

SPD0049ERN
PROCESS DESIGN MANUAL
PREPARATION of P&ID and UFD

REV. : 3

DATE: 21 NOV 2013



**SAMSUNG
ENGINEERING**

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1. GENERAL

1.1. [Purpose](#)

The purpose of this Process Design Manual is to prescribe guidelines for the preparation of the Piping and Instrument Diagram (P&ID) and Utility Flow Diagram (UFD). [The P&ID and UFD are process engineering deliverables that convey engineering and design information to enable detailed design and construction of a project.](#)

1.2. [Use Limitation](#)

[All the guidelines described hereafter are applicable for both P&ID and UFD unless other engineering standards are specified by contract or process licensor. The process lead engineer must obtain an approval from a project manager for any revision or addition to this guideline \(apart from those specifically identified in project specifications\).](#)

[The responsibility of preparing and issuing of P&ID and UFD shall rest upon the process engineer assigned to the project. After the first issue for construction, the responsibility to revise and re-issue of the P&ID and UFD shall be handed to the assigned project engineer who will oversee the documents until the project is completed and closed out.](#)

1.3. [References](#)

SPD0020ENN P&ID issuing stage and establishment of engineering design stage

SPD0004ENN Drawing number assignment

SPD0005ENN Description of drawing Issue and assigning method of revision number

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SPD0006ENN Filling method for drawing title block

SPD0007ENN AFC Issuing method of drawing

SPD0008ENN Method of drawing preparation

SPD0008EPN Method of line schedule preparation

SPD0015ENN Design change procedure

SPD0019EPN Deciding The Line Number

SEM-3010 Piping class determination

2. DEFINITION AND ACRONYMS

Definitions and Acronyms used in this manual are described below:

2.1. Flow Diagram

There are many types of flow diagrams. Project phase and special project needs dictate the type of flow diagram to be prepared. Typical flow diagrams include but are not limited to the ones shown below:

- (1) Block Flow Diagram
- (2) Process Flow Diagram (PFD)
- (3) Piping & Instrument Diagram (P&ID)
- (4) Utility Flow Diagram (UFD)

The definitions of P&ID and UFD are as follows:

- (1) Piping & Instrument Diagram (P&ID)

A P&ID is a flow diagram that contains process equipment, piping, instrument and equipment mechanical data. The P&ID is prepared based on a process flow diagram (PFD). The P&IDs are the most important flow

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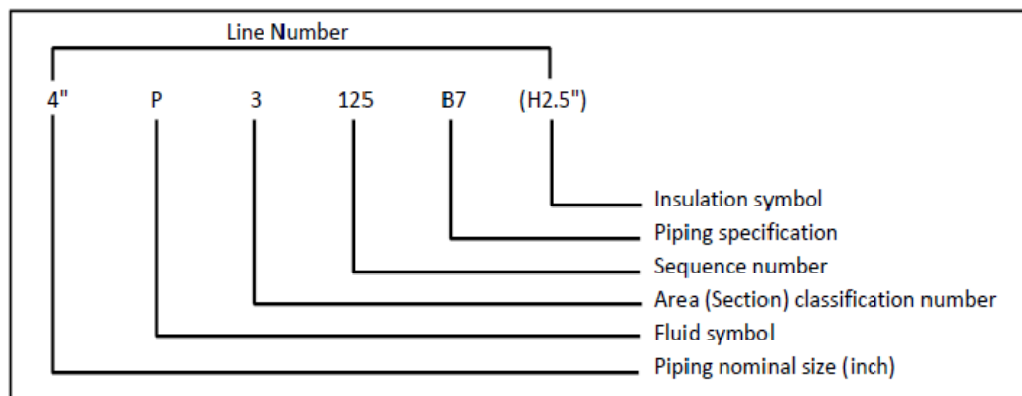
diagrams used for detailed plant design and construction of a process plant. P&ID's are also referred to as Mechanical Flow Diagrams or Engineering Flow Diagrams.

(2) Utility Flow Diagram (UFD)

The UFD is similar to the P&ID but developed for a utility system. It contains utility generating or handling equipment, piping, instrument and some mechanical data. The difference between the P&ID and UFD is that the UFD has branch lines connecting utility header and process equipment. The branch line positions are drawn relative to the piping routes shown in the actual plot plan and based on the main utility flow sequence and utility supply facility. Another difference is that the P&ID is prepared based on the PFD and no process equipment detail is shown on the UFD.

2.2. Line number

The line number provides detail information of the pipe. A typical line number is shown below.



As a minimum, a line number shall present the following information in sequence.

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(1) Line Size

The first number shall be the nominal pipe size in inches or mm according to the project design basis document.

(2) Fluid Symbol

The fluid symbol shall be the next letter following the line size after a dash. It indicates the type of fluids the pipe is normally handling using simple abbreviation. The purpose of assigning a fluid symbol as a part of line numbers is that any particular line can be easily identified. Another purpose is to draw the engineer's attention to the line handling the fluid when doing design work.

(3) Area (Section) Classification number

This number is optional depending on the project specific requirement. If required, this number represents the electrical area classification of the line from where it was originated.

(4) Line Sequence Number

It is a sequential number, 4-5 digits, assigned uniquely to a line.

(5) Piping Specification

This is a symbol or code indicating piping specification code. Refer to project piping specification for piping symbol and codes.

(6) Insulation Code

Hot (H) or Cold (C) insulation is shown for energy conservation insulation. Personal protection insulation is designated as (P). Insulation thickness shall be shown following the code, i.e. (C2.5").

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[See Section 7.4 for more detail on line numbering.](#)

2.3. Drawing Symbol and Convention

[A symbology drawing\(s\) shall be prepared and used as reference for the project. As a minimum, the symbology drawing shall contain the following information:](#)

(1) Instrument Symbol & Letter

[This is a standard symbol to clearly indicate the type of instrument, its function, variables, type of display panel and inter-relationship between instruments. The ISA \(Instrument Society of America\) symbols should be employed.](#)

(2) Piping Symbol

This is a standard symbol to indicate the shape of piping, equipment and valves inside the piping system.

(3) Equipment Symbol

This symbol is standardized for general and typical equipment by using the shape that looks like actual shape of equipment. This standardized shape is called an equipment symbol.

(4) [Fluid Code](#)

(5) [Insulation Code](#)

[See Section 6 for more information on the symbology drawings.](#)

[In general, lines shall enter the drawing from the left and exit to the right.](#)

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2.4. Issuing Stage of Drawing

The issuing stage of drawing sheet shall be marked in the revision block and clearly show the stage and purpose or reason for the revision.

The following issue convention shall be used:

Letter issues shall be used for all issues up to and including issue for design.

Number issues starting with 0 shall be used for issue for construction and after.

Each project shall develop required issue stage for drawings per client requirement. In an absent of such requirement, the following issue stages are recommended:

(1) Preliminary

This is P&ID and UFD issued first time after process design work resumed. The technical information on major equipment, piping, instrument, etc are shown in this drawing sheet.

(2) Approved For Planning (AFP)

This is P&ID and UFD issued before starting the basic design work on the process data. In this drawing sheet, almost all the process requirements that normal operation, start-up and shutdown were considered are written.

(3) Approved For Design (AFD)

This is the P&ID and UFD issued before starting the detailed design work after the results of basic design and collection of vendor

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information are very much finalized. Almost all the information required for P&ID and UFD should be included in this drawing sheet.

(4) Approved For Construction (AFC)

This is the P&ID and UFD issued before starting the construction work. Basically AFC contains all the same information shown in AFD. However, AFC is used to revise any items that need to be changed according to the detailed design results done by other design teams and finalized vendor information.

(5) For Approval

This is the P&ID and UFD that are issued to obtain the client's approval for basic information that is necessary to comply with the contract conditions. In general, this drawing sheet contents are same as compared with preliminary. If the client's comments are received, their comments should be reflected when issuing AFP.

[The belows are alternative case. Recently, Client from Middle East request follow the below issue stage.](#)

(1) [Issued For Review \(IFR\)](#)

[This is when P&ID and UFD are issued first time for an internal review. The drawings will not be issued to client at this stage. At this point, the P&ID should show most lines with preliminary sizes for major process lines and basic control elements. The symbology drawing shall be prepared and issued at this stage. An issue for information \(IFI\), prior to the IFR, may be required for preliminary cost estimates and process evaluation.](#)

(2) [Issued For Approval \(IFA\)](#)

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This issue is for client review and approval of the design. At this stage, the P&ID and UFD should show preliminary line sizes for all lines, along with the pipe classification and specification breaks. In addition, for the control systems, there shall be detailed control schemes with instrument tag numbers. The preliminary line designation tables (LDTs) shall be prepared and issued with the P&ID.

(3) Issued For HAZOP (IFH)

All lines should be complete and finalized and all the piping details shall be shown. Additionally, preliminary relief valve (RV) sizes and inlet and discharge line sizes shall be shown with "HOLD". The final number of exchanger shells and air cooler bundles and bays shall be identified. For the control systems, all the required control and shutdown functionality details shall be shown.

(4) Issued For Design (IFD)

The information in the IFD issue is the basis for the detailed engineering design effort. Therefore, all P&ID details shall be complete, except for non-available vendor data. LDT's shall be issued along with the P&IDs. Any changes after this issue will be documented through the management of change (MOC) procedure.

(5) Issued For Construction (IFC)

This P&ID issue is used for the start of the construction work. The IFC issue contains all the same information shown in IFD, and has been fully updated with approved design change items, vendor and supplier information. Revisions can occur as needed.

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3. PAPER SIZE AND COMPOSITION

3.1. Paper size

[In principle, use ANSI D size paper as described in manual, SPD0008ENN \(Drawing Preparation\).](#)

3.2. Composition

All kinds of equipment, piping, fittings, valves, instrument controls, signal, various notes, equipment name and number, short specification of equipment, and equipment description will be shown on P&ID and UFD. Also, the continuity symbols, title block, revision column and issue block should be described to establish the completeness of the drawing.

Special attention should be given to aesthetics of the document, the ease to read and understand, and the accuracy of the contents shown. Since the composition needs to be properly balanced, the following rules should be followed to avoid confusion. In addition, detailed information on the size of letter, thickness of line, etc. is given in the guidelines of P&ID CAD preparation.

3.2.1. Equipment number and arrangement for each drawing

In principle, equipment number should be limited to no more than 10-15 characters. In the early stage, sufficient space must be provided to establish appropriate arrangement because the contents at the IFC issuing stage are more complicated than that for the preliminary issuing stage. It is recommended that the number of major equipment per drawing sheet be limited to two.

3.2.2. Note position of equipment name and item number

The equipment number and name block should be shown at the top or bottom of the drawing sheet such that the equipment number and

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name can be easily identified in terms of the equipment position.

Based on the following category, the equipment number and name block should be located appropriately at the top or bottom.

<u>Type of Equipment</u>	<u>Note Location</u>
Furnace, Boiler, Water treatment equipment (See Note 1)	Top
Tower, Reactor	Top
Heat Exchanger	Top
Tank, Bin, Separator, Dryer	Top
Pump, Compressor, Mixer	Bottom
Treatment facility for raw material & product, conveyor	(See Note 2)
Other equipment	(See Note 2)

Note:

- (1). Since the water treatment system consists of various equipment, the name of this system shall reflect its category and function.
- (2). The location of equipment name and number need to be clearly visible relative to the location of the equipment.

3.2.3. Notes

The space above the title block shall be reserved for the P&ID notes. Three types of notes may be used:

(1). General Notes

Notes pertaining to drawing are classified as general notes. For example, "For instrument details and symbols refer to P&ID-3801-001 and P&ID-3801-002".

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(2). Technical Notes

Notes pertaining to design and technical information are classified as technical notes. For example “Safety valve with spare shall have interlock to assure positive overpressure protection of the equipment exists at all time”.

(3). Construction Notes

Notes pertaining to plan layout, equipment arrangement etc are classified as construction notes. For example “valve actuator to be no higher 5 ft from grade”.

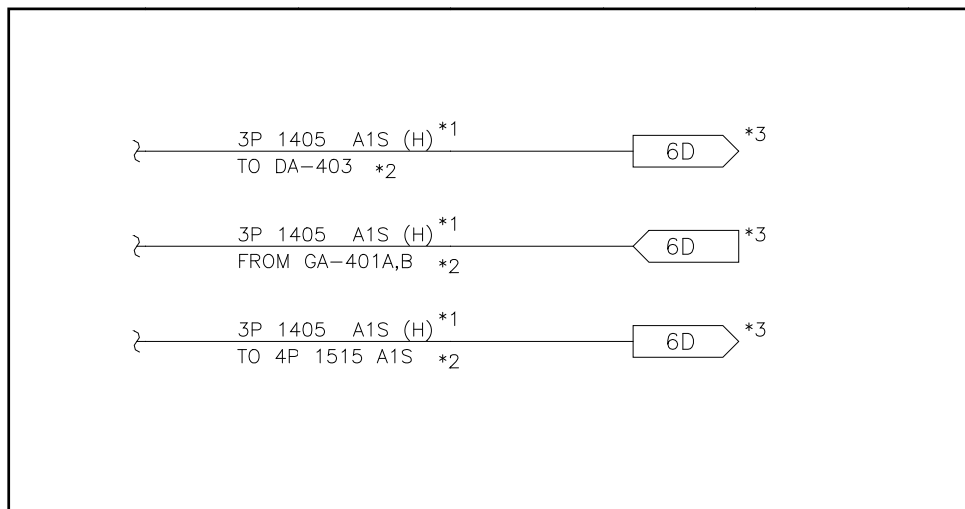
3.2.4. Continuity Block

(1). Continuity between P&IDs

The block arrow symbol shall be used to show continuity between drawings. Lines entering or leaving the drawing shall have a continuity block at the start or the end respectively. Samples of continuity are shown below:

The continuation drawing number should be written inside of the continuity block (). The line number should be placed above the line and the equipment number (i.e. starting/destination) below the line. Example:

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Where:

- * 1 Line Number
- *2 Equipment number/ name from or to which line is coming from or going to. An equipment item number should be used to indicate all the equipment the line is coming from or going to. In the case that the line is connected to a line in the next drawing, that line number should be shown.
- *3 Drawing Continuation Number

The continuity symbol for entering or exiting line () should be placed on the line at the left or right-hand side of the drawing. It is preferred that continued line be at the same elevated position.

The continuity symbols for lines entering the drawing should be placed at the left-hand side of the drawing sheet; while, the continuity symbol for lines exiting the drawing should be

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placed at the right-hand side of the drawing sheet. The process line that will be connected to other units should be placed at the bottom of the drawing sheet.

(2).Connection between P&ID and UFD

a) Expression on the P&ID

In principle, the connecting method between P&ID and UFD should be based on the following example:

Example:



Where:

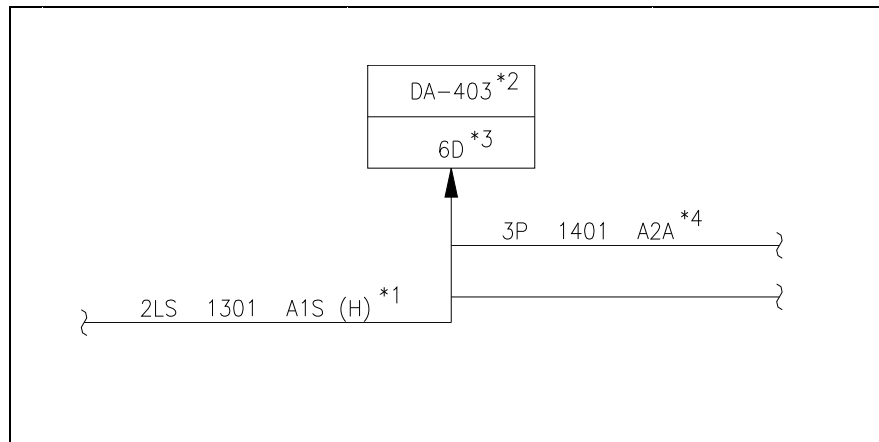
* 1 Line Number

* 2 Drawing Continuity Number

b) Expression on the UFD

In principle, the method for connecting lines between P&ID and UFD is as shown in the following example:

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Where:

- * 1 Line Number
- * 2 Equipment item number in the destination drawing to which the line is connected.
- * 3 Drawing number where the destination equipment is shown.
- * 4 In case a utility line is connected with a process line before connecting to equipment, the line number of the process line should also be shown.

(3).Connection between UFD and UFD

It is the same as described in Section (2). In principle, judgment in using Section (2)-(a) or (2)-(b) should be based on the following:

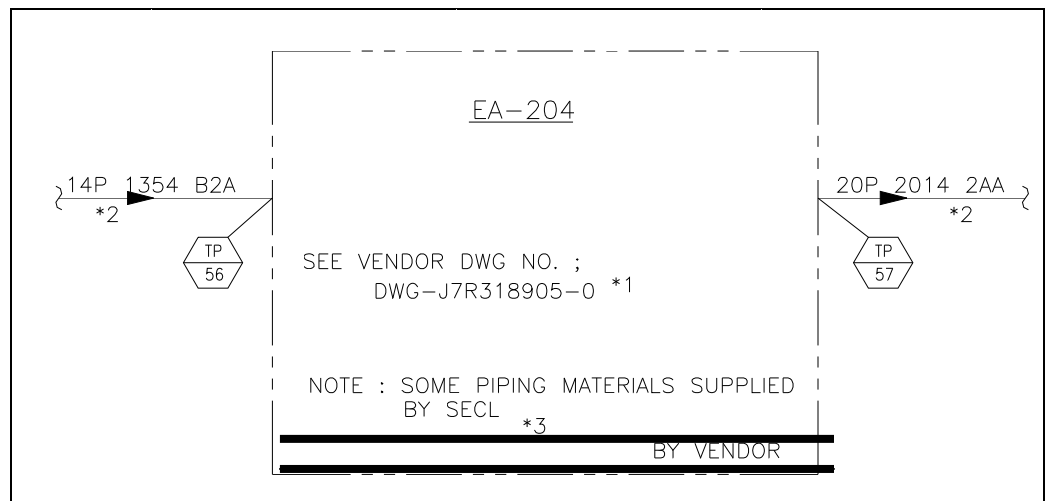
- a) Use the methods described in Section (2)-(a) for utility supply facility.
- b) Use the methods described in Section (2)-(b), except for the above method.

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c) In some cases, either Section (3)-(a) or (3)-(b) is applicable to the same drawing sheet. The symbols based on both Sections (2)-(a) and (2)-(b) can coexist in the same drawing sheet.

(4).Connections between P&ID or UFD and Vendor Drawing

Use the following example to create vendor drawing connections on UFD or P&ID:



*

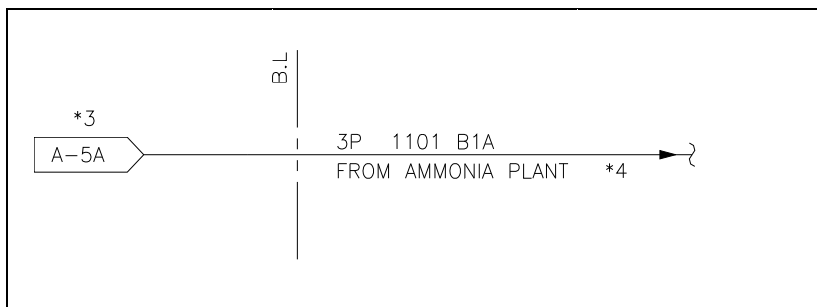
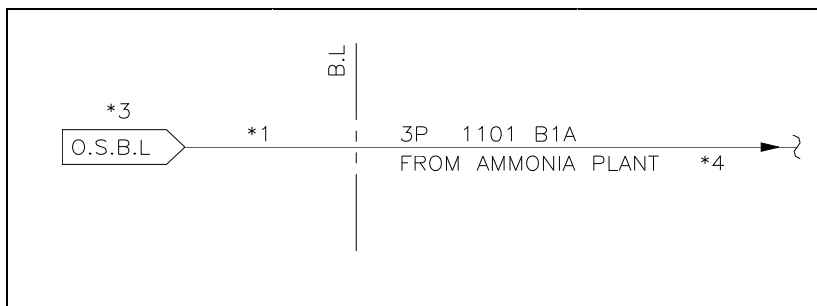
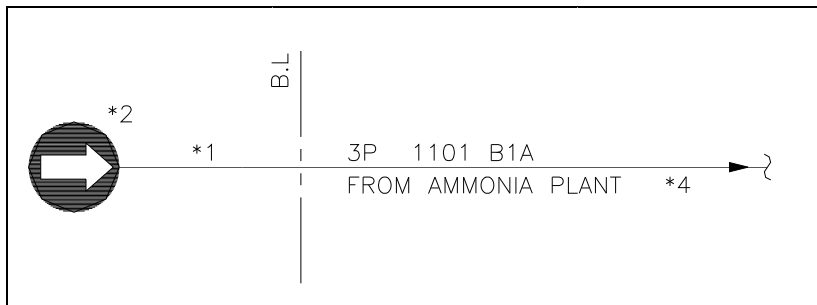
Where:

- *1. Vendor's P&ID Flow Diagram Drawing No.
- * 2. Tie-in Point number to vendor drawing (including instrumental piping). Use the same tie-in point number on vendor drawing

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(5).Connection with Battery Limit (Refer to Section 6.6.1)

a) Connection with B.L in P&ID



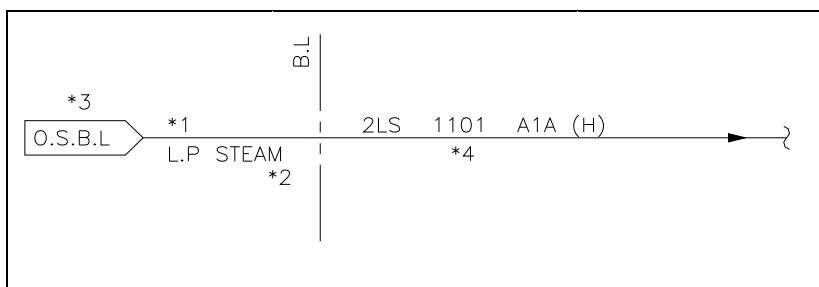
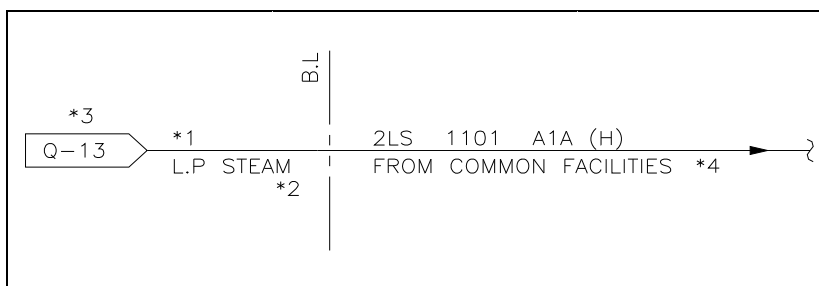
Notes:

- * 1 In case the piping line number of B.L is identified, it should be indicated. The stream name should be written under the continuity block.

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- * 2 Symbol for the starting point of main process line.
- * 3 In principle, the inside of the continuity block can be filled with “O.S.B.L”. The drawing number should be used if the drawing number of continuity is identifiable.
- * 4 If the plant name is known, it should be written.

b) Connection with B.L in the UFD sheet



Notes:

- * 1 If the piping line number is known, it should be indicated.
- * 2 The fluid name should be written.
- * 3 In principle, the inside of the continuity block can be filled with “O.S.B.L”. The drawing number of continuity should be written if it is identifiable.
- * 4 The plant name should be written if it is known

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4. THE TITLE BLOCK FILLING METHOD

The title block should show Job Number, Client and Plant Name, Plant Capacity, Type of Drawing, issuing stage, etc.

Since there is a Revision Column, Issue Block shall show the history of the drawing and its progress. Generally, information to be used for the title is specified in the Job Instruction.

4.1. Composition of Title Block

The Title Block shall be as shown below. An instruction to fill the contents for each part is detailed in Section 3.2.

1	1/14/98	For Construction	I.H. KIM	HWAN G	T.H. LEE	Y.Y. KOO		
0	9/11/97	For Construction		ORIGINAL SIGNED				
D	11/7/97	For Design		ORIGINAL SIGNED				
B	5/26/97	For Review		ORIGINAL SIGNED				
A	4/9/97	For Information		ORIGINAL SIGNED				
Rev.	Date	Description	DWN	AE	LE	APPD	PE	PM
30000 MTPA AC/ECH PLANT								
ULSAN, KOREA								
 SAMSUNG FINE CHEMICALS CO., LTD ULSAN, KOREA								
 SAMSUNG ENGINEERING AMERICA INC HOUSTON, TX Project No.: _____								
PIPING AND INSTRUMENTATION DIAGRAM								
SCALE NONE		DWG. NO. D-S00091-6B-ECH				REV.		1

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4.2. Content of Title Block

4.2.1. Plant Name and Production Capacity

The production capacity and plant name shall be shown in this area of the title block.

Example: 300,000 MTPA ETHYLENE PLANT

Do not use abbreviation for the plant name.

4.2.2. Client Name and Plant Location

The client name (company or organization) and plant location should be shown in this area. For the plant location, use the local area name (i.e. City and village) and country name.

Example:

IRAN-KOREA PETROCHEMICAL CO., LTD.

BANDAR, SHAHPUR, IRAN

4.2.3. Job No.

SECL Job Number or Proposal Number shall be shown in this block.

4.2.4. Type of Flow Diagram

To clearly indicate the type of flow diagram, write the formal name according to the type of flow diagram defined in Section 2.4.

For example, Piping & Instrument Diagram or Utility Flow Diagram.

4.2.5. Process name or system name

Generally, a process plant consists of two main facilities: process and its auxiliary facility and utility facility. The P&ID is used to represent the process and its auxiliary facilities while the UFD is

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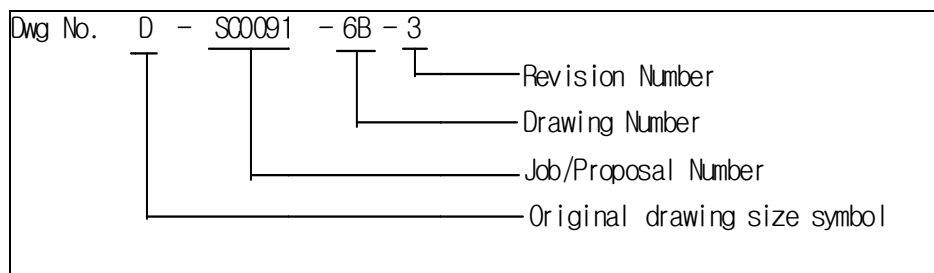
used for the utility facility. The process or utility system name chosen needs to be related to the system containing in the drawing.

As a rule, a process P&ID should be named according to the process name of the system depicted on the P&ID. The auxiliary facility and utility facility name should be based on the system name according to the fluid name written in the Remark column of the table in Section 4.2.6. Also, for drawings containing two or more systems on one drawing, i.e. plant Air and Nitrogen systems, it is acceptable to use more than one system name in the same drawing sheet.

4.2.6. Drawing Number and revision number

[P&ID drawing numbers are typically developed based on client/project guidelines. If none are available, the following system can be used.](#)

A drawing number is composed of the following:



Of these, the drawing number shall represent the type of flow diagram as shown in the table below.

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Drawing number and type of flow diagram

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Drawing number	Drawing Type	
	Type of Flow Diagram	Remark
1	Block Flow Diagram	
2	Process Flow Diagram* 1	
3	Utility Balance Diagram	
4	General Note	General Notes, Legend, symbols, & References for flow Diagram
5~8	P & ID Flow Diagram	Process Area
9	P & ID Flow Diagram	Tank Yard
10	Plot Plan	
11	General Arrangement	
12	P & ID Flow Diagram	Miscellaneous* ³
13,14	Utility Flow Diagram	Steam System
15	Utility Flow Diagram	Refrigeration and heating System
16,17	Utility Flow Diagram	Water System* ²
18	Utility Flow Diagram	Firefighting System
19	Utility Flow Diagram	Air and Inert Gas System
20	Utility Flow Diagram	Fuel System
21	Utility Flow Diagram	Flare and Vent System
22	Utility Flow Diagram	Waste Effluent System
23~27	Utility Flow Diagram	Miscellaneous System
28~49		Reserved

Notes:

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* 1 Material balance may be shown on the PFD, but preferred to be on separate sheets.

* 2 Consider the following names for Water.

- Potable (or Drinking) Water
- Industrial Water
- Filtered (Clarified) Water
- Pure (or De-mineralized) Water
- Polished Water
- Process Water
- (Circulating) Cooling Water
- (Cooling) Sea Water
- Hot (or Tempered) Water
- Chilled (or Refrigerated) Water

In addition, drawing number 16 or 17 can be used for Brine system (i.e. sodium chloride solution, salt solution, etc.).

* 3 The following can be considered as miscellaneous systems:

- Seal Fluid System
- Lubrication System
- Hydraulic System etc.

In general, the procedure for interconnecting P&ID and UFD can also be applied to the miscellaneous category.

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5. DATA REQUIRED AT EACH STAGE.

5.1. Data Requirements

Required data for preparation of P&ID & UFD are listed below:

- a) Contract and associated project documents (Especially, applicable regulations and standards, basic engineering design data (BEDD), process design basis and philosophy, performance guarantees, test methods, sampling methods, etc. which shall be specified in the contract)
- b) Heat And Material Balance
- c) Equipment Type
- d) Process Flow Diagram
- e) Utility Balance Diagram
- f) Equipment List
- g) Symbol of Equipments and Piping
- h) Symbol of Instrument
- i) Line Numbering Method And Piping Specification
- j) Process Sketches and Engineering Drawings
- k) Pump and Compressor Data Sheet
- l) Heat Exchanger Data Sheet and Engineering Drawing
- m) Heater Data Sheet
- n) Other Special Equipment Data Sheet
- o) Instrument Process Data and Instrument Schedule
- p) In-Line Equipment Process Data Sheet and Specification Sheet
- q) Vendor drawing or data sheet for equipment and Instrument
- r) Manual and standard

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- s) Job Special Specification
- t) Operation Manual or Guide
- u) Safety Equipment Design or Installation for Preventing Overpressure
- v) Accessories Installation for Preventing Overpressure
- w) Comparison of Regulation and Standard for Pressure Vessel And Boiler
- x) [Over Pressure Protection Devices Calculations](#)

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5.2. Contents and purpose for each issuing stage of P&ID and UFD

ISSUE STAGE	Contents of P&ID or UFD
(1) <u>Preliminary</u> <u>Purpose</u> Client participation is not required for this stage of issue. The purpose of this issue is to enable the project team to kick off the following activities: The P&ID and UFD a) Plot Plan study b) Pipe routing Study and Critical Line Study c) Civil engineering activities: (i) Building (Compressor Room etc) Study (ii) Initial estimate for Concrete, Steel Structure and Pipe Rack	a) Basic structure and flow for process and utility system b) Items associated with Equipment (i) Equipment Item Number and Name (ii) Equipment Type and Driver Type (iii) Piping Connected with Equipment, the Shape of Vent, Drain, Instrument nozzle, Built-In Level Gauge, Sight Glass, Nozzle, etc (iv) Insulation and External pipe heating: Steam Coil or electric Tracing (v) Tie-in point (vi) Safety shutdown valves c) Piping Items (i) Piping specification (process piping, utility and instrument piping, above ground and underground piping, double piping, etc) (ii) Piping branch and join

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ISSUE STAGE	Contents of P&ID or UFD
a) Plot Plan Preparation	(Injection nozzle, internal coil, internal baffle, tray No., packing, demister, screen, spray nozzle, spray ring, steam silencer, vortex breaker, chemical foam nozzle)
b) Final Issue of Civil Information	(ii) Piping size connected with equipment, requirement of reducer, minimum flow or by-pass line
c) Piping Specification shall be issued for construction.	(iii) Tie-in point
d) Preparation of Piping Planning drawing	(iv) Loading and unloading of chemicals, catalysts, product
e) Nozzle Orientation and Platform Ladder Information	
f) Thermal stress calculation	
g) Preparation of Underground Piping Drawing	
h) Piping Material 1st Take off.	c) Piping Item
i) LDT issue for review	(i) Piping size, fluid symbol, class symbol (ii) By-pass Line (iii) Piping specialty (Flame Arrester, Sight Glass, Filter, Strainer, steam trap, flexible hose, expansion joint, flexible joint, etc) (iv) Sampling Connection (v) Loading Arm

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ISSUE STAGE	Contents of P&ID or UFD
	(vi) Hose Connection and Hose Station (vii) Safety Shower, Eye Wash station (viii) Caution in Piping Design Work * Relative location of valve is required in terms of layout.
	(E.g. Locate valve to allow easy reading of the gauge. Install valve at minimum distance from the pipe branch or equipment to minimize plugging) * There is elevation requirement for process purpose (E.g. Seal leg height, angle of repose, gravity flow line, skirt height, NPSH requirement, relative position between tower and re-boiler, relative position between tower and reflux drum (gravity flow case) etc) * Range of sloped line and slope * Pocket and low point not allowable in piping (ix) Completion of line numbering (Area classification and serial number) d) Instrument and electrical item (i) Type of instrument device (ii) Instrument connection size and requirement of reducer

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ISSUE STAGE	Contents of P&ID or UFD
	(iii) Clear indication of instrument signal (iv) Straight-run length required for special gauge and location of detecting element (v) Safety device connection size and reducer requirement (vi) Sequence and Interlock system
(3) APPROVED FOR DESIGN (AFD) The purpose of IFD drawing is to initiate the piping design work. a) Preparation of piping drawing b) Piping B/M	(vii) Gauge, indicate the location of alarm light, control result, and distinguish local control panel, local gauge board, main control panel, etc. (viii) Instrument tag number, as per information from design department. (ix) Static electricity bonding (x) Instrumentation batch system a) Follow-up the note contents in AFD (Client comments, hold point, additional items, etc) b) Equipment related items (by information from instrument department) (i) Finalize connection parts (ii) Finalize the relief valve calculation and the flare header sizing and vent and drain system c) Piping related items

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ISSUE STAGE	Contents of P&ID or UFD
c) Piping Hanging Design	(i) Completion of line numbering (Area classification) (ii) Tag number of in-line equipment (iii) Vent and drain required in terms of piping and test plan (iv) Finalize the connection parts with In-line equipment
(4) APPROVED FOR CONSTRUCTION (AFC)	a) Follow-up of note contents for AFC (Hold Point, occurrence of revised parts after AFC)
(5) AS BUILT DRAWING	a) Notes of discrepancies and correct drawing according to actual installation.

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6. GENERAL NOTES FOR P&ID AND UFD

"General Notes and Legend & Symbols" drawings shall be prepared for use as references for P&ID and UFD preparation. Use drawing code number 4 for these diagrams.

The content of the General Notes and Legend & Symbols drawings shall be based on SECL standard P&ID Symbols and Legend and the following:

- (1). Instrument Symbols and Legend
- (2). Piping Symbols and Legend
- (3). Reference Drawings (or Drawing Index)
- (4). General Notes
- (5). Line Service Identification

6.1. Instrument Symbols and Legend

In principle, this legend should follow the symbols described in Standard P&ID Symbols and Legend. In case additional rules and modification of Standard P&ID and Legend are necessary, these rules and modification should be approved by the project manager.

6.2. Piping Symbols and Legend

Same as described in Section 4.1.

6.3. Reference Drawings (or Drawing Index)

The drawing index drawing shall have a drawing code number 4. This drawing shall list the type of flow diagram and drawing number (including revision number) that are directly related to P&ID and UFD. The following drawings shall be listed on the reference drawing:

- | | |
|--------------------------------|--------|
| a) Process Flow Diagram | (PFD) |
| b) Utility Balance Diagram | (UBD) |
| c) Piping & Instrument Diagram | (P&ID) |

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d) Utility Flow Diagram (UFD)

e) Vendor's Drawing * 1

Note:* 1

For vendor's drawing, prepare a list in case that it is referenced in P&ID or UFD.

6.4. General Note

Notes related to overall or various parts of P&ID and UFD shall be included in this section. For example,

- a) Type and size rule of vent and drain valves to be attached to piping
- b) Type and size rule of main instrument valve
- c) General process requirements for piping that handle special fluids
- d) In case the provisions are specially required for the following:
 - * Countermeasure for highly hot area
 - * Countermeasure for cold area
 - * Prevention of freezing or solidification
 - * Countermeasure for preventing interruption of electric power

6.5. Line Service Identification

Write down the fluid symbols used in line number of P&ID and UFD. (Refer to Section 8.4.2)

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7. MAJOR DOCUMENTS

The following documents or design calculations should be completed when starting P&ID and UFD preparation work:

- a) Material, heat and pressure balance calculation
- b) Design calculation for major equipments
- c) Process Flow Diagram
(Major Control System)
- d) Job specific items (including contract contents, various symbol selections)

In this section and section 7, various expression methods and items that need to be reviewed in preparation of P&ID and UFD are listed. Prepare the method of detailed consideration separately.

- (1). Items for applied law and regulation
- (2). Review items for process and operation
- (3). Review items for maintenance
- (4). Review items for safety
- (5). Others

7.1. Items covered by local law and regulation

For equipment or piping regulated by local law and regulation, sufficient investigation and review should be carried out. For further information, parts (u), (v) and (w) of Section 3.1 can be used.

7.2. Review items for operation

- a) Prevention of freezing or special procedures for high/low temperature region and other special climates
- b) Insulation requirement
- c) Requirement of tracing, coil and jacket

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- d) Consideration of low load operation
- e) Consideration of normal start-up and shut-down
- f) Consideration of emergency shut-down
- g) Consideration of initial start-up
- h) Import/export consideration for utility, raw materials, chemical, utility, etc. at B.L. (pipe line, loading arm, tank lorry, bags or drums, bulk)
- i) Storage tank type and seal type for floating roof tank
- j) Requirement of desuperheater
- k) Requirement of by-pass line (Instrument, Control Valve, Compressor & Blower, Pump (including min. flow), etc.)
- l) Requirement of fire water spray
- m) Steam condensate treatment method
- n) Selection of valve type, method of installation and special piping items
(Double Block & Bleed System, etc)
- o) Selection of vent and drain method
- p) Seal leg requirement
- q) Fluid that requires special handling (Refer to maintenance items)
- r) Review of instrumentation type
- s) Review of Sewer classification
- t) Selection of Flexible Hose type
- u) Selection of Blind type
- v) Utilities for rotating machinery
- w) Selection of sampling type
- x) Selection of Steam Trap type

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y) Review of chemical (Including inhibitor) injection point

z) Requirement of silencer

aa) Review of actuator type for the large size valve (i.e. Motor, Gear or Manual)

bb) Regeneration method of catalyst, etc

7.3. Review items in maintenance purpose

a) Review items that require special cleaning prior to being put in service.

(i) Fluids that require careful handling

- Easy to be polymerized – containing unsaturated compounds
- Easily crystallized, solidified or causing scale problems,
- Slurry that can be precipitated
- Easily foamed or bubbled
- Explosive, combustible gas or a mixture with combustible gases
- Combustible fluids or powder materials that can easily ignite by static electricity
- Toxic (poisonous) gas

(ii) Batch Process

(iii) Others

- Venting method (Atmospheric release, closed vent system, Flare or Stack etc.)
- Drain method
- Heating method such as steam tracing, etc
- Cleaning method (Disassemble, Chemical Cleaning, Jet Cleaning, Pig, Air or Nitrogen, Purge, Steam Purge, etc.)

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- Vent nozzle, Light Hole & Sight Hole
- Hose Connection & Station
- Disassembling equipment and other tools (Hoist, Crane, Chain Block, other tools)
- Cleaning Fluid, Post-cleaning inert gas

b) Periodical repair

7.4. Safety Review Items

a) Emergency Plan

- (i) Interruption of electric power (Emergency source of electricity, Auto-Start, valve action etc.)
- (ii) Instrument air failure (Interlock, Valve Action etc.)
- (iii) Cooling water failure (Interlock etc.)
- (iv) Steam failure (Interlock etc.)
- (v) Others, fluid pressure, liquid seal, etc

b) Static Electricity prevention

c) Requirement of Flame Arrester installation

d) Requirement of Safety Valve, Rupture Disc, Breather Valve, Vacuum Breaker installation

e) Interlock for Protecting Equipment and Installation

f) Piping spec Break (or Design Break)

g) Notes for Valves that are Important in Terms of Safety

h) Locked Open or Close, Car Seal Open or Close etc.

i) Installation of Check Valve, Blind, etc.

j) Burn Prevention and Fire Protection

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k) Fire Fighting equipment (Fire Extinguishers, fire monitors, Sprinkler etc.)

l) Requirement of Safety Shower and Eye Washer

7.5. Others

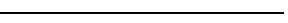
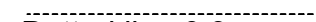
a) Utility Supply for Building (Control Room, Switch Room, Office, Maintenance Shop, Gatehouse, Canteen, Warehouses, etc.)

b) Future Expansion

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8. MAJOR SYMBOLS USED IN P&ID AND UFD

8.1. Type of Line symbol

Symbol	Application
 Phantom 1.0 mm	Battery Limit
 Bold line 0.9 mm	Process Main Line
 Line width 0.5 mm	Lines except process main line and utility flow diagram lines
 Phantom 0.5 mm	Scope of Vendor supply. Scope of Detail drawing
 Line width 0.3 mm	Lead line of Equipment and Instrument, Circle fill with tag number of instrument. ex) Jacket
 Dotted line 0.3 mm	Steam Tracing, Instrument Signal

8.2. Equipment Symbol

There are two methods used for assigning Number to equipment.

- (1). [Due to client or licensor request, an equipment numbering system that is different from SECL's may be required. In this case, it is required to use two kinds of item numbers. \(In principle, write down client's item number first and then put the SECL's inside of parenthesis\)](#)
- (2). The equipment description requirements for the P&ID/UFD may be set by client request or project requirements. If this is not the case, standard expression is as follows:
 - Tower: Capacity (No. of Tray or Packing Height), Size (Dia*Height), Design Pressure, Design Temperature, Material of construction
 - Drum/Tank: Capacity (Volume), Size (Dia*Height), Design Pressure, Design Temperature, Material of construction
 - H/E: Capacity (Heat Duty or Surface Area), Size (Shell ID * Tube Length), Design Pressure (S/T), Design Temperature (S/T), Material of construction(S/T)

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- Pump/ Compressor: Capacity (Flow Rate), Differential Head, Driver H.P, Material of construction

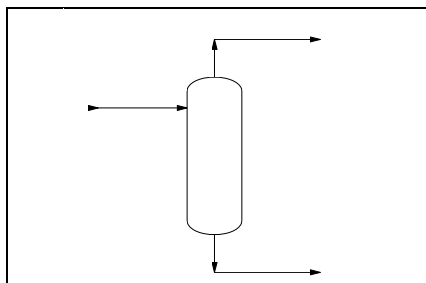
8.3. Various Equipment Symbols

In this section, equipment symbols that are generally used in various plants are provided. However, in case that special items or additional detailed information is requested by the client and licensor or the symbols given here are not sufficient , most appropriate symbols shall be developed as a special item.

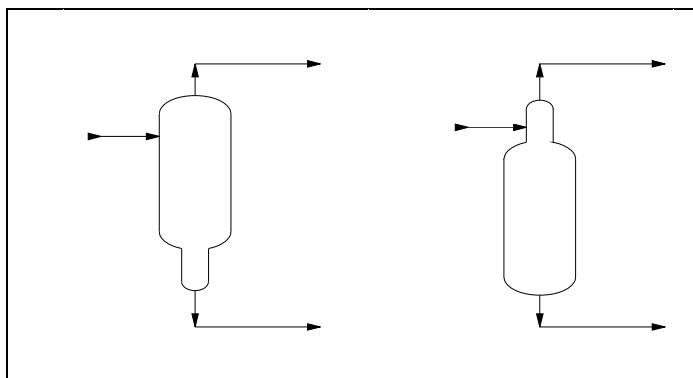
8.3.1. Equipment Form and Shape

1. Tower

a) Column



b) Two Diameter Column

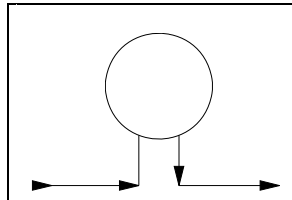


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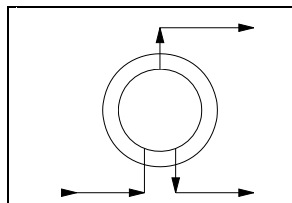
2. Tank/Drum

a) Bullet, Sphere

(i) Single Wall

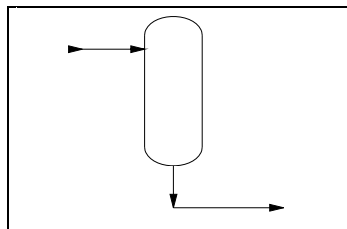


(ii) Double Wall

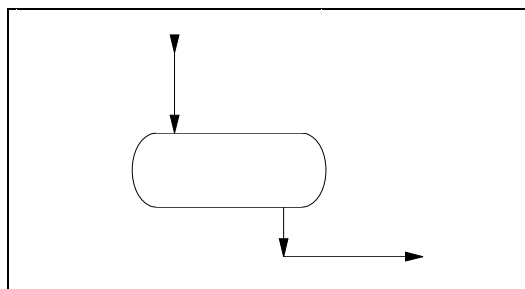


b) Cylindrical vessel

(i) Vertical



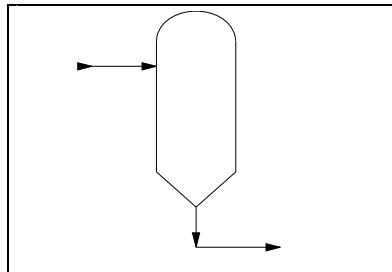
(ii) Horizontal



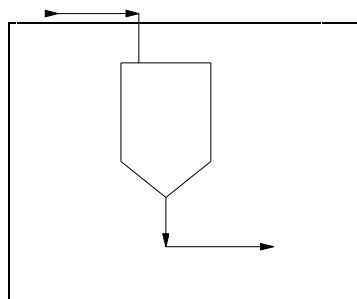
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c) Low Pressure Tank

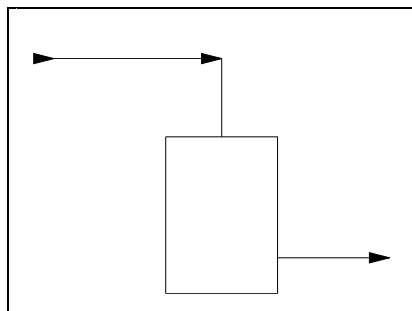
(i) Dish Head, Cone Bottom



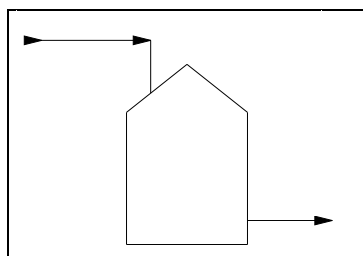
(ii) Flat Head, Cone Bottom



(iii) Flat Head & Bottom

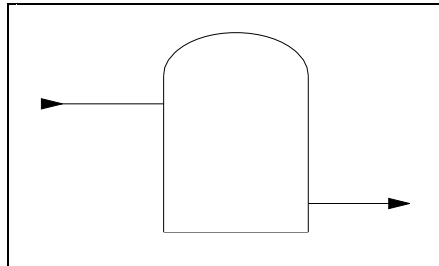


(iv) Cone Roof Tank

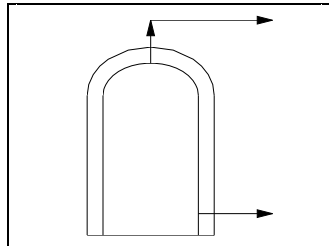


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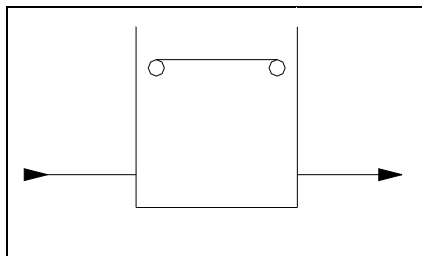
(v) Dome Roof Tank (Single Wall)



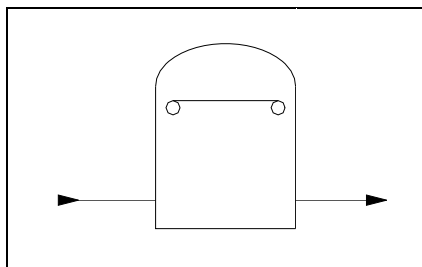
(vi) Dome Roof Tank (Double Wall)



(vii) Open Floating Roof Tank

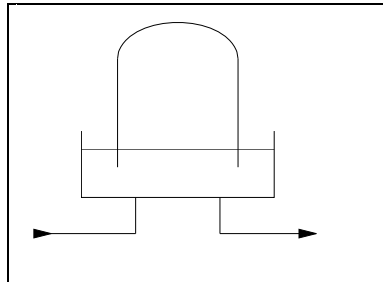


(viii) Internal Floating Roof Tank

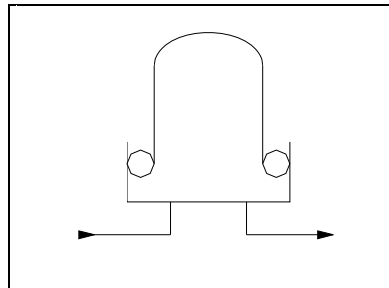


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(ix) Water (Liquid) Sealed Gas Holder

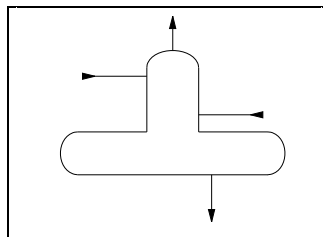


(x) Dry Sealed Gas Holder

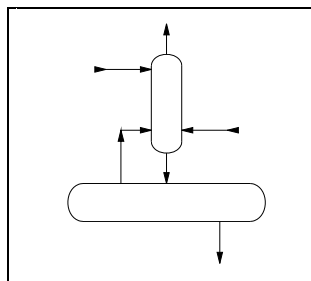


d) Other

(i) De-aerator

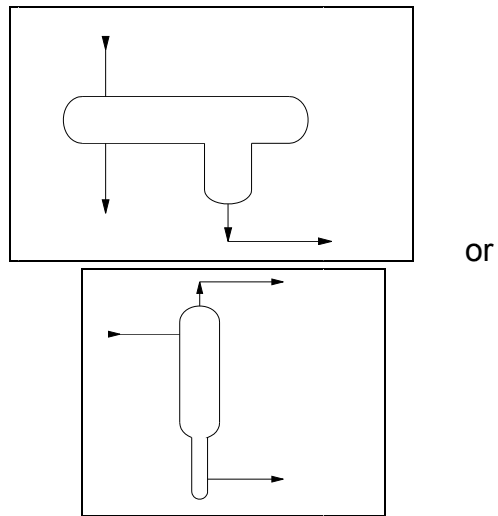


or



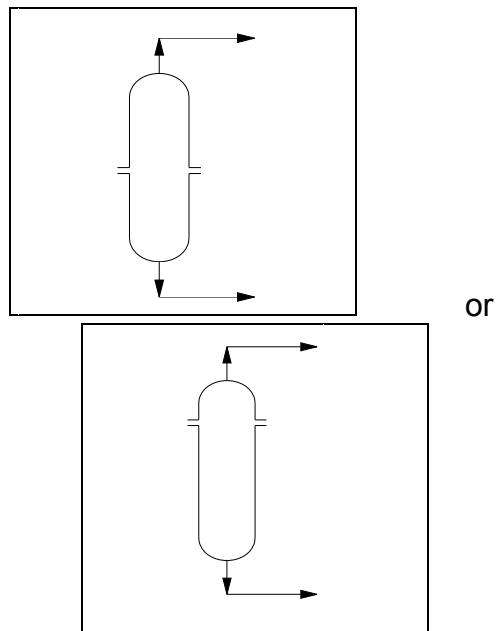
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(ii) In case of Pot or Boots



(iii) flange top or bottom vessel

Example for cylinder type



(iv) For jacketed vessel, refer to Section 3)-(e)

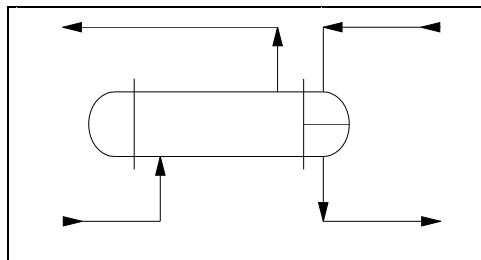
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3. Heat Exchanger

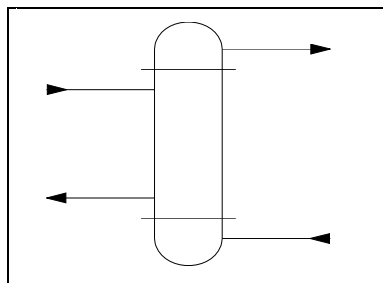
a) Shell & Tube Type

There are several different methods for depiction of shell and tube exchangers. Refer to Section (h) below for the symbology by TEMA type. Also, refer to the Section (i) below for simple symbols for Shell & Tube and Kettle type (as typically used on PFDs).

(i) Horizontal type

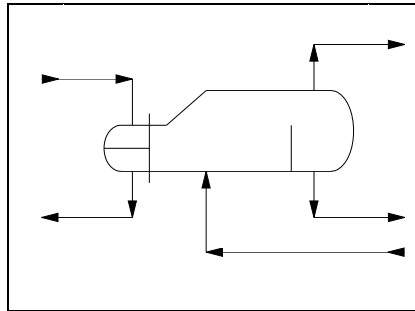


(ii) Vertical type

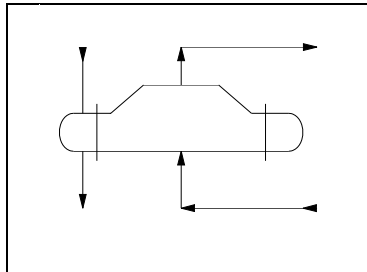


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b) Kettle type

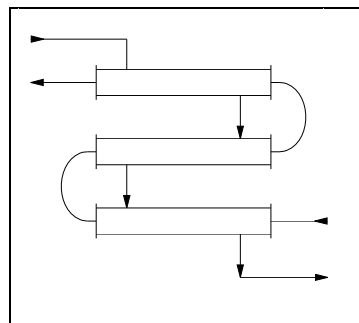


or

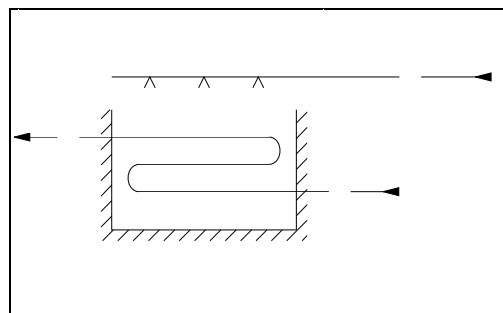


c) Pipe type

(i) Double Pipe type



(ii) Cascade type (Irrigation, Trombone and Spray type)



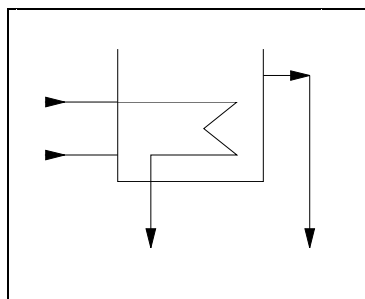
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(Note): In case of pipe type exchanger, add description under the item number so that the parallel or hair pin number can be seen.

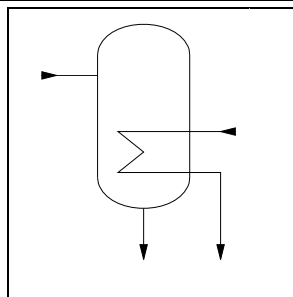
(Example):8 Hair Pins * 2 Parallel

d) Coil type

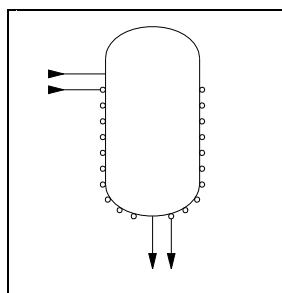
(i) Internal Coil



or

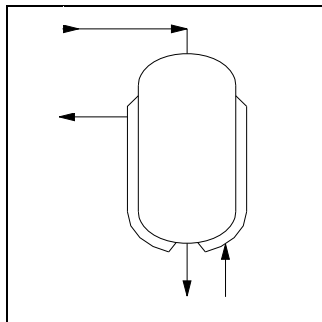


(ii) External Coil



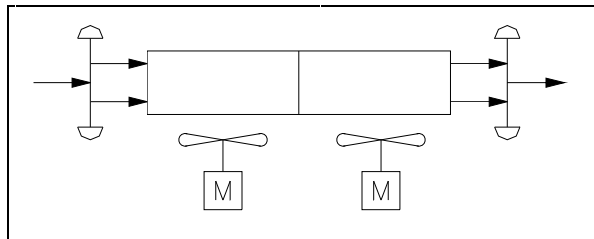
	PROCESS DESIGN MANUAL	SPD0049ERN REV.: <u>3</u>
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e) Jacket type

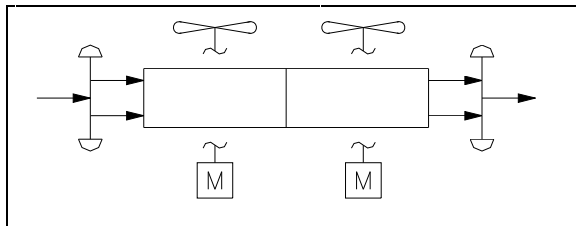


f) Air cooled type

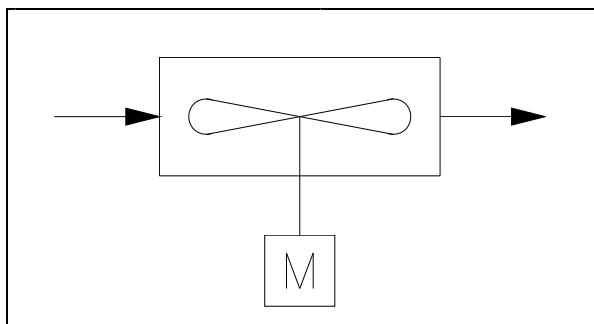
(i) In case of Forced Draft Fan (2 Fans type)



(ii) In case of Induced Draft Fan (2 Fans type)



(iii) FOR PFD

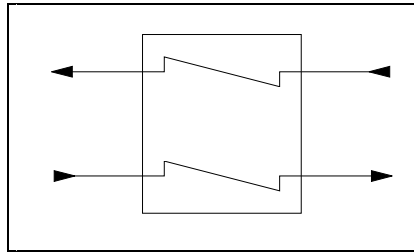


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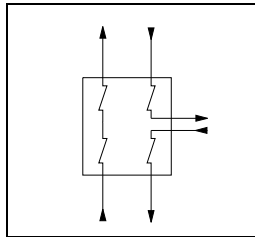
g) Other

(i) Plate type and Plate Fin type

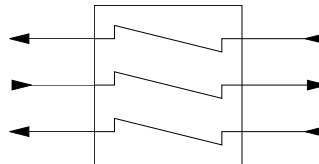
2 Fluid Cases:



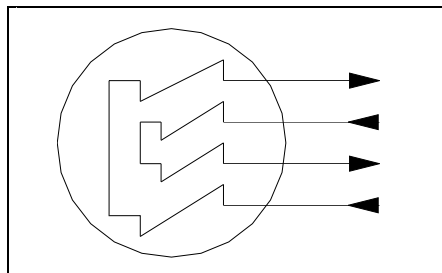
3 Fluid Cases:



or

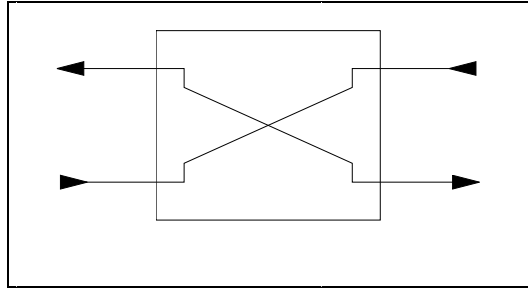


(ii) Spiral type

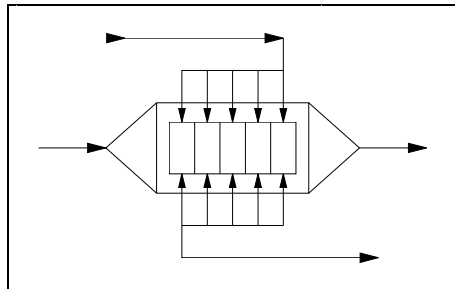


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(iii) Block type

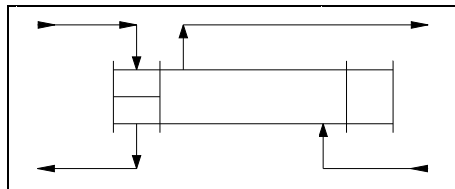


(iv) Aero-Fin Heater

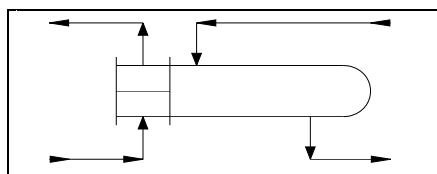


- h) In order to represent a shell and tube heat exchanger in accordance with TEMA classification, Head type of heat exchanger shall be indicated in P&ID and UFD. But, for design convenience, expression method based on TEMA classification can be used in some cases as follows. (Adoption of this method would be determined at the time of job start):

(i) AEL

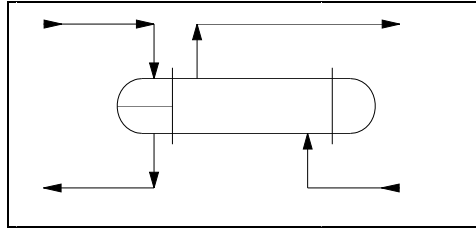


(ii) AEU

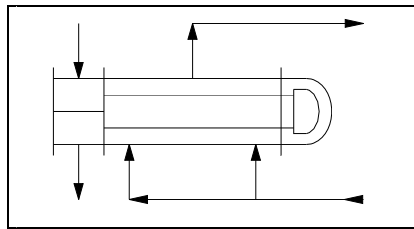


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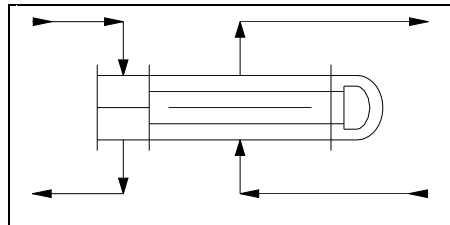
(iii) BEM



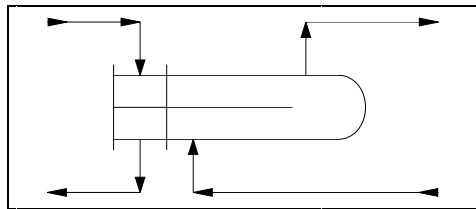
(iv) AJS



(v) AGT

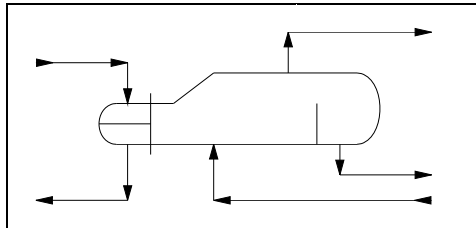


(vi) CFU

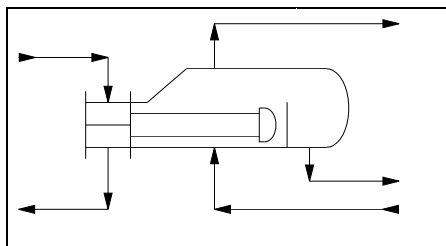


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(vii) BKU



(viii) AKT



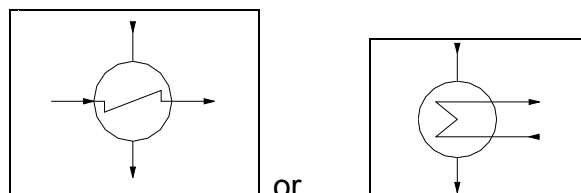
- i) Simplified symbol of shell and tube type and kettle type exchanger.

Use Simplified symbol for PFD preparation. This method can also be used for P&ID by the agreement with client at the beginning of the project.

Example EA-301

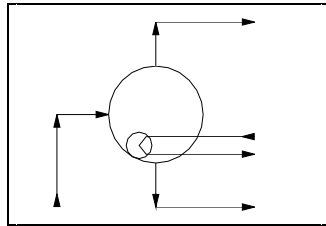
TEMA Type: AEM

(i) Shell-Tube type

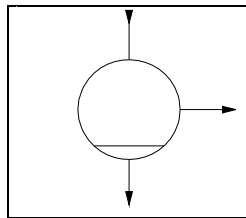


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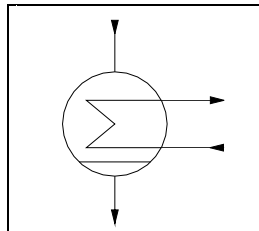
(ii) Kettle type



(iii) Jet Condenser



(iv) Surface Condenser



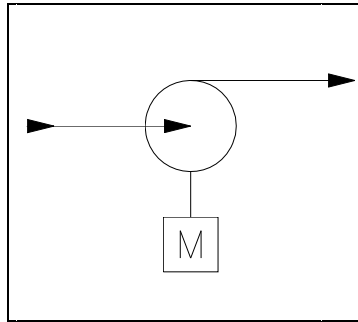
4. Pump

a) Horizontal Centrifugal Pump

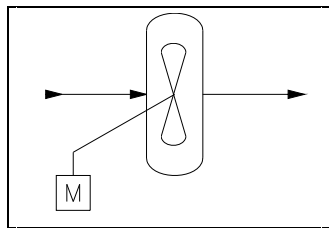
In general, the symbol shown in (i) below shall be used. But, at the client's request, the symbol shown in (ii) and (iii) can be referred.

	PROCESS DESIGN MANUAL	SPD0049ERN REV.: <u>3</u>
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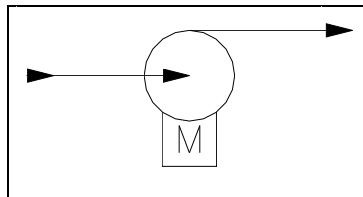
(i) Volute and Turbine or Diffuser type



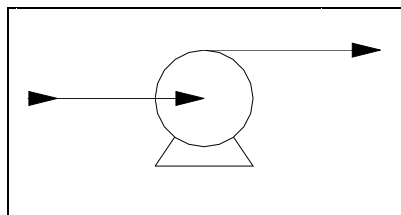
(ii) Propeller Pump



(iii) Non-Seal type (Canned Pump)



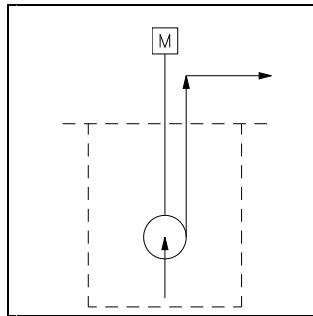
(iv) Centrifugal Pump for PFD (No Horizon/Vertical Classification)



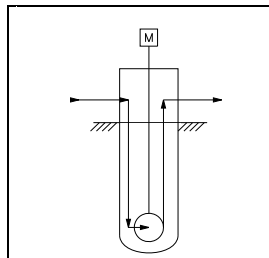
	PROCESS DESIGN MANUAL	SPD0049ERN REV.: <u>3</u>
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b) Vertical Centrifugal Pump

(i) Submerged pump (driver above liquid level)



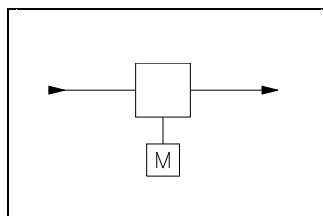
(ii) Installation Outside Vessel



c) Reciprocating Pump

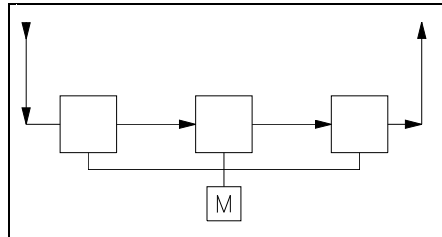
In general, it can be shown as (i) or (ii) below. However, if Client/Licensor's requested, the method shown in (iii) can be used (indicate as job specific item).

(i) Piston type and Plunger type (Single Stage)

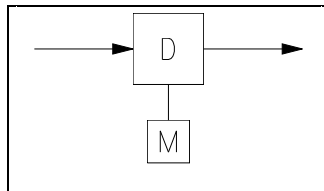


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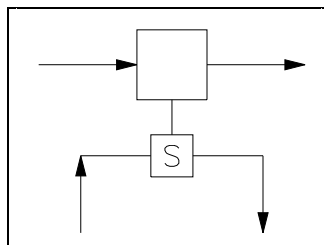
(ii) Piston type and Plunger type (Multi Stage)



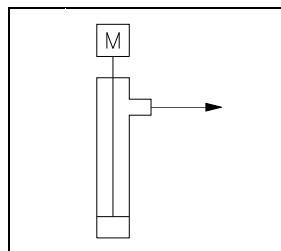
(iii) Diaphragm type



(iv) Direct Acting Steam



d) Vertical Type Reciprocating Pump

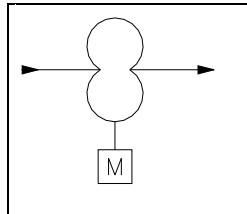


e) Rotary Pump

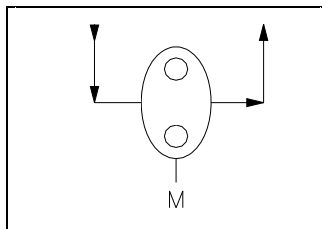
The symbol used for rotary pump is as shown in (i). In case of screw pump, it can be shown as in (ii).

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(i) Gear Pump/Rotary Pump/Regenerative Turbine Pump

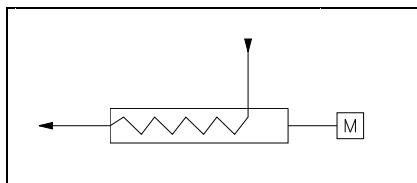


(ii) Screw type



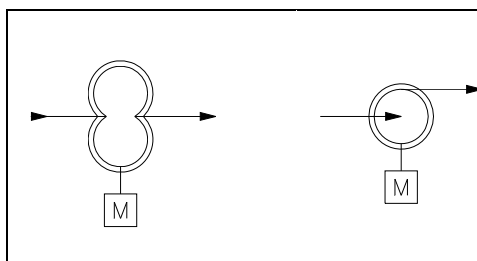
f) Other

(i) Progressive Cavity Pump



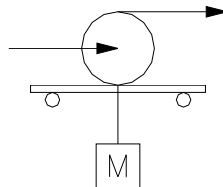
Note:

1. Jacketed Pump



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2. Pump that is attached with wheels (i.e. Movable Pump)

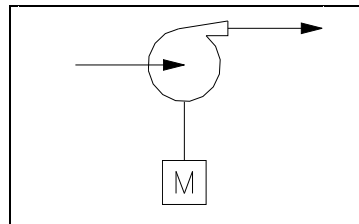


5. Blower and Fan

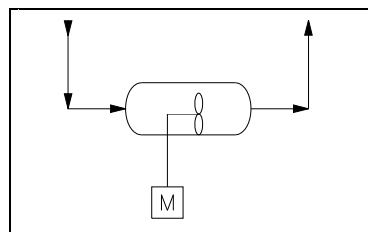
a) Centrifugal Type (Turbo Blower)

In general, it is as shown in (i). But, if necessary, it can be shown as (ii) at the client/licensor's request.

(i) Common or Normal Type

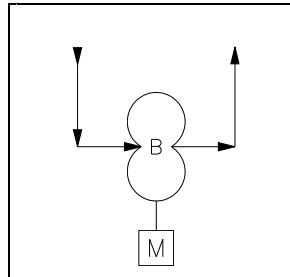


(ii) Axial (Propeller Fan)

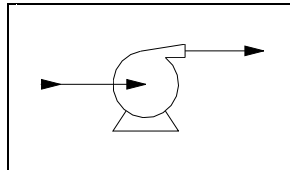


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(iii) Roots Blower



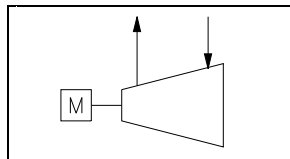
(iv) Blower for PFD



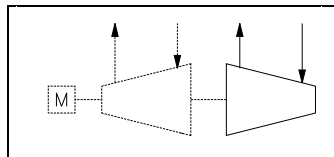
6. Compressor

a) Centrifugal (Turbo Compressor)

(i) Common or Normal Type (PFD common use)



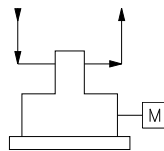
(ii) Tandem type (Expander)



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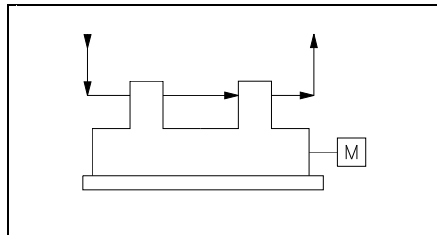
b) Reciprocating

(i) Single Stage Type

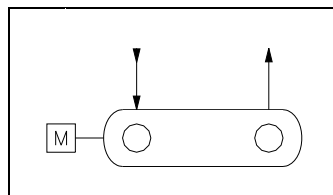


(ii) Multi-Stage Type

Example for 2 stages.

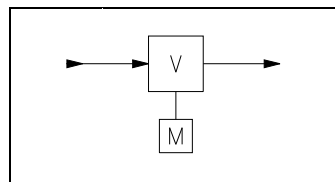


c) Rotary Type



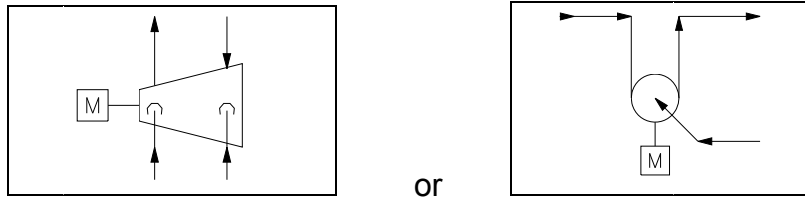
7. Vacuum Pump

a) Reciprocating vacuum Pump

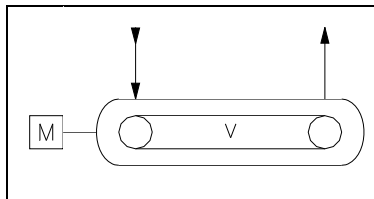


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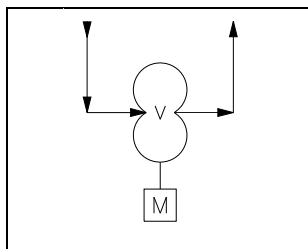
b) Water seal vacuum Pump (NASH Type)



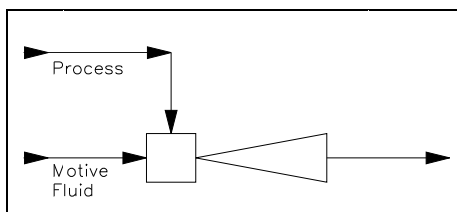
c) Screw (Eccentric) vacuum Pump



d) Mechanical Booster (Roots-Pump)



e) Steam-Ejector, Air Ejector and Water Jet-Condenser

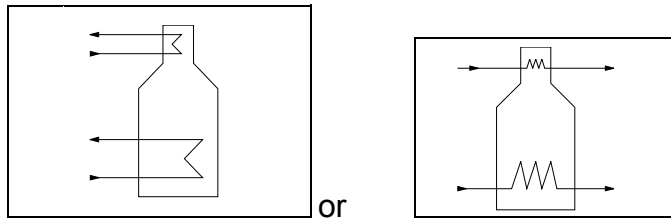


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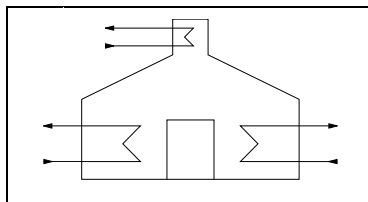
8. Heater and Boiler

The symbol shown below is employed.

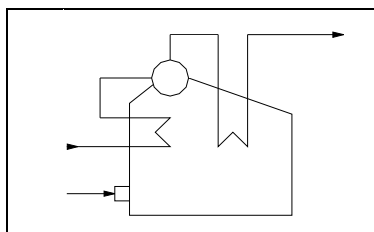
a) One Cell type (Gas Damper should be shown in P&ID)



b) Twin (or two cell) type



c) Boiler, Economizer, Superheater



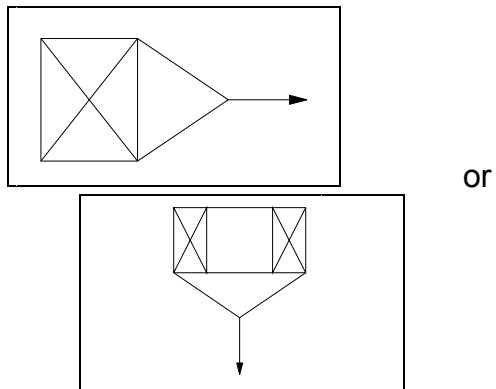
9. Dust Collector (Gas-Particle Separation)

(a) - (e) show the internal structure to differentiate from others.
Refer to "Section 7.3.2.9 Filter Element" for the symbol of internal elements.

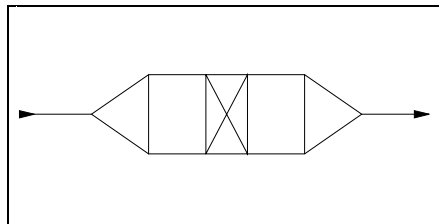
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a) Plate Type Suction Filter

(i) Atmospheric Suction Type (Suction Filter)

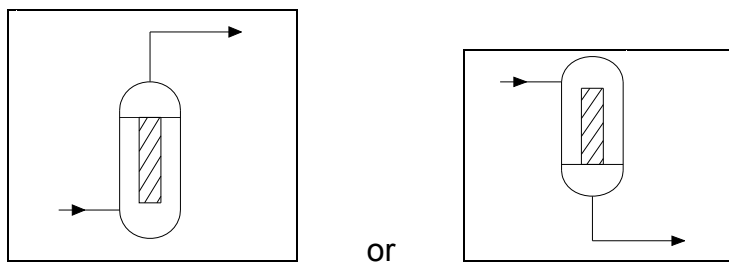


(ii) In-line Installation Type (In-line Suction Filter)



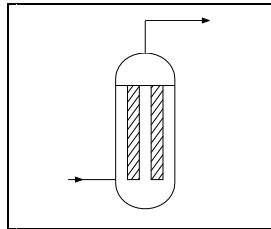
b) Cartridge Type Filter

(i) Single cartridge Type

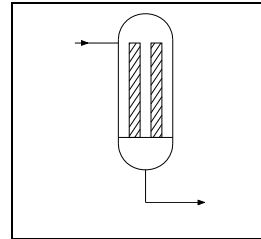


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(ii) Multiple cartridge Type

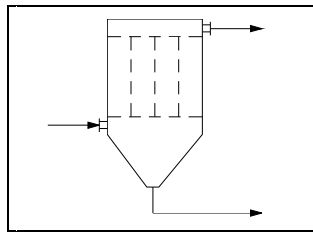


or

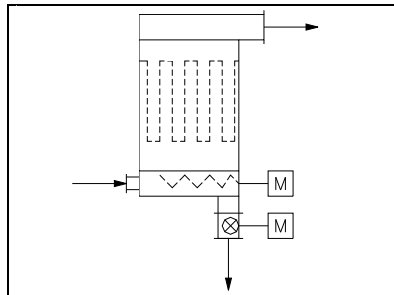


c) Bag Filter

(i) Common or Normal Type



(ii) Screw-Conveyer Installed



Notes:

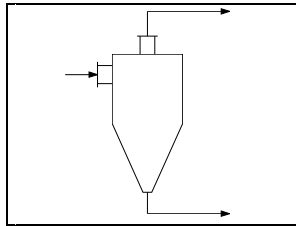
In case that vibrator is attached, put 

or in case that Motor is attached, put 

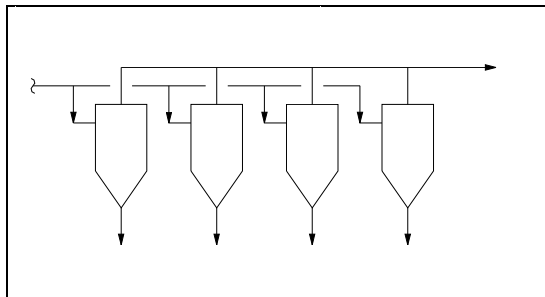
	PROCESS DESIGN MANUAL	SPD0049ERN REV.: <u>3</u>
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d) Cyclone

(i) Single Stage Type



(ii) Multiple Stage Type (Parallel Connection)

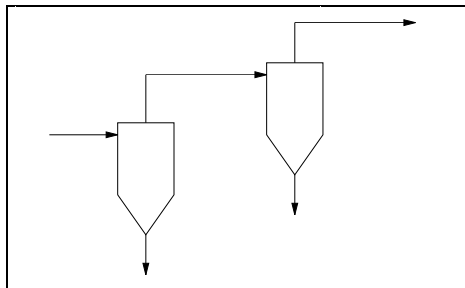


Notes:

In case that vibrator is attached, put 

Or In case that Motor is attached, put 

(iii) Multi-Stage Cyclone (Series Connection)



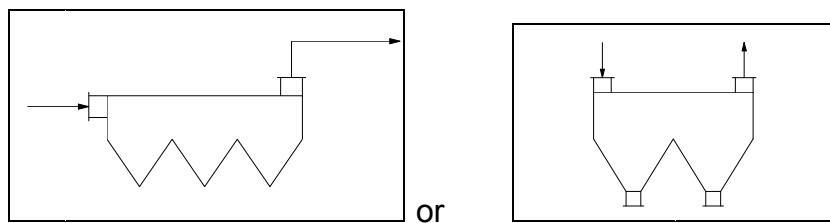
	PROCESS DESIGN MANUAL	SPD0049ERN REV.: <u>3</u>
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Notes:

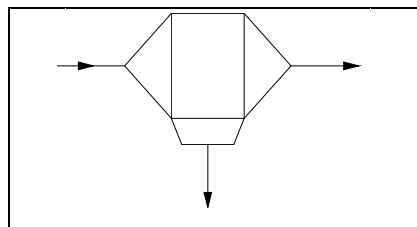
In case that vibrator is attached, put 

Or In case that Motor is attached, put 

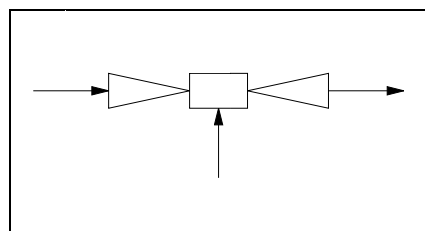
e) Dust Chamber Air Tumbler (Bag Filter House)



f) Electro Static Precipitator (ESP)



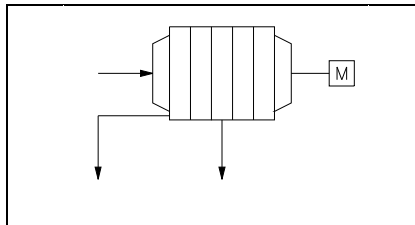
g) Venturi Scrubber



10. Filtering and Precipitation Equipment (Liquid-Solid Separation)

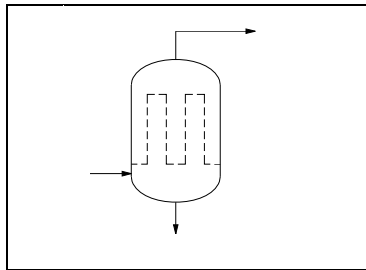
a) Filter Press

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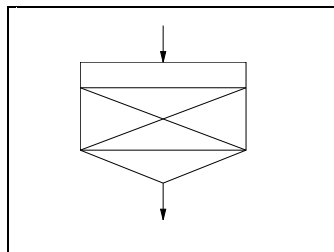
b) Pressure Leaf Filter (Cartridge Type)

Since there are various kinds of leaf filter, it needs to modify realistically.

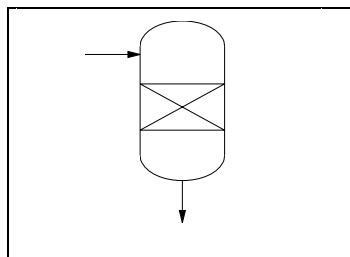


c) Sand Filter

(i) Gravity Flow Type



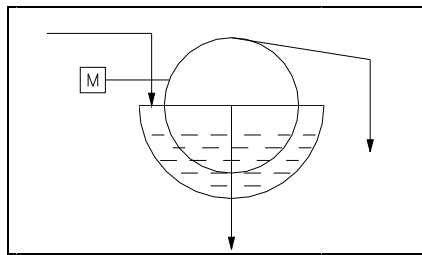
(ii) Pressure Type



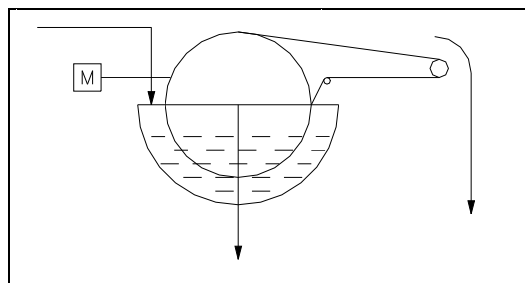
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d) Drum type (Oliver type) Filtering equipment

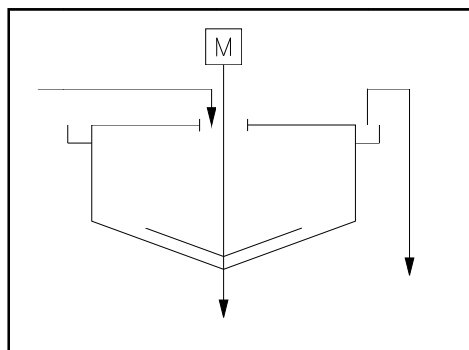
(i) Common or Normal type



(ii) Belt type and String type



e) Thickener



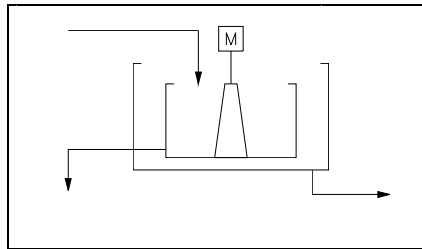
11. Centrifugal Separator, Centrifugal Precipitator

There are many kinds of centrifuges. Except for the following types, it should be shown according to actual shape.

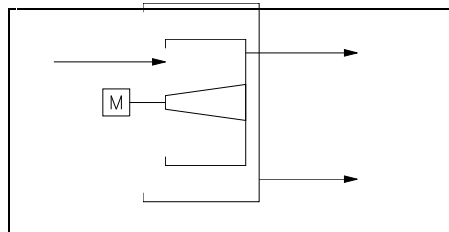
	PROCESS DESIGN MANUAL	SPD0049ERN
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a) Basket Type Centrifuge

(i) Vertical Type

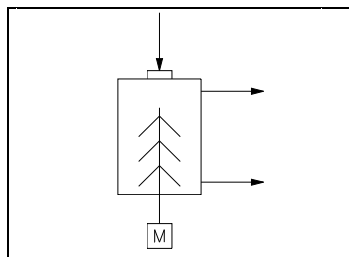


(ii) Horizontal Type

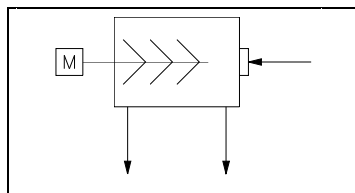


b) Disk Type Centrifuge

(i) Vertical Type



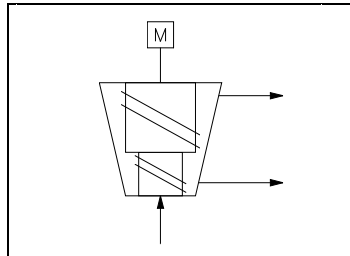
(ii) Horizontal Type



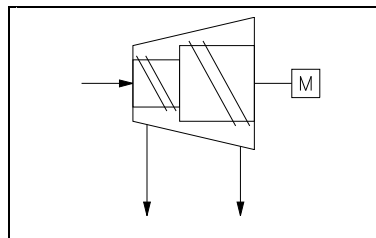
c) Solid Bowl Type Centrifuge

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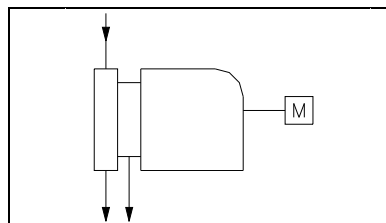
(i) Vertical type



(ii) Horizontal type



d) Push Basket Type Centrifuge



Note: Specify number of motors.

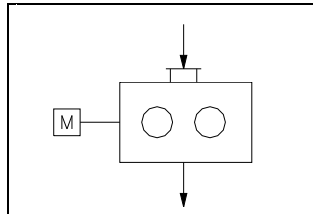
12. Crusher, Mixing equipment

In principle, it should be shown as follows:

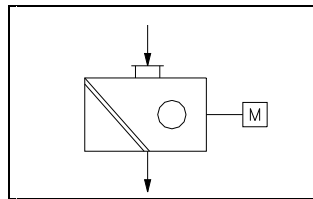
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a) Roll Crusher

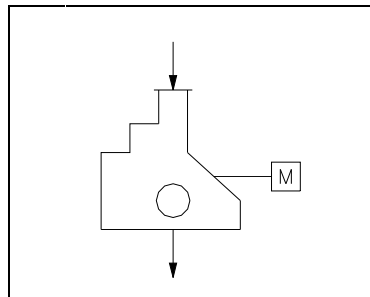
(i) Double Roll Crusher (Mill)



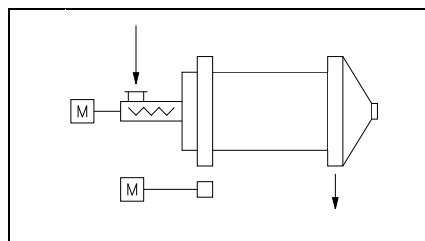
(ii) Single Roll Crusher (Mill)



b) Hammer Mill

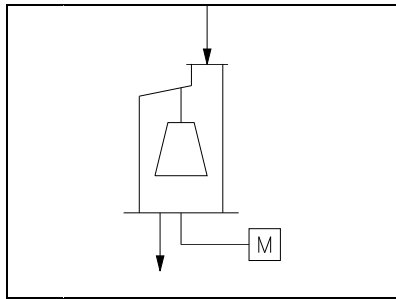


c) Ball Mill

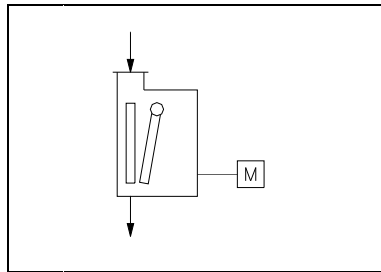


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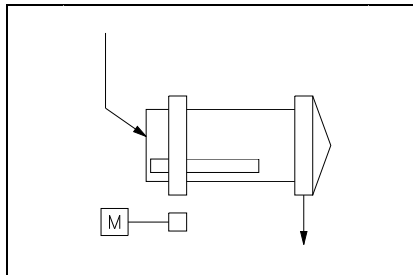
d) Gyratory Crusher, Cone Crusher



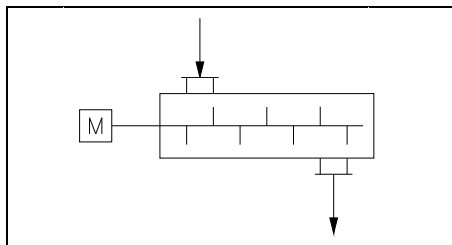
e) Jaw Crusher



f) Rod Mill



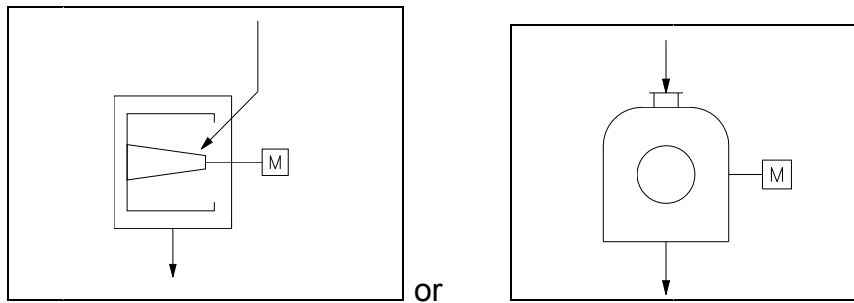
g) Pug Mill



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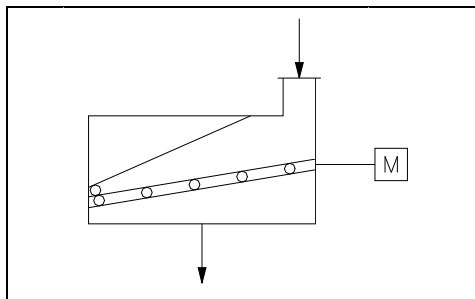
Note: In case of two axes, show both.

h) Disintegrator

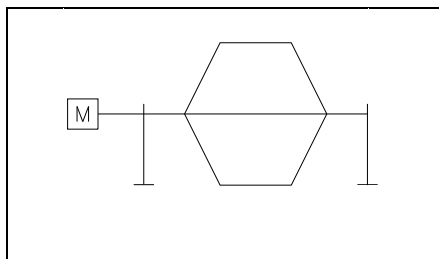


Note: In case of two motors, write down that type.

i) Urea Crusher

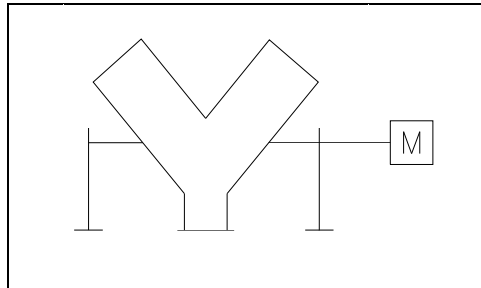


j) Double Cone Mixer

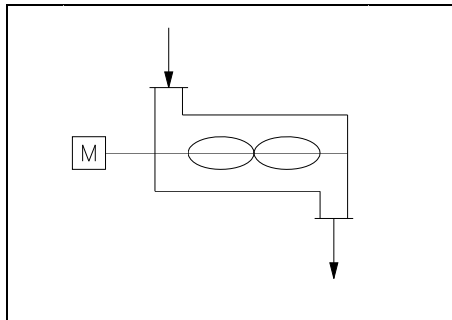


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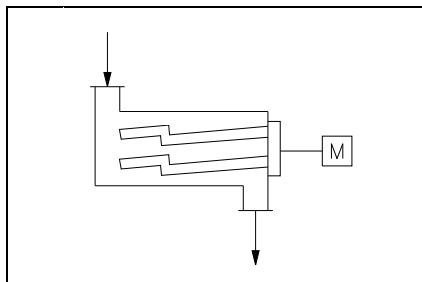
k) V-Mixer



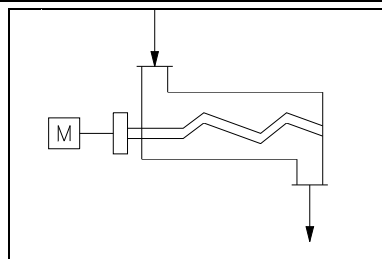
l) Ribbon Mixer



m) Kneader Mixer



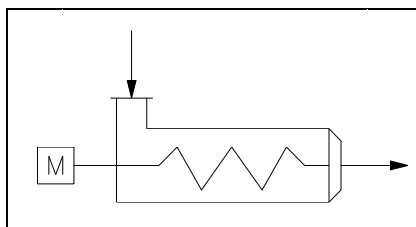
or



Note: In case of shape of the two rotating axis is different, draw its shape and add some equipment attached with jacket.

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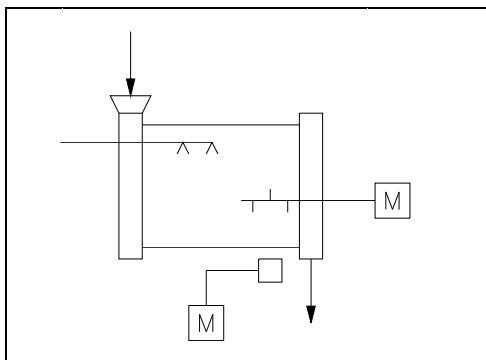
n) Screw Extruder



Note: In case jacket exists, draw its shape and show the in/out of utility line.

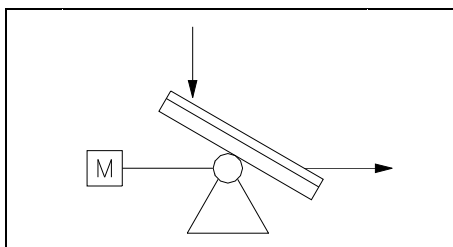
13. Granulator (Pelletizer)

a) Drum Granulator (Drum Pelletizer)



Note: In case where a hot air blower is connected, show that line.

b) Pan Granulator (Pan Pelletizer)

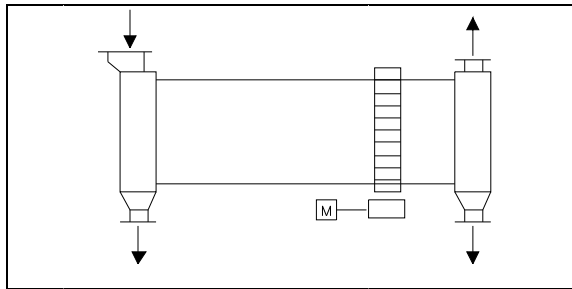


14. Solid drying and cooling device

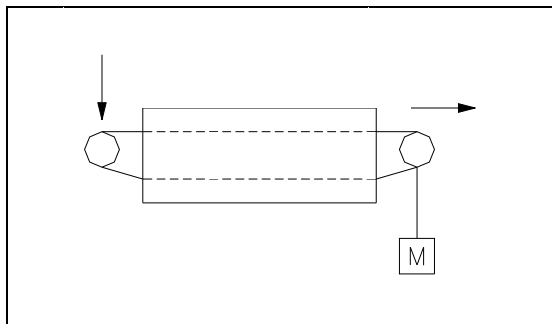
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There are various types of drying devices such as draft, spray, rotating, fluidization bed etc. Therefore, it needs to be shown as closely as to the real figure. Refer to the following examples:

a) Rotary Dryer (Rotary Cooler)

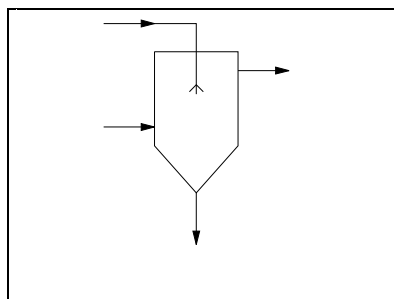


b) Band Dryer (Band Cooler)



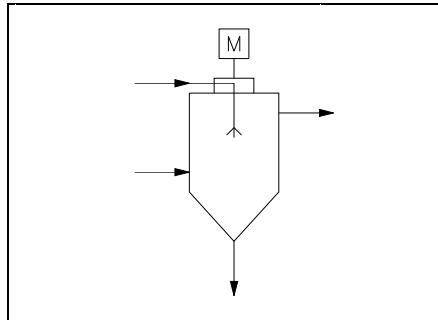
c) Spray-Dryer

(i) Nozzle type



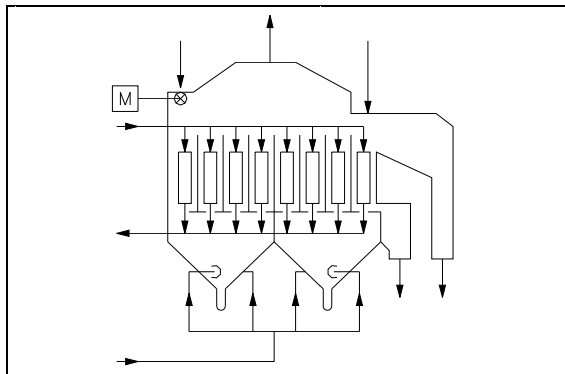
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(ii) Disk type

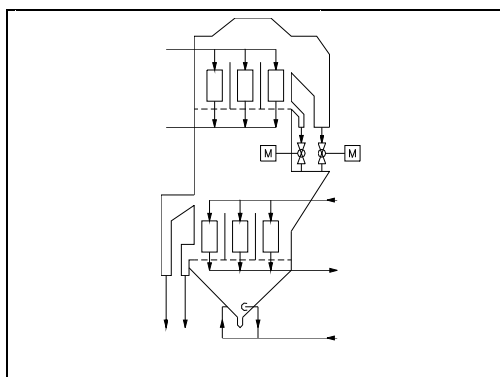


d) Fluidized dryer

(i) Parallel multi cell 1 stage type

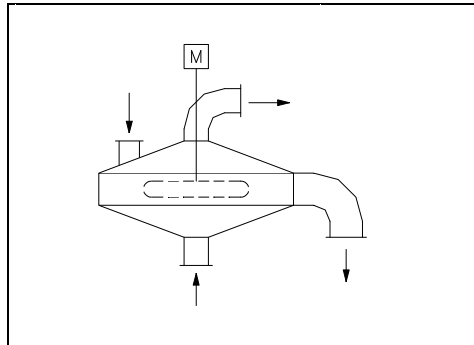


(ii) Parallel multi cell 2 stage type



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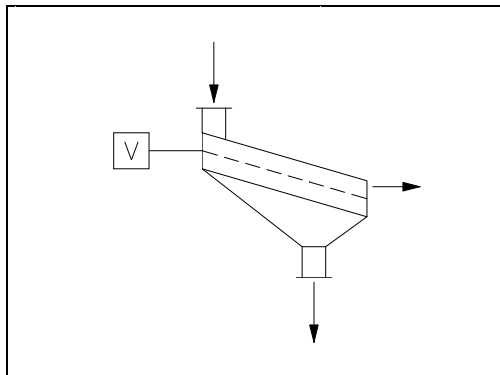
(iii) Fluidizing Bed Cooler



15. Screen

a) Vibrating Screen

(i) Single Deck



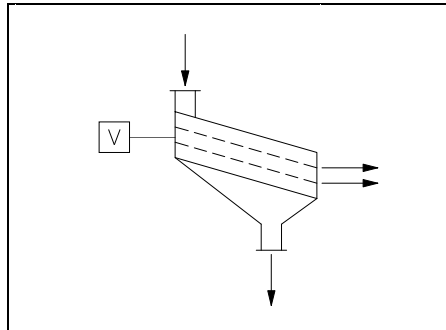
Note:

In case of vibrator is with motor driven

Use ————  instead of ———— 

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(ii) Double Deck

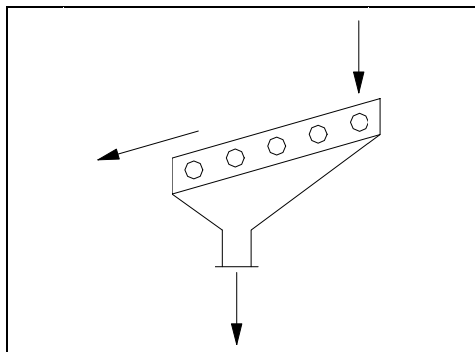


Note:

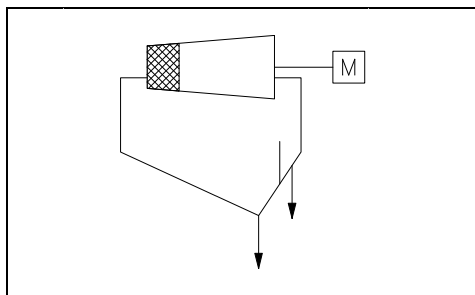
In case of vibrator is with motor driven

Use  instead of 

b) Grizzly Screen



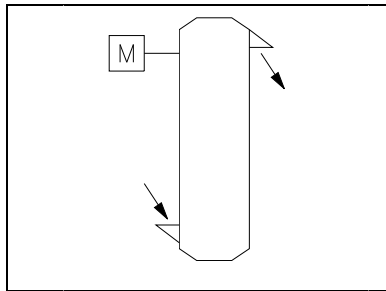
c) Trommel



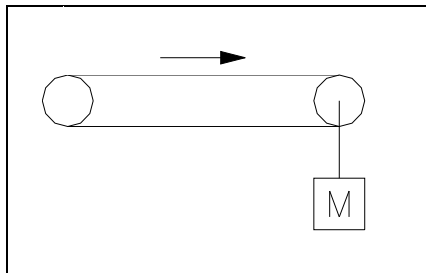
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16. Conveyor

a) Bucket Elevator

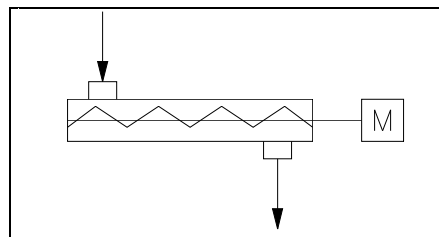


b) Belt Conveyor

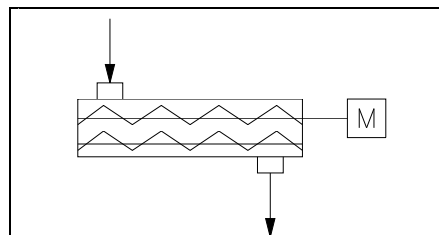


c) Screw Conveyor

(i) Single Screw



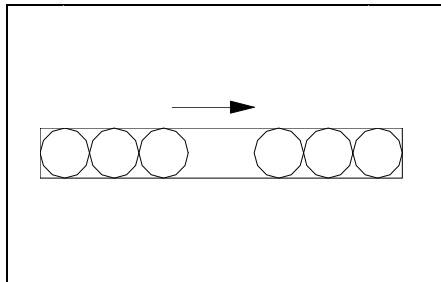
(ii) Double Screw



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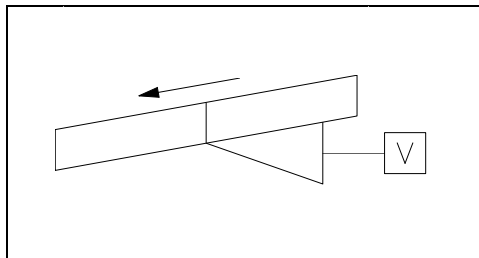
Note: In case of 2 motors, show both.

d) Roller Conveyor



Note: In case of Motor driven, show ————  .

e) Vibrating Conveyor



Note:

In case of vibrator is with motor driven,

Show ————  instead of ————  ,

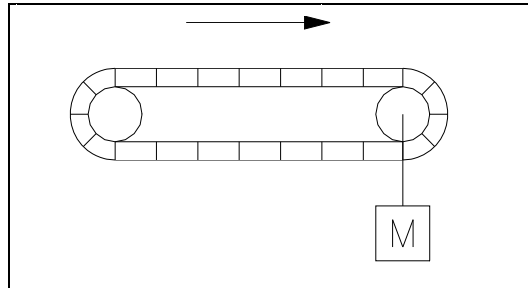
f) Chain Conveyor

(i) Slat Conveyor

(ii) Apron Conveyor

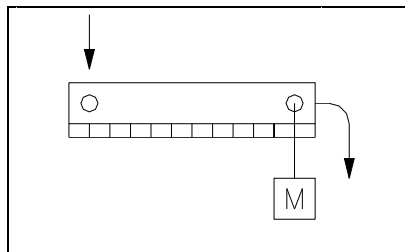
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(iii) Pan Conveyor

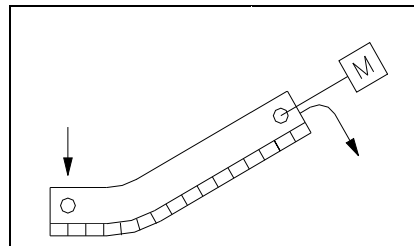


Note: Revise properly according to the type of conveyor.

(iv) Flow Conveyor



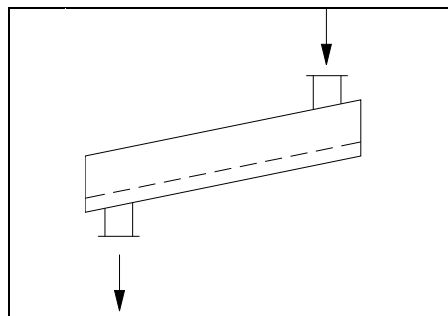
or



F type

L type

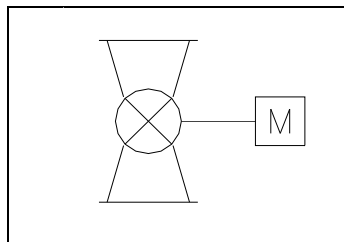
g) Air Slide Conveyor



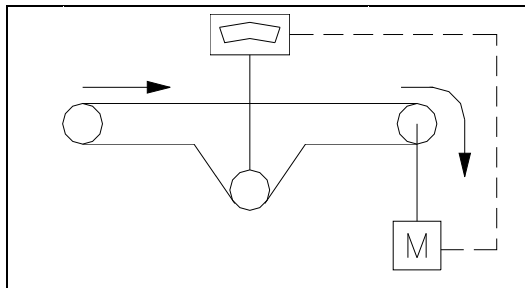
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17. Feeder

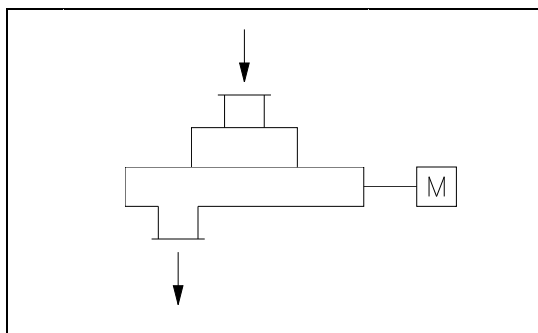
a) Rotary Valve (Feeder)



b) Constant Feeder



c) Table Feeder



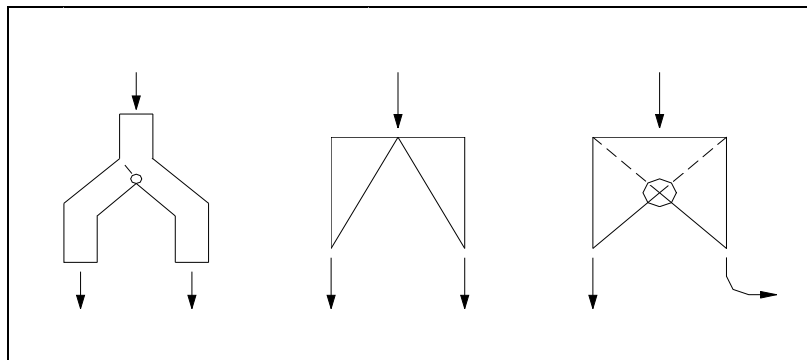
d) Vibrating Feeder

It is same as Section 7.3.1.16.e

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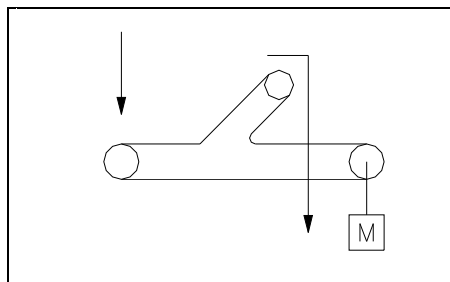
18. Chute, Scraper, Tripper

a) Dividing Chute

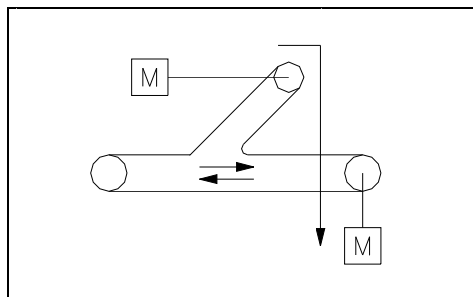


b) Tripper

(i) Fixed type



(ii) Movable type

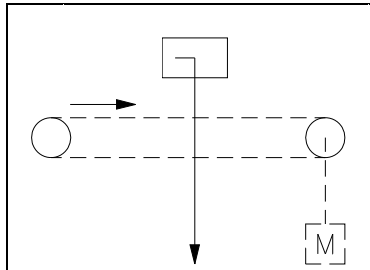


Note:

In case of other type of drivers, ————  needs to be revised to other driver's symbol.

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c) Scraper

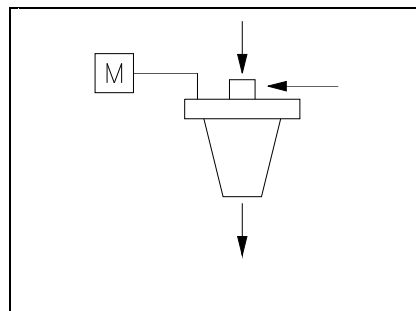


19. Bagging machine, measuring machine

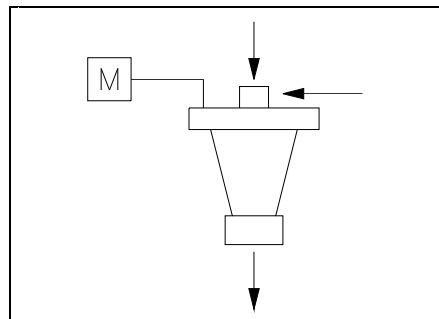
a) Packer Scale

Bagging Machine

(i) Manual type



(ii) Automatic type

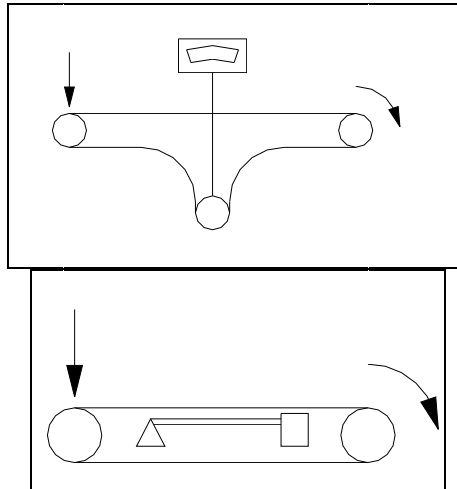


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b) Belt Scale

•

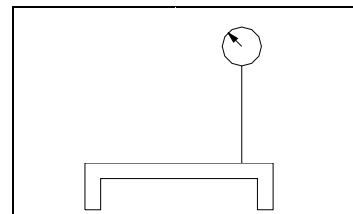
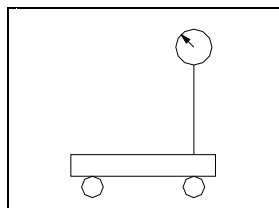
Belt Weigher



c) Weight Scale

(i) Weighing scale with support

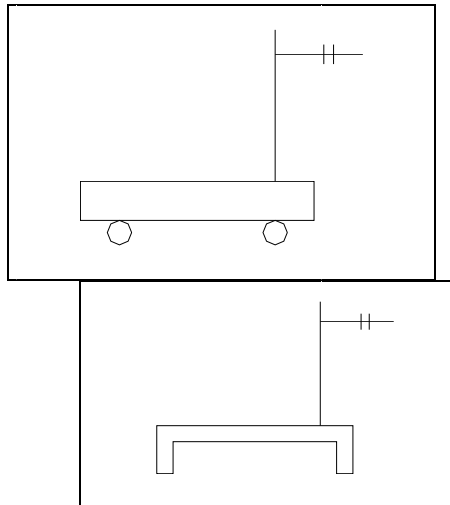
(ii) Gauge, sloped automatic type



(Portable type) (Fixed type)

Scale with weight type suspension

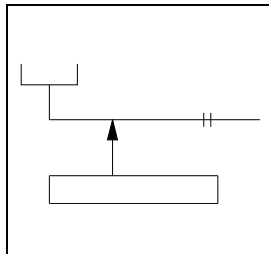
	PROCESS DESIGN MANUAL	SPD0049ERN REV.: <u>3</u>
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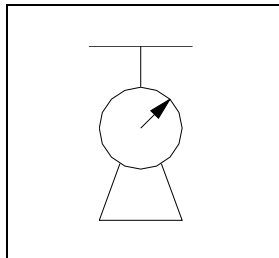
(Portable type) (Fixed type)

(iii) Platform balance

Counterweight

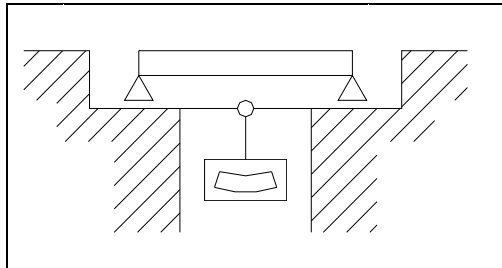


Platform balance with gauge

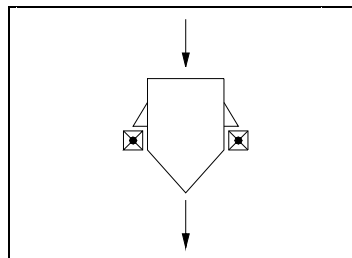


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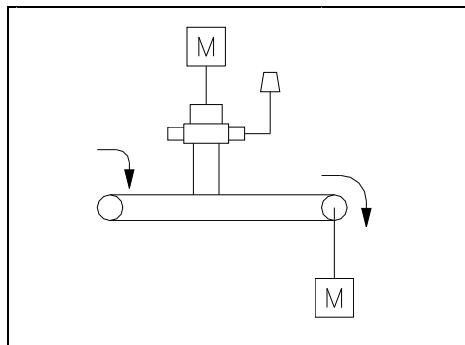
d) Car (Truck, Forklift) Scale



(i) Hopper Scale (Load Cell)

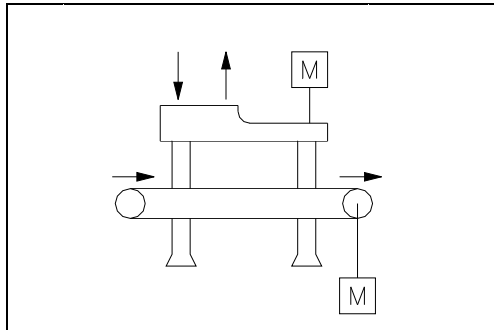


(ii) Sewing Machine

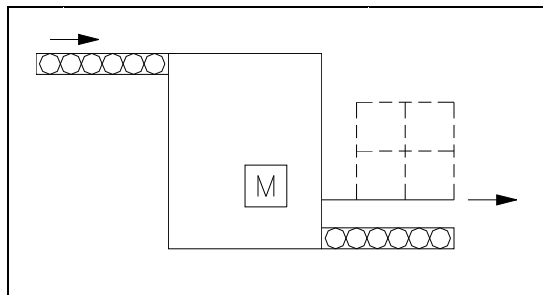


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e) Heat Sealer

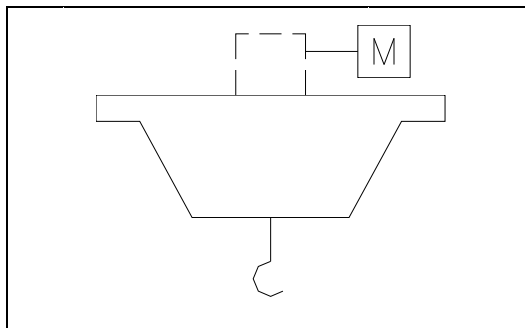


f) Pelletizer



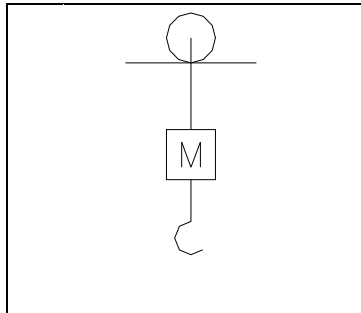
20. Hoist or Winch

a) Overhead Crane



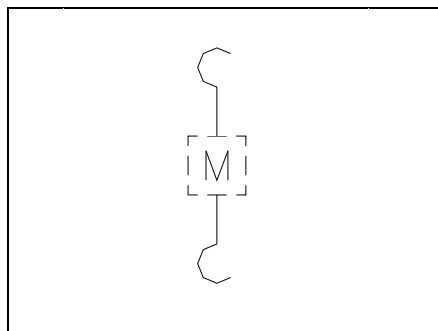
	PROCESS DESIGN MANUAL	SPD0049ERN
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b) Travelling Hoist

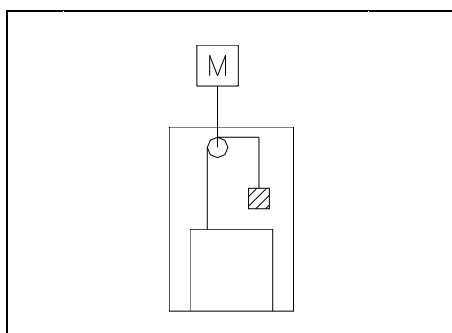


c) Fixed Hoist

Chain Block



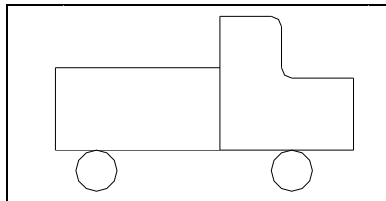
d) Elevator or Dumb Weigher



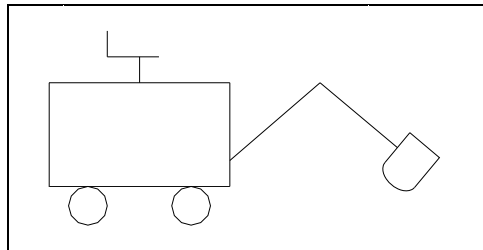
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21. Transportation and tool

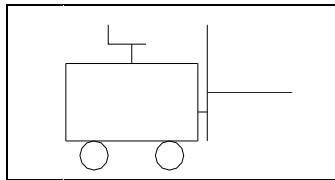
a) Truck



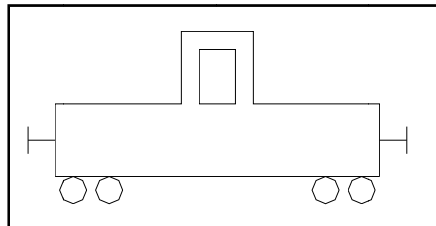
b) Shovel Loader



c) Fork Lift

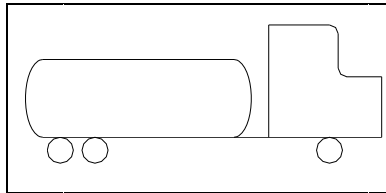


d) Diesel Locomotive

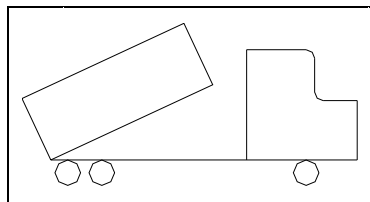


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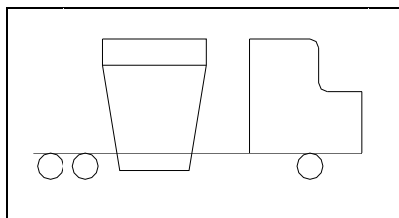
e) Tank Lorry (& Vacuum Car)



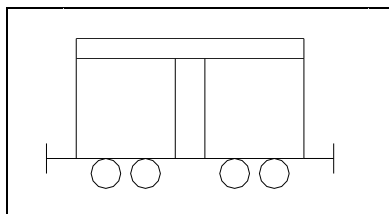
f) Dump Truck



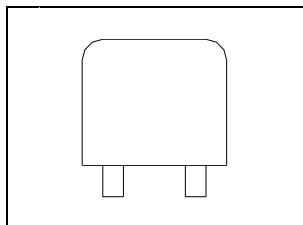
g) Hopper Truck



h) Covered Wagon

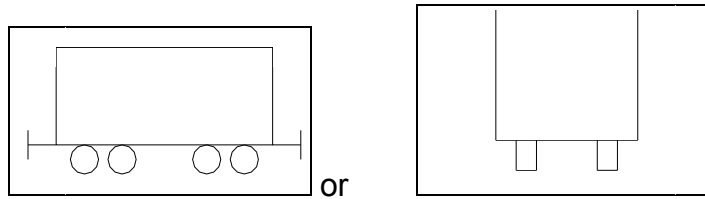


or

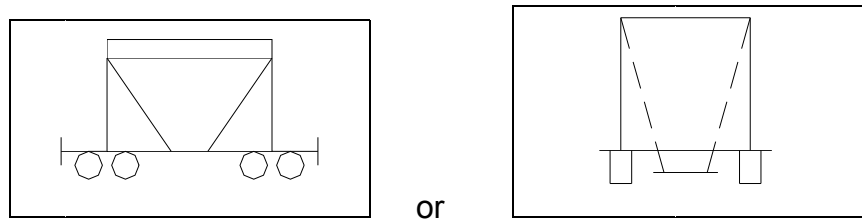


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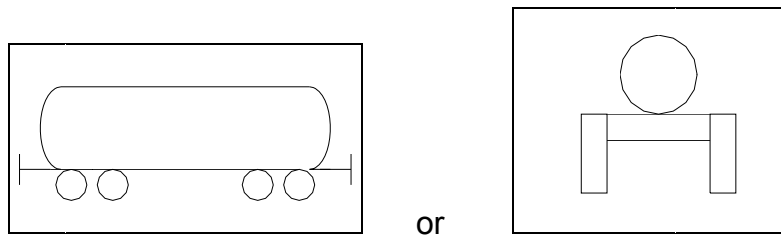
i) Open Wagon



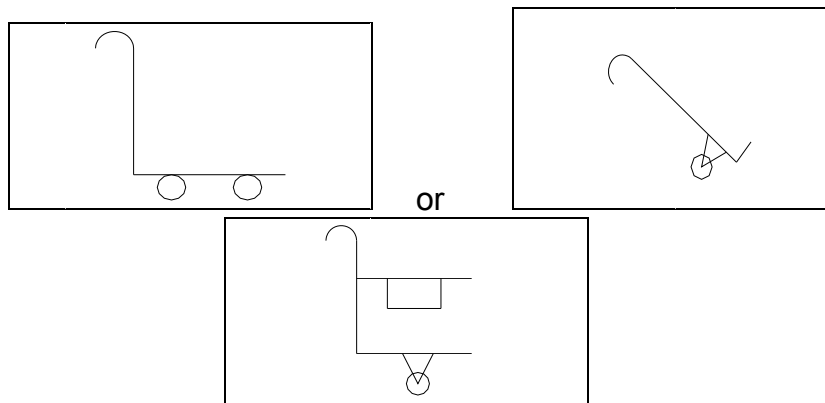
j) Hopper Wagon



k) Tank Car, Tank lorry



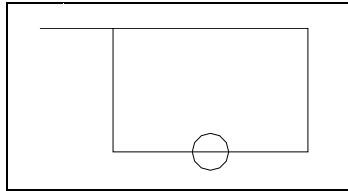
l) Hand Cart



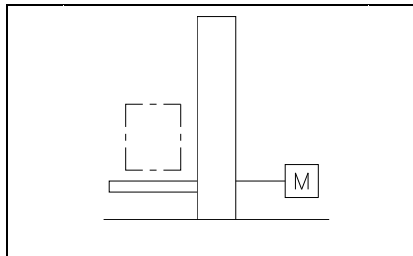
(Sing wheel cart) (Drum Porter or Drum Carrier)

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Rear Car



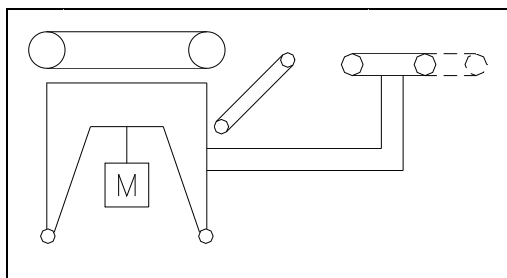
m) Drum Lifter



22. Unloading facility

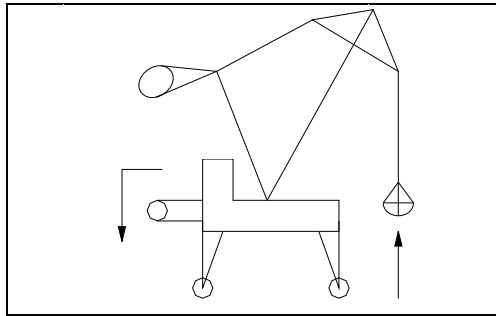
Describe the number of motor.

a) Wagon Loader



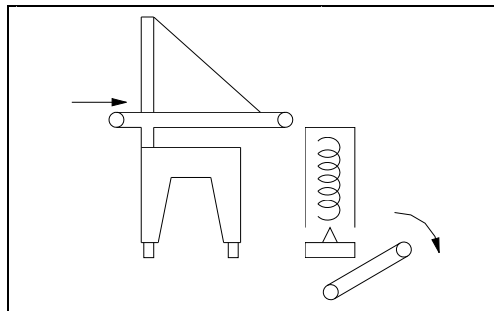
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b) Ship Unloader (Bulk)

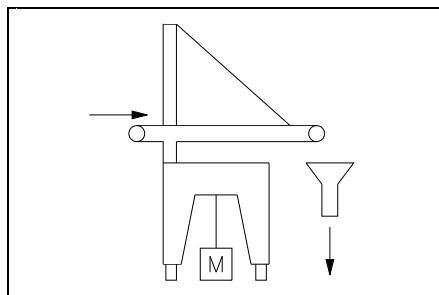


c) Ship Loader

(i) For Bag

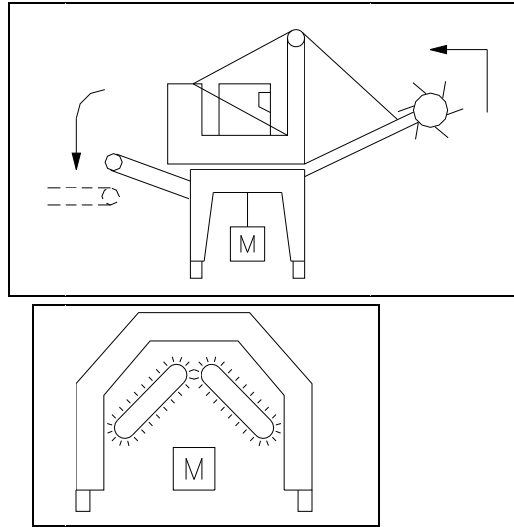


(ii) For Bulk



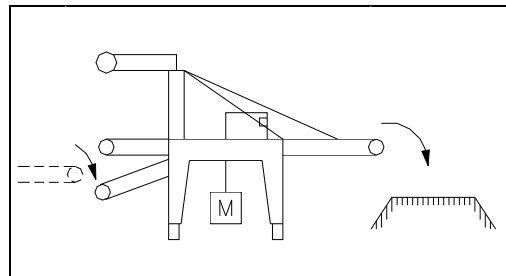
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d) Reclaimer



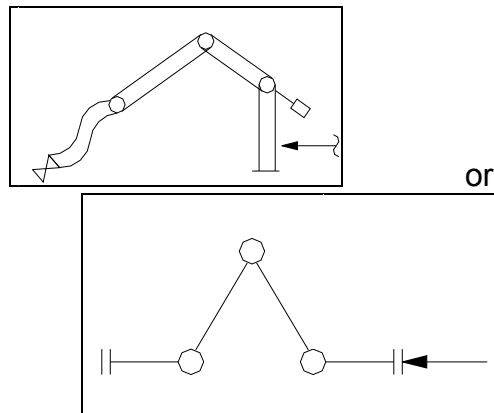
or

e) Stacker



f) Loading Arm

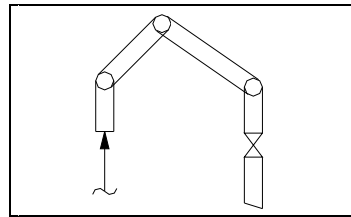
(i) For Ship



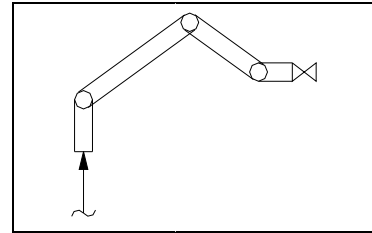
or

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(ii) For Tank Lorry & Car



or

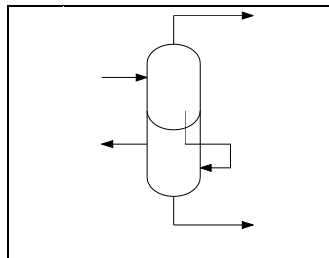


(Top Loading)

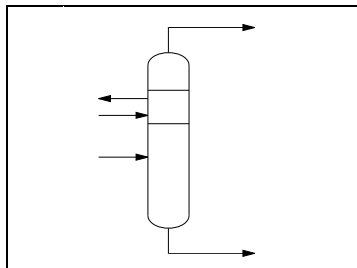
(Bottom)

23. Complex equipment

a) 2 Stage Vessel

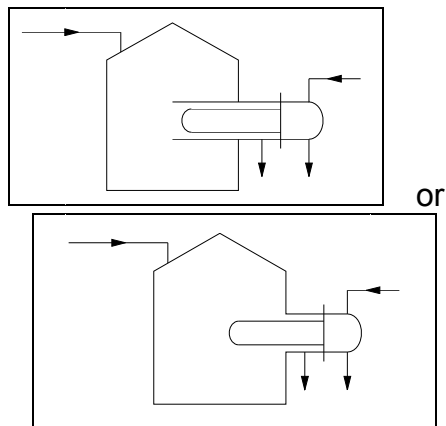


b) Internal Condenser Tower

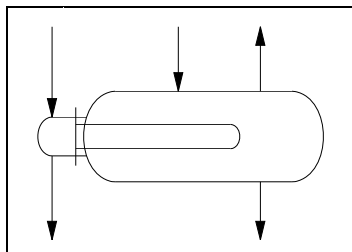


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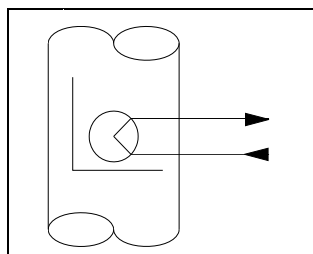
c) Tank including heater or cooler



d) Vessel including Heater or Cooler



e) Internal Reboiler Tower



f) Combined Air Cooled Heat Exchanger

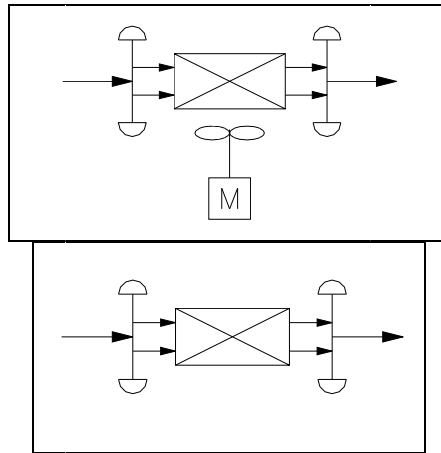
More than two are connected (Fan is common)

EA - 201 EA - 501

1st Condenser 2nd Condenser

(Combined with EA-501) (Combined with EA-201)

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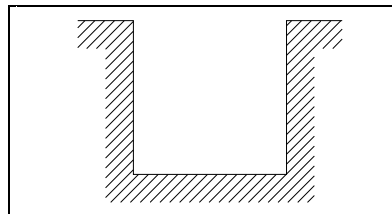
g) Others

For the equipment that has special shape, draw appropriate symbol closely looking like the equipment shape.

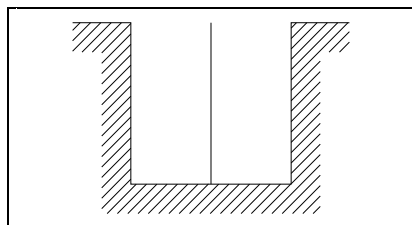
24. Others

a) Pit

(i) No Partition exists

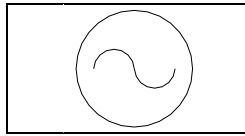


(ii) Partition exists



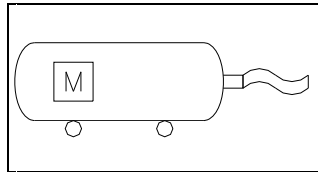
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b) Electric Power Generator

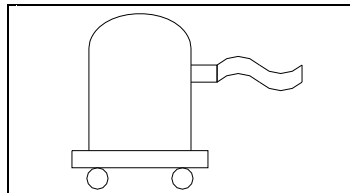


c) Vacuum cleaner

(i) Horizontal

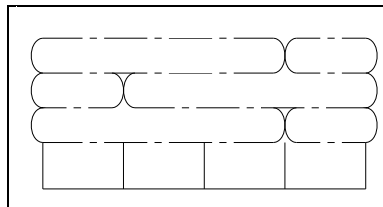


(ii) Vertical

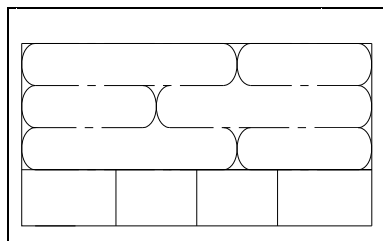


d) Pallet

(i) Plate Pallet



(ii) Box type Pallet



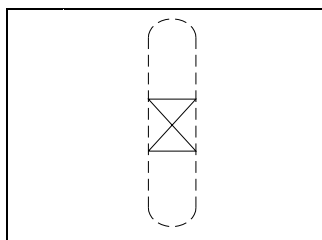
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e) For the equipment that has special shape, draw appropriate symbol closely looking like the equipment shape.

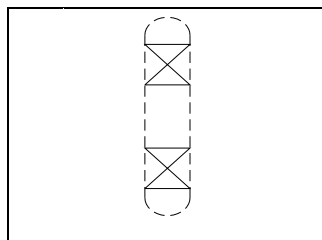
8.3.2. Internal parts of Equipment

1. Fixed type (packing bed)

a) 1 bed

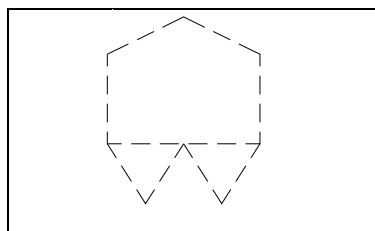


b) Multiple bed (ex. 2 bed)



2. Fluidized type

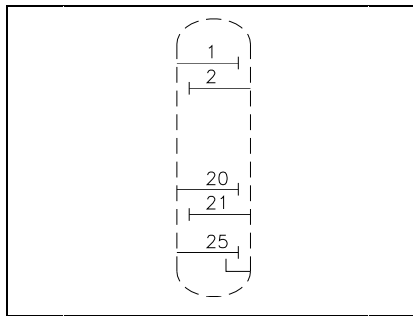
If it is same as liquid phase, it does not need to be described. The distributor is as follows.



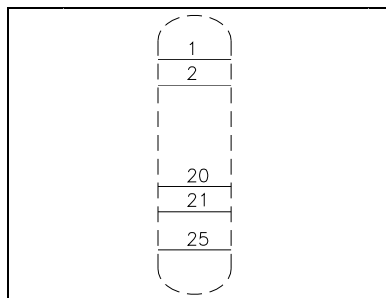
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3. Tray

a) Down-comer Tray

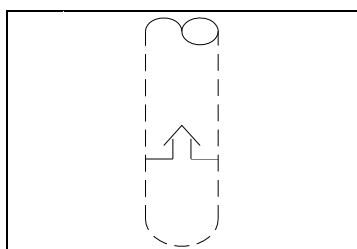


b) Non Down-Comer Tray

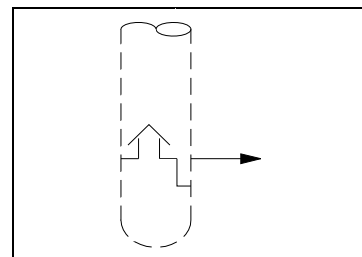


Note: The Tray number shall be assigned to the top tray, bottom tray, instrument installed tray, liquid supplied or discharged tray. Tray number shall be assigned from top to bottom 1, 2, ---, etc.

c) Chimney Tray



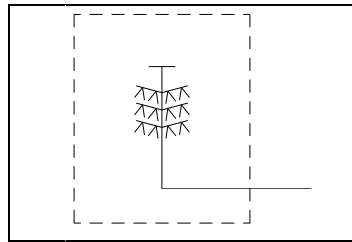
or



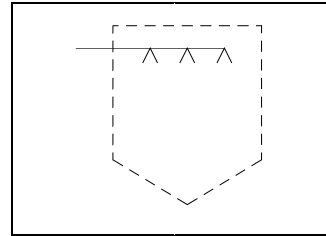
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4. Spray

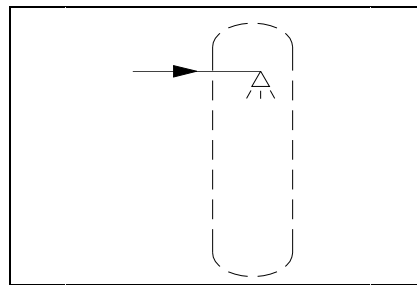
a) Spray pipe



or



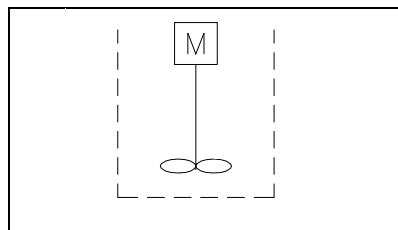
b) Spray Nozzle



5. Mixer

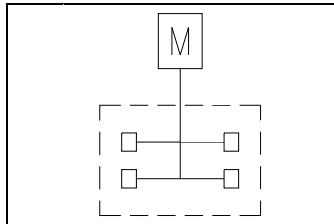
There are various types of impellers. Typical types are given in this section. Other than these, appropriate symbol has to be selected based on the shape. Number of stages shall be described exactly.

a) Propeller type (ex. 1 stage)

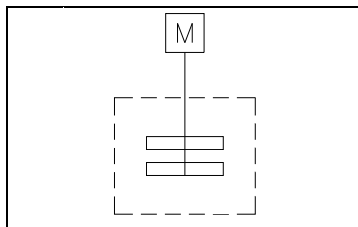


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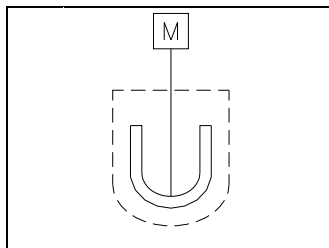
b) Turbine type (ex. 2 stage)



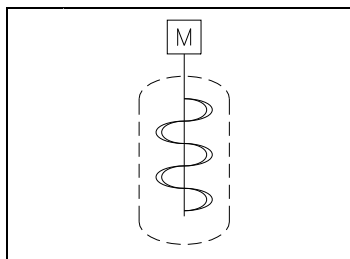
c) Paddle type (ex. 2 stage)



d) Anchor Type



e) Helical Type



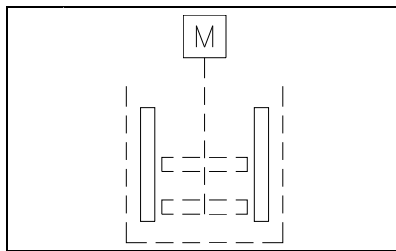
f) Others

For the equipment that has special shape, draw appropriate symbol closely looking like the equipment shape.

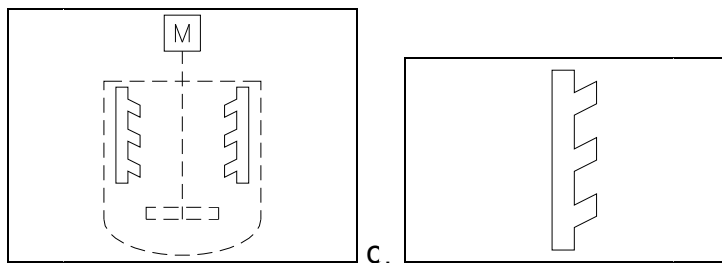
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6. Baffle

a) Common type

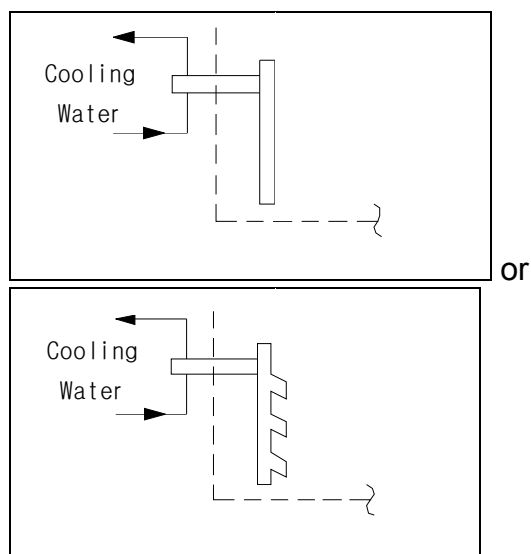


b) Finger Type



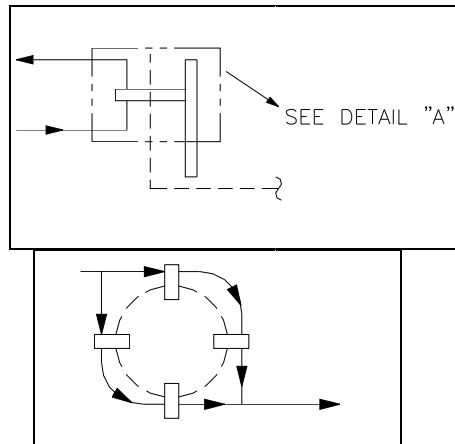
c) Cooling Baffle

Cooling water passes through internal of type (a) and (b) as follows.



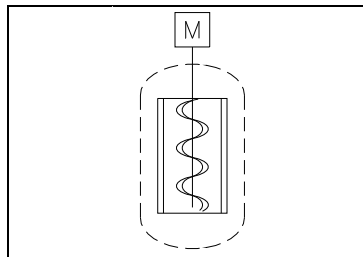
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Of many baffles, cooling baffle is described as follows.



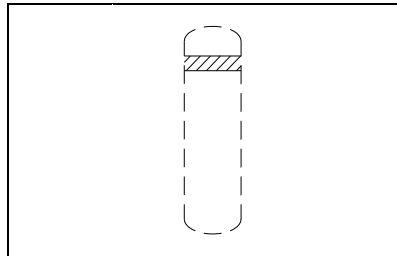
DETAIL "A" cooling water

7. Draft Tube

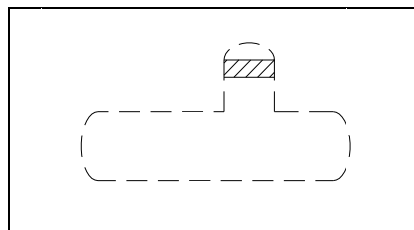


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8. De-mister

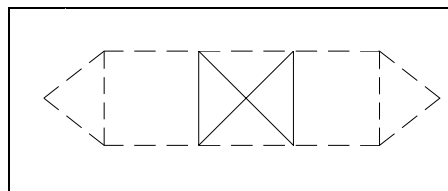


or



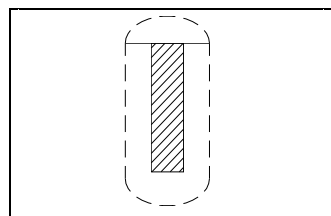
9. Filter Element

a) Plate type



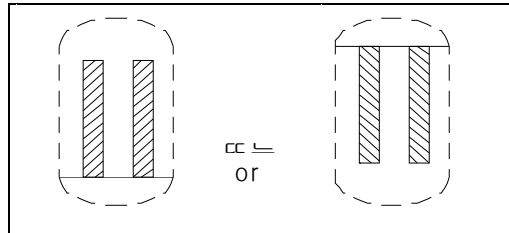
b) Cartridge Type

(i) Single Cartridge

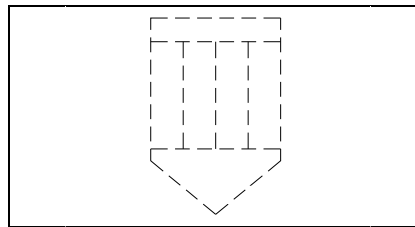


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(ii) Multi Cartridge



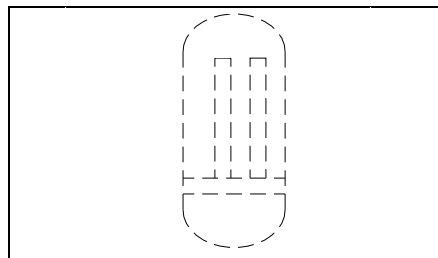
c) Bag Type



d) Packing Type

Refer to paragraph 7.3.2. (1) P.78

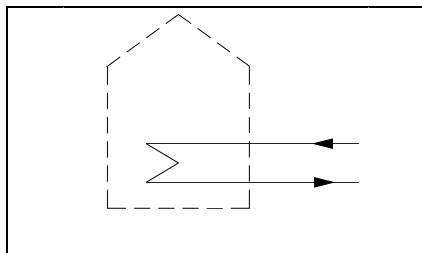
e) Leaf Type



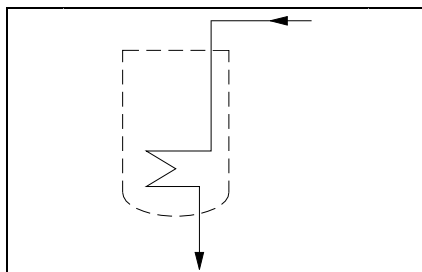
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10. Coil

a) In case that Nozzle is Horizontal



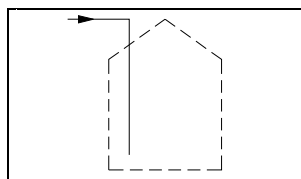
b) In case that Nozzle is Vertical



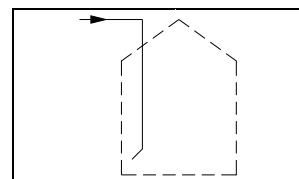
11. Inlet Nozzle

a) Connected into Bottom

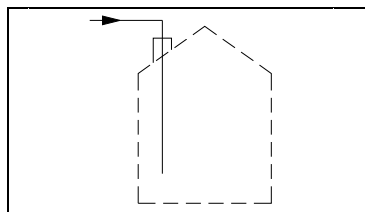
(i) Welding with tank itself



or

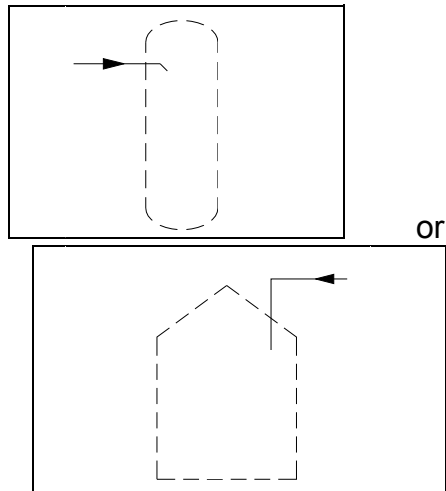


(ii) Double Nozzle (Inner/Outer)



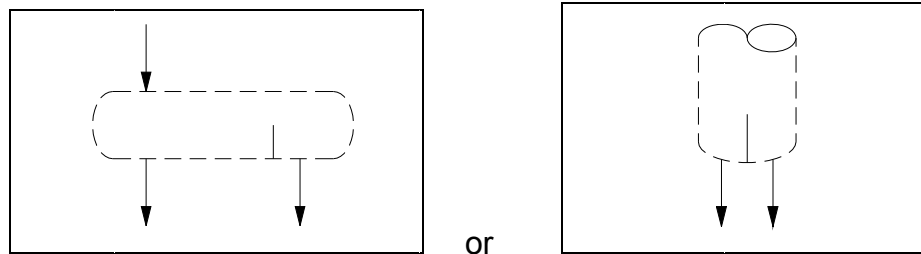
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b) Short pipe is injected into internal



12. Internal Baffle

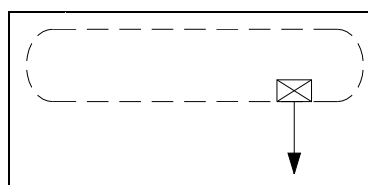
In general, description is for tank or vessel only, not for exchanger.



13. Vortex-Breaker

This is shown in (a). But, (b) and (c) may be used at client/licensor request, etc.

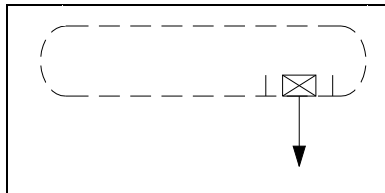
a) Attached above Liquid Outlet Nozzle



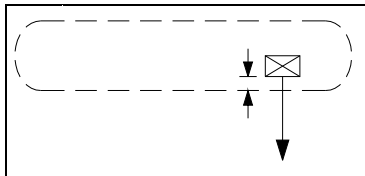
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b) Attached above Liquid Outlet Nozzle

Baffle is installed to prevent solid entering the nozzle.

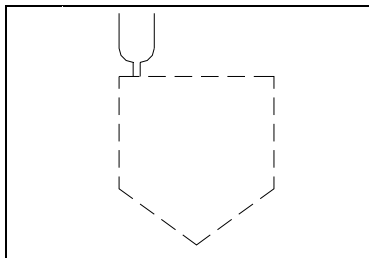


c) Attached above Projection Nozzle

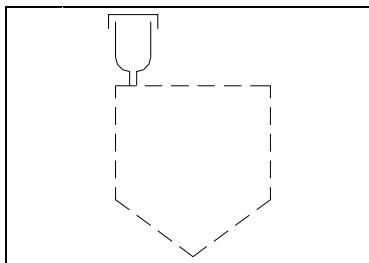


14. Feeding Hopper

a) Open



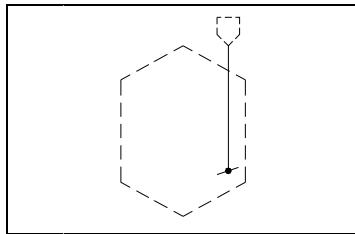
b) Cover



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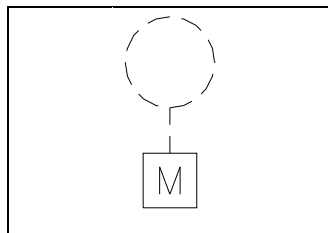
15. Others

a) Trickle Valve



8.3.3. Driver

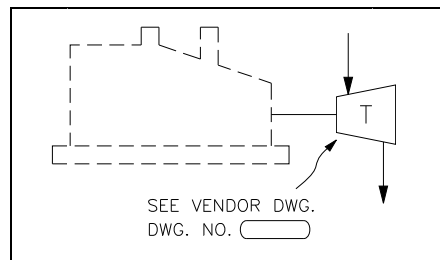
1. Motor



2. Steam-Turbine

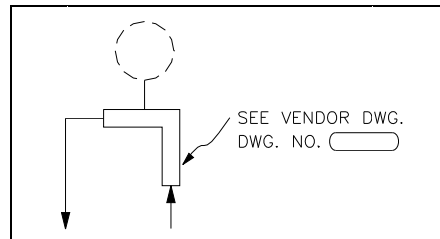
In general, it is shown as (a). When it needs to be specially classified, it could also be shown as (b).

a) For Large, Compressor

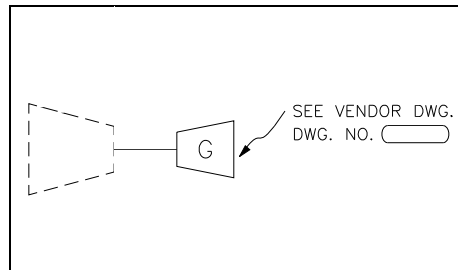


	PROCESS DESIGN MANUAL	SPD0049ERN
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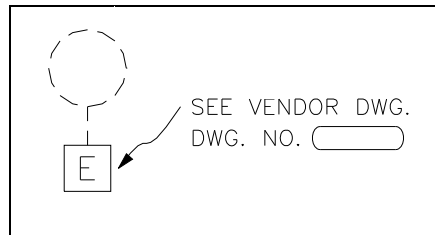
b) For Small, Pump



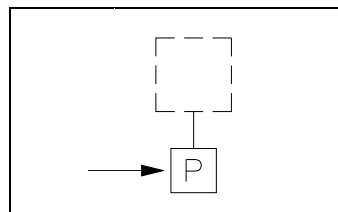
3. Gas-Turbine



4. Diesel or Gas Engine

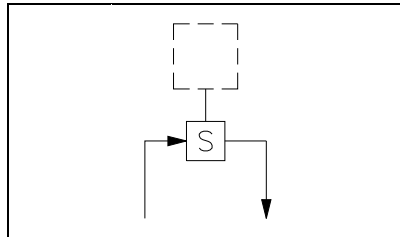


5. Air (ex. Pneumatic Pump)

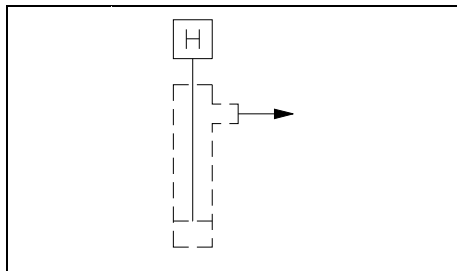


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6. Steam driven

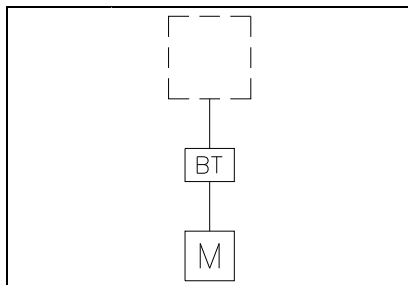


7. Manual (ex. Pump)



Note: Turbine and engine information can be found on Vendor P&ID because it is for vendor's package. The scope of package shall be determined at job start. Regarding other equipment, instrument and piping, it needs to be described in SECL's P&ID and UFD.

8. Motor Belt



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8.3.4. Piping, Connection, Valve, Pipe End Figure, etc

1. Piping

a) Piping (Refer to Section 7.1 for identification of line)

b) Jacketed Line

—  —

c) Underground or Buried

— B — B —

d) Steam Traced

=====

e) Electrically Traced

— E — E —

f) Hot Water Traced

=====

g) Sloped Line (degree of slope should be written when necessary in the process point of view)

 _____

h) Crossed Line

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i) Crossing Not Connecting



j) Obstructed Line



k) Continuity Arrow



l) Starting point of Process Main Line in P & ID



m) Rubber hose

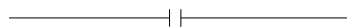


2. Connection, etc

a) Reducer



b) Flange Connection

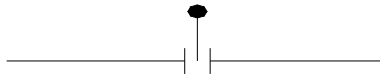


c) Removable Spool Piece

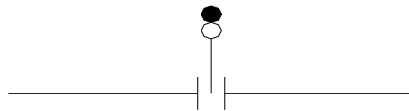


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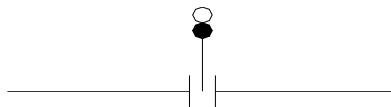
d) Line Blind



e) Reversible or figure 8 Blind (Normally Open)



f) Reversible or figure 8 Blind (Normally Close)



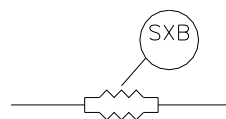
g) Venturi Flow Nozzle



h) Flexible Hose (Rubber, Vinyl, Stainless material)



i) Expansion Joint (Bellows type)

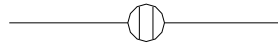


j) Ball, Swivel, Universal Joint, etc



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k) Victaulic Joint



l) Union Joint

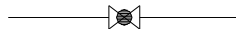


3. Valve

a) Gate Valve



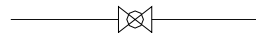
b) Globe Valve



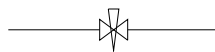
c) Slide-Gate Valve



d) Ball Valve

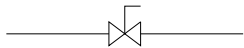


e) (V Ball Valve)



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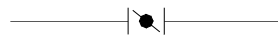
f) Cock or Plug Valve



g) Needle Valve



h) Butterfly Valve



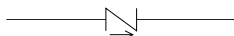
i) Flush Bottom Valve



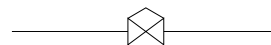
j) Diaphragm Valve



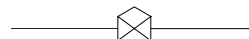
k) Check Valve



l) Foot Valve With Strainer



m) Vacuum Valve (for High Vacuum)

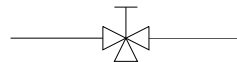


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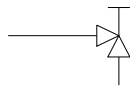
n) High pressure (Balance type) Valve



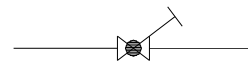
o) Three-Way Valve



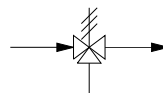
p) Angle Valve



q) Y type Valve



r) Breather Valve



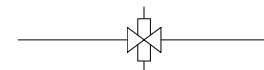
s) Damper



t) Pinch Valve



u) Jacket Valve

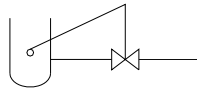


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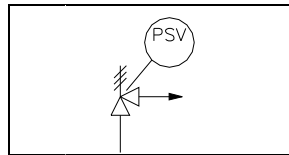
v) Velocity Control Valve



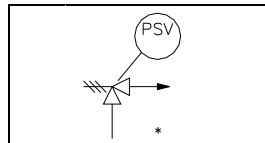
w) Regulator With Mechanical Link



x) Safety Relief Valve

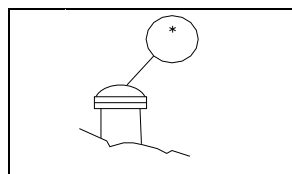


y) Vacuum Relief Valve



z) *PSV - Pressure Relieving Manway

* PVSV - Pressure / Vacuum Relieving Manway

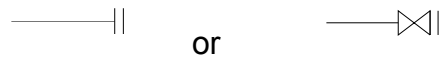


Note: Special valve symbols for stop-check valve, expansion-gate valve, quick-opening valve, vent valve, etc. must be determined based on the discussion with other design departments.

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4. Pipe End Figure

a) Blind Flange



b) Butt weld Cap



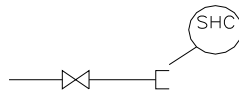
c) Screwed Cap



d) Pipe Plug



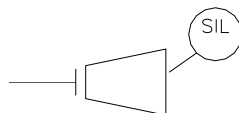
e) Hose-Connection



f) Quick-Coupling (Male) Quick-Coupling (Female)

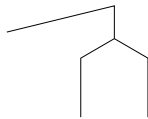


g) Silencer



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h) Hood



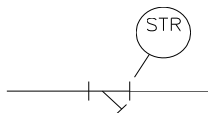
i) Cover to prevent entering of rainy water



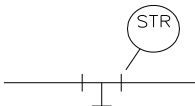
8.3.5. Equipment Installation in Piping System

1. Strainer

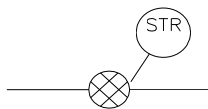
a) Y-Strainer



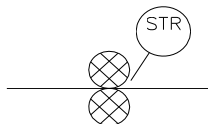
b) T-Strainer



c) Other Type Strainer

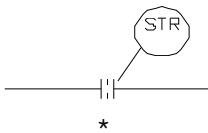


d) Duplex Strainer

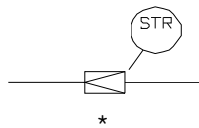


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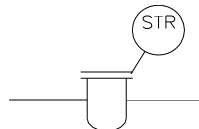
e) Flat Strainer (*.TS If Temporary)



f) Conical Strainer (*.TS If Temporary)

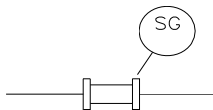


g) Bucket Type Strainer



2. Sight-Glass

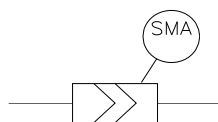
a) Sight Glass (Looking Glass)



b) Body Sight Glass

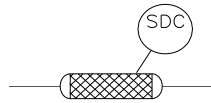


3. Flame-Arrester



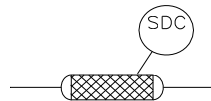
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4. Drying agent

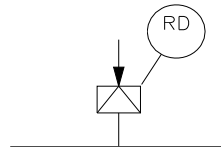


5. Rupture Disk

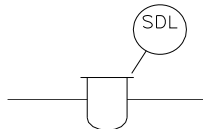
a) Pressure Relief Rupture Disk



b) Vacuum Relief Rupture Disk

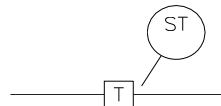


6. Oiler



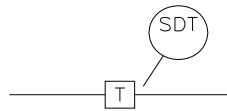
7. Trap

a) Steam Trap & Condensate Drainer

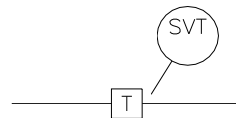


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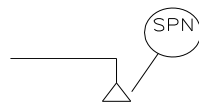
b) Air Trap & Drainer



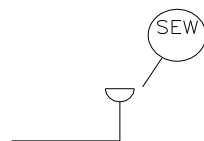
c) Vacuum Trap



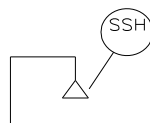
8. Spray Nozzle



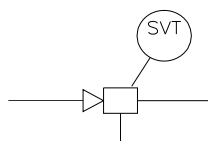
9. Eye Wash



10. Shower

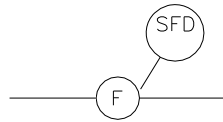


11. Mixer



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12. In-Line Filter



8.3.6. Insulation

For insulation symbols, see also Section 7.4.3.

1. Piping Insulation

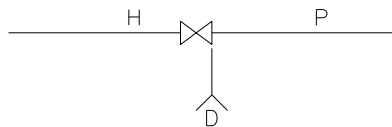
a) Insulation code

It should be marked at the end of Line number.

4-P-4032-AIA-H

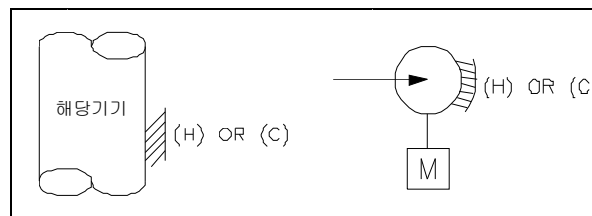
4-P-4032-AIA-C

b) Insulation area and identification

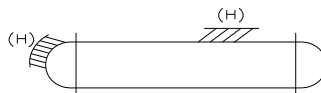


2. Equipment Insulation

a) Show the insulation symbol on equipment and write down the type of insulation as shown below:



b) For Exchanger, mark the shell and tube type.



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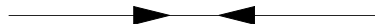
Note: Refer to Section 8.4.3 for insulation symbols.

8.3.7. Flow Direction

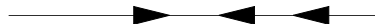
1. One Side Flow



2. Both Side Flow



3. Both Side Flow



Note: show the main flow direction by



8.3.8. Spec. Break and Design Break

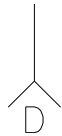
In principle, it is better to use a Spec. Break. But, use a Design Break in case that detail border line needs to be shown.

1. Spec. Break (mark on the border when class symbol is different)



2. Design Break (Even if class symbol is same, use design break on the border in case that fluid symbol, design temperature, design pressure and insulation necessity are different).

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8.3.9. Sewer Type

1. Storm Sewer



2. Oily Sewer



3. Chemical Sewer



4. Process Sewer



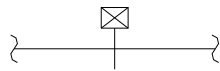
5. Sewer (when necessary, use * with appropriate symbol according to the job specific requirements)



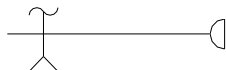
8.3.10. Miscellaneous Symbol

1. Vortex Breaker

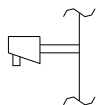
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2. Steam Injection Silencer



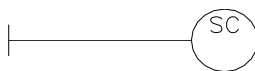
3. Air Foam Chamber



4. Sampling Connection



5. Sampling Connection with Sample Cooler



6. Hose Station

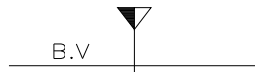


7. Battery Limits

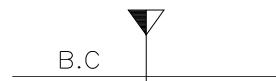


8. By Vendor

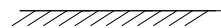
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9. By Customer

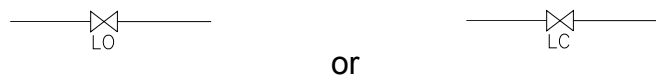


10. Grade



11. Locked Open (or Closed)

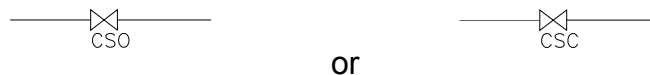
Valve Stem is locked open or closed by key



or

12. Car Sealed Open (or Closed)

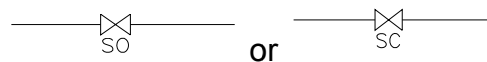
(Valve Handle is fixed with chain)



or

13. Sealed Open (or Closed)

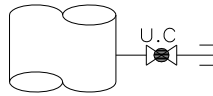
(Valve is painted to draw attention)



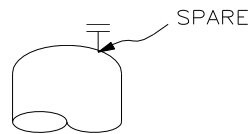
or

14. Utility Connection (cap or bull plug)

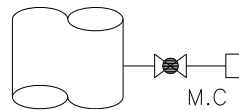
	PROCESS DESIGN MANUAL	SPD0049ERN
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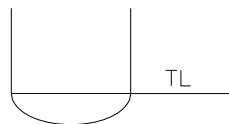
15. Spare Nozzle



16. Manometer Connection



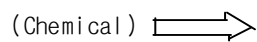
17. Equipment's Tangential Line



18. Electro static bonding (grounding) of piping (In principle, it is not shown. But use this symbol in case of licensor/client request)



19. This is a symbol for chemical loading by hand. Put the chemical name in parenthesis.



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8.3.11. Instrument symbol

1. Basic composition

The Instrument symbol is represented by a balloon with abbreviation letters for variable and function and instrument number inscribed. It is used to show instrument gauge or loop by showing variable and function. It consists of "letter symbol" and "instrument gauge number". These can be shown with "figure symbol" in P&ID and UFD. Instrument symbol and numbering system shall follow ISA convention.

2. Instrumentation Method

a) The instrument symbol is as follows:

Letter Symbol	Instrument Number
- <u>F</u> <u>IC</u>	<u>1 0 5</u> <u>A</u>
(i) (ii)	(iii) (iv)

The above examples show flow rate recording controller attached with alarm.

i. First Letter

It is an abbreviation of the variable to be measured. For instance, flow rate is represented by the letter F, pressure by the letter P and temperature by T etc. Refer to Section 7.3.11.3 (immediately below) for definition.

ii. Second Letter

It is an abbreviation of the function according to the symbology given in Section 7.3.11.3 (immediately below).

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When multiple functions are represented, the letters are combined. For example, TRC represents a temperature recorder controller.

iii. Instrument number

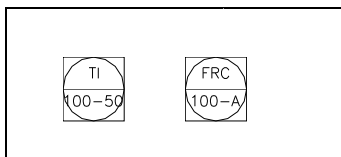
Instrument number shall be defined according to project procedure. In general, sequential number composing of 4 digit number may be used to identify instrument.

iv. Additional symbol

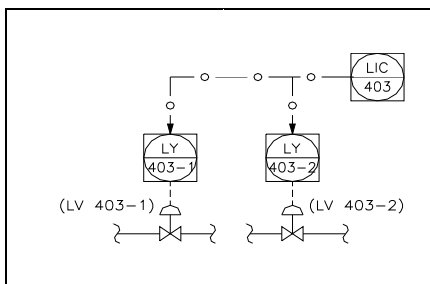
A letter is added to the end of the number when there are more than two lines or equipment with same purpose and same function. Letters A through Z are used after the same instrument number.

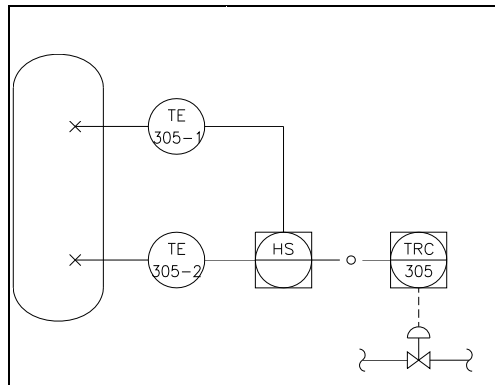
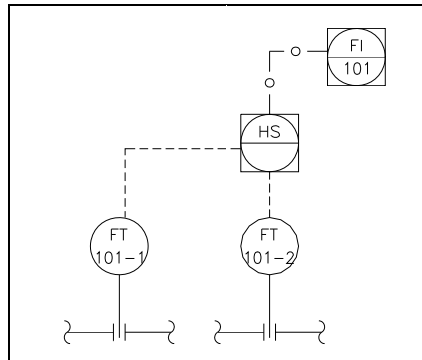
Notes:

1. Additional symbols are shown as follows:



When there are more than two of the same type of elements in the same loop and it needs to be classified, gauge symbol can be shown to each element. Example:





3. Letter Symbol

Letter symbol are provided in the following table:

a) Basic Letter Symbol

LETTER	FIRST LETTER		SECOND LETTER		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER FLAME		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	CONDUCTIVITY			CONTROLLER	

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LETTER	FIRST LETTER		SECOND LETTER		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
	(ELECTRICAL)				
D	DENSITY (MASS) OR SPECIFIC GRAVITY	DIFFERENTIAL			
E	VOLTAGE (EMF)		PRIMARY ELEMENT		
F	FLOW RATE	RATIO (FRACTION)			
G	GAGING (DIMENSIONAL)		GLASS		
H	HAND (MANUALLY INITIATED)				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME OR TIME SCHEDULE			CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOISTURE OR HUMIDITY				MIDDLE OR INTERMEDIATE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	USER'S CHOICE		ORIFICE (RESTRICTION)		

LETTER	FIRST LETTER		SECOND LETTER		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
P	PRESSURE OR VACUUM		POINT (TEST CONNECTION)		
Q	QUANTITY OR EVENT	INTEGRATE OR TOTALIZE			
R	RADIOACTIVITY		RECORD OR PRINT		
S	SPEED OR SAFETY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTI VARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION			VALVE, DAMPER OR LOUVER	
W	WEIGHT		WELL		
X	UNCLASSIFIED		UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	USER'S CHOICE			RELAY OR COMPUTE	
Z	POSITION			DRIVE, ACTUATE OR UNCLASSIFIED FINAL CONTROL ELEMENT	

b) Special letter symbol

Special letter symbol except basic letter symbol are as follows:

No.	Symbol	Application
-----	--------	-------------

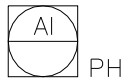
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No.	Symbol	Application
1	EM	Emergency (13)
2	HH	High High (show at the upper line) (4)
3	LL	Low Low (show at the lower line) (4)
4	FO	Valve Open at the time of power source loss (normal operation) (14)
5	FC	Valve Close at the time of power source loss (abnormal operation) (14)
6	FL	Valve lock at the time of power source (14) (No change of positioner) Classify FLO/FLC according to valve open/close for the minimum signal
7	FF	Free valve operation even if there is no locker when power is lost (Double-Action and motorized Valve)
8	HV	Manual Control Valve installed in the field (Independently) (15)
9	RO	Restriction Orifice
10	EO	Valve open at emergency (14)
11	EC	Valve close at emergency (14)
12	PSV	Safety Valve and Relief Valve (Independently)
13	RD	Rupture disc (Independently)
14	PU	Manometer (Independently)
15	PL	Panel Lamp (Independently)
16	PB	Push Button Switch (Independently)
17	PH	PH Meter (Independently)
18	ZO	Valve Open Limit Switch (Independently)
19	ZC	Valve Close Limit Switch (Independently)
20	MO	Motor Operated

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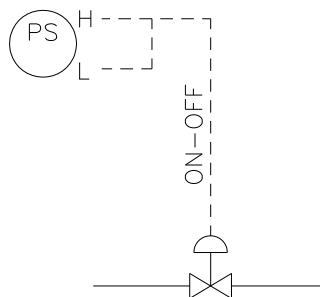
1. If analyzer is marked as the first letter "A", write down the measuring composition at the bottom right hand side of the balloon.

Example:



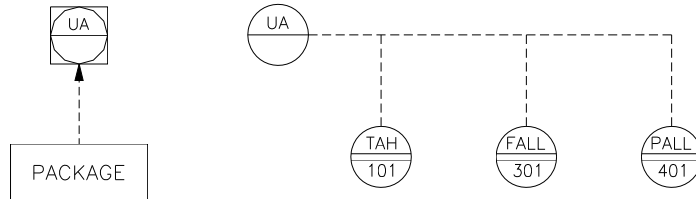
2. Use the function symbol "S" for On-Off Control switch and mark down (On-Off) on figure symbol. Use the same expression in case of on-off control with electrical relay. The emergency equipment, watch lamp, etc. should be clearly shown.

Example:



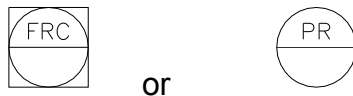
3. Show the function symbol "E" when Element itself is independently installed or is supportively connected to the loop having other function.
4. "R" and "I" cannot be written down together even if it has a directive function in case that the function is marked as "R". For example, it does not show as "PRI-101".
5. Use function symbol "T" when transportation body is installed solely and is supportively connected to the loop having other function.
6. Variable symbol "U" will be used for the common alarm system that collects various alarms as follows:

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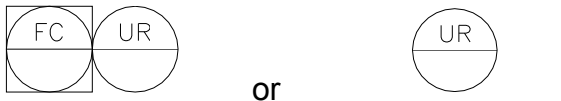


Multi Pen Recorder belongs to multi variable. However, it should not be expressed as "UR" and the associated records in each loop should be established in "R" body.

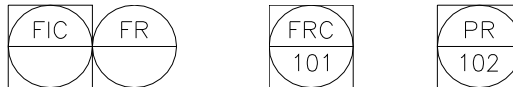
In other words, the expression method in P&ID and UFD is:



And should not be shown as:



7. Trend recorder should be shown with "R", and "R" has to be shown in the case of Trend by Hard copy Recorder. However, in case of DCS Trend, "R" or "I" should be used; but these should not used together. Example:



8. The function symbol; "TW" should be used for thermo-well installation.
9. For variable and function expression "X", the contents of variable and function should be shown in parenthesis ().

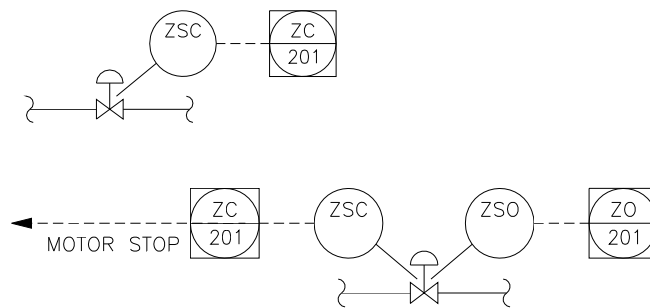
Example:

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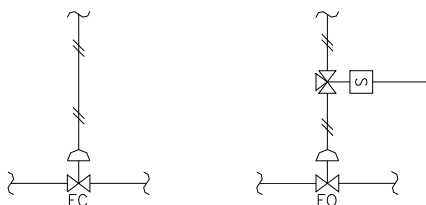
10. When there are more than 2 limit switches, 2 limit switches should be shown and this rule is also applicable in case that it is related with other figure symbol. Also, signal direction and control action can be shown.

Example:



11. Use Symbol "ESDV" to show the emergency shutdown valve.
12. Action expression of Control Valve is written down in figure symbol.

Example:



13. "HV" has Control Valve characteristics (Equal Percentage, linear characteristics) and it has to be shown on body of the valve that is manually operating.

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14. Use “HS” for hand Operated Switch.

15. The symbol for gas detector shall be determined according to the job specification.

16. Use function symbol “Y” for expression of calculation and relay for Add, Subtract, Divide, Multiply, Signal Select, Signal Limit, Ratio Set, Signal Convert, and Root Extract. It should be shown at the upper side of symbols outside. In general, it can be omitted when the function is clear.

c) Method of instrument symbols

AI	Analysis indication
AIC	Analysis indication and control
AR	Analysis record
ARC	Analysis record control

BA	Flame alarm
BI	Flame indication
BDV	Blowdown valve
CA	Electric conductivity alarm
CR	Electric conductivity record

DI	Density (or specific gravity) indication
DIC	Density indication and control
DR	Density record
DRC	Density record control

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EI Voltage (Ampere or power) indicating

ESDV Emergency shut-down valve

FA Flow rate alarm

FE Flow measuring element

FG (Flow rate) Purge-Meter or Purge-Set

FI Flow rate indication

FIC Flow rate indication and control

FIQ Flow rate indication and totalized

FICQ Flow rate indication, control and totalized

FQ Flow rate totalized

FQC Flow rate totalized control

FR Flow rate record

FRC Flow rate record and control

FRQ Flow rate record and totalized

FRCQ Flow rate record, control and totalized

FDC Flow rate differential control

FDI Flow rate differential indication

FDIC Flow rate differential indication and control

FDR Flow rate differential record

FDI Flow rate differential indication

FS Flow rate switch

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FT	Flow rate transmitter
HC	manual control
HV	Field manual control valve
HS	manual switch
JR	Power indication
JRQ	Power record and totalized
LA	Level (or interface) alarm
LC	Level control
LV	(Automatic) Level control valve
LG	Level gauge
LI	Level indication
LIC	Level indication and control
LR	Level record
LRC	Level record and control
LS	Level switch
LT	Level transmitter
MA	Moisture (or humidity) alarm
MI	Moisture indicating
MIC	Moisture indicating and control

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MOV	Motor operated valve
MR	Moisture record
MRC	Moisture record and control
RO	Restriction Orifice
PA	Pressure alarm
PC	Pressure control
PCV	(Automatic) Pressure control valve
PG Manometer	Pressure Gauge, Draft-Gauge U type
PI	Pressure indication
PIC	Pressure indication and control
PR	Pressure record
PRC	Pressure record and control
PDA	Pressure difference alarm
PDC	Pressure difference control
PDCV	(Automatic) Pressure difference control valve
PDG	Pressure difference gauge
PDI	Pressure difference indication
PDIC	Pressure difference indication and control
PDR	Pressure difference record
PDRC	Pressure difference record and control

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PS	Pressure Switch
PSV	Safety, Relief Valve
PT	Pressure transmitter
SA	Speed (or revolution) alarm
SI	Speed indication
SIC	Speed indication and control
SR	Speed record
SRC	Speed record and control
TA	Temperature alarm
TC	Temperature control
TCV	Temperature control valve
TE	Temperature element
TG	Temperature gauge (Dial gauge)
TI	Temperature indication
TIC	Temperature indication and control
TR	Temperature record
TRC	Temperature record and control
TDI	Temperature difference indication
TDIC	Temperature difference indication and control
TDR	Temperature difference record
TDRC	Temperature difference record and control

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TS	Temperature Switch
TT	Temperature Transmitter
TW	Thermo well
UA	Common Alarm (One common alarm collecting each alarm)
VT	Vibration Transmitter
WI	Weight indication
WIC	Weight indication and control
WR	Weight record
WRC	Weight record and control
ZA	Position alarm
ZI	Position indicating
ZS	Position Switch (Limit Switch)

X Special variable and function is shown as following examples:

Torque

Television (camera and monitor)

Coefficient

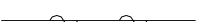
Vibration

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Noise

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4. Instrument Line symbol

NO.	SYMBOL	DESCRIPTION / APPLICATION
(a)		CONNECTION TO PROCESS
(b)		UNDEFINED SIGNAL
(c)		PNEUMATIC SIGNAL **
(d)	 or 	ELECTRIC SIGNAL
(e)		HYDRAULIC SIGNAL
(f)		CAPILLARY TUBE
(g)		ELECTROMAGNETIC OR SONIC SIGNAL *** (GUIDED)
(h)		ELECTROMAGNETIC OR SONIC SIGNAL *** (NOT GUIDED)
(i)		INTERNAL SYSTEM LINK(SOFTWARE OR DATA LINK)
(j)		MECHANICAL LINK

Note: 'Or' means user's choice. Consistency is recommended.

*The following abbreviations are suggested to denote the types of power supply:

(These designations may also be applied to purge fluid supply.)

AS: Air Supply (Options) HS - Hydraulic Supply

IA: Instrument Air (Options)

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NS: Nitrogen Supply

ES: Electric Supply (Options)

SS: Steam Supply

GS: Gas Supply

WS: Water Supply

**The pneumatic signal symbol applies to a signal using instrument air or inert gas as the signal medium. If a gas other than air is used, the gas may be identified by a note on the signal symbol.

***Electromagnetic phenomena include heat, radio waves, nuclear radiation and light.

5. General Instrument and Function Symbols

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NO	SYMBOL	DESCRIPTION
(a)		LOCAL FIELD INSTRUMENT
(b)		INSTRUMENT ON PANEL OR HARD CONSOLE IN CENTRAL CONTROL ROOM
(c)		INSTRUMENT ON LOCAL PANEL
(d)		INSTRUMENT, EITHER RACK MOUNTED OR BEHIND THE PANEL IN CONTROL ROOM
(e)		INSTRUMENT MOUNTED BEHIND THE LOCAL PANEL BOARD
(f)		LOCAL INSTRUMENT FOR MORE THAN ONE FUNCTION
(g)		MICROPROCESSOR BASED INSTRUMENT DISPLAYED ON SHARED-CRT IN CENTRAL CONTROL ROOM
(h)		NOT NORMALLY ACCESSIBLE TO OPERATOR
(i)		*IDENTIFIES DETAIL FUNCTION
(j)		DCS AUXILIARY INTERFACE DEVICE
(k)		SEQUENTIAL LOGIC CONTROL IN DCS OR PLC
(l)		INTERLOCK* : NUMBER CAN BE INSERTED, IF NECESSARY.
(m)		COMPUTER
(n)		LIGHT INDICATOR

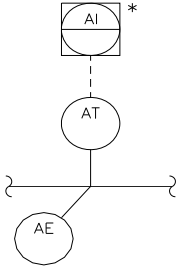
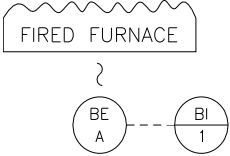
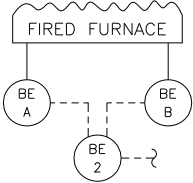
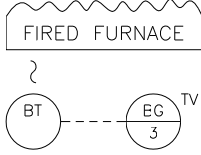
* SYMBOLS FOR DETAIL FUNCTION

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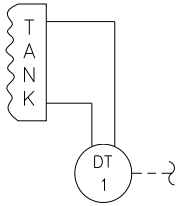
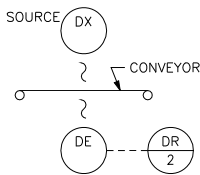
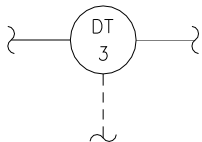
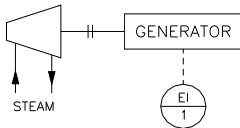
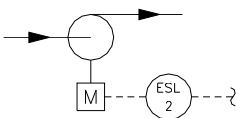
Σ ADD OR TOTALIZE
 Δ SUBTRACT
 $\times$ MULTIPLY
 $\div$ DIVIDE
 $>$ HIGH SELECT
 $<$ LOW SELECT
 $\sqrt{}$ EXTRACT SQUARE ROOT
 $\pm$ BIAS
I:I VOLUME BOOSTER
AVGAVERAGE
 $\triangleright$ HIGH LIMIT
 $\triangleleft$ LOW LIMIT
DIR DIRECT
REVREVERSE

	PROCESS DESIGN MANUAL	SPD0049ERN REV.: <u>3</u>
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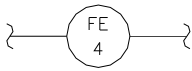
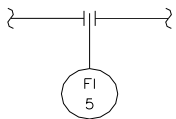
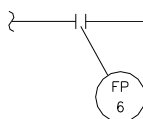
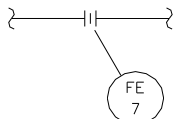
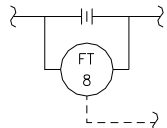
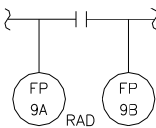
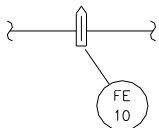
6. Primary Element Symbols

ITEM	NO	SYMBOL	DESCRIPTION
A ANALYSIS	1		* IDENTIFIES KEY COMPONENTS
B BURNER/FLAME	1		ONE BURNER ULTRA-VIOLET FLAME DETECTOR CONNECTED TO ANALOG-TYPE FLAME INTENSITY INDICATOR
	2		TWO BURNER FLAME ROD SENSORS CONNECTED TO COMMON SWITCH
	3		TELEVISION CAMERA AND RECEIVER TO VIEW BURNER FLAME

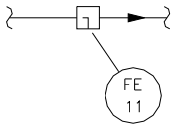
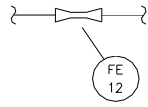
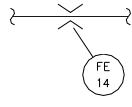
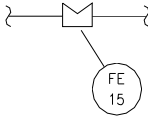
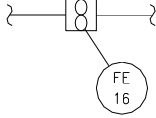
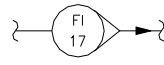
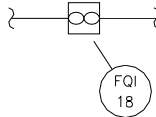
	PROCESS DESIGN MANUAL	SPD0049ERN
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ITEM	NO	SYMBOL	DESCRIPTION
D DENSITY/ SP.GR	1		DENSITY TRANSMITTER, DIFFERENTIAL PRESSURE TYPE, EXTERNALLY CONNECTED
	2		RADIOACTIVE TYPE DENSITY ELEMENTS CONNECTED TO RECORDER ON PANEL
	3		SPECIFIC GRAVITY TRANSMITTER FLOW THROUGH TYPE
E VOLTAGE	1		INDICATING VOLTMETER CONNECTED TO TURBINE GENERATOR
	2		LOW-VOLTAGE SWITCH CONNECTED TO PUMP MOTOR

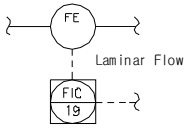
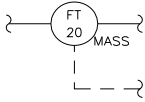
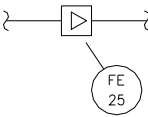
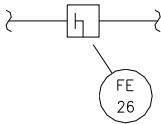
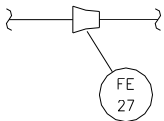
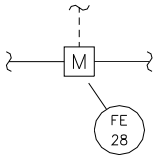
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ITEM	NO	SYMBOL	DESCRIPTION
F FLOW RATE	1		GENERAL SYMBOL THE WORDS LAMINAR, ETC., MAY BE ADDED
	2		ORIFICE PLATE WITH FLANGE OR CORNER TAPS CONNECTED TO DIFFERENTIAL- PRESSURE TYPE FLOW INDICATOR
	3		FLANGE OR CORNER TAP TEST CONNECTIONS WITHOUT ORIFICE PLATE
	4		ORIFICE PLATE WITH VENA CONTRACTA TAPS
	5		ORIFICE PLATE WITH VENA CONTRACTA, RADIUS, OR PIPE TAPS CONNECTED TO DIFFERENTIAL- PRESSURE TYPE FLOW TRANSMITTER
	6		RADIUS TAP TEST CONNECTIONS WITHOUT ORIFICE PLATE
	7		ORIFICE PLATE IN QUICK-CHANGE FITTING

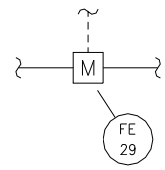
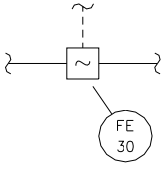
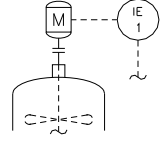
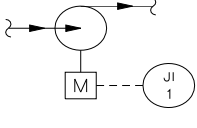
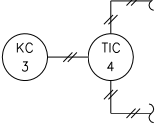
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ITEM	NO	SYMBOL	DESCRIPTION
	8		PITOT TUBE OR PITOT-VENTURI TUBE
	9		VENTURI TUBE
	10		FLUME
	11		WEIR
	12		TURBINE OR PROPELLER TYPE PRIMARY ELEMENT
	13		VARIABLE AREA FLOW INDICATOR
	14		POSITIVE DISPLACEMENT TYPE FLOW TOTALIZING INDICATOR

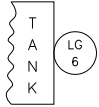
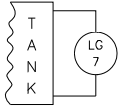
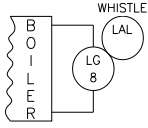
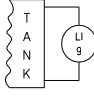
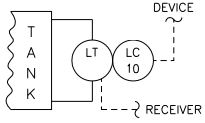
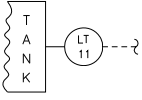
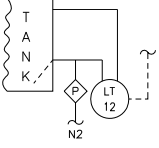
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ITEM	NO	SYMBOL	DESCRIPTION
	15		FLOW ELEMENT WITH CONNECTION FOR CONTROLLER
	16		FLOW ELEMENT INTEGRAL WITH TRANSMITTER
	17		VORTEX FLOW METER
	18		IMPACT FLOW METER
	19		FLOW NOZZLE
	20		MAGNETIC FLOWMETER

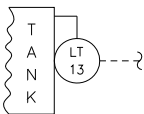
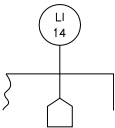
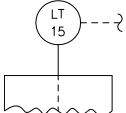
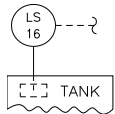
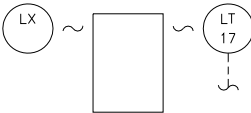
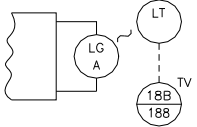
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ITEM	NO	SYMBOL	DESCRIPTION
	21		MAGNETIC FLOWMETER WITH INTEGRAL TRANSMITTER
	22		SONIC FLOWMETER "DOPPLER" OR "TRANSIT TIME" MAY BE ADDED
I CURRENT	1		CURRENT TRANSFORMER MEASURING CURRENT OF ELECTRIC MOTOR
J POWER	1		INDICATING WATTMETER CONNECTED TO PUMP MOTOR
K TIME OR TIME-SCHEDULE	1		CLOCK
	2		MULTI POINT ON-OFF TIME SEQUENCING PROGRAMMER POINT 7
	3		TIME-SCHEDULE CONTROLLER, ANALOG TYPE, OR SELF CONTAINED FUNCTION GENERATOR

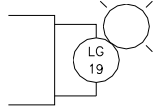
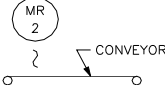
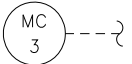
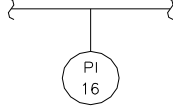
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ITEM	NO	SYMBOL	DESCRIPTION
L LEVEL	1		GAUGE GLASS, INTEGRALLY MOUNTED ON TANK
	2		GAUGE GLASS, EXTERNALLY CONNECTED
	3		WATER COLUMN WITH INTEGRAL GAGE GLASS AND ALARM WHISTLE
	4		LEVEL INDICATOR, WITH TWO CONNECTIONS
	5		DUPLEX LEVEL TRANSMITTER-CONTROLLER, WITH TWO CONNECTIONS
	6		LEVEL TRANSMITTER, WITH ONE CONNECTION
	7		LEVEL TRANSMITTER, DIFFERENTIAL PRESSURE TYPE, EXTERNALLY CONNECTED, WITH DIP TUBE

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ITEM	NO	SYMBOL	DESCRIPTION
	8		LEVEL TRANSMITTER DIFFERENTIAL PRESSURE TYPE, MOUNTED ON TANK
	9		LEVEL INDICATOR, FLOAT TYPE
	10		CAPACITANCE OR DIELECTRIC TYPE LEVEL ELEMENT CONNECTED TO LEVEL TRANSMITTER (TAG LEVEL ELEMENT LE-15)
	11		LEVEL SWITCH, PADDLE WHEEL OR LEVER TYPE, TO MEASURE LEVEL OF SOLIDS
	12		RADIOACTIVE OR SONIC TYPE LEVEL TRANSMITTER WITH INTEGRAL SENSOR
	13		REMOTE VIEWING OF GAUGE GLASS BY USE OF TELEVISION

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ITEM	NO	SYMBOL	DESCRIPTION
	14		LEVEL GLASS WITH ILLUMINATOR
M MOISTURE HUMIDITY	1		MOISTURE RECORDER (IF THERE IS A SEPARATE PRIMARY ELEMENT, IT SHOULD BE TAGGED ME-2)
	2		SELF-CONTAINED HUMIDITY CONTROLLER IN ROOM
P PRESSURE OR VACUUM	1		PRESSURE INDICATOR, DIRECT CONNECTED

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9. REVISION HISTORY

Rev. No.	Rev. Date	Rev. Page	Reason for Revision
0	30 SEP 1998	All	First Issue Written at Proces & System Eng'g Dept. -Prepared by: Y.Y.Gu, K.J.Moon, J.S.Lee, S.J.Lee -Checked by: J.C.Ro -Approved by: S.G.Oh
1	31 DEC 2005	All	Revision Written at Proces & System Eng'g Dept. -Prepared by: C.S.Song -Checked by: E.D.Lee -Approved by: C.S.Jeong
2	25 NOV 2010		Revision Written at Proces & System Eng'g Dept. -Prepared by: C.H.Yoon -Checked by: J.H.Park -Approved by: Y.Y.Koo

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<u>3</u>	<u>21 NOV</u> <u>2013</u>	<u>All</u>	<u>Revision</u> <u>Written at Proces & System Eng'g</u> <u>Dept.</u> <u>-Prepared by: M.H.LEE</u> <u>-Checked by: J.H.Park, M.H.OH,</u> <u>I.H.HWANG</u> <u>-Approved by: S.B.LEE</u>
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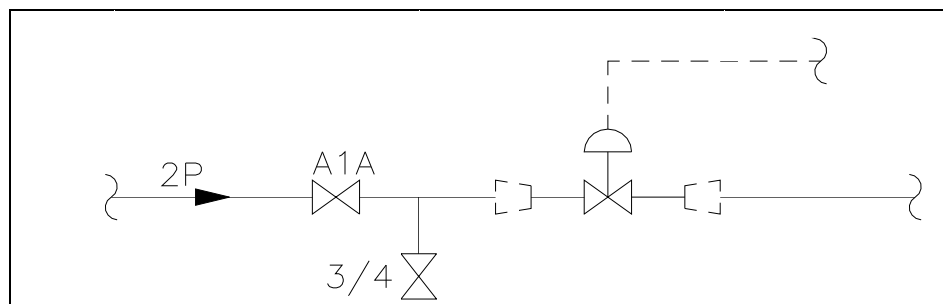
10. APPENDIX

10.1.Example of General Description on P&ID and UFD

10.1.1. Examples of design development as shown on the P&ID/UFD according to work progress by P&ID and UFD Stages.

a) Around Control Valve (small size bypass)

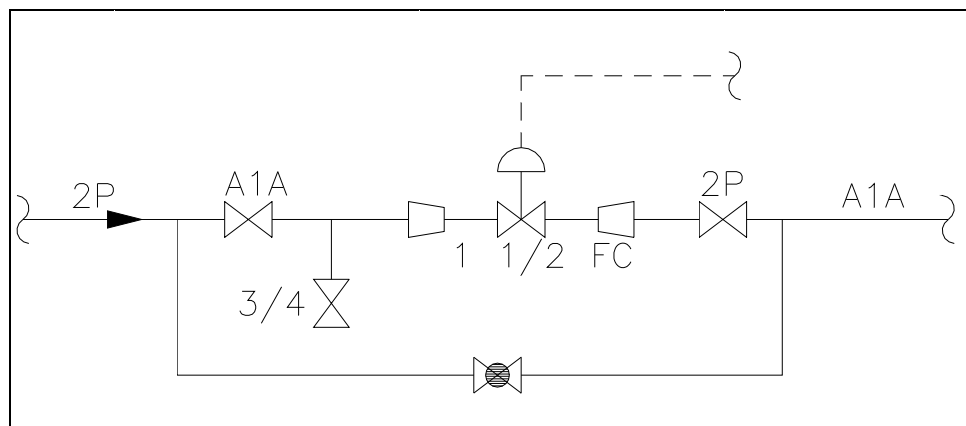
(i) IFR Issue



Remark:

Provide adequate space to place reducer to the line

(ii) IFA Issue



Remarks:

- *Add after identifying the necessity of bypass piping.

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- *In principle, the bypass line should be one size smaller than the control valve line size, but no smaller than 3/4".

(iii) IFD Issue

It is same as IFA issue.

(iv) IFC Issue

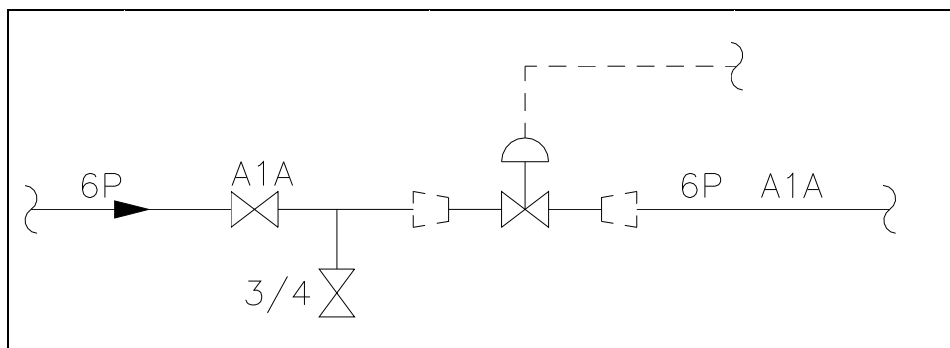
It is same as IFD.

Remarks:

The explanation above deals with the contents of the P&ID and UFD at the issue stage in case of a new process. Therefore, when the presence of a bypass and a reducer is determined for the licensed process or other processes, it can be specified in the preliminary stage.

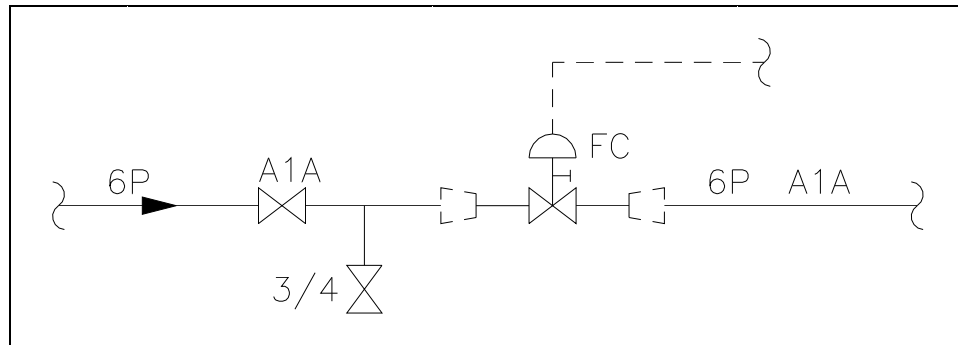
b) Around Control Valve (Large Size Manual Hand wheel)

(i) IFR Issue



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(ii) IFA Issue



(iii) IFD Issue

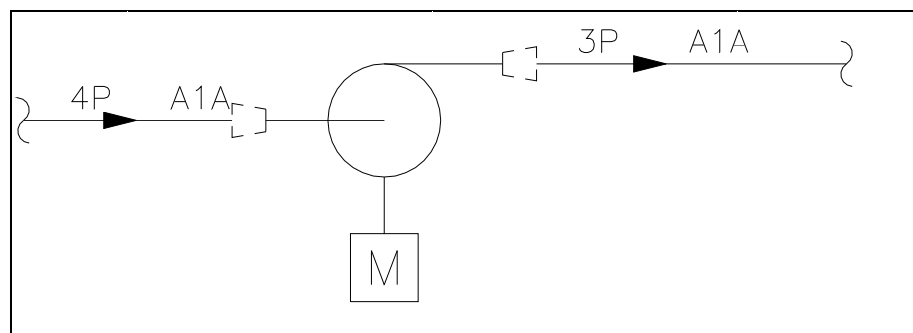
It is same as IFA.

(iv) IFC Issue

It is same as IFD Issue.

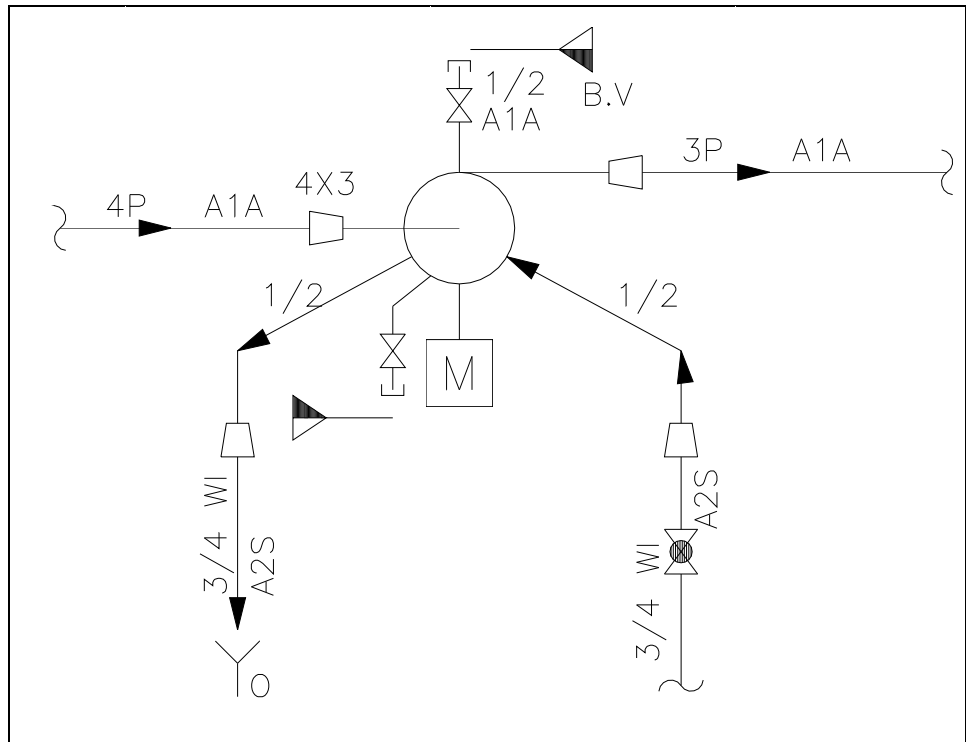
c) Around Pump

(i) IFR Issue



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(ii) IFA Issue



(iii) IFD Issue

It is same as IFA Issue.

(iv) IFC Issue

It is same as IFD Issue.

Remarks:

In the preliminary stage, it should be specified if it is initially determined according to job type and process requirements such as pump drain, vent valve, flushing or cooling etc.

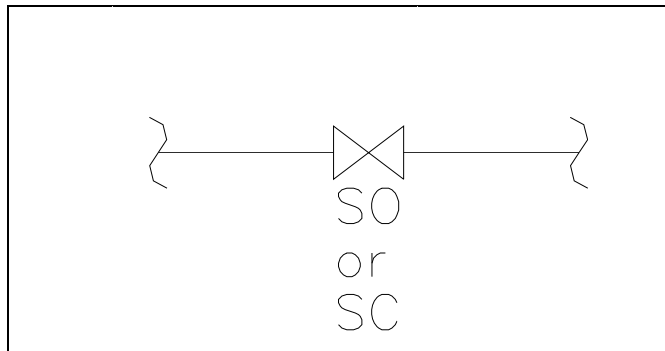
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10.1.2. Sealed/Locked Valves

In normal operation, the valve operating conditions, such as open or close for safety should be shown on P&ID.

a) Sealed Open/Sealed Close

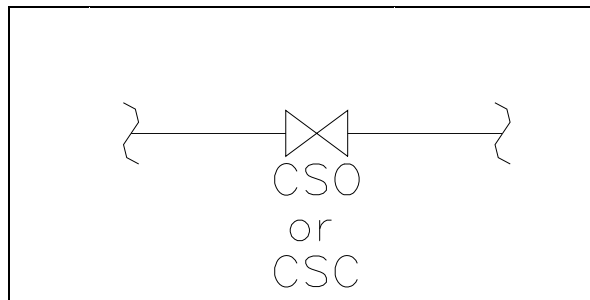
To prevent operation without the direction of the operation manager. A color code on the valve may be use for caution.



b) Car Sealed Open/Car Sealed Close

* To prevent operation without special instructions. Valve handle is fixed by car seal device.

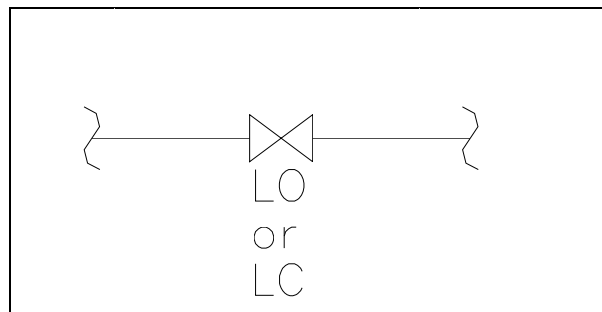
* Car seal open valves are required for the inlet and outlet of a safety valve.



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c) Locked Open/Locked Close (LO/LC)

It shall be used to prevent the accidental open/close of the valve without proper administrative procedure. The system is a key and lock mechanism.

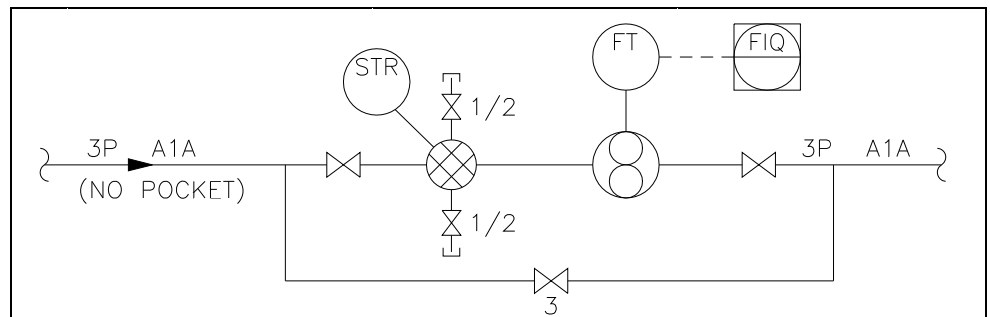


10.1.3. Equipment and Instrument having By-Pass Line

a) Instrument

(i) Volumetric Flow Meter

1. Common Case

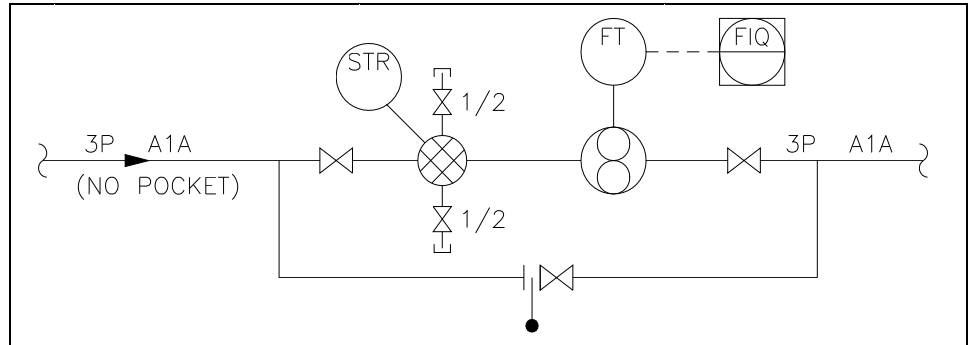


2. When gas separation is required at the upstream of a flow meter for sale

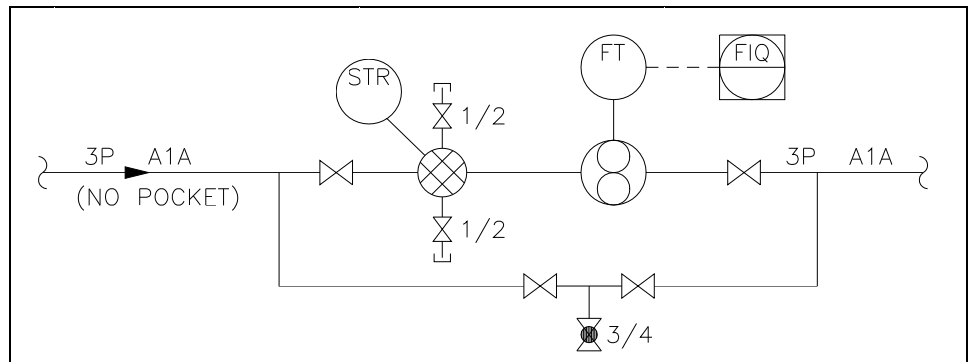
Refer to subsection (2)-(b) of Section 7.10.6

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3. For Custody transfer meter (example of bypass installation)



or



Remarks:

In case of custody transfer meter, the bypass line should be avoided because valve leaks are not desirable. However, if necessary for start-up, specify the bypass valve as locked-close with blind as shown above, or specify double-block and bleed system.

(ii) Other Flow Meters

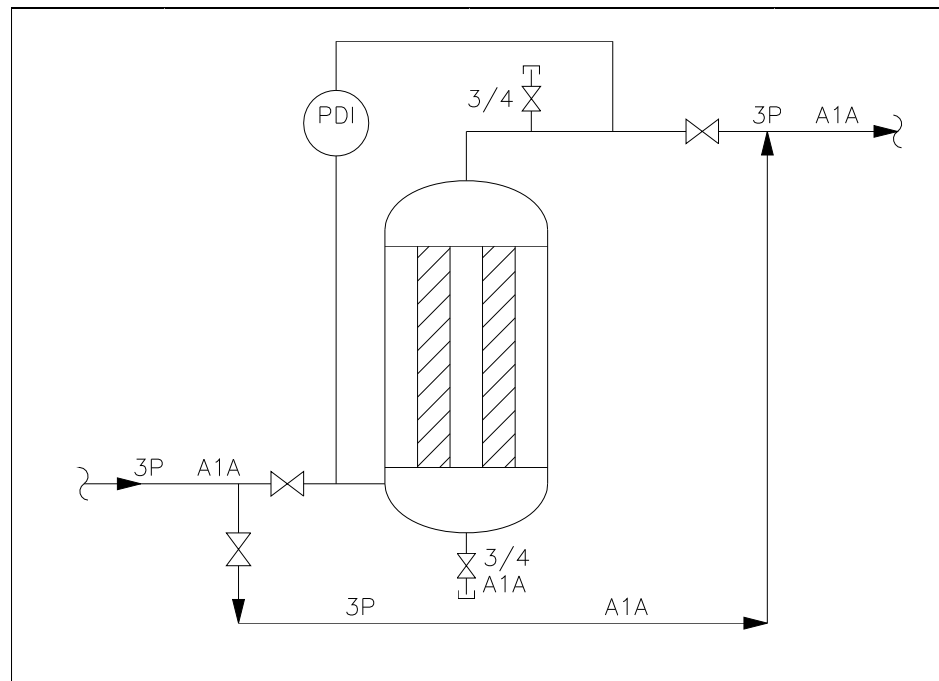
Refer to volumetric flow meter in section (i) above.

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(iii) Control Valve

Strainer can be installed at the inlet side of high ΔP control valve and steam control valve. Caution should be taken because, in some case, drain valve is not always installed at low-pressure control valve, slurry control valve and by-pass line.

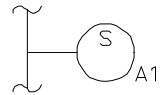
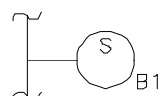
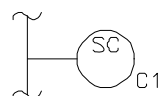
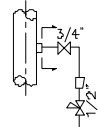
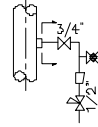
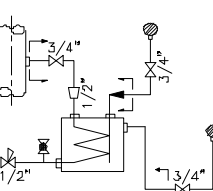
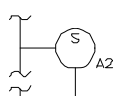
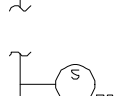
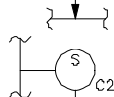
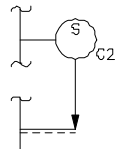
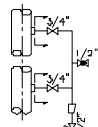
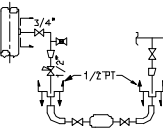
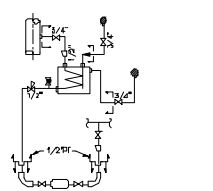
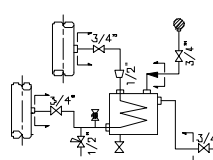
b) Equipment By-Pass



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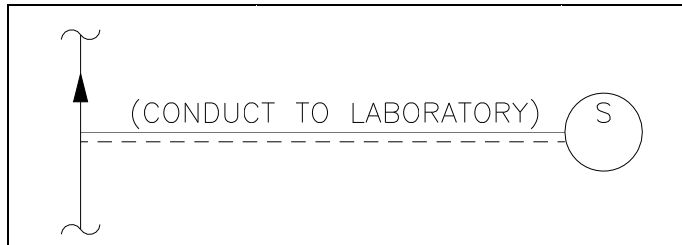
10.1.4. Sample Connection Type

a) Local Sampling

T Y P E	D E T A I L	S E R V I C E
  	  	Water , Heavy Oil Light Oil When Sample Cooler is installed Hot Water Hot Hydrocarbon Liquid
   	   	Light Oil Gas , Liquefied Gas When Sample Cooler is installed Hot Hydrocarbon Gas Hot Light Oil

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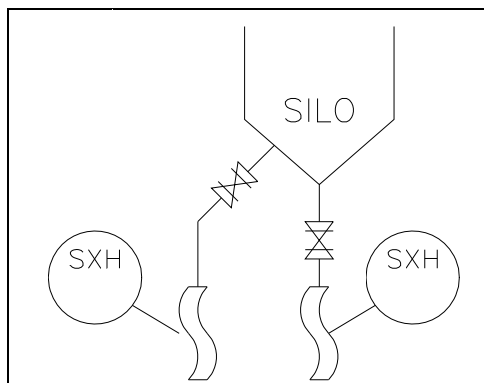
(b) When sampling at laboratory by piping connection



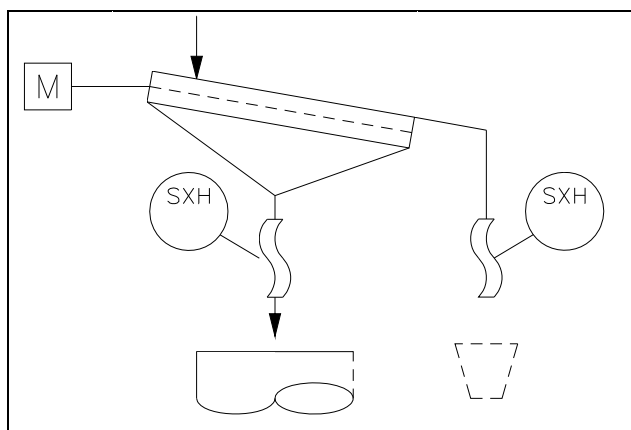
10.1.5. Flexible Hose

a) For powder materials (made from canvas)

(i) When pulling out the powder materials from Silo



(ii) Transferring from Vibrating Screen to Hopper



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b) For Liquid and Gas

Hose material and general application of this material are as follow:

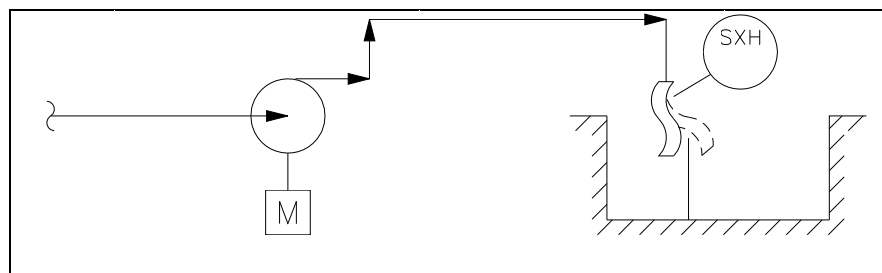
Rubber hose: For water, condensable fluids and slurry

Stainless Steel Hose: For high temperature fluids, high vapor pressure fluid solvent, not easily solidifying

Wired Vinyl Hose: Low-pressure system, intended to check internal fluid flow.

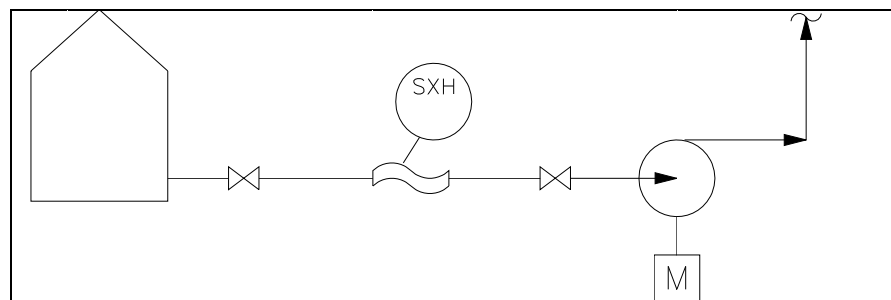
Teflon Hose: Applicable when rubber and stainless steel are not suitable.

(i) When transferring drainage containing powder materials to settling pit



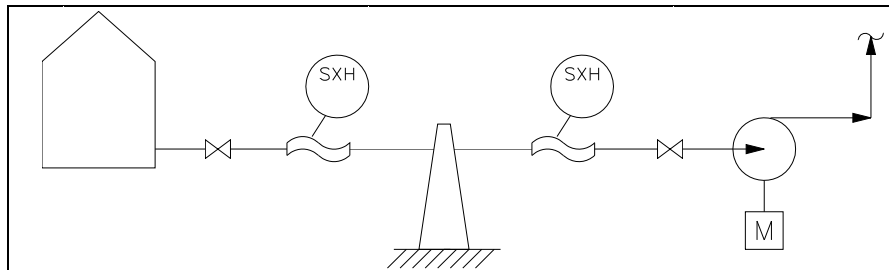
(ii) Flexible hose installed between tank and pump to prevent settling and heat stress

1. Passing above the tank dike



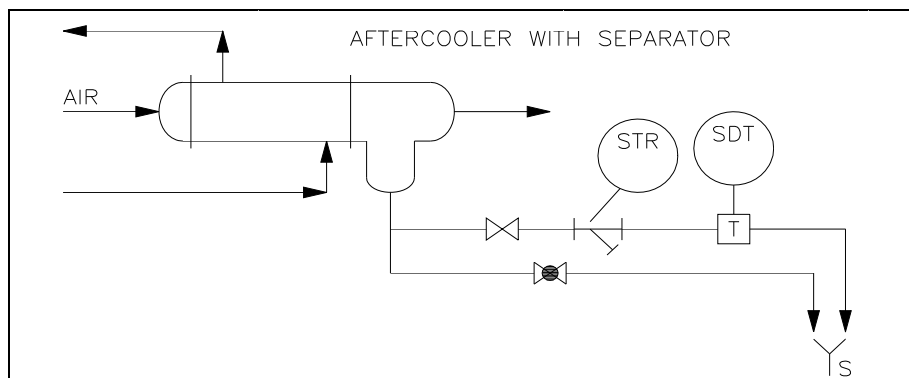
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2. Passing through the tank dike



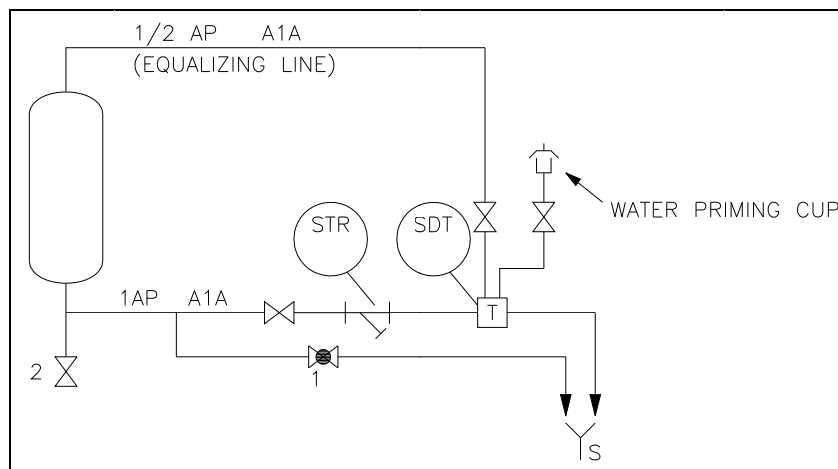
10.1.6. Air Trap & Drainer

a) Common example when necessary for intermittent drain



b) Equalizing Line and Water Priming Cup

(i) When draining is not required

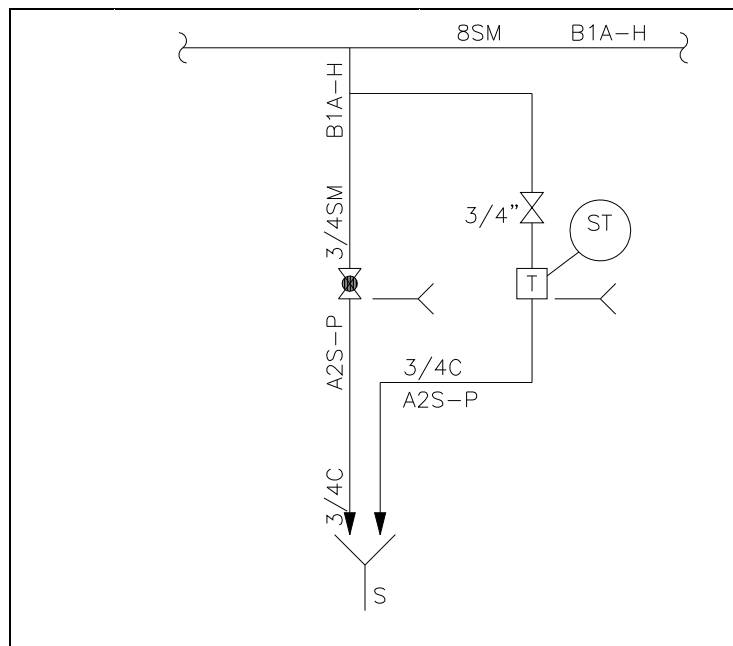


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10.1.7. Steam Trap

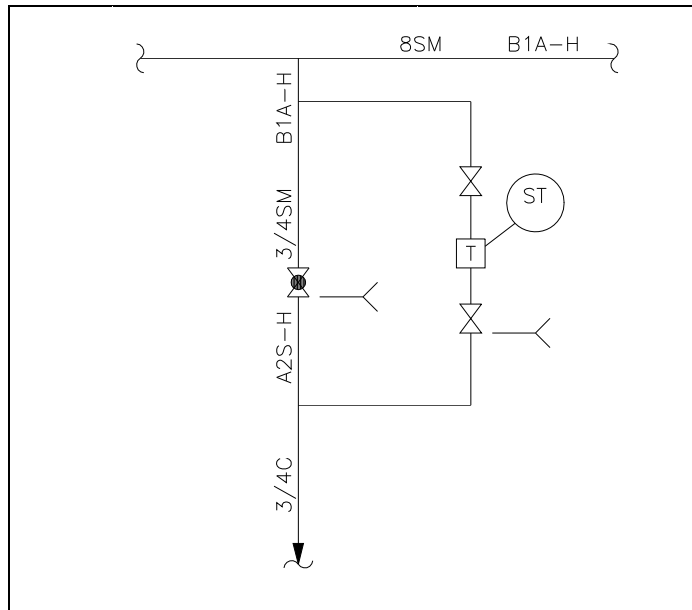
a) Steam trap installed with strainer upstream of trap.

(i) Release to sewer



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(ii) Collection of Atmospheric Condensate

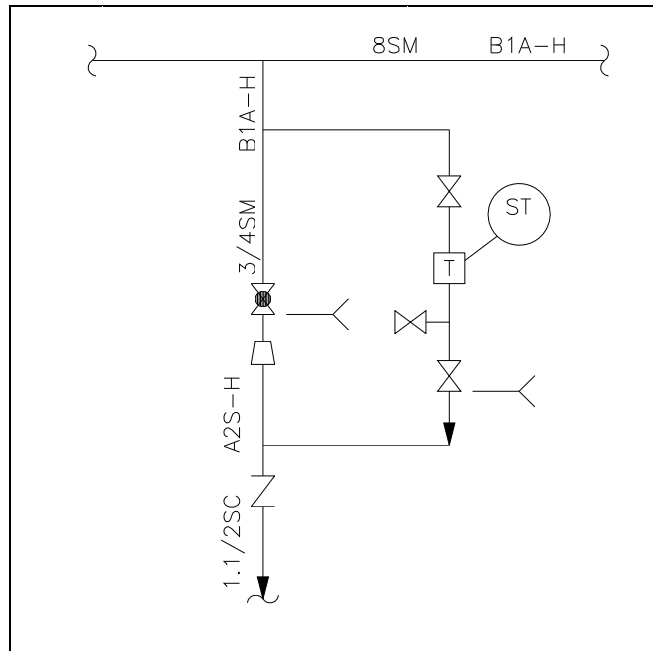


Remarks:

Try cock or check valve as shown in Section (iii) can be installed.
Refer to Section 7.7.1 (3) for specification break of steam trap down-stream.

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(iii) Collection of Pressurized Condensate

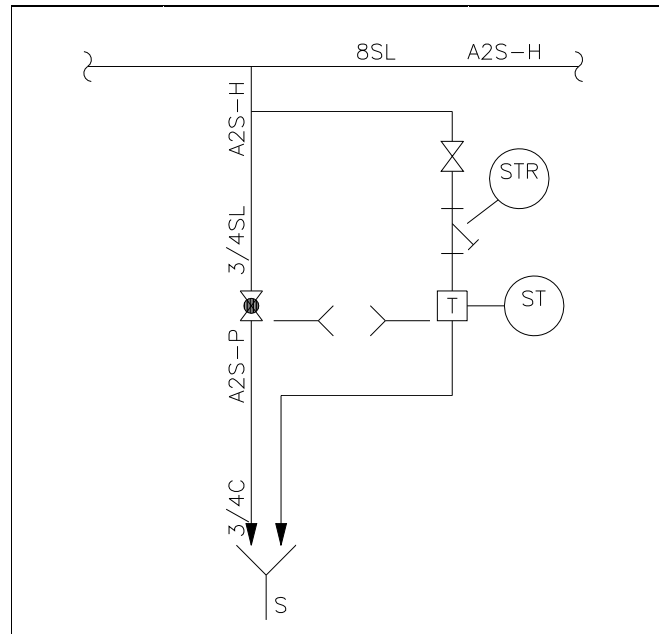


Remark

Check the piping size based on the pipe arrangement because water hammer is likely to occur between the piping systems up to condensate collection drum. Also, refer to Section 7.7.1 (3) for specification break of steam trap downstream.

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b) Steam trap not containing a strainer



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10.1.8. Safety Valve and Rupture Disk

In principle, a safety valve should be directly installed on the equipment body. However, when it needs to be installed in the piping system, the relationship between equipment design pressure, set pressure of safety valve, and over-pressure, considering pressure loss (less than 3% of set pressure) up to valve inlet from the protected equipment connected to piping system, needs to be considered. In addition, the pipe size from the equipment to the safety valve must not be less than the valve inlet nozzle size.

a) Treatment standard on released materials from safety valve

They are classified based on flammability and hazardous property of the released materials as shown on the following table:

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Material and Condition	Vent to ATM	Discharge to Flare System	Discharge to Blow-down System	Recovery to Facility
1. Process Vapor a) Flammable (Non-condensable) b) Flammable (Condensable) c) Nonflammable, Non-condensable, Non-hazardous d) Nonflammable, Non-condensable, Hazardous e) Nonflammable, Condensable, Non-hazardous f) Nonflammable, Condensable, Hazardous g) Liquid & Gas Mixture	X	X	X	
2. Process Liquid a) Liquid (from Relief Valve)			X	X

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b) Liquid (from Blow-down Valve)			X	
3. Steam, etc				
a) Excess Steam Discharge	X			
b) Boiler Blow-down			X	

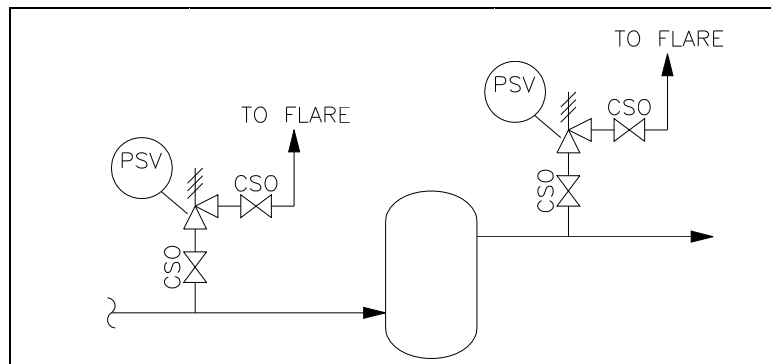
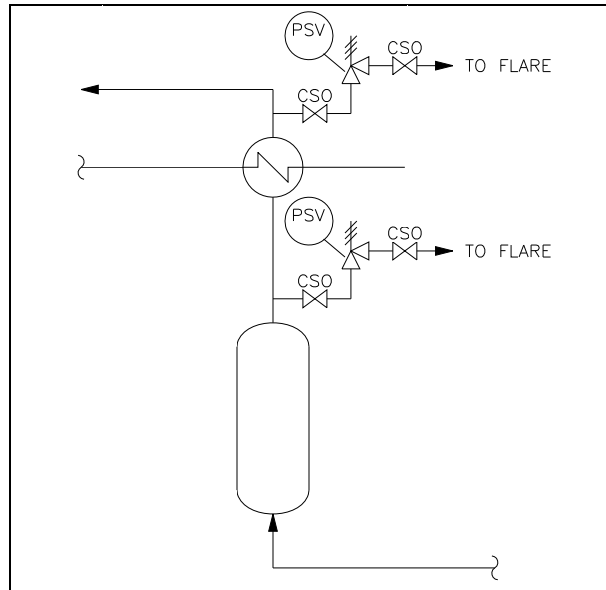
Remarks:

Condensable materials are those materials that more than 50% of it can be condensed at atmospheric conditions (pressure and temperature).

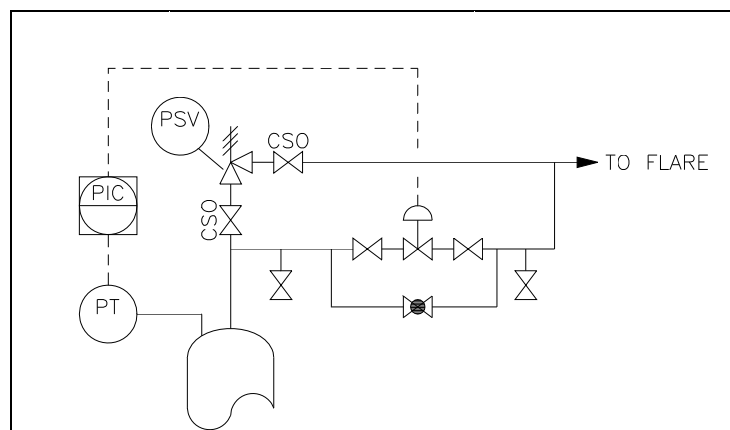
b) Block valve installation standard at safety valve inlet and outlet

Block valves installation around safety valve shall conform to API Standard 521 "Pressure-Relieving and Depressuring Systems".

(i) Safety valve installed at the pressurized equipment,



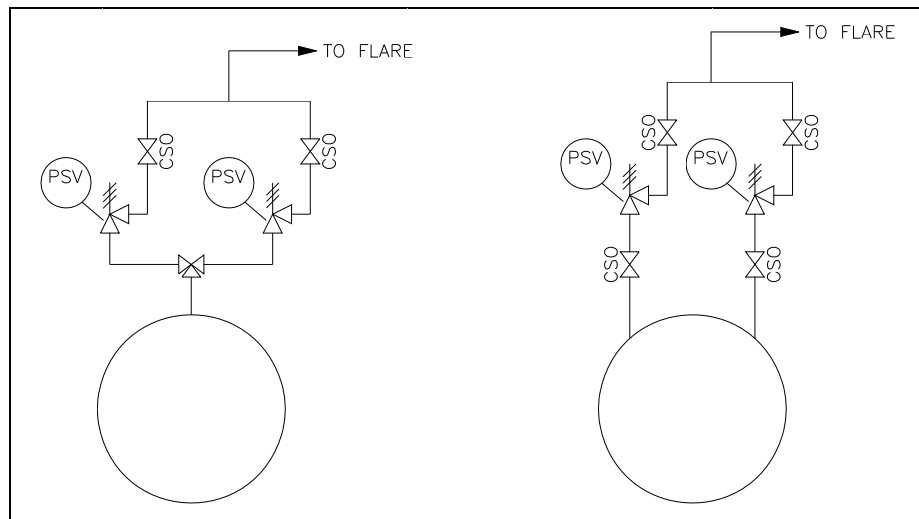
(ii) Automatic pressure control valve installed in parallel to the safety valve



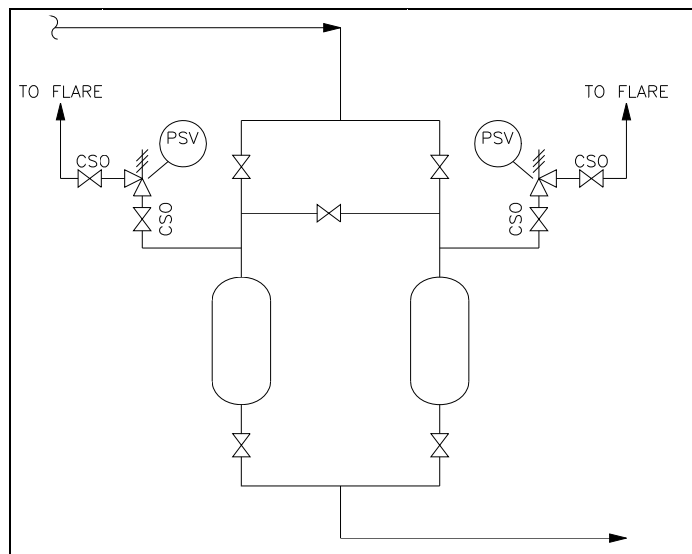
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(iii) Spare Safety Valve

A special case where one PSV is operating while the other is in maintenance service, two PSV (each 100% load) will be installed.

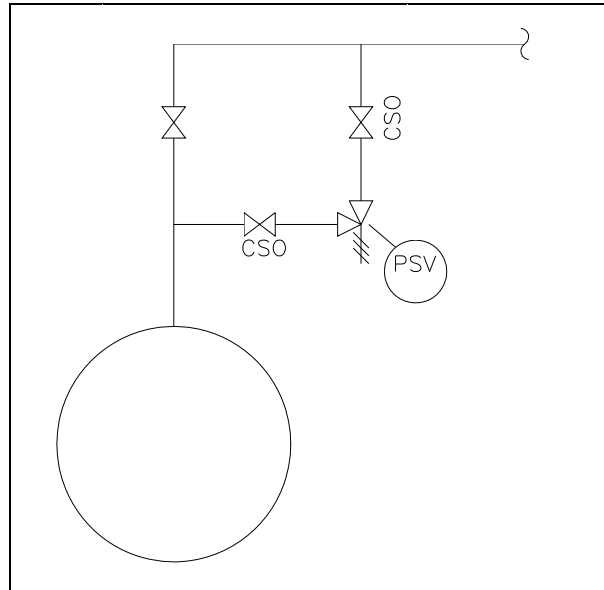


(iv) Two pressurized equipment items, one on stand-by, a safety valve is installed for each



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(v) Thermal Relief Valve



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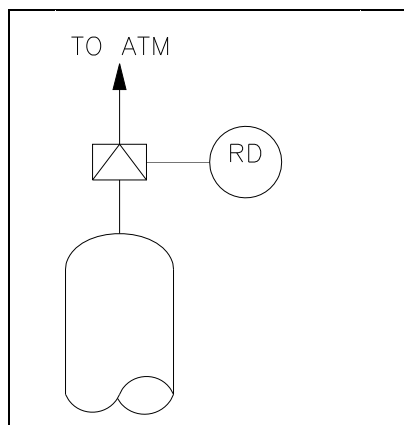
c) Rupture Disk

(i) When to install a rupture disk

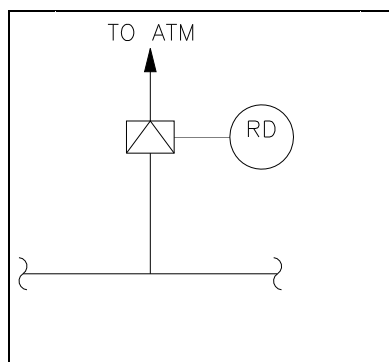
- When run-away reaction is likely to occur by polymerization of inlet fluid
- High viscous or slurry fluid
- corrosive or toxic fluid
- System with potential rapid pressure surge

(ii) Typical cases

1. Direct installation on the equipment body

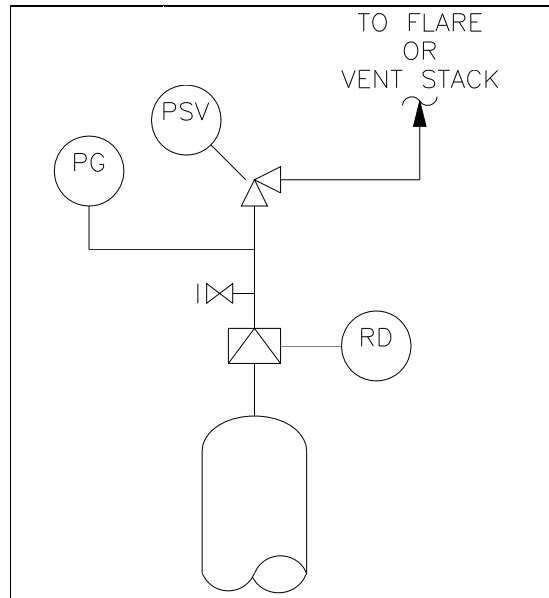


2. Installation in piping



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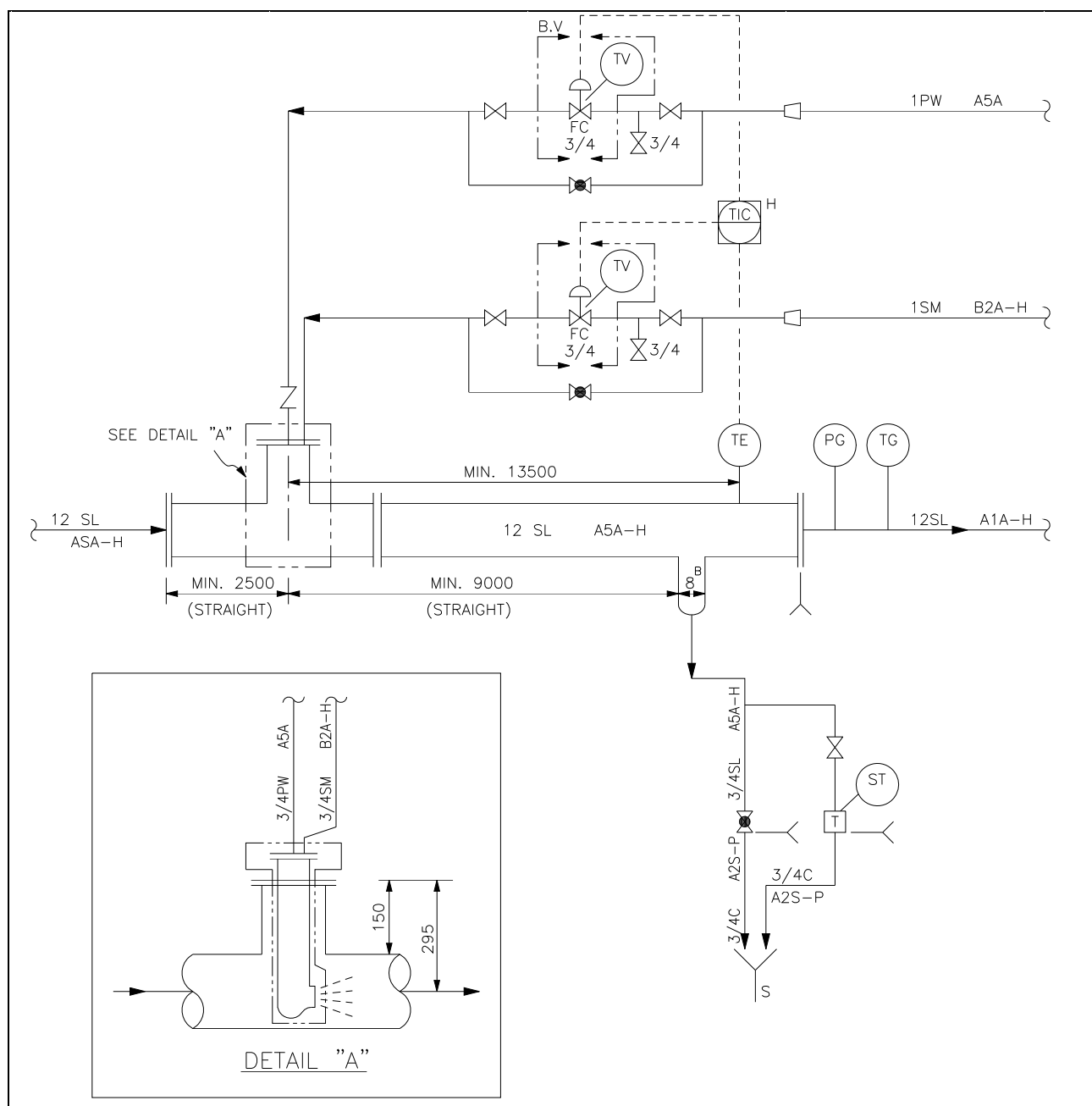
d) Safety valve combination with rupture disk



Remarks:

- In principle, install at the inlet side of the safety valve
- Install pressure gauge in between the safety valve and the rupture disk to check bursting of rupture disk
- Install appropriate telltale indicator, free vent or try-coc k between rupture disk and safety valve because pinhole or bursting can occur due to instant overpressure or superannuating.

b. Steam atomizing type



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In the example above, the water injection rate is controlled by a remote valve; but, as shown in section (b), temperature control can also be used.

10.1.10. Pump

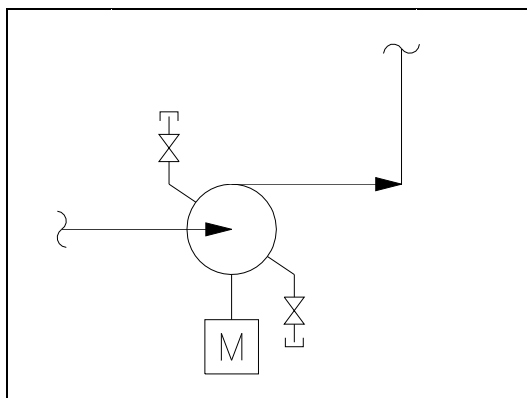
Pump accessory includes vent, drain valve, discharge pipe, cooling water line, flushing line, steam line, and lube oil line. Among these, the lube oil line is generally not shown in P&ID, but others are shown below:

API RP 686 may be followed for typical piping arrangements for pump suction and discharge.

a) Drain and Vent

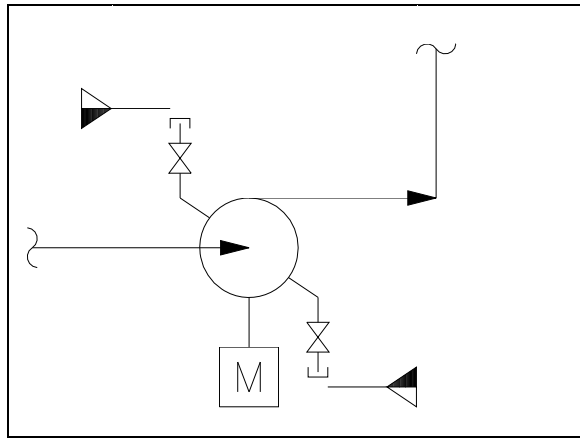
In principle, show pump drain and vent with a valve.

(i) Open to Atmosphere



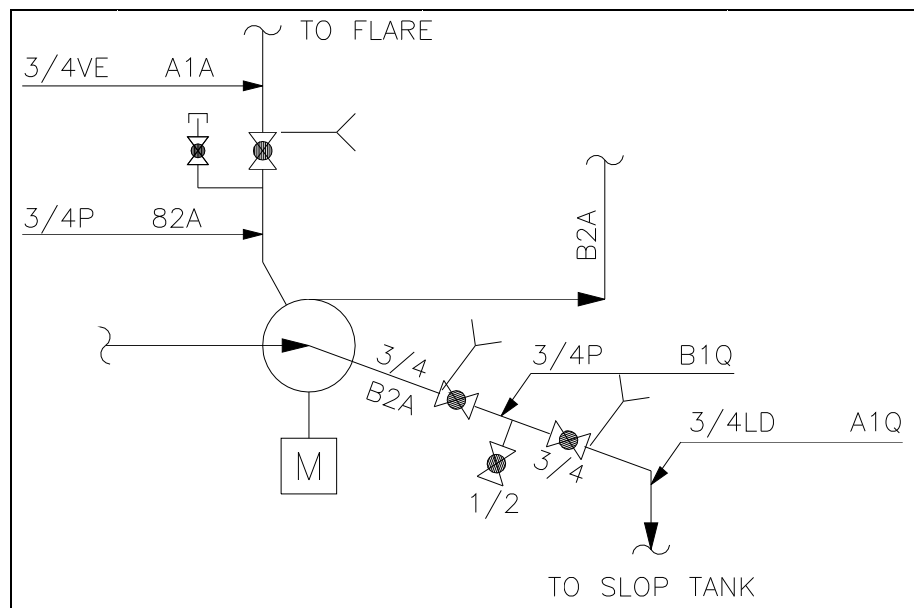
The valve is supplied by the project.

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The valve is supplied by vendor.

(ii) Vent to flare stack or Drain to slop tank



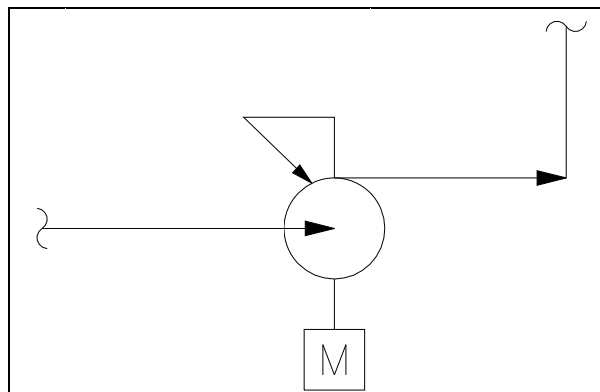
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b) Flushing Liquid Line (Centrifugal Pump)

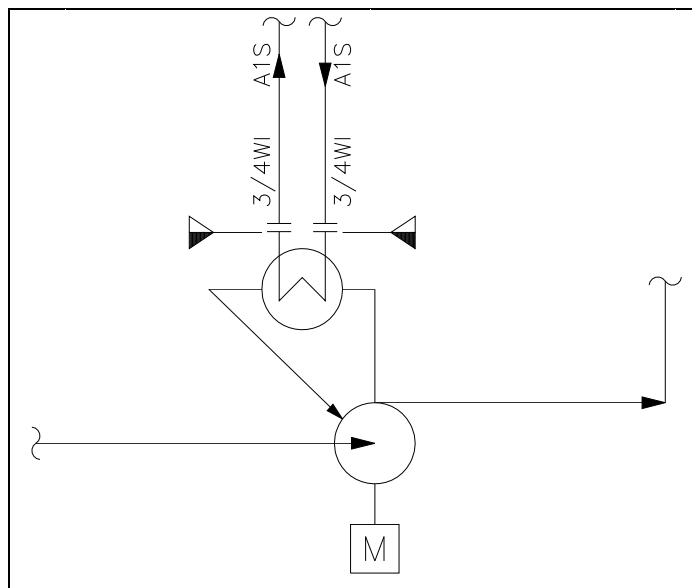
(i) Self Flushing

In general, they are not shown on P&ID and UFD. Refer to the following methods when special expression is necessary:

1. Without Cooler



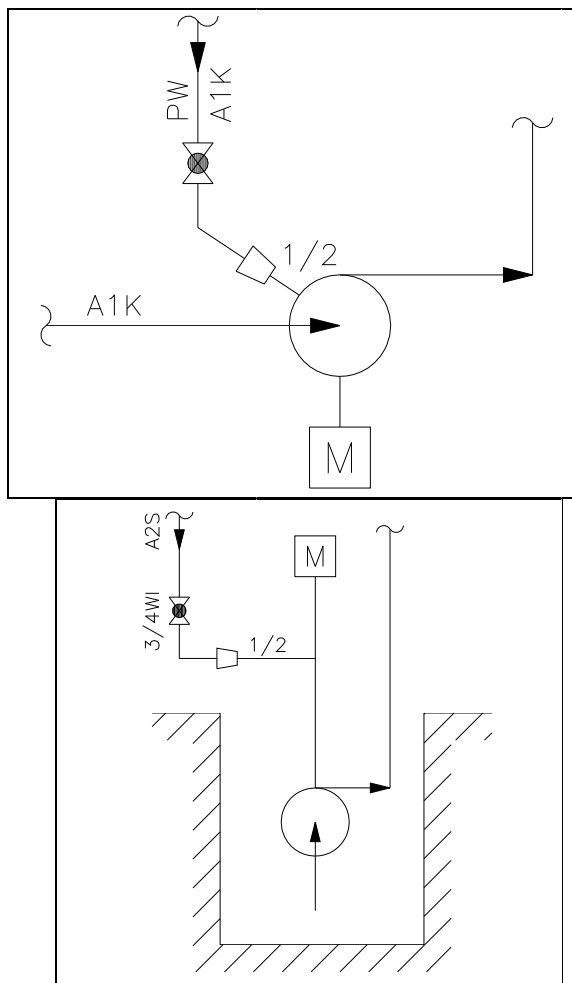
2. With Cooler



	PROCESS DESIGN MANUAL	SPD0049ERN
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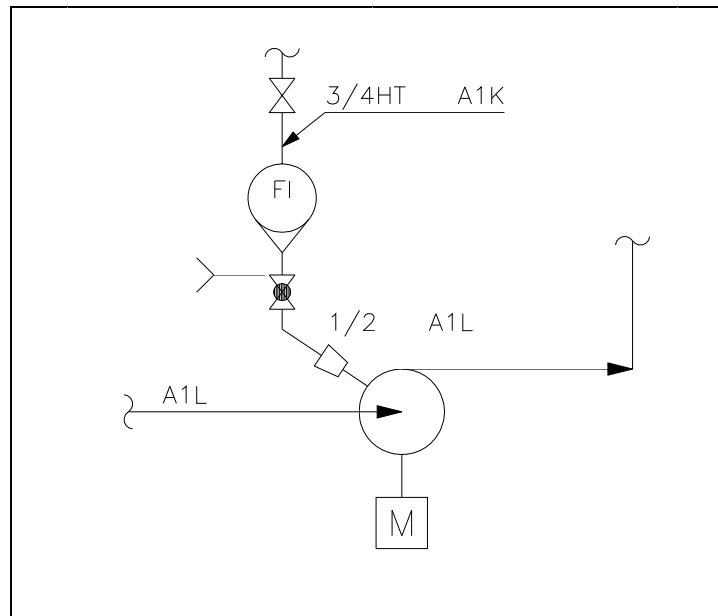
(ii) External Flushing

1. Without Flow Control



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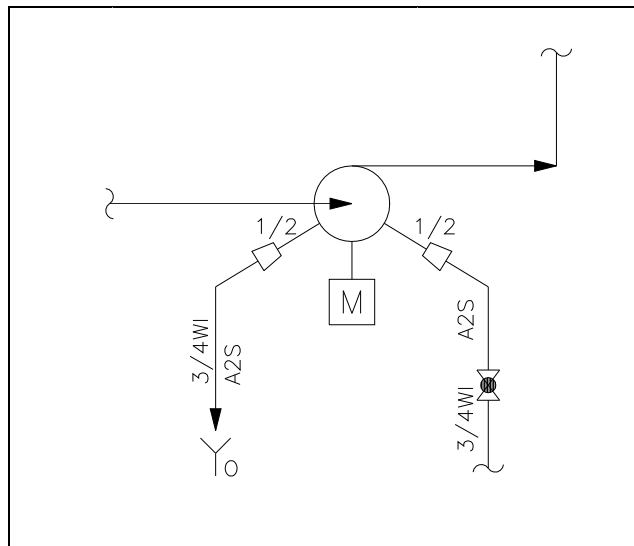
2. With Flow Control



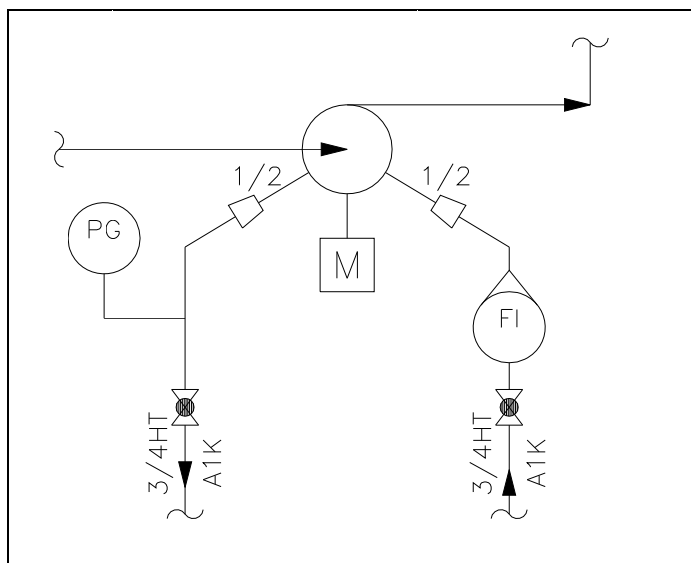
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c) Cooling liquid line (Centrifugal Pump)

(i) Open System



(ii) Close System



Remarks:

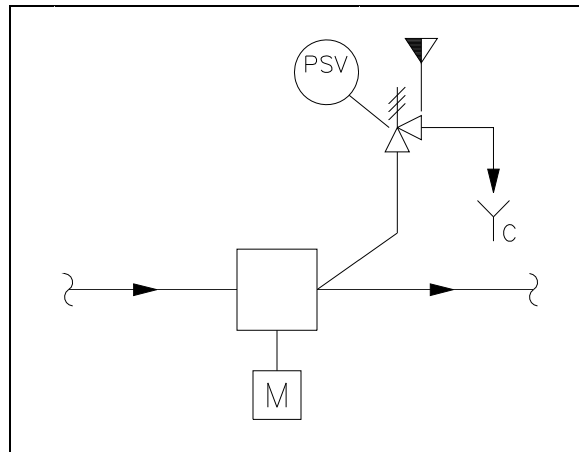
Install “PG” to control back-pressure and “FI” to confirm flow of cooling fluid because of closed pipe line.

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f) Safety Valve (Reciprocating Pump)

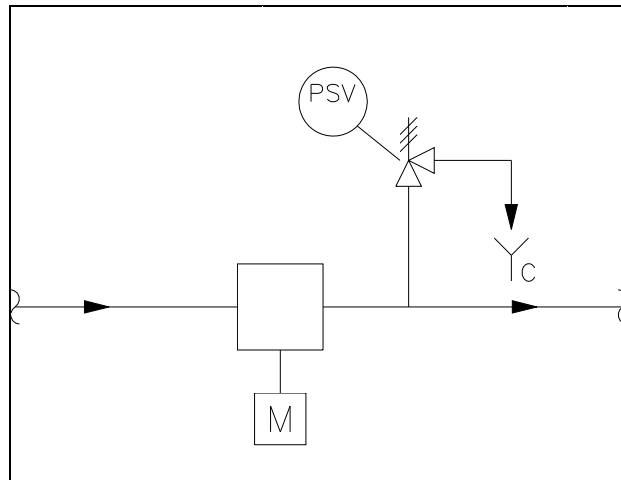
(i) Connection to the main body (mostly vendor portion)

1. Piston Type



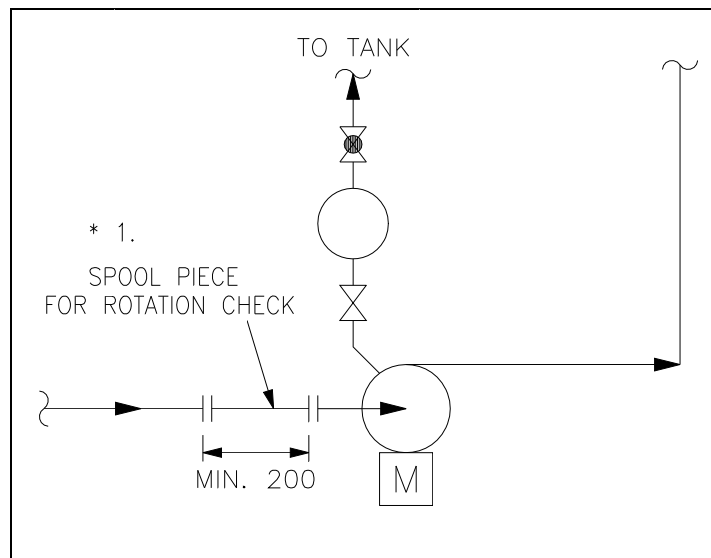
Safety valve installed on discharge nozzle .

(ii) Connection to Pipe Line (Piston Type)



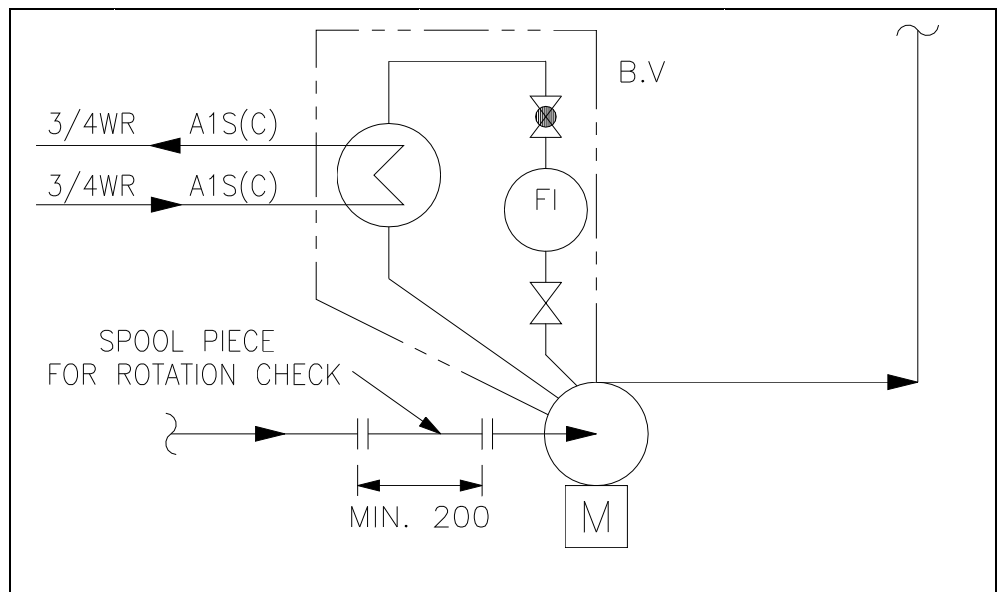
g) Recirculation of Non-seal Pump

(i) Recirculation to Suction Tank



Include recirculation rate in the hydraulic calculation of the suction line

(ii) Recycle to Pump Suction



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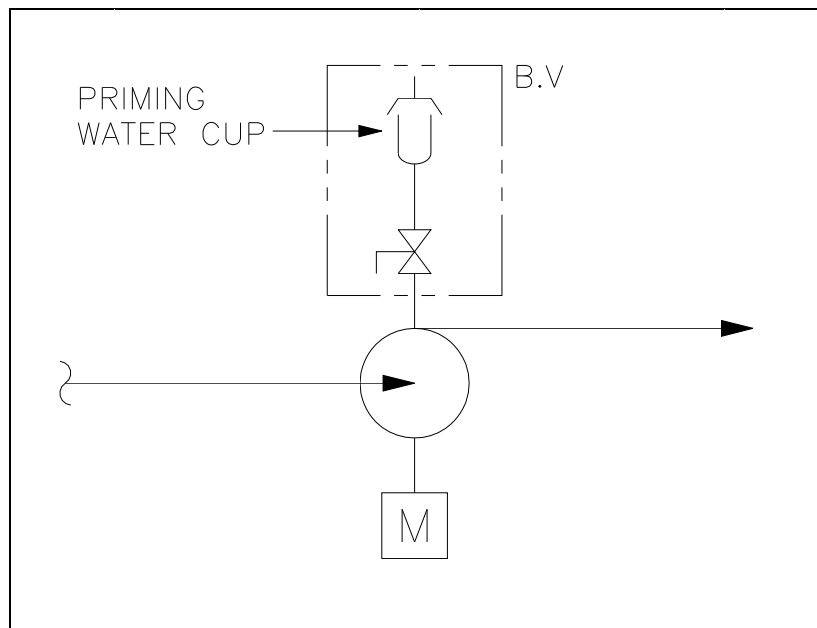
Remarks:

In general, precautionary items in pump selection, such as chilled water requirements for cooler, should be specified.

*Spool piece in suction line is needed for checking circulation direction of non-sealing pump.

h) Expression of Priming Connection (Centrifugal Pump)

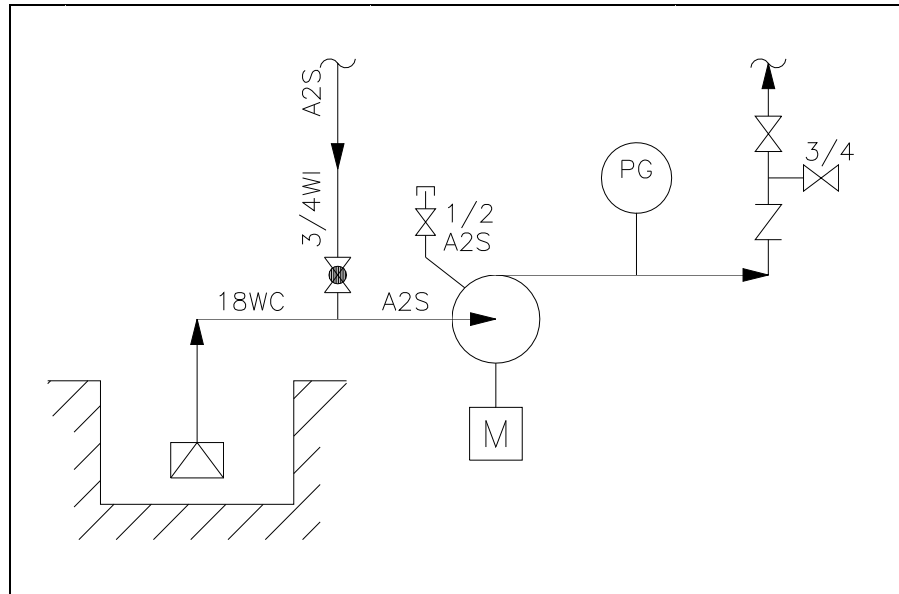
(i) Priming Water Cup



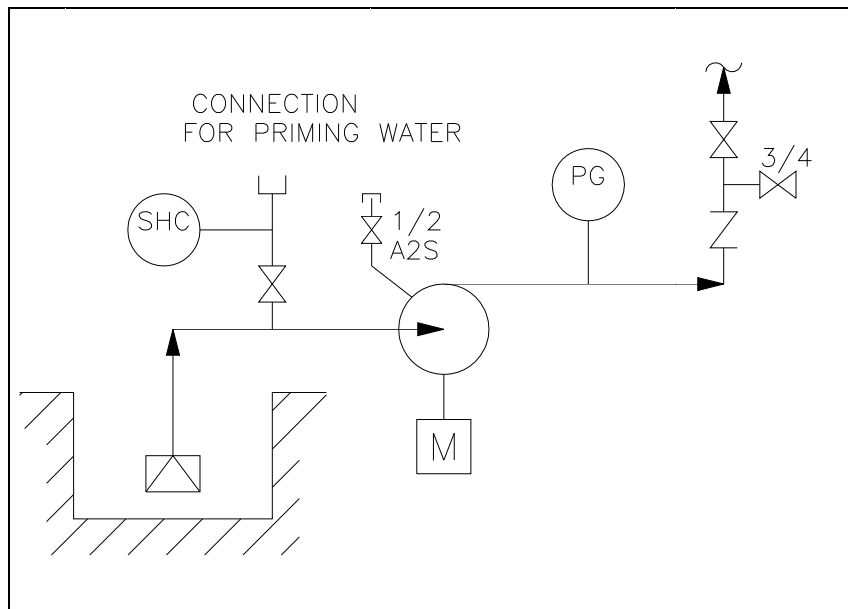
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(ii) Water supplying connection (large capacity pump with foot valve with strainer)

1. Fixed Connection



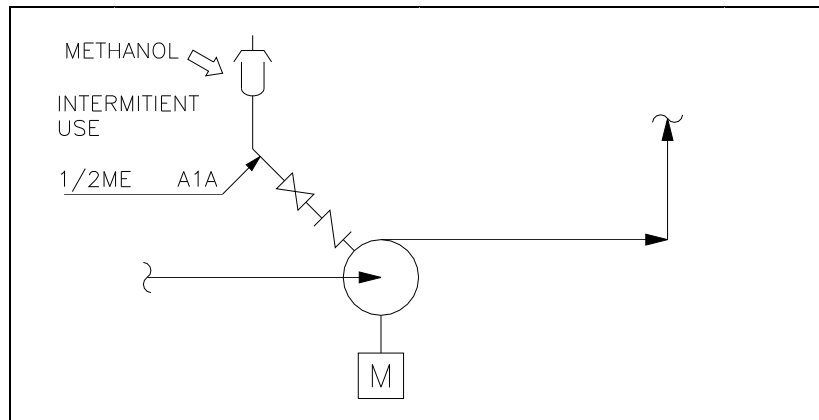
2. Hose Connection



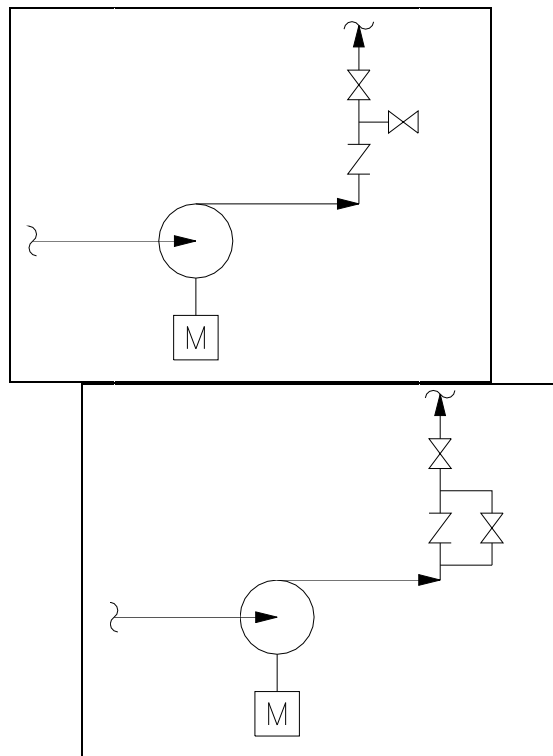
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i) Others

(i) Injection of Anti-freeze Solution

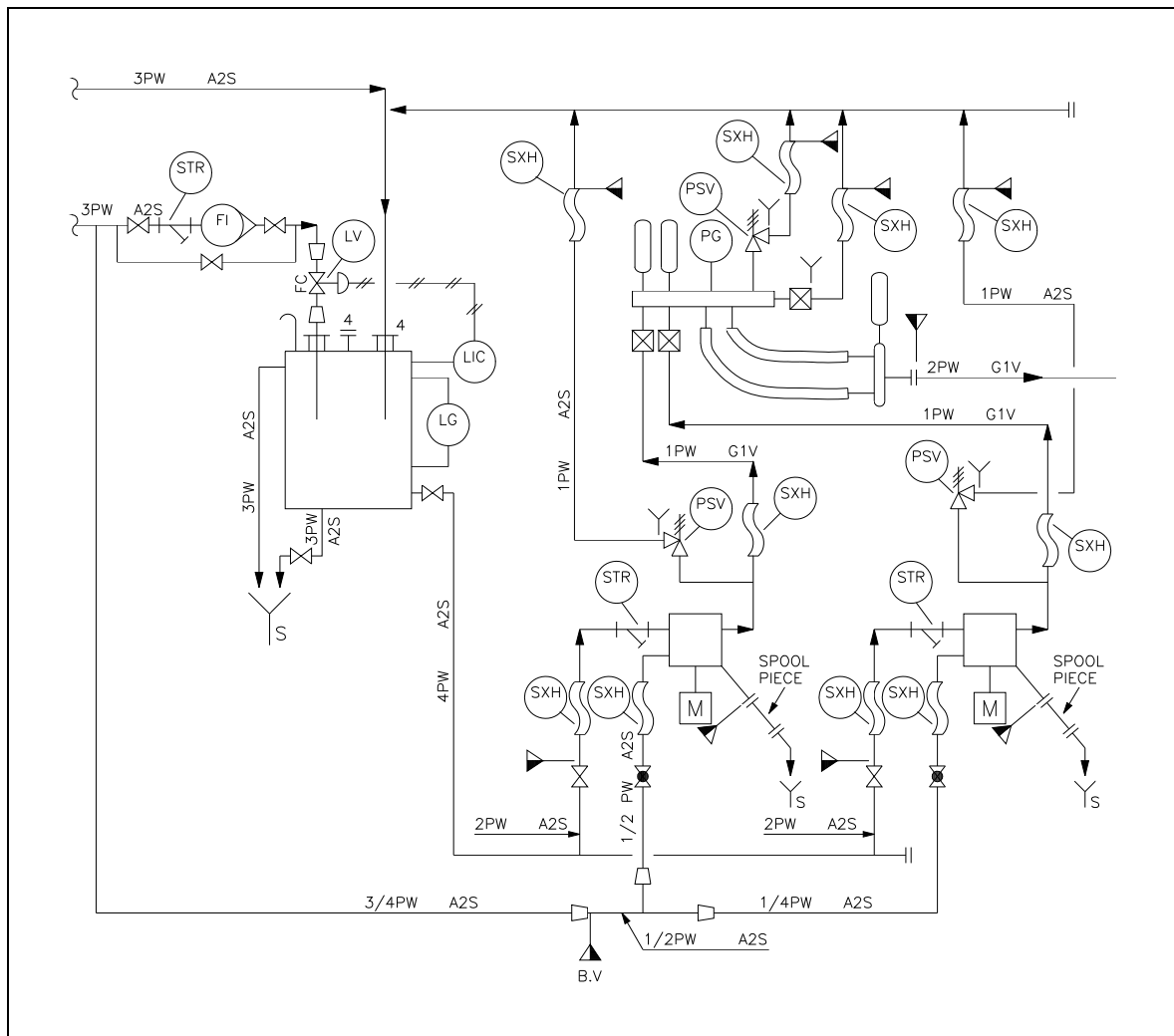


(ii) Around Check Valve



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(iii) High Pressure Plunger Pump



The figure above is an example of jet cleaning pump using horizontal triplex-plunger motor pump made by the Sukitsu Machine Company.

Discharge Pressure: 300kg/Cm²G, Flow Volume: 150l/min,
NPSH: required 3m

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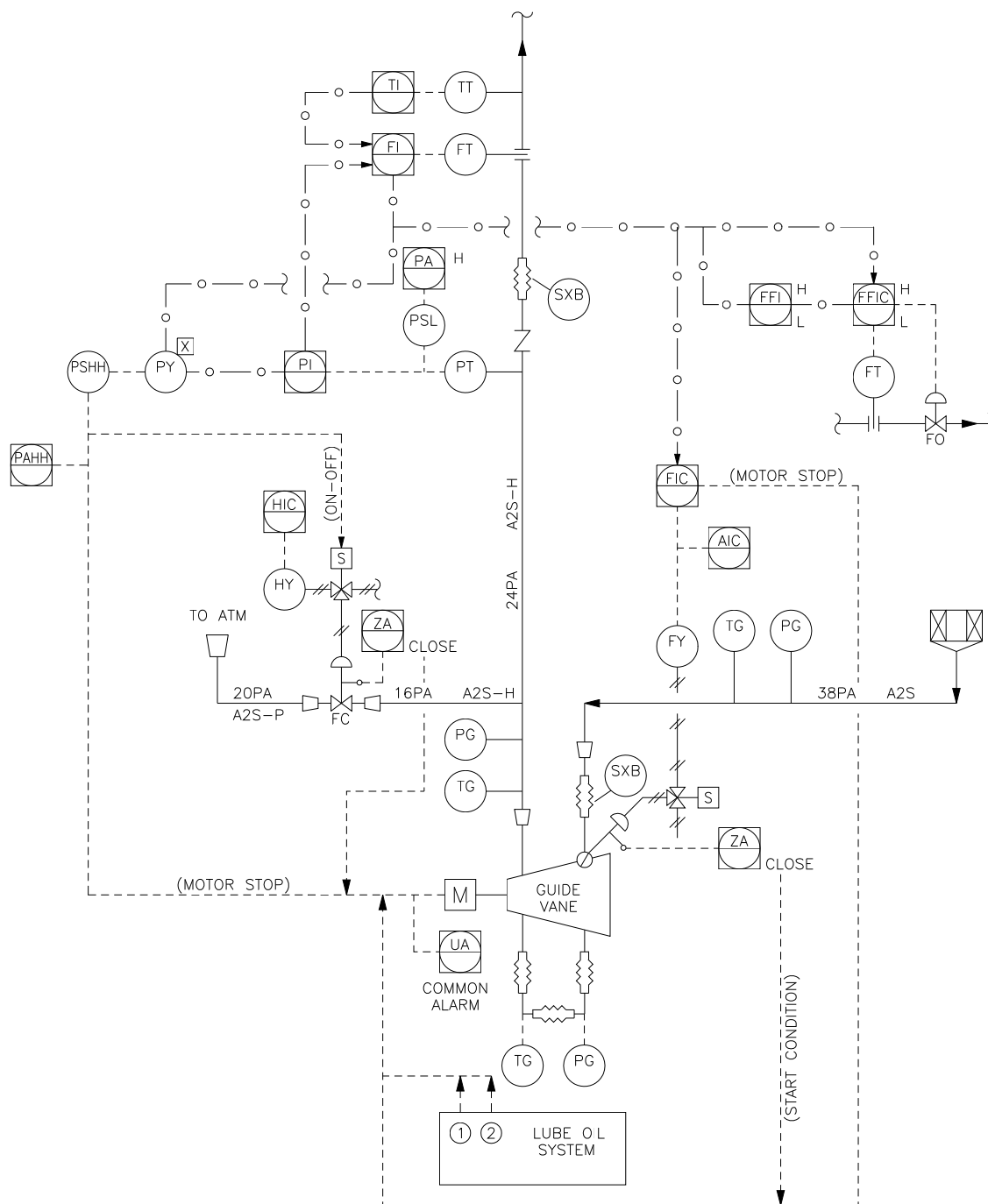
10.1.11. Compressor and Blower

a. Centrifugal Compressor

(i) Centrifugal Air Compressor for Process (Motor)

See following sketch.

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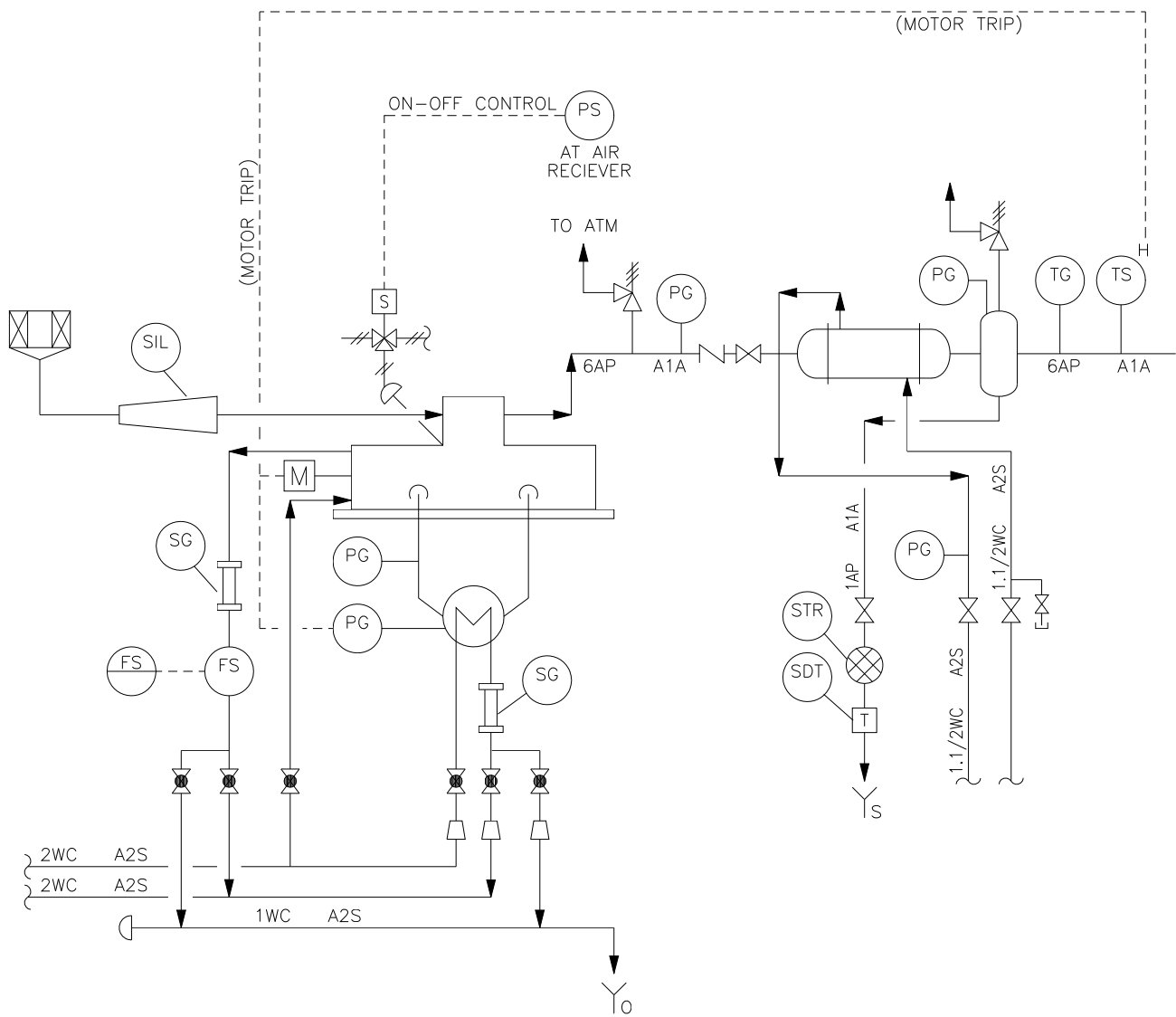
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Remarks:

- This figure exemplifies a process air blower.
- Even though a reactor is present in the middle, the system eventually vents directly to the atmosphere. This system does not need an anti-surge bypass because there is not much load variable. In addition, during a high load operation (in winter), the system is designed so that the blow-off line can be switched on and off by multiplication of discharge pressure and flow volume as not to engage with over load trip. Flow guide vane control is adopted.

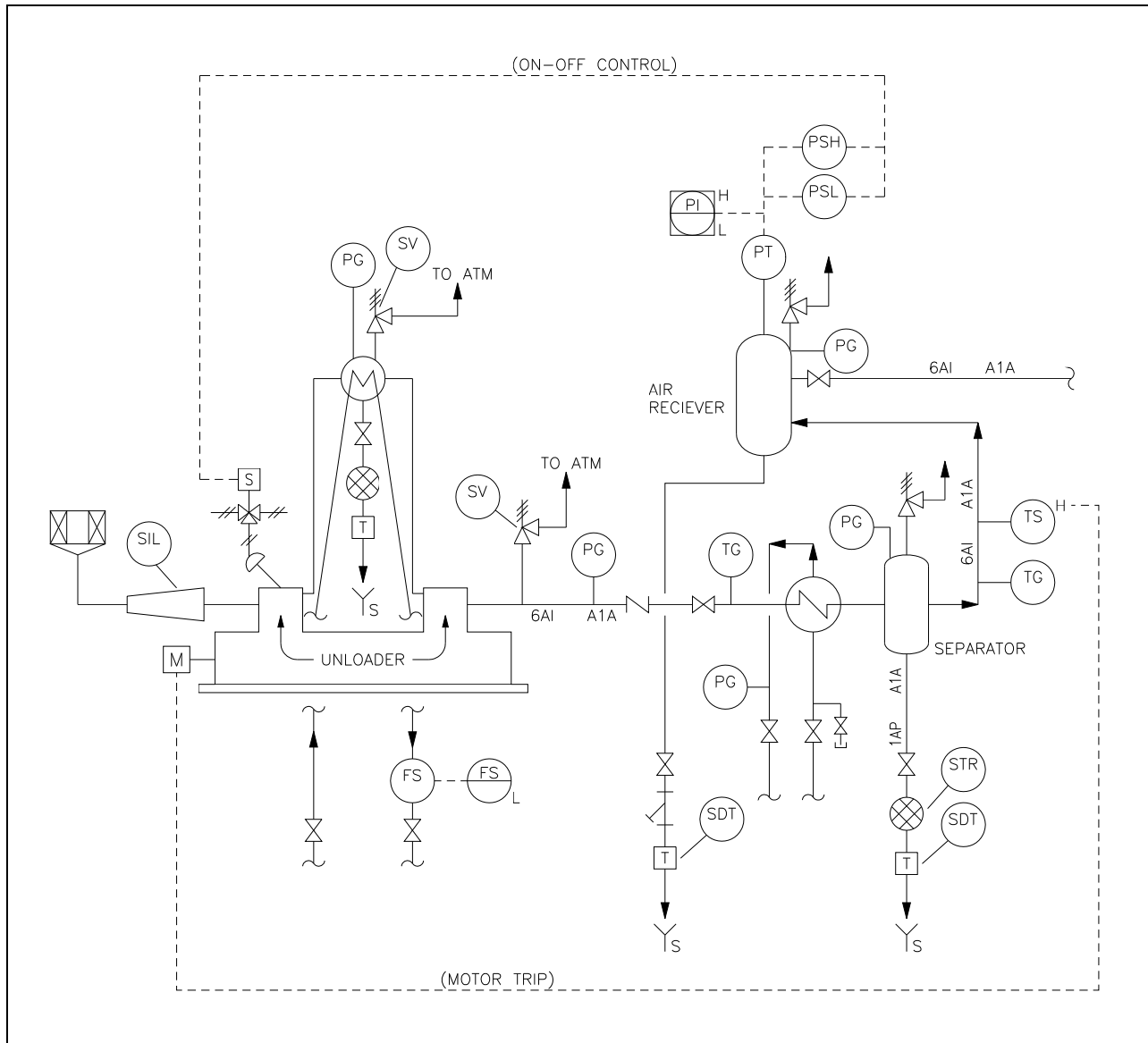
b. Reciprocating Compressor

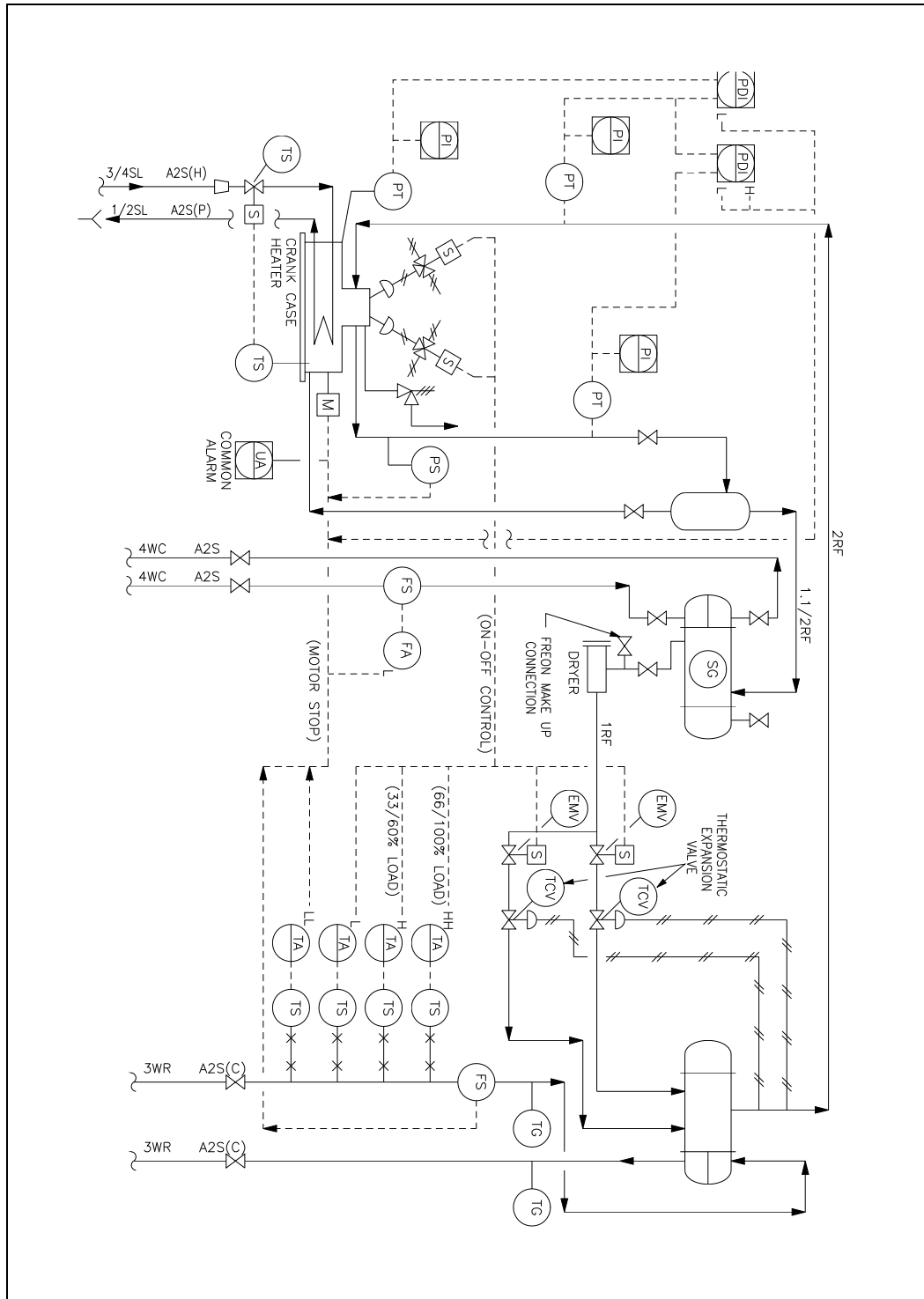
(i) Medium Size Air Compressor (One Stage Lubricating Type)



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(ii) Medium Size Non-Lubricating Two Stage Air Compressor





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Remarks:

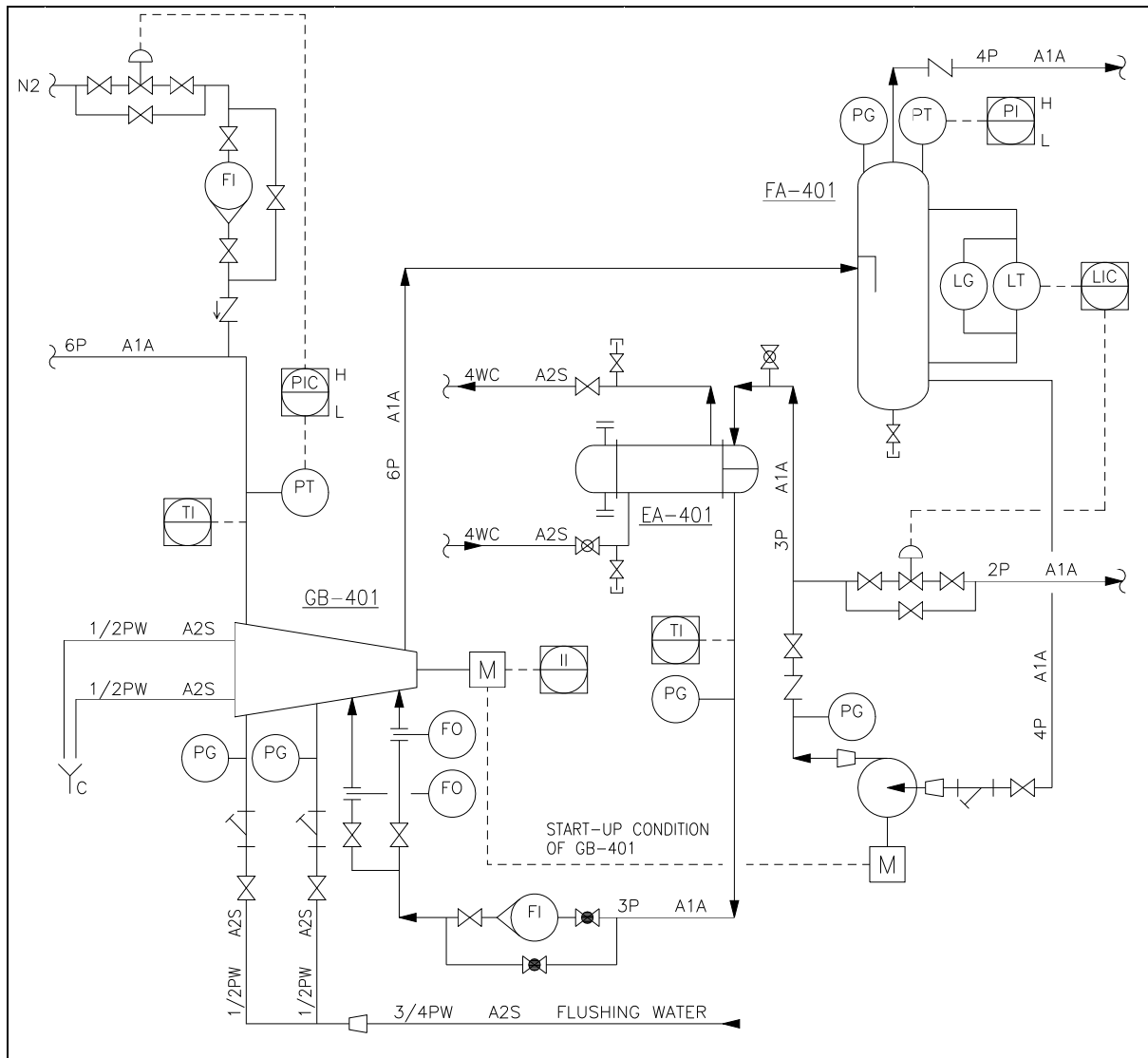
Since the chilled water volume change is significant, a 0%, 33%, 66%, or 100% unload system is selected. In addition, an interlock is installed to prevent freezing problems of chilled water due to freezing and cooling water stopping at the condenser. For protection of equipment, an interlock is installed to shut down the compressor when suction and discharge pressures are abnormal.

c. Water Sealed Vacuum Pump

(i) For Process System

See following sketch.

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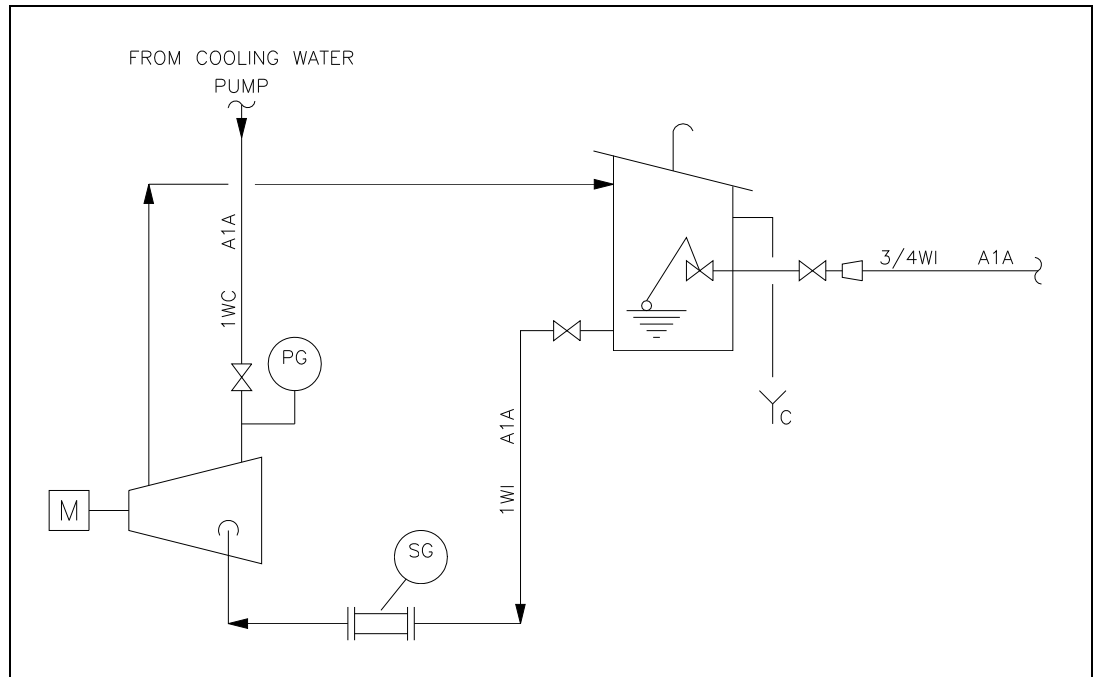


Remarks:

Permissive for GB-401 start when liquid seal pump is operating.

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(ii) Water Sealing Vacuum Pump for Cooling Water Priming



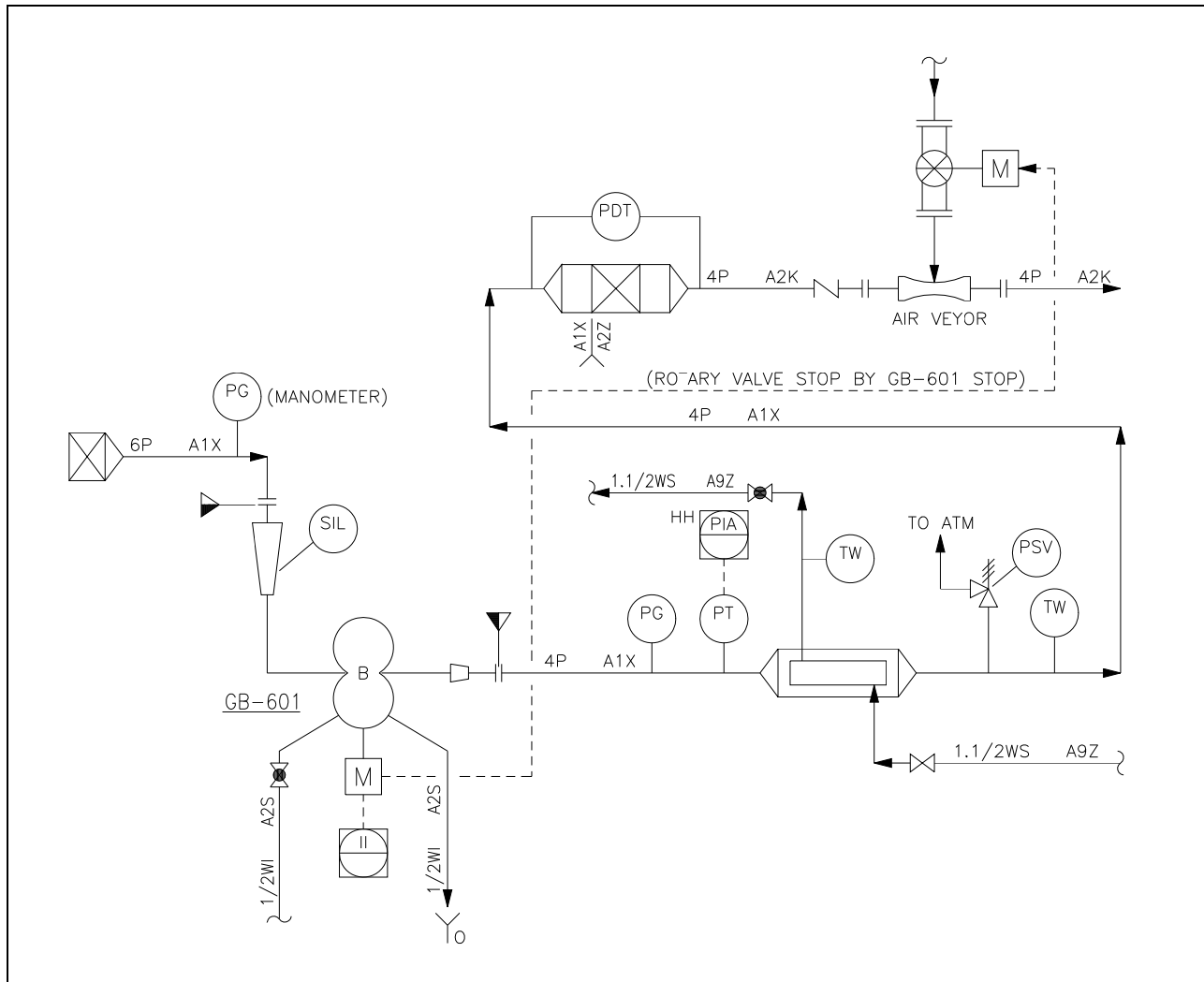
Remarks:

This pump is for quick cooling water start up, as sealing water supply is always maintained.

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e. Rotary Blower

(i) Example 1



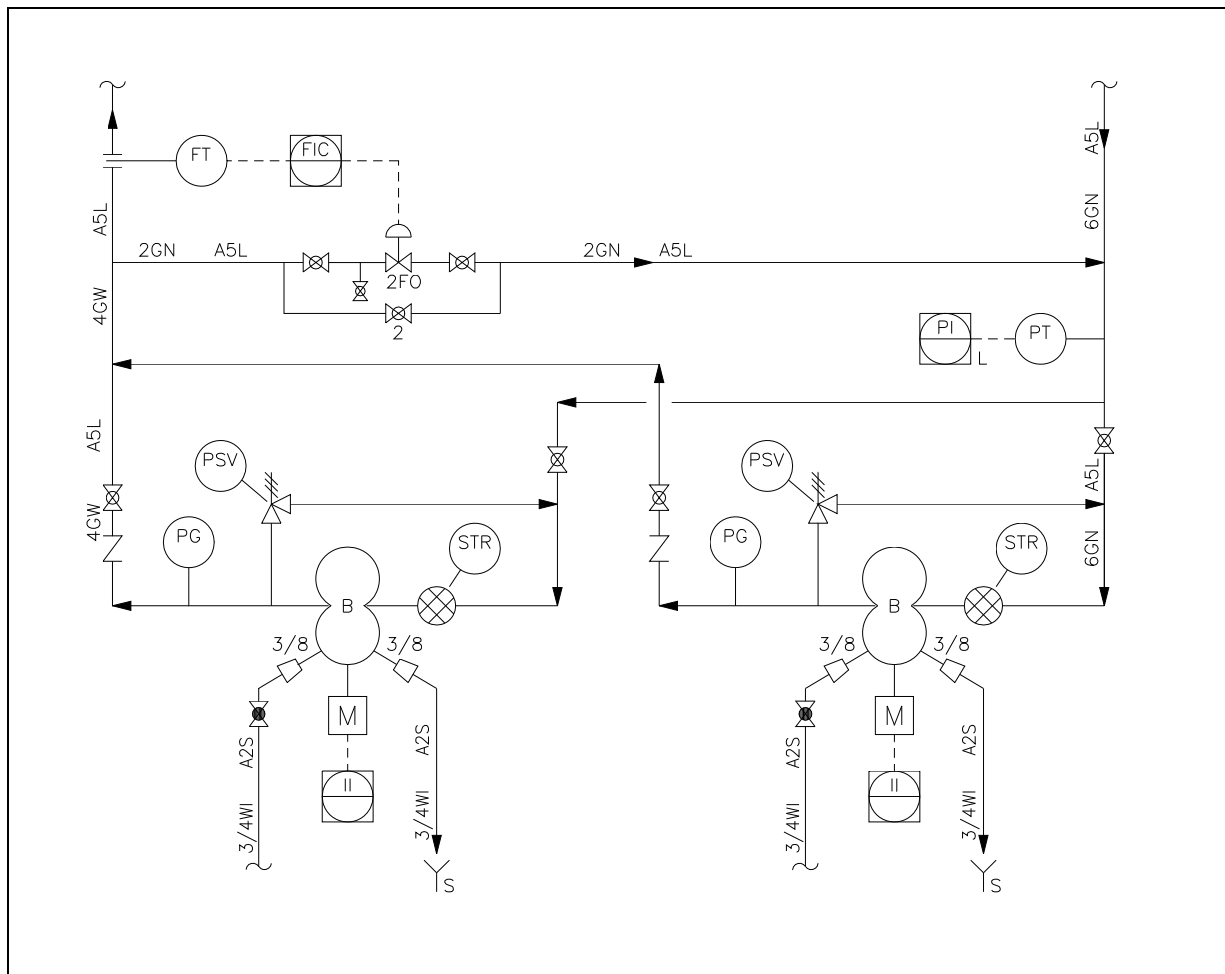
Remarks:

This is an example for a rotary blower system that transfers the powder material pneumatically. Due to a high atmospheric temperature, discharge temperature is cooled to the limit

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temperature of the powder materials. At the blower operating conditions, the interlock of the pneumatic transfer system is used to stop the rotary valve in the powder material supply. If not done that way, re-start is not possible without removing the powder materials settled inside the pipeline.

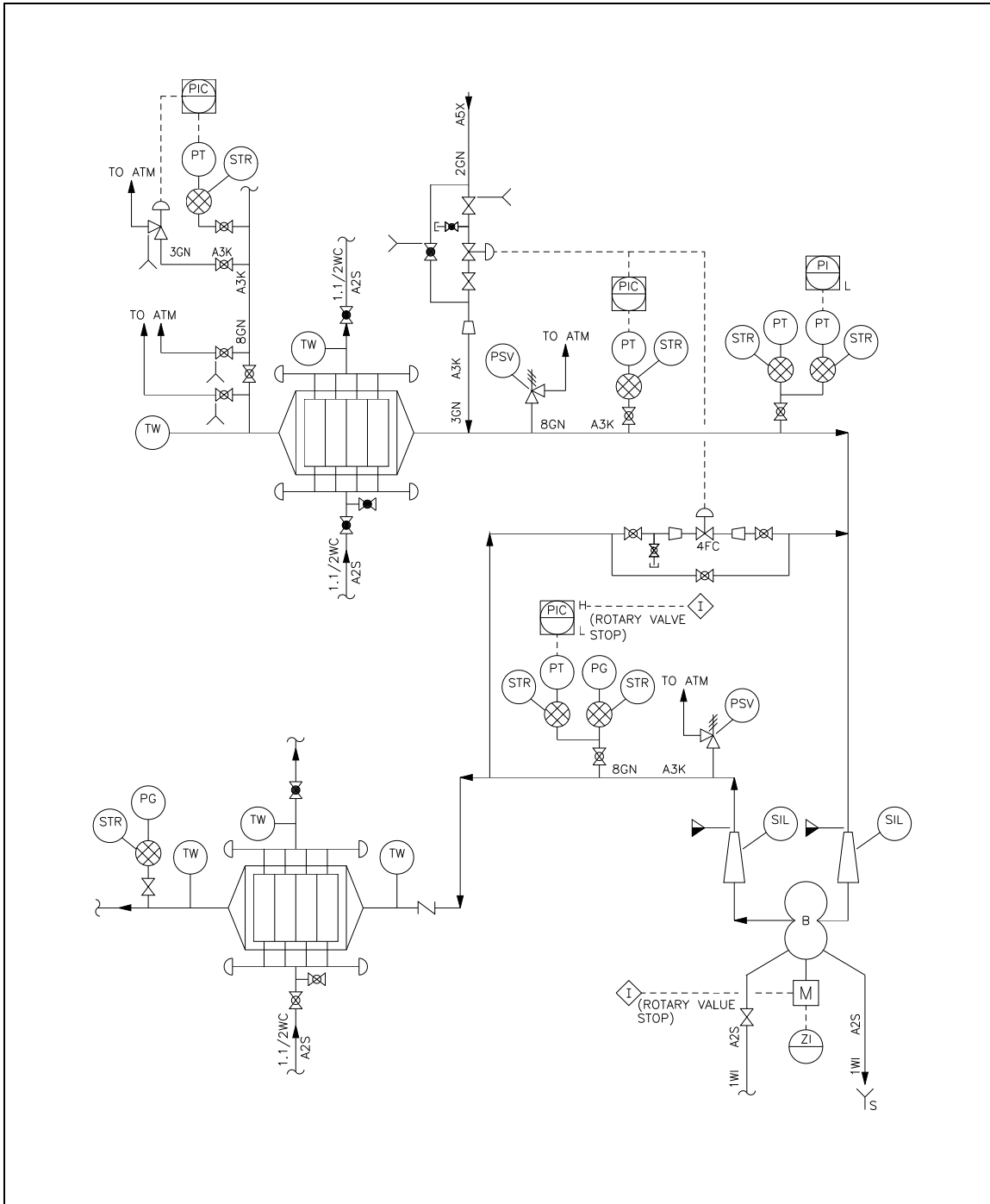
(ii) Example 2



Remarks:

This is an example of the rotary blower system transfer of the powder material pneumatically by a closed loop.

(iii) Example 3



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Remarks:

This example shows a rotary blower used in closed loop powder materials pneumatic transfer system.

Due to the temperature limit of the powder materials, the cooler shall be installed at the blower outlet side to control blower outlet temperature. Also, by installing a cooler at the blower inlet side, eliminate the temperature rise caused by the heat transfer of powder materials.

Note:

The strainer downstream of the pressure transmitter valve has an important and special shape to prevent plugging.

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temperature region, temperature rise is prevented by completely stopping the heat transfer by the use of an external cooling system.

10.1.13. Sealing Method of Low Pressure Tank

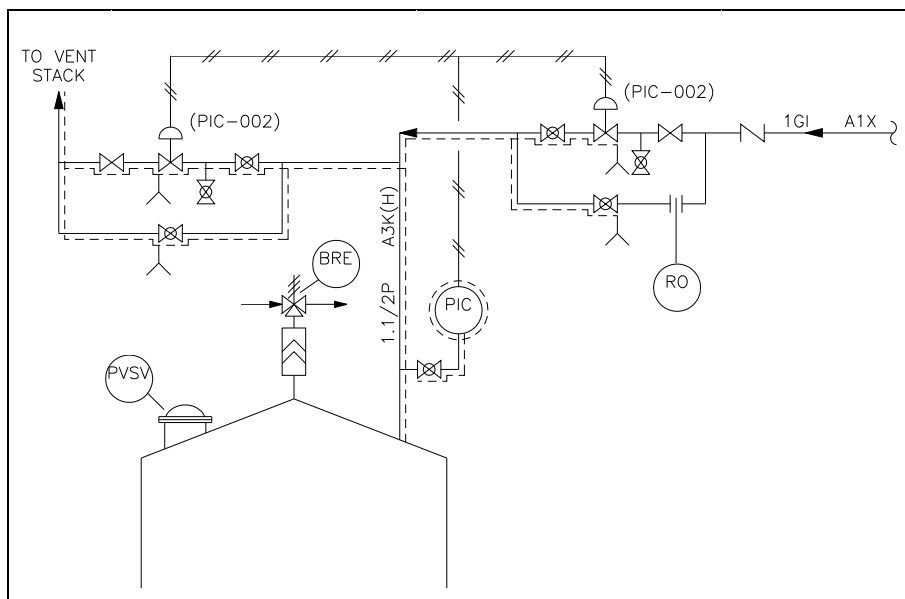
a) Inert gas blanketing

*Nitrogen: It is possible to apply to all fluids.

**CO₂: Its usage is restricted because of reaction with NH₃ and food production.

b) Control Valve Type

(i) Single Tank Sealing



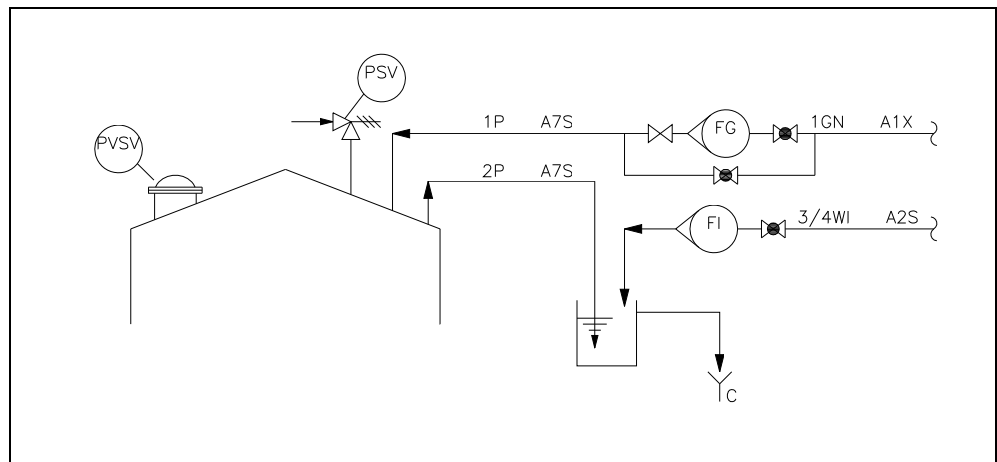
Remarks:

- Steam tracing is installed because in this case the tank internal vapor can easily be condensed.
- In case of flammable liquid, pressure-vacuum relieving device must be installed.

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c) Water Sealing Type

(i) Water Sealing

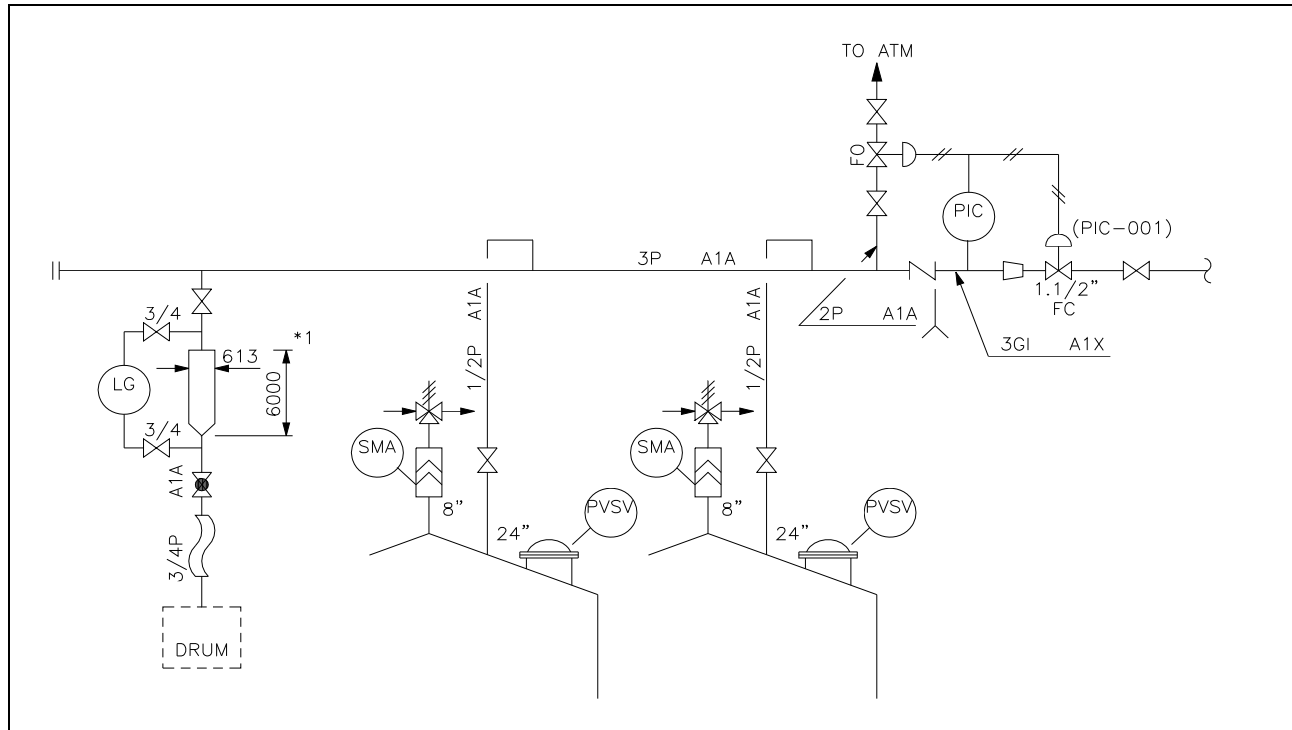


Remarks:

- This is an example of nitrogen sealing.

(ii) Common Sealing of Multi-Tank

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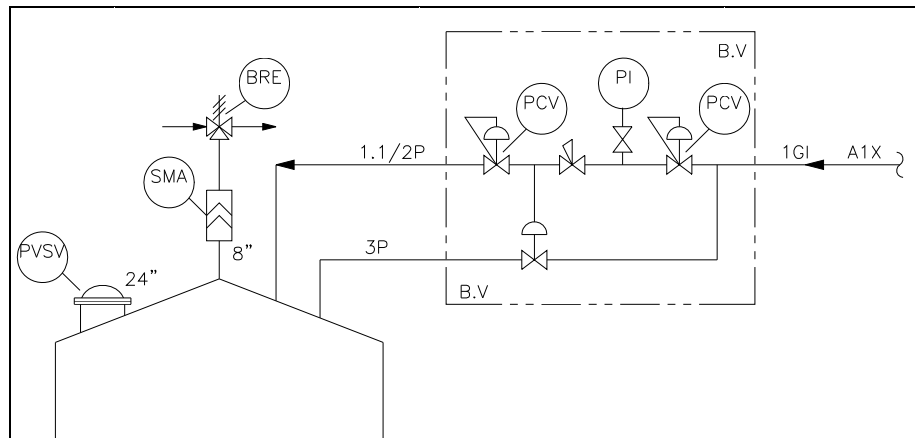
Remarks:

This method is applicable in cases where there is a possibility of contamination via the seal gas header.

*1 In lieu of drain pot, direct connection to the slop tank would be preferred.

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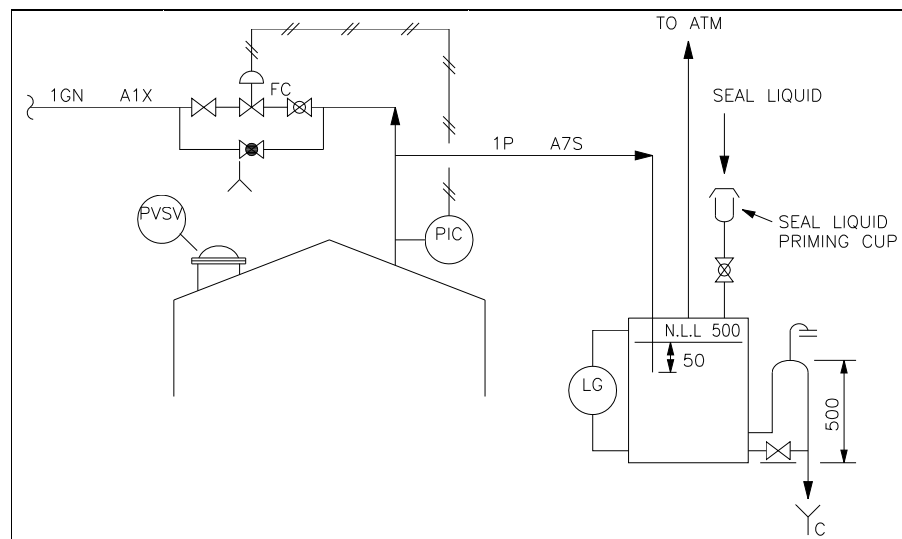
(iii) When a pilot operated valve is used



Remarks:

A breather valve must be installed

d) Seal-Pot Type

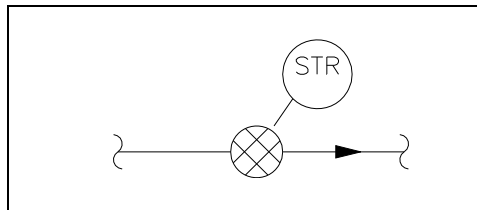


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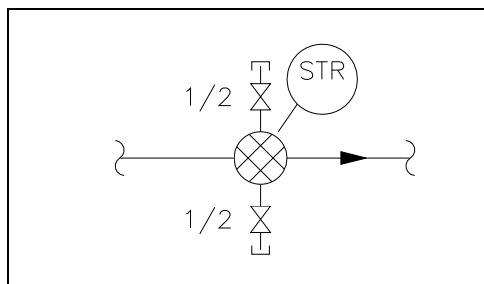
10.1.14. Strainer

a) General Expression

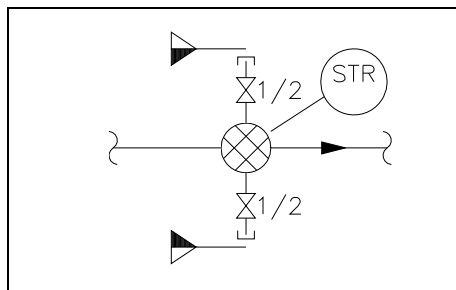
(i) When drain valve or vent valve is not necessary



(ii) When drain valve or vent valve is necessary



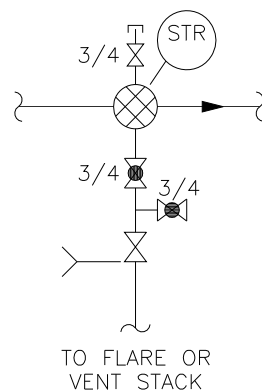
(iii) When drain and vent valve are vendor's supply items



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b) When drainpipe is connected

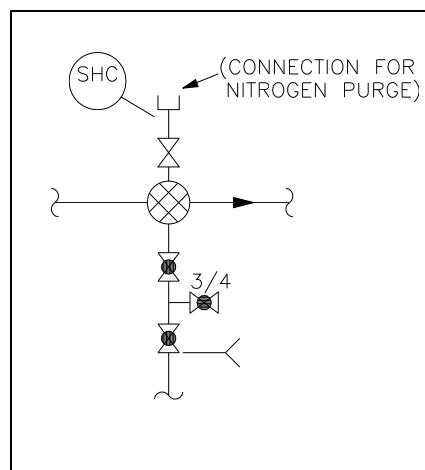
(i)



Remarks:

This figure shows the case when flammable or toxic fluid that is easily polluted and is sent to vent stack or flare.

(ii)



This example also portrays the case mentioned in Section (i) above, where it is desired to purge completely with N₂.

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10.1.15. Insulation and Tracing

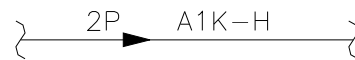
For the basic expression method for insulation, refer to Section 7.3.6 or Section 7.4.3.

a) Equipment Insulation

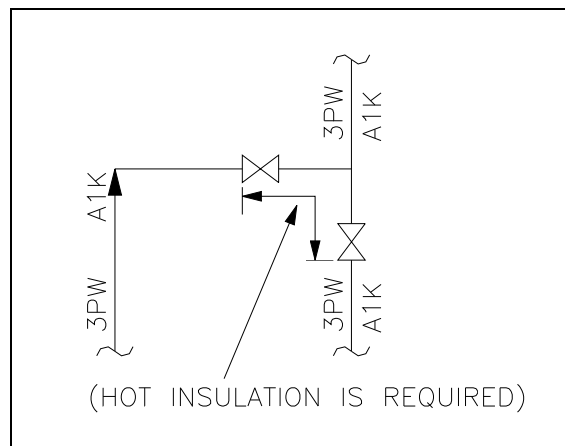
Refer to Section 7.3.6 (2).

b) Piping Insulation

(i) Hot Insulation (Keep Warm)

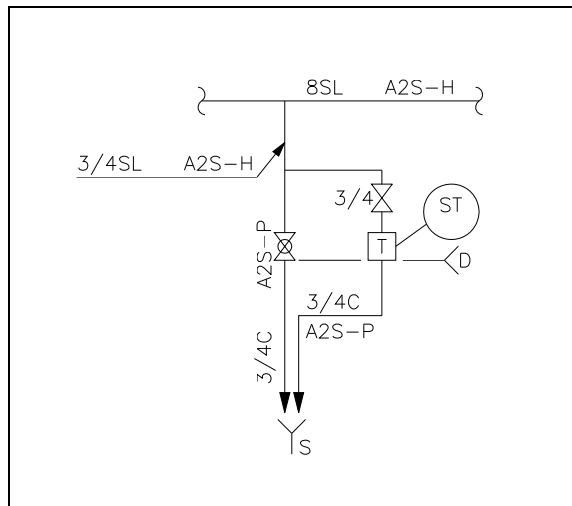


(ii) Partial Insulation

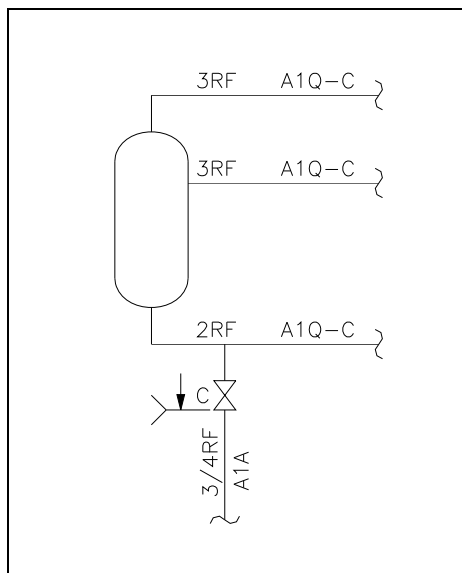


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(iii) Boundary expression between hot insulation (keep warm) and personal protection



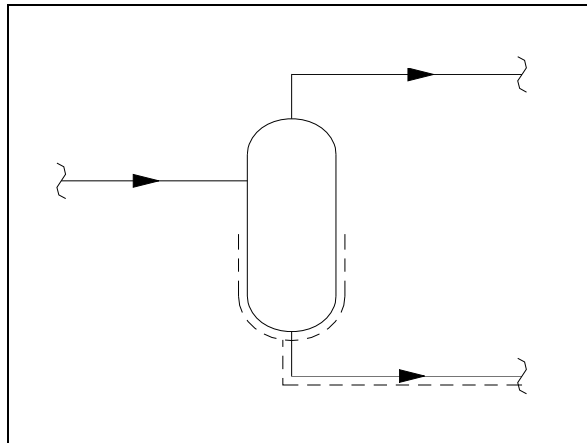
(iv) Boundary of Cold Insulation (Keep Cold)



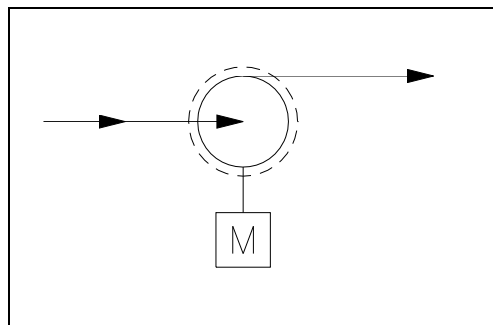
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c) Equipment Tracing

(i) Steam Tracing of Tower Bottom side

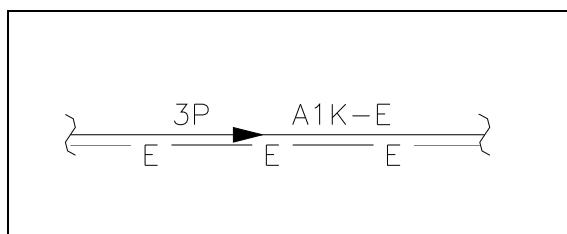


(ii) Steam Tracing of Pump



d) Pipe Tracing

(i) Electric Tracing

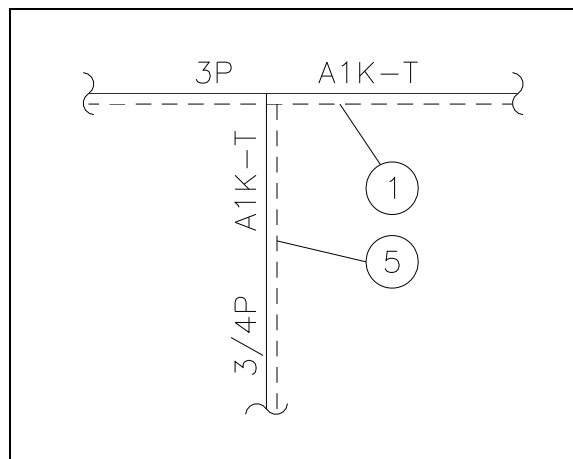


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(ii) Steam Tracing



(iii) When there are various steam-tracing methods.



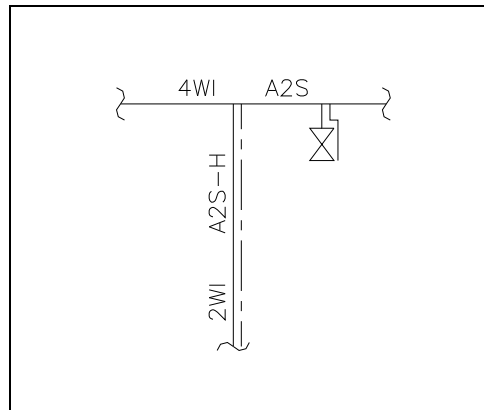
*Use this method when the method is determined based on the job specific requirement.

(iv) Hot Water Tracing



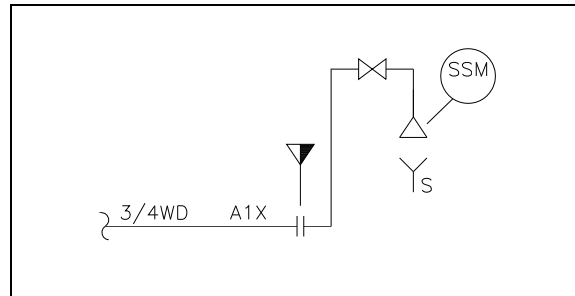
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(v) Partial Hot Water Tracing

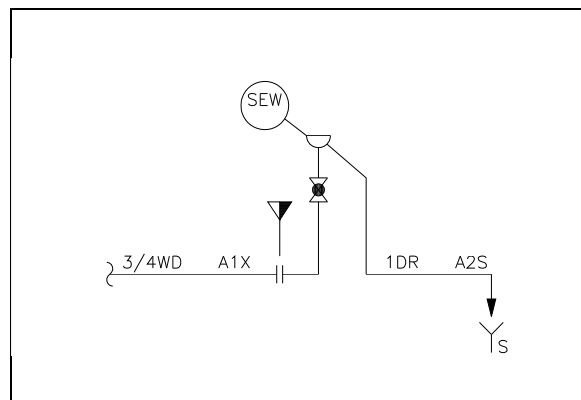


10.1.16. Shower & Eye Wash

a) Shower

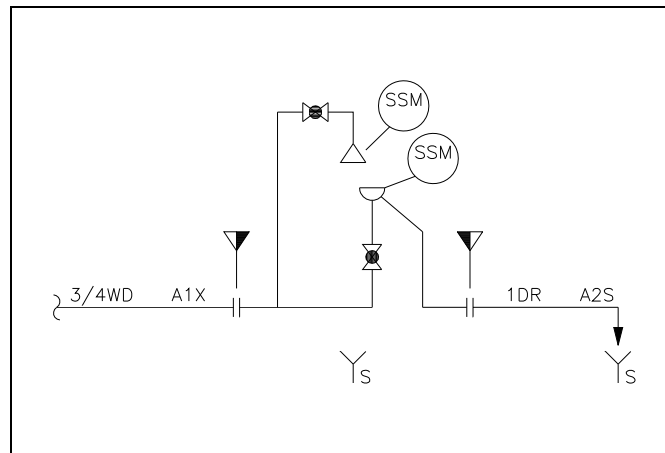


b) Eye Wash



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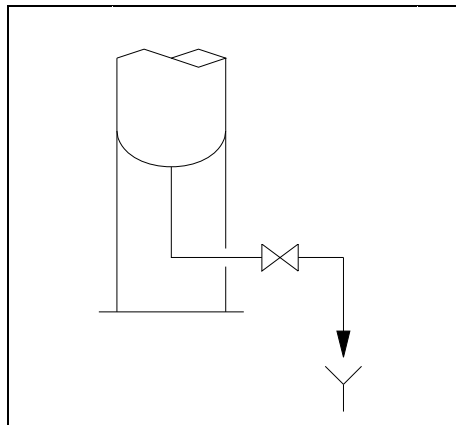
c) Shower and Eye Wash



10.1.17. Typical Vent/Drain Systems

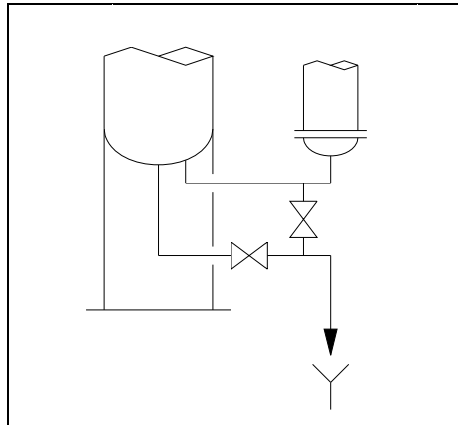
a) Tower Drain

(i) Open Drain

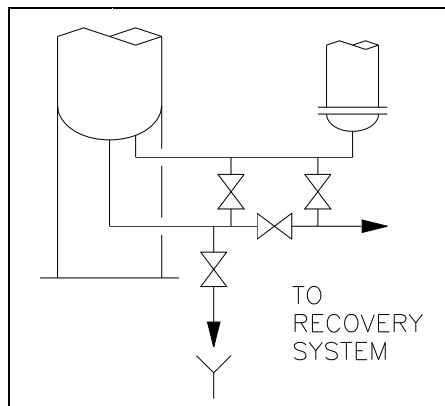


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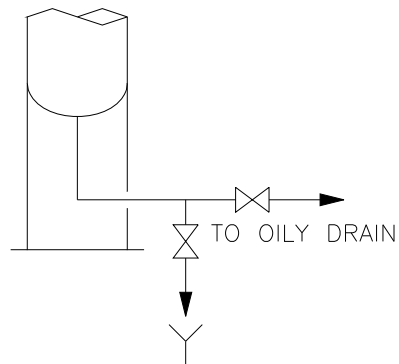
(ii) Open Drain (with Reboiler)



(iii) Oily Drain Recovery (with Reboiler)

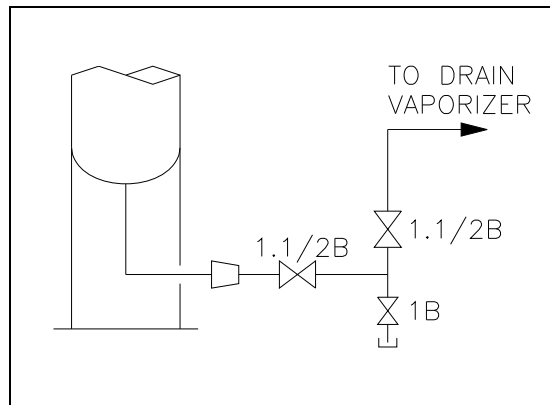


(iv) Oily Drain Recovery

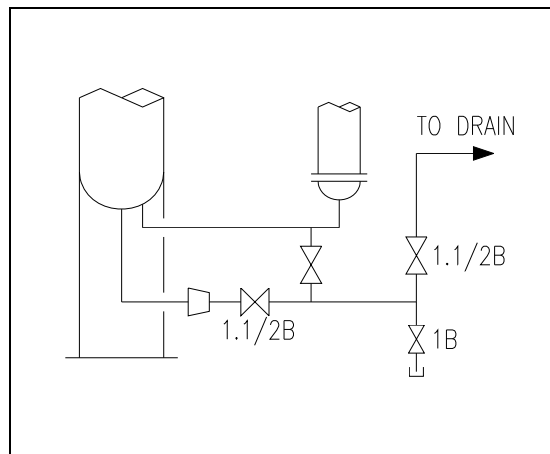


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(v) Liquid Drain System



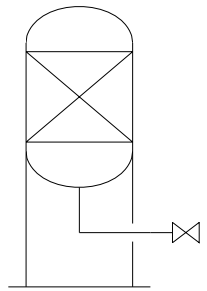
(vi) Liquid Drain System (with Reboiler)



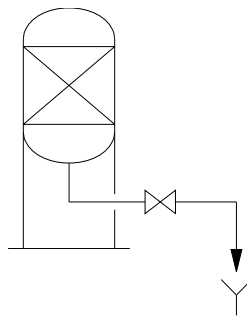
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b) Drum Drain

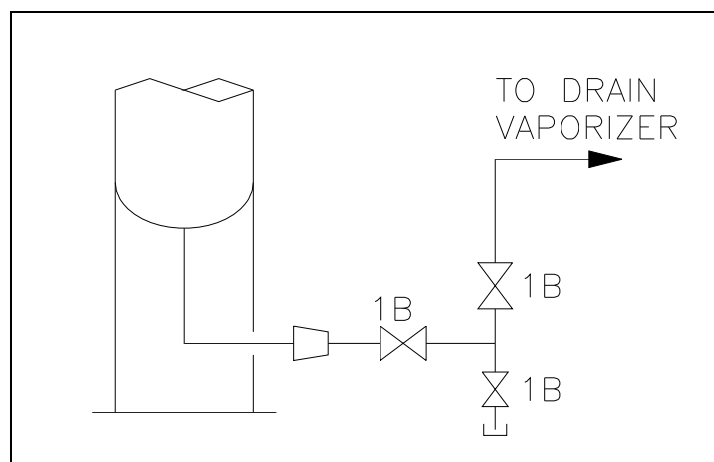
(i) When not draining during operation



(ii) When draining is needed during operation



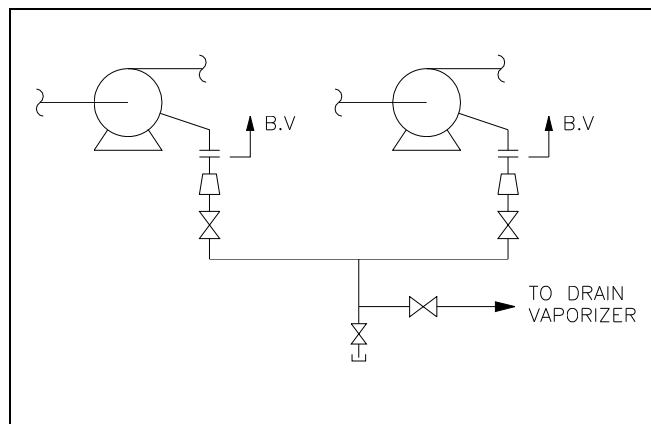
(iii) When needed to be routed to drain vaporizer



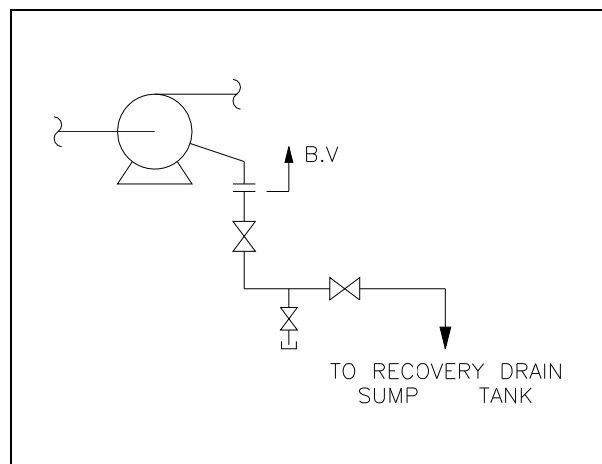
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c) Pump Drain

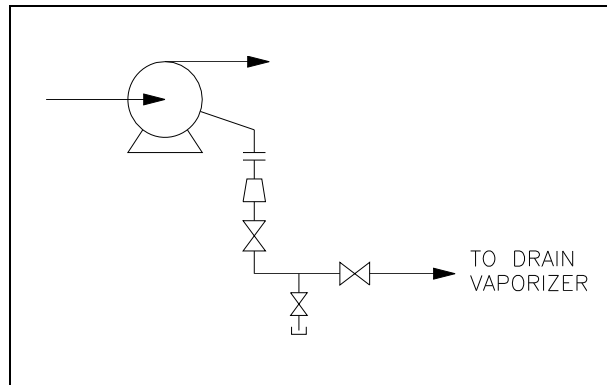
(i) For light hydrocarbons (lighter than C₄)



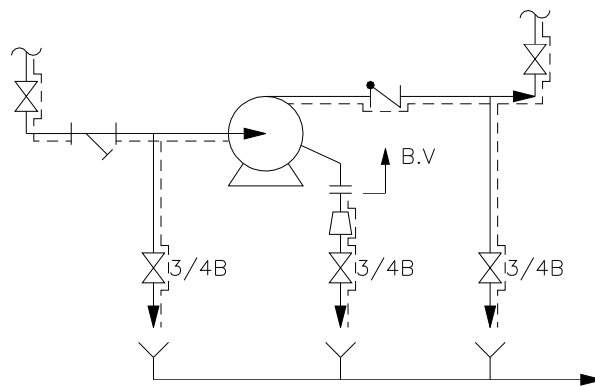
(ii) For heavier hydrocarbons (heavier than C₅) that require recovery



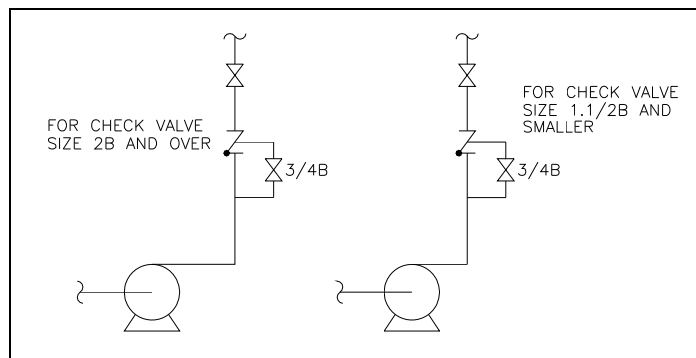
(iii) Liquid drain for hydrocarbons lighter than C4



(iv) In case of gum forming polymer and viscous fluids



(v) Pump Discharge Line

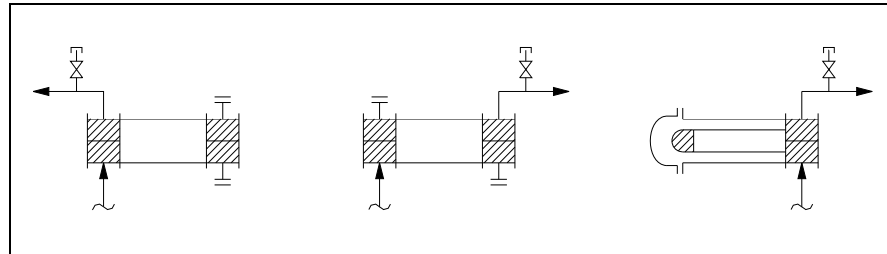


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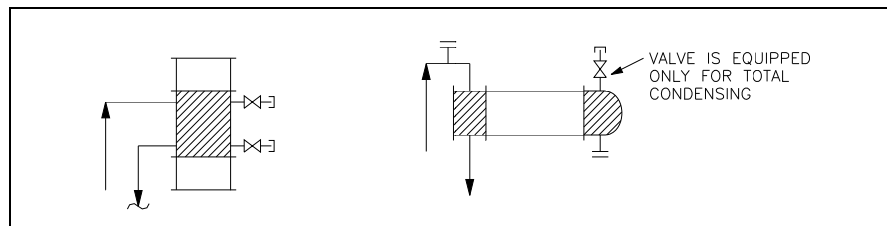
(vi) Drain pump suction/discharge line through pump

d) Vent/Drain of Heat Exchanger

(i) Cooling Water Service Case

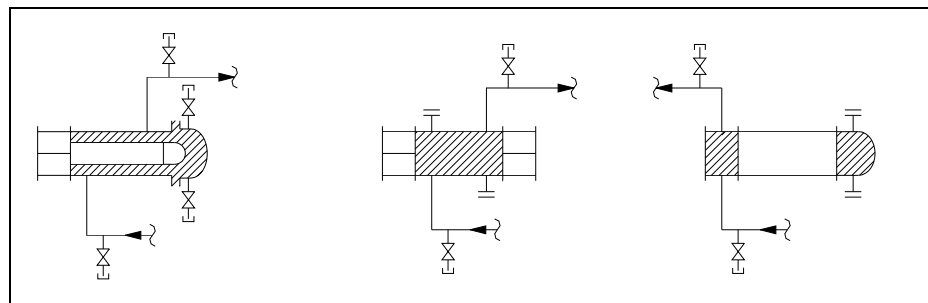


(ii) Steam Condensing Case



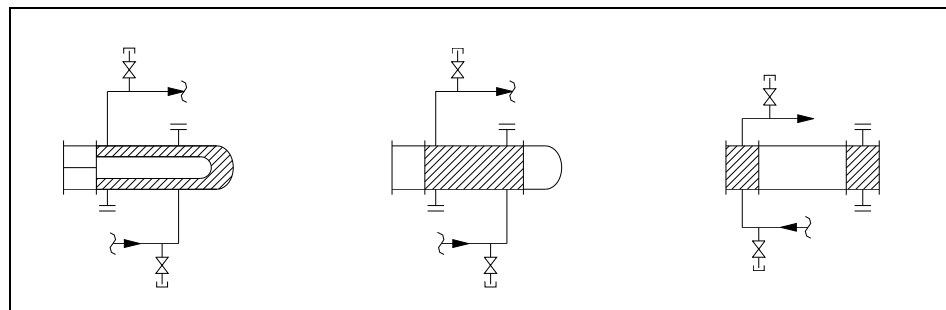
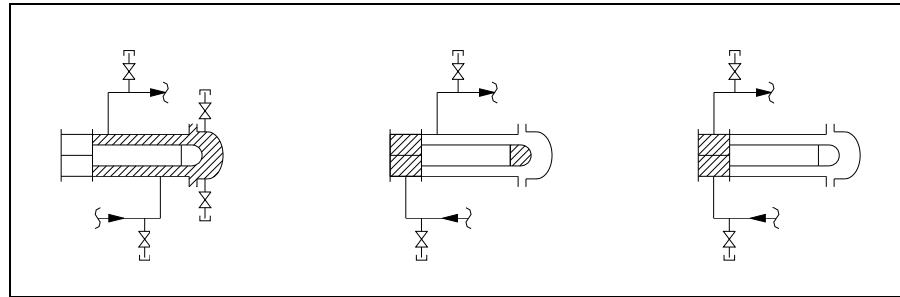
(iii) Install double valve for the very high-pressure steam.

(iv) Water Service Case except for Cooling Water

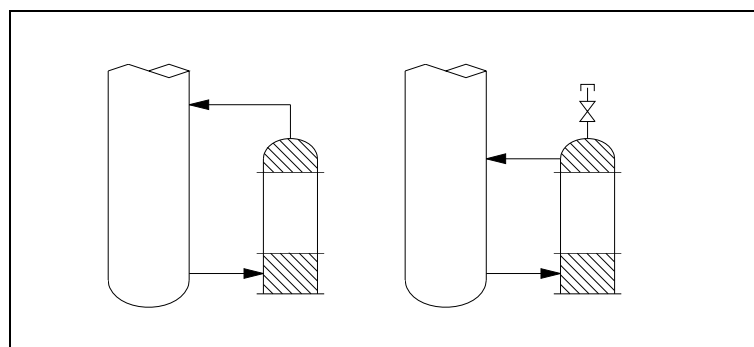
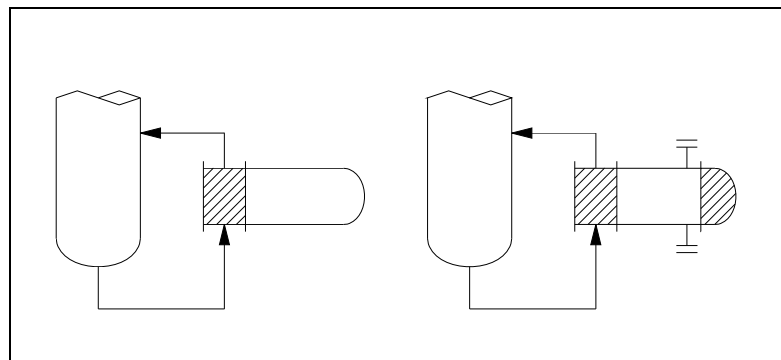


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(v) Process Service Case

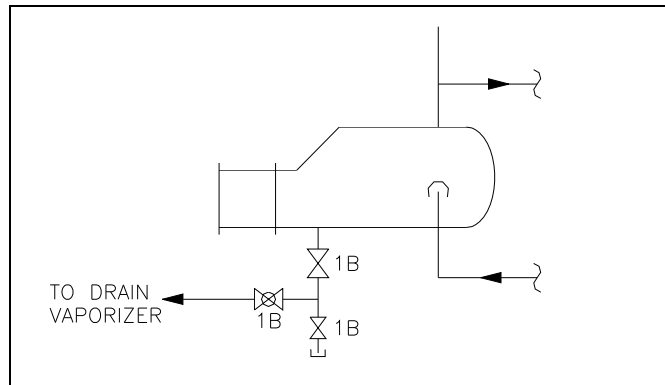


(vi) Reboiler Case

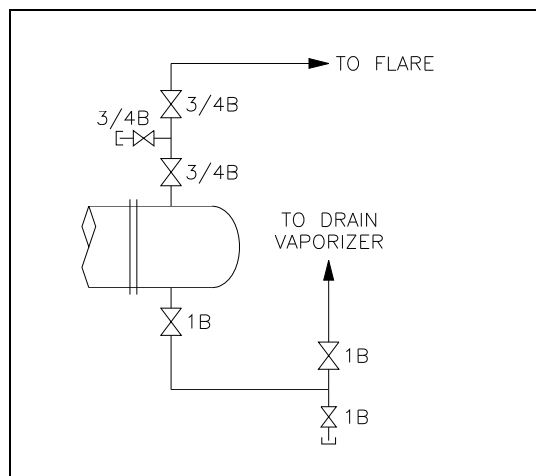


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(vii) Refrigerant Service Case



(viii) Closed System Case

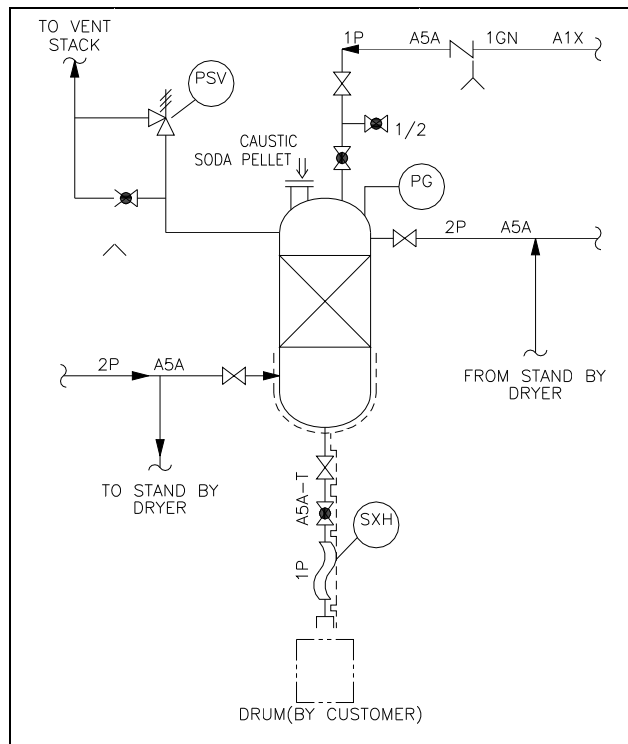


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10.1.18. Purge Piping and Connection

a) For Equipment Purge

(i) Purge Piping



Remarks:

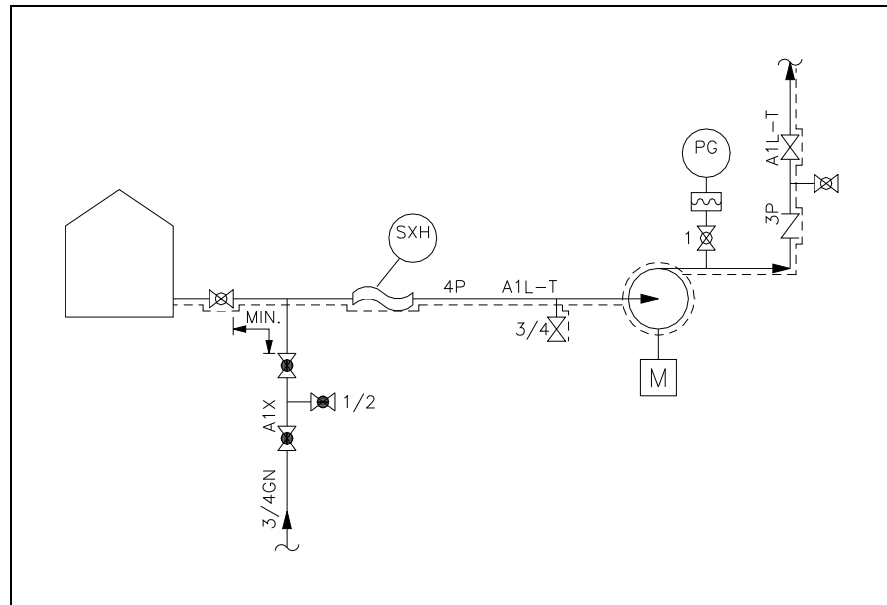
The figure above shows a tower that is in service for absorption and removal of water vapor in the fluid by using solid caustic soda. Because caustic soda, as a 50% water solution, will remain at the bottom of tower, the bottom water needs to be drained every 1-2 month and fresh caustic soda needs to be added as necessary. During this time, after completely depressurizing the vessel, nitrogen will be used to pressurize and purge the vessel multiple times. After that, the 50% bottom water solution and supply caustic soda pellet

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should be drained out through the bottom of the tower. Caustic soda pellet will be added via the handhole on the top.

b) For Line Purge

(i) Purge Piping



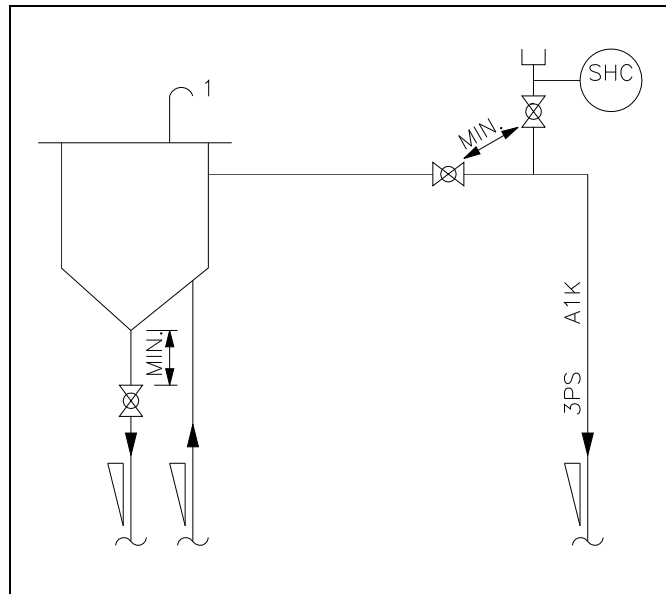
This pump requires steam for the steam jacket and a bearing-cooling medium, but is not shown in the figure above.

Remarks:

Because this fluid has a high freezing point, the piping fluid has to be purged by nitrogen when transfer stop. However, the residual fluids should be purged via the lowest line and pump drain.

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(ii) Connection for Purge



This picture shows a connection for water flushing.

Remarks:

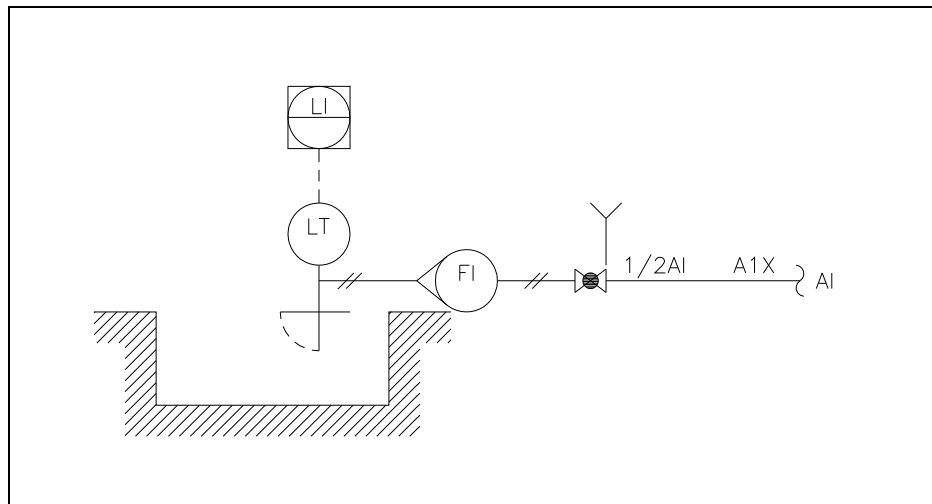
Because the slurry handling piping system uses water as a dispersion medium, solid sediments can sometimes form. At this time, hose connection shall be used for washing out the sediments with process water when the operation is stopped. In addition, this is necessary before re-starting.

For hose connection configuration, refer to Attachment (18), (a) (ii).

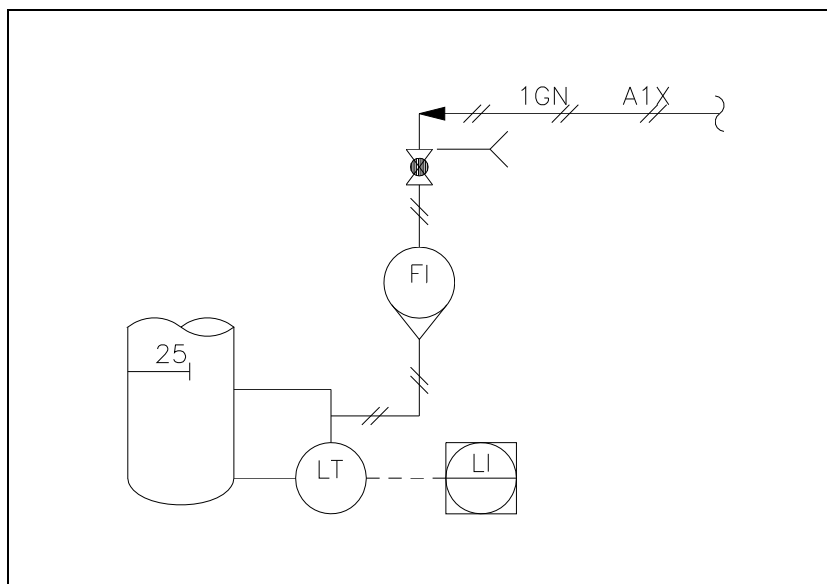
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c) Purge Pipe Instrument System

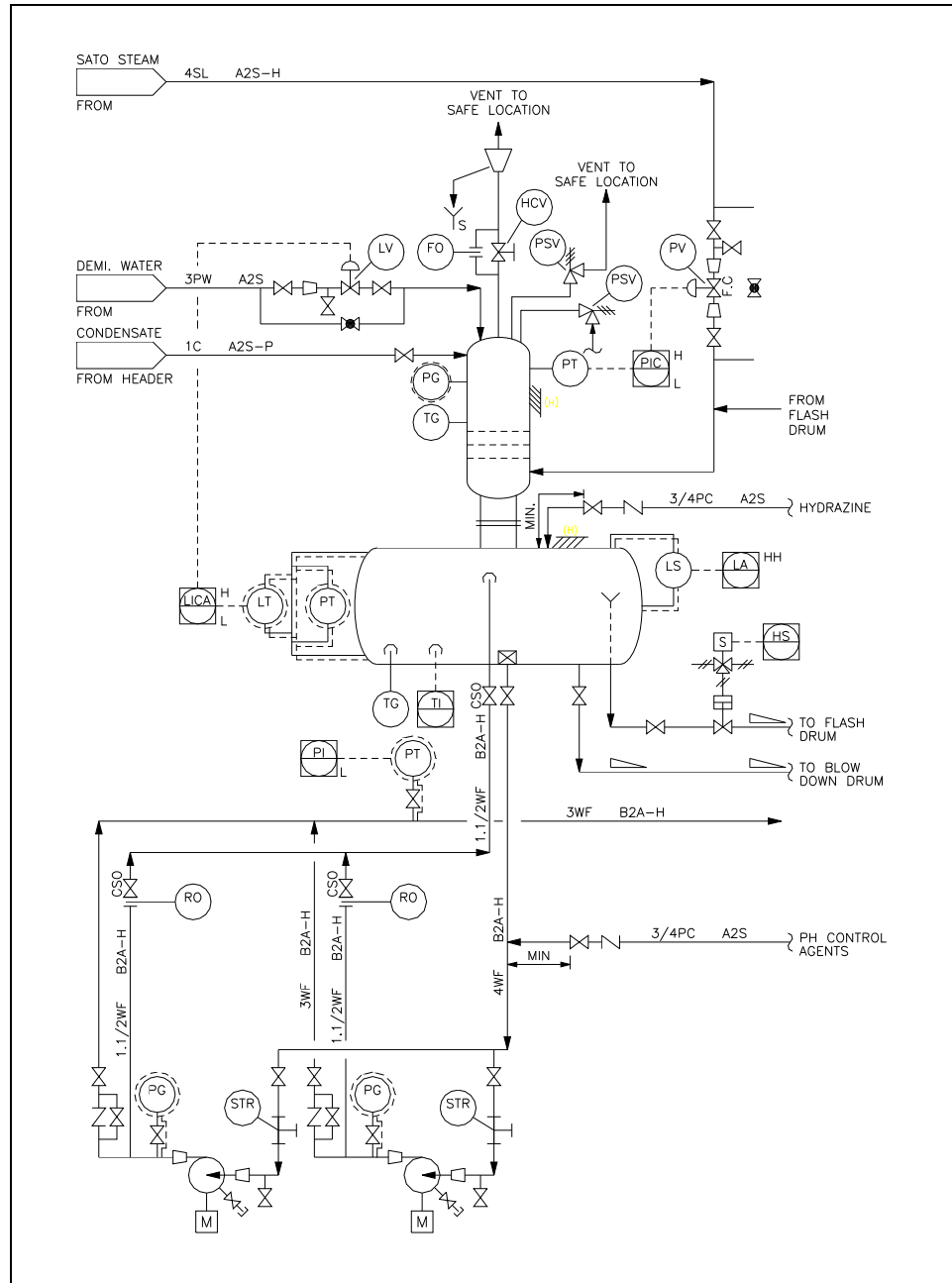
(i) Purge Type Level Indicator



(ii) Gas Side Purge of Differential Pressure Type Level Indicator



10.1.19. Deaerator



Remarks:

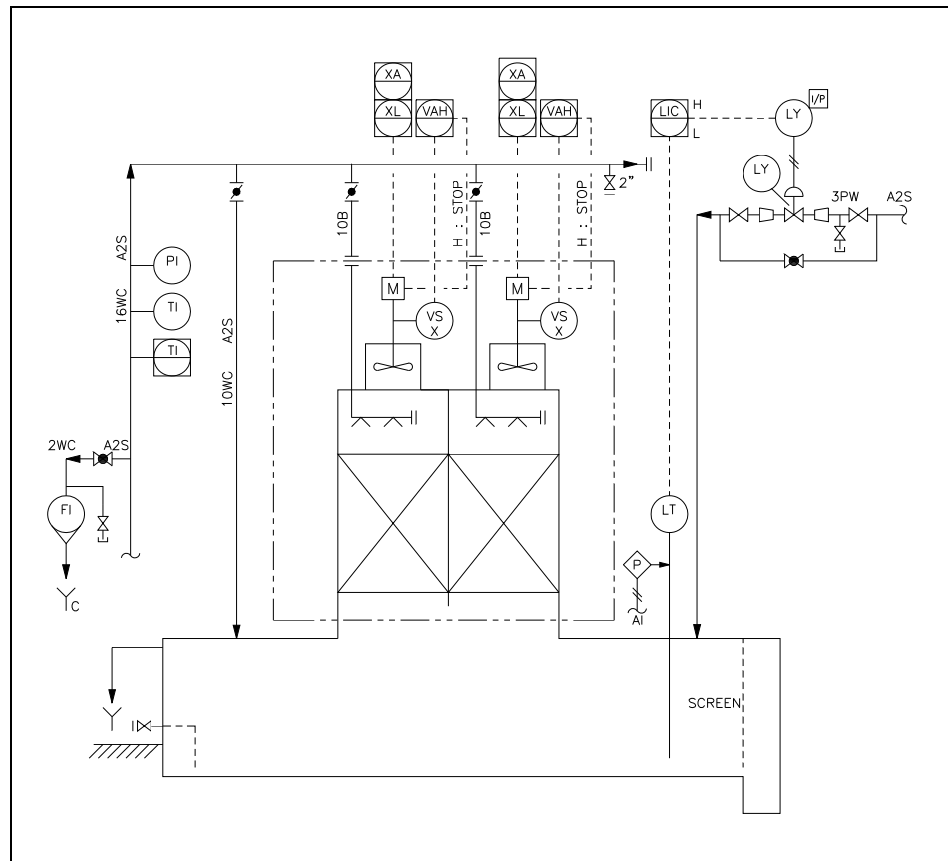
- The picture above is an example for a deaerator and boiler feed water pump.

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- Because there is enough time for pump replacement, automatic start-up is not adopted.

10.1.20. Cooling Tower

a) Expression of Blow-Down and Make-up Water

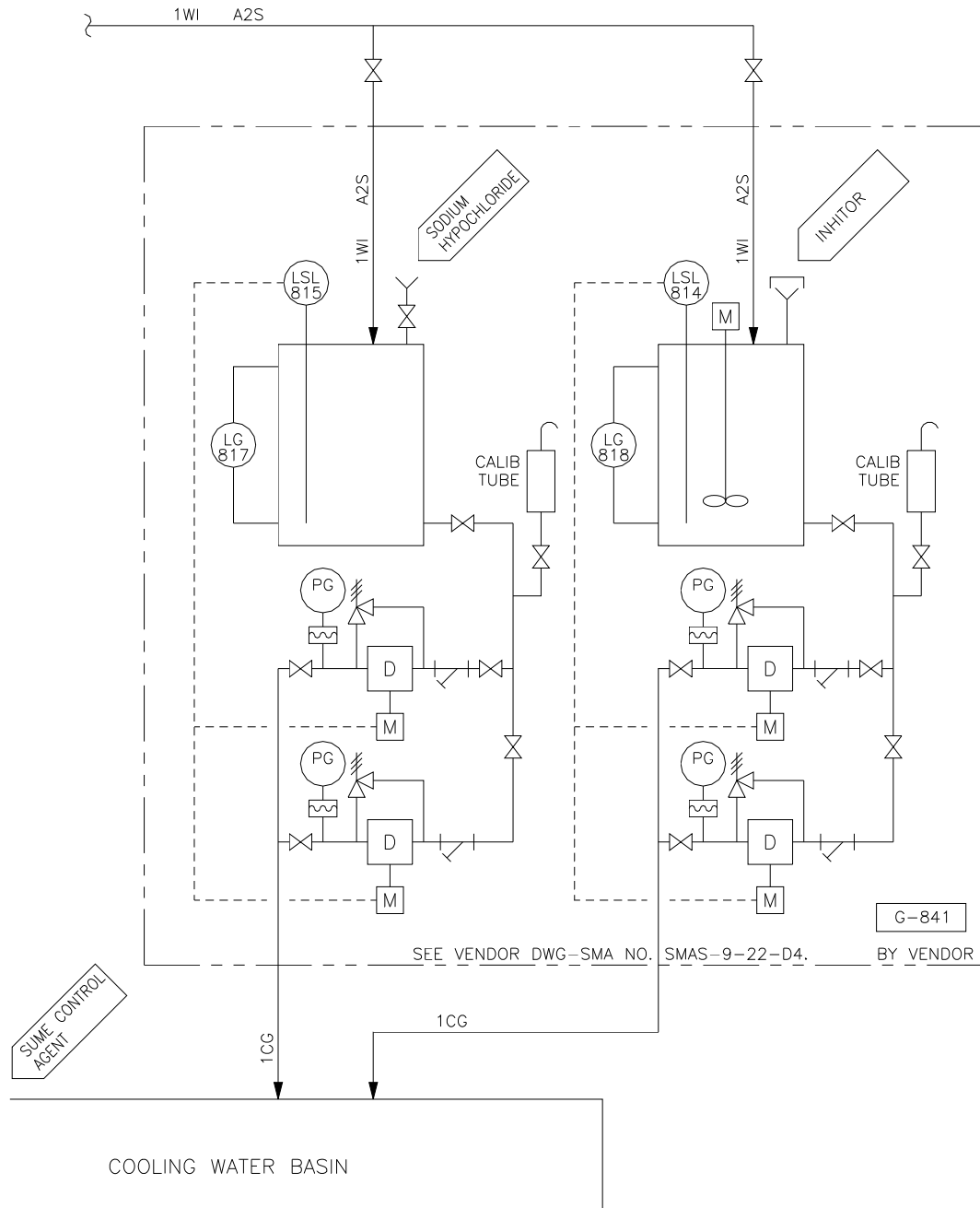


Remarks:

The figure above illustrates a situation when the water drain line is on the ground.

During winter season, the 10" piping is not routed to cooling tower except for draining, but has the purpose to let the flow directly to basin.

b) Chemical Injection Method

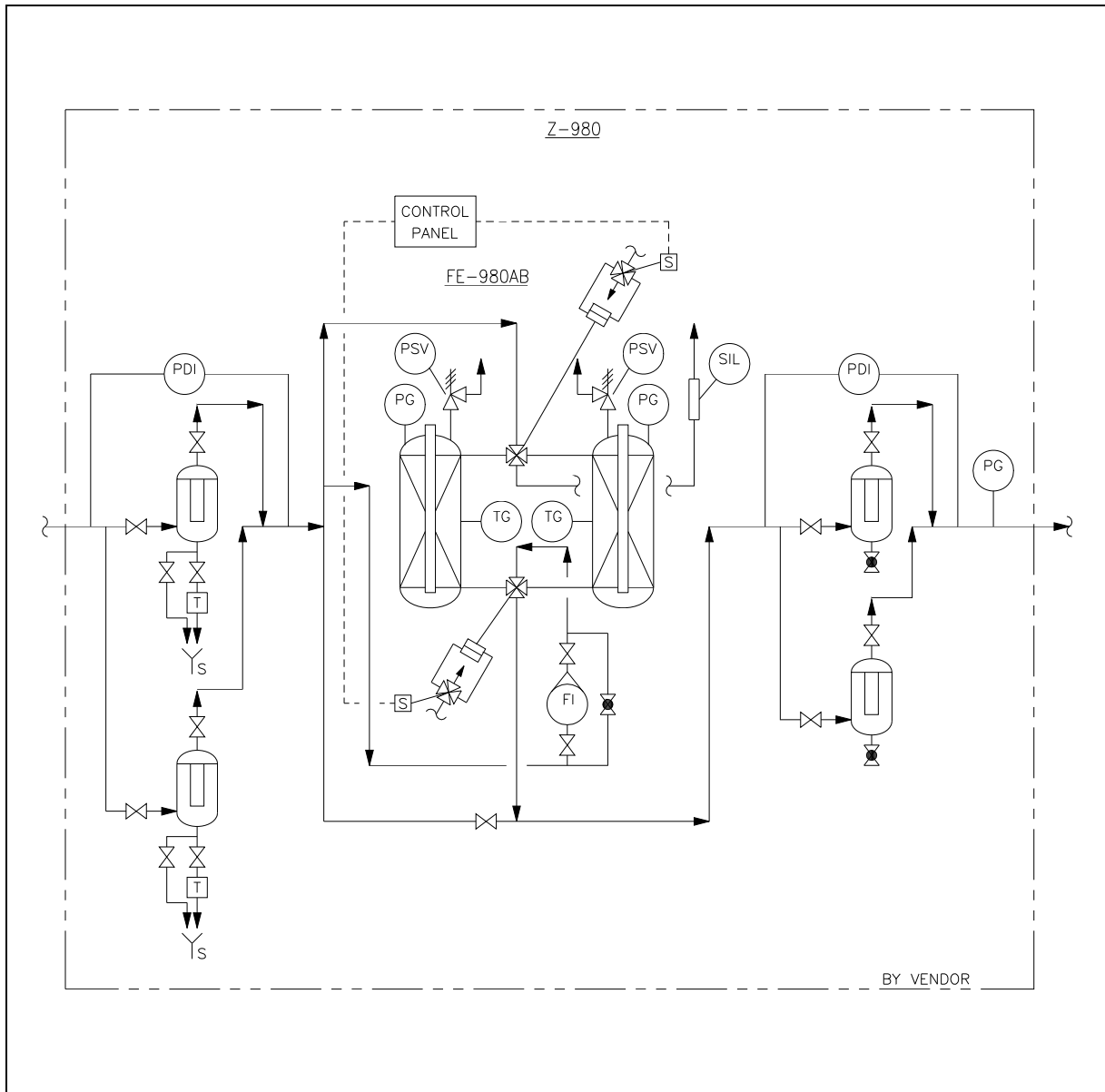


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10.1.21. Air Dryer for Instrument Control System

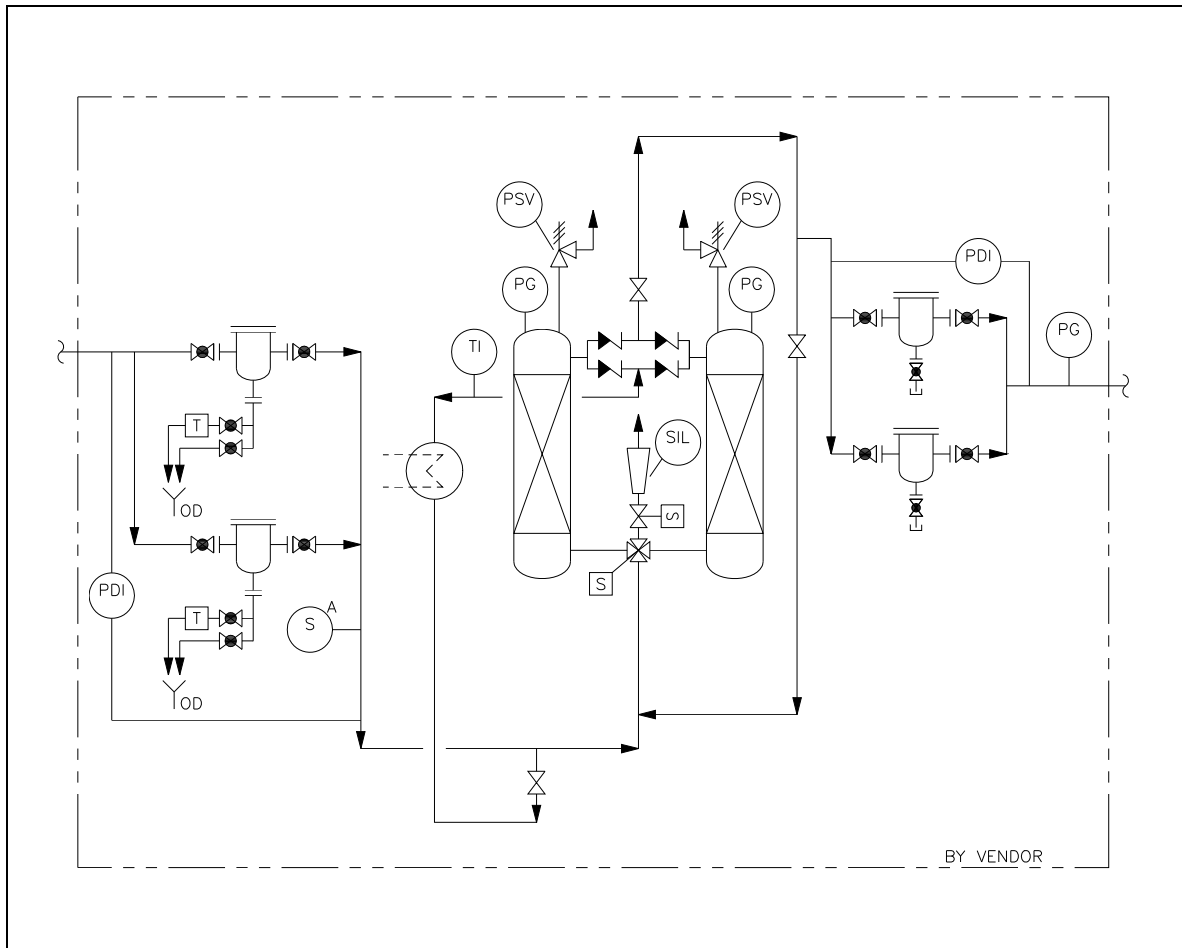
a) Heat Generated Type

(i) Internal Heater

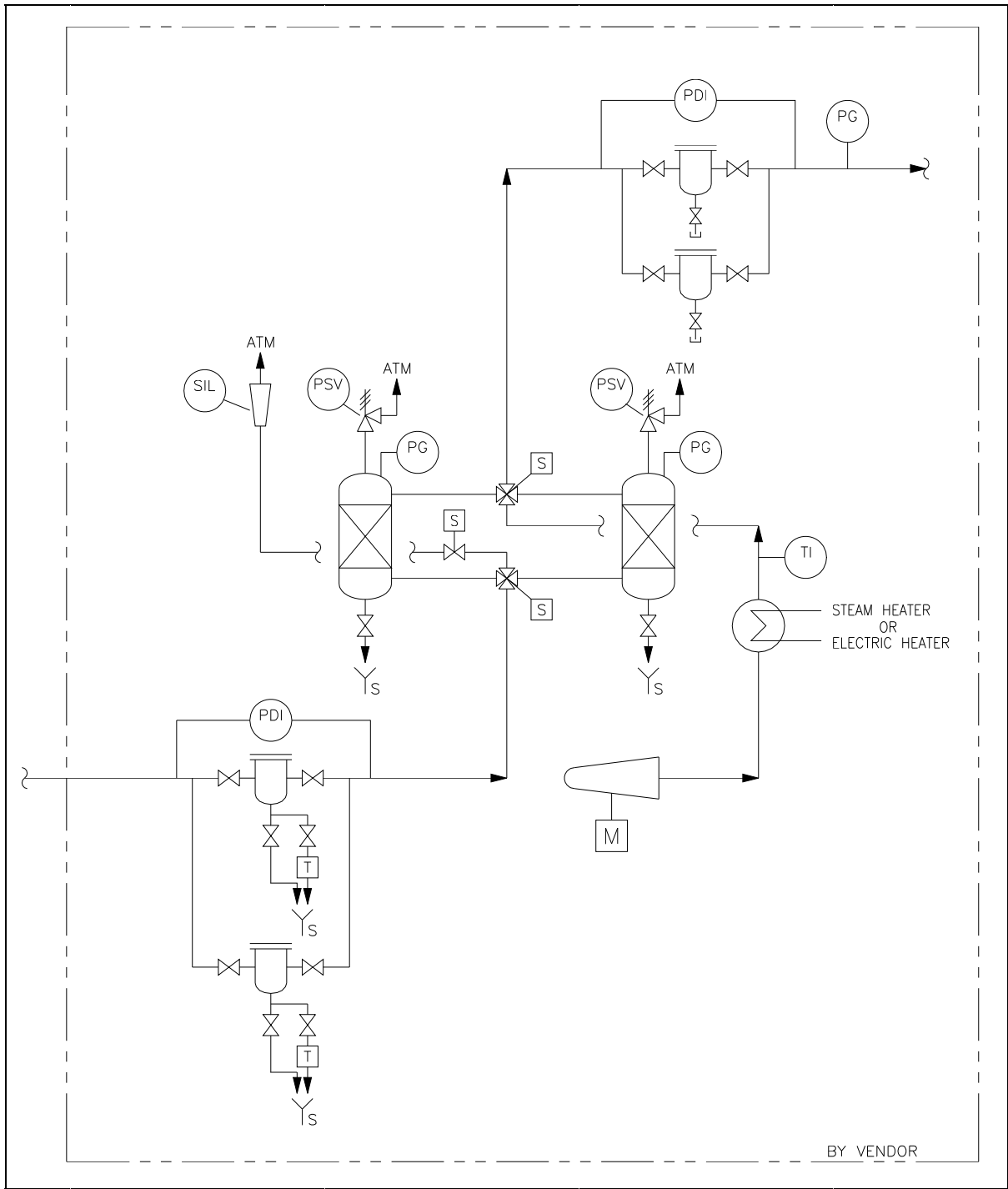


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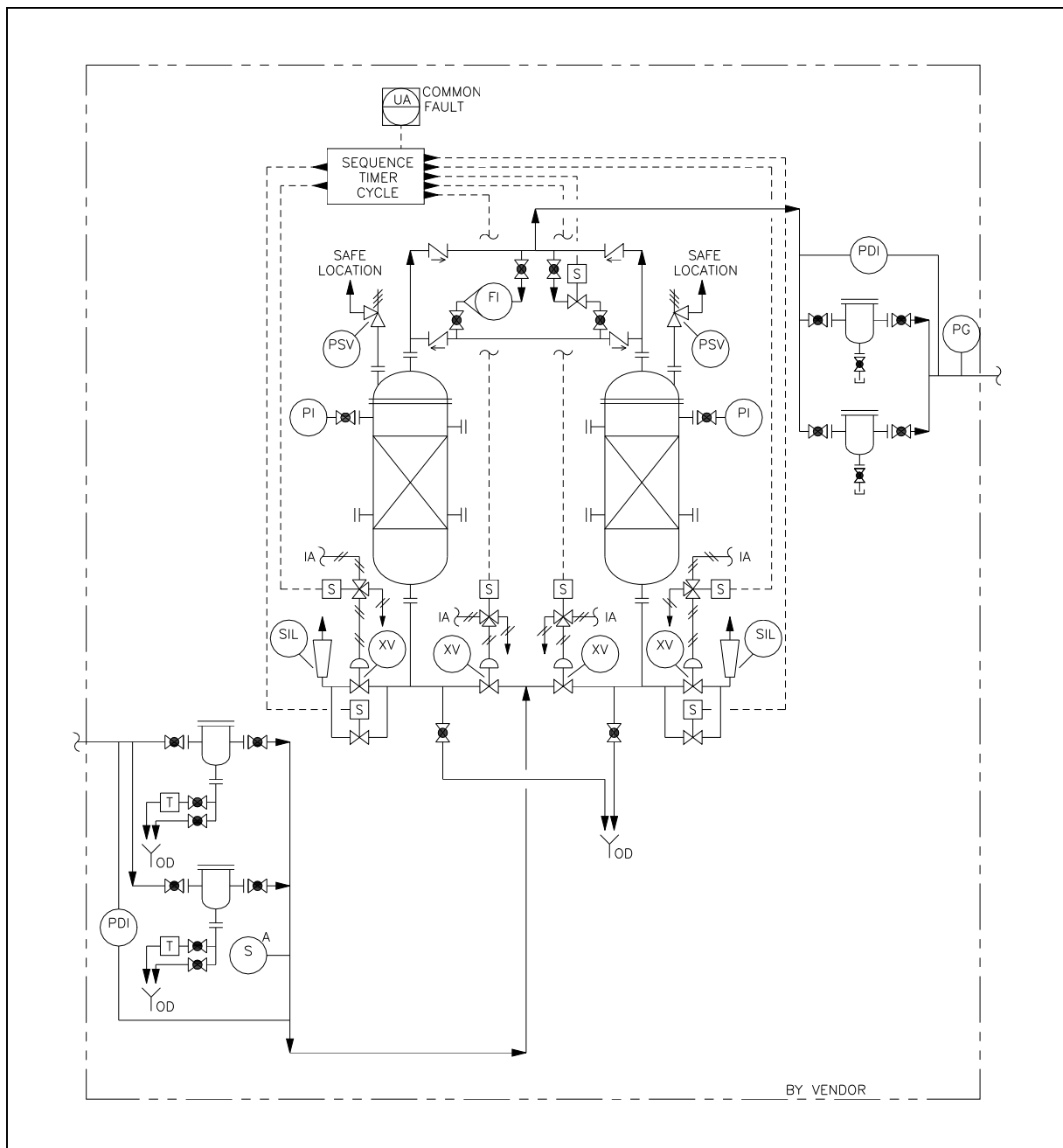
(ii) External Heater



(iii) External Heater with Regeneration Blower



b) Heatless Regeneration Type



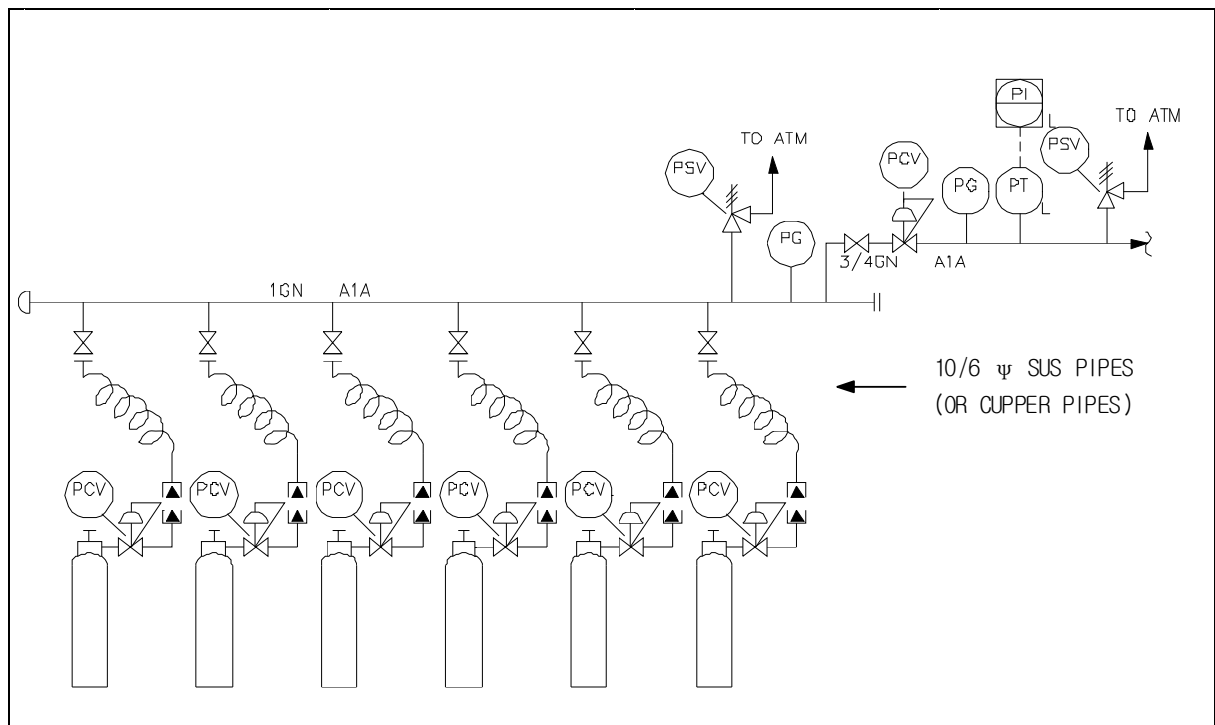
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Remarks:

- This is an example for an absorbent regeneration method by using a part of dry air.
- It is a Pressure Swing Adsorption System

10.1.22. Gas Supply by Cylinders

a) Nitrogen Cylinders

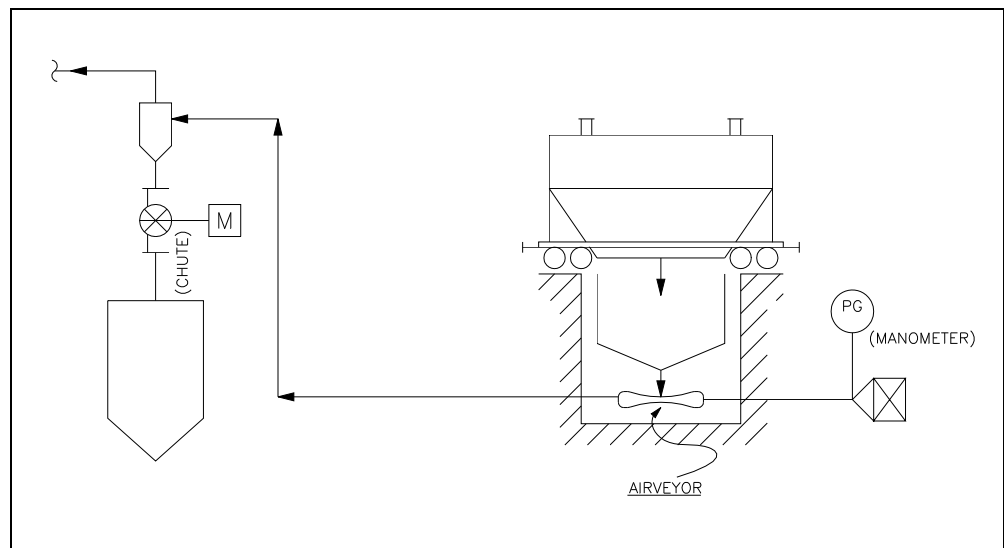


The picture above is an example of N₂ cylinders. BY OWNER

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10.1.23. Pneumatic Conveying of Particle Materials

a) Vacuum Pneumatic Conveying by Hopper



b) Vacuum Pneumatic Conveying by Direct Suction Hose

