

ISA-5.5-1985

Formerly ISA-S5.5-1985



Graphic Symbols for Process Displays

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ISA—The Instrumentation,
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Preface

This preface is included for informational purposes and is not a part of ISA-5.5-1985.

This Standard has been prepared as a part of the service of ISA toward a goal of uniformity in the field of instrumentation. To be of real value, this document should not be static, but should be subject to periodic review. Toward this end, the Society welcomes all comments and criticisms and asks that they be addressed to the Secretary, Standards and Practices Board, ISA, 67 Alexander Drive, P.O. Box 12277, Research Triangle Park, North Carolina 27709, Telephone (919) 549-8411, e-mail: standards@isa.org.

The ISA Standards and Practices Department is aware of the growing need for attention to the metric system of units in general and the International System of Units (SI) in particular, in the preparation of instrumentation standards. The Department is further aware of the benefits to U.S.A. users of ISA Standards of incorporating suitable references to the SI (and the metric system) in their business and professional dealings with other countries. Toward this end, this Department will endeavor to introduce SI-acceptable metric units in all new and revised standards to the greatest extent possible. *The Metric Practice Guide*, which has been published by the Institute of Electrical and Electronics Engineers as ANSI/IEEE Std. 268-1982, and future revisions will be the reference guide for definitions, symbols, abbreviations, and conversion factors.

It is the policy of ISA to encourage and welcome the participation of all concerned individuals and interests in the development of ISA Standards. Participation in the ISA Standards-making process by an individual in no way constitutes endorsement by the employer of that individual of ISA or any of the standards which ISA develops.

The information contained in this preface, in the footnotes, and in the appendices is included for information only and is not part of the standard.

The original draft of this document resulted from the committee work of the International Purdue Workshop on Industrial Computer Systems, the Man/ Machine Communication Committee TC-6.

The use of graphic symbols representing entities and characteristics of processes has evolved rapidly during the course of the last decade. Technology has allowed the presentation of a physical process to be represented and controlled by the use of computers and advanced electronic systems. These systems use video-display technologies such as CRTs, plasma screens, and other media to present to the user a graphic representation of his process. It is through these devices and the symbology used to represent the process in question that the user monitors and controls the particular operation.

Process displays convey information to the user in the form of both text and graphic symbols. Text information is based on the use of numeric data and the alphabet to construct the words necessary to convey the meaning of the information. This text information is structured around the use of written language and is highly ordered and understood by users. On the other hand, the use of graphic symbols for process and information presentation is highly dependent upon the manufacturer and the user of the product. These graphic symbols are generally customized to the particular application at hand.

Standard graphic symbols provide a more logical and uniformly understandable mechanism for modern control processes. For example, a control system may be constructed of several control systems and a central control system. In cases such as this, the operator often finds that he

must become familiar with the graphic symbology of several different systems, although they may represent common elements.

It is the intent of this document that both the manufacturers and users of process displays use these graphic symbols in their systems whenever applicable. It is recognized that technology is rapidly changing in the types of devices available for process display use. The graphic symbols suggested in this standard should provide a foundation for all display systems that are used to display and control processes. The graphic symbols that are represented in this standard are divided into 13 major groups. Attributes associated with the various types of symbols such as color usage, blink, orientation, etc., are addressed in the document.

The symbols defined in ISA-S5.5 are intended to supplement those of ISA-S5.1 and ISA-S5.3 to provide a cohesive integration of graphic symbology and common industry usage of flow diagrams. ISA-S5.1 and ISA-S5.3 are drafting standards which govern the depiction of process and instrumentation symbols for drawings and other printed documents. The ISA-S5.5 symbols were developed for use on video devices that represent both character display and pixel addressable displays. Use of the symbols also applies to both color and monochromatic video displays as well as other media. Therefore, the symbols that are represented in this standard may differ from those in the other standards because of the nature of the physical devices used to display the symbols. The principal users of these symbols are operators and other personnel who use information concerning process operations.

The main intent of the graphic symbols is to provide to the user an easily understandable representation of his process on a display device. Computers, distributed control systems, stand-alone microprocessor-based systems, etc., can appear to be similar or to perform similar functions; however, they are diverse in philosophy and graphic presentation. Therefore, it is essential that a common set of symbols be used to convey process information to the users of such devices.

The symbols presented in this standard are by no means all that were suggested or that may be required; however, by adopting these as a standard, the majority of present processes may be adequately represented. When it becomes necessary to develop special symbols for equipment not included in the standard, simplicity of form is considered of paramount importance.

The ISA Standards Committee on Graphic Symbols for Process Displays SP5.5 operates within the ISA Standards and Practices Department, Norman Conger, Vice President. The persons listed below served as members of ISA Committee SP5.5, which prepared this standard:

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R. F. Carroll, Chairman 1981	Setpoint, Inc.
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This standard was approved for publication by the ISA Standards and Practices Board in December 1985.

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1 Purpose

The purpose of this standard is to establish a system of graphic symbols for process displays that are used by plant operators, engineers, etc., for process monitoring and control. The system is intended to facilitate rapid comprehension by the users of the information that is conveyed through displays, and to establish uniformity of practice throughout the process industries.

Resulting benefits are intended to be as follows:

- a) A decrease in operator errors
- b) A shortening of operator training
- c) Better communication of the intent of the control system designer to the system users

An objective of the standard is to insure maximum compatibility of symbols on process visual display units (VDUs) with related symbols used in other disciplines.

The symbols in this standard are intended to depict processes and process equipment. The symbols are suitable for use on Visual Display Units (VDUs), such as Cathode Ray Tubes (CRTs).

2 Scope

The standard is suitable for use in the chemical, petroleum, power generation, air conditioning, metal refining, and numerous other industries.

Though the standard may make use of standard symbols now used for piping and instrument diagrams, logic diagrams, loop diagrams, and other documents, the symbols of the standard are generally expected to be used in ways complementing existing types of engineering documents.

The symbolism is intended to be independent of type or brand of hardware or computer software.

2.1 Application to work activities

This standard is suitable for use whenever any reference to process equipment on VDUs is required. Such references may be required for the following uses as well as others:

- a) Process displays on CRTs
- b) Process displays on other visual media such as plasma displays, liquid crystal displays, etc.

2.2 Relationship to other ISA Standards

This standard complements, whenever possible, ISA Standards S5.1 "Instrumentation Symbols and Identification," S5.3 "Flow Diagram Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems," RP60.05 "Graphic Displays for Control Centers," and ANSI/ISA S51.1 "Process Instrumentation Terminology."

2.3 Relationship to other symbol standards

This document complements the ANSI Standard for process flow sheets, ANSI Y32.11M — "Graphic Symbols for Process Flow Diagrams in the Petroleum and Chemical Industries" and ANSI/NEMA Standard ICS 1-1978 "General Standards for Industrial Control and Systems" whenever possible and practical.

2.4 Definitions

Aspect ratio: The ratio of a symbol's height to its width.

Background: The field that information is displayed upon for contrast.

Blinking: A periodic change of hue, saturation, or intensity of a video display unit pixel, character, or graphic symbol.

Character: A term used to refer to a predefined group of pixels.

Chromaticity: The color quality of light, which is characterized by its dominant wavelength and purity.

Color coding: The use of different background and foreground colors to symbolically represent processes and process equipment attributes, such as status, quality, magnitude, identification, configuration, etc.

Foreground: The information element on a background field.

Graphic symbol: An easily recognized pictorial representation.

Highlighting: A term encompassing various attention-getting techniques, such as blinking, intensifying, underscoring, and color coding.

Intensity: The lumination level (i.e., brightness) of the pixels of a VDU.

Pixel: The smallest controllable display element on a VDU. Also referred to as picture element (PEL).

Process visual display: A dynamic display intended for operators and others engaged in process monitoring and control.

Reverse Video: The interchange of foreground and background attributes, such as intensity, color, etc.

Task/Surround lumination ratio: The luminance ratio between the keyboard and screen (TASK) and workplace (SURROUND) within the operator's field of view.

Visual Display Unit (VDU): A generic term used for display units based on technologies such as Cathode Ray Tubes (CRTs), Plasma Discharge Panels (PDPs), Electroluminescent Devices (ELs), Liquid Crystal Displays (LCDs), etc.

3 Symbols

3.1 Symbol usage

3.1.1 General

- 1) The graphic symbols in this standard are intended for use on VDUs.
- 2) Because size variations of symbols representing the various pieces of equipment are anticipated, no scale is indicated on the graphic symbol sketches. The integrity of the defined symbols should be preserved by maintaining the aspect ratio depicted.
- 3) Color coding to improve the perception of information and ease of interpretation of the displayed image is anticipated.
- 4) Graphic symbols should be arranged to depict spatial relationships, energy, material and data flows in a consistent manner (e.g., left to right, top to bottom, etc.). Equipment outlines and piping lines may be differentiated by color, intensity, or width.
- 5) Symbols may be rotated in any orientation on a VDU in order to represent the process in the most effective manner.
- 6) Arrows may be used on process lines to indicate direction of flow.
- 7) Symbols should be shown only when they are important to understanding the operation or are an integral part of the process depicted. Symbol qualities, such as luminance, size, color, fill, and contrast should be considered collectively and judiciously in order to avoid any psychophysiological masking of adjacent display targets, such as measurement values, alarm messages, labels, etc.
- 8) Numeric values and text may be included to enhance comprehension. The values may be either static or dynamic.
- 9) Graphic displays may contain both static and dynamic symbols and data. The symbol set, while intended for color displays, is also usable on monochromatic displays.
- 10) Special characteristics of displays should be used to enhance the understanding of process symbols. These characteristics may be used to indicate the status of process devices:

- Reverse video
- Blinking
- Intensity variation
- Color coding

These characteristics can be used for both static and dynamic symbol applications.

- 11) The use of outline and solid (filled) forms to indicate status is as follows:

- An outline symbol form indicates an off, stopped, or nonactive state.
- A solid (filled) symbol form indicates an on, running, or active state.

Status designation by use of solid or outline forms are particularly applicable to the

Rotating Equipment and Valves and Actuators groups of symbols. Prudence in judgment should be used when adhering to this practice as some symbols should not change from their outline form. In depicting valve position, use solid to show open (material flowing or active) and outline to show closed (material stopped or nonactive). Another usage is solid/outline to represent a pump running/stopped as the generally accepted practice. Some industries, such as the power industry, use solid/outline to show closed (active or unit energized)/open (nonactive or unit deenergized). In these special cases, the explicit uses of these conventions are to be made clear to the operator and noted in operation manuals.

- 12) A symbol may be partially filled or shaded to represent the characteristic of the contents of a vessel, e.g., level, temperature, etc.
- 13) Properties of physical or chemical states, as measured by primary elements or instruments, can be represented on a VDU by symbolic characters. It is not normal to display these characters on a process display, but they are available if required. Appendix B contains the recommended designated characters and an example of their usage. This list has been derived from character designations based on the ISA Standard S5.1, "Instrumentation Symbols and Identification." It has been modified for use on VDU displays. An excerpt of the S5.1 document explaining the identification-letter usage is also included in Appendix B.

3.1.2 Color

Color is an effective coding technique used either singularly or redundantly with symbol, shape, and alphanumeric coding. Although this standard pertains exclusively to the definition and configuration of display symbols, certain color application guidelines have, nevertheless, been included for the convenience of the display designer. They are as follows:

- 1) Information-bearing color schemes should be simple, consistent, and unambiguous.
- 2) The most common color technology is the CRT using the raster display scheme and an additive color generation technique based on the three primaries: red, blue, and green. The number of selectable colors can range from six plus black and white to the thousands. The number of colors in one display should be limited to the minimum necessary to satisfy the process interface objectives of the display. Color is an effective coding technique for dynamic identification and classification of display elements. Used judiciously, it can improve operator performance, e.g., reduce search time, improve element identification, etc. Conversely, irrelevant color can act as visual noise and negate the positive effects of color coding. Typically, four colors can accommodate the dynamic coding requirements of process displays.
- 3) Large background areas should be black. In situations where the black background results in a high task/surround lumination ratio, a brighter background may be used, preferably blue or brown.
- 4) Compatible color combinations, i.e., those with high chromaticity contrast, should be used. Some good combinations include: black-on-yellow, red-on-white, blue-on-white, and green-on-white. Combinations to avoid include: yellow-on-white, yellow-on-green, red-on-magenta, and cyan-on-green. In each case, the weight or size of the foreground element must also be considered. Certain combinations like blue-on-black can be acceptable only when the blue element is sufficiently large. These generalizations neglect the effects of lumination levels and ambient lighting. Each pair should be evaluated on a per-case basis.

- 5) Use color as a redundant indicator along with text, symbol, shape, size, reverse video, blinking, and intensity coding to preserve communications of critical process state and quality information with individuals having limited color perception.
- 6) To insure fast operator response, use highly saturated colors such as red or yellow.
- 7) Colors should not be used to indicate quantitative value.
- 8) The display designer should establish a project-related set of generic color meanings before developing a list of specific color-to-display-element associations. This generic set should be based on applicable plant, industry, and agency (OSHA, NRC, ANSI, etc.) conventions. Each project may have its unique set of generic definitions; e.g., Project A uses red to indicate closed or inactive states, while Project B uses green. In some special cases, such as the power industry, red may indicate closed and active or unit energized. This is suitable as long as the color meanings are defined as such for the particular project. Listed below is an example of a unique project-related color plan:

Color plan example

Color	Generic meaning	Element association
Black	Background	
Red	Emergency	A) Stop B) Highest Priority Alarm C) Closed D) Off
Yellow	Caution	A) Abnormal Condition B) Second Priority Alarm
Green	Safe	A) Normal Operation B) Start C) Open D) On
Cyan (Light Blue)	Static & Significant	A) Process Equipment in Service B) Major Labels
Blue	Nonessential	A) Standby Process Equipment B) Labels, Tags, etc.
Magenta (Purple)	Radiation	A) Radiation Alarms B) Questionable Values
White	Dynamic Data	A) Measurements & State Information B) System Messages C) Trend D) Active Sequential Step

3.2 Grouping of symbols

The graphic symbols for process displays have been divided into related groups. There are 13 groups and their contents are as follows:

Group	Symbol	Section
Connectors		3.3.1
Containers and Vessels		3.3.2
Process	Distillation Tower	3.3.2
	Jacketed Vessel	3.3.2
	Reactor	3.3.2
	Vessel	3.3.2
Storage	Atmospheric Tank	3.3.2
	Bin	3.3.2
	Floating Roof Tank	3.3.2
	Gas Holder	3.3.2
	Pressure Storage Vessel	3.3.2
	Weigh Hopper	3.3.2
Electrical	Circuit Breaker	3.3.3
	Manual Contactor	3.3.3
	Delta Connection	3.3.3
	Fuse	3.3.3
	Motor	3.3.3
	State Indicator	3.3.3
	Transformer	3.3.3
	Wye Connection	3.3.3
Filters	Liquid Filter	3.3.4
	Vacuum Filter	3.3.4
Heat Transfer Devices	Exchanger	3.3.5
	Forced Air Exchanger	3.3.5
	Furnace	3.3.5
	Rotary Kiln	3.3.5
HVAC (Heating Ventilating and Air Conditioning)	Cooling Tower	3.3.6
	Evaporator	3.3.6
	Finned Exchanger	3.3.6
Material Handling	Conveyor	3.3.7
	Mill	3.3.7
	Roll Stand	3.3.7
	Rotary Feeder	3.3.7
	Screw Conveyor	3.3.7

Group	Symbol	Section
Mixing	Agitator	3.3.8
	Inline Mixer	3.3.8
Reciprocating Equipment	Reciprocating Compressor or Pump	3.3.9
Rotating Equipment	Blower	3.3.10
	Compressor	3.3.10
	Pump	3.3.10
	Turbine	3.3.10
Scrubbers and Precipitators	Electrostatic Precipitator	3.3.11
	Scrubber	3.3.11
Separators	Cyclone Separator	3.3.12
	Rotary Separator	3.3.12
	Spray Dryer	3.3.12
Valves and Actuators		3.3.13
Actuators	Actuator	3.3.13
	Throttling Actuator	3.3.13
	Manual Actuator	3.3.13
Valves	Valve	3.3.13
	3-Way Valve	3.3.13
	Butterfly Valve	3.3.13
	Check Valve	3.3.13
	Relief Valve	3.3.13

The symbols are presented in Section 3.3, Structure of Symbols. The symbols are categorized into their respective groups and are presented in alphabetical order. Each symbol is described with the following information:

Group	An associated classification of similar symbols
Subgroup	Represents further division within a group
Symbol Name	The name of the process symbol
Symbol Mnemonic	A four-character name given to the symbol to be used as its reference name in a computer system
Description	A brief description of what the symbol represents
Symbol Drawing	The actual drawing of the symbol itself. Although no specific aspect ratio is given, the shape that is drawn should be depicted as closely as possible. Process connections and flow directions have been included with some symbols for functional clarity. These may be arranged as necessary. Heads shown on containers and vessels are those most frequently encountered for that specific type. However, dished, elliptical, hemispherical, conical, or flat heads may be substituted where appropriate to match the actual configuration of the device.

3.3 Structure of symbols

3.3.1 Group: Connectors

Subgroup: N/A


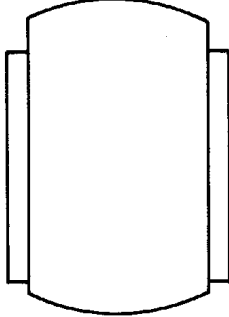
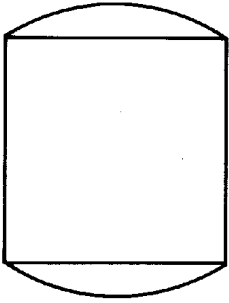
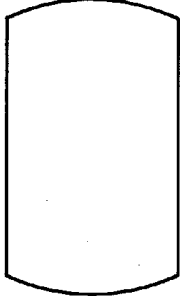
Symbol Name: N/A

Symbol Mnemonic: N/A

Description: For the purpose of this document, the various possible connectors have been excluded. In the majority of cases, pipe connections are not required to be detailed. A recommended practice to avoid any confusion on the video display is to use line breaks to indicate that the lines do not join. The most important lines should be kept solid with the secondary lines being broken. If all lines are of equal importance, a usual convention is to break the vertical line.

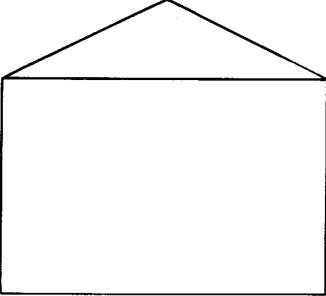
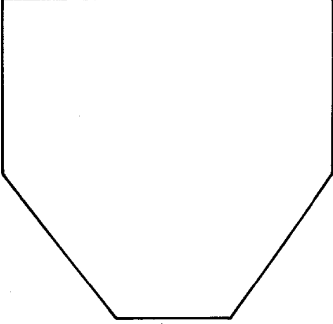
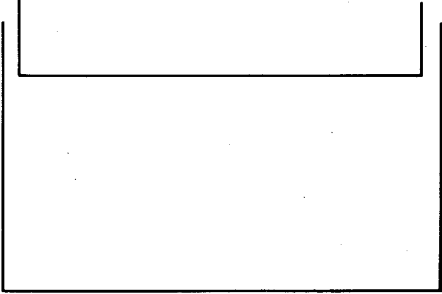
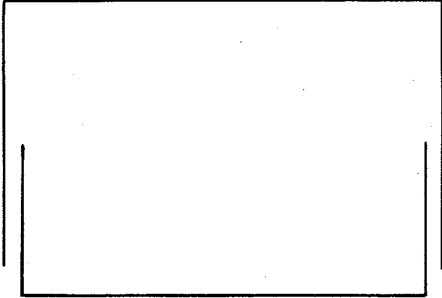
3.3 Structure of symbols

3.3.2 Group: Containers and vessels

<p>Subgroup: Process Symbol Name: Distillation Tower Symbol Mnemonic: DTWR</p> <p>Description: A packed or trayed distillation tower used for separation. Packing or trays may be shown to indicate type of distillation tower.</p> 	<p>Subgroup: Process Symbol Name: Jacketed Vessel Symbol Mnemonic: JVSL</p> <p>Description: A vessel with a heating or cooling jacket. Jacket may be on straight shell, on bottom head, on top head, or any combination, as required to match the actual process vessel.</p> 
<p>Subgroup: Process Symbol Name: Reactor Symbol Mnemonic: RCTR</p> <p>Description: A chemical reactor. Internal details may be shown to indicate type of reactor.</p> 	<p>Subgroup: Process Symbol Name: Vessel Symbol Mnemonic: VSSL</p> <p>Description: A vessel or separator. Internal details may be shown to indicate type of vessel. Can also be used as a pressurized vessel in either a vertical or horizontal arrangement.</p> 

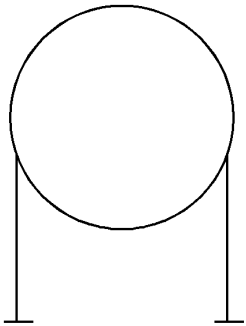
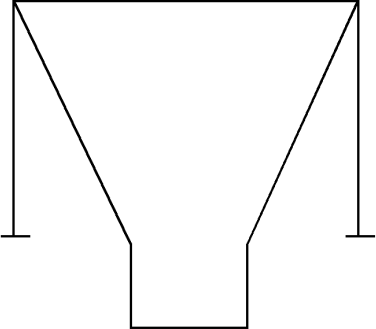
3.3 Structure of symbols

3.3.2 Group: Containers and vessels (cont'd)

<p>Subgroup: Storage Symbol Name: Atmospheric Tank Symbol Mnemonic: ATNK</p> <p>Description: A tank for material stored under atmospheric pressure.</p> 	<p>Subgroup: Storage Symbol Name: Bin Symbol Mnemonic: BINN</p> <p>Description: A container used to store solid or granular material that is discharged from the bottom.</p> 
<p>Subgroup: Storage Symbol Name: Floating Roof Tank Symbol Mnemonic: FTNK</p> <p>Description: A tank for liquids with roof of vessel moving up and down with a change in stored volume.</p> 	<p>Subgroup: Storage Symbol Name: Gas Holder Symbol Mnemonic: GHDR</p> <p>Description: A tank for gases with roof of vessel moving up and down with a change in stored volume.</p> 


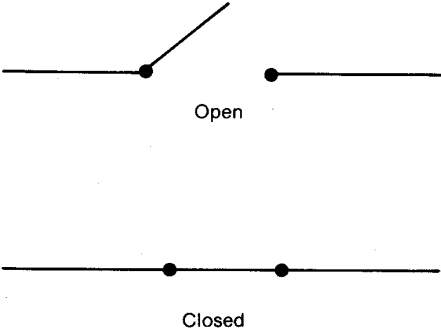
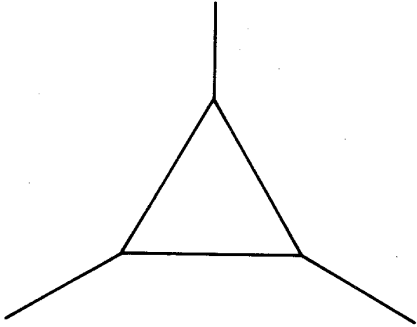
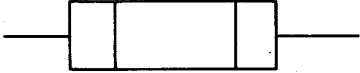
3.3 Structure of symbols

3.3.2 Group: Containers and vessels (cont'd)

<p>Subgroup: Storage Symbol Name: Pressure Storage Vessel Symbol Mnemonic: PVSL Description: A pressurized spherical vessel for storage of gases and liquids.</p> 	<p>Subgroup: Storage Symbol Name: Weigh Hopper Symbol Mnemonic: WHPR Description: A vessel used for weighing material.</p> 
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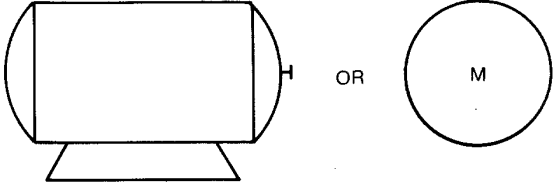
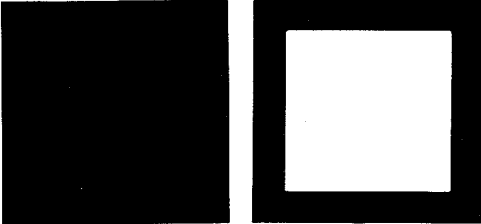
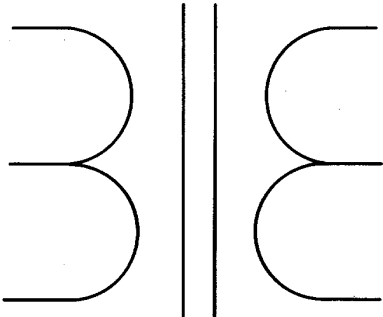
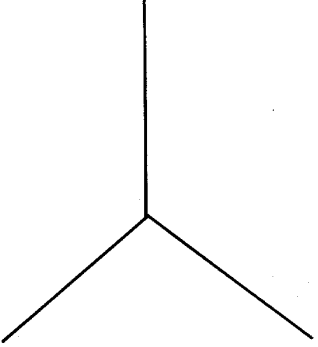
3.3 Structure of symbols

3.3.3 Group: Electrical

<p>Subgroup: N/A Symbol Name: Circuit Breaker Symbol Mnemonic: CBRK</p> <p>Description: Representation of a circuit breaker for electrical systems. See STATE INDICATOR symbol for alternative use.</p> 	<p>Subgroup: N/A Symbol Name: Manual Contactor Symbol Mnemonic: MCTR</p> <p>Description: A power distribution switch used for device isolation.</p> 
<p>Subgroup: N/A Symbol Name: Delta Connection Symbol Mnemonic: DLTA</p> <p>Description: Representation of a 3-phase delta connection.</p> 	<p>Subgroup: N/A Symbol Name: Fuse Symbol Mnemonic: FUSE</p> <p>Description: Representation of a fuse as an over-current protection device.</p> 

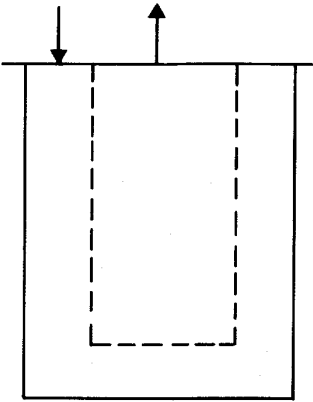
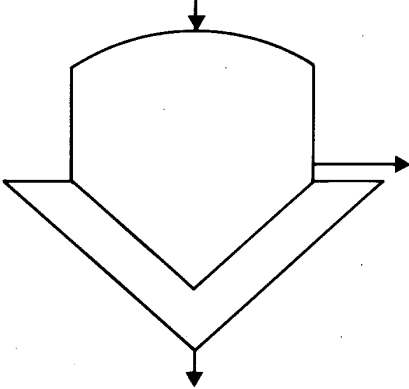
3.3 Structure of symbols

3.3 Group: Electrical (cont'd)

<p>Subgroup: N/A Symbol Name: Motor Symbol Mnemonic: MOTR Description: An ac or dc motor.</p>  <p>OR</p> <p>This is the preferred symbol for process diagrams (base optional).</p> <p>This is the preferred symbol for electrical diagrams.</p>	<p>Subgroup: N/A Symbol Name: State Indicator Symbol Mnemonic: STAT Description: Used to represent binary states. For example: Circuit Closed/Circuit Open, etc.</p>  <p>Circuit Closed Circuit Open</p>
<p>Subgroup: N/A Symbol Name: Transformer Symbol Mnemonic: XFMR Description: A universal transformer.</p> 	<p>Subgroup: N/A Symbol Name: WYE Connection Symbol Mnemonic: WYEC Description: Representation of a 3-phase wye (star) connection.</p> 

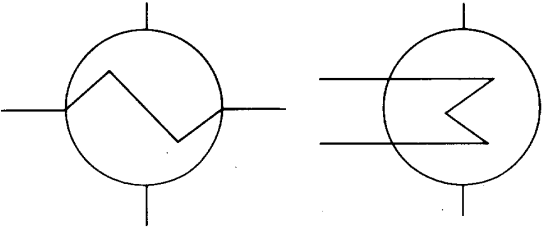
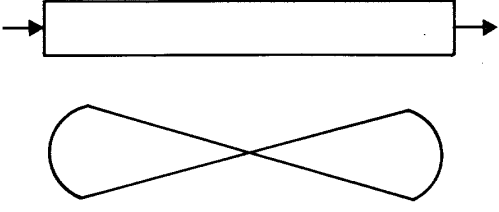
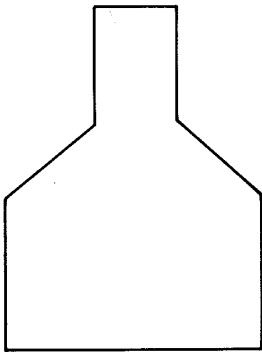
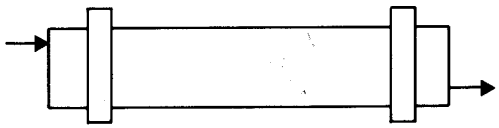
3.3 Structure of symbols

3.3.4 Group: Filters

<p>Subgroup: N/A Symbol Name: Liquid Filter Symbol Mnemonic: LFLT Description: A liquid filter.</p> 	<p>Subgroup: N/A Symbol Name: Vacuum Filter Symbol Mnemonic: VFLT Description: A vacuum-assisted filtration device.</p> 
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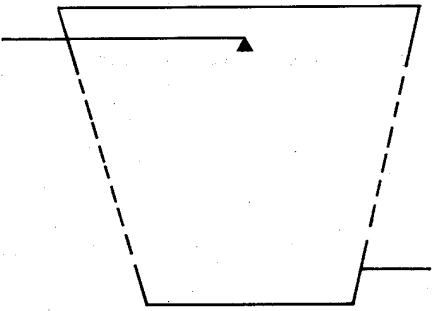
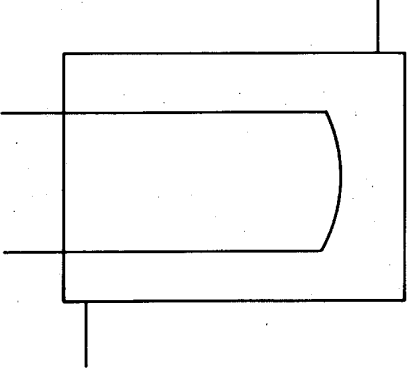
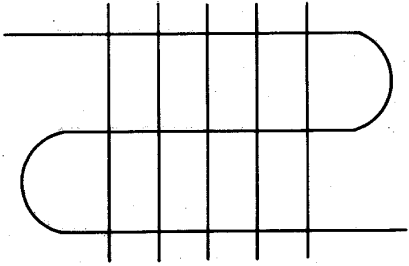
3.3 Structure of symbols

3.3.5 Group: Heat transfer devices

<p>Subgroup: N/A Symbol Name: Exchanger Symbol Mnemonic: XCHG</p> <p>Description: Heat transferral equipment. An alternative symbol is depicted.</p>  <p>Alternative</p>	<p>Subgroup: N/A Symbol Name: Forced Air Exchanger Symbol Mnemonic: FAXR</p> <p>Description: A forced-air heat exchanger.</p> 
<p>Subgroup: N/A Symbol Name: Furnace Symbol Mnemonic: FURN</p> <p>Description: Process heater or furnace. Internal details may be shown as needed.</p> 	<p>Subgroup: N/A Symbol Name: Rotary Kiln Symbol Mnemonic: KILN</p> <p>Description: Typical gas, oil, coal or coke-fired kiln.</p> 

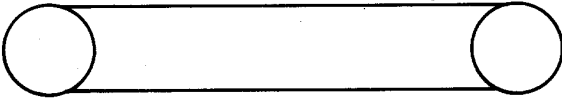
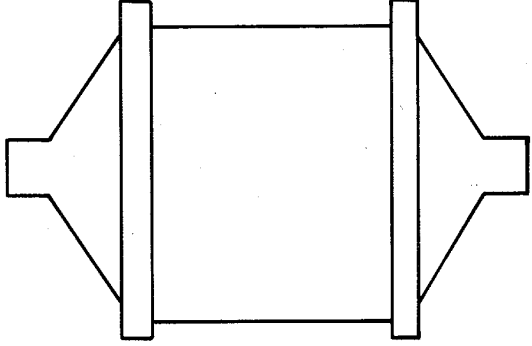
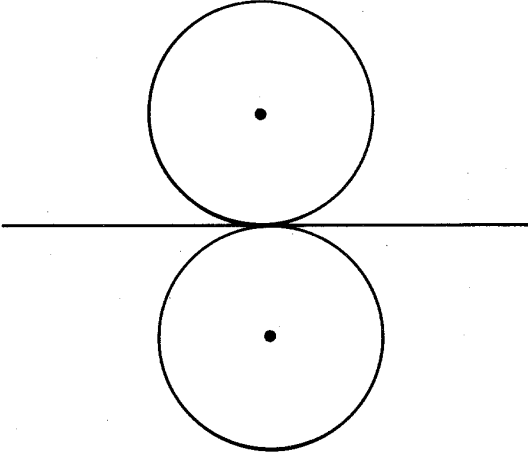
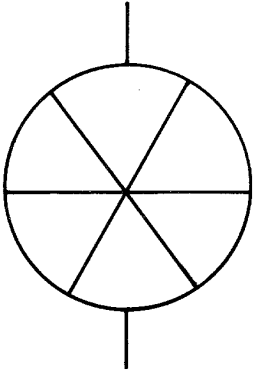
3.3 Structure of symbols

3.3.6 Group: HVAC (heating ventilation & air conditioning)

<p>Subgroup: N/A Symbol Name: Cooling Tower Symbol Mnemonic: CTWR</p> <p>Description: A device for use in HVAC or other processes indicating the atmospheric cooling of water by forced evaporation.</p> 	<p>Subgroup: N/A Symbol Name: Evaporator Symbol Mnemonic: EVPR</p> <p>Description: An HVAC device used to represent the exchange of heat between a liquid or gas and a refrigerant.</p> 
<p>Subgroup: N/A Symbol Name: Finned Exchanger Symbol Mnemonic: FNXR</p> <p>Description: A high surface transfer device used to exchange heat between a liquid or gas and air.</p> 	

3.3 Structure of symbols

3.3.7 Group: Material handling

<p>Subgroup: N/A Symbol Name: Conveyor Symbol Mnemonic: CNVR</p> <p>Description: Belt conveyors, chain conveyors, and roller conveyors used in association with other symbols to represent more complex equipment such as a paper machine.</p> 	<p>Subgroup: N/A Symbol Name: Mill Symbol Mnemonic: MILL</p> <p>Description: Rotating rod, ball, autogenous, or semiautogenous mill used for size reduction of solids.</p> 
<p>Subgroup: N/A Symbol Name: Roll Stand Symbol Mnemonic: RSTD</p> <p>Description: Roll stand used in metal, paper, rubber, plastic, and glass industries.</p> 	<p>Subgroup: N/A Symbol Name: Rotary Feeder Symbol Mnemonic: RFDR</p> <p>Description: A rotary feeder used to convey material in dry powder form from one location to another.</p> 

3.3 Structure of symbols

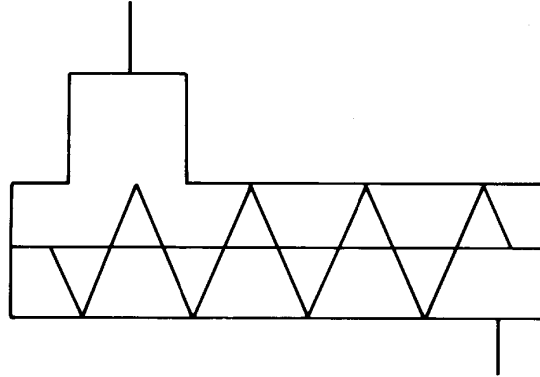
3.3.7 Group: Material handling (cont'd)

Subgroup: N/A

Symbol Name: Screw Conveyor

Symbol Mnemonic: SCNV

Description: A typical screw conveyor or screw pump.



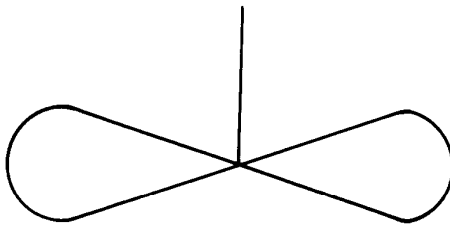
3.3.8 Mixing

Subgroup: N/A

Symbol Name: Agitator

Symbol Mnemonic: AGIT

Description: A blade, propeller, or paddle-type agitator.

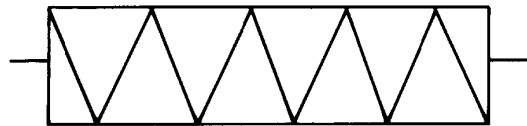


Subgroup: N/A

Symbol Name: Inline Mixer

Symbol Mnemonic: IMIX

Description: A mixing device used to continuously blend materials.



3.3 Structure of symbols

3.3.9 Group: Reciprocating equipment

Subgroup: N/A

Symbol Name: Reciprocating Compressor

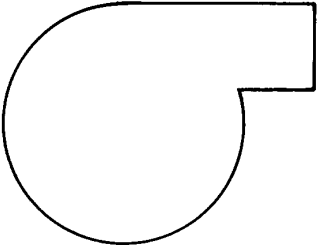
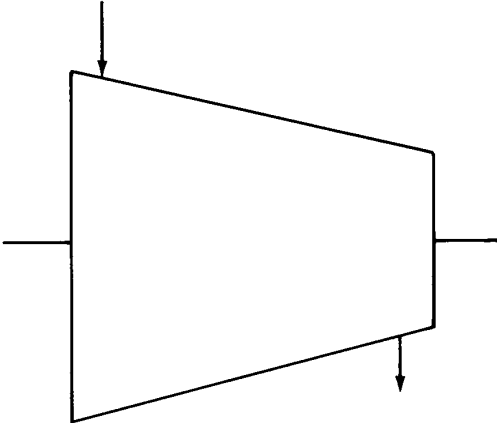
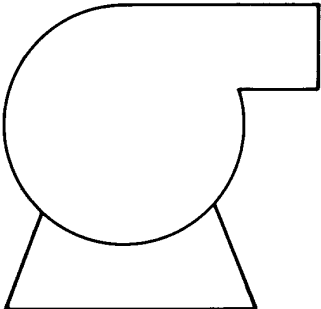
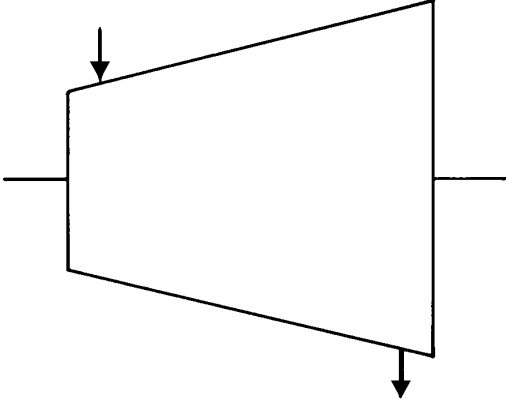
Symbol Mnemonic: RECP

Description: A reciprocating compressor or pump represents that class of equipment used to transport slurries or liquids by reciprocating action. Examples are pistons, diaphragms, plungers, etc.



3.3 Structure of symbols

3.3.10 Group: Rotating equipment

<p>Subgroup: N/A Symbol Name: Blower Symbol Mnemonic: BLWR</p> <p>Description: A device used to convey a gas under slight pressure.</p> 	<p>Subgroup: N/A Symbol Name: Compressor Symbol Mnemonic: CMPR</p> <p>Description: A device used to convey a gas under high pressure.</p> 
<p>Subgroup: N/A Symbol Name: Pump Symbol Mnemonic: PUMP</p> <p>Description: Represents that class of equipment used to transport slurries or liquids by internal rotary action. Examples are centrifugal, gear, lobe, etc.</p> 	<p>Subgroup: N/A Symbol Name: Turbine Symbol Mnemonic: TURB</p> <p>Description: A device using the force of expanding gas to propel rotating equipment.</p> 

3.3 Structure of symbols

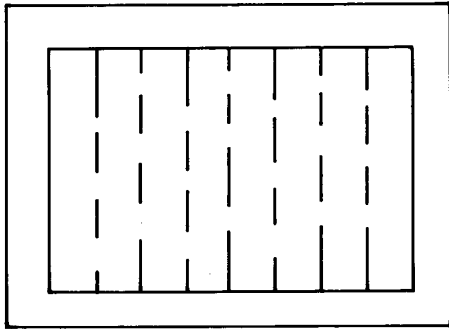
3.3.11 Group: Scrubber and precipitators

Subgroup: N/A

Symbol Name: Electrostatic Precipitator

Symbol Mnemonic: EPCP

Description: A device used to separate solid particles from a gas (e.g., in a smoke stack) by means of an electrostatically charged grid.

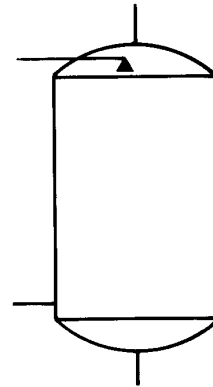


Subgroup: N/A

Symbol Name: Scrubber

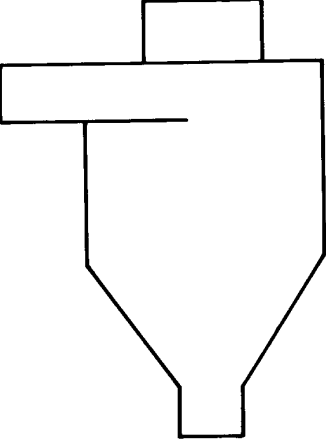
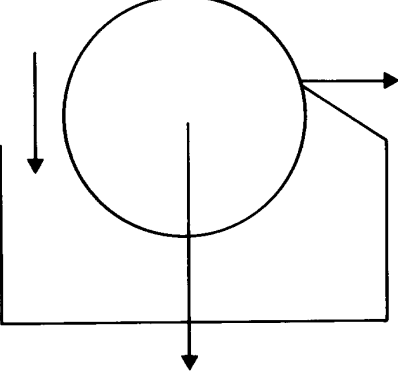
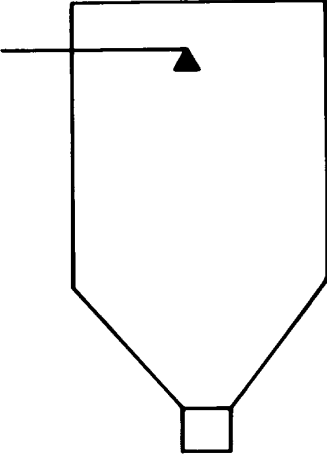
Symbol Mnemonic: SCBR

Description: A device that uses a liquid spray to scrub gas.



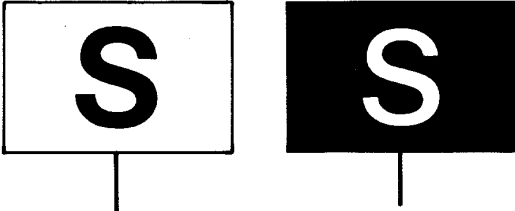
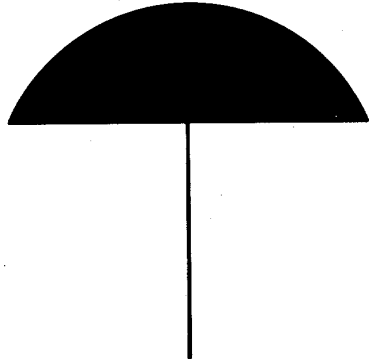
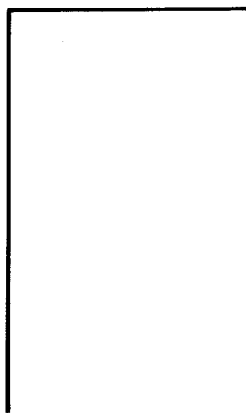
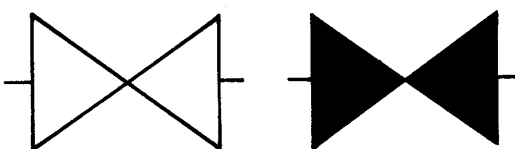
3.3 Structure of symbols

3.3.12 Group: Separators

<p>Subgroup: N/A Symbol Name: Cyclone Separator Symbol Mnemonic: CSEP</p> <p>Description: A device used for solid, liquid, or vapor separation.</p>  <p>The diagram shows a cyclone separator, which is a vertical cylindrical vessel with a conical bottom. It has a horizontal inlet pipe on the left side that enters near the top. At the top center, there is a smaller cylindrical outlet. The bottom of the vessel tapers to a small square outlet.</p>	<p>Subgroup: N/A Symbol Name: Rotary Separator Symbol Mnemonic: RSEP</p> <p>Description: A rotary device for separating solids from liquids.</p>  <p>The diagram shows a rotary separator, which is a circular vessel mounted on a vertical shaft. It has a horizontal inlet pipe on the left side that enters near the top. At the top right, there is a horizontal outlet pipe. At the bottom center, there is a vertical outlet pipe. Arrows indicate the flow direction: down the inlet, up the shaft, and out through the top and bottom pipes.</p>
<p>Subgroup: N/A Symbol Name: Spray Dryer Symbol Mnemonic: SDRY</p> <p>Description: A device used for evaporation of liquids from mixtures of solids and liquids.</p>  <p>The diagram shows a spray dryer, which is a vertical cylindrical vessel with a conical bottom. It has a horizontal inlet pipe on the left side that enters near the top. At the bottom center, there is a small square outlet.</p>	

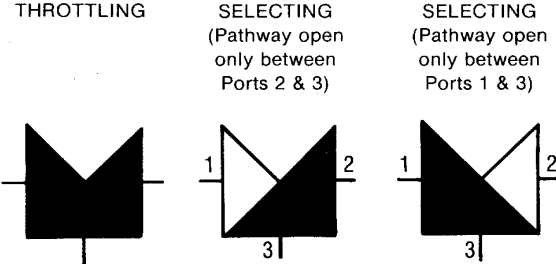
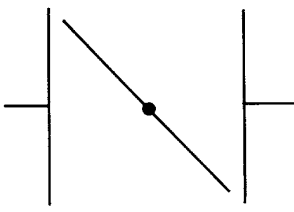
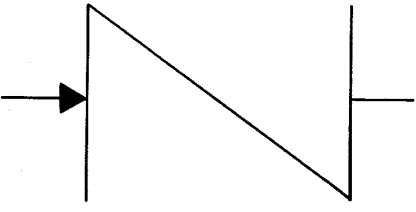
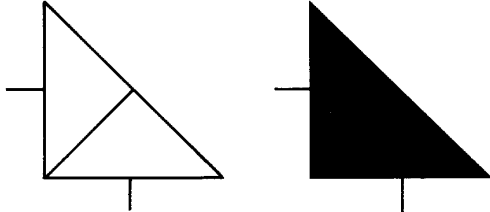
3.3 Structure of symbols

3.3.13 Group: Valves and actuators

<p>Subgroup: Actuators Symbol Name: Actuator Symbol Mnemonic: ACTR</p> <p>Description: Represents the final control element that determines the state of a two-state device.</p> <p>Desired Device State is CLOSED Desired Device State is OPEN</p>  <p>The use of a letter in the symbol to designate the type of actuator is optional. Other choices include:</p> <p><u>Character Designation</u> M = Electrical Motor S = Solenoid H = Hydraulic A = Air Motor</p>	<p>Subgroup: Actuators Symbol Name: Throttling Actuator Symbol Mnemonic: TACT</p> <p>Description: Represents a diaphragm actuator that can affect multiple positions of the controlled device.</p> 
<p>Subgroup: Actuators Symbol Name: Manual Actuator Symbol Mnemonic: MATR</p> <p>Description: Represents a manually-operated valve actuator.</p> 	<p>Subgroup: Valves Symbol Name: Valve Symbol Mnemonic: VLVE</p> <p>Description: Represents GLOBE, GATE, BALL, and NEEDLE valves used to regulate fluid flow through piping systems. Can be used with various combinations of actuators to convey multiple manipulation schemes.</p> <p>Actual State is CLOSED Actual State is OPEN</p> 

3.3 Structure of symbols

3.3.13 Group: Valves and actuators (cont'd)

<p>Subgroup: Valves Symbol Name: 3-Way Valve Symbol Mnemonic: VLV3</p> <p>Description: Represents a valve used in piping systems to select flow paths or regulate between flow paths. Can be used with various combinations of actuators to convey multiple manipulation schemes.</p> <p>THROTTLING SELECTING (Pathway open only between Ports 2 & 3) SELECTING (Pathway open only between Ports 1 & 3)</p>  <p>Note: Port numbers are not part of symbol.</p>	<p>Subgroup: Valves Symbol Name: Butterfly Valve Symbol Mnemonic: BVLV</p> <p>Description: Represents a butterfly valve, damper, or vane used to throttle (modulate) fluid flow through a pipe, duct, or stack.</p> 
<p>Subgroup: Valves Symbol Name: Check Valve Symbol Mnemonic: CVLV</p> <p>Description: Represents a device that mechanically limits fluid flow to only one direction in a piping system — typically a check valve or back-draft damper.</p>  <p>Arrow shows direction of allowable flow and is part of the symbol.</p>	<p>Subgroup: Valves Symbol Name: Relief Valve Symbol Mnemonic: RVLV</p> <p>Description: Represents a one-way mechanically actuated pressure relief valve. While these valves are normally closed, two symbols are shown to accommodate those situations where feedback signals are provided to indicate actual status.</p> <p>Normally closed valve that is actually CLOSED Normally closed valve that is actually OPEN</p> 

Appendix A — Examples of use

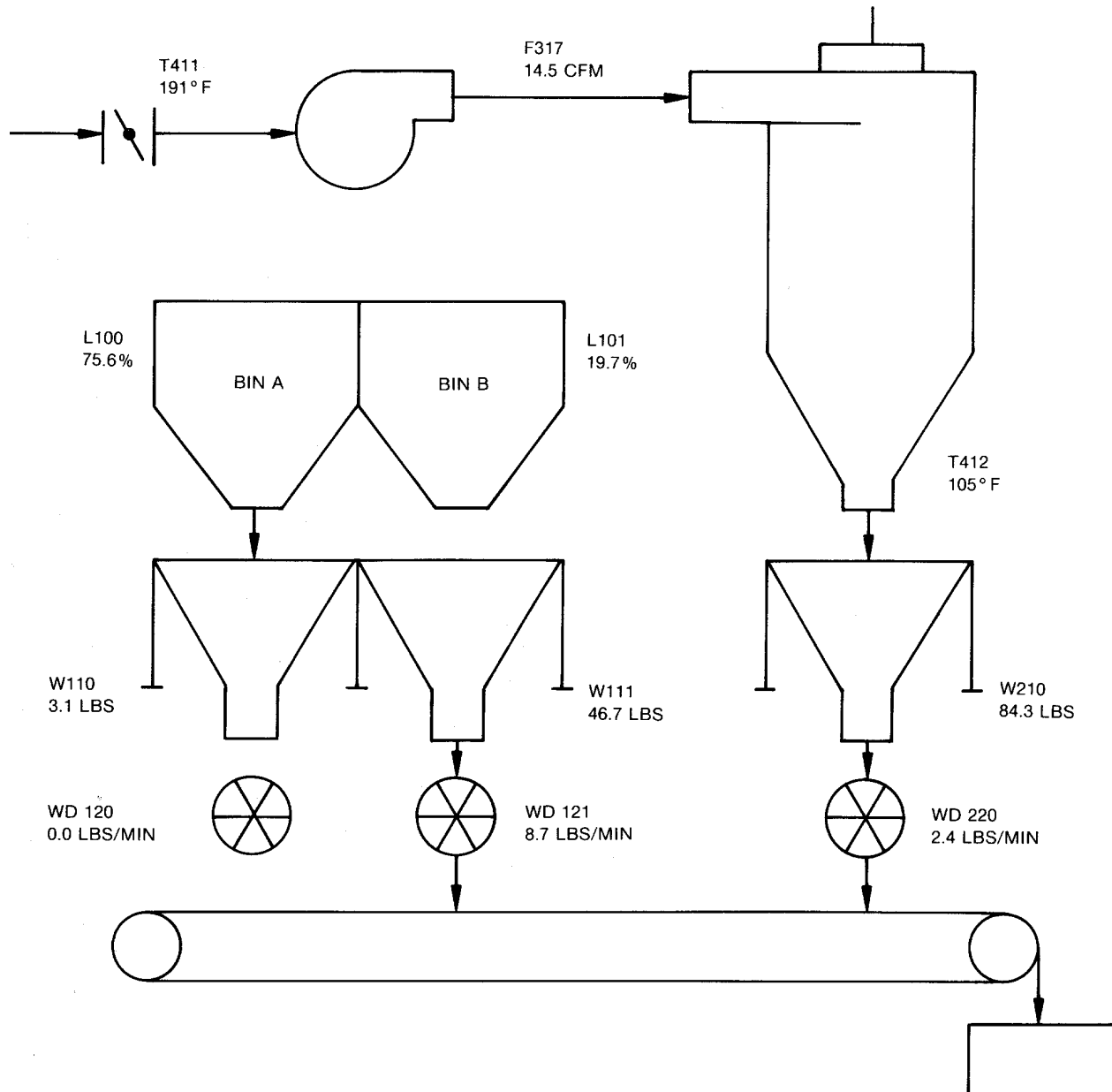


Figure A-1 — Gas cleaning and particle collection

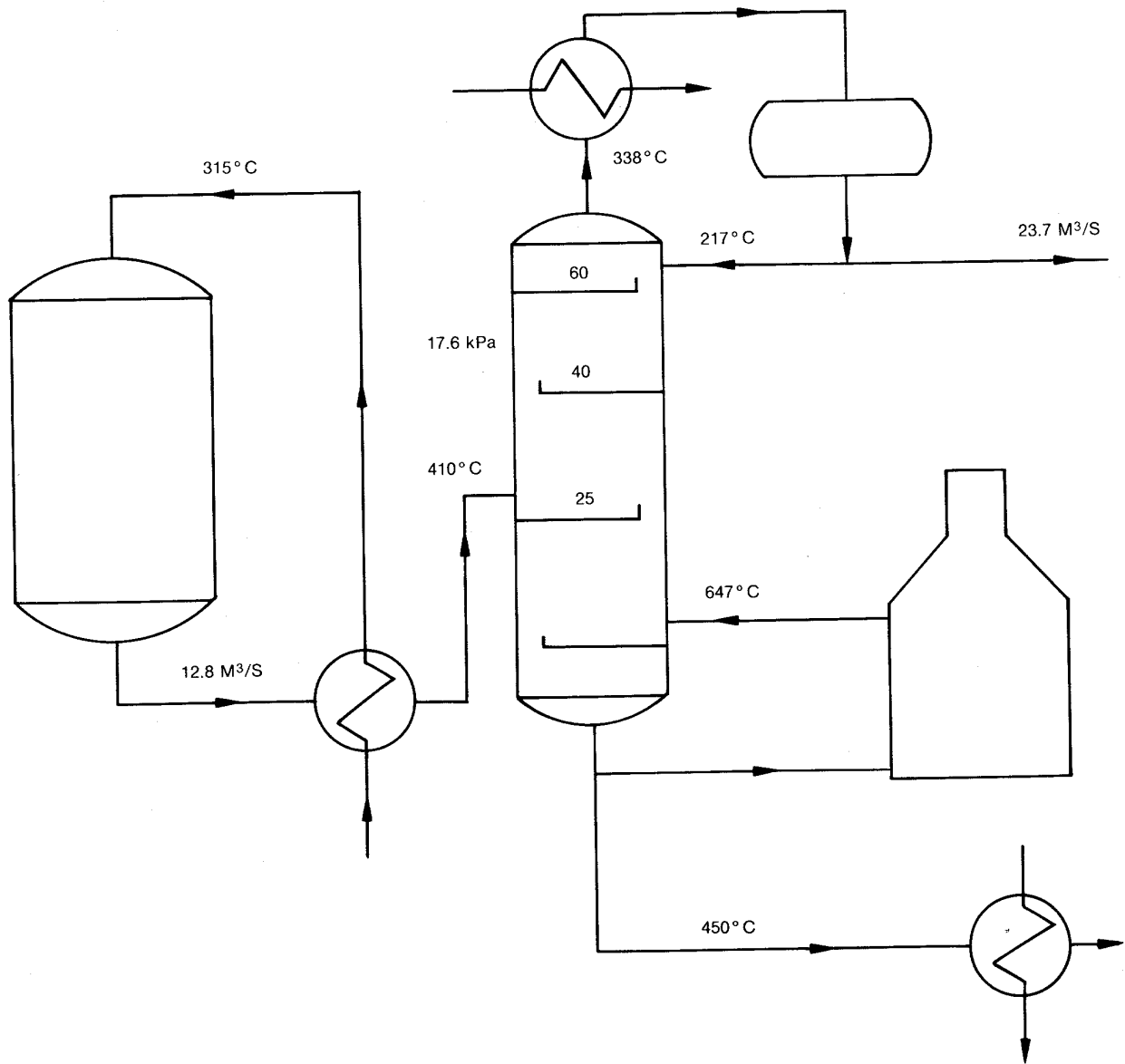


Figure A-2 — Chemical process

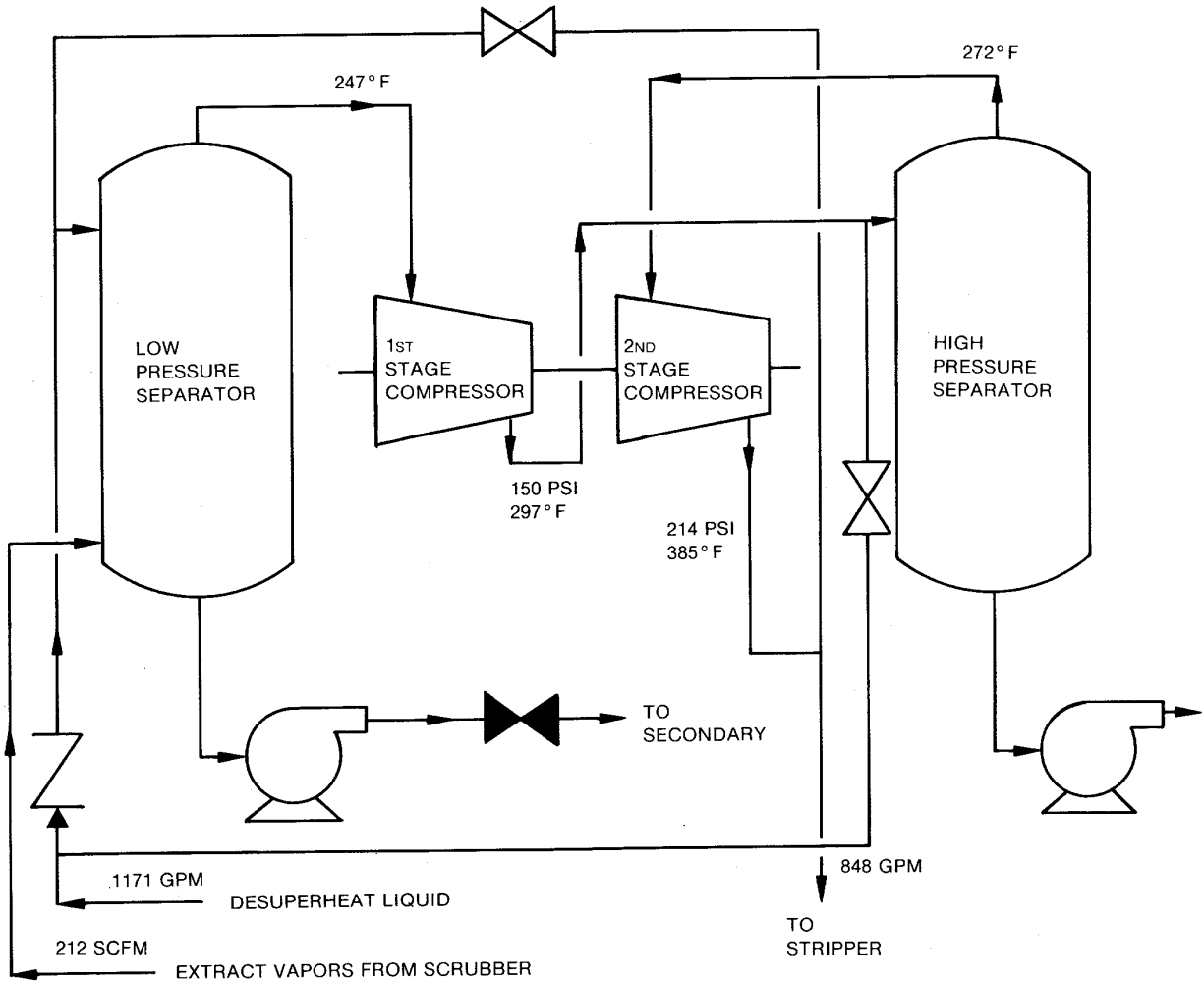


Figure A-3 — Heat pump system

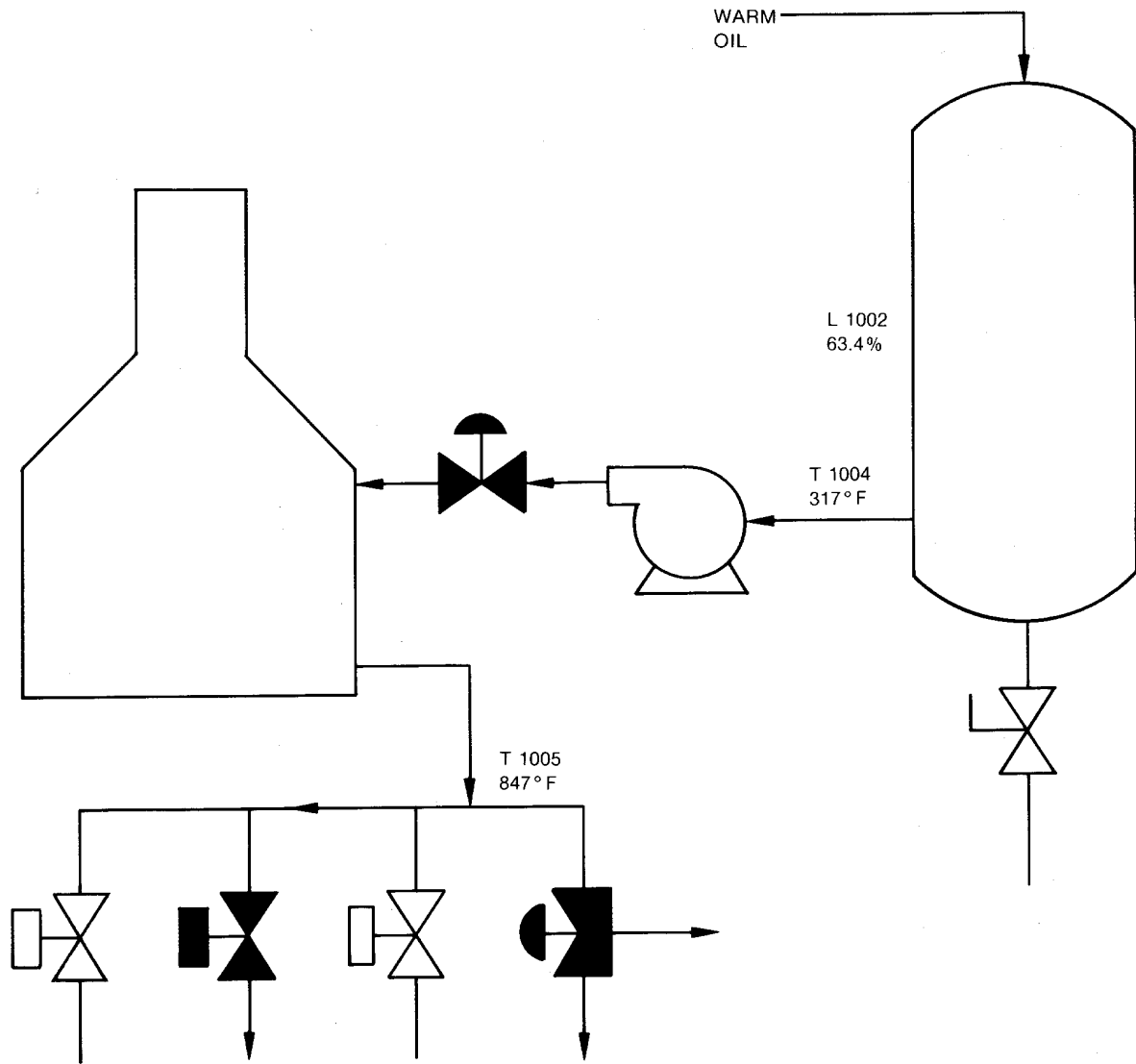


Figure A-4 — Hot oil system

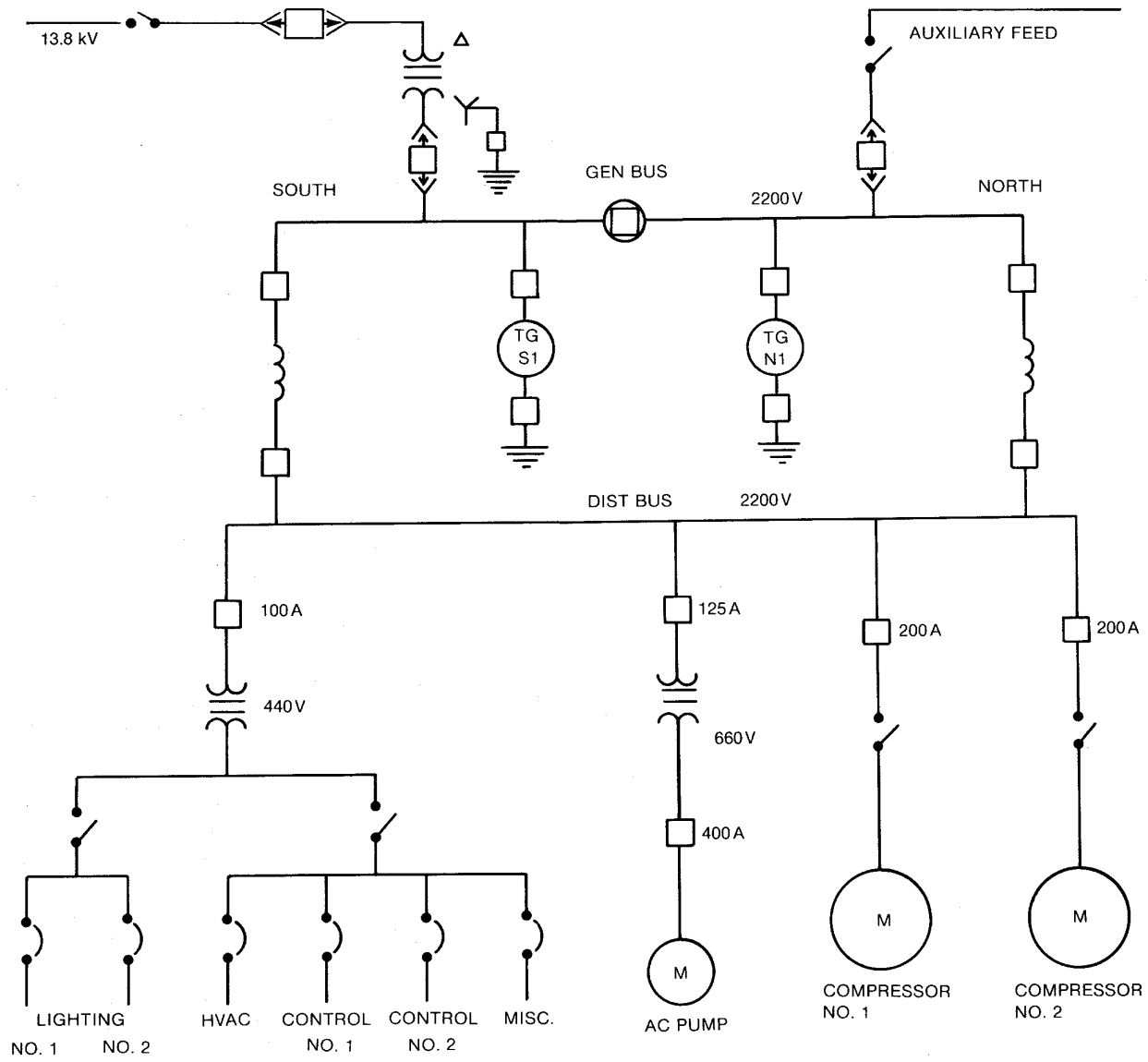


Figure A-5 — Electrical power system

Appendix B — Primary measurement recommended usage

Primary elements or instruments can be depicted on a VDU by a character(s). The characters that are recommended for use are:

First character	Type of measurement	Notes
A	Analysis	4
B	Burner, Combustion	
C	User's Choice	1
D	User's Choice	1
E	Voltage (EMF)	
F	Flow Rate	
G	User's Choice	1
H	Hand (Manual)	
I	Current (Electric)	
J	Power	
K	Time	
L	Level	
M	User's Choice	1
N	User's Choice	1
O	User's Choice	1
P	Pressure/Vacuum	
Q	Quantity	
R	Radiation	
S	Speed, Frequency	
T	Temperature	
U	Multivariable	5
V	Vibration, Mechanical Analysis	6
W	Weight, Force	
X	Unclassified	2
Y	Event, State or Presence	7
Z	Position, Dimension	
First modifier*	Type of measurement	Notes
D	Differential	
F	Ratio	
K	Time Rate of Change	8
Q	Integrate or Totalize	

*(See Note 3)

The above character designations are based on ISA Standard S5.1, "Instrumentation Symbols and Identification."

NOTE 1: A "USER'S CHOICE" letter is intended to cover unlisted meanings for primary measurements that will be used repetitively in a particular project. If used, the letter will have one meaning as a first letter and a different meaning for the second letter. The meanings need be defined only once in the beginning of the project. For example, the letter 'M' may be defined as "MOISTURE" in one project, but as "MASS" in another.

NOTE 2: The unclassified letter 'X' is intended to cover unlisted meanings that will be used only once or to a limited extent. If used, the letter may have any number of meanings as a first letter and any number of meanings as a succeeding letter.

Except for its use with distinctive measurements, it is expected that the meaning will be defined outside the symbol. For example, 'X' may be a stress measurement at one point and a volume measurement at another point.

The units of the quantity measured will assist in determining the actual usage of the letter 'X'.

NOTE 3: Any first letter, if used in combination with modifying letters 'D' (differential), 'F' (ratio), 'K' (time rate of change), or 'Q' (integrate or totalize), or any combination of them, shall be construed to represent a new and separate measured variable, and the combination shall be treated as a first-letter entity. Thus, instrument measurements 'T' and 'TD' measure two different variables, namely, temperature and differential temperature. These modifying letters shall be used when applicable.

NOTE 4: First letter 'A' for analysis covers all analyses not described by a "USER'S CHOICE" letter. It is expected that the type of analysis will be defined outside the symbol. The units of the quantity measured will assist in determining the actual type of analysis occurring. Additional information can be added as text to the Visual Display Unit.

NOTE 5: Use of the first letter 'U' for "Multivariable" in lieu of a combination of first letters is optional. It is recommended that nonspecific designators such as 'U' be used sparingly.

NOTE 6: First letter 'V,' "Vibration or Mechanical Analysis," is intended to perform the duties in machinery monitoring that the letter 'A' performs in more general analyses. Except for vibration, it is expected that the variable of interest will be defined outside the actual symbol. This definition can occur as a result of units of the quantity measured or as additional text shown on the visual display unit.

NOTE 7: First letter 'Y' is intended for use when control or monitoring responses are event-driven as opposed to time or time-schedule driven. It can also signify presence or state.

NOTE 8: Second letter 'K,' in combination with a first letter such as 'L,' 'T,' or 'W,' signifies a time rate of change of the primary measurement. As an example, 'WK' may represent "Rate of Weight Loss or Gain."

The following are Identification Letters and their usage from ISA Standard S5.1, "Instrumentation Symbols and Identification," Revision 4.

Table B-1: Identification letters

First letter (4)			Succeeding letters (3)		
Measured or initiating variable		Modifier	Readout or passive function	Output function	Modifier
A	Analysis (5, 19)		Alarm		
B	Burner, Combustion		User's Choice (1)	User's Choice (1)	User's Choice (1)
C	User's Choice (1)			Control (13)	
D	User's Choice (1)	Differential (4)			
E	Voltage		Sensor (Primary Element)		
F	Flow Rate	Ratio (Fraction) (4)			
G	User's Choice (1)		Glass, Viewing Device (9)		
H	Hand				High (7, 15, 16)
I	Current (Electrical)		Indicate (10)		
J	Power	Scan (7)			
K	Time, Time Schedule	Time Rate of Change (4, 21)		Control Station (22)	
L	Level		Light (11)		Low (7, 15, 16)
M	User's Choice (1)	Momentary (4)			Middle, Intermediate (7, 15)
N	User's Choice (1)		User's Choice (1)	User's Choice (1)	User's Choice (1)
O	User's Choice (1)		Orifice, Restriction		
P	Pressure, Vacuum		Point (Test) Connection		
Q	Quantity	Integrate, Totalize (4)			
R	Radiation		Record (17)		
S	Speed, Frequency	Safety (8)		Switch (13)	
T	Temperature			Transmit (18)	
U	Multivariable (6)		Multifunction (12)	Multifunction (12)	Multifunction (12)
V	Vibration, Mechanical Analysis			Valve, Damper, Louver (13)	
W	Weight, Force		Well		
X	Unclassified (2)	X Axis	Unclassified (2)	Unclassified (2)	Unclassified (2)
Y	Event, State or Presence (20)	Y Axis		Relay, Compute, Convert (13, 14, 18)	
Z	Position Dimension	Z Axis		Driver, Actuator, Unclassified Final Control Element	

Notes for Table B-1:

NOTE 1: A "USER'S CHOICE" letter is intended to cover unlisted meanings that will be used repetitively in a particular project. If used, the letter may have one meaning as a first letter and another meaning as a succeeding letter. The meanings need to be defined only once in a legend, or otherwise, for that project. For example, the letter 'N' may be defined as "MODULUS OF ELASTICITY" as a first letter and "OSCILLOSCOPE" as a succeeding letter.

NOTE 2: The unclassified letter 'X' is intended to cover unlisted meanings that will be used only once or to a limited extent. If used, the letter may have any number of meanings as a first letter and any number of meanings as a succeeding letter. Except for its use with distinctive symbols, it is expected that the meanings will be defined outside a tagging bubble on a flow diagram. For example, XR-2 may be a stress recorder and XX-4 may be a stress oscilloscope.

NOTE 3: The grammatical form of the succeeding letter meanings may be modified as required. For example, "indicate" may be applied as "indicator" or "indicating," "transmit" as "transmitter" or "transmitting," etc.

NOTE 4: Any first letter, if used in combination with modifying letters 'D' (differential), 'F' (ratio), 'M' (momentary), 'K' (time rate of change), 'Q' (integrate or totalize), or any combination of these is intended to represent a new and separate measured variable, and the combination is treated as a first-letter entity. Thus, instruments 'TDI' and 'TI' indicate two different variables, namely, differential temperature and temperature. Modifying letters are used when applicable.

NOTE 5: First letter 'A,' "Analysis," covers all analyses not described by a "USER'S CHOICE" letter. It is expected that the type of analysis will be defined outside a tagging bubble.

NOTE 6: Use of first letter 'U' for "Multivariable" in lieu of a combination of first letters is optional. It is recommended that nonspecific designators such as 'U' be used sparingly.

NOTE 7: The use of modifying terms "high," "low," "middle" or "intermediate," and "scan" is optional.

NOTE 8: The term "safety" applies to emergency protective primary elements and emergency protective final control elements only. Thus, a self-actuated valve that prevents operation of a fluid system at a higher than desired pressure by bleeding fluid from the system is a backpressure-type PCV, even if the valve is not intended to be used normally. However, this valve is designated as a PSV if it is intended to protect against emergency conditions, i.e., conditions that are hazardous to personnel and/or equipment and that are not expected to arise normally.

The designation 'PSV' applies to all valves intended to protect against emergency pressure conditions regardless of whether the valve construction and mode of operation place them in the category of the safety valve, relief valve, or safety relief valve. A rupture disc is designated 'PSE.'

NOTE 9: The passive function 'G' applies to instruments or devices that provide an uncalibrated view such as sight glasses and television monitors.

NOTE 10: "Indicate" normally applies to the readout, analog or digital, of an actual measurement. In the case of a manual loader, it may be used for the dial or setting indication, i.e., for the value of the initiating variable.

NOTE 11: A pilot light that is part of an instrument loop should be designated by a first letter followed by the succeeding letter 'L.' For example, a pilot light that indicates an expired time period should be tagged 'KQL.' If it is desired to tag a pilot light that is not part of an instrument loop, the light is designated in the same way. For example, a running light for an electric motor may be tagged 'EL,' assuming voltage to be the appropriate measured variable, or 'YL,' assuming the operating status is being monitored. The unclassified variable 'X' should be used only for applications that are limited in extent. 'XL' should not be used for motor running lights as these are commonly numerous. It is permissible to use the "USER'S CHOICE" letters 'M,' 'N,' or 'O' for a motor running light when the meaning is previously defined. If 'M' is used, it must be clear that the letter does not stand for the word "Motor," but for a monitored state.

NOTE 12: Use of a succeeding letter 'U' for "Multifunction" instead of a combination of other functional letters is optional. This nonspecific variable designator should be used sparingly.

NOTE 13: A device that connects, disconnects, or transfers one or more circuits may be either a switch, a relay, an ON-OFF controller, or a control valve, depending on the application.

If the device manipulates a fluid process stream and is not a hand-actuated ON-OFF block valve, it is designated as a control valve. It is incorrect to use the succeeding letters 'CV' for anything other than a self-actuated control valve. For all applications, other than fluid process streams, the device is designated as follows:

A *switch*, if it is actuated by hand.

A switch or an ON-OFF controller, if it is automatic and is the first such device in a loop. The term "Switch" is generally used if the device is used for alarm, pilot light, selection, interlock, or safety. The term "Controller" is generally used if the device is used for normal operating control.

A relay, if it is automatic and is not the first such device in a loop, i.e., it is actuated by a switch or an ON-OFF controller.

NOTE 14: It is expected that the functions associated with the use of succeeding letter 'Y' will be defined outside a bubble on a diagram when further definition is considered necessary. This definition need not be made when the function is self-evident, as for a solenoid valve in a fluid signal line.

NOTE 15: The modifying terms "high," "low," and "middle" or "intermediate" correspond to values of the measured variable, not of the signal, unless otherwise noted. For example, a high-level alarm derived from a reverse-acting level transmitter signal shall be an 'LAH,' even though the alarm is actuated when the signal falls to a low value. The terms may be used in combinations as appropriate (see Section 6.9A ISA-S5.1).

NOTE 16: The terms "high" and "low," when applied to positions of valves and other open-close devices, are defined as follows: "high" denotes that the valve is in or approaching the fully open position, and "low" denotes it is in or approaching the fully closed position.

NOTE 17: The word "record" applies to any form of permanent storage of information that permits retrieval by any means.

NOTE 18: For use of the term "transmitter" versus "converter," see the definitions in Section 3, ISA-S5.1.

NOTE 19: First letter 'V,' "Vibration or Mechanical Analysis," is intended to perform the duties in machinery monitoring that the letter 'A' performs in more general analyses. Except for vibration, it is expected that the variable of interest will be defined outside the tagging bubble.

NOTE 20: First letter 'Y' is intended for use when control or monitoring responses are event-driven as opposed to time- or time-schedule-driven. 'Y,' in this position, can also signify presence or state.

NOTE 21: Modifying letter 'K,' in combination with a first letter, such as 'L,' 'T,' or 'W,' signifies a time rate of change of the measured or initiating variable. 'WKIC,' for instance, may represent a rate-of-weight-loss controller.

NOTE 22: Succeeding letter 'K' is a user's option for designating a *control station*, while the succeeding letter 'C' is used for describing automatic or manual *controllers*. See Definitions, ISA S5.1.

Table B-2 — Typical letter combinations

First letters	Controllers					Readout devices		Switches and alarm devices*			Transmitters			Solenoids relays computing devices	Primary elements	Test point	Well or probe	Viewing device glass	Safety device	Element
	Initiating or measured variable	Recording	Indicating	Blind	Self-actuated control valves	Recording	Indicating	High†	Low†	Comb	Recording	Indicating	Blind							
A	Analysis	ARC	AIC	AC		AR	AI	ASH	ASL	ASHL	ART	AIT	AT	AY	AE	AP	AW		AV	
B	Burn./Comb.	BRC	BIC	BC		BR	BI	BSH	BSL	BSHL	BRT	BIT	BT	BY	BE		BW	BG	BZ	
C	User's Choice																			
D	User's Choice																			
E	Voltage	ERC	EIC	EC		ER	EI	ESH	ESL	ESHL	ERT	EIT	ET	EY	EE				EZ	
F	Flow Rate	FRC	FIC	FC	FCV, FICV	FR	FI	FSH	FSL	FSHL	FRT	FIT	FT	FY	FE	FP		FG	FV	
FQ	Flow Quantity	FQRC	FQIC			FQR	FQI	FQSH	FQSL			FQIT	FQT	FQY	FQE				FQV	
FF	Flow Ratio	FFRC	FFIC	FFC		FFR	FFO	FFSH	FFSL					FE					FV	
G	User's Choice																			
H	Hand		HIC	HC															HV	
I	Current	IRC	IIC			IR	II	ISH	ISL	ISHL	IRT	IIT	IT	IY	IE				IZ	
J	Power	JRC	JIC			JR	JI	JSH	JSL	JSHL	JRT	JIT	JT	JY	JE				JV	
K	Time	KRC	KIC	KC	KCV	KR	KI	KSH	KSL	KSHL	KRT	KIT	KT	KY	KE				KV	
L	Level	LRC	LIC	LC	LCV	LR	LI	LSH	LSL	LSHL	LRT	LIT	LT	LY	LE		LW	LG	LV	
M	User's Choice																			
N	User's Choice																			
O	User's Choice																			
P	Press./Vacuum	PRC	PIC	PC	PCV	PR	PI	PSH	PSL	PSHL	PRT	PIT	PT	PY	PE	PP			PSV, PSE	PV
PD	Press./Diff.	PDRC	PDIC	PDC	PDCV	PDR	PDI	PDSH	PDSL		PDRT	PDIT	PDT	PDY	PDE	PDP				PDV
Q	Quantity	QRC	QIC			QR	QI	QSH	QSL	QSHL	QRT	QIT	QT	QY	QE					QZ
R	Radiation	RRC	RIC	RC		RR	RI	RSH	RSL	RSHL	RRT	RIT	RT	RY	RE		RW			RZ
S	Speed/Frequency	SRC	SIC	SC	SCV	SR	SI	SSH	SSL	SSHL	SRT	SIT	ST	SY	SE					SV
T	Temperature	TRC	TIC	TC	TCV	TR	TI	TSH	TSL	TSHL	TRT	TIT	TT	TY	TE	TP	TW		TSE	TV
TD	Temperature/Diff.	TDRC	TDIC	TDC	TDCV	TDR	TDI	TDSH	TDSL		TDRT	TDIT	TDT	TDY	TE	TP	TW			TDV
U	Multivariable					UR	UI							UY						UV
V	Vibration Machinery Analysis					VR	VI	VSH	VSL	VSHL	VRT	VIT	VT	VY	VE					VZ
W	Weight/Force	WRC	WIC	WC	WCV	WR	WI	WSH	WSL	WSHL	WRT	WIT	WT	WY	WE					WZ
WD	Weight/Force/Diff.	WDRC	WDIC	WDC	WDCV	WDR	WDI	WDSH	WDSL		WDRT	WDIT	WDT	WDY	WDE					WDZ
X	Unclassified																			
Y	Event, State Presence			YC		YR	YI	YSH	YSL			YT	YY	YE						YZ
Z	Pos./Dimen.	ZRC	ZIC	ZC	ZCV	ZR	ZI	ZSH	ZSL	ZSHL	ZRT	ZIT	ZT	ZY	ZE					ZV
ZD	Gaug./Devia.	ZDRC	ZDIC	ZDC	ZDCV	ZDR	ZDI	ZDSH	ZDSL		ZDRT	ZDIT	ZDT	ZDY	ZDE					ZDV

NOTE: This table is not all inclusive.

*A, alarm, the annunciating device, may be used in the same fashion as S, switch, the actuating device.

† The letters H and L may be omitted in the undefined case.

Other possible combinations:

FO	(Restriction Orifice)	PFR	(Ratio)
FRK, HIK	(Control Stations)	KQI	(Running Time Indicator)
FX	(Accessories)	QQI	(Indicating Counter)
TJR	(Scanning Recorder)	WKIC	(Rate-of-Weight Loss Controller)
LLH	(Pilot Light)	HMS	(Hand Momentary Switch)

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