

## How to read P&IDs

**Dave Harrold, senior editor -- 8/1/2000**

Instrumentation detail varies with the degree of design complexity. For example, simplified or conceptual designs, often called process flow diagrams, provide less detail than fully developed piping and instrumentation diagrams (P&IDs). Being able to understand instrumentation symbols appearing on diagrams means understanding ANSI/ISA's S5.1-1984 (R 1992) Instrumentation symbols and identification standard. S5.1 that defines how each symbol is constructed using graphical elements, alpha and numeric identification codes, abbreviations, function blocks, and connecting lines.

### Deciphering symbols

ISA S5.1 defines four graphical elements-discrete instruments, shared control/display, computer function, and programmable logic controller-and groups them into three location categories (primary location, auxiliary location, and field mounted).

Discrete instruments are indicated by circular elements. Shared control/display elements are circles surrounded by a square. Computer functions are indicated by a hexagon and programmable logic controller (PLC) functions are shown as a triangle inside a square.

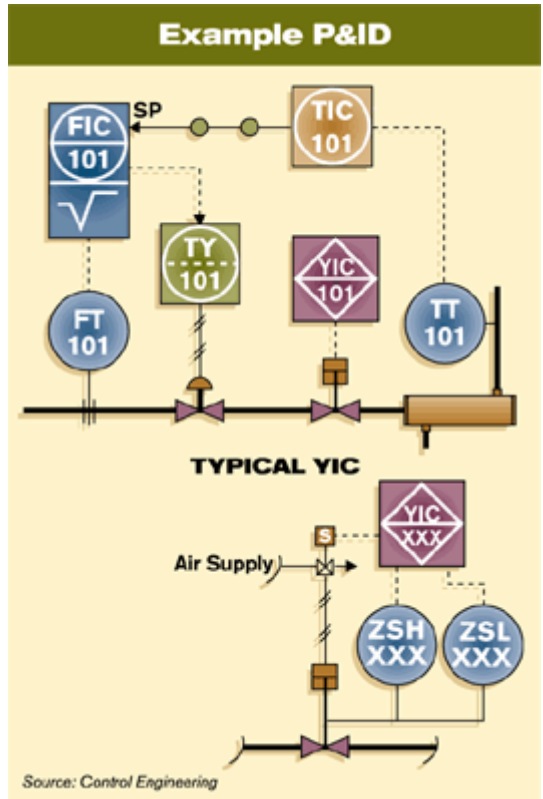
Adding a single horizontal bar across any of the four graphical elements indicates the function resides in the primary location category. A double line indicates an auxiliary location, and no line places the device or function in the field. Devices located behind a panel-board in some other inaccessible location are shown with a dashed horizontal line

Letter and number combinations appear inside each graphical element and letter combinations are defined by the ISA standard. Numbers are user assigned and schemes vary with some companies use of sequential numbering, others tie the instrument number to the process line number, and still others adopt unique and sometimes unusual numbering systems.

The first letter defines the measured or initiating variables such as Analysis (A), Flow (F), Temperature (T), etc. with succeeding letters defining readout, passive, or output functions such as Indicator (I), Record (R), Transmit (T), and so forth.

### Example shows the story

Referring to the Example P&ID diagram, FT 101 represents a field-mounted















flow transmitter connected via electrical signals (dotted line) to flow indicating controller FIC 101 located in a shared control/display device. A square root extraction of the input signal is applied as part of FIC 101's functionality. The output of FIC 101 is an electrical signal to TY 101 located in an inaccessible or behind-the-panel-board location. The output signal from TY 101 is a pneumatic signal (line with double forward slash marks) making TY 101 an I/P (current to pneumatic transducer). TT 101 and TIC 101 are similar to FT 101 and FIC 101 but are measuring, indicating, and controlling temperature. TIC 101's output is connected via an internal software or data link (line with bubbles) to the setpoint (SP) of FIC 101 to form a cascade control strategy.

Often P&ID's include a cover page where common and typical terms, symbols, numbering systems, etc., are defined. On the example, Typical YIC would likely appear on the cover page and the simplified form of YIC would appear throughout the P&IDs.

Typical YIC indicates an on/off valve is controlled by a solenoid valve and is fitted with limit switches to indicate open (ZSH) and closed (ZSL) positions. All inputs and outputs are wired to a PLC that's accessible to the operator (diamond in a square with a solid horizontal line). The letter 'Y' indicates an event, state, or presence. The letter 'I' depicts indication is provided, and the letter 'C' means control takes place in this device.

Adherence to ISA's S5.1 Instrumentation Symbols and Identification standard ensures a consistent, system independent means of communicating instrumentation, control, and automation intent is developed for everyone to understand.

<b>General instrument or function symbols</b>			
	<b>Primary location accessible to operator</b>	<b>Field mounted</b>	<b>Auxiliary location accessible to operator</b>
<b>Discrete instruments</b>	1 	2 	3 
<b>Shared display, shared control</b>	4 	5 	6 
<b>Computer function</b>	7 	8 	9 
<b>Programmable logic control</b>	10 	11 	12 
1. Symbol size may vary according to the user's needs and the type of document. 2. Abbreviations of the user's choice may be used when necessary to specify location. 3. Inaccessible (behind the panel) devices may be depicted using the same symbol but with a dashed horizontal bar.  Source: Control Engineering with data from ISA S5.1 standard			

<b>Identification letters</b>	
<b>First letter</b>	<b>Succeeding letters</b>

	Measured or initiating variable	Modifier	Readout or passive function	Output function	Modifier
<b>A</b>	Analysis		Alarm		
<b>B</b>	Burner, combustion		User's choice	User's choice	User's choice
<b>C</b>	User's choice			Control	
<b>D</b>	User's choice	Differential			
<b>E</b>	Voltage		Sensor (primary element)		
<b>F</b>	Flow rate	Ration (fraction)			
<b>G</b>	User's choice		Glass, viewing device		
<b>H</b>	Hand				High
<b>I</b>	Current (electrical)		Indication		
<b>J</b>	Power	Scan			
<b>K</b>	Time, time schedule	Time rate of change		Control station	
<b>L</b>	Level		Light		Low
<b>M</b>	User's choice	Momentary			Middle, intermediate
<b>N</b>	User's choice		User's choice	User's choice	User's choice
<b>O</b>	User's choice		Orifice, restriction		
<b>P</b>	Pressure, vacuum		Point (test connection)		
<b>Q</b>	Quantity	Integrate, totalizer			
<b>R</b>	Radiation		Record		
<b>S</b>	Speed, frequency	Safety		Switch	
<b>T</b>	Temperature			Transmit	
<b>U</b>	Multivariable		Multifunction	Multifunction	Multifunction
<b>V</b>	Vibration, mechanical analysis			Valve, damper, louver	
<b>W</b>	Weight, force		Well		
<b>X</b>	Unclassified	X axis	Unclassified	Unclassified	Unclassified
<b>Y</b>	Event, state, or presence	Y axis		Relay, compute, convert	
<b>Z</b>	Position, dimension	Z axis		Driver, actuator	

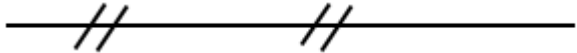
Source: Control Engineering with data from ISA S5.1 standard

## Common connecting lines

Connection to process, or instrument supply:



Pneumatic signal:



Electric signal:



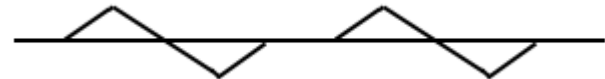
Capillary tubing (filled system):



Hydraulic signal:



Electromagnetic or sonic signal (guided):



Internal system link (software or data link):



Source: Control Engineering with data from ISA S5.1 standard