25	40
25 < DN ≤ 150	60

6.3 Torsion and bending

6.3.1 *General*

Zero governors shall be constructed such that they have adequate strength to withstand likely mechanical stress to which they may be subjected during installation and service.

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6.3.2 *Torsion — group 1 and group 2 zero governors with threaded connections*

Zero governors shall be subjected to the torque specified in Table 3 in accordance with **7.4.2**. After testing, there shall be no permanent deformation, and any leakage shall not exceed the values specified in Table 2.

6.3.3 *Torsion — group 1 and group 2 zero governors with compression fittings*

Zero governors shall be subjected to the torque specified in Table 3 in accordance with **7.4.3**. After testing, there shall be no permanent deformation, and any leakage shall not exceed the values specified in Table 2.

6.3.4 *Bending — group 1 and group 2 zero governors*

Zero governors shall be subjected to the bending moment specified in Table 3 in accordance with **7.4.3.1**. After testing, there shall be no permanent deformation, and any leakage shall not exceed the values specified in Table 2. For group 1 zero governors, the test of **7.4.3.2** shall additionally be applied.

6.3.5 *Zero governors with inlet and outlet connections not of the same nominal size and not on a common axis*

For zero governors which do not have inlet and outlet connections of the same nominal size or not on a common axis, each connection shall be subjected to the appropriate torque and bending moment specified in Table 3 in accordance with **7.4.5**.

6.4 Durability

6.4.1 *Elastomers*

6.4.1.1 *General*

The elastomeric material of valve pads, O-rings, diaphragms and lip seals used in the zero governor shall be homogeneous, free from porosity, inclusions, grit, blisters and surface imperfections visible to the naked eye.

6.4.1.2 *Resistance to lubricants*

The resistance to lubricants of elastomers shall be checked by an immersion test in test oil No. 2 carried out according to **7.5.1.2**. After this test, the change of mass shall be between −10 % and +10 %.

6.4.1.3 *Resistance to gas*

The resistance to gas of elastomers in contact with gas shall be checked by an immersion test using *n*-pentane (minimum 98 % by mass of *n*-pentane, estimated by gas chromatography) carried out according to **7.5.1.3**. After this test, the change in mass shall be between −15 % and +5 %.

6.4.2 *Marking*

Labels and all required marking shall be resistant to abrasion, humidity and temperature and shall neither lift nor discolour such that the marking becomes illegible.

Compliance with these requirements shall be checked in accordance with **7.5.2**.

6.4.3 *Resistance to scratching*

Surfaces exclusively protected with paint shall withstand the scratch test of **7.5.3** before and after the humidity test of **7.5.4** without the ball penetrating the protective coating to expose bare metal.

Table 3 — Torque and bending moment

Nominal size	Torque N·m	Bending moment N·m		
	Group 1 and 2	Group 1		Group 2
DN[1)]	10 s	10 s	900 s	10 s
6	15	15	7	25
8	20	20	10	35
10	35	35	20	70
15	50	70	40	105
20	85	90	50	225
25	125	160	80	340
32	160	260	130	475
40	200	350	175	610
50	250	520	260	1 100
65	325	630	315	1 600
80	400	780	390	2 400
100	—	950	475	5 000
125	—	1 000	500	6 000
150	—	1 100	550	7 600

[1)] Equivalent connection sizes are given in Table 1.

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6.4.4 *Resistance to humidity*

All parts including those with protected surface e.g. coated with paint or plating shall withstand the humidity test of **7.5.4** without signs of corrosion, lifting, or blistering, that are visible with the naked eye.

6.5 Zero governor performance

6.5.1 *General*

Zero governors shall be tested according to **7.6** for outlet pressure variation over the range of inlet pressure given in Table 4 for the respective gas families or wider limits as declared by the manufacturer, and over the range of flow rates from q_{min} to q_{max}.

The variation in outlet pressure with changes in inlet pressure and flow rate shall not exceed $\pm$10 % of the outlet pressure or $\pm$0,5 mbar, whichever is the greater or closer tolerances as declared by the manufacturer. This applies to all outlet pressures set in the range declared by the manufacturer.

Table 4 — Gas pressure at inlet to the zero governor

Type of gas	Nominal pressure mbar	Minimum pressure mbar	Maximum pressure mbar
1st family gases	8	6	15
2nd family gases group 2H	20	17	25
2nd family gases group 2L	25	20	30
2nd family gases group 2E	20	17	25
3rd family gases	29	20	35
	29	25	25
	37	25	45
	50	42,5	57,5
	67	50	80
	112	60	140
	148	100	180

6.5.2 *Stability of control*

Zero governors shall not chatter or hunt when being tested for performance in accordance with **7.6**.

6.6 Endurance

After testing as described in **7.8**, the leak-tightness and performance shall remain within the limits specified in **6.2** and **6.5** respectively.

6.7 Lock-up pressure

When a zero governor is claimed by the manufacturer to have the ability to lock-up, the outlet pressure shall not rise by more than 15 % or 0,75 mbar, whichever is the greater, above the outlet pressure at 5 % of q_{max}. Such a governor shall be tested in accordance with the method described in **7.9**.

6.8 Response time

When tested in accordance with **7.10** the response time shall be not exceed that declared by the manufacturer.

7 Test methods

7.1 Mounting position

The tests shall be carried out in the mounting position declared by the manufacturer. Where there are several mounting positions, tests shall be made in the least favourable position to check compliance with **6.1.1**.

7.2 Test conditions

Tests shall be carried out with air at (20 $\pm$ 5) °C and at an ambient temperature of (20 $\pm$ 5) °C except where otherwise specified. All measured values shall be corrected to the standard reference conditions of 15 °C, 1 013 mbar dry.

When carrying out performance tests at any particular setting, the minimum inlet pressure used shall be at least 2 mbar in excess of the set outlet pressure.

7.3 External leak-tightness

7.3.1 *Zero governor: complete*

The tests shall be carried out first with a test pressure of 6 mbar and then 1,5 times the maximum inlet pressure but at least 150 mbar. For zero governors suitable for 3rd family gases with a nominal pressure of 112 mbar or 148 mbar the test pressure shall be at least 220 mbar.

The zero governor is mounted on the test equipment. It is pressurized to the required test pressure and the leakage rate is measured. The accuracy of measurement of leakage shall be within 5 cm^3/h.

Closure parts are dismantled and reassembled five times, using commonly available tools according to the manufacturer's instructions, after which the leak-tightness is re-checked.

7.3.2 *Zero governor: after fracture of non-metallic part(s)*

Non-metallic parts of the housing which separate a gas-carrying compartment from the atmosphere shall be pierced with a hole with an area greater or equal to 50 % of the surface area of the part.

The inlet and outlet of the zero governor are pressurized to the maximum inlet pressure. The leakage rate is measured. O-rings, seals and gaskets shall not be removed during the test.

7.3.3 *Leakage rate of breather holes*

The dynamic part of the working diaphragm is ruptured. The maximum inlet pressure is applied to pressurize all gas-carrying chambers. The leakage rate is measured.

7.4 Torsion and bending

7.4.1 *General — threaded and flanged connections*

a) The pipes used for test purposes according to **7.4.2** and **7.4.3** shall conform to ISO 65:1981, medium series.

— For zero governors of nominal diameter $\leq$ DN 50, the length shall be at least 40 $\times$ DN.

— For zero governors of nominal diameter > DN 50 the length shall be at least 300 mm.

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b) Only non-hardening sealing paste shall be used on the connections.

c) For the purpose of the torsion and bending moment test, flanged connections shall be treated as threaded connections.

d) The zero governor is checked for external leak-tightness (**7.3.1**) prior to the following test.

7.4.2 ***Ten second torsion test — group 1 and group 2 zero governors with threaded connections***

Proceed as follows.

a) Screw pipe 1 with a torque, not exceeding the required torque indicated in Table 3, into the zero governor. Clamp pipe 1 at a distance equal to or greater than 2*d* from the zero governor (see Figure 1).

b) Screw pipe 2 with a torque, not exceeding the required torque indicated in Table 3, into the zero governor. Ensure that the joint is leak-tight.

c) Support pipe 2 such that no bending moment is applied to the zero governor.

d) Apply the required torque to pipe 2 for 10 s. The torque shall be applied progressively and smoothly without undue delay. The last 10 % of the torque shall be applied over a period not exceeding 1 min. The torque given in Table 3 shall not be exceeded.

e) With the force removed, check the assembly for external leak-tightness (**7.3.1**) and visually for any deformation.

f) If the inlet and outlet connections are not on a common axis, the tests shall be repeated with the connections reversed.

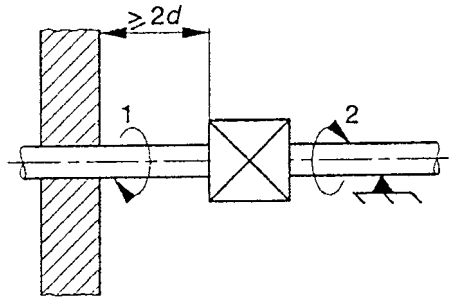

Figure 1 — Arrangement for torsion test

7.4.3 ***Ten second torsion test — group 1 and group 2 zero governors with compression joints***

7.4.3.1 *Olive-type compression joints*

For olive compression fittings, a steel tube is used with a new brass olive of the recommended size.

Proceed as follows.

a) With the body of the zero governor rigidly clamped, the test torque given in Table 3 is applied to the tubing nut for 10 s.

b) The same procedure is followed for all the connections.

c) The zero governor is then checked for deformation and leakage. Any deformation of the olive seating or mating surfaces consistent with the applied torque is discounted.

7.4.3.2 *Flared compression joints*

For flared compression joints, a short length of steel tube with a flared end is used, and the procedure given in **7.4.3.1** is followed. Any deformation of the cone seating or mating surfaces consistent with the applied torque is discounted.

7.4.4 ***Bending moment tests***

7.4.4.1 *Ten second bending moment test — group 1 and group 2 zero governors*

Proceed as follows.

a) Use the same zero governor as for the torsion test.

b) The force necessary to give the required bending moment given in Table 3 for a group 1 or group 2 zero governor is applied for 10 s, and as shown in Figure 2.

— For zero governors of nominal diameter ≤ DN 50, 40 × DN from the centre of the zero governor.

— For zero governors of nominal diameter > DN 50, at least 300 mm from the zero governor connection.

The mass of the pipe shall be taken into consideration.

c) With the stress removed, check the assembly for external leak-tightness (**7.3.1**) and visually for any deformation.

d) If the inlet and outlet connections are not on a common axis, the tests shall be repeated with the connections reversed.

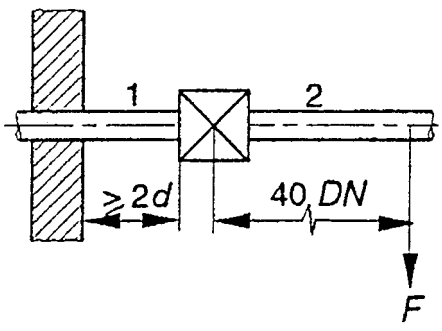

Figure 2 — Arrangement for bending moment test

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7.4.4.2 *900 s bending moment test — group 1 zero governors only*

Proceed as follows.

a) Use the same zero governor as for the torsion test.

b) The force necessary to give the required bending moment given in Table 3 for a group 1 zero governor is applied for 900 s and, as shown in Figure 2.

— For zero governors of nominal diameter ≤ DN 50, 40 × DN from the centre of the zero governor.

— For zero governors of nominal diameter > DN 50, at least 300 mm from the zero governor connection.

The mass of the pipe shall be taken into consideration.

c) With the force still applied check the assembly for external leak- tightness to **7.3.1.**

d) If the inlet and outlet connections are not on a common axis, the tests shall be repeated with the connections reversed.

7.4.5 ***Zero governors with inlet and outlet connections not of the same nominal size***

For zero governors which do not have inlet and outlet connections of the same nominal size, clamp the body of the zero governor and, following the appropriate procedures given in **7.4.2** and/or **7.4.3** as necessary, apply the torque and bending moment appropriate to each connection in turn. Check for deformation and leakage.

7.5 Durability

7.5.1 ***Elastomers***

7.5.1.1 *Elastomers in contact with gas*

The tests shall be carried out with the finished component or with parts of the finished component.

7.5.1.2 *Resistance to lubricants*

The test shall be carried out according to **8.2** of ISO 1817:1985 using the gravimetric method but the duration of immersion shall be (168 ± 2) h in oil No. 2 at the maximum declared ambient temperature of the zero governor.

Determine the relative change in mass, Δm, using the following equation:

$$\Delta m = \frac{m_3 - m_1}{m_1} \times 100\,\%$$

where

m_1 is the initial mass of the test piece;

m_3 is the mass of the test piece after immersion.

7.5.1.3 *Resistance to gas*

The test shall be carried out according to **8.2** of ISO 1817:1985 using the gravimetric method and clause **9** concerning the determination of extracted soluble matter, but under the following conditions:

a) the duration of immersion shall be (72 ± 2) h at (23 ± 2) °C in *n*-pentane (normal pentane);

b) dry the test pieces for a period of (168 ± 2) h in an oven at (40 ± 2) °C at atmospheric pressure;

c) determine the relative change in mass, Δm, with reference to mass of the test piece, using the following equation:

$$\Delta m = \frac{m_5 - m_1}{m_1} \times 100\,\%$$

where

m_1 is the initial mass of the test piece in air;

m_5 is the mass of the test piece in air after drying.

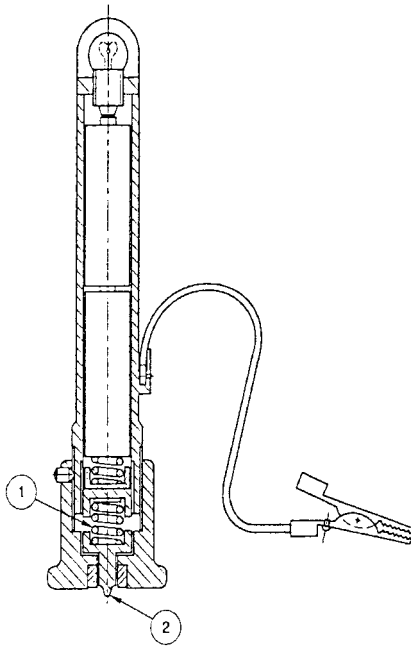
7.5.2 ***Marking***

The durability of the marking (see **8.1**) is tested in accordance with annex A of EN 60730-1:1995.

7.5.3 ***Scratch test***

A 1 mm diameter fixed steel ball is drawn across the surface at a speed of 30 mm/s to 40 mm/s with a contact force of 10 N (see Figure 3).

This test is repeated after the humidity test.



1 Spring loading = 10 N

2 Scratching point (steel ball, 1 mm diameter)

Figure 3 — Paint scratch test apparatus

7.5.4 ***Humidity test***

The zero governor is placed in a chamber at a temperature of 40 °C and with a relative humidity exceeding 95 % for 48 h. The zero governor is then removed from the chamber and examined with the naked eye for signs of corrosion, or lifting or blistering of the coated surface. The zero governor is then left for 24 h at ambient temperature and examined again.

7.6 Zero governor performance test

7.6.1 ***Apparatus***

The test is carried out with the apparatus in Figure 4. The uncertainty of measurement of pressure, temperature and flow shall be not greater than ±2 % of reading.

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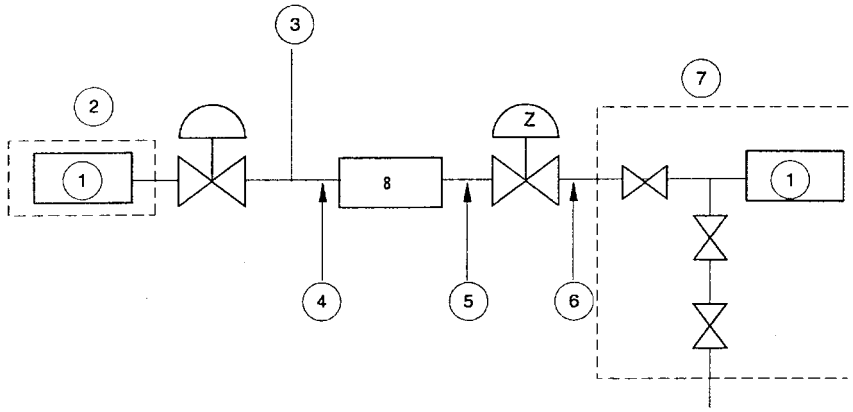

1 Fan
2 A suitable air supply
3 Vent to avoid problems with the supply governor locking up at low pressures
4 Pressure and temperature for meter correction
5 Pressure in
6 Pressure out
7 Either a variable speed fan and/or an arrangement for providing a variable load on the zero governor
8 Flow meter

Figure 4 — Performance test rig

7.6.2 *Conversion of the air flow rate*

The following equation shall be used for conversion of flow rate to standard conditions.

$$q_n = q\left[\frac{p_a + p}{1\,013} \times \frac{288}{273 + t}\right]^{1/2}$$

where

q_n is the rated flow rate in m^3/h;
q is the measured flow rate in m^3/h;
p is the test pressure in mbar;
p_a is the atmospheric pressure in mbar;
t is the air temperature at the zero governor in °C.

The performance is quoted in terms of m^3/h air under standard conditions.

7.6.3 *Test procedure*

Equilibrium conditions shall always be reached before readings are taken.

Examples of performance curves with p_2 as ordinate and p_1 as abscissa when the inlet pressure is variable as shown in Figure 5. Examples of performance curves with p_2 as ordinate and q as abscissa when the flow rate is variable are shown in Figure 6.

Proceed by the following steps:

a) **Adjustment of the outlet setting pressure of the zero governor**

With the inlet pressure to the zero governor set at p_{1max}, and valves B and C closed, adjust valve A to obtain the maximum flow rate declared by the manufacturer.

Reduce the flow rate to the minimum declared by the manufacturer by opening valve B fully and opening valve C until the required flow rate is obtained.

Readjust the flow rate to $½q_{max}$ by adjusting valve B and then adjust the outlet pressure to p_{2min} by means of the adjustment spring (in the case of a zero governor which claims to control the outlet pressure to zero only, with a control tolerance, then p_2 is set to zero); check minimum flow rate by opening valve B and readjust on valve C; repeat above until the value of p_2 remains constant. There is now no further adjustment of valve C or the spring.

Close valve B and check the maximum flow rate, readjust on valve A. There is no further adjustment of valve A.

The outlet setting pressure being set, the following tests in sections b), and c), are performed.

Section a) is then repeated but with the inlet pressure set to p_{1min} and the outlet pressure being set to p_{2max} (in the case of a zero governor which claims to control the outlet pressure to zero only, with a control tolerance, then p_2 should be set to zero) and then sections b), and c), should be repeated.

b) **Variation of the outlet pressure with the inlet pressure**

With the installation set up as described in a) and with maximum flow rate, q_{max}, vary the inlet pressure p_1 from the minimum p_{1min} to the maximum value p_{1max} and back to p_{1min} and record the outlet pressure for, at least five values of p_1 in each direction.

The flow rate should then be adjusted to q_{min} and section b), repeated (see Figure 5).

c) **Determining the zero governor performance**

Whilst maintaining the inlet pressure constant at p_{1min}, vary the flow rate from q_{max} to q_{min} and back by means of valve B, and record the outlet pressure for at least five values of q in both directions.

The inlet pressure should then be adjusted to p_{1max} and section c) repeated (see Figure 6).

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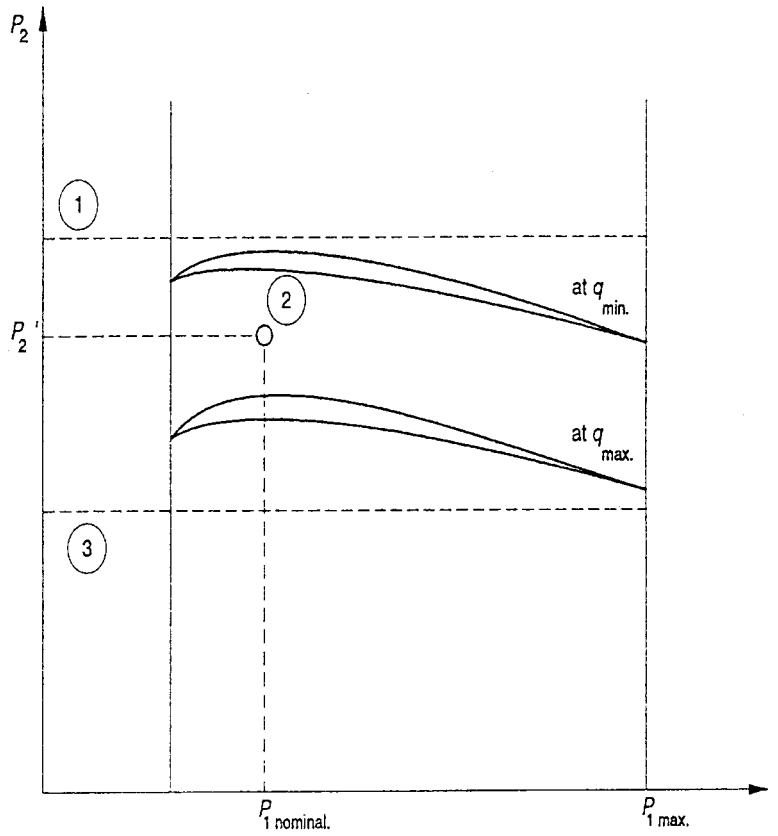
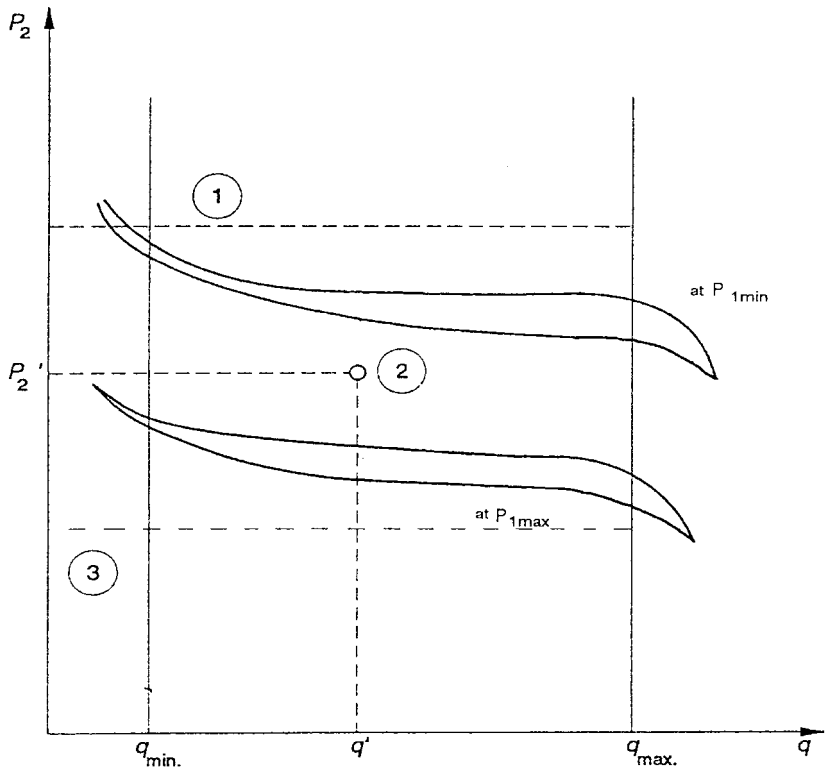


1 Upper tolerance limit
2 Setting point
3 Lower tolerance limit

Figure 5 — Characteristics of p_2 as p_1 varies



1 Upper tolerance limit
2 Setting point
3 Lower tolerance limit

Figure 6 — Characteristics of p_2 as q varies

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7.6.4 *Stability of control*

During the tests described in **7.6.3**, the zero governor shall be monitored for chattering and/or hunting.

7.7 Pressure drop (fully open)

Adjust the inlet pressure p_1 to 1 mbar less then the value of outlet pressure p_2 obtained at minimum inlet pressure and at maximum flow. The zero governor valve should then be fully open.

Measure the difference between the inlet and outlet pressures under these conditions.

7.8 Endurance

Position the zero governor in a temperature-controlled chamber with an air supply at ambient temperature and at the maximum inlet pressure declared by the manufacturer. Connect quick acting shut-off valves upstream and downstream of the zero governor. The valves are controlled by a time switch such that as one opens the other closes, with a complete cycle in a period not shorter than that declared by the manufacturer.

The test consists of 50 000 cycles, in each of which the diaphragm is fully flexed and the valve held on its seat.

25 000 of these 50 000 cycles are at the maximum ambient temperature declared by the manufacturer but at least 60 °C, and 25 000 cycles are at the minimum ambient temperature declared by the manufacturer but at most 0 °C.

After cycling, the zero governor is subjected to the tests described in **7.3** and **7.6** without further adjustment.

7.9 Lock-up pressure

Proceed as follows.

a) Install the zero governor in the apparatus shown in Figure 4.

b) Adjust the inlet pressure to $p_{1\max}$ and set the flow rate to 5 % $q_{\max}$.

c) Measure the outlet pressure p_2.

d) Slowly close the outlet control valve in not less than 20 s.

e) Measure the outlet pressure, p_2, 30 s after the outlet control valve is completely closed.

7.10 Dynamic response test

The test is performed by recording the outlet pressure as the inlet pressure is increased from zero to maximum over a time of 0,9 × the declared response time and also as it is reduced from maximum to zero over 0,9 × the declared response time.

During the tests the flow is set to $q_{\max}$.

The response time between the first change of inlet pressure and the moment that the outlet pressure has reached the set point stable condition is measured.

8 Marking, installation and operating instructions

8.1 Marking

The following information at least, shall be durably marked on the zero governor in a clearly visible position:

a) manufacturer and/or trade mark;

b) type reference;

c) group reference;

d) date of manufacturer (at least the year); this may be in code;

e) direction of gas flow by an arrow (e.g. cast or embossed);

f) maximum inlet pressure.

8.2 Installation, operating and servicing instructions

One set of instructions shall be supplied with each consignment, written in the language(s) of the country into which the zero governor will be delivered. This shall include all relevant information on use, installation, operation and servicing, in particular:

a) gas families for which the zero governor is suitable;

b) performance curves including inlet pressure range, outlet pressure range and flow rate range;

c) setting point (inlet pressure, outlet pressure and flow rate);

d) ambient temperature range;

e) mounting position(s);

f) instructions for changing the spring and if appropriate putting the zero governor out of action;

g) lock-up pressure, if applicable.

8.3 Warning notice

A warning notice shall be attached to each consignment of controls. This notice shall state “Read the instructions before use. This control must be installed in accordance with the rules in force.”

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Annex ZA (informative)

Clauses of this European Standard addressing essential requirements or other provisions of EU Directives

This European Standard has been prepared under a mandate given to CEN by the European Commission and supports essential requirements of EU Directive 90/396/EEC.

WARNING: Other requirements and other EU Directives *may* be applicable to the products falling within the scope of this standard.

The following clauses are likely to support requirements of Directive 90/396/EEC.

Compliance with this standard provides one of the means of conforming with the specific essential requirements of the Directive concerned and associated EFTA regulations.

Annex I Essential requirements		Clause number in EN 12078
1	**General conditions**	
1.1	Safety of operations	Complete standard
1.2	Installation instructions User instructions Warning notices Official language of instructions	**8.2** **8.2** **8.3** **8.2**
1.2.1	Installation instructions	**8.2**
1.2.2	User instructions	**8.2**
1.2.3	Warning notices	**8.3**
1.3	Fittings Instructions	**5.1.1** **8.2**
2	**Materials**	
2.1 2.2	Suitability for safety and intended purpose	**5.2, 6.1.1**
3	**Design and construction**	
3.1	General	
3.1.1	Safety of construction	**5.1, 6.4, 7.4**
3.1.2	Water/air penetration in gas circuit	n/a
3.1.3	Risk of explosion in the event of external fire	**5.2**
3.1.4	Water penetration	n/a
3.1.5	Normal fluctuation of auxiliary energy	n/a
3.1.6	Abnormal fluctuation of auxiliary energy	n/a
3.1.7	Hazards of electrical origin	n/a
3.1.8	Pressurized parts	**5.2.1, 7.3, 7.4**
3.1.9	Failure of safety, controlling and regulating devices	n/a
3.1.10	Overruling safety devices	n/a
3.1.11	Protection of parts set by the manufacturer	**5.1.11**
3.1.12	Controlling and setting devices	**5.1.11**
3.2	Unburned gas release	
3.2.1	Gas leakage	**5.2.4, 7.3, 6.7**
3.2.2 3.2.3	Gas accumulation	n/a
3.3	Ignition	n/a
3.4	Combustion	n/a
3.5	Rational use of energy	n/a
3.6	Temperatures	n/a
3.7	Foodstuffs and water used for sanitary purposes	n/a

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Annex II	
Certification procedures	n/a

Annex III CE conformity mark and inscriptions	
1. Mark	n/a
2. Data plate	**8.1**

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