INTERNATIONAL STANDARD

ISO 10931-2

First edition
1997-02-15

Plastics piping systems for industrial applications — Poly(vinylidene fluoride) (PVDF) — Part 2: Pipes

Système de canalisation en matières plastiques pour les applications industrielles — Poly(fluorure de vinylidène) (PVDF) —

Partie 2: Tubes

INTERNATIONAL ISO

Reference number
ISO 10931-2:1997(E)

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.

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.

International Standard ISO 10931-2 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 3, *Plastics pipes and fittings for industrial applications*.

ISO 10931 consists of the following parts, under the general title *Plastics piping systems for industrial applications — Poly(vinylidene fluoride) (PVDF)*:

— *Part 1: General*

— *Part 2: Pipes*

— *Part 3: Fittings*

— *Part 4: Valves and auxiliary equipment*

— *Part 5: Fitness for system purpose*

— *Part 6: Recommendations for installation*

Annex A of this part of ISO 10931 is for information only.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet central@iso.ch
X.400 c=ch; a=400net; p=iso; o=isocs; s=central

Printed in Switzerland

Introduction

ISO 10931, which is divided into six parts (see Foreword), specifies the properties of pipes and piping system components made of poly(vinylidene fluoride) (PVDF) for industrial applications. It includes recommendations for installation (see ISO 10931-6) and is intended to be used by authorities, design engineers, testing and certification institutes and manufacturers. This part of ISO 10931 covers the characteristics of pipes.

This page intentionally left blank

Plastics piping systems for industrial applications — Poly(vinylidene fluoride) (PVDF) —

Part 2:
Pipes

1 Scope

This part of ISO 10931 specifies the requirements for poly(vinylidene fluoride) (PVDF) pipes intended for industrial applications, which include the conveyance of water and chemicals in liquid and gaseous forms.

It also specifies the parameters for the test methods referred to in this part of ISO 10931.

It is applicable to PVDF pipes intended for the conveyance of fluids under pressure at temperatures up to 150° C. However, for applications above 120 °C, which depend on the crystalline melting point of the specific PVDF grade being used, the advice of the pipe and fittings manufacturers should be sought.

NOTE — For information about the resistance of PVDF materials in contact with chemicals, see ISO/TR 10358.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 10931. At the time of publication, the editions indicated were valid. All standards are subject to revisions, and parties to agreements based on this part of ISO 10931 are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1167:1996, *Thermoplastics pipes for the transport of fluids — Resistance to internal pressure — Test method.*

ISO 2505-1:1994, *Thermoplastics pipes — Longitudinal reversion — Part 1: Determination methods.*

ISO 3126:1974, *Plastics pipes — Measurement of dimensions.*

ISO 4065:1996, *Thermoplastics pipes — Universal wall thickness table.*

ISO/TR 8584-2:1993, *Thermoplastics pipes for industrial applications under pressure — Determination of the chemical resistance factor and of the basic stress — Part 2: Pipes made of halogenated polymers.*

ISO/TR 9080:1992, *Thermoplastics pipes for the transport of fluids — Methods of extrapolation of hydrostatic stress rupture data to determine the long-term hydrostatic strength of thermoplastics pipe materials.*

ISO 10931-1:1997, *Plastics piping systems for industrial applications — PVDF — Part 1: General.*

ISO 11922-1:1977[1)], *Thermoplastics pipes for the transport of fluids — Dimensions and tolerances.*

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

1) To be published.

3 Definitions, symbols and abbreviations

For the purposes of this part of ISO 10931, the definitions, symbols and abbreviations given in ISO 11922-1 and ISO 10931-1 apply.

4 Material

4.1 The material from which the pipes are made shall be a PVDF homopolymer of category 1 in accordance with ISO 10931-1.

4.2 Clean reworked PVDF material produced during the manufacture and works testing of products conforming to this part of ISO 10931 may be used in limited amounts, provided it is derived from the same compound as that being used for the relevant production, and the final product has properties conforming to the requirements of this part of ISO 10931.

5 Appearance

When viewed without magnification, the internal and external surfaces of the pipe shall be smooth, clean and free from scoring, cavities and other surface defects. The ends of the pipe shall be cut cleanly and perpendicular to the axis of the pipe.

6 Geometric characteristics

6.1 The general dimensions of pipes shall be measured in accordance with ISO 3126, as applicable.

6.2 The nominal outside diameter of the pipe, d_n, shall conform to table 1.

6.3 The out-of-roundness tolerance shall conform to table 1. The maximum deviation between the measured maximum and minimum diameters shall not exceed 0,012 d_n. All tolerances shall be rounded to the next higher 0,1 mm.

NOTE — The out-of-roundness should be measured at the latest 24 h after production of the pipe.

Table 1 — Nominal outside diameters and tolerances

Dimensions in millimetres

Nominal outside diameter d_n	Tolerance on the outside diameter relative to d_n	Maximum out-of-roundness
8	$^{+0,3}_{0}$	0,1
10	$^{+0,3}_{0}$	0,2
12	$^{+0,3}_{0}$	0,2
16	$^{+0,3}_{0}$	0,2
20	$^{+0,3}_{0}$	0,3
25	$^{+0,3}_{0}$	0,3
32	$^{+0,3}_{0}$	0,4
40	$^{+0,3}_{0}$	0,5
50	$^{+0,3}_{0}$	0,6
63	$^{+0,4}_{0}$	0,8
75	$^{+0,4}_{0}$	0,9
90	$^{+0,4}_{0}$	1,1
110	$^{+0,5}_{0}$	1,3
125	$^{+0,6}_{0}$	1,5
140	$^{+0,8}_{0}$	1,7
160	$^{+1,0}_{0}$	2,0
180	$^{+1,1}_{0}$	2,2
200	$^{+1,2}_{0}$	2,4
225	$^{+1,4}_{0}$	2,7
250	$^{+1,6}_{0}$	3,0
280	$^{+1,8}_{0}$	3,4
315	$^{+2,0}_{0}$	3,8

6.4 Wall thickness and tolerances

6.4.1 Nominal wall thickness, e_n

The nominal wall thickness of the PVDF pipe shall conform to table 2, as appropriate to the pipe series S (see ISO 4065).

Table 2 — Nominal wall thickness

Dimensions in millimetres

Nominal outside diameter d_n	Nominal wall thickness e_n			
	S6,3 PN 25	S8 PN 20	S10 PN 16	S16 PN 10
10	1,9			
12	1,9			
16	1,9			
20	1,9			
25	1,9			
32	2,4			
40		2,4		
50		3,0		
63		3,8	3,0	2,0
75		4,5	3,6	2,3
90		5,4	4,3	2,8
110		6,6	5,3	3,4
125			6,0	3,9
140			6,7	4,3
160			7,7	4,9
180			8,6	5,5
200			9,6	6,2
225			10,8	6,9
250			11,9	7,7
280				8,6
315				9,7

NOTE — For safety reasons, the minimum wall thickness should not be less than 1,9 mm.

6.4.2 Tolerances on the wall thickness at any point, e_y

The tolerance on the wall thickness at any point, e_y, shall conform to table 3. The permissible variation between the mean wall thickness (e_m), and the nominal wall thickness (e_n) shall not exceed $0{,}1\ e_n + 0{,}2$ mm.

Table 3 — Tolerances on wall thickness at any point

Dimensions in millimetres

Wall thickness e_y	Tolerance
$1 \leqslant e_y \leqslant 2$	$^{+0,4}_{0}$
$2 < e_y \leqslant 3$	$^{+0,5}_{0}$
$3 < e_y \leqslant 4$	$^{+0,6}_{0}$
$4 < e_y \leqslant 5$	$^{+0,7}_{0}$
$5 < e_y \leqslant 6$	$^{+0,8}_{0}$
$6 < e_y \leqslant 7$	$^{+0,9}_{0}$
$7 < e_y \leqslant 8$	$^{+1}_{0}$
$8 < e_y \leqslant 9$	$^{+1,1}_{0}$
$9 < e_y \leqslant 10$	$^{+1,2}_{0}$
$10 < e_y \leqslant 11$	$^{+1,3}_{0}$

6.4.3 Basic stress and safety factors

The nominal pressure of a pipe (PN) is the maximum allowable working pressure (PMA) for 50 continuous years using water at 20 °C, and is related to the series S (table 2) by application of the following equation:

$$PN = \frac{\sigma_n}{S}$$

where

σ_n is the nominal stress, corresponding to the basic stress σ_s (50 years - 20 °C - H_2O) as defined in ISO 10931-1;

S is the pipe series, in accordance with ISO 4065 (see ISO 10931-1).

For PVDF pipes intended for industrial applications, the minimum required strength (MRS, see ISO 10931-1) determined with water is 25 MPa for continuous service during 50 years at 20 °C; however, even for the conveyance of water, a lower

nominal stress, 16 MPa, shall be chosen by using a safety factor of 1,6. When a piping system is used to convey fluid chemicals, for derating the PMA for a given fluid at a temperature for a required service time, the following equation shall be used:

$$PMA = \frac{\sigma_{s,fluid}}{S \cdot C_{spec}}$$

where

$\sigma_{s,fluid}$ is the design stress for this fluid chemical at this temperature for the required service time;

S is the pipe series;

C_{spec} is an additional application coefficient, to be applied according to user requirements (see ISO 10931-1).

The $\sigma_{s,fluid}$ is a function of $\sigma_{s,\ water}$ for the pipe as given in table 4 and of the f_{CR} (chemical resistance factor) in accordance with ISO/TR 8584-2.

6.5 Length of pipe

Pipe lengths and their tolerances are subject to agreement between supplier and purchaser.

7 Mechanical properties

7.1 Material

The PVDF material shall have a MRS not lower than 25 MPa as determined according to ISO 9080.

NOTE — Typical physical properties and the relevant test methods and test parameters are given in ISO 10931-1:1997, table A.1.

7.2 Component test for resistance to internal pressure

When tested in accordance with ISO 1167 under the conditions given in table 5, the test pieces shall not fail within the test time given.

The test results obtained according to method A for resistance to internal pressure are intended primarily to indicate possible defects caused by the pipe manufacturing process and not the long-term performance of the PVDF material.

In the case of higher working temperatures, method B may be used. The test using method B is not mandatory for evaluation of pipe components and shall be verified separately.

Table 4 — Design stress values for PVDF pipes with a MRS of 25 MPa and an overall service coefficient C_{min} = 1,6

Service temperature °C	Service time years	Design stress using water, $\sigma_{s,water}$ MPa
20	0,5	19,0
	2,5	17,9
	10	17,0
	25	16,4
	50	16,0
30	0,5	16,5
	2,5	15,6
	10	14,8
	25	14,3
	50	13,9
40	0,5	14,4
	2,5	13,5
	10	12,9
	25	12,4
	50	12,1
50	0,5	12,5
	2,5	11,8
	10	11,2
	25	10,8
	50	10,5
60	0,5	10,9
	2,5	10,2
	10	9,7
	25	9,4
	50	9,2
70	0,5	9,5
	2,5	8,9
	10	8,5
	25	8,2
	50	8,0
80	0,5	8,2
	2,5	7,7
	10	7,4
	25	7,1
	50	6,9
90	0,5	7,2
	2,5	6,7
	10	6,4
	25	6,2
	50	6,0
100	0,5	6,2
	2,5	5,9
	10	5,6
	25	5,4
	50	5,3
110	0,5	5,4
	2,5	5,1
	10	4,9
120	0,5	4,7
	2,5	4,4

Table 5 — Test conditions for PVDF pipe resistance to internal pressure

Test method	Temperature °C	Time h	Stress MPa
A	95	200	11,5
B	120	200	8,5

7.3 Longitudinal reversion

When tested in accordance with ISO 2505-1, under the conditions given in table 6, the longitudinal reversion of the pipe shall be not greater than 2 %.

Table 6 — Longitudinal reversion test for PVDF pipe

Test temperature °C	Test time h	Longitudinal reversion %
150	1	≤ 2

8 Marking

8.1 Marking details shall be printed or formed directly on the pipe in such a way that the marking does not initiate cracks or other types of failure, and in such a way that the marking legibility is maintained during storage, weathering and normal methods of installation and use.

8.2 If printing is used, the colour of the printed information shall differ from the basic colour of the product.

8.3 The marking shall be easily legible without magnification.

8.4 The marking shall include the information listed in table 7.

Table 7 — Minimum required marking

Information	Marking or symbol
Manufacturer	(Name and/or trademark)
Dimensions	d_n .....
Pipe series	S or SDR .....
Material	PVDF
Nominal pressure	PN .....
Manufacturing data	(Date or code)