FINAL
DRAFT

INTERNATIONAL
STANDARD

**ISO/FDIS
12238**

ISO/TC **131**/SC **5**

Secretariat: **AFNOR**

Voting begins on:
2022-07-15

Voting terminates on:
2022-09-09

Pneumatic fluid power — Directional control valves — Measurement of shifting time

Transmissions pneumatiques — Distributeurs de commande directionnels — Mesure du temps de commutation

Reference number
ISO/FDIS 12238:2022(E)

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Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 5, *Control products and components.*

This second edition cancels and replaces the first edition (ISO 12238:2001), which has been technically revised.

The main changes are as follows:

— the Scope has been extended to include monostable and bistable valves with two or three shifting position functions;

— extensions to the concept of shifting time measurement by addition of specifications for tests when shifting into non-exhausting positions have been added;

— consistency with other International Standards such as the ISO 6358 series has been improved;

— references to state-of-the-art test equipment and procedures have been updated.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

In pneumatic fluid power systems, power is transmitted and controlled through a gas under pressure circulating within a circuit. In some applications, the designer of a fluid power system needs to know the time required to cause the valving elements in a pneumatic directional control valve to move and to generate an output signal.

Pneumatic fluid power — Directional control valves — Measurement of shifting time

1 Scope

This document specifies test procedures for measuring the shifting times of electrically or pneumatically operated directional control valves.

It is applicable to monostable and bistable pneumatic directional control valves, with 2 or 3 position functions.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 80000-1, *Quantities and units — Part 1: General*

ISO 1219-1, *Fluid power systems and components — Graphical symbols and circuit diagrams — Part 1: Graphical symbols for conventional use and data-processing applications*

ISO 5598, *Fluid power systems and components — Vocabulary*

ISO 6358-1, *Pneumatic fluid power — Determination of flow-rate characteristics of components using compressible fluids — Part 1: General rules and test methods for steady-state flow*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5598 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
shifting time (exhaust)
shifting time for shifts into a position where the working port is exhausting, obtained for a change of 10 % in the outlet pressure

3.2
shifting time (fill)
shifting time for shifts into a position where the working port is filling a connected component or system, obtained for a change of 10 % in the outlet pressure

3.3
shifting time (non-exhausting)
shifting time for shifts into a position where the working port is closed.

4 Symbols and abbreviated terms

4.1 The symbols and units for parameters used in this document shall be as given in Table 1 and shall be in accordance with ISO 80000-1.

Table 1 — Symbols and units

Symbol	Parameter	Unit
t_0	base for time measurement	ms
t_E	shifting time (exhaust)	ms
t_F	shifting time (fill)	ms
t_{NE}	shifting time into non-exhausting position (exhaust)	ms

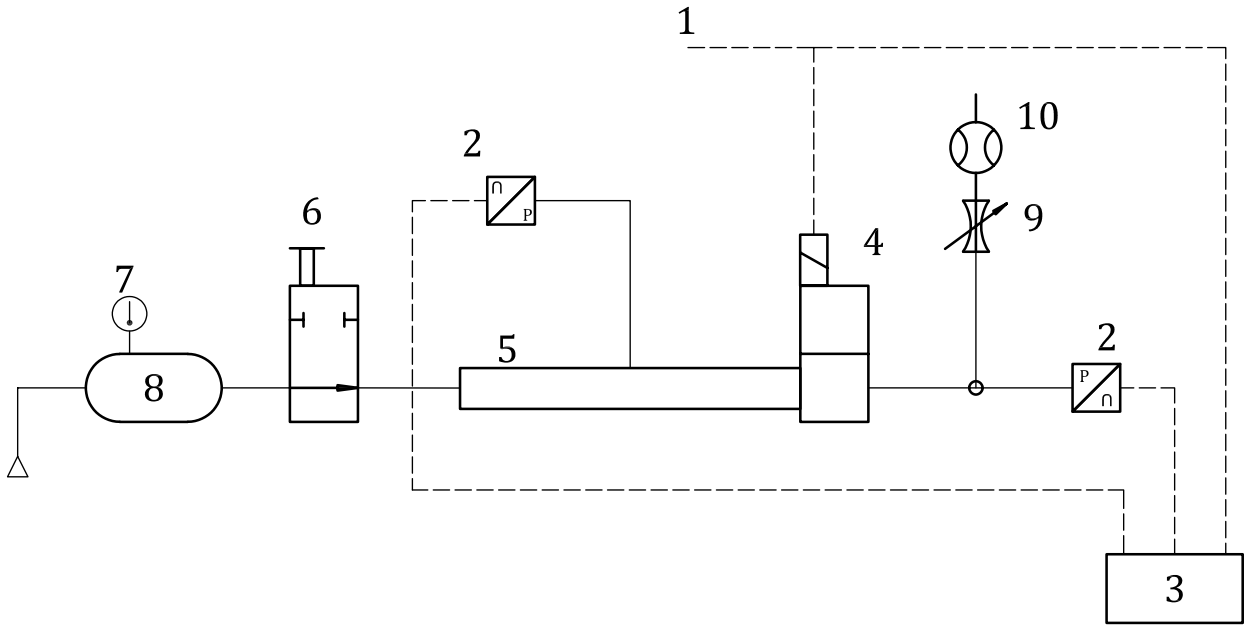
4.2 Graphic symbols used in this document shall conform to the requirements of ISO 1219-1.

5 Test equipment

5.1 Basic test setup

The basic test equipment shall be as shown in Figures 1 and 2.

When shifting into a non-exhausting valve position the shifting time cannot be measured due to a lack of a pressure drop. For measuring the shifting time of shifts into non-exhausting valve positions (e.g. 2/2 or 5/3 closed centre position) a throttle valve and a flow sensor shall be used (also see key 9 and key 10 in Figures 1 and 2).

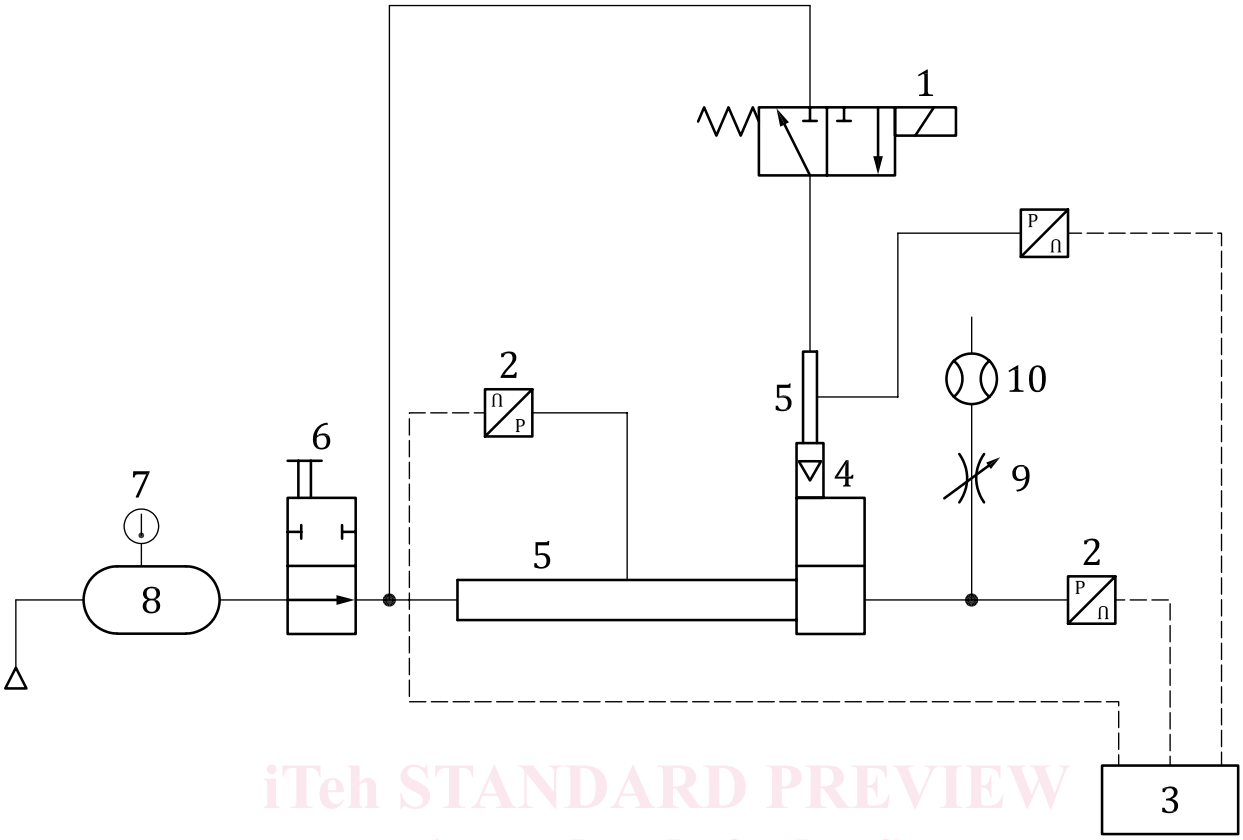


Key

1 control signal
2 pressure transducers
3 output recording device(s)
4 valve under test
5 pressure measuring tube in accordance with ISO 6358-1
6 shut-off valve (optional)
7 thermometer
8 supply reservoir
9 throttle valve (only for non-exhausting valve positions)
10 flow sensor (only for non-exhausting valve positions)

Figure 1 — Test equipment for electrically-operated valves

For pneumatically operated valves (Figure 2) the sonic conductance *C* as defined in ISO 6358-1 of the control valve (key 1) shall be larger than the *C*- value of the pilot port of the valve under test (key 4). The connection between control valve (key 1) and the pressure measuring tube (key 5) at the pilot port of the valve under test should be as short as possible.



Key

1 control valve (to generate control signal)
2 pressure transducers
3 output recording device(s)
4 valve under test
5 pressure measuring tube in accordance with ISO 6358-1
6 shut-off valve (optional)
7 thermometer
8 supply reservoir
9 throttle valve (only for non-exhausting valve positions)
10 flow sensor (only for non-exhausting valve positions)

Figure 2 — Test equipment for pneumatically-operated valves

5.2 Pressure measuring tubes

5.2.1 A straight pressure measuring tube should be threaded into the valve inlet port, as well as into the valve pilot port when applicable, and shall be made in accordance with ISO 6358-1.

The test setup from ISO 6358-1 requires transition connectors for the flow measurement. These reduce the speed of the flow in the measuring tube. This is not necessary for shifting time measurement and the transition connectors are not required for this test. Nevertheless, the transition connectors from ISO 6358-1 may be used for the tests according to ISO 12238.

5.2.2 Select and attach pressure measuring tubes to the test valve whose threads correspond to each port size of the valve flow path, and to the valve pilot port when applicable.

5.3 Pressure transducers

5.3.1 Install a pressure transducer into the inlet pressure measuring tube. Also install a pressure transducer directly into each outlet port to be tested, to have an outlet volume as small as possible. All untested outlet ports shall be plugged.

5.3.2 When a pneumatically-operated valve is tested, mount an additional control pressure transducer into the pilot pressure measuring tube.

5.4 Supply reservoir

5.4.1 Use a supply reservoir of sufficient capacity so that the pressure drop caused by the piping and measured in the pressure measuring tube at the inlet port during the test does not exceed 3 % of the supply pressure. A larger pressure drop is permissible but will increase the shifting time and result in a less favourable rating for the product under test. Connections from the supply reservoir should be several times larger than the pressure measuring tube and as short as possible, to minimize the pressure drop.

5.4.2 Use a supply reservoir that allows measuring the internal air temperature of the reservoir. Maintain the supply reservoir temperature between 18 °C and 30 °C.

5.4.3 Locate the optional shut-off valve, and the control valve when applicable, as close as possible to the reservoir outlet. Use a valve with a C value larger than that of the pressure measuring tube, because a smaller valve can restrict the flow and increase the shifting time.

5.5 Control signal

5.5.1 For solenoid pilot-operated valves or pneumatically-operated valves, maintain the external pilot supply pressure at either the test pressure supplied to the valve or the maximum permitted pilot supply pressure, whichever is less.

5.5.2 For AC solenoid-operated valves, generate the control signal with a trigger device set to trigger at the zero-voltage crossover point. Maintain voltage to within ±2 % of the rated voltage.

5.5.3 For DC solenoid-operated valves, maintain steady-state voltage to within ±2 % of the rated voltage.

5.5.4 Changes in the shifting time caused by limitation of the negative voltage peaks due to the test equipment should not exceed 0,1 ms.

5.5.5 For bistable valves, add a pause of non-operation between control signals to ensure that the pilot control volumes are completely exhausted, before measuring the shifting time in the opposite condition.

5.6 Data recording system

5.6.1 Use pressure transducers, amplifiers and recording devices that together have a system frequency response of within −3,0 dB at minimum 2 000 Hz and a resolution of less than 0,1 ms. For shifting times smaller than 5 ms, a system frequency response of within −3,0 dB at minimum 5 000 Hz shall be used.

