

ASME Y14.40.6-2002

(Identical to ISO 14617-6: 2002)

GRAPHICAL SYMBOLS FOR DIAGRAMS, PART 6: MEASUREMENT AND CONTROL FUNCTIONS

An American National Standard



**The American Society of
Mechanical Engineers**

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ASME Y14.40.6-2002
(Identical to ISO 14617-6: 2002)

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FOREWORD

This Standard is the adoption as an American National Standard of ISO 14617-6: 2002. The ASME Standards Committee Y14, Engineering Drawing Practices and Related Documentation, 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 14617-5 through the U.S. Technical Advisory Group for ISO/TC 10.

This Standard is *identical* to ISO 14617-6: 2002 as that term is defined in ISO/IEC Guide 21: 1999 and part of a series of standards providing graphical symbols for diagrams in a variety of technical disciplines. The titles in this series are:

- Part 1: General Information and Indexes
- Part 2: Symbols Having General Application
- Part 3: Connections and Related Devices
- Part 4: Actuators and Related Devices
- Part 5: Measurement and Control Devices
- Part 6: Measurement and Control Functions
- Part 7: Basic Mechanical Components
- Part 8: Valves and Dampers
- Part 9: Pumps, Compressors, and Fans
- Part 10: Fluid Power Converters
- Part 11: Devices for Heat Transfer and Heat Engines
- Part 12: Devices for Separating, Purification and Mixing
- Part 15: Installation Diagrams and Network Maps

Other parts are under preparation.

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

This Standard was approved as an American National Standard on December 19, 2002.

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GRAPHICAL SYMBOLS FOR DIAGRAMS, PART 6: MEASUREMENT AND CONTROL FUNCTIONS

1 SCOPE

This Standard specifies graphical symbols for measurement and control functions in diagrams, with the same symbols in simple applications possibly representing instead components or devices implementing such functions. For graphical symbols for measurement and control components and devices, see ASME Y14.40.5.

For the fundamental rules of creation and application of graphical symbols in diagrams, see ASME Y14.40.0.

For an overview of the ASME Y14.40 series, information on the creation and use of registration numbers for identifying graphical symbols used in diagrams, rules for the presentation and application of these symbols, and examples of their use and application, see ASME Y14.40.1.

2 REFERENCES

The following references contain provisions which, through reference in this text, constitute provisions of this Standard. For dated references, subsequent amendments to, or revisions of any of these publications do not apply. However, parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the references indicated below. For undated references, the latest edition applies.

ASME Y14.40.0, Basic Rules for the Design of Graphical Symbols for Use in the Technical Documentation of Products

ASME Y14.40.1, Graphical Symbols for Diagrams, Part 1: General Information and Indexes

ASME Y14.40.2, Graphical Symbols for Diagrams, Part 2: Symbols Having General Application

ASME Y14.40.3, Graphical Symbols for Diagrams, Part 3: Connections and Related Devices

ASME Y14.40.4, Graphical Symbols for Diagrams, Part 4: Actuators and Related Devices

ASME Y14.40.5, Graphical Symbols for Diagrams, Part 5: Measurement and Control Devices

ASME Y14.40.8, Graphical Symbols for Diagrams, Part 8: Valves and Dampers

Publisher: The American Society of Mechanical Engineers (ASME International), Three Park Avenue, New York, NY 10016 5990; Order Department: 22 Law

Drive, Box 2300, Fairfield, NJ 07007-2300

IEC 60617-12: 1997, Graphical Symbols for Diagrams — Part 12: Binary Logic Elements¹

IEC 60617-13: 1993, Graphical Symbols for Diagrams — Part 13: Analogue Elements¹

IEC 61175: 1993, Designations for Signals and Connections¹

Publisher: International Electrotechnical Commission (IEC), 3 rue de Varembe, Case Postale 131, CH-1211, Genève 20, Switzerland/Suisse

ISO 31 (all parts), Quantities and Units¹

Publisher: International Organization for Standardization (ISO), 1 rue de Varembe, Case Postale 56, CH-1211, Genève 20, Switzerland/Suisse

3 TERMS AND DEFINITIONS

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

3.1

control: purposeful action on or in a system to meet specified objectives.

NOTE: Control may include monitoring and safeguarding in addition to the control action itself.

3.2

operation: transfer of mechanical parts.

EXAMPLE: The closing member of a shut-off valve or the contacts of an electromechanical switching device.

NOTES:

(1) The transfer direction may be defined as an opening operation, closing operation, ON-operation, OFF-operation, etc.

(2) The term has a specific meaning in conjunction with electric measuring relays. An over/under-relay is operating when its characteristic quantity reaches the set value by increasing/decreasing in value (IEC 60050-448).

3.3

manual control: control of an operation by human intervention.

¹ Copies may be obtained from the American National Standards Institute (ANSI), 25 West 43rd Street, New York, NY 10036.

3.4

automatic: (control, operation) self-acting (not needing human intervention).

3.5

final controlling element: element that directly changes the output variable of a controlling system (manipulated variable).

3.6

delay device: device providing a time interval between the instant when an actuating force is applied or removed and the instant when the consequent change of position or state of the affected parts start.

3.7

automatic return device: device for returning movable parts, such as those of a valve to initial position (at-rest position), after an actuating force has been removed.

3.8

detent: device that retains movable parts, for example, those of a valve, in a certain position until sufficient force is applied to overcome the detaining force in order to move the parts to another position.

3.9

latching device: mechanical device giving movable parts, for example, those of a valve, the possibility to move in

one direction but preventing them from returning until the latch has been released.

3.10

blocking device: mechanical device preventing movable parts, for example, those of a valve, from moving in any direction until the blocking device has been released.

3.11

interlocking device: mechanical device making the operation of movable parts of one component, for example, a contactor, dependent on the position or state of another component with movable parts.

3.12

information processing: performing of operations on data to obtain or treat information.



3.13

primary location: location of measuring instruments, potentiometers etc., accessible to an operator, cf. *auxiliary location* (3.14).

3.14

auxiliary location: location of measuring instruments, potentiometers, etc. not accessible to an operator, for example, behind a panel, cf. *primary location* (3.13).

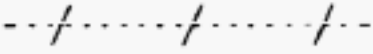

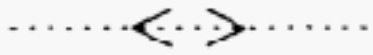
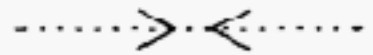


4 FUNCTIONAL LINKS AND JUNCTIONS**4.1 Symbols of a Basic Nature**

Reference Number	Registration Number	Symbol form/Shape	Symbol Description
4.1.1	401		Functional connection. See R401 (4.2.1) and R402 (4.2.2).
4.1.2	501		Joint of connections. See R501 (4.2.3).

4.2 Application Rules for the Symbols in Para. 4.1

Reference Number	Registration Number	Application Rules
4.2.1	R401	Symbols for connections may cross each other.
4.2.2	R402	When confusion between symbols 401 (4.1.1) and 405 (3-4.1.5) to 410 (3-4.1.10) for other types of connections is likely, symbol 431 (4.3.1) shall be added.
4.2.3	R501	The diameter of the dot should be five times the width of the line. The symbol may be omitted in a T-joint. For an example, see X505 (3-5.5.5).

4.3 Symbols Giving Supplementary Information

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
4.3.1	431		Pure functional type.
4.3.2	249		Direction of propagation, energy, or signal flow (simplex). See R247 (4.4.1).
4.3.3	250		Direction of propagation, energy, or signal flow, alternative directions (half-duplex). See R247 (4.4.1).
4.3.4	251		Direction of propagation, energy, or signal flow simultaneously in both directions possible (full-duplex). See R247 (4.4.1).
4.3.5	234		Analog signal.
4.3.6	235		Digital signal.
4.3.7	236	BIN	Binary signal.

4.4 Application Rules for the Symbols in Para. 4.3


Reference Number	Registration Number	Application Rules
4.4.1	R247	The symbol shall be shown on the connecting line and located such that it does not touch any other symbol. The symbol may also be used to indicate the transfer direction of a component or device, in which case the symbol should be located on the outline of the basic symbol.

4.5 Application Examples

See para. 10.

5 POINT OF MEASUREMENT

5.1 Symbol of a Basic Nature

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
5.1.1	1011		Point of measurement. See R1011 (5.2.1).

5.2 Application Rule for the Symbol in Para. 5

Reference Number	Registration Number	Application Rule
5.2.1	R1011	The symbol shall be used if it is necessary to clearly indicate the location of the point of measurement. For an example, see X1011 (5.5.1).

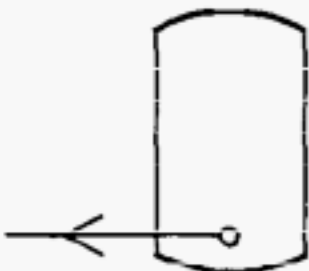

5.3 Symbol Giving Supplementary Information

None.

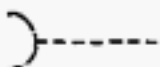

5.4 Application Rule for the Symbol in Para. 5.3

None.

5.5 Application Examples

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
5.5.1	X1011	 <p>249, 401, 1011, 2062</p>	Measurement inside and near the bottom of a pressure vessel.
5.5.2	X1012	 <p>249, 401, 405</p>	Measurement in a pipeline. The use of symbol 1011 (5.1.1) is not regarded as necessary.


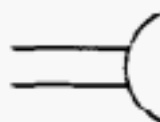
6 OPERATION OF FINAL CONTROLLING ELEMENTS**6.1 Symbols of a Basic Nature**

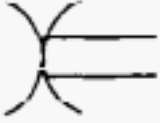


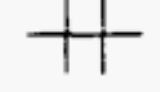


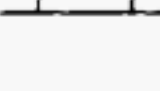
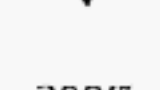
Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
6.1.1	1021		Manual operation of a final controlling element.
6.1.2	1022		Automatic operation of a final controlling element. The input may be a binary (#) or an analog (n) signal. See R1021 (6.2.1).

6.2 Application Rules for the Symbols in Para. 6.1

Reference Number	Registration Number	Application Rules
6.2.1	R1021	<p>If necessary, the input or inputs shall be provided with signal designations (see IEC 61175) indicating the action of the signals.</p> <p>When the final controlling element is of the bistable type, two input signals are needed. For an example, see X1032 (6.5.12). In many cases the diagram may be simplified by indicating the two inputs by only one functional link provided with two signal names. For an example, see X1033 (6.5.13).</p>

6.3 Symbols Giving Supplementary Information

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
6.3.1	651	<p>Form 1</p>  <p>200%</p>	Delay device where the action is delayed when the direction of movement is towards the center of the arc. See R651 (6.4.1).
6.3.2	652	<p>Form 2</p>  <p>200%</p>	

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
6.3.3	653	 200%	Delay device where the action is delayed in both directions. See R651 (6.4.1).
6.3.4	654	 200%	Automatic return device. The return direction is towards the apex. See R652 (6.4.2) and R1022 (6.4.3).
6.3.5	655	 200%	Detent for detaining in a discrete position. See R652 (6.4.2).
6.3.6	659	 200%	Detent for detaining in any position. See R652 (6.4.2).
6.3.7	660	 200%	Detent for detaining in any position, drift to the left permitted. See R1023 (6.4.4).
6.3.8	661	 200%	Latching device.
6.3.9	664	 200%	Blocking device.
6.3.10	666	 200%	Interlocking device.

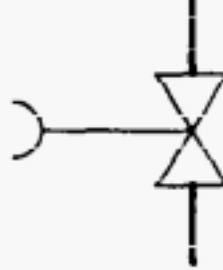
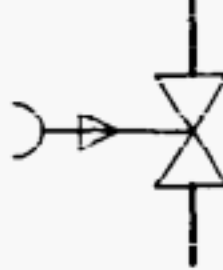
6.4 Application Rules for the Symbols in Para. 6.3

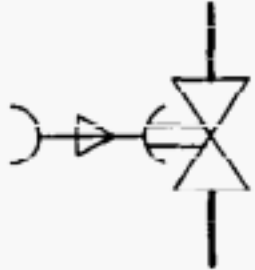
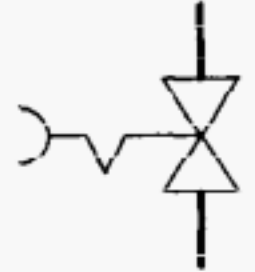
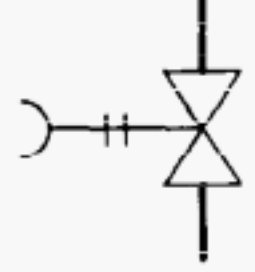
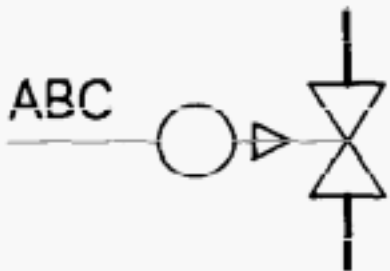
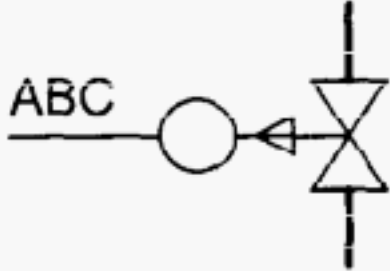
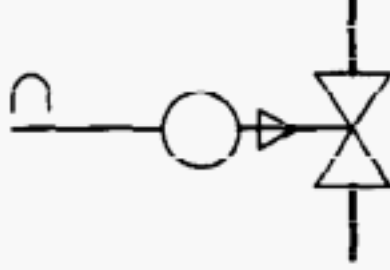
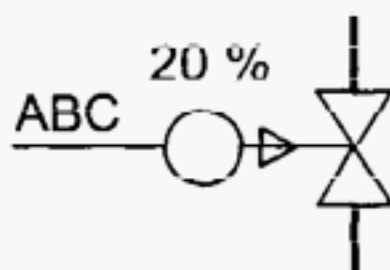
Reference Number	Registration Number	Application Rules
6.4.1	R651	The double line shall be attached to the symbol for the element of a component or device that is delayed. For examples, see X653 (4-4.5.3), X654 (4-5.5.4) and X1023 (6.5.3).
6.4.2	R652	The symbol may be omitted if the behavior of the component is understood by the symbol for the actuator, cf. 4-5.1; R683 (4-5.2.3); and R685 (4-5.2.5). For example, see 4-5.5.

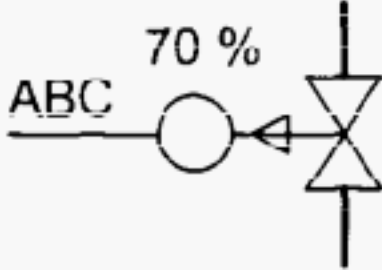
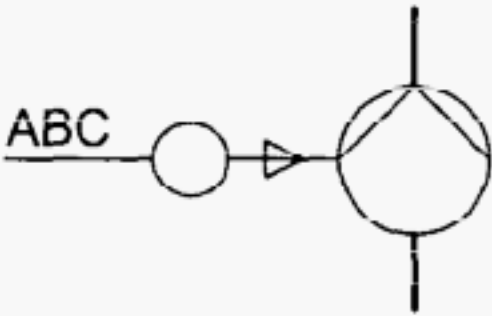
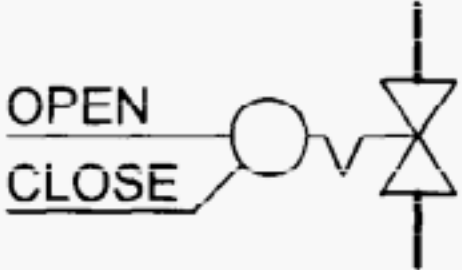
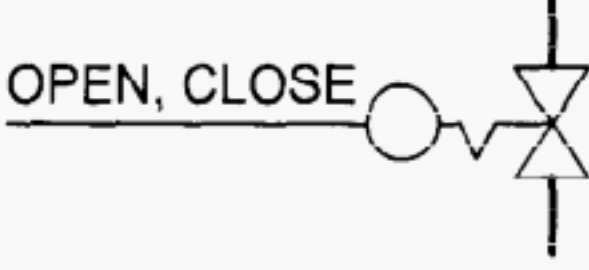
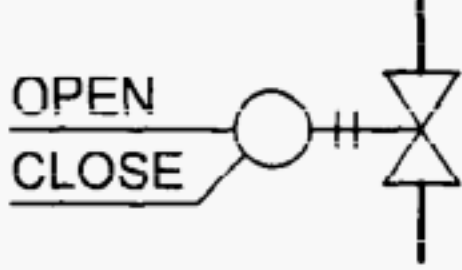
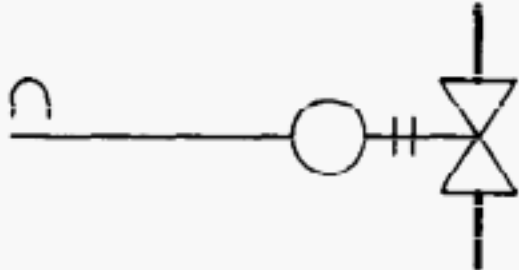
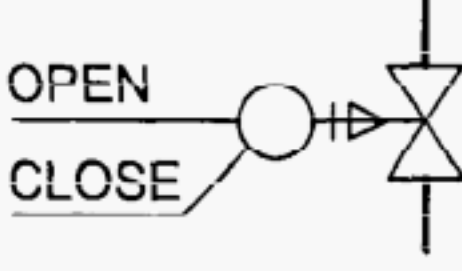
Reference Number	Registration Number	Application Rules
6.4.3	R1022	<p>Besides signifying the meaning automatic return when the control signal changes to zero (shut-off valves) or a lower value (control valves), the symbol shall be used for indication of automatic return when the auxiliary supply voltage or pressure fails.</p> <p>When the symbol is used in connection with a symbol for a valve (see ASME Y14.40.8) the following applies:</p> <ul style="list-style-type: none"> — Symbol pointing towards the symbol for the valve: valve returns to, or towards, closed position when the control signal becomes zero or decreases, or when the auxiliary supply fails — for examples, see X1022 (6.5.2), X1026 (6.5.6), and X1028 (6.5.8), cf. R5101 (8-4.2.1). If no ambiguity is likely, the symbol may be omitted in this case. — Symbol pointing from the symbol for the valve: valve returns to, or towards, open position when the control signal becomes zero or decreases, or when the auxiliary supply fails — for an example, see X1027 (6.5.7), cf. R5101 (8-4.2.1). <p>The symbol may be supplemented by a figure $n\%$, indicating restricted closing or opening. For examples, see X1029 (6.5.9) and X1030 (6.5.10).</p> <p>When the symbol is used in connection with symbols for devices other than valves (e.g., a pump), the corresponding principle applies. For example, an automatic return symbol pointing towards the symbol for a pump implies that the pump stops (will take on its inactive state) when the output signal becomes zero or when the supply fails. For an example, see X1031 (6.5.11).</p>
6.4.4	R1023	<p>When the symbol is used in connection with a symbol for a valve, the following applies:</p> <ul style="list-style-type: none"> — Symbol pointing towards the symbol for the valve: safe and permitted drift is towards closed state of the valve — for an example, see X1035 (6.5.15). — Symbol pointing from the symbol for the valve: safe and permitted drift is towards open state of the valve.

6.5 Application Examples

NOTE: For more examples of the application of symbols for automatic return, detaining, latching, delaying, etc., see ASME Y14.40.4, para. 4.5.

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
6.5.1	X1021	 <p>403, 1021, 2101</p>	Manual operation of valve.
6.5.2	X1022	 <p>403, 654, 1021, 2101</p>	Manual operation of valve with automatic return to closed position.

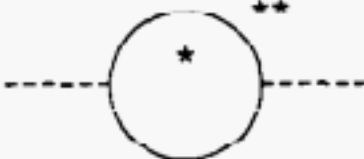

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
6.5.3	X1023		Manual operation of valve with delayed automatic return to closed position.
403, 651, 654, 1021, 2101			
6.5.4	X1024		Manual operation of valve with two stable positions, closed and open.
403, 655, 1021, 2101			
6.5.5	X1025		Manual operation of valve with infinite number of stable positions.
403, 659, 1021, 2101			
6.5.6	X1026		Automatic operation of valve with automatic return to closed position. When the statement <i>ABC</i> is true (the signal has taken on its 1-state), the valve is opened. When the statement <i>ABC</i> is not true (the signal has taken on its 0-state), or when the auxiliary supply fails, the valve returns to its closed position.
401, 403, 654, 1022, 2101			
6.5.7	X1027		Automatic operation of valve with automatic return to open position. When the statement <i>ABC</i> is true (the signal has taken on its 1-state), the valve is closed. When the statement <i>ABC</i> is not true (the signal has taken on its 0-state), or when the auxiliary supply fails, the valve returns to its open position.
401, 403, 654, 1022, 2101			
6.5.8	X1028		Automatic operation of valve controlled by analog signal. The throughput increases/decreases when the value of the analog signal increases/decreases. When the analog signal takes on its minimum value or when the auxiliary supply fails, the valve closes.
234, 401, 403, 654, 1022, 2101			
6.5.9	X1029		Automatic operation of valve with automatic return towards closed position. When the statement <i>ABC</i> is true (the signal has taken on its 1-state), the valve is opened. When the statement <i>ABC</i> is not true (the signal has taken on its 0-state), or when the auxiliary supply fails, the valve returns to 20% open position.
401, 403, 654, 1022, 2101			

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
6.5.10	X1030	 <p>401, 403, 654, 1022, 2101</p>	<p>Automatic operation of valve with automatic return towards open position.</p> <p>When the statement <i>ABC</i> is true (the signal has taken on its 1-state), the valve is closed. When the statement <i>ABC</i> is not true (the signal has taken on its 0-state), or when the auxiliary supply fails, the valve returns to 70% open position.</p>
6.5.11	X1031	 <p>401, 403, 654, 1022, 2301</p>	<p>Automatic operation of pump.</p> <p>When the binary input signal stands at its 1-state the pump is running. When the binary input signal takes on its 0-state or when the auxiliary supply fails, the pump stops.</p>
6.5.12	X1032	 <p>401, 403, 655, 1022, 2101</p>	<p>Automatic operation of valve with two stable positions, open and closed.</p> <p>When the binary signal <i>OPEN</i> takes on its 1-state in the form of a pulse, the valve is instantaneously opened. When the binary signal <i>CLOSE</i> takes on its 1-state in the form of a pulse the valve is instantaneously closed.</p>
6.5.13	X1033	 <p>401, 403, 655, 1022, 2101</p>	<p>Two methods are shown.</p>
6.5.14	X1034	 <p>401, 403, 659, 1022, 2101</p>	<p>Automatic operation of valve with infinite number of stable positions.</p> <p>When the binary signal <i>OPEN</i> takes on its 1-state the valve starts opening. When the binary signal <i>CLOSE</i> takes on its 1-state the valve starts closing. As soon as the input signal turns to 0-state the operation is interrupted.</p>
6.5.15	X1035	 <p>234, 401, 403, 659, 1022, 2101</p>	<p>Automatic operation of valve controlled by analog signal.</p> <p>The throughput increases/decreases when the value of the analog signal increases/decreases. If the analog signal or the auxiliary supply (if any) fails, the valve remains in its latest position.</p>
6.5.16	X1036	 <p>401, 403, 660, 1022, 2101</p>	<p>Automatic operation of valve with infinite number of stable positions.</p> <p>When the binary signal <i>OPEN</i> takes on its 1-state the valve starts opening. When the binary signal <i>CLOSE</i> takes on its 1-state the valve starts closing. As soon as the input signal turns to 0-state the operation is interrupted. Drift towards the closed position is permitted.</p>


7 INFORMATION-PROCESSING FUNCTIONS

7.1 Symbols of a Basic Nature

NOTE: For general application rules, see R1041 (7.2.1) to R1045 (7.2.5).

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
7.1.1	1041		Information-processing function.
7.1.2	1042		Information-processing function performed by time-sharing, for example, in a programmable device or computer. See R1046 (7.2.6).

7.2 Application Rules for the Symbols in Para. 7.1

Reference Number	Registration Number	Application Rules
7.2.1	R1041	When a symbol is provided with an enabling input, this input shall be located 90° apart from the input. For examples, see X1043 (7.5.3) and X1044 (7.5.4). When the symbols are used for analog signals and provided with an enabling input, the effect of the enabling signal when this has taken on its disabling state shall be noted on the opposite side of the enabling input, when applicable. For an example, see X1073 (7.5.33).
7.2.2	R1042	The asterisk shall be replaced with: <ul style="list-style-type: none"> — first, a letter symbol for measured or initiating variable according to 7.3.1; — second, a letter symbol for modifier according to 7.3.1, when applicable; and — third, a letter or more letters for function according to 7.3.1. The double asterisk shall be replaced with: <ul style="list-style-type: none"> — a symbol according to 7.3.2 if the letter symbol for function is A, S, or Z, when applicable, or else shall be omitted; — a symbol according to 7.3.3 if the letter symbol for function is Y.
7.2.3	R1043	If necessary, the symbols may be extended to give place for a code consisting of many letters: <div style="text-align: center;">  </div>
7.2.4	R1044	An identifying number may be located below the letter code for function.
7.2.5	R1045	For analog-converting or -computing functions (letter code Y), the use of symbols according to IEC 60617-13 may be used instead of the symbols given in 7.1.
7.2.6	R1046	If all measurement and control functions (except those directly connected to the process flow) are performed by time-sharing, symbol 1041 (7.1.1) may be used instead.

7.3 Symbols Giving Supplementary Information

7.3.1 Letter Symbols for Data Processing Functions

NOTE: For application rules, see R1051 (7.4.4) to R1067 (7.4.20).

Reference Number	Registration Number	Symbol	Measured or Initiating Variable	Modifier	Function
7.3.1.1	1051	A			Alarming
7.3.1.2	1052	B			Displaying discrete state
7.3.1.3	1053	C			Controlling

Reference Number	Registration Number	Symbol	Measured or Initiating Variable	Modifier	Function
7.3.1.4	1054	<i>D</i>	Density	Difference	
7.3.1.5	1055	<i>E</i>	Electric variable		Sensing
7.3.1.6	1056	<i>F</i>	Flow rate	Ratio, fraction	
7.3.1.7	1057	<i>G</i>	Gauge, position, length		Viewing
7.3.1.8	1058	<i>H</i>	Hand		
7.3.1.9	1059	<i>I</i>			Indicating
7.3.1.10	1060	<i>J</i>	Power	Scanning	
7.3.1.11	1061	<i>K</i>	Time	Time rate of change	
7.3.1.12	1062	<i>L</i>	Level		
7.3.1.13	1063	<i>M</i>	Moisture, humidity	Momentarily	
7.3.1.14	1064	<i>N</i>	User's choice		User's choice
7.3.1.15	1065	<i>O</i>	User's choice		
7.3.1.16	1066	<i>P</i>	Pressure, vacuum		Connection of test point
7.3.1.17	1067	<i>Q</i>	Quality	Integral, total	Integrating, summing
7.3.1.18	1068	<i>R</i>	Radiation		Registering, recording
7.3.1.19	1069	<i>S</i>	Speed, frequency		Switching
7.3.1.20	1070	<i>T</i>	Temperature		Transmitting
7.3.1.21	1071	<i>U</i>	Multi-variable		Multi function
7.3.1.22	1072	<i>V</i>	User's choice		Impact on process by valve, pump, etc.
7.3.1.23	1073	<i>W</i>	Weight, force	Multiplying	
7.3.1.24	1074	<i>X</i>	Unclassified		Unclassified
7.3.1.25	1075	<i>Y</i>	User's choice		Converting, computing
7.3.1.26	1076	<i>Z</i>	Number of events, quantity		Emergency or safety acting


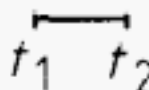






7.3.2 Letter Codes for Set Values

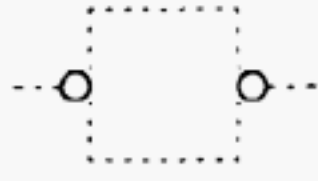
Reference Number	Registration Number	Letter Code	Description
7.3.2.1	1081	H	High.
7.3.2.2	1082	HH	Very High.
7.3.2.3	1083	H2	
7.3.2.4	1084	HHH	Extremely High.
7.3.2.5	1085	H3	
7.3.2.6	1086	L	Low.

Reference Number	Registration Number	Letter Code	Description
7.3.2.7	1087	LL	Very Low.
7.3.2.8	1088	L2	
7.3.2.9	1089	LLL	Extremely low.
7.3.2.10	1090	L3	
7.3.2.11	1091	HL	High or low.

7.3.3 Other General Functions





NOTE: Symbols for other general functions are to be found in ASME Y14.40.2. However, in order to facilitate the use of this Standard, some of the symbols are also shown here. For the construction of mathematical expressions, see ISO 31-11.

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
7.3.3.1	115		Amplification. NOTE: The triangle is pointed in the direction of transmission.
7.3.3.2	123		Delay. t_1 is the switch-on delay, t_2 the switch-off delay. See R112 (7.4.1) and the explanation in 2-4.3.2.9.
7.3.3.3	124		Hysteresis.
7.3.3.4	133	Form 1 	High limitation.
7.3.3.5	134	Form 2 	
7.3.3.6	135	Form 1 	Low limitation.
7.3.3.7	136	Form 2 	
7.3.3.8	137		Dead band; threshold.
7.3.3.9	138	HSEL	Selection of highest value.
7.3.3.10	139	LSEL	Selection of lowest value.
7.3.3.11	140	COMP	Comparing.
7.3.3.12	142	&	Logic AND-function.
7.3.3.13	143	≥ 1	Logic OR-function.
7.3.3.14	145	ϕ	Complex function. See R116 (7.4.2).
7.3.3.15	161	$\frac{X}{Y}$	Dividing. NOTE: The symbol for division in the form of an oblique stroke is not used because reserved for conversion, see symbol 112 (2-4.3.2.2).
7.3.3.16	162	$X * K$	Bias. See R117 (7.4.3).

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
7.3.3.17	163	1 - X	Reverse.
7.3.3.18	181		Logic negation (shown at an input and an output).

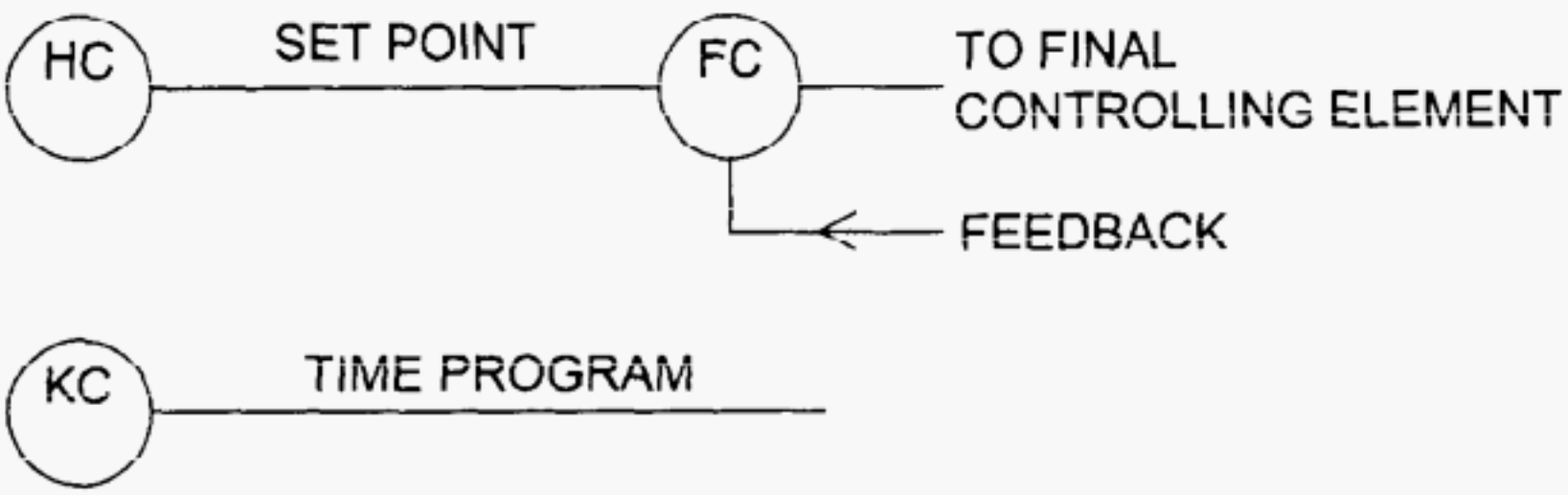
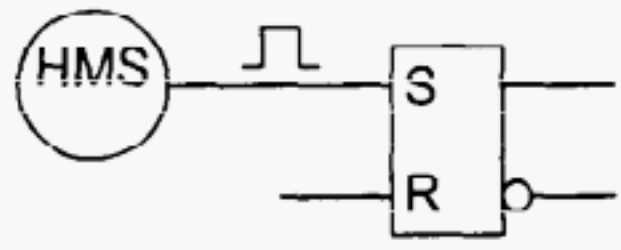
7.3.4 Indication of Location

NOTE: For application rules, see R1101 (7.4.21).

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
7.3.4.1	1101		Primary location in a central control room, for example, of a control station.
7.3.4.2	1102		Auxiliary location in a central control room.
7.3.4.3	1103		Primary location in a local control room or on a local control panel. See R1102 (7.4.22).
7.3.4.4	1104		Auxiliary location in a local control room or on a local control panel. See R1102 (7.4.22).

7.4 Application Rules for the Symbols in Para. 7.3



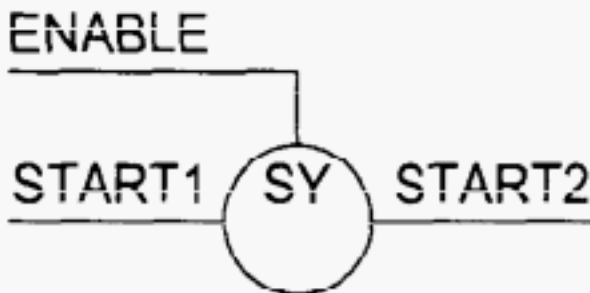
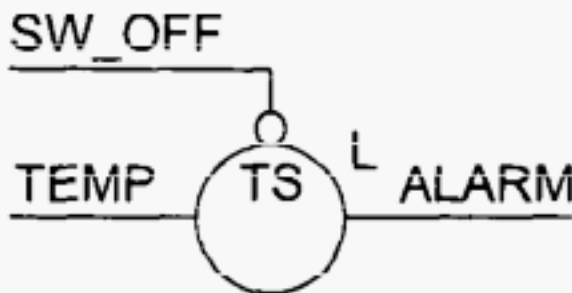
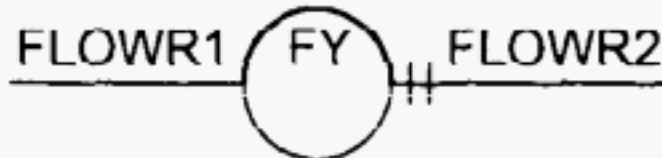
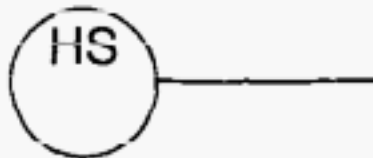
Reference Number	Registration Number	Application Rules
7.4.1	R112	<p>If only switch-on delay occurs, t_2 shall be omitted or replaced with 0. If only switch-off delay occurs, t_1 shall be omitted or replaced with 0. If $t_1 = t_2$, the notation may be replaced with the letter t centered.</p> <p>The notations may be replaced with the actual values.</p> <p>If the delay type is obvious, the notations may be left out.</p>
7.4.2	R116	The ϕ shall be supported by an indication of the function or a reference to an explanation. This information shall be stated within square brackets, for example, [Table 1].
7.4.3	R117	The asterisk shall be replaced with +, -, or \pm , depending on the type of bias.
7.4.4	R1051	<p>When two or more code letters for function according to the last column in 7.3.1 occur, the order of sequence shall be:</p> <p style="text-align: center;">G, I, B, R, C, T, X, Y, Q, S, Z, A</p> <p>Examples of complete letter codes according to this rule:</p> <p>QRC: Quality recording and control</p> <p>EIC: Indication and control of electric variable, for example, voltage</p> <p>TIT: Temperature indication and transmitting</p> <p>FRCQ: Flow rate recording and control with summation of volume</p> <p>PDICA: Pressure difference indication, control and alarm</p>
7.4.5	R1052	A "User's choice" letter shall be used for unlisted meanings used repetitively in a project. The meanings shall be explained on the diagram or in a supporting document.

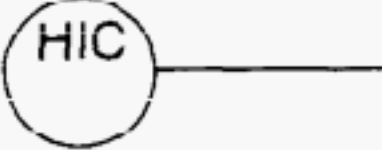
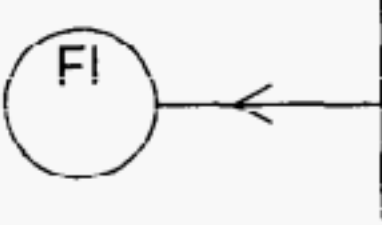
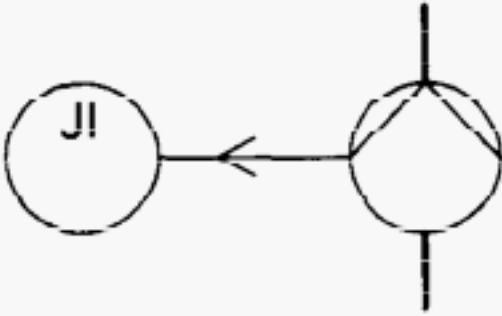

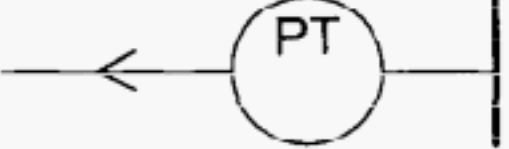

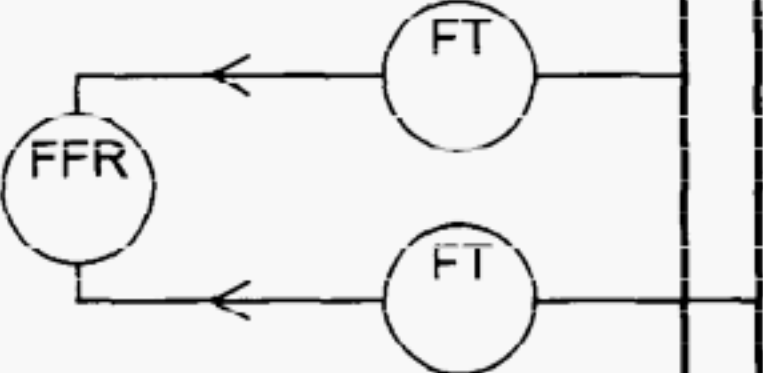
Reference Number	Registration Number	Application Rules
7.4.6	R1053	<p>The letter <i>C</i> for function shall be used both for feedback and open loop control functions as well as for the setting of reference values. However, for control by switching on or off by the operator or by the process itself the letter <i>S</i> shall be used for function.</p> 
7.4.7	R1054	The letter <i>G</i> for function refers to viewing, for example, by means of a sight glass or a television monitor.
7.4.8	R1055	The letter <i>H</i> for initiating variable stands for all types of manual actuation, for example, setting of reference value for feedback control and stop/start of a pump.
7.4.9	R1056	<p>The letter <i>I</i> for function applies to analog and digital readout functions of an actual measurement. It may also be used for indication of a setting value.</p> <p>NOTES: (1) For discrete indication, see letter <i>B</i>. (2) For simultaneous indication and recording, see R1062 (7.4.15).</p>
7.4.10	R1057	In the electrical field, the letter <i>J</i> as measured variable represents active power. For reactive power and apparent power, the letter <i>J</i> shall be used and, outside the circle, the annotation REACT or APPAR.
7.4.11	R1058	The letter <i>K</i> as modifier shall be used for, for example, acceleration (<i>SK</i>) and temperature derivative (<i>TK</i>).
7.4.12	R1059	<p>The letter <i>M</i> as modifier refers to a pulse-shaped output signal. The function of a manually actuated push-button (with automatic return) should be indicated thus:</p> 
7.4.13	R1060	The letter <i>P</i> as function shall be used to indicate the possibility of connecting, for example, a testing device to a process flow path, for example, a flow rate indicator. For an example, see X1052 (7.5.12).
7.4.14	R1061	The letter <i>Q</i> as measured variable should be supplemented with an indication outside the circle, specifying the type of quality.
7.4.15	R1062	The letter <i>K</i> as function shall be used for simultaneous recording and indication.
7.4.16	R1063	For the choice between letters <i>C</i> and <i>S</i> as function, see R1053 (7.4.6).
7.4.17	R1064	When the letter <i>U</i> for multivariable is used, it shall be made obvious to the reader of a diagram which variables are indicated, this being done, for example, by using the diagram itself or by a reference to an explanation.
7.4.18	R1065	When the letter <i>U</i> for multi-function is used, it shall be made obvious to the reader of a diagram which functions are indicated, this being done, for example, by a reference to an explanation.
7.4.19	R1066	The letter <i>X</i> shall be used for unlisted meanings used only to a limited extent. The letter may have any number of meanings as measured variable and any number of meanings as function. The meaning shall be defined just outside the circle.

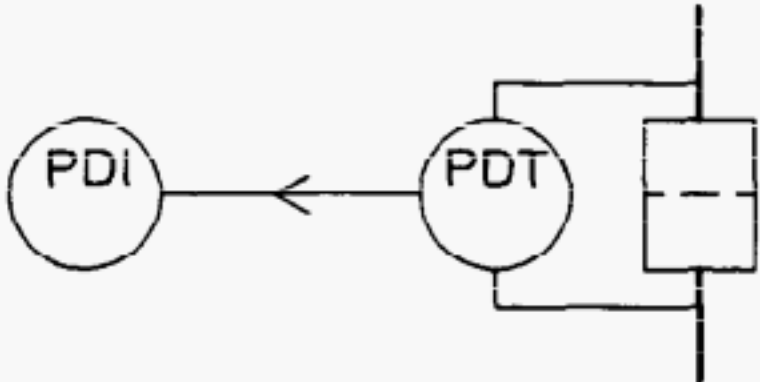
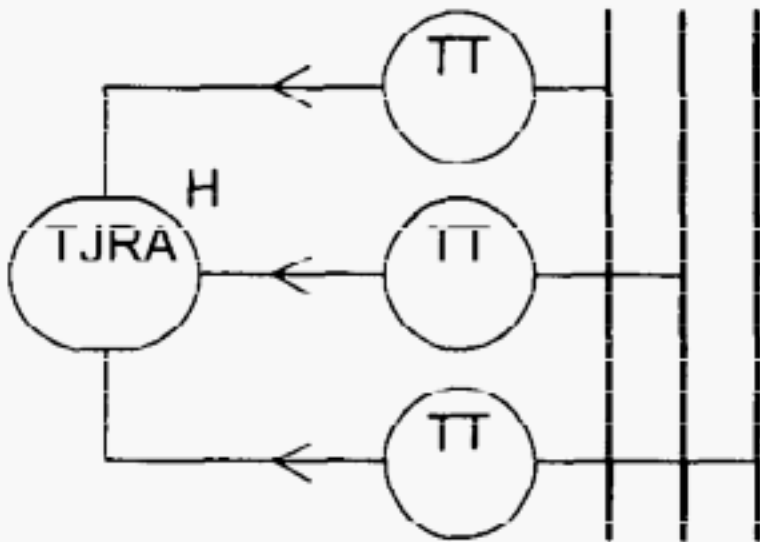
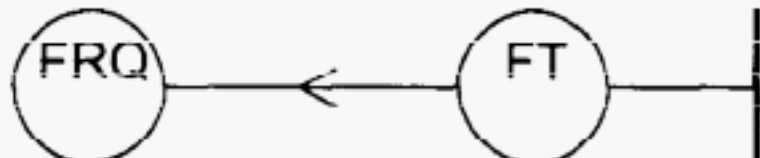
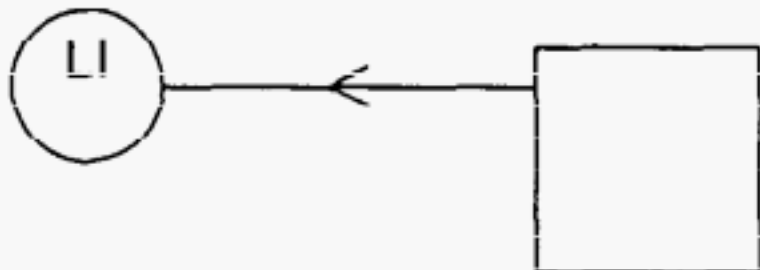
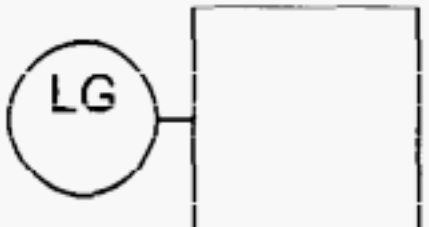
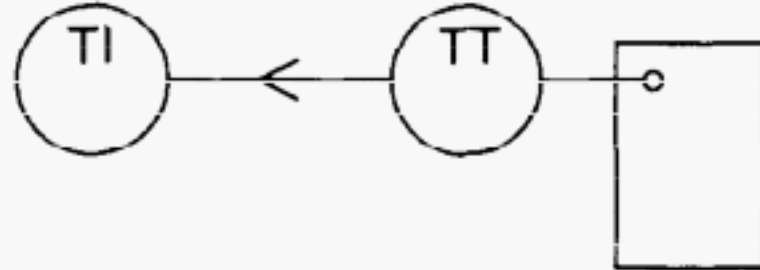
Reference Number	Registration Number	Application Rules
7.4.20	R1067	The letter Z as measured variable shall be used when control or monitoring responses are event-driven as opposed to time-or time schedule-driven. The letter may also signify presence or state.
7.4.21	R1101	The symbols for location may be placed at any height inside the symbols given in 7.1. Absence of a location symbol indicates that: <ul style="list-style-type: none"> — the location has not been decided or is of less interest, or — the device implementing the function is field-mounted. It shall be stated on the diagram which of these two possibilities applies, if it is not already obvious.
7.4.22	R1102	The symbol may be supplemented with information on the name of the local control room or the local control panel, just outside the symbols from 7.1, for example, COMPRESSOR, i.e. the local control room or local control panel for a compressor.

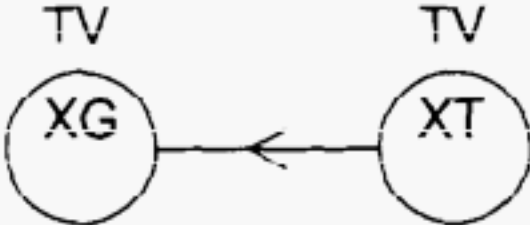
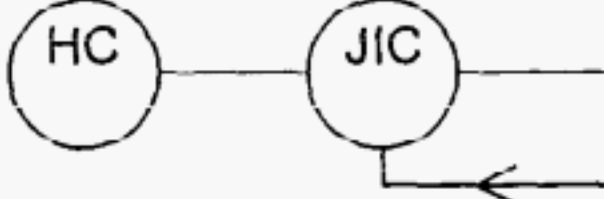
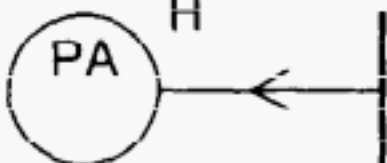
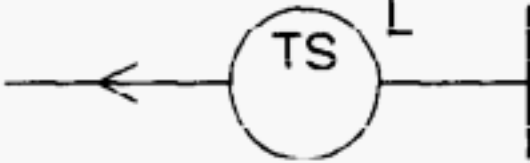
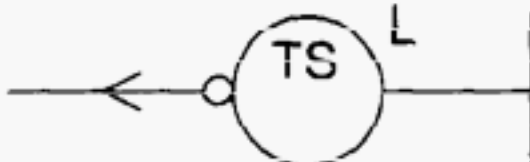
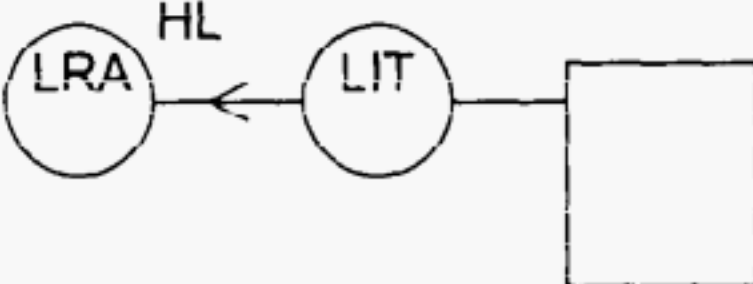
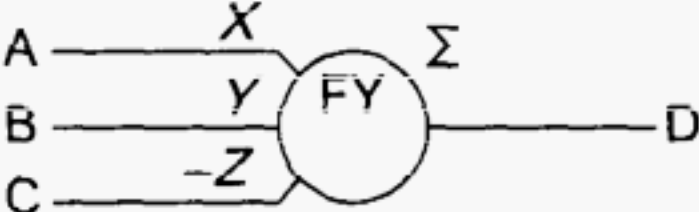

7.5 Application Examples

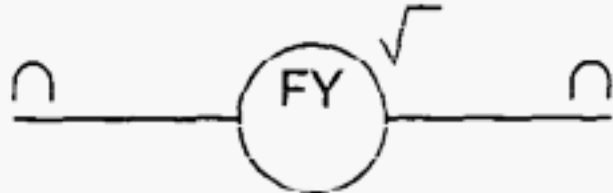
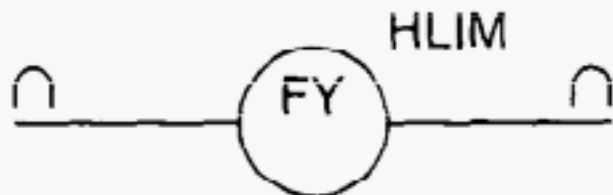
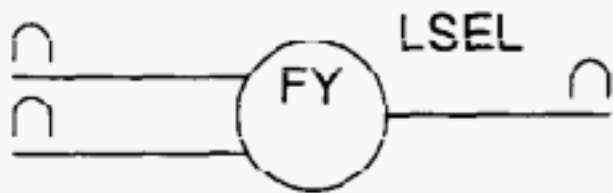
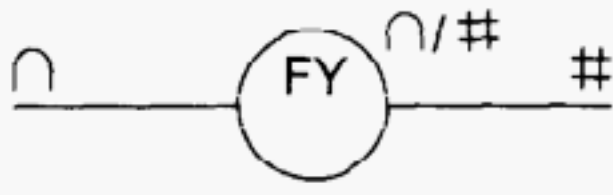
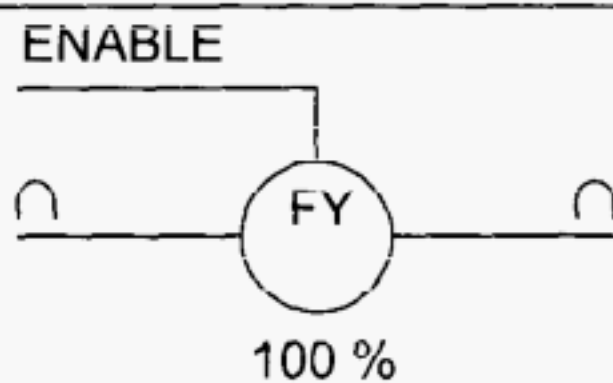
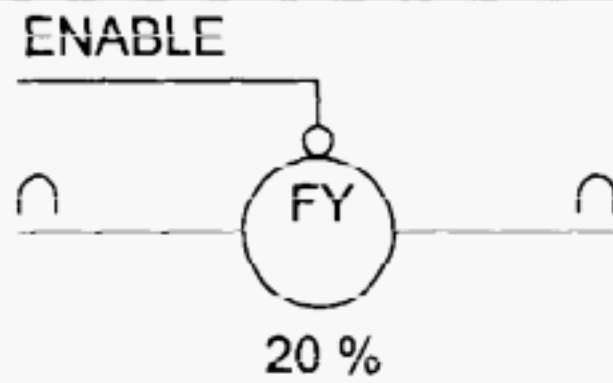
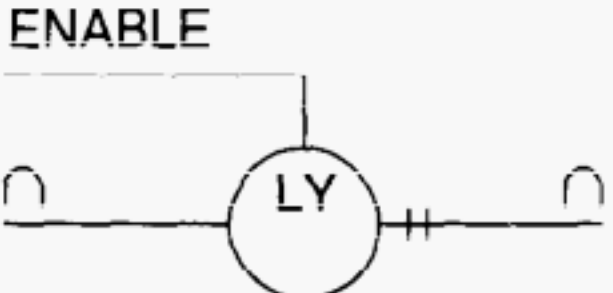
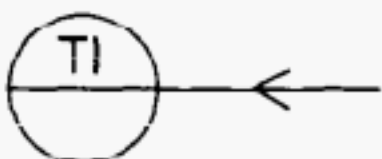
NOTE: In the application examples, the signal direction is from left to right if not otherwise specified by the use of symbols 249 (4.3.2) to 251 (4.3.4).


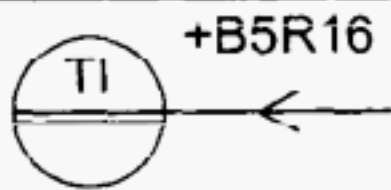
Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
7.5.1	X1041	 <p>181, 401, 1041, 1069, 1075</p>	Information processing function with negated input. When the statement COLD is true, then the statement START is not true (is false).
7.5.2	X1042	 <p>181, 401, 1041, 1056, 1072</p>	Information processing function with negated output. When the statement NOTRDY (not ready) is true, then the statement OPEN is not true.
7.5.3	X1043	 <p>401, 1041, 1069, 1075</p>	Information processing function with enabling. When the statement START1 is true, the statement START2 is true provided the statement ENABLE is true.
7.5.4	X1044	 <p>181, 401, 1041, 1069, 1070</p>	Information processing function with negated enabling (disabling). If the temperature is low, then the statement ALARM is true provided the statement SW_OFF is not true.
7.5.5	X1045	 <p>401, 659, 1041, 1056, 1075</p>	Information processing function with retained output signal. The value of the signal FLOWR2 (flow rate 2) is the same as that of the signal FLOWR1. However, if FLOWR1 disappears, FLOWR2 maintains its latest value.
7.5.6	X1046	 <p>401, 1041, 1058, 1069</p>	Manual switching, for example, for start and stop of motor-pump set.

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
7.5.7	X1047		Manual setting of set value of feedback control function with indication of set value, or manual control of control valve with indication.
		401, 1041, 1053, 1058, 1059	
7.5.8	X1048		Flow rate indication.
		249, 401, 405, 1041, 1056, 1059	
7.5.9	X1049		Pump motor power indication.
		249, 401, 1041, 1059, 1060, 2301	
7.5.10	X1050		Voltage registering.
		249, 401, 405, 1041, 1055, 1068	
7.5.11	X1051		Pressure transmitting.
		249, 401, 405, 1041, 1066, 1070	
7.5.12	X1052		Pressure testing facility by direct connection to process flow.
		401, 405, 1041, 1066	
7.5.13	X1053		Flow rate transmitting and registering of ratio between two flow rates.
		249, 401, 405, 1041, 1056, 1068, 1070	

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
7.5.14	X1054	 <p>249, 301, 401, 405, 1041, 1054, 1059, 1066, 1070, 2602</p>	Difference pressure transmitting for strainer and indication.
7.5.15	X1055	 <p>249, 401, 405, 1041, 1051, 1060, 1068, 1070, 1081</p>	Temperature registering by scanning and alarm at high temperature.
7.5.16	X1056	 <p>249, 401, 405, 1041, 1056, 1067, 1068, 1070</p>	Recording of flow rate with summation of volume.
7.5.17	X1057	 <p>249, 401, 1041, 1059, 1062, 2061</p>	Indication of level in a vessel.
7.5.18	X1058	 <p>401, 1041, 1057, 1062, 2061</p>	Indication of level in a vessel by viewing.
7.5.19	X1059	 <p>249, 401, 1011, 1041, 1059, 1070, 2061</p>	Measuring point inside and at top of vessel, temperature transmitting and indication.

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
7.5.20	X1060	 <p>249, 401, 1041, 1057, 1070, 1074</p>	Television transmission and monitoring.
7.5.21	X1061	<p>REACT.</p>  <p>249, 401, 1041, 1053, 1058, 1059, 1060</p>	Indication and feedback control of electric reactive power.
7.5.22	X1062	 <p>249, 401, 405, 1041, 1051, 1066, 1081</p>	High-pressure alarm.
7.5.23	X1063	 <p>249, 401, 405, 1041, 1069, 1070, 1086</p>	Temperature switching. The output signal takes on its 1-state when the temperature assumes a value below the set point.
7.5.24	X1064	 <p>181, 249, 401, 405, 1041, 1069, 1070, 1086</p>	Temperature switching. The output signal takes on its 0-state when the temperature assumes a value below the set point.
7.5.25	X1065	 <p>249, 401, 1041, 1051, 1059, 1062, 1068, 1070, 1091, 2061</p>	Indicating and transmitting of level in a vessel, registering and alarm at high or low level.
7.5.26	X1066	 <p>106, 401, 1041, 1056, 1075</p>	Summing of flow rate signals: $D = A + B - C$
7.5.27	X1067	 <p>106, 401, 1041, 1056, 1075</p>	Subtraction of flow rate signals: $C = A - B$

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
7.5.28	X1068	 <p>234, 401, 1041, 1056, 1075</p>	Square root extraction of flow rate signal.
7.5.29	X1069	 <p>133, 234, 401, 1041, 1056, 1075</p>	Limitation of high values of flow rate signal.
7.5.30	X1070	 <p>139, 234, 401, 1041, 1056, 1075</p>	Selection of the lowest flow rate signal.
7.5.31	X1071	 <p>112, 234, 235, 401, 1041, 1056, 1075</p>	Conversion of analog flow rate signal to digital form.
7.5.32	X1072	 <p>234, 401, 1041, 1056, 1075</p>	Flow rate computing. When the enabling binary signal takes on its 1-state the output signal is the same as the input signal. When the enabling signal takes on its 0-state the output signal assumes a value representing 100% of the rated value of the flow rate.
7.5.33	X1073	 <p>181, 234, 401, 1041, 1056, 1075</p>	Flow rate computing. When the enabling binary signal takes on its 0-state the output signal is the same as the input signal. When the enabling signal takes on its 1-state the output signal assumes a value representing 20% of the rated value of the quantity being measured.
7.5.34	X1074	 <p>234, 401, 659, 1041, 1062, 1075</p>	Level computing. When the enabling binary signal takes on its 1-state the output signal is the same as the input signal. When the enabling signal takes on its 0-state the output signal retains its latest momentary value.
7.5.35	X1075	 <p>249, 401, 1041, 1059, 1070, 1101</p>	Temperature indication in central control room.

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
7.5.36	X1076		Temperature indication in central control room; instrument not accessible to the operator.
249, 401, 1041, 1059, 1070, 1102			
7.5.37	X1077		Temperature indication in local control room designated +B5R16 or on local control panel in that room.
249, 401, 1041, 1059, 1070, 1103			

8 BINARY LOGIC FUNCTIONS

See IEC 60617-12.

9 BACK-UP FUNCTIONS

9.1 Symbols of a Basic Nature

See para. 7.1.

9.2 Application Rule for Symbols in Para. 9.1

Reference Number	Registration Number	Application Rule
9.2.1	R1201	Back-up functions shall be indicated by a symbol abutted on the symbol for the ordinary function and unconnected to the functional link. For an example, see X1081 (9.5.1).

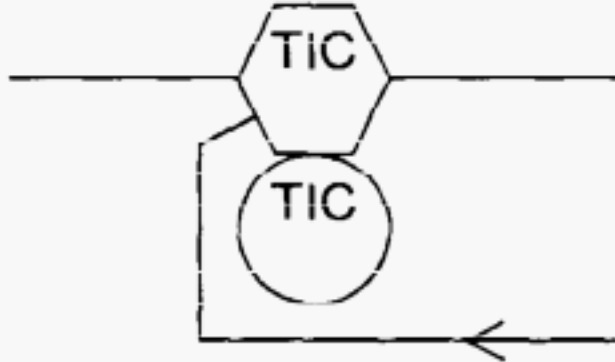
9.3 Symbol Giving Supplementary Information

None.

9.4 Application Rule for Symbol in Para. 9.3

None.

9.5 Application Example

Reference Number	Registration Number	Symbol Form/Shape	Application Example
9.5.1	X1081		Temperature indication and control performed by computer with back-up by discrete device.
249, 401, 1041, 1042, 1053, 1059, 1070			

10 EXAMPLES OF USE OF SYMBOLS IN CONTROL LOOPS

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
10.1	X1101	<p>401, 403, 654, 1022, 1041, 1058, 1069, 2101</p>	Manual, remote control of valve with automatic return to closed position.
10.2	X1102	<p>249, 401, 403, 501, 659, 1022, 1041, 1057, 1058, 1059, 1069, 1070, 2101</p>	Manual, remote control of valve with infinite number of stable positions and indication of the valve position.
10.3	X1103	<p>201, 234, 401, 403, 654, 1022, 1041, 1053, 1058, 1059, 2101</p>	Manual, remote control of control valve with indication of set value.
10.4	X1104	<p>201, 249, 401, 403, 654, 1022, 1041, 1053, 1056, 1058, 1059, 1068, 1070, 2101</p>	Flow rate feedback control.
10.5	X1105	<p>201, 249, 301, 401, 403, 654, 1022, 1041, 1042, 1053, 1056, 1058, 1059, 1068, 1070, 2101, 2501</p>	Temperature-flow rate cascade control.

Reference Number	Registration Number	Symbol Form/Shape	Symbol Description
10.6	X1106	<p>201, 249, 401, 403, 654, 1022, 1041, 1042, 1053, 1056, 1058, 1059, 1070, 1075, 2101</p>	Flow rate feedback control, based on square-root value of flow rate.
10.7	X1107	<p>181, 201, 249, 401, 403, 654, 1022, 1041, 1042, 1053, 1056, 1058, 1059, 1069, 1070, 1075, 1081, 2101</p>	Flow rate feedback control with automatic closing of valve at flow rate higher than set value.
10.8	X1108	<p>101, 106, 181, 249, 401, 403, 654, 1022, 1041, 1056, 1058, 1063, 1067, 1069, 1070, 1081, 2101, IFC</p>	Flow rate feedback control where valve opens at manual command and closes when preset volume reached or by manual stop command.

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