P&ID SYMBOLS

ISA Symbols and Loop Diagrams
P&IDs

Piping and Instrumentation Diagrams or simply P&IDs are the “schematics” used in the field of instrumentation and control (Automation).

The P&ID is used to by field techs, engineers, and operators to better understand the process and how the instrumentation is interconnected.

Most industries have standardized the symbols according to the ISA Standard S5.1 Instrumentation Symbol Specification.

- Piping & Instrumentation Drawing (original)
- Process & Instrumentation Diagram Diagram (also used)
- Process Flow Diagram – PFD (simplified version of the P&ID)
Temperature Process

Using pictorial diagrams may be informative however it is not practical or CAD friendly especially in a multi-loop process.
Building the P&ID

The P&ID will use symbols and circles to represent each instrument and how they are inter-connected in the process.
Tag “numbers” are letters and numbers placed within or near the instrument to identify the type and function of the device.
The first letter is used to designate the measured variable.

The succeeding letter(s) are used to designate the function of the component, or to modify the meaning of the first letter.

- **P**ressure
- **L**evel
- **F**low
- **T**emperature
- **I**ndicator
- **R**ecorder
- **C**ontroller
- **T**ransmitter
Tag Numbers

Tag “numbers” are letters and numbers placed within or near the instrument to identify the type and function of the device.

Temperature Recording Controller

Temperature Transmitter

Temperature Indicator

Temperature Sensing Bulb
## ISA S5.1 Identification Letters

<table>
<thead>
<tr>
<th>First-letter</th>
<th>Succeeding Letters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured or Initiating variable</td>
<td>Modifier</td>
</tr>
<tr>
<td>A</td>
<td>Analysis</td>
</tr>
<tr>
<td>C</td>
<td>Control</td>
</tr>
<tr>
<td>D</td>
<td>Differential</td>
</tr>
<tr>
<td>F</td>
<td>Flow Rate</td>
</tr>
<tr>
<td>H</td>
<td>Hand</td>
</tr>
<tr>
<td>I</td>
<td>Current</td>
</tr>
<tr>
<td>L</td>
<td>Level</td>
</tr>
<tr>
<td>P</td>
<td>Pressure, vacuum</td>
</tr>
<tr>
<td>Q</td>
<td>Quantity</td>
</tr>
<tr>
<td>S</td>
<td>Safety</td>
</tr>
<tr>
<td>T</td>
<td>Temperature</td>
</tr>
<tr>
<td>V</td>
<td>Vibration</td>
</tr>
<tr>
<td>z</td>
<td>Position</td>
</tr>
</tbody>
</table>

Examples
The presence or absence of a line determines the location of the physical device. For example **no line** means the instrument is installed in the field near the process.

- **No Line**
  - The instrument is mounted in the field near the process, (close to the operator)

- **Solid Line**
  - The instrument is mounted in the control room (accessible to the operator)

- **No Line**
  - The instrument is mounted out of sight (not accessible to the operator)
Some instruments are part of a Distributed Control System (DCS) where a specific controller or indicator can be selected from many others but shown in one location (like a terminal screen).
# Summary of instrument type & location

<table>
<thead>
<tr>
<th></th>
<th>Accessible to the Operator; Primary Location on the Main Control Panel</th>
<th>Mounted in the Field</th>
<th>Not Normally Accessible to Operator, Behind the Panel</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distinct Elements</strong></td>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
<td><img src="image3.png" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>Shared Display</strong></td>
<td><img src="image4.png" alt="Diagram" /></td>
<td><img src="image5.png" alt="Diagram" /></td>
<td><img src="image6.png" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>Shared Control in Distributed Control System</strong></td>
<td><img src="image7.png" alt="Diagram" /></td>
<td><img src="image8.png" alt="Diagram" /></td>
<td><img src="image9.png" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>Computer Logic Function</strong></td>
<td><img src="image10.png" alt="Diagram" /></td>
<td><img src="image11.png" alt="Diagram" /></td>
<td><img src="image12.png" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>Programmable Logic Control</strong></td>
<td><img src="image13.png" alt="Diagram" /></td>
<td><img src="image14.png" alt="Diagram" /></td>
<td><img src="image15.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>
Piping and Connection Symbols

These symbols are used to identify how the instruments in the process connect to each other.

And what type of signal is being used. (electrical, pneumatic, data, etc)
Valve Symbols

Valves

- Gate Valve, Hand-operated
- Globe Valve, Hand-operated
- Plug or Cock Valve, Hand-operated
- Check Valve
- Butterfly Valve
- Angle Valve, Hand-operated
- Control Valve
- Solenoid Valve
- Motor-operated
- Piston-operated
- Safety Valve or Relief Valve
P&ID Example

Temperature Controller and Recorder

Temperature Transmitter

Water

Pneumatic Control Valve

Heat Exchanger

TRC 206

TCV 206

TI 206

S
P&ID Exercise
P&ID Exercise

FIC – Flow Indicating Controller

TIC
Temperature Indicating Cont.

YIC
PLC Indicating Controller

TY
Temperature Computer
Output

FT
Flow Transmitter

TT
Temperature Transmitter
Process Flow Diagram - PFD

A PFD shows less detail than a P&ID and is used only to understand how the process works.