
**Pneumatic fluid power — Assessment
of component reliability by testing —**

**Part 4:
Pressure regulators**

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

Partie 4: Régulateurs de pression

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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).

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 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 19973-4:2007), 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*

The following part is under preparation:

- *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. Within the ISO 19973 series, this part is intended to provide requirements and test conditions that permit the assessment of the inherent reliability of pneumatic pressure regulators.

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 is possible when products are operating and data on their failures are available.

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Pneumatic fluid power — Assessment of component reliability by testing —

Part 4: Pressure regulators

1 Scope

This part of ISO 19973 provides test procedures for assessing the reliability of pneumatic pressure regulators 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 pressure regulators is usually given as a number of cycles. Therefore, whenever the term “time” is used in this part of ISO 19973, this variable shall be understood as either cycles or time.

This part of ISO 19973 applies to manually adjustable and remote-piloted pressure regulators, both relieving and non-relieving. This part of ISO 19973 does not apply to pressure regulators that have a permanent bleed.

This part of ISO 19973 also specifies test equipment and failure criteria (threshold levels) for tests to assess the reliability of pneumatic pressure regulators.

The life determined by the method in this part of ISO 19973 and in ISO 19973-1 will be more closely related to applications that have a large variation in flow rate.

NOTE See [Annex A](#) for a flow chart illustrating the test procedure specified in this part of ISO 19973.

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 6953-1, *Pneumatic fluid power — Compressed air pressure regulators and filter-regulators — Part 1: Main characteristics to be included in literature from suppliers and product-marking requirements*

ISO 6953-3, *Pneumatic fluid power — Compressed air pressure regulators and filter-regulators — Part 3: Alternative test methods for measuring the flow-rate characteristics of pressure regulators*

ISO 19973-1:—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*

1) To be published. (Revision of ISO 19973-1:2007)

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5598, ISO 6953-1, ISO 19973-1, and IEC 60050-191 apply.

NOTE Where a conflict of definitions exists for a term in any of these four documents, the following priority order shall apply: first, ISO 19973-1; second, ISO 6953-1; third, ISO 5598; and fourth, IEC 60050-191.

4 Symbols and units

4.1 The units of measurement are in accordance with ISO 80000-1.

4.2 The graphic symbols used in this part of ISO 19973 conform to the requirements of ISO 1219-1.

5 Test equipment

5.1 Basic test equipment

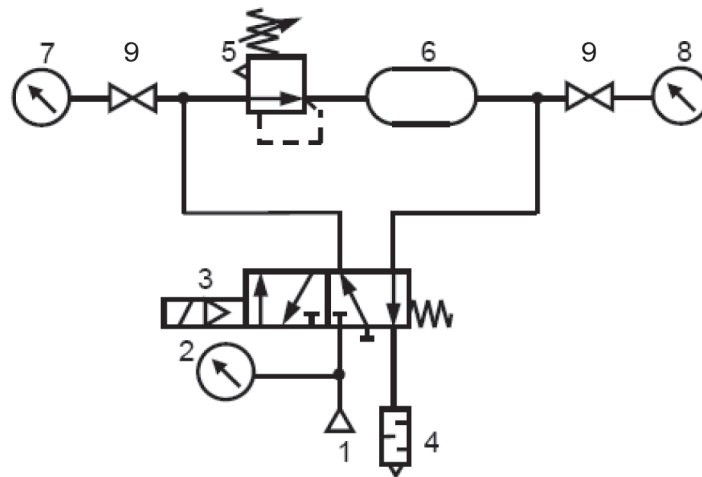
5.1.1 Each pressure regulator to be tested (test unit) shall be installed in a test circuit that includes the components shown in either [Figure 1](#) or [Figure 2](#). Multiple test circuits can use the same source of compressed air; if this is the case, each test circuit shall be composed of identical components. [Annex B](#) describes an optional expanded test circuit that incorporates additional components to isolate measuring instruments.

[Figure 1](#) illustrates a basic circuit that does 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.

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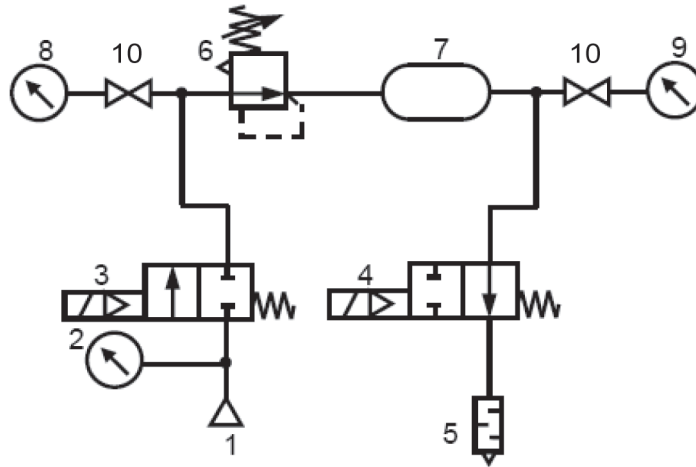
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**Key**

- 1 supply
- 2 pressure gauge for measuring pressure, p_1
- 3 five-port, two-position directional control valve
- 4 silencer
- 5 pressure regulator under test (i.e. test unit) (example)
- 6 volume
- 7 pressure gauge or transducer for measuring pressure, p_2
- 8 pressure gauge or transducer for measuring pressure, p_3
- 9 shut-off valve or quick-action coupling

Figure 1 — Test circuit

5.1.2 An alternative test circuit in accordance with [Figure 2](#) can also be used, if the five-port, two-position directional control valve (key item 3 in [Figure 1](#)) is too large. In this circuit, the two-port, two-position directional control valves shall be operated simultaneously.



Key

- 1 supply
- 2 pressure gauge for measuring pressure, p_1
- 3 two-port, two-position directional control valve (NC, normally closed)
- 4 two-port, two-position directional control valve (NO, normally open)
- 5 silencer
- 6 pressure regulator under test (example)
- 7 volume
- 8 pressure gauge or transducer for measuring pressure, p_2
- 9 pressure gauge or transducer for measuring pressure, p_3
- 10 shut-off valve or quick-action coupling

Figure 2 — Alternative test circuit

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5.1.3 If the body of the test unit has ports of two or three different sizes, use the largest port size.

5.1.4 Before installing the test units, perform a forward flow test on them in accordance with ISO 6953-3. Determine the forward sonic conductance, C_f , of each test unit in accordance with ISO 6953-3.

5.1.5 Install pressure measuring instruments (gauges or transducers) into the test circuit as shown in Figure 1 (key items 2, 7, and 8) or Figure 2 (key items 2, 8, and 9), using either quick action couplings or shut-off valves (key item 9 in Figure 1 and key item 10 in Figure 2).

5.2 Directional control valve

An external pilot type or direct-operated type of directional control valve is used in the test circuit. The sonic conductance, C , of the directional control valve used shall be greater than or equal to the C_f value measured for the test unit in 5.1.4. The size of the directional control valve shall also ensure that the requirements of 7.3.1 b) will be fulfilled.

5.3 Volumes

Volumes 6 or 7, in Figures 1 and 2 respectively, shall be sized as described in Table 3 of ISO 19973-1:—.

6 Test conditions

6.1 General test conditions

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