

### 3. The Master Sheet

#### Unit Objectives

Upon completing this unit, you should be able to use a Master sheet as a reference for identifying P&ID symbols and labels found in the:

1. Line tables,
2. Instrument symbols and designations tables,
3. Graphic symbols tables.

#### **What is the Master sheet?**

When you complete this course, you will be familiar with many symbols and line designations and identifications; but this course does not try to cover all the possible equipment and line combinations that can appear on P&IDs. However, with the skills taught in this course, you should be able to look at any P&ID and describe the relationship between system components and trace process flow. You can do this using the **Master sheet to look up the symbols and line identifications that you do not know.**

*The information given on the Master sheet for a set of P&IDs will vary from site to site depending on who made the drawings and what processes are involved.*

A Master sheet should come with the set of diagrams for a process area. It is printed on the same kind of paper and with the same kind of ink as the P&IDs, and should be on file with them. The sheet is the key to what symbols and labels mean on the set of P&IDs. How this information is recorded and what is included will vary from site to site. We will look at an example Master that has four parts:

- Table I - Line Designations
- Table II - Instrument Symbols
- Table III - Graphic Symbols
- Table IV - Process Equipment Symbols

*We will practice skills that will help you to understand and use a typical Master sheet.*

**In this course, we will practice the skills needed to use a typical Master as a reference.** More complete tables than our examples are included in the appendices of this manual. Use them throughout the course just as you would use the Master sheet on site if you needed additional information.



3.1

If you do not know the meaning of a symbol on a P&ID, you should look it up on the:

- Master sheet
- Maintenance procedures
- Procedures manual
- Safety manual

The line schedule in the previous unit (see pages 13-15) gave us several pieces of important information about each pipeline. The material flowing through a pipe is given on the line schedule and in the line identification number as an abbreviation. In the example line designation we used in the previous unit, "WTOL" stands for wet toluene. **The Line Designations section of the Master tells you what the abbreviations mean.**

A sample table is given below. Remember, a real table may include many more abbreviations than we show here. See Appendix 1 for a more complete list.

**Table I  
Line Designations**

**Table I  
Line Designations**

A	Compressed air (wet)	G	Gasoline
AA	Acetic acid	H	Hydrogen
AC	Acetylene	HA	Hot air
AD	Ammonia drains	HCN	Hydrogen cyanide
AG	Ammonia gas	IA	Instrument air (dry )
ALC	Alcohol	LA	Liquid ammonia
AN	Acrylonitrile	LS	Lime solution
ANH	Anhydrous ammonia	M	Methane
ANS	Ammonia nitrate solution	MA	Methanol
ANV	Ammonia nitrate vapor	MG	Mixed gas and steam
AOT	Aerosol	N	Nitrogen
AQS	Aqua solution	NG	Natural gas
AS	Acid slurry	NTA	Ammonium nitrate
ATV	Atmospheric vent	O	Oxygen
BD	Boiler blow down	OF	Off gas
BG	Burner gas	PGC	Cooled process gas
BI	Blend	PRG	Process gas
BR	Brine	PV	Pressure vent
C	Comensate	S	Steam
CA	Conditioning agent	SL	Slurry
CAT	Catalyst	SLG	Sludge
CB	Continuous blow off	STG	Stack gas
CF	Chemical feed	SV	Solvent
CLG	Chlorine gas	SH	Sodium hydroxide
CLS	Chlorine solution	SUR	Surfactant
CNG	Converter / converted gas	TOL	Toluene
CS	Chemical sewer	U	Urea
D	Drains	UA	Utility air
EA	Exhaust air	V	Vent
EQ	Equalizer line	VAC	Vacuum
ES	Exhaust steam	VC	Vent cold
F	Filtrate (cold)	VCL	Vinyl chloride
FG	Fuel gas	VG	Vent gas
FLRG	Flare gas	WC	Cooling water supply
FO	Fuel oil	WCR	Cooling water return
FR	Freon	WT	Treated water
FRG	Freon gas	WTOL	Wet toluene
FRL	Freon liquid	WWH	Wash water
FS	Freon solvent		
FSL	Ferrous sulfate		

*Part of an example  
Line Designations Table*

***Line designation letters  
may be the same as  
instrument designations  
in some cases.***

*If the letters are on a line,  
their meaning can be found  
on a Line Designation  
Table. If they are in an  
instrument symbol, their  
meaning can be found on an  
Instrument Designation  
Table. For example "PV"  
means pressure vent on a  
line and pressure valve  
when it is an instrument  
symbol.*

## Tables III and IV Graphic Symbols

When you look at a P&ID, you see many connecting lines and a wide variety of symbols. We have identified the symbols that contain instrument abbreviations and numbers. The many other symbols and what they stand for are given in the remaining tables on the Master. Our example Master gives the following symbols tables:

Table III	Graphic Symbols (for use on flow diagrams)
Table IV	Equipment Symbols (for process equipment)

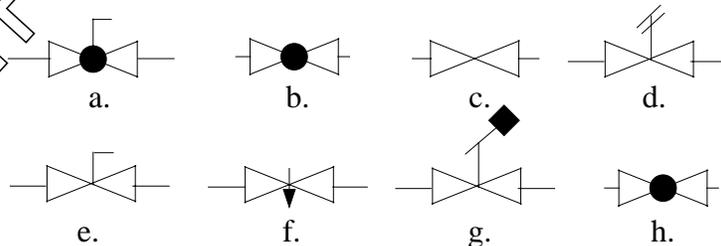
### Table III Graphic Symbols for Flow Diagrams

Table III contains most of the smaller symbols you will see on a drawing of a process system. **You should be familiar with the symbols for the equipment in your area.** If you see a symbol you do not know, check the Master. You will notice that many symbols are similar. There are several types of valves, for example. We will look more closely at specific groups of equipment symbols later in the course. For now, **remember that an extra line or slight difference between two symbols can indicate a different type of equipment.**

3.16

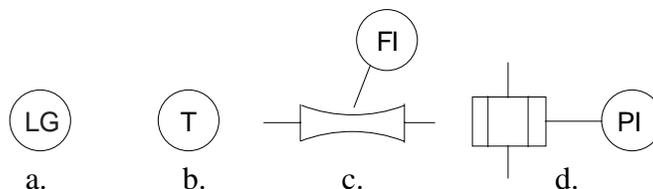
Circle the two symbols below that show **the exact same type of valve**.

*Small differences in symbols may mean that they are specific kinds of equipment. Look carefully, and check the Master if you are not sure exactly what kind of equipment is represented.*



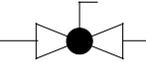
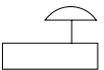
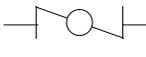
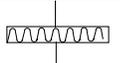
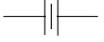
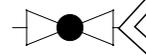
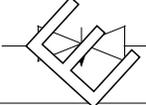
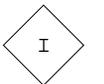
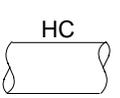
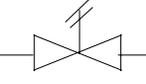
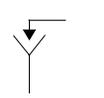
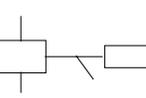
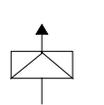
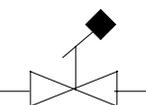
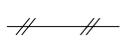
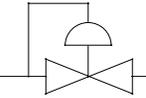
3.17

Using what you know about instrument identification on P&IDs from the previous section, circle the instrument symbol below that represents a special type of **pressure gage**.



Below is a sample of the symbols in Table III. A more complete table is in Appendix 3. Some P&IDs may have differences in how they show specific pieces of equipment depending on who drew them. If you have any questions, ask your supervisor.

**Table III**  
**Graphic Symbols for Use on Flow Diagrams**

	BURNER		BALL VALVE
	EYEWASH FOUNTAIN		CHECK VALVE (BALL TYPE)
	FLAME ARRESTOR		GLOBE VALVE
	FLOW ELEMENT OF ORIFICE		GLOBE VALVE
	PRESSURE GAUGE WITH CHEMICAL SEAL		NEEDLE VALVE
	INTERLOCK		PLUG OR COCK VALVE
	HEAT CONSERVATION INSULATION		QUICK OPENING VALVE (LEVER TYPE)
	SAMPLING VALVE WITH LINE INSERT		SAMPLING VALVE WITH LINE INSERT
	RUPTURE DISC		WEIGHT-OPERATED GATE VALVE
	INSTRUMENT SIGNAL (AIR LINE)		BACK PRESSURE CONTROL VALVE (SELF-OPERATED)

*The way specific symbols are drawn may differ from site to site.*

If you need help with the questions in this unit, use the following appendices at the back of this workbook for your Master:

Appendix 2: Instrument Designations

Appendix 3: Graphic Symbols for Flow Diagrams

5.3

All instruments and controlling elements in a control loop will have the same \_\_\_\_\_ on a P&ID.

- Number     Design     Actuators     Function



5.4

Draw a line from the instrument designations below to the **variables** they monitor or control.

- |     |                |
|-----|----------------|
| PI  | a. Temperature |
| LAH | b. Level       |
| TIC | c. Weight      |
| FCV | d. Pressure    |
| WSL | e. Flow        |

The letters after the first letter in the identification for an instrument tell us its **function**. The action or work performed by a device is its function. In the example on the opposite page, PIC, "IC" means that it is an indicating controller. Likewise, if the label is PRC, the instrument is a recording controller for the pressure inside the tank.

### Identifying Instrument Function

There are many possible combinations of instruments on P&IDs. Designations for controllers, transmitters, switches, and alarms are common, but there are many others. The letter designations are often relatively easy to figure out, but some may not be obvious.

*Check the Master sheet if you are not sure what an instrument designation means.*

5.5

Draw a line from the instrument designations to the correct instrument names.



- |     |                                      |
|-----|--------------------------------------|
| PI  | a. Level alarm high                  |
| LAH | b. Temperature indicating controller |
| TIC | c. Flow control valve                |
| FCV | d. Pressure indicating device        |
| WSL | e. Weight switch low                 |
| AS  | f. Manual control valve              |
| HV  | g. Analyzer switch                   |

*Use the Appendix 2 if you need help.*

## 6. Line Designations

### Unit Objectives

Upon completing this unit, you should be able to:

1. Identify piping on a P&ID.
2. Give specific information about a pipeline including material in the line, size of the pipe, line number, and whether or not the line is insulated or traced.
3. Identify pneumatic, electric, and hydraulic instrumentation signal lines.

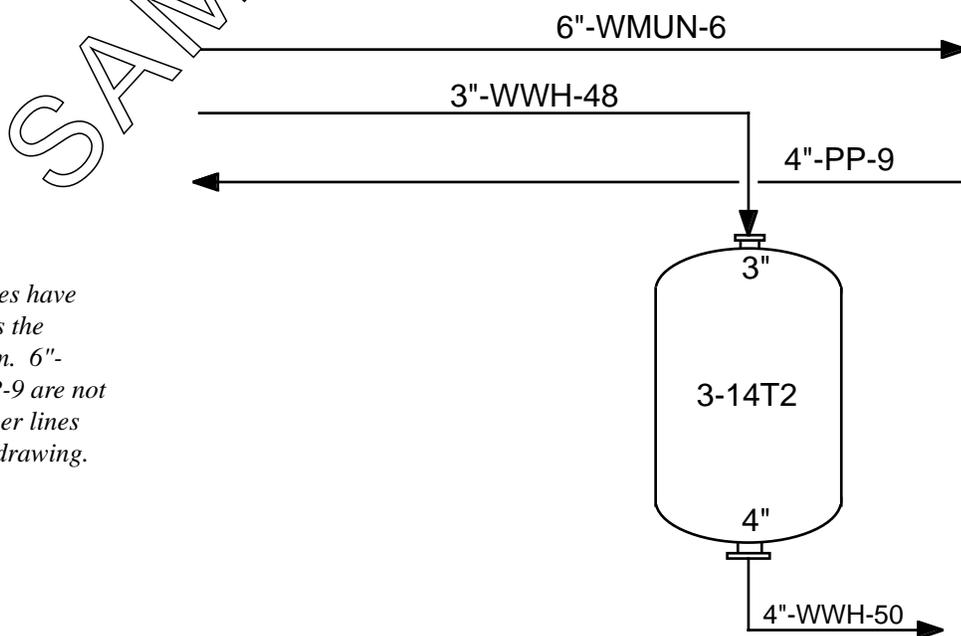
### Piping

We have looked at the symbols and designations for equipment and instruments. On a P&ID, symbols will be connected with numerous drawn lines that represent piping and instrument lines. In the overview of what information is given in the main diagram, we covered:

- Lines that were physically connected and physically not connected.
- Arrows that show flow direction.

We saw that specific information about each pipe may be given in the Line Schedule. Some information will also be included in the main diagram to identify each pipeline. Pipelines are drawn as a solid line on a P&ID. The figure below shows several pipelines, including one that feeds into the top of a tank.

*Review what we have learned in previous units about pipelines. See pages 11-15.*

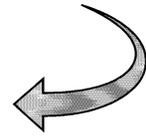


*Notice that the nozzles have the same diameter as the pipes going into them. 6"-WMUN-6 and 4"-PP-9 are not connected to any other lines or equipment in the drawing.*

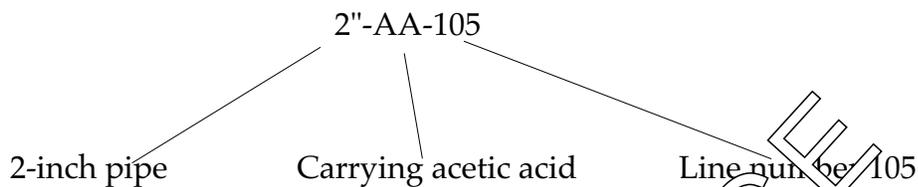
**Figure 22**

The line designation on a P&ID will include:

- Size of the pipe;
- Letters that stand for the material in the pipe;
- An identifying number, usually associated with the pipe's point of origin, where it begins.



In this example:



Example line label

Use the Figure 22 on the opposite page to answer the following questions. Remember that you can find the abbreviations for materials on the Master. (See Appendix (L).)

6.1

What is the size of the pipe carrying WMUN?

- 6 inches
- 4 inches
- 1 1/4 inches
- 1/2 inch



6.2

What is the size of the nozzle connecting the pipe WWH-48 to the tank?

- 1/2 inches
- 6 inches
- 3-1/2 inches
- 1/2 inch

6.3

What material is flowing through the 3-inch pipe?

- Nitric acid
- Wash water
- Warm water
- Solvent

6.4

What is the line number of the pipe carrying material that is leaving the tank?

- 48
- 50
- 148
- 4

6.5

As far as you can tell from this section of P&ID, are line numbers 6 and 9 connected in the plant?

- Yes
- No