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PIPING AND INSTRUMENTATION DIAGRAMS (P&ID)

(PROJECT STANDARDS AND SPECIFICATIONS)

TABLE OF CONTENT

SCOPE

This Engineering Standard Specification covers the format and technical basis for the Piping and Instrumentation Diagrams (P&IDs) and Utility Distribution Flow Diagrams (UDFDs) for process, offsite and utility plants. Namely, the purpose of this manual is to indicate in general terms, the extents of detailing, valving philosophy and instrumentation requirements of similar process designs.

This Standard is also intended to establish uniform symbols for equipment, piping and instrumentation on P&IDs and UDFDs throughout the Oil, Gas and Petrochemical (OGP) projects.

REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

1. **ASME(AMERICAN SOCIETY OF MECHANICAL ENGINEERS)**
   - B31 Series "For Pressure Piping"
   - B16.1 "Cast Iron Pipe Flange and Flanged Fittings, Class 25, 1st.Ed.,1989"

2. **ISA (THE INTERNATIONAL SOCIETY OF AUTOMATION)**
   - S5.1 "Instrumentation Symbols and Identification 1st. Ed., 1984"
   - S5.2 "Binary Logic Diagrams for Process Operations 2nd. Ed., 1981 (Reaffirmed 1992)"
   - S5.3 "Graphic Symbols for Distributed Control / Shared Display Instrumentation, Logic and Computer Systems “Ed.,1983"
   - S5.4 "Instrument Loop Diagrams Ed., 1991"
   - S5.5 "Graphic Symbols for Process Displays 1st. Ed., 1985"

- S18.1 "Annunciator Sequences and Specifications 1st. Ed., 1979 (Reaffirmed 1992)"
- S50.1 "Compatibility of Analogue Signals for Electronic Industrial Process Instruments 1st. Ed., 1975 (Reaffirmed 1995)"
- S51.1 "Process Instrumentation Terminology 1st. Ed., 1979 (Reaffirmed 1993)"
-

3. **ISO (INTERNATIONAL ORGANIZATION FOR STANDARDIZATION)**
   - 3098 "Drawings-Lettering, Part 1: Currently Used Characters 1st. Ed. 1974"
   - 3511 "Process Measurement Control Functions and Instrumentation-Symbolic Representation
   - 6708 "Pipe Work components-Definition and Selection of DN(Nominal size) "
   -
4. **API (AMERICAN PETROLEUM INSTITUTE)**
   - Standard 602 "Compact steel gate valves flanged, threaded, welding and extended body ends 7th Ed., 1998"

DEFINITIONS AND TERMINOLOGY

Licenser - A company duly organized and existing under the laws of the said company's country and as referred to in the preamble to the contract.

Project- the equipment, machinery and materials to be procured by the contractor and the works and/or all activities to be performed and rendered by the contractor in accordance with the terms and conditions of the contract documents.

Unit- one or all process, offsite and/or utility Units and facilities as applicable to form a complete operable oil, gas and/or petrochemical plant.

SYMBOLS AND ABBREVIATIONS

For symbols and abbreviations refer to Appendix A of this Standard.

UNITS

This Standard is based on International System of Units (SI), except where otherwise specified.

GENERAL

Definition

The Piping and Instrument Diagram (P&ID), based on the Process Flow Diagram (PFD), represents the technical realization of a process by means of graphical symbols for equipment and piping as well as graphical symbols for process measurement and control functions. The Utility Distribution Flow Diagram (UDFD) is a special type of a P&ID which represents the utility systems within a process plant showing all lines and other means required for the transport, distribution and collection of utilities. The process equipment in the UDFD can be represented as a box with inscription (e.g., identification number) and with utility connections.

Representation

The representation and designation of all the equipment, instrumentation and piping should comply with the requirements of this Standard. Auxiliary systems may be represented by rectangular boxes with reference to the separate diagrams.

Dimensions of the graphical symbols for equipment and machinery (except pumps, drivers, valves and fittings) should reflect the actual dimensions relative to one another as to scale and elevation. The graphical symbols for process measurement and control functions for equipment, machinery and piping, as well as piping and valves themselves, shall be shown in the logical position with respect to their functions.

All equipment shall be represented such that the consistency in their dimensions is considered if not in contrast to the good representation of the equipment.

Drafting

1. General rules

   Drafting shall be in accordance with the requirements outlined in this Standard. The drafting must be of sufficiently high quality to maintain legibility when the drawing is reduced to an A3 size sheet.

2. Drawings sheet sizes

   Diagrams should be shown on A0 size (841 mm × 1189 mm). A1 size (591 mm × 841 mm) may be used for simple P&IDs and UDFDs as per Company's approval.

3. Drawing title block

   a. The following requirements shall be shown on the title block of each drawing (see Appendix B):

      - Revision table;
      - Main Company's name (e.g., National Oil Company);
      - Name of Company Relevant Organization, (if any), (e.g., Refineries Engineering and Construction);
      - Name of refinery or plant (in English words);
      - COMPANY'S emblem;
      - Contractor's name;
      - Drawing title;
      - Company's project No.;
      - Contractor's job No. (optional);
      - Contractor's drawing No. (optional);
      - Company's drawing No.

b. Title block sizes and drawing dimensions shall be as follows:

Drawing Dimensions (mm × mm)	Title Block Size (Including Revision Table) Width (mm) × Length (mm)
A0 = 841 × 1189	180 × 190
A1 = 594 × 841	130 × 175
A2 = 420 × 594	100 × 155
A3 = 297 × 420	75 × 120

4. Line widths

To obtain a clear representation, different line widths shall be used. Main flow lines or main piping shall be highlighted.
The following line widths shall be applied:

- 0.8 mm for main process lines;
- 0.5 mm for other process lines; utility lines, and underground lines;
- 0.5 mm for graphical symbols for equipment and machinery, except valves and fittings and piping accessories;
- 0.5 mm for rectangular boxes for illustrating Unit operations, process equipment, etc.;
- 0.5 mm for subsidiary flow lines or subsidiary product lines and for energy carrier lines and auxiliary system lines;
- 0.4 mm for class changes designation;
- 0.3 mm for graphical symbols for valves and fittings and piping accessories and for symbols for process measurement and control functions, control and data transmission lines;
- 0.3 mm for all electrical, computer and instrument signals;
- 0.3 mm for reference lines;

Line widths of less than 0.3 mm shall not be used.

5. Line spacing

The space between parallel lines shall not be less than twice the width of the heaviest of these lines with a minimum value of 1 mm. A spacing of 10 mm and more is desirable between flow lines.

6. Direction of flow

   In general, the main direction of flow proceeds from left to right and from top to bottom. Inlet and outlet arrows are used for indicating the inlet and outlet of flows into or out of the diagram. Arrows are incorporated in the line for indicating the direction of the flows within the flow diagram. If necessary for proper understanding, arrows may be used at the inlets to equipment and machinery (except for pumps) and upstream of pipe branches. If a diagram consists of several sheets, the incoming and outgoing flow lines or piping on a sheet may be drawn in such a manner that the lines continue at the same level when the individual sheets are horizontally aligned.

7. Connections

   Connections between flow lines or pipelines shall be drawn as shown in Fig. 1 and 2 below:

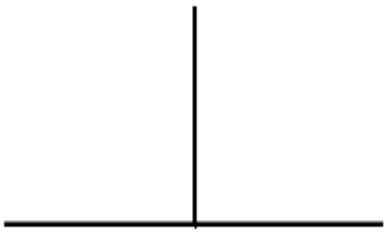

Fig.1

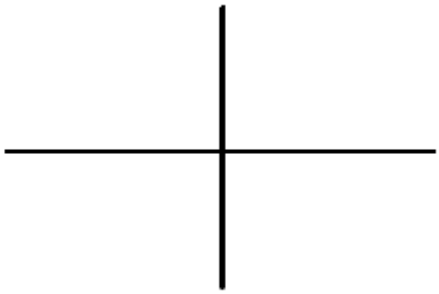

Fig.2

Figs. 3 and 4 show two flow lines or pipelines, which are not connected:

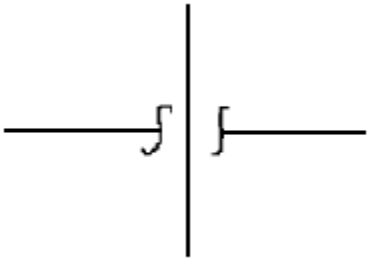

Fig.3

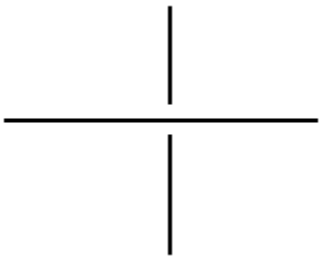

Fig.4

8. Inscriptions

   a. Type of lettering

      Lettering in accordance with ISO 3098 Part 1, Type B vertical, to be used.

   b. Height of lettering

      The height of letters should be:

      - 7 mm for drawing number;
      - 5 mm for drawing title and identification numbers of major equipment;
      - 3 mm for other inscriptions.

   c. Arrangement of inscription

      i) Equipment

         Identification numbers for equipment should be located close to the relevant graphical symbol, and should not be written into it. Further details (e.g., designation, design capacity, design pressure, etc.) may also be placed under the identification numbers.

      ii) Flow lines or piping

         Designation of flow lines or piping shall be written parallel to and above horizontal lines and at the left of and parallel to vertical lines. If the beginning and end of flow lines or piping are not immediately recognizable, identical ones should be indicated by corresponding letters.

      iii) Valves and fittings

         Designation of valves and fittings shall be written next to the graphical symbol and parallel to the direction of flow.

      iv) Process measurement and control functions

         The representation should be in accordance with the requirements stipulated in ISA-S5.1 and ISO 3511, Parts 1 and 4, latest revisions unless otherwise specified in this Standard.

Equipment Location Index

Piping and Instrument Diagrams shall be divided into equivalent intervals (each in 50 mm) either in length or width. The intervals shall be designated with numbers from 1 to 23 in length and alphabets from "A" to "P" in width. Equipment location on each diagram shall be addressed by the relevant coordinates where required. In upper right-hand area of the flow diagram under title of "Item Index" all main equipment shall be listed by equipment number, alphabetically and numerically and equipment location coordinates. In a separate sheet apart from P&IDs, an "Item Index" shall be prepared to summarize all equipment of the Unit/Plant with reference P&IDs and equipment location.

Arrangement

1. The preferred arrangement is such that towers, vessels and fired heaters are shown in the upper half of the diagram, heat exchange equipment in the upper three quarters as practical, and machinery equipment in the lower quarter. The spacing of equipment and flow lines shall permit identification and tracing of the lines easily.
2. The area above the title block on each sheet shall be completely left open for notes.
3. The general flow scheme shall be from left to right. Unnecessary line crossing should be avoided.
4. Process lines entering and leaving the diagram from/to other drawings in the Unit shall be terminated at the left-hand or right-hand side of the drawing. Lines from/to higher number drawings shall enter and leave the drawing on the right-hand end and vice versa.
5. Each process line entering or leaving the side of the drawing should indicate the following requirements in an identification box (see Appendix B):
    a. The line service
    b. The origin or destination equipment item number
    c. Continuation drawing number with the relevant coordinates.
6. Process lines to/from other Units should be terminated at the bottom of the drawing at a box indicating the following requirements (see also Appendix B):
    a. The line service
    b. Source or destination Unit name and number

c. The drawing number of the connecting flow diagrams with the relevant coordinates.

7. All utility lines entering or leaving the diagram shall be terminated at any convenient location at a box indicating the relevant utility service abbreviation (e.g., CWS, CWR, IA, etc.). See Appendix A of this Standard for utility services abbreviations. “Utilities Identification Table” Showing utility services with the reference drawings should be provided at top or left hand side of each drawing title block (see Appendix C).
8. Instrument, control system and software linkage signals from sheet to sheet shall be terminated preferably at the side of sheet or in an appropriate location at a box indicating the continuation instrument number, location, and drawing number (see Appendix B).
9. Equipment descriptions of towers, vessels, tanks, furnaces, exchangers, mixers and other equipment except machinery shall be located along the top of the flow diagram. Machinery descriptions shall be along the bottom.

MINIMUM INFORMATION TO BE SHOWN ON P&I DIAGRAMS

General

Each P&ID shall present all information as required herein below during implementation of a project in detailed design phase. Extent of information shown on each P&ID in the basic design stage shall be agreed by Company in advance.

Vendor supplied packages with an outline of the main components shall be shown in a dashed/dotted box. Letter "PU" referring to package shall be indicated adjacent to each equipment and instrument of the package.

Equipment, instruments or piping which are traced or jacketed, shall be shown.

The identification number and service presentation shall be shown for each piece of equipment. This information shall be indicated in or adjacent to towers, drums, heaters, tanks and heat exchangers, etc.

Equipment Indication

1. Vessels, towers, drums
   a. The following requirements shall be shown:
      - Changes of shell diameter (if any);
      - Top and bottom trays, and those trays which are necessary to locate feed, reflux and product lines;
      - All draw-off trays with tray number and diagrammatic representation of the downcommer position (e.g., side or center);
      - All nozzles, manholes, instrument connections, drains, vents, pump-out and steam-out connections, blank-off ventilations, vortex breakers, safety/relief valve connections, sample connections and hand holes;
      - Skirt or legs, top and bottom tangent lines;
      - Elevations above base line to bottom tangent line of column or to bottom of horizontal drum;
      - The position of high high liquid level (HHLL), high liquid level (HLL), normal liquid level (NLL), low liquid level (LLL) and low low liquid level (LLLL);

        Notes:

        i) For draw-offs only "NLL" shall be shown. The other liquid positions will be shown as required.

        ii) Indication of "HHLL" and "LLLL" shall be made when they are actuating start/stop of an equipment or machinery through a switch.

        iii) "HLL", "NLL" and "LLL" shall be shown for all cases except as specified under Note i) above.

      - All flanged connections; [all connections whose purpose is not readily] evident shall indicate the purpose (e.g., spare inlet, catalyst draw-off, etc.)
      - Catalyst beds, packings, demisters, chimney trays, distributors, grids, baffles, rotating discs, mixers, cyclones, tangential inlet and all other internals;
      - Water drop-out boots;

- Maintenance blinds for the vessel nozzles.

b. Important notes:

- All nozzles and connections indicated on the equipment data sheet shall be shown in their correct positions.
- All indications shall be such that the consistency in the dimensions is considered, although not necessarily to scale.
- Numbering of the trays shall be from bottom to top.
- Height of the vessel bottom tangent line shall be indicated.
- Self standing : Skirt height
- Elevated vessel: Minimum required height shall be shown as "min. ...."
- A valved drain for all columns and vessels shall be indicated. Generally, this valve is to be located on the bottom line outside the skirt and between the vessel and the first pipe line shut-off location (valve or blinding flange). The drain valve shall be located on the bottom of the vessel when:
  i) No bottom line is present, or
  ii) The bottom line is not flushed with the lowest point of the vessel.
- The valved vent with blind flange for all columns and vessels provided on the top of the vessel should be indicated.
- Safety Relief valves generally located on the top outlet line downstream of the vessel blinding location or directly connected to the vessel should be indicated
- Utility connections on all vessel/columns shall be shown.
- One local PI shall be indicated on top of vessel/column.
- One local TI shall be indicated on the top outlet line of vessel/column.
- Nozzles identifications on vessels, reactors and towers shall be according to Appendix D of this Standard.

c. The following requirements shall be described under equipment description:
   - Vessel item number (this number will also appear adjacent to the vessel);
   - Service;
   - Size [inside diameter(s) and tangent to tangent length];
   - Design pressure (internal/external) and design temperature;
   - Indication of insulation;
   - Line number of vessel trim (this applies to LG & LC connections, vents, sample connections, etc.);
   - Indication of cladding and lining (if any).

2. Tanks
   a. The following requirements shall be shown:
      - All nozzles, man ways, instrument connections, drains, vents, vortex breakers, and safety/relief valve connections;
      - All internals such as steam coils, air sparkers, tank heaters, vortex breakers, water-draw off sump and etc.
   b. Equipment description
      - equipment item number (this number also appears adjacent to the tank);
      - Equipment Description
      - equipment item number (this number also appears adjacent to the tank);
      - inside diameter and height;
      - nominal capacity, in (m^3);
      - Indication of insulation.
3. Fired heaters, boilers, incinerators
   a. The following requirements shall be shown:
      - All nozzles, instrument connections, drains, vents and damper(s);
      - Ducting arrangement including damper actuators where required;
      - Detail of draft gages piping and arrangement;

- Waste heat recovery system (if present), such as economizer, air preheater, forced draft fan, induced draft fan, etc.;
- Decoking connections;
- Detail of one complete set of burners for each cell and total burner number required for each type of burner;
- Tube coils schematically in correct relative positions and all skin point thermocouples;
- Logic diagram of shut down system (heat off sequence);
- Number of passes and control arrangement;
- Snuffing steam nozzles and piping arrangement;
- Blow-down and steam-out connections;
- Testing facilities;
- Convection section (where applicable).

b. Equipment description

- item number (this number will also appear adjacent to the equipment);
- service;
- duty (kJ/s);
- design pressure and temperature of coils;

4. Heat exchangers, coolers, reboilers

a. The following requirements shall be shown:

- All nozzles, instrument connections, drains and vents, chemical cleaning connections and safety/relief valves as indicated on the equipment data sheet;
- Spectacle blinds for the isolation;
- Elevations required for process reason (e.g., reboilers, condensers, etc.);
- The connections which allow pressure and temperature survey of heat exchanger facilities;
- The position of high liquid level (HLL), normal liquid level (NLL) and low liquid level (LLL) for kettle type reboilers;
- Direction of flow in each side of exchanger.

b. Important notes

Due considerations should be made for proper indication in the following requirements:

- Generally, direction of flow shall be downflow for cooled media and upflow for heated media.
- Isolation valves shall be provided on inlet and outlet lines where maintenance can be performed on the exchanger with the Unit operating. Provision of by-passing is required for this case.
- Shell and channel piping shall be provided with a valved vent connection and a drain connection unless venting and draining can be done via other equipment.
- At exchangers with circulating heat transfer media, the outlet valve shall be of a throttling type for control of heat duty.
- An inlet and outlet, temperature indicator shall be provided on each exchanger (on either shell or tube side) so that to facilitate checking of heat balance around exchanger.

Type of temperature indicator shall be as follows:

- A board mounted temperature indicator (TI) shall be provided at the inlet and outlet of all shell and tube process/process exchanger.
- For water coolers, the water side outlet shall be provided with a local TI only. The shell side in and out shall be provided with board mounted TIs.
- Thermowells (TWs) shall be provided between each shell side and tube side of the same services when the exchangers are in series.
- Local indicator type shall be provided for the requirement of local temperature control, such as manual bypass control.

c. Equipment description

- Equipment item number (this number also appears adjacent to the equipment);
- Service;
- Duty (kJ/s);
- shell side design pressure and temperature;

- tube side design pressure and temperature;
- Indication of insulation.

d. Sequence of numbering for stacked exchangers/coolers shall be from top to bottom.

5. Air fin coolers

a. The following requirements shall be shown:

- All nozzles and instrument connections;
- Blinds for the isolation;
- Any automatic control (fan pitch control or louver control) and any alarm (vibration alarm, etc.);
- Configuration of inlet and outlet headers and the branches. Only one bundle and fan shall be shown; total number of fans and bundles shall be indicated. When multiple bundles are required, header's arrangement as separate detailed sketch shall be indicated;
- Steam coil and condensate recovery system (if required);
- Isolation valves (if required); isolation valves shall be provided in corrosive and fouling services where individual bundles can be repaired and maintained with the Unit operating;
- Valved vent and valved drain connection for each header, vent header should be connected to closed system for volatile services;
- A board mounted TI at inlet and outlet, (the TI will monitor the process side of each air fin service). If multiple bundles to be used for fouled services, provide TW's on the outlet of each bundle.

b. Equipment description

- Equipment item number (this number will also appear adjacent to the equipment);
- Service;
- Duty (kJ/s);
- Tube side design pressure (internal and external) and design temperature.

6. Rotary machineries

a. The following requirements shall be shown:

i) Pumps

- All nozzles including instrument connections;
- Pump suction valve and strainer, and discharge valve and check valve. Provision of wafer type check valve should be avoided unless otherwise specified;
- Pump drains and vents piping and destination.
- The type of pump;
- Pump auxiliary system connections such as, cooling water, seal oil and lube oil, steam, etc.;
- Detail of lube and seal oil /sealing systems, cooling water piping arrangement, and minimum flow bypass line requirement for pumps;
- Winterization and/or heat conservation (steam or electrical) where required;
- Warm-up and flushing oil lines detail; a DN20 (¾ inch) bypass/drain from the check valve to the pump discharge line shall be provided as warm-up line for the cases specified in item 8.1.4 of this Standard;
- Pressure gage located on the discharge of each pump; the gage shall be installed between the pump discharge nozzle and the check valve;
- Pressure relief safety valves (if any);
- Automatic start-up of standby unit (if required);
- Balanced or equalized line for vacuum service.

ii) Compressors and blowers

- Type of compressor or blower;
- Start-up facilities (i.e., inert gas purge system);
- Safety/relief valves;
- Suction and discharge valves;
- Suction strainer (filter) and discharge check valve;
- Suction and discharge pulsation dampener where required;

- Valved vents and casing drains;
- Winterization (steam or electrical tracing on suction piping) where required;
- Lube and seal oil / sealing system and cooling water systems detail arrangement;
- Interstage coolers where required;
- Surge protection (where required);
- Inlet and outlet nozzles;
- All instrument connections.

iii) Steam and gas turbine drivers

- All nozzles and connections;
- Detail of all auxiliary systems for steam turbine drivers such as steam supply, condensate return, surface condenser and etc.;
- Detail of lube oil, cooling water, etc.;
- All instrumentations such as PI, TI, etc.;
- Safety/relief valves; relief valves shall be located between the discharge nozzle and the outlet isolation valve; weep hole at exhaust of the relief valve which opens to atmosphere shall be provided to draw-off the condensate drain.
- Warming bypass around inlet isolation valve for steam turbines; the valve on warm-up line shall be DN25 (1 inch) globe type;
- Steam traps and condensate recovery system for the steam turbine casing drain and upstream of isolation valve at inlet of the turbine;
- Vent line to atmosphere at turbine exhaust; the vent is required for the start-up/test operation of the turbine.
- Detail of all firing and control systems for gas turbine drivers.

b. Equipment description

i) Pumps

- Pump item number (this number also appears below the pump);
- Service;
- Capacity, (m^3/h, dm^3/h for injection pumps);

- Differential pressure, (kPa
- Relative density (specific gravity) of pumped fluid at pumping temperature;
- Indication of insulation and tracing;
- Miscellaneous auxiliary piping (CW, flushing oil, seal oil, etc.).

ii) Compressors and blowers

- Equipment item number and stage (this number also appears below the compressor);
- Service;
- Capacity, (Nm^3/h);
- Suction pressure, and temperature, [kPa (g)], (°C);
- Discharge pressure, and temperature, [kPa (g)], (°C);
- Miscellaneous auxiliary piping (CW, lube oil, seal oil / sealing system, etc.);
- Gas horse power, (kW).

c. Other requirements

- When a pump or compressor is spared, the data is listed once commonly for both pumps and compressors at the bottom of the flow diagram. The spare is identified by the word "Spare" below the pump or compressor. The operating equipment and the spare have the same number but with suffixes "A" and "B".
- Stage numbers are shown only for multistage compressors. All compressor data for the first stage shall be indicated. For subsequent stages only N m^3/h may be omitted.

7. Miscellaneous equipment

Depending on the type of equipment (silencer, flame arrestor, filter, etc.) the following information shall be presented:

a. All nozzles, instrument connections, vents, drains, etc.;

b. Equipment description at top of the flow diagram and including:

- Equipment item number;
- Service;
- Tracing/insulation requirements;

- Design pressure and temperature;
- Capacity

Instrumentation

The following requirements shall be shown:

1. All instrumentation including test points;
2. Isolation valves connecting to instruments (primary connection valve);
3. Control valve sizes and air failure action (FC, FO, FL);
4. Block and bypass valve sizes at control valve stations;
5. Level gages connection type and range, and level controllers connection type, range and center of float (where NLL is not shown). Type, material and tracing requirement of level gages shall be shown
6. Sequence of opening and closing for the split range control valves;
7. Solenoid shut-down devices at control valves/shut-off valves;
8. Tight shut-off valves requirements (where required);
9. Hand wheels when provided on control valves;
10. Limit switches on control valves when required;
11. Mechanical stopper and/or signal stopper on control valves when required;
12. Push buttons and switches associated with shut-down systems;
13. The instrument tag number for each instrument;
14. Analyzer loop details and special notes as required;
15. Winterization of instruments;
16. Compressor local board mounted instrumentation;
17. Software linkage and alarm and shut-down logic system. Complex shut-down systems shall be shown as a "black box" with reference made to the logic diagram shown on a separate sheet. All actuating and actuated devices shall be connected to the "black box";
18. All elements of advance control and optimization systems;
19. Indication of "Readable From" for all local indicators and/or gages which shall be readable from a designated valve.

Piping

1. General
   a. All piping shall be shown on P&I Diagrams, including:
      - Process lines;
      - Utility/common facility branch lines (e.g., sealing and flushing lines, cooling water lines, steam-out lines and connection, nitrogen lines, etc.);
      - Flare lines, including safety/relief valves discharge lines;
      - Start-up and shut-down lines;
      - Pump-out lines;
      - Drain and vent lines and connections;
      - Purge and steam-out facilities;
      - Catalyst regeneration lines;
      - Catalyst sulphiding lines;
      - Catalyst reduction lines;
      - Equipment and control valve bypasses;
      - Detail of spool pieces, equipment internals, etc., when required;
      - Steam tracing and steam jacketing.
   b. All line numbers, sizes and line classification shall be shown.
   c. The direction of normal flow shall be shown for all lines.
   d. The points or spec. breaks at which line sizes or line specifications change shall be clearly indicated.
   e. All blinds shall be indicated on the drawings, and the symbols used shall distinguish between tab blinds and spectacle blinds.
   f. All vent and drain connections shall be identified whether screw caped or blind flanged, if required.
   g. Steam traced lines and steam jacketed lines shall be so indicated.
   h. All equipment flanges, all reducers and non-standard fittings, such as expansion bellows, flexible tubes, shall be shown.