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Aspen HYSYS
V8
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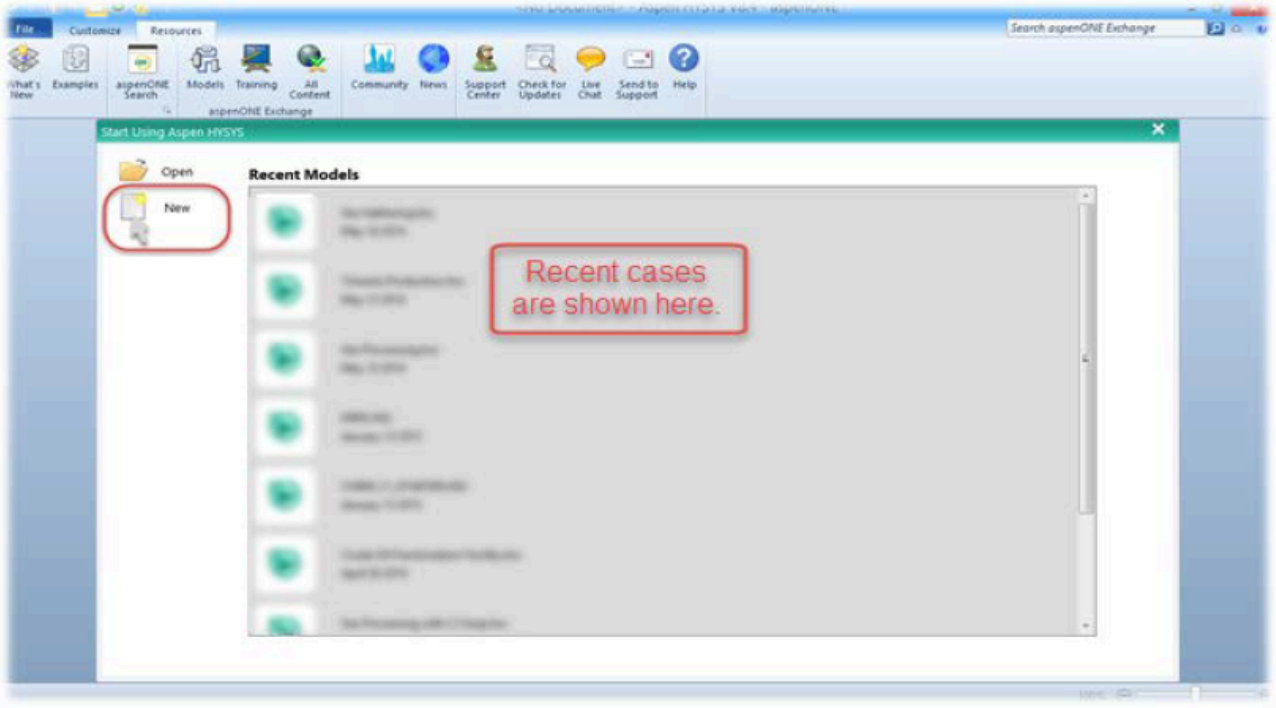
aspenONE

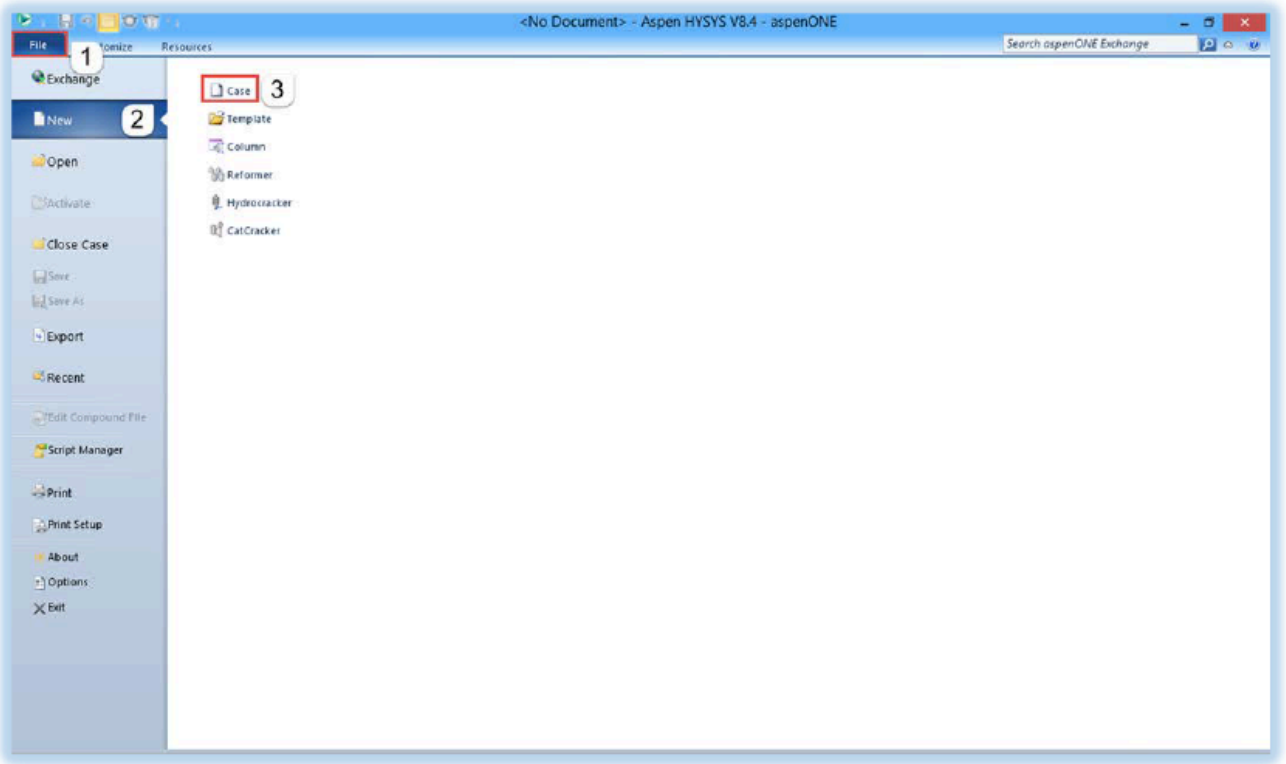
➢ STARTING A NEW CASE:-

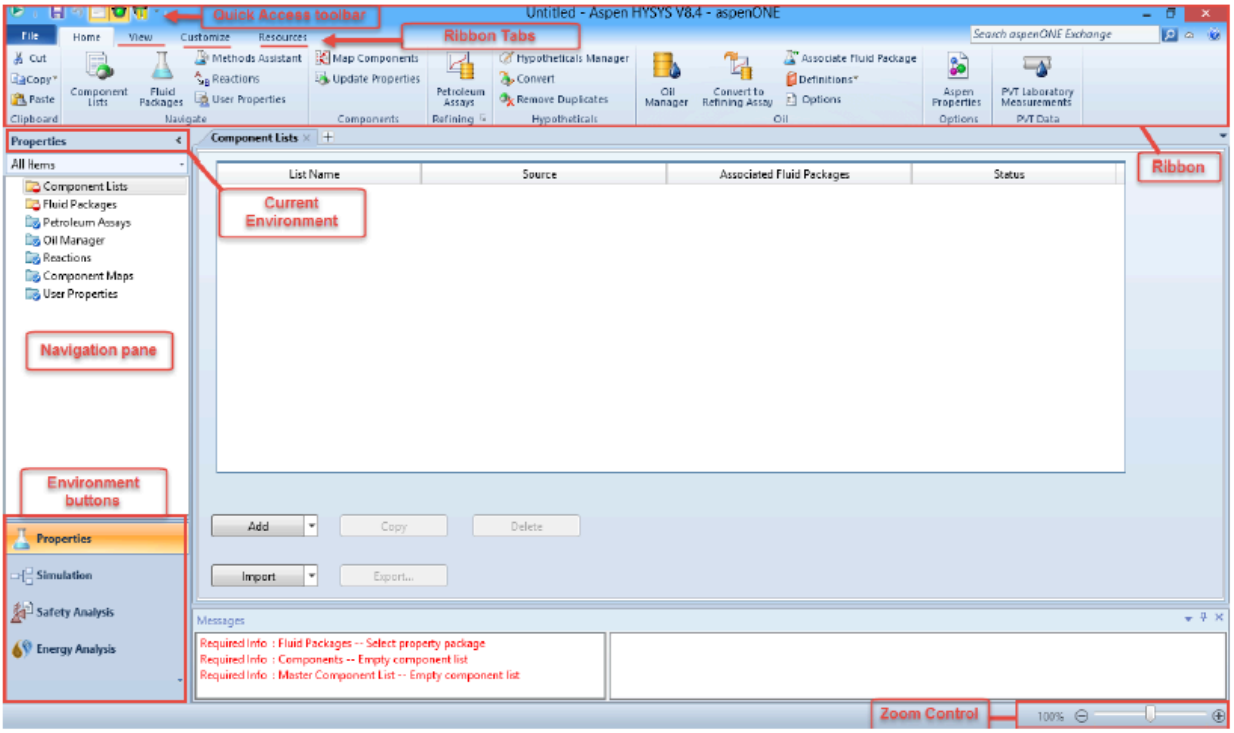
For every new case in HYSYS we need first to specify the basics of the case, then start building it.



Basics are defined in the Properties (Basis) Environment.

- Required basics to be defined are:
  1. Component List.
  2. Property Package.





1) Component List:-

Component lists are collections of components you assemble in the Properties Environment for specific simulation purposes.

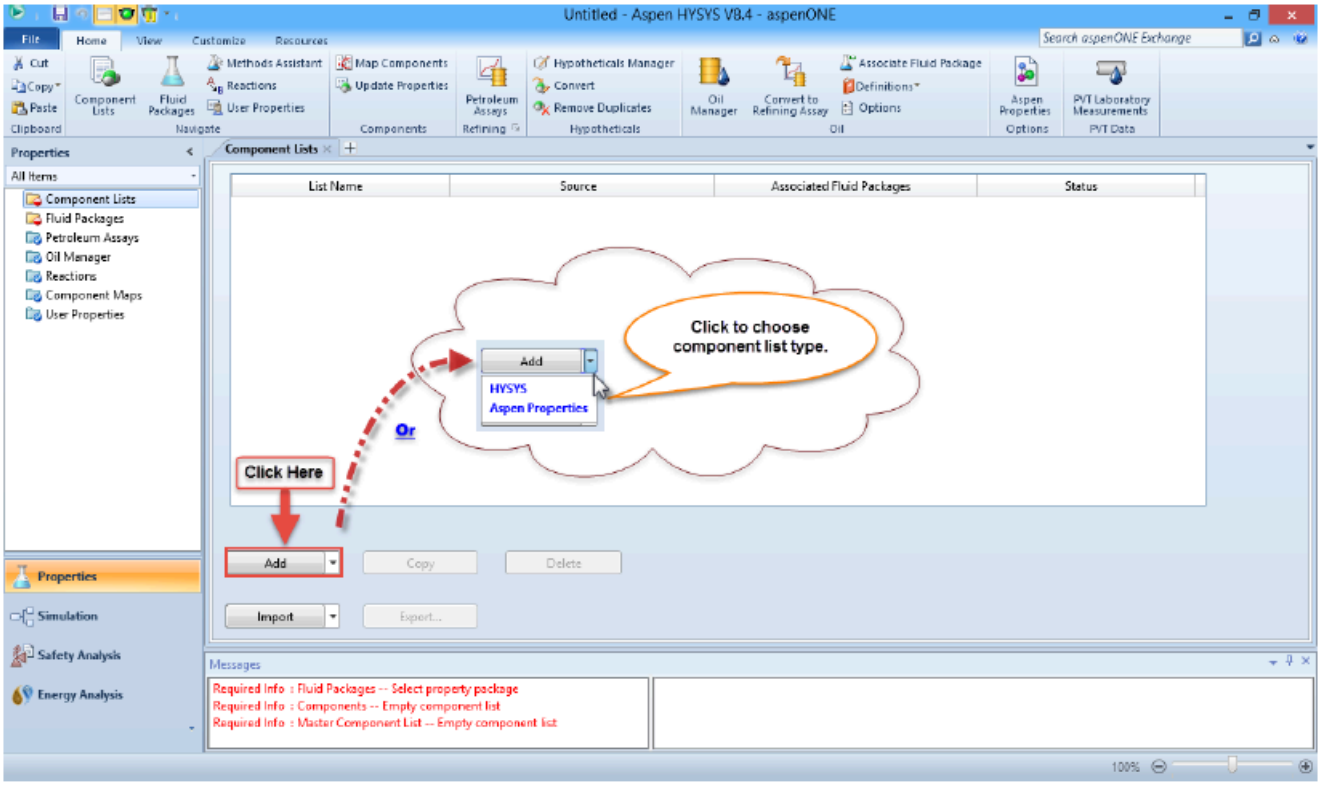
One component can be added to several lists; however, the instances do not become separate objects. If you edit the properties of a component in any component list, the edits apply to all other components of the same name in any other list. You can create separate instances of a component by cloning and editing pure components or by creating hypothetical components.

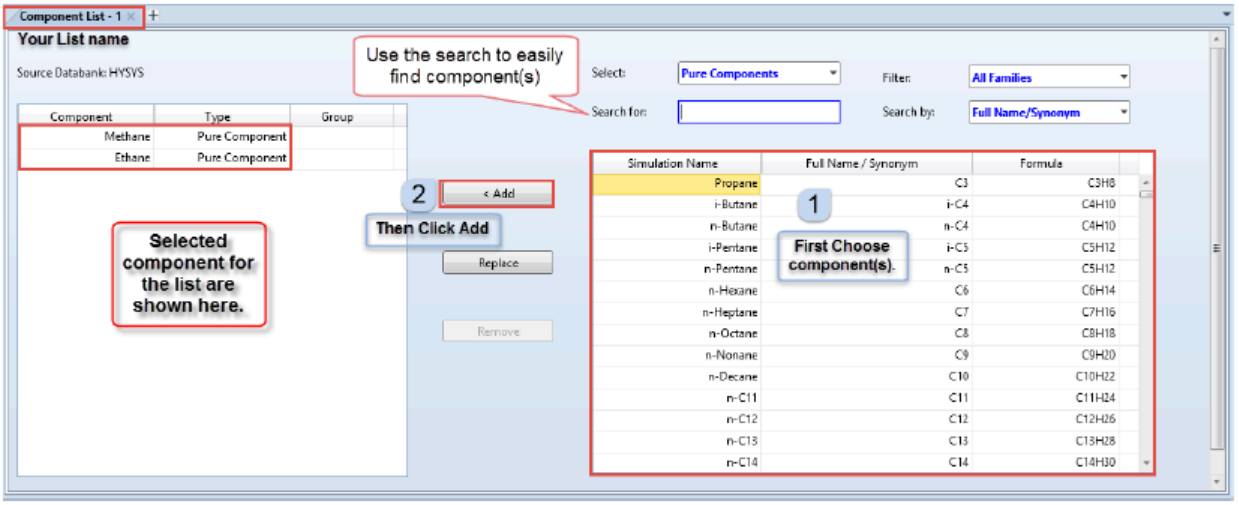
o Creating Component List:

To add components to the Properties Environment:

1. Click the **Component Lists** folder in the Properties Environment navigation pane.
2. In the Component Lists window, use the **Add** drop down arrow to select the **HYSYS** or **Aspen Properties** database as a source for the components.
3. Use the respective library browsers (HYSYS or Aspen Properties) to add components from the database to the new list.
    a. Both browsers let you either add pure components or define groups of hypothetical components within the same list.
    b. HYSYS and Aspen Properties components cannot be added to the same list.

When you have successfully created the list, its folder icon goes from red to a blue check. You can now associate the component list with a property package to create a complete fluid package.

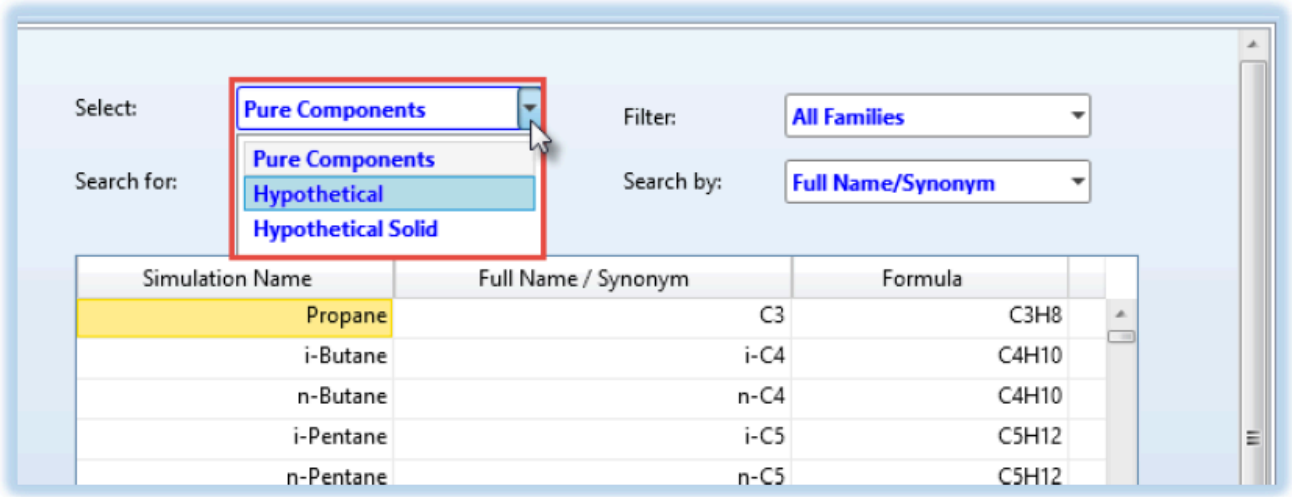

Untitled - Aspen HYSYS V8.4 - aspenONE
File
Home
View
Customize
Resources
Search aspenONE Exchange
Cut
Copy
Paste
Clipboard
Component Lists
Fluid Packages
Methods Assistant
Reactions
User Properties
Navigate
Map Components
Update Properties
Components
Petroleum Assays
Refining
Hypotheticals Manager
Convert
Remove Duplicates
Hypotheticals
Oil Manager
Convert to Refining Assay
Associate Fluid Package
Definitions
Options
Oil
Aspen Properties
Options
PVT Laboratory Measurements
PVT Data
Properties
All Items
Component Lists
Fluid Packages
Petroleum Assays
Oil Manager
Reactions
Component Maps
User Properties
Component Lists
List Name
Source
Associated Fluid Packages
Status
Click to choose component list type.
Add
HYSYS
Aspen Properties
Or
Click Here
Add
Copy
Delete
Import
Export...
Properties
Simulation
Safety Analysis
Energy Analysis
Messages
Required Info : Fluid Packages -- Select property package
Required Info : Components -- Empty component list
Required Info : Master Component List -- Empty component list
100%



- **Hypothetical Component (Hypo-Component):**

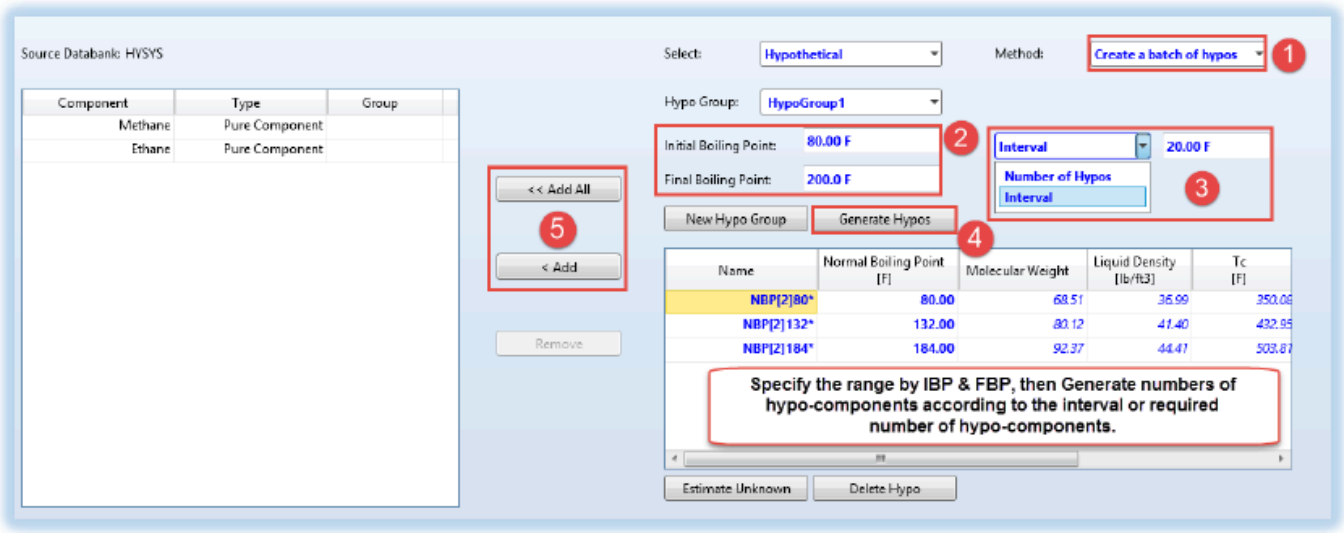
The Hypothetical components are non-library. Hypothetical components can be pure components, defined mixtures, undefined mixtures, or solids. You can also clone HYSYS library components into hypotheticals, allowing you to modify the library values.

Hypothetical components are independent of the Fluid Package. When a hypothetical is created, it is placed in a Hypo Group. Since Hypothetical components are not exclusively associated with a particular Fluid Package, it is possible for multiple Fluid Packages to share Hypotheticals. In other words, you need only create a Hypothetical once, and it can be used in any Fluid Package in the case.

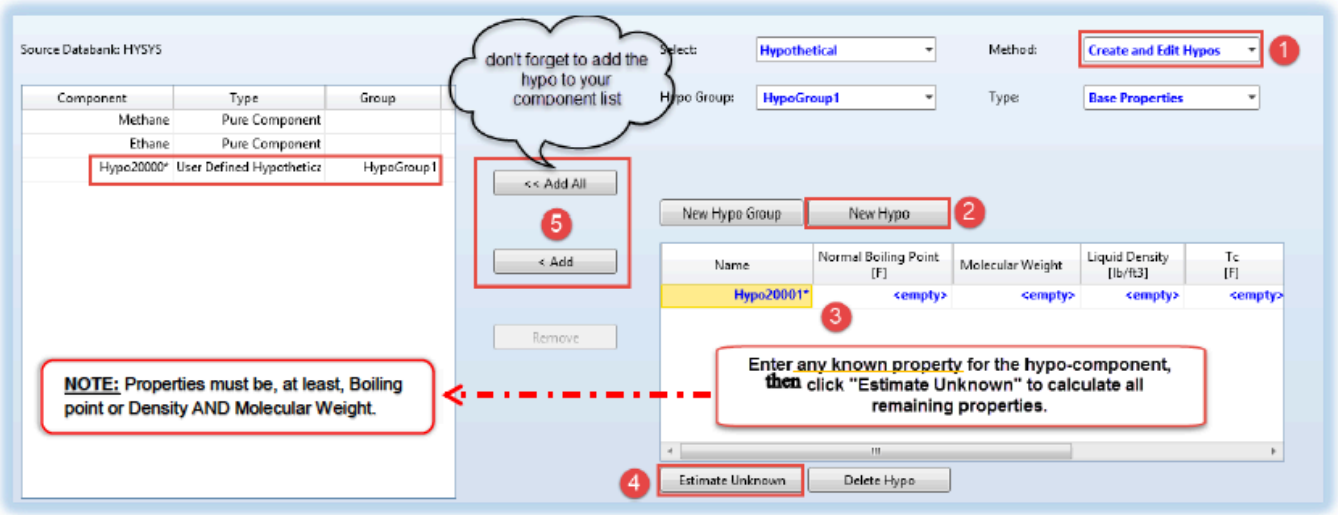


There is TWO methods to add Hypo-Components:

1. Create a batch of Hypos:



2. Create and Edit single Hypos one by one separately:



2) Property Package:

Property packages are specialized collections of methods for calculating the properties of components and values of parameters within the simulation. When you have established a component list, you combine the component list with a property package. The combination of the component list and the property package, (along with other simulation settings), comprise the HYSYS fluid package. Hence:

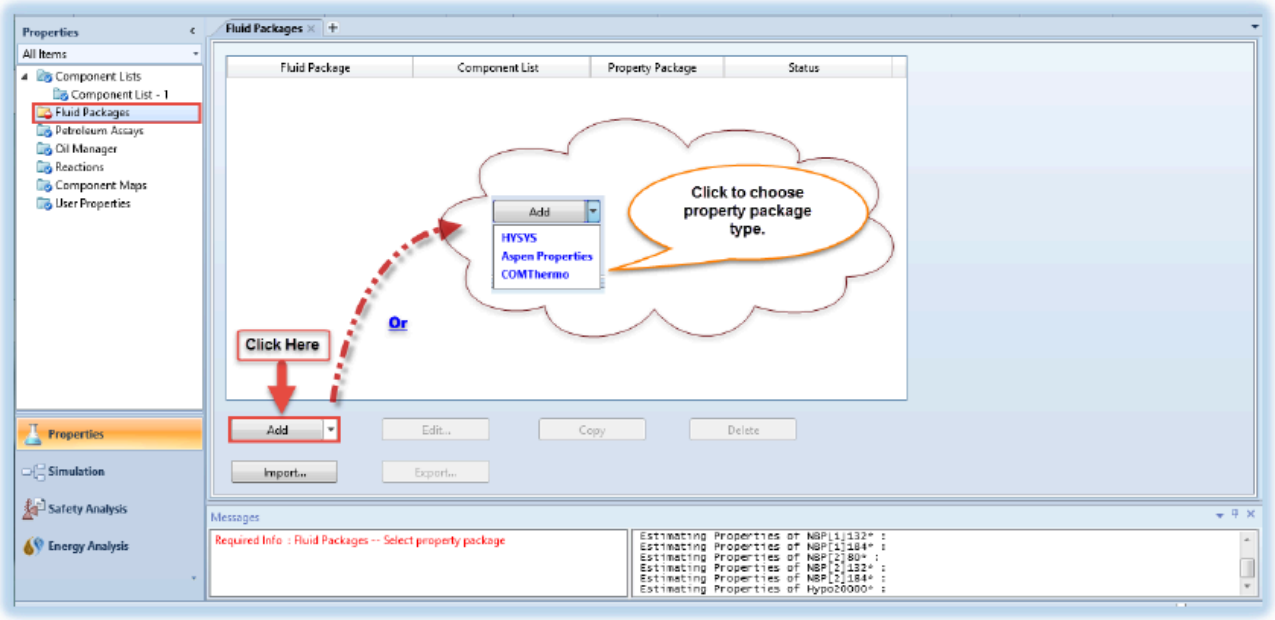
Property Package + Component List = Fluid Package.

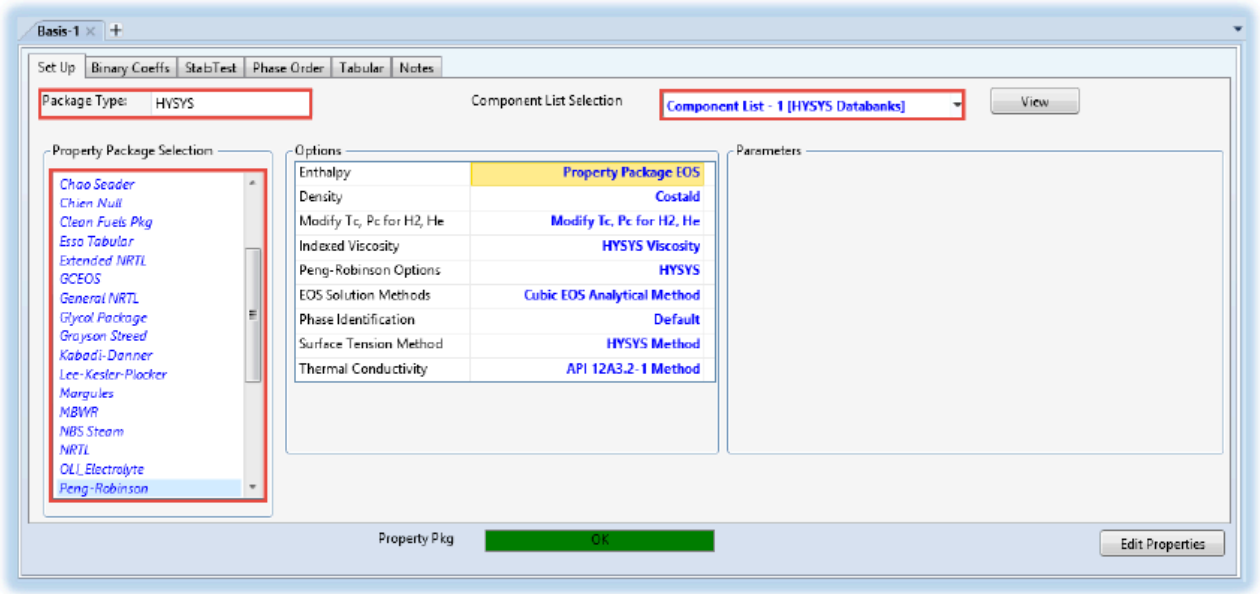
Available Property Packages:

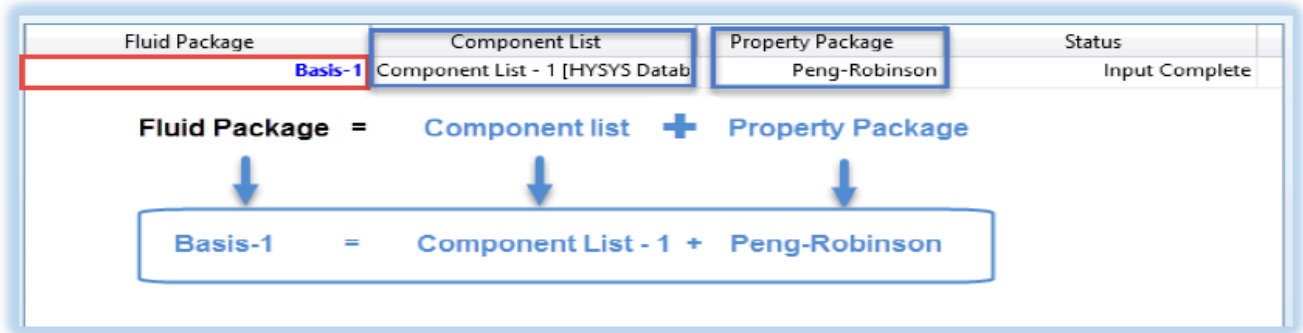
- Equations of State (EOS):
  GCEOS, Kabadi Danner, Lee-Kessler Plocker, Peng-Robinson, PRSV, SRK, Sour PR, Sour SRK, Zudkevitch Joffee, BWRS.
- Activity Models:
  Chien Null, Extended NRTL, General NRTL, Margules, NRTL, UNIQUAC, van Laar, Wilson.
- Chao Seader & Grayson Streed Models:
  Chao Seader, Grayson Streed.
- Vapor Pressure Models:
  Antoine, Braun K10, Esso Tabular.
- Acid Gas, Glycol, Electrolyte
  Acid Gas Package, DBR Amine Package, ASME Steam, Glycol PPkg, NBS Steam, MBWR, OLI_Electrolyte.

- Choosing the proper property package depend on the process you are going to build. Use the following table to help you in choosing the property package:

Type of System	Recommended Property Package
TEG Dehydration	PR
Sour Water	PR, Sour PR
Cryogenic Gas Processing	PR, PRSV
Air Separation	PR, PRSV
Atm Crude Towers	PR, PR Options, GS
Vacuum Towers	PR, PR Options, GS <10mm Hg, Braun K10, Esso K
Ethylene Towers	Lee Kesler Plocker
High H_2 Systems	PR, ZJ or GS (see T/P limits)
Reservoir Systems	PR, PR Options
Steam Systems	Steam Package, CS or GS
Hydrate Inhibition	PR
Chemical Systems	Activity Models, PRSV
HF Alkylation	PRSV, NRTL (Contact Hyprotech)
TEG Dehydration with Aromatics	PR (Contact Hyprotech)


Properties
All Items
Component Lists
Component List - 1
Fluid Packages
Petroleum Assays
Oil Manager
Reactions
Component Maps
User Properties
Fluid Packages
Fluid Package
Component List
Property Package
Status
Add
HYSYS
Aspen Properties
COMThermo
Click to choose property package type.
Or
Click Here
Add
Edit...
Copy
Delete
Import...
Export...
Properties
Simulation
Safety Analysis
Energy Analysis
Messages
Required Info : Fluid Packages -- Select property package

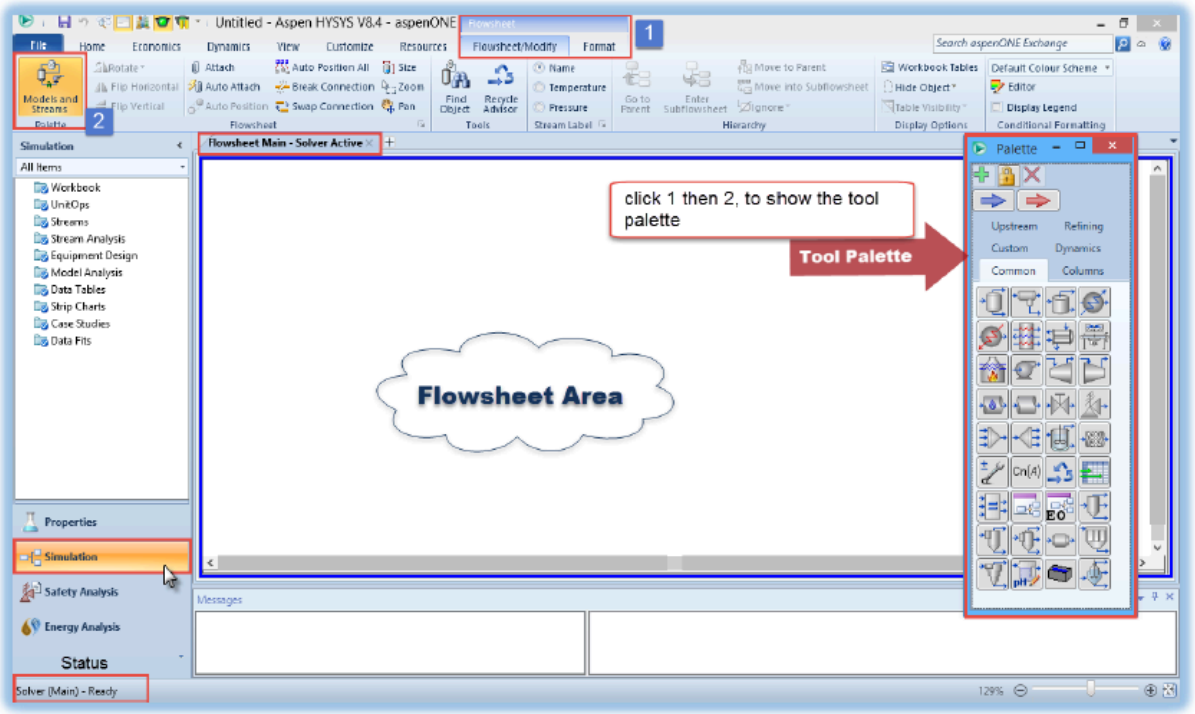

Basis-1
Set Up
Binary Coeffs
StabTest
Phase Order
Tabular
Notes
Package Type:
HYSYS
Component List Selection
Component List - 1 [HYSYS Databanks]
View
Property Package Selection
Chao Seader
Chien Null
Clean Fuels Pkg
Esso Tabular
Extended NRTL
GCEOS
General NRTL
Glycol Package
Grayson Streed
Kabadi-Danner
Lee-Kesler-Plocker
Margules
MBWR
NBS Steam
NRTL
OLI_Electrolyte
Peng-Robinson
Options
Enthalpy
Property Package EOS
Density
Costald
Modify Tc, Pc for H2, He
Modify Tc, Pc for H2, He
Indexed Viscosity
HYSYS Viscosity
Peng-Robinson Options
HYSYS
EOS Solution Methods
Cubic EOS Analytical Method
Phase Identification
Default
Surface Tension Method
HYSYS Method
Thermal Conductivity
API 12A3.2-1 Method
Parameters
Property Pkg
OK
Edit Properties


Fluid Package
Component List
Property Package
Status
Basis-1
Component List - 1 [HYSYS Datab
Peng-Robinson
Input Complete
Fluid Package = Component list + Property Package
Basis-1 = Component List - 1 + Peng-Robinson

➢ BUILDING THE PROCESS (SIMULATION ENVIRONMENT):

In simulation environment, we build our case (process PFD) and do all the simulation work.

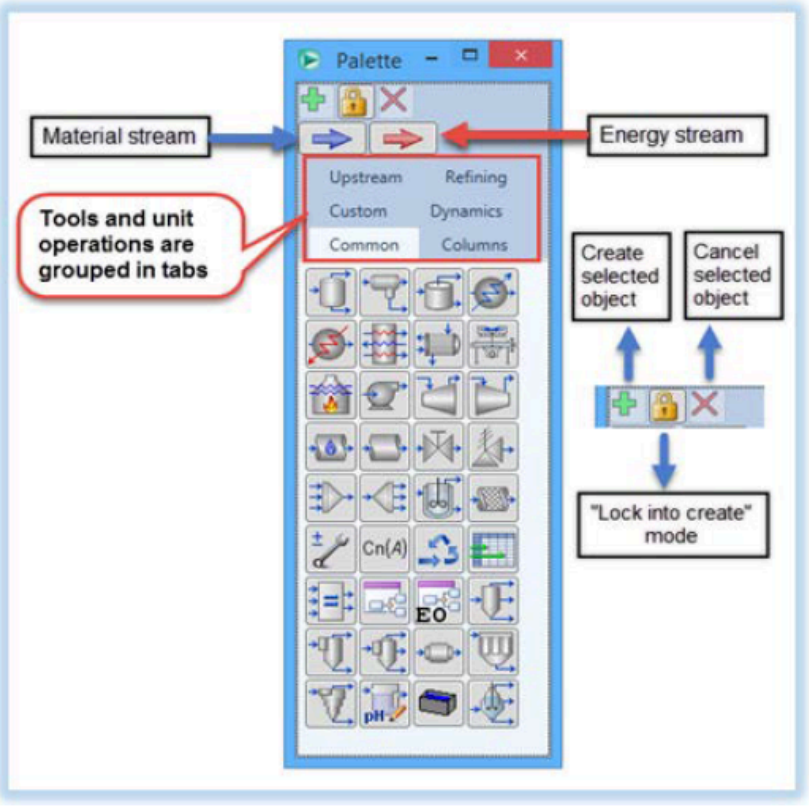
Any process represented by equipment and unit operation interconnected together by material streams, every piece of equipment has its own parameter, properties, and specification.



Any equipment for representing the process can be found in the tool palette shown in the next figure.

<u>If the tool palette does not appear</u>, show it by any of the following:

- From the ribbon, "flowsheet/Modify" tab, choose "Models and streams".
- From the ribbon, "View" tab, choose "Models palette".
- Press "F4".



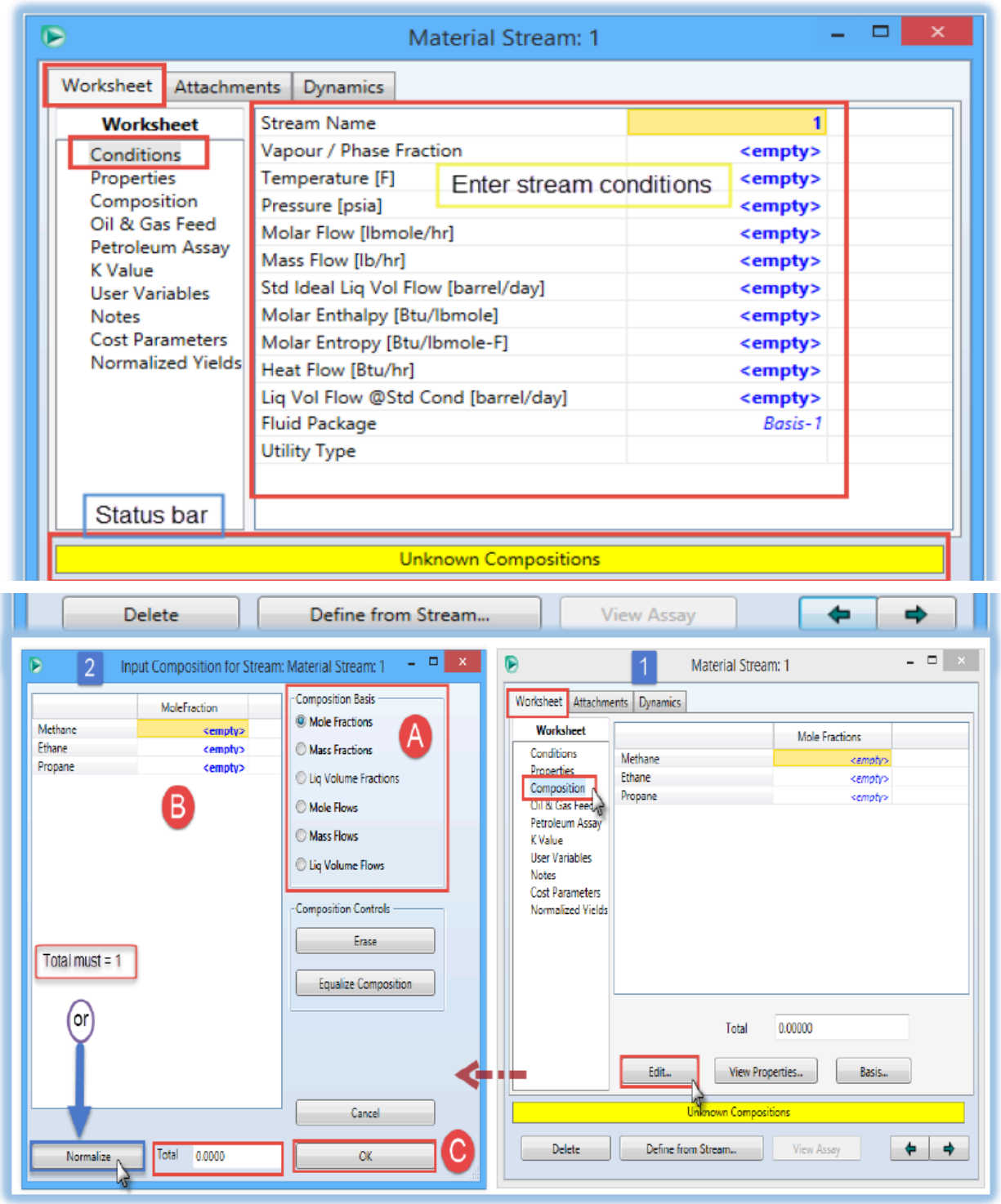
<u>To add any equipment or stream:</u>

a. Double click on it in the palette.
b. (or) Choose it (by click), then press the green plus sign in the top left corner.
c. (or) Choose it (by click), then click on any empty area in the flowsheet.

DEFINING THE MOST COMMON UNIT OPERATIONS

1) Material stream:-

After adding the material stream to your PFD, double click on it to show its property window and define it as shown in the following figures:

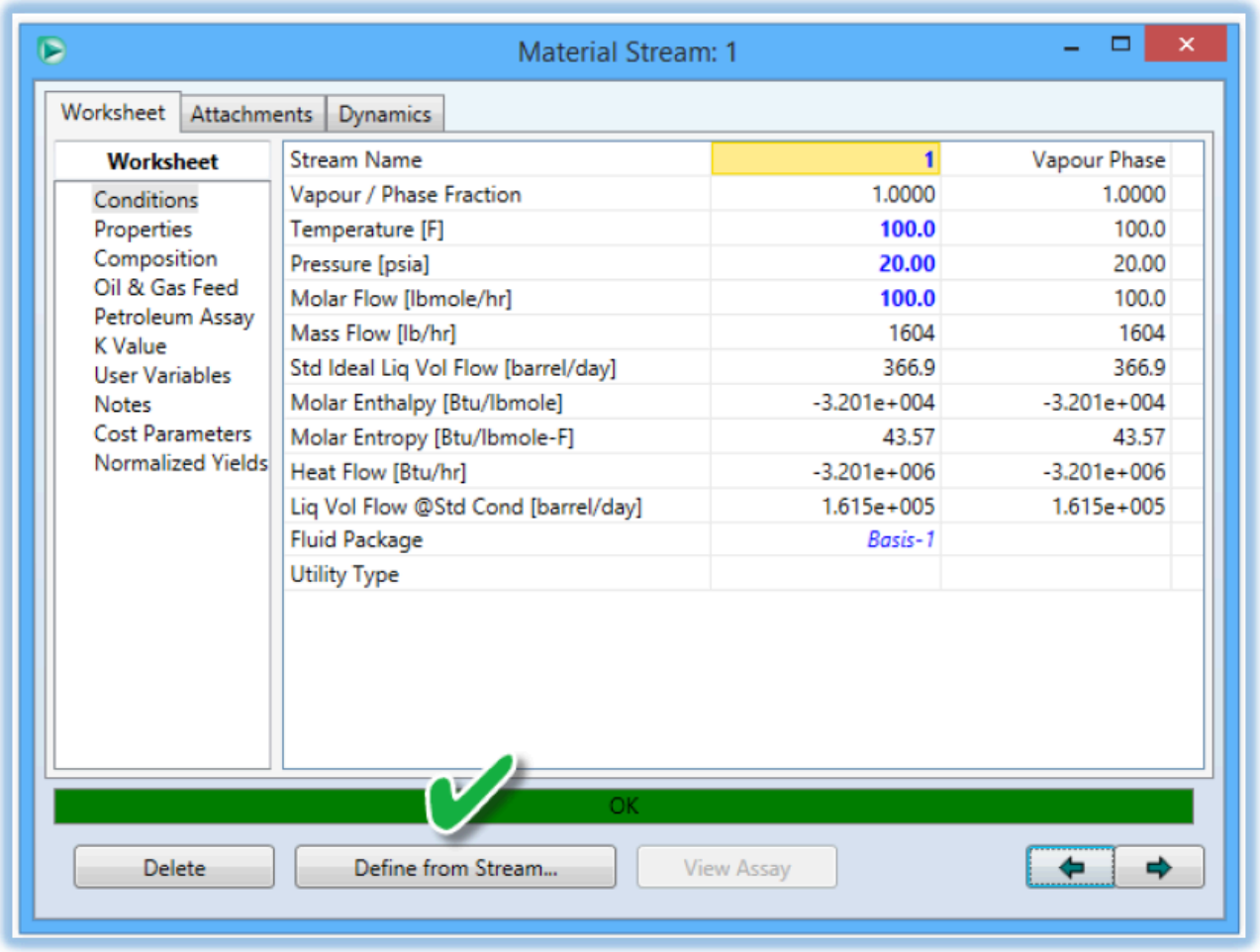


Always keep your eyes on the status bar for every stream/equipment to which appear in three colors:

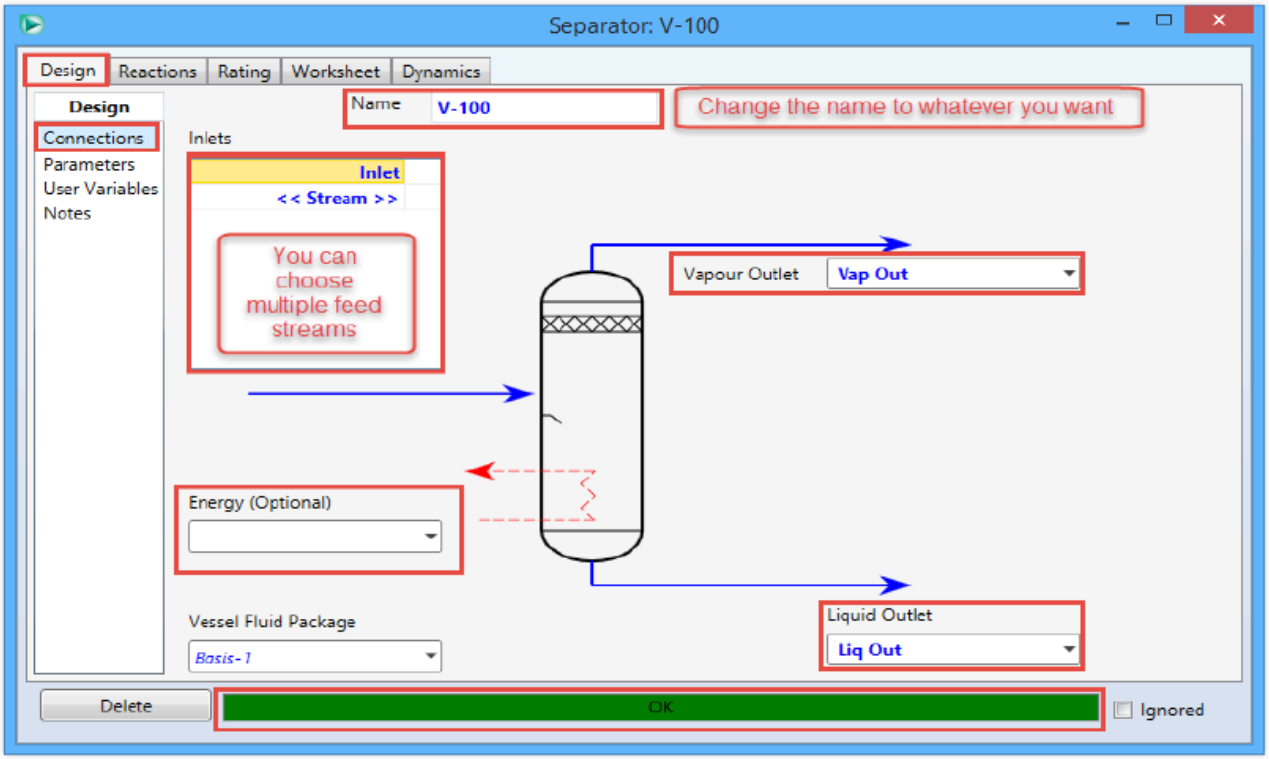
Red: The object is missing a basic requirement or contains errors.

Yellow: All connections are complete but the block is underspecified or contains warnings.

Green: Solved without errors.



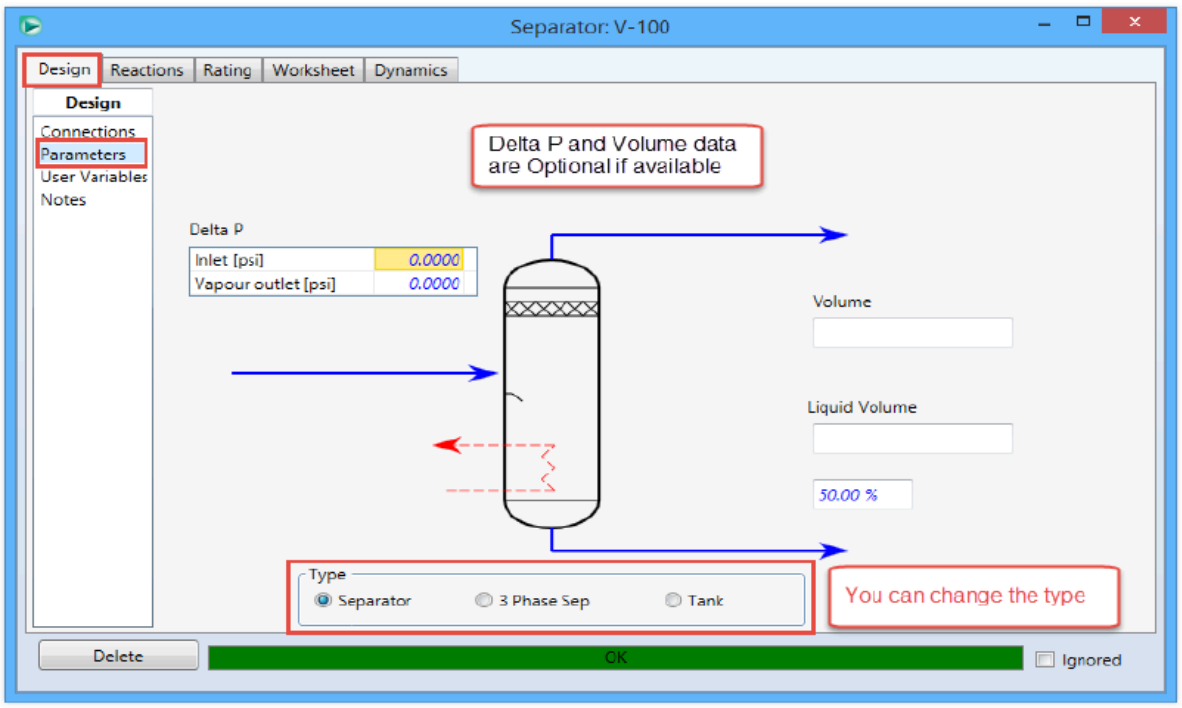
2) Separator:

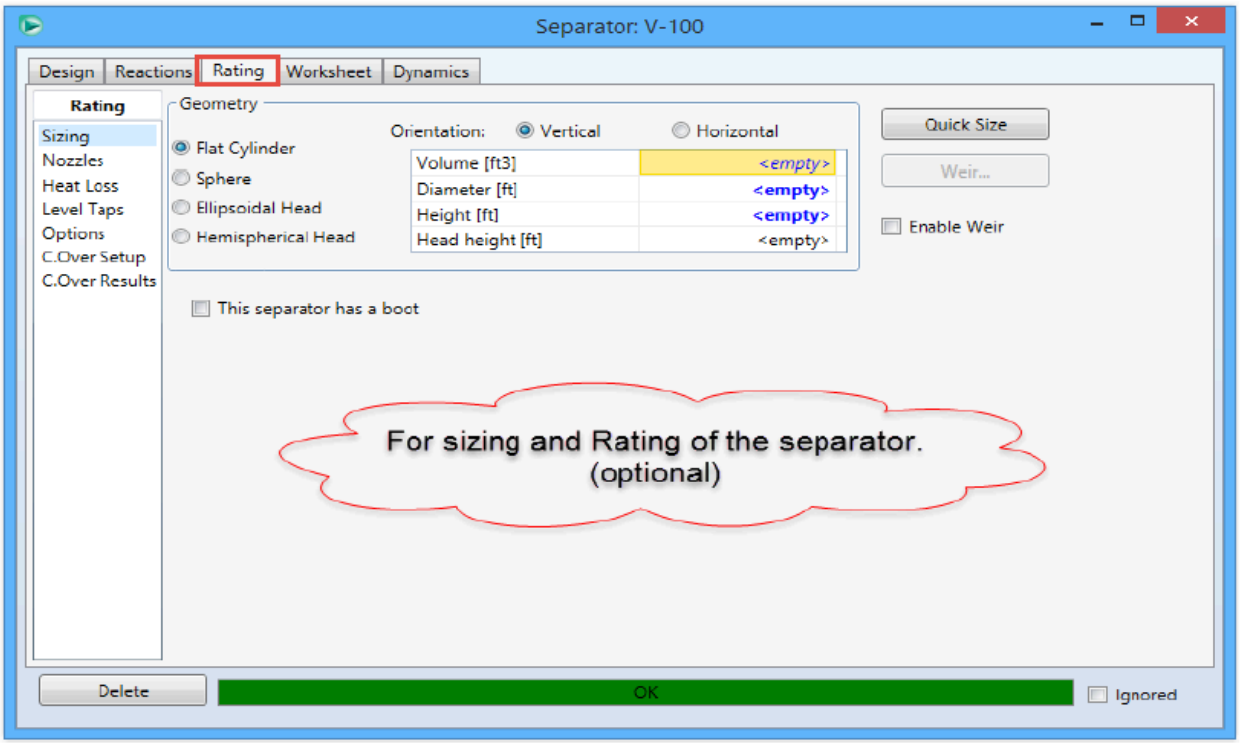


The basic requirements for separator are:

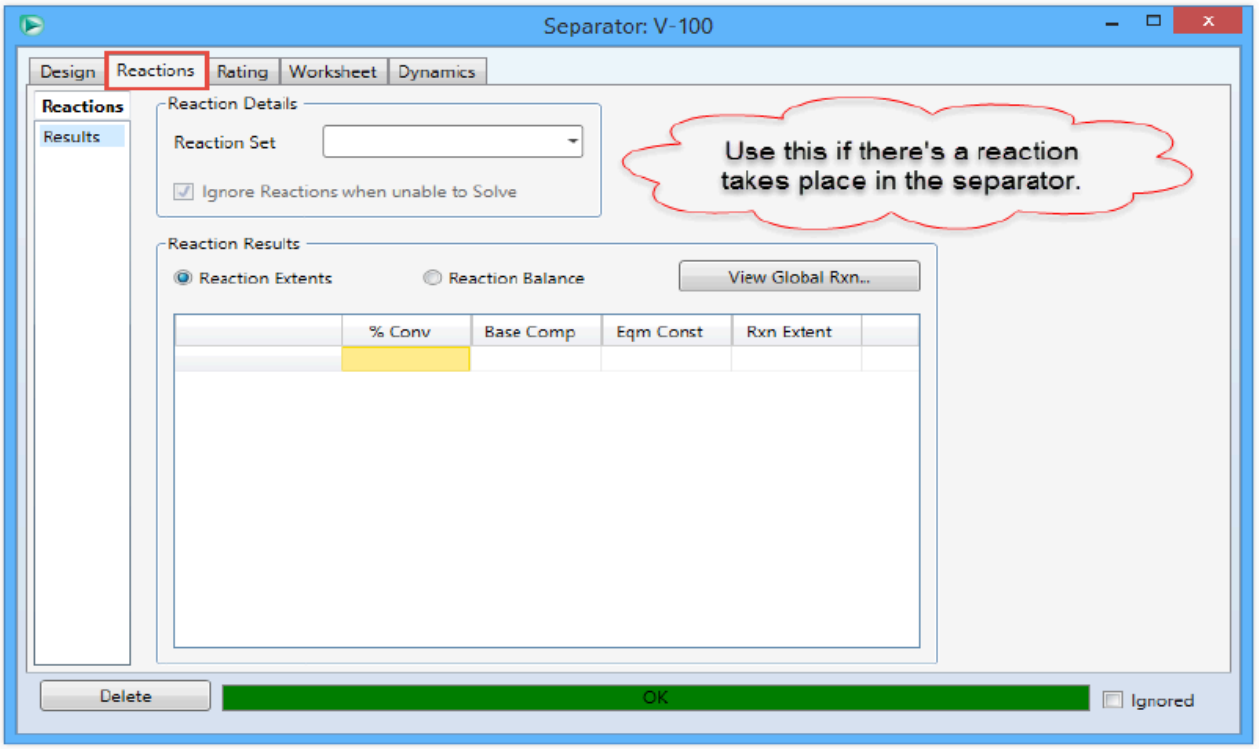
- Inlet stream.
- Liquid outlet stream.
- Vapor outlet stream.

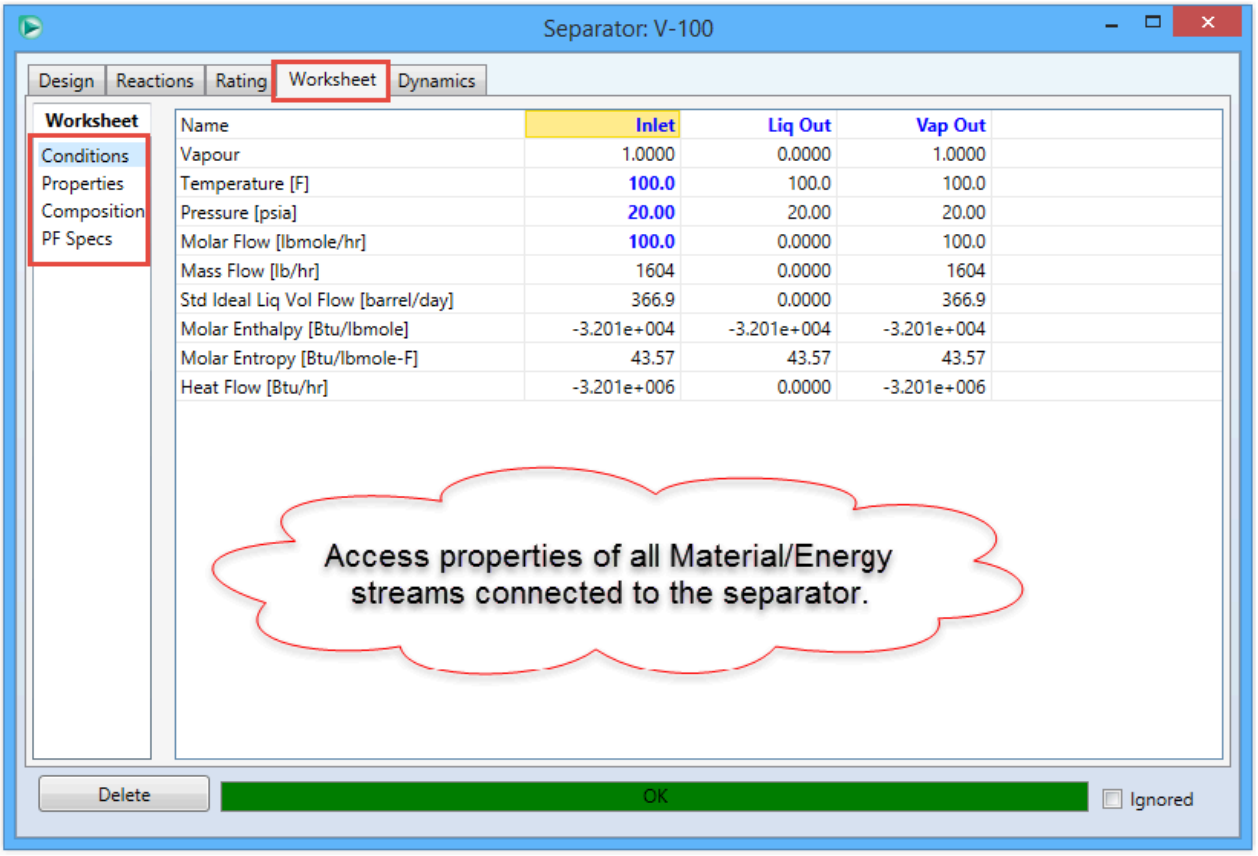
All other parameters are optional, and it helps in rigorous design and rating for the separator.





➢ Reactions may occur within the separator, and reactions added to the separator as following:





3) Cooler/Heater:

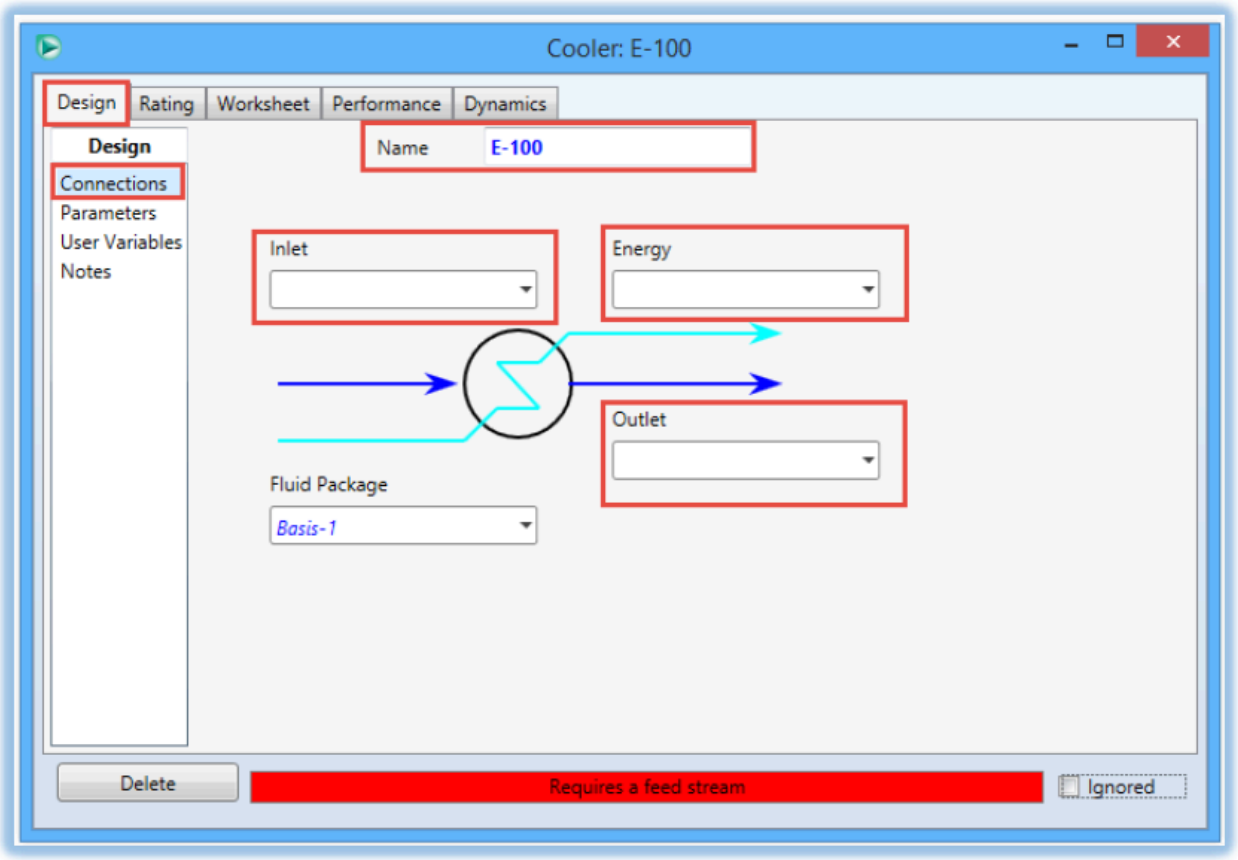
The Cooler and Heater operations are one-sided heat exchangers. These operations are useful when you are interested only in how much energy is required to cool or heat a process stream with a utility, but you are not interested in the conditions of the utility itself.

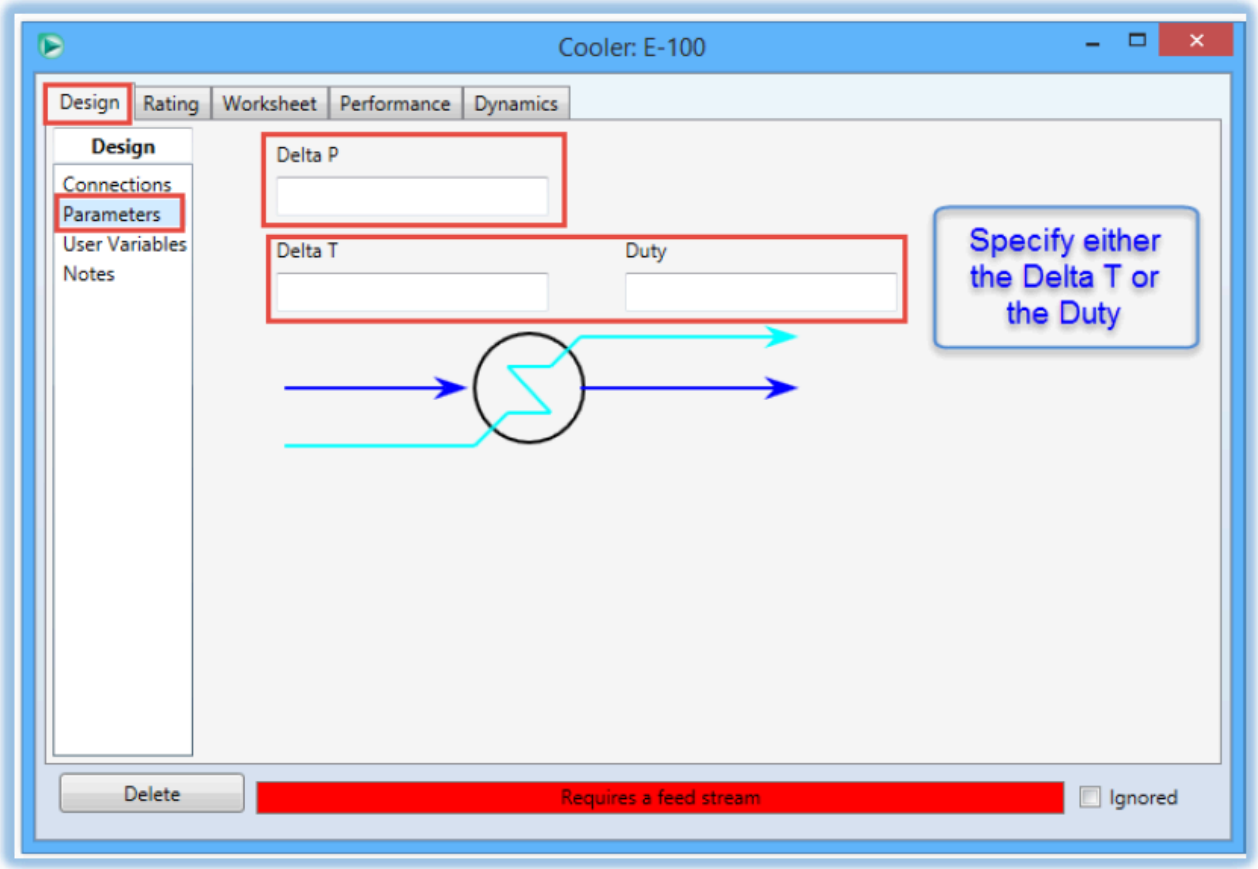
The basics requirements for a cooler/heater are:

- Inlet and outlet stream.
- Energy stream.
- Delta P, or defining pressure for each in/out stream.

  You can enter a specific duty, then it calculate the other side temperature, or specify inlet and outlet temperature and let it calculate the duty.

The Heater has the same following properties view except the energy is consumed not released.

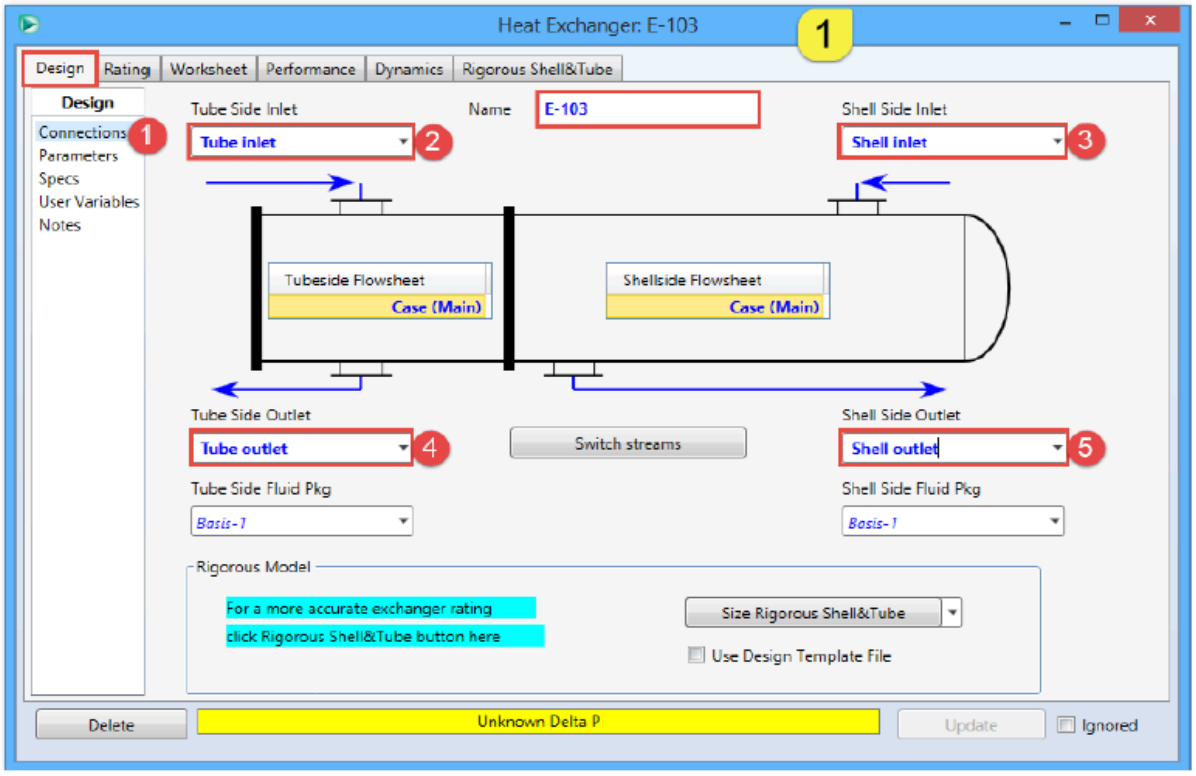

Cooler: E-100
Design
Rating
Worksheet
Performance
Dynamics
Design
Connections
Parameters
User Variables
Notes
Name
E-100
Inlet
Energy
Outlet
Fluid Package
Basis-1
Delete
Requires a feed stream
Ignored

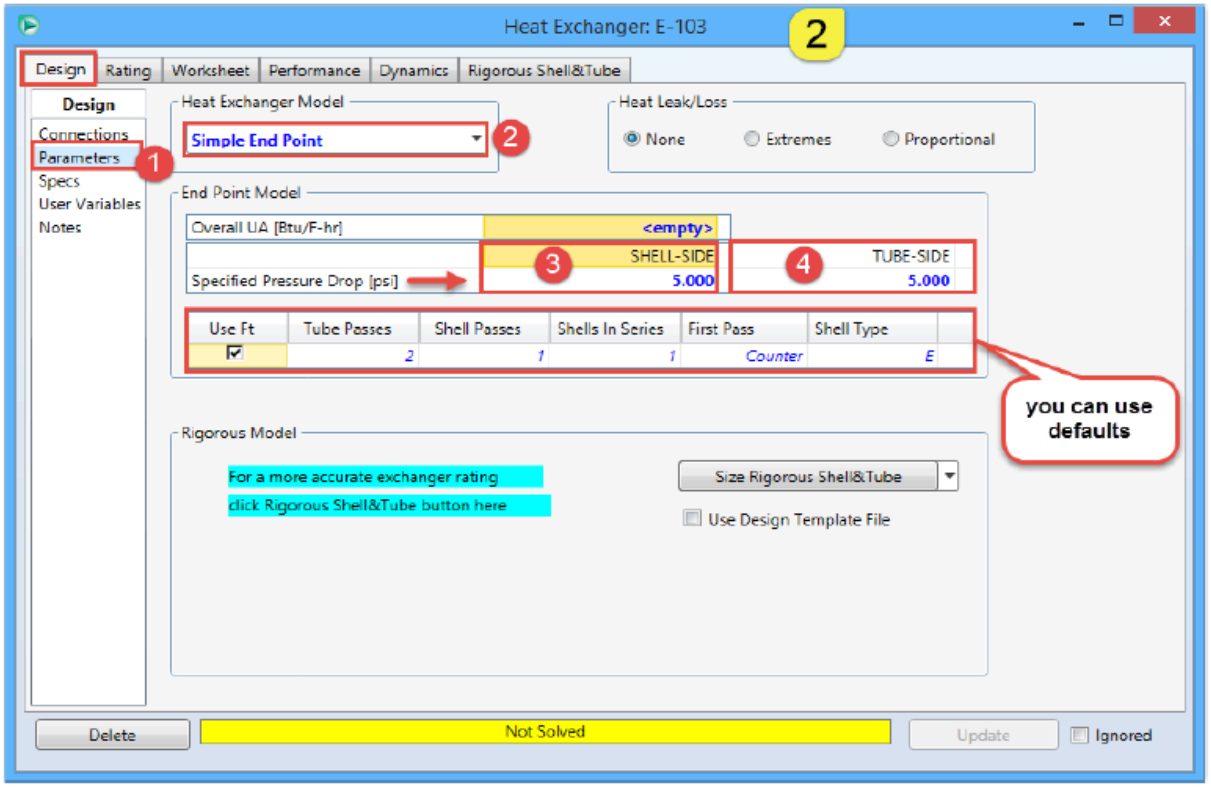

Cooler: E-100
Design
Rating
Worksheet
Performance
Dynamics
Design
Connections
Parameters
User Variables
Notes
Delta P
Delta T
Duty
Specify either the Delta T or the Duty
Delete
Requires a feed stream
Ignored

4) Heat Exchanger (Shell and Tube):

The heat exchanger performs two-sided energy and material balance calculations. The heat exchanger is very flexible and can solve for temperatures, pressures, heat flows (including heat loss and heat leak), material stream flows, or UA.

➢ The following figures show the basic steps for adding and defining a heat exchanger:





HYSYS has five different model for the heat exchanger:

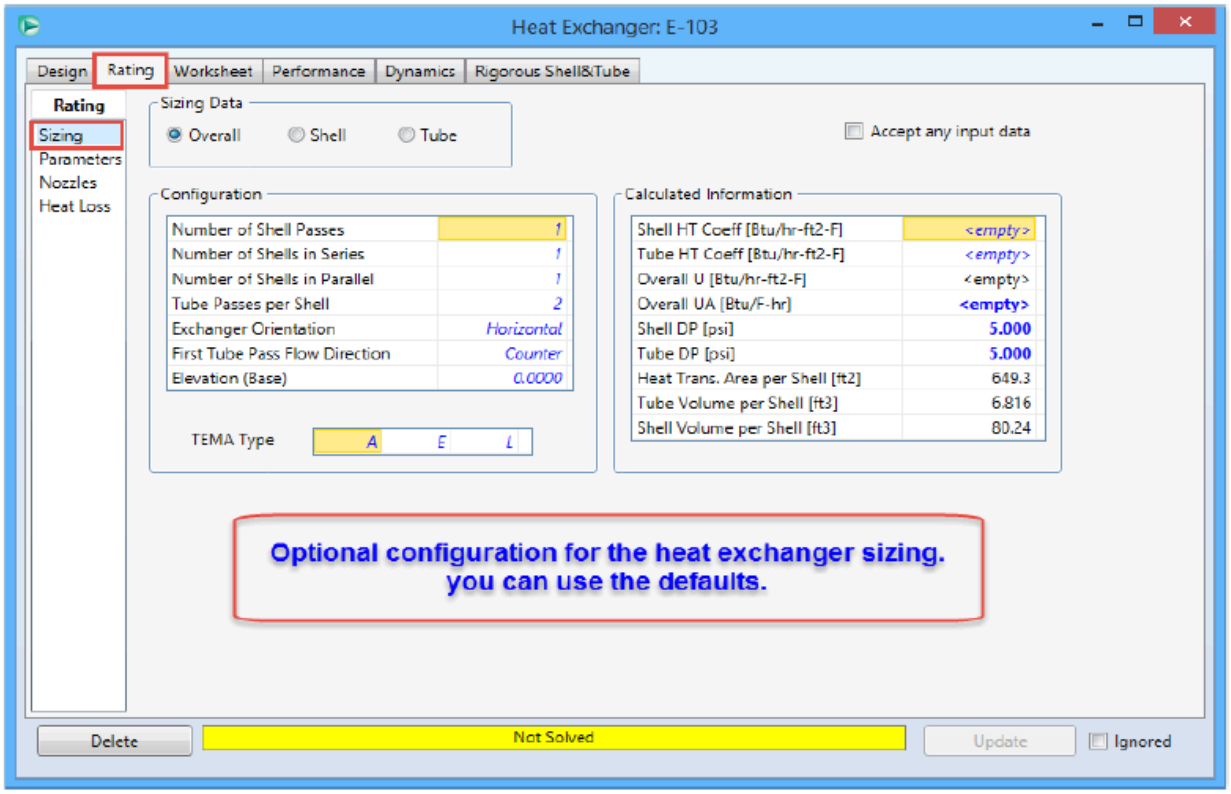
i. Rigorous Shell and Tube: This mode accesses the Aspen Exchanger Design and Rating (EDR) program and lets you set up a rigorous shell and tube exchanger model within it.

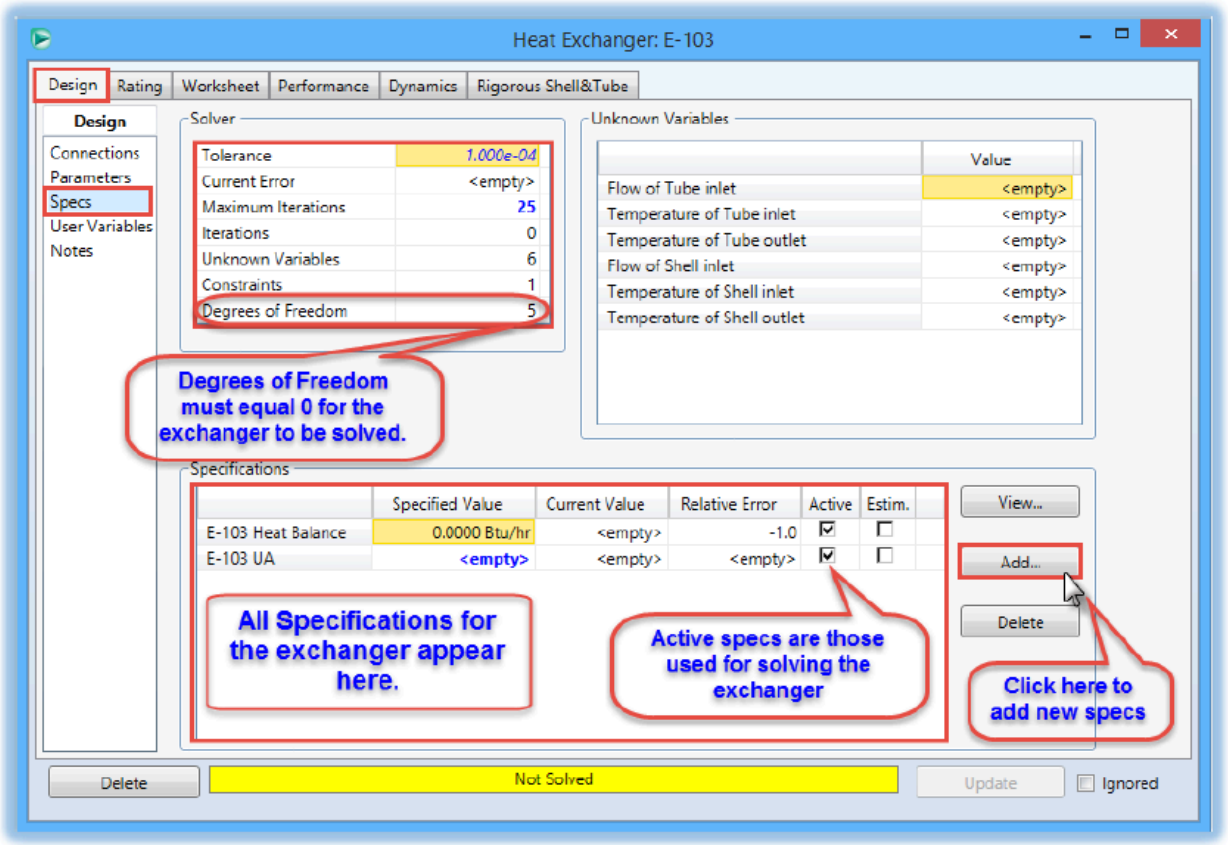
ii. Dynamic Rating: Two models are available for Dynamic Rating: Basic and Detailed. If you specify three temperatures or two temperatures and a UA, you can rate the exchanger with the Basic model. If you provide detailed geometry information, you can rate the exchanger using the Detailed model. Once Dynamic Rating is selected, no further information is required from the Parameters page of the Design tab. Choice of Basic or Detailed model is made on the Parameters page of the Rating tab or the Model Page of the Dynamics tab.

iii. Simple End Point: This model is based on the standard heat exchanger duty equation defined in terms of overall heat transfer coefficient, area available for heat exchange and the log mean temperature difference. The main assumptions of the model are overall heat transfer coefficient U is constant and specific heats of both shell and tube side streams are constant.
This model treats the heat curves for both heat exchanger sides as linear. For simple problems where there is no phase change and Cp is relatively constant, this option may be sufficient to model your heat exchanger. For non-linear heat flow problems, the Weighted model should be used instead.

iv. Simple Steady State Rating: The Steady State Rating model is an extension of the End Point model to incorporate a rating calculation, and uses the same assumptions as the End Point model. If you provide detailed geometry information, you can rate the exchanger using this model. As the name suggests, this model is only available for steady state rating.

v. Simple Weighted: This is an excellent model to deal with non-linear heat curve problems such as the phase change of pure components in one or both heat exchanger sides. The heating curves are broken into intervals and an energy balance is performed along each interval. A LMTD and UA are calculated for each interval in the heat curve and summed to calculate the overall exchanger UA.


Heat Exchanger: E-103
Design
Rating
Worksheet
Performance
Dynamics
Rigorous Shell&Tube
Rating
Sizing
Parameters
Nozzles
Heat Loss
Sizing Data
Overall
Shell
Tube
Accept any input data
Configuration
Number of Shell Passes 1
Number of Shells in Series 1
Number of Shells in Parallel 1
Tube Passes per Shell 2
Exchanger Orientation Horizontal
First Tube Pass Flow Direction Counter
Elevation (Base) 0.0000
TEMA Type A E L
Calculated Information
Shell HT Coeff [Btu/hr-ft2-F] <empty>
Tube HT Coeff [Btu/hr-ft2-F] <empty>
Overall U [Btu/hr-ft2-F] <empty>
Overall UA [Btu/F-hr] <empty>
Shell DP [psi] 5.000
Tube DP [psi] 5.000
Heat Trans. Area per Shell [ft2] 649.3
Tube Volume per Shell [ft3] 6.816
Shell Volume per Shell [ft3] 80.24
Optional configuration for the heat exchanger sizing.
you can use the defaults.
Delete
Not Solved
Update
Ignored

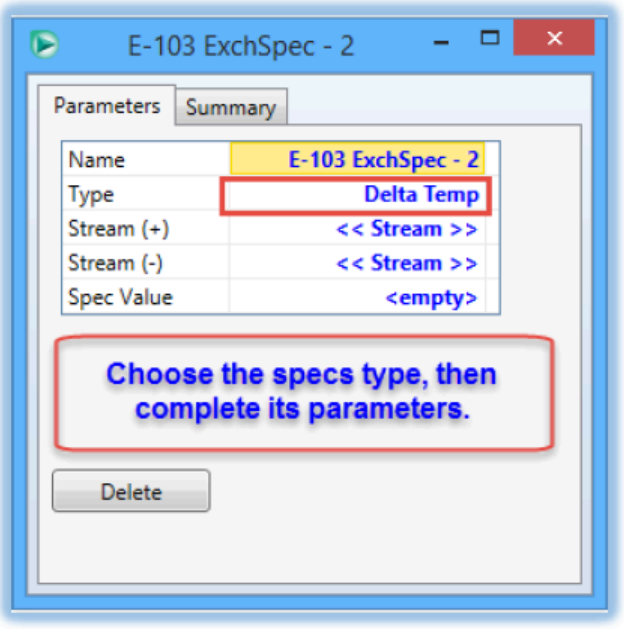


- **To add a new specification for the heat exchanger**

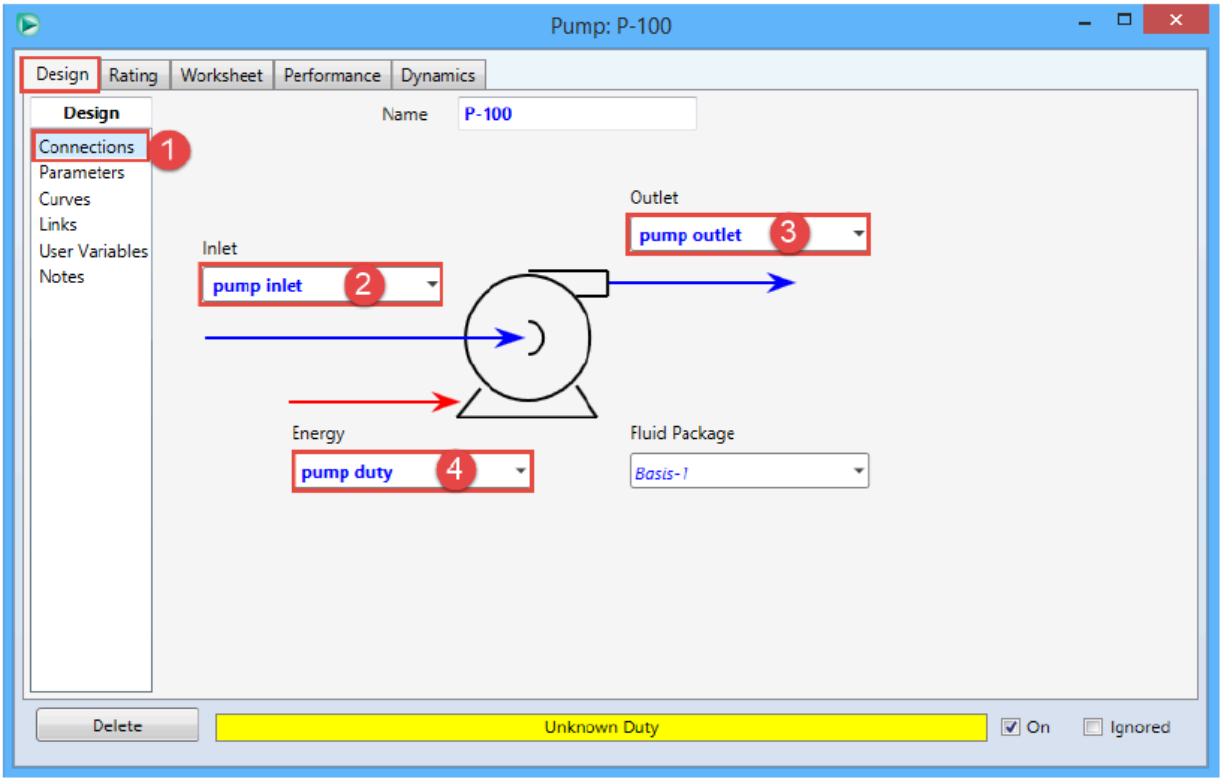
From the **Type** drop-down list, select one of the following specification types:

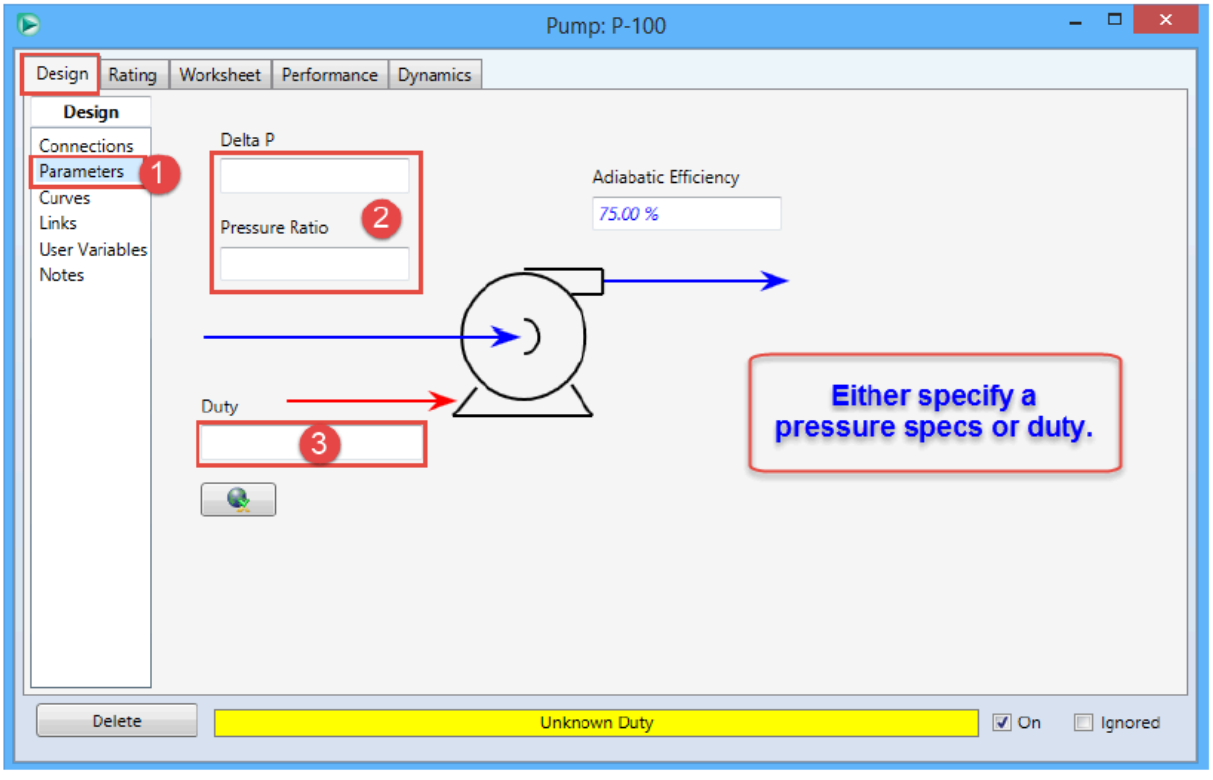
Temperature, Delta Temp, Minimum Approach, UA, LMTD, Duty, Duty Ratio, Flow, Flow Ratio, Subcooling, or Superheating.

The property view changes depending on the type selected. Specify the appropriate parameters for each specification type.



5) Pumps:


Pump: P-100
Design
Rating
Worksheet
Performance
Dynamics
Design
Connections
Parameters
Curves
Links
User Variables
Notes
1
Name
P-100
Outlet
pump outlet
3
Inlet
pump inlet
2
Energy
pump duty
4
Fluid Package
Basis-1
Delete
Unknown Duty
On
Ignored


Pump: P-100
Design
Rating
Worksheet
Performance
Dynamics
Design
Connections
Parameters
Curves
Links
User Variables
Notes
1
Delta P
Pressure Ratio
2
Adiabatic Efficiency
75.00 %
Duty
3
Either specify a pressure specs or duty.
Delete
Unknown Duty
On
Ignored

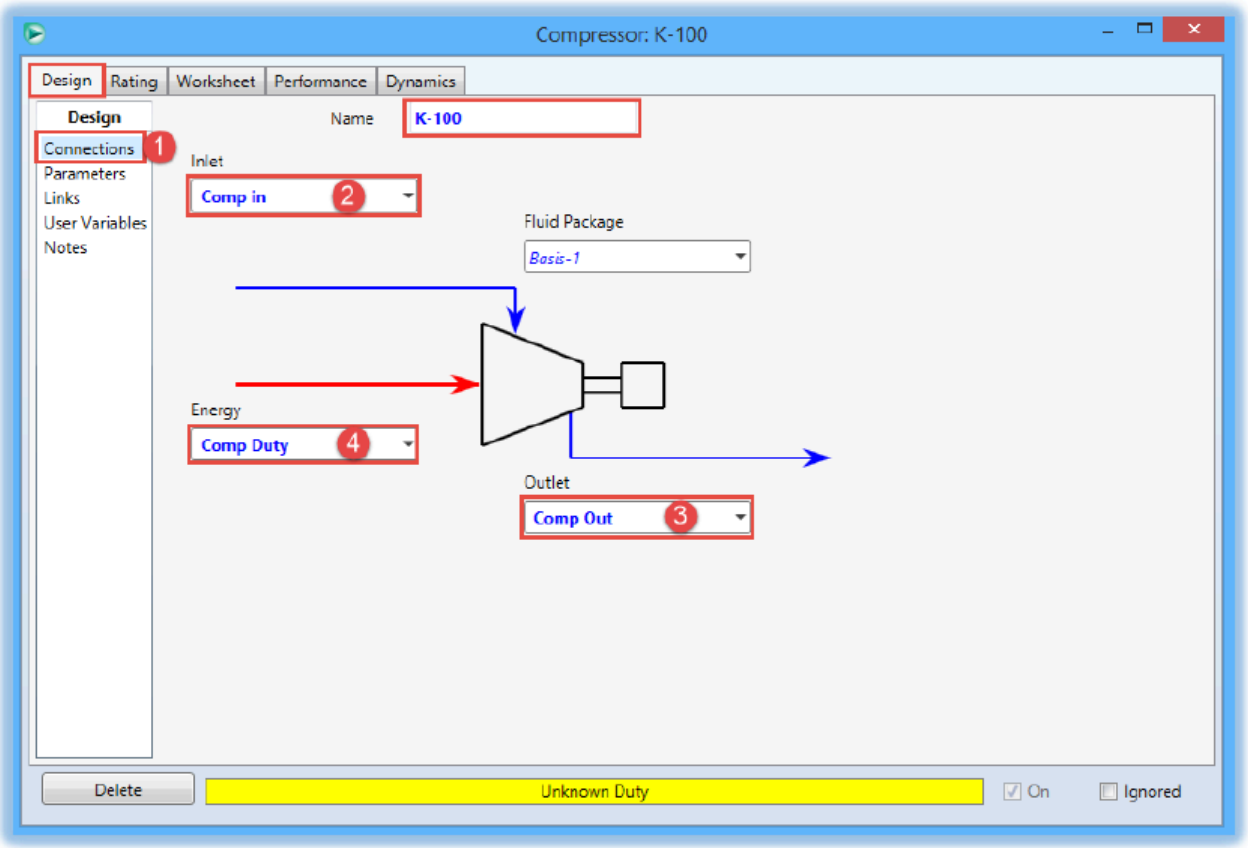
6) Compressor/Expander:

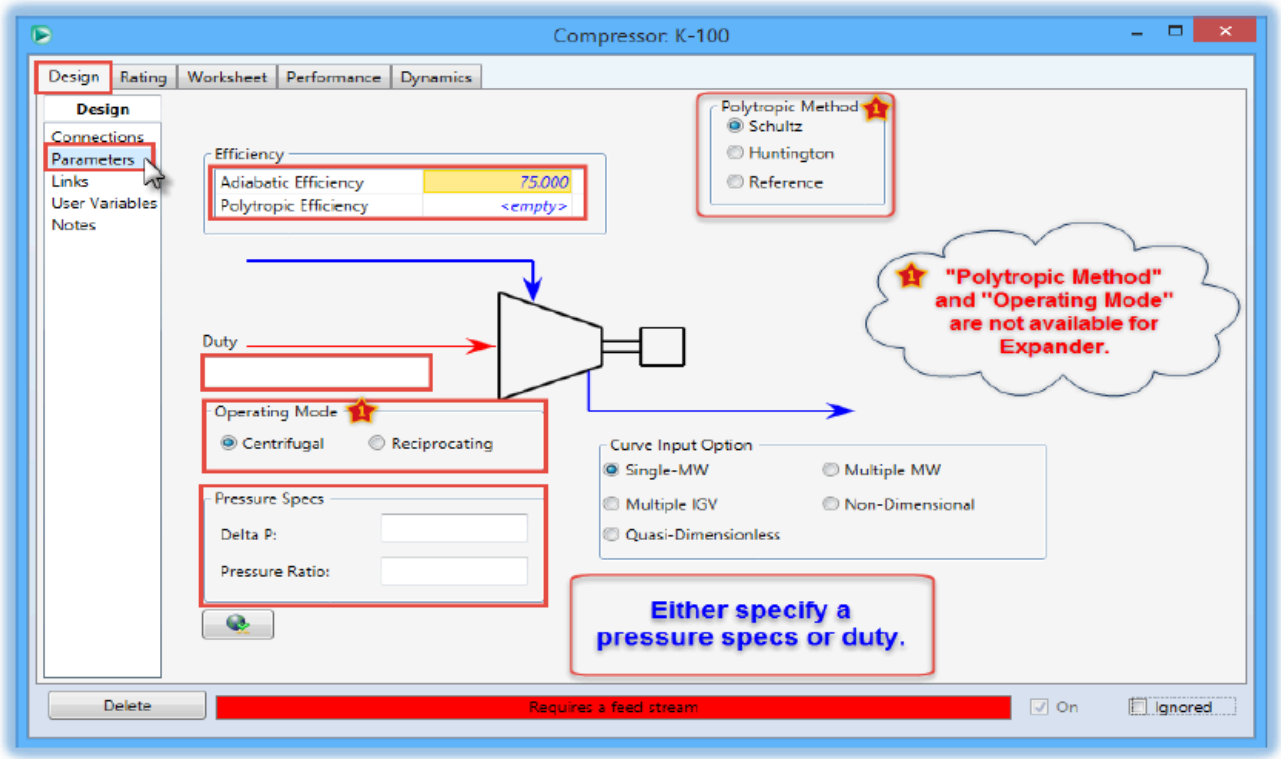
Compressor and Expander are very similar in operation but in reverse direction, so we combined the together in definition and configuration.

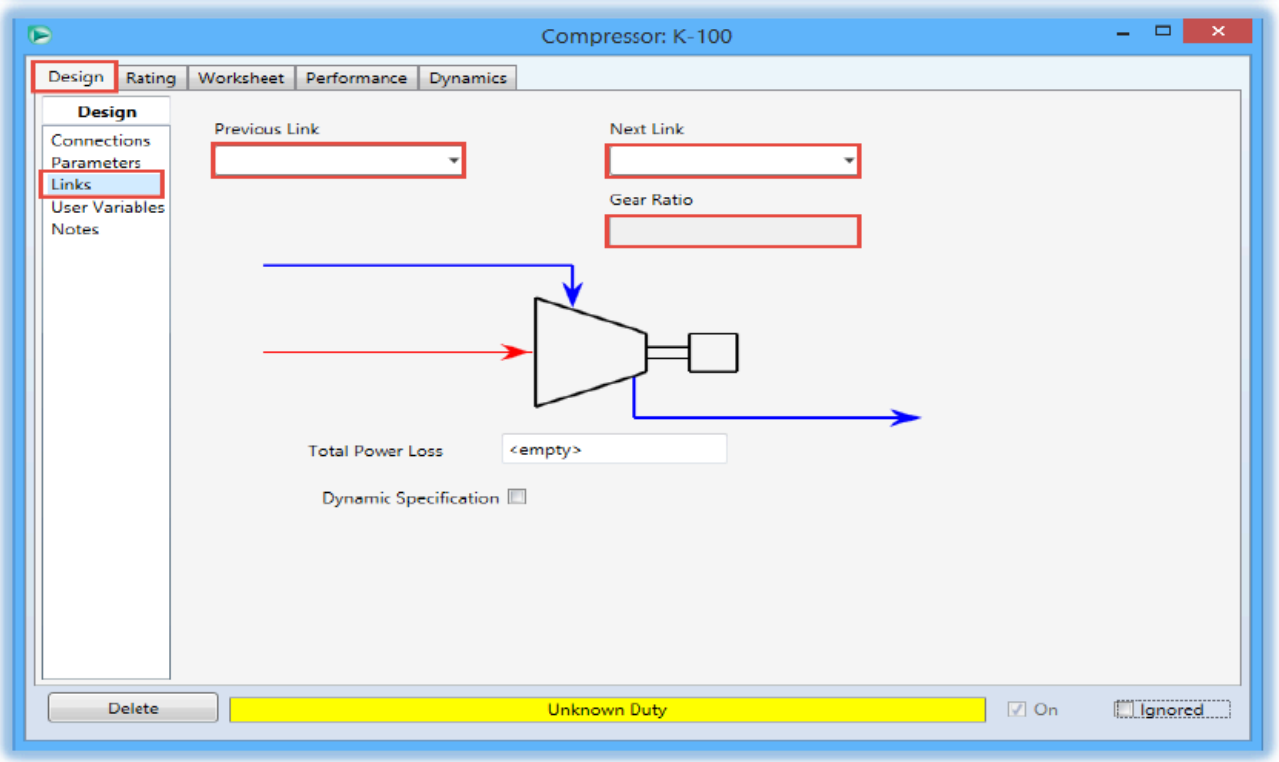
The Compressor operation is used to increase the pressure of an inlet gas stream, while the Expander operation is used to decrease the pressure of a high-pressure inlet gas stream to produce an outlet stream with low pressure and high velocity.

In general, the solution for compressor/expander is a function of flow, pressure change, applied energy, and efficiency.

In the following figures are the basic steps for configuring compressor which typically applied for configuring an expander, and any difference will be mentioned.







Linking compressors and expanders in HYSYS means: The speed of each linked unit operation is the same, the sum of duties of each linked pump/compressor/expander and the total power loss equals zero.

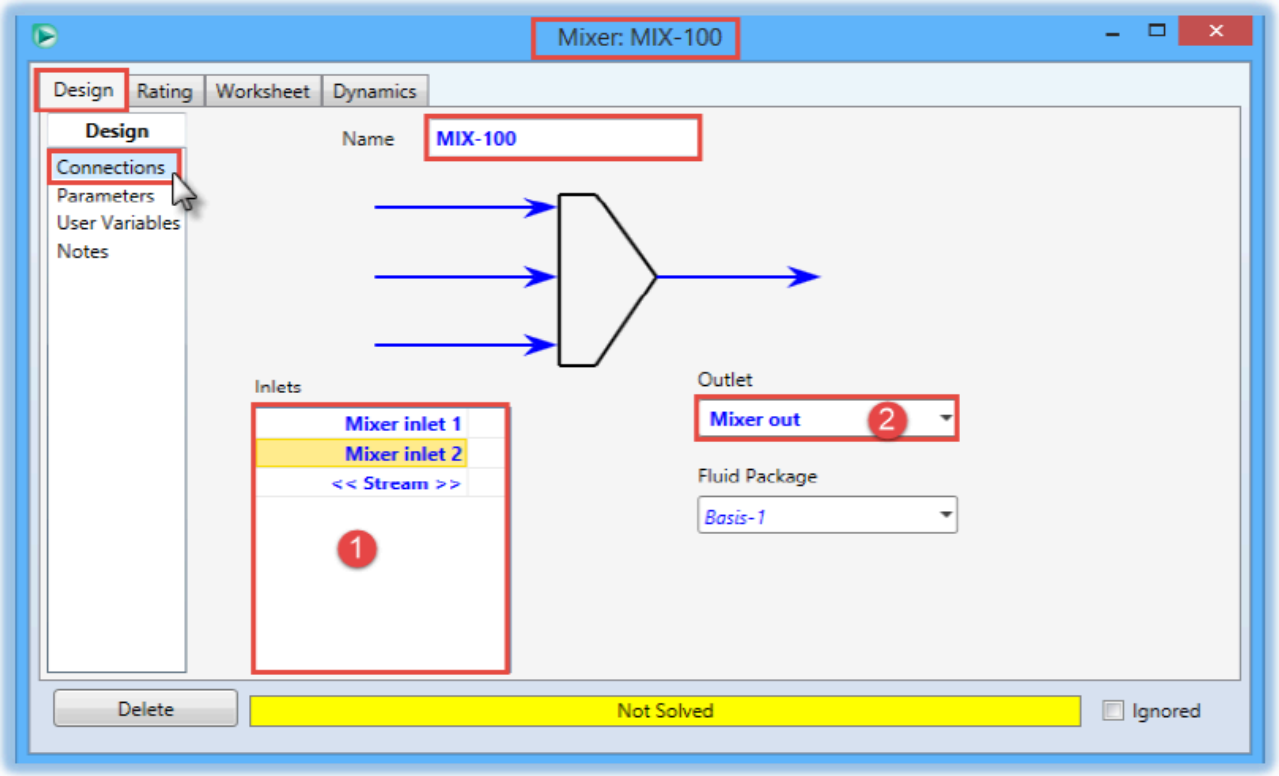
- The **Previous Link** field displays the name of the operation that is attached to current compressor.
- The **Gear Ratio** field displays the ratio of the speed from the next linked operation divided by the speed of the current pump.
- The **Total Power Loss** field displays the total power loss or input to the linked operations.

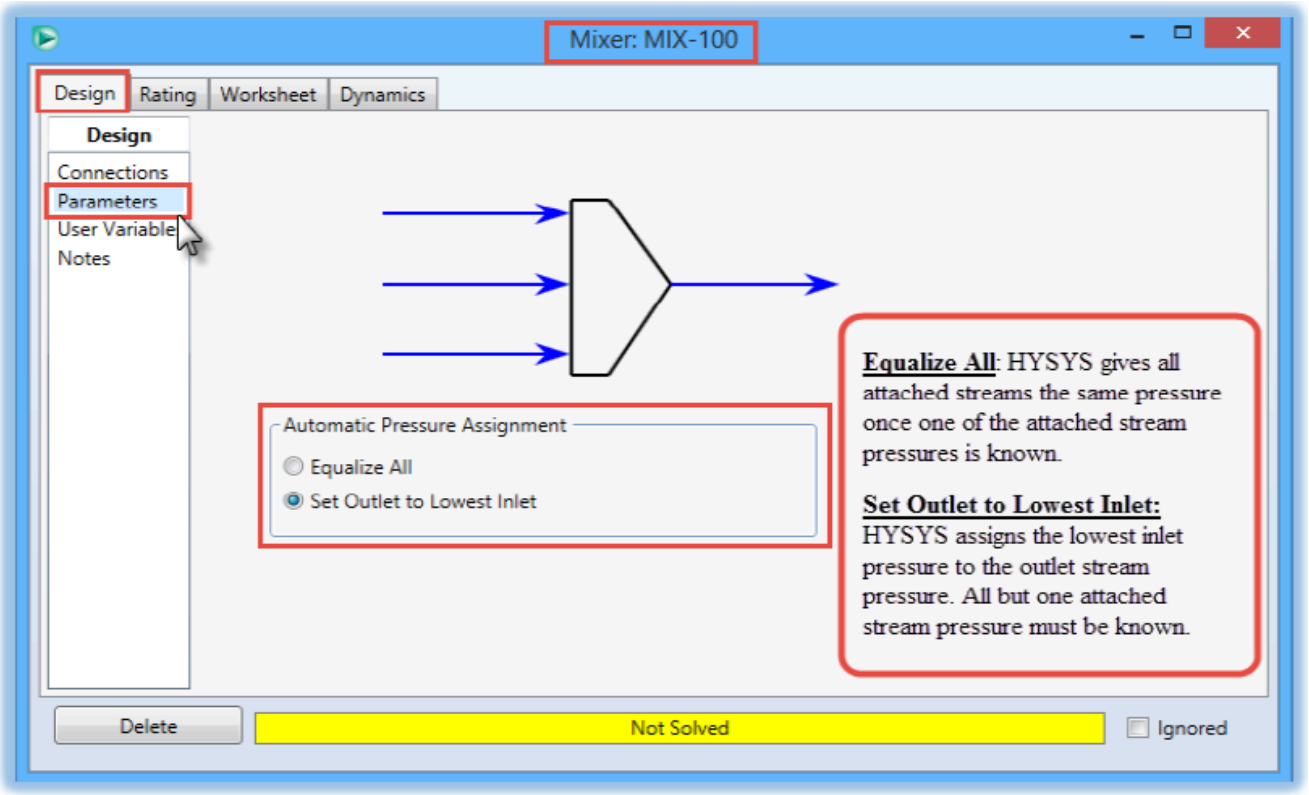
From the **Next Link** drop-down list, select the pump, expander, or compressor you want to link to.

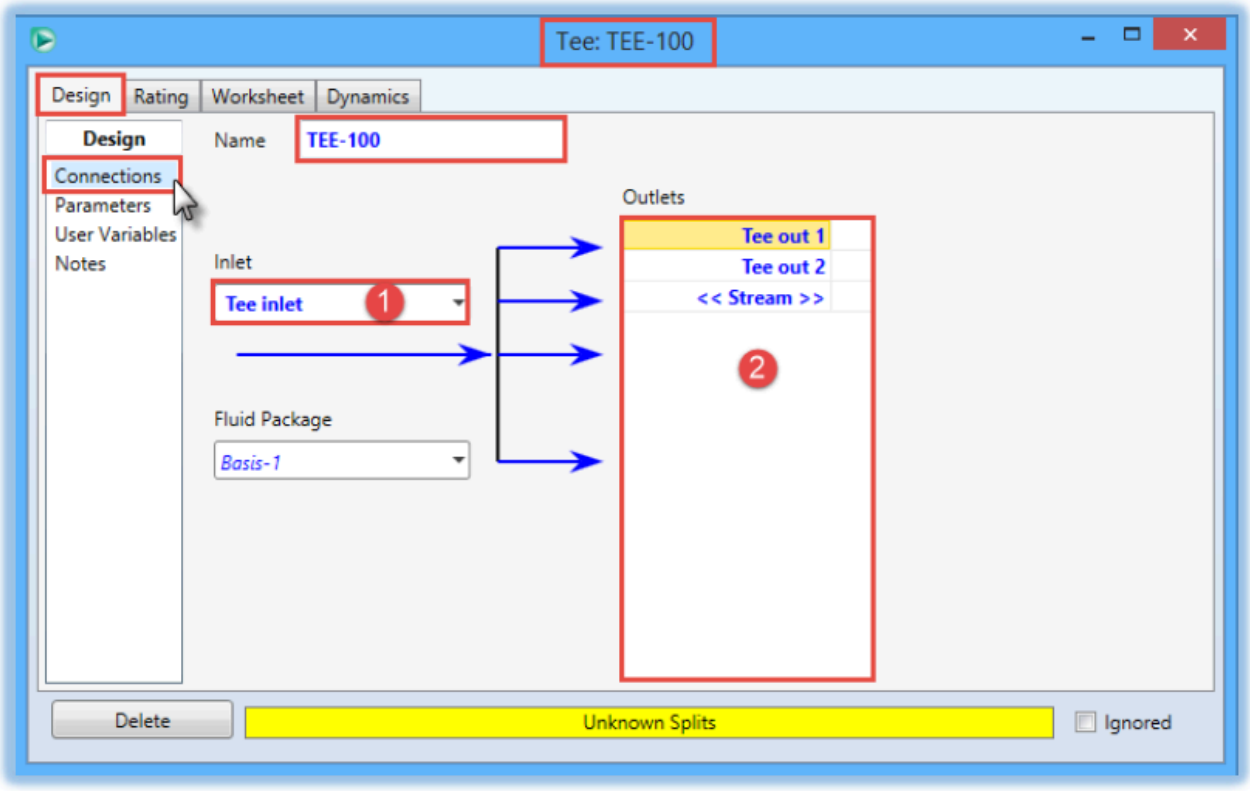
7) Mixer and Tee:

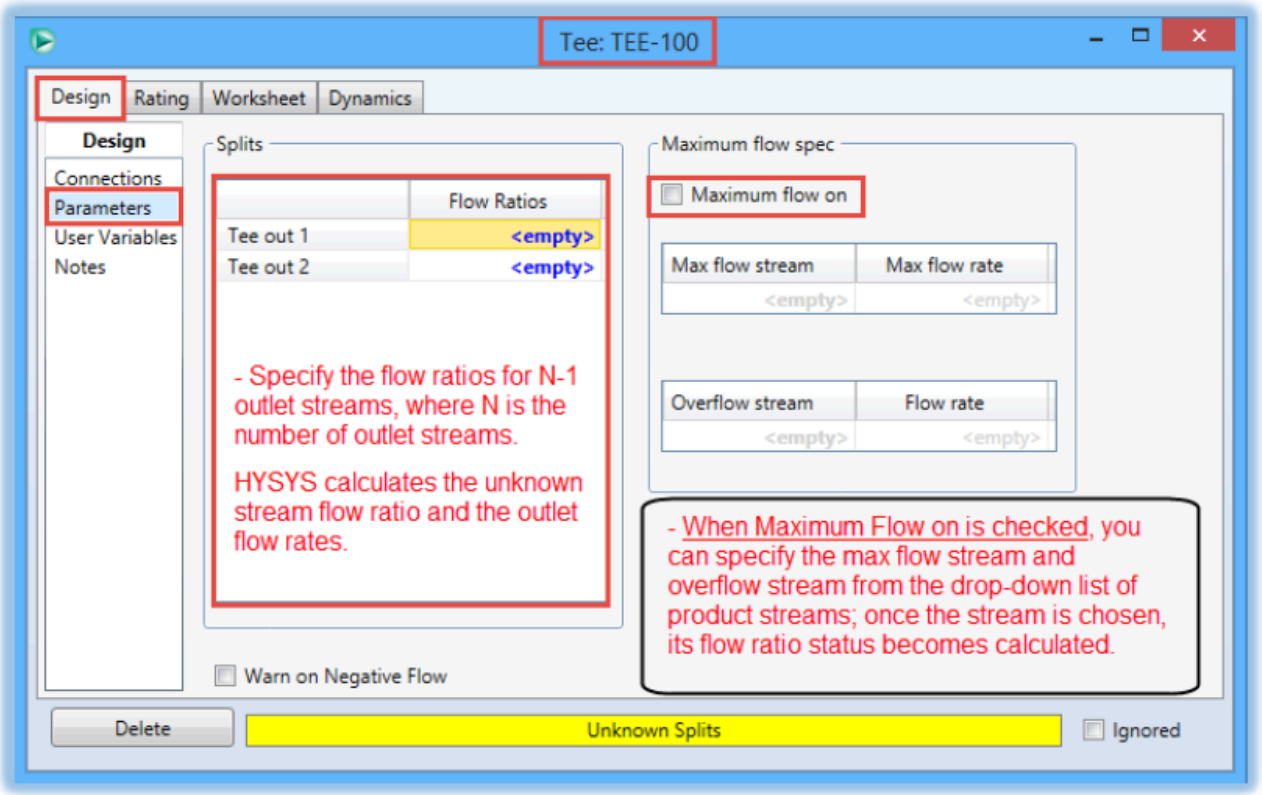
The mixer operation combines two or more inlet streams to produce a single outlet stream. A complete heat and material balance is performed on the mixer.

The Tee operation splits one feed stream into multiple product streams with the same conditions and composition as the feed stream, and is used for simulating pipe tees and manifolds.



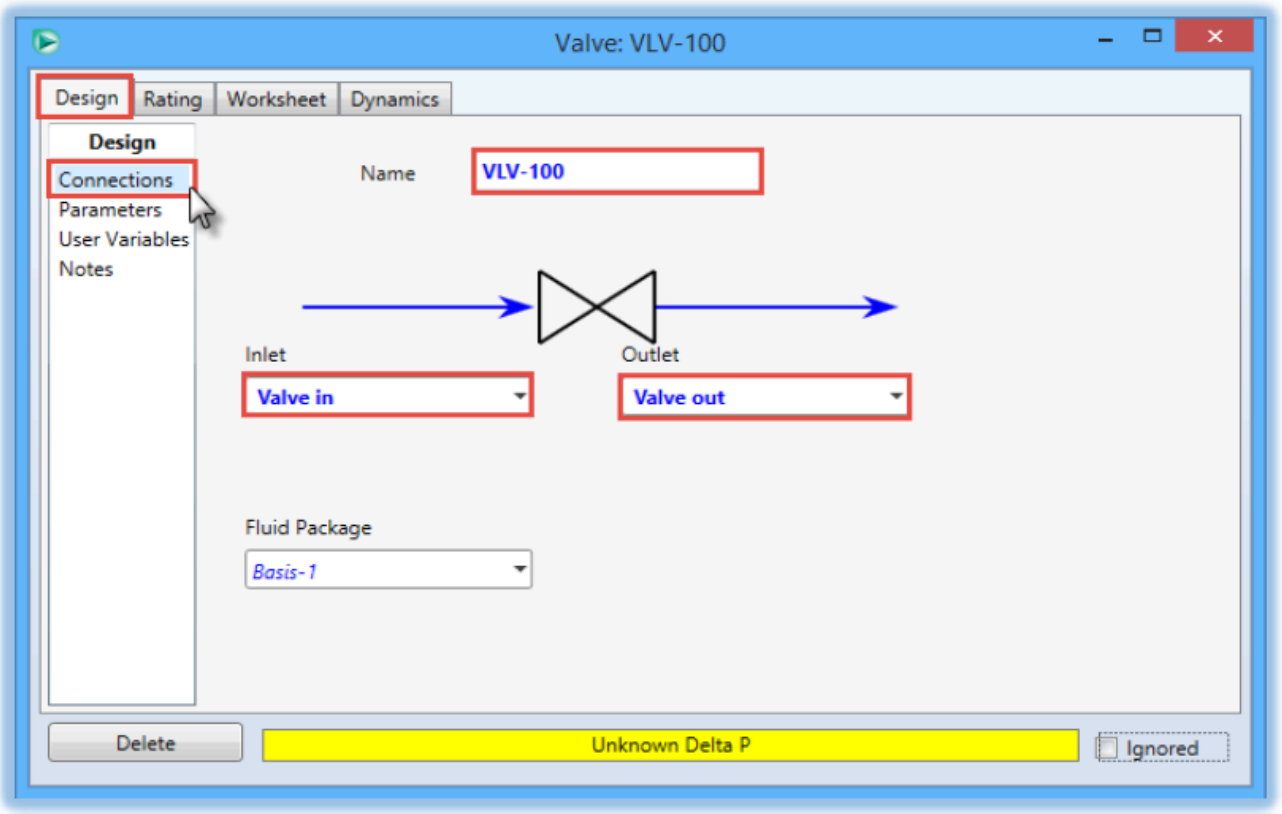

Mixer: MIX-100
Design
Rating
Worksheet
Dynamics
Design
Connections
Parameters
User Variable
Notes
Automatic Pressure Assignment
Equalize All
Set Outlet to Lowest Inlet
Equalize All: HYSYS gives all attached streams the same pressure once one of the attached stream pressures is known.
Set Outlet to Lowest Inlet: HYSYS assigns the lowest inlet pressure to the outlet stream pressure. All but one attached stream pressure must be known.
Delete
Not Solved
Ignored

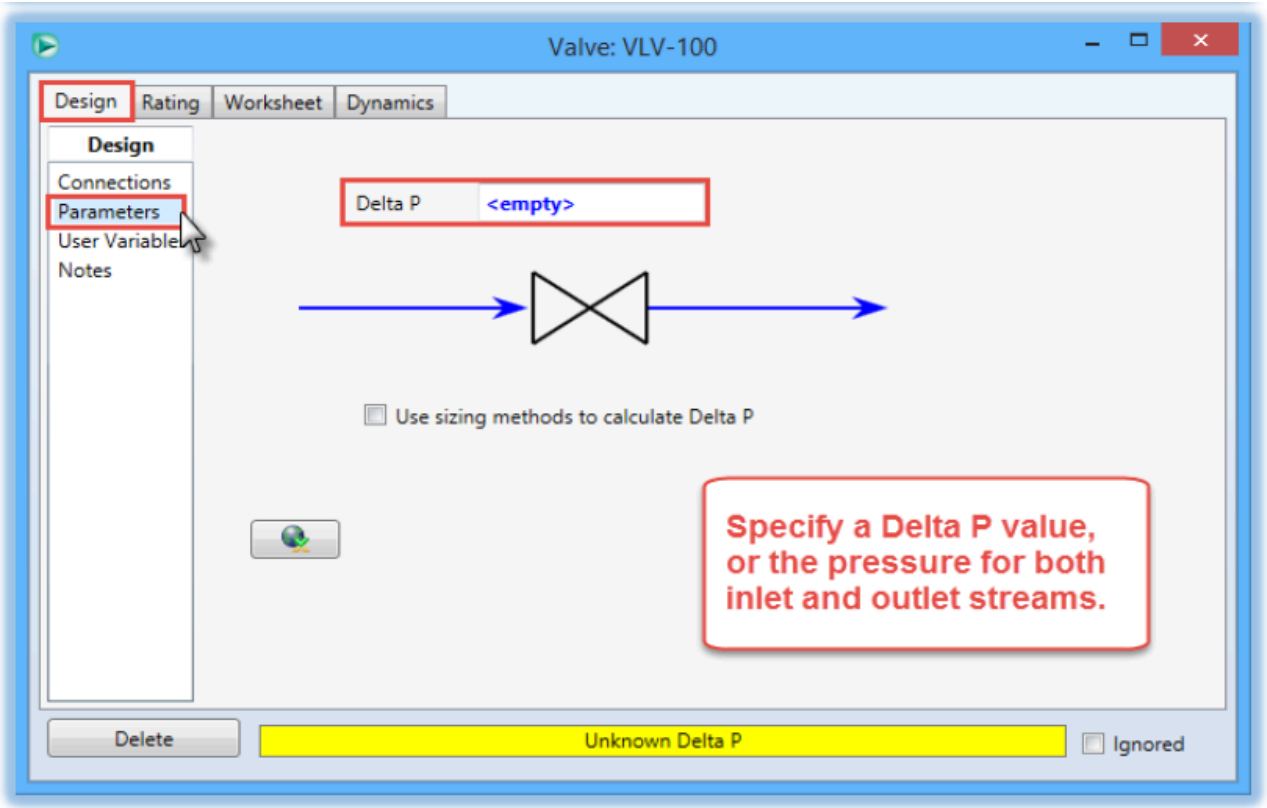

Tee: TEE-100
Design
Rating
Worksheet
Dynamics
Design
Connections
Parameters
User Variables
Notes
Name
TEE-100
Inlet
Tee inlet
1
Fluid Package
Basis-1
Outlets
Tee out 1
Tee out 2
<< Stream >>
2
Delete
Unknown Splits
Ignored



8) Valve:

HYSYS performs a material and energy balance on the inlet and exit streams of the Valve operation. HYSYS performs a flash calculation based on equal material and enthalpy between the two streams. It is assumed that the valve operation is isenthalpic.


Valve: VLV-100
Design
Rating
Worksheet
Dynamics
Design
Connections
Parameters
User Variables
Notes
Name
VLV-100
Inlet
Valve in
Outlet
Valve out
Fluid Package
Basis-1
Delete
Unknown Delta P
Ignored


Valve: VLV-100
Design
Rating
Worksheet
Dynamics
Design
Connections
Parameters
User Variables
Notes
Delta P
<empty>
Use sizing methods to calculate Delta P
Specify a Delta P value, or the pressure for both inlet and outlet streams.
Delete
Unknown Delta P
Ignored

COLUMNS

HYSYS provide a simple method to define columns which is "The Column Input Expert".

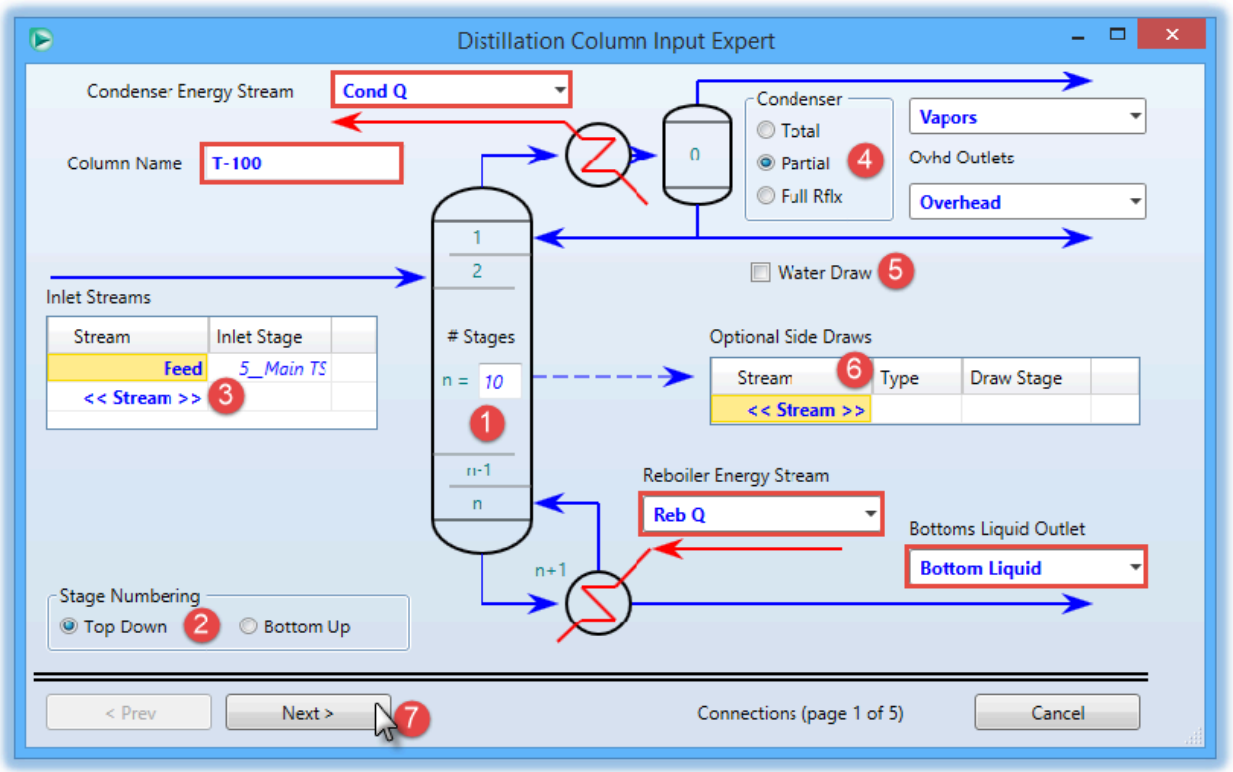
The Input Expert contains a series of input pages. You must supply the required information for the page before advancing to the next one. When you have worked through all the pages, you will have supplied the basic information required to build your column, and the Column property view appears.

It is not necessary to use the Input Experts to install a column. You can disable the use of Input Experts by deactivating the Use Input Experts checkbox on the Options page in the Simulation tab of the Session Preferences property view. If you do not use the Input Expert, the Column property view appears when you install a new column.

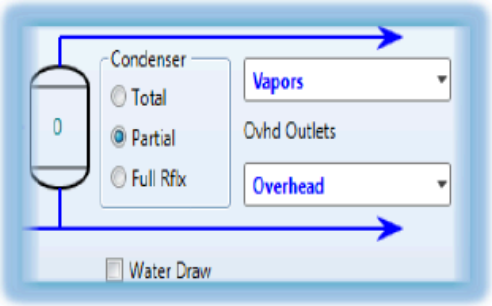
- The Input Expert is available for the following standard column templates:
  - Absorber
  - Liquid-Liquid Extractor
  - Reboiled Absorber
  - Refluxed Absorber
  - Distillation
  - Three Phase Distillation

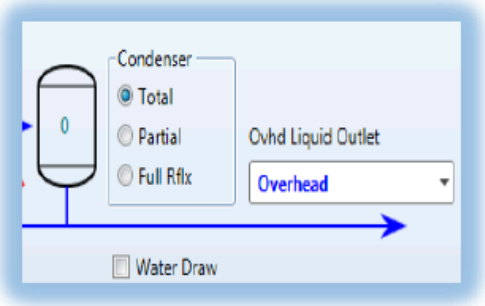
- The input pages of the Input Expert are the same for all the previous mentioned column types, they only differ in the pages related to some equipment does not exist in the other type, i.e., the pages for configuring a reboiler will not be exist if the column does not have a reboiler, and so on.

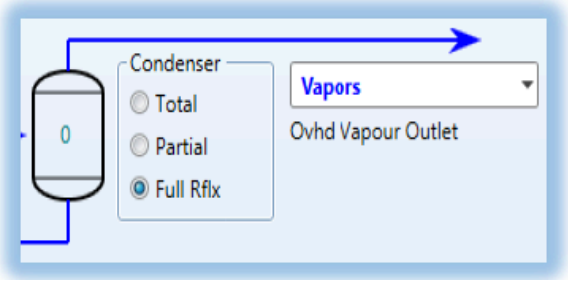
Next, will show the basic steps for installing a distillation column, and any difference with other column types we mention.



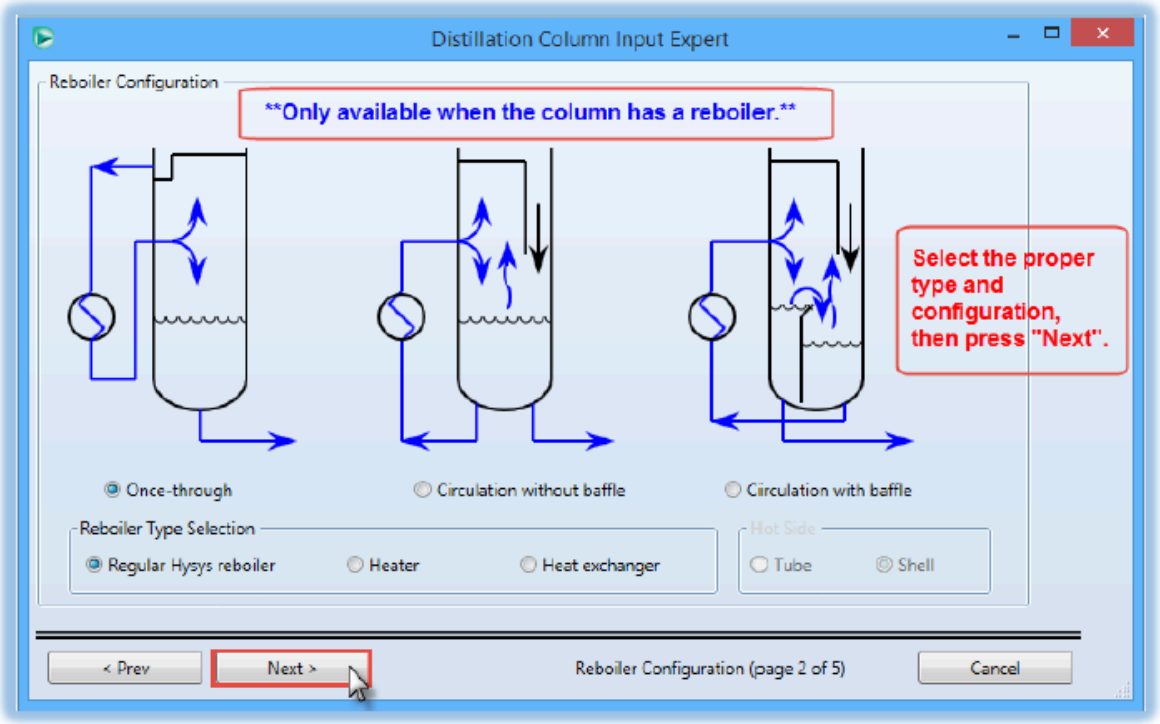
1. Specify the number of theoretical stages (or trays) in the column.
2. Specify the way the column is numbered.
3. Specify the inlet stream(s). For each inlet stream, select the stage the stream is entering column from the **Inlet Stage** drop-down list.
4. In the Condenser group click one of the following radio buttons: **Total**, **Partial**, or **Full Rflx**.
   - Total: all vapors condensed so, there is liquid product stream but no vapor product stream.
   - Partial: Vapors are partially condensed, and has liquid and vapor product streams.
   - Full Rflx: Full condenser but all its liquid product return the column as a reflux.

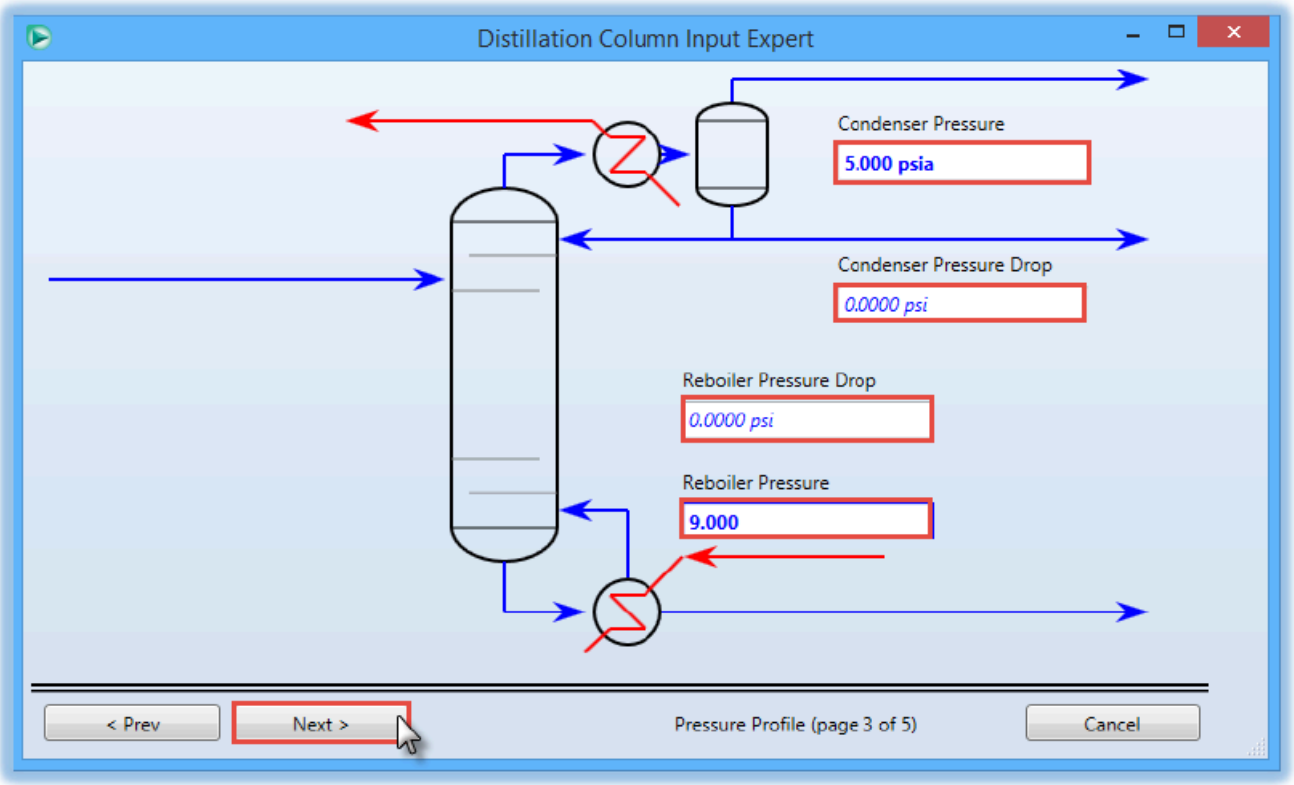




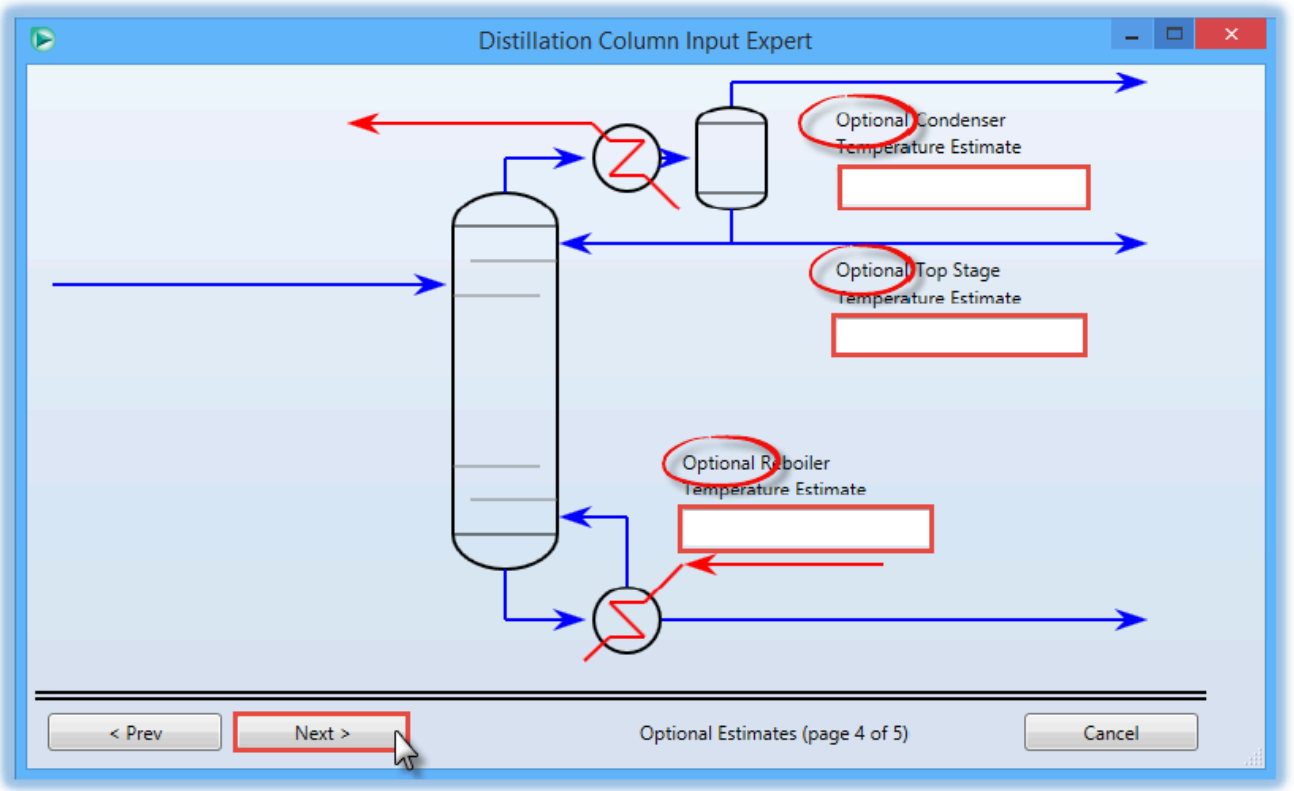


5. The **Water Draw** checkbox appears when either the **Total** or **Partial** radio button is selected.
6. For each optional side draw stream, select the type of draw stream from the **Type** drop-down list and select the stage the stream is leaving the column from the **Draw Stage** drop-down list. You are given three options: **L** (Liquid), **V** (Vapor), and **W** (Water).

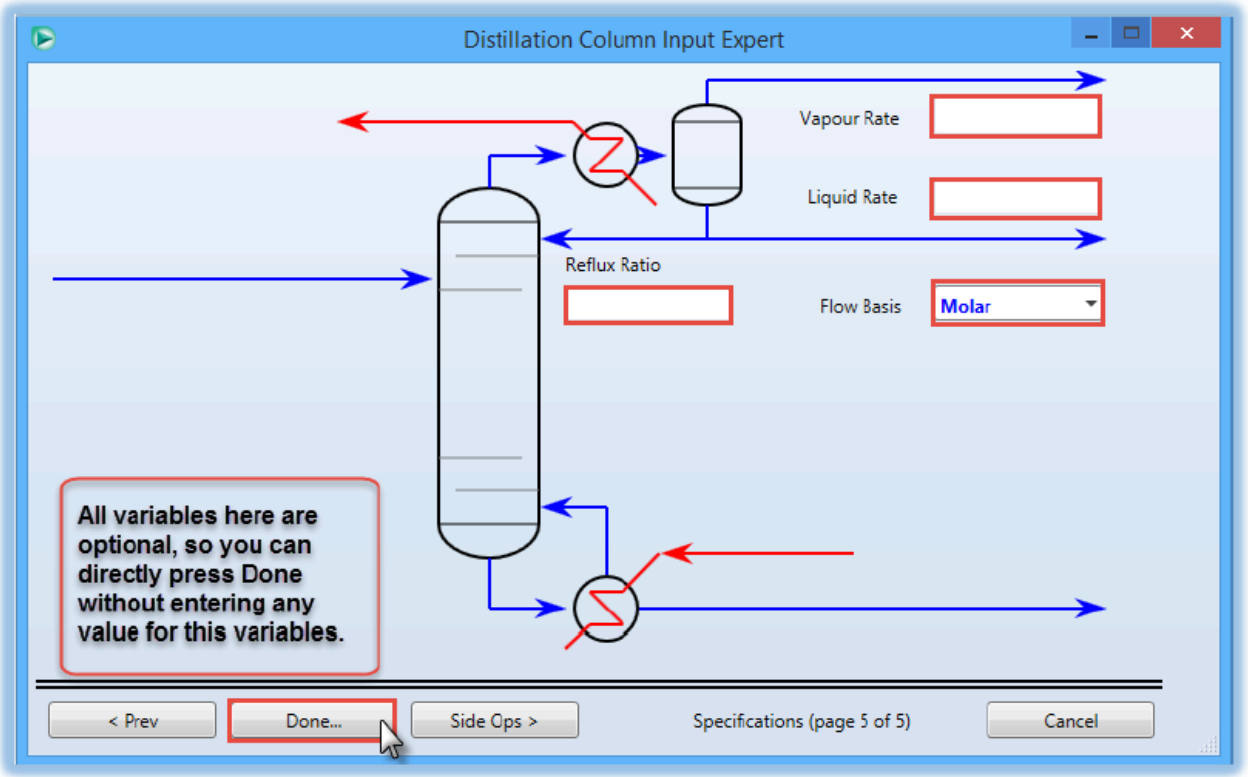




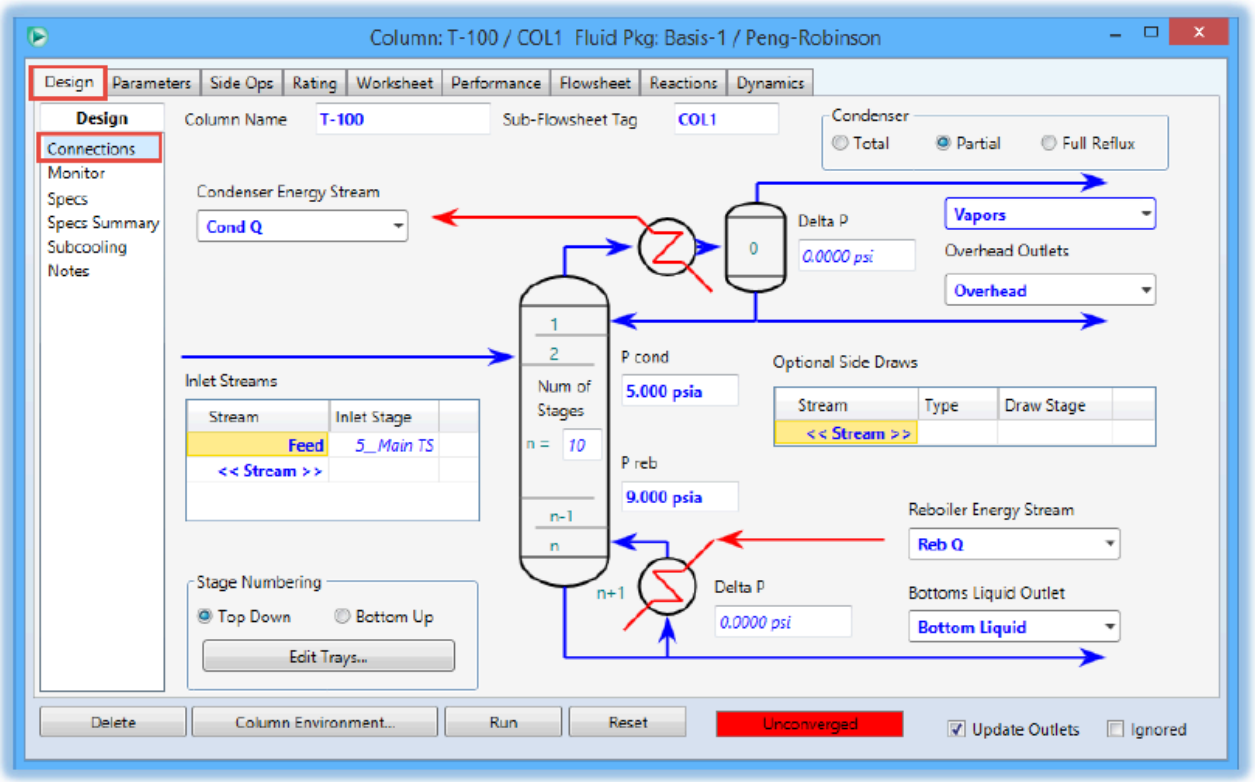
- If the column does not have a condenser, the condenser pressure replaced by the top stage pressure.
- If the column does not have a reboiler, the reboiler pressure replaced by the bottom stage pressure.



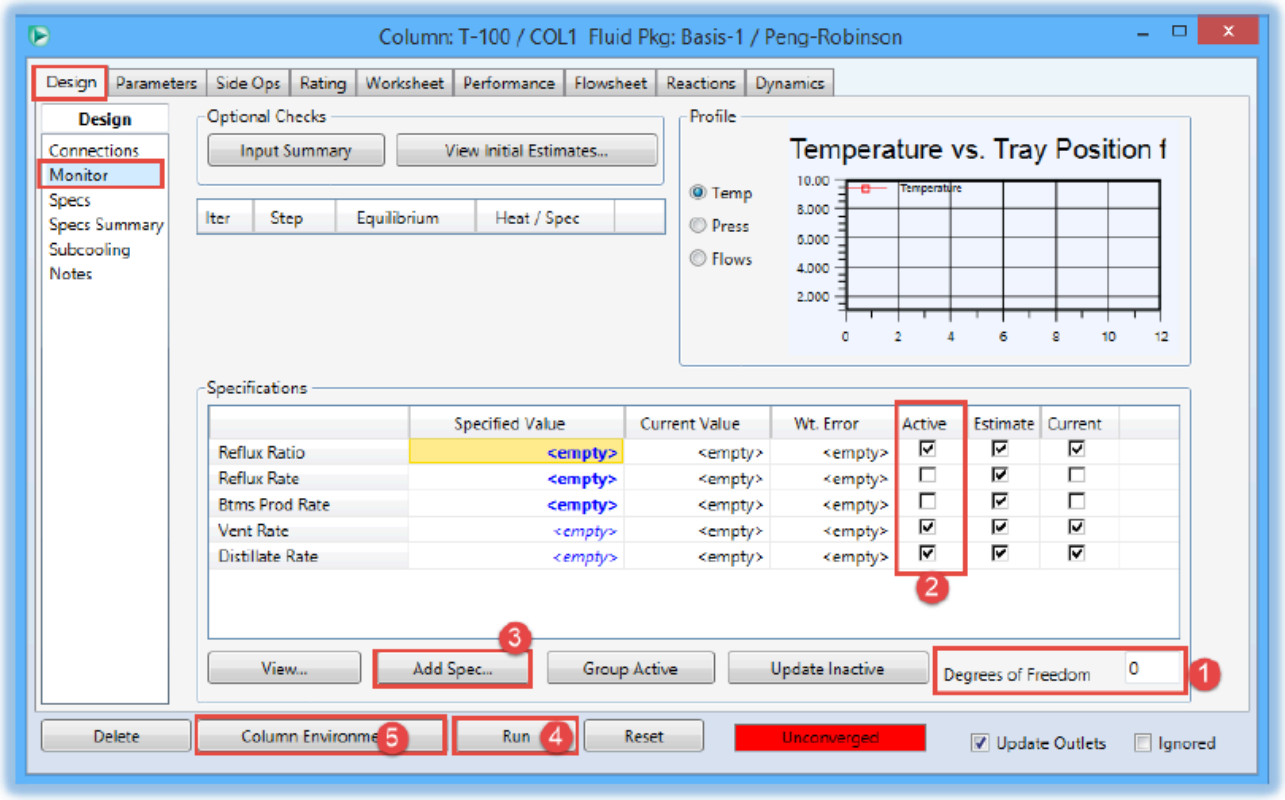
- If the column does not have a condenser, the condenser temperature will not be exist.
- If the reboiler does not exist, the reboiler temperature replaced by the bottom stage temperature.



- If the column has only a reboiler and does not have a condenser, then this page will ask for the reboiler "Boil-up Ratio".



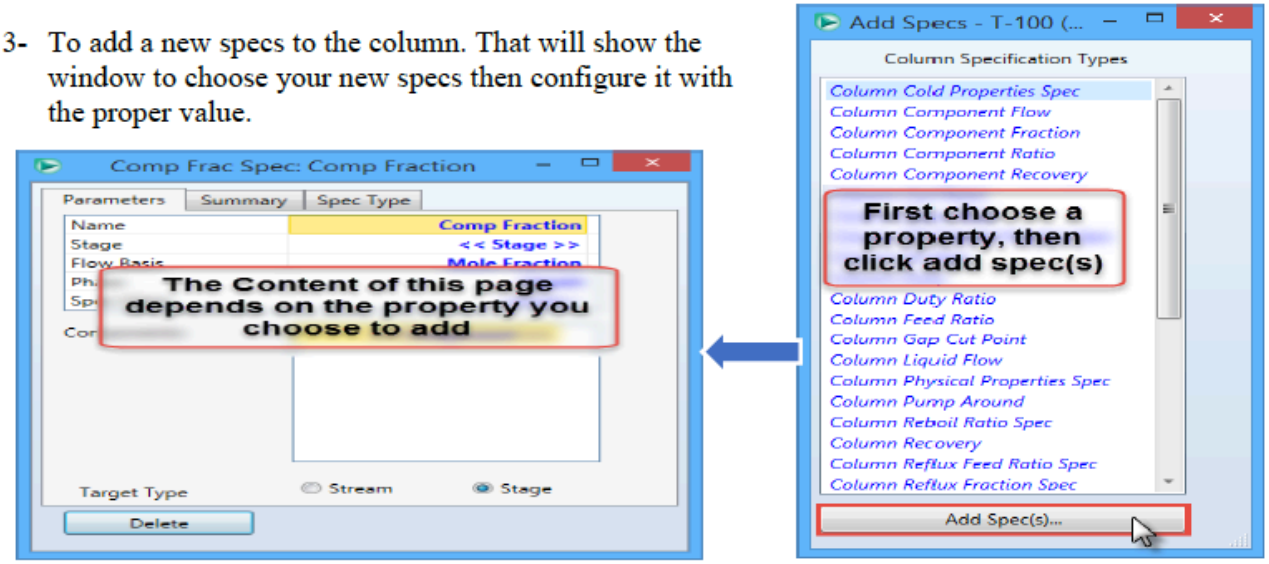
Before running the column, go to the "Monitor" page to see the column specs and which are active.



1- The degrees of freedom must equal zero for the column to be converged.

2- **Active**: The active specification is one that the convergence algorithm is trying to meet. An active specification always serves as an initial estimate. An active specification always exhausts one degree of freedom.
Estimate: An estimate is considered an inactive specification because the convergence algorithm is not trying to satisfy it. The value then serves only as an initial estimate for the convergence algorithm. An estimate does not exhaust an available degree of freedom.
Current: When the Active check box is selected, the Current check box is automatically selected as well. You cannot alter this check box. When Alternate specs are used and an existing hard to solve spec has been replaced with an Alternate spec, this check box makes clear to you the current specs used to solve the column.

3- To add a new specs to the column. That will show the window to choose your new specs then configure it with the proper value.



4- When you complete the configuration of the column, press Run to converge the column.

5- The Column Environment (Column Subflowsheet):

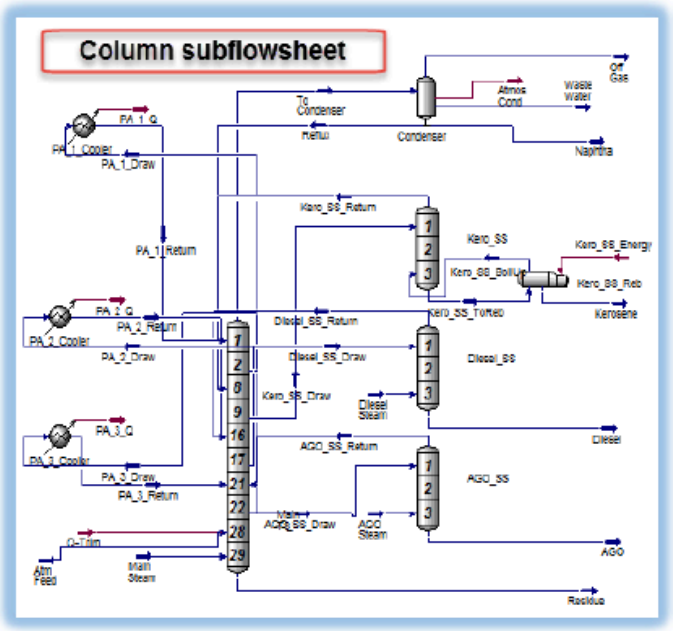
When you install any prebuilt column, HYSYS creates a column subflowsheet containing all operations and streams associated with the column template you have chosen. The subflowsheet operates as a unit operation in the main flowsheet.

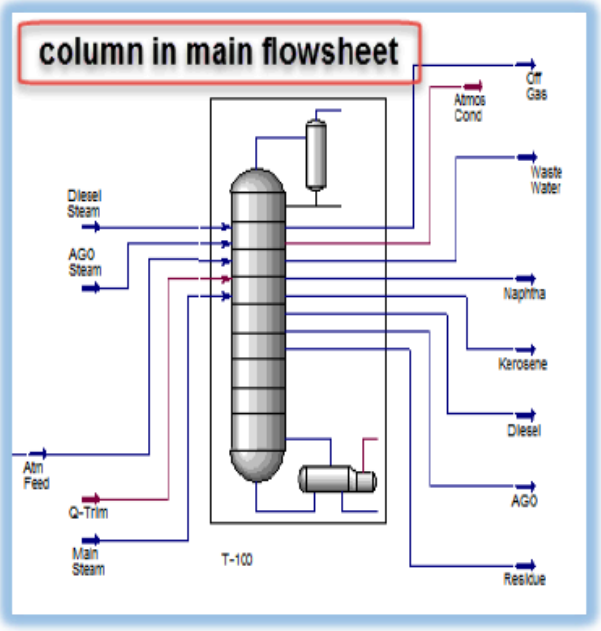
When you are working in the parent flowsheet, the column appears just as any other unit operation, with multiple input and output streams, and various adjustable parameters. If changes are made to any of these basic column parameters, both the Column subflowsheet and parent flowsheet are recalculated.

Having a Column subflowsheet provides a number of advantages: isolation of the Column Solver, optional use of different Property Packages, construction of custom templates, and the ability to solve multiple towers simultaneously.

From the Column window, you can enter the column's own subflowsheet, or the "column environment," and make changes to the specific parts of the column operation if necessary.

- To return to the Column's parent environment, click the Parent Environment button in the Column Runner property view or the View Parent icon in the toolbar.

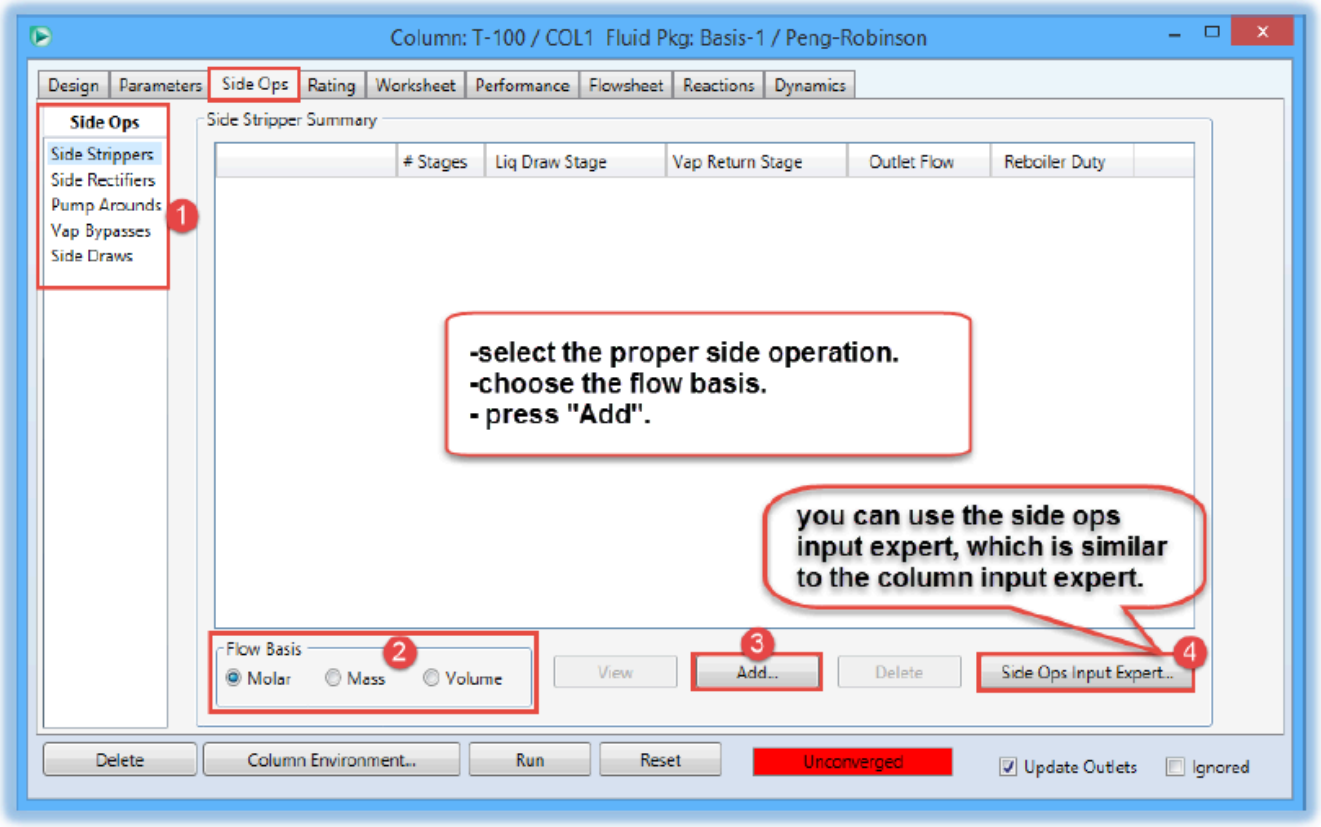




- **SIDE OPERATION IN COLUMNS:**

There are five type of side operations can be attached to the columns:

1. Side stripper (with reboiler or steam).
2. Side rectifier.
3. Pump around.
4. Vapor bypass.
5. Side draw.



They all require defining:

i. Draw stage.
ii. Return stage (except side draw).
iii. If exist, Specify the drawn product and its rate.
iv. If exist, specify reboiler or side steam stream.

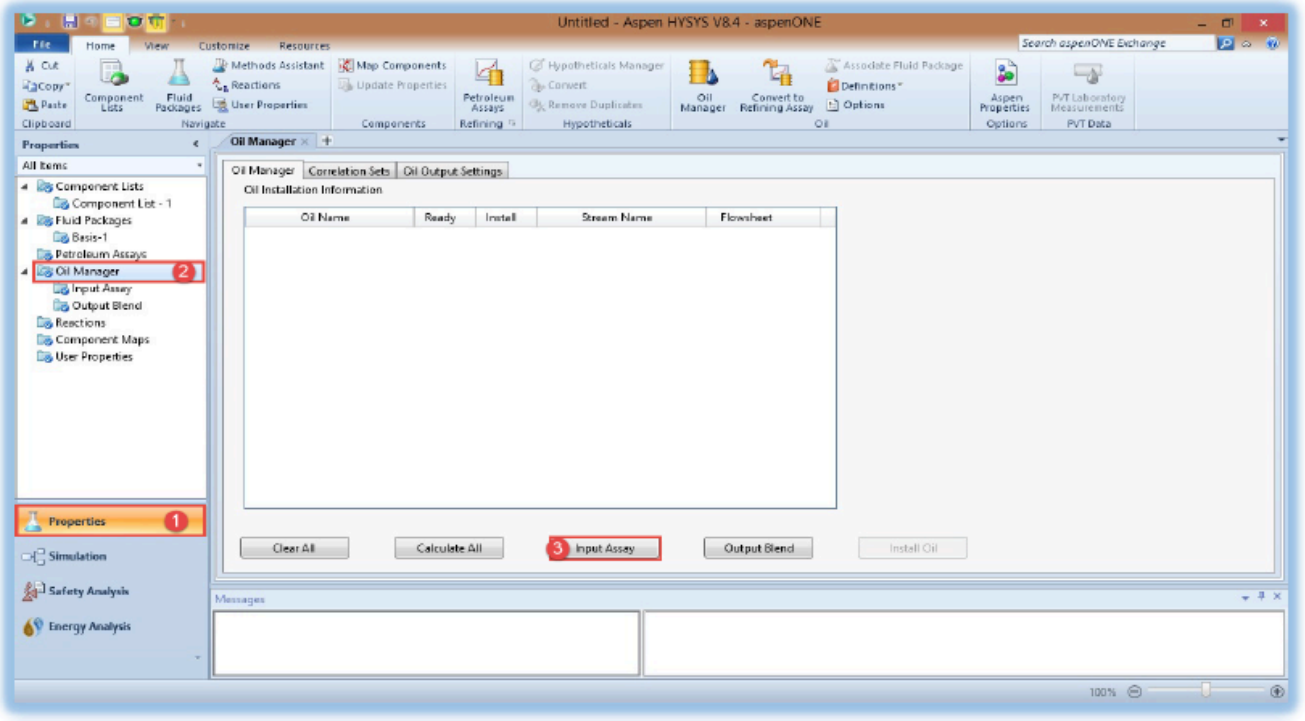
OIL CHARACTERIZATION

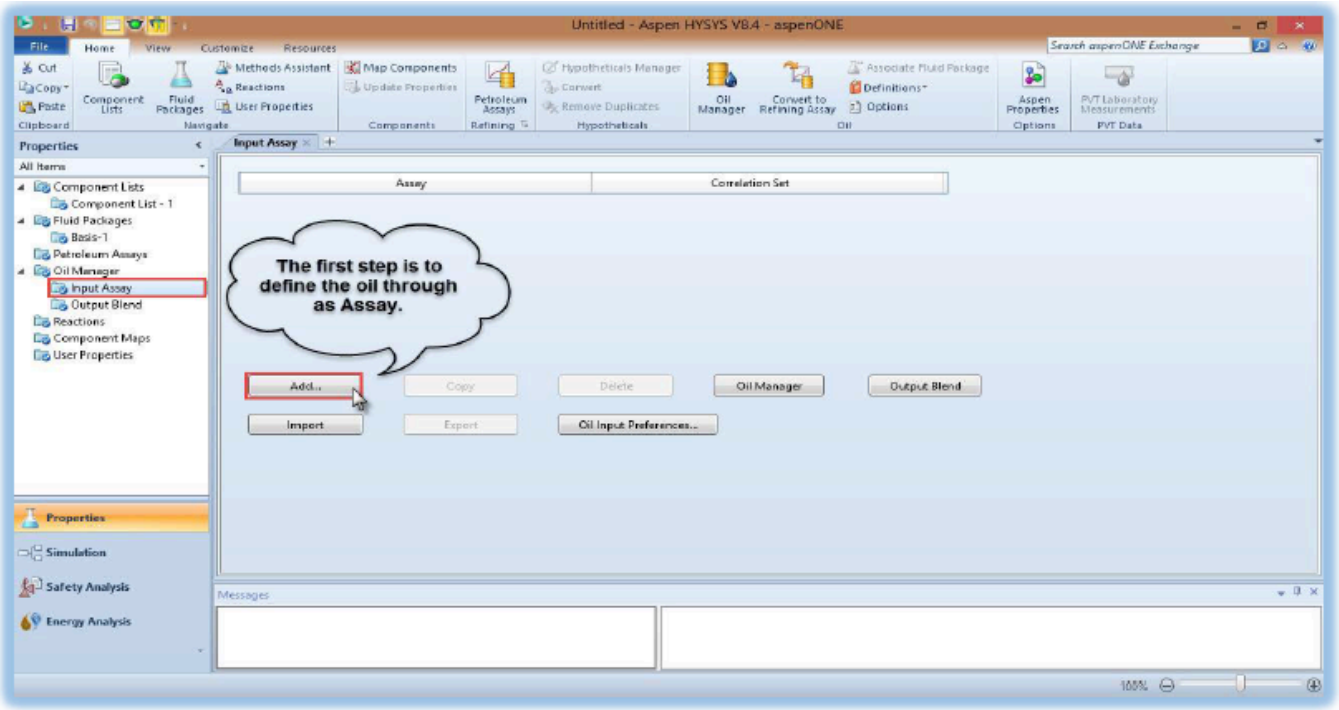
Installing crude oil in HYSYS to use it in simulation cases consist of two basic steps:

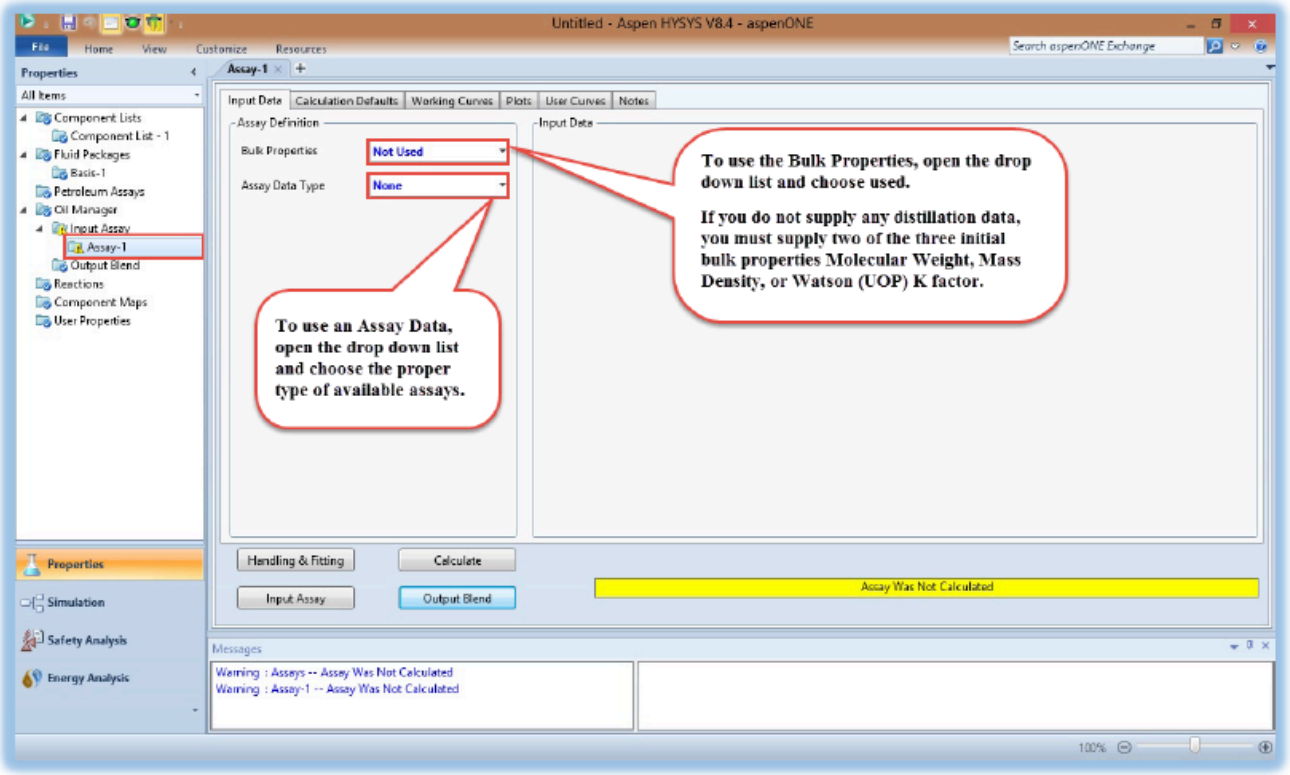
- Defining the crude oil using "Assays" (oil characterization).
- Creating a "Blend" by using discrete hypothetical components to install in the PFD.

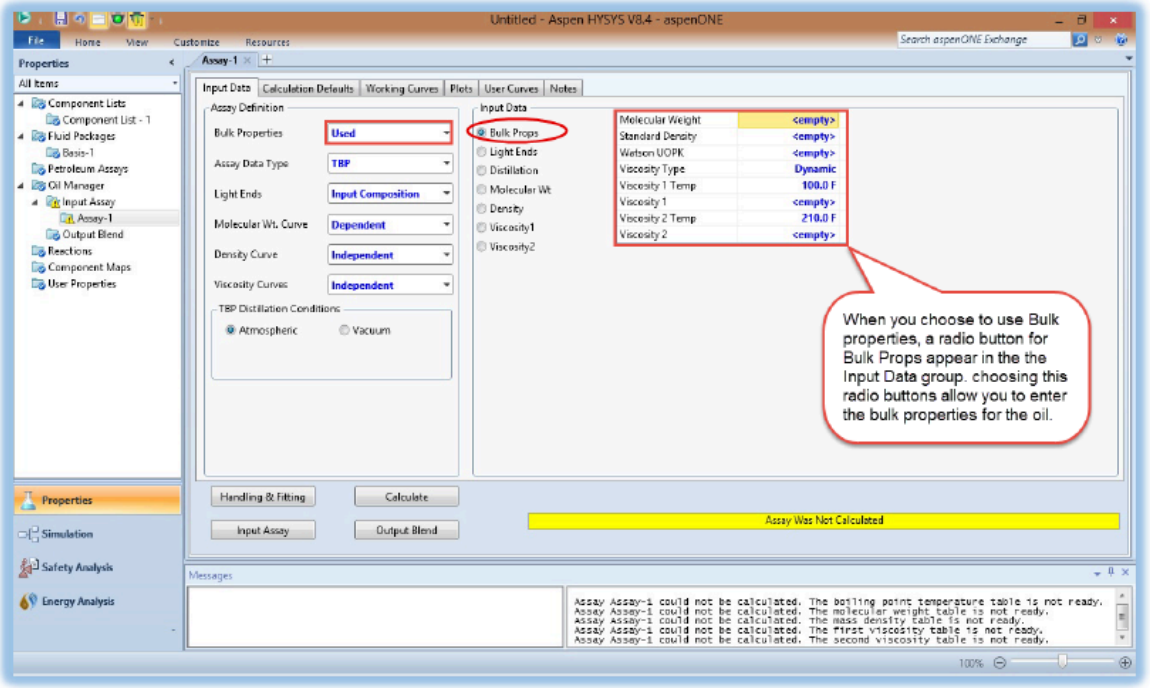
Both of these two steps are completed in the oil manager (also called oil environment). Access the Oil Characterization environment from the **Oil Manager** folder of the Properties Environment navigation pane.

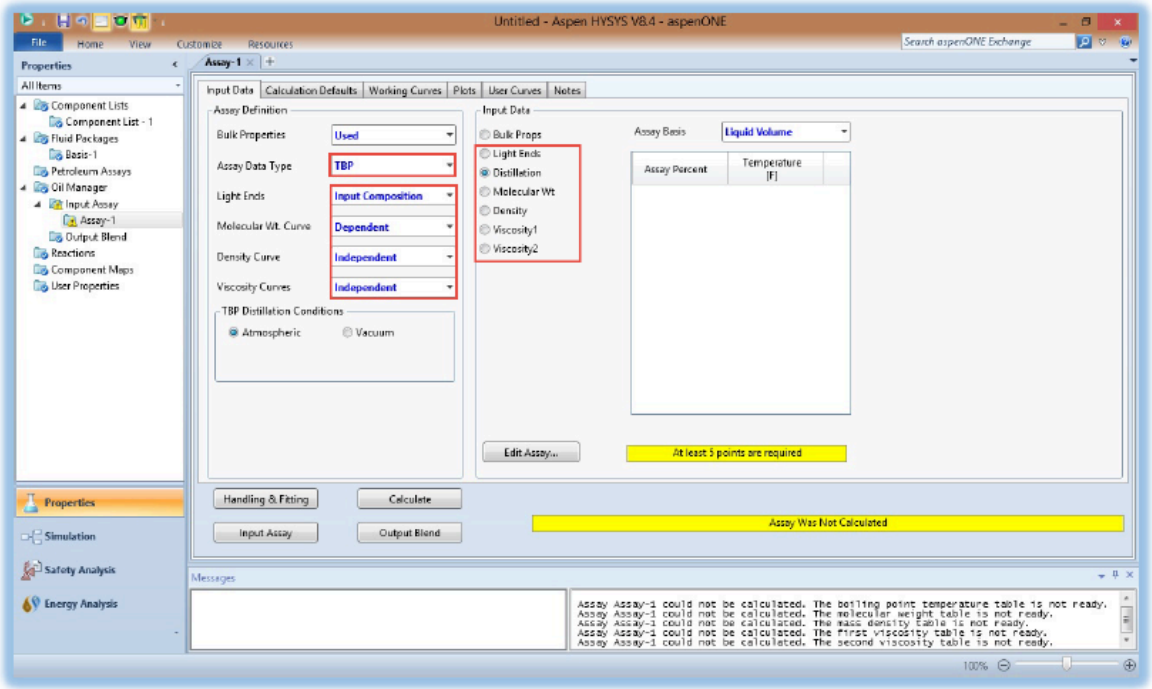
➢ To enter the environment, at least one Fluid Package must exist in the case and any hypothetical (pseudo) components must be compatible with the property method being used by the Fluid Package.




Untitled - Aspen HYSYS V8.4 - aspenONE
Input Assay
Assay
Correlation Set
The first step is to define the oil through as Assay.
Add...
Copy
Delete
Oil Manager
Output Blend
Import
Export
Oil Input Preferences...
Properties
Simulation
Safety Analysis
Energy Analysis
Messages


Untitled - Aspen HYSYS V8.4 - aspenONE
Assay-1
Input Data
Calculation Defaults
Working Curves
Plots
User Curves
Notes
Assay Definition
Bulk Properties
Not Used
Assay Data Type
None
Input Data
To use the Bulk Properties, open the drop down list and choose used.
If you do not supply any distillation data, you must supply two of the three initial bulk properties Molecular Weight, Mass Density, or Watson (UOP) K factor.
To use an Assay Data, open the drop down list and choose the proper type of available assays.
Handling & Fitting
Calculate
Input Assay
Output Blend
Assay Was Not Calculated
Warning : Assays -- Assay Was Not Calculated
Warning : Assay-1 -- Assay Was Not Calculated

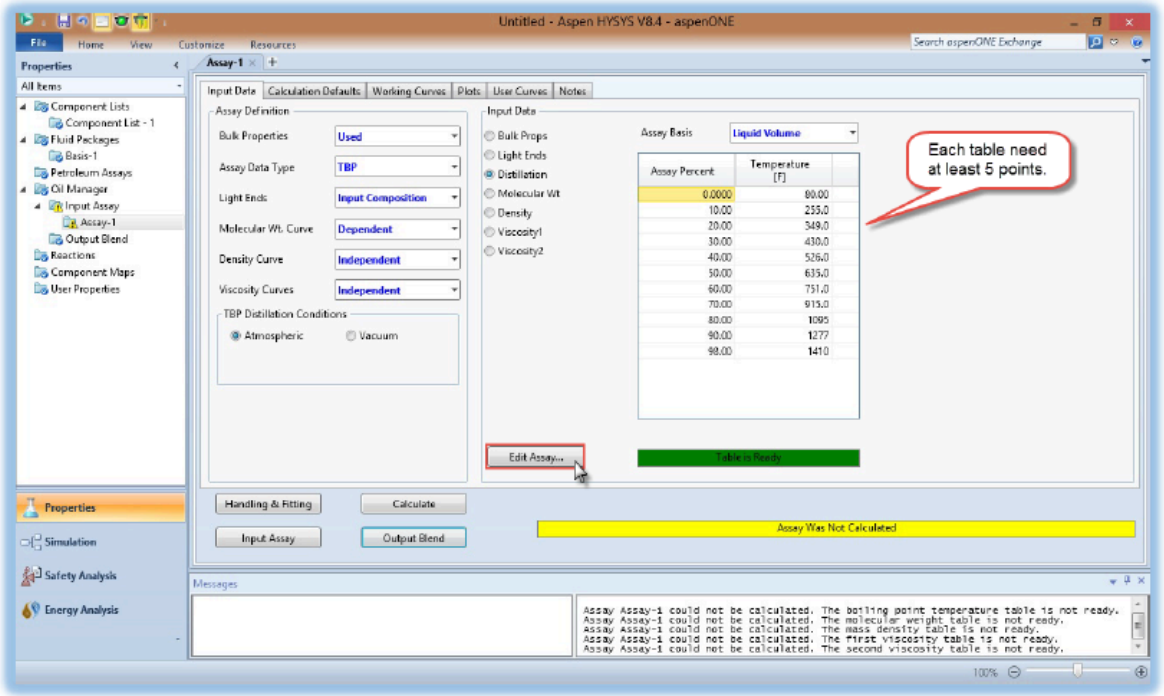

Untitled - Aspen HYSYS V8.4 - aspenONE
Assay-1
Input Data
Calculation Defaults
Working Curves
Plots
User Curves
Notes
Assay Definition
Bulk Properties
Used
Assay Data Type
TBP
Light Ends
Input Composition
Molecular Wt. Curve
Dependent
Density Curve
Independent
Viscosity Curves
Independent
TBP Distillation Conditions
Atmospheric
Vacuum
Input Data
Bulk Props
Light Ends
Distillation
Molecular Wt
Density
Viscosity1
Viscosity2
Molecular Weight
Standard Density
Watson UOPK
Viscosity Type
Viscosity 1 Temp
Viscosity 1
Viscosity 2 Temp
Viscosity 2
<empty>
Dynamic
100.0 F
210.0 F
When you choose to use Bulk properties, a radio button for Bulk Props appear in the the Input Data group. choosing this radio buttons allow you to enter the bulk properties for the oil.
Handling & Fitting
Calculate
Input Assay
Output Blend
Assay Was Not Calculated
Messages
Assay Assay-1 could not be calculated. The boiling point temperature table is not ready.
Assay Assay-1 could not be calculated. The molecular weight table is not ready.
Assay Assay-1 could not be calculated. The mass density table is not ready.
Assay Assay-1 could not be calculated. The first viscosity table is not ready.
Assay Assay-1 could not be calculated. The second viscosity table is not ready.

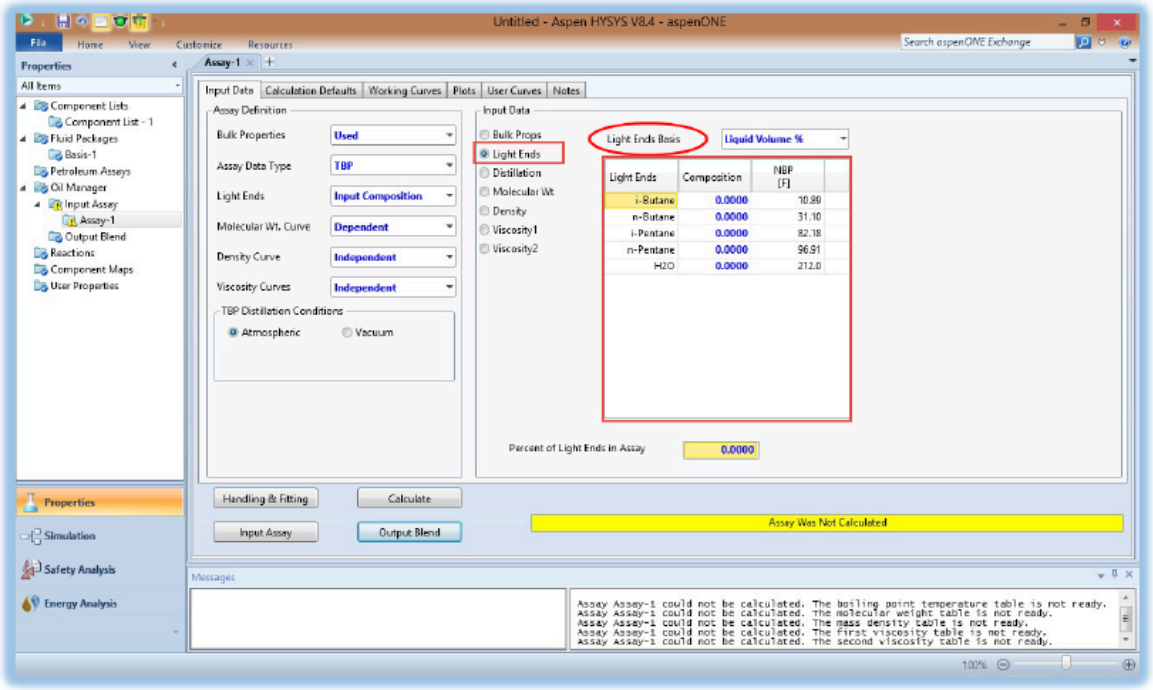

Untitled - Aspen HYSYS V8.4 - aspenONE
Assay-1
Input Data
Calculation Defaults
Working Curves
Plots
User Curves
Notes
Assay Definition
Bulk Properties
Used
Assay Data Type
TBP
Light Ends
Input Composition
Molecular Wt. Curve
Dependent
Density Curve
Independent
Viscosity Curves
Independent
TBP Distillation Conditions
Atmospheric
Vacuum
Input Data
Bulk Props
Light Ends
Distillation
Molecular Wt
Density
Viscosity1
Viscosity2
Assay Basis
Liquid Volume
Assay Percent
Temperature [F]
Edit Assay...
At least 5 points are required
Handling & Fitting
Calculate
Input Assay
Output Blend
Assay Was Not Calculated
Messages
Assay Assay-1 could not be calculated. The boiling point temperature table is not ready.
Assay Assay-1 could not be calculated. The molecular weight table is not ready.
Assay Assay-1 could not be calculated. The mass density table is not ready.
Assay Assay-1 could not be calculated. The first viscosity table is not ready.
Assay Assay-1 could not be calculated. The second viscosity table is not ready.

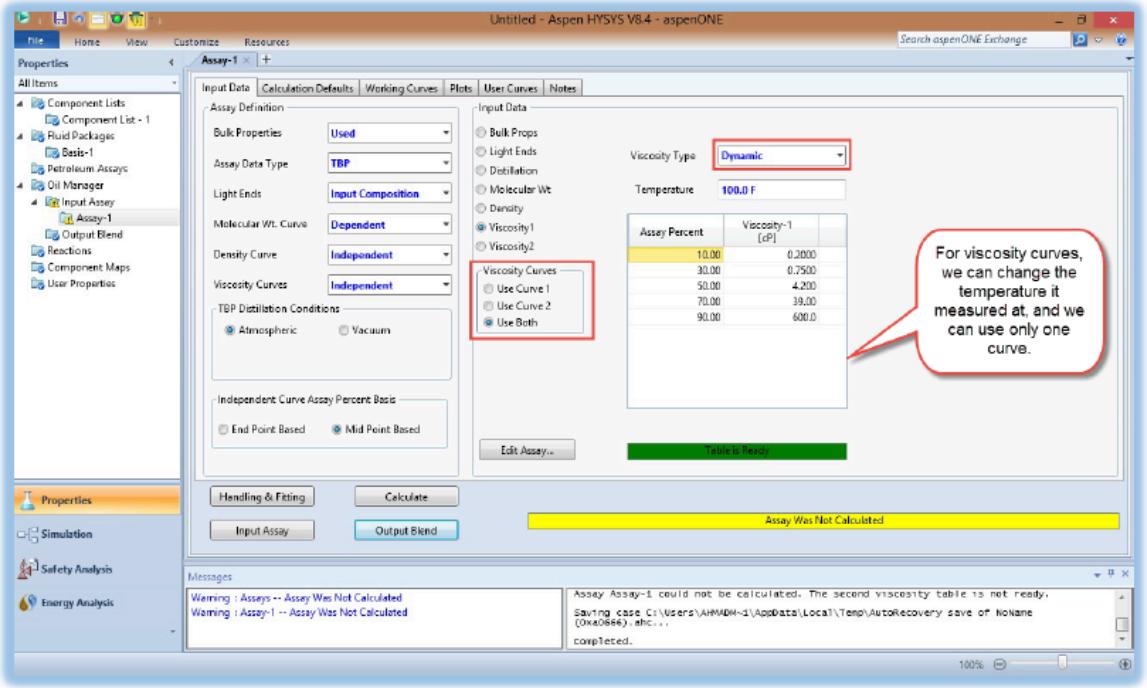
When you choose to use an Assay data, you have different options for dealing with the following properties:

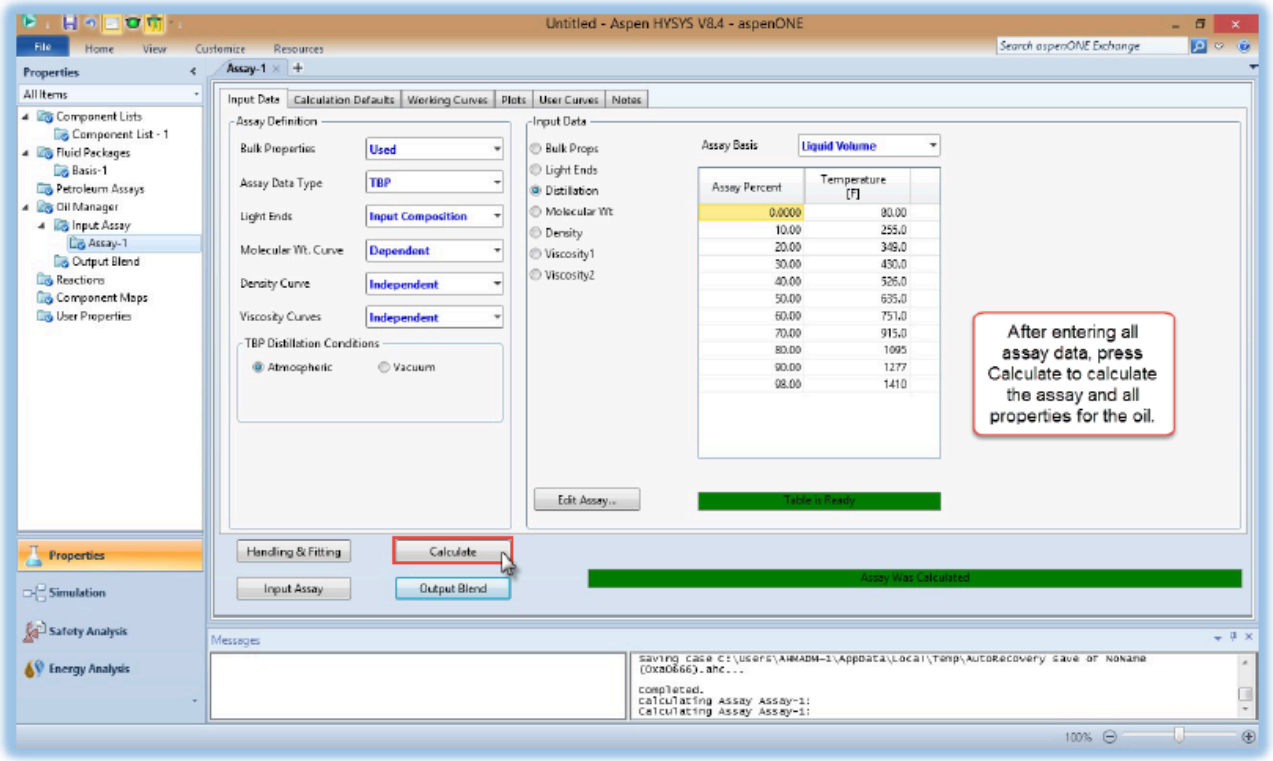
1. **Light Ends:**
   - **Ignore:** HYSYS will characterize the light ends portion of your sample as a hypocomponent. This is the least accurate method and as such, is not recommended.
   - **Input composition**: Select this when you have a separate light ends assay and your petroleum assay was prepared with the light ends in the sample. HYSYS will provide a form listing the pure components you selected in the Fluid Package. Input your data on a non-cumulative basis.
   - **Auto-Calculate**: Select this when you do not have a separate Light Ends analysis but you want the low boiling portion of your assay represented by pure components. HYSYS will only use the pure components you have selected in the Fluid Package.
2. **Molecular Wt. Curve, Density Curve, and Viscosity Curves:**
   - **Not used:** No property data will be considered in the assay calculation.
   - **Dependent**: A common set of assay fractions is utilized for both the distillation curve and the physical property curves.
   - **Independent**: A common set of assay fractions is not used for both the distillation curve and physical property curve.

If you switch the status to Not Used after you have entered assay data, all your data for that property curve will be lost when you return your selection to Dependent or Independent.

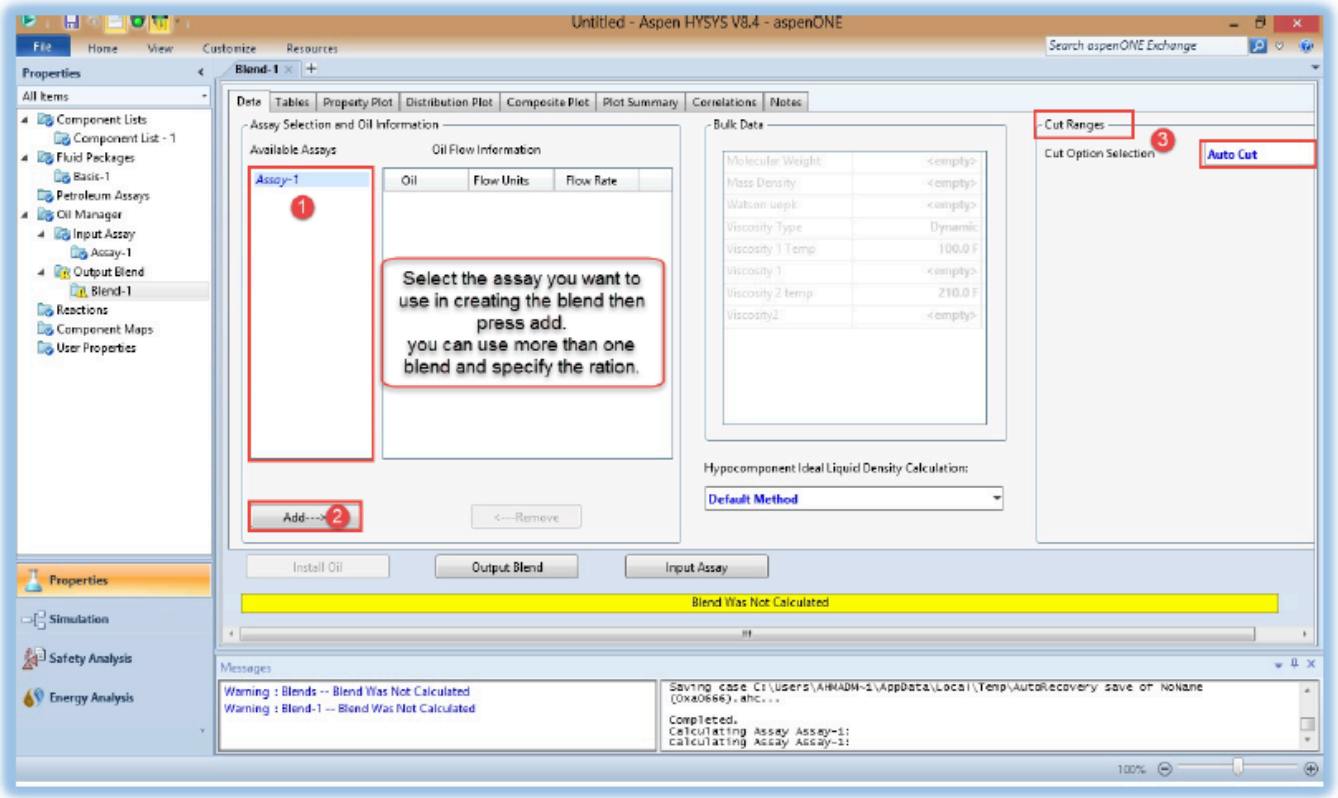



Untitled - Aspen HYSYS V8.4 - aspenONE
Assay-1
Input Data
Calculation Defaults
Working Curves
Plots
User Curves
Notes
Assay Definition
Bulk Properties
Used
Assay Data Type
TBP
Light Ends
Input Composition
Molecular Wt. Curve
Dependent
Density Curve
Independent
Viscosity Curves
Independent
TBP Distillation Conditions
Atmospheric
Vacuum
Input Data
Bulk Props
Light Ends
Distillation
Molecular Wt
Density
Viscosity1
Viscosity2
Light Ends Basis
Liquid Volume %
Light Ends
Composition
NBP [F]
i-Butane 0.0000 10.89
n-Butane 0.0000 31.10
i-Pentane 0.0000 82.18
n-Pentane 0.0000 96.91
H2O 0.0000 212.0
Percent of Light Ends in Assay
0.0000
Handling & Fitting
Calculate
Input Assay
Output Blend
Assay Was Not Calculated
Properties
Simulation
Safety Analysis
Energy Analysis
Messages
Assay Assay-1 could not be calculated. The boiling point temperature table is not ready.
Assay Assay-1 could not be calculated. The molecular weight table is not ready.
Assay Assay-1 could not be calculated. The mass density table is not ready.
Assay Assay-1 could not be calculated. The first viscosity table is not ready.
Assay Assay-1 could not be calculated. The second viscosity table is not ready.


Untitled - Aspen HYSYS V8.4 - aspenONE
Assay-1
Input Data
Calculation Defaults
Working Curves
Plots
User Curves
Notes
Assay Definition
Bulk Properties
Used
Assay Data Type
TBP
Light Ends
Input Composition
Molecular Wt. Curve
Dependent
Density Curve
Independent
Viscosity Curves
Independent
TBP Distillation Conditions
Atmospheric
Vacuum
Independent Curve Assay Percent Basis
End Point Based
Mid Point Based
Input Data
Bulk Props
Light Ends
Distillation
Molecular Wt
Density
Viscosity1
Viscosity2
Viscosity Curves
Use Curve 1
Use Curve 2
Use Both
Viscosity Type
Dynamic
Temperature
100.0 F
Assay Percent
Viscosity-1 [cP]
10.00 0.2000
30.00 0.7500
50.00 4.200
70.00 39.00
90.00 600.0
For viscosity curves, we can change the temperature it measured at, and we can use only one curve.
Edit Assay...
Table is Ready
Handling & Fitting
Calculate
Input Assay
Output Blend
Assay Was Not Calculated
Properties
Simulation
Safety Analysis
Energy Analysis
Messages
Warning : Assays -- Assay Was Not Calculated
Warning : Assay-1 -- Assay Was Not Calculated
Assay Assay-1 could not be calculated. The second viscosity table is not ready.
completed.



- **Second Step: Creating a "Blend":-**



From the **Cut Option Selection** drop-down list select one of the following cut options:

Auto Cut: HYSYS will perform the cutting automatically. HYSYS uses the boiling point width guidelines.

Cutpoint Range	Internal Weighting
IBP - 800°F (425°C)	4 per 100°F
800°F - 1200°F (650°C)	2 per 100°F
1200°F to FBP	1 per 100°F

User Ranges:

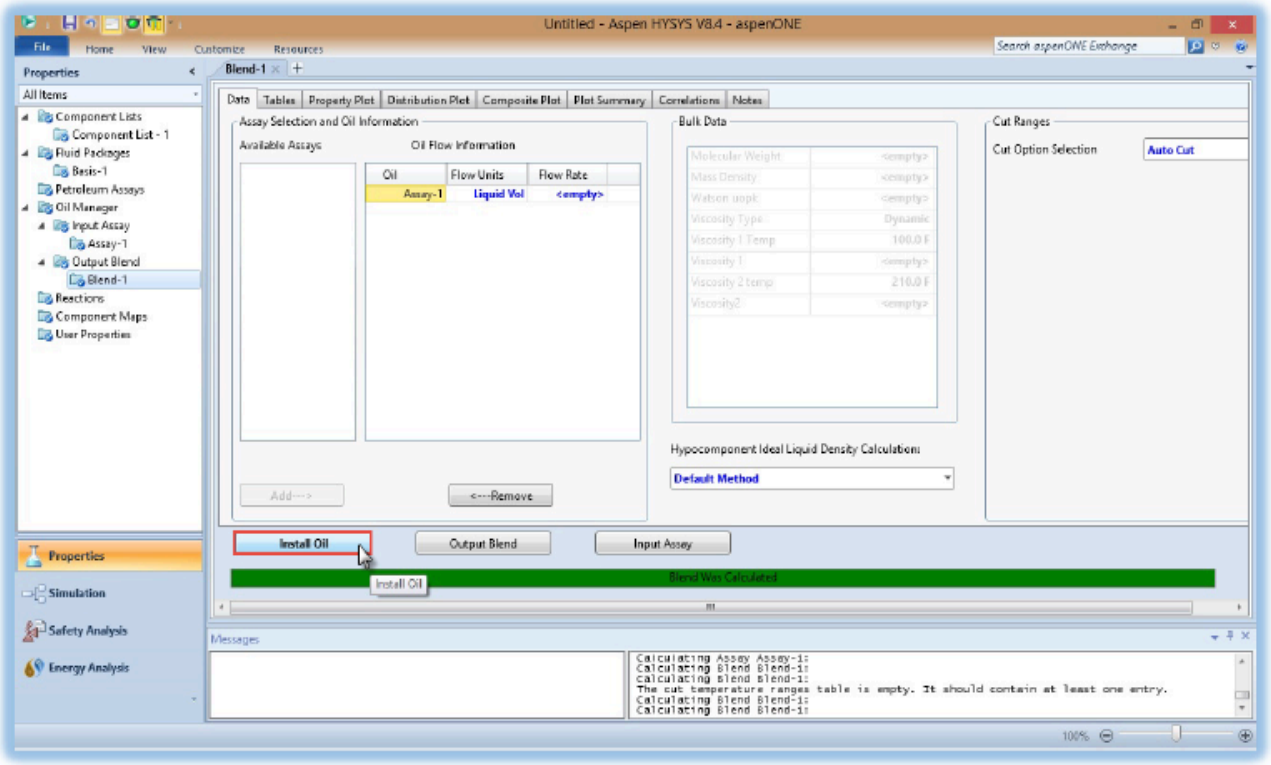
1. In the Starting Cut Point cell, specify the initial cut point of your blend. By default HYSYS will use the initial boiling point temperature. HYSYS combines the material boiling between the IBP and the initial cut point temperature with the material from the first cut to produce the first component. This component will have an NBP centered approximately half way between these boundaries.
2. In the cut point table enter the remaining cut points and the number of cuts in each section. If the final cut point temperature is not equal to or greater than the FBP, HYSYS will combine the material between the FBP and the last cut temperature with the material in the last component.
3. The Lower Temp Limit and Upper Temp Limit fields correspond to the initial boiling point (IBP) and the final boiling point (FBP) of HYSYS' internal TBP working curve. At this point all light ends have been removed (if requested) and the IBP presented is on a light ends free basis.
4. Click Submit to tell HYSYS to create the hypocomponents.

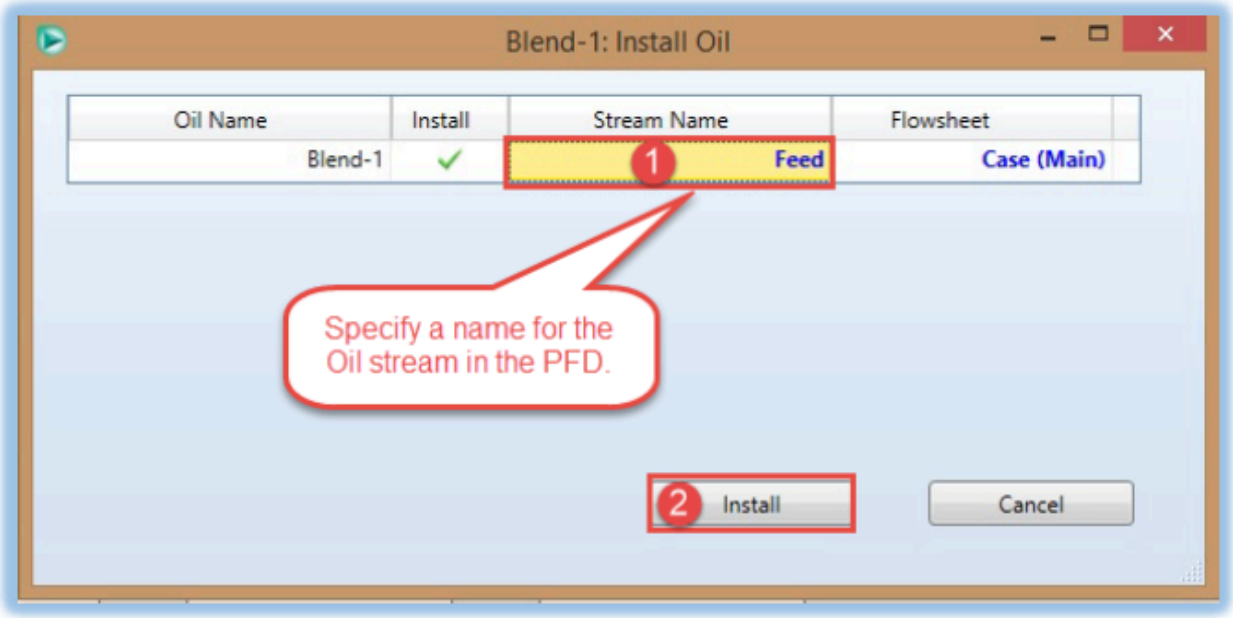
User Points:

Specify the number of cuts you want to use for the oil and HYSYS will perform the cutting process. All splits are based upon TBP temperature, independent of the source or type of assay data. HYSYS will proportion the cuts according to the following:

Cutpoint Range	Internal Weighting
IBP - 800°F (425°C)	4 per 100°F
800°F - 1200°F (650°C)	2 per 100°F
1200°F to FBP	1 per 100°F

After the blend calculated, press install Oil to install a material stream in the PFD represent the oil you specified.





CHEMICAL REACTIONS

Reactions within HYSYS are defined inside the Reaction Manager. The Reaction Manager lets you define an unlimited number of reactions and attach combinations of these reactions in reaction sets. The reaction sets are then attached to unit operations in the flowsheet.

The following table describes the five types of Reactions that can be modeled in HYSYS:

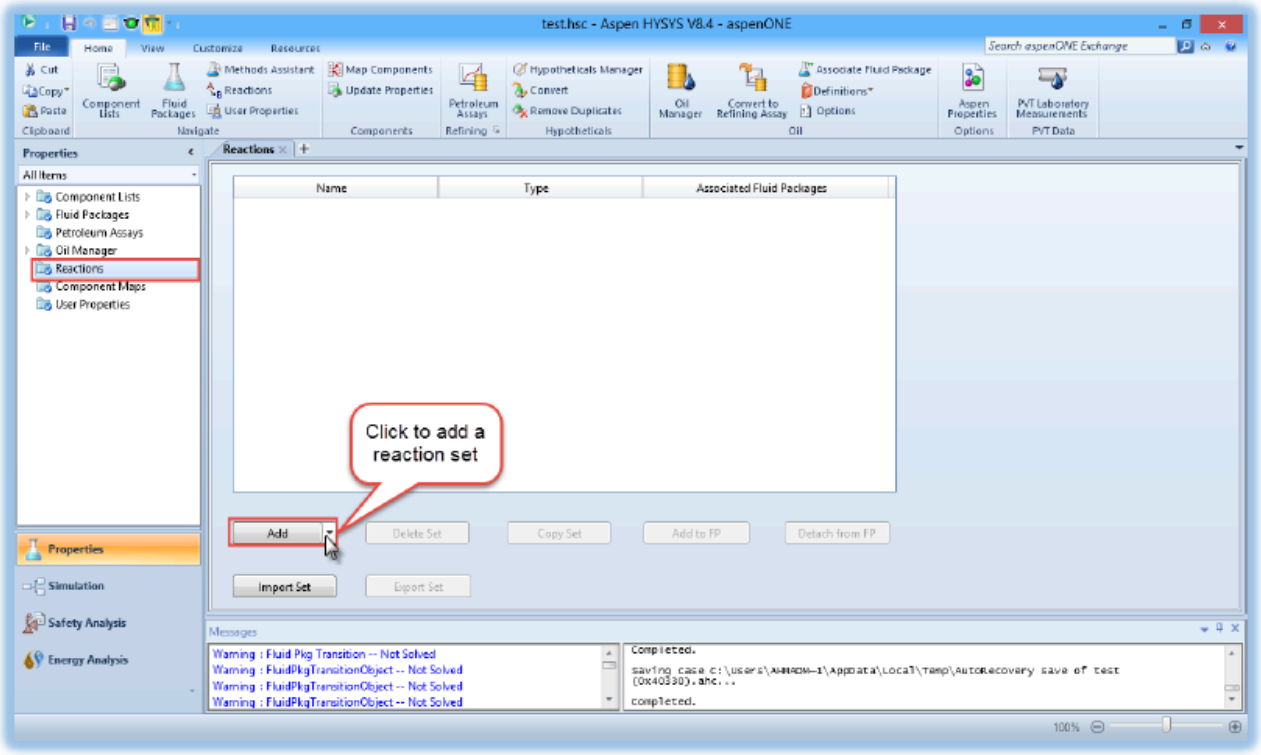
Reaction Type	Requirements
Conversion	Requires the stoichiometry of all the reactions and the conversion of a base component in the reaction.
Equilibrium	Requires the stoichiometry of all the reactions. The term Ln(K) may be calculated using one of several different methods, as explained later. The reaction order for each component is determined from the stoichiometric coefficients.
Heterogeneous Catalytic	Requires the kinetics terms of the Kinetic reaction as well as the Activation Energy, Frequency Factor, and Component Exponent terms of the Adsorption kinetics.
Kinetic	Requires the stoichiometry of all the reactions, as well as the Activation Energy and Frequency Factor in the Arrhenius equation for forward and reverse (optional) reactions. The forward and reverse orders of reaction for each component can be specified.
Simple Rate	Requires the stoichiometry of all the reactions, as well as the Activation Energy and Frequency Factor in the Arrhenius equation for the forward reaction. The Equilibrium Expression constants are required for the reverse reaction.

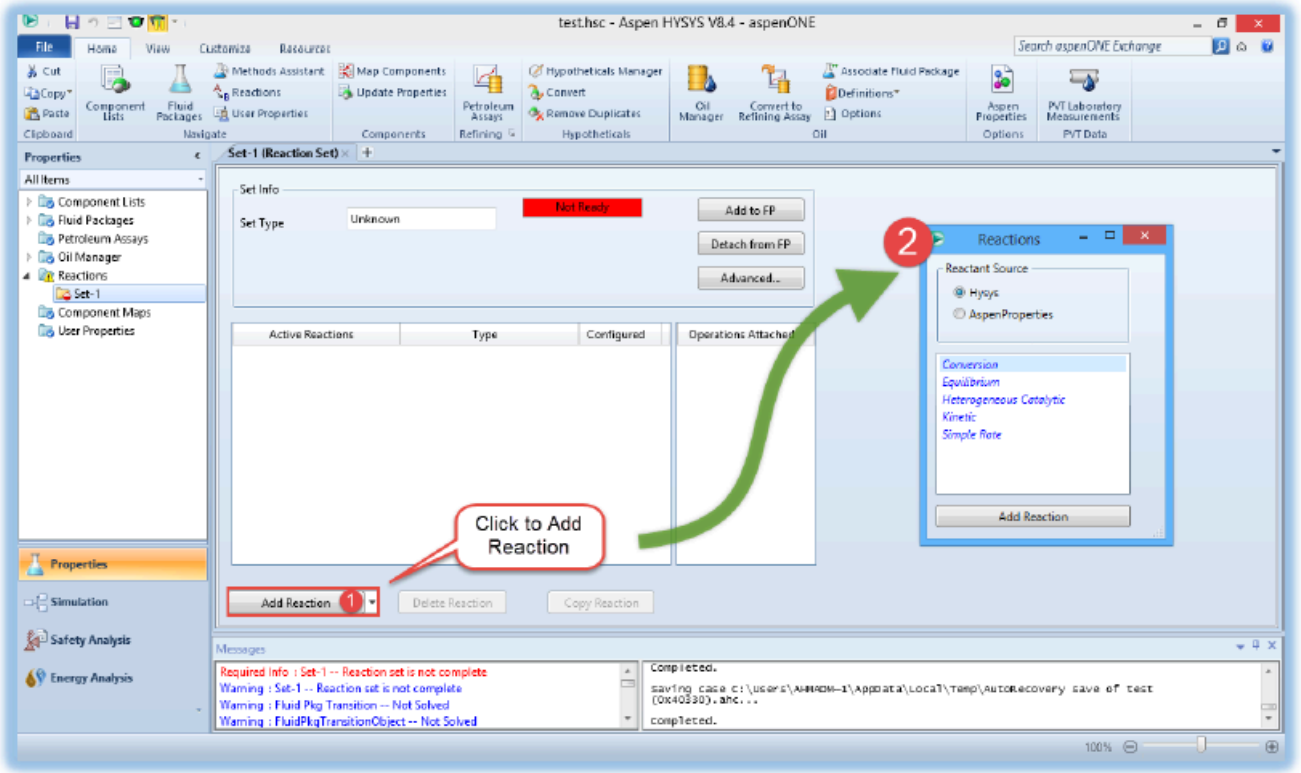
Each of the reaction types require that you supply the stoichiometry. To assist with this task, the Balance Error tracks the molecular weight and supplied stoichiometry. If the reaction equation is balanced, this error is equal to zero. If you have provided all of the stoichiometric coefficients except one, you may select the Balance button to have HYSYS determine the missing stoichiometric coefficient.

Reactions can be on a phase specific basis. The Reaction is applied only to the components present in that phase. This allows different rate equations for the vapour and liquid phase in same reactor operation.

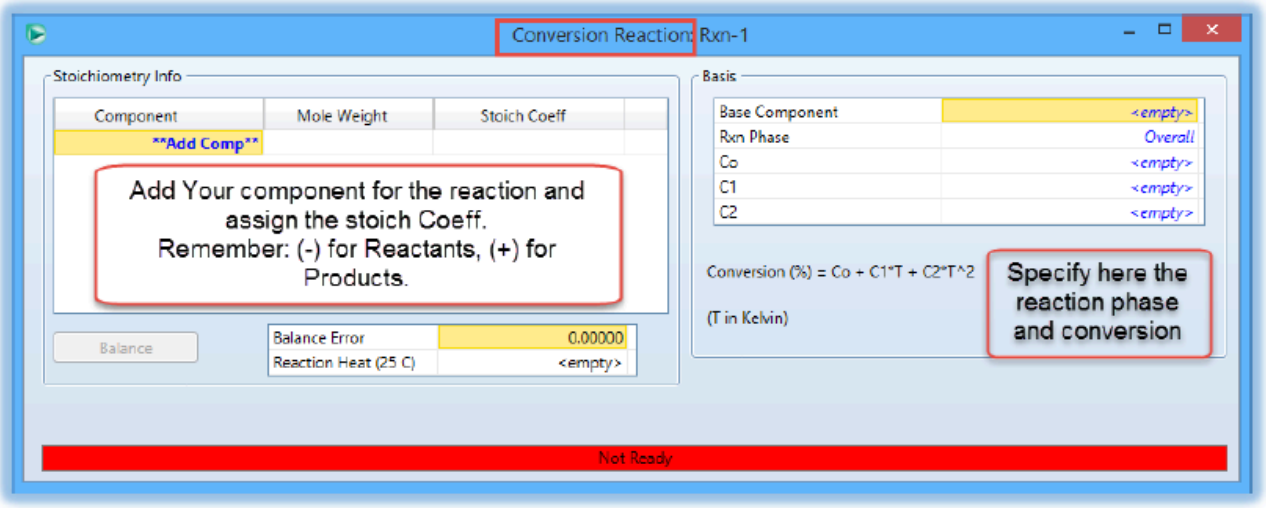
Possible choices for the Reaction Phase are:

- Overall Reaction -- occurs in all Phases.
- Vapour Phase Reaction -- occurs only in the Vapour Phase.
- Liquid Phase Reaction -- occurs only in the Light Liquid Phase.
- Aqueous Phase Reaction -- occurs only in the Heavy Liquid Phase.
- Combined Liquid Reaction -- occurs in all Liquid Phases.

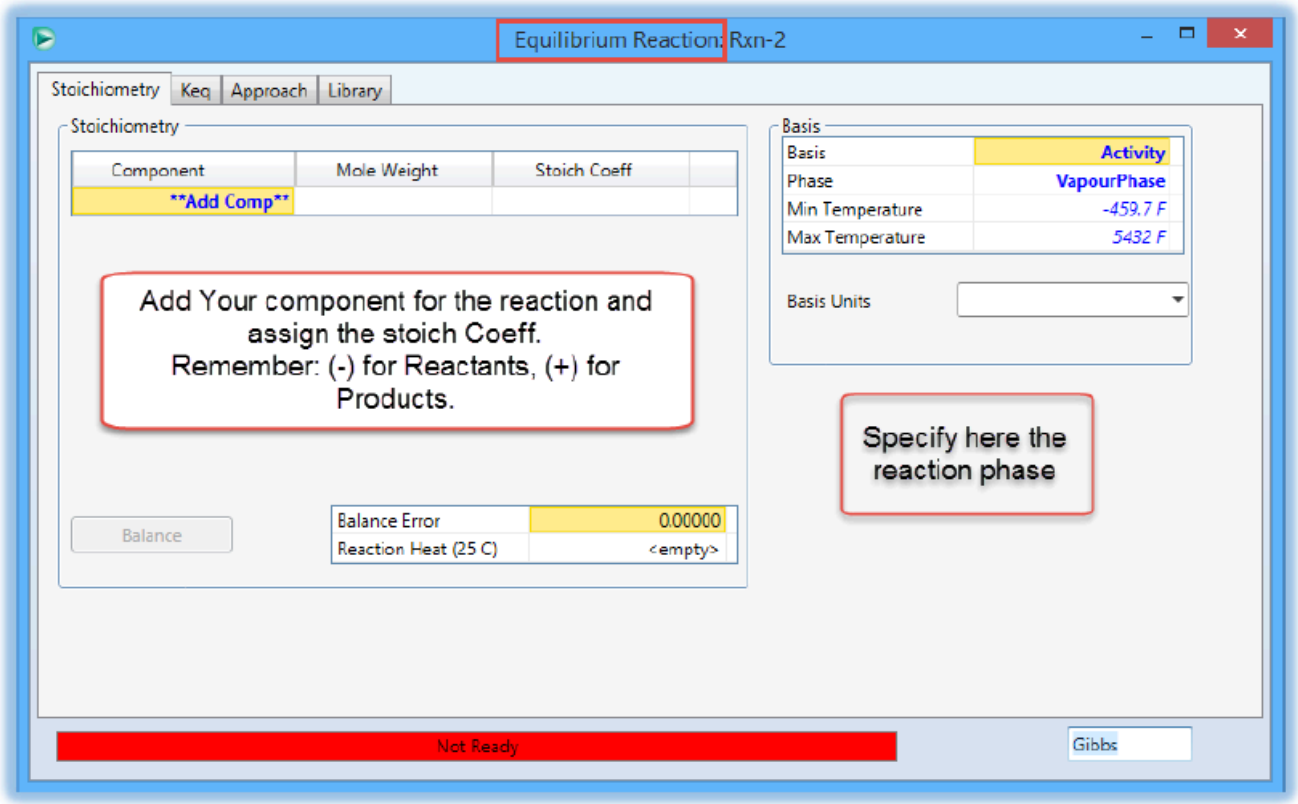

test.hsc - Aspen HYSYS V8.4 - aspenONE
Reactions
Name
Type
Associated Fluid Packages
Click to add a reaction set
Add
Delete Set
Copy Set
Add to FP
Detach from FP
Import Set
Export Set
Messages
Warning : Fluid Pkg Transition -- Not Solved
Warning : FluidPkgTransitionObject -- Not Solved
Warning : FluidPkgTransitionObject -- Not Solved
Warning : FluidPkgTransitionObject -- Not Solved
Completed.
completed.

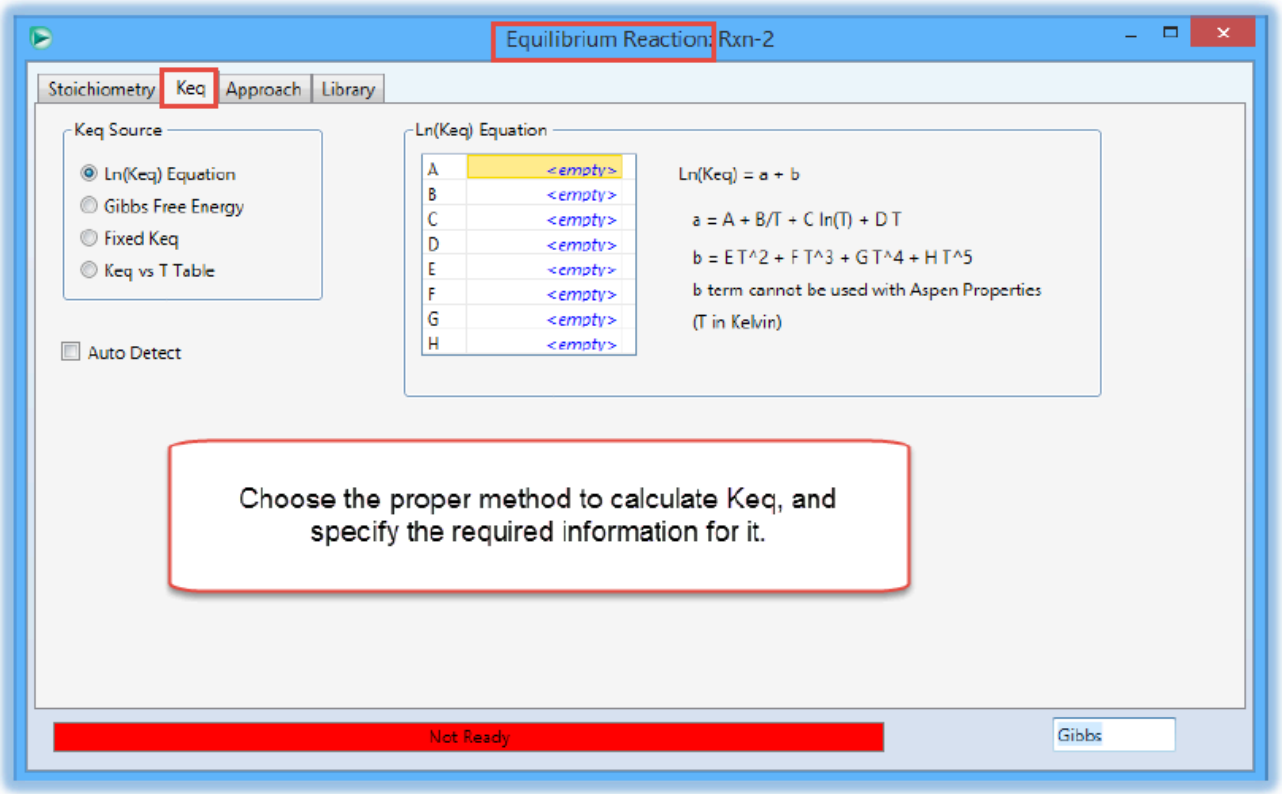

test.hsc - Aspen HYSYS V8.4 - aspenONE
Set-1 (Reaction Set)
Set Info
Set Type
Unknown
Not Ready
Add to FP
Detach from FP
Advanced...
Active Reactions
Type
Configured
Operations Attached
Reactions
Reactant Source
Hysys
AspenProperties
Conversion
Equilibrium
Heterogeneous Catalytic
Kinetic
Simple Rate
Add Reaction
Click to Add Reaction
Add Reaction
Delete Reaction
Copy Reaction
Messages
Required Info : Set-1 -- Reaction set is not complete
Warning : Set-1 -- Reaction set is not complete
Warning : Fluid Pkg Transition -- Not Solved
Warning : FluidPkgTransitionObject -- Not Solved
Completed.
completed.

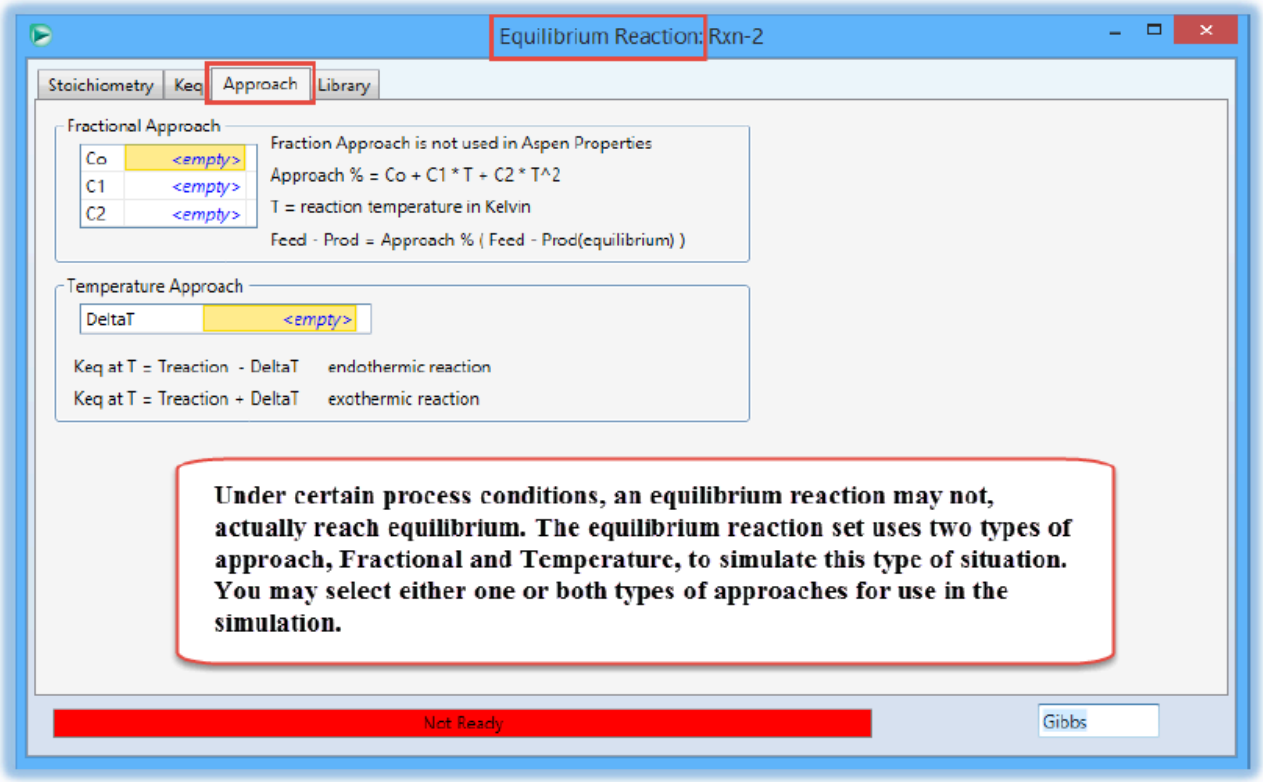
- **Conversion Reaction:**

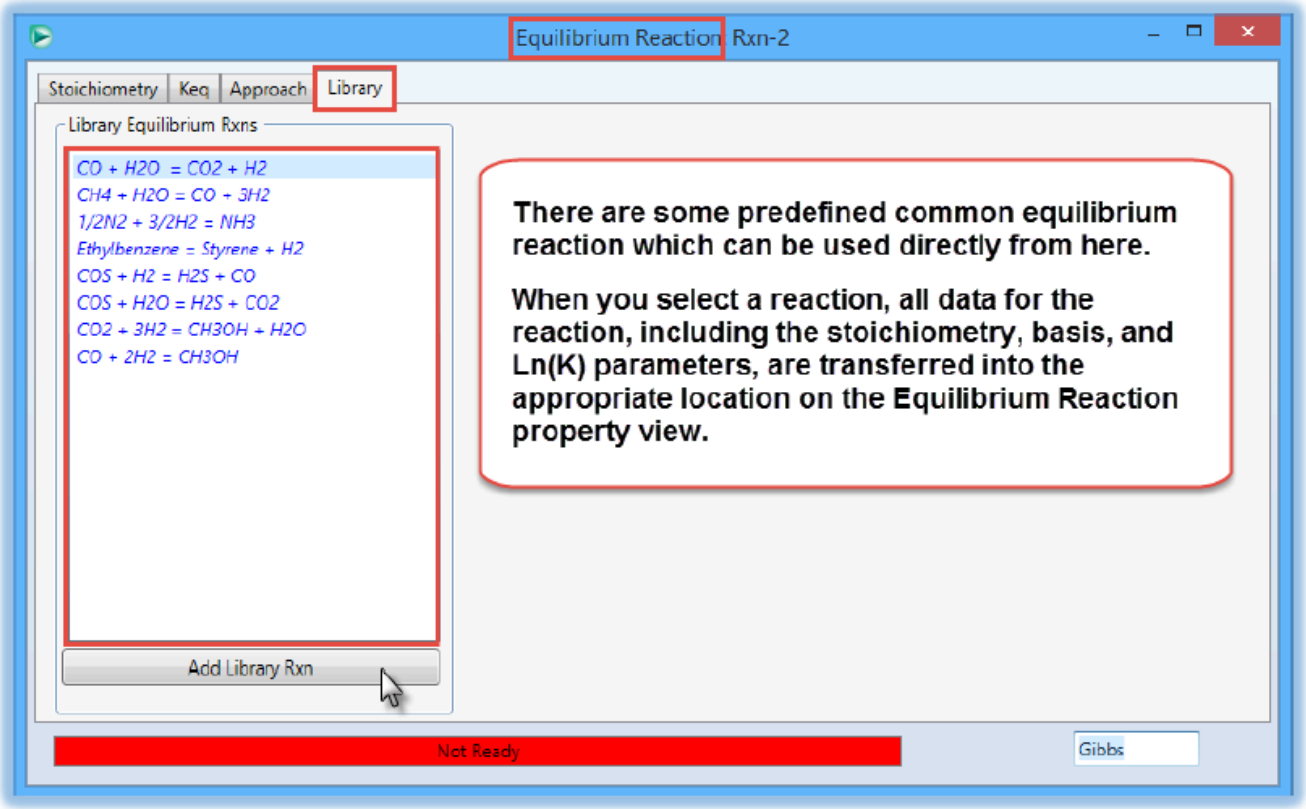


- **Equilibrium Reaction:**

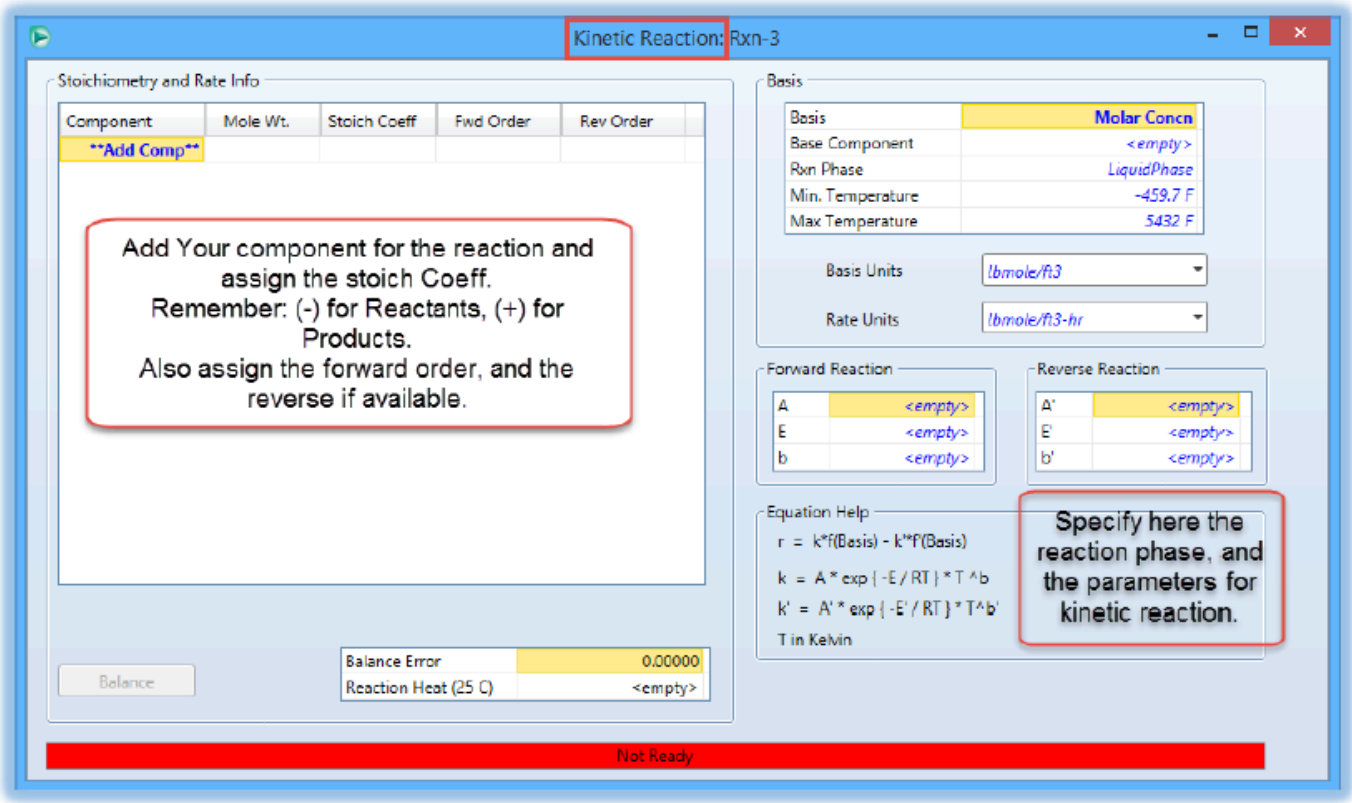



Equilibrium Reaction: Rxn-2
Stoichiometry
Keq
Approach
Library
Keq Source
Ln(Keq) Equation
Gibbs Free Energy
Fixed Keq
Keq vs T Table
Auto Detect
A
B
C
D
E
F
G
H
<empty>
Ln(Keq) = a + b
a = A + B/T + C ln(T) + D T
b = E T^2 + F T^3 + G T^4 + H T^5
b term cannot be used with Aspen Properties
(T in Kelvin)
Choose the proper method to calculate Keq, and specify the required information for it.
Not Ready
Gibbs


Equilibrium Reaction: Rxn-2
Stoichiometry
Keq
Approach
Library
Fractional Approach
Co
C1
C2
<empty>
Fraction Approach is not used in Aspen Properties
Approach % = Co + C1 * T + C2 * T^2
T = reaction temperature in Kelvin
Feed - Prod = Approach % (Feed - Prod(equilibrium))
Temperature Approach
DeltaT
Keq at T = Treaction - DeltaT endothermic reaction
Keq at T = Treaction + DeltaT exothermic reaction
Under certain process conditions, an equilibrium reaction may not, actually reach equilibrium. The equilibrium reaction set uses two types of approach, Fractional and Temperature, to simulate this type of situation. You may select either one or both types of approaches for use in the simulation.
Not Ready
Gibbs



- **Kinetic Reaction:**



DIFFERENT REACTORS AVAILABLE IN HYSYS:

Reactor	Appearance in PFD	Description
PFR		The Plug Flow Reactor can be used with Kinetics, Kinetics (Rev. Eqm.), or Langmuir-Hinshelwood reactions (any number and combination of the three types can be used in the reaction set).
CSTR		The CSTR can be used with Kinetics, Kinetics (Rev. Eqm.), or Langmuir-Hinshelwood reactions (any number and combination of the three types can be used in the reaction set).
Gibbs Reactor		The Gibbs Reactor (like the one in Aspen) is unique among the reactors in that you are not required to enter a reaction set for it to work. The Gibbs reactor works by finding the equilibrium state with the lowest Gibbs Free Energy. It appears to be akin to finding all the possible equilibrium reactions and allowing them all to equilibrate. It's nice because you do not need to know anything about the individual equilibrium constants.
Equilibrium Reactor		The Equilibrium Reactor uses reaction sets with only, equilibrium reactions in it.
Conversion Reactor		The Conversion Reactor deals with, conversion reactions. You use it when you know how much of the reactants will be converted into products.

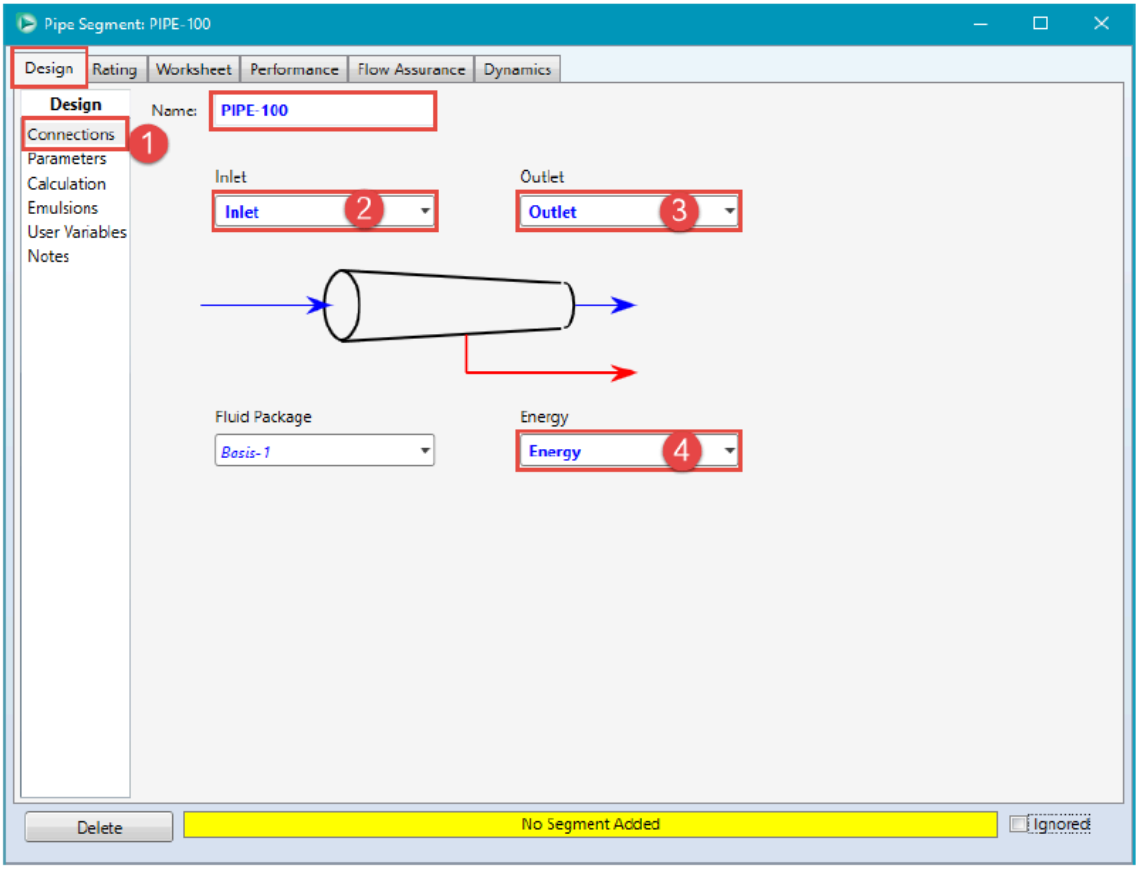
PIPING OPERATIONS

Use the Pipe Segment Operation to model pipelines either for single or multiple phases.

The Pipe Segment operation contains four calculation modes:

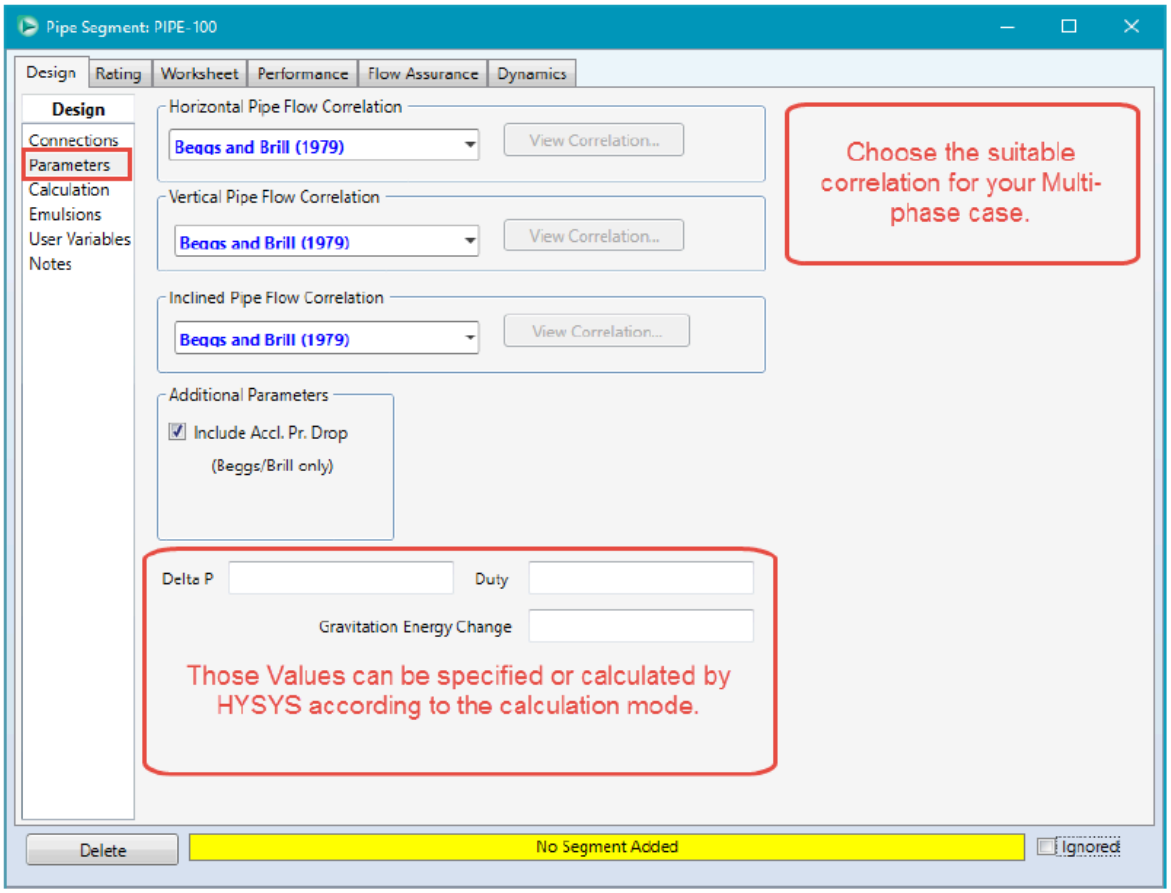
- Pressure Drop
- Length
- Flow
- Diameter

The mode is automatically assigned depending on what information is specified.



For Single Phase streams, the Darcy equation is used for pressure drop predictions. This equation is a modified form of the mechanical energy equation, which takes into account losses due to frictional effects as well as changes in potential energy.

for predicting two-phase pressure drops, you can select one of the correlation method used for Two Phase (VL) flow calculations shown in the parameters section as bellow:



Delta P: The overall pressure drop for the operation. The pressure drop includes the losses due to friction, static head, and fittings.

Duty: The total heat loss from the Pipe Segment.

The Gravitational Energy Change: Displays the change in potential energy experienced by the fluid across the length of the pipe. It is determined for the overall elevation change, based on the sum of the elevation change specified for each segment on the Sizing page of the Rating tab.

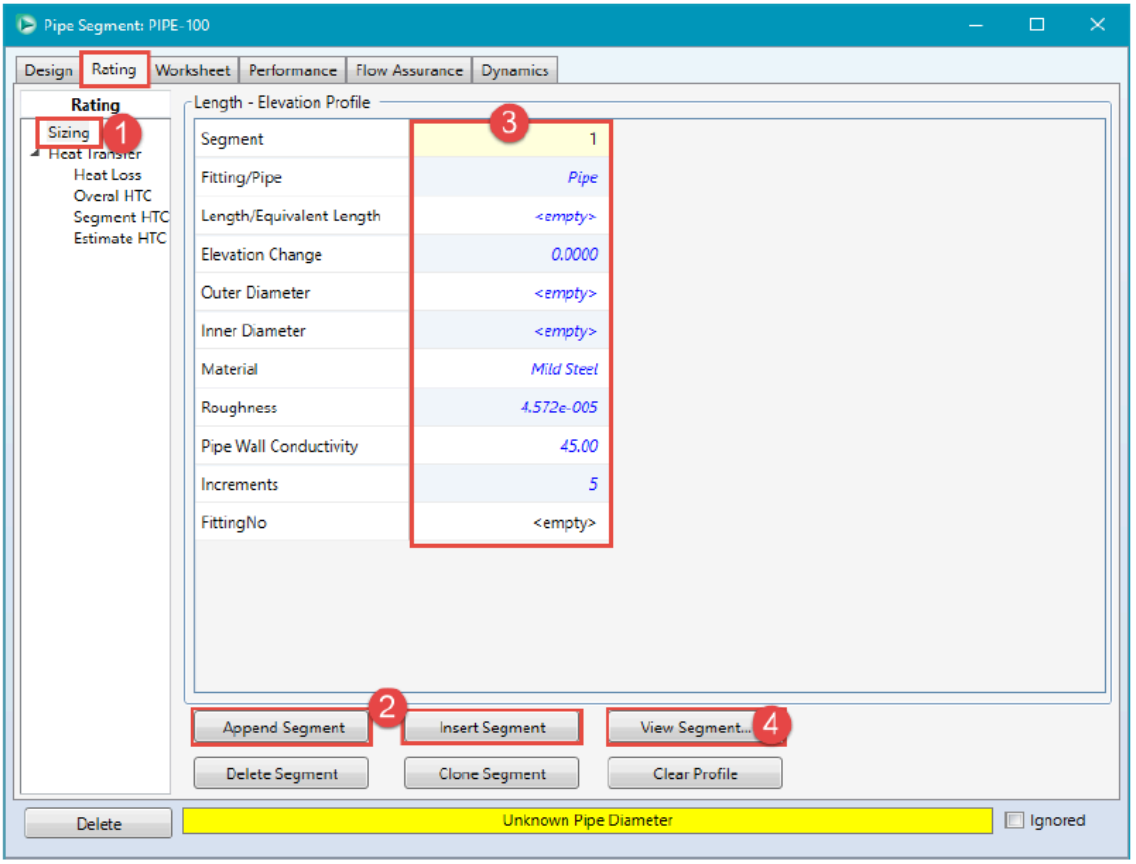
When the pressure drop is specified, the Pipe Segment can be used to calculate either the length of the Pipe Segment or the flow of the material through the length of pipe.

The methods (Correlations) have all been developed for predicting twophase pressure drops. Some methods were developed exclusively for flow in horizontal pipes, others exclusively for flow in vertical pipes while some can be used for either. Some of the methods define a flow regime map and can apply specific pressure drop correlations according to the type of flow predicted. Some of the methods calculate the expected liquid holdup in two-phase flow while others assume a homogeneous mixture.

The table below summarizes the characteristics of each model:

Model	Horizontal Flow	Vertical Flow	Liquid Holdup	Flow Map
Aziz, Govier & Fogarasi	No	Yes	Yes	Yes
Baxendell & Thomas	Use with Care	Yes	No	No
Beggs & Brill (1973 or 1979)	Yes	Yes	Yes	Yes
Duns & Ros	No	Yes	Yes	Yes
Gregory, Aziz, Mandhane	Yes	Use with Care	Yes	Yes
Hagedorn & Brown	No	Yes	Yes	No
HTFS Homogeneous	Yes	Yes	No	No
HTFS Liquid Slip	Yes	Yes	Yes	No
Olgas2000	Yes	Yes	Yes	Yes
Orkisewski	No	Yes	Yes	Yes
Poettman & Carpenter	No	Yes	No	No
Tulsa	No	Yes	Yes	Yes

- **Sizing:**



Use "Append Segment" to add New segment before the selected one, or use "Insert Segment" to add New segment after the selected one.

Pipe/Fitting: Select a pipe section, swage or one of the available fittings from the drop-down list.

Length: The actual length of the Pipe Segment. Not required for fittings.

Elevation Change: The change in vertical distance between the outlet and inlet of the pipe section. Positive values indicate that the outlet is higher than the inlet. Not required for fittings.

Outer Diameter: Outside diameter of the pipe or fitting.

Inner Diameter: Inside diameter of the pipe or fitting.

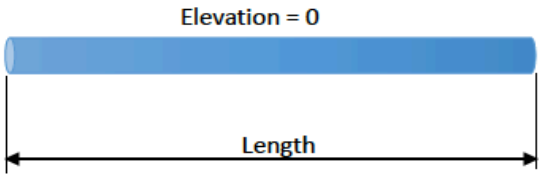
Material: Select one of the available default materials or choose User Specified for the pipe section. Not required for fittings.

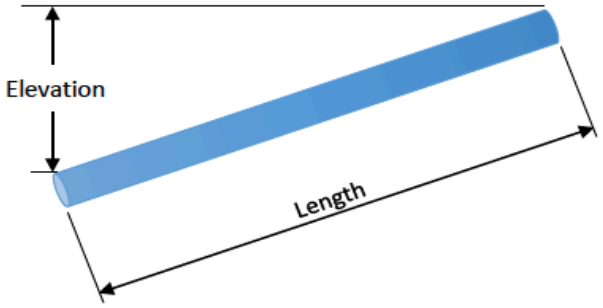
Roughness: A default value is provided based on the Pipe Material. You can specify this value.

Pipe Wall Conductivity: Thermal conductivity of pipe material in W/m.K to allow calculation of heat transfer resistance of pipe wall.

Increments: The number of increments the pipe section is divided for calculation purposes.

- The horizontal pipe sections have an Elevation of zero. A positive elevation indicates that the outlet is higher than the inlet.

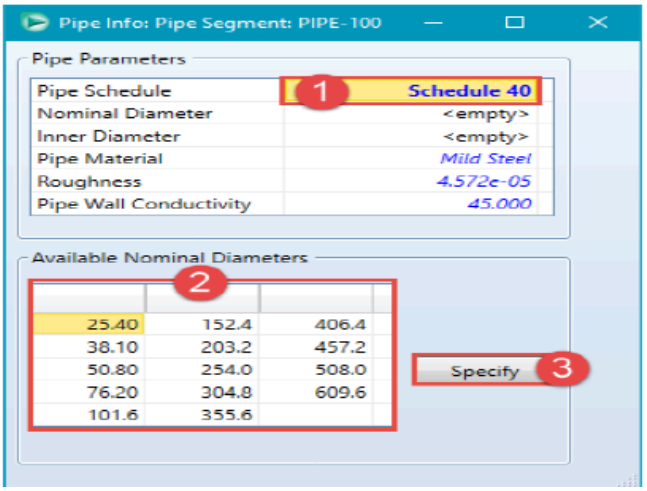




With the cursor located on a segment, click the View Segment button to show the segment Info property view.

Pipe Schedule: Choose from Schedule 40, 80, or 160. If you choose "Actual", the nominal diameter cannot be specified.

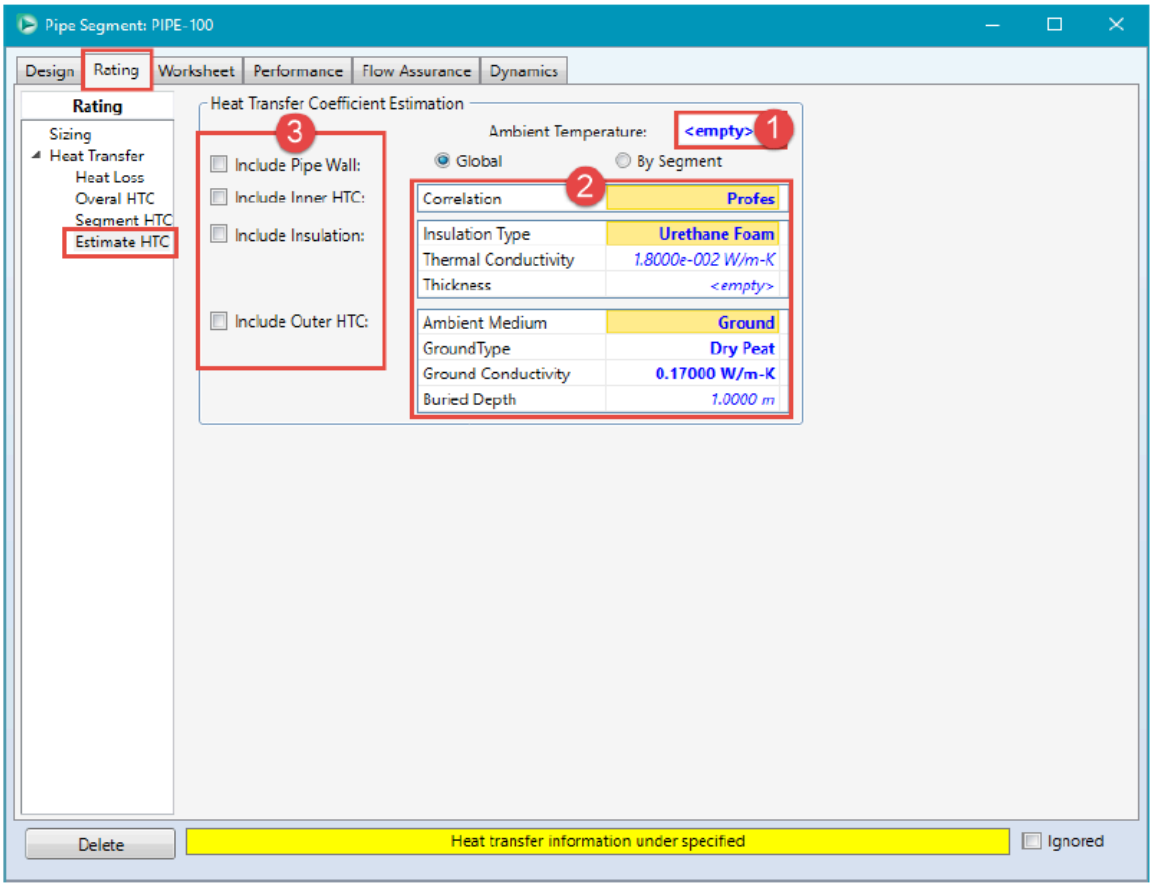
Available Nominal Diameters: Choose the proper diameter then click specify to automatically specify nominal and inner diameter for the pipe.



➢ **Heat transfer:**

There are four ways of defining heat transfer:

- **Heat loss:** If the Overall heat duty of the pipe is known, each increment is assumed to have the same heat loss.
- **Overal HTC:** If the overall HTC and a representative ambient temperature are known, rigorous heat transfer calculations are performed on each increment.
- **Segment HTC:** If the heat transfer coefficient and a representative ambient temperature are known for each segment.
- **Estimate HTC:** If the pipe's HTC is unknown, you can enter information in this property view and HYSYS calculates the HTC for the pipe.



Include Pipe Wall: To include the pipe's thermal resistance in your HTC calculations.

Include Inner HTC: to estimate the inside film HTC using one of the five correlations provided.

Include Insulation: To estimate conduction through the insulation or any other pipe coating. You must specify a thickness.

Include Outer HTC: To include outside convection to either Air, Water, or Ground.