

Method of evaluating

Pneumatic valve positioners with input signal of 3 to 15 lbf/in² (Gauge)

Co-operating organizations

The Instrument Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

- British Clock and Watch Manufacturers' Association
- British Electrical and Allied Manufacturers' Association
- British Industrial Measuring and Control Apparatus Manufacturers' Association*
- British Iron and Steel Federation
- British Nautical Instrument Trade Association
- British Railways Board
- British Scientific Instrument Research Association*
- Council of British Manufacturers of Petroleum Equipment
- Electrical Research Association
- Electricity Council, the Central Electricity Generating Board and the Area Boards in England and Wales*
- Electronic Engineering Association
- Engineering Equipment Users' Association*
- Gauge and Tool Makers' Association
- Institution of Chemical Engineers
- Institution of Electrical Engineers
- Institution of Heating and Ventilating Engineers
- Institution of Mechanical Engineers
- Institution of Production Engineers
- Iron and Steel Institute
- Meteorological Office
- Ministry of Defence, Army Department
- Ministry of Health
- National Coal Board
- National Physical Laboratory (Ministry of Technology)
- Oil Companies Materials Association*
- Scientific Instrument Manufacturers' Association*
- Society of Instrument Technology*
- Water Resources Board
- Water-tube Boilermakers' Association

The scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

Ministry of Technology

This British Standard, having been approved by the Instrument Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 22 March 1967

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Foreword

This standard makes reference to the following British Standards:

BS 1523, *Glossary of terms used in automatic controlling and regulating systems*.

BS 1780, *Bourdon tube pressure and vacuum gauges*.

BS 2643, *Glossary of terms relating to the performance of measuring instruments*.

This British Standard has been prepared under the authority of the Instrument Industry Standards Committee as one of a series of standards dealing with the evaluation testing of process control instruments. One standard, already published, covers the testing of pneumatic transmitters BS 3512:1962, "*Method of evaluating the performance of pneumatic transmitters with 3 to 15 lbflin² (gauge) output*"; another one dealing with automatic controllers is nearing completion and further standards relating to electronic controllers and electronic transmitters are being prepared.

No attempt has been made to provide a form of grading or classification of valve positioners tested in accordance with this document; instead, requirements are laid down for the evaluation testing of positioners coming under the scope of the standard's title.

The methods of testing for various parameters of instrument performance which are detailed in this standard are intended for use by manufacturers in determining the performance of their equipment and by users or independent testing establishments in verifying manufacturers' performance specifications.

The specified conditions of test in this standard, e.g. the range of ambient temperatures, barometric pressures, electricity supply voltages and frequency relate to those which commonly arise in normal conditions of use. Consequently the values given should be employed where no other values are specified. The test conditions are not necessarily sufficient for instruments specifically designed for unusually arduous duties; conversely a restricted series of tests, eliminating or amending those in the standard which might be considered inappropriate, would serve adequately for instruments designed to perform within a more limited range of conditions.

With principles of evaluation testing as enumerated above it will be appreciated that the closest collaboration should be maintained between evaluator and manufacturer. Due notice should be taken by the evaluating facility of the manufacturer's specification for the equipment being tested, and the manufacturer should be invited to comment upon the results.

It is hoped that the introduction of standard evaluation tests will result in improved process control equipment. An indirect result should be an improvement in the content and form of specifications and trade literature; standardized presentation of manufacturers' claims for instrument performance would enable a better assessment of products to be made by users and should ultimately benefit both user and manufacturing interests. With this in mind it is the intention to supplement the series of British Standards for evaluating process control equipment with a standard layout for the presentation of performance data and test results.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 8 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This standard specifies tests designed to determine the performance of pneumatic valve positioners which accept input signals of 3 lbf/in² to 15 lbf/in².

NOTE Throughout this British Standard the term "valve operator" is used; alternative and equally appropriate terms used within industry are "valve motor" and "valve actuator".

Although some valve positioners may be tested without being fitted to a valve operator, there are some positioners which form an integral part of the operator and these cannot be separately tested. The method of evaluation described in this standard therefore specifies the use of a valve operator in all cases since this allows a ready comparison to be made between different types.

The operator may be a spring-opposed or double-acting diaphragm or piston.

2 Terminology

Terms used in the standard are in accordance with BS 2643¹⁾ and BS 1523²⁾. For the purposes of this standard the following terms and definitions have been adopted:

2.1 Dead zone

2.1.1

forward path dead zone

the largest change in input signal that can be effected without causing a detectable change in valve stem position

2.1.2

feedback path dead zone

the largest change in stem position that can occur without causing feedback

2.2

gain

the ratio of change in valve operator pressure to change in input pressure when the stem is not allowed to move. In the case of a double-acting operator, it is the ratio of the change in pressure difference between the two sides to the change in input pressure without position feedback

3 General testing procedure

3.1 For testing, valve positioners should be fitted to a valve operator acceptable for the purpose by the manufacturer of the positioner.

3.2 The valve operator should, where applicable, be of a size and rating that gives a stem movement of 2 in for a change in operator pressure from 3 lbf/in² to 15 lbf/in². If a stem movement of 2 in cannot be achieved, the nearest value to this should be used.

If necessary an alternative operator should be used to allow the positioner to be tested with its maximum recommended output pressure. Where a manufacturer specifies an operator pressure other than 3 lbf/in² to 15 lbf/in² then the specified range should be used. Valve positioners fitted with cams should be tested with input/output characteristics which are nominally linear.

3.3 The positioner and operator should be mounted on a test rig which shall be designed to make it possible to:

- 1) Carry out tests with variable, measurable friction on the stem. The friction may be measured, for example, by determining the force required to initiate stem movement when the operator pressure is constant.
- 2) Put different plug masses on the end of the stem.
- 3) Measure the stem position with an average error of less than 0.20 % and a repeatability of 0.1 % of the stroke of the valve.
- 4) Transmit the stem movement over a restricted range with a sensitivity of 0.10 % of the stroke and a response speed which allows the signal to follow the fastest motion of the valve without significant attenuation or lag.
- 5) For integrally mounted assemblies only, lock the stem at three positions so that its movement is less than 0.1 % of the span for maximum change in operator pressure (see 4.5 Note).

3.4 All tests should be done with covers in position.

3.5 Test gauges to BS 1780³⁾ should be used for pressure measurement.

3.6 Except where otherwise stated, the tests should be carried out under vibration-free conditions and between 15 °C and 20 °C.

3.7 The air supply pressure should be maintained to within ± 1 % of the value specified by the manufacturer and should not be subject to short term fluctuations. The supply of air should be such that it does not impair the dynamic performance of the equipment under test.

¹⁾ BS 2643, "Glossary of terms relating to the performance of measuring instruments".

²⁾ BS 1523, "Glossary of terms used in automatic controlling and regulating systems".

³⁾ BS 1780, "Bourdon tube pressure and vacuum gauges".