BRITISH STANDARD

BS 5070-3: 1988

Engineering diagram drawing practice —

Part 3: Recommendations for mechanical/fluid flow diagrams

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British Paper and Board Industry Federation (PIF)
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British Standards Society
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Foreword

This part of BS 5070 has been prepared under the direction of the General Mechanical Engineering Standards Committee and, together with Part 1 and Part 2*, supersedes BS 5070:1974 which is now withdrawn. The 1974 edition set out recommendations for drawing practice to be followed in preparing engineering diagrams in all fields of engineering with a view to securing uniformity between one drawing office and another in the same industry. It also aimed to increase uniformity between one field of engineering and another in the basic principles involved and in the designations for different types of diagram.

Attention is drawn to BS 5070 being a companion standard to BS 308; the latter covers engineering drawing practice used in a wide range of engineering disciplines. Commonly, as a diagram can be called a "drawing" and a drawing can be called a "diagram", it is useful to summarize the difference in the scopes of these standards. BS 308 covers what are commonly accepted to be drawings that define shape, size and form. BS 5070 covers the drawing of diagrams that are normally associated with flow of one sort or another and which relate components (usually indicated by symbols) functionally one to another by the use of lines, but do not depict their shape, size or form; neither do they in general indicate physical connections or locations.

From experience with the 1974 edition it was decided that for this first revision, whilst bearing in mind the long term aim of uniformity of conventions, there was a need for more comprehensive treatment of the varying requirements of differing industries and for more careful attention to their presentation. BS 5070 is therefore now revised in parts by which the practice and conventions of several disciplines and industries are collected into three groups. Part 1 covers general principles common to all subsequent parts, which in turn deal particularly with electrotechnology; mechanical and fluid flow and systems; and logic.

This standard gives recommendations for the drawing of engineering diagrams using the symbols given in relevant British Standards. It does not itself originate symbols. The diagrams in this standard contain symbols as they appear in the particular standards current at the time this publication was prepared. However, although every effort has been made to ensure that correct and current symbols have been used, it has to be recognized that the particular symbols standards are themselves subject to periodic review. It is therefore stressed that the relevant symbols standards, and not this standard, have to be consulted to obtain definitive symbols.

The recommendations of this standard have been established having regard to the requirements of microfilming. Diagrams prepared in accordance with this standard should be suitable for microfilming and reduced-size reproduction techniques.

During the course of this revision particular attention has been paid to developments in computer aided machine draughting and it has been established that such machines are currently capable of complying with this standard. Any minor exceptions due to the limitations of a particular system would not be expected to prejudice the understanding of a diagram otherwise claimed to comply with this standard.

It is recognized that though this standard is published in a number of parts, there may be instances when certain recommendations and descriptions are repeated. This has been kept to a minimum and it is hoped that all the needs of any specialized engineering discipline are contained in the part of this standard that deals with those specific needs.

This part of this standard deals with a variety of non-electrical diagrams including control and flow; transfer of materials (both fluids, i.e. liquids, vapours and gases, and solids); and energy transfer (hydraulic, pneumatic and mechanical).

* An additional Part 4 is also in preparation

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Part 1 of this standard deals with general principles of diagram drawing and is the base document. Part 2 of this standard deals with all forms of diagrams in electrical, electronics and telecommunications engineering. Part 4 of this standard deals with logic diagrams.

Engineering diagrams are a major factor in the development of a project. They are used either to build complex engineering plants or the smallest item of equipment.

It is important that the information contained should be complete, easily understood and maintained in an up-to-date condition. In the case of certified "as-built" diagrams a design change procedure is recommended for record and historic purposes. Such a procedure is the key to ensuring control of cost, time and technical accuracy for the project.

Sequencing or progression of diagrams can be variable. It is, however, recommended that guide lines be introduced at the commencement of a project to present the assembly of information, proceeding from one diagram to the other.

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

Notes on the presentation of this standard

NOTE 1 The figures illustrating the text in this standard are independent and each is selected solely for its simplicity and clarity to illustrate only the text to which it relates. They are not the only possible examples and they are not intended as design examples or to be fully working diagrams, but otherwise are drawn according to the basic recommendations of this standard.

NOTE 2 Numerical values of components given in the figures throughout are arbitrarily chosen to assist in illustrating the point under consideration; they are typical and are not given as recommendations.

NOTE 3 In the figures in this standard, a convention is adopted of using capital letters for notes that would appear as part of the drawing and lower case letters are used for notes explaining the point under consideration in relation to the text. An exception to this may be found in some diagrams where unit symbols are customarily written in lower case.

Summary of Pages

This document comprises a front cover, inside front cover, pages i to iv, pages 1 to 41 and a back cover.

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1 Scope

This part of BS 5070 gives recommendations for the practice to be followed in preparing mechanical, process and fluid flow diagrams. It covers all aspects of diagram representation except the choice of symbols for particular components; this is the subject of BS 1553 and other relevant standards giving symbols for specific industrial use.

This part of this standard should always be used in conjunction with BS 5070-1 and the relevant symbol standards when preparing mechanical, process and fluid flow diagrams.

NOTE 1 The relevant part of BS 5775 should be complied with for the correct application of units and symbols for quantities.

NOTE 2 British Standards detailing graphic symbols for use in engineering diagrams are listed in Appendix B.

NOTE 3 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Principal types of diagrams

The following list, covered by this part of BS 5070, is of the main classification of diagrams used by industry and has been prepared in order to reduce ambiguity and to achieve standardization in terminology:

a) Block diagram.

b) Flow/process diagram.

c) Circuit diagram (fluid).

d) Piping/system diagrams.

e) Piping and instrumentation line diagram (P and ID).

f) Installation diagram.

g) Supplementary diagram.

In complex plants it is desirable to prepare a hierarchy of diagrams whereby the user is guided through basic simple concepts down to detail information stages.

3 Principles of presentation

3.1 General

For the purposes of this part of BS 5070 a symbol is a symbolic graphic convention representing a discrete manufactured device contributing to the functioning of a system or circuit (see Appendix A.). A line is a graphic convention showing how devices (represented by symbols) are connected. A variety of types of line, some with embellishments, are used to represent connections having different functions. Table 1 shows typical applications of different line types.

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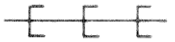
Table 1 — Types of line

Line	Description	General application	Particular application			Thickness mm
			Process engineering (e.g. chemical)	Pneumatic hydraulic (fluid)	Instrument control	
	Continuous double width	Primary link lines	Primary process pipelines	Main pressure pipelines	Single line representation	0.7 to 1.0
	Continuous single width	General contents of diagram	Secondary pipelines or plant outlines		Impulse lines	0.5
	Short dash	Secondary or hidden line		Control, vents or drains	Interconnect signal lines electrical*	0.5
	Short chain	Differentiating similar equipment	Differentiating pipes or existing items			0.5
	Long chain	Boundaries and centre lines	Boundaries			0.3
	Double continuous	Special purpose		Mechanical linkage		0.5
	Continuous single with short dash	Insulated pipelines	Insulated or traced pipelines			0.5
	Single width intermittent single hatch	Pneumatic instrument impulse			Pneumatic instrument impulse	0.5
	Single width intermittent inverted 'V'	Alternative pneumatic impulse	Alternative pneumatic instrument impulse		Pneumatic impulse lines	0.5
	Single width intermittent 'open E'	Alternative electrical impulse	Alternative electrical impulse		Electrical impulse lines†	0.5
	Single width intermittent cross symbol	Capillary		Replenish pipelines	Capillary pipelines	0.5
	Single width intermittent double arrow	Transmitted radiation	Transmitted radiation		Transmitted radiation	0.5
	Single width intermittent letter 'L'	Hydraulic			Hydraulic impulse lines	0.5

*The single width intermittent "open E" line may be used as an alternative.
†The short dash line may be used as an alternative.

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3.2 Cross-overs and junction of lines

3.2.1 *Cross-overs*. The understanding of a process or item of equipment will be helped by clearly identifying cross-over and junction positions. A cross-over without joining should be shown at right angles and without change of direction. Three methods are acceptable and are of equal status; however, on any one diagram or set of diagrams only one method should be used (see Figure 1).

Where method 2 is adopted the jumper or bridge should preferably be placed in the horizontal line.

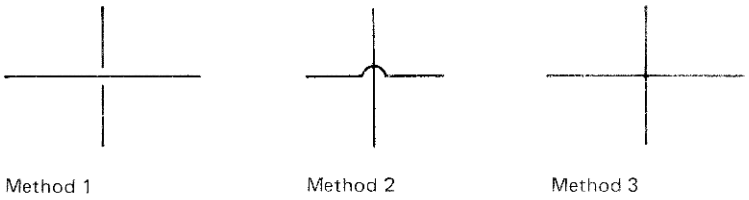

Figure 1 — Line cross-overs

3.2.2 *Junctions*. It is recommended that no more than two connecting lines should be shown coming to a point to form a junction (see Figure 2).

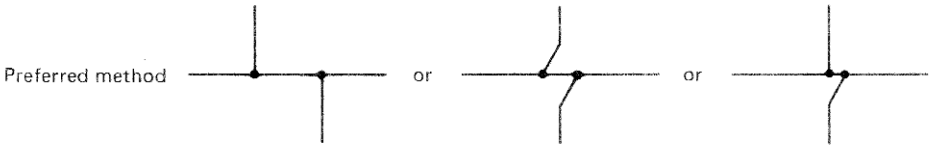

Figure 2 — Line junctions

3.3 Omission of lines

One of two methods should be employed where it is possible to avoid a multiplicity of long parallel uninterrupted lines across a diagram.

Figure 3(a) illustrates the method where the length of line is omitted and each cut end is suitably described and referenced.

Figure 3(b) illustrates the method whereby single line representation can be applied.

NOTE Methods of omitting lines on control instrumentation systems are given in BS 5070-2.

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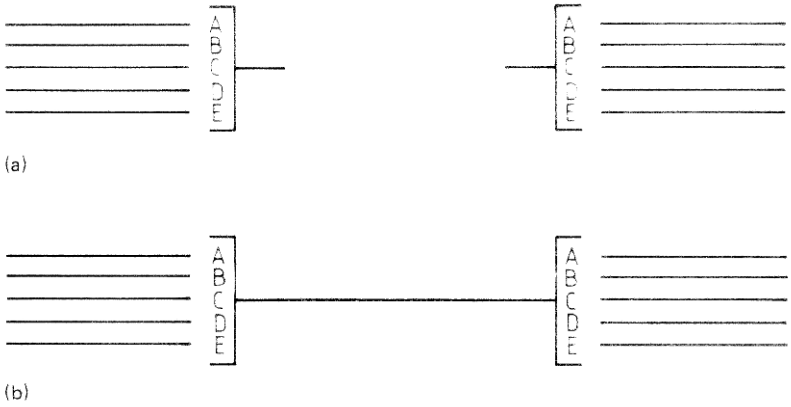
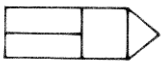


Figure 3 — Omission of lines

3.4 Arrows

The particular uses of arrows should be as shown in Table 2.

Table 2 — Applications of arrows

Arrow	Description	Application
	Closed, filled or unfilled	Direction of flow on diagrams. Also conventionally may be used at ends of lines and changes in direction on the diagram
	Closed and filled	Indicating pipeline fall (or rise)
	Broad unfilled arrow blocks	Drawing/piping continuation data. Used at ends of lines to contain references from one diagram to another
NOTE Included angles of arrowheads are given in BS 5070-1.		

4 Block diagram

4.1 General

The purpose of a block diagram is to show the essentials of an installation in sufficient block outline to indicate the main design features. It is a relatively simple diagram in which an installation or item of equipment, together with functional inter-relationships are represented by block symbols or annotated enclosures, without showing all the connections (see Figure 4Figure 4 and Figure 7).

4.2 Presentation

4.2.1 *Block outline*. Normally simple geometric shapes, e.g. squares, rectangles, triangles or circular enclosures. The sizes and proportions should be chosen to accommodate the connections needed. The actual drawn size is dependent on many factors, annotations or symbols that may be required inside the outline.

The block outlines should be placed on the diagram such that a clear and recognizable flow path is apparent.

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4.2.2 *Contents of block outlines.* The appropriate symbol or description of the function should be shown within the block. If space does not allow this method the description may be placed adjacent to the outline.

4.2.3 *Connecting lines.* Lines between block outlines should be drawn using a continuous line. Where it is necessary to emphasize a particular connection a thicker line may be used (see Table 1).

4.2.4 *Supplementary information.* Depending on the purpose of a block diagram it may be useful to add the following information.

a) Origin and destination of input and output flow.

b) Connecting line description and direction symbol.

c) Service and ancillary connections where required, e.g. power input, service information (import or export).

5 Flow diagram

5.1 General

The purpose of a flow diagram is to depict all the essential parts of a process or item of equipment which enables the analysis and calculation of physical characteristics to be undertaken. These are so arranged to show the operation as clearly as possible without regard to physical layout of the items, their parts or connections (see Figure 5 and Figure 8).

5.2 Presentation

5.2.1 Flow diagrams should be drawn so that the sequence from cause to effect is shown from left to right. Vertical orientation will be dependent on pressure facilities and sequences and should be indicated by arrow symbols.

5.2.2 Flow diagrams should be subject to separation when functional or operational sequences are required. Separate diagrams should be adequately cross-referenced to facilitate understanding of the process.

6 Circuit diagram (fluid)

6.1 General

The purpose of a circuit diagram is to show the function of fluid and motion systems depicting all their essential parts and connections by means of graphical symbols.

Its arrangement should clearly show the operation of the system but without regard to physical layout of parts and connections.

The circuit diagram facilitates the understanding of the circuit and enables the analysis and calculation of the circuit characteristics.

6.2 Presentation

6.2.1 *Hydraulics.* The layout of hydraulic circuit diagrams should show components in sequential order from bottom to top of diagram to illustrate direction of the energy flow, e.g. tanks, pumps, control cylinders, hydraulic heads (see Figure 11 and Figure 12).

NOTE Closed circuits and circuits having no main direction of flow may be shown as desired, e.g. horizontally from left to right.

6.2.2 *Pneumatics.* The layout of pneumatic circuits should show the sequence of operational process or function. The components of individual control chains and groups should be drawn in the direction of energy flow (see Figure 13 and Figure 14).

Cylinders and directional control valves should be shown horizontally and fluid lines should be represented by straight lines without intersection.

6.2.3 *Circuit diagram data.* This should include identification of all components, ports, oil or air lines with suitable positional information for switching rotational and directional operation.

NOTE In certain industries it may be customary or necessary to show the circuit and symbols in relation to the physical locations of the items they represent.

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7 System and piping diagrams

7.1 General

The purpose of system and piping diagrams is to show the detailed connections between components or items of equipment and in some cases the routing of connections. The identity of pipes, fittings and accessories may be added to facilitate requirements of the design, e.g. material, pipe stressing, cost estimation, etc. The routing of pipelines on the diagram need not represent the actual physical route of the pipe unless this is critical (see Figure 9 and Figure 10).

7.2 Presentation

The recommendations given in **5.2** apply. A piping diagram may be simplified by using single line representation as given in **3.3**.

Where special requirements necessitate a particular termination of the pipe this should be identified.

Where individual components are difficult to locate on a diagram alternative arrangements should be provided; for example, where the information is contained in tabular form it is recommended that a column be added for grid location references on the drawing.

NOTE Piping diagrams may include small sketch outlines or tabulated information to indicate details of additional mechanical devices, colour codings and ancillary information. Where grouping of apparatus may need to be highlighted, e.g. tank farm area, pumping stations, etc. these may be surrounded on a diagram by a long chain type line. This type of grouping is often used to designate areas of classification where flammable liquids are used.

8 Piping and instrumentation diagrams (P and ID's)

8.1 General

This type of diagram is recommended for progression from a piping or systems diagram to an installation type diagram subject to accuracy and definition.

The purpose of a P and ID is to show in sufficient detail all pipeline, control and instrument information by adopting the piping or systems diagram and adding functional standard symbols and text. It may be considered as a key document during all stages of design, preparation for start-up, and completion of installation (see Figure 6).

8.2 Presentation

8.2.1 Units of equipment should be shown by the appropriate symbol and annotated to distinguish all connections (see Figure 6).

NOTE The diagram may contain information to allow detail design and procurement data to be compiled for the equipment, instruments, valves and pipeline materials.

8.2.2 It is recommended that this type of diagram is limited to a particular section of plant, vessel or item of equipment to maintain clarity on completion.

8.2.3 Where it is necessary to subdivide a section on diagrams, all lines running from one diagram to another should enter and leave at corresponding points.

8.2.4 For cross-referencing locations the broad unfilled arrow, identifying drawing number, grid reference and item, is recommended (see Table 2).

8.2.5 Special attention should be paid to symbol details when identifying instruments requiring local, control panel or computer locations.

8.2.6 This diagram should numerically identify all items of equipment in systematic order.

NOTE In certain industries it may be customary or necessary to show the circuit and symbols in relation to the physical locations of the items they represent.

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9 Supplementary diagrams

9.1 General

The purpose of supplementary diagrams is to allow a better understanding of the intent of previously defined diagrams.

Particular principles are not given because the purpose may vary from a generalized introduction to a detailed installation package.

9.2 Typical supplementary diagrams (Figure 17, Figure 18 and Figure 19)

9.2.1 *Topographical diagram*. A diagram showing the overall view of major services and systems at various levels, i.e. plant, district, national or international (see Figure 16).

9.2.2 *Equipment location diagram*. A diagram of equipment with positional information (see Figure 15).

9.2.3 *Installed or "as-built" diagram*. A diagram that is a development of the P and I diagram (see clause **8**) in which "as-built" information is added for true record purposes. It is a means of identifying, as necessary, fixing details, supports and treatment for pipes, cables and other equipment. Where special references such as quality control, handling and testing are required these are annotated with respect to separate documentation. Depending on the type of diagrammatic layout the weight, overall dimensions, fixing detail and other installation data can be included within a tabulated index.

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Appendices

Appendix A. Examples of diagrams

The figures in this appendix are examples of the types of diagram described in this standard and are as follows.

Figure 4. Block diagram
Figure 5. Flow diagram } carbon dioxide removal system
Figure 6. Piping and instrumentation diagram

Figure 7. Block diagram
Figure 8. Flow diagram } steam and feed system
Figure 9. System diagram

Figure 10. Piping diagram: filtration unit
Figure 11. Circuit diagram: hydraulic power pack
Figure 12. Circuit diagram: hydraulics
Figure 13. Circuit diagram: pneumatics
Figure 14. Circuit diagram: pneumatics
Figure 15. Location diagram: aircraft hydraulics
Figure 16. Topographical diagram: fluid distribution system
Figure 17. Supplementary diagram: ship's ballast mimic diagram
Figure 18. Supplementary diagram: ship's steam and feed system
Figure 19. Installation drawing: gas drier

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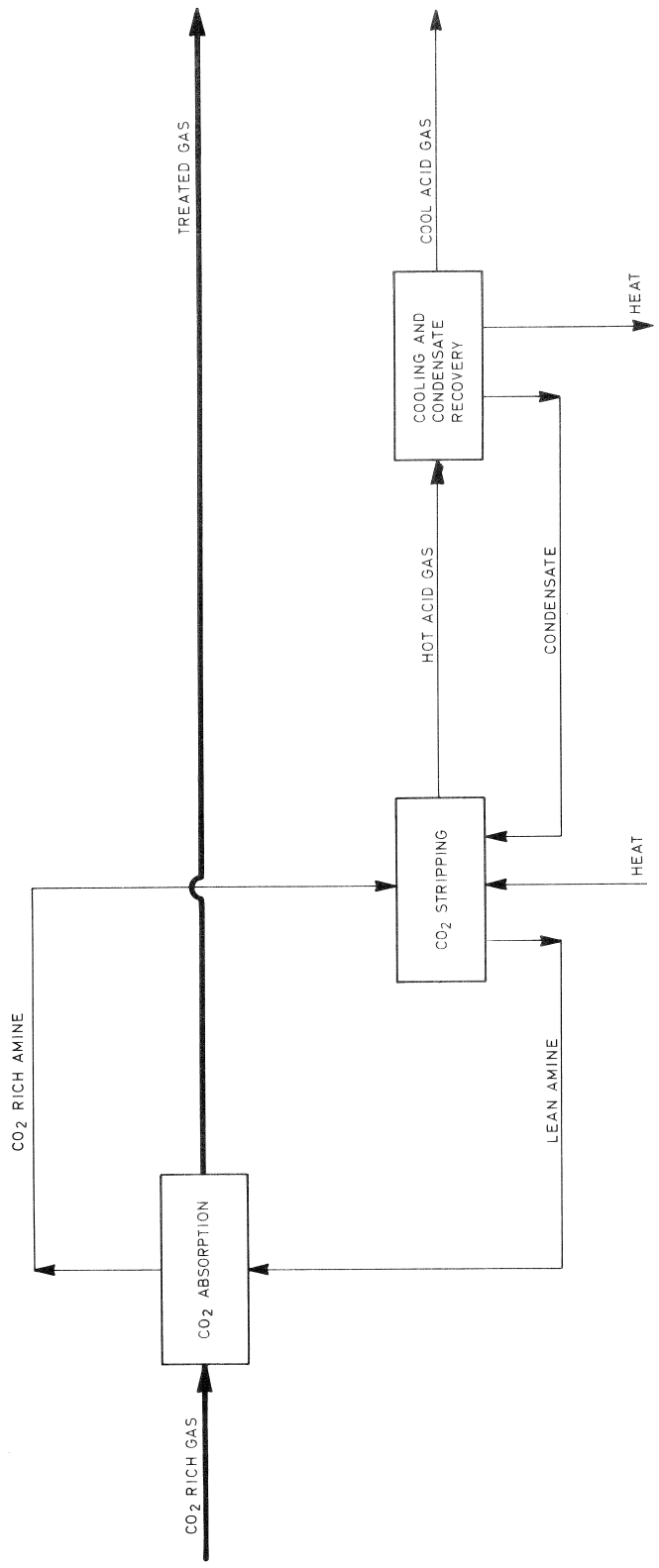

Figure 4 — Block diagram: carbon dioxide removal unit

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