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Industrial valves — Butterfly valves of thermoplastics materials

Robinetterie industrielle — Robinets à papillon en matériaux thermoplastiques

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 16136 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 69, *Industrial valves,* in collaboration with ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 7, *Valves and auxiliary equipment of plastics materials*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Industrial valves — Butterfly valves of thermoplastics materials

1 Scope

This International Standard specifies requirements for the design, functional characteristics and manufacture of butterfly valves made of thermoplastics materials intended for isolating and control service, their connection to the pipe system, the body materials and their pressure/temperature rating between − 40 °C and + 120 °C, for a lifetime of 25 years, and also specifies their tests.

This International Standard is applicable to hand- or power-operated valves to be installed in industrial pipe systems, irrespective of the field of application and the fluids to be conveyed.

NOTE 1 Industrial pipe systems also include systems for water supply for general purposes, drainage and sewerage.

NOTE 2 Special requirements can apply to pipe systems for water for human consumption.

This International Standard is concerned with the range of DN

DN 15, DN 20, DN 25, DN 32, DN 40, DN 50, DN 65, DN 80, DN 100, DN 125, DN 150, DN 200, DN 250, DN 300, DN 350, DN 400, DN 450, DN 500 and DN 600

and the range of PN and Class

PN 6, PN 10, PN 16 and Class 150.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

ISO 898-1:1999, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs*

ISO 5211:2001, *Industrial valves — Part-turn actuator attachments*

ISO 8233:1988, *Thermoplastics valves — Torque — Test method*

ISO 8659:1989, *Thermoplastic valves — Fatigue strength — Test method*

ISO 9393-2:2005, *Thermoplastics valves for industrial applications — Pressure test methods and requirements — Part 2: Test conditions and basic requirements*

ISO/TR 10358:1993, *Plastics pipes and fittings — Combined chemical-resistance classification table*

ISO 10931:2005, *Plastics piping systems for industrial applications — Poly(vinylidene fluoride) (PVDF) — Specifications for components and the system*

ISO 12092:2000, *Fittings, valves and other piping system components, made of unplasticized poly(vinyl chloride) (PVC-U), chlorinated poly(vinyl chloride) (PVC-C) acrylonitrile-butadiene-styrene (ABS) and acrylonitrile-styrene-acrylester (ASA) for pipes under pressure — Resistance to internal pressure — Test method*

ISO 12162:1995, *Thermoplastics materials for pipes and fittings for pressure applications — Classification and designation — Overall service (design) coefficient*

ISO 15493:2003, *Plastics piping systems for industrial applications — Acrylonitrile-butadiene-styrene (ABS), unplasticized poly(vinyl chloride) (PVC-U) and chlorinated poly(vinyl chloride) (PVC-C) — Specifications for components and the system — Metric series*

ISO 15494:2003, *Plastics piping systems for industrial applications — Polybutene (PB), polyethylene (PE) and polypropylene (PP) — Specifications for components and the system — Metric series*

EN 558-1:1995, *Industrial valves — Face-to-face and centre-to-face dimensions of metal valves for use in flanged pipe systems — Part 1: PN-designated valves*

EN 558-2:1995, *Industrial valves — Face-to-face and centre-to-face dimensions of metal valves for use in flanged pipe systems — Part 2: Class-designated valves*

EN 736-1:1995, *Valves — Terminology — Part 1: Definition of types of valves*

EN 736-2:1997, *Valves — Terminology — Part 2: Definition of components of valves*

EN 736-3:1999, *Valves — Terminology — Part 3: Definition of terms*

EN 1092-1:2001, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*

EN 1267:1999, *Valves — Test of flow resistance using water as test fluid*

EN 1759-1:2004, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, Class designated — Part 1: Steel flanges, NPS ½ to 24*

EN 12107:1997, *Plastics piping systems — Injection-moulded thermoplastics fittings, valves and ancillary equipment — Determination of the long-term hydrostatic strength of thermoplastics materials for injection moulding of piping components*

EN 12266-1:2003, *Industrial valves — Testing of valves — Part 1: Pressure tests, test procedures and acceptance criteria — Mandatory requirements*

EN 12570:2000, *Industrial valves — Method for sizing the operating element*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 736-1, EN 736-2 and EN 736-3, and the following apply.

NOTE Other terms and definitions relative to thermoplastics materials are given in ISO 15493, ISO 15494 and ISO 10931.

3.1
nominal size
DN
alphanumeric designation of size for components of a pipework system, which is used for reference purposes, comprising the letters DN followed by a dimensionless whole number which is indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections

[ISO 6708:1995, definition 2.1]

3.2
nominal pressure
PN
numerical designation relating to pressure that is a convenient round number for reference purposes

NOTE 1 It is intended that all equipment of the same nominal size (DN) designated by the same PN number have the same mating dimensions appropriate to the type of end connections.

NOTE 2 The permissible working pressure depends upon materials, design and working temperature and is to be selected from the pressure/temperature rating tables in corresponding standards.

[ISO 7268:1983, Clause 2]

3.3
Class
alphanumeric designation used for reference purposes related to a combination of mechanical and dimensional characteristics of a component of a pipework system, which comprises the word “Class” followed by a dimensionless whole number

NOTE The number following the word “Class” does not represent a measurable value and is not intended to be used for calculation purposes except where specified in the relevant standard.

3.4
allowable maximum operating pressure
PMA
maximum pressure occurring from time to time, including surge, that a component is capable of withstanding in service

[EN 805:2000, definition 3.1.1]

NOTE EU Directive 97/23/EC (PED) designates PS (maximum allowable pressure) irrespective of temperature. The values of PMA and PS are identical at 20 °C.

3.5
trim
inside parts of the valve in contact with the fluid

NOTE Adapted from EN 736-2:1997, definition 3.2.

3.6
rating factor
f_r
rating factor used in the relationship between PMA and PN or Class and used to calculate the maximum allowable pressure PMA at temperatures other than 20 °C

3.7
manual forces
F **and** F_s
operating manual force (F) and maximum manual force (F_s) which one person is capable of applying to the manual operating element of a valve

NOTE Adapted from EN 12570:2000.

4 Requirements

4.1 Design

4.1.1 Valve function

Butterfly valves in accordance with this International Standard shall be suitable for isolating service and may be designed to be used for control service.

4.1.2 Design characteristics

Valves shall have the following design characteristics:

a) a seat of soft material for the obturation;

b) if the tight obturation is preferred in one direction only, this shall be marked by an arrow on the outside of the valve body as specified in Table 2, item 10;

c) in accordance with EN 736-3, a seat diameter which shall be

- either full bore, i.e. not less than 90 % of DN expressed in millimetres (mm), or
- reduced bore, in which case the manufacturer shall declare the pressure loss factor of the valve;

d) a disc which shall be turned by a shaft at 90°, the stroke being limited by the actuating device in the end positions;

e) an actuating shaft that

- shall be fixed in the body and blow-out proof according to EN 736-3,
- shall have a shaft sealing system by self-sealing elements,
- shall indicate at the visible end by design or by marking the orientation of the disc, and
- shall be connected to the disc in such design that the orientation of the disc cannot be changed, not even after disassembling and re-assembling.

4.1.3 Types of valve end connection

The types of valve end connection can be chosen from the following alternatives:

- butt fusion ends;
- spigot ends for cementing or for welding;
- socket ends for electro-fusion;
- socket ends for heated tool welding;
- socket ends for cementing;
- socket ends for/with elastomeric seal rings;
- flanged ends;
- wafer type ends;

— threaded ends;

— union ends.

Other types of end connection are possible.

All valve ends shall be an integral part of, or threaded onto, the valve body. Different types of end connection on one body are possible.

4.2 Materials

4.2.1 Materials for the shell

The valve body and bonnet/cover materials may be selected from ISO 15493 or ISO 15494 or ISO 10931, and shall be in accordance with the requirements of the relevant above International Standard:

— ABS;

— PE;

— PP;

— PVC-C;

— PVC-U;

— PVDF.

If other body and bonnet/cover materials are used, the manufacturer shall ensure that these materials fulfil adequate requirements (such as those contained in the above International Standards for the above materials).

The bolting material between body and bonnet/cover shall be selected according to ISO 898-1.

4.2.2 Materials for other valve components

The choice of the materials for the obturator and all other internal components shall be the responsibility of the manufacturer. Design of these components shall ensure the mechanical integrity of the valve and shall be tested as specified in 5.2. A component failing any test according to 5.2 is not in conformity with the requirements of this International Standard.

4.3 Pressure/temperature rating

The valve body shall be designed in accordance with the MRS values as defined in ISO 12162 for the material specified in 4.2.1, and rated for PN 6, PN 10, PN 16 or Class 150.

The PMA, in relation to the working temperature of the complete valve, depends not only on the pressure/temperature (p/t) rating of the valve body material, but also on the valve design, and can be different from the p/t rating of the shell material. The PMA for thermoplastics valves shall be determined using a rating factor f_r as follows:

$$\text{PMA} = f_r \times \text{PN}\ \text{[in bar}\ ^{1)}\text{]}\ \text{or PMA} = f_r \times \text{Class [in psi}\ ^{2)}\text{]}$$

1) 1 bar = 0,1 MPa = 10^5 Pa; 1 MPa = 1 N/mm^2.

2) Pounds per square inch.

The minimum values for the rating factor f_r for valves shall be as specified in Table 1 and are valid for

— the relevant body material,

— a lifetime of 25 years,

— fluids without any effect on the physical and chemical characteristics of the valve parts in contact with the fluid.

NOTE For applications with lifetimes other than 25 years and/or with fluids with any effect on the physical and/or chemical characteristics of the valve material of the valve body, the rating factor f_r is usually established by the manufacturer.

Table 1 gives the minimum rating factors and the allowable temperature range for the valve body materials.

If the choice of materials of the trim parts (e.g. obturator, seals) limits the maximum allowable pressure and/or the maximum allowable temperature of the complete valve to less than the values given in Table 1, then this limitation shall be marked as specified in item 8 of Table 2.

The p/t rating factor for each valve type and each body material shall be declared by the manufacturer.

Table 1 — Minimum values for rating factor f_r for a lifetime up to 25 years

Temperature °C	Minimum rating factor f_r for body material					
	ABS	PE	PP	PVC-C	PVC-U	PVDF
− 40	1,0	1,0	—	—	—	a
− 30	1,0	1,0	—	—	—	a
− 20	1,0	1,0	—	—	—	1,0
− 10	1,0	1,0		—	—	1,0
0	1,0	1,0	—	—	—	1,0
+ 5	1,0	1,0	1,0	—	—	1,0
10	1,0	1,0	1,0	1,0	1,0	1,0
20	1,0	1,0	1,0	1,0	1,0	1,0
25	1,0	1,0	1,0	1,0	1,0	1,0
30	0,8	0,76	0,85	0,85	0,80	0,9
40	0,6	0,53	0,70	0,65	0,60	0,8
50	0,4	0,35	0,55	0,50	0,35	0,71
60	0,2	0,24	0,40	0,35	0,15	0,63
70	—	—	0,27	0,25	—	0,54
80	—	—	0,15	0,15	—	0,47
90	—	—	0,08	a	—	0,36
100	—	—	a	—	—	0,25
110	—	—	—	—	—	0,17
120	—	—	—	—	—	0,12
130	—	—	—	—	—	a
140	—	—	—	—	—	a

NOTE These values do not coincide with the relevant factors for pipes and fittings.

[a] A rating factor for this temperature may be declared by the manufacturer.

4.4 Dimensions

4.4.1 Face-to-face dimensions

The face-to-face dimensions of valves for use in flanged pipe systems shall be selected from

— EN 558-1 for PN designated flanges,

— EN 558-2 for Class designated flanges.

For all other types of end connection, the face-to-face dimensions shall be the responsibility of the manufacturer.

4.4.2 Joint dimensions of the valve end connections

The joint dimensions for flanged valve end connections shall be in accordance with

— EN 1092-1 for PN designated flanges,

— EN 1759-1 for Class designated flanges.

The joint dimensions of valves to be connected by threaded ends shall be in accordance with ISO 7-1 or ISO 228-1.

The joint dimensions for other end connections shall be, as applicable, in accordance with ISO 15493, ISO 15494 and ISO 10931. If end connections not defined in the above standards but specified in 4.1.3 are selected, the manufacturer shall declare the joint dimensions.

4.5 Operation

All operating devices shall be suitable for flow velocities up to 3 m/s.

All operating devices shall

— have a stroke limited by mechanical stops at the “OPEN” and “CLOSED” end positions,

— be lockable in all intended positions, and

— indicate the orientation of the disc by an indicating device or by the position of the lever. It shall not be possible to change this specified lever position relative to the shaft.

Hand-operated valves shall

— be closed by turning the lever or hand-wheel clockwise when viewed from above.

Gear- and power-operated valves shall

— have actuator attachments in accordance with the requirements of ISO 5211.

Valve actuators of a compact design integrated in the valve may be excepted from this requirement.

4.6 Functional characteristics

4.6.1 Design strength

For each valve body material, the shell design strength shall conform to ISO 9393-2:2005,

— Clause 5, for the test of the valve body, and

— Clause 6, for the long-term behaviour test of the complete valve.

4.6.2 Flow characteristics

The manufacturer shall specify the k_v values according to EN 1267 for the fully open position.

If the valve is used for control service, the manufacturer shall declare the k_v values in accordance with EN 1267 for intermediate positions.

4.6.3 Seat and shell leaktightness

The seat and shell leaktightness shall be in accordance with the requirements of ISO 9393-2:2005, Clause 7.

4.6.4 Operating torque

The manufacturer shall declare the maximum operating torque value allowed to fully open or fully close a valve at a differential pressure equal to the PN, in bar (or equal to the Class, in psi).

4.6.5 Permissible manual forces

The lever and hand-wheel rim forces to open and fully close the valve shall not exceed the values given for the force F in EN 12570:2000, Table 1.

The elevated forces F_s in EN 12570:2000, Table 1 may not be necessary.

All functional parts shall remain serviceable after the application of the force F.

4.6.6 Durability

After the endurance test carried out in accordance with 5.2.6, the following requirements shall apply:

— the shell leaktightness shall be in accordance with the requirements of ISO 9393-2;

— all functional parts shall be serviceable after endurance testing;

— a seat leakage rate (if any) according to EN 12266-1 shall be checked and recorded.

4.7 Manufacture

4.7.1 Traceability for materials of body and bonnet/cover

The manufacturer shall ensure that

— for body and bonnet/cover the material is in accordance with 4.2.1,

— the material properties of the incoming raw material are in accordance with a written specification,

— the body marking in accordance with item 3 of Table 2 conforms to the raw material supplied,

— the body is marked with a code for the year of production, and

— the body is marked with a code or the name of the manufacturer.

4.7.2 Permanent jointing

The welding process or the cementing by solvent process for permanently jointed parts of the valve body shall be carried out using procedures supervised by competent personnel in accordance with written instructions.

4.8 Other requirements

4.8.1 Wear

Where the valve functionality can be affected by erosion or abrasion, the design of the valve shall permit serviceability of the affected parts or else the manufacturer's operating instructions shall give recommendations for the replacement of the complete valve.

4.8.2 Corrosion resistance or other chemical attack

Where fluids other than water are to be conveyed, the effect of the fluid on the trim materials can be established by reference to ISO/TR 10358 or by consulting the valve manufacturer.

4.8.3 Operating instructions

The manufacturer shall supply the following minimum instructions in his documentation.

a) Definitions of "Intended use"

This instruction shall declare the valve functions and the service conditions for which the valve can be used.

b) Warnings

Where design of the valve does not exclude hazards in its intended use or where misuses are reasonably foreseeable, the manufacturer shall give adequate warnings in these operating instructions.

c) Maintenance and repair

To exclude reasonably foreseeable hazards during the intended life of the valve, instructions for maintenance and — where applicable — for repair shall be included in these operating instructions.

5 Test procedures

5.1 Documentation of test results

The manufacturer shall maintain test results and documentation as follows:

a) type tests — available at least ten years after manufacture of the last relevant valve type;

b) factory production control tests — available at least five years after dispatch.

5.2 Initial type tests

5.2.1 General

The initial type tests shall verify conformance to the material and functional requirements given below. Not all tests shall be performed on the complete valve.

These tests shall be carried out by the manufacturer for each DN size per valve design.

The tests according to 5.2.4, 5.2.6, 5.2.7 and 5.2.8 on any valve body and/or obturator material are representative for all other materials listed in Table 1.

The number of the representative type test specimens shall be the responsibility of the manufacturer.

5.2.2 Testing of materials

The testing of the body and bonnet/cover raw materials shall be in accordance with EN 12107. The requirements of 4.2.1 shall apply.

It is not necessary to retest a material which has been tested by the raw material supplier.

5.2.3 Shell test

The valve shell shall be tested in accordance with ISO 9393-2. The requirements of 4.6.1 shall apply.

5.2.4 Seat leaktightness test

The seat leaktightness of a complete valve shall be tested in accordance with ISO 9393-2. The requirements of 4.6.3 shall apply.

5.2.5 Long-term behaviour test of the complete valve

The complete valve shall be tested in accordance with ISO 12092. The requirements of 4.6.1 shall apply.

5.2.6 Durability test

The complete valve shall be endurance tested for opening and closing, under the following conditions:

a) the test fluid shall be water at PMA and 15 °C to 30 °C at the upstream side of the valve;

b) with the valve fully open, establish a flow of water at a velocity of (1 ± 0,2) m/s;

c) then fully close the valve, the pressure downstream shall be atmospheric;

d) then fully open the valve as specified in b);

e) then repeat until a minimum of 5 000 cycles.

The test method according to ISO 8659 shall apply.

The requirements of 4.6.6 shall apply.

5.2.7 Operating torque test

A valve with a manual operating element shall be tested at PMA at room temperature in accordance with ISO 8233. The requirements of 4.6.4 and 4.6.5 shall apply.

5.2.8 Final test

After the tests in accordance with 5.2.3 to 5.2.7, the test in accordance with 5.2.3 and 5.2.4 shall be repeated to the requirements of 4.6.6.

6 Declaration of compliance

The manufacturer shall declare compliance to this International Standard by reference to the number of this International Standard. The requirement of item 7 of Table 2 shall apply.

7 Designation

Butterfly valves in accordance with this document shall be designated by the following elements in the sequence given:

— butterfly valve;

— ISO 16136;

— type of valve end connection (see 4.1.3) and (where applicable) joint dimensions (see 4.4.2);

— symbol DN and number (see Clause 1);

— PN or Class designation (see Clause 1);

— material of the body (see 4.2.1);

— where applicable, material of the soft seating or restriction of maximum service temperature due to the characteristics of the seat or shaft seal material (see 4.3);

— for flanged valves, the face-to-face dimension basic series number (see 4.4.1);

— if not manually actuated, the type and specification of power actuator.

For guidance on procurement information, see Annex A.

8 Marking and preparation for storage and transportation

8.1 Marking and documentation

The minimum required marking and documentation of each valve shall be in accordance with Table 2.

The marking items shall be

— printed or formed directly on the valve, or

— marked on a label attached to the valve, or

— included in the valve accompanying documentation.

Markings on the valve surface or on a label shall remain legible at the time of installation of the valve.

NOTE The manufacturer is not responsible for marking being illegible due to actions caused during installation and use such as painting, scratching, covering of the valves or by use of detergents, etc. on the valve outside surface.

Markings shall not initiate cracks or other types of defects which adversely influence the performance of the valve.

If printing is used for the markings, the colouring of the printed information shall differ from the basic colouring of the component or of the label.

The size of the marking shall be such that the marking is legible without magnification.

Table 2 — Minimum required marking and valve data sheet

Item	Subject	Marking on valve	Information on data sheet
1	DN	X	—
2	PN or Class	X	—
3	Material designation of the body (as listed in 4.2.1)	X	—
4	Manufacturer's identification	X	—
5	Production code or date of manufacture[a]	X	—
6	p/t rating	—	X
7	Number of this International Standard	—	X
8	Seat/seal material[b] and/or (if any) limitation of allowable pressure[b] and/or allowable temperature[c]	X	X
9	Valve pressure loss factor [for valves with reduced seat diameter only, see 4.1.2 c)]	—	X
10	If applicable: marking of the preferred tightness direction in closed position by an arrow [see 4.1.2 a)]	X	—

a For providing traceability, the requirements of 4.7.1 shall be respected.

b A limited pressure — if applicable (see 4.3) — shall be marked on the valve. The seat/seal material shall be marked on the valve.

c Limitation of service temperature (see 4.3) shall be given in the data sheet.

Additional specific markings for power actuated valves may be attached at the valve actuator.

8.2 Preparation for storage and transportation

Each valve shall be drained of any test liquid.

The obturator shall remain in a slightly open position.

Flange covers — when provided — shall extend over the entire gasket face. Body end surfaces to be welded or jointed by cementing with solvents shall be suitably protected to prevent mechanical damage during normal conditions of transportation and storage.

The valve packaging or the body end protection shall prevent the introduction of foreign matter.