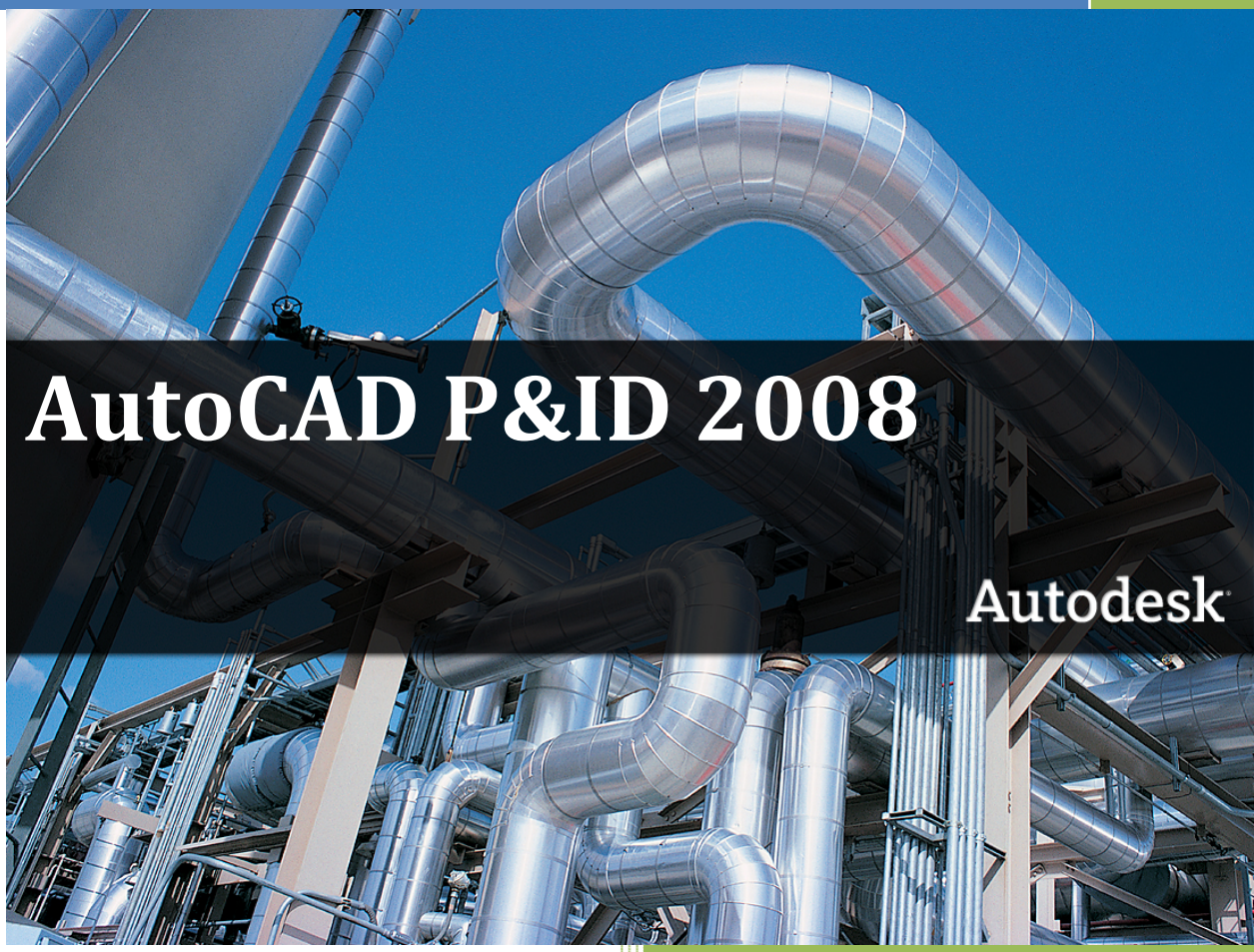
User Exercises



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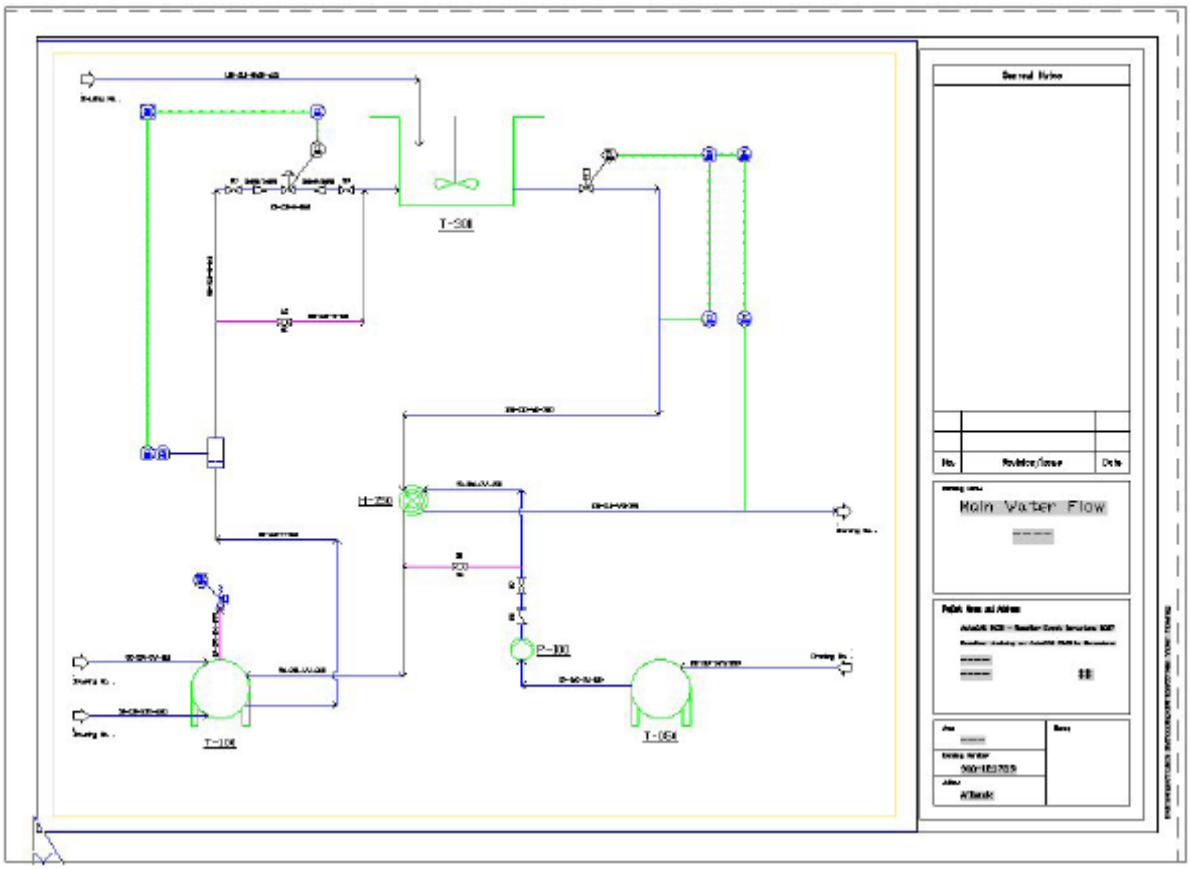
Session 1: Introduction to AutoCAD® P&ID: The New P&ID

What is in this course Learn how to use AutoCAD Plant to draw intelligent Piping and Instrumentation Diagrams (P&IDs). At the end of the session you will understand how Autodesk Plant leverages standard AutoCAD productivity tools with user-customizable symbols to quickly and easily create and edit drawings in a way not possible using base AutoCAD You will receive in-depth step-by-step instructions on how to take a typical P&ID and leverage standard AutoCAD functionality to make a number of graphical revisions to the drawing while ensuring all end-line and in-line equipment maintain connectivity and inheritance. You will learn how to ensure consistency of process pipe line properties across multiple drawing files.

Creating a P&ID drawing

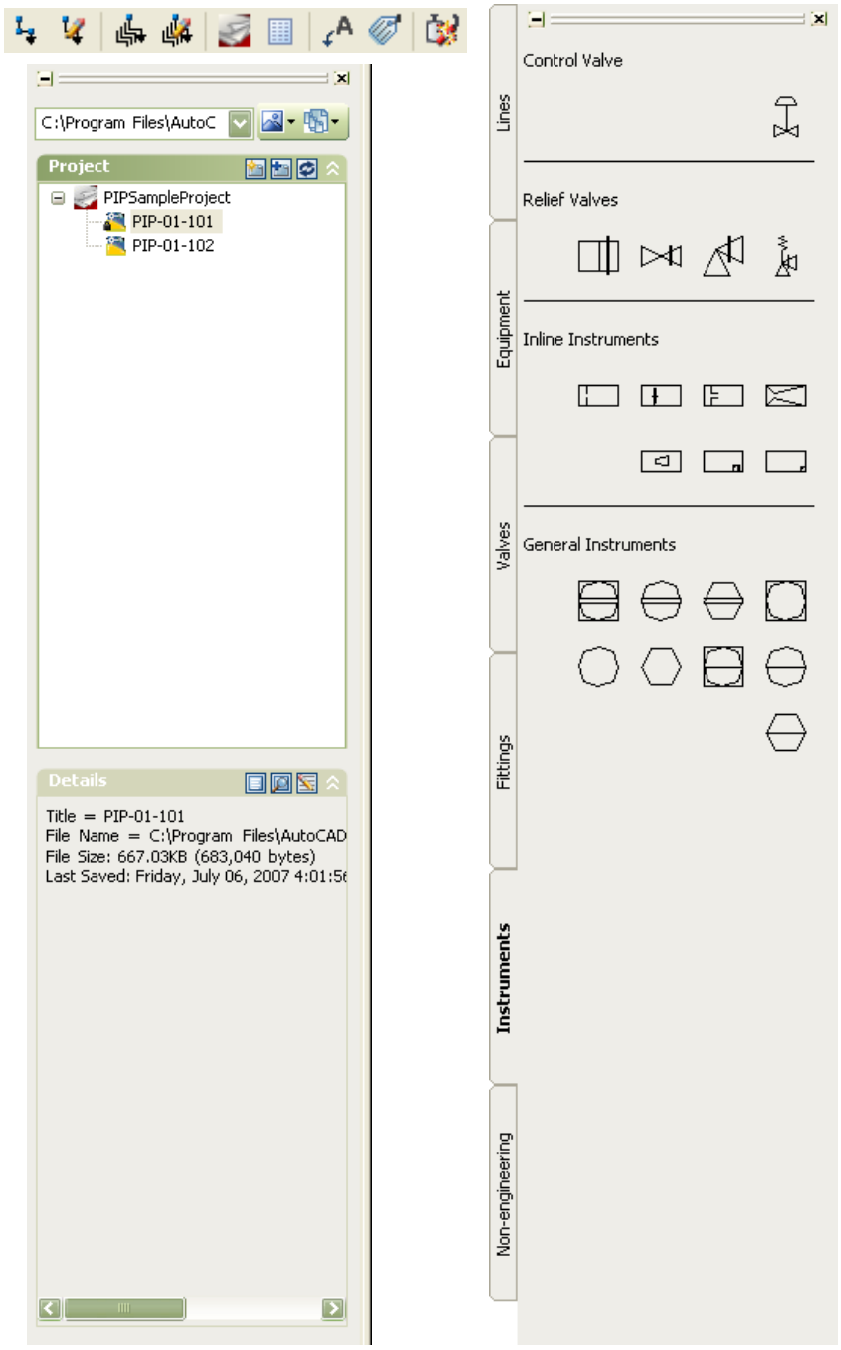
In this session we will create the P&ID (shown below), to provide a general idea of how to use AutoCAD P&ID to create production P&IDs. In particular, we will cover these items in this order:

A. Drawing equipment & assigning tags
B. Connecting equipment with process lines
C. Placing hand valves, reducers and control valves
D. Placing instrumentation
E. Entering equipment data and placing equipment annotations
F. Entering pipeline data and placing pipeline annotations
G. Placing off page connectors.



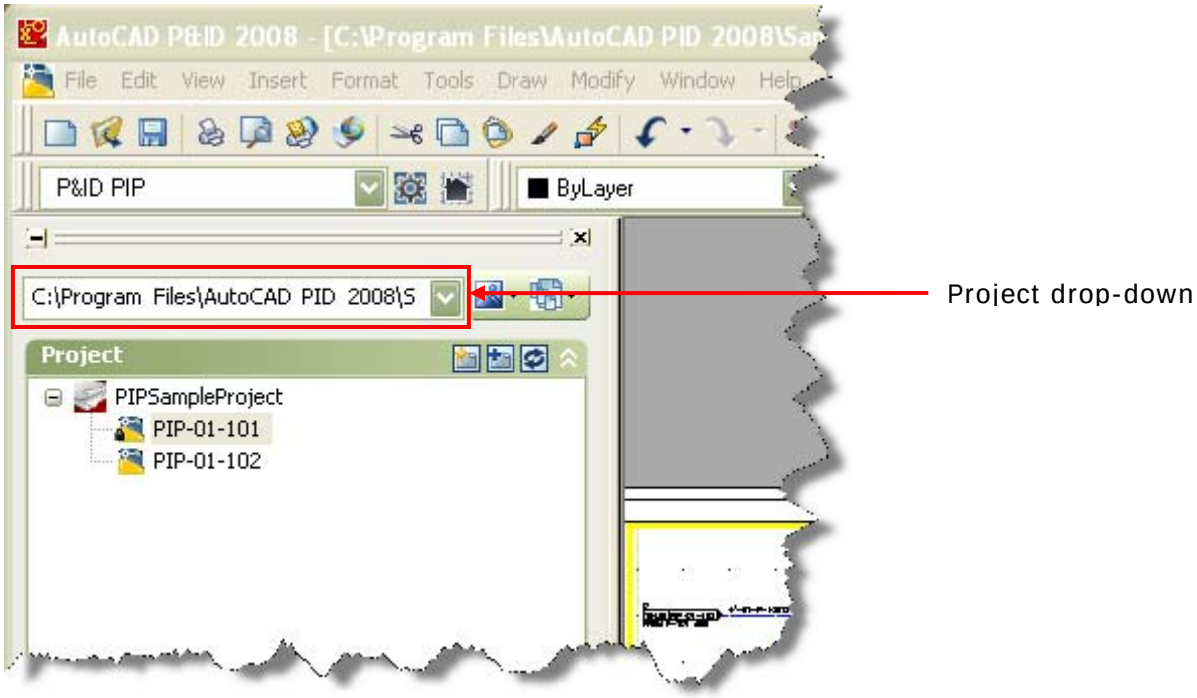
Launching AutoCAD Plant Solutions P&ID 2008

As with other AutoCAD based products, you can launch P&ID from either the desktop icon or from the programs start menu. This will invoke AutoCAD in the P&ID workspace. The environment should be familiar as it is leveraging standard AutoCAD. The most important elements of P&ID workspace to become familiar with are the P&ID workspace toolbar, the tool palette and the Project Manager.



Creating a project

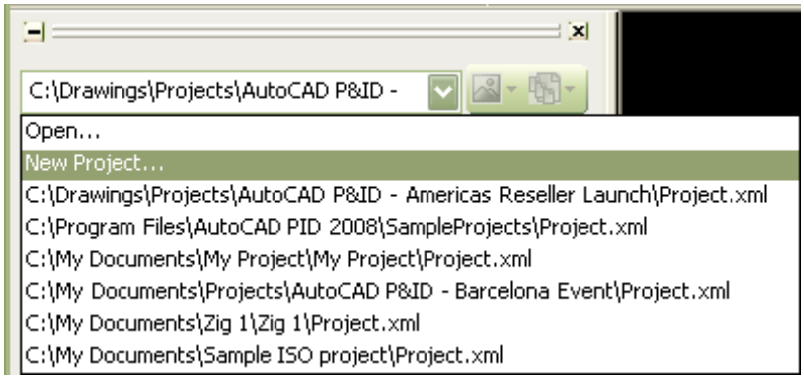
In Plant P&ID 2008 you will create P&IDs in a project environment. This is an administrative task not typically done by all users, but for the sake of familiarity with the concepts of the project environment we will create a new project with folders and subfolders.



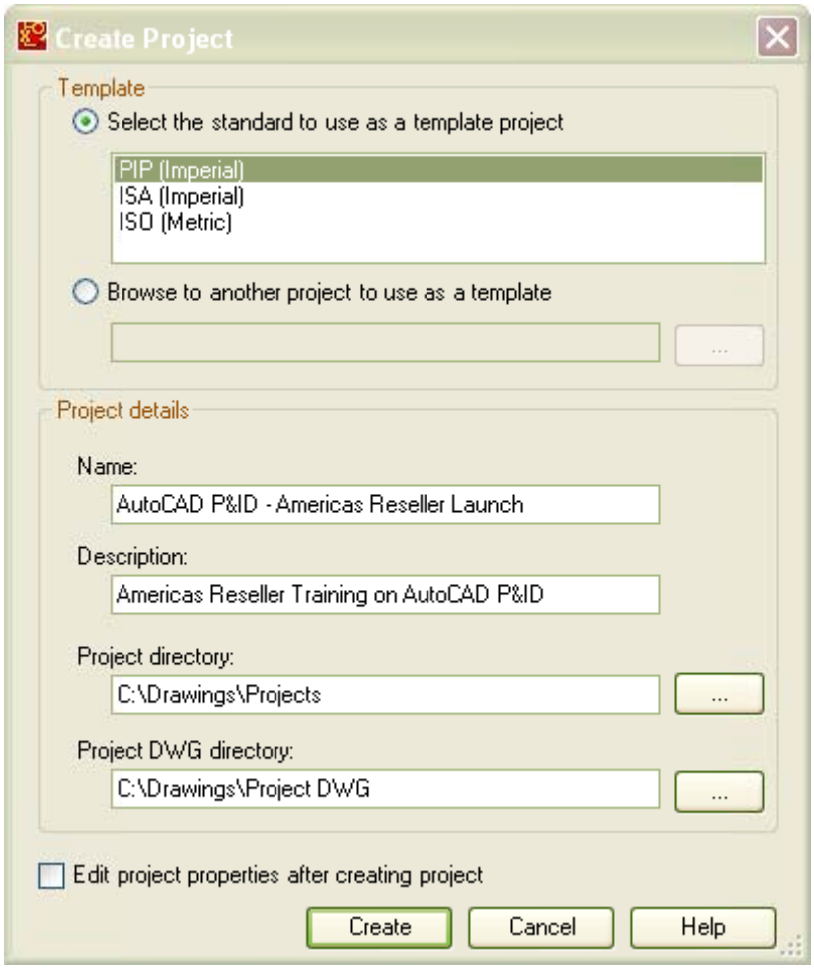
These folders and subfolders get their own specific settings as we will see in this exercise. Once you've established the required structure you will create some new drawings. So, be sure to save this structure, because you will need it later. Use the following inputs when you set up your structure (see second diagram, below):

Standard:	PIP
Project Name:	AutoCAD P&ID – Americas Reseller Launch
Project Description:	Americas Reseller Training on AutoCAD P&ID
Project directory:	Create a folder named Drawings with a subfolder named Projects
Project DWG directory:	Create a second folder in the Drawings folder named Project DWG

1 Click on the Project drop-down (just above the Project navigation window) and select New Project…



Project drop-down

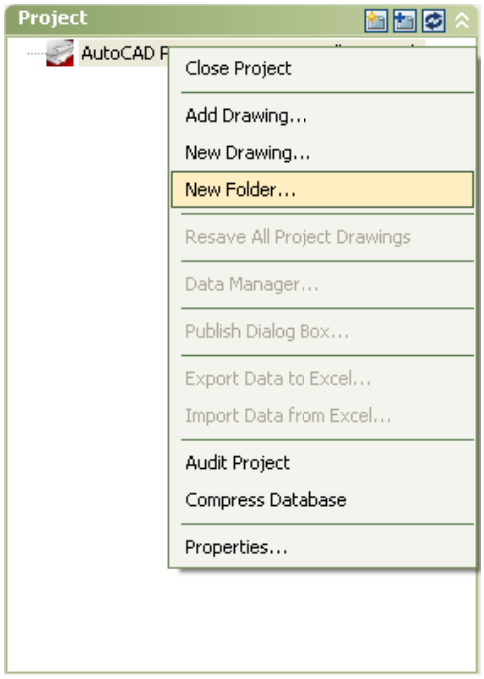


Create Project dialog

Before accepting these settings, make sure the option "*Edit project properties after creating"* is unchecked.

When the project is created you will add some folders and subfolders. This is done using the project manager in AutoCAD P&ID.

1 Right click on the project name and select New Folder from the menu.



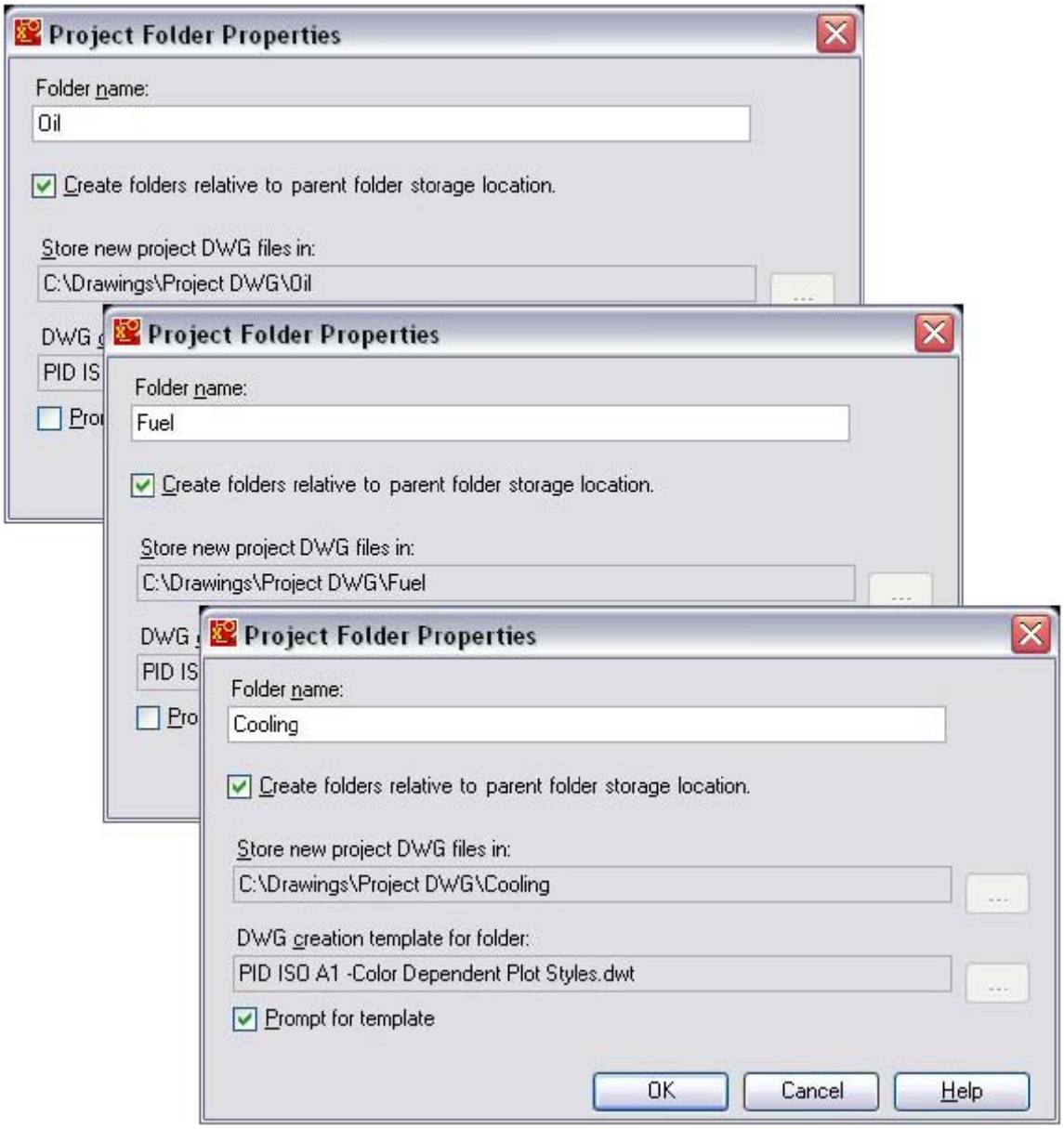
Project right-click menu

Each folder becomes its own folder in your "*Project DWG"* folder.

The main folders you are going to create are:

- **Oil**
- **Fuel**
- **Cooling**

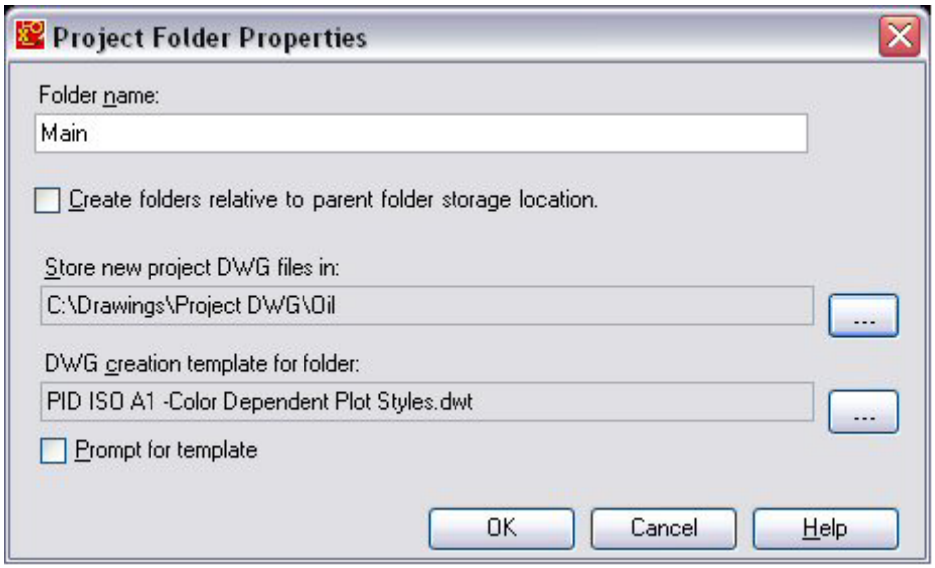
See the following diagram.



Notice the check in the "*Prompt for template"* checkbox when we create the Cooling folder. When you create a drawing in Oil or Fuel the project default template will be used. But, you will be prompted for the template when you create drawings in the Cooling folder.

Now, let's create more subfolders in Oil, Fuel and Cooling. The folders we create in this part of the exercise are for organization within the project tree. Physical folders will not be created on your hard disk, because we uncheck the box "*Create folders relative to parent folder storage location"*. They will inherit the attributes of the parent folders.

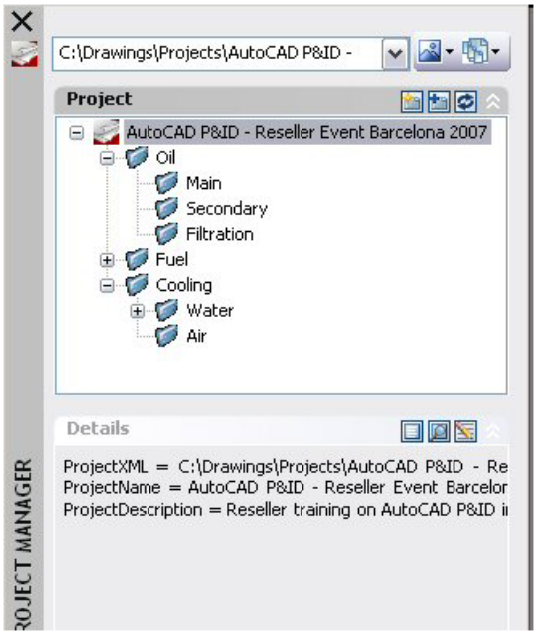
1 This time, right-click on the parent directory and select New Folder from the menu.



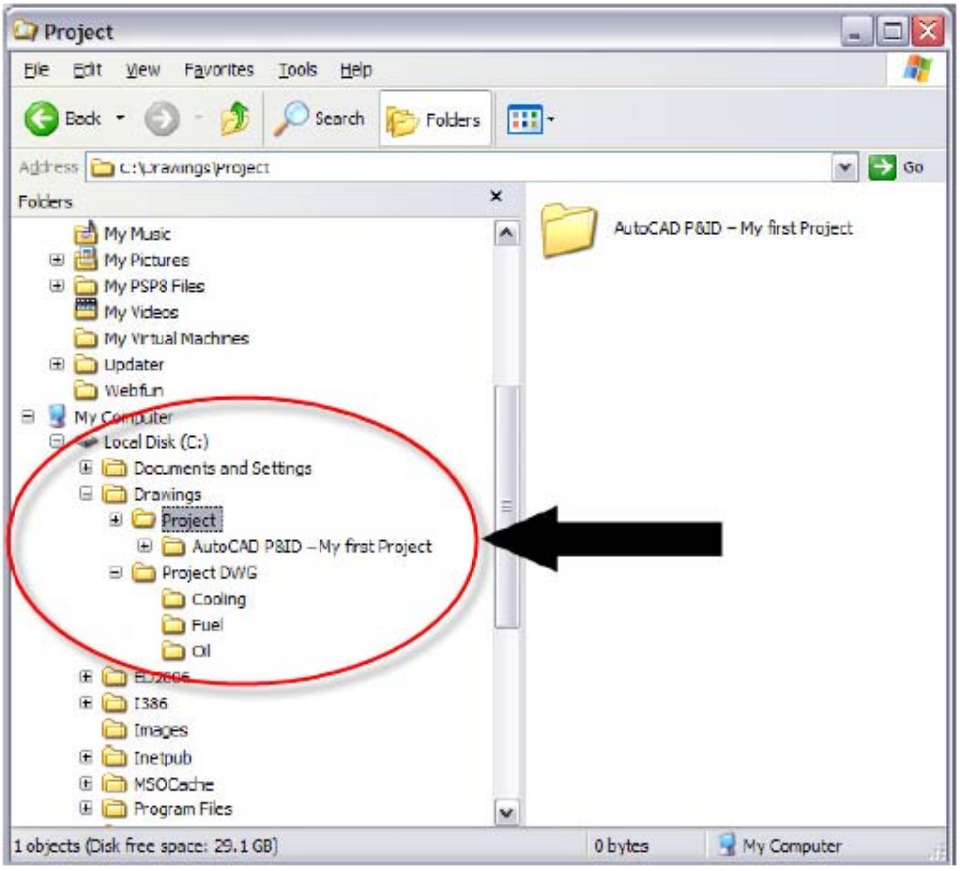
Now that you understand the procedure, create the following subfolders:

In Oil create Main, Secondary and Filtration
In Fuel create Gas, Gasoline and Measuring
In Cooling create Water and Air

When you finish creating the project the project tree should look like this:



And your local hard disk should look like this:

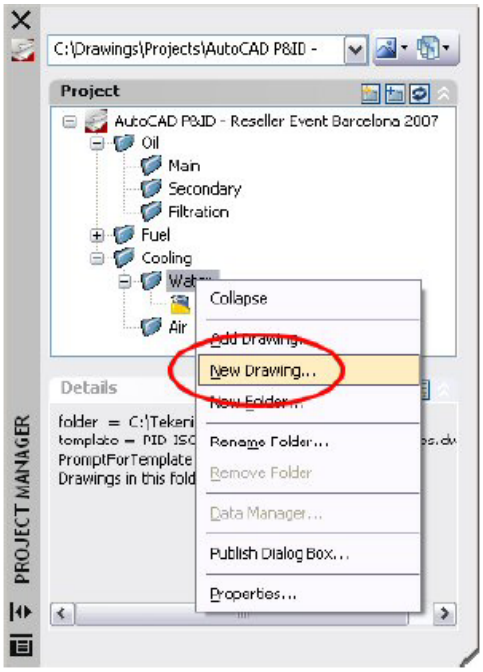


Create a drawing and place equipment

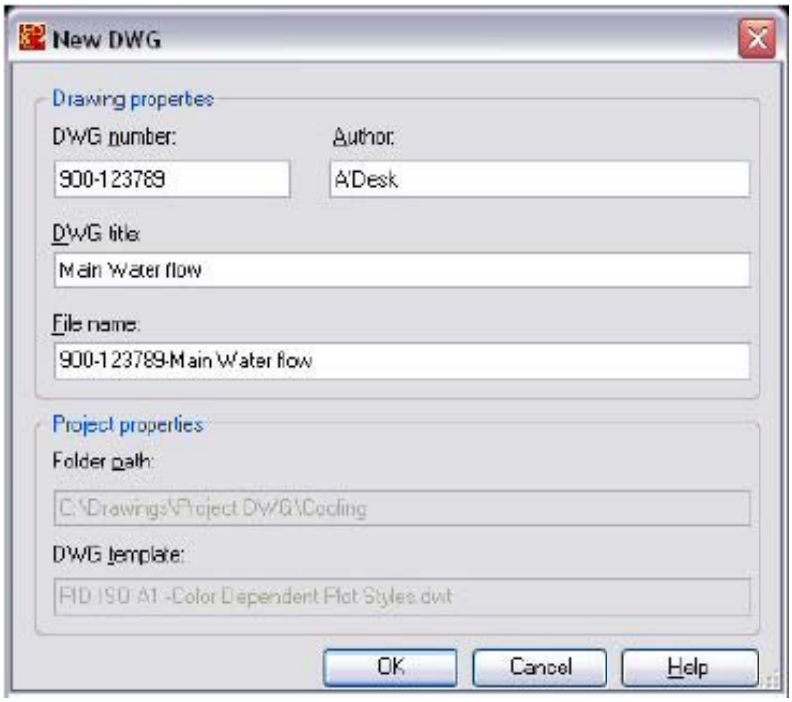
Create drawing

Now we will start a new drawing in the project you just created. This P&ID is going to be created in the Cooling folder and is part of the Water subfolder.

1 Right-click on the Water folder and in the menu select New Drawing.



2 Enter values as shown below:



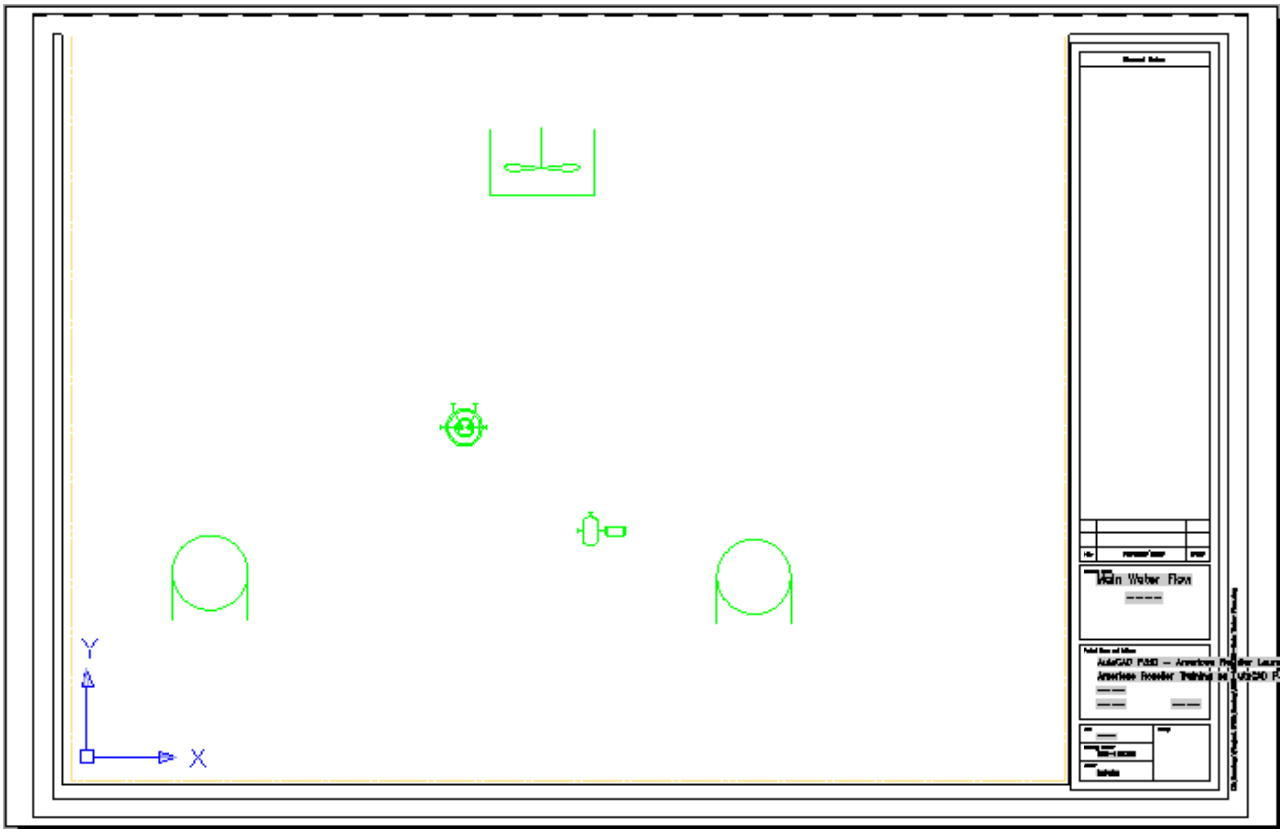
Place Equipment

We are now ready to add items to the drawing. You will place 6 pieces of equipment, to start. You will find the equipment in the Equipment tab of the Tool Pallet. While you can drag symbols from the Tool Pallet to your drawing, it is best to click on the equipment you want to place and then click again where you want it located on the drawing. Place the following equipment with the indicated tag and location on the drawing:

Equipment	**Tag** (enter this in dialog)	**Location on Drawing**
Open Top Tank	TK-300	Up at top
Propeller Agitator	The agitator has no tag	Inside tank
Spherical Tank	TK-100	At bottom on the left
Spherical Tank	T-K050	At bottom on the right
Spiral Heat Exchanger	E-150	Low center
Horizontal Centrifugal Pump	P-100z z	Bottom center

NOTE *Depending on project settings, you may be prompted to place these tags on the drawing right after assigning a tag number*.

When you finish your drawing should look something like this:



Save your drawing. We will use it as we continue through the exercises.

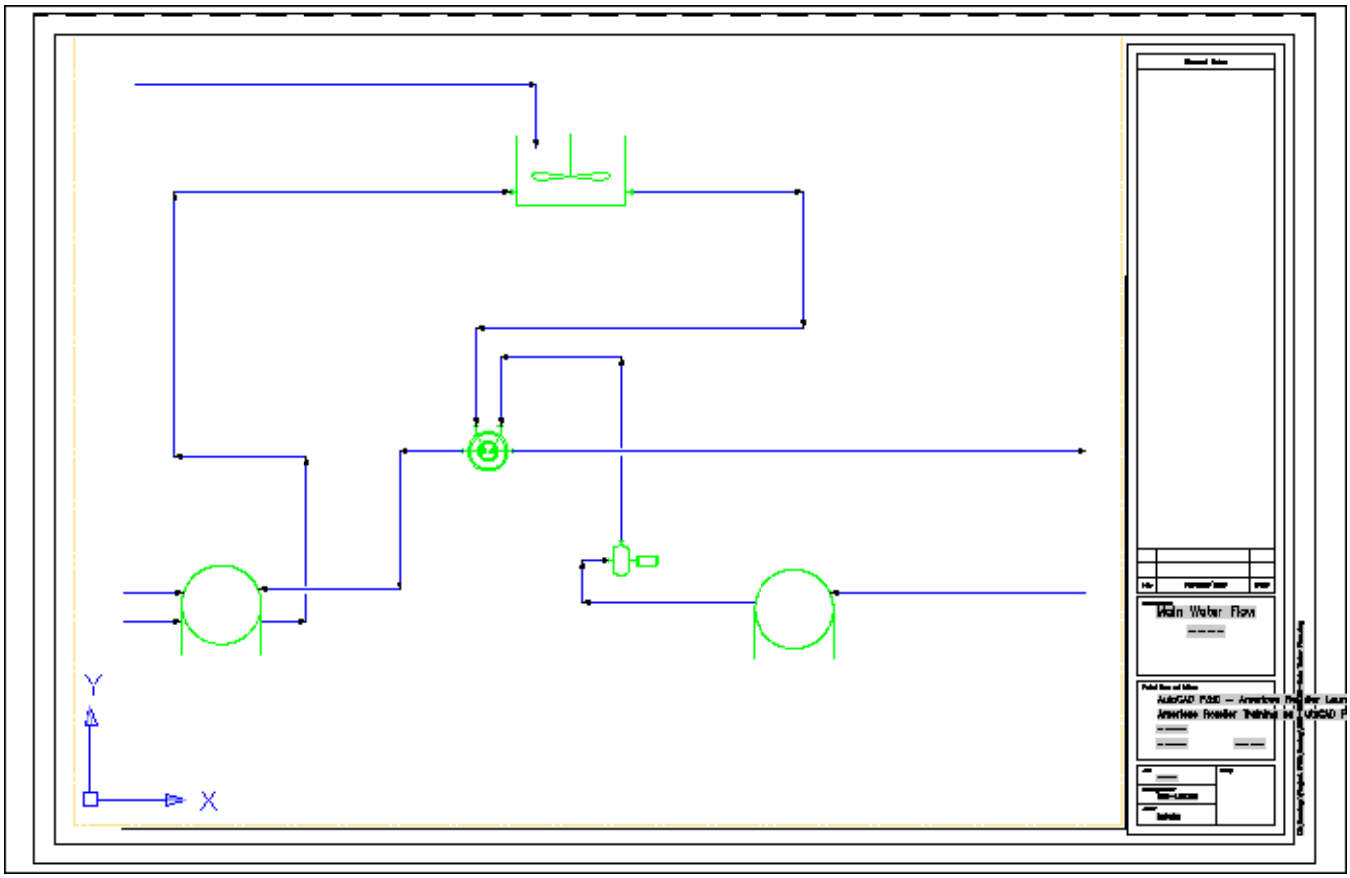
Adding primary and secondary lines

Primary lines

We will now add primary and secondary lines to connect the equipment we just placed. The direction of flow for the lines will be determined by the direction you create the lines. If necessary, the direction can be changed. We will cover this later, when we look at the editing tools.

1 Select Primary Line from the Lines tool pallet and start creating the lines in the following diagram.

HINT *Use the right-click Repeat and Recent Input options to speed placement of lines and duplicate equipment.*



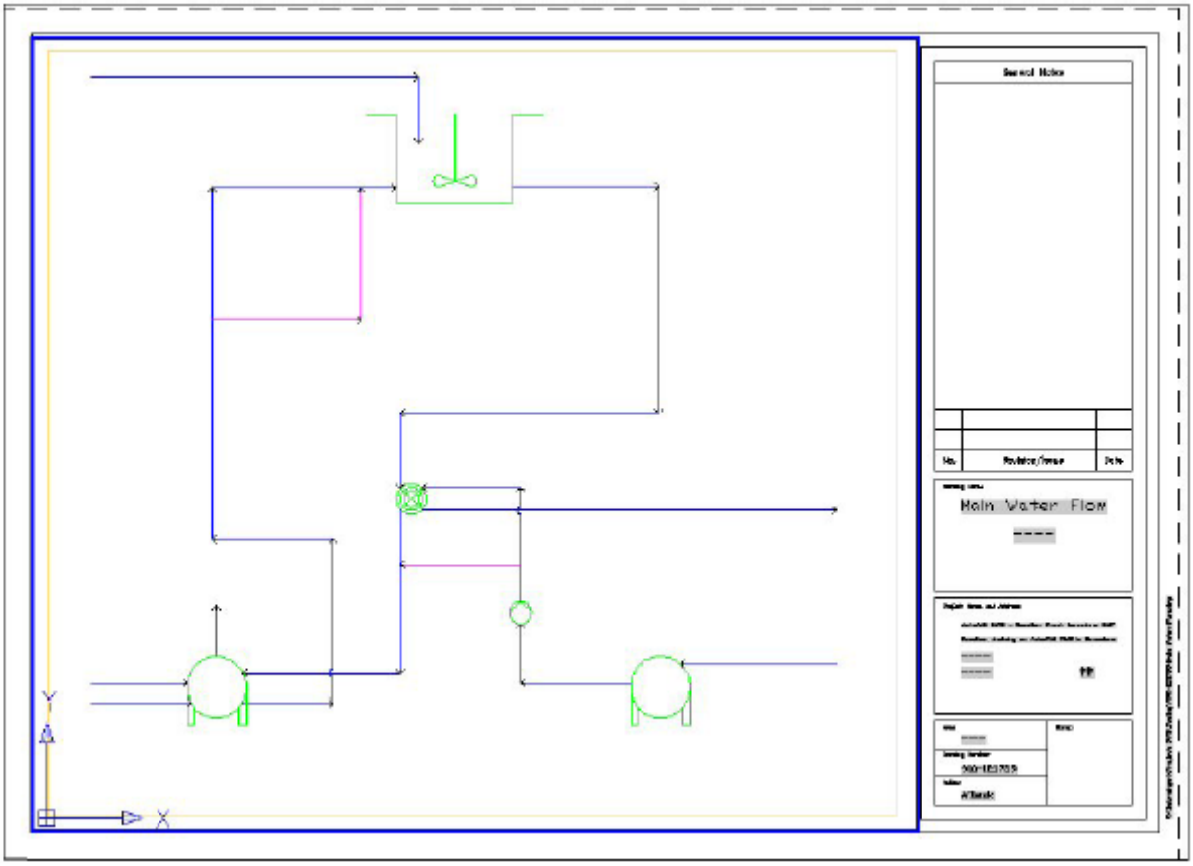
HINT *To determine if a line is attached to a piece of equipment, select it. If it is attached, there will be a circular shaped grip at the attached end. If not, the grip will look like a plus sign (+).*

Secondary lines

When your drawing looks like the one above, you are ready to add some secondary lines. Your color scheme may not match what you see in our diagrams. You can set your color preferences in Project Settings and we will cover that later.

1 Select Secondary Line from the Lines tool pallet and start creating the lines shown in the following diagram.

Aside from the color differences, your drawing should look like this:



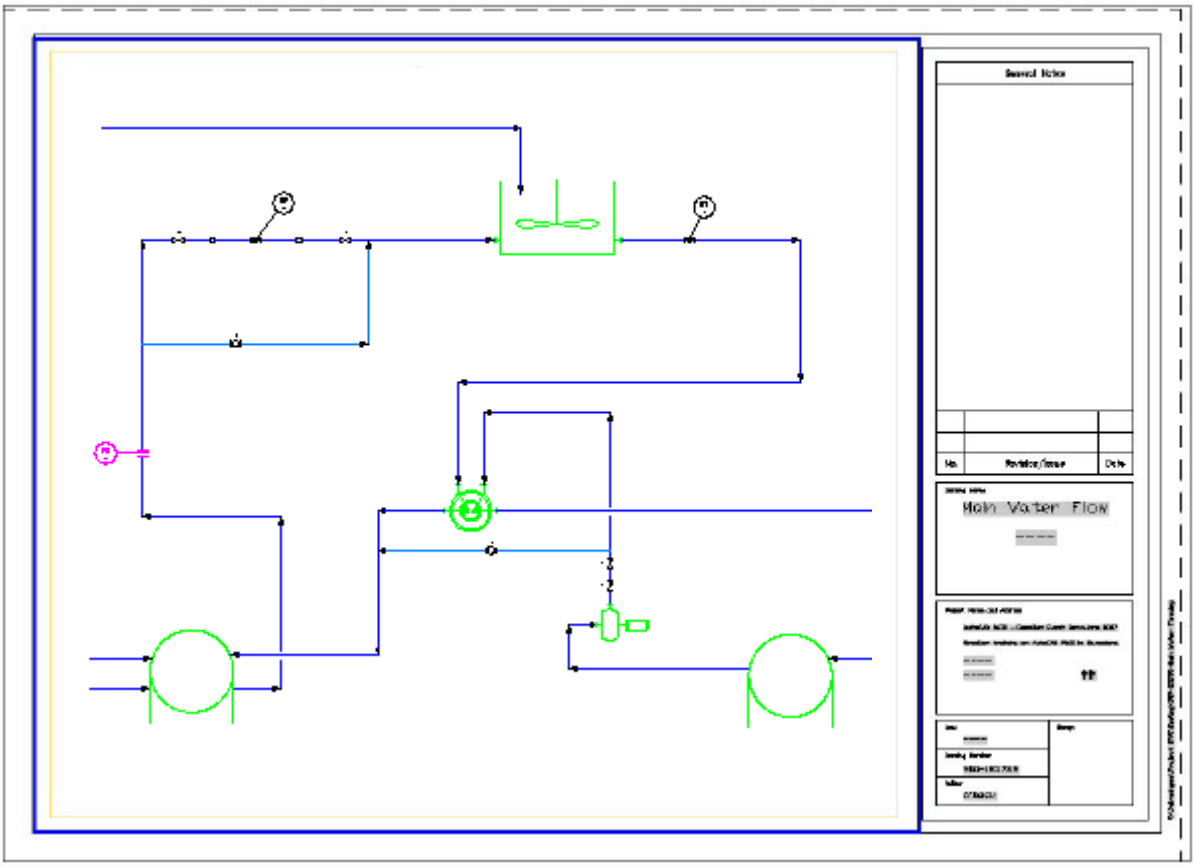
Now save your drawing and we will move on to the next topic.

Placing inline components

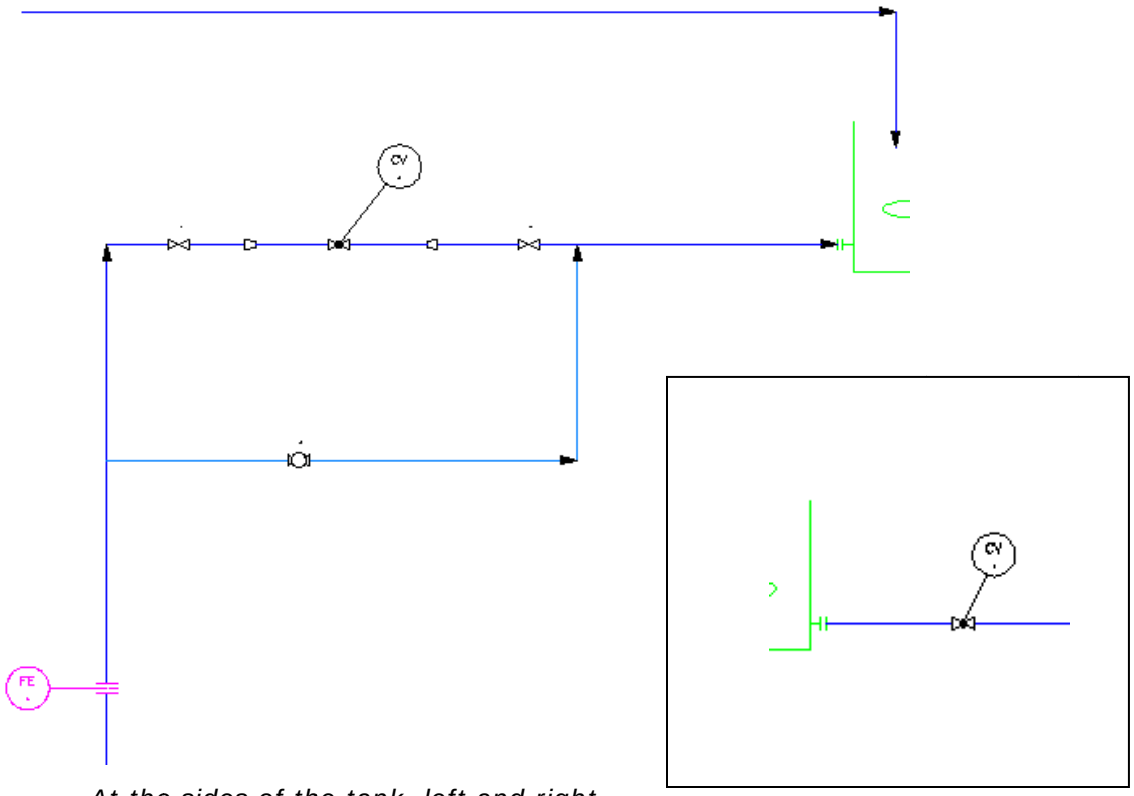
Now that you have completed the basic layout of your P&ID, it is time to place some inline components such as hand valves, check valves and control valves. You will add these components on both sides of the tank, near the pump and at the heat exchanger.

You should place them according to the following diagram. Remember, inline components can be modified later.

1 Select a valve symbol from the Valves tool pallet and start placing the valves shown in the following diagram (reducers are found in the Fittings palette and instruments, in the Instruments palette).

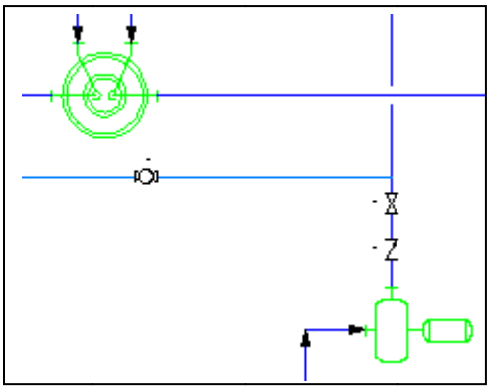


To help you with the location of these components we created the following detail views:



At the sides of the tank, left and right

NOTE *To flip the direction of a reducer, select it and click on the Flip grip (arrow shape).*



Around the heat exchanger

When you are finished placing your inline components, save your drawing.

Adding Instrumentation and tags

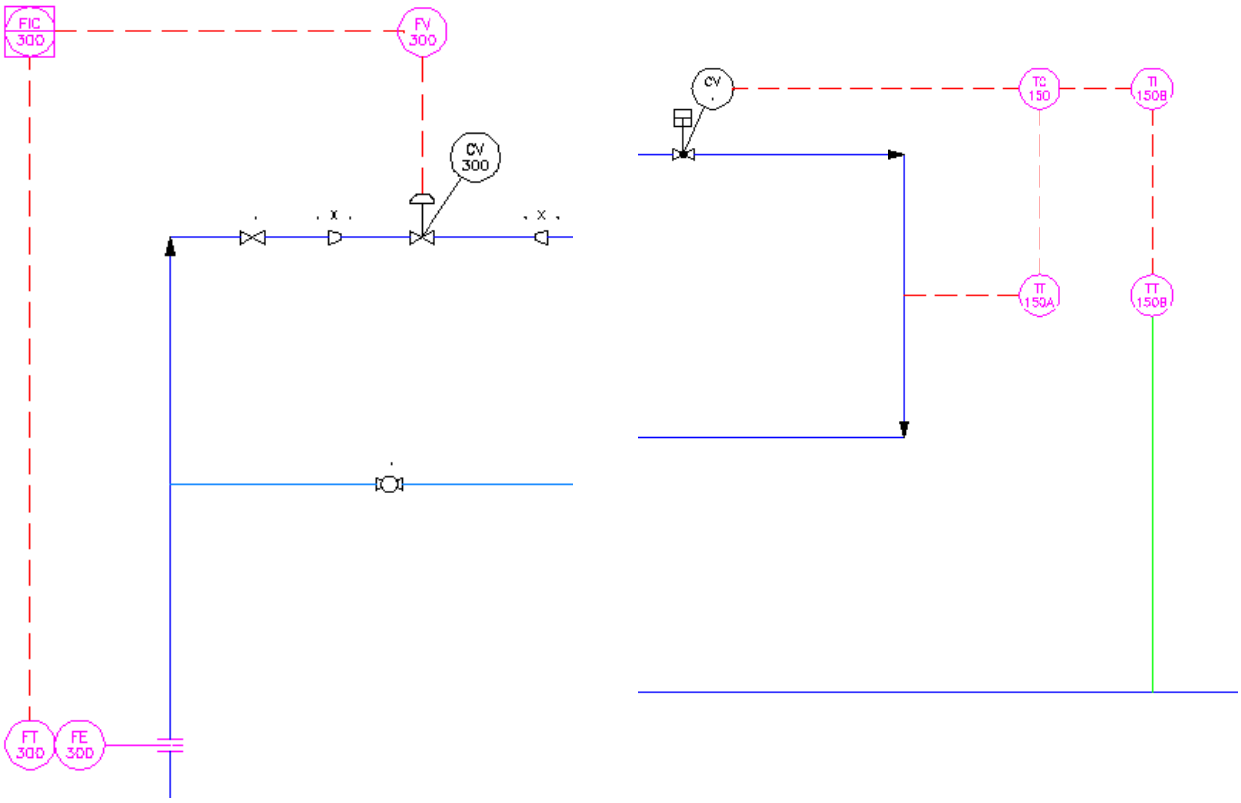
Add instruments

As you probably know, instrumentation is very often connected to control valves and/or other regulating inline components. They react on signals – such as, pressure, temperature or flow – that they receive from the process lines they are attached to. In this exercise, we are going to build some instrumentation loops connected to control valves, flow transmitters and temperature indicators. We will also add some tags to the equipment. You will see your drawing starting to look like a real P&ID.

In the next figure, you will see what instrument you should place and where it should be placed.

1 Select the appropriate instruments from the Instruments palette. Place them in the locations shown in the following diagrams.

2 Select the signal line from the Lines palette (and one tubing line). Connect the instruments, as shown.



When you have finished the instrumentation, save your drawing.

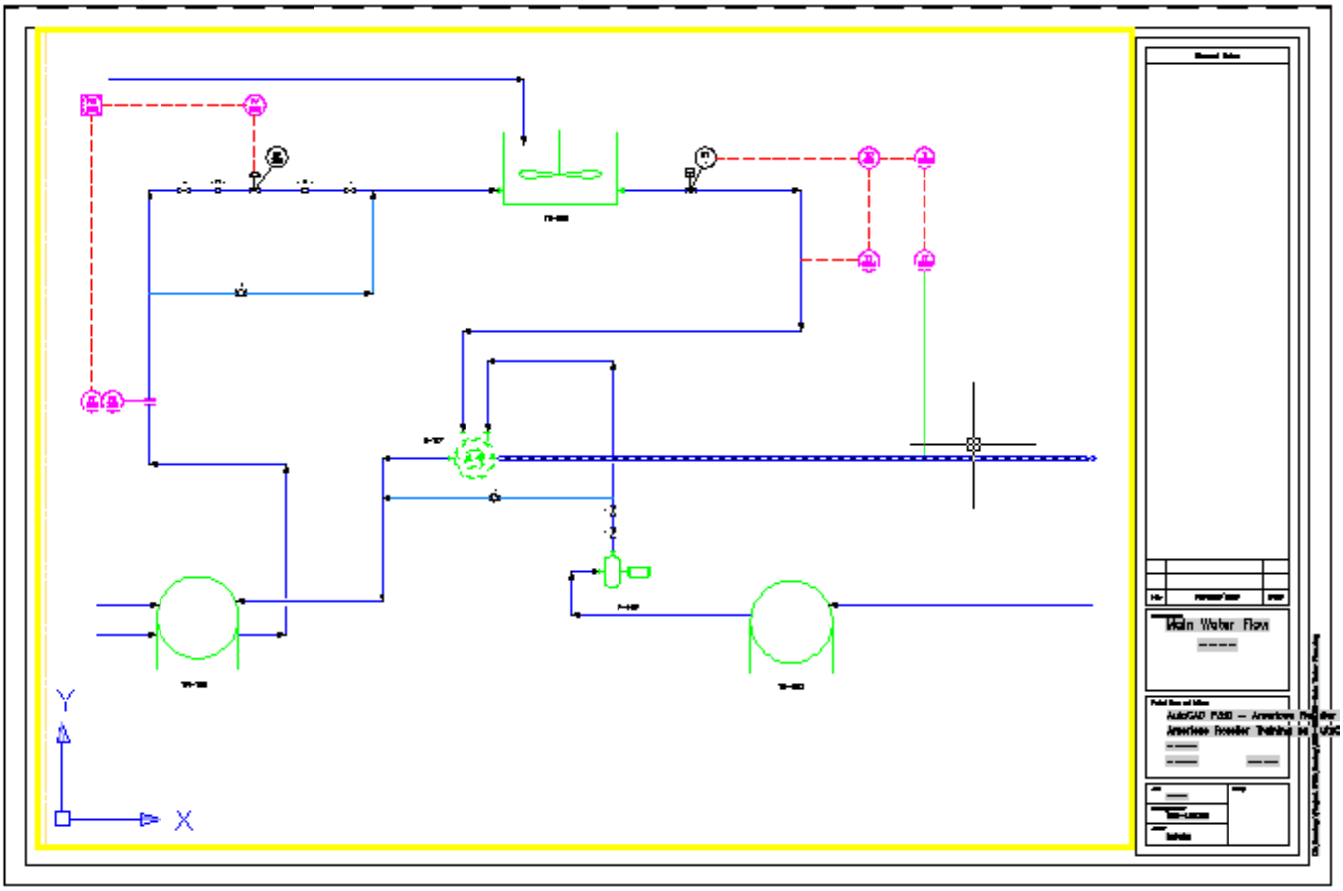
Add tags

Next we will add tags to the equipment.

1 Place the tags by right-clicking on the equipment you want to tag and selecting Annotate -> Tag.

2 Add tag information in the dialog.

3 Position your tags as shown in the next figure.



Save your drawing.

Offpage Connectors

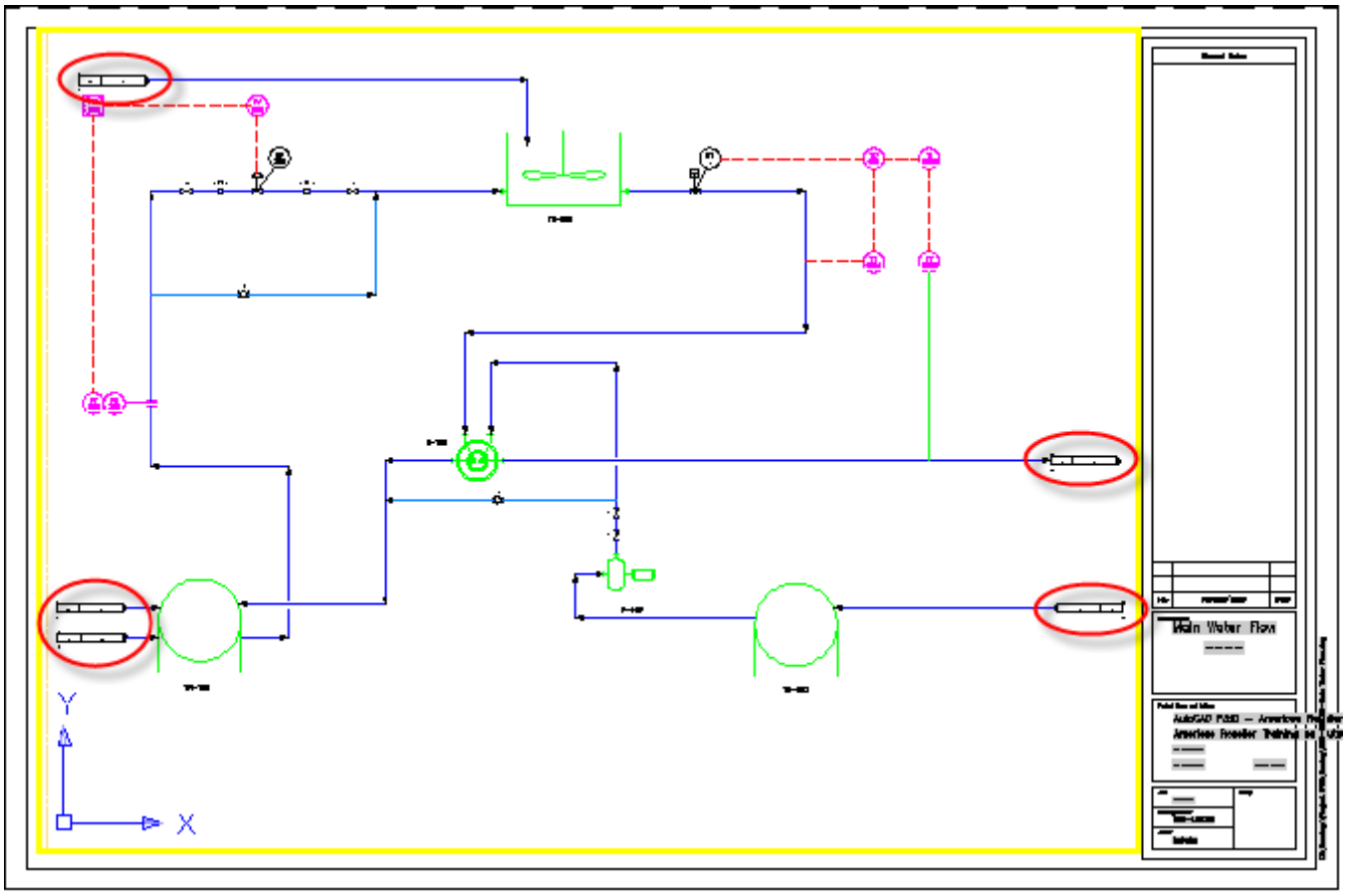
Place Connectors on first drawing

Quite often a process is laid out on multiple drawing sheets. The continuation of a pipeline from sheet to sheet is marked by using Offpage Connectors. In this exercise we will add another sheet to our drawing and connect the continuous pipelines with Offpage Connectors. Let's start with the drawing we've already made.

1 In the Non-engineering palette, select the Offpage Connector symbol.

2 Place the 5 Offpage Connectors as shown in the following diagram.

We will add required information to these arrows in a later exercise.

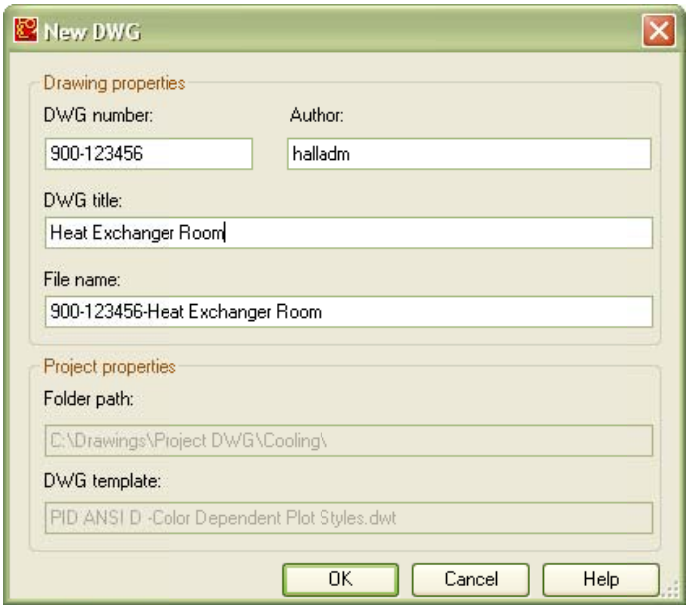


Create second drawing

Now that you've placed these connectors, you need another drawing to connect them to. We will create a new drawing in the Cooling folder, Water subfolder.

1 Right-click on the Water subfolder and create a new drawing.

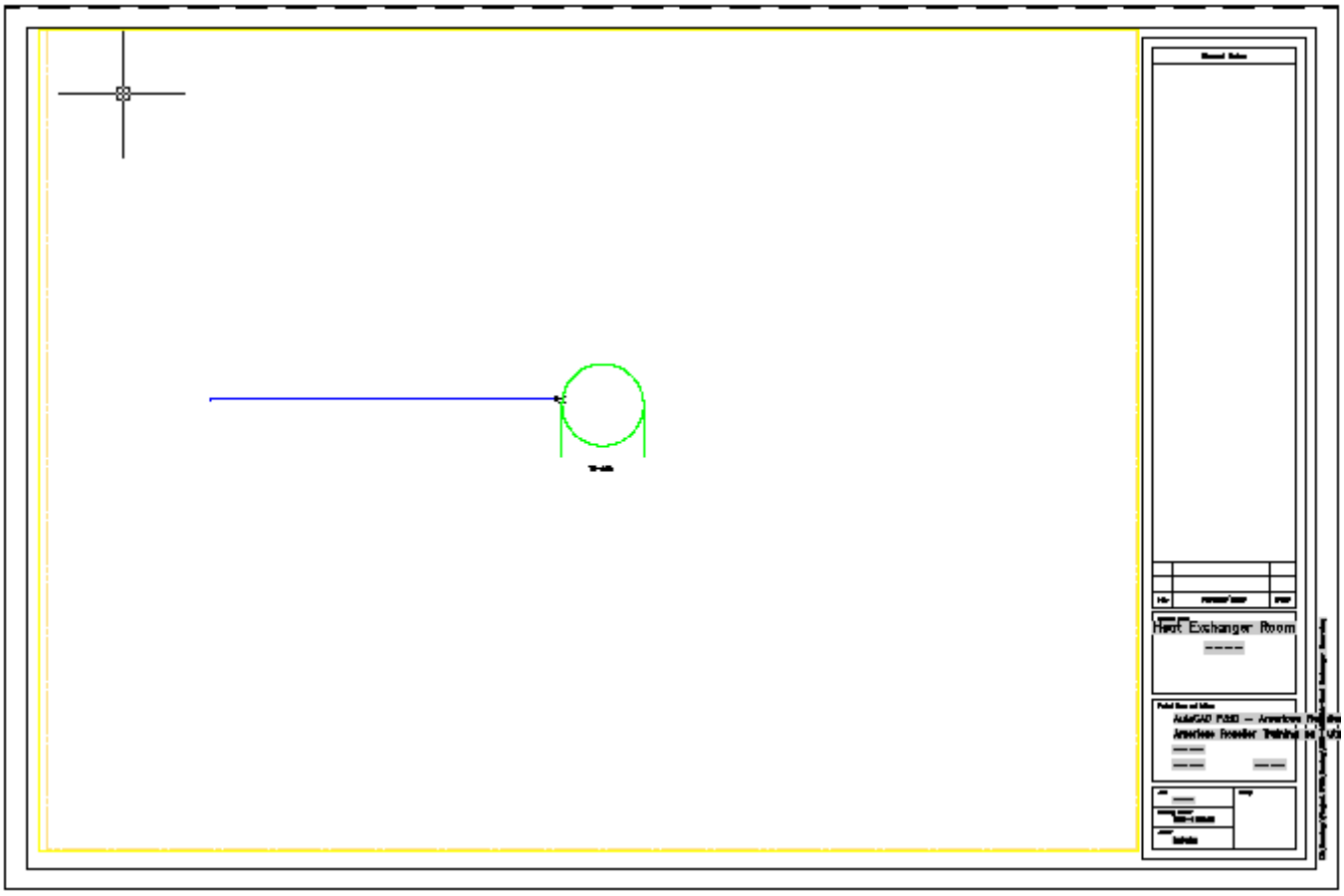
2 Enter the following information into the New DWG dialog.



Place items on new drawing

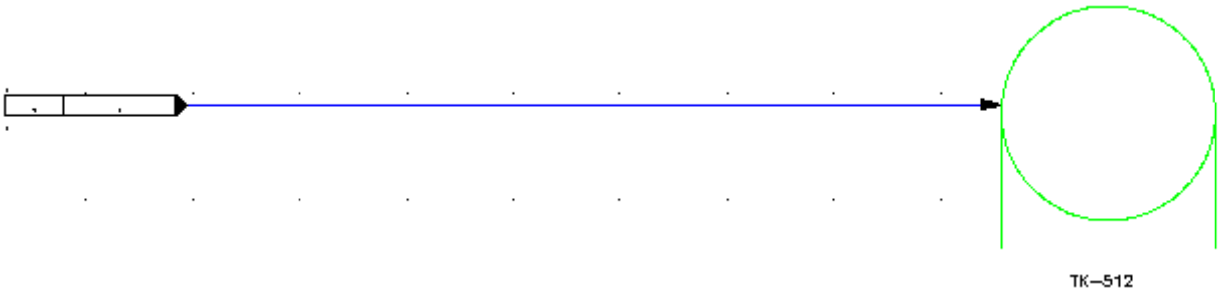
1 Place a tank on the new P&ID and give a tag of TK-512.

2 Draw a primary line from the left edge of the drawing to the tank as shown in the next figure.



3 Now place an Offpage Connector at the left end of the primary line you just created.

This is where this line will connect to the same line on the other drawing. It will correspond with the connector coming from the Heat Exchanger H-150. It should look something like this:



Save both drawings before we continue to the next exercise.

Tagging Pipelines

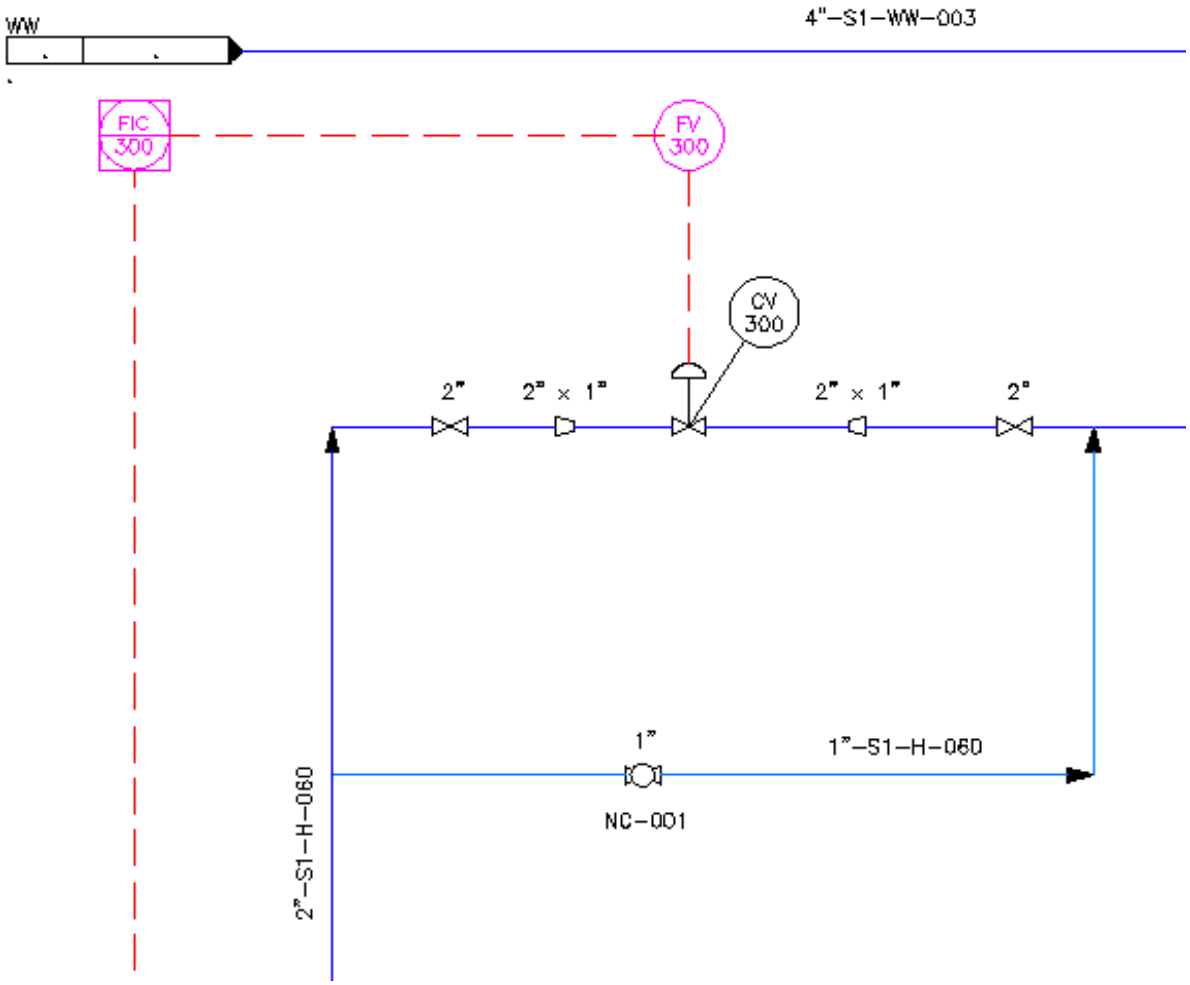
In the following figures you will see the sizes, specs, service and line number that should be entered at the tag assignment for each line. After entering the necessary information you will also need to place the different tags near the appropriate pipeline. These tags will be placed in the first drawing you created.

NOTE *If the box is checked next to Place annotation after assigning tag, you will be prompted to select a location for the tag in the same operation.*

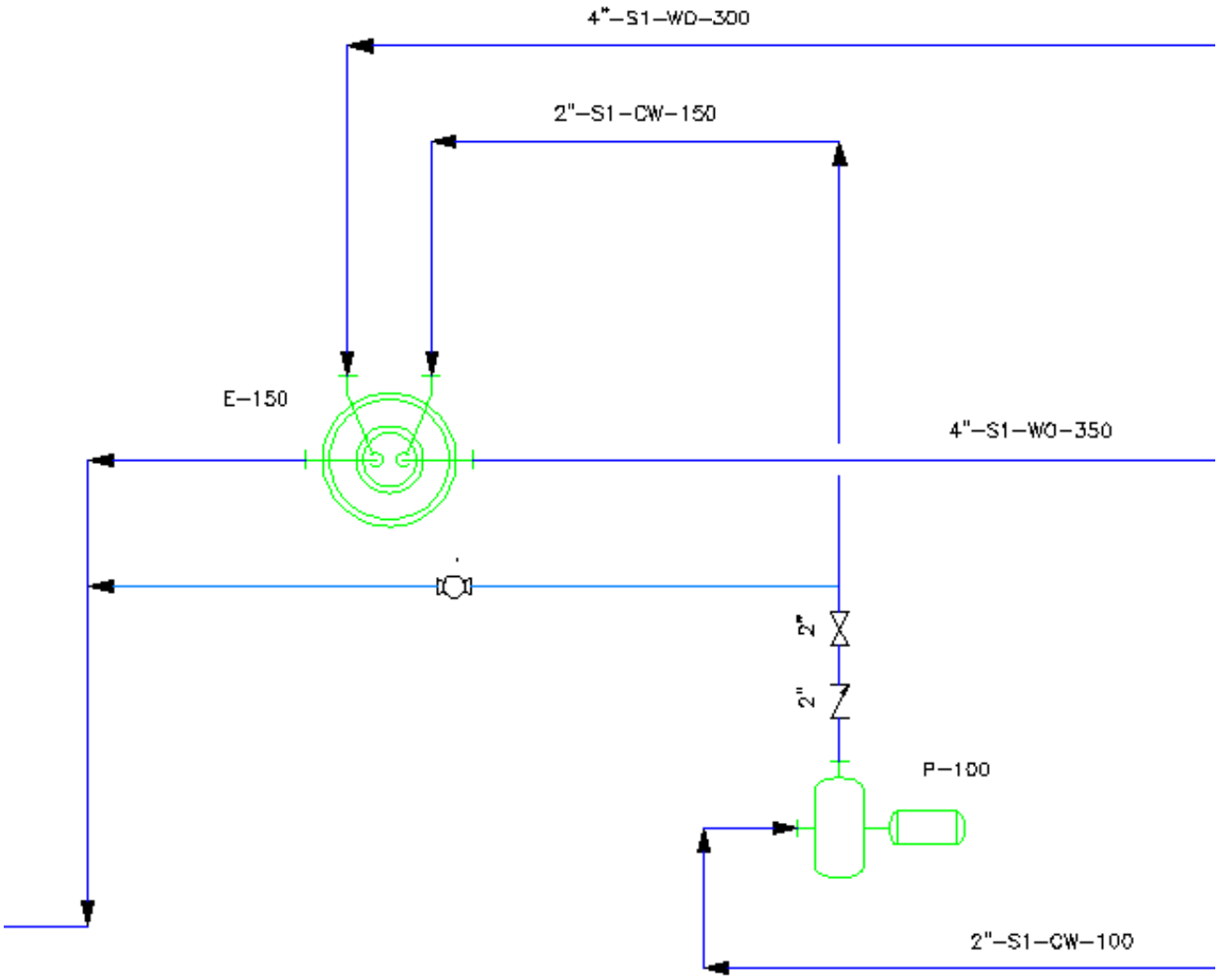
1 Right-click over a line and select Assign Tag…

2 Fill in the appropriate size, spec, service and number for each line you see in the following diagrams.

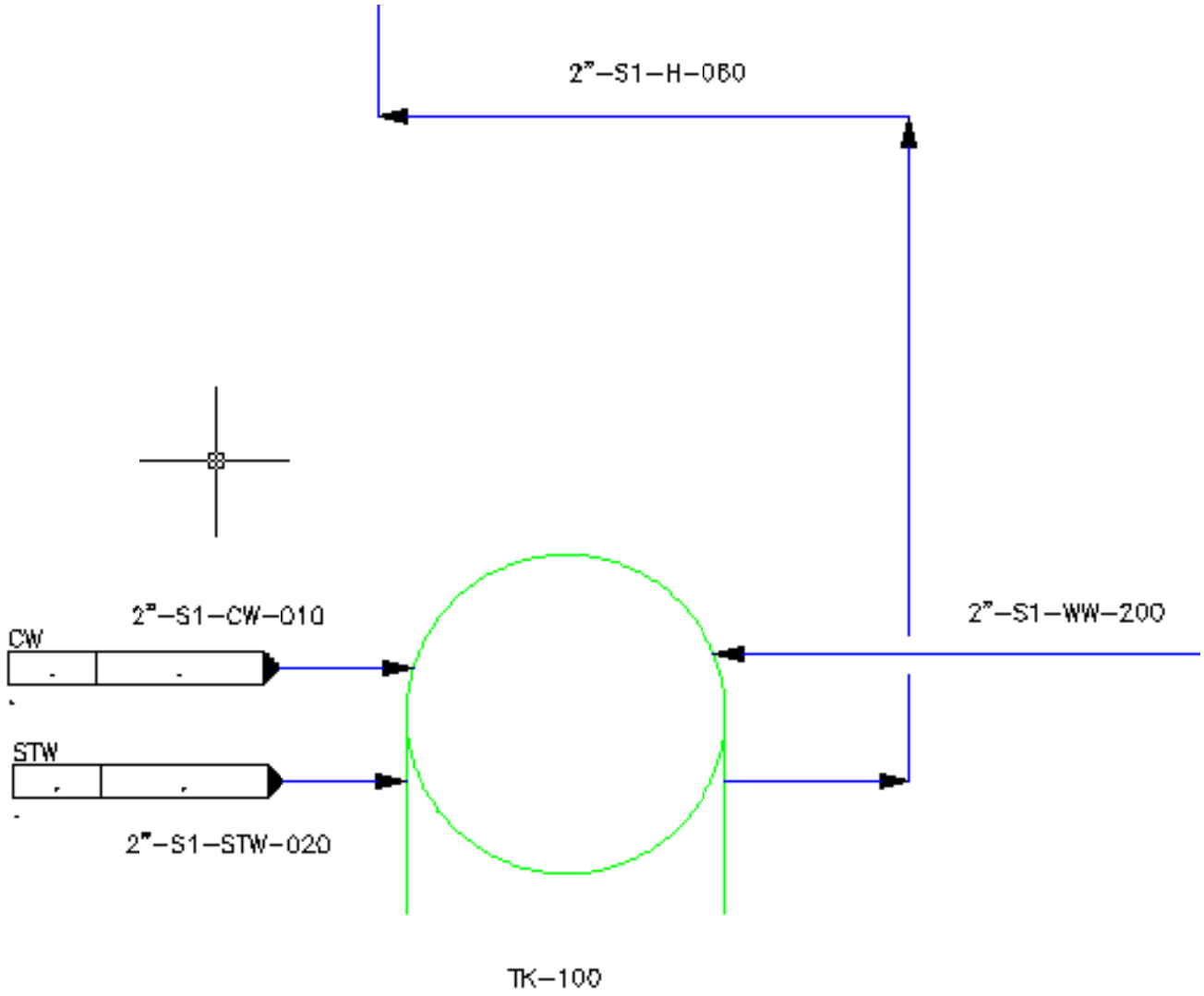
3 Edit the reducer annotations to get the appropriate tag.



Detail view showing tag locations and added information.

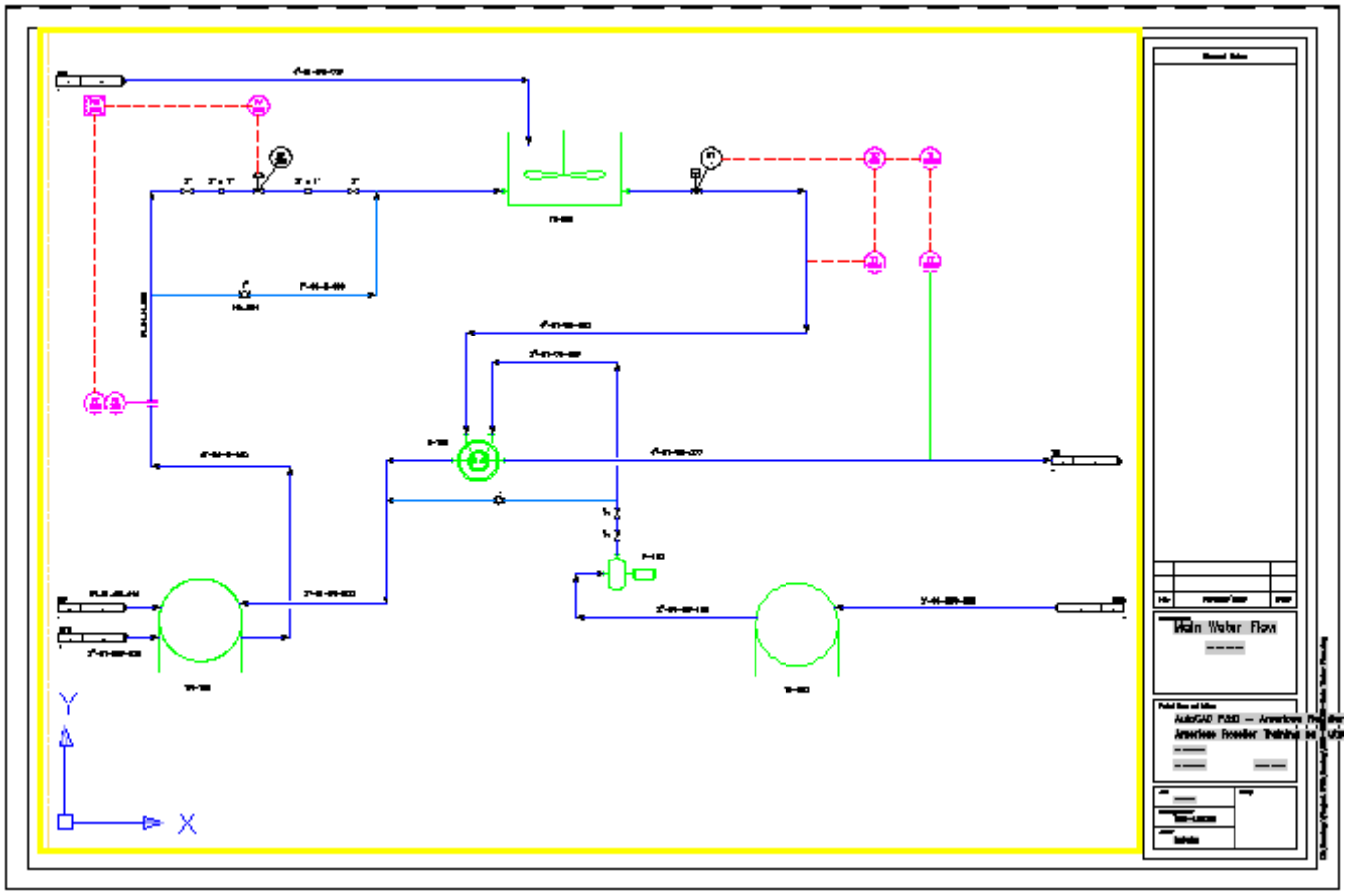


Detail view showing tag locations and added information.



Detail view showing tag locations and added information. Descriptions will be handled later when we cover Data Manager.

When you have finished, the drawing should look like the one below.



Adding Drawing and Project Properties

Drawing properties

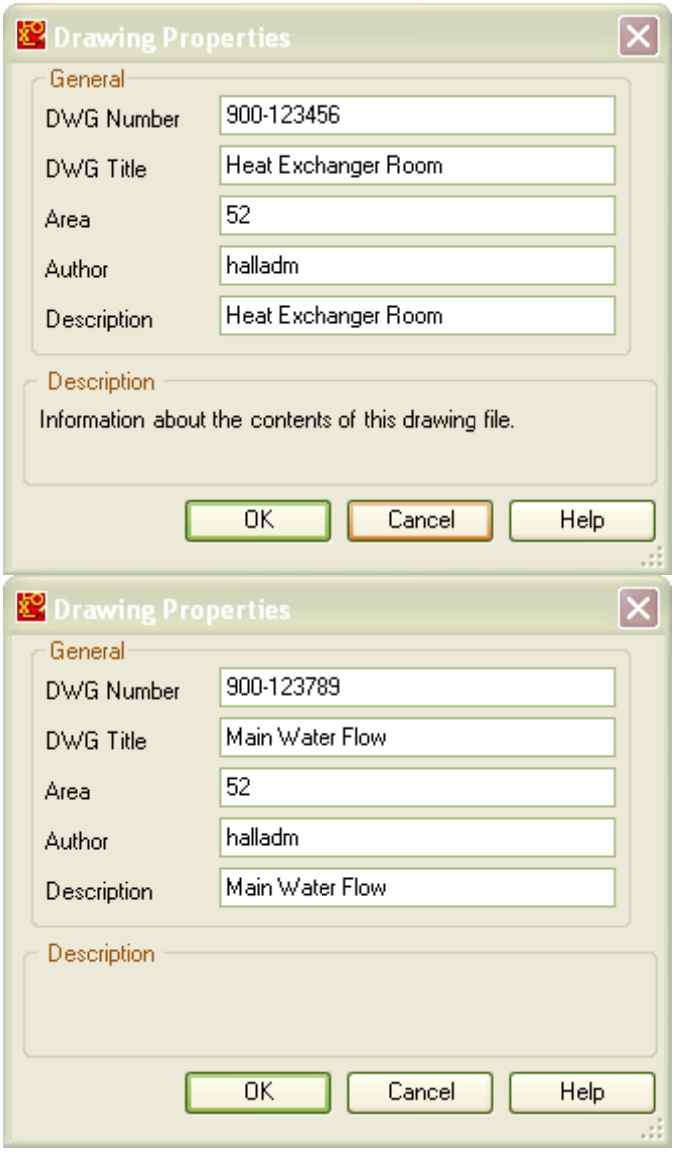
It is important to capture all relevant data not only on the drawing, but in the data model, as well. Since this is an intelligent P&ID application data stored in the data model will automatically show in the appropriate location on the drawing. Other data not typically shown on the drawing will be used in common reports. We'll talk about reporting later. Right now, we want to add more information into our project and drawing properties.

In the following figures you will see the drawing and project properties to enter for this exercise. You should see from/to drawing information that was automatically added to the connectors (this may require a Rebuild, first).

1 Right click on each of the two drawings and select Properties.

2 Enter the information from the following diagrams.

NOTE *The Author field is automatically filled.*



Drawing Properties to be entered.

Project properties

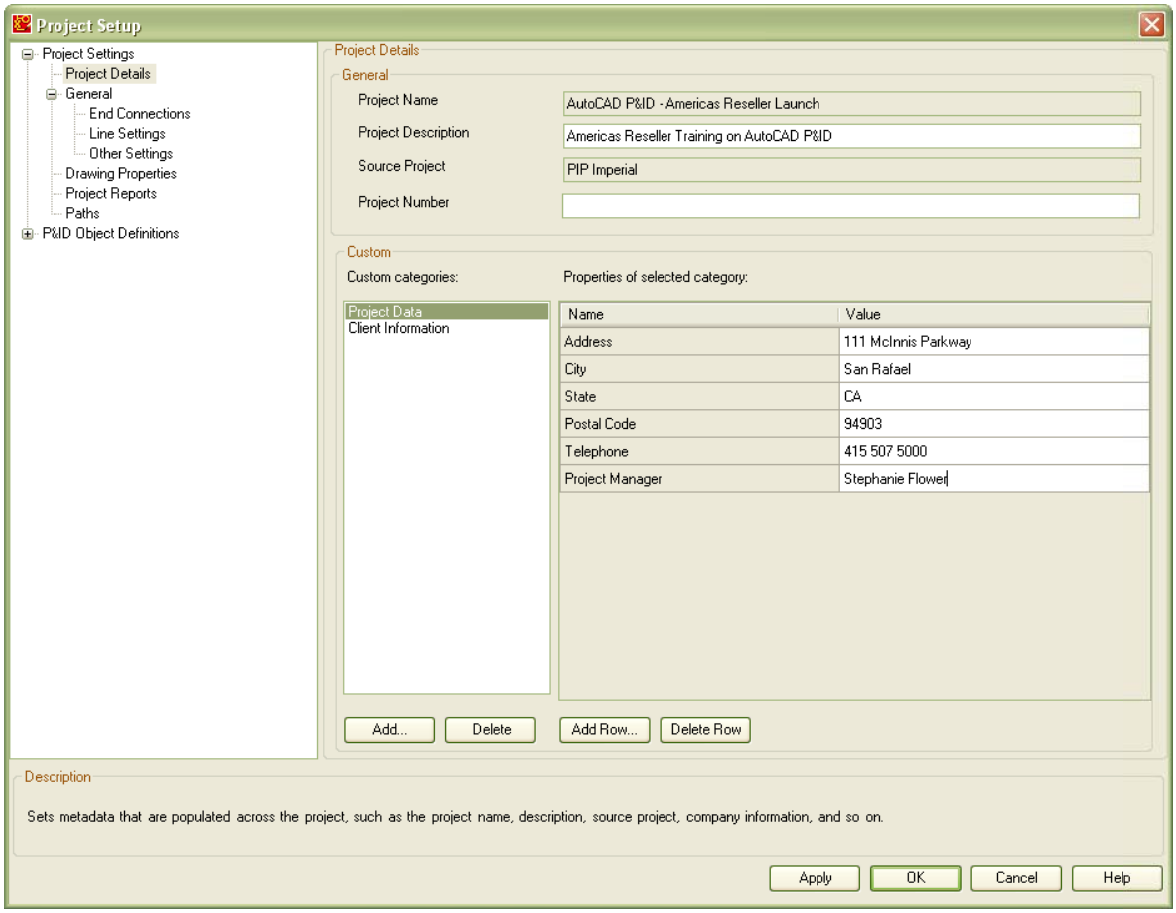
In the Project Setup dialog you will want to enter information in both Project Data and Client Information. Enter the information that is shown in the following diagrams.

1 Right-click on the project name and select Properties.

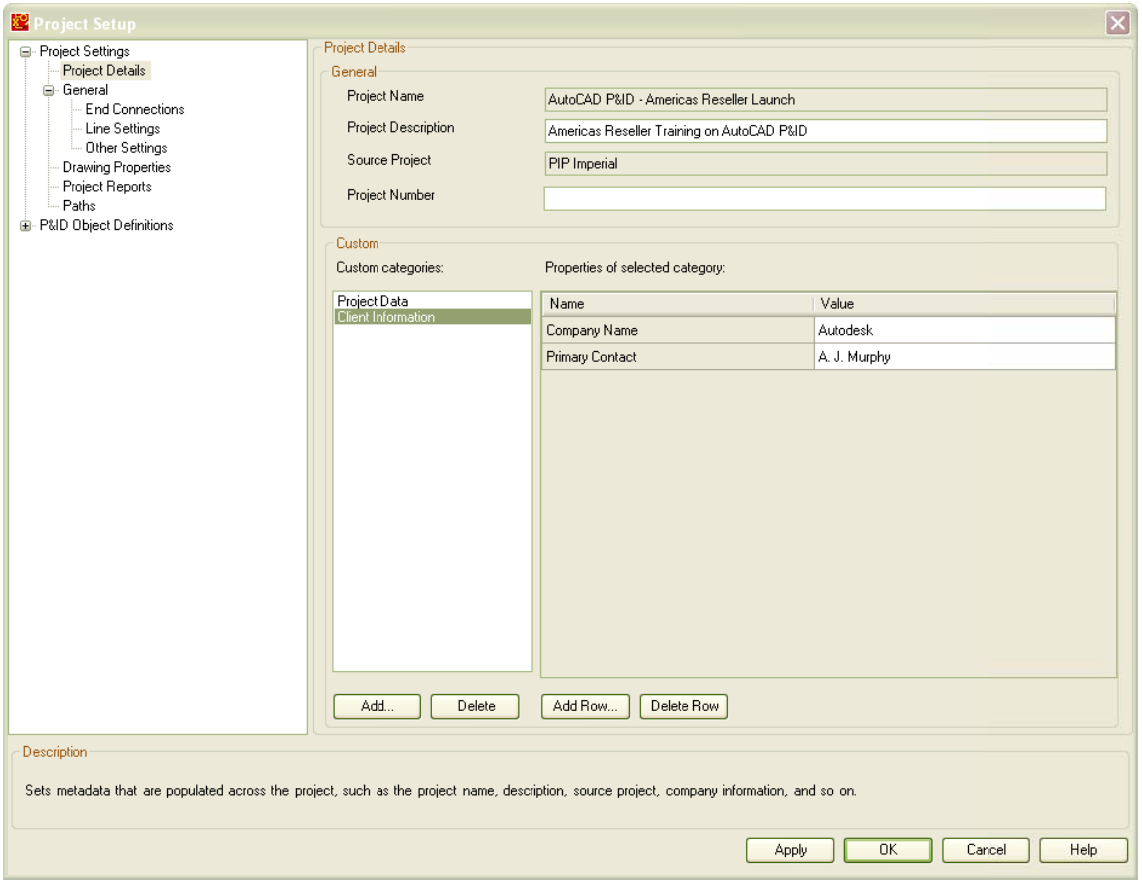
2 Enter information into the Project Data fields.

3 Select Client Information and enter information for those fields.

NOTE *These are the default fields for a project. More fields can be added and these fields can be deleted. Categories can also be added and deleted.*



Project Data properties to be entered.



Client Information properties to be entered.

When you are done entering this information, save your drawings.

eTransmit files

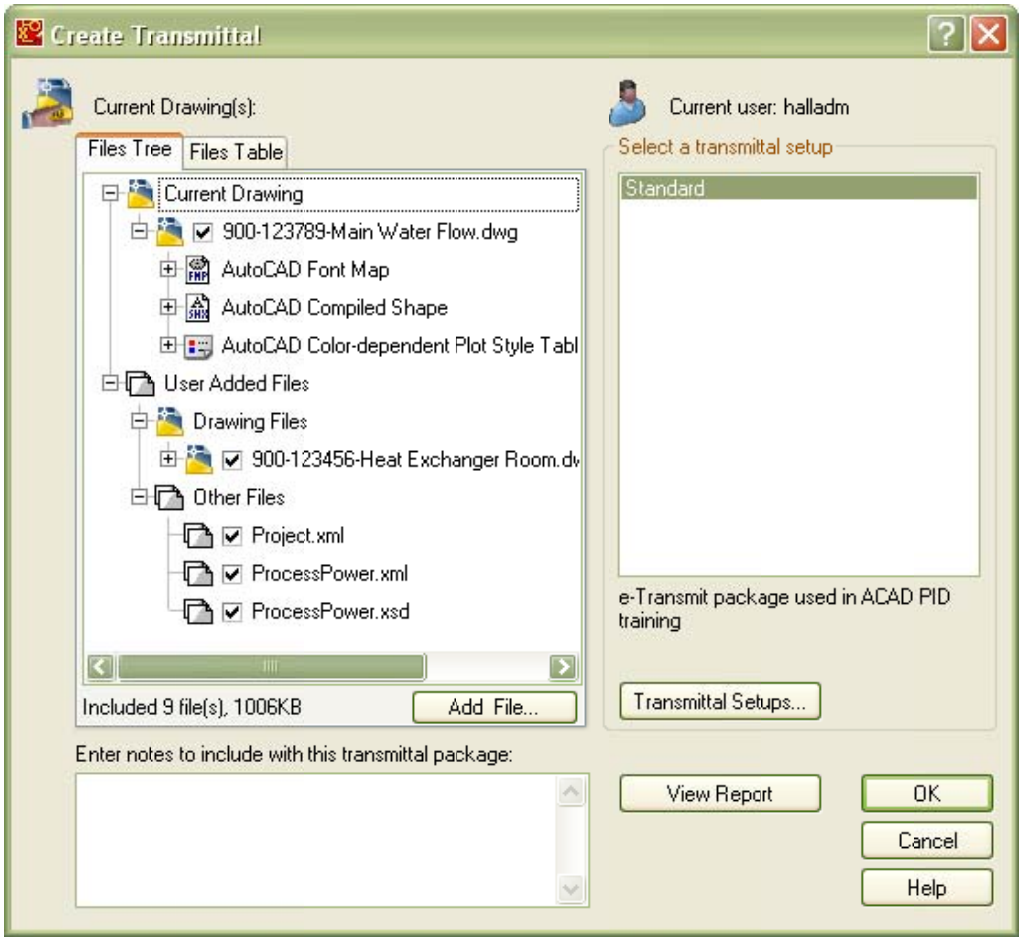
E-transmit files are used to send drawings and information to other people that need them, like customers and contractors. In this exercise we will create an e-transmit file. It is important that all drawings and all project settings are captured in this transmittal, so that the receiving party can start to work with our project settings right away.

1 Select File->eTransmit

The current drawing and associated files will be added to the Files Tree.

2 Click Add File.

Add the other drawing (remember the file structure we set up when we created the project?). Add also the Project.xml, ProcessPower.xml and the ProjectPower.xsd. They can be found in the Project folder, which for this project is C:\Drawings\Projects\AutoCAD P&ID - Americas Reseller Launch.



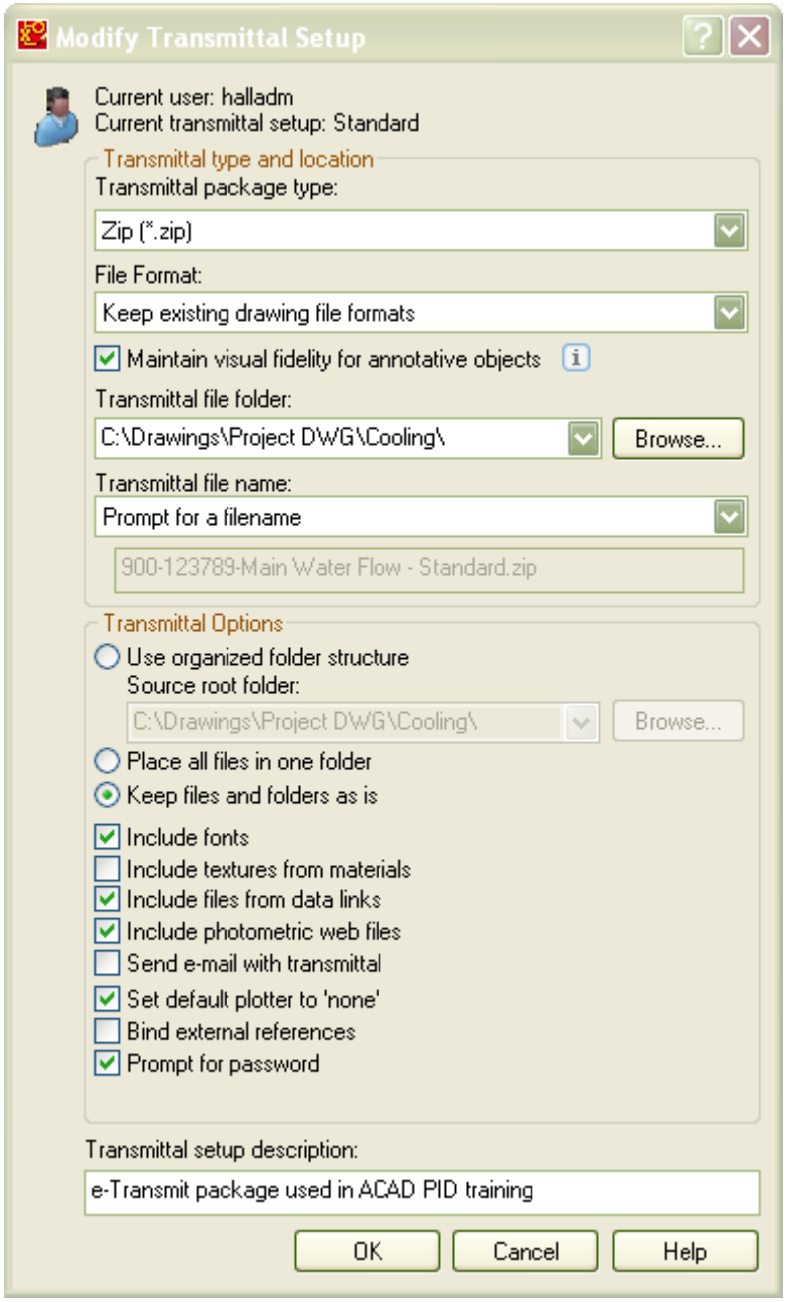
E-transmit example

3 Click Transmittal Setups…

4 Select Modify.

In our e-transmit, the following settings are required:

Package type:	Zip
File Format:	Keep Existing
Transmittal Options:	Keep files and folders as is
	Include Fonts
	Include files from data links
	Include photometric web files
	Set default plotter to None
	Prompt for password
Transmittal Description:	e-Transmit package used in ACAD P&ID training



e-Transmit settings

When these settings have been made you can create your transmittal in the same directory as the project settings and project drawings.

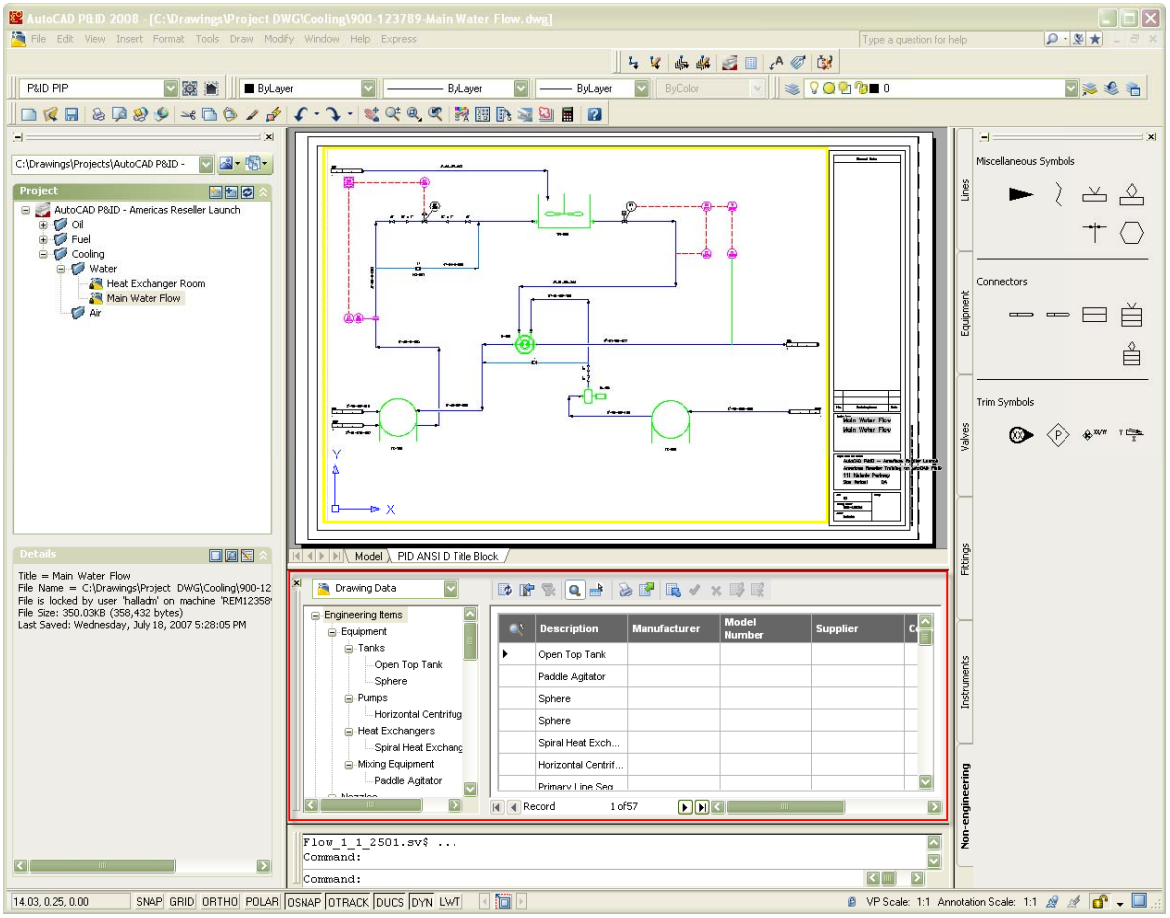
The Data Manager

You can use the Data Manager to view, edit, and manipulate your component and line data and to generate reports that you export to and import from Microsoft Excel. In this exercise we will add extra information to the different types of equipment using the Data Manager. This information is necessary to determine the type of equipment, the settings of the equipment and all other related information that is used for building the system you designed with AutoCAD P&ID.

In this exercise you will need to work in the drawing, Main Water Flow (the first drawing you created). You will add information to the equipment and to the offpage connectors you created earlier.

Also, you will need to make sure the Data Manager is active. If the data manager is not displayed at the bottom of your workspace, you need to click on the Data Manager icon in the AutoCAD P&ID tool bar or enter datamanager at the command prompt.

AutoCAD P&ID Toolbar



The Data Manager, in Project Data Mode

1 Make sure the Data Manager is in Drawing Data mode (check the dropdown at the upper-left of the Data Manager).

2 Add the following information to your equipment:

a. Browse to Engineering Items > Equipment > Tanks and enter the following property data.

NOTE *Your columns will probably not be in the same order as shown in these diagrams. Use the scroll bar at the bottom of the Data Manager to scroll over to these columns.*

NOTE *You can rearrange the order of your columns by dragging the column header into the position you want.*

	Description	Tag	Height	Width	Design Pressure	Design Temperature
	Mixing Kettle	TK-300	25'	10'	0 (open top)	225 F
	Cold Water Tank	TK-100	8'	4'	100 psi	33 F
▶	Hot Water Tank	TK-050	8'	4'	100 psi	

b. Browse to Engineering Items > Equipment > Pumps and enter the following property data.

	Description	Tag	Manufacturer	Flow Capacity	Total Dynamic Head	Model Number
▶	Hot Water Pump	P-100	Goulds	50 Gpm	25'	

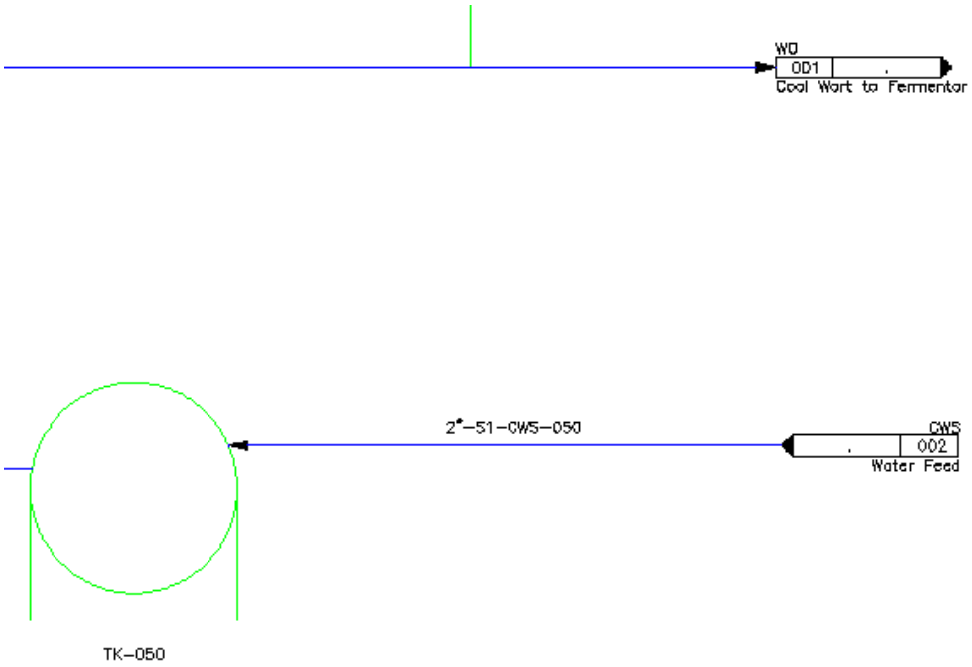
c. Browse to Engineering Items > Equipment > Heat Exchangers and enter the following property data.

	Description	Tag	Shell Design Pressure	Shell Design Temperature	Tube Design Pressure	Tube Design Temperature
▶	Spiral Heat Exch...	E-150	100 psi	32 F	100 psi	

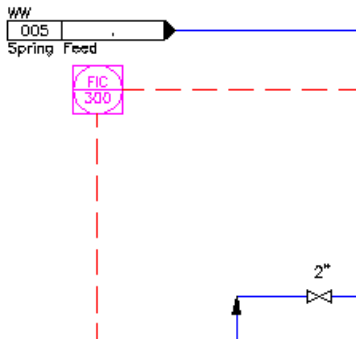
d. Browse to Non Engineering Items > Connectors > Off Page Connectors and enter the following property data.

NOTE *To help clarify which data go with which connector, see also the diagrams after the table.*

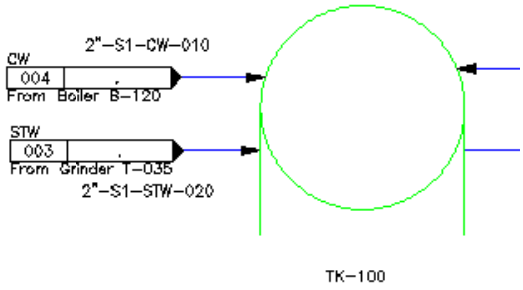
	Connector Number	Description	Comment	Class Name	PnPID	Origin or Destination
▶	001	Off Page Connec...		Off Page Connec...	757	Cool Wort to Fermentor T-512
	002	Off Page Connec...		Off Page Connec...	763	Water Feed
	003	Off Page Connec...		Off Page Connec...	765	From Grinder T-035
	004	Off Page Connec...		Off Page Connec...	767	From Boiler B-120
	005	Off Page Connec...		Off Page Connec...	769	Spring Feed



Right hand side of drawing.



Top left of drawing



Bottom left of drawing

3 When you have entered all of the data, save the changes.

Export to Excel

Sometimes other people need to have input on what data is associated with items in your P&ID. AutoCAD P&ID allows you to export data from the Data Manager to an Excel spreadsheet which can be modified by others and imported back into your drawing through the Data Manager. This can be either Project or Drawing specific data. When you import the spreadsheet, all changes will be

highlighted and you have the opportunity to accept or reject the changes. You can accept/reject the changes one at a time or all at once.

In this exercise you will export data from the project, specific to primary line segments. You will add data to the spreadsheet in Excel, and then import the changes.

1 In the Data Manager make sure that you are looking at Project Data (check the dropdown).

2 Select Primary Line Segments and export the line information (your project folder is probably a good destination for the export file).

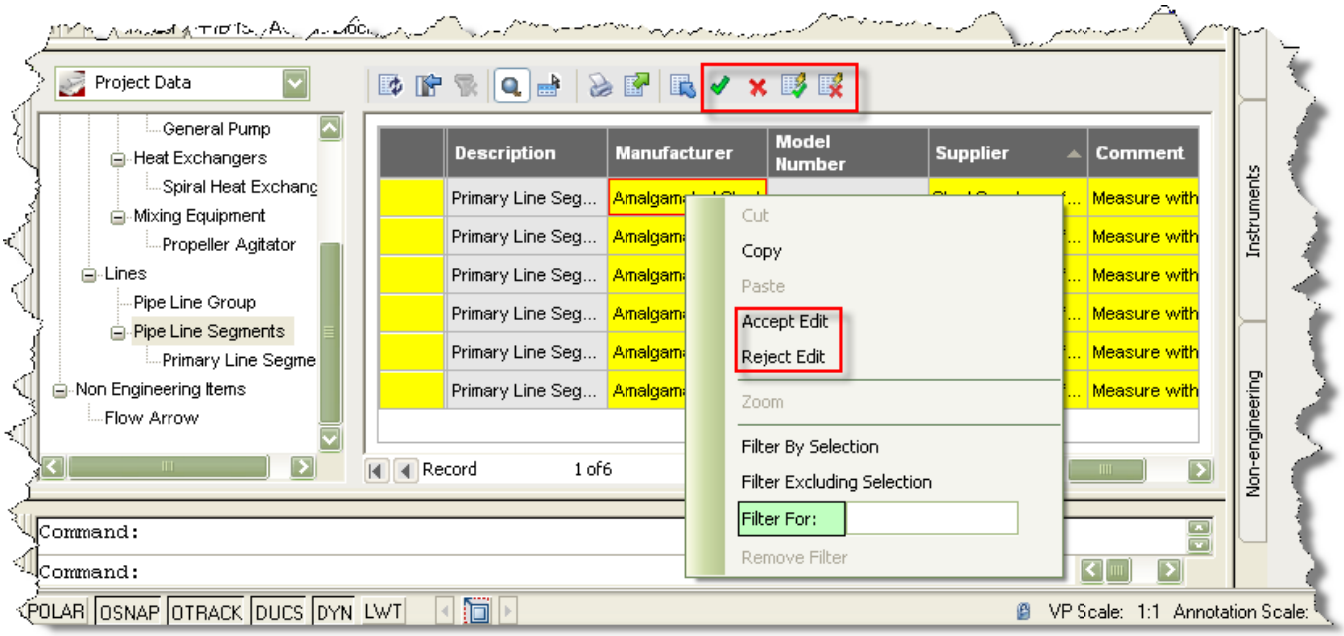
3 Open Microsoft Excel and add information about the manufacturer, the supplier and some comments on each line.

4 When you have added information for each pipeline segment, save your spreadsheet and close Excel.

5 Return to AutoCAD P&ID and import the updated spreadsheet.

Look at the Data Manager. Each line that has a change is preceded by a yellow highlighted cell and every cell that has changed is highlighted. Notice, also, that when you mouse over a changed field, the previous value for that field shows in the tool tip, next to the cursor.

At this point you have the option to accept or reject each change (right-click on a modified cell) or use the tools at the top of the Data Manager.



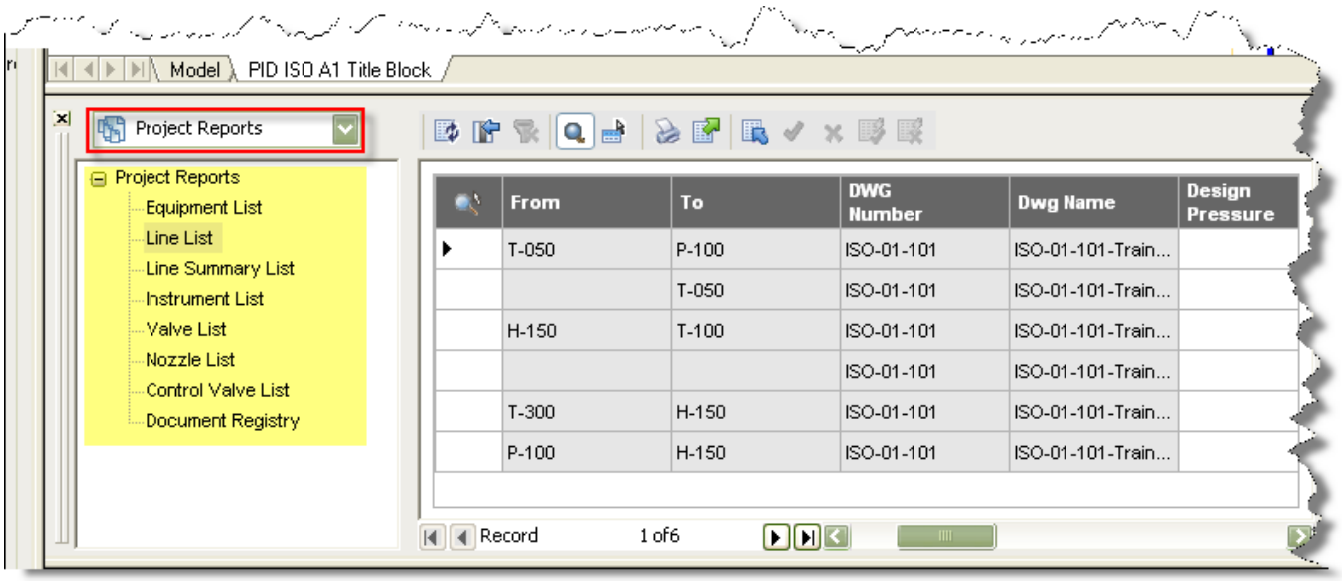
6 Try accepting some and rejecting others. Save your changes.

Reporting

As stated earlier, some data is better represented in a report rather than on a drawing. Since AutoCAD P&ID creates intelligent drawings and keeps the data in the drawing, you have access to many common reporting functions through the program interface. This will save you a lot of time counting pipelines for a line list!

In this exercise we will again export data, but in this case it will be formatted in a specific report type.

1 Make sure that your Data Manager is set to Project Reports (check the dropdown).

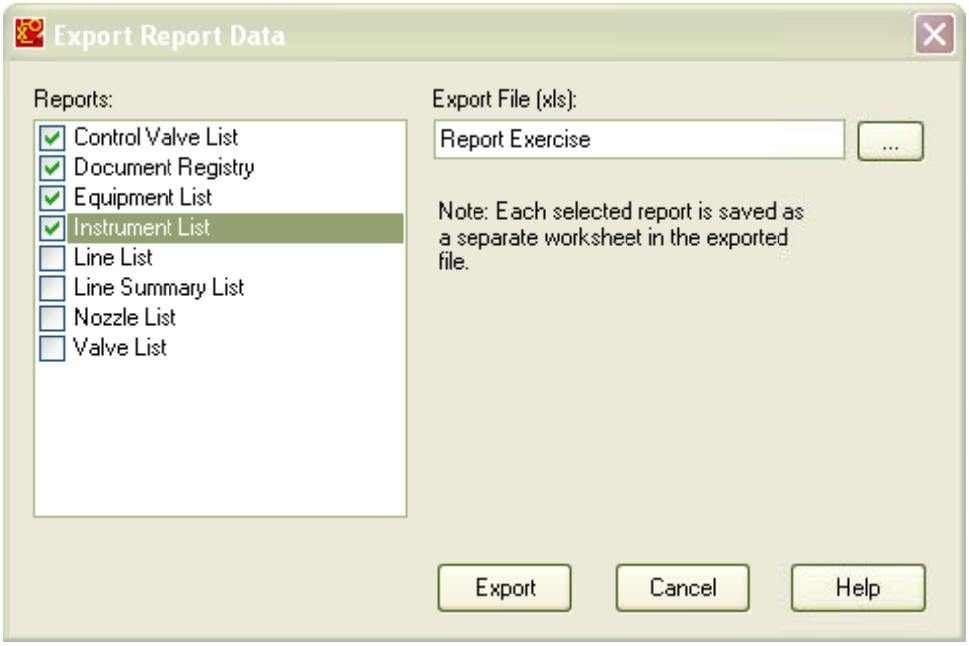


The highlighted list, above, shows the default report types. You can also create custom report templates. This procedure is detailed in the help files.

2 Highlight (click on) Project Reports and click on the Export tool.

3 Mark the checkbox for each of the following report types:

- Control Valve List
- Document Registry
- Equipment List
- Instrument List



4 Open the report in Excel.

Notice that each list has become a sheet in the Excel file.

5 Change or add some information on the different sheets and save the file.

6 Return to AutoCAD P&ID and make sure that you are still in Project Reports mode.

7 Import the Report Exercise.xls and notice that AutoCAD P&ID shows the changes per line and field (just like we saw in the data view export/import exercise).

Of course, you have the option to accept or reject the changes one at a time or all at once.

8 Save the drawing we may want to use it later in this course.

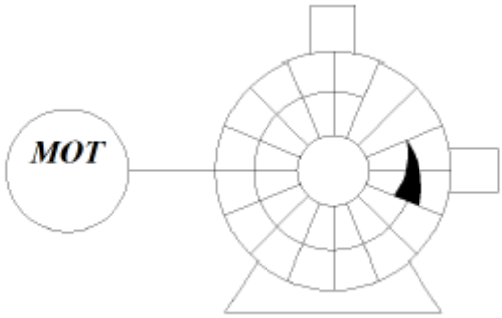
Convert AutoCAD Block to P&ID Symbol

Converting generic AutoCAD geometry into intelligent P&ID geometry is easy to do in AutoCAD P&ID. We call this process “classifying”. This can make your life easier if you have been creating P&IDs in base AutoCAD or AutoCAD LT.

To convert AutoCAD symbols we first need a symbol to convert.

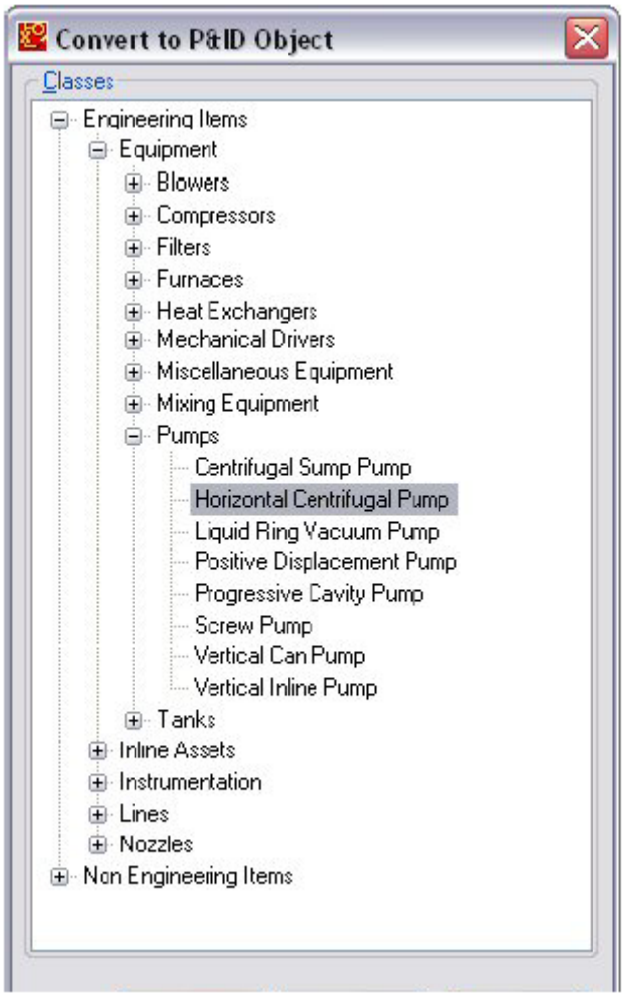
1 Create the Centrifugal Pump shown in the next figure and save it as a block.

The size of the pump is relatively the same as the pump in the Main Water Flow drawing you created earlier.



2 When the block is done, right-click on it and select Convert to P&ID Object.

This is necessary to add intelligence to the symbol. This symbol can be classified as an Engineering Item, Equipment, Pumps and finally Horizontal Centrifugal Pump as shown in the following figure.



Conclusion

This concludes the course. We hope we have been able to show how easy it is to create intelligent P&IDs from an interface that is already familiar to you.

We thank you for working through our class exercises and we hope you are excited about the ease and power of creating P&IDs in AutoCAD P&ID.