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PROCESS FLOW DIAGRAMS

(PROJECT STANDARDS AND SPECIFICATIONS)

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SCOPE

This Project Engineering Standard specifies general and specific requirements for the contents of process flow diagram (PFD) which shall be used throughout the process industries. However, further requirements may be requested by the company to fulfill specific project requirements. The aim of this Project Engineering Standard is to make the engineers able to: review process diagram symbols; describe the use of process diagram and the information they contain; draw a process flow diagram; draw a process and instrument drawing; describe the various process equipment relationships.

DEFINITIONS AND TERMINOLOGY

Electrical drawings—symbols and diagrams that depict an electrical process.

Elevation drawings—a graphical representation that shows the location of process equipment in relation to existing structures and ground level.

Equipment location drawings—show the exact floor plan for location of equipment in relation to the plan's physical boundaries.

Flow diagram—a simplified sketch that uses symbols to identify instruments and vessels and to describe the primary flow path through a unit.

Foundation drawings—concrete, wire mesh, and steel specifications that identify width, depth, and thickness of footings, support beams, and foundation.

Legends—a document used to define symbols, abbreviations, prefixes, and specialized equipment.

Process and instrument drawing (P&ID)—a complex diagram that uses process symbols to describe a process unit; also called piping and instrumentation drawing.

UNITS

This Standard is based on Units of the design country, except where otherwise specified.

DEFINITION OF PROCESS FLOW DIAGRAM (PFD)

Process flow diagram mainly defines:

1. A schematic representation of the sequence of all relevant operations occurring during a process and includes information considered desirable for analysis.
2. The process presenting events which occur to the material(s) to convert the feedstock(s) to the specified products.
3. An operation occurring when an object (or material) is intentionally changed in any of its physical or chemical characteristics, is assembled or disassembled from another object or is arranged or prepared for another operation, transportation, inspection or storage.

PURPOSE OF PFD

The purpose of PFD is generally as follows:

1. Plant design basis

   PFD shows the plant design basis indicating feedstock, product and main streams flow rates and operating conditions.

2. Scope of process

   PFD serves to identify the scope of the process.

3. Equipment configuration

   PFD shows graphically the arrangement of major equipment, process lines and main control loops.

4. Required utilities

   PFD shows utilities which are used continuously in the process.

CONTENTS OF PFD

Inclusive

PFD shall comprise but not limited to the following items:

1. All process lines, utilities and operating conditions essential for material balance and heat and material balance.
2. Type and utility flow lines which are used continuously within the battery limits.

3. Equipment diagrams to be arranged according to process flow, designation, and equipment number.
4. Simplified control instrumentation pertaining to control valves and the likes to be involved in process flows.
5. Major process analyzers.
6. Operating conditions around major equipment.
7. Heat duty for all heat transfer equipment.
8. Changing process conditions along individual process flow lines, such as flow rates, operating pressure & temperature, etc.
9. All alternate operating conditions.
10. Material balance table.

Not Inclusive

The following items are generally not be shown on PFD, except in special cases:

1. Minor process lines which are not usually used in normal operation and minor equipment, such as block valves, safety/relief valves, etc.
2. Elevation of equipment.
3. All spare equipment.
4. Heat transfer equipment, pumps, compressor, etc., to be operated in parallel or in series shall be shown as one unit.
5. Piping information such as size, orifice plates, strainers, and classification into hot or cold insulated of jacket piping.
6. Instrumentation not related to automatic control.
7. Instrumentation of trip system, (because it cannot be decided at the PFD preparation stage).
8. Drivers of rotating machinery except where they are important for control line of the process conditions.
9. Any dimensional information on equipment, such as internal diameter, height, length, and volume. Internals of equipment shall be shown only if required for a clear understanding of the working of the equipment.

GENERAL DRAFTING INSTRUCTIONS

Scale

PFDs should not be drafted to scale. However, their size should be compatible with that of equipment drawings.

Flow Direction

As a rule, PFDs should be drawn from the left to the right in accordance with process flows.

Process and Utility Lines in General

The main process flow shall be accentuated by heavy lines.

Process utility lines shall be shown only where they enter or leave the main equipment.

Pipe lines shall not be identified by numbers.

Valves, vents, drains, by-passes, sample connections, automatic or manual control systems, instrumentation, electrical systems, etc. shall be omitted from the schemes.

The direction of the flow shall be indicated for each line.

Kind of Lines

As a rule, Process lines, utility lines, and loop lines for instrument should be drawn as follows:

1. Main process line; thickness = 0.8 mm

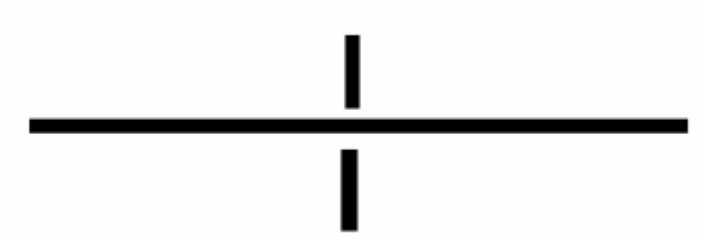
2. Secondary process lines and utility line; thickness = 0.5 mm

3. All electrical, computer, and instrument signals; thickness = 0.3 mm

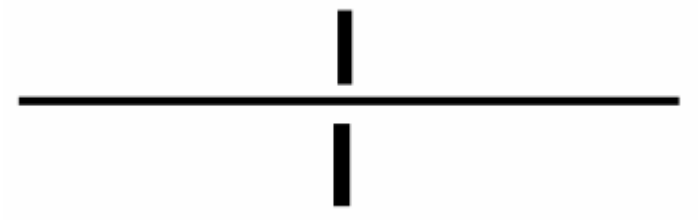
Line Crossover

Where two lines cross each other, the horizontal line should be drawn as a continuous line in all cases. This shall not apply to loop lines for instruments.

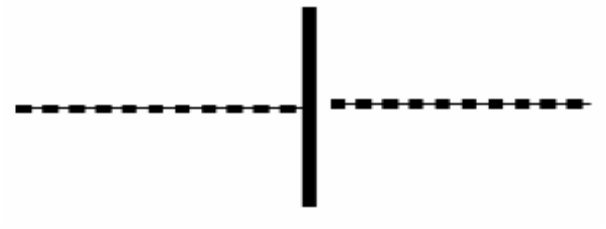
1. Where two main process lines cross



2. Where one main line crosses one secondary process and utility lines



3. Where one main line crosses one loop line for an instrument



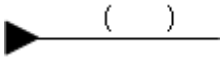
Denotation of Lines at Battery Limit Tie-In Points

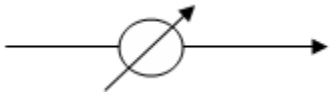
1. Process lines

   From Item No. and/ or Dwg. No. To Item No. and/ or Dwg. No.

   Where a PFD consists of two or more divided sheets, drawing numbers should be indicated.

2. Utility lines





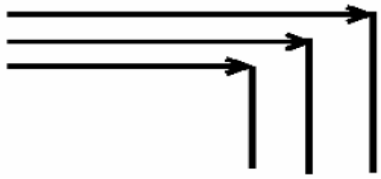
Names of fluids should be given in parentheses above the utility lines.

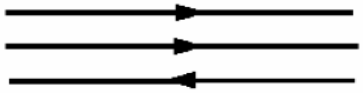
3. Direction of Flow

The direction of flow should be indicated by arrows. In principle all flow lines should be denoted by arrows located at the inlet of equipment, at merging points, and at the corners of the lines. Where a process line is long, however, the process flow may be denoted by arrows located at intermediate points.

The number of arrows used to denote one process flow line is not restricted. However, care should be taken not to clutter the drawing with excessive arrows.

Arrows at corners may be suitably omitted.





Division of PFD

Where a PFD must be divided into two or more sheets, it should be divided at portions where division is easiest from the process standpoint and each divided section should be drawn on a separate sheet.

Other Trains

Where there are two or more identical trains of process flows, one representative train may be given in the PFD and the others omitted. However, notations pointing out such omissions must be clearly indicated in the titles of all relevant PFDs to avoid confusion.

Base Line

As a rule, base lines should not be drawn. Similar items of equipment, however, should be aligned at the same level as far as possible.

Title

The title should be given in the title block at the lower right-hand corner of the PFD.

Legend

The legend may be given in separate schematic drawing to which reference shall be made if necessary.

Size

The size of PFD should normally be A1 (594 mm × 841 mm).

IDENTIFICATION AND NUMBERING OF EQUIPMENT

Process Equipment

Letter of group

Each item of equipment shall be identified by an identifying or a tag number composed of letter.

Equipment number and name

The equipment number and name should be given in the PFD, as a rule, at the upper or the lower part of the sheet, preferably in a space close to the center line of the equipment which is to be denoted. However, depending upon the space, either the number or the name can be omitted.

Installed spare equipment

Installed spare equipment, such as pumps, shall be indicated by a suffix letter like "A" or "B".

Equipment drivers

Equipment drivers shall carry the same designation as the driven equipment.

Instrumentation

It is not necessary to assign an identifying number in the PFD.

DESCRIPTION OF EQUIPMENT

Symbols of Equipment and Operating Conditions

1. As a rule, piping and equipment symbols which are common to individual processes should be unified.
2. Symbols to denote other equipment not specified in this standard manual shall be decided during project execution upon the company's approval.
3. The position of the operating condition denotation should be as close as possible to the point requiring indication. Where it is difficult to find space for such denotation, however, an auxiliary line should be used to indicate it.

Minimum Information Requirements for Equipment

Designated streams

1. Stream numbers should be serially denoted by Decimal numbers.
2. Fluid name.
3. Total flow rate.
4. Density and/or molecular mass (weight) if required.
5. Operating pressure and temperature if required.

Heat exchangers

1. Identification number and service name.
2. Operating heat duty.
3. Inlet and outlet temperatures on both shell and tube sides.

Furnaces

1. Identification number and service name.
2. Operating absorbed heat duty.
3. Inlet and outlet operating temperatures on tube side.

Reactors

1. Identification number and service name.

2. Inlet and outlet operation temperature.
3. Inlet and/or outlet pressure.

Columns

1. Identification number and service name.
2. Tray numbers, operating temperature and pressure for top and bottom trays and also for special trays such as feed and draw-off, etc.
3. Trays shall be numbered from bottom to top.

Drums

1. Identification number and service name.
2. Operating temperature.
3. Operating pressure.

Pumps

1. Identification number and service name.
2. Normal operating capacity and differential pressure.

Compressors and blowers

1. Identification number and service name.
2. Normal operating capacity and differential pressure.

Ejectors

1. Identification number and service name.
2. Inlet and outlet operating pressure for ejector system.

Tanks

1. Identification number and service name.
2. Operating temperature.
3. Operating pressure.

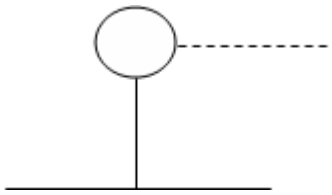
DESCRIPTION OF INSTRUMENTATION

Instrumentation to be denoted are instruments, measuring devices and control valves.

Instruments

Symbols for instrument

1. The symbol for an instrument is a circle which shall be connected to the line which is nearest the point of measurement.



2. Where the instrument is a controller, a dotted line representing the control impulse shall connect the instrument circle to the controller valve.
3. The denotation of such functional symbols as "R" for recorder, "I" for indicator, and "A" for alarm, etc. should be omitted except for the functional symbol "C" for control.

   There should be no distinction as to whether instruments should be locally installed or mounted on the main instrument panel.

Functional symbols for control

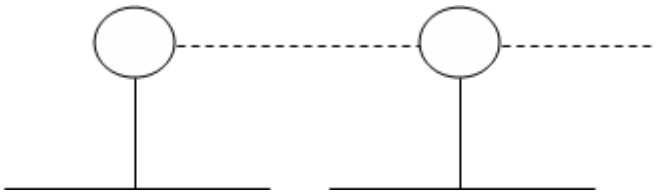
The following symbols are shown inside the circle representing the instrument.

Flow Controlling	FC
Flow Ratio Controlling	FRC
Level Controlling	LC
Pressure Controlling	PC
Pressure Differenial Controlling	PDC
Temperature Controlling	TC
Temperature Differencial Controlling	TDC
Speed Controlling	SC

Mass (Weight) Controlling MC

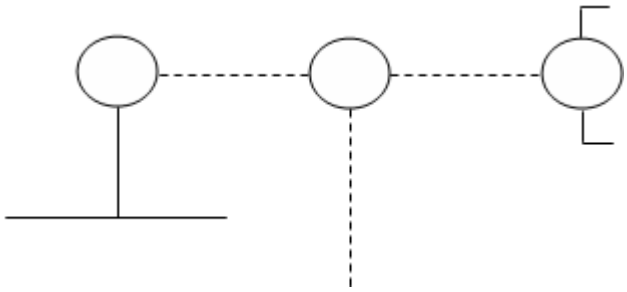
Cascade control

Where one controller alters the desired value of one or more other controllers, the instruments circles shall be connected by a dotted line.



Compound control

Where the control actions of two or more controllers combine to operate one or more control valves, the instrument circles representing the controllers shall be joined by dotted lines to the instrument circle representing the combining device.

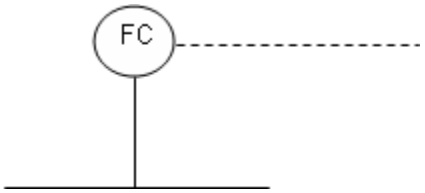


Measuring Devices

The connecting line between the circle representing the instrument and the stream line represents the measuring device such as for temperature measurement, pressure measurement, flow rate measurement, etc.

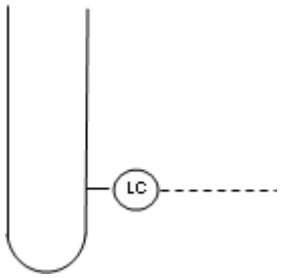
Flow rate measuring

1. Regarding flow rate measurement, definitions of apparatus type such as rotameter, pitot tube, turbine meter,
2. Valves associated with the device need not be shown.



Level measuring

1. Definitions of apparatus type such as ball float, displacement, difference pressure, etc., need not be shown.
2. A distinction should not be made as to whether the apparatus is an internal or external type.
3. Valves associated with the device need not be shown.



Measurement of pressure, temperature, etc.

1. No distinction should be made regarding measuring type.
2. Valves associated with measuring devices need not be shown.