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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

[Revision of first edition (ISO 19973-4:1997)]

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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.

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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 19973-4 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Working Group 4, *Pneumatic component reliability.*

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. Within the ISO 19973 series, this part 4 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.

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 part 1 of ISO 19973. The methods specified in that part of ISO 19973 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 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 1219-1, *Fluid power systems and components — Graphic symbols and circuit diagrams — Part 1: Graphic 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 6953-3:201X, *Pneumatic fluid power — Compressed air pressure regulators and filter-regulators — Part 3: Alternative test methods for measuring the flow-rate characteristics of pressure regulators* (to be published)

ISO 19973-1:201X, *Pneumatic fluid power — Assessment of component reliability by testing—— Part 1: General procedures* (to be published)

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 6953-1, ISO 19973-1, and IEC 60050-191 apply. 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.

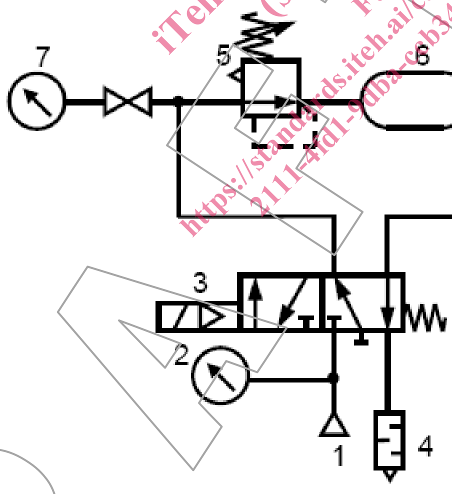
5 Test equipment

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 may use the same source of compressed air; if this is the case, each test circuit shall be composed of identical components.

NOTE 1 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.

NOTE 2 Annex B describes an optional, expanded test circuit that incorporates additional components to isolate measuring instruments.



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)

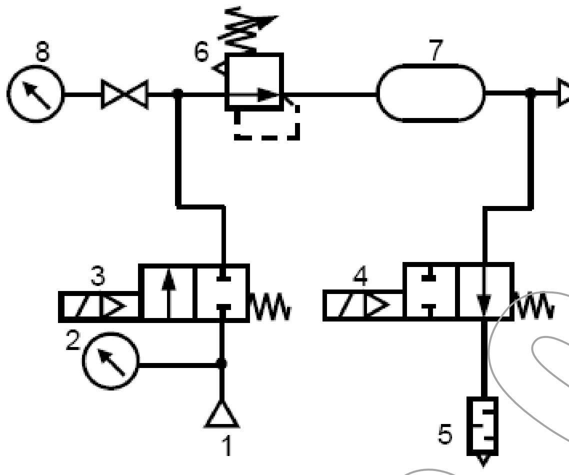
6 volume

7 pressure gauge or transducer and shut-off valve or quick-action coupling for measuring pressure p_2

8 pressure gauge or transducer and shut-off valve or quick-action coupling for measuring pressure p_3

Figure 1 — Test circuit

5.1.2 An alternative test circuit in accordance with Figure 2 may also be used, if the five-port 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.



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1 supply

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8 pressure gauge or transducer and shut-off valve or quick-action coupling for measuring pressure p_2

9 pressure gauge or transducer and shut-off valve or quick-action coupling for measuring pressure p_3

Figure 2 — Alternative test circuit

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 6.3.3 of ISO 6953-3:201X. *(Note to secretary: change these to ISO 6953-2 if necessary, at the FDIS stage.)*

5.1.5 Install pressure gauges or pressure-recording devices into the test circuit, using either quick-action couplings or shut-off valves (see Figure 1, key items 4 and 6, and Figure 2, key items 7, 8 and 9).

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 Connecting piping and volumes

The piping between the inlet and outlet sides of the regulator and the directional control valve shall have a conductance approximately equal to that to the test unit. Volumes 6 or 7, in figures 1 or 2 respectively, shall be sized as described in 8.5 and Table 3 of ISO 19973-1:201X.