Pneumatic, Hydraulic and P&ID Diagrams

This chapter goes through the steps for creating Piping & Instrumentation (P&ID) and Hydraulic drawings but the same workflow can be applied for Pnuematics. Once your drawing is created, you can use the regular tools in the AutoCAD® Electrical software to modify your drawing.

In this chapter

- Setting Up Hydraulic Drawings
- Inserting Hydraulic Schematic Symbols
- Creating Pipes
- Completing the Hydraulic Drawing
- Setting Up Your P&ID Drawing
- Inserting P&ID Schematic Symbols
- Creating Pipes
Setting Up Hydraulic Drawings

Use the Project Manager to manage your hydraulic drawings. From here you can create a new drawing and modify any drawing properties.

Create a new drawing

1. In the Project Manager, right-click the project name, and select Properties.
2. In the Project Properties → Project Settings dialog box, click Default to switch on all paths for pneumatic, hydraulic and P&ID schematic libraries.
3. Click OK.
4. In the Project Manager, click the Create New Drawing tool.
5. In the Create New Drawing dialog box, specify:
   - Name: AEGS12
   - Template: Mouse over the edit box to verify AutoCAD_Electrical.dwt is specified
   - Description 1: Hydraulic Example
   - Click OK.

   NOTE You can also Click OK-Properties to proceed to Drawing Properties dialog box if you want to set the component, wire number, cross-reference, style and drawing format settings.

6. Select Tools → Drafting Settings.
7 In the Drafting Settings ➤ Snap and Grid dialog box, turn on Snap and Grid and set the size of both to 0.125.

8 Click OK.

9 Click the Drawing Properties tool.

Projects ➤ Drawing Properties

10 In the Drawing Properties ➤ Drawing Format dialog box, Scale section, make sure that the feature scale multiplier is set to 1.0 inch.

11 Click OK.

**NOTE** For metric unit, the following settings are recommended so that the wire connection points will be placed on the grids for easier drafting. Grid and Snap Size = 2.5 mm; Feature scale multiplier = 20 (scale factor = 20)

12 Select Projects ➤ Toolbars ➤ Extra Libraries.

**NOTE** You can also turn on the toolbar by right-clicking on any toolbar and selecting ACE: Extra Libraries.

This toolbar has tools for inserting Pneumatic, Hydraulic and P&ID components.

---

### Inserting Hydraulic Schematic Symbols

The hydraulic symbol library in AutoCAD® Electrical includes filters, valves, cylinders, pressure switches, motors, pumps, meters, restrictors, quick disconnects, flow arrows and more. The hydraulic symbol library consists of all the hydraulic symbols and is found at \Program Files [(x86)]\Autodesk\Acad [version]\Libs\hyd_iso125.

**Insert hydraulic symbols**

1 Click the Insert Hydraulic Component tool.
2 In the Insert Component: Hydraulic Symbol dialog box, select the check box for Vertical.

3 In the Insert Component: Hydraulic Symbol dialog box, click the General Valves icon.

4 In the Hydraulic: General Valves dialog box, click Shut Off Valve Open.

5 Respond to the prompts as follows:

   Specify insertion point:
   Select to place the valve in the upper left corner of your drawing

6 In the Insert/Edit Component dialog box, specify:

   Component Tag: VAL2

   Click OK.

7 Repeat steps 1 - 3.

8 In the Hydraulic: General Valves dialog box, click Checkvalve Flow Left.

9 Respond to the prompts as follows:

   Specify insertion point:
   Select to place the check valve below the shut off valve

10 In the Insert/Edit Component dialog box, click OK.

11 Click the Insert Hydraulic Component tool.

12 In the Insert Component: Hydraulic Symbol dialog box, click Motors & Pumps.

13 In the Hydraulic: Motors and Pumps dialog box, click Fixed Displacement.

15. Respond to the prompts as follows:
   Specify insertion point: Select to place the pump below the check valve

16. In the Insert/Edit Component dialog box, specify:
   Component Tag: Hydraulic Oil Pump
   Click OK.

17. Insert another Shut Off Valve Open below the Hydraulic Oil Pump.

18. Click the Insert Hydraulic Component tool.

19. In the Insert Component: Hydraulic Symbol dialog box, click Filters.

20. In the Hydraulic: Filters dialog box, click Filter.

21. Respond to the prompts as follows:
   Specify insertion point: Select to place the filter below the shut off valve

22. In the Insert/Edit Component dialog box, specify:
   Component Tag: FI2
Click the Insert Hydraulic Component tool.

In the Insert Component: Hydraulic Symbol dialog box, click Miscellaneous.

In the Hydraulic: Miscellaneous dialog box, click Reservoir.

Respond to the prompts as follows:

Specify insertion point: Select to place the reservoir below the filter

In the Insert/Edit Component dialog box, click OK.
Creating Pipes

In the AutoCAD Electrical application, we use different types of wires to represent the type of running pipes that allows water or oil flows from one instrument to another. Let's start by setting up the type of wires for pipe runs.

Insert wires as pipes

1. Expand the Insert Wire tool, and then click the Create/Edit Wire Type tool.
2. In the Create/Edit Wire Type dialog box, specify:
   - Wire Color: RED
   - Size: 20
   The Layer Name is automatically created. The name RED_20 is assigned to the wire layer you are creating.
3. Click Color.
4. In the Select Color dialog box, select red and click OK.
5. Click Linetype.
6. In the Select Linetype dialog box, select Continuous and click OK.
7. In the Create/Edit Wire Type dialog box, specify:
   - Wire Color: GREEN
   - Size: 10
   - Linetype: Hidden2
8. Select RED_20 in the grid and click Mark Selected as Default.
9  Click OK.

10  Click the Insert Wire tool.

   Wires ➤ Insert Wire

11  Respond to the prompts as follows:

   Specify wire start or [wireType/X-show connections]:

   Enter X and press ENTER
Specify wire start or [wireType/X-show connections]:

Select the bottom of the shut off valve

Specify wire end or [Scoot/T-wiretype, X-show connections]:

Select the top of the check valve

Continue inserting wires connecting the components together. Right-click to exit the command.

Your drawing should look like the following.
NOTE You can also insert the vertical or horizontal pipes first and then insert the components onto the pipe, one at a time.

13  Click the Insert Hydraulic Component tool.

14  In the Insert Component: Hydraulic Symbol dialog box, select the check box for Vertical.

15  In the Insert Component: Hydraulic Symbol dialog box, click Pressure Relief Valves.

16  In the Hydraulic: Pressure Relief Valves dialog box, click N.C. Pressure Relief Valve with Preset -1.
17  Respond to the prompts as follows:
   Specify insertion point:  \textit{Select to place the valve to the right of the pump}

18  In the Insert/Edit Component dialog box, specify:
   Component Tag: VAL4
   Description: Line 1: \textit{Pressure Relief}
   Click OK.

19  Click the Insert Wire tool.
   Wires ➤ Insert Wire

20  Respond to the prompts as follows:
   Specify wire start or [wireType/X-show connections]:
      \textit{Enter X, press ENTER}
   Specify wire start or [wireType/X-show connections]:
      Press \textit{SHIFT} + right-click and select Midpoint from the menu, then select the
      midpoint on the pipe between the pump and the shut off valve above it
   Specify wire end or [V=start Vertical/H -start Horizontal/Continue):
      \textit{Drag the pipe to the right so that it is directly above the pressure relief valve,}
      \textit{drag the pipe down and click the top connection point on the pressure relief}
      \textit{valve}
   You now need to insert a pipe that connects the end of the valve back to the pump.
TIP Make sure that Snap is turned off and that the Wire Layer is set to GREEN_10.

Specify wire start or [wireType/X-show connections]:

Select the bottom connection point on the pressure relief valve

Specify wire end or [V-start Vertical/H -start Horizontal/Continue):

Drag the pipe down and to the left, click the connection point at the bottom of the pump, right-click

Completing the Hydraulic Drawing

The rest of the hydraulic drawing consists of inserting a Pressure Gauge and Check Valve at the left side of the pump and then inserting devices (Cylinder; Restrictors; Filter; Check valve and 2-ways valve) along the top of the drawing.

NOTE During insertion, clear the Vertical option in the Insert Component: Hydraulic Symbols dialog box.

Insert components

1. Click the Insert Hydraulic Component tool.
2 In the Insert Component: Hydraulic Symbol dialog box, click Meters.

3 In the Hydraulic: Meters dialog box, click Pressure Gauge.

4 Respond to the prompts as follows:
   Specify insertion point:
   Select to place the pressure gauge to the far left (and slightly above) of the pump

5 In the Insert/Edit Component dialog box, specify:
   Component Tag: MTR1
   Description: Line 1: Pressure Gauge
   Click OK.

6 Click the Insert Hydraulic Component tool.

7 In the Insert Component: Hydraulic Symbol dialog box, click General Valves.

8 In the Hydraulic: General Valves dialog box, click Shut Off Valve Open.

9 Respond to the prompts as follows:
   Specify insertion point:
   Select to place the valve to the right of the pressure gauge
10 In the Insert/Edit Component dialog box, click OK.
11 Set the wire layer to RED_20.

12 Click the Insert Wire tool.

13 Respond to the prompts as follows:
   Specify wire start or [wireType/X=show connections]:
   Select the right connection point on the pressure gauge
   Specify wire end or [Continue]:
   Drag the pipe to the right and click the left connection point on the valve
   Specify wire start or [Scoot/wireType/X=show connections]:
   Select the right connection point on the valve
   Specify wire end or [Continue]:
   Drag the pipe to the right and click the vertical pipe, right-click
14  Click the Insert Hydraulic Component tool.

15  Insert and place the devices listed below as shown in the following illustration. In the Insert/Edit Component dialog box, click OK after each insertion.

**NOTE** You can also insert the vertical or horizontal pipes first and then insert the components onto the pipe, one by one.

<table>
<thead>
<tr>
<th>Icon</th>
<th>Symbol to Insert</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 Way Valves ➤ Solenoid Spring Return -1</td>
</tr>
<tr>
<td></td>
<td>(insert as Vertical symbol)</td>
</tr>
<tr>
<td></td>
<td>General Valves ➤ Checkvalve Flow Left (insert as a Vertical symbol)</td>
</tr>
</tbody>
</table>
Icon | Symbol to Insert
---|---
Filters ➤ Filter (insert as a Vertical symbol)
Restrictors ➤ Restrictor with Variable Output Flow
Restrictors ➤ By-Pass Flow Regulator with Variable Output Flow
Cylinders ➤ Single Acting Single Ended Piston Rod

**TIP** Align the components horizontally and vertically using the Align tool to make inserting the pipes easier.
16 Click the Insert Wire tool.

Wires ➤ Insert Wire

17 Connect the pipes from one control device to another as illustrated.

18 Click the Insert Hydraulic Component tool.

19 In the Insert Component: Hydraulic Symbol dialog box, click General Valves.

20 In the Hydraulic: General Valves dialog box, click Checkvalve Flow Left.

21 Respond to the prompts as follows:

Specify insertion point: Select to place the valve below the restrictor
22 In the Insert/Edit Component dialog box, click OK.

23 Click the Insert Wire tool.
   Wires ➤ Insert Wire

24 Connect the pipes as shown.
The hydraulic schematic diagram is complete.
If you want to create a pneumatic drawing, use the Insert Pneumatic Components tool on the Extra Libraries toolbar. Refer to the pneumatic demo drawing file (Demo03.dwg) in the “Extra Library Demo” project.

Setting Up Your P&ID Drawing

Use the Project Manager to manage your P&ID drawings. From here you can create a new drawing and modify any drawing properties.

Create a new drawing

1. In the Project Manager, click the Create New Drawing tool.
2. In the Create New Drawing dialog box, specify:
   Name: AEGS13
Template: Mouse over the edit box to verify AutoCAD_Electrical.dwt is specified

Description 1: P&ID Example

Click OK.

NOTE You can also Click OK-Properties to proceed to Drawing Properties dialog box if you want to set the component, wire number, cross-reference, style and drawing format settings.

3 Select Tools ➤ Drafting Settings.

4 In the Drafting Settings ➤ Snap and Grid dialog box, turn on Snap and Grid and set the size of both to 0.125.

5 Click OK.

6 Click the Drawing Properties tool.

Projects ➤ Drawing Properties

7 In the Drawing Properties ➤ Drawing Format dialog box, Scale section, make sure that the feature scale multiplier is set to 1.0 inch.

8 Click OK.

NOTE For metric unit, the following settings are recommended so that the wire connection points will be placed on the grids for easier drafting. Grid and Snap Size = 2.5mm; Feature scale multiplier =20 (scale factor = 20)

Set up wire layers

1 Expand the Insert Wire tool, and then click the Create/Edit Wire Type tool.

Wires ➤ Create/Edit Wire Type

2 In the Create/Edit Wire Type dialog box, click in the Wire Type #2 row and specify:

Wire Color: RED

Size: 25
The Layer Name is automatically created. The name RED_25 is assigned to the wire layer you are creating.

3 Click Color.
4 In the Select Color dialog box, select red and click OK.
5 Click Linetype.
6 In the Select Linetype dialog box, select Continuous and click OK.
7 Click Lineweight.
8 In the Select Lineweight dialog box, select 0.30 and click OK.

For this example, you need to create three more wire types (two yellow wire layers and one green wire layer) using the Create/Edit Wire Type dialog box.

9 In the Create/Edit Wire Type dialog box, specify:

<table>
<thead>
<tr>
<th>Wire Type #3</th>
<th>Wire Color: YELLOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size: 15</td>
<td>Yellow</td>
</tr>
<tr>
<td>Linetype: Continuous</td>
<td>default</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wire Type #4</th>
<th>Wire Color: YELLOW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size: 10</td>
<td>Yellow</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wire Type #5</th>
<th>Wire Color: GREEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size: 10</td>
<td>Green</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Used</th>
<th>Wire Color</th>
<th>Size</th>
<th>Layer Name</th>
<th>USER1</th>
<th>USER2</th>
<th>USER3</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>RED</td>
<td>25</td>
<td>RED_25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>YELLOW</td>
<td>15</td>
<td>YELLOW_13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>YELLOW</td>
<td>10</td>
<td>YELLOW_10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>GREEN</td>
<td>10</td>
<td>GREEN_10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
NOTE For pipe runs in P&ID drawings, you must include the different linetypes from the *acad.e.lin* file. You can set up the wire types for pipes at the beginning of the drawing or before creating the pipes.

10 To set the Linetype for the GREEN_10 wire layer, click Linetype.

11 In the Select Linetype dialog box, click Load.

12 In the Load or Reload Linetypes dialog box, click File.

13 In the Select Linetype File dialog box, select acad.e.lin and click Open.

NOTE The default location for the *acad.e.lin* file is *Documents and Settings*\{username\}*\Application Data*\*Autodesk*\*AutoCAD Electrical* \{version\} \{release number\} \{country code\}* \Support*.

14 In the Load or Reload Linetypes dialog box, select Pneumatic Signal and click OK.
15 In the Select Linetype dialog box, select Pneumatic Signal and click OK.
16 In the Create/Edit Wire Type dialog box, click OK.

Inserting P&ID Schematic Symbols

The P&ID symbol library in AutoCAD electrical includes equipment, tanks, nozzles, pumps, fittings, valves, actuators, logic functions, instrumentation, flow, and flow arrows. The P&ID symbol library consists of all the piping and instrumentation symbols and is found at \Program Files [(x86)]\Autodesk\AutoCAD [version]\Libs\Pid.

Insert P&ID Symbols

1 Click the Insert P&ID Component tool.

2 In the Insert Component: Piping and Instrumentation Symbols dialog box, click Equipment.

3 In the PID: Equipment dialog box, click Ball Mill.

4 Respond to the prompts as follows:

   Specify insertion point:

   Select to place the ball mill in the upper left corner of your drawing
In the Insert/Edit Component dialog box, specify:

Component Tag: C-100
Description: Line 1: BALL MILL
Click OK.

Follow steps 1-2 above.

In the PID: Equipment dialog box, click Conveyors.

In the PID: Conveyors dialog box, click Conveyor 1.

Respond to the prompts as follows:

Specify insertion point:
Select to place the conveyor to the right and diagonally below the ball mill

In the Insert/Edit Component dialog box, specify:

Component Tag: N-100
Description: Line 1: CONVEYOR
Click OK.

Follow steps 1-2 above.

In the PID: Equipment dialog box, click Mixer 2.

Respond to the prompts as follows:

Specify insertion point:
Select to place the mixer to the right and diagonally below the conveyor
14 In the Insert/Edit Component dialog box, specify:

Component Tag: A-100
Description: Line 1: MIXER
Click OK.

15 Click the Insert P&ID Component tool.

16 Insert and place the devices listed below as shown in the following illustration. In the Insert/Edit Component dialog box, click OK after each insertion.

<table>
<thead>
<tr>
<th>Icon</th>
<th>Symbol to Insert</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Gate Valve Icon]</td>
<td>Gate Valve</td>
</tr>
<tr>
<td>![Dryer Icon]</td>
<td>Dryer</td>
</tr>
<tr>
<td>![Field Mounted Icon]</td>
<td>Discrete Instruments</td>
</tr>
</tbody>
</table>

In the Insert/Edit Component dialog box, clear the Component Tag:
- Component Tag = C-200; Description Line 1 = DRYER
- Component Tag = TE 201

Inserting P&ID Schematic Symbols | 251
Creating Pipes

In AutoCAD Electrical, we use different types of wires to represent the type of running pipes that allow water or oil flows from one instrument to another.

Insert wires as pipes

1. In the AutoCAD Layers toolbar, change the wire layer to RED_25.

2. Click the Insert Wire tool.
   Wires ➤ Insert Wire

3. Connect the pipes as shown. Right-click to exit the command.
4 In the AutoCAD Layers toolbar, change the wire layer to POS and the linetype to HIDDEN2.

5 Click the Insert Wire tool.
   Wires ➤ Insert Wire

6 Respond to the prompts as follows:
   Specify wire start or [wireType/X-show connections]:
   Select the bottom of the discrete instrument
   Specify wire end or [Continue]:
   Drag the wire down a few spaces, press ENTER

7 Click the Insert P&ID Component tool.
8 In the Insert Component: Piping and Instrumentation Symbols dialog box, click Flow Arrows.

9 In the PID: Equipment dialog box, click Flow Arrow Down.

10 Respond to the prompts as follows:

   Specify insertion point:

   Select to place the flow arrow at the bottom of the new wire

The P&ID diagram is complete.

If you want to see how to expand the P&ID drawing, refer to the P&ID demo drawing file (Demo01.dwg) in the "Extra Library Demo" project.