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ISO TC 131/SC 5/WG 5

Secretariat: AFNOR

**Pneumatic fluid power — Compressed air pressure regulators and filter-regulators —
Part 2: Test methods to determine the main characteristics to include in supplier's
literature**

*Transmissions pneumatiques — Régulateurs de pression et filtres-régulateurs pour air comprimé
— Partie 2: Méthodes d'essai pour déterminer les principales caractéristiques à inclure dans la
documentation des fournisseurs*

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

This third edition cancels and replaces the second edition (ISO 6953-2:2015), which has been technically revised.

The main changes are as follows:

- addition of new paragraph for an additional test for relief flow rate (7.3.3);
- addition of new paragraph for a test for resolution in case of pressure-pilot air pressure regulator (10.3);

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- **addition of** new detailed test procedure for repeatability test for manual air-pressure regulator and pilot pressure air-pressure regulator (10.5);
- **addition of** measure of the sensitivity ~~added~~.

A list of all parts in the ISO 6953 series can be found on the ISO website.

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.

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Introduction

In pneumatic fluid power systems, power is transmitted and controlled through a gas under pressure within a circuit.

When pressure reduction or pressure regulation is required, regulators and filter-regulators are components designed to maintain the pressure of the gas at an approximately constant level.

It is therefore necessary to know the performance characteristics of these components in order to determine their suitability in an application.

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Pneumatic fluid power — Compressed air pressure regulators and filter-regulators — Part 2: Test methods to determine the main characteristics to include in supplier's literature

1 Scope

This document specifies test procedures and a method of presenting the results concerning the parameters which define the main characteristics to be included in the literature from suppliers of regulators and filter-regulators conforming to ISO 6953-1.

The purpose of this document is to:

- facilitate the comparison of pressure regulators and filter-regulators by standardizing test methods and presentation of test data;
- assist in the proper application of pressure regulators and filter-regulators in compressed air systems.

The tests specified are intended to allow comparison among the different typetypes of regulators and filter-regulators; they are not production tests to be carried out on each pressure regulator or filter-regulator manufactured.

ISO 6953-3 can be used for as an alternative dynamic test method for flow-rate characteristics using an isothermal tank instead of a flow meter. However, this method measures only the decreasing flow rate part of the hysteresis curve of forward flow and relief flow characteristics.

NOTE 1— The tests related to electro-pneumatic pressure control valves are specified in ISO 10094-2.

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 3448, *Industrial liquid lubricants— ISO viscosity classification*

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*

ISO 6953-1:2015-1, *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*

¹ Under preparation. Stage at the time of publication: ISO/FDIS 6953-1:2023.

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ISO 10094-1, Pneumatic fluid power — Electro-pneumatic pressure control valves — Part 1: Main characteristics to include in the supplier's literature

3 Terms and definitions

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For the purposes of this document, the terms and definitions given in ISO 5598, ISO 6358-1, ISO 6953-1, and ISO 10094-1, and apply.

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

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

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

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3 Symbols and terms

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3.2.4 Symbols and units

The symbols and units used in this document are shown in Table 1.

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Table 1 — Symbols and units

Description	Symbol	SI unit	Practical unit
Reference atmosphere	p_{atm}	Pa	kPa or bar
Inlet pressure	p_1	Pa	kPa or bar
Regulated pressure	p_2	Pa	kPa or bar
Pilot pressure	w	Pa	kPa or bar
Forward volumetric flow rate at standard reference atmosphere	q_{vf}	m ³ /s (ANR)	dm ³ /min (ANR)
Relief volumetric flow rate at standard reference atmosphere	q_{vr}	m ³ /s (ANR)	dm ³ /min (ANR)
Sonic conductance	C_f	kg / (s.Pa) (ANR)	m ³ / (s.Pa)(ANR)
Reference temperature	T_0	K	°C
Inlet temperature	T_1	K	°C
Temperature at the regulated port	T_2	K	°C
Hysteresis	H	-	% FS
Resolution	S	-	% FS
Output resolution	S_o	-	% FS
Sensitivity	m	-	Pa/Pa or Pa/number of turns of control knob
Repeatability	r	-	% FS

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Key

ANR standard reference atmosphere (see ISO 8778)

FS full scale

NOTE 1 bar = 100 kPa = 0,1 MPa = 10⁵ Pa = 10⁵; 1 MPa = 1 N/mm²

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4.5 Test conditions

4.4.5.1 Gas supply

Unless otherwise specified, testing shall be conducted with compressed air. If another gas is used, it shall be noted in the test report.

4.4.5.2 Temperature

The ambient fluid and the component under test shall be maintained at 23 °C ± 10 °C during all the tests.

4.4.5.3 Pressures

The specified pressures shall be maintained within ±2 %.

4.4.5.4 Inlet pressure

The inlet pressure used for testing shall be the lower of the following pressures:

- the maximum regulated pressure, $p_{2,max}$, plus 200 kPa (2 bar);
- the specified maximum inlet pressure, $p_{1,max}$.

4.4.5.5 Test pressures (regulated pressure)

The preferential test pressures are chosen as approximately equal to 20 %, 40 %, 60 %, and 80 % of the upper limit of the recommended adjustable pressure range.

5.6 Test procedure to verify rated pressure

6.1 Perform this test on three random samples if a single-rated pressure is proposed for the entire product or on six random samples if separate ratings are proposed for the inlet and outlet sections. If the product uses a diaphragm, modify or replace it to withstand the pressure applied (diaphragms are excluded from the test criteria, but not the diaphragm support plates or any piston). Other product sealing means can be modified to prevent leakage and allow structural failure to occur during the test, but modifications shall not increase the structural strength of the pressure-containing envelope. For relieving regulators, the relieving system shall be blocked.

6.2 Prepare the test samples as follows:

- If a single pressure rating is proposed for the entire product, remove the control spring and replace it with a solid spacer whose length maintains the poppet in its approximately half-open position. Close the gauge ports and the inlet port with plugs, and perform all testing by applying pressure to the outlet port. For relieving regulators, the relieving system shall be blocked.

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b) If a separate pressure rating is proposed for the inlet and outlet sections of the regulator, relieve the control spring force on three of the samples. Using a proposed pressure rating for the inlet, perform testing on the inlet port, allowing the poppet to be closed and keeping the outlet port open. Prepare the other three samples as described in 6.2 a) and test them using a proposed pressure rating for the outlet port.

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6.3 The test shall be done with a liquid which does not exceed ISO VG 32 according to ISO 3448 or with compressed air. Maintain the temperature given in 5.2. When using a compressible medium, exercise safety precautions to contain an explosive failure.

6.4 After stabilizing the temperature, slowly pressurize to a level of one-half its proposed rated pressure. Hold at this level for 2 min and observe for leakage or failure, as defined in 6.5.

6.4.1 For products constructed of light alloys, brass, and steel, continue raising the pressure until a level of four times the proposed rated pressure has been reached.

6.4.2 For products constructed of zinc, die cast alloys, or plastics:

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- with design operating temperatures of up to 50 °C, continue raising the pressure until a level of four times the proposed rated pressure has been reached;
- with design operating temperature between 50 °C to 80 °C, continue raising the pressure until a level of five times the proposed rated pressure has been reached.

6.5 The ~~eriterion~~criteria for a failure ~~is are~~: a fracture, separation of parts, or a crack, or that which can allow enough liquid to pass across the pressure-containing envelope to wet the outer surface. Leakage across the port threads shall not constitute a failure, unless caused by a fracture or a crack.

6.6 The proposed rated pressure is verified if all three samples pass their respective tests.

6.7 Where a unit or sub-assembly in the unit (e.g. reservoir sight glass) is constructed of different materials, the higher appropriate factor should be used. The applied pressure can be restricted to the area of the interface between the different materials.

6.8 Where the pressure-containing envelope design is covered by a pressure vessel code in the market of sale, the requirements of that code take precedence over the requirements stated in this document.

6.7 Flow characteristics tests

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6.7.1 Test installation

A suitable test circuit as shown in Figure 1 shall be used for measuring forward or relief flow rates. This test circuit combines:

- the constant upstream pressure (in-line) test circuit, as described in ISO 6358-1 for characterizing the components with upstream and downstream pressure-measuring tubes and transition connectors (used for forward flow rate measurements), and