BRITISH STANDARD

BS 1646-2: 1983

Symbolic representation for process measurement control functions and instrumentation —

Part 2: Specification for additional basic requirements

Confirmed December 2011

UDC 53.08:681.2:003.62

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Industrial-process Measurement and Control Standards Committee (PCL/-) to Technical Committee PCL/4 upon which the following bodies were represented:

Association of Consulting Engineers

Beama Transmission and Distribution Association

British Industrial Measuring and Control Apparatus Manufacturers' Association (BEAMA)

Energy Industries Council

Institute of Measurement and Control

Institution of Gas Engineers

Ministry of Defence

This British Standard, having been prepared under the direction of the Industrial-process Measurement and Control Standards Committee, was published under the authority of the Board of BSI and comes into effect on
30 November 1983

The following BSI references relate to the work on this standard:
Committee reference PCL/4
Draft for comment 78/31228 DC

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Amendments issued since publication

Amd. No.	Date of issue	Comments

Contents

Foreword

This British Standard has been prepared under the direction of the Industrial-process Measurement Control Standards Committee and is technically equivalent to the International Organization for Standardization (ISO) draft international standard ISO/DIS 3511/2 *"Process measurement control functions and instrumentation — Symbolic representation, — Part 2: Extension of basic requirements"*.

The decision to publish now rather than await the publication of the corresponding ISO standard, recognises the urgent need of the industry for a standard with worldwide application based on an international text. It is anticipated that any differences with the finally published ISO version will be of a minor nature. This standard incorporates minor editorial corrections to the ISO draft which have been submitted by the British Member Body to the ISO Technical Committee.

For ease of production the text of the draft international standard has been used for this British Standard; some terminology and certain conventions are not identical with those used in British Standards.

Cross-reference

International standard	Corresponding British Standard
IEC 117	BS 3939 Graphical symbols for electrical power, telecommunications and electronic diagrams (Technically equivalent)

The rectangular symbols in accordance with IEC 117-15, referred to in clause **9**, are identical with those given in BS 3939-21.

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, 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.

0 Introduction

This British Standard has been devised to provide a universal means of communication among the various interests involved in the design, manufacture, installation and operation of measurement and control equipment used in the process industries.

Requirements within the industries vary considerably; in recognition of this, this British Standard is presented in several parts, as follows:

— *Part 1: Basic requirements (directed towards the needs of those employing comparatively simple measurements and control means);*

— *Part 2: Extension of basic requirements;*

— *Part 3: Detailed symbols for instrument interconnection diagrams;*

— *Part 4: Basic symbols for process computer, interface, and shared display/control functions*[1)].

The four parts together are intended to:

a) meet the requirements of those, possibly employing more sophisticated measurement and control means, who may wish to depict such aspects as the measurement techniques embodied in a particular instrument, or the means — hydraulic, pneumatic, electrical, mechanical — used for its actuation;

b) provide standard symbolic representation for process measurement control functions and instrumentation. These symbols are not intended to replace graphic symbols for electrical equipment as contained in IEC Publication 117.

1 Scope and field of application

This Part of BS 1646 is an extension of Part 1, which is limited to identification of instrument functions.

It includes additional symbols and is intended for the communication of measurement and control functions among instrument specialists and other engineers involved with vessels, piping, layout design and operation.

The symbols are used on piping and instrumentation diagrams and engineering line diagrams.

2 Reference

IEC 117-15, *Recommended graphical symbols; graphical symbols — Part 15: Binary logic elements.*

3 Definitions

The definitions given in BS 1646-1 equally apply to this Part of BS 1646.

The following definition also applies:

3.1
sensing element

that part of an instrument loop that first senses the value of a process variable and that assumes a predetermined and intelligible state or output

NOTE The sensing element may be separate from or integral with another functional element of a loop, but should be given an individual tag number only if it is separate.

Examples:

Where a direct-connected pressure transmitter has an integral pressure-sensitive element, the combined element and transmitter assembly shall be tagged PT.

Where an external pressure cell is connected to a transmitter, the pressure cell shall be tagged PE and the transmitter shall be tagged PT.

4 Letter code

4.1 Identifying letters

The function of the instrument shall be defined by a letter code included within the instrument symbol circle.

4.2 Basis for the letter code

The letter code is built up similarly to the letter code for basic symbols given in BS 1646-1 but the table extends the letters available for use.

[1)] At present at the stage of draft.

Table — Letter code for identification of instrument functions

NOTE Entries in normal type are identical with the entries in the Table of BS 1646-1. Entries in italics indicate the supplementary symbols.

1	2	3	4
	First letter[a]		Succeeding letter[a]
	Measured or initiating variable	Modifier	Display or output functions
A			Alarm
B			*Display of state* (e.g., motor running)
C			Controlling
D	Density	Difference	
E	All electrical variables[b]		*Sensing element*
F	Flow rate	Ratio	
G	Gauging, position or length		
H	Hand (manually initiated) operated		
I			Indicating
J		Scan	
K	Time or time programme		
L	Level		
M	Moisture or humidity		
N	User's choice[c]		*User's choice*[c]
O	User's choice[c]		
P	Pressure or vacuum		*Test-point connection*
Q	Quality[b] for example Analysis Concentration Conductivity	Integrate or totalise	Integrating or summating
R	Nuclear radiation		Recording
S	Speed of frequency		Switching
T	Temperature		Transmitting
U	Multivariable[d]		*Multifunction unit*
V	Viscosity		*Valve, damper, louvre, actuating element, unspecified correcting unit*
W	Weight or force		
X	Unclassified variables[c]		*Unclassified functions (for example cathode-ray tube)*
Y	User's choice[c]		*Computing relay, relay*
Z			Emergency or safety acting

[a] Upper case letters shall be used for the measured or initiating variable and succeeding letters for display or output function. Upper case letters are preferred for modifiers, but lower case letters may be used if this facilitates understanding.

[b] A note shall be added to specify the property measured.

[c] Where a user has a requirement for measured or initiating variables to which letters have not been allocated and are required for repetitive use on a particular contract, the letters allocated to "User's Choice" may be used provided that they are identified or defined for a particular measured or initiating variable and reserved for that variable. Where a user has a requirement for a measured or initiating variable that may be used either once or to a limited extent the letter X may be used provided that it is suitably identified or defined.

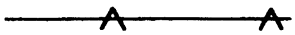
[d] The letter U may be used instead of a series of first letters where a multiplicity of inputs representing dissimilar variables feed into a single unit.

NOTE Where it is necessary to denote HIGH or LOW, the qualifying letters H or L may be used in association with the instrument symbol. Other letters may be used, for example for deviation, for rate of change, etc. but must be defined on the drawing rather than the table.

5 Instrument signal lines

5.1 Electric (E)

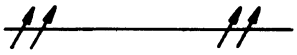
5.2 Pneumatic (A)



5.3 Hydraulic (L)

5.4 Capillary

5.5 Conducted radiation (radio waves, visible light)

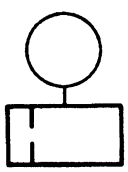


6 Primary elements, correcting elements, and actuating elements

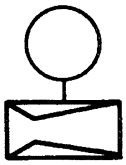
NOTE In cases where it is necessary to use detail symbols in functional diagrams the symbols should be as given in BS 1646-3, simplifying if possible. Examples are as follows.

6.1 Flow primary elements

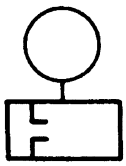
6.1.1 ***Orifice plate***



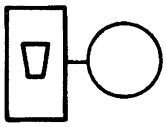
6.1.2 ***Venturi tube***



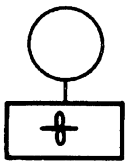
6.1.3 ***Nozzle***



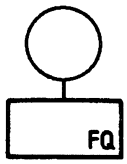
6.1.4 ***Variable area meter***



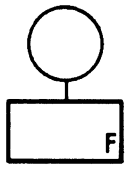
6.1.5 ***Turbine meter***



6.1.6 ***Volume meter – general***

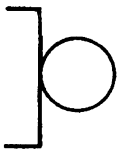


6.1.7 ***Any other flow primary element***

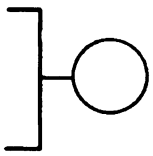


6.2 Level instrument connections

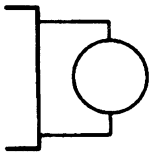
6.2.1 ***Integrally mounted instrument, for example welded-on type***



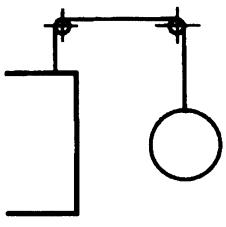
6.2.2 ***Instrument with single connection, for example internal-float type***



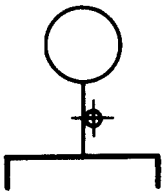
6.2.3 ***Instrument with two connections, for example external displacer type***



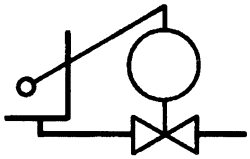
6.2.4 ***Tank gauge-float type***



6.2.5 ***Tank gauge-float type, top-mounted***

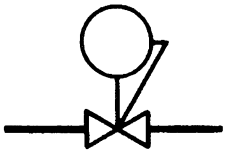


6.2.6 ***Level control valve — mechanical linkage***

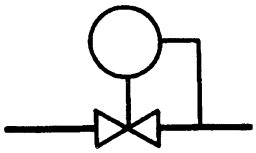


6.3 Pressure regulators, self-actuated

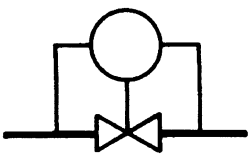
6.3.1 ***Pressure regulator with internal tap***



6.3.2 ***Pressure regulator with external tap***



6.3.3 ***Differential-pressure regulator with external taps***



6.4 Actuating elements

(where it is desired to show the type of actuating element)

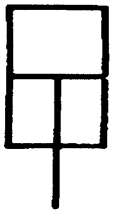
6.4.1 ***Diaphragm actuator***

6.4.2 ***Diaphragm actuator, pressure-balanced***

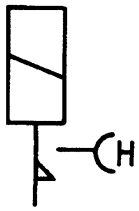
6.4.3 ***Rotary motor actuator***

6.4.4 ***Solenoid actuator (Preferred side relationship 1:2)***

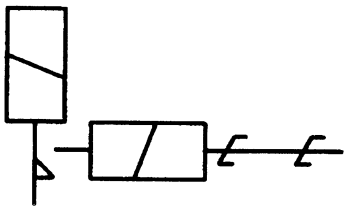
6.4.5 ***Piston actuator (Preferred side relationship 1:2)***



6.4.6 ***Solenoid actuator with reset (manual)***



6.4.7 ***Solenoid actuator with reset (remote electrical)***



7 Local control panels

Instruments on local control panels can be specified by an additional horizontal line across the symbol.

The particular panel can be identified by a note alongside the symbol, for example:

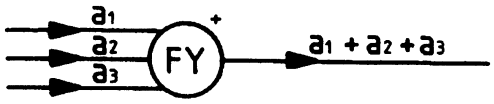
	Compressor	Pressure indicator on the compressor panel
	Services	Flow recorder on the services panel

8 Signal modifiers, analogue

Lower case letter designations (for example a1, a2, etc.) are standardized values of signals, shown for descriptive purposes only. They are not part of the symbol. Other arithmetic functions may be similarly treated. Upper case letters (for example Z) represent signals without specific values.

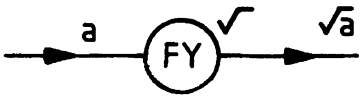
8.1 Addition

For example, flow signals



8.2 Root extraction (square root)

For example, flow signal

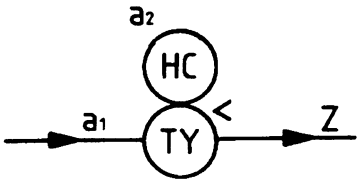


8.3 Limitation of output when a hand-set high-limit value is reached (same as selecting lower signal)

For example, temperature controller signal

when a1 < a2 then Z = a1

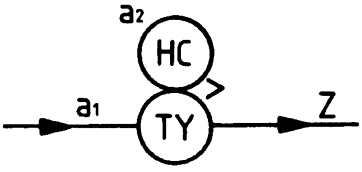
when a1 ≥ a2 then Z = a2



8.4 Limitation of output when a hand-set low-limit value is reached (same as selecting higher signal)

when a1 ≤ a2 then Z = a2

when a1 > a2 then Z = a1

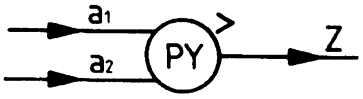


8.5 High-signal selector

For example, pressure signals

when a1 ≥ a2 then Z = a1

when a1 < a2 then Z = a2

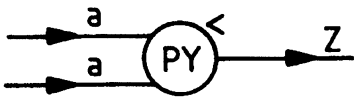


8.6 Low-signal selector

For example, pressure signals

when a1 > a2 then Z = a2

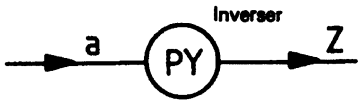
when a1 ≤ a2 then Z = a1



8.7 Reversing relay

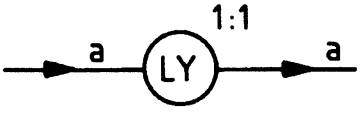
For example, pressure signal

Z = 1 – a



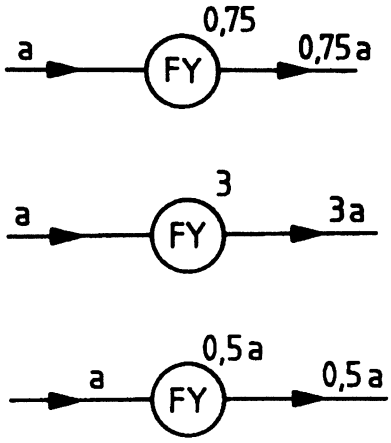
8.8 Volume booster

For example, level controller signal



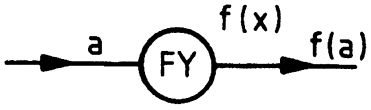
8.9 Gain or attenuation relay

For example, flow signals



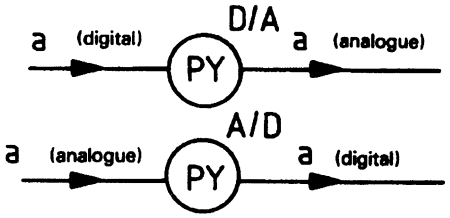
8.10 Characterizing relay f (x)

For example, flow signal



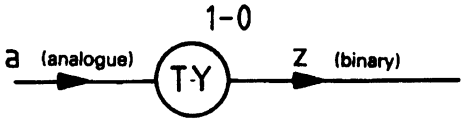
8.11 Digital-to-analogue or analogue-to-digital signal converter

For example, pressure signals



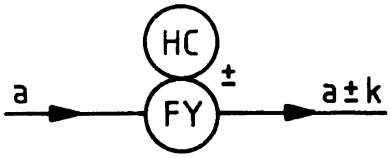
8.12 On-off relay 1-0

For example, temperature analogue input signal with binary output signal



8.13 Bias relay ±, + or –, representing relays respectively for plus-or-minus adjustability, for addition, or for subtraction.

For example, flow signal, with adjustable plus or minus bias, k



9 Binary logic

The basic elements are "and", "or", "not" and "delay elements" and these shall have rectangular symbols in accordance with IEC 117 15.

10 Action of binary signals on analogue signals

When an input analogue signal A is influenced by a binary signal B, the output analogue signal Z can

a) retain the last value; or

b) assume a predetermined minimum value; or

c) assume a predetermined maximum value; or

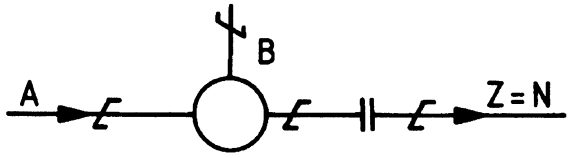
d) assume some other predetermined value.

This may occur in both the 1-state and the 0-state of the binary signal. Diagrams are shown with electrical signals but are otherwise typical for all signals.

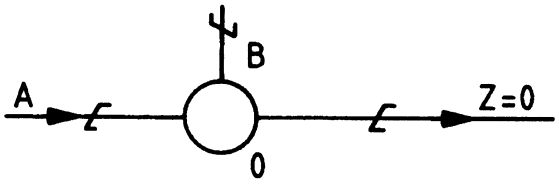
Where "A", "Z", etc., appear in the examples, they are not a part of the symbol. They are there for clarity of the symbol.

10.1 When B = 1, then Z = A. When B = 0, then there are four possibilities as follows:

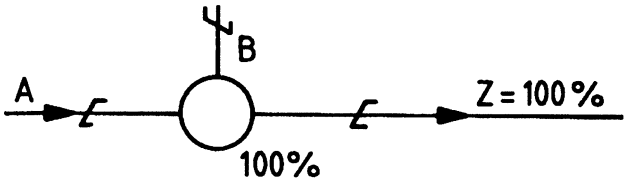
10.1.1 ***Z retains the last momentary value (N)***



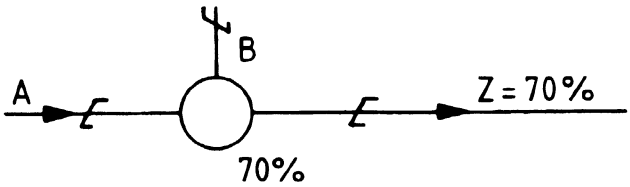
10.1.2 ***Z assumes the minimum value***



10.1.3 ***Z assumes the maximum value***

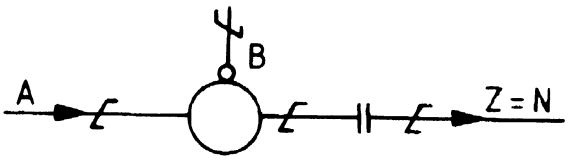


10.1.4 Z assumes a predetermined value, for example 70 %

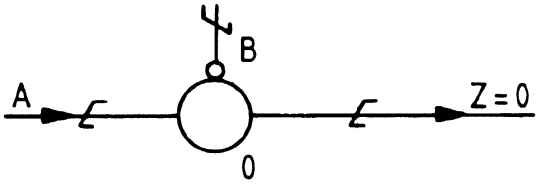


10.2 When B = 0, then Z = A. When B = 1, then there are four possibilities, as follows:

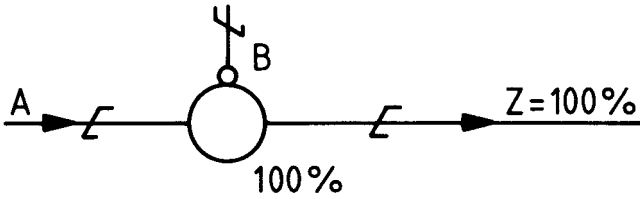
10.2.1 ***Z retains the last momentary value N***



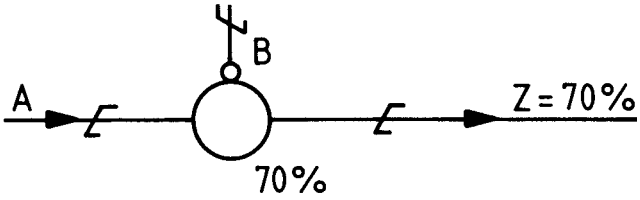
10.2.2 ***Z assumes the minimum value***



10.2.3 ***Z assumes the maximum value***



10.2.4 Z assumes a predetermined value, for example 70 %



Publications referred to

BS 1646, *Symbolic representation for process measurement control functions and instrumentation.*
BS 1646-1, *Basic requirements.*
BS 1646-3, *Specification for detailed symbols for instrument interconnection diagrams.*

See also foreword.

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