

PROCESS CONTROL SYSTEMS

2

**LEARNING
ACTIVITY
PACKET**

INSTRUMENT TAGS



B270-XD

INSTRUMENT TAGS**INTRODUCTION**

People often look at drawings of a process control system to gain an understanding of it. The most common of these drawings is the Piping and Instrumentation Diagram (P&ID). One of the basic building blocks of a P&ID is an instrument tag. Instrument tags describe various details about a device and its location.

This LAP covers how to interpret the information given in an instrument tag so that you will become proficient in reading process control documentation.

ITEMS NEEDED

Amatrol Supplied

- 1 T5552 Process Control Learning System

School Supplied

- 1 Water Supply
- 1 Compressed Air Supply

FIRST EDITION, LAP 2, REV. A

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Amatrol, Inc., P.O. Box 2697, Jeffersonville, IN 47131 USA, Ph 812-288-8285, FAX 812-283-1584 www.amatrol.com

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SEGMENT 1

BLOCK DIAGRAMS

OBJECTIVE 1

DESCRIBE THE FUNCTION OF A BLOCK DIAGRAM



Block diagrams are simplified graphical representations of control systems. A block diagram, like the one in figure 1, shows the major components of the system, how they are related, and certain performance characteristics.

Block diagrams are often used for process control systems because they allow complex processes to be more easily understood and analyzed.

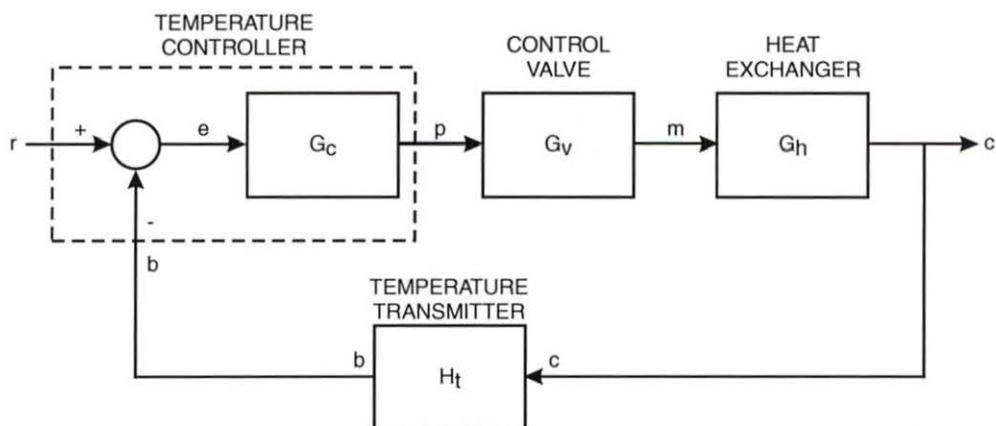


Figure 1. A Block Diagram

OBJECTIVE 2

DESCRIBE THE FUNCTION OF THE THREE BASIC SYMBOLS OF A BLOCK DIAGRAM



Block diagrams consist of three basic symbols: lines, circles, and rectangles, as shown in figure 2. These symbols are arranged to show the energy transfer taking place in a loop, how decisions are made by the loop, and what result would take place.

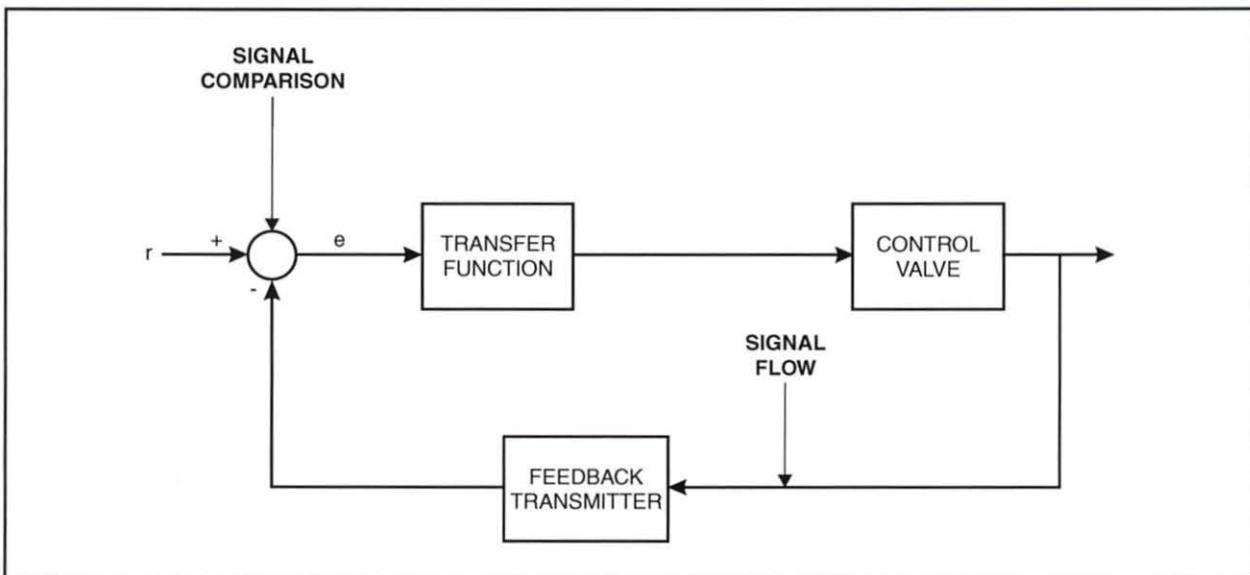


Figure 2. Symbols of a Block Diagram

Lines

Lines show the flow of signals in and out of elements in a process loop. The arrowheads indicate the direction of signal flow.

Circle Components

A circle, often referred to as a summing junction, represents the comparison of two signals. The polarity of the signals is indicated outside the circle, as figure 3 shows. This comparison is most often an addition or subtraction of the signals.

Notice in figure 3 that the setpoint (SP) enters the circle on the left side. The plus sign near the line where it enters indicates that SP is a positive variable. The process variable (PV) enters the circle on the bottom and has a negative polarity. The output of this block is the error signal, indicated by the small “e” symbol. Taking the visible information and combining it gives you the equation for this block, $SP - PV = e$.

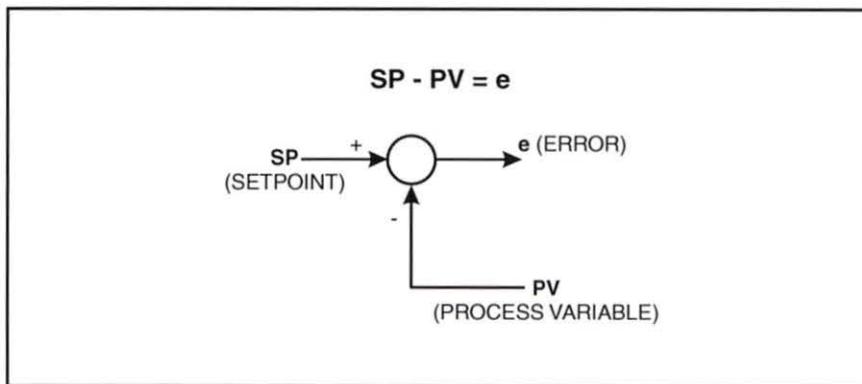


Figure 3. Circle Diagram Representing PV, SP, and Error

Rectangle Components

Rectangles represent transfer functions. Transfer functions describe the relationship between the input and output signal of a component or several components. This relationship is defined as the ratio of the output to the input. Figure 4 shows an example of a transfer function rectangle.

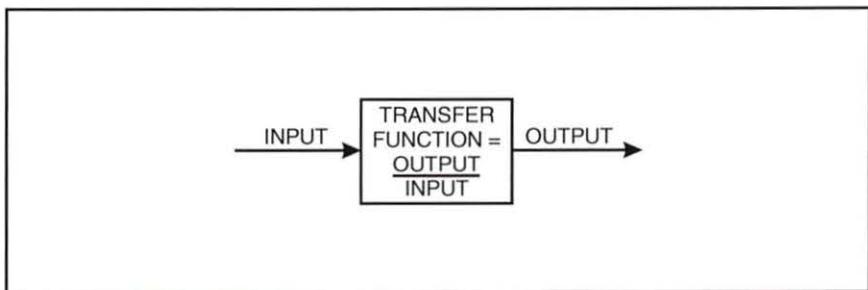


Figure 4. Transfer Function

Some block diagrams only give a general overview of the process. In these cases, the rectangles may be labeled as physical components (e.g. controller, valve, sensor, etc.) and every input and output may not be specified, as shown in figure 5. However, it is understood that each component is in some way changing the input to give a different output. Therefore, each rectangle still represents a transfer function.

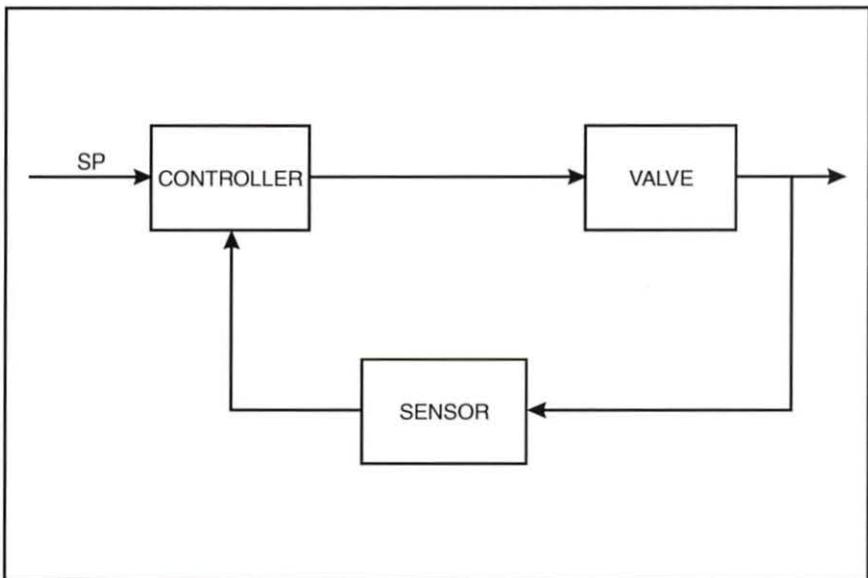


Figure 5. Block Diagram Showing Overview of a Process

In figure 6, the thermocouple is a component and the signal amplifier represents the amplification transfer function. The rectangles in this section of a block diagram show that the output from the thermocouple (0 - 10mV) passes through an amplifier (the transfer function) and becomes amplified to 0 - 10V.

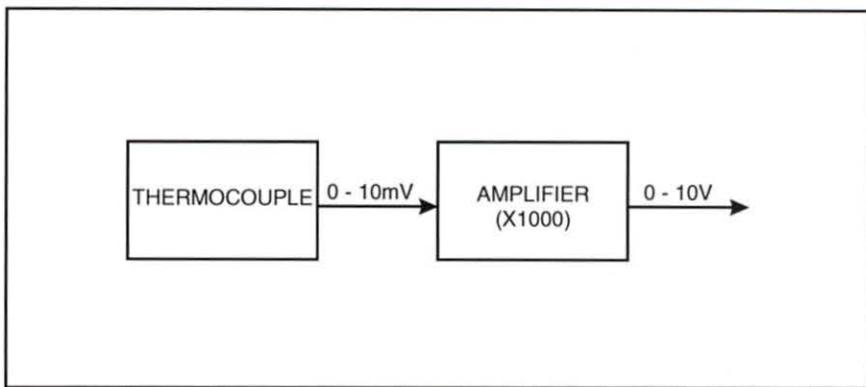


Figure 6. Transfer for a Thermocouple

Procedure Overview

In this procedure, you will develop your ability to draw a block diagram by drawing the block diagrams for a number of processes. This will help develop your analytical skills and should make you more comfortable reading a block diagram.



- 1. Perform the following substeps to draw a block diagram of the actions that take place to maintain the speed of a vehicle, as shown in figure 7.



Figure 7. Driver of a Vehicle Maintains Desired Speed

- A. Determine the steps necessary for a person to maintain the speed of a vehicle.

Step 1 _____

Step 2 _____

Step 3 _____

Step 4 _____

The first step is that the driver must determine the desired speed. This is the set point of the process.

Step 2 is that the driver must determine the current actual speed.

For step 3, the driver must determine if there is a difference between the desired speed and the actual speed (error).

For step 4, the driver must act upon the error signal to bring the actual speed (PV) to the desired speed (SP). This requires pressing down more on the accelerator pedal if the vehicle is going too slow or letting up on the pedal if the vehicle is going too fast. This process must continue to maintain the speed of the vehicle.

- B. Draw a circle to indicate the driver's comparison of the desired speed to the actual speed, as shown in figure 8. In addition, add the flow lines that represent the desired speed input signal and the actual speed input signal.

The positive input is the desired speed. The negative input (feedback) is the actual speed of the vehicle. The output of this comparison is the error signal.

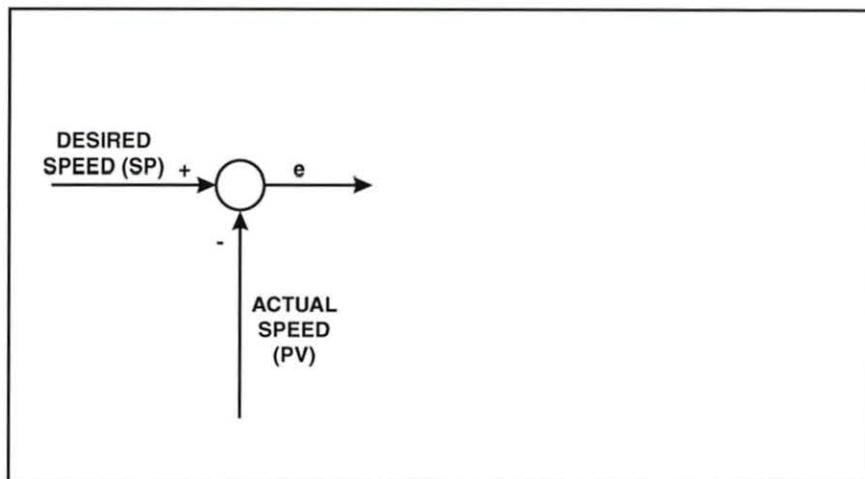


Figure 8. Circle to Indicate Comparison of Desired Speed to Actual Speed

- C. Draw a rectangle to the right of the circle to represent the final control element (accelerator pedal), as shown in figure 9. In addition, draw the flow line from the output of the comparison circle to the final control element. This flow line represents the error between the desired speed and the actual speed.

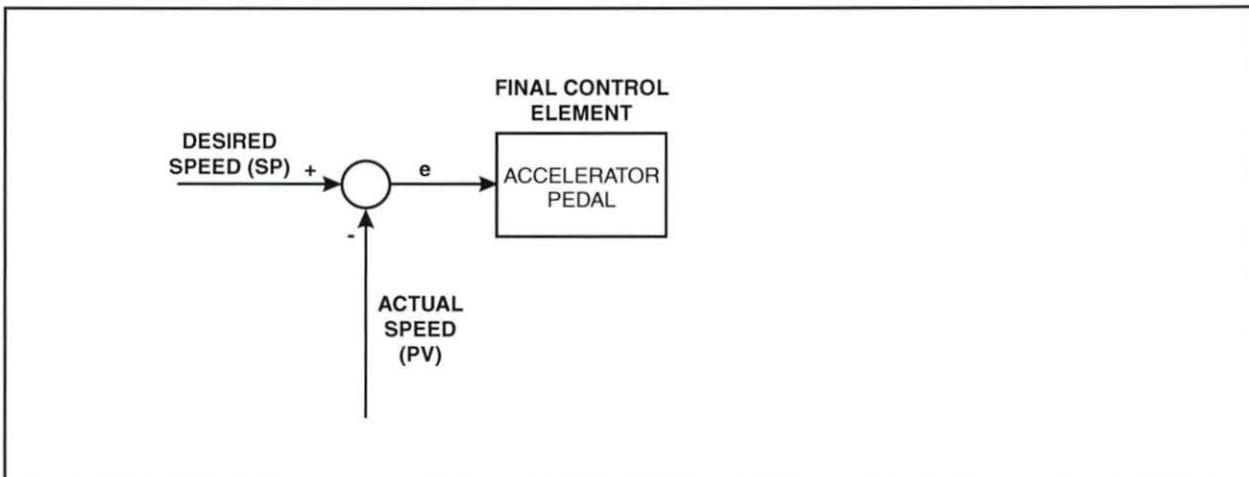


Figure 9. Rectangle to Indicate the Final Control Element (Accelerator Pedal)

- D. Draw another rectangle to the right of the final control element to represent the process variable (speed). In addition, draw a flow line from the final control element to the process variable. This is all shown in figure 10.

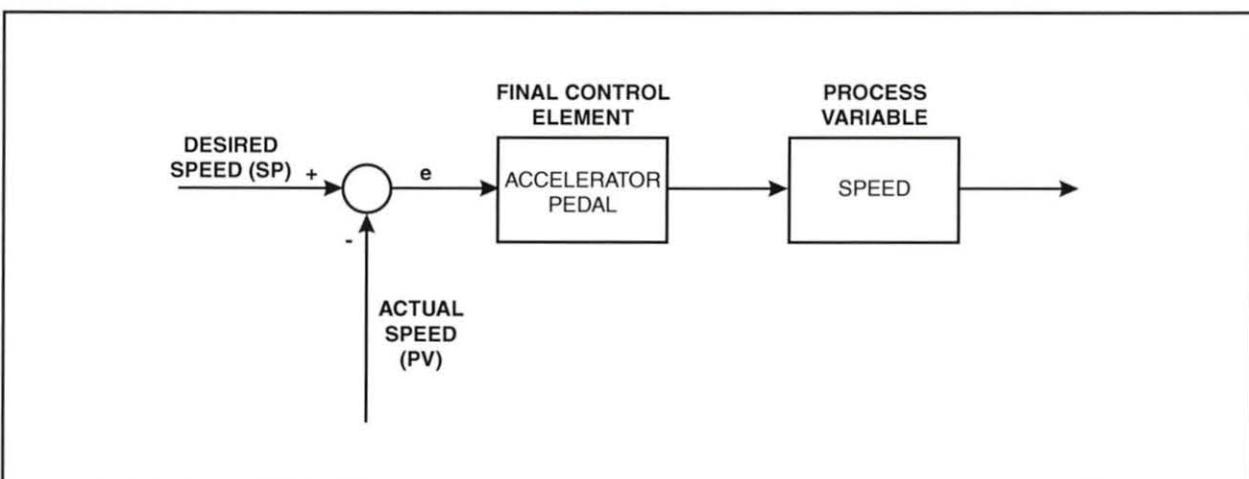


Figure 10. Addition of Process Variable Element

- E. Complete the block diagram by adding the feedback loop, as figure 11 shows.

In this case, the sensing element is represented by the driver's visual observation of the speedometer, which indicates the actual speed of the vehicle.

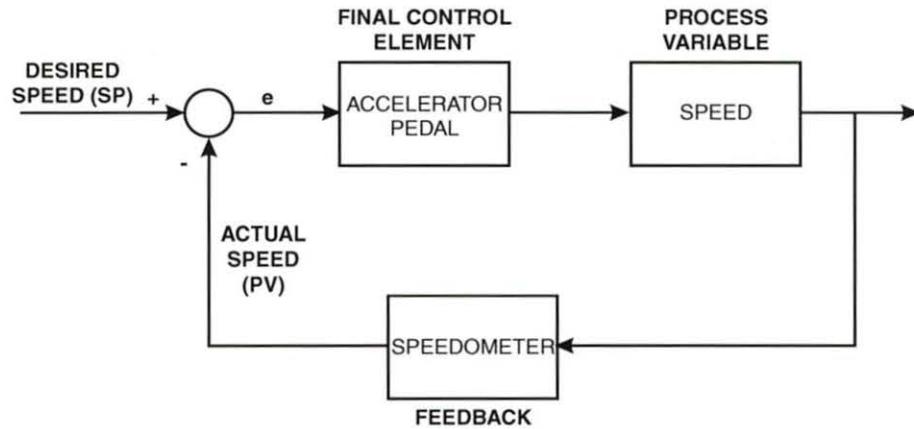


Figure 11. Addition of the Feedback Loop

- F. Compare your final block diagram to the one in figure 11. Your block diagram should be very similar.

2. Draw a block diagram of the actions that take place while maintaining the temperature in a room. Remember, the first step is to write out the steps required to control room temperature.



Figure 12. Temperature Control of a Room

3. Draw the block diagram for a system that maintains the level in a tank. Again, don't forget to write out the steps required to maintain the level in the tank.

The level sensors are used to control the solenoid valve. In this case, when the liquid level is too low, the solenoid valve is closed. When the liquid level is too high, the solenoid valve is opened.

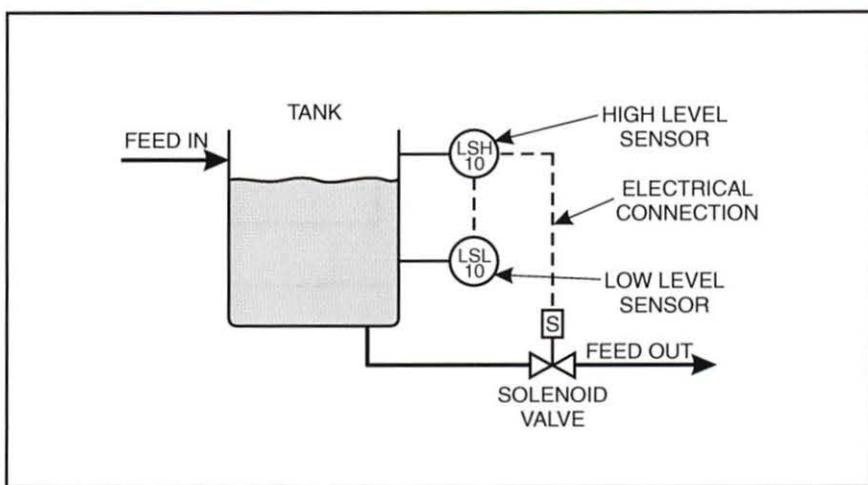


Figure 13. Level Control System

4. Draw the block diagram for a system that controls the flow through a pipe.

The vortex sensor senses the flow through the pipe and opens or closes the solenoid valve to control flow.

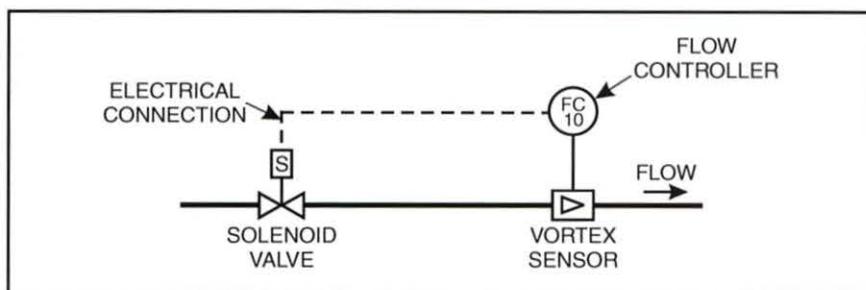


Figure 14. Flow Control System

5. Draw the block diagram for a system that controls the pressure in a pressure vessel.

In this case, there are two final control elements: the nitrogen supply control valve and the atmospheric vent control valve.

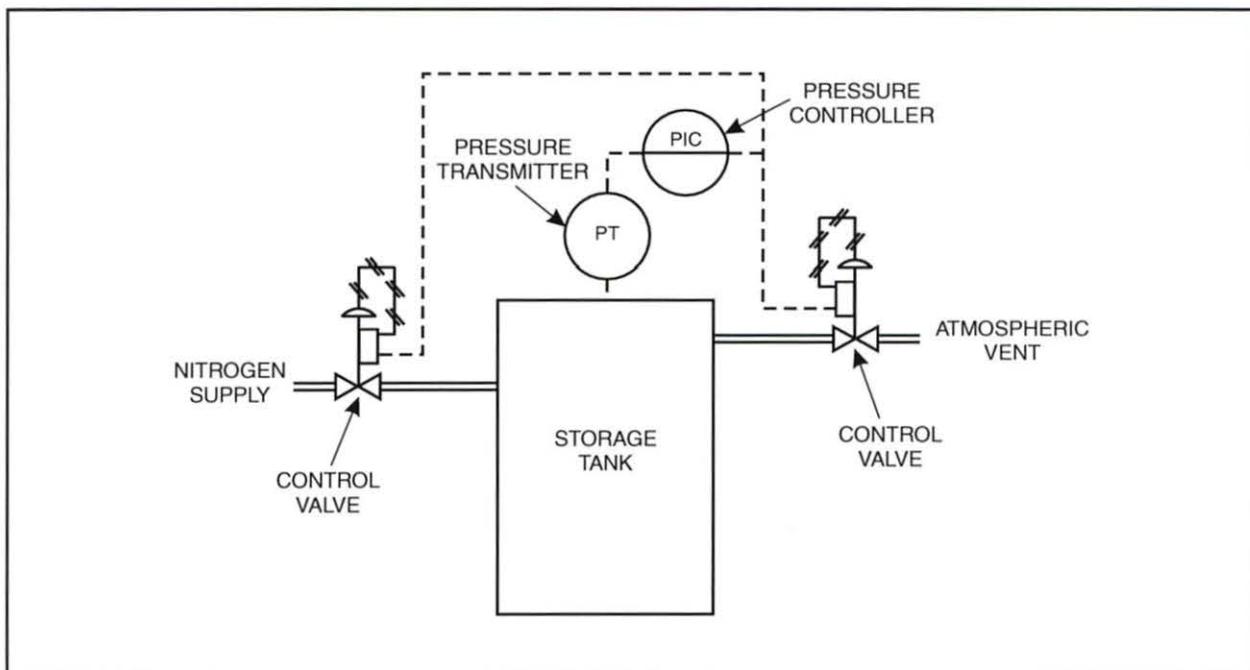


Figure 15. Pressure Control System

SEGMENT 1

SELF REVIEW



1. A _____ diagram is commonly used to represent process control systems.
2. Block diagrams consist of rectangles, lines, and _____.
3. _____ and arrowheads show the flow of signals in and out of elements in a process loop.
4. A circle indicates a signal _____.
5. In the formula $SP - PV = e$, the e represents _____.
6. Rectangles represent a _____ within a loop.

SEGMENT 2

INSTRUMENT TAG FUNDAMENTALS

OBJECTIVE 3

DESCRIBE THE FUNCTION OF AN INSTRUMENT TAG



Instrument tags are symbols used in process control documentation that contain information about the devices in the process. Instrument tags are often referred to as *bubbles* or *balloons* because of the basic shape of a tag. Figure 16 shows examples of some common instrument tags.

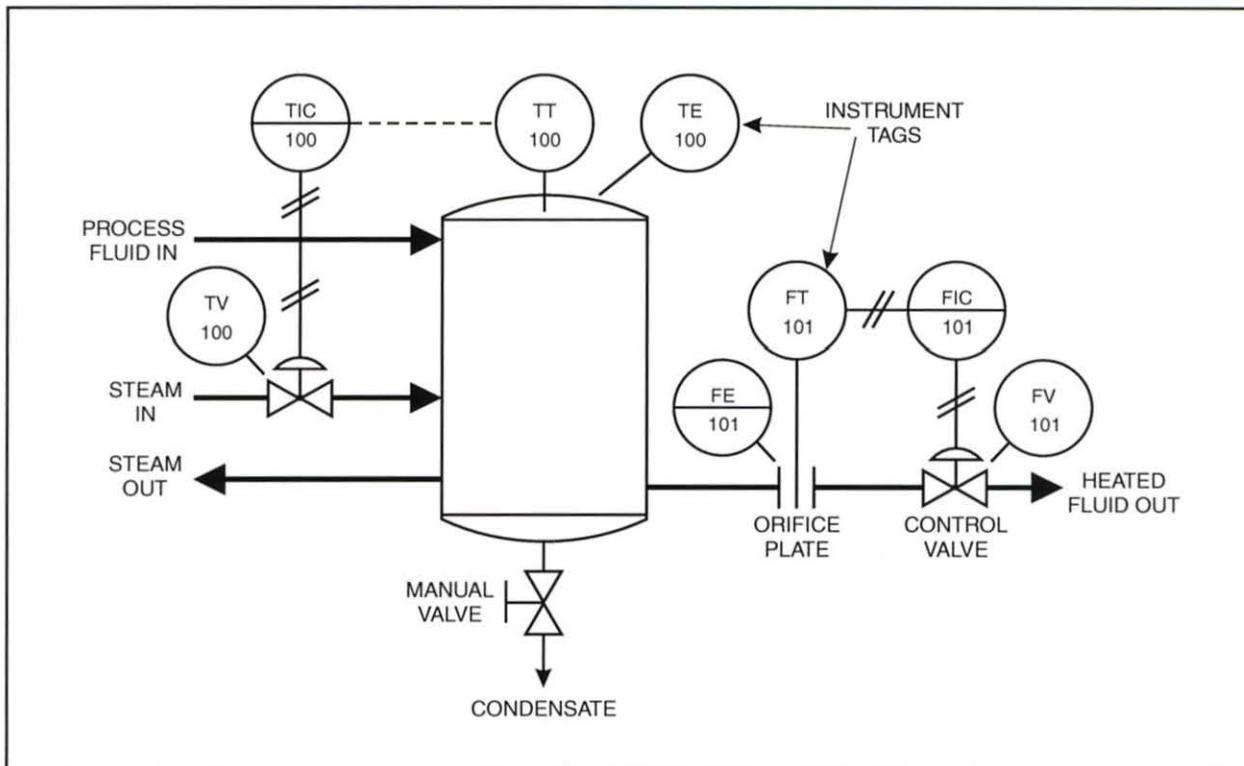


Figure 16. Process Diagram with Instrument Tags

Instrument tags are also placed on the physical devices to identify them. For example, figure 17 shows an instrument tag attached to a hand valve. The information on these tags match the instrument tags in the process documentation.

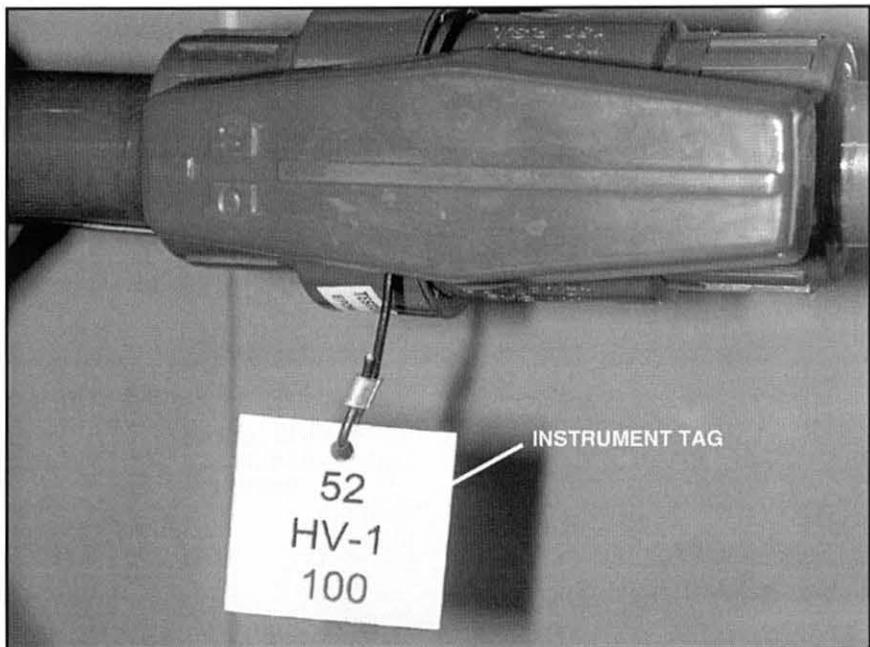


Figure 17. Instrument Tag on a Hand Valve

OBJECTIVE 4

DEFINE THE SIX TYPES OF INFORMATION DESCRIBED BY AN INSTRUMENT TAG



Instrument tags, or “balloons,” provide six basic pieces of information about an instrument:

- Type of device
- Location of the instrument
- Measured or initiated variable
- Function of the device
- Loop in which the device is connected
- Area in which the device is located

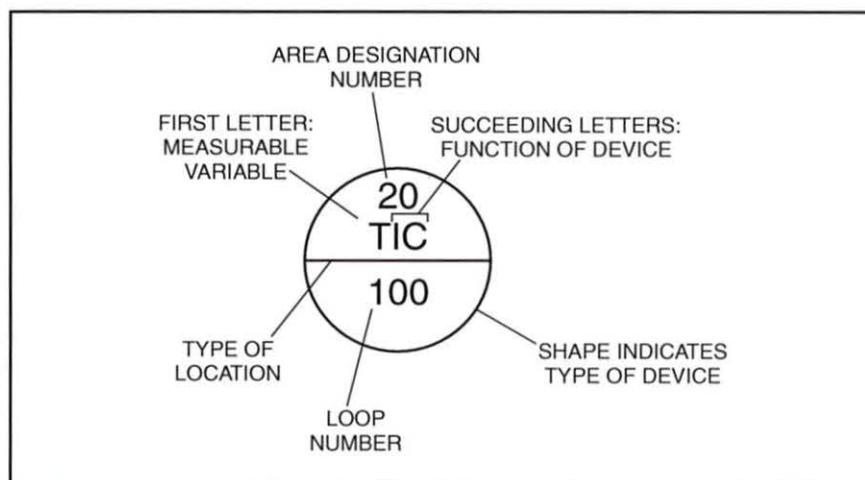


Figure 18. Information Given in an Instrument Tag



NOTE

All instrument tags shown meet the Instrument Society of America (ISA) standards. ISA standards will be observed throughout this set of LAPs.



The external shape of the instrument tag indicates the type of device, as shown in figure 19.

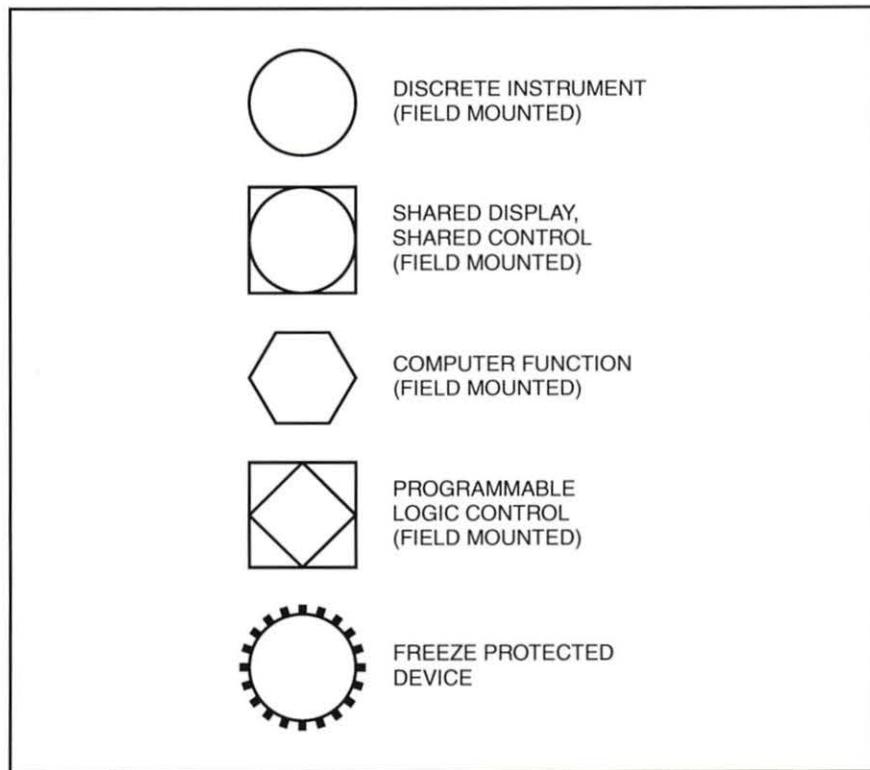


Figure 19. Basic Instrument Tags

A circular shape indicates a discrete instrument tag. A discrete instrument tag is used when details about the device are not critical. An external square with a circle inside of it indicates that the device is a shared display or a shared control. Simply put, one device is performing more than one function in a single loop or the device is being used in more than one loop.

A hexagon-shaped symbol indicates a computer is connected in the process. A square with a diamond inside indicates a programmable logic controller (PLC). A circle with a broken line around it indicates that the device is freeze protected.

Procedure Overview

In this procedure, you will identify the type of device using an instrument tag.



1. Determine the type of device indicated by the tag in figure 20.

Type of Device _____



Figure 20. Instrument Tag

You should find that the device is a computer because the tag shows a hexagon.

2. Determine the type of device indicated by the tag in figure 21.

Type of Device _____

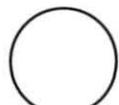


Figure 21. Instrument Tag

You should find that the device is a discrete device because the tag shows a circle.

3. Determine the type of device indicated by the tag in figure 22.

Type of Device _____

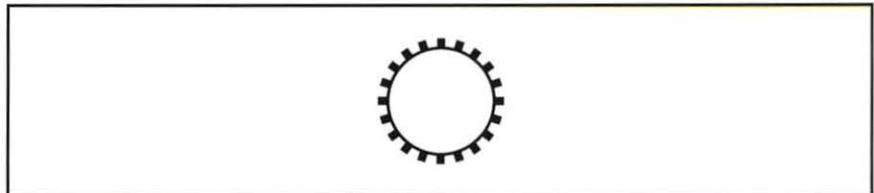


Figure 22. Instrument Tag

You should find that the device is a freeze protected device because the tag shows a circle with a broken line around it.

4. Determine the type of device indicated by the tag in figure 23.

Type of Device _____

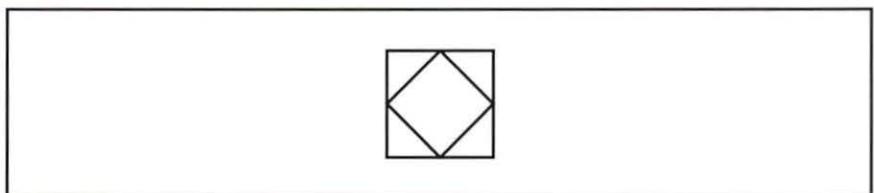


Figure 23. Instrument Tag

You should find that the device is a PLC because the tag shows a diamond enclosed in a square.

5. Determine the type of device indicated by the tag in figure 24.

Type of Device _____

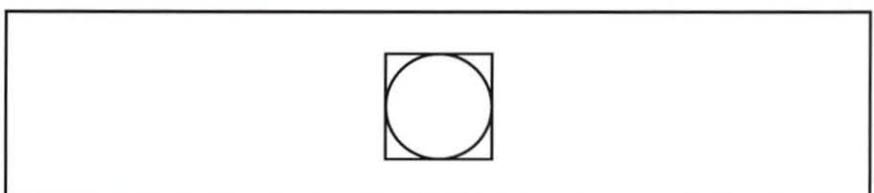


Figure 24. Instrument Tag

You should find that the device is a shared device because the tag shows a square with a circle inside it.

6. Determine the type of device indicated by each of the following tags indicated in figure 25.

Tag A _____

Tag B _____

Tag C _____

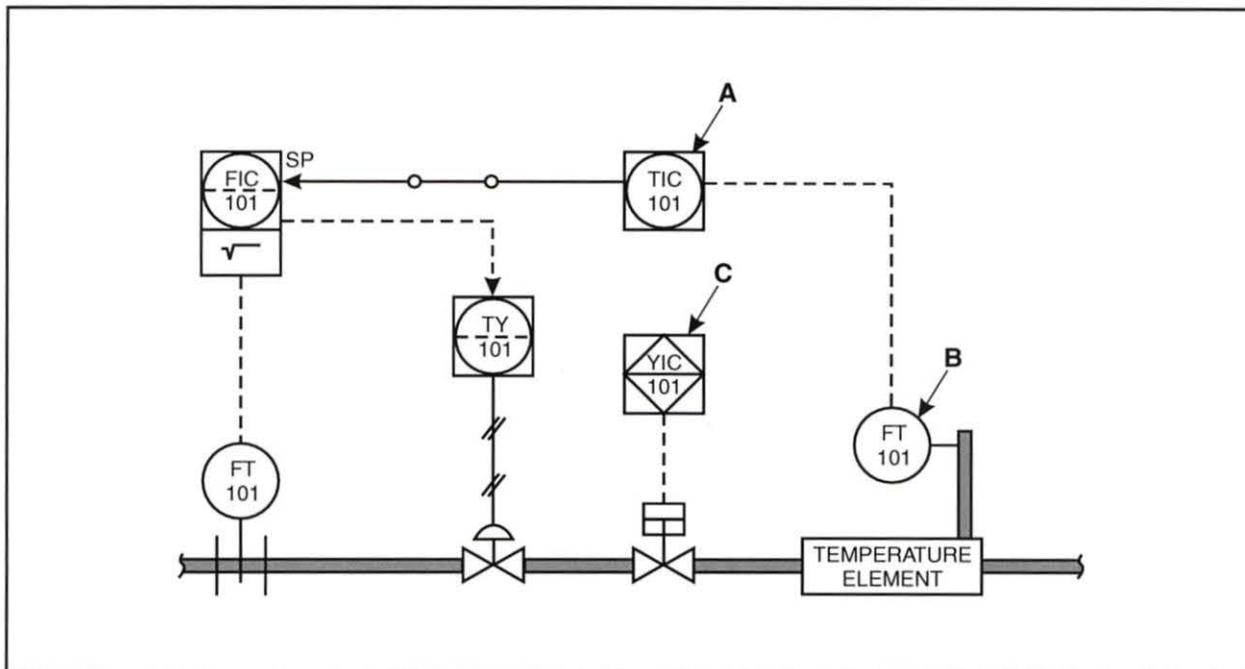


Figure 25. P&ID

You should find that tag A indicates a shared device, tag B indicates a discrete device, and tag C indicates a programmable logic controller (PLC).

OBJECTIVE 6

DESCRIBE HOW AN INSTRUMENT TAG IDENTIFIES THE LOCATION OF A DEVICE



Instruments can be located in one of three locations:

- Field Mounted
- Primary Location
- Auxiliary Location

The location of an instrument in a process control system is indicated by the presence of (or the lack of) a line or lines drawn through the center of the symbol.

Figure 26 shows tags that represent each type of location.

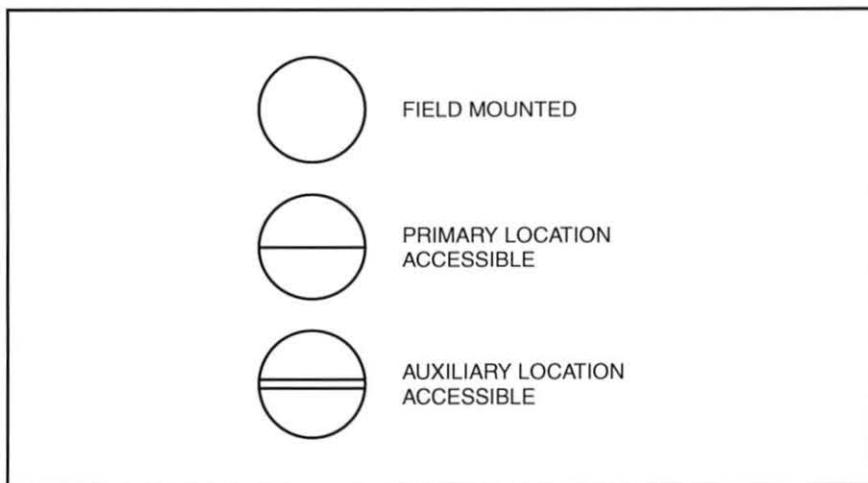


Figure 26. Instrument Tags Indicating Device Location

Field Mounted

Field mounted devices are located on the process itself. The tags that you have seen to this point have indicated field mounted devices, as shown in figure 27. Field mounted tags have no lines through their center.

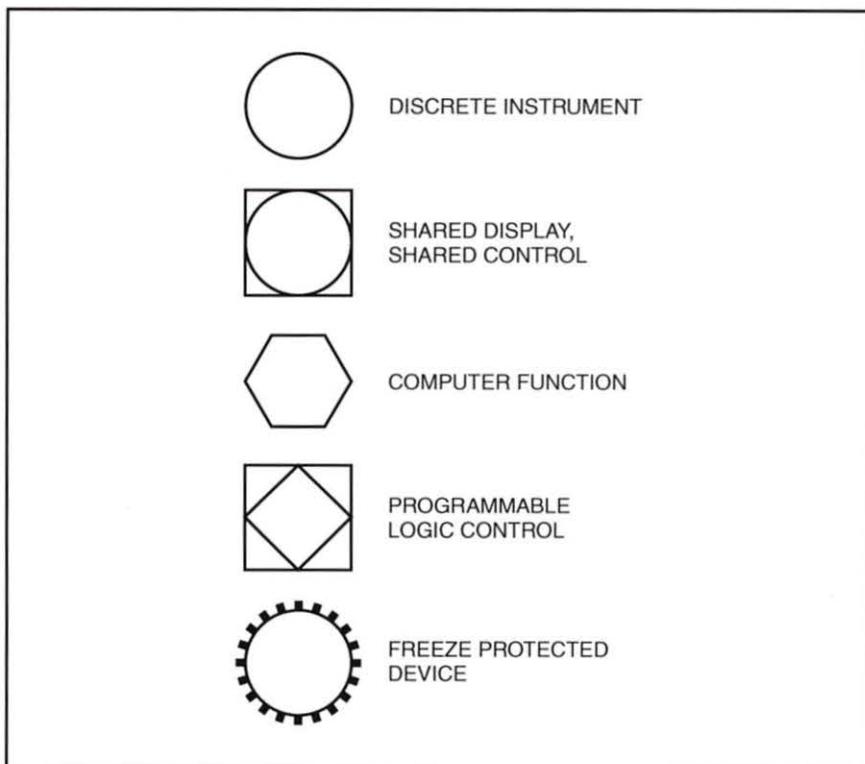


Figure 27. Field Mounted Device Tags

Primary Location

A single line through the tag symbol indicates that the device is located in a primary location such as a control room. Figure 27 shows some examples of primary location tags.

Dashed lines through any tag means that the device is not accessible to the operator. This could mean that the device is behind a panel or under an operator's station.

Figure 28 also shows an example of an inaccessible primary location device tag.

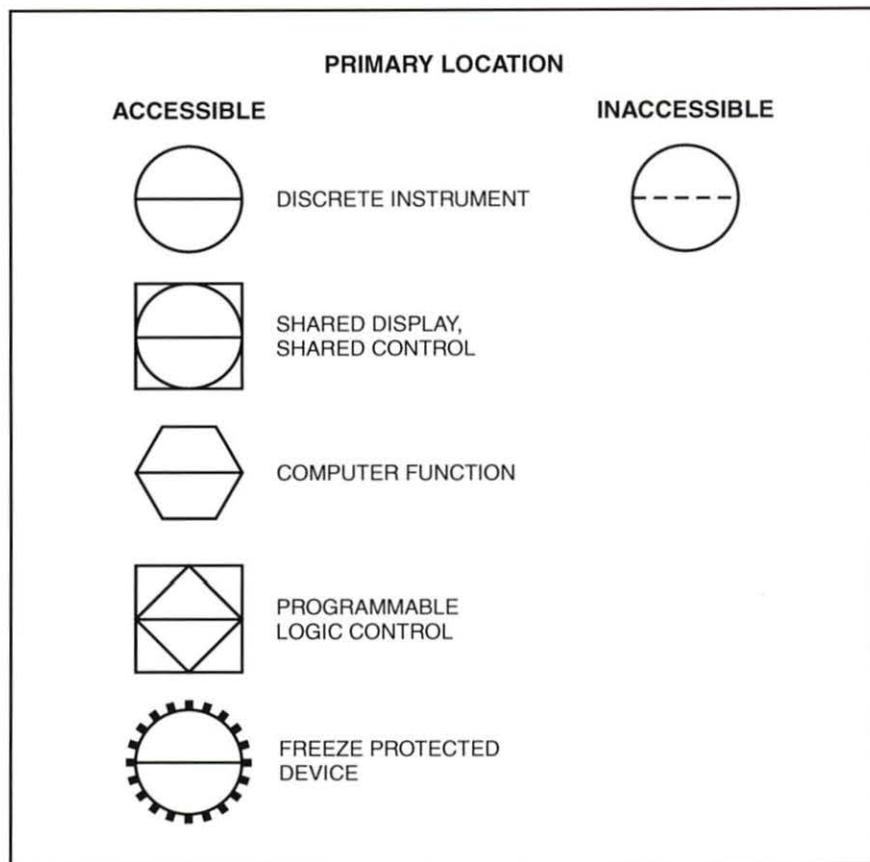


Figure 28. Primary Location Device Tags

Auxiliary Location

A tag with two lines through the center of the symbol, as shown in figure 29, indicates that the device is located in an auxiliary location. Examples of an auxiliary location include an operator station or remote control panel that is located away from the control room.

The figure also shows an example of an inaccessible auxiliary location device tag which has two dashed lines.

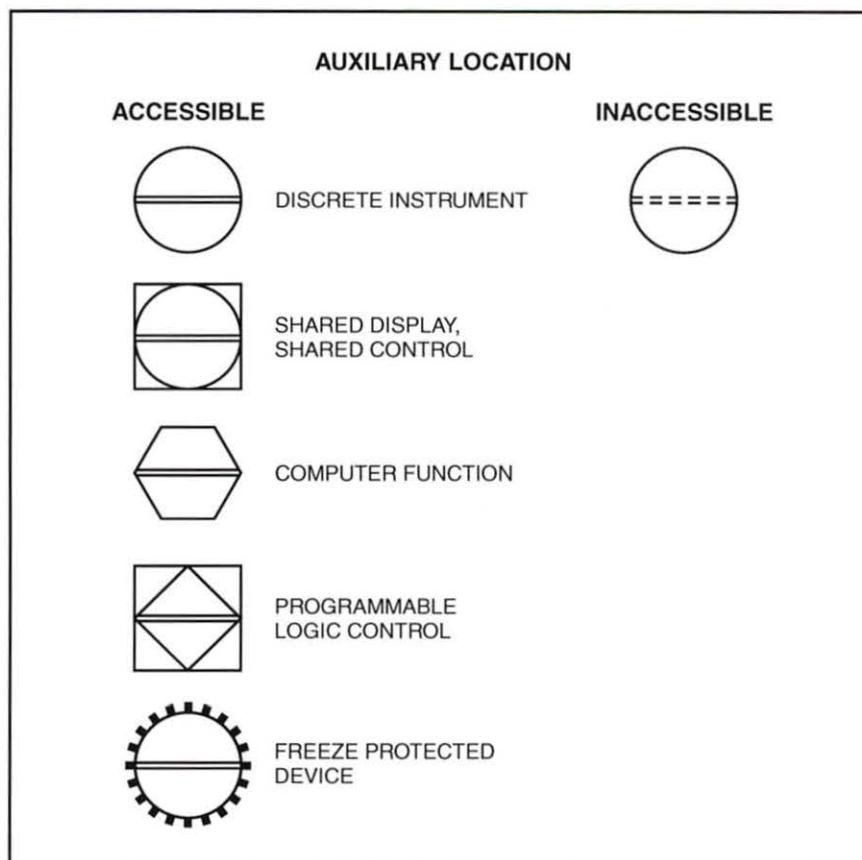


Figure 29. Auxiliary Location Device Tags

SKILL 3**IDENTIFY THE LOCATION OF A DEVICE USING AN INSTRUMENT TAG****Procedure Overview**

In this procedure, you will identify the type and location of a device using an instrument tag. You will also use the instrument tag to determine if the device is accessible to the operator.



1. Determine the type of device indicated by the tag in figure 30.

Type of Device _____

Location _____

Accessible/Inaccessible _____

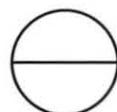


Figure 30. Instrument Tag

You should find that the device is a discrete device in an accessible primary location because the tag shows a circle with a single solid line through it.

2. Determine the type of device indicated by the tag in figure 31.

Type of Device _____

Location _____

Accessible/Inaccessible _____

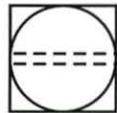


Figure 31. Instrument Tag

You should find that the device is a shared device in an inaccessible auxiliary location because the tag shows a circle enclosed in a square with two dashed lines through it.

3. Determine the type of device indicated by the tag in figure 32.

Type of Device _____

Location _____

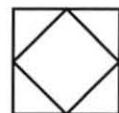


Figure 32. Instrument Tag

You should find that the device is a field mounted PLC because the device shows a diamond enclosed in a square with no line through it.

4. Determine the type of device indicated by the tag in figure 33.

Type of Device _____

Location _____

Accessible/Inaccessible _____

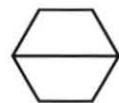


Figure 33. Instrument Tag

You should find that the device is a computer in an accessible primary location because the tag shows a hexagon with a single solid line through it.

5. Determine the type of device indicated by the tag in figure 34.

Type of Device _____

Location _____

Accessible/Inaccessible _____

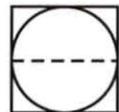


Figure 34. Instrument Tag

You should find that the device is a shared device in an inaccessible primary location because the tag shows a circle enclosed in a square with a single dashed line through it.

6. Determine the type of device indicated by the tag in figure 35.

Type of Device _____

Location _____

Accessible/Inaccessible _____

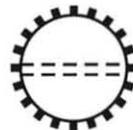


Figure 35. Instrument Tag

You should find that the device is a freeze protected device in an inaccessible auxiliary location because the tag shows a circle with two dashed lines through it and a broken line around it.

7. Determine the type of device indicated by the tag in figure 36.

Type of Device _____

Location _____

Accessible/Inaccessible _____



Figure 36. Instrument Tag

You should find that the device is a field mounted computer because the tag shows a hexagon with no line through it.

8. Determine the type of device indicated by the tag in figure 37.

Type of Device _____

Location _____

Accessible/Inaccessible _____

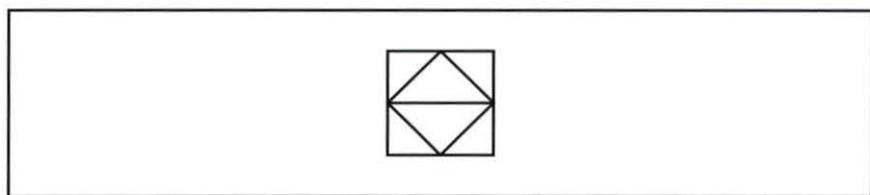


Figure 37. Instrument Tag

You should find that the device is a PLC in an accessible primary location because the tag shows a diamond enclosed in a square with a single solid line through it.

9. Determine the type of device indicated by the tag in figure 38.

Type of Device _____

Location _____

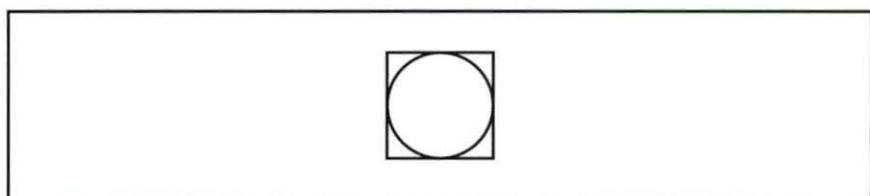


Figure 38. Instrument Tag

You should find that the device is a field mounted shared device because the tag shows a circle enclosed in a square with no line through it.

10. Determine the type of device indicated by the tag in figure 39.

Type of Device _____

Location _____

Accessible/Inaccessible _____

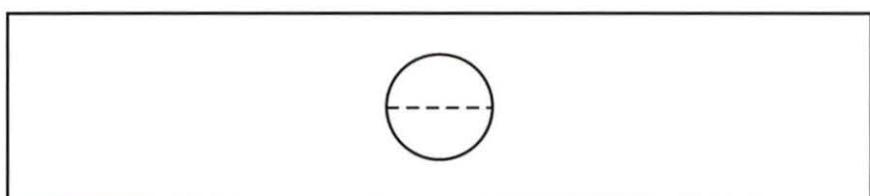


Figure 39. Instrument Tag

You should find that the device is a discrete device in an inaccessible primary location because the tag shows a circle with single dashed line through it.

□ 11. Determine the instrument information for each tag identified in figure 40.

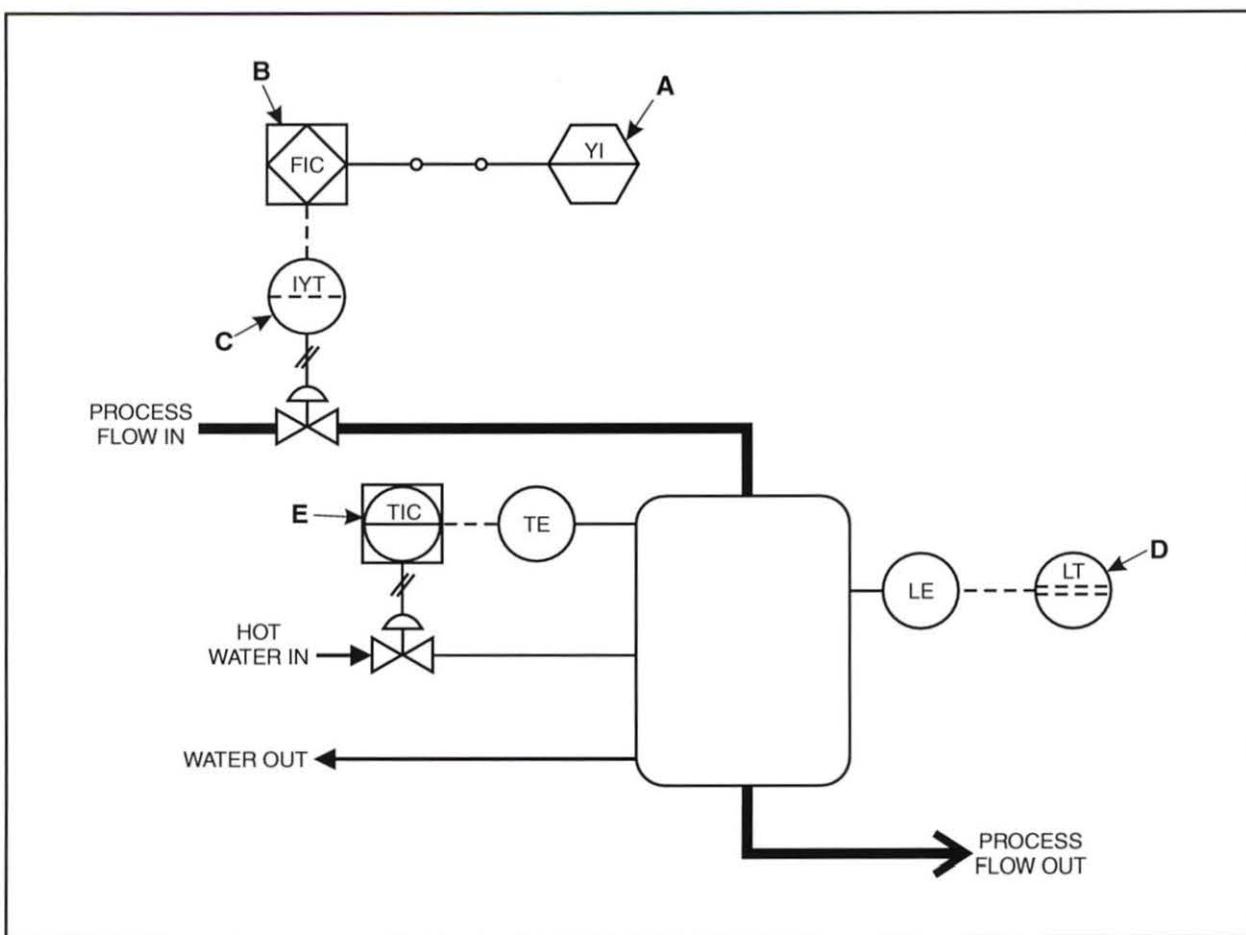


Figure 40. Temperature Control P&ID

Tag A

Type of Device _____

Location _____

Accessible/Inaccessible _____

You should find that the tag represents a computer in a primary, accessible location.

Tag B

Type of Device _____

Location _____

Accessible/Inaccessible _____

You should find that the tag represents a PLC that is field mounted.

Tag C

Type of Device _____

Location _____

Accessible/Inaccessible _____

You should find that the tag represents a discrete device in a primary, inaccessible location.

Tag D

Type of Device _____

Location _____

Accessible/Inaccessible _____

You should find that the tag represents a discrete device in an auxiliary, inaccessible location.

Tag E

Type of Device _____

Location _____

Accessible/Inaccessible _____

You should find that the tag represents a shared device in a primary, accessible location.



1. If the shape of an instrument tag is a diamond inside a square, that device is a _____.
2. If there is a dashed line through the center of a device tag, the device is _____ to the operator.
3. Two lines through the center of a tag indicates that the device is located in a(n) _____ location.
4. If the outer shape of a device tag is a hexagon, the device is a _____.
5. Device tags with no line through their center indicate _____ devices.
6. If the shape of an instrument tag is a circle inside a square, the tag represents a _____.
7. A control room is an example of a(n) _____ location.
8. Instrument tags are often referred to as bubbles or _____.
9. Instrument tags provide _____ basic pieces of information about an instrument.

SEGMENT 3

INTERPRETING INSTRUMENT TAGS

OBJECTIVE 7

DESCRIBE HOW AN INSTRUMENT TAG IDENTIFIES A MEASURED OR INITIATED VARIABLE



The upper portion of an instrument tag contains two or more letters that describe the characteristics of the device. The first letter in the upper portion of the tag describes what the device measures.

For example, figure 41 shows an instrument tag that measures pressure.

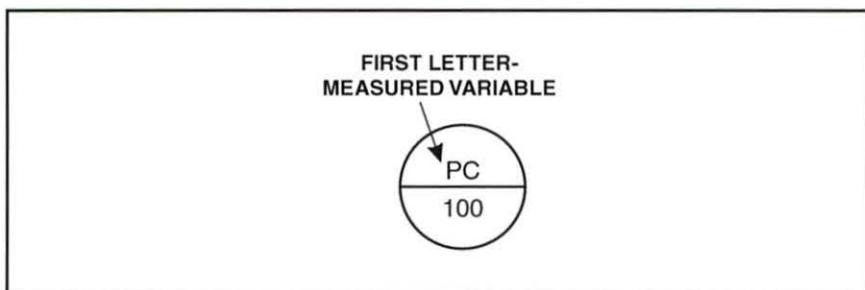


Figure 41. Measured Variable Tag Example

Figure 42 shows a list of some measured variable letters and the variables they represent.

MEASURED VARIABLE LETTERS			
LETTER	MEASURED VARIABLE	LETTER	MEASURED VARIABLE
A	Analysis	N	User's Choice
B	Burner	O	User's Choice
C	Conductivity (Electrical)	P	Pressure or Vacuum
D	Density (Mass) or Specific Gravity	Q	Quantity or Event
E	Voltage	R	Radiation or Radioactivity
F	Flow Rate	S	Speed or Frequency
G	Gauging (Dimensional)	T	Temperature
H	Hand (Manually Initiated)	U	Multivariable
I	Current (Electrical)	V	Vibration or Viscosity
J	Power	W	Weight or Force
K	Time	X	Unclassified
L	Level	Y	Event, State, or Presence
M	Moisture or Humidity	Z	Position or Dimension

Figure 42. Measured Variable Letters

Procedure Overview

In this procedure, you will read an instrument tag and identify the variable measured by the device. You will need to use the table in figure 41 for reference.



1. Determine the measured variable indicated in the instrument tag in figure 43.

Measured Variable _____

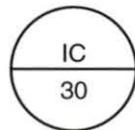


Figure 43. Instrument Tag

You should find that the measured variable is current because the first letter (the measured variable letter) is I.

2. Determine the measured variable indicated in the instrument tag in figure 44.

Measured Variable _____

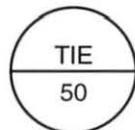


Figure 44. Instrument Tag

You should find that the measured variable is temperature because the first letter is T.

3. Determine the measured variable indicated in the instrument tag in figure 45.

Measured Variable _____

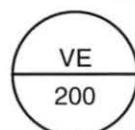


Figure 45. Instrument Tag

You should find that the measured variable is vibration because the first letter is V.

4. Determine the measured variable indicated in the instrument tag in figure 46.

Measured Variable _____

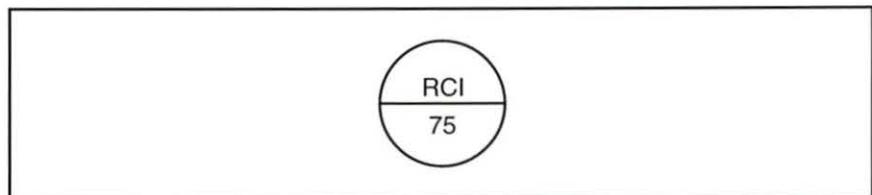


Figure 46. Instrument Tag

You should find that the measured variable is radiation because the first letter is R.

5. Determine the measured variable indicated in the instrument tag in figure 47.

Measured Variable _____

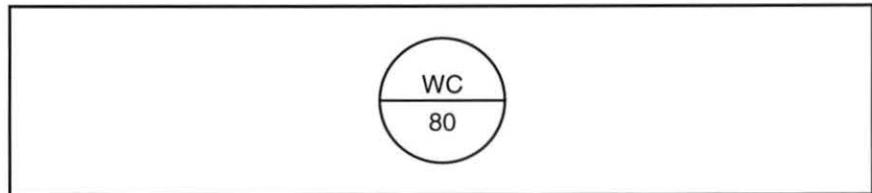


Figure 47. Instrument Tag

You should find that the measured variable is weight because the first letter is W.

6. Determine the measured variable indicated in the instrument tag in figure 48.

Measured Variable _____

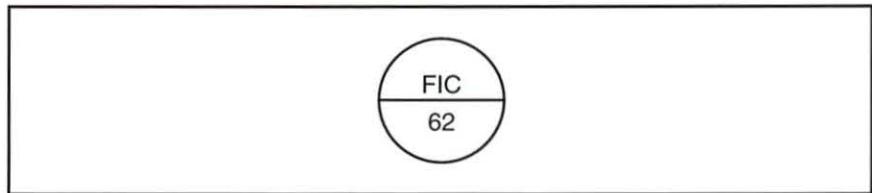


Figure 48. Instrument Tag

You should find that the measured variable is flow because the first letter is F.

7. Determine the measured variable indicated in the instrument tag in figure 49.

Measured Variable _____

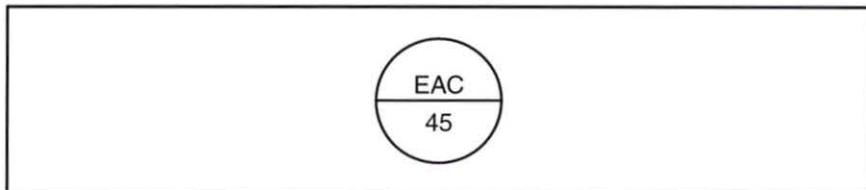


Figure 49. Instrument Tag

You should find that the measured variable is voltage because the first letter is E.

8. Determine the measured variable indicated in the instrument tag in figure 50.

Measured Variable _____

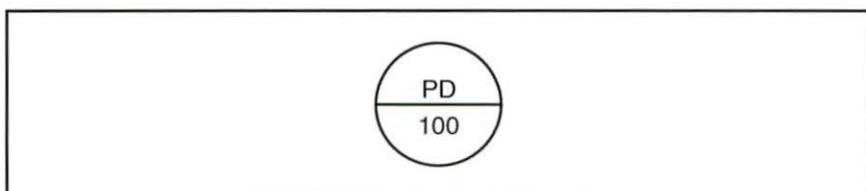


Figure 50. Instrument Tag

You should find that the measured variable is pressure because the first letter is P.

9. Determine the measured variable indicated in the instrument tag in figure 51.

Measured Variable _____

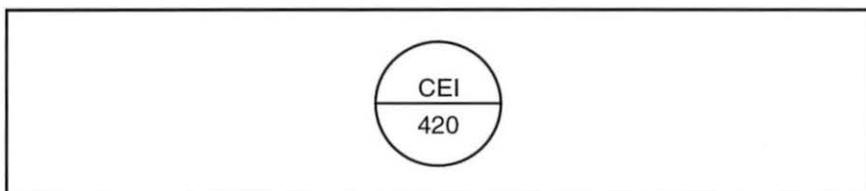


Figure 51. Instrument Tag

You should find that the measured variable is conductivity because the first letter is C.

10. Determine the measured variable indicated in the instrument tag in figure 52.

Measured Variable _____

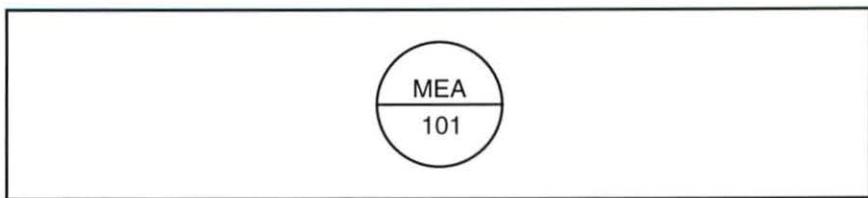


Figure 52. Instrument Tag

You should find that the measured variable is moisture because the first letter is M.

11. Determine the measured variable indicated in the instrument tag in figure 53.

Measured Variable _____

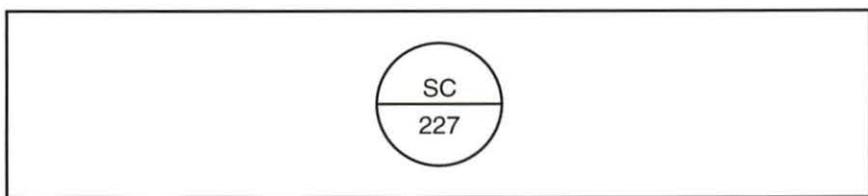


Figure 53. Instrument Tag

You should find that the measured variable is speed because the first letter is S.

12. Determine the measured variable indicated in the instrument tag in figure 54.

Measured Variable _____

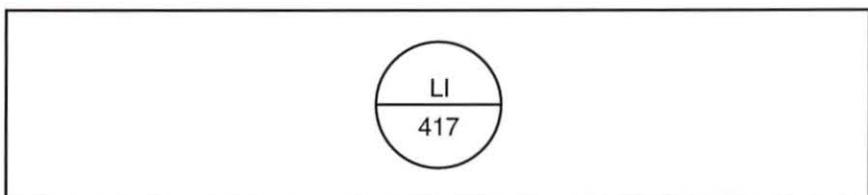


Figure 54. Instrument Tag

You should find that the measured variable is level because the first letter is L.

13. Determine the measured variable indicated in the instrument tag in figure 55.

Measured Variable _____

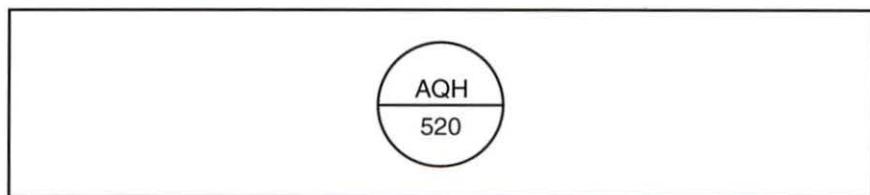


Figure 55. Instrument Tag

You should find that the measured variable is analysis because the first letter is A.

14. Determine the measured variable indicated in the instrument tag in figure 56.

Measured Variable _____

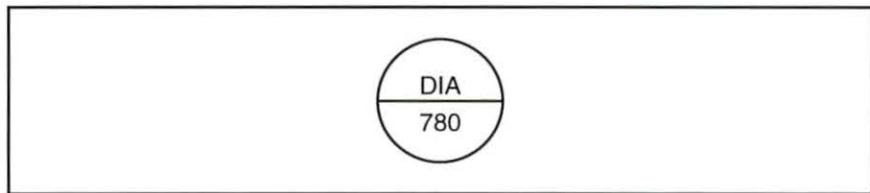


Figure 56. Instrument Tag

You should find that the measured variable is density because the first letter is D.

15. Determine the measured variable indicated in the instrument tag in figure 57.

Measured Variable _____

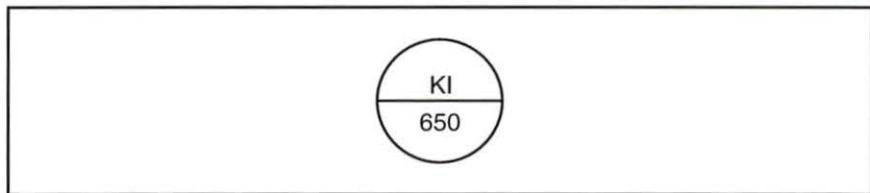


Figure 57. Instrument Tag

You should find that the measured variable is time because the first letter is K.

- 16. Determine the measured variable indicated by each tag identified in figure 58.

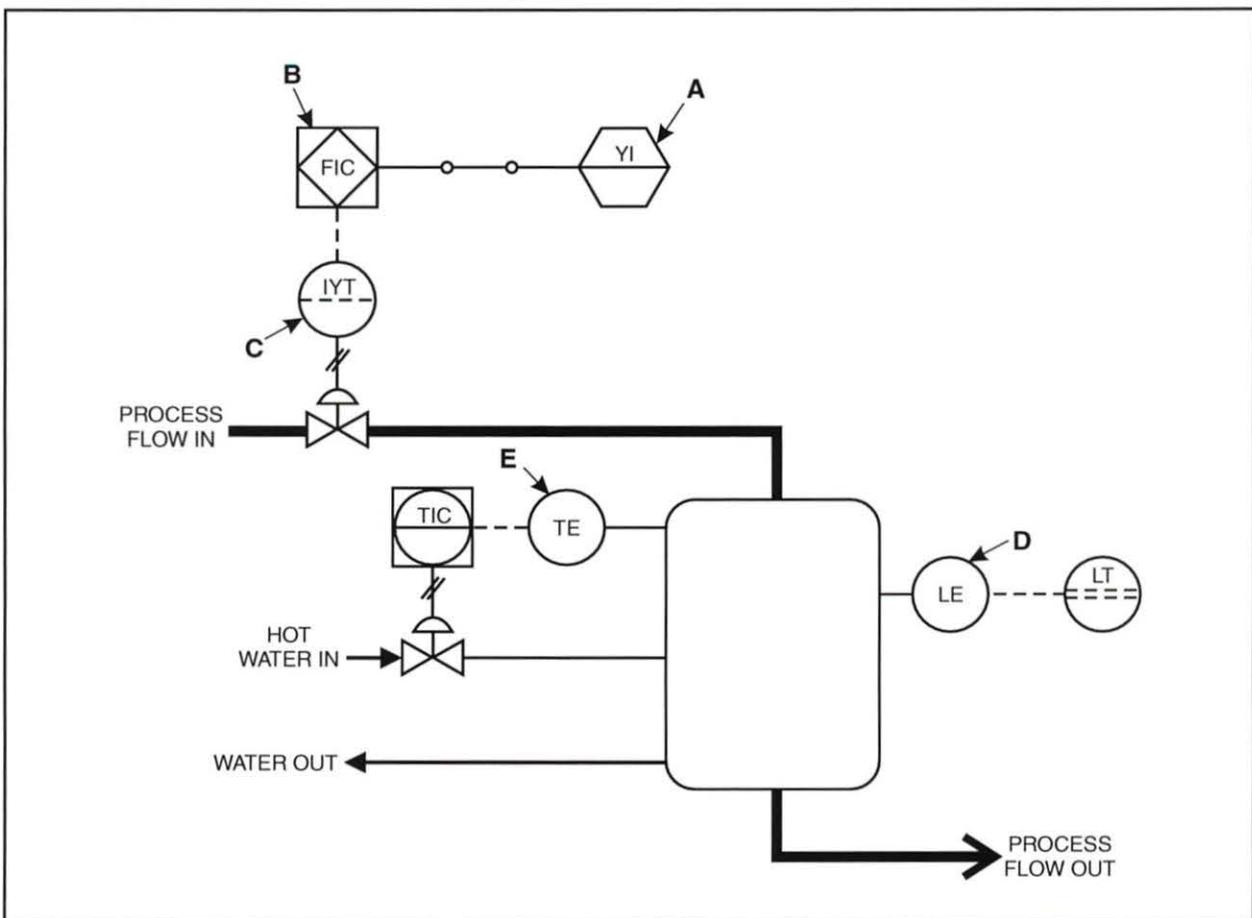


Figure 58. Instrument Tag

Tag A

Measured Variable _____

You should find that the measured variable is a state or event.

Tag B

Measured Variable _____

You should find that the measured variable is flow.

Tag C

Measured Variable _____

You should find that the measured variable is current.

Tag D

Measured Variable _____

You should find that the measured variable is level.

Tag E

Measured Variable _____

You should find that the measured variable is temperature.

OBJECTIVE 8**DESCRIBE HOW AN INSTRUMENT TAG IDENTIFIES
THE FUNCTION OF A DEVICE**

The letter or letters that follow or succeed the first letter on an instrument tag identify the function of the device. The succeeding letters may indicate a passive function such as a readout or an output function of the device.

For example, examine the tag shown in figure 59, which reads "TASH". This translates to Temperature Alarm Switch High.

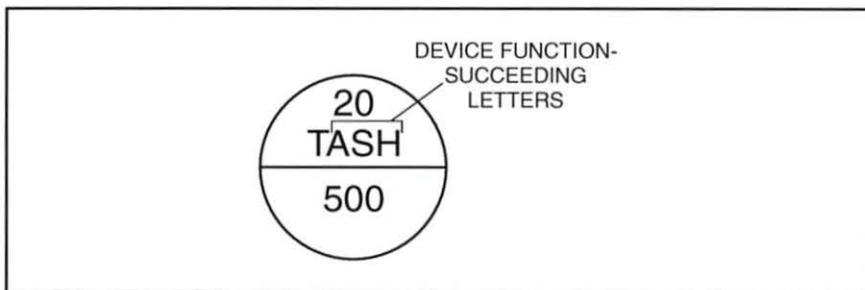


Figure 59. Device Function Example

Figure 60 shows the functions indicated by each succeeding letter in a tag symbol.

INSTRUMENT TAG FUNCTION LETTERS				
SUCCEEDING LETTER	FIRST-LETTER MODIFIER	READOUT/PASS. FUNCTION	OUTPUT FUNCTION	MODIFIER
A	—	Alarm	—	—
B	—	User's Choice	User's Choice	User's Choice
C	—	—	Control	—
D	Differential	—	—	—
E	—	Sensor (Primary Element)	—	—
F	Ratio (Fraction)	—	—	—
G	—	Glass (Viewing Device)	—	—
H	—	—	—	High
I	Indicate	—	—	—
J	Scan	—	—	—
K	Time (Rate of Change)	—	Control Station	—
L	—	Light (Pilot)	—	Low
M	Momentary	—	—	Middle
N	—	User's Choice	User's Choice	User's Choice
O	—	Orifice Restriction	—	—
P	—	Point (Test Connection)	—	—
Q	Integrate, Totalize	—	—	—
R	—	Record or Print	—	—
S	Safety	—	Switch	—
T	—	—	Transmit	—
U	—	Multifunction	Multifunction	Multifunction
V	—	—	Valve, Damper, Louver	—
W	—	Well	—	—
X	X Axis	Unclassified	Unclassified	Unclassified
Y	Y Axis	—	Relay, Compute, or Convert	—
Z	Z Axis	—	Driver, Actuator, Unclassified Final Control Element	—

Figure 60. Function Letters

Procedure Overview

In this procedure, you will identify the measured variable and function of a device using an instrument tag. You will need to use the table in figures 42 and 60 for reference.



1. Determine the measured variable and function of the device using the instrument tag in figure 61.

Measured Variable _____

Function/Modifier _____

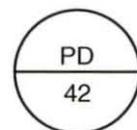


Figure 61. Instrument Tag

You should find that the measured variable is pressure with differential as its modifier because the first letter is P and the following letter(s) (the modifier/function letters) is D.

2. Determine the measured variable and function of the device using the instrument tag in figure 62.

Measured Variable _____

Function/Modifier _____

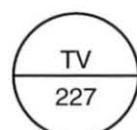


Figure 62. Instrument Tag

You should find that the measured variable is temperature and that the device functions through a valve because the first letter is T and the following letter is V.

3. Determine the measured variable and function of the device using the instrument tag in figure 63.

Measured Variable _____

Function/Modifier _____

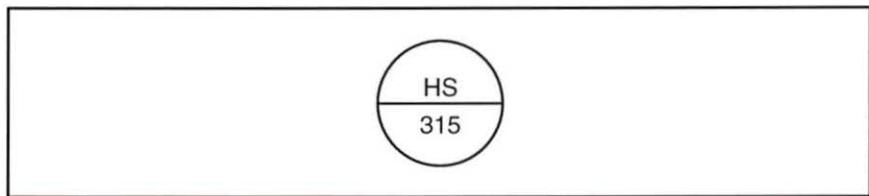


Figure 63. Instrument Tag

You should find that the measured variable is hand (manually initiated) and the device functions as a switch because the first letter is H and the following letter is S.

4. Determine the measured variable and function of the device using the instrument tag in figure 64.

Measured Variable _____

Function/Modifier _____

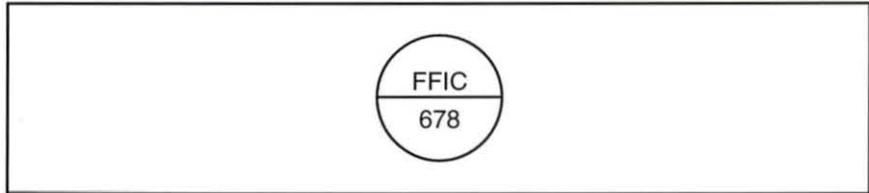


Figure 64. Instrument Tag

You should find that the measured variable is flow with a ratio modifier and the device functions as an indicator and a controller because the first letter is F and the following letters are F, I, and C.

5. Determine the measured variable and function of the device using the instrument tag in figure 65.

Measured Variable _____

Function/Modifier _____

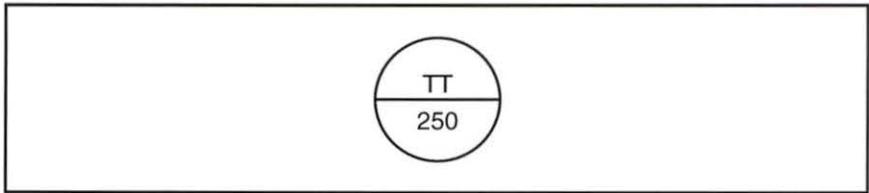


Figure 65. Instrument Tag

You should find that the measured variable is temperature and the device functions as a transmitter because the first letter is T and the following letter is T.

6. Determine the measured variable and function of the device using the instrument tag in figure 66.

Measured Variable _____

Function/Modifier _____

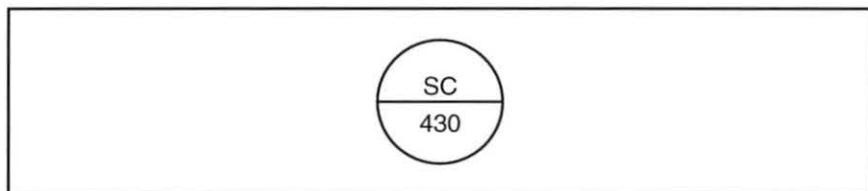


Figure 66. Instrument Tag

You should find that the measured variable is speed and the device functions as a controller because the first letter is S and the following letter is C.

7. Determine the measured variable and function of the device using the instrument tag in figure 67.

Measured Variable _____

Function/Modifier _____

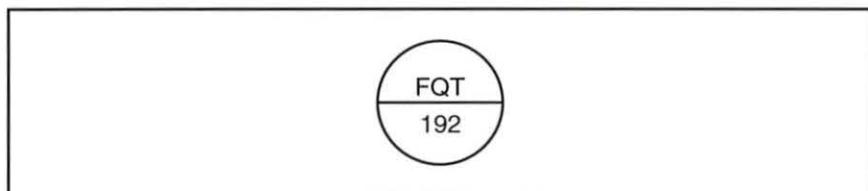


Figure 67. Instrument Tag

You should find that the measured variable is flow with an integration modifier and the device functions as a transmitter because the first letter is F and the following letters are Q and T.

8. Determine the measured variable and function of the device using the instrument tag in figure 68.

Measured Variable _____

Function/Modifier _____

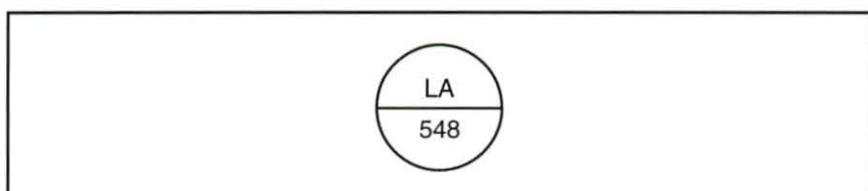


Figure 68. Instrument Tag

You should find that the measured variable is level and the device functions as an alarm because the first letter is L and the following letter is A.

9. Determine the measured variable and function of the device using the instrument tag in figure 69.

Measured Variable _____

Function/Modifier _____

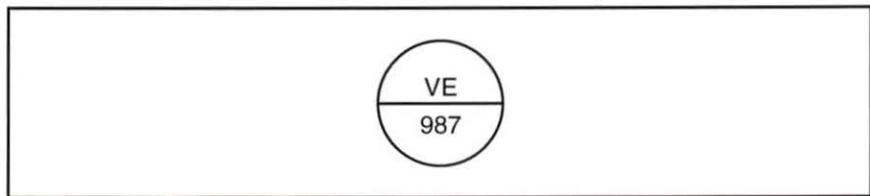


Figure 69. Instrument Tag

You should find that the measured variable is vibration or viscosity and the device functions as a sensor because the first letter is V and the following letter is E.

10. Determine the measured variable and function indicated by each tag identified by figure 70.

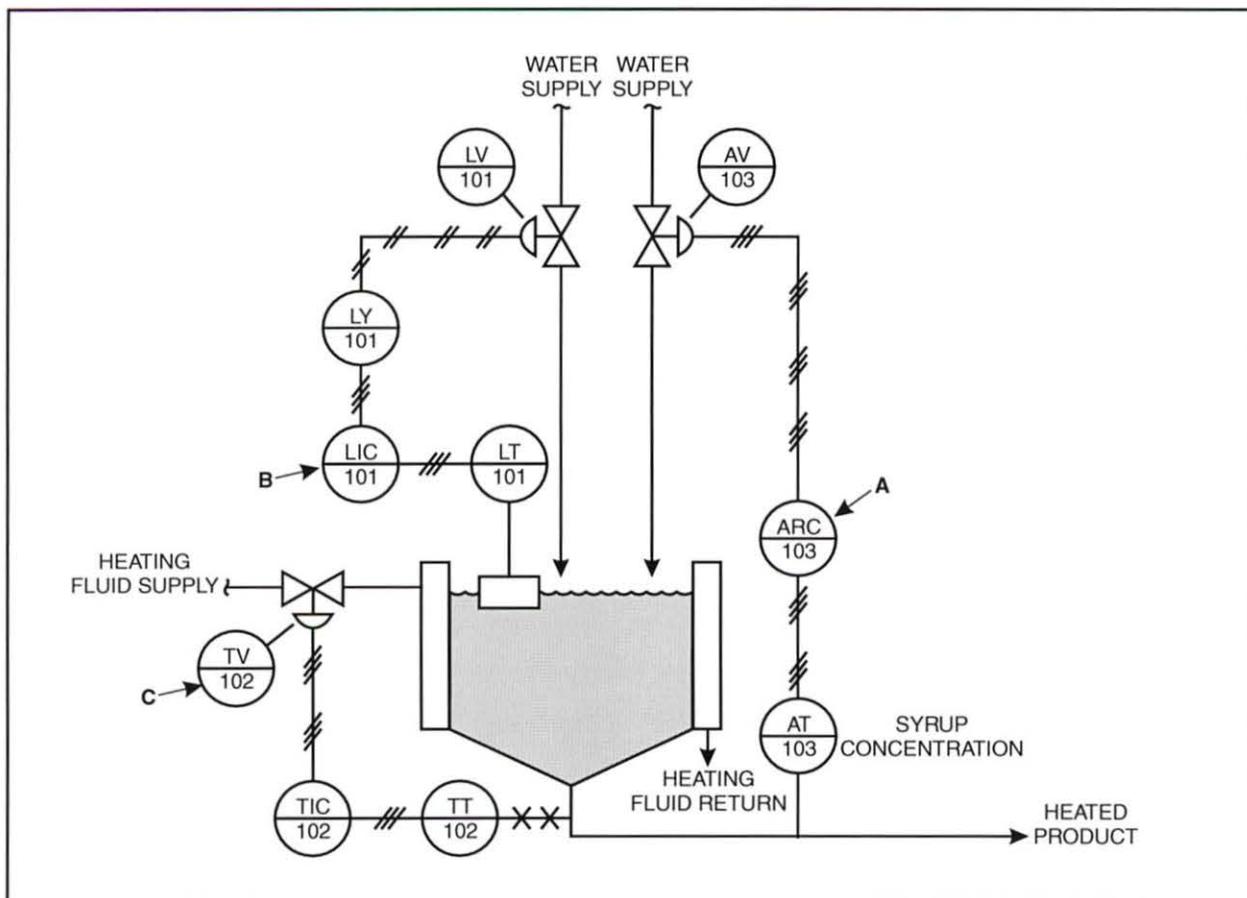


Figure 70. Heating and Mixing System

Tag A

Measured Variable _____

Function/Modifier _____

You should find that the measured variable is analysis and the device functions as a recorder and controller.

Tag B

Measured Variable _____

Function/Modifier _____

You should find that the measured variable is level and the device functions as an indicator and controller.

Tag C

Measured Variable _____

Function/Modifier _____

You should find that the measured variable is temperature and the device functions as a valve.

OBJECTIVE 9

DESCRIBE HOW TO IDENTIFY THE AREA WHERE A DEVICE IS LOCATED GIVEN ITS INSTRUMENT TAG



Many process control systems are very large, often occupying multiple buildings or different areas in the same building. To help locate devices, instrument tags may contain an area or location designation number.

The designation number can be found above the function identification letters or as a prefix to the function identification letters, as shown in figure 71. For example, this tag shows that the flow control device is located in the area designated by the number 50.

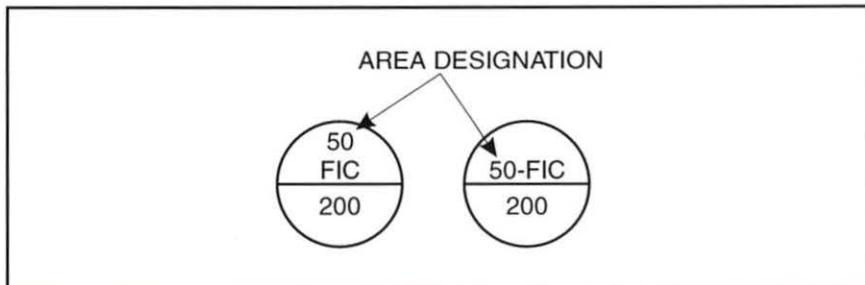


Figure 71. Instrument Tag with Area Designations

OBJECTIVE 10**DESCRIBE HOW TO IDENTIFY THE LOOP IN WHICH A DEVICE IS CONNECTED GIVEN ITS INSTRUMENT TAG**

A process loop consists of one or more instruments connected together to control or measure a process variable. In most cases, a process control system is made up of multiple loops. To help identify the loop to which a device belongs, instrument tags contain a loop number on the bottom of the tag. This helps you to quickly identify all of the devices that are working together.

For example, the four devices in figure 72 all have the same loop number (401) because they are all used in the same loop. This particular loop measures and controls flow.

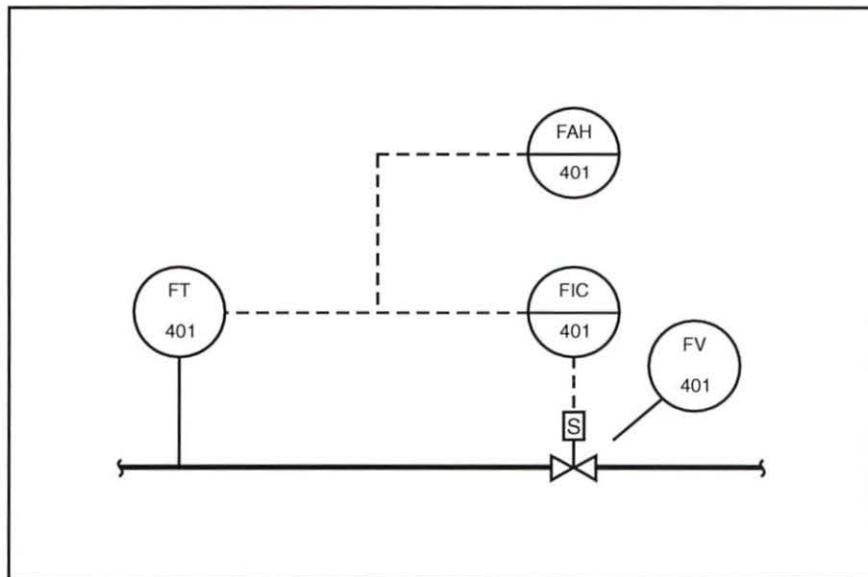


Figure 72. Flow Loop Tags

In some cases, multiple devices perform the same function in one loop. If this occurs, a suffix is added to the end of their loop identification number. This allows you to distinguish the devices from each other.

For example, in figure 73, the loop measures the flow through a pipe by creating a restriction in the pipe and measuring the pressure difference across the restriction. Notice that there are two devices denoted as "PD." These devices perform the same function on different sides of the restriction. Therefore, on the bottom portion of the tags, one device is marked 100A and the other is marked 100B. This allows you to differentiate between the two devices.

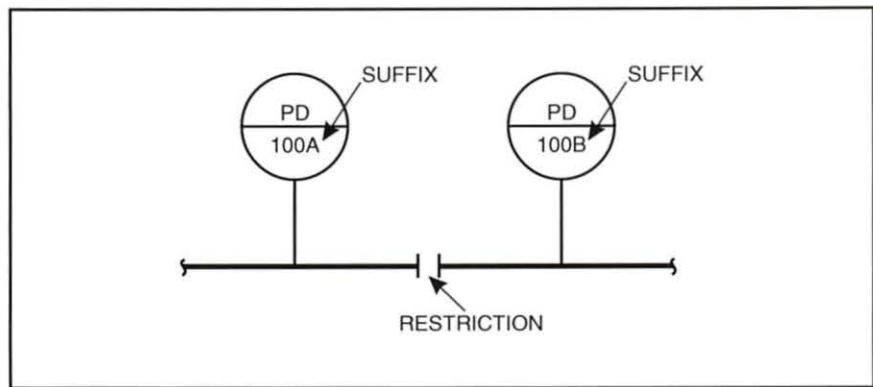


Figure 73. Differential Pressure Loop Device Tags

Procedure Overview

In this procedure, you will identify the loop and area in which a device is connected using an instrument tag.



1. Identify the loop and area the device is in using the instrument tag in figure 74.

Loop _____

Area _____

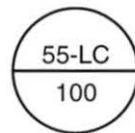


Figure 74. Instrument Tag

You should find that the device is located in loop 100 and area 55 because the loop number (beneath the variable letters) is 100 and the area number (at the top) is 55.

2. Identify the loop and area the device is in using the instrument tag in figure 75.

Loop _____

Area _____

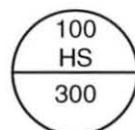


Figure 75. Instrument Tag

You should find that the device is located in loop 300 and area 100 because the loop number (beneath the variable letters) is 300 and the area number (at the top) is 100.

3. Identify the loop and area the device is in using the instrument tag in figure 76.

Loop _____

Area _____

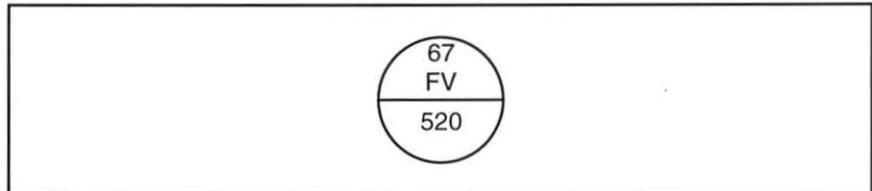


Figure 76. Instrument Tag

You should find that the device is located in loop 520 and area 67 because the loop number (beneath the variable letters) is 520 and the area number (at the top) is 67.

4. Identify the loop and area the device is in using the instrument tag in figure 77.

Loop _____

Area _____

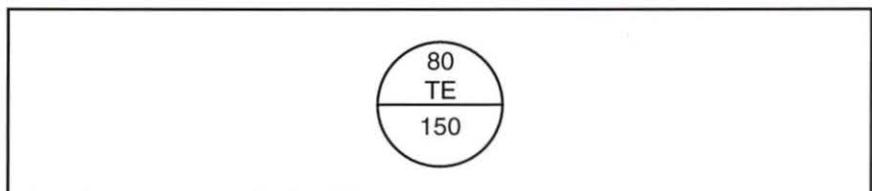


Figure 77. Instrument Tag

You should find that the device is located in loop 150 and area 80 because the loop number (beneath the variable letters) is 150 and the area number (at the top) is 80.

5. Identify the loop and area the device is in using the instrument tag in figure 78.

Loop _____

What does the "B" indicate? _____

Area _____

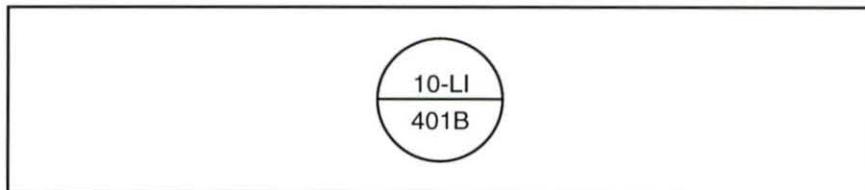


Figure 78. Instrument Tag

You should find that the device is located in loop 401 and area 10 because the loop number (beneath the variable letters) is 401 and the area number (at the top) is 10. You should also recall that "B" indicates that there is more than one of the same device in the loop.

6. Identify the loop and area the device is in using the instrument tag in figure 79.

Loop _____

Area _____

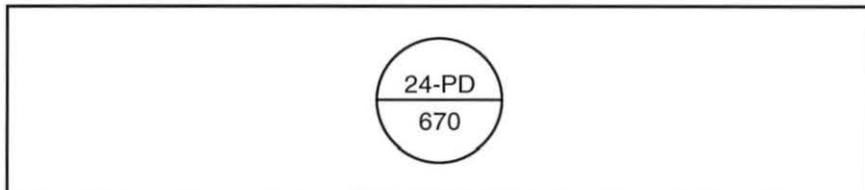


Figure 79. Instrument Tag

You should find that the device is in loop 670 and area 24 because the loop number (beneath the variable letters) is 670 and the area number (at the top) is 24.

7. Identify the loop and area the device is in using the instrument tag in figure 80.

Loop _____

Area _____

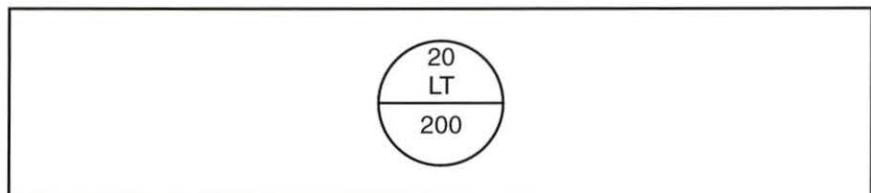


Figure 80. Instrument Tag

You should find that the device is in loop 200 and area 20 because the loop number (beneath the variable letters) is 200 and the area number (at the top) is 20.

8. Determine the loop and area number indicated by each tag shown in figure 81.

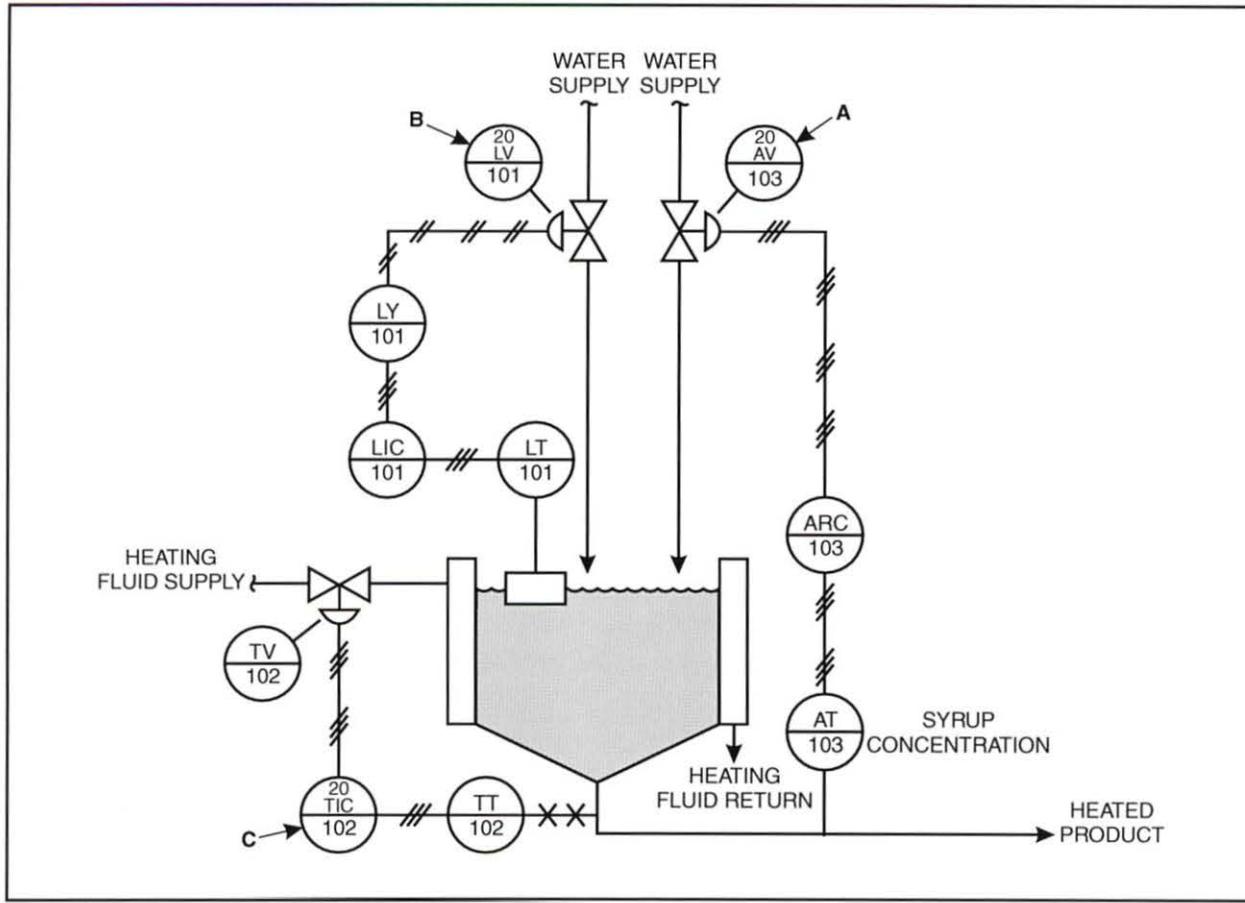


Figure 81. Heating and Mixing System P&ID

Tag A

Loop _____

Area _____

You should find that the device is located in loop 103 and area 20.

Tag B

Loop _____

Area _____

You should find that the device is located in loop 101 and area 20.

Tag C

Loop _____

Area _____

You should find that the device is located in loop 102 and area 20.

In the steps that follow, you will interpret all of the information provided by an instrument tag.

9. Perform the following substeps to interpret the information on the instrument tag in figure 82.

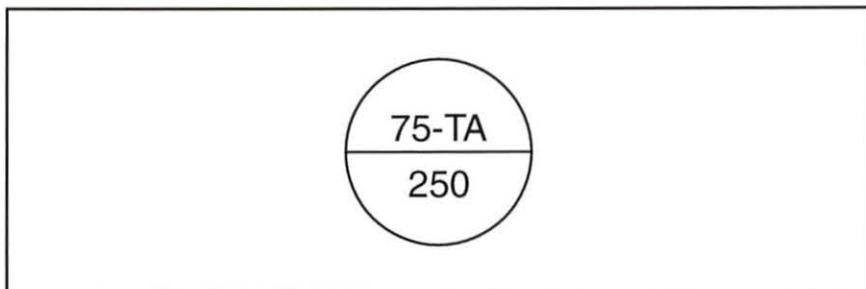


Figure 82. Instrument Tag

- A. Determine the type of device indicated by the tag in figure 82.

Type of Device _____

- B. Determine where the device indicated by the tag in figure 82 is located.

Location of the Device _____

- C. Determine what the device indicated by the tag in figure 82 is measuring.

Measured Variable _____

- D. Determine the first modifier of the tag in figure 82.

First Modifier _____

- E. Determine the loop in which the device is located, according to the tag in figure 82.

Loop Number _____

- F. Determine the area in which the device is located, according to the tag in figure 82.

Area Number _____

You should find that the device tag in figure 82 represents a field discrete instrument, mounted in a primary location. You should also find that the device is measuring temperature and that the modifier indicates an alarm function. Finally, the device is located in loop 250 and area 75.

10. Perform the following substeps to interpret the information on the instrument tag in figure 83.

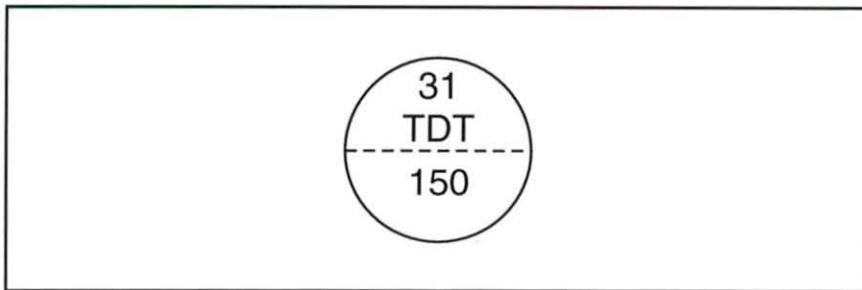


Figure 83. Instrument Tag

- A. Determine the type of device indicated by the tag in figure 83.

Type of Device _____

- B. Determine where the device indicated by the tag in figure 83 is located.

Location of the Device _____

- C. Determine if the device is accessible by the operator.

Is the device accessible? _____ (Yes/No)

- D. Determine what the device indicated by the tag in figure 83 is measuring.

Measured Variable _____

- E. Determine the loop in which the device is located, according to the tag in figure 83.

Loop Number _____

- F. Determine the area in which the device is located, according to the tag in figure 83.

Area Number _____

- G. Determine the second and third modifiers of the device tag in figure 83.

Second Modifier _____

Third Modifier _____

- 11. Perform the following substeps to interpret the information on the instrument tag in figure 84.

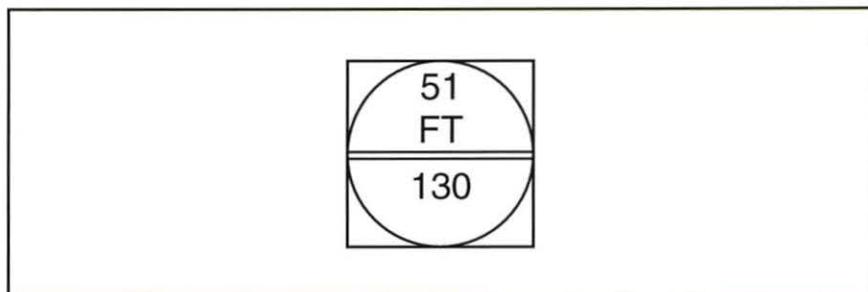


Figure 84. Instrument Tag

- A. Determine the type of device indicated by the tag in figure 84.

Type of Device _____

- B. Determine where the device indicated by the tag in figure 84 is located.

Location of the Device _____

- C. Determine if the device is accessible by the operator.

Is the device accessible? _____ (Yes/No)

- D. Determine what the device indicated by the tag in figure 84 is measuring.

Measured Variable _____

- E. Determine the loop in which the device is located, according to the tag in figure 84.

Loop Number _____

- F. Determine the area in which the device is located, according to the tag in figure 84.

Area Number _____

- G. Determine the first modifier of the device tag in figure 84.

First Modifier _____

12. Perform the following substeps to interpret the information on the instrument tag in figure 85.

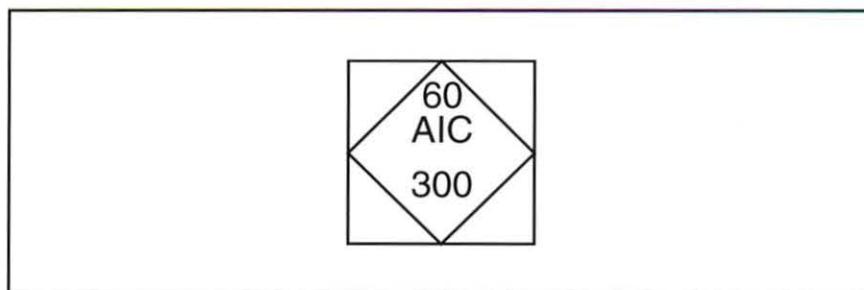


Figure 85. Instrument Tag

- A. Determine the type of device indicated by the tag in figure 85.

Type of Device _____

- B. Determine where the device indicated by the tag in figure 85 is located.

Location of the Device _____

- C. Determine if the device is accessible by the operator.

Is the device accessible? _____ (Yes/No)

- D. Determine what the device indicated by the tag in figure 85 is measuring.

Measured Variable _____

- E. Determine the loop in which the device is located, according to the tag in figure 85.

Loop Number _____

- F. Determine the area in which the device is located, according to the tag in figure 85.

Area Number _____

- G. Determine the modifiers of the device tag in figure 85.

First Modifier _____

Second Modifier _____

- ❑ 13. Perform the following substeps to interpret the information on the instrument tag in figure 86.

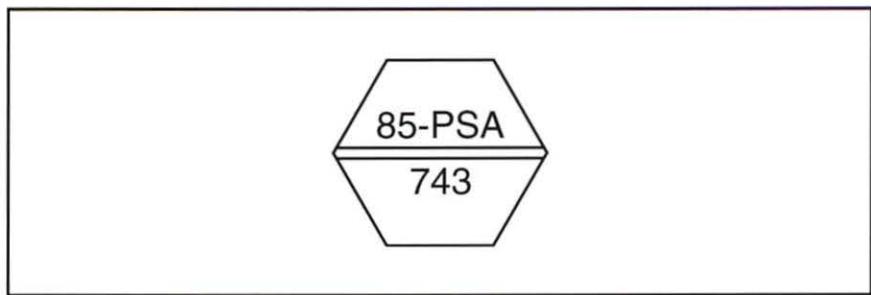


Figure 86. Instrument Tag

- A. Determine the type of device indicated by the tag in figure 86.
Type of Device _____
- B. Determine where the device indicated by the tag in figure 86 is located.
Location of the Device _____
- C. Determine if the device is accessible by the operator.
Is the device accessible? _____ (Yes/No)
- D. Determine what the device indicated by the tag in figure 86 is measuring.
Measured Variable _____
- E. Determine the loop in which the device is located, according to the tag in figure 86.
Loop Number _____
- F. Determine the area in which the device is located, according to the tag in figure 86.
Area Number _____
- G. Determine the modifiers of the device tag in figure 86.
First Modifier _____
Second Modifier _____



Instrument tags can be easily drawn using the steps below.

- Draw the outer shape of the instrument tag.
- Draw the lines that indicate the location of the device (if necessary).
- Add the letters that indicate the measured variable and function(s) of the device.
- Add the loop number.
- Add the area designation number.

Consider the following example.

Example: An instrument in area 75 of your plant indicates flow to the operator. It also serves as the controller for the flow in loop 243. It is an instrument that is accessible to the operator in the control room.

The first step to create an instrument tag is to draw the outer shape of the instrument tag.

Recall that the outer shape indicates the type of device. In this case, a square is drawn with a circle inside it, as figure 87 shows. This indicates a shared control.

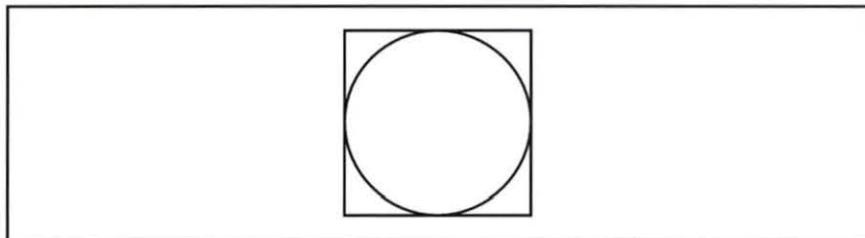


Figure 87. Shape for a Shared Control

The next step is to draw the lines that indicate the location of the device (if necessary).

Since the device is located in a primary location (e.g. the control room), a single line is drawn through the tag, as figure 88 shows.

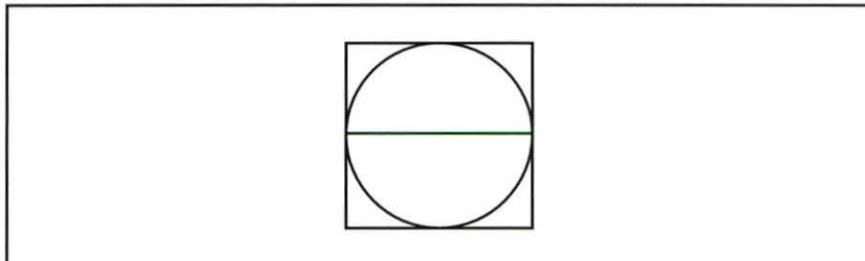


Figure 88. Single Line to Indicate Primary Location

In the upper portion of the tag, add the letters that indicate what the device measures and the function of the device. Since the device measures flow, the first letter should be F, as figure 89 shows. The device also indicates flow, therefore the second letter should be I (indicate). In addition, since it controls flow in another loop, a C is added, as figure 89 also shows.

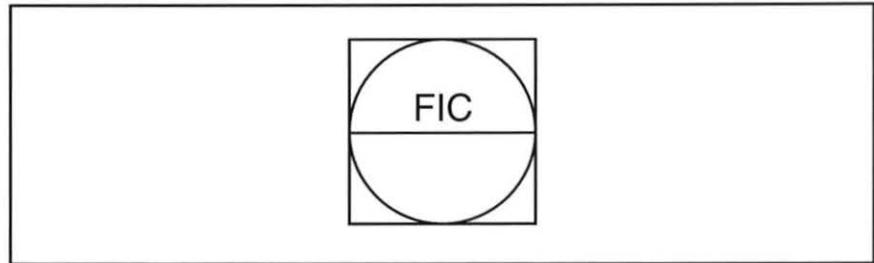


Figure 89. Letters Added to Tag

The loop number is added at the bottom of the tag, as figure 90 shows.

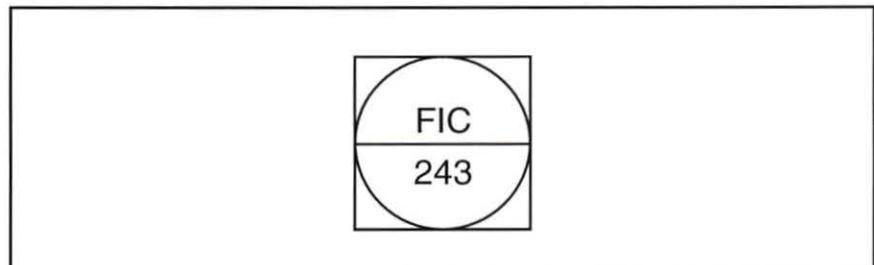


Figure 90. Loop Number Added to Tag

The area designation number is added at the top of the tag, as figure 91 shows.

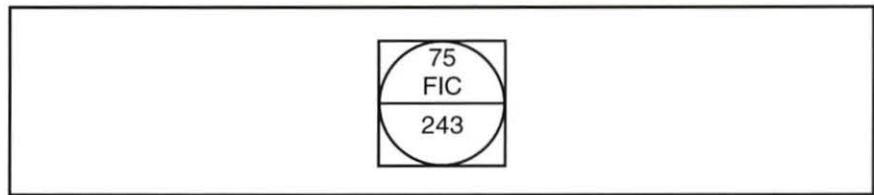


Figure 91. Area Designation Number Added to Tag

Procedure Overview

In this procedure, you will draw an instrument tag for a given device. This will help you to further become familiar with instrument tags.



- 1. Draw the instrument tag for the device described as follows. Draw the tag on a separate piece of paper.

Description: An instrument transmits a pressure signal to another device. This device is field mounted in area 56 and connected to loop 456.

- 2. Draw the instrument tag for the device described as follows. Draw the tag on a separate piece of paper.

Description: There is a PLC mounted inside a panel box outside of the control room in area 20. The PLC is controlling the speed of a motor in loop 098.

- 3. Draw the instrument tag for the device described as follows. Draw the tag on a separate piece of paper.

Description: A temperature sensor mounted inside a panel in the control room monitors the temperature of the equipment in the control room. The sensor is in area 45 and loop 987, which monitors control room parameters.

- 4. Draw the instrument tags for the devices described as follows. Draw the tags on a separate piece of paper.

Description: You have a tank that contains liquid nitrogen. You are using a sensor to measure the level in the tank. Due to the extreme cold, the level element is freeze protected. Due to safety concerns, there are two devices measuring this in loop 690, area 30.

- 5. Draw the instrument tag for the device described below.

Description: A tank in your plant uses a valve to control the level. The valve is connected to the devices in loop 48 and is located in the process piping in area 82.

- 6. Draw the instrument tag for the device described below.

Description: You are using a weight scale to weigh trucks that are entering and leaving your plant. The instrument that performs the weight measurements is also indicating to the operator in the control room. This device feeds all of the information that comes into it into a recorder. The weight loop is loop 83 and the device is located in the control room in area 67.

7. Draw the instrument tag for the device described below.

Description: A computer senses a pressure differential between two vessels. If the pressure difference becomes too high, the device acts as an alarm. This device is located at an operator's station but is not readily visible. The device is connected in loop 80 and area 77.

8. Draw the instrument tag for the device described below.

Description: A sensing element serves as safety switch in case of a radiation leak. This device is located in the control room and is accessible to the operator. It is connected in loop 76 and area 95.

9. Draw the instrument tag for the device described below.

Description: A computer element determines if a machine becomes out of balance and begins to vibrate. The device also analyzes the vibration to determine if it is critical. The device is located in the control room and is accessible to the operator. This device is connected in loop 786 and area 34.



1. The first letter in the upper portion of an instrument tag describes what the device _____.
2. The number that is located at the bottom of an instrument tag identifies the _____ in which the device is connected.
3. Devices that are the same and connected in the same loop use a _____ at the end of the loop number to indicate they are different devices.
4. The letters that follow the first letter in the upper portion of an instrument tag indicate the _____ of the device.
5. A number at the top of an instrument tag or as a prefix to the function identification letters represents a(n) _____.
6. If F is the first letter in the upper portion of an instrument tag, the device measures _____.