INTERNATIONAL STANDARD

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Pneumatic fluid power — Assessment of component reliability by testing —

Part 2: Directional control valves

Transmissions pneumatiques — Évaluation par essais de la fiabilité des composants —

Partie 2: Distributeurs

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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.

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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 131, *Fluid power systems.*

This second edition cancels and replaces the first edition (ISO 19973-2:2007), which has been technically revised.

ISO 19973 consists of the following parts, under the general title *Pneumatic fluid power — Assessment of component reliability by testing*:

— *Part 1: General procedures*

— *Part 2: Directional control valves*

— *Part 3: Cylinders with piston rod*

— *Part 4: Pressure regulators*

— *Part 5: Non-return valves, shuttle valves, dual pressure valves (AND function), one-way adjustable flow control valves, quick-exhaust valves.*

Introduction

In pneumatic fluid power systems, power is transmitted and controlled through a gas under pressure within a circuit. Pneumatic fluid power systems are composed of components and are an integral part of various types of machines and equipment. Efficient and economical production requires highly reliable machines and equipment. This part of ISO 19973 is intended to provide requirements and test conditions that permit the assessment of the inherent reliability of pneumatic and electro-pneumatic directional control valves.

It is necessary that machine producers know the reliability of the components that make up their machine's pneumatic fluid power system. Knowing the reliability characteristic of the component, the producers can model the system and make decisions on service intervals, spare parts inventory and areas for future improvements.

There are three primary levels in the determination of component reliability:

a) preliminary design analysis: finite element analysis (FEA), failure mode and effect analysis (FMEA);

b) laboratory testing and reliability modelling: physics of failure, reliability prediction, pre-production evaluation;

c) collection of field data: maintenance reports, warranty analysis.

Each level has its application during the life of a component. A preliminary design analysis is useful to identify possible failure modes and eliminate them or reduce their effect on reliability. When prototypes are available, in-house laboratory reliability tests are run and initial reliability can be determined. Reliability testing is often continued into the initial production run and throughout the production lifetime as a continuing evaluation of the component. Collection of field data are possible when products are operating and data on their failures are available.

Pneumatic fluid power — Assessment of component reliability by testing —

Part 2:
Directional control valves

1 Scope

This part of ISO 19973 provides test procedures for assessing the reliability of pneumatic directional control valves by testing and the methods of reporting the results of testing. General test conditions and the calculation method are provided in ISO 19973-1. The methods specified in ISO 19973-1 apply to the first failure, as obtained with the three-points moving average (*3PMA*) method, without repairs, but excluding outliers.

The lifetime of pneumatic and electro-pneumatic directional control valves is usually given as a number of cycles. Therefore, whenever the term “time” is used in this part of ISO 19973, this variable is to be understood as cycles.

This part of ISO 19973 also specifies test equipment and threshold levels for tests to assess the reliability of pneumatic directional control valves.

2 Normative references

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

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 8778, *Pneumatic fluid power — Standard reference atmosphere*

ISO 19973-1, *Pneumatic fluid power — Assessment of component reliability by testing — Part 1: General procedures*

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

IEC 60050-191, *International Electrotechnical Vocabulary, chapter 191: Dependability and quality of service*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5598, ISO 19973-1 and IEC 60050-191 apply.

NOTE Where a conflict of definitions exists for a term in any of these three documents, the following priority order applies: first, ISO 19973-1; second, ISO 5598; and third, IEC 60050-191.

4 Symbols and units

Units of measurement shall be in accordance with ISO 80000-1.

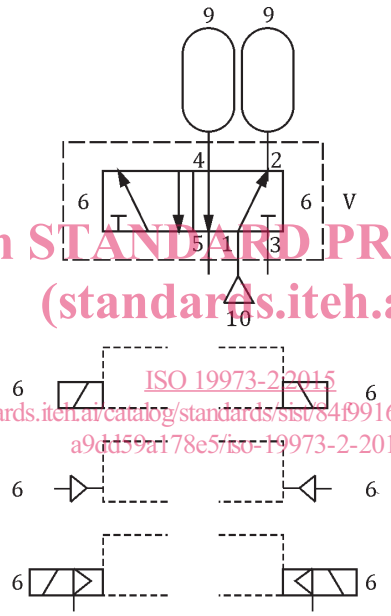
NOTE Graphical symbols used in this part of ISO 19973 conform to the requirements given in ISO 1219-1.

5 Test equipment

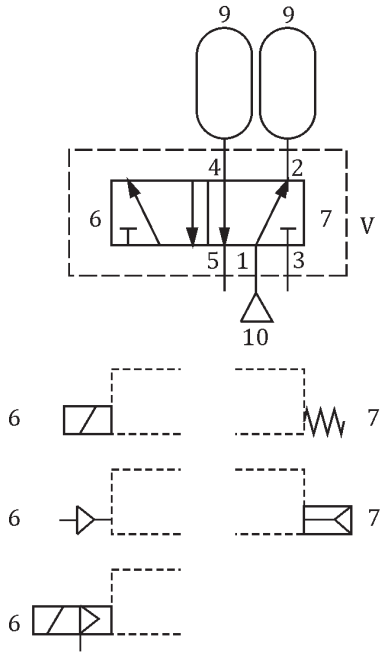
5.1 Basic test equipment

Basic test equipment shall conform to the requirements given in Figure 1. Any silencers fitted to exhaust ports shall not restrict the valve's flow rate.

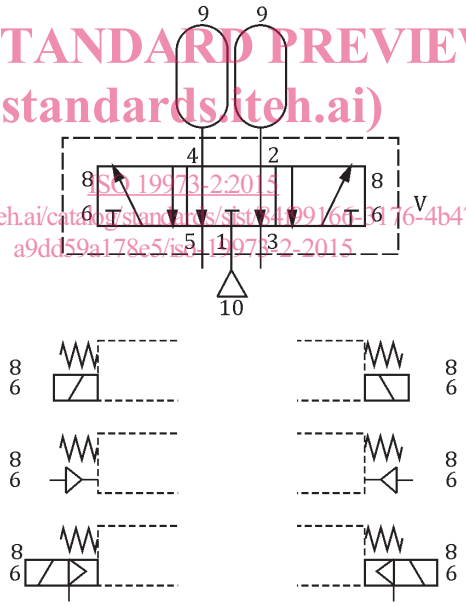
The basic circuits in Figure 1 do not incorporate all the safety devices necessary to protect against damage in the event of component failure. It is important that those responsible for carrying out the test give due consideration to safeguarding both personnel and equipment.



a) Two-position bi-stable valves



b) Two-position mono-stable valves with spring or air return



c) Three-position valves

Key

1 to 5	ports	9	volume
6	control signal: electrical, pneumatic, or pilot operated	10	supply pressure to port 1
7	spring or air-spring return	V	valve being tested
8	spring return to centre position		

NOTE The pilot supply can be either internal or external as long as it has the capability described in 7.2.

Figure 1 — Basic test equipment requirements

5.2 Connecting piping and volume

5.2.1 Connect the volume to the outlet ports of the test units either directly or by means of sections of tubes, in a manner that does not restrict flow.

NOTE Volume sizes are given in ISO 19973-1.

5.2.2 Tubes in the connecting lines shall be kept as short as possible so that the volumes can be charged and vented within the times provided by the control signal.

5.3 Simultaneous operation of multiple pneumatically operated valves

When testing pneumatically operated valves, several test units may be operated simultaneously from one control valve. In doing so, the control pressure described in 6.3.1 shall be applied to all test units.

6 Test conditions

6.1 General test conditions

The general test conditions shall be in accordance with ISO 19973-1.

6.2 Initial condition

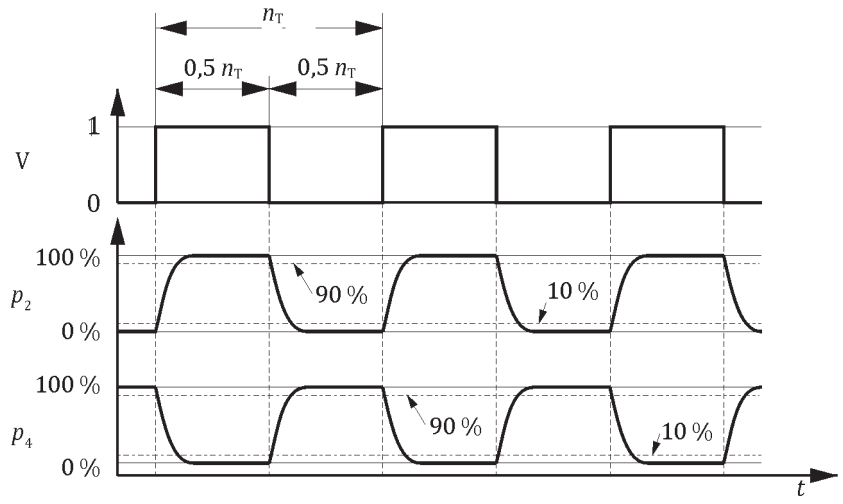
All new test units shall pass a functional check (see 7.2) and the initial test data shall not exceed the threshold levels defined in this part of ISO 19973.

6.3 Cycling frequencies

6.3.1 Actuate the test valves in a manner to ensure that the pressure in the outlet port volumes drops below 10 %, and rises above 90 %, of the supply pressure during the cycle.

6.3.2 The ratio between the actuation-impulse on/off times shall be 1:1.

6.3.3 For mono-stable two-position valves, the control signal shall be applied in accordance with Figure 2.

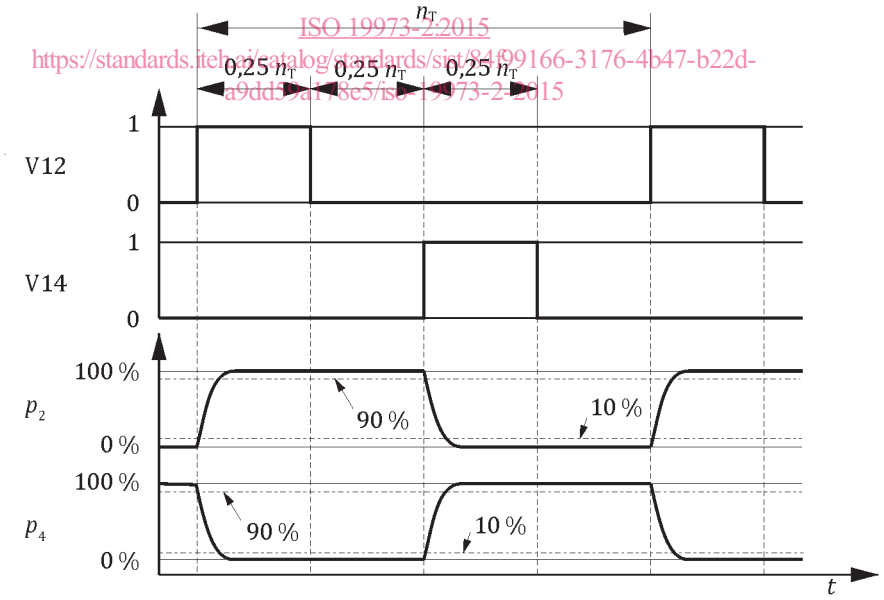


Key

V	valve control signal	0	control valve signal OFF
t	time	n_T	cycle time
1	control valve signal ON	p_2, p_4	pressure in the outlet port volumes

Figure 2 — Control signal for mono-stable two-position valves

6.3.4 For bi-stable and three-position valves, the control signal shall be applied in accordance with Figure 3.



Key

V12, V14	valve control signals	0	control valve signal OFF
t	time	n_T	cycle time
1	control valve signal ON	p_2, p_4	pressure in the outlet port volumes

NOTE Outlet pressure is shown as an example for a bi-stable two-position valve.

Figure 3 — Control signal for bi-stable and three-position valves