BRITISH STANDARD

BS 5754:1987

Incorporating Amendment No. 1

Specification for

Electrical analogue and state signals for use in coal mines

Confirmed January 2011

UDC 622.489:621.398:621.3.037.3

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Mining and Quarrying Requisites Standards Committee (MQE/-) to Technical Committee MQE/25, upon which the following bodies were represented:

Association of British Mining Equipment Companies
British Coal
Council for Electrical Equipment for Flammable Atmospheres (BEAMA)
Health and Safety Executive

This British Standard, having been prepared under the direction of the Mining and Quarrying Requisites Standards Committee, was published under the authority of the Board of BSI and comes into effect on 27 February 1987

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The following BSI references relate to the work on this standard:
Committee reference MQE/25
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Amendments issued since publication

Amd. No.	Date of issue	Comments
6481	November 1990	Indicated by a sideline in the margin

Contents

Foreword

This revision of BS 5754 has been prepared under the direction of the Mining and Quarrying Requisites Standards Committee. It supersedes BS 5754:1980 which is withdrawn.

In this revision the opportunity has been taken to review the text in the light of experience. Terms such as "data transmission outstation" which in 1980 described the usual destination for analogue signals has been replaced by "signal measuring circuit" which is a better description of current and future practice.

The rapid growth of control and monitoring of activities below ground in coal mines has stimulated the development of many new types of apparatus giving intrinsically safe outputs in the form of electrical analogue or state signals. These outputs may be used for local indication/control or connected into other intrinsically safe apparatus. The design of the interconnected apparatus calls for a range of expertise that can only be supplied by a number of different manufacturers, each of whose apparatus has to be able to work effectively as part of a complete system for a mine. The purpose of this specification is to promote compatibility between interconnected apparatus of different manufacture.

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. Attention is drawn to the Health and Safety at Work etc. Act 1974, the Factories Act 1961, the Mines and Quarries Act 1954, the Regulations made under these Acts, and also any other appropriate statutory requirements or byelaws. These place responsibility for complying with certain specific safety requirements on the manufacturer and the user. The address of the recognized certification authority in the UK for Group I (coal mining) apparatus for intrinsic safety purposes is as follows:

Health and Safety Executive
HSE (M) Certification Support Unit
Harpur Hill
Buxton
Derbyshire SK17 9JN

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 6, an inside back cover 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.

Section 1. General

1 Scope

This British Standard specifies requirements for apparatus incorporating signal circuits intended to be certified intrinsically safe for use in coal mines and which have inputs or outputs, as appropriate, in the form of d.c. voltage analogue signals (type V), or state signals (type S).

It specifies those electrical input and output characteristics of signal sources and signal loads necessary to achieve operational compatibility and also to simplify design for compliance with the relevant standards for intrinsic safety.

Section 1 specifies the general requirements applicable to both types of signals. Sections 2 and 3 contain specific requirements for voltage analogue and state signals respectively.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard the following definitions apply.

2.1
powered device

an apparatus that requires an internal or external power source for the signal measuring circuit, e.g. a tape recorder is a powered signal measuring instrument

2.2
operational fault

a defect of any component or connection which affects the performance of the device

NOTE This should not be confused with faults affecting only the intrinsic safety of the device; these are defined in BS 5501-7.

2.3
galvanic connection

a continuous conducting d.c. path

2.4
safety coupler

a safety device that is used to limit the transfer of electrical energy between intrinsically safe circuits

2.5
safety barrier

a safety device that is used to limit the transfer of electrical energy from a non-intrinsically safe to an intrinsically safe circuit

3 Design

The signal input or output circuits shall comply with either:

a) BS 5501-7 for Group I category "ia" apparatus;

or

b) BS 1259, Class 1.

4 Power supplies

4.1 All apparatus requiring an external power supply shall be capable of working from either a power supply specified in BS 6182, or a non-intrinsically safe mains power supply having a voltage within the limits of + 10 % and – 25 % of the nominal value.

In the latter case, apparatus for use in a hazardous area shall be either housed in a flameproof enclosure, or afforded an alternative type of protection as specified in BS 5501.

NOTE The value of the mains voltage is not specified as a requirement of this standard. The preferred values are 120 V and/or 240 V, or 550 V and/or 1 100 V r.m.s. 50 Hz frequency.

4.2 Reversal of power supply polarity shall not damage the apparatus.

5 Interconnection via multicore cables[1)]

Analogue and state signals shall only be routed through multicore cables containing other circuits complying with this standard provided that either:

a) it is permitted by the certification documents;

or

b) connection is made by way of a safety coupler unit acceptable to a certifying authority for this usage.

NOTE Examples of safety couplers that have been used for this purpose are shown in Appendix A.

[1)] When the outputs from several signal circuits complying with this standard are to be carried in the same multicore cable, the intrinsic safety of the arrangement will need to be assessed under cable fault conditions on the basis that two or more power sources, each having a maximum open-circuit voltage of 22.4 V d.c., i.e. the maximum output voltage of a type 18 DC power supply complying with BS 6182, as specified in **9.3** and **10.3**, may be interconnected. The purpose of the safety coupler is to limit the maximum open-circuit voltage of the source, thereby permitting more than one source to be interconnected in any manner without degradation of intrinsic safety.
The requirements for the full assessment of faults in multicore cables are given in BS 5501-9.

6 Connection to non-intrinsically safe apparatus

Analogue signal sources shall only be connected to non-intrinsically safe apparatus provided that either:

a) it is permitted by the certification documents; or

b) connection is made by way of a safety barrier unit acceptable to a certifying authority for this usage and which is sited in a safe area, or is contained within a flameproof enclosure, or is afforded an alternative type of protection as specified in BS 5501.

7 Marking

Apparatus shall be marked with the number and date of this British Standard, i.e. BS 5754:1987[2)], followed by the type of signal, i.e. "type V", or "type S" as appropriate.

NOTE This is additional to any marking required by a certifying authority.

8 Documentation

The manufacturer/supplier of apparatus complying with this standard shall produce and make available such information as is necessary for the safe and correct use of the apparatus.

[2)] Marking BS 5754:1987 on or in relation to a product is a claim by the manufacturer that the product has been manufactured to the requirements of the standard. The accuracy of such a claim is therefore solely the manufacturer's responsibility. Enquiries as to the availability of third party certification should be addressed to the appropriate certification body.

Section 2. D.C. voltage analogue signals (type V)

9 Signal output circuit

9.1 The analogue signal shall be + 0.4 V at the zero or lowest point of the measured range and + 2.0 V at the highest point of the range. In addition, the common of the signal output circuit shall be referenced to 0 V of the power supply.

NOTE A signal offset of 0.4 V provides a means of distinguishing some operational faults (e.g. power supply failure) from a true zero indication.

9.2 The apparatus shall be designed such that operational faults shall cause the analogue output to fall to less than 0.2 V or to rise to greater than 2.2 V.

NOTE 1 Whilst it may not be possible to design the apparatus so that every type of fault will cause the output to fall below 0.2 V, or to rise above 2.2 V, the designer should aim to meet the requirement in the case of the majority of types of faults and, in particular, the types of faults most likely to occur.

NOTE 2 It is preferred that faults should cause the analogue output to fall to less than 0.2 V, rather than rise to greater than 2.2 V.

9.3 The open circuit voltage at the signal output terminals or between any signal output terminal and earth shall not exceed 22.4 V with any two faults (as defined in BS 5501-7).

9.4 The effective source resistance of the signal output circuit shall not exceed 50 Ω when connected to a load resistance of 1 000 Ω.

9.5 The signal output circuit shall have no galvanic connection to earth within the apparatus.

9.6 The manufacturer shall state the accuracy and output characteristic of the signal as a percentage of full scale, and the test conditions used.

NOTE The following test conditions are preferred:

a) connection to a load resistance of 1 000 Ω;

b) a power supply as specified in **4.1**;

c) an ambient temperature range of – 5 °C to + 40 °C;

d) a humidity up to 95 % r.h. normally not condensing. Any condensation which may form when the apparatus is first installed underground should not permanently affect its accuracy.

10 Signal measuring circuit

10.1 The resistance presented to the signal at its point of measurement shall be not less than 1 000 Ω.

10.2 Powered devices shall be designed so that with any two faults (as defined in BS 5501-7) the maximum open circuit voltage that can appear at the signal input terminals or between any terminal and earth does not exceed 22.4 V.

10.3 Each unearthed input lead of a powered device receiving the signal shall incorporate a resistance of not less than 1 000 Ω. Each resistor shall be infallible and be rated in accordance with BS 5501-7 for a maximum input voltage of 22.4 V.

Section 3. State signals (type S)

11 Signal output circuit

11.1 The state signal shall be either a fluctuating on-off (flashing) signal, or a continuous simple on or off signal.

11.2 The signal output circuit shall be separated from other circuits within the same apparatus by an infallible distance in accordance with BS 5501-7. The circuit shall have no galvanic connection to earth within the apparatus.

11.3 Where relay contacts are used, each shall have a minimum current rating of 100 mA d.c. and a minimum voltage rating of 22.4 V d.c. The contact resistance shall not exceed 250 mΩ at the rated current.

11.4 Where solid-state devices are used, the voltage drop in the closed condition shall not exceed 1.0 V at 20 mA and the current in the open condition shall not exceed 200 μA at 22.4 V.

11.5 A fluctuating state signal shall be an alternately open and closed circuit derived from relay contacts or solid-state devices. The normal state shall be indicated by a closed condition for 100 ± 20 ms at 15 ± 3 s intervals. An alarm or warning condition shall be indicated by a closed condition for 100 ± 20 ms at 500 ± 50 ms intervals. Where an intermediate early warning alarm is required, it shall be indicated by a closed condition for 100 ± 20 ms at 2 000 ± 200 ms intervals. All changes between open and closed circuit conditions shall take place in less than 5 ms.

NOTE As far as is reasonably practicable an operational fault condition should be indicated by a continuous open or a continuous closed condition.

11.6 To provide operational fault detection on external circuits each continuous on or off state signal circuit shall include, in series with one outgoing connection, a diode (or provision for fitting a diode) having a peak inverse rating of 200 V and a forward current rating of 1 A. Where changeover contacts are used there shall be provision for connecting diodes as shown in Figure 1.

NOTE The double-diode arrangement provides a means of distinguishing between two operational states.

12 Signal detection circuit

12.1 The maximum output current of the detection circuit shall not exceed 100 mA.

12.2 The detection circuit shall incorporate a resistor of not less than 100 Ω connected in each unearthed lead. Each resistor shall be infallible and shall be rated in accordance with BS 5501-7 assuming the voltage to be 22.4 V.

12.3 The detection circuit shall be designed so that with any two faults (as defined in BS 5501-7) the maximum open circuit voltage that can appear at the signal terminals or between any terminal and earth shall not exceed 22.4 V.

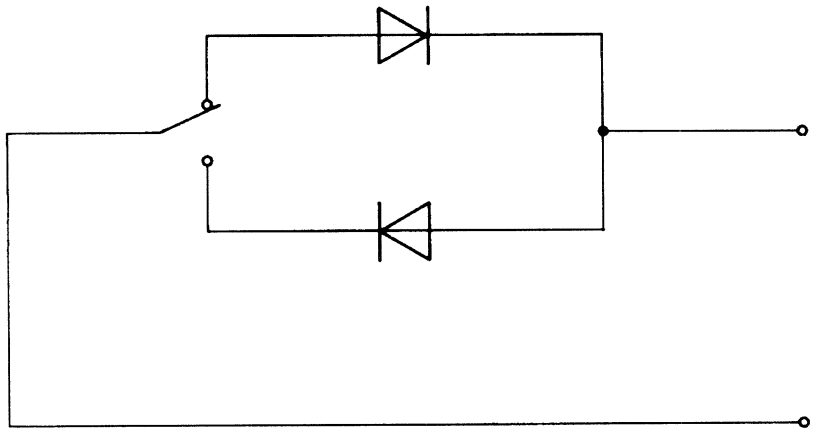
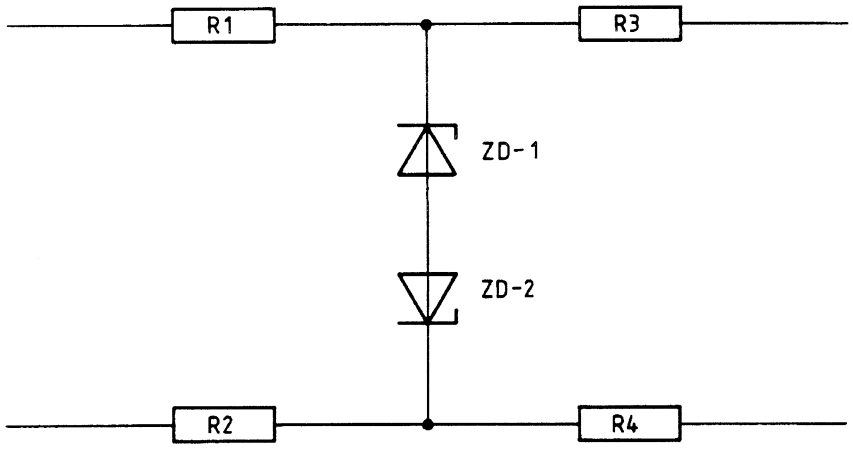


Figure 1 — Arrangement of detection diodes

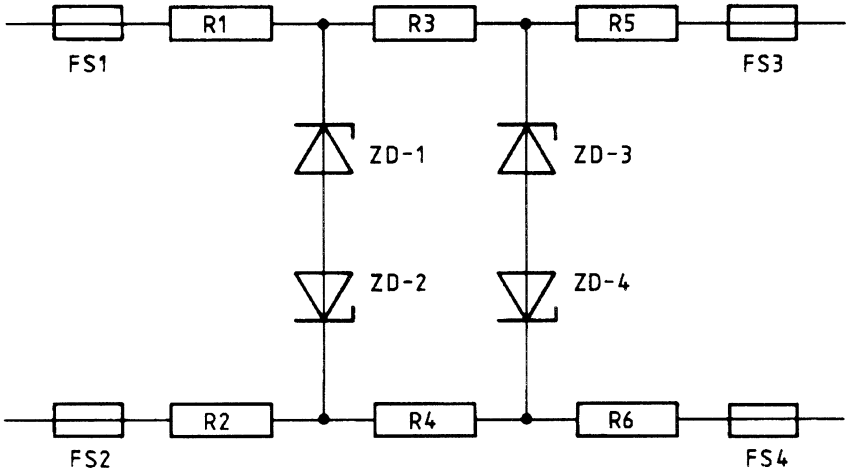
Appendix A Examples of safety couplers used where signals are routed through multicore cables

Type BB2



R1 to R4: 47 Ω ± 5 % 2W
Infallible resistor
ZD-1 to ZD-2: 5.6 V ± 5 % 5W
Zener diodes

Type BB5



FS1 to FS4: 150 mA fuse
R1, R2, R5, R6: 2.2 Ω ± 5 % 1 W
Infallible resistor
R3, R4: 5.6 Ω ± 5 % 1 W
Infallible resistor
ZD-1 to ZD-4: 5.6 V ± 5 % 5 W
Zener diodes

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Publications referred to

BS 1259, *Intrinsically safe electrical apparatus and circuits for use in explosive atmospheres.*
BS 5501, *Electrical apparatus for potentially explosive atmospheres.*
BS 5501-7, *Intrinsic safety "i".*
BS 5501-9, *Intrinsically safe electrical systems "i".*
BS 6182, *Intrinsically safe power supplies for use in coal mines.*
BS 6182-1, *Specification for d.c. power supplies.*
BS 6182-2, *Specification for a.c. power supplies.*
BS 6182-3, *Specification for rechargeable battery units.*

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