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Methods

Assessing the performance characteristics of ultrasonic flaw detection equipment —

Part 2: Electrical performance

Co-operating organizations

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

Associated Offices Technical Committee*	Engineering Equipment Users' Association
Association of Consulting Engineers	Gas Council
Association of Hydraulic Equipment Manufacturers	Institution of Civil Engineers
Association of Mining Electrical and Mechanical Engineers	Institution of Gas Engineers
British Chemical Plant Manufacturers' Association	Institution of Heating and Ventilating Engineers
British Compressed Air Society	Institution of Mechanical Engineers
British Electrical and Allied Manufacturers' Association*	Institution of Mechanical Engineers (Automobile Division)
British Gear Manufacturers' Association	Institution of Plant Engineers
British Internal Combustion Engine Manufacturers' Association	Institution of Production Engineers*
British Mechanical Engineering Confederation	Locomotive and Allied Manufacturers' Association of Great Britain
British Pump Manufacturers' Association	London Transport Executive
British Steel Industry*	Machine Tool Trades Association
Crown Agents for Oversea Governments and Administrations	Ministry of Defence*
Department of Employment and Productivity (H.M. Factory Inspectorate)	Ministry of Defence, Army Department*
Department of the Environment	National Coal Board*
Department of Trade and Industry*	National Physical Laboratory (Department of Trade and Industry)*
Department of Trade and Industry — National Engineering Laboratory*	Royal Institute of British Architects
Electricity Council, the Central Electricity Generating Board and the Area Boards in England and Wales*	Telecommunications Engineering Manufacturing Association
	Water Tube Boilermakers' Association*

The Government departments and 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.

Aluminium Federation	Ministry of Defence, Navy Department
British Chemical Engineering Contractors' Association	Non-destructive Testing Centre
British European Airways	Non-destructive Testing Society of Great Britain
British National Committee for Non-destructive Testing	Oil Companies' Material Association
British Non-ferrous Metals Federation	Scientific Instrument Manufacturers' Association
British Non-ferrous Metals Research Association	Society of British Aerospace Companies Ltd.
British Overseas Airways Corporation	Society of Motor Manufacturers and Traders Ltd.
Institute of Physics and The Physical Society	Society of Non-destructive Examination
Institution of Engineering Inspection	The Welding Institute
Lloyd's Register of Shipping	Tube Investments Ltd.
Ministry of Aviation Supply	United Kingdom Atomic Energy Authority

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Foreword

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 9,000, fully indexed and with a note of the contents of each, will be found in the BSI Catalogue which may be purchased from BSI Sales Department. The Catalogue may be consulted in many public libraries and similar institutions.

This standard makes reference to the following British Standards:

BS 204, *Glossary of terms used in telecommunication (including radio) and electronics.*

BS 205, *Glossary of terms used in electrical engineering.*

BS 2011, *Methods for the environmental testing of electronic components and electronic equipment.*

BS 3683, *Glossary of terms used in non-destructive testing.*

BS 3683-4, *Ultrasonic flaw detection.*

BS 4331-1, *Methods for assessing the performance characteristics of ultrasonic flaw detection equipment.*

BS 4331, *Overall performance.*

This British Standard, which is one of a series dealing with the non-destructive testing of engineering materials and components, has been prepared under the authority of the Mechanical Engineering Industry Standards Committee. During the preparation of this series of standards, it has become evident that ancillary standards are required for the test equipment and testing materials, and the purpose of this standard is to establish methods by which the electrical performance characteristics of ultrasonic flaw detection equipment can be assessed.

Whilst Part 1 of this standard establishes comparatively simple methods by which the overall performance of the equipment can be determined, this Part is particularly concerned with the functioning of the different units incorporated in the ultrasonic equipment, e.g. the transmitter, amplifier, time base circuits etc., and hence the electrical measurements required to assess their individual performance. The standard is, therefore, intended to provide methods by which both manufacturers and purchasers of ultrasonic equipment can check the electrical characteristics of an instrument. Consideration is being given to the preparation of a further Part dealing specifically with probe characteristics.

It is emphasized that the person responsible for assessing electrical performance characteristics should be fully conversant not only with the use of ultrasonic flaw detection equipment and the measuring instruments involved, but also with the significance of the parameters to be measured.

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

1.1 This British Standard describes methods for assessing the electrical performance characteristics of ultrasonic flaw detection equipment (excluding probes) and accordingly deals with the functioning of the transmitter (pulse generator), amplifier, time base and power supply.

1.2 Information concerning ancillary testing circuits and the measuring equipment required for carrying out the tests is given in respective appendices.

NOTE The titles of the British Standards referred to in this standard are listed on page ii.

2 Definitions

For the purposes of this British Standard, the definitions given in BS 3683-4 apply. Attention is also drawn to BS 204 and BS 205.

3 General

3.1 When carrying out the checks described in this standard, the equipment shall be operated in accordance with the manufacturer's instructions. It is recommended that the warming-up period prior to commencing the checks be not less than 15 minutes.

3.2 Attention is drawn to the fact that external electrical interference caused by other apparatus etc., might affect the performance of the equipment.

3.3 For environmental checks, reference should be made to BS 2011.

4 Transmitter pulses

This clause applies to uni-directional pulses only. For the measurements given in 4.3 to 4.8 inclusive, the transmitter shall be terminated in the non-reactive resistor as used in 4.1.1 2) and, wherever practicable, the checks shall be carried out with the instrument switched to double probe working. For the measurements given in 4.4 to 4.8 inclusive, the pulse repetition frequency shall be set to maximum.

4.1 Effective output impedance (Z_o)

4.1.1 *Instrument switched to double probe conditions (without probe)*

- 1) At the output socket of the equipment, measure the open circuit EMF on a calibrated cathode ray oscilloscope (V_1).
- 2) Terminate the output socket of the equipment directly with a non-reactive resistor whose value (R) is within $\pm 1\%$ of its nominal value, and measure the potential difference across this termination (V_2). It will be found convenient to use standard terminations of 50 Ω or 75 Ω and the value selected shall be noted.

- 3) Calculate the effective output impedance (Z_o) using the following formula:

$$Z_o = \frac{V_1 - V_2}{V_2} \times R$$

The above procedure shall be repeated to determine the effect of controls such as "pulse tuning", "pulse height" etc., on the effective output impedance of the equipment.

4.1.2 *Instrument switched to single probe conditions (without probe)*. The procedure described in 4.1.1 shall be repeated with the gain and attenuator controls set to give minimum and maximum sensitivity.

4.2 Pulse repetition frequency. The pulse repetition frequency shall be measured with the PRF control set at maximum and at minimum. If the instrument controls include a switched selection of pulse repetition frequencies, the PRF at each switch setting shall be measured.

NOTE In some equipment, the PRF may be linked to a range control and be continuously variable. In such cases, the number of measurements taken is at the discretion of the user.

4.3 Pulse amplitude. The peak amplitude of the pulse shall be measured on a calibrated cathode ray oscilloscope and recorded with the pulse repetition frequency set at maximum and at minimum.

4.4 Pulse shape. A photograph shall be taken of the pulse as displayed on a calibrated cathode ray oscilloscope. The graticule shall be visible on the photograph, and the time base and y deflection calibration settings used when the photograph is taken shall be recorded.

4.5 Rise time. The maximum interval between the instants at which the value of a pulse reaches 90 % and 10 % of its peak value shall be recorded in micro-seconds.

4.6 Decay time. The maximum interval between the instants at which the value of a pulse reaches 90 % and 10 % of its peak value shall be recorded in micro-seconds.

4.7 Pulse duration. The duration of the interval between the first and last instant at which the value of a pulse reaches 10 % of its peak amplitude shall be recorded in micro-seconds.

4.8 Stability (short term). For this check, a period equal to at least 10 pulses shall be displayed on the test oscilloscope, using a suitably slow time base setting. If there are noticeable variations in pulse amplitude and pulse spacing, these shall be estimated and recorded. Alternatively, the fact that there are no detectable variations shall be recorded.

NOTE This check is particularly relevant where very high pulse repetition frequencies are used.