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BASIC RULES FOR THE DESIGN OF GRAPHICAL SYMBOLS FOR USE IN THE TECHNICAL DOCUMENTATION OF PRODUCTS

ASME Y14.40.0-2002
(Identical to ISO 81714-1:1999)

Date of Issuance: February 18, 2003

The next edition of this Standard is scheduled for publication in 2008. There will be no addenda or written interpretations of the requirements of this Standard issued to this edition.

The American Society of Mechanical Engineers
Three Park Avenue, New York, NY 10016-5990

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FOREWORD

This Standard is the adoption as an American National Standard of ISO 81714-1:1999, Design of Graphical Symbols for Use in the Technical Documentation of Products — Part 1: Basic Rules. The ASME Standards Committee Y14, Engineering Drawing and Related Documentation Practices, is responsible for this Standard and supervises the U.S. participation in the ISO Technical Committee 10 activity responsible for the development and maintenance of its counterpart ISO 81714-1 through the U.S. Technical Advisory Group for ISO/TC 10.

This Standard is identical to ISO 81714-1:1999 as that term is defined in ISO/IEC Guide 21:1999.

Suggestions for improvement of this Standard are welcomed. They should be sent to The American Society of Mechanical Engineers, Attention: Secretary, Y14 Main Committee, Three Park Avenue, New York, NY 10016-5990.

This Standard was approved as an American National Standard on December 17, 2002.

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Engineering Drawing and Related Documentation Practices

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BASIC RULES FOR THE DESIGN OF GRAPHICAL SYMBOLS FOR USE IN THE TECHNICAL DOCUMENTATION OF PRODUCTS

1 SCOPE

This Standard specifies basic rules for the design of graphical symbols for use in the technical documentation of products, taking into account basic application needs.

2 REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. These references are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60027, Letter symbols to be used in electrical technology

IEC 61286:1995, Information technology — Coded graphic character set for use in the preparation of documents used in electrotechnology and for information interchange

ISO 31-11:1992, Quantities and units — Part 11: Mathematical signs and symbols for use in the physical sciences and technology

ISO 128-20, Technical drawings — General principles of presentation — Part 20: Basic conventions for lines

ISO 129:1985, Technical drawings — Dimensioning — General principles, definitions, methods of execution and special indications

ISO 3098-2, Technical product documentation — Lettering — Part 2: Latin alphabet, numerals and marks

ISO 6428:1982, Technical drawings — Requirements for microcopying

ISO/IEC 646, Information technology — ISO 7-bit coded character set for information interchange

ISO/IEC 8859 (all parts), Information technology — 8-bit single-byte coded graphic character sets

ISO/IEC 10367:1991, Information technology — Standardized coded graphic character sets for use in 8-bit codes

ISO/IEC 10646-1:1993, Information technology — Universal Multiple-Octet Coded Character Set (UCS) — Part 1: Architecture and Basic Multilingual Plane

In the United States, ISO and IEC standards are available from the American National Standards Institute, 25 West 43rd Street, New York, NY 10036.

3 DEFINITIONS

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

3.1

graphical symbol: visually perceptible figure used to transmit information independently of language.

NOTES:

(1) The graphical symbol may represent objects of interest, such as products, functions, or requirements for manufacturing, quality control, etc.

(2) This is not to be confused with the simplified representation of products, which is always drawn to scale and may look like a graphical symbol.

3.2

reference point: origin of the coordinate system used in the description of all the graphical elements of the graphical symbol.

NOTE: The reference point may be used for positioning and transformation, e.g., mirroring, turning, moving.

3.3

symbol family: set of graphical symbols with a common conception using graphical characteristics with specific meanings.

3.4

connect node: location on a graphical symbol intended for connection.

3.5

terminal line: line of a graphical symbol ending at a connect node.

3.6

text: string of alphabetical, numerical, and/or other characters.

3.7

arc: curved line without inflection point.

4 MARKERS

In this Standard, the following marker is used in order to illustrate positions of connect nodes.

5 DESIGN OF GRAPHICAL SYMBOLS

5.1 Graphic Representation

Graphical symbols shall be designed to convey information concerning a function or a special requirement. This also applies when physical products are to be represented by graphical symbols.

5.2 Design Procedure

The design of graphical symbols shall follow the rules defined in section 6, taking into account:

(a) the description of what the graphical symbol is intended to represent;

(b) the requirements pertaining to their presentation on paper or other solid media and in data processing;

(c) the analysis of the consequences when turning, mirroring, or scaling (permitting different values of scaling factors on the *x*- and *y*-axes, if required);

(d) if graphical symbols are functionally related, they shall be designed as a symbol family;

(e) the normal application of the graphical symbol, e.g., of reference designation, technical data, etc.;

(f) additional requirements as specified in ISO 6428 shall be applied if microcopying is intended.

6 DESIGN PRINCIPLES

6.1 Shape

The shape of a graphical symbol shall be:

(a) simple, in order to improve perceptibility and reproducibility;

(b) easily associated with its intended meaning, i.e., either self-evident, or easy to learn and to remember.

Graphical symbols with the same shape representing different information should be avoided.

Due to the limited number of graphical elements and the limited number of combinations of these elements, different meanings may have to be assigned to graphical symbols having the same shape. In these cases, a separate graphical symbol shall be assigned to each meaning.

Graphical symbols with different shapes shall not represent the same information.

For a human reader, the meaning of a graphical symbol can normally be recognized because of the context of the document. If not, such graphical symbols shall be provided with supplementary information.

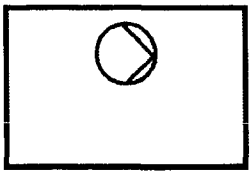


Fig. 1 Pumping System

Fig. 2 Electrostatic Microphone

6.2 Operational State

Graphical symbols having an element representing a movable part in a product (e.g., a valving element in a directional valve for fluid power and a contact in an electromechanical switching device) shall be designed in a position that corresponds to:

(a) the at-rest (unaffected) position for products with automatic return (e.g., a spring return);

(b) the nonactive position for products without automatic return (e.g., a closed valve, an electromechanical switching device in open-circuit position).

If operational states other than those specified here are required, the relevant information should be given in the standard for graphical symbols.

6.3 Classes of Graphical Symbols

Two classes of graphical symbols are recognized:

(a) class 1 — graphical symbols providing basic information;

(b) class 2 — graphical symbols providing supplementary information.

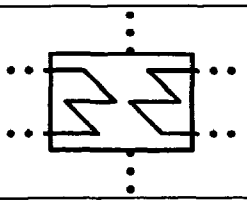
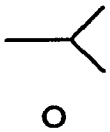
Graphical symbols belonging to class 2 should be designed without relation to any specific context in order to make their application as broad as possible. These graphical symbols are intended to be used only together with graphical symbols of class 1.

Graphical symbols belonging to class 1, normally reduced in size, may be used to provide supplementary information as well (see Figs. 1 and 2).

NOTE: The graphical symbols providing the basic information for a pump as shown in Fig. 1, and for a capacitor as shown in Fig. 2, are used in each of the combinations as a graphical symbol giving supplementary information.

6.4 Combination of Graphical Symbols

6.4.1 General. Graphical symbols may be combined to form a new graphical symbol. The information represented by the new composite graphical symbol shall be consistent with the information represented by its

Example	Graphical Symbol	Assigned Description	Composite Graphical Symbol	Assigned Description
1		Anode Directly heated cathode Bulb of a tube		Diode with directly heated cathode
2		Envelope, vessel Heating or cooling coil		Heat exchanger with 3 flow paths
3		Seat of a check valve Moving part of a check valve		Check valve/nonreturn valve

GENERAL NOTE: The dotted lines shown in example 2 are not part of the graphical symbol (see para. 6.12).

Fig. 3 Examples of Combinations of Graphical Symbols

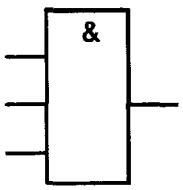


Fig. 4 "And" Element

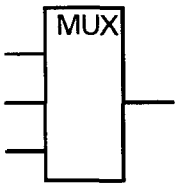


Fig. 5 Multiplexer

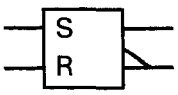


Fig. 6 Bistable Element

constituents. Examples of combinations of graphical symbols are shown in Fig. 3.

6.4.2 Graphical Symbols for Complex Assemblies. The graphical symbol representing an assembly shall be constructed by combining the graphical symbols representing the constituents of that assembly.

If the graphical symbol for a complex assembly, either for reasons of complexity or lack of graphical symbols representing the constituents, cannot be constructed in the above way, the following applies.

The graphical symbol shall be based on a simple solid outline, being supplemented preferably within this outline by information according to (a) through (f) or combinations of these as shown below. The outline should preferably be that of a square or, if necessary, a rectangle or any other closed shape.

(a) Graphical symbol(s) representing the most significant constituent(s) (see Fig. 1).

(b) Mathematical signs and/or formulas, letter symbols for quantities, chemical formulas, graphs, and symbols of International Standards. Mathematical signs shall be in accordance with ISO 31-11 (see Fig. 4).

(c) An abbreviation, preferably mnemonic, based on the English language (see Fig. 5).

NOTE: In the United States, ASME Y14.38, Abbreviations and Acronyms, is the preferred source for abbreviations based on the English language.

(d) Graphical symbols providing supplementary information related to each input and each output (see Fig. 6).

(e) Graphical symbols providing supplementary information related to the assembly as a whole, located inside or outside the continuous outline (see Fig. 7).

(f) If it is impossible to describe the meaning of the graphical symbol by the methods given in (a) through (e), a short descriptive text may be added. This text

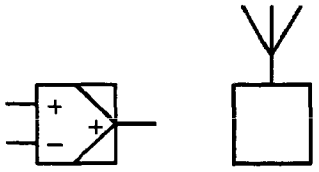


Fig. 7 Feedback Controller and Radio System

should be written in English, independent of the language(s) used, e.g., in a diagram. However, for use limited to a defined language region, a different language may be used instead. The text may be located inside or outside the outline (see Fig. 8) and should be as short as possible.

6.4.3 Graphical Symbols Including Flow Direction. Graphical symbols applying a flow direction, used to provide supplementary information, shall be applied in such a way that the overall flow is emphasized [see Fig. 16, sketch (a)].

6.5 Grid and Module

As a basis for the design of a graphical symbol, an orthogonal grid of parallel lines spaced 1*M* apart, where *M* is the module, shall be used. This grid may be subdivided into a 0.1*M* or a 0.125*M* grid (see Fig. 9). For the same graphical symbol or symbol family, only one of these two grid systems shall be used and indicated in an appropriate document.

6.6 Line Width

The relation between the line width and the module size *M* used for the design of graphical symbols shall be 0.1. Characters and lines of graphical symbols should have the same line width. If additional line widths are required, the ratio between any two line widths should be at least 2:1. Standardized line widths given in ISO 128-20 are recommended.

6.7 Arcs and Lines

Line types should be in accordance with ISO 128-20. Lines which come into contact or intersect at an acute angle should not have angles of less than 15°. Straight lines which do not run parallel to grid lines should have increments of 15° or should be defined with gradient ratios (e.g., 1:1, 2:1, 3:1, 4:1). Straight lines should begin and end on an intersection of the grid.

The endpoints of an arc shall lie on intersections of the grid. Curves shall consist only of arc segments and/or straight lines.

The following applies to straight lines and arcs defining the outline of a graphical symbol on which connect nodes are required (see Fig. 10):

(a) the axis of horizontal and vertical lines shall lie on the 0.5*M* or 1*M* grid;

(b) the axis of inclined lines or arcs shall intersect as many intersections of the 0.5*M* grid as connect nodes are needed.

6.8 Minimum Space Between Parallel Lines

The minimum space between parallel lines shall be at least twice the line width of the widest line.

6.9 Hatched and Filled Areas

For hatched areas, the requirements with respect to the minimum space between parallel lines and to the line width shall be applied. Filled areas should be avoided.

6.10 Connect Node

If required, the graphical symbol should be provided with the appropriate number of connect nodes representing inputs and outputs.

6.11 Position of a Connect Node

A connect node should lie on an intersection of the 1*M* or the 0.5*M* grid (see, e.g., Fig. 10).

If it is intended to position text between connect nodes or parallel terminal lines, the minimum space between these nodes or lines shall be 2*M*.

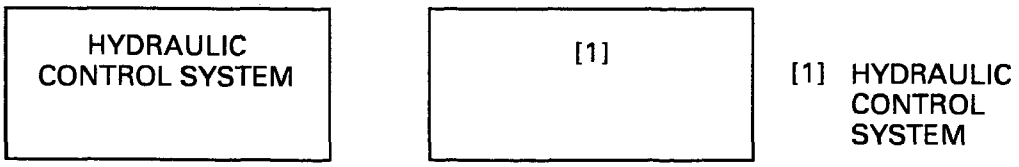
6.12 Terminal Line

If a terminal line is required, it should be as short as practicable.

In those cases where the graphical symbol does not include terminal lines and the connection lines should be attached to the graphical symbol in a specific manner, the connection lines should be indicated by dotted lines (see Fig. 3, example 2).

6.13 Reference Point

For use in computer-aided systems, graphical symbols require a reference point. It shall lie on a 0.5*M* or



GENERAL NOTE: Location of the text outside the outline distinguishes an international graphical symbol from language-related information and facilitates reproduction in different languages.

Fig. 8 Hydraulic Control System

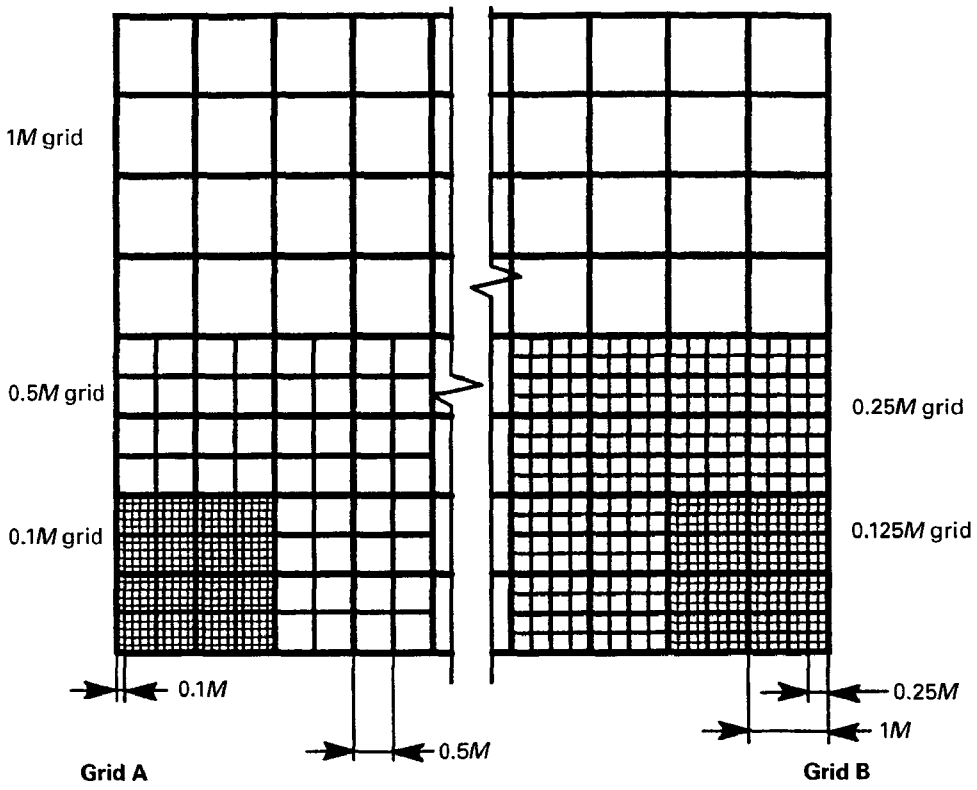


Fig. 9 Examples of Grids

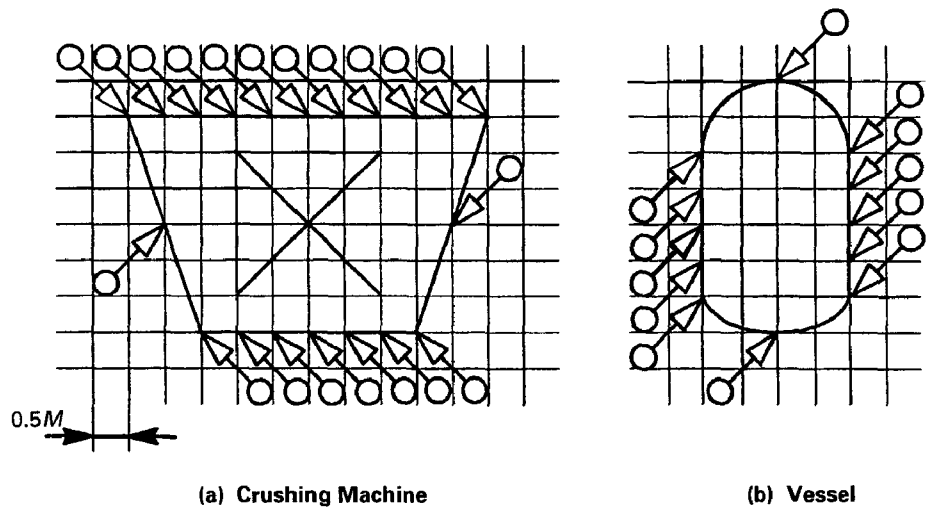


Fig. 10 Examples of Graphical Symbol Outlines Containing Connect Nodes

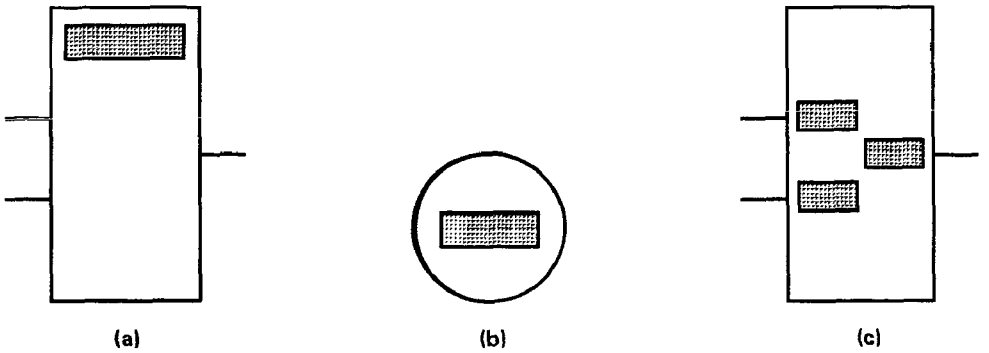
1M intersection of the same grid as that used for the design of the graphical symbol.

NOTE: Further recommendations regarding the location of the reference point may be given in other relevant International Standards.

6.14 Text Assigned to Graphical Symbols

6.14.1 Typeface of Characters. The typeface of characters should conform to ISO 3098-2 type B vertical, where applicable. Letter symbols of quantities, given in ISO 31 and IEC 60027, are recommended.

6.14.2 Set of Characters. Any text within graphical symbols should be composed from standard character sets. To maintain compatibility with computer processing, characters should be restricted to those characters encoded in the ISO/IEC 646 seven-bit character set, International Reference Version (IRV), excluding control



GENERAL NOTE: The filled-in areas show the areas occupied by the text.

Fig. 11 Examples of Text Locations

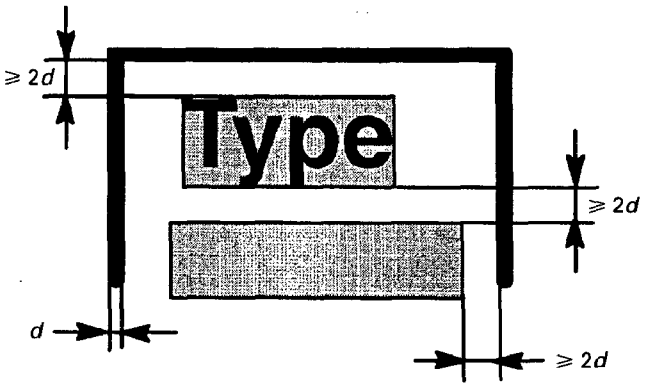


Fig. 12 Minimum Distances Between Text and Lines

and national replacement characters. If additional characters are required, they shall be selected from existing coded character sets, i.e., ISO/IEC 8859, ISO/IEC 10367, ISO/IEC 10646-1, and IEC 61286.

6.14.3 Text Orientation. The orientation of text (reading direction) shall comply with the rules for the orientation of dimensioning values in ISO 129, limited to horizontal and vertical values.

6.14.4 Location of Text Inside an Outline. Text related to the graphical symbol as a whole should preferably be placed in the top center [see Fig. 11, sketch (a)] or alternatively in the middle [see Fig. 11, sketch (b)] of the outline of the graphical symbol.

Text related to input/output shall be placed next to the relevant input/output [see Fig. 11, sketch (c)].

6.14.5 Minimum Distances. The minimum space between a text and its surrounding geometry shall be at least twice the line width d of the wider line (see Fig. 12).

6.15 Size of Graphical Symbols

The size of a graphical symbol should take into account space requirements, such as included text, included constituent graphical symbols, other graphical details, location, and number of connect nodes.

7 MODIFICATION OF PROPORTIONS

The standardized proportions of graphical symbols should be as shown in relevant International Standards. When applied, however, the proportions of an existing graphical symbol (e.g., the graphical symbols shown in Figs. 4 and 5) may be modified, as long as the modified graphical symbol conveys the same information as the original one.

NOTE: Allowed modifications or versions of graphical symbols may be shown, e.g., in a separate documentation or in application standards.

8 VARIANTS OF GRAPHICAL SYMBOLS

NOTE: In the context of this Standard, variants of graphical symbols are not considered to be different graphical symbols.

When applied, different variants of a graphical symbol, satisfying different requirements with regard to flow direction and reading directions, may be needed. Due to the different geometric shape of the graphical symbol,

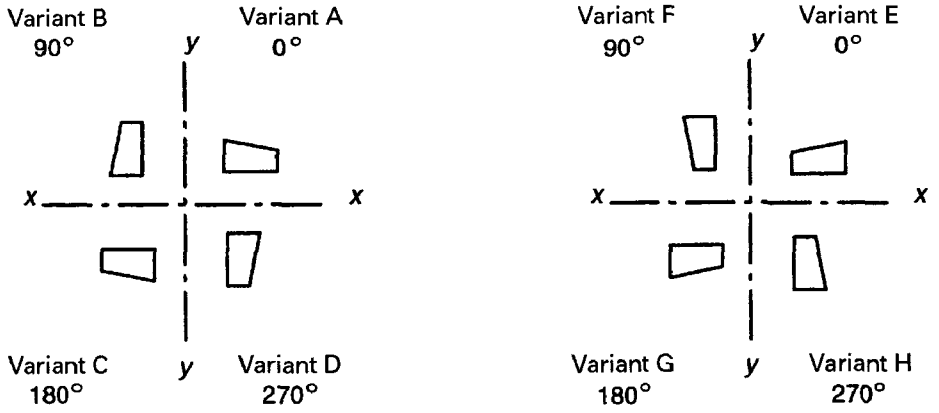


Fig. 13 Possible Variants of the Graphical Symbol for an Asymmetric Reduction

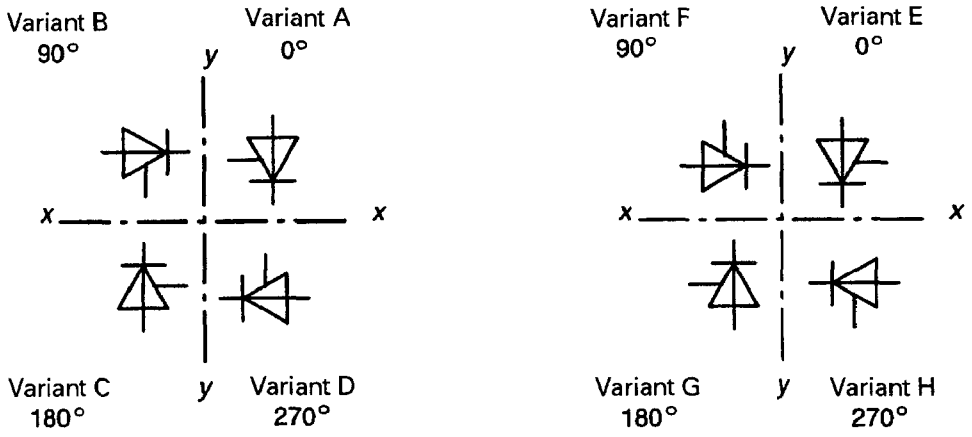


Fig. 14 Possible Variants of the Graphical Symbol for a Thyristor

up to two, four, or eight such variants may be required.

In simple cases, the variants can be obtained by turning or mirroring. As examples, in Figs. 13, 14, and 15, variant A is turned counterclockwise by steps of 90° to variants B, C, and D. Variant E is constructed by mirroring variant A around the *y–y* axis. Variant E again is turned counterclockwise by steps of 90° to variants F, G, and H.

In more complicated cases (e.g., if the graphical symbol includes text), it might be necessary to adjust the reading direction (see para. 6.14.3) and to shift the position of the text.

Of all the possible variants shown in Fig. 16, variants A, B, E, and F are the preferred ones in accordance with the rules set up in this Standard.

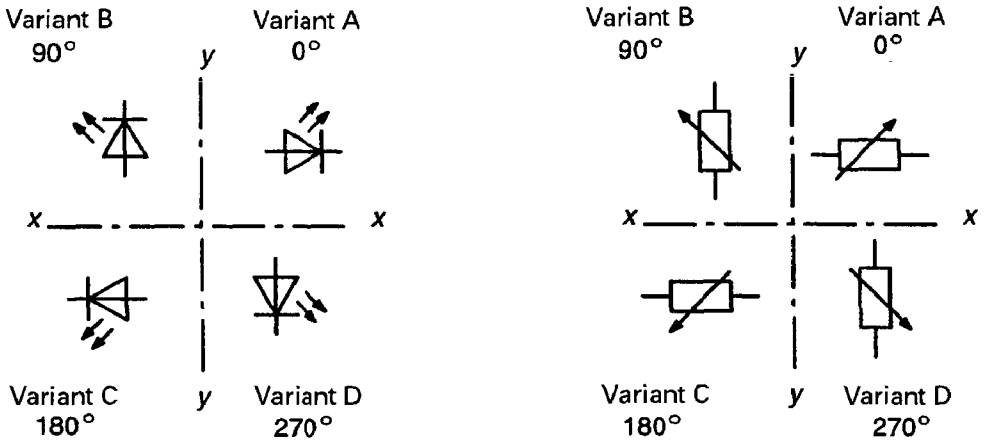
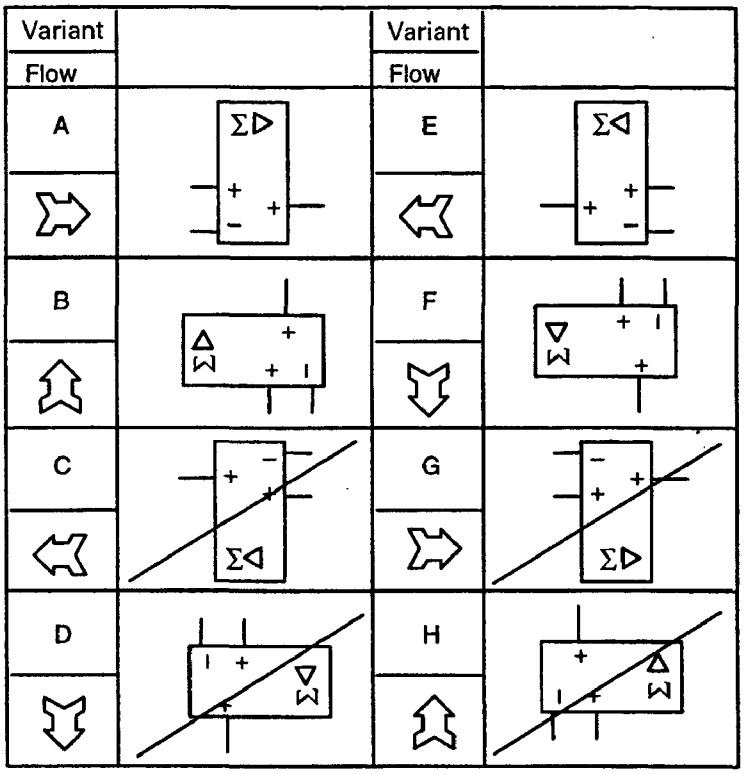
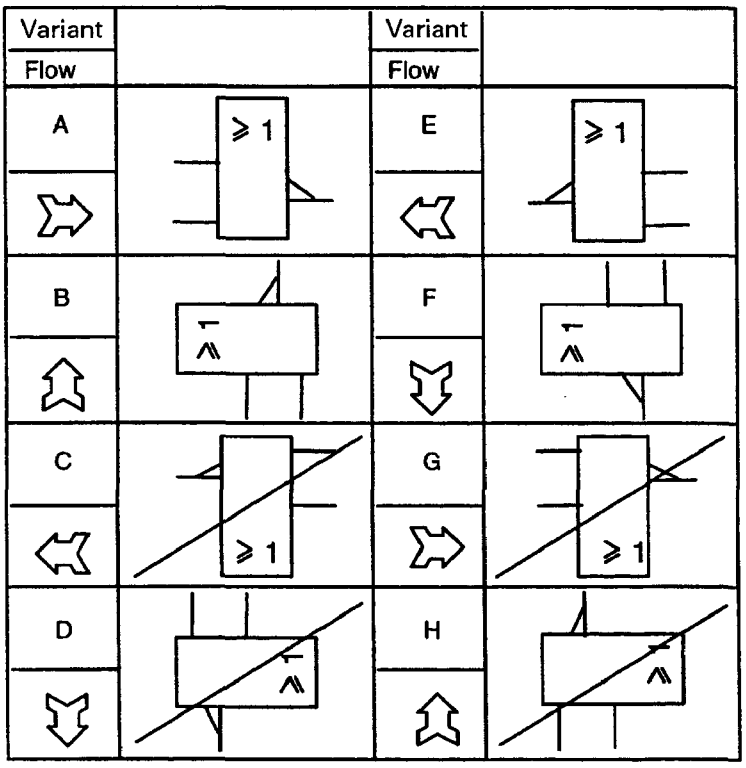


Fig. 15 Possible Variants of Composite Graphical Symbols



(a)



(b)

Fig. 16 Examples of Required Modifications in Different Variants

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- Metric Drawing Sheet Size and Format Y14.1M-1995
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