PROCESS INDUSTRY PRACTICES

TECHNICAL CORRECTION
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P&ID

PIP PIC001
Piping and Instrumentation Diagram Documentation Criteria

PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

In an effort to minimize the cost of process industry facilities, this Practice has been prepared from the technical requirements in the existing standards of major industrial users, contractors, or standards organizations. By harmonizing these technical requirements into a single set of Practices, administrative, application, and engineering costs to both the purchaser and the manufacturer should be reduced. While this Practice is expected to incorporate the majority of requirements of most users, individual applications may involve requirements that will be appended to and take precedence over this Practice. Determinations concerning fitness for purpose and particular matters or application of the Practice to particular project or engineering situations should not be made solely on information contained in these materials. The use of trade names from time to time should not be viewed as an expression of preference but rather recognized as normal usage in the trade. Other brands having the same specifications are equally correct and may be substituted for those named. All Practices or guidelines are intended to be consistent with applicable laws and regulations including OSHA requirements. To the extent these Practices or guidelines should conflict with OSHA or other applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by the Practice.

This Practice is subject to revision at any time.

Note: *PIP PIC001, Piping and Instrumentation Diagram Documentation Criteria*, incorporates symbols previously published in standards owned and copyrighted by The Instrumentation, Systems, and Automation Society (ISA). These are printed with agreement from ISA.

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PIP PIC001
Piping and Instrumentation Diagram Documentation Criteria

Table of Contents

1. Scope

This Practice provides requirements for designers preparing Piping and Instrumentation Diagrams (P&IDs). This Practice describes the requirements for P&ID format and content. The Practice is independent of time in a facility life cycle and encompasses design, construction, operations, and maintenance.

This Practice covers the generation of new P&IDs and does not apply to the revision of existing P&IDs. This Practice also applies to P&IDs provided by packaged equipment vendors.

This Practice applies to all diagrams that fit the definition of a P&ID in Section 3.

The requirements provided in this Practice can be applied to any CAD system used for developing the P&IDs and are not vendor, hardware, or software specific.

This practice uses U.S. Customary units of measure for drafting dimensions. Line weights are also given in metric units. Current PIP experience is that symbol sizes and drafting dimensions are often based on U.S. Customary units even if the project design and labeling is in metric units. All drafting dimensions could be stated in metric units at the discretion of the user.

The requirements provided in this Practice provide a balance between showing all data on P&IDs and making P&IDs legible and easy to read.

Process specific overlays may be developed to define necessary additional requirements or exceptions.

The example P&IDs included in the Appendixes of this Practice are not intended to recommend specific design details or requirements. Example P&IDs are included to provide an illustration of how the elements of this Practice are combined into a P&ID.

Electronic native files for the text, symbols, and legend sheets are available to PIP Member Companies for input to members' CAD systems. Development of project-specific legend sheets is recommended using the PIP native files as a starting point. Additions and/or deletions are allowed to meet requirements. Legend sheet borders and title blocks can be altered.

Development of P&IDs has historically been led by the petrochemical, oil & gas, and specialty chemical industries. While applicable to all industries, guidelines and practices have primarily focused on these industries. In this revision, we have expanded the scope to include information specific to developing P&IDs for the hygienic processing industries – pharmaceutical, food, and beverage. While Sections 2, 3 and 4 contain requirements for P&IDs across all industries, Appendix D contains content specific to the hygienic processing industry that supplements or replaces that in Sections 2, 3 and 4.

If PIP membership grows to include other industries, it is anticipated that this Practice will expand to have sections on developing P&IDs for the mining, power, pulp and paper, and other industries.

2. References

Applicable parts of the following Practices, industry codes and standards, and references shall be considered an integral part of this Practice. The edition in effect on the date of start of P&ID development shall be used, except as otherwise noted. Short titles are used herein where appropriate. This list is not all inclusive of standards and codes that may be used in the development of a P&ID.

2.1 Process Industry Practices (PIP)

- PIP INEG1000 – *Insulation Design and Type Codes*
- PIP PCCIP001 – *Instrument Piping and Tubing Systems Criteria*
- PIP PCSIP001 – *Instrument Piping and Tubing Systems Specifications*
- PIP PNE00001 – *Design of ASME B31.3 Metallic Piping Systems*
- PIP PNSM0001 – *Piping Line Class Designator System*

2.2 Industry Codes and Standards

- American National Standards Institute (ANSI)
  - ANSI/FCI 70-2-2003 – *Control Valve Seat Leakage*
- American Society of Mechanical Engineers (ASME)
  - *ASME Boiler and Pressure Vessel Code*
    Section VIII – *Pressure Vessels*
- The Instrumentation, Systems, and Automation Society (ISA)
  - ISA 5.1 – *Instrumentation Symbols and Identification*
  - ISA 84.00.01 – *Functional Safety: Safety Instrumented Systems for the Process Industry Sector*
- Tubular Exchanger Manufacturers Association (TEMA)
  - TEMA Standards

2.3 Government Regulations

- Occupational Safety and Health Administration (OSHA)
  - OSHA 29 CFR 1910.119 – *Occupational Safety and Health Standards, Process Safety Management of Highly Hazardous Chemicals*

3. Definitions

accessible: A feature of a device or function, a feature of an interactive shared system function, or a feature that can be used or seen by an operator for the purpose of performing control actions (*e.g.*, set point changes, auto-manual transfer, or on/off operations) (Reference *ISA 5.1*)

automated valve: Any valve with a locally or remotely controlled actuator. Examples are throttling control valves and on/off block valves. Actuators are typically air-operated (diaphragm or piston), electric or hydraulic, some with a spring-return function. Manually-operated valves are sometimes tagged as automated valves (*e.g.*, if a manual valve is fitted with position switches).

auxiliary P&ID: Used to show details to unclutter other P&IDs (*e.g.*, lube oil system, sample systems, instrument details)

Basic Process Control System (BPCS): Instrumentation and systems that are installed to monitor and control normal production operations using, but not limited to, combinations of single-loop pneumatic and electronic monitors and controllers, Programmable Logic Controllers (PLCs) and Distributed Control Systems (DCSs). A BPCS is necessary to operate a plant or process. A BPCS is not an SIS. (Reference *ISA 5.1*) *bubble:* The preferred term for the circle-based symbols used to denote and identify the purpose of an instrument or function. The bubble may contain a tag number. (Synonym for balloon) (Reference *ISA 5.1*)

design pressure: Pressure used in the design of a vessel component together with the coincident design metal temperature for determining the minimum permissible thickness or physical characteristics of the different zones of the vessel (Reference *ASME Boiler Pressure Vessel Code,* Section VIII, Division 1, Appendix 3)

fail closed (FC): Characteristic of an automated valve that causes the valve to close as a result of specific malfunctions, including loss of signal or motive power (Reference *ISA 5.1*)

fail indeterminate (FI): Characteristic of an automated valve that causes the valve to move to an unknown position as a result of specific malfunctions, including loss of signal or motive power. Some automated valves will not stay at the last position upon failure and instead move with the process differential pressure. Additional equipment may be needed to meet the definition of FC, FO, or FL. (Reference *ISA 5.1*)

fail locked (FL) last position: Characteristic of an automated valve that causes the valve to remain in the last (locked) position as a result of specific malfunctions, including loss of signal or motive power. Automated valves may fail indeterminately without additional equipment. (Reference *ISA 5.1*)

fail open (FO): Characteristic of an automated valve that causes the valve to open as a result of specific malfunctions, including loss of signal or motive power. (Reference *ISA 5.1*)

hand switch (HS): Any operator-manipulated discrete control device, including hardwired panel switches and software points

heat exchanger type: Type designation shall be shell and tube, plate and frame, spiral, etc. For shell and tube exchangers, use the three-letter designation describing stationary head, shell, and rear end or head, in that order, in accordance with TEMA.

High Level Control System (HLCS): A system that provides sophistication above that of the BPCS. HLCS functions are typically based in process computers or higher level hardware that interacts with the process by manipulating set points in the BPCS. Examples of control functions in the HLCS are statistical process control and model predictive control. An HLCS is not necessary to operate a plant or process. (See also BPCS and SIS) (Reference *ISA 5.1*)

implied components: A drafting method where some components are not shown on a P&ID (to reduce drawing clutter) but are known to exist. Implied components shall be shown in the legend sheet(s). See Appendix B-004.

interlock: System that, in response to a predetermined condition, initiates a predefined action. Typically comprised of binary (on/off) signals and logic used for process control, sequencing, or protective interruption of normal process control functions. Protective interlocks are typically further defined as being either safety-related or commercial-related (asset or production protection).

isolation valve: A valve used for isolation of process equipment while performing activities such as purging, de-pressuring or de-inventorying. This valve is also commonly referred to as the primary block valve.

line class: Section of the Piping Material Specifications that provides a listing of piping components for specific design conditions

logic solver: Control equipment that performs the logic function. It can be either hardwired (*e.g.*, relays) or Programmable Electronic Systems.

manual loading station (HIC): a device or function that has a manually adjustable output, and may also have indicators, lights, and/or other functions, that is used to actuate and/or modulate one or more devices, but does not provide switching between auto-manual modes of a control loop. (Reference *ISA 5.1*)

modular equipment – a section of plant equipment grouped together for fabrication and construction purposes only

off page: transfer to or from another drawing that is part of the user defined system, plant or project

off plot: transfer to or from another drawing that is not part of the user defined system, plant or project

packaged equipment: One or more pieces of equipment furnished by a vendor with supportive devices and components to perform a specific operation as a unit

pigging systems: Systems using pipeline inspection gauges or 'pigs' to perform various maintenance operations on a pipeline. This may be done without stopping the flow of the product in the pipeline. These operations include but are not limited to cleaning and inspecting of the pipeline.

Piping and Instrumentation Diagram (P&ID): Detailed graphical representation of a process including the hardware and software (*i.e.*, piping, equipment, and instrumentation) necessary to design, construct and operate the facility. Common synonyms for P&IDs include Engineering Flow Diagrams (EFDs), Utility Flow Diagrams (UFDs), and Mechanical Flow Diagrams (MFDs).

Programmable Electronic System (PES): Logic performed by programmable or configurable devices

root valve: First valve or valves between the process and an auxiliary device (*e.g.*, an instrument) that contacts the process and is used to isolate the device from the process. This valve is typically a line class valve used for shut-off and isolation.

Safety Integrity Level (SIL): One of four possible discrete integrity levels (SIL 1, SIL 2, SIL 3, and SIL 4) of Safety Instrumented Systems. SILs are defined in terms of Probability of Failure on Demand (PFD). (Reference *ISA 84.01*)

Safety Instrumented Systems (SIS): A system composed of sensors, logic solvers, and final control elements for the purpose of taking the process to a safe state when predetermined conditions are violated. Other terms commonly used include Emergency Shutdown System (ESD or ESS), Safety Shutdown System (SSD), and Safety Interlock System (SIS). (Reference *ISA S84.01*) (See also BPCS and HLCS.)

skirt: Cylindrical supporting structure, welded to the bottom of a vertical vessel and extended to the base support

specialty item: Piping specialty items are items typically not specified in piping material specifications

tagged: For the purposes of labeling instrumentation and control components, a hardware device or a software point that is identified with an ISA style tag number

Tight Shut-Off (TSO): Tight Shut-Off is defined in this Practice as *ANSI Class V* or *ANSI Class VI* in accordance with *ANSI/FCI 70-2*

trim: Item attached to equipment as an integral component, identified as part of the equipment that is exposed to the process, and having a function local to the equipment being served. Examples are vent and drain valves, instrument bridles, blind flanges, plugs, or other miscellaneous items associated with a piece of equipment. Typically, trim is purchased independently from the equipment.

4. Requirements

4.1 General

4.1.1 Most details available from other types of documentation (*e.g.*, instrument loop diagrams and vessel data sheets) should not be included on P&IDs.

4.1.2 This Practice uses the concepts of typical details with implied components where appropriate to simplify P&IDs. (See the legend sheet in Appendix B for examples.) Additional examples can be added as required.

4.1.3 While the intent of this Practice is to simplify the P&IDs through the use of implied components and legend sheets, this may not be compatible with the work processes or design software used for a project. Therefore, this Practice does not require the use of implied components. It is the responsibility of the project team to determine the compatibility of implied components with project needs and work processes (*e.g.*, safety reviews, material take-off method, integration plan, etc.).

4.2 Format

Comment: This section denotes general drafting layout practices which are recommended as optimal. Slight deviations are acceptable.

4.2.1 Layout

4.2.1.1 Drawing size shall be 22 inches x 34 inches. (All symbol and text sizes called out are based on this drawing size).

4.2.1.2 Flow Orientation

1. Primary flow shall be shown on each P&ID from left to right.
2. Flow-through equipment shall be shown relative to actual arrangement (*e.g.*, cooling water supply in bottom of exchanger tube bundle and cooling water return out top).

4.2.1.3 Piping Orientation

1. The top of a horizontal line and the left side of a vertical line shall be the top of a pipe.
2. The bottom of a horizontal line and the right side of a vertical line shall be the bottom of a pipe.
3. A note shall be used to clarify the orientation as required.

4.2.1.4 Each P&ID shall be laid out to avoid clutter and allow future modifications. No more than three pieces of major equipment shall be shown on a P&ID.

4.2.1.5 Piping and instrumentation lines on the P&ID are to be routed as directly as possible in vertical and horizontal orientation with minimal changes in direction. Avoid showing lines in non-vertical and non-horizontal routing.

4.2.1.6 Primary process lines shall be shown heavier than secondary and utility lines as described in Section 4.2.3.

4.2.1.7 Connector Symbols

1. Off-page and off-plot connectors for primary, secondary, and instrumentation lines shall be shown entering the P&ID horizontally 0.25 inch from the left inside borderline and exiting 0.25 inch horizontally from the right inside borderline in accordance with Appendix C.
2. Utility connectors can be shown at any convenient location in the body of the P&ID.

4.2.1.8 Connector Descriptions

Text associated with off-page and off-plot connectors should be left-justified.

4.2.1.9 Utility P&IDs

1. Utility collection/distribution P&IDs shall be laid out relative to plot plan orientation in accordance with Appendix C.
2. To depict plot plan orientation, utility off-page connectors for a utility connection/distribution P&ID may be positioned vertically in accordance with Appendix C.
3. If match lines are required on utility collection/distribution P&IDs, the lines shall match the connecting drawing match lines in accordance with Appendix C.

4.2.1.10 Equipment arrangement shall be shown relative to its elevation to grade (*e.g.*, pumps at bottom of P&ID) in accordance with Appendix C.

4.2.1.11 A control valve actuator shall be shown above a horizontal line or left of a vertical line.

4.2.1.12 If a control valve identification bubble is required, the center point of the bubble shall be shown 0.5 inch above and 0.5 in away from the actuator in a horizontal line or 0.5 inch to the left and 0.5 inch away from the actuator in a vertical line.

4.2.1.13 The center point of an instrument bubble shall be shown 0.5 inch directly above an in-line instrument in a horizontal line or 0.5 inch directly left of an in-line instrument in a vertical line. Examples are restriction orifices and stand-alone thermowells.

4.2.1.14 Pump and compressor driver piping, instrumentation, and auxiliaries can be shown on a separate, auxiliary P&ID. "Primary" P&ID and auxiliary P&ID shall be cross-referenced.

4.2.1.15 Typical details shall be used if clutter can be eliminated without detracting from clarity. These details shall be shown on the P&ID, on an auxiliary P&ID, or on a legend sheet.

4.2.1.16 Pressure Safety Valves

1. The Pressure Safety Valve (PSV) shall be shown in a vertical and upright position.
2. The center point of a PSV identification bubble shall be shown 0.5 inch above and 0.5 inch away from the safety valve.

4.2.1.17 The center point of a Pressure Safety Element (PSE) identification bubble shall be shown 0.5 inch above a horizontal line or left of a vertical line and 0.5 inch away from the PSE or equipment.

4.2.2 Symbols

4.2.2.1 Format, equipment, piping, and instrument symbols shall be shown in accordance with Appendixes B.

4.2.2.2 Equipment internals shall be shown using a short dash/space line at a weight of 0.010 inch (0.25 mm).

4.2.2.3 A mating piping flange to an equipment nozzle shall be shown at a distance of 0.06 inch.

4.2.2.4 A connection to an equipment nozzle shall be shown if the connection is welded in accordance with Appendix B-1.

4.2.2.5 A note reference symbol shall be shown in accordance with Appendix B-1 at a weight of 0.014 inch (0.35 mm).

4.2.2.6 A note number shall be shown in the note reference symbol at a weight of 0.010 inch (0.25 mm).

4.2.2.7 Normally closed manual valves shall be shown using a darkened solid symbol.

4.2.2.8 If darkened-in valve symbols cannot be used because of symbol type (*e.g.*, butterfly valve), the abbreviation for Normally Closed (NC) shall be used directly below the valve in a horizontal line or to the right of the valve in a vertical line.

4.2.2.9 Control valves or relief valves shall not be shown as NC.

4.2.3 Lines

4.2.3.1 Primary process lines shall be shown in accordance with Appendix B-1 at a weight of 0.028 inch (0.70 mm).

4.2.3.2 Secondary, utility, and future lines shall be shown in accordance with Appendix B-1 at a weight of 0.014 inch (0.35 mm).

4.2.3.3 Instrument line symbols shall be shown in accordance with Appendix B-2 at a weight of 0.010 inch (0.25 mm).

4.2.3.4 Packaged equipment limit lines shall be shown in accordance with Appendix B-1 at a weight of 0.014 inch (0.35 mm).

4.2.3.5 Equipment outlines shall be shown in accordance with Appendix B-3 at a weight of 0.020 inch (0.50 mm).

4.2.3.6 Inline piping components shall be shown in accordance with Appendix B-1 at a weight of 0.010 inch (0.25 mm).

4.2.3.7 Line class and insulation breaks shall be shown in accordance with Appendix B-1 at a weight of 0.014 inch (0.35 mm).

4.2.3.8 Spacing between lines shall be maintained at a minimum of 0.5 inch.

4.2.3.9 Flow arrows shall be shown at corners and intersecting lines.

4.2.3.10 Line Breaks

1. Vertical primary process lines shall be broken if crossing horizontal primary process lines.
2. Secondary and utility lines shall be broken if crossing primary process lines.
3. Vertical secondary and utility lines shall be broken if crossing horizontal secondary and utility lines.
4. Instrument lines shall be broken if crossing process and utility lines.
5. For utility collection/distribution P&IDs, entering and exiting lines shall be broken if crossing pipe rack lines.

4.2.3.11 Line break gaps shall be maintained at 0.13 inch.

4.2.3.12 Routing lines across equipment or text shall be avoided.

4.2.4 Text

Comment: Many variables may adversely affect text legibility such as font availability and plotter/printer limitations. Text heights specified herein are recommended as optimal, and slight deviation, although not encouraged, may be required for legibility.

4.2.4.1 Text Arrangement

1. Text shall be shown horizontal if possible.
2. Vertically oriented text shall be read from bottom to top.

4.2.4.2 Abbreviations shall be in accordance with Appendix B.

4.2.4.3 Drawing Notes

1. General text and drawing notes shall be shown using a text height of 0.1 inch at a weight of 0.01 inch (0.25 mm).
2. General text and drawing notes shall be aligned left and shall start in the upper-left corner of the notes area in accordance with Appendix C.
3. If a note contains more than one line, the line spacing shall be 0.05 inch between each line.

4. Spacing between notes shall be shown at 0.25 inch beneath the last line of the preceding note maintaining a top and left text justification.

4.2.4.4 Equipment Information

1. Equipment numbers shall use a text height of 0.16 inch at a weight of 0.014 inch (0.35 mm).
2. Equipment numbers shall be underlined.
3. Equipment title and data shall use a text height of 0.1 inch at a weight of 0.014 inch (0.35 mm).
4. Equipment text shall be justified at the top and center.
5. Equipment numbers, titles, and data for equipment shall be shown within 2 inches from the top inside borderline of the P&ID, directly above the equipment, and on the same horizontal plane as other equipment identification.

   Comment: Equipment numbers, titles, and data for rotating equipment (*i.e.*, pumps, blowers, compressors, and agitators) may be shown within 2 inches from the bottom inside borderline of the P&ID, directly below the equipment, and on the same horizontal plane as other equipment identification.

6. Equipment number, title, and data shall be shown once for identical equipment with the same number, title, and service (*e.g.*, P-601A/B).

4.2.4.5 Line Numbers

1. Line numbers shall be shown in accordance with Appendix B-1. See examples shown in Appendix C.
2. Line numbers shall use a text height of 0.1 inch at a weight of 0.010 inch (0.25 mm). Arial narrow, font size 10 may be used.
3. Line number text shall be placed 0.06 inch from the line and shall be lined up vertically 0.25 inch from the connector.
4. Line numbers at entering off-page and off-plot connectors shall be justified at the top and left.
5. Line numbers at exiting off-page and off-plot connectors shall be justified at the top and right.

6 Line numbering shall be shown with the orientation of the line.

4.2.4.6 Control Valve Information

1. Control valve failure action abbreviation shall be shown at 0.06 inch directly below the control valve in horizontal lines and 0.06 inch to the right of the control valve in vertical lines. See examples shown in Appendix C.

2. If the valve size is not line size or easily inferred from adjoining pipe, reducers, or equipment, control valve size shall be shown between the actuator and valve body symbol. If necessary, control valve size can be repositioned so as not to be obscured by other items shown on actuator (*i.e.*, position switches, handwheels, etc.). See examples shown in Appendix C.
3. Control valve seat leakage criteria (*i.e.*, tight shut-off [TSO]) shall be shown between the actuator and valve body symbol. If necessary, control valve leakage criteria can be repositioned so as not to be obscured by other items shown on the actuator (*i.e.*, position switches, handwheels, etc.). See examples shown in Appendix C.

4.2.4.7 For PSVs, PSEs, and pressure control valves (PCVs), the device size and set pressure shall be shown close to the identification bubble. See examples shown in Appendix C.

4.3 Equipment

4.3.1 General

4.3.1.1 Equipment Symbols

1. Equipment symbols shall be shown in accordance with Appendix B-3.
2. Equipment shall be shown with simple outline representation.
3. Discretion shall be exercised for equipment symbols to not dominate the drawing, but the symbols shall be drawn large enough for clear understanding.
4. Equipment shall not be drawn to scale.
5. Equipment shall be shown relative to associated equipment both in size and general orientation.
6. All connection types can be added to any equipment symbol.
7. A dashed symbol can be used to identify proposed, funded or multiple representations of the same equipment.

4.3.1.2 Nozzles

1. Nozzles, including spares, shall be shown on equipment as single lines.
2. Manways shall be shown as double lines.
3. Process and utility nozzles may be labeled.
4. Nozzle sizes shall be shown, unless the size is implied by piping connections.

4.3.1.3 Equipment not specifically identified in this Practice shall be shown with an equipment symbol that is a reasonable representation of the equipment as it will exist in the field.

4.3.1.4 Equipment shall be identified by a classification letter and sequence number. Classifications used in this Practice are shown in Section 4.3.2.

Comment: The classifications shown in Section 4.3.2 are used on the example P&IDs contained in Appendix C for illustrative purposes only. The classifications are only one example of classifications allowed by this Practice.

4.3.1.5 Equipment Item Number and Title/Service shall be shown as a minimum. Section 4.3.3 provides a complete list of equipment data for all equipment addressed in this Practice. For equipment not covered in this Practice, equipment data shall be shown as necessary.

4.3.1.6 Internals for equipment shall be shown as dashed lines as described in Section 4.2.2.2. Details of internals that have no significant bearing on the piping design and layout or equipment operation shall be omitted.

4.3.1.7 Equipment elevation labels shall not be shown unless the elevations are necessary to specify process requirements for associated equipment location or orientation relative to one another.

4.3.1.8 Trim

1. Associated trim (*e.g.*, vent and drain valves, instrument bridles) for equipment shall be shown.
2. Equipment trim labels shall be shown as required.

Comment: Note that not all equipment has trim, and that some equipment may have multiple trims.

4.3.1.9 Auxiliary system requirements for individual pieces of equipment (*e.g.*, lube oil systems, seal flush systems, turbine gland leak-off piping, sample systems) shall be shown on auxiliary P&IDs.

4.3.1.10 Jacketing and tracing requirements for equipment shall be shown.

4.3.1.11 The type of insulation (*e.g.*, personnel protection, heat conservation) for equipment shall be shown as part of the equipment data. Insulation thickness shall be shown where applicable.

4.3.2 Classification of Equipment

The equipment classifications listed in Table 1 are used on the example P&IDs contained in Appendix C for illustrative purposes only. These equipment classifications are only one example of classifications allowed by this Practice.

Table 1: Equipment Classifications

CLASS	SUBJECT	DESCRIPTION
A	Mixing Equipment	Agitators, Aerators, Mechanical Mixers, Blenders
B	Blowers	Centrifugal Blowers, Positive Displacement Blowers, Fans
C	Compressors	Centrifugal, Reciprocating, Screw, Vacuum
D	Mechanical Drivers	Electric and Pneumatic Motors, Diesel Engines, Steam and Gas Turbines
E	Heat Exchangers	Unfired Heat Exchangers, Condensers, Coolers, Reboilers, Vaporizers and Heating Coils, Double Pipe, Spiral, Plate & Frame, Air Coolers, Electric Heaters, Printed Circuits, Scraped Surface Heat Exchangers
F	Fired Equipment	Fired Heaters, Furnaces, Boilers, Kilns
FL	Filters	Bag Filters, Micron Filters, Nano Filters, Membrane Filters, Vent Filters, Depth Filters, Vacuum / Neutsch Filters, Sterile Filters
MH	Material Handling Equipment	Conveyors, Dust Collectors, Cyclones, Rotary Air Locks, Sifters
P	Pumps	Horizontal and Vertical Centrifugal, Positive Displacement, Vertical Canned, Screw, Gear, Sump, Piston, Metering, Diaphragm
PE	Packaged Equipment	RO Skids, DI Skids, Water Softener Systems, Refrigeration Skids
R	Reactors	
T	Towers / Columns	
TK	Tanks	atmospheric and low pressure tanks, bins, silos
U	Miscellaneous Equipment	anything not specified
V	Vessels	Separators, Driers, Accumulators, Drums, Jacketed Vessels

4.3.2.1 Agitators

The term agitator shall apply to mechanical mixers and aerators.

4.3.2.2 Blowers

Blower symbols shall be shown as centrifugal or positive displacement as required.

4.3.2.3 Compressors

1. Compressor symbols shall be shown according to their type such as centrifugal, screw or reciprocating.
2. The compressor symbol shall be shown for each stage of multistage compressors.
3. Multistaged compressors can be shown on multiple P&IDs.

4.3.2.4 Drivers

1. Drivers shall be shown with the driven equipment and shall use the symbols for motors, diesel engines, and turbines.
2. Equipment numbers for drivers are normally not required because equipment data for the drivers is shown as an integral part of the associated driven component.
3. Equipment number shall be shown for driver if it drives more than one piece of equipment or if the driver number is different from the equipment it drives.
4. The base symbol for the pneumatic driver is the same as the electric driver. Air inlet and discharge nozzles shall be shown for the pneumatic driver.

4.3.2.5 Heat Exchangers

1. The term heat exchanger includes unfired heat exchangers, coolers, condensers, reboilers, vaporizers, heating coils, and electric heaters.
2. Exchanger nozzles shall be oriented to indicate the flow path through the exchanger.
3. The total duties shall be shown for multiple exchangers utilized in series or parallel configurations for common service.
4. Air-cooled exchangers shall include two basic types, forced draft or induced draft. Each type can have recirculation, multiple bundles, multiple fans, variable (automatic or manual) fan pitch, variable louvers, or steam coils. Symbols can be modified to represent the type of air-cooled exchanger used.
5. Shell and tube exchangers shall be shown following the TEMA convention (*e.g.*, AEL, BEM) for the type utilized in the process.

4.3.2.6 Fired Equipment

1. Fired equipment includes furnaces, preheaters, boilers etc.
2. The symbol shown in Appendix B-3 is one of many possible representations. The radiant coils and convection coils for the furnace shall be shown to distinguish between the respective sections.

4.3.2.7 Pumps

1. Base plates shall not be shown unless panned and drained.
2. Drains and lube oil lines shall be shown.
3. Vendor-supplied instrumentation or controls (*e.g.*, relief for a positive displacement pump, high temperature shutoff switch) shall be shown.
4. External piping and instrumentation for pump seals shall be identified on the P&ID, either by showing or calling out API seal number. The details may be shown on an auxiliary P&ID.

4.3.2.8 Packaged Equipment

1. The term packaged equipment includes units such as air driers, refrigeration systems, etc. Packaged equipment differs from and does not include modular equipment.
2. Packaged equipment shall be shown in its entirety.

   Comment: To satisfy this requirement and avoid duplication of effort in producing P&IDs, vendor drawings can be referenced in a box showing points of connection drawn with package equipment lines.
3. Equipment/Item Numbers shall be assigned to individual equipment in the package.
4. Packaged equipment limit lines shall be shown in accordance with Appendix B-1.

4.3.2.9 Tanks

Tanks shall be shown as representing the actual tank shape and orientation in accordance with Appendix B-3.

4.3.2.10 Vessels

1. Vessels shall be shown as representing the actual vessel shape and orientation.
2. Manways, handholes, and skirts shall be shown.
3. Other equipment (*e.g.*, spheres) supports shall be shown only if needed.
4. Trays and tray numbers shall be shown at process connection points.
5. Trays shall be numbered in accordance with the project convention.
6. The top and bottom trays shall be shown.
7. Example representations of common vessels are shown in Appendix B-3.

4.3.3 Equipment Data

Equipment information shall be shown on the P&ID in relation to the appropriate equipment symbol and in accordance with Section 4.2.4.4. Units of measure (*e.g.*, GPM, PSIG, BTU/hr) for equipment data shall be shown as required. Equipment not listed shall be described as appropriate to convey important data. Appendix A lists some examples of detailed equipment labels incorporating the following data and information for a number of equipment classes.

Comment: Title/Service – a descriptive equipment name combining both the process service and the equipment classification description. Process service is either the unit operation or process fluid being handled.

4.3.3.1 Agitators, Mixers

- Equipment/Item Number
- Title/Service
- Power Requirements
- Materials of Construction

4.3.3.2 Blowers

- Equipment/Item Number
- Title/Service
- Capacity (Flow and D/P)
- Power Requirements
- Materials of Construction

4.3.3.3 Compressors

- Equipment/Item Number
- Title/Service
- Capacity (Flow and D/P)
- Power Requirements
- Materials of Construction

4.3.3.4 Heat Exchangers

- Equipment/Item Number
- Title/Service
- Duty
- Surface Area
- Shell Design Pressure @ Temperature
- Tube Design Pressure @ Temperature
- Materials of Construction (Shell/Tubes)
- Insulation

4.3.3.5 Fired Equipment

- Equipment/Item Number
- Title/Service
- Duty

4.3.3.6 Filters

- Equipment/Item Number
- Title/Service
- Size, Capacity
- Design Pressure @ Temperature
- Materials of Construction

4.3.3.7 Material Handling Equipment

- Equipment/Item Number
- Title/Service

- Size, Capacity
- Materials of Construction

4.3.3.8 Pumps

- Equipment/Item Number
- Title/Service
- Capacity (Flow and TDH)
- Power Requirements
- Materials of Construction
- Insulation/Tracing

4.3.3.9 Vessels/Tanks

- Equipment/Item Number
- Title/Service
- Size, Capacity
- Design Pressure @ Temperature
- Materials of Construction
- Insulation/Tracing

4.4 Piping

4.4.1 Line Data Identification

4.4.1.1 The line data identification shall be shown in accordance with Appendix B-1.

4.4.1.2 Unit symbols (*e.g.*, “"” for inches) shall be included with line sizes.

4.4.1.3 A leading zero shall be used if calling out piping in decimal format.

4.4.1.4 Additional characters can be added to the size tag (*i.e.*, user is not limited to “XXXX”).

4.4.1.5 Suffixes shall not be used as part of the sequence number.

4.4.1.6 Sequence numbers shall typically originate and terminate at equipment.

4.4.1.7 Different sequence numbers shall be assigned to line branches that terminate at different equipment numbers or lines.

4.4.1.8 The sequence number shall not be changed if the line flows through a piping specialty item or a control valve unless the piping specification changes at this component.

4.4.1.9 The sequence number may be changed if there is a line class break.

4.4.1.10 Different sequence numbers shall be assigned to the inlet and outlet of pressure relief valves.

4.4.1.11 The size and insulation thickness fields accommodate either English or metric units.

4.4.1.12 Insulation code changes shall be shown using the point of change symbol referenced in Appendix B-1.

4.4.1.13 Special layout requirements (*e.g.*, No Pockets) shall be shown with a note.

4.4.2 Line Service Codes

4.4.2.1 Line service codes are listed in Appendix B-1.

Comment: Additional line service codes can be added as required.

4.4.2.2 Each line service code shall consist of one to four alpha characters.

4.4.3 Piping Line Symbols

4.4.3.1 Piping shall be shown for primary, secondary, utility, jacketed or double containment, and future lines in accordance with Appendix B-1 and Section 4.2.3.

4.4.3.2 New lines added to P&IDs showing existing piping should be clouded on the P&ID. Use tie-in symbol in accordance with Appendix B-1 to denote connection to existing piping.

Comment: Existing drawings do not need to be upgraded to the requirements of this practice

4.4.3.3 Piping for above ground (AG) and underground (UG) lines shall be shown in the same manner.

4.4.3.4 An AG/UG line break or a piping line class break shall be used to distinguish between AG and UG lines.

4.4.4 Valve Symbols

4.4.4.1 Valve symbols shall be shown in accordance with Appendix B-1.

4.4.4.2 Additional valve symbols can be added as required.

4.4.4.3 All valve symbols shall be shown full size.

4.4.4.4 Reduced size valve symbols shall not be shown for drain and vent valving.

4.4.4.5 Valve size shall not be shown unless the size cannot be clearly identified from the equipment nozzle or pipe label on the P&ID.

4.4.4.6 The listed valve symbols shall be used for defining control valve body types.

4.4.4.7 If the control valve body type is unknown, a gate valve or rotary valve symbol shall be used as the generic symbol.

4.4.4.8 Permanent hydrotest high-point vent and low-point drain valves shall be shown.

Comment: These valves are typically identified in the later stages of P&ID development and verified when an “as-built” issue is made.

4.4.4.9 Temporary hydrotest valves (valves removed after testing) shall not be shown.

4.4.4.10 The full commodity code shall not be shown as a valve tag. A valve tag or abbreviated commodity code may be shown.

Comment: To distinguish between two types of valves allowed by the same pipe specification or for non-spec valves, an abbreviation or commodity reference may be used.

4.4.4.11 A note or symbol shall be used to specify required installation/ orientation for a valve if necessary (*e.g.*, valves with a vented ball/disc).

4.4.4.12 Valve end connections shall not be indicated, with the exception of a blinded, capped, or plugged valve, and any design in which this requirement is critical.

4.4.4.13 Integral bypass (warm-up/pressurization) valves shall be shown where applicable.

4.4.5 Piping Specialty Items

4.4.5.1 Piping specialty items shall be shown in accordance with Appendix B-1. Additional piping specialty symbols can be added as required.

4.4.5.2 A tag number shall be assigned to each piping specialty item.

4.4.5.3 The tag number shall be designated as “SP-XXXX” in which SP indicates a special piping item and XXXX is a four-character maximum identifier.

4.4.5.4 Identical piping specialty items located in multiple locations may be designated with the same tag number.

4.4.6 Piping Fittings

4.4.6.1 Typical piping fittings shall be shown in accordance with Appendix B-1. Additional piping fitting symbols can be added as required.

4.4.6.2 All reducers shall be shown on the P&ID.

4.4.6.3 Reducer size shall not be shown unless it cannot be clearly identified from the equipment nozzle or pipe label on the P&ID.

4.4.6.4 Weld connections shall be shown if appropriate (*e.g.*, at vessel nozzles).

4.4.7 Connectors and Tie-in Symbols

4.4.7.1 All connectors and tie-ins shall be shown as in Appendix B-1.

Comment: The connector number shall be a number unique to a set of connectors for a line traveling between two P&IDs.

4.4.7.2 The off-page connector shall be used for lines that continue to/from another P&ID showing the same unit or system.

4.4.7.3 The utility or drain connector shall be used for lines that enter/exit a P&ID from a utility distribution type P&ID.

Comment: A service description and equipment number reference are not required for utilities.

4.4.7.4 The off-page connector shall be used for utility lines if these lines are the primary system represented on the P&ID.

Comment: Utility primary systems include utility headers and non-distribution type utility lines (*e.g.*, raw water treatment lines).

4.4.7.5 The off-plot connector shall be used for lines that cross unit or battery limits.

4.4.7.6 Service description, connector number, P&ID number, and origin or destination shall be shown for off-page and off-plot connectors in accordance with Appendix B-1.

4.4.7.7 Origin or destination shall be shown as an equipment number, line number, or loop number.

4.4.7.8 Service description for a piping off-page and off-plot connector shall be shown as name of fluid (e.g., Cracked Gas) or line description (e.g., Reactor Feed, Tower Overhead).

4.4.8 Notes

4.4.8.1 The notes listed on the legend sheets of Appendix B shall represent typical design notes.

4.4.8.2 Specific design notes shall be shown on the applicable P&ID.

4.5 Instrumentation and Controls

4.5.1 Symbols

4.5.1.1 Instrument and control symbols shall be shown in accordance with Appendix B-2. (Reference *ISA-5.1* for additional details)

4.5.1.2 The conventions established by *ISA-5.1* for function identifier shall be followed for tagging and numbering of instrument and control devices. (Reference Appendix B-2.)

Comment: The tagging and numbering scheme described in the following example is used on the example P&IDs contained in the Appendixes for illustrative purposes only. This example tagging and numbering scheme is only one example of tagging and numbering schemes described in this Practice. The tagging structure is shown in the following example:

01 FC 100 01 A

01 – Plant/Unit/Area Number (may not appear on P&IDs or in a bubble)

FC – Function Identifier (*e.g.*, Flow Controller)

100 – Equipment (or P&ID) Number (optional)

01 –Sequence Number.

A-Suffix (optional)

Breaks in the instrument bubble may be used to accommodate longer tag numbers.

4.5.1.3 All measurement types shall be identified by an ISA symbol.

4.5.1.4 If necessary, a descriptive text label may be added (*e.g.*, analysis components like CO, H_2, CH_4, or unique flow measurement devices like “Mass”).

4.5.1.5 Interlock symbols shall be depicted as follows:

a. For discrete, hardware-based interlocks, the conventional diamond symbol shall be used in accordance with *ISA-5.1*.

b. For PLC-based interlocks, the diamond-in-a-box symbol shall be used in accordance with *ISA-5.1*.

c. For DCS-based interlocks, the DCS symbol (bubble-in-a-box) shall be used.

d. For PLCs integral to the DCS, the PLC symbol (diamond-in-a-box) shall be used.

Comment: Reference Appendix B-2 and Section 4.5.6 for additional information.

4.5.1.6 Directional arrows on instrumentation signal lines shall be used only if the function is not obvious (*e.g.*, cascades, selectors, interlocks).

4.5.1.7 Instrument function symbols, shown in Appendix B-2, shall be used to clarify the function of certain tagged instrument bubbles. The symbol shall be placed outside the bubble at the upper right.

4.5.1.8 The off-page connector shall be used in accordance with Appendix B-1 to depict continuation of instrumentation signals from one P&ID to another.

1. Service description, connector number, P&ID number, and origin/destination shall be shown for off-page and off-plot connectors in accordance with Appendix B-1.
2. Origin/destination shall be shown as an equipment number, line number, or loop number.
3. Service description for an instrument off-page and off-plot connector shall be shown as a line function (*e.g.*, Low Level Override) or equipment to be controlled (*e.g.*, PV-10014A/B).

4.5.1.9 An individual instrument bubble shall not be shown more than once, unless needed to clarify operation of the loop.

4.5.1.10 If it is necessary to show an instrument bubble more than once, the succeeding occurrences shall be shown as dotted (*e.g.*, turbine controls shown on a different sheet than the turbine).

4.5.1.11 Instrument Line Symbols shall be shown in accordance with Appendix B-2.

4.5.1.12 The ISA optional binary (on-off) symbols shall not be used for instrument lines.

4.5.1.13 Device location and accessibility shall be shown in accordance with Appendix B-2.

4.5.1.14 FO shall be used to tag all flow orifices and restriction orifices in accordance with *ISA-5.1*.

4.5.1.15 RO shall not be used for restriction orifices.

4.5.1.16 The same symbol (not tag) shall be used for a measuring flow element (FE) orifice and a restriction orifice (FO).

4.5.1.17 Instrument symbols on the P&ID do not necessarily reflect orientation.

4.5.1.18 Physical arrangement shall be covered by installation details or special notes.

4.5.2 Measurements

4.5.2.1 All transmitters shall be shown to avoid misinterpretations of physical and wiring connections between the transmitter and other devices or systems.

4.5.2.2 Isolation and Root Valves

1. Isolation valves shall be shown where an instrument is mounted on a vessel or other piece of equipment.
2. Root valves shall not be shown where these installation details can be adequately defined on a P&ID legend sheet.
3. Typical details, contained in the legend sheets (Appendix B), shall be used to identify the valve type, size, rating, and materials of construction in accordance with the applicable piping line class.

4.5.2.3 Instrument Leads

1. If instrument leads or analyzer lines are piping (*e.g.*, level bridles), the piping and related components shall be shown in accordance with Section 4.4.
2. If instrument leads are tubing, only the tubing shall be shown. Tubing valves, connections, and fittings shall not be shown.
3. Both leads for differential pressure type measurements shall be shown.
4. A single line, representing two leads, shall be used to simplify the drawing if intent is clear (*e.g.*, only a single line shall be typically shown for flange tap orifice meters).

4.5.2.4 Dip Tubes, Bubblers, and Stilling Wells

1. Dip tubes, bubblers, and stilling wells shall be shown for both process and instrumentation.
2. Notes shall be added as required for relevant specifications, materials, dimensions, weep holes, spray heads, radar level devices, etc.

4.5.2.5 Flow Meters

1. Flow meters shall be shown with the appropriate ISA symbol.
2. If no unique symbol exists or if a device type is unknown, a generic symbol shall be used and a text label shall be provided to identify the measurement type. (Reference Appendix B-2)
3. A tag shall be provided for all in-line generic flow meter bubbles.
4. A bubble shall be shown with a loop tag for other flow meter element symbols only if the loop association is not readily apparent. (Reference Section 4.2.1.13)

5. The size of all in-line devices shall be shown if not line sized or otherwise implied.
6. Flow meter accuracies shall not be shown.
7. If used, flow conditioning devices (*e.g.*, straightening vanes) shall be labeled with an instrumentation tag (*e.g.*, "FX-…") associated with the flow measurement loop.

4.5.2.6 Quality designations (e.g., ISO-9000) shall not be shown.

4.5.2.7 Temperature

1. A symbol and tag shall be shown for a thermowell if it is a stand-alone, spare, or test well.
2. Unless the loop association is not readily apparent, thermowell symbols or tags shall not be shown if a thermal measuring element is connected to it.
3. If a bare element is necessary (no thermowell), then a note or text label (*e.g.*, BARE) shall be added.

   Comment: Text should be placed outside the symbol in the lower right.

4. Unless the loop association is not readily apparent (*e.g.*, dual elements), thermal or temperature measuring elements (TE) shall not be shown with a symbol or tag.

4.5.2.8 Purge and Blowback

1. Process connection purge and blowback requirements shall be shown for all measuring devices requiring it in accordance with Appendix B-1.
2. Purge media and pressure shall be included.
3. Detailed hardware associated with purge/blowback (*e.g.*, rotameters) shall be shown on installation details, auxiliary P&IDs, or legend sheets.

4.5.2.9 Air Supplies

1. Air supplies to individual devices are not generally shown.
2. Air supplies to solenoids or other special applications shall be shown as needed on the P&ID or a legend sheet to clarify valve porting or operation (*e.g.*, trip solenoids or pneumatic hand switches).

4.5.2.10 Process Analyzers

1. Analyzer sample points, return lines, and connections shall be shown.
2. Analyzer piping shall be labeled in accordance with Appendix B-1.
3. Analyzer tubing shall be labeled with size and the applicable instrument piping and tubing system specification from *PIP PCSIP001*.
4. Sampling system hardware shall be shown on analyzer or other auxiliary drawings.

5. A single stream analyzer shall be shown on the same P&ID as its sample point.
6. Multi-stream analyzers shall be shown only once with off-page connectors from/to the multiple sample points/returns.
7. Sample connections that supply/return samples to/from multiple analyzers shall be shown only once, with continuations to/from other analyzers.
8. Measured components shall be shown at the upper left of each analyzer or sample point bubble as required.

4.5.2.11 Winterization and heat tracing requirements shall be shown for analyzers and instrumentation.

Comment: The insulation type code should be placed at the lower left of the bubble.

4.5.2.12 Indicators

1. If an indicator is integral to a transmitter, a single bubble and tag (*e.g.*, LIT) shall be used.
2. If separate devices are used for the transmitter and the indicator (*e.g.*, a remotely located indicator), separate bubbles and tags (*e.g.*, LT and LI) shall be shown.

4.5.2.13 Level Gauges

1. Level and gauge glasses shall be shown with the appropriate symbol and tag.

   Comment: Gauge glasses are typically armored as a safety requirement and may be shown with a unique symbol.

2. For level and gauge glasses, a single function (one bubble and tag) shall be used regardless of the number of individual sections required to span the length.

   Comment: A text label or note can be used to define the number of sections.

3. Separate bubbles and tags shall be shown for redundant gauge glasses or for applications with separate taps (*e.g.*, overlapping gauges).
4. The distance between level gauge connections shall not be shown.

4.5.3 Valves

4.5.3.1 General

1. Valves shall be shown in accordance with Appendix B-1.

   Comment: The symbols for automated valve bodies and for manual valves are identical.

2. The appropriate actuator symbols (*e.g.*, diaphragm and piston) shall be used to distinguish automated valves from manual valves. (Reference ISA 5.1 symbols in Appendix B-2)

Comment: Typically, a throttling control valve is shown with a diaphragm actuator and an on-off valve is shown with a cylinder/piston actuator, regardless of actual type.

3. The symbols shown in Appendix B-2 shall be used for pressure and temperature regulators.

4.5.3.2 Automated Valves

1. Automated valve fail actions shall be shown with text (FC/FO/FL/FI) in accordance with ISA-5.1. (Reference Section 4.2.4.6)

   Comment: Using stem arrows as outlined in *ISA-5.1* is not recommended because it becomes difficult to see on reduced-sized drawings.

2. For multi-port automated valves, FL and FI shall be used where appropriate.

   Comment: FO and FC shall not be used; instead, arrows shall be used to show fail position flow paths. Note that multiple arrows may be required.

3. Valves with different fail actions for loss of signal and for loss of motive power require an explanatory note.
4. Valve body sizes shall be shown for all automated valves if not line sized or otherwise implied. (Reference Section 4.2.4.6)
5. Automated valve specifications or commodity codes shall not be shown.
6. For automated valves, tight shut-off requirements shall be identified by using the abbreviation "TSO." (Reference Section 4.2.4.6)

   Comment: TSO defines the seat shut-off requirements for a new valve. Testing requirements, if any, are defined in other unit operation documents.

4.5.3.3 Identifying Tags

1. Valve identifying tags with bubbles shall not be shown if the associated loop tag is readily apparent.
2. An identifying tag with a bubble shall be shown for split range valves, self-contained regulators, or valves located on a separate P&ID from its controller. (Reference Section 4.2.1.6)

4.5.3.4 The ranges (*e.g.*, 0-50%, 50-100%) shall be shown for split range control valves.

Comment: The preferred labeling is controller percentage output because it applies to both pneumatic and electronic systems.

4.5.3.5 Valve positioners shall not be shown unless necessary to clarify loop operation (*e.g.*, if used with trip solenoids or pneumatic trip relays).

Comment: If shown, valve positioners are normally included with the automated valve symbol and are not tagged.

4.5.3.6 If engineered as a separate item from the control valve, current to pneumatic converters (I/Ps) shall be shown with a bubble symbol, tag, and function box only if furnished and mounted separately from the control valve, or if used with a trip solenoid valve.

4.5.3.7 Solenoid Valves

1. All solenoids that actuate final control elements (*e.g.*, trip valves and pneumatic relays) shall be shown.
2. Solenoid valve fail actions shall be shown using a directional arrow indicating the open flow path if de-energized.

   Comment: A four-way solenoid valve requires two directional arrows to adequately define the flow paths.

3. Resets (manual or remote) shall be shown if included with the solenoid valve.

4.5.3.8 Actuator Position Indication

1. Limit switches on automated valves shall be identified with a bubble and tag.

   Comment: The open or closed tag can be depicted with ZSO or ZSC. If both limit switches are provided, a single bubble should be used with O and C modifiers outside the bubble.

2. Limit switches on diverter valves can be tagged as ZST and ZSD for the Through and Divert positions.
3. A transmitter or positioner may be used in place of switches to identify valve stem position. This is shown as a single bubble labeled ZT.

4.5.3.9 Automated valve auxiliaries (*e.g.*, handwheels, volume tanks, nitrogen back-up bottles) shall be shown.

Comment: The use of typical details reduces clutter.

4.5.3.10 A note shall be used to identify the need for valve travel stops.

4.5.3.11 Set points on process regulators shall be shown.

4.5.4 Safety/Relief Devices

4.5.4.1 Relief devices and conservation vents shall be shown and tagged in accordance with Appendix B-1&2 (*e.g.*, PSE and PSV).

4.5.4.2 Optional explanatory text may be used for clarification of the type and function of the device (*e.g.*, “Emergency Relief,” “Conservation Vent,” “Explosion Panel”) located next to the tag. (Reference Sections 4.2.1.16 and 4.2.1.17)

4.5.4.3 PSE shall be used only for safety related service.

Comment: PSV typically refers to reclosing devices. PSE typically refers to non-reclosing devices (*i.e.*, rupture discs, buckling pin relief device). “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.” See *ISA-5.1*

4.5.4.4 The relief device set pressure shall be shown.

4.5.4.5 The relief device inlet and outlet sizes shall be clearly conveyed for the following items, if applicable:

a. PSVs

b. Rupture discs

c. Buckling Pin PSE

d. Conservation vents

4.5.4.6 Surface area or dimensions should be called out for explosion panels.

4.5.4.7 Relieving Manway size must be identified.

4.5.4.8 The orifice size letter designation for relief valves shall be shown between the inlet and outlet sizes (*e.g.*, 3K4).

4.5.4.9 The relief device sizing basis or flow capacity shall not be shown.

4.5.4.10 The materials of construction for relief devices shall not be shown.

4.5.5 Equipment Start/Stops

4.5.5.1 Local (field) hand switches (bubble and tag) shall be shown that:

a. Are part of an operator control panel

b. Interface with other systems (*e.g.*, interlocks)

c. Otherwise need explanation

4.5.5.2 All control room (DCS or panel board) hand switches shall be shown with the appropriate bubble symbol and tag.

4.5.5.3 All hand switch positions or functions shall be labeled. The labels shall be located outside the bubble symbol, on the upper right, using the standard text abbreviations shown in the Appendixes. All others shall be spelled out.

4.5.5.4 All required feedback signals or functions (*e.g.*, run lights) shall be clearly shown.

Comment: Hardwired signals are normally shown using standard instrument line symbols. Soft-linked feedback functions can be shown outside the display bubble at the upper left.

4.5.6 Interlocks

4.5.6.1 Interlocks shall be shown symbolically on the P&ID and include, at a minimum, the interlock number within the diamond.

4.5.6.2 The functional definition shall be defined on auxiliary documents (*e.g.*, binary logic diagrams, descriptive narratives, truth tables) or in the P&ID notes section.

Comment: Interlocks can be designed for a variety of functions, from simple process sequences to complex safety shutdown systems. A variety of hardware can be used for implementation (*e.g.*, DCS, PLC, relays, redundant, fault-tolerant Safety Interlock Systems).

Alarms can be similarly designed in a variety of ways. Alarms come from hardware, over serial links, from DCS software and can be shown on a variety of facility documents, including P&IDs, alarm summaries, logic and loop diagrams, and operating procedures.

4.5.6.3 Logic functions or interlocks shall be shown with the proper symbols in accordance with Section 4.5.1.

4.5.6.4 Binary logic gates, input/output tables, or descriptive narratives shall not be shown.

4.5.6.5 All logic function and interlock symbols shall contain an identification that provides reference to a unique logic diagram, narrative, truth table, or program. The reference shall be located within the interior of the symbol. The format of the reference shall be determined by the owner. Descriptive text or a note reference can be placed outside the symbol.

4.5.6.6 If Safety Instrumented Systems (SIS) are distinguished from other interlock systems, the preferred method shall be to add an “S” prefix to the unique interlock identification.

4.5.6.7 Each interlock shall be uniquely labeled, using a serial (not parallel) tagging scheme. The “S” prefix shall not be used to distinguish a unique interlock label.

Comment: A valid tagging scheme shall be I-100, I-101, SI-200, SI-201. The scheme I-100, SI-100 should not be used.

4.5.6.8 The type of logic solver hardware or level of redundancy shall not be shown except through the normal use of ISA symbols and the input and output signals described in Section 4.5.1 and the Appendixes.

4.5.6.9 Classifications or Safety Integrity Levels (SIL) shall not be shown for interlocks.

4.5.6.10 All operator-initiated interlock trip and reset hand switches shall be shown.

4.5.6.11 If used, all bypass hand switches for SIS interlocks shall be shown, including all individual initiator and system bypass switches.

Comment: Unnecessary clutter can be avoided by use of a table or reference note if large numbers of bypasses are necessary.

4.5.7 Alarms

4.5.7.1 All hardwired alarms shall be shown.

4.5.7.2 All alarms that require engineering or other review and approval based on safety or operability shall be shown.

4.5.7.3 Alarm trip points or settings shall not be shown.

4.5.7.4 For alarms based on analog measurements, the functional tag (*e.g.*, PI) shall be shown inside the bubble and the alarm levels shall be shown outside the bubble. High alarms (*e.g.*, H, HH) shall be placed at the upper right outside the bubble, and low alarms (*e.g.*, L, LL) shall be placed at the lower right outside the bubble.

Comment: The alarm modifier (A) should not be shown inside the bubble.

4.5.7.5 For discrete alarm points (on/off signals), the complete functional tag and alarm level (*e.g.*, PAH) shall be shown inside the bubble. Standard *ISA-5.1* abbreviations shall be used for both trip and alarm functions (*e.g.*, LSHH and LAHH).

4.5.8 DCS Points

4.5.8.1 A DCS point shall be shown if operations manipulates the process with it or receives information from it, or if the point is essential to understanding the functional operation of the process controls.

Comment: It is not necessary for every point configured in a DCS to be shown. It is not necessary for implied functions (*e.g.*, I for indicate, R for recorder) to be included in every DCS point tag.

It is not the intent of this section to define which DCS points to show for every supplier of a DCS or each type of system that can communicate with a DCS via a software link (*e.g.*, analyzer data highways, anti-surge control systems, vibration monitoring systems, Safety Instrumented Systems, PLCs, tank gauging systems).

Application of these requirements to specific systems shall determine which DCS points to show. DCS points not shown can be displayed on special purpose auxiliary drawings.

4.5.8.2 DCS points that indicate measured process values, including both analog and digital values obtained from hardwired inputs or via software links shall be shown (*e.g.*, flows, temperatures, pressures, compositions from analyzers, and valve open/closed status).

4.5.8.3 DCS points that manipulate analog or digital output hardware devices shall be shown (*e.g.*, flow, temperature and pressure controllers, hand switches, and logic points).

4.5.8.4 DCS points that operations employ to manipulate the process shall be shown (*e.g.*, regulatory controllers and pump start/stop switches).

4.5.8.5 DCS points that provide operations an interface to manipulate the process through a software link to other systems shall be shown (*e.g.*, points that interface with controllers in the linked system and SIS reset hand switches).

4.5.8.6 DCS points that are essential to understanding the operation of the process controls shall be shown (*e.g.*, selectors in override controls or enthalpy calculators in heat duty controls).

4.5.8.7 DCS points that are required for regulatory compliance and mechanical integrity needs shall be shown (*e.g.*, rolling averages for emissions monitoring or compressor runtimes).

4.5.8.8 DCS points that are necessary to understand the functional operation of process control schemes shall be shown.

4.5.8.9 DCS points needed only for implementation shall not be shown (*e.g.*, points that provide bumpless transfer, initialization, some logic functions).

4.5.8.10 Higher Level Control Systems shall not be shown (*e.g.*, model predictive multivariable control systems).

4.5.8.11 Symbols (*e.g.*, hexagons, footballs) to indicate that a BPCS DCS point is being manipulated by a Higher Level Control System shall not be added.

Comment: A note can be used to reference HLCS details.

4.5.8.12 DCS points that exist solely to facilitate information transfer via a software link shall not be shown.

4.5.8.13 DCS points that are used solely to log, journal, or time stamp events shall not be shown.

4.5.8.14 Nonprocess indicators and alarms in locations such as rack rooms and motor control centers shall be shown on auxiliary P&IDs.

Comment: Examples include area monitors and safety shower status.

4.5.9 Miscellaneous

4.5.9.1 The following information shall be specifically excluded:

a. Controller actions

b. Controller and alarm set points

c. Configuration information (*e.g.*, controller or output actions, address information)

4.5.9.2 Miscellaneous instrument symbols shall be shown in accordance with Appendix B-2.

4.5.9.3 Typical details illustrating the use of implied tags shall be shown in accordance with Appendix B.

Appendixes Summary

The Appendixes of this Practice contain tables of commonly used symbols, abbreviations and labels, typical details, and example P&IDs.

Appendix A contains detailed equipment labels for various equipment classes. The text is shown the same size as would be utilized for a standard, full-size (22 inches x 34 inches) P&ID.

Appendix B contains symbols, abbreviations, and nomenclature, organized into legend sheets. Legend sheets are also commonly referred to as lead sheets or cover sheets.

Appendix C contains example P&IDs that illustrate the text and utilize the symbols and nomenclature on the legend sheets.

Appendix D contains information, symbols, and example P&IDs specific to the development of P&IDs for the hygienic processing industries – pharmaceutical, food, and beverage.

Comment: The legend sheets and P&IDs are drawn as standard, full-size (22 inches x 34 inches) P&IDs, but reduced to standard 8-1/2 inch x 11-inch pages for electronic distribution purposes. It is recommended that the legend sheets and P&IDs be printed on 11-inch x 17-inch pages.

Appendix A – Detailed Equipment Labels

A-1 Equipment Labels

1. Agitator
2. Blower
3. Heat Exchanger
4. Jacketed Vessel
5. Other/Miscellaneous
6. Pump
7. Tank/Vessel

APPENDIX A
SUGGESTED DETAILED EQUIPMENT LABELS

A-101
BOTTOMS TANK AGITATOR
POWER REQ'T: 40 HP
MOC: 316 SS

B-201
WASTE HEAT BLOWER
CAPACITY – FLOW @ D/P: 300 SCFM @ 15 mBAR
POWER REQ'T: 15 KW
MOC: 304 SS

E-105
COLUMN REFLUX CONDENSER
DUTY: 15,000 BTU/HR
SURFACE AREA: 400 SQ FT
SHELL DESIGN PRESS @ TEMP: 150 PSIG @ 300° F
TUBE DESIGN PRESS @ TEMP: 300 PSIG @ 300° F
MOC – SHELL/TUBE: CS/316 SS
INSULATION/TRACING: 2 INCH FIBERGLASS

P-205
PRODUCT TRANSFER PUMP
CAPACITY – FLOW @ TDH: 17 CU M/HR @ 2.2 BAR
POWER REQ'T: 25 KW
MOC: ALLOY 20
INSULATION/TRACING: ELECTRIC TRACING

NOTES:

1. THESE SUGGESTED LABELS ARE SHOWN CENTER JUSTIFIED WITH THE COLON AS THE CENTERPOINT FOR THE PROPERTIES AND VALUES LISTED. OTHER JUSTIFICATIONS MAY BE USED FOR THE TEXT.

2. FOR ILLUSTRATION PURPOSES, DIFFERENT UNITS OF MEASURE HAVE BEEN USED FOR THE EXAMPLE LABELS. UNITS SHOULD BE STANDARDIZED FOR EACH PROJECT.

APPENDIX A
SUGGESTED DETAILED EQUIPMENT LABELS

V-401

INTERMEDIATE WASH TANK

SIZE & CAPACITY:	8'-6" OD x 10'-8" T/T, 5,000 GAL
DESIGN PRESS @ TEMP:	300 PSIG @ 450 °F
MOC:	HASTELLOY C-276
INSULATION/TRACING:	4 INCH CALCIUM SILICATE

V-306

CHLORINATION REACTOR

SIZE & CAPACITY:	1.9 M OD x 2.6 M T/T, 9 CU M
VESSEL DESIGN PRESS @ TEMP:	20 BAR @ 250 °C
JACKET DESIGN PRESS @ TEMP:	20 BAR @ 250 °C
MOC:	HASTELLOY C-276
INSULATION/TRACING:	2 INCH PHENOLIC FOAM

NOTES:

1. THESE SUGGESTED LABELS ARE SHOWN CENTER JUSTIFIED WITH THE COLON AS THE CENTERPOINT FOR THE PROPERTIES AND VALUES LISTED. OTHER JUSTIFICATIONS MAY BE USED FOR THE TEXT.

2. FOR ILLUSTRATION PURPOSES, DIFFERENT UNITS OF MEASURE HAVE BEEN USED FOR THE EXAMPLE LABELS. UNITS SHOULD BE STANDARDIZED FOR EACH PROJECT.

Appendix B – Legend sheets

B-1: Symbols and Nomenclature – Typical Piping

B-2: Symbols and Nomenclature – Typical Instrumentation

B-3: Symbols and Nomenclature – Typical Equipment

B-4: Typical Details with Implied Components

Note: The example legend sheets in this Appendix are not all-inclusive of the potential uses of implied components. The implied component examples shown do not cover all actual occurrences or design possibilities for instrument assemblies, such as the level bridles shown. The user must ensure that the legend sheets capture their piping/instrument requirements for their use of implied components. There are many more systems that may require a legend sheet explanation to show the implied components – pump seals, sampling systems, analyzer systems for example, as well as other types of level systems than those shown here.

ABBREVIATIONS

AG	ABOVE GROUND
ATM	ATMOSPHERE
BL	BATTERY LIMIT
BTL	BOTTOM TANGENT LINE
BYP	BYPASS
CC	CHEMICAL CLEANOUT
CL	CENTERLINE
CO	CLEANOUT
CONN	CONNECTION
CSC	CAR SEAL CLOSED
CSO	CAR SEAL OPEN
CTR	CENTER
DCS	DISTRIBUTED CONTROL SYSTEM
DES	DESIGN
DIA	DIAMETER
DP	DESIGN PRESSURE
D/P	DIFFERENTIAL PRESSURE
DRN	DRAIN
DT	DESIGN TEMPERATURE
DWG	DRAWING
(E)	EXISTING
EL	ELEVATION
ESD	EMERGENCY SHUTDOWN
FOF	FACE OF FLANGE
(F)	FURNISHED
FLG	FLANGE
FP	FULL PORT
FV	FULL VACUUM
GO	GEAR OPERATED
GR	GRADE
HC	HOSE CONNECTION
HDR	HEADER
HH	HAND HOLE
HOA	HAND/OFF/AUTOMATIC
HP	HIGH PRESSURE
HPT	HIGH POINT
IAS	INSTRUMENT AIR SUPPLY
ISBL	INSIDE BATTERY LIMITS
LC	LOCKED CLOSED
LO	LOCKED OPEN
LP	LOW PRESSURE
LPT	LOW POINT
MAX	MAXIMUM
MIN	MINIMUM
MOV	MOTOR OPERATED VALVE
MTL	MATERIAL
MW	MANWAY
NC	NORMALLY CLOSED
NNF	NORMALLY NO FLOW
NO	NORMALLY OPEN
NOZ	NOZZLE
O/C	OPEN/CLOSE
O/O	ON/OFF
OP	OUTPUT
OSBL	OUTSIDE BATTERY LIMITS
OVHD	OVERHEAD
PLC	PROGRAMMABLE LOGIC CONTROLLER
PRESS	PRESSURE
PV	PROCESS VARIABLE
(R)	RELOCATED
REQD	REQUIRED
RTD	RESISTANCE TEMP. DETECTOR
SC	SAMPLE CONNECTION
SCH	SCHEDULE
SD	SHUTDOWN
SG	SPECIFIC GRAVITY
SIS	SAFETY INSTRUMENTED SYSTEM
SO	STEAM OUT
SP	SET POINT
SS	STAINLESS STEEL
S/S	START/STOP
STD	STANDARD
T/C	THERMOCOUPLE
TDH	TOTAL DIFFERENTIAL HEAD
TEMP	TEMPERATURE
THRD	THREADED
TL	TANGENT LINE
TSO	TIGHT SHUT-OFF
T/T	TANGENT TO TANGENT
TYP	TYPICAL
UG	UNDERGROUND
VNT	VENT
VAC	VACUUM
VB	VORTEX BREAKER
W/	WITH
W/O	WITHOUT

VALVE SYMBOLS (9)

- GATE (OR GENERIC)
- CHECK (8)
- STOP CHECK (8)
- GLOBE
- BUTTERFLY
- NEEDLE
- BALL
- GENERIC ROTARY (1/4 TURN)
- PLUG
- DIAPHRAGM
- 3-WAY
- 4-WAY
- PINCH
- ANGLE
- KNIFE
- DOUBLE BLOCK & BLEED VALVE

PIPING FITTINGS

- FLANGE
- WELDED CONNECTION
- CAP
- CONCENTRIC (OR GENERIC) REDUCER
- ECCENTRIC REDUCER
- HOSE CONNECTION
- SPACER
- BLANK
- OPEN FIGURE 8 BLIND
- CLOSED FIGURE 8 BLIND
- PLUG
- BLIND FLANGE

PIPING SPECIALTY ITEMS

- Y-TYPE STRAINER (8)
- CONE STRAINER (8)
- T-TYPE STRAINER
- DUPLEX STRAINER
- BASKET STRAINER
- TEMPORARY STRAINER (8)
- FILTER
- D — DETONATION ARRESTOR
- F — FLAME ARRESTOR
- T — STEAM TRAP
- EJECTOR/EDUCTOR (8)
- PULSATION DAMPENER
- S — IN-LINE SILENCER
- S — VENT SILENCER
- RS — REMOVABLE SPOOL
- DS — DESUPERHEATER
- FLEXIBLE HOSE
- EXPANSION JOINT
- DAMPER
- BREATHER
- VENT COVER
- IN-LINE MIXER
- DIVERTER VALVE (8)
- ROTARY VALVE
- EXCESS FLOW VALVE (8)
- EXHAUST HEAD
- SPRAY NOZZLE

INSULATION TYPE CODES

AC	ACOUSTIC CONTROL INSULATION
CC	COLD SERVICE INSULATION
CJ	CHILLED FLUID JACKETED
CP	CONDENSATION CONTROL
CT	CHILLED FLUID TRACED
ET	ELECTRIC TRACED
FP	FIRE PROTECTION INSULATION
HC	HEAT CONSERVATION INSULATION
HJ	HOT FLUID JACKETING
HT	HOT FLUID TRACED
PF	PREVENTION FROM FREEZING INSULATION
PP	PERSONNEL PROTECTION INSULATION
PS	PROCESS STABILITY INSULATION
SJ	STEAM JACKETED
ST	STEAM TRACED

PIPING LINE SYMBOLS

- PRIMARY (AG & UG)
- SECONDARY / UTILITY (AG & UG)
- FUTURE
- (13) JACKETED OR DOUBLE CONTAINMENT

LINE DATA IDENTIFICATION

UNIT/AREA (NUMERIC) — SERVICE (ALPHA) — SEQUENCE (NUMERIC) — SIZE (NUMERIC WITH UNITS) — LINE CLASS (10)

XX - XXX - XXXX - XXXX - XXXXXXXXXX

XXXX - XXXX - XXXX

(11) INSUL. TYPE — THICKNESS (NUMERIC WITH UNITS) — OPTIONAL (USER DEFINED)

OFF-PAGE & DRAIN CONNECTORS

OFF-PLOT CONNECTOR

CONNECTOR NUMBER — SERVICE DESCRIPTION — XXXXX — P&ID NO — ORIGIN OR DESTINATION

PRIMARY/SECONDARY LINES AND INSTRUMENT SIGNAL CONNECTOR

CONNECTOR NUMBER — SERVICE DESCRIPTION — XXXXX — P&ID NO — ORIGIN OR DESTINATION

UTILITY CONNECTOR

CONNECTOR NUMBER — XXXXX — P&ID NO (12)

CLOSED DRAIN

CONNECTOR NUMBER — XXXXX; DESTINATION — YYY; LINE SERVICE CODE — P&ID NO

OPEN DRAIN

CONNECTOR NUMBER — XXXXX; DESTINATION — YYY; LINE SERVICE CODE — P&ID NO

CLOSED DRAIN (NO P&ID)

DESTINATION LINE SERVICE CODE — YYY

OPEN DRAIN (NO P&ID)

DESTINATION LINE SERVICE CODE — YYY

LINE SERVICE CODES

AV	ATMOSPHERIC VENT
BA	BREATHING AIR
BD	BLOWDOWN
BFW	BOILER FEED WATER
BRR	BRINE RETURN
BRS	BRINE SUPPLY
CC	CONTAMINABLE CONDENSATE
CF	COLD FLARE
CHS	CHEMICAL SEWER
CV	COLD VENT
CWR	COOLING WATER RETURN
CWS	COOLING WATER SUPPLY
DMW	DEMINERALIZED WATER
DR	DRAIN
DS	DILUTION STEAM
DW	DRINKING WATER
ER	ETHYLENE REFRIGERANT
FF	FLUSHING FLUID
FG	FUEL GAS
FO	FUEL OIL
FW	FIRE WATER
GLR	GLYCOL RETURN
GLS	GLYCOL SUPPLY
H	HYDROGEN
HS	HIGH PRESSURE STEAM
IA	INSTRUMENT AIR
IS	INTERMEDIATE PRESSURE STEAM
LNG	LIQUIFIED NATURAL GAS
LO	LUBE OIL
LPG	LIQUIFIED PETROLEUM GAS
LS	LOW PRESSURE STEAM
ME	METHANOL
MR	MIXED REFRIGERANT
MS	MEDIUM PRESSURE STEAM
N	NITROGEN
NA	CAUSTIC
NAS	CAUSTIC SEWER
NG	NATURAL GAS
NH	AMMONIA
OWS	OILY WATER SEWER
OX	OXYGEN
P	GENERAL PROCESS
PA	PLANT AIR
PC	PROCESS CONDENSATE
PR	PROPYLENE REFRIGERANT
PW	PROCESS WATER
QO	QUENCH OIL
RS	RECOVERED SLOPS
RV	RELIEF VENT
RW	RAW WATER
SC	STEAM CONDENSATE
SG	SYNTHESIS GAS
SO	SEAL OIL
SS	SANITARY SEWER
STS	STORM SEWER
SW	SERVICE WATER
SWR	SEA WATER RETURN
SWS	SEA WATER SUPPLY
TWR	TEMPERED WATER RETURN
TWS	TEMPERED WATER SUPPLY
VC	VACUUM CONDENSATE
VE	VACUUM EXHAUST
WF	WARM FLARE
WO	WASH OIL
WW	WASTE WATER

MISCELLANEOUS

- P XXXX — PURGE CONNECTION (XXXX = PURGE PRESSURE AND MEDIUM)
- SC XX/YY — SAMPLE CONNECTION (XX/YY = TYPE/NUMBER)
- XX — NOTE REFERENCE SYMBOL (XX = NOTE NUMBER, ROTATE ARROW AS REQUIRED)
- T XXXX — TIE-IN SYMBOL (XXXX = IDENTIFICATION NUMBER)
- POINT OF CHANGE IN LINE CLASS OR INSULATION REQUIREMENT
- SP XXXX — SP-XXXX — PIPING SPECIALTY ITEM
- PACKAGED EQUIPMENT LIMITS
- BATTERY LIMITS (OR MATCH LINE)

NOTES:

1. FOR GENERAL PIPING REQUIREMENTS, SEE DESIGN SPECIFICATION PIP PNE00001. FOR INSTRUMENT PIPING AND TUBING SYSTEMS CRITERIA, SEE PIP PCCIP001.
2. ALL SINGLE VALVED CONNECTIONS TO ATMOSPHERE IN PROCESS SERVICE WILL BE PLUGGED, CAPPED OR BLIND FLANGED.
3. ALL VENTS AND DRAINS ARE 3/4 " UNLESS OTHERWISE NOTED.
4. DEFINITIONS:

   GRAVITY FLOW – ELEVATIONS DOWNSTREAM NEVER EXCEED INLET ELEVATIONS. LINE MAY CONTAIN POCKETS.

   Y X – SLOPED LINE: NO POCKETS PERMITTED.

   FREE DRAINING – NO POCKETS PERMITTED.

   NO POCKETS – NO POCKETS IN LINE.
5. CLOSED PRESSURE RELIEF VALVE DISCHARGE LEADS SHALL BE FREE DRAINING FROM THE PRESSURE RELIEF VALVE TO THE TOP OF THE DISCHARGE HEADER.
6. 3/8 " WEEP HOLES ARE PROVIDED AT LOW POINTS OF VENT, PRESSURE RELIEF VALVE AND RUPTURE DISK DISCHARGE LINES TO ATMOSPHERE.
7. REDUCERS IN PRESSURE RELIEF VALVE INLET OR OUTLET PIPING SHALL BE INSTALLED IMMEDIATELY ADJACENT TO THE PRESSURE RELIEF VALVES.
8. THESE SYMBOLS ARE SHOWN WITH FLOW FROM LEFT TO RIGHT.
9. VALVES WHICH ARE NORMALLY CLOSED ARE SO INDICATED BY "DARKENED IN" SYMBOL. EXAMPLE:

   NORMALLY CLOSED GATE VALVE

   NORMALLY CLOSED BUTTERFLY VALVES ARE INDICATED BY THE ABBREVIATION "NC".
10. DEFINED BY PIP PNSM0001; PIPING LINE CLASS DESIGNATOR SYSTEM. FOR INSTRUMENT PIPING AND TUBING SPECIFICATION, SEE PIP PCSIP001.
11. DEFINED BY PIP INEG1000; INSULATION DESIGN AND TYPE CODES. TWO SETS OF INSULATION TYPE CODES MAY BE USED IF A COMBINATION OF REQUIREMENTS ARE TO BE SPECIFIED.
12. ON P&ID'S WHICH SHOW UTILITY COLLECTION/DISTRIBUTION SYSTEMS, AN ADDITIONAL NOTE INDICATING USER OR AREA MAY BE PLACED ADJACENT TO THE UTILITY CONNECTOR. SEE APPENDIX C, p.3.
13. FOR THE JACKETED OR DOUBLE CONTAINMENT PIPING LINE SYMBOL, THE OUTER LINES MAY EXTEND THE ENTIRE LENGTH OF THE PIPE (INNER LINE).

PROCESS INDUSTRY PRACTICES
PIPING AND INSTRUMENTATION DIAGRAM

SYMBOLS AND NOMENCLATURE
TYPICAL PIPING LEGEND SHEET
APPENDIX B-1

PRACTICE REF. PIC001
ISSUED: FEBRUARY 2018
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PIC001-B-001

INSTRUMENT LINE SYMBOLS

- INSTRUMENT SUPPLY OR CONNECTION TO PROCESS
- PNEUMATIC SIGNAL
- ELECTRIC SIGNAL
- HYDRAULIC SIGNAL
- CAPILLARY TUBE
- ELECTROMAGNETIC, SONIC, OPTICAL, OR NUCLEAR SIGNAL
- SOFTWARE OR DATA LINK
- MECHANICAL LINK
- FIELDBUS

MISCELLANEOUS SYMBOLS

- CHEMICAL SEAL/DIAPHRAGM
- PILOT LIGHT OR GAUGE GLASS ILLUMINATOR
- DUAL FUNCTION OR INSTRUMENTS SHARING COMMON HOUSING
- I — UNDEFINED INTERLOCK LOGIC
- FC 1230–99 — INSTRUMENT WITH LONG TAG NUMBER
- XX — HEAT (COOL) TRACED INSTRUMENT

CONTROL VALVE ACTUATOR SYMBOLS (4)

- T — MANUAL OPERATOR
- DIAPHRAGM
- PRESSURE BALANCED DIAPHRAGM
- HANDWHEEL – USED WITH ANY ACTUATOR
- CYLINDER/PISTON
- M — MOTOR OPERATED
- E/H — ELECTRO–HYDRAULIC
- S — SINGLE SOLENOID
- S — SINGLE SOLENOID WITH REMOTE RESET
- S — SINGLE SOLENOID WITH MANUAL RESET
- S, FC — TYPICAL CONTROL VALVE WITH POSITIONER AND SOLENOID

VALVE FAIL STATES

- FC FAIL CLOSED
- FI FAIL INDETERMINATE
- FL FAIL LOCKED (LAST POSITION)
- FO FAIL OPEN

PRIMARY ELEMENT SYMBOLS (FLOW) (2)

- XX — GENERAL SYMBOL IN–LINE ELEMENT XX = FS, FG, FE, FT
- FT, XXXX — GENERIC IN–LINE FLOW ELEMENT WITH INTEGRAL TRANSMITTER XXXX = MASS, CORIOLIS, THERMAL, INT. ORIFICE ...
- FT, FE, XXXX — GENERIC IN–LINE FLOW ELEMENT WITH SEPARATE TRANSMITTER XXXX = MASS, CORIOLIS, THERMAL...
- ORIFICE
- M — MAGNETIC
- TURBINE OR PROPELLER
- CORIOLIS
- ULTRASONIC
- VORTEX
- PITOT TUBE
- AVERAGING PITOT TUBE
- FLOW NOZZLE
- VENTURI
- WEDGE METER
- FLUME
- WEIR
- POSITIVE DISPLACEMENT
- ORIFICE IN QUICK CHANGE FITTING
- TARGET
- FI — ROTAMETER (OR PURGE) (SHOWN WITH OPTIONAL INTEGRAL VALVE)
- FS* — FLOW SWITCH * = H/L
- FG — FLOW GLASS
- FLOW CONDITIONING DEVICES (e.g., STRAIGHTENING VANES)
- FO — RESTRICTION ORIFICE

INSTRUMENT FUNCTION SYMBOLS

Σ	SUMMING	>	HIGH SELECT
Σ/n	AVERAGING	<	LOW SELECT
Δ	DIFFERENCE		HIGH LIMIT
X	MULTIPLYING		LOW LIMIT
÷	DIVIDING	±	BIAS
√	SQUARE ROOT	f(x)	UNSPECIFIED FUNCTION
x^n	EXPONENTIAL		USER DEFINED
/	CONVERSION INPUT/OUTPUT		

/

- A ANALOG
- B BINARY
- D DIGITAL
- E VOLTAGE
- H HYDRAULIC
- I CURRENT
- O ELECTROMAGNETIC, SONIC
- P PNEUMATIC
- R RESISTANCE (ELECTRICAL)

SELF–ACTUATED DEVICES (2) (5)

- RUPTURE DISC OR SAFETY HEAD FOR PRESSURE RELIEF (EXPLOSION PANEL)
- RUPTURE DISC OR SAFETY HEAD FOR VACUUM RELIEF (EXPLOSION PANEL)
- PRESSURE RELIEF OR SAFETY VALVE
- VACUUM RELIEF VALVE
- PRESSURE AND VACUUM RELIEF VALVE OR CONSERVATION VENT
- BUCKLING PIN RELIEF VALVE
- P — PILOT OPERATED RELIEF VALVE WITH REMOTE SENSOR (USE APPROPRIATE RELIEF VALVE SYMBOL)
- PRESSURE REDUCING REGULATOR (SELF–CONTAINED)
- BACK PRESSURE REGULATOR (SELF–CONTAINED)
- BACK PRESSURE REGULATOR W/ EXTERNAL TAP
- PRESSURE REDUCING REGULATOR W/ EXTERNAL TAP
- DIFFERENTIAL PRESSURE REDUCING REGULATOR
- TEMPERATURE REGULATOR FILLED SYSTEM TYPE

GENERAL INSTRUMENT SYMBOLS (3)

SHARED DISPLAY, SHARED CONTROL		COMPUTER SYSTEMS AND SOFTWARE	DISCRETE	LOCATION & ACCESSIBILITY
PRIMARY CHOICE OR BASIC PROCESS CONTROL SYSTEM	ALTERNATE CHOICE OR SAFETY INSTRUMENTED SYSTEM			
				1. LOCATED IN FIELD. 2. NOT PANEL, CABINET, OR CONSOLE MOUNTED. 3. VISIBLE AT FIELD LOCATION. 4. NORMALLY OPERATOR ACCESSIBLE.
				1. LOCATED IN OR ON FRONT OF CENTRAL OR MAIN PANEL OR CONSOLE. 2. VISIBLE ON FRONT PANEL OR ON VIDEO DISPLAY. 3. NORMALLY OPERATOR ACCESSIBLE AT PANEL FRONT OR CONSOLE.
				1. LOCATED IN REAR OF CENTRAL OR MAIN PANEL. 2. LOCATED IN CABINET BEHIND PANEL. 3. NOT VISIBLE ON FRONT OF PANEL OR ON VIDEO DISPLAY. 4. NOT NORMALLY OPERATOR ACCESSIBLE AT PANEL OR CONSOLE.
				1. LOCATED IN OR ON FRONT OF SECONDARY OR LOCAL PANEL OR CONSOLE. 2. VISIBLE ON FRONT OF PANEL OR ON VIDEO DISPLAY. 3. NORMALLY OPERATOR ACCESSIBLE AT PANEL FRONT OR CONSOLE.
				1. LOCATED IN REAR OF SECONDARY OR LOCAL PANEL. 2. LOCATED IN FIELD CABINET. 3. NOT VISIBLE ON FRONT OF PANEL OR ON VIDEO DISPLAY. 4. NOT NORMALLY OPERATOR ACCESSIBLE AT PANEL OR CONSOLE.

INSTRUMENT IDENTIFICATION LETTERS

	FIRST LETTER		SUCCEEDING LETTERS		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, FLAME, COMBUSTION		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	USER'S CHOICE (TYPICALLY CONDUCTIVITY – ELECTRICAL)			CONTROL	CLOSED
D	USER'S CHOICE (TYPICALLY DENSITY OR SPECIFIC GRAVITY)	DIFFERENCE, DIFFERENTIAL			DIVERT, DEVIATION
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)		
F	FLOW, FLOW RATE	RATIO (FRACTION)			
G	USER'S CHOICE OR GAUGING (DIMENSIONAL)		GLASS, GAUGE, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	USER'S CHOICE (TYPICALLY MOISTURE OR HUMIDITY)	MOMENTARY			MIDDLE, INTERMEDIATE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	USER'S CHOICE		ORIFICE, RESTRICTION		OPEN
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY OR HEAT DUTY	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	THROUGH
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE OR PRESENCE	Y AXIS		RELAY, SOLENOID COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z AXIS, SIS		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

NOTES:

1. REFERENCE ISA S5.1.
2. FLOW ASSUMED LEFT TO RIGHT AS SHOWN.
3. MULTIPLE LOCATIONS OF THE SAME TYPE CAN BE DISTINGUISHED BY ADDING A TEXT LABEL OR NOTE.
4. FOR VALVE SYMBOLS, SEE APPENDIX B, p.1.
5. FLOW DIRECTIONAL ARROWS DO NOT NEED TO BE INCLUDED AS PART OF SYMBOL.

PROCESS INDUSTRY PRACTICES
PIPING AND INSTRUMENTATION DIAGRAM

SYMBOLS AND NOMENCLATURE
TYPICAL INSTRUMENTATION LEGEND SHEET
APPENDIX B–2

PIP

PRACTICE REF. PIC001
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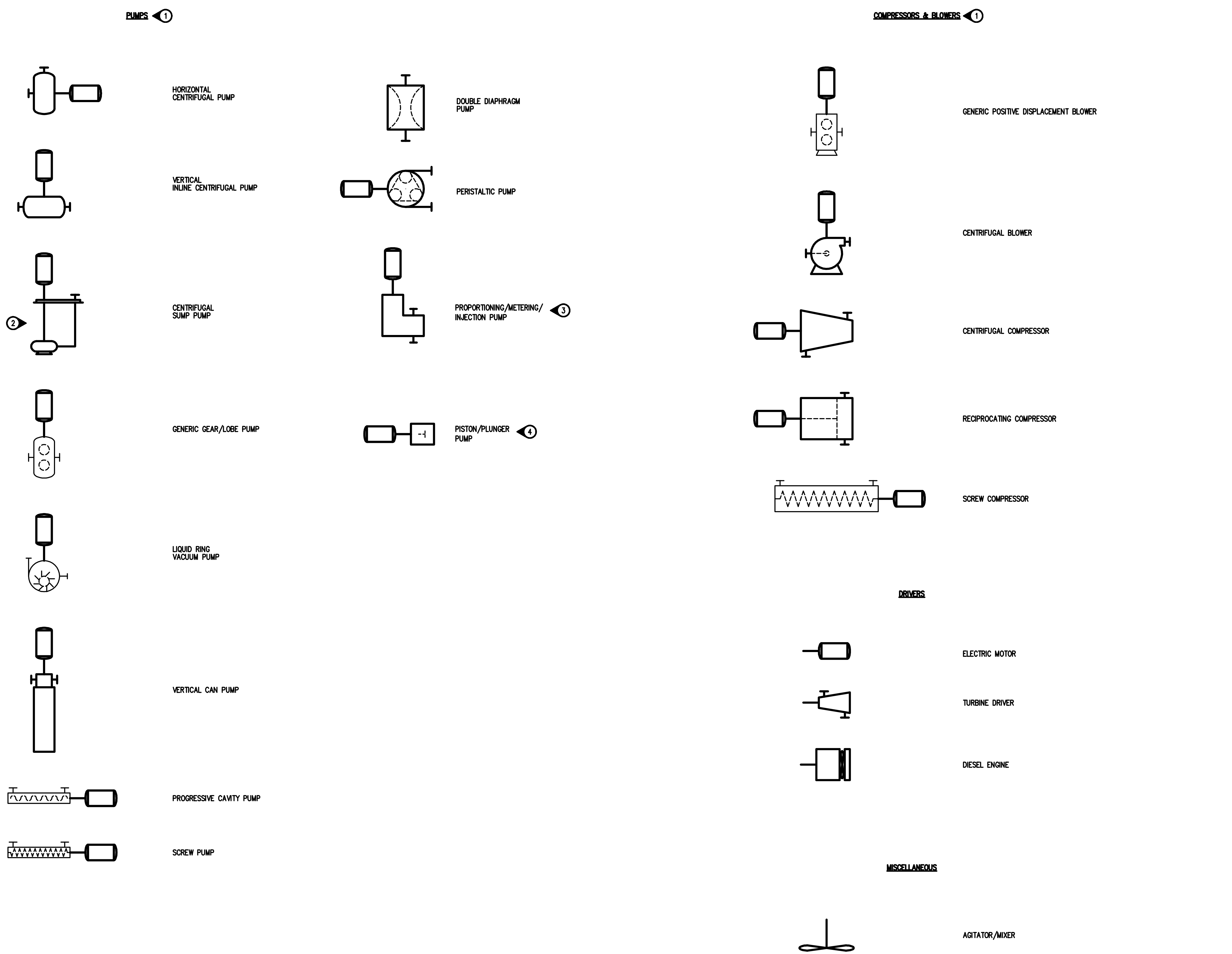
PAGE 1 OF 1
PIC001–B–002



NOTES:

1. MOTORS ARE SHOWN HERE TO ILLUSTRATE DRIVER ORIENTATION.
2. LENGTH OF SYMBOL VARIES DEPENDING UPON DEPTH OF SUMP SYMBOL.
3. INLET AND OUTLET NOZZLES MAY BE CONFIGURED AT DIFFERENT LOCATIONS.
4. MULTIPLE REPRESENTATIONS OF THIS SYMBOL MAY BE BUILT IN PARALLEL TO SHOW MULTI-HEAD OPERATION.

PROCESS INDUSTRY PRACTICES
PIPING AND INSTRUMENTATION DIAGRAM

SYMBOLS AND NOMENCLATURE
TYPICAL EQUIPMENT LEGEND SHEET
DRIVEN EQUIPMENT
APPENDIX B-3

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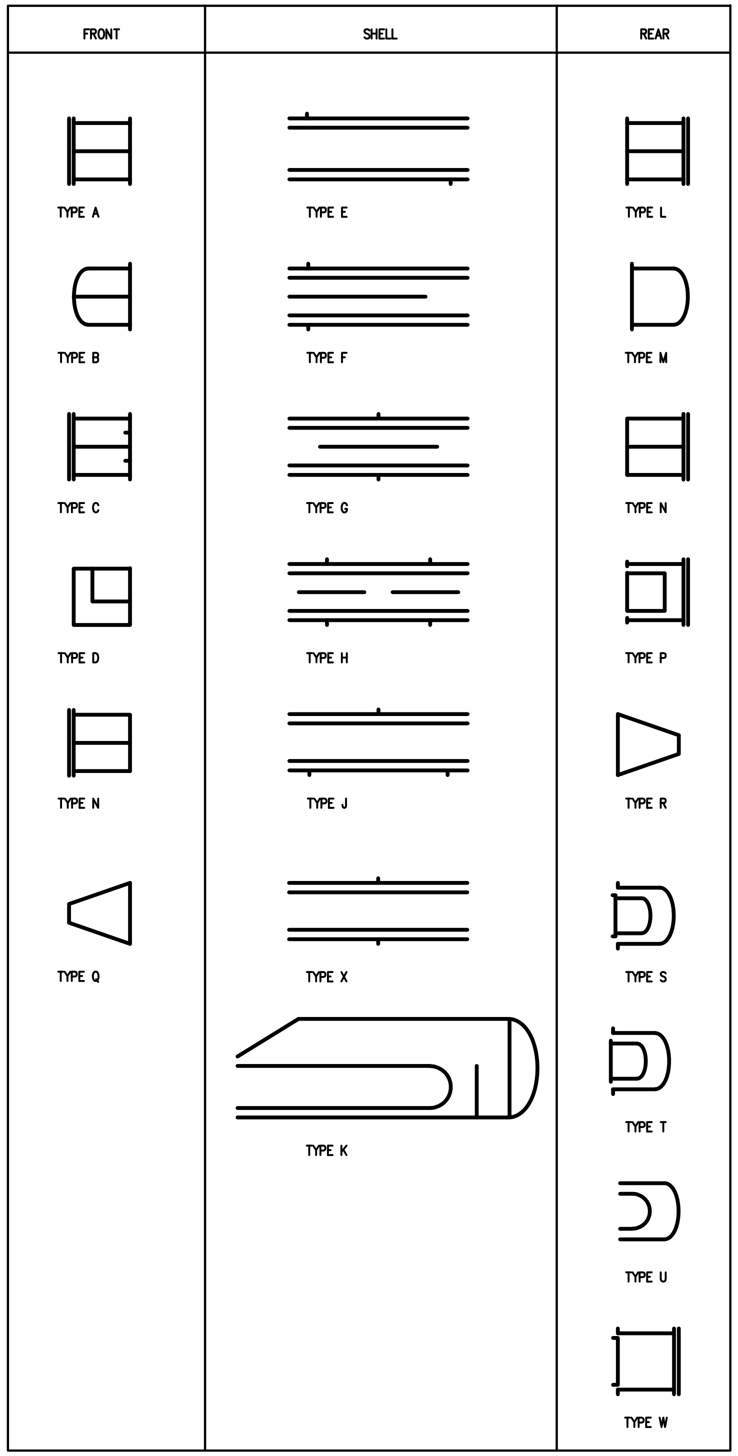
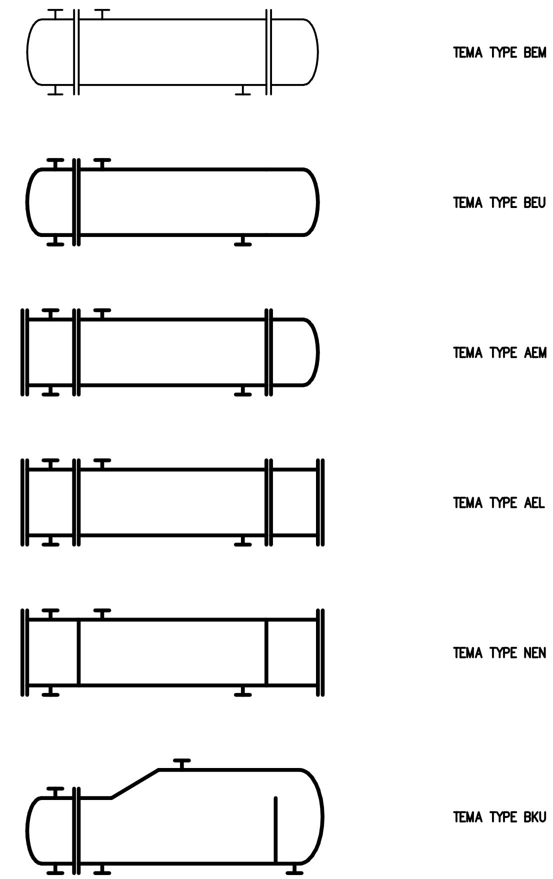
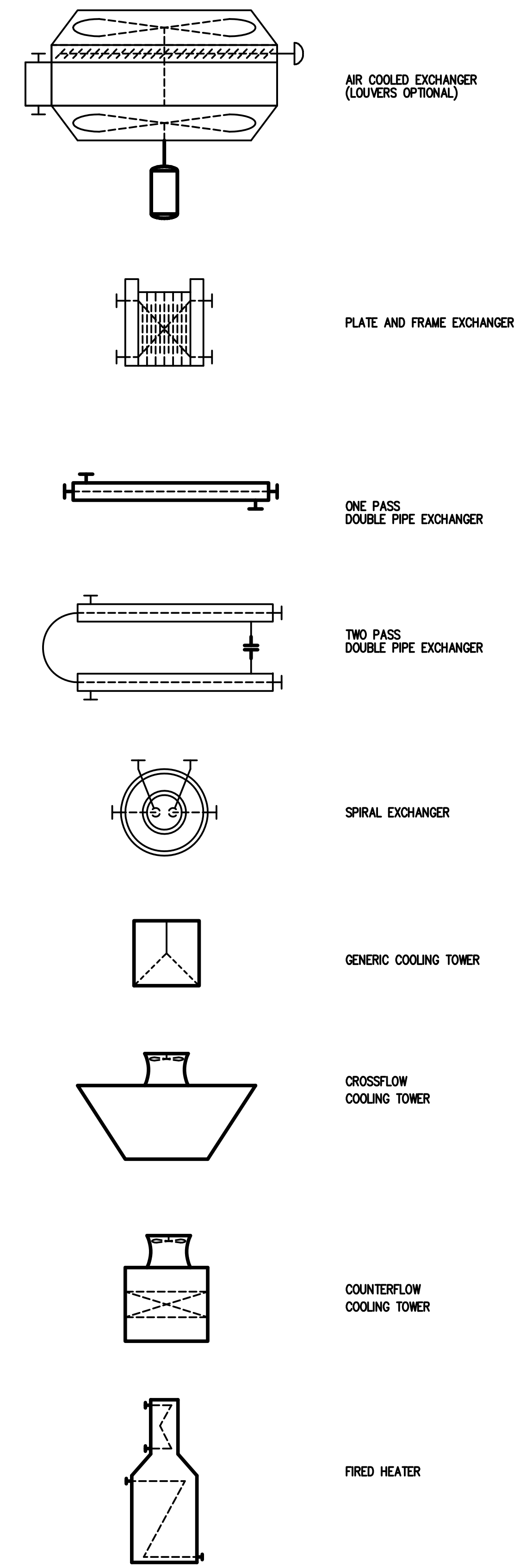
TEMA HEAD & SHELL TYPES



EXAMPLE TEMA HEAT EXCHANGERS (2) (3)



OTHER STYLE HEAT EXCHANGERS



NOTES:

1. REFERENCE TEMA FOR DETAIL EXPLANATION OF TEMA TYPES AND FOR ADDITIONAL TEMA TYPES NOT SHOWN HERE.
2. EXCHANGERS SHOWN HERE REPRESENT SINGLE PASS SHELL AND EVEN NUMBER OF TUBE PASSES. OTHER HEAD AND SHELL COMBINATIONS ARE POSSIBLE.
3. NOZZLES HAVE BEEN SHOWN HERE TO ILLUSTRATE SHELL AND TUBE PASS CONFIGURATIONS. THEY SHOULD NOT BE PART OF SHELL OR HEAD SYMBOLS.

PROCESS INDUSTRY PRACTICES
PIPING AND INSTRUMENTATION DIAGRAM

SYMBOLS AND NOMENCLATURE
TYPICAL EQUIPMENT LEGEND SHEET
HEAT TRANSFER EQUIPMENT
APPENDIX B-3

PRACTICE REF. PIC001
ISSUED: AUGUST 2018
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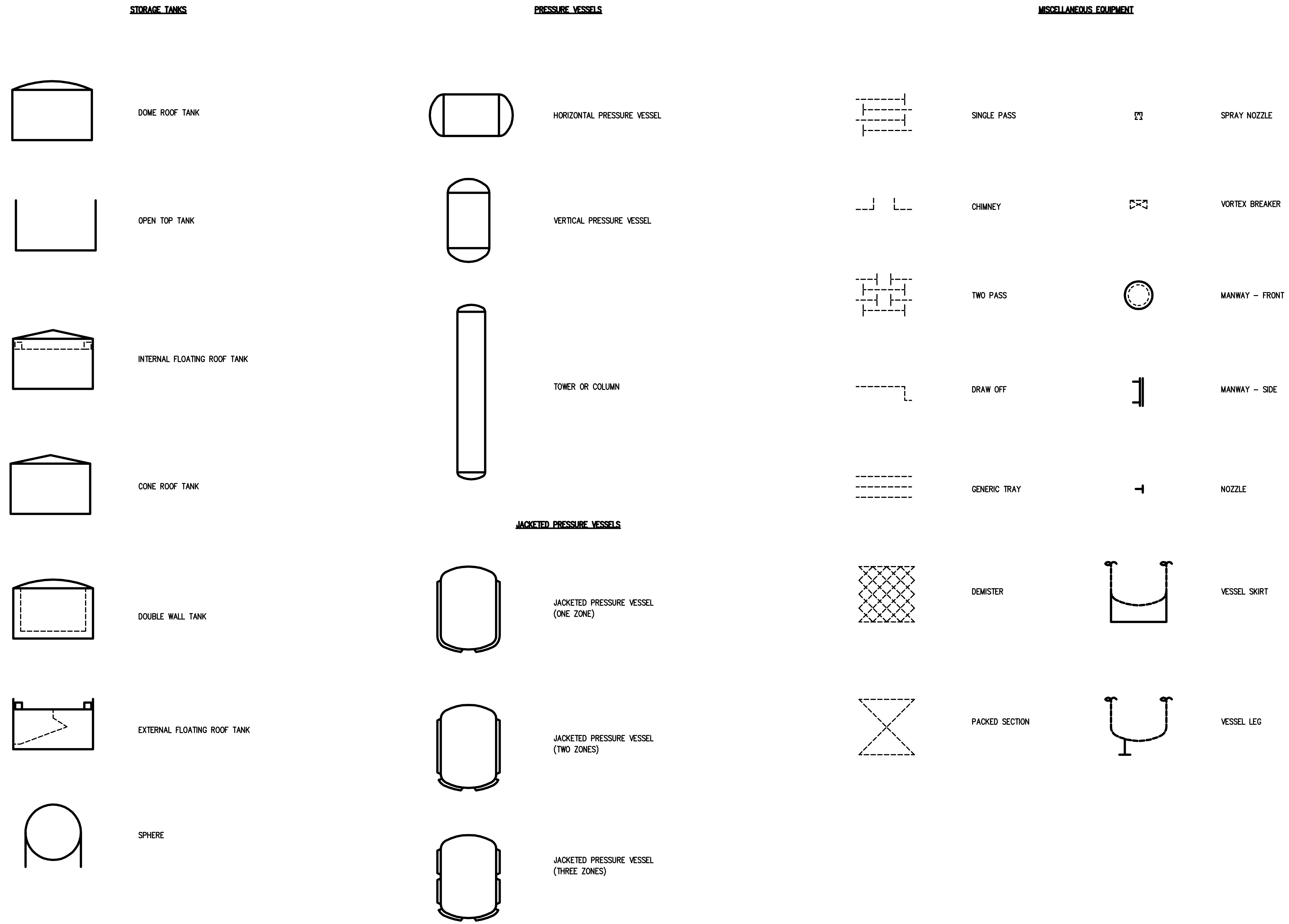
PAGE 2 OF 5
PIC001-B-003-2



NOTES:

PROCESS INDUSTRY PRACTICES
PIPING AND INSTRUMENTATION DIAGRAM

SYMBOLS AND NOMENCLATURE
TYPICAL EQUIPMENT LEGEND SHEET
VESSELS AND TANKS
APPENDIX B-3

PRACTICE REF. PIC001
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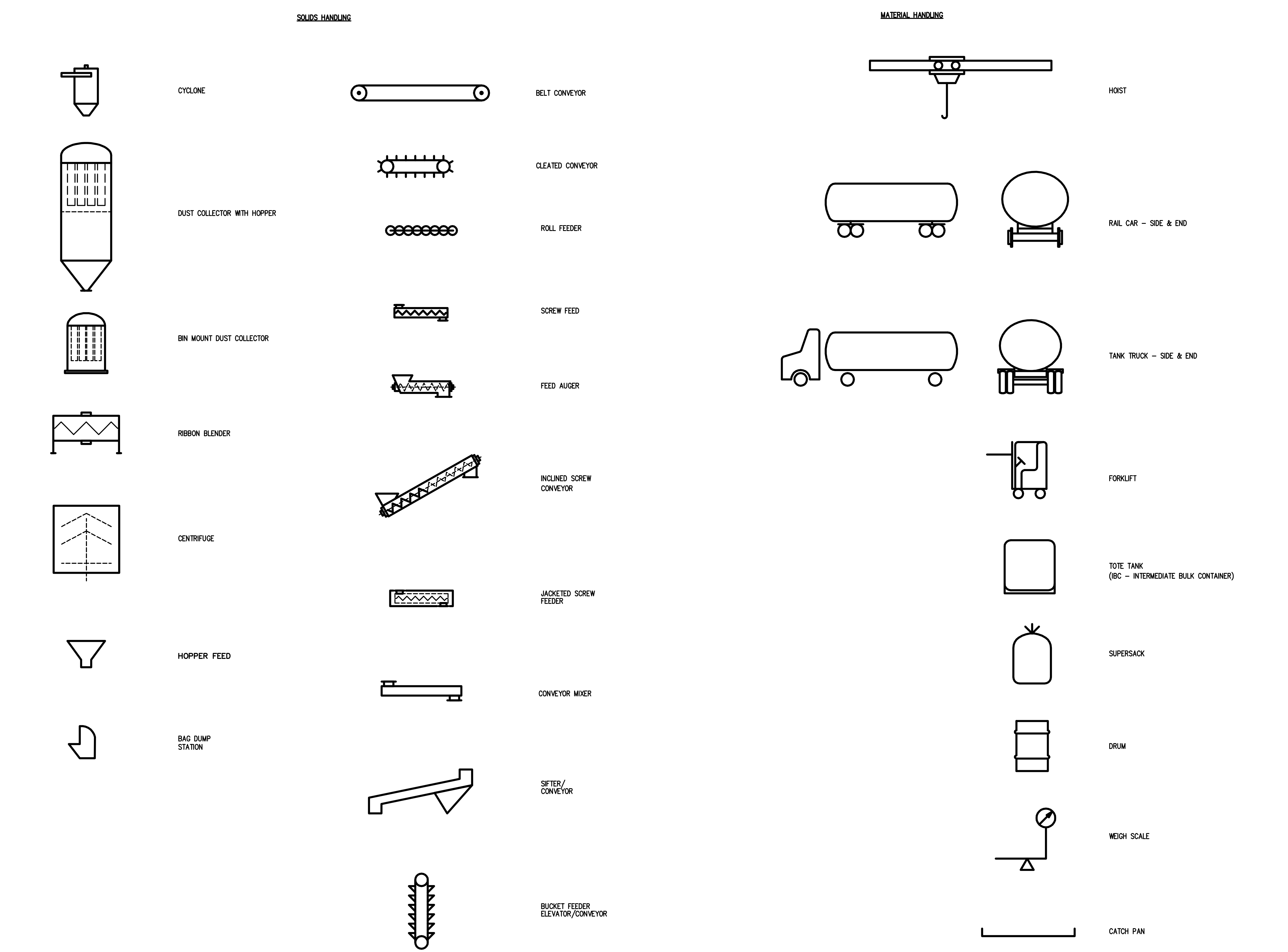
PAGE 3 OF 5

PIC001-B-003-3



NOTES:

PROCESS INDUSTRY PRACTICES
PIPING AND INSTRUMENTATION DIAGRAM

SYMBOLS AND NOMENCLATURE
TYPICAL EQUIPMENT LEGEND SHEET
SOLIDS AND MATERIAL HANDLING
APPENDIX B-3

PRACTICE REF. PIC001
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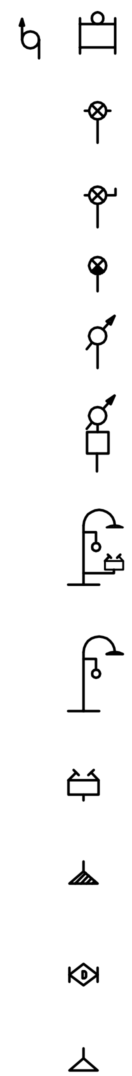
PAGE 4 OF 5
PIC001-B-003-4

FIRE & SAFETY



HOSE REEL

HYDRANT

HYDRANT W/ MONITOR

HYDRANT WITH PUMPER

MONITOR

REMOTE MONITOR

SAFETY SHOWER W/ EYEWASH

SAFETY SHOWER

EYEWASH

SPRINKLER

DELUGE VALVE

DELUGE NOZZLE

NOTES:

PROCESS INDUSTRY PRACTICES
PIPING AND INSTRUMENTATION DIAGRAM

SYMBOLS AND NOMENCLATURE
TYPICAL EQUIPMENT LEGEND SHEET
FIRE AND SAFETY
APPENDIX B-3

PRACTICE REF. PIC001
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PAGE 5 OF 5

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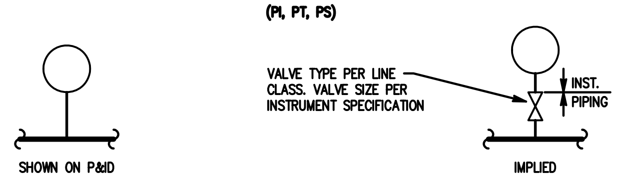
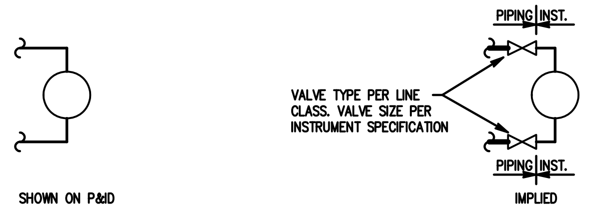
NOTES:

1. FOR NOTES, SYMBOLS AND ABBREVIATIONS, SEE "SYMBOLS AND NOMENCLATURE", PIP-00-001 THROUGH 003.

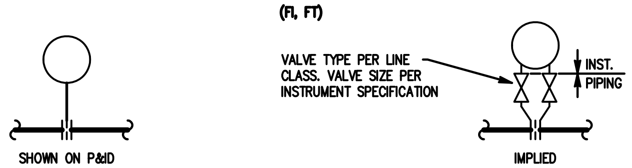
FIELD MOUNTED PRESSURE INSTRUMENT
(PI, PT, PS)



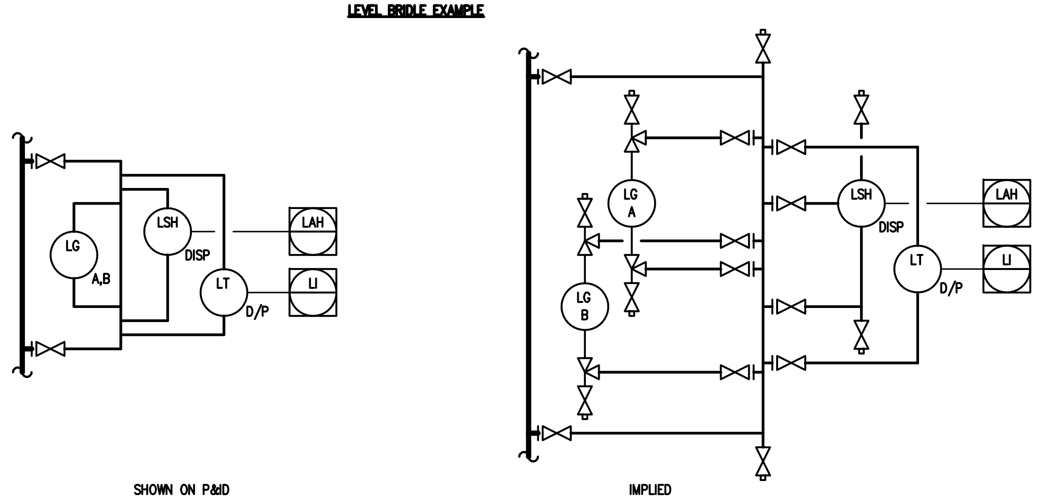
LEVEL OR D/P INSTRUMENT
(PDI, PDT, LC, LG, LT, LS)



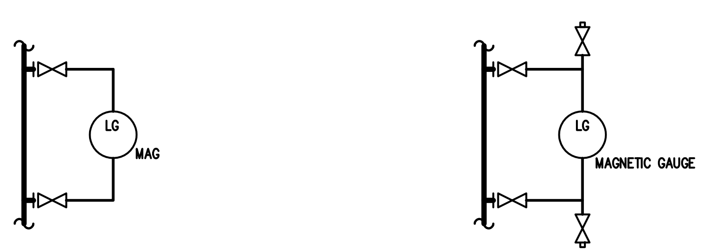
ORIFICE FLANGE - MOUNTED FLOW INSTRUMENT
(FI, FT)



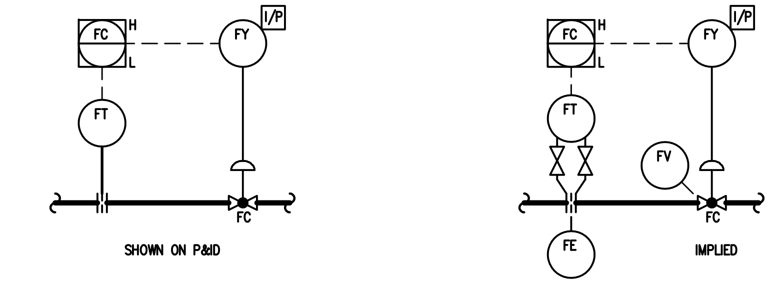
LEVEL BRIDLE EXAMPLE



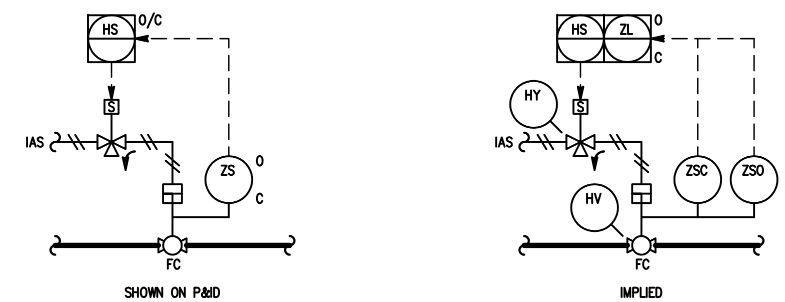
SINGLE MAGNETIC FOLLOWER TYPE LEVEL GAUGE



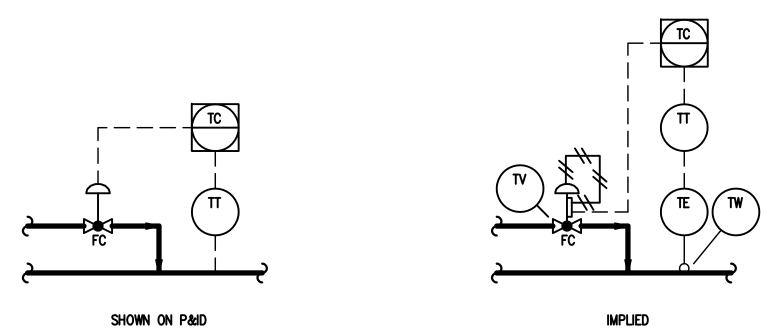
TYPICAL FLOW LOOP WITH SEPARATE I/P



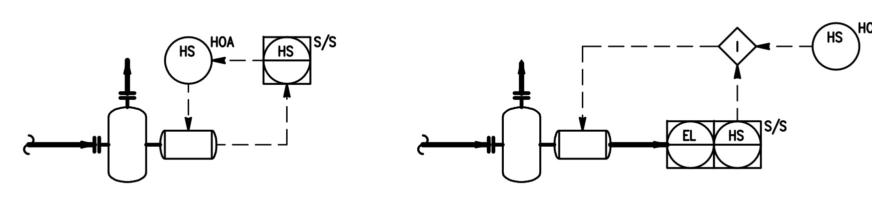
TYPICAL VALVE DETAIL



TYPICAL TEMPERATURE LOOP WITH VALVE POSITIONER



TYPICAL PUMP MOTOR CONTROLS



PROCESS INDUSTRY PRACTICES
PIPING AND INSTRUMENTATION DIAGRAM

TYPICAL DETAILS WITH IMPLIED COMPONENTS
APPENDIX B-4

PRACTICE REF. PIC001
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PAGE 1 OF 1
PIC001-B-004

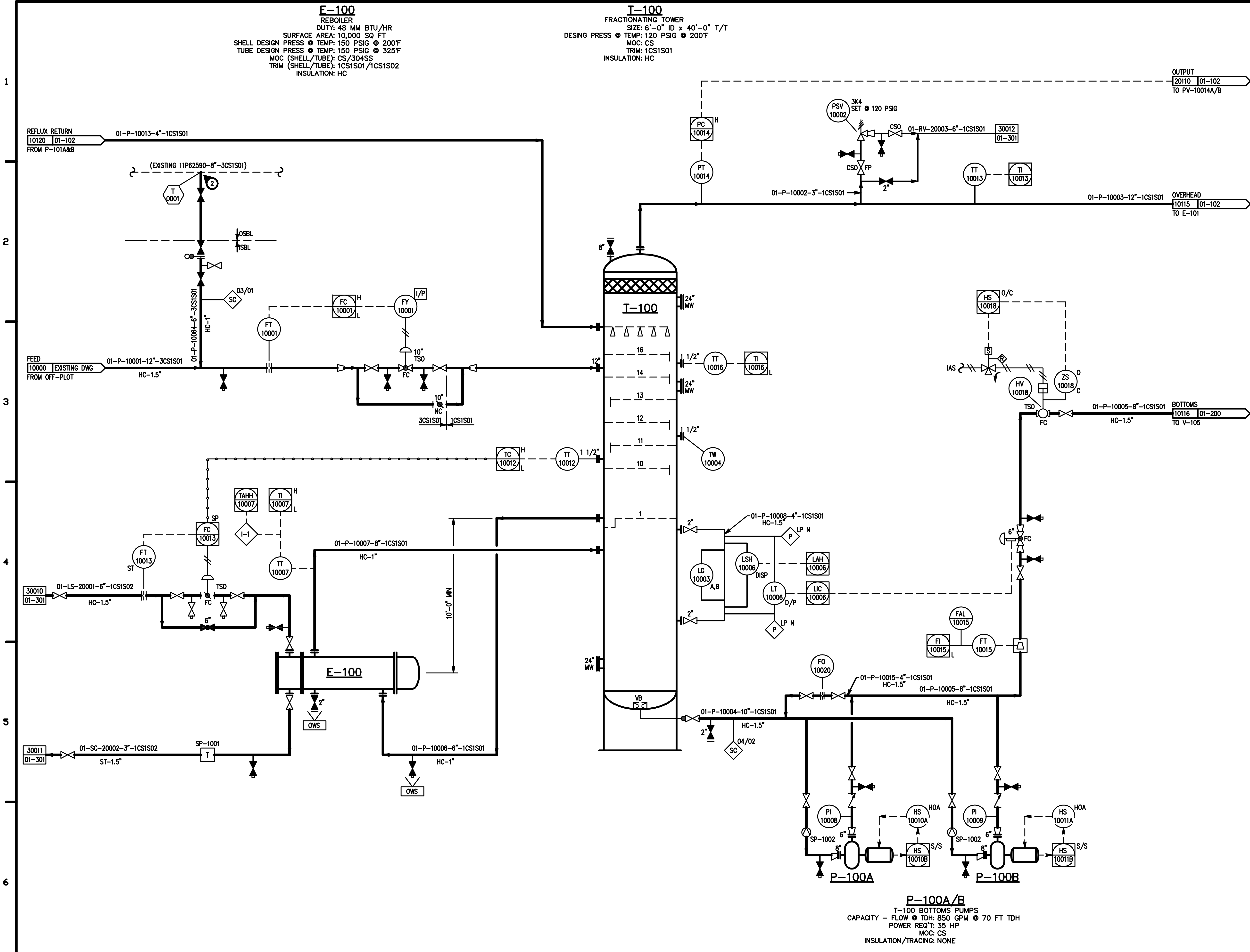
Appendix C – Example P&IDs

C-1: Example Process P&ID 1

C-2: Example Process P&ID 2

C-3: Example Utility P&ID

Note: The examples shown on the sample P&IDs in this Appendix are not all-inclusive of the potential uses of implied components. The user must ensure that the legend sheets capture their piping/instrument requirements for their use of implied components. There are many more systems that may require a legend sheet explanation to show the implied components – pump seals, sampling systems, analyzer systems for example, as well as other types of level systems than those shown here.



NOTES:

1. FOR NOTES, SYMBOLS AND ABBREVIATIONS, SEE "SYMBOLS AND NOMENCLATURE", PIP-00-001 THROUGH 003, AND "TYPICAL DETAILS WITH IMPLIED COMPONENTS", PIP-00-004.
2. CONNECT TO TOP OF LINE.

PROCESS INDUSTRY PRACTICES
PIPING AND INSTRUMENTATION DIAGRAM

EXAMPLE P&ID 1
APPENDIX C-1

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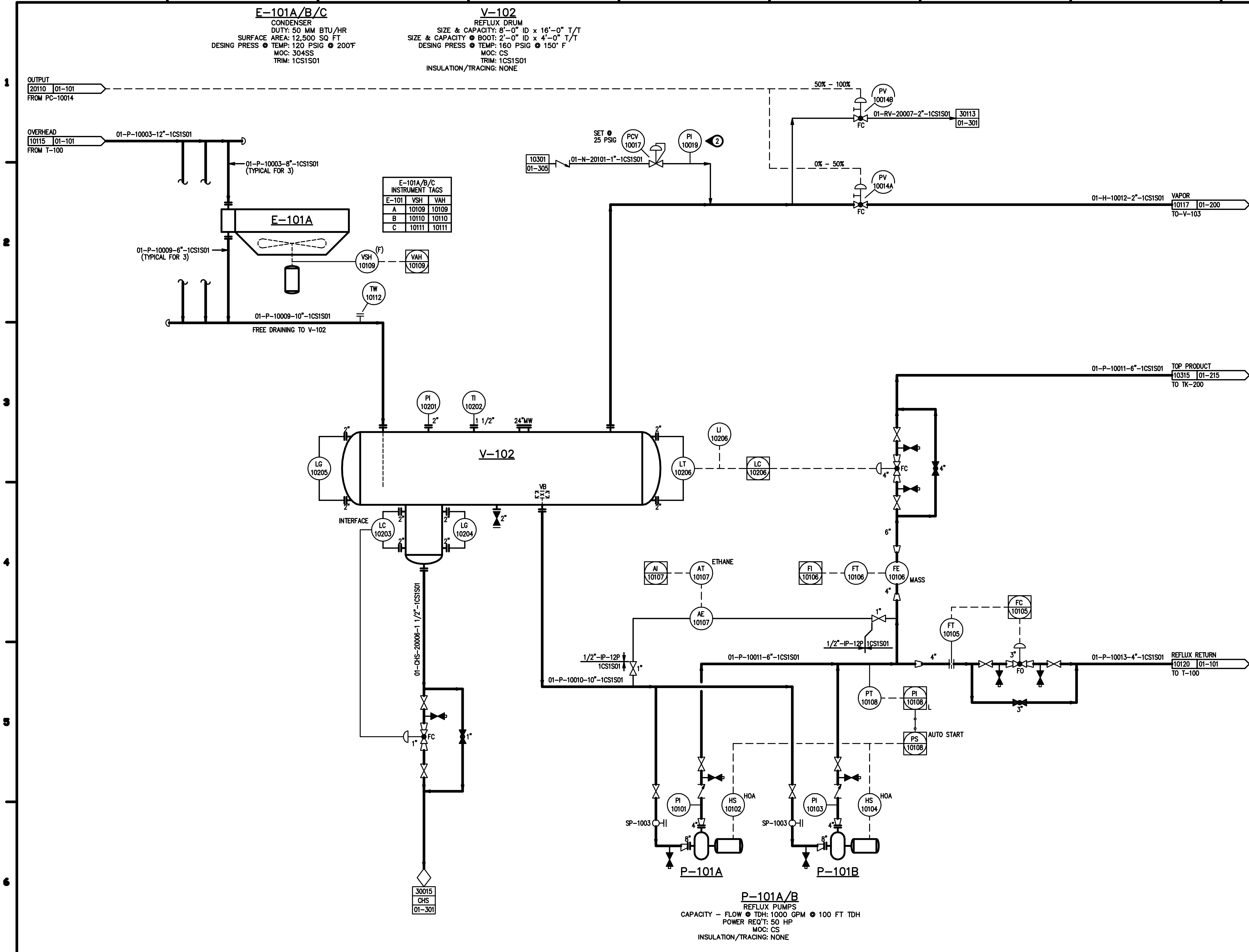
PIC001-C-001



NOTES:

1. FOR NOTES, SYMBOLS AND ABBREVIATIONS, SEE "SYMBOLS AND NOMENCLATURE", PIP-00-001 THROUGH 003, AND "TYPICAL DETAILS WITH IMPLIED COMPONENTS", PIP-00-004.
2. LOCATE IN VIEW OF PCV-10017.

PROCESS INDUSTRY PRACTICES
PIPING AND INSTRUMENTATION DIAGRAM

EXAMPLE P&ID 2
APPENDIX C-2

PRACTICE REF. PIC001
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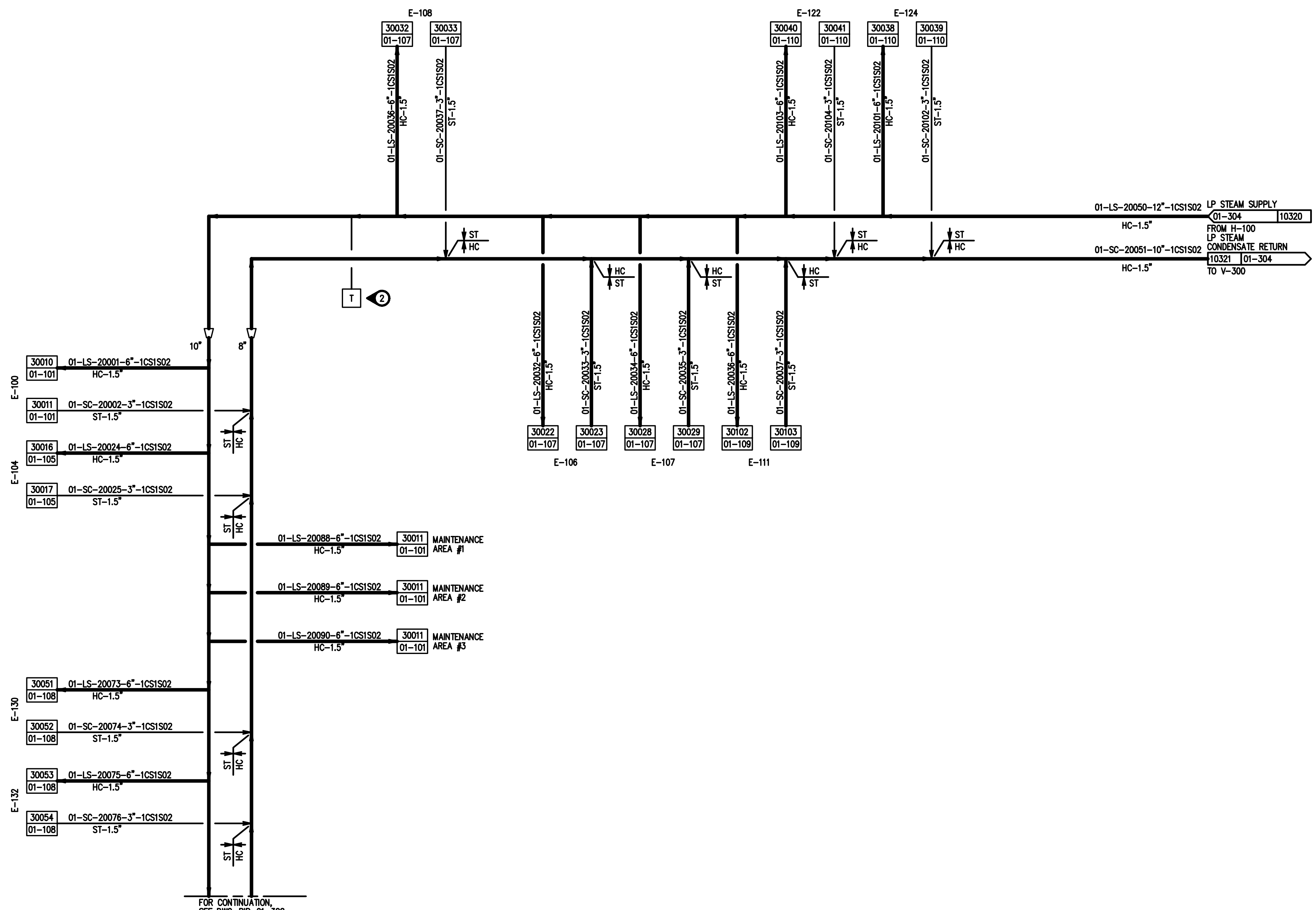
PIC001-C-002

NOTES:

1. FOR NOTES, SYMBOLS AND ABBREVIATIONS, SEE "SYMBOLS AND NOMENCLATURE", PIP-00-001 THROUGH 003, AND "TYPICAL DETAILS WITH IMPLIED COMPONENTS", PIP-00-004.
2. SEE AUXILIARY P&ID PIP-01-401.



PROCESS INDUSTRY PRACTICES
PIPING AND INSTRUMENTATION DIAGRAM

EXAMPLE P&ID 3
APPENDIX C-3

PRACTICE REF. PIC001
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PAGE 1 OF 1
PIC001-C-003

Appendix D – P&IDs for the Hygienic Processing Industries

Section 1 - Introduction

The following section contains information specific to the development of P&IDs for hygienic process systems – pharmaceutical, food, and beverage. Together, this Appendix and the PIC001 core document provide the requirements for the preparation of P&IDs for the hygienic processing industries.

The numbering of the following headings and paragraphs in this Appendix corresponds to the numbering of the PIC001 core document which this Appendix supplements. All of the following requirements are in addition to, or modifications of, those in the core document. Provisions of the core document that are not revised or noted here remain in force.

2. References

The following Industry Codes and Standards and Government Regulations are additional references for consultation when working on P&IDs for hygienic process systems.

2.2 Industry Codes and Standards

- American Society of Mechanical Engineers (ASME)
  - ASME BPE – *Bioprocessing Equipment*
- ASTM International
  - ASTM E2500 – *Standard Guide for Specification, Design, and Verification of Pharmaceutical and Biopharmaceutical Manufacturing Systems and Equipment*

2.3 Government Regulations

- CFR - Current Good Manufacturing Practices (CGMPs)
  - 21 Code of Federal Regulations Part 110 – *Current Good Manufacturing Practice in Manufacturing, Packing, or Holding Human Food*
  - 21 Code of Federal Regulations Part 210 – *Current Good Manufacturing Practice in Manufacturing Processing, Packing, or Holding of Drugs*
  - 21 Code of Federal Regulations Part 211 – *Current Good Manufacturing Practice for Finished Pharmaceuticals*

3. Definitions

The following are additional definitions that are specific to the hygienic processing industry.

Current Good Manufacturing Practice (CGMP): The FDA ensures the quality of food and drug products by carefully monitoring drug manufacturers' compliance with its Current Good Manufacturing Practice (CGMP) regulations. The CGMP regulations for drugs contain minimum requirements for the methods, facilities, and controls used in manufacturing, processing, and packing of food and drug products. The regulations make sure that a product is safe for use, and that it has the ingredients and strength it claims to have. (Reference http://www.fda.gov)

clean-in-place (CIP): Internally cleaning a piece of equipment without relocation or disassembly. The equipment is cleaned but not necessarily sterilized. The cleaning is normally done by acid, caustic, or a combination of both, with water-for-injection (WFI) rinse. (Reference *ASME BPE*)

clean-out-of-place (COP): Cleaning of a piece of equipment that can be partially disassembled and cleaned in specialized COP pressure tanks

critical component: A component within a system where the operation, contact, data control, alarm, or failure will have a direct impact on the quality of the product

direct impact system: A system that is expected to have a direct impact on product quality. These systems are designed and commissioned in line with good engineering practice and in addition, are subject to Qualification Practices that incorporate the enhanced review, control, and testing against specifications or other requirements necessary for CGMP compliance. In some instances, *direct impact systems* will depend *on indirect impact systems* for effective operation and therefore, any interfaces need to be carefully assessed.

flow plate: An assembly consisting of a plate with multiple ports and one or more *swing connections* or pipe bends. Flow plates are used in processing units for redirection of flows to multiple destinations.

Hazard Analysis Critical Control Points (HACCP): a management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product (Reference http://www.fda.gov)

hygienic process: A process that requires a defined level of purity and bioburden control, typically applicable to the pharmaceutical, food and beverage, and bioprocessing industries

indirect impact system: A system not expected to have a direct impact on product quality, but typically will support a *direct impact* system

management of change: The application of a structured process and tools to enable individuals or groups to transition from a current state to a future state, such that a desired outcome is achieved

no impact system: A system that will not have any impact, either directly or indirectly, on product quality

non-critical component: A component within a system where the operation, contact, data control, alarm, or failure will have an indirect impact, or no impact on the quality of product

pigging systems: Pigging systems are used in hygienic processes for product recovery and to improve CIP operations *steam-in-place (SIP)*: the use of steam to sanitize or sterilize a piece of equipment without the use of an autoclave (Reference *ASME BPE*)

swing connections: The combination of fittings that will swing up, down, or sideways slightly for aligning pipe and for absorbing movement or strain

4. Requirements

4.2 Format

Following is additional information to supplement Section 4.2.1 on types of flow diagrams specific to the hygienic processing industry.

4.2.1.18 Packaging Line and Material Handling Flow Diagrams

1. P&ID's are developed for hygienic processes including pharmaceutical, food, beverage, consumer products, and bio processing processes including material handling systems and packaging lines. The P&ID's utilize specific symbols that identify the hygienic connections required for the processes.
2. Packaging Lines and Material Flow Diagrams shall be laid out relative to the plot plan orientation, sequence of operations, and in accordance with Appendix DC.
2. To depict plot plan orientation, off-page connectors for a connection/distribution P&ID may be positioned vertically in accordance with Appendix C-3.
3. If match lines are required on utility collection/distribution P&IDs, the lines shall match the connecting drawing match lines in accordance with Appendix C-3.

4.2.1.19 Direct and Indirect Impact Systems

Comment: Direct and indirect impact systems strategies are commonly utilized in the pharmaceutical and food & beverage industries. The layout and orientation statements specified herein are recommended as optimal and slight deviation, although not encouraged, may be required due to space constraints.

4.2.1.19.1 System Breaks

1. Direct and indirect impact systems shall be shown on separate drawings or sheets whenever possible.
2. When direct and indirect impact systems must be shown on the same drawing or sheet, direct and indirect impact system breaks shall be shown in accordance with Appendix B-1 at a weight of 0.014inch (0.35 mm).

4.3 Equipment

The equipment classes are expanded in this section to cover equipment types that are specific to hygienic process systems.

4.3.2 Classification of Equipment

The equipment classifications listed in Table 1 are used on the example P&IDs contained in Appendix DC for illustrative purposes only. These equipment classifications are only one example of classifications allowed by this Practice. In some cases, additional equipment types have been added to the existing equipment classes of the Section 4.3 table.

Table 1: Equipment Classifications

CLASS	SUBJECT	DESCRIPTION
CM	Containment	Isolators, Downflow Booths, Restricted Access Barrier Systems, Rapid Transfer Ports and Containers, Shrouds Systems
E	Heat Exchangers	Continuous Cookers, Pasteurizers, Vapor Compression Stills, Pure Steam Generators, Double Tube Sheet Sanitary, Multi-Effect Stills
FP	Filling and Packaging	Rotary Fillers, Linear Fillers, Accumulators, Case Erectors, Case Packers, Labelers, Table Top Conveyors, Case and Pallet Conveyors
HV	HVAC	Air Handling Units, Unit Heaters, Exhaust Fans, Air Cooled Condensing Units, Louvers, Dampers
MT	Material Transfer	Vacuum Transfer Systems, Belt Conveyors, Screw Conveyors, Bucket Conveyors, Drag Conveyors, Vibratory Conveyors, Walking Floors, Tubeveyors, Statistical Weighers, Feeders, Chutes, Spouts
O	Ovens / Cookers / Fryers	Roasters, Warmers, Steam Sterilizers, Blanchers, Temperature Tunnels, Pasteurizers
P	Pumps	Peristaltic, Circumferential Piston,
PE	Packaged Equipment	Depyrogenation Tunnels, CIP Skids, Vial Washers, Chromographs, Stopper Washers, Spiral Freezers, Freezing Tunnels
PS	Particle Size Adjustment / Dryers	Agglomerators, Spheronizer, Comill, Fitzmill, Hammer Mill, Pin Mill, Fluid Bed Dryers & Granulators, Wurster Columns, High Shear Granulators, Microwaves, V-Blenders, Slant Cone Blenders, Ribbon Blenders, Extruders, Screens, Air Classifying Mills
U	Miscellaneous Equipment	Lyophilizers, Autoclaves, Metal Checkers, Static Mixers, Crystallizers, Evaporators, Airgap Drains, Tablet Presses, Encapsulators, Bread Pans
V	Vessels	Kettles, Liquifiers

4.3.2.6 Heat Exchangers

4.3.6.1 The term heat exchanger also includes high temperature short time (HTST) pasteurizers and sterilizers.

4.3.6.7 High temperature short term (HTST) processing / heat exchange is typically conducted with a series of plates and tubes. This process is typically used in pasteurization and sterilization. Symbols can be modified to represent the type of heat exchanger arrangement used.

4.3.3 Equipment Data

The following equipment information shall be shown on the P&ID in relation to the appropriate equipment symbol and in accordance with Section 4.2.4.4 for these additional hygienic processing equipment classes.

4.3.3.10 Containment

- Equipment / Item Number
- Title/Service
- Materials of Construction

4.3.3.11 Filling and Packaging Equipment

- Equipment/Item Number
- Title/Service
- Size, Capacity

4.3.3.12 HVAC Equipment

- Equipment/Item Number
- Title/Service
- Size, Capacity
- RH, Air Flows, Filtration Type (MERV)

4.3.3.13 Material Transfer Equipment

- Equipment/Item Number
- Title/Service
- Size, Capacity
- Materials of Construction

4.3.3.14 Ovens / Cookers / Fryers

- Equipment/Item Number
- Title/Service
- Size, Capacity

4.3.3.15 Particle Size Adjustment / Drying Equipment

- Equipment/Item Number
- Title/Service
- Size, Capacity
- Materials of Construction

4.5 Instrumentation and Controls

The following is an additional requirement to the Instrumentation and Controls sub paragraph on Level Gauges.

4.5.2.13 Level Gauges

5. Sight glasses shall be shown in the approximate relative location desired with respect to the associated equipment for hygienic processes.

Appendix DB– Legend sheets

DB-1: Symbols and Nomenclature – Typical Piping

DB-3: Symbols and Nomenclature – Typical Equipment

Appendix DC– Example P&IDs

DC-1: Example Process P&ID 1

DC-2: Example Process P&ID 2

DC-3: Example Process P&ID 3

Note: The examples shown on the sample P&IDs in this Appendix are not all-inclusive of the potential uses of implied components. The user must ensure that the legend sheets capture their piping/instrument requirements for their use of implied components. There are many more systems that may require a legend sheet explanation to show the implied components – pump seals, sampling systems, analyzer systems for example, as well as other types of level systems than those shown here.

FITTINGS AND MISC.

- CIPFLOW, HORIZONTAL
- CIPFLOW, VERTICAL
- HYGIENIC CLAMP JOINT
- RS — REMOVABLE SPOOL – WITH HCJ ENDS
- SANITARY FILTER
- SANITARY FILTER AND VENT W/HCJ ENDS
- SANITARY FLEX HOSE W/HCJ ENDS
- SWING CONNECTION W/HCJ ENDS
- SWING CONNECTION W/HCJ ENDS
- MULTI–SWING CONNECTION W/HCJ ENDS

SANITARY VALVES

- SANITARY PLUG VALVE W/HCJ ENDS
- SANITARY BALL VALVE W/HCJ ENDS
- SANITARY BUTTERFLY W/HCJ ENDS
- SANITARY DIAPHRAGM VALVE W/HCJ ENDS
- PIG CATCHER W/HCJ ENDS
- SANITARY SPRING BALL CHECK W/HCJ ENDS
- SANITARY SPRING CHECK VALVE W/HCJ ENDS
- SANITARY PISTON VALVE W/HCJ ENDS
- TWO WAY AIR OPERATED SHUT OFF VALVE W/HCJ ENDS
- 3 WAY AIR OPERATED SHUT OFF VALVE W/HCJ ENDS

PROCESS INDUSTRY PRACTICES
PIPING AND INSTRUMENTATION DIAGRAM

SYMBOLS AND NOMENCLATURE
HYGIENIC PROCESS SYMBOLS
TYPICAL PIPING LEGEND SHEET
APPENDIX DB–1

PRACTICE REF. PIC001
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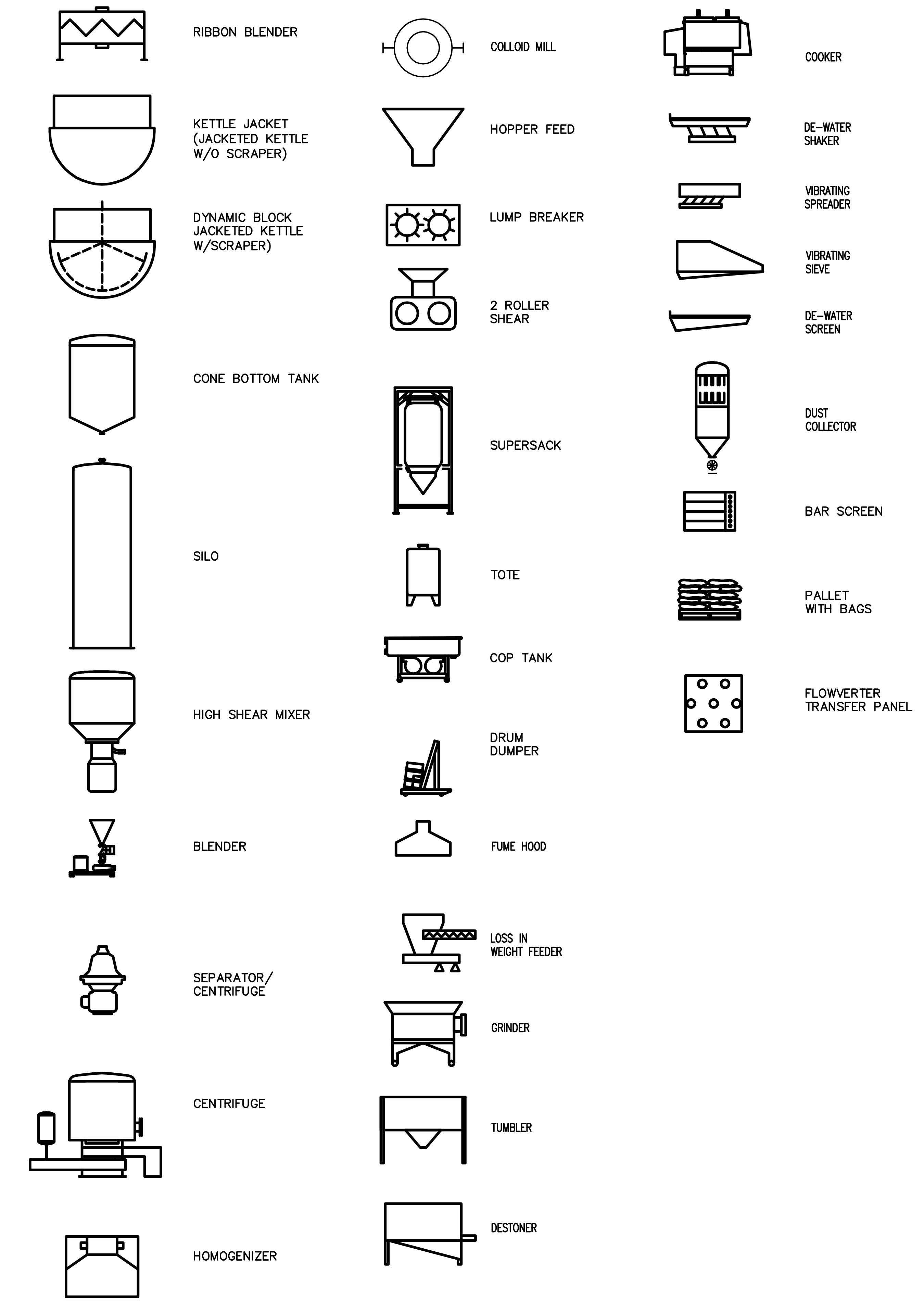
PAGE 1 OF 1
PIC001–DB–001



PROCESS INDUSTRY PRACTICES
PIPING AND INSTRUMENTATION DIAGRAM

SYMBOLS AND NOMENCLATURE
HYGIENIC PROCESS SYMBOLS
TYPICAL EQUIPMENT LEGEND SHEET
APPENDIX DB-3

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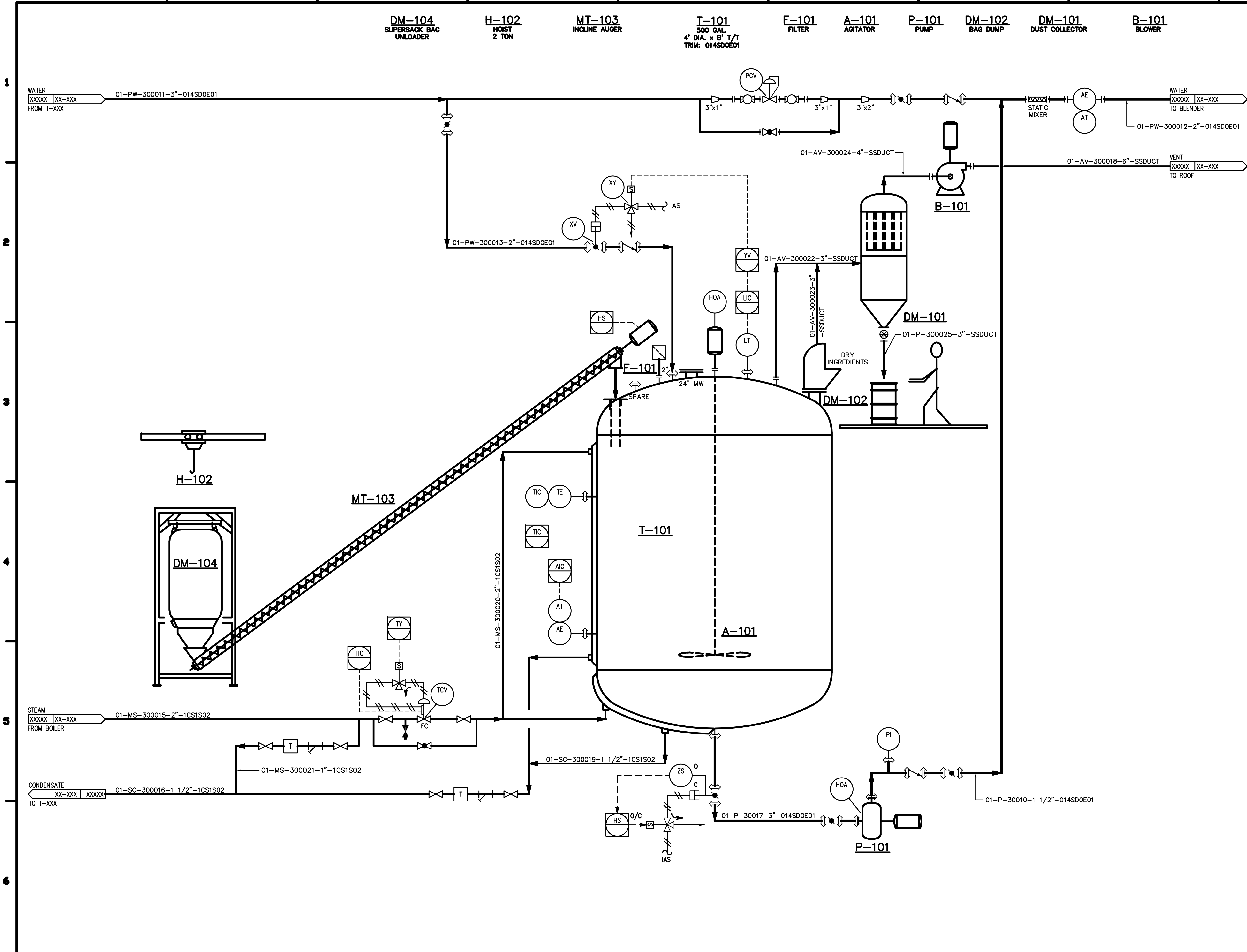
PAGE 1 OF 1
PIC001-DB-003



PROCESS INDUSTRY PRACTICES
PIPING AND INSTRUMENTATION DIAGRAM

EXAMPLE P&ID 1
HYGIENIC PROCESS SYSTEMS
APPENDIX DC-1

PIP

PRACTICE REF. PIC001
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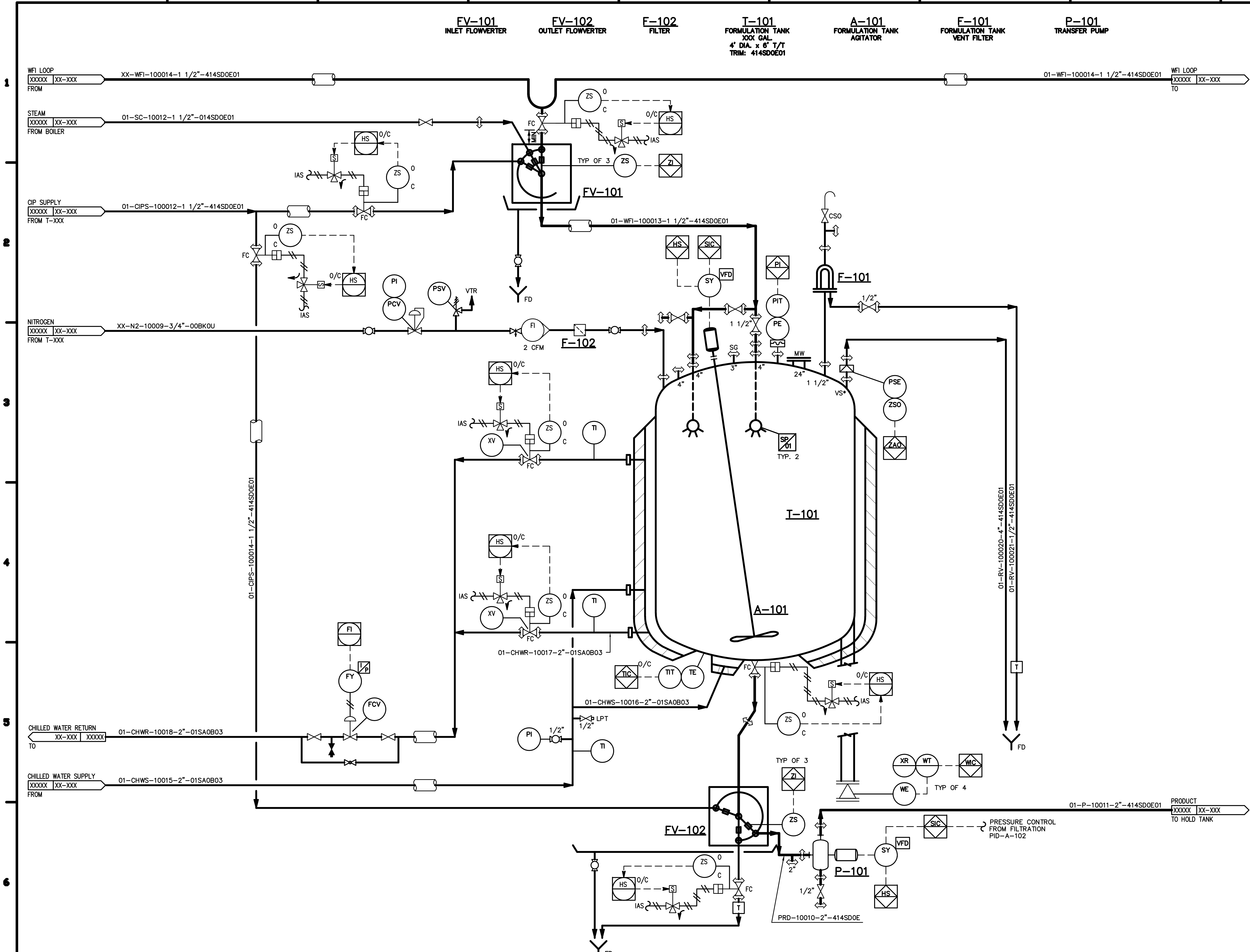
PIC001-DC-001



PROCESS INDUSTRY PRACTICES
PIPING AND INSTRUMENTATION DIAGRAM

EXAMPLE P&ID 2
HYGIENIC PROCESS SYSTEMS
APPENDIX DC-2

PRACTICE REF. PIC001
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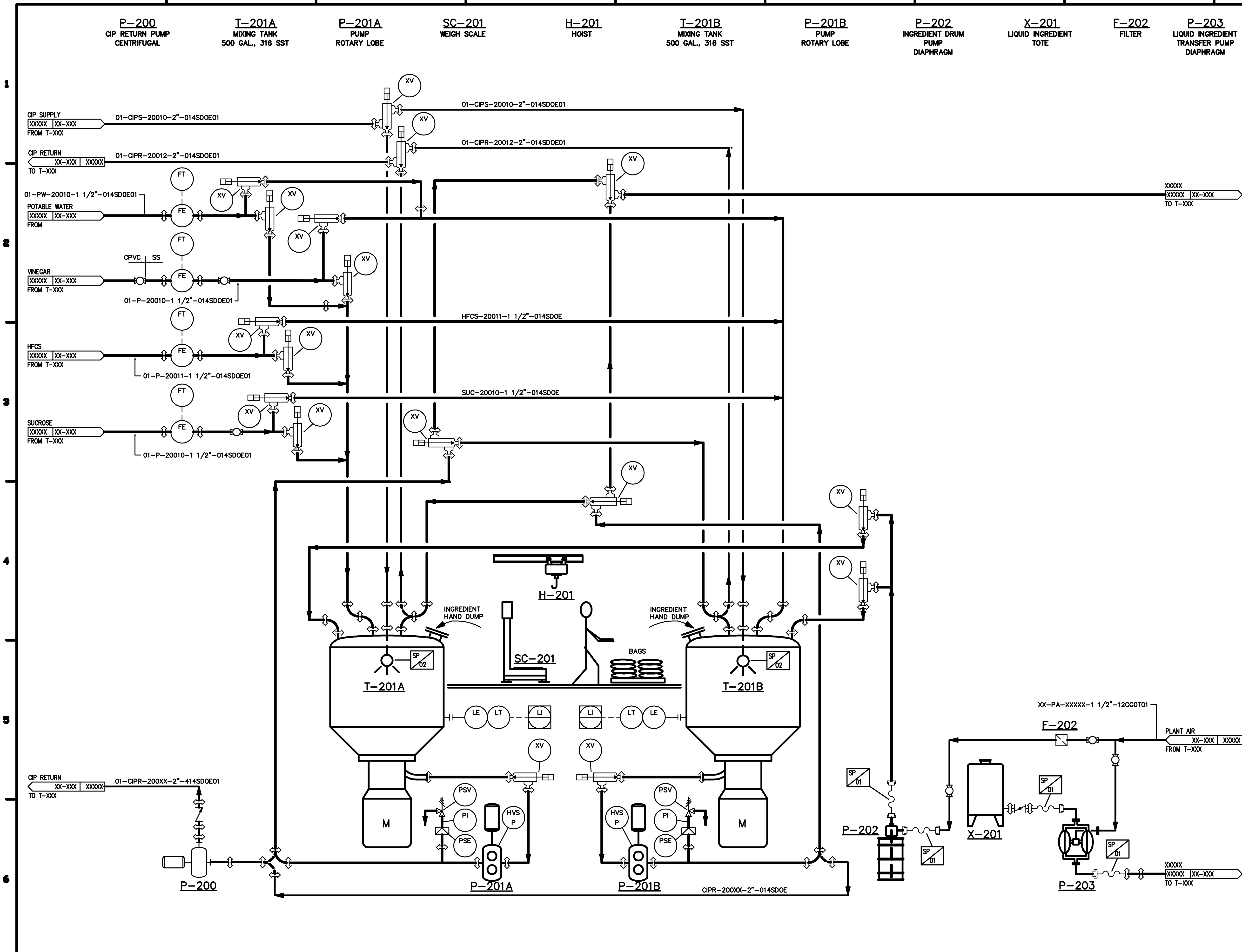
PAGE 1 OF 1
PIC001-DC-002



PROCESS INDUSTRY PRACTICES
PIPING AND INSTRUMENTATION DIAGRAM

PIP

EXAMPLE P&ID 3
HYGIENIC PROCESS SYSTEMS
APPENDIX DC-3

PRACTICE REF. PIC001
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