Click the Advanced button to access the view that provides more detailed information about the holdup of that unit operation. Refer to **Section 1.3.7 - Advanced Holdup Properties** in the **HYSYS Dynamic Modeling** guide for more information.

The Zone Holdup view appears, and provides more detailed information about the holdup of that unit operation.

Stripchart Page

The Stripchart page allows you to select and create default strip charts containing various variable associated to the operation. Refer to **Section 1.3.4 - Stripchart Page/Tab** for more information.

4.3 Heat Exchanger

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.

Additional Heat Exchanger models, such as TASC and STX, are also available. Contact your local AspenTech representative for details.

In HYSYS, you can choose the Heat Exchanger Model for your analysis. Your choices include an End Point analysis design model, an ideal (Ft=1) counter-current Weighted design model, a steady state rating method, and a dynamic rating method for use in dynamic simulations. The dynamic rating method is available as either a Basic or Detailed model, and can also be used in Steady State mode for Heat Exchanger rating. The unit operation also allows the use of third party Heat Exchanger design methods via OLE Extensibility.

In Dynamic mode, the shell and tube of the Heat Exchanger is capable of storing inventory like other dynamic vessel operations. The direction of flow of material through the Heat Exchanger is governed by the pressures of the surrounding unit operations.

The following are some of the key features of the dynamic Heat Exchanger operation:

- A pressure-flow specification option which realistically models flow through the Heat Exchanger according to the pressure network of the plant. Possible flow reversal situations can therefore be modeled.
- The choice between a Basic and Detailed Heat Exchanger model. Detailed Heat Exchanger rating information can be used to calculate the overall heat transfer coefficient and pressure drop across the Heat Exchanger.
- A dynamic holdup model which calculates level in the Heat Exchanger shell based on its geometry and orientation.
- A heat loss model which accounts for the convective and conductive heat transfer that occurs across the Heat Exchanger shell wall.

4.3.1 Theory

The Heat Exchanger calculations are based on energy balances for the hot and cold fluids.

Steady State

In the following general relations, the hot fluid supplies the Heat Exchanger duty to the cold fluid:

$$\text{Balance Error} = (M_{cold}[H_{out} - H_{in}]_{cold} - Q_{leak}) - (M_{hot}[H_{in} - H_{out}]_{hot} - Q_{loss}) \quad (4.19)$$

where:

M = fluid mass flow rate

H = enthalpy

Q_{leak} = *heat leak*

Q_{loss} = *heat loss*

Balance Error = a Heat Exchanger Specification that equals zero for most applications

$_{hot}$ and $_{cold}$ = *hot and cold fluids*

$_{in}$ and $_{out}$ = *inlet and outlet stream*

The Heat Exchanger operation allows the heat curve for either side of the exchanger to be broken into intervals. Rather than calculating the energy transfer based on the terminal conditions of the exchanger, it is calculated for each of the intervals, then summed to determine the overall transfer.

The total heat transferred between the tube and shell sides (Heat Exchanger duty) can be defined in terms of the overall heat transfer coefficient, the area available for heat exchange, and the log mean temperature difference:

$$Q = UA\Delta T_{LM}F_t \quad (4.20)$$

where:

U = overall heat transfer coefficient

A = surface area available for heat transfer

ΔT_{TM} *= log mean temperature difference (LMTD)*

F_t *= LMTD correction factor*

The heat transfer coefficient and the surface area are often combined for convenience into a single variable referred to as UA. The LMTD and its correction factor are defined in the Performance section.

Dynamic

The following general relation applies to the shell side of the Basic model Heat Exchanger.

$$M_{shell}(H_{in} - H_{out})_{shell} - Q_{loss} + Q = \rho \frac{d(VH_{out})_{shell}}{dt} \quad (4.21)$$

For the tube side:

$$M_{tube}(H_{in} - H_{out})_{tube} - Q = \rho \frac{d(VH_{out})_{tube}}{dt} \quad (4.22)$$

where:

M_{shell} = *shell fluid flow rate*

M_{tube} = *tube fluid flow rate*

ρ = *density*

H = *enthalpy*

Q_{loss} = *heat loss*

Q = *heat transfer from the tube side to the shell side*

V = *volume shell or tube holdup*

Refer to **Section 1.3.4 - Heat Loss Model** in the **HYSYS Dynamic Modeling** guide for more information.

The term Q_{loss} represents the heat lost from the shell side of the dynamic Heat Exchanger. For more information regarding how Q_{loss} is calculated.

Pressure Drop

The pressure drop of the Heat Exchanger can be determined in one of three ways:

- Specify the pressure drop.
- Calculate the pressure drop based on the Heat Exchanger geometry and configuration.
- Define a pressure flow relation in the Heat Exchanger by specifying a k-value.

If the pressure flow option is chosen for pressure drop determination in the Heat Exchanger, a k value is used to relate the frictional pressure loss and flow through the exchanger. This relation is similar to the general valve equation:

$$f = \sqrt{density} \times k\sqrt{P_1 - P_2} \tag{4.23}$$

This general flow equation uses the pressure drop across the Heat Exchanger without any static head contributions. The quantity, P_1 - P_2, is defined as the frictional pressure loss which is used to “size” the Heat Exchanger with a k-value.

Dynamic Specifications

The following tables list the minimum specifications required for the Heat Exchanger unit operation to solve in Dynamic mode.

The Basic Heat Exchanger model requires the following specifications:

Dynamic Specifications	Description
Volume	The tube and shell volumes must be specified.
Overall UA	The Overall UA must be specified.
Pressure Drop	Either specify an Overall Delta P or an Overall K-value for the Heat Exchanger. Specify the Pressure Drop calculation method in the Dynamic Specifications group on the Specs page of the Dynamics tab. You can also specify the Overall Delta P values for the shell and tube sides on the Sizing page of the Rating tab.

The Detailed Heat Exchanger model requires the following specifications:

The overall tube/shell volumes, and the heat transfer surface area are calculated from the shell and tube ratings information.

Dynamic Specifications	Description
Sizing Data	The tube and shell sides of the Heat Exchanger must be completely specified on the Sizing page of the Rating tab.
Overall UA	Either specify an Overall UA or have it calculated from the Shell and Tube geometry. Specify the U calculation method on the Parameters page of the Rating tab. The U calculation method can also be specified on the Model page of the Dynamics tab.
Pressure Drop	Either specify an Overall Delta P or an Overall K-value for the Heat Exchanger. Specify the Pressure Drop calculation method on the Parameters page of the Rating tab. You can also specify the Pressure Drop calculation method in the Pressure Flow Specifications group on the Specs page of the Dynamics tab.

4.3.2 Heat Exchanger Property View

There are two ways that you can add a Heat Exchanger to your simulation:

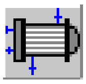
You can also add a new heat exchanger by pressing the **F12** hot key.

1. In the **Flowsheet** menu, select the **Add Operation** command. The UnitOps view appears.
2. Click the **Heat Transfer Equipment** radio button.
3. From the list of available unit operations, select Heat Exchanger.
4. Click the **Add** button. The Heat Exchanger property view appears.

OR

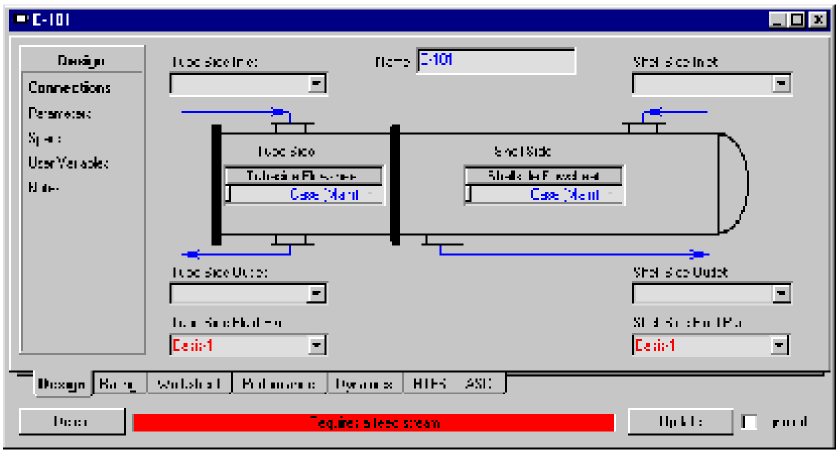
You can also open the Object Palette by pressing the **F4** hot key.

1. In the **Flowsheet** menu, select the **Palette** command. The Object Palette appears.
2. Double-click the **Heat Exchanger** icon. The Heat Exchanger property view is displayed.



Heat Exchanger icon

Figure 4.33



To ignore the Heat Exchanger during calculations, activate the Ignored checkbox. HYSYS completely disregards the operation (and cannot calculate the outlet stream) until you restore it to an active state by deactivating the checkbox.

4.3.3 Design Tab

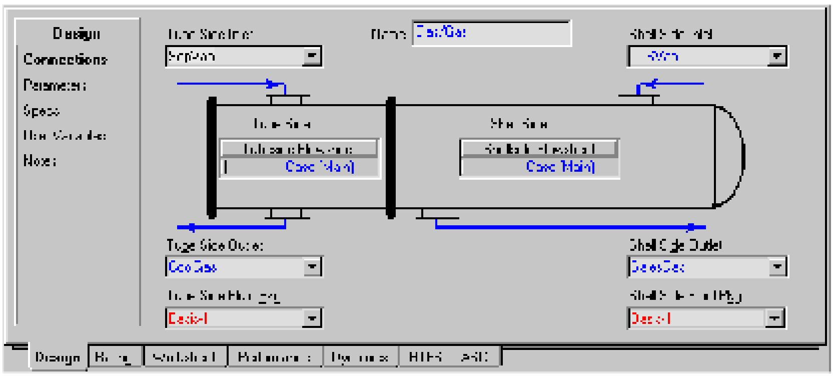
The Design tab contains the following pages:

- Connections
- Parameters
- Specs
- User Variables
- Notes

Connections Page

The Connections page allows you to specify the operation name, and the inlet and outlet streams of the shell and tube.

Figure 4.34



The main flowsheet is the default flowsheet for the Tube and Shell side. You can select a sub-flowsheet on the Tube and/or Shell side which allows you to choose inlet and outlet streams from that flowsheet. This is useful for processes such as the Refrigeration cycle, which require separate fluid packages for each side. You can define a sub-flowsheet with a different fluid package, and then connect to the main flowsheet Heat Exchanger.

Parameters Page

The Parameters page allows you to select the Heat Exchanger Model and specify relevant physical data. The parameters appearing on the Parameters page depend on which Heat Exchanger Model you select.

When a heat exchanger is installed as part of a column sub-flowsheet (available when using the Modified HYSIM Inside-Out solving method) these Heat Exchanger Models are not available. Instead, in the column sub-flowsheet, the heat exchanger is "Calculated from Column" as a simple heat and mass balance.

From the Heat Exchanger Model drop-down list, select the calculation model for the Heat Exchanger. The following Heat Exchanger models are available:

- Exchanger Design (Endpoint)
- Exchanger Design (Weighted)
- Steady State Rating
- Dynamic Rating
- HTFS - Engine
- TASC Heat Exchanger (Refer to the **TASC Thermal Reference** guide for more information.)

The HTFS - Engine and TASC Heat Exchanger options are only available if you have installed TASC.

For both the Endpoint and Weighted models, you can specify whether your Heat Exchanger experiences heat leak/loss.

- **Heat Leak**. Loss of cold side duty due to leakage. Duty gained to reflect the increase in temperature.
- **Heat Loss**. Loss of hot side duty due to leakage. Duty lost to reflect the decrease in temperature.

The table below describes the radio buttons in the Heat Leak/ Loss group of the Endpoint and Weighted models.

Radio Button	Description
None	By default, the None radio button is selected.
Extremes	On the hot side, the heat is considered to be "lost" where the temperature is highest. Essentially, the top of the heat curve is being removed to allow for the heat loss/leak. This is the worst possible scenario. On the cold side, the heat is gained where the temperature is lowest.
Proportional	The heat loss is distributed over all of the intervals.

Refer to **Section 4.3.4 - Rating Tab** for further details.

All Heat Exchanger models allow for the specification of either Counter or Co-Current tube flow.

End Point Model

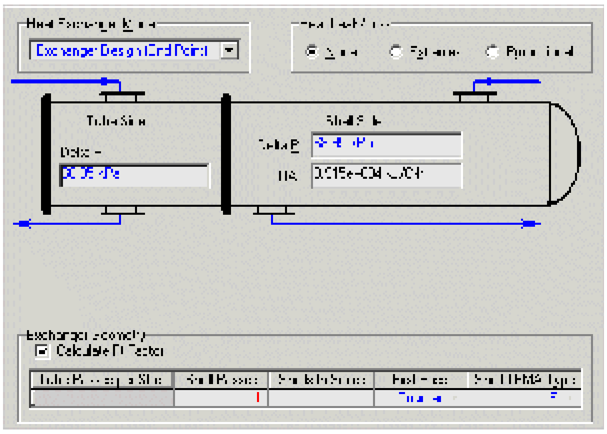
The End Point model is based on the standard Heat Exchanger duty equation (**Equation (4.20)**) defined in terms of overall heat transfer coefficient, area available for heat exchange, and the log mean temperature difference (LMTD).

The main assumptions of the model are as follows:

- Overall heat transfer coefficient, U is constant.
- Specific heats of both shell and tube side streams are constant.

The End Point model treats the heat curves for both Heat Exchanger sides as linear. For simple problems where there is no phase change and C_p 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.

Figure 4.35



The following parameters are available when the End Point model is selected:

Parameters	Description
Tubeside and Shellside Delta P	The pressure drops (DP) for the tube and shell sides of the exchanger can be specified here. If you do not specify the Delta P values, HYSYS calculates them from the attached stream pressures.
UA	The product of the Overall Heat Transfer Coefficient, and the Total Area available for heat transfer. The Heat Exchanger duty is proportional to the log mean temperature difference, where UA is the proportionality factor. The UA can either be specified, or calculated by HYSYS.
Exchanger Geometry	The Exchanger Geometry is used to calculate the Ft Factor using the End Point Model. It is not available for the weighted model. Refer to the Rating tab for more information on the Exchanger Geometry.

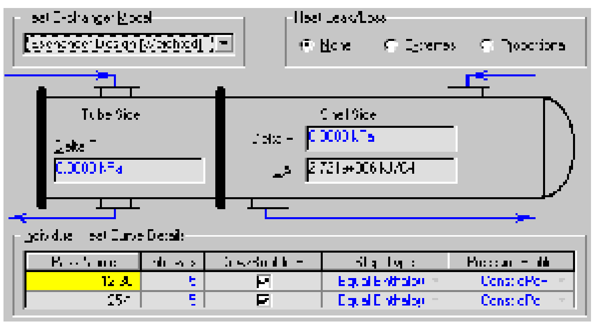
Weighted Model

The Weighted model is an excellent model to apply to non-linear heat curve problems such as the phase change of pure components in one or both Heat Exchanger sides. With the Weighted model, 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.

The Weighted model is available only for counter-current exchangers, and is essentially an energy and material balance model. The geometry configurations which affect the Ft correction factor are not taken into consideration in this model.

When you select the Weighted model, the Parameters page appears as shown in the figure below.

Figure 4.36



The following table describes the parameters available on the Parameters page when the Weighted model is selected:

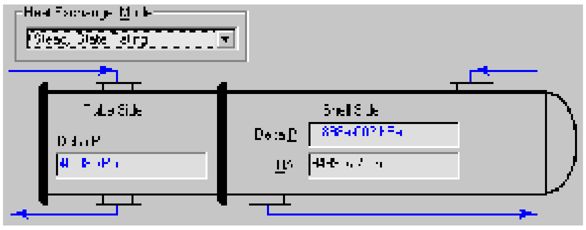
Parameters	Description
Tubeside and Shellside Delta P	The pressure drops (DP) for the tube and shell sides of the exchanger can be specified here. If you do not specify the DP values, HYSYS calculates them from the attached stream pressures.
UA	The product of the Overall Heat Transfer Coefficient and the Total Area available for heat transfer. The Heat Exchanger duty is proportional to the log mean temperature difference, where UA is the proportionality factor. The UA can either be specified, or calculated by HYSYS.
Individual Heat Curve Details	For each side of the Heat Exchanger, the following parameters appear (all but the Pass Names can be modified). • **Pass Name**.Identifies the shell and tube side according to the names you provided on the Connections page. • **Intervals**.The number of intervals can be specified. For non-linear temperature profiles, more intervals are necessary. • **Dew/Bubble Point**.Activate this checkbox to add a point to the heat curve for the dew and/or bubble point. If there is a phase change occurring in either pass, the appropriate checkbox should be activated. There are three choices for the **Step Type**: • **Equal Enthalpy**. All intervals have an equal enthalpy change. • **Equal Temperature**. All intervals have an equal temperature change. • **Auto Interval**. HYSYS determines where points should be added to the heat curve. This is designed to minimize error using the least number of intervals. The **Pressure Profile** is updated in the outer iteration loop, using one of the following methods: • **Constant dPdH**.Maintains constant dPdH during update. • **Constant dPdUA**.Maintains constant dPdUA during update. • **Constant dPdA**. Maintains constant dPdA during update. This is not currently applicable to the Heat Exchanger, as the area is not predicted. • **Inlet Pressure**.Pressure is constant and equal to the inlet pressure. • **Outlet Pressure**. Pressure is constant and equal to the outlet pressure.

Steady State Rating Model

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.

When dealing with linear or nearly linear heat curve problems, the Steady State Rating model should be used. Due to the solver method incorporated into this rating model, the Steady State Rating model can perform calculations exceptionally faster than the Dynamic Rating model.

Figure 4.37



The following parameters are available on the Parameters page when the Steady State Rating model is selected:

Parameters	Description
Tubeside and Shellside Delta P	The pressure drops (DP) for the tube and shell sides of the exchanger can be specified here. If you do not specify the Delta P values, HYSYS calculates them from the attached stream pressures.
UA	The product of the Overall Heat Transfer Coefficient, and the Total Area available for heat transfer. The Heat Exchanger duty is proportional to the log mean temperature difference, where UA is the proportionality factor. The UA can either be specified, or calculated by HYSYS.

Dynamic Rating

Two models are available for Dynamic Rating using the Heat Exchanger unit operation: a Basic and a Detailed model. 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.

The Specs page no longer appears when Dynamic Rating is selected.

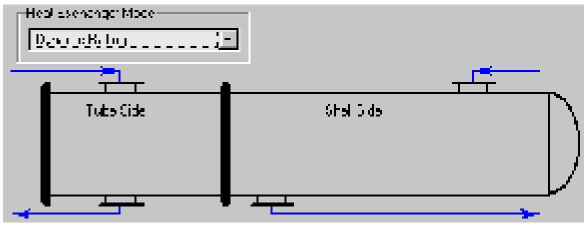
The Basic model is based on the same assumptions as the End Point model, which uses the standard Heat Exchanger duty equation (**Equation (4.20)**) defined in terms of overall heat transfer coefficient, area available for heat exchange, and the log mean temperature difference. The Basic model is actually the counterpart of the End Point model for dynamics and dynamic rating. The Basic model can also be used for steady state Heat Exchanger rating.

The Detailed model is based on the same assumptions as the Weighted model, and divides the Heat Exchanger into a number of heat zones, performing an energy balance along each interval. This model requires detailed geometry information about your Heat Exchanger. The Detailed model is actually the counterpart of the Weighted model for dynamics and dynamic rating, but can also be used for steady state Heat Exchanger rating.

The Basic and Detailed Dynamic Rating models share rating information with the Dynamics Heat Exchanger model. Any rating information entered using these models is observed in Dynamic mode.

Once the Dynamic Rating model is selected, no further information is required on the Parameters page of the Design tab. You can choose the model (Basic or Detailed) on the Parameters page of the Rating tab.

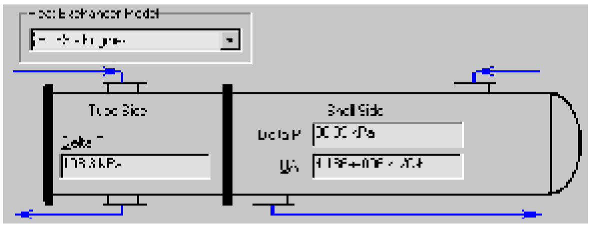
Figure 4.38



HTFS - Engine

The figure below shows the Parameters page of the Design tab, if you select the HTFS - Engine model. Notice that the values in the fields appear in black, indicating that they are HYSYS calculated values, and you cannot change them in the current fields.

Figure 4.39



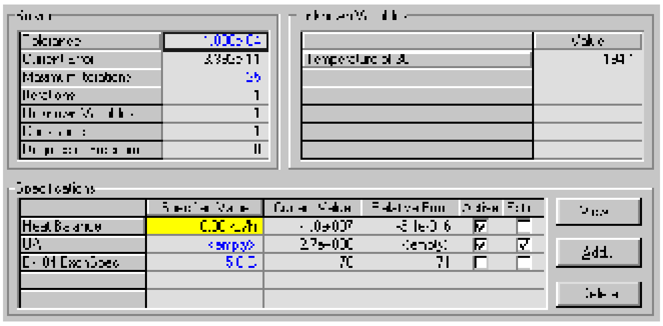
To change the variable values shown on this page, you have to go to the HTFS - TASC tab on the Heat Exchanger property view. Refer to **Section 4.3.8 - HTFS-TASC Tab** for more information.

Specs Page

If you are working with a Dynamic Rating model, the Specs page does not appear on the Design tab.

The Specs page includes three groups that organize various specifications and solver information. The information provided on the Specs page is only valid for the Weighted, Endpoint, and Steady State Rating models.

Figure 4.40



Solver Group

The following parameters are listed in the Solver group:

Parameters	Details
Tolerance	The calculation error tolerance can be set.
Current Error	When the current error is less than the calculation tolerance, the solution is considered to have converged.
Iterations	The current iteration of the outer loop appears. In the outer loop, the heat curve is updated and the property package calculations are performed. Non-rigorous property calculations are performed in the inner loop. Any constraints are also considered in the inner loop.

Unknown Variables Group

HYSYS lists all unknown Heat Exchanger variables according to your specifications. Once the unit has solved, the values of these variables appear.

Specifications Group

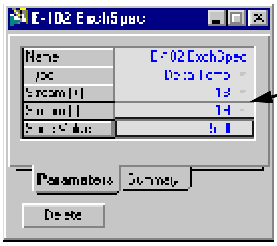
Without the Heat Balance specification, the heat equation is not balanced. For this reason, it is considered a heat exchanger constraint.

Notice the Heat Balance (specified at 0 kJ/h) is considered to be a constraint. This is a Duty Error spec, which you cannot turn off. Without the Heat Balance specification, you could, for example, completely specify all four Heat Exchanger streams, and have HYSYS calculate the Heat Balance error which would be displayed in the Current Value column of the Specifications group.

The UA is also included as a default specification. HYSYS displays this as a convenience, since it is a common specification. You can either use this spec or deactivate it.

You can View or Delete highlighted specifications by using the buttons at the right of the group. A specification view appears automatically each time a new spec is created via the Add button. The figure below shows a typical view of a specification, which is accessed via the View or Add button.

Figure 4.41



Defining the Delta Temp spec requires two stream names and a value for the specification.

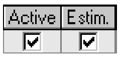
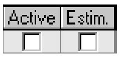
Each specification view has the following tabs:

- Parameters
- Summary

The Summary page is used to define whether the specification is Active or an Estimate. The Spec Value is also shown on this page.

Information specified on the specification view also appears in the Specifications group.

All specifications are one of the following three types:

Specification Type	Description
Active 	An active specification is one that the convergence algorithm is trying to meet. An active specification always serves as an initial estimate (when the Active checkbox is checked, HYSYS automatically activates the Estimate checkbox). An active specification exhausts one degree of freedom. An Active specification is one that the convergence algorithm is trying to meet. An Active specification is on when both checkboxes are activated.
Estimate 	An Estimate is considered an Inactive specification because the convergence algorithm is not trying to satisfy it. To use a specification as an estimate only, uncheck the Active checkbox. The value then serves only as an initial estimate for the convergence algorithm. An estimate does not use an available degree of freedom. An Estimate is used as an initial “guess” for the convergence algorithm, and is considered to be an inactive specification.
Completely Inactive 	To disregard the value of a specification entirely during convergence, deactivate both the Active and Estimate checkboxes. By ignoring rather than deleting a specification, it remains available if you want to use it later. A Completely Inactive specification is one that is ignored completely by the convergence algorithm, but can be made Active or an Estimate at a later time.

The specification list allows you to try different combinations of the above three specification types. For example, suppose you have a number of specifications, and you want to determine which ones should be active, which should be estimates and which ones should be ignored altogether. By manipulating the checkboxes among various specifications, you can test various combinations of the three types to see their effect on the results.

The available specification types include the following:

The Hot Inlet Equilibrium temperature is the temperature of the inlet hot stream minus the heat loss temperature drop.

The Cold Inlet Equilibrium temperature is the temperature of the inlet cold stream plus the heat leak temperature rise.

Specification	Description
Temperature	The temperature of any stream attached to the Heat Exchanger. The hot or cold inlet equilibrium temperature can also be defined.
Delta Temp	The temperature difference at the inlet or outlet between any two streams attached to the Heat Exchanger. The hot or cold inlet equilibrium temperatures (which incorporate the heat loss/heat leak with the inlet conditions) can also be used.
Minimum Approach	Minimum internal temperature approach. The minimum temperature difference between the hot and cold stream (not necessarily at the inlet or outlet).
UA	The overall UA (product of overall heat transfer coefficient and heat transfer area).
LMTD	The overall log mean temperature difference.
Duty	The overall duty, duty error, heat leak or heat loss. The duty error should normally be specified as 0 so that the heat balance is satisfied. The heat leak and heat loss are available as specifications only if the Heat Loss/ Leak is set to Extremes or Proportional on the Parameters page.
Duty Ratio	A duty ratio can be specified between any two of the following duties: overall, error, heat loss, and heat leak.
Flow	The flowrate of any attached stream (molar, mass or liquid volume).
Flow Ratio	The ratio of the two inlet stream flowrates. All other ratios are either impossible or redundant (i.e., - the inlet and outlet flowrates on the shell or tube side are equal).

User Variables Page

The User Variables page enables you to create and implement your own user variables for the current operation. For more information refer to **Section 1.3.3 - User Variables Page/ Tab**.

Notes Page

For more information, refer to **Section 1.3.2 - Notes Page/Tab**.

The Notes page provides a text editor that allows you to record any comments or information regarding the specific unit operation or the simulation case in general.

4.3.4 Rating Tab

The Parameters page is used exclusively by the dynamics Heat Exchanger, and only becomes active either in Dynamic mode or while using the Dynamic Rating model.

The Rating tab contains the following pages:

- Sizing
- Parameters
- Nozzles
- Heat Loss

Sizing Page

The Sizing page provides Heat Exchanger sizing related information. Based on the geometry information, HYSYS is able to calculate the pressure drop and the convective heat transfer coefficients for both Heat Exchanger sides and rate the exchanger.

The information is grouped under three radio buttons:

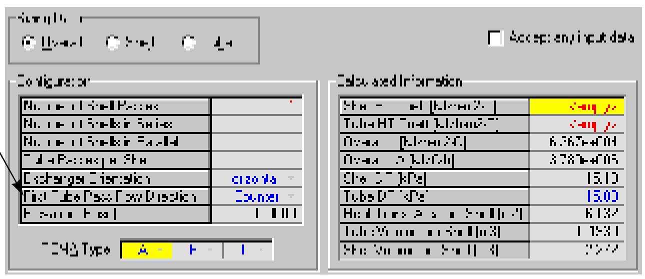
- Overall
- Shell
- Tube

Overall

When you select the Overall radio button, the overall Heat Exchanger geometry appears:

Figure 4.42

Tube flow direction can be defined as either Counter or Co-Current for all heat exchanger calculation models.

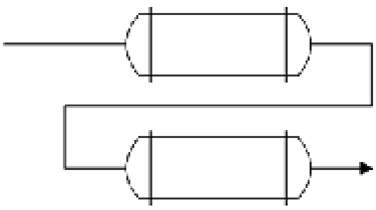
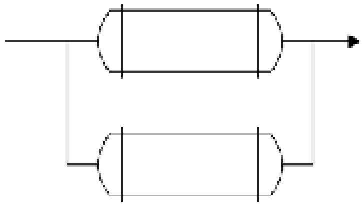


In the Configuration group, you can specify whether multiple shells are used in the Heat Exchanger design.

The following fields appear, and can be modified in, the Configuration group.

For n shell passes, HYSYS solves the heat exchanger on the basis that at least 2n tube passes exist. Charts for Shell and Tube Exchanger LMTD Correction Factors, as found in the GPSA Engineering Data Book, are normally in terms of n shell passes and 2n or more tube passes.

The Shell Feed at Bottom checkbox is only visible for the vertical oriented exchanger.

Field	Description
Number of Shell Passes	You have the option of HYSYS performing the calculations for Counter Current (ideal with Ft = 1.0) operation, or for a specified number of shell passes. Specify the number of shell passes to be any integer between 1 and 7. When the shell pass number is specified, HYSYS calculates the LMTD correction factor (Ft) for the current exchanger design. A value lower than 0.8 generally corresponds to inefficient design in terms of the use of heat transfer surface. More passes or larger temperature differences should be used in this case.
Number of Shells in Series	If a multiple number of shells are specified in series, the configuration is shown as follows: 
Number of Shells in Parallel	If a multiple number of shells are specified in parallel, the configuration is shown as follows:  Currently, multiple shells in parallel are not supported in HYSYS.
Tube Passes per Shell	The number of tube passes per shell. The default setting is 2 (i.e., the number of tubes equal to 2n, where n is the number of shells.)
Exchanger Orientation	The exchanger orientation defines whether or not the shell is horizontal or vertical. Used only in dynamic simulations. When the shell orientation is vertical, you can also specify whether the shell feed is at the top or bottom via the Shell Feed at Bottom checkbox.

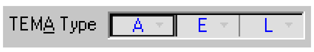
Field	Description
First Tube Pass Flow Direction	Specifies whether or not the tube feed is co-current or counter-current.
Elevation (base)	The height of the base of the exchanger above the ground. Used only in dynamic simulations.

You can specify the number of shell and tube passes in the shell of the Heat Exchanger. In general, at least 2n tube passes must be specified for every n shell pass. The exception is a counter-current flow Heat Exchanger which has 1 shell pass and one tube pass. The orientation can be specified as a vertical or horizontal Heat Exchanger. The orientation of the Heat Exchanger does not impact the steady state solver, however, it is used in the Dynamics Heat Exchanger Model in the calculation of liquid level in the shell.

For a more detailed discussion of TEMA-style shell-and-tube heat exchangers, refer to page 11-33 of the Perry's Chemical Engineers' Handbook (1997 edition).

The shape of Heat Exchanger can be specified using the TEMA-style drop-down lists. The first list contains a list of front end stationary head types of the Heat Exchanger. The second list contains a list of shell types. The third list contains a list of rear end head types.

Figure 4.43



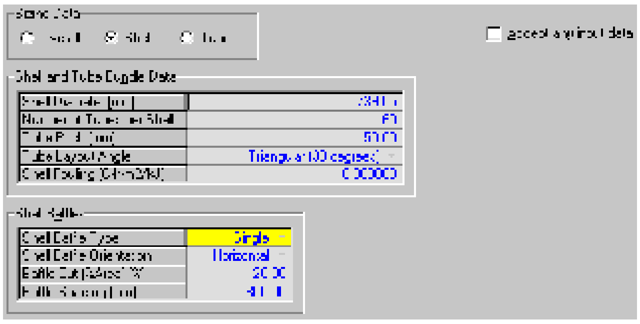
In the Calculated Information group, the following Heat Exchanger parameters are listed:

- Shell HT Coeff
- Tube HT Coeff
- Overall U
- Overall UA
- Shell DP
- Tube DP
- Heat Trans. Area per Shell
- Tube Volume per Shell
- Shell Volume per Shell

Shell

Selecting the Shell radio button allows you to specify the shell configuration and the baffle arrangement in each shell.

Figure 4.44



In the Shell and Tube Bundle Data group, you can specify whether multiple shells are used in the Heat Exchanger design. The following fields appear, and can be modified in, the Shell and Tube Bundle Data group.

Field	Description
Shell Diameter	Diameter of the shell(s).
Number of Tubes per Shell	Number of tubes per shell. You can change the value in this field.
Tube Pitch	Shortest distance between the centres of two adjacent tubes.
Tube Layout Angle	In HYSYS, the tubes in a single shell can be arranged in four different symmetrical patterns: • Triangular (30°) • Triangular Rotated (60°) • Square (90°) • Square Rotated (45°) For more information regarding the benefits of different tube layout angles, refer to page 139 of Process Heat Transfer by Donald Q. Kern (1965)
Shell Fouling	The shell fouling factor is taken into account in the calculation of the overall heat transfer coefficient, UA.

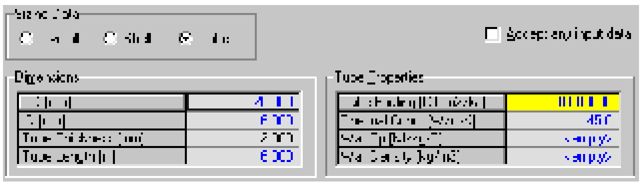
The following fields appear, and can be modified in, the Shell Baffles group:

Field	Description
Shell Baffle Type	You can choose from four different baffle types: • Single • Double • Triple • Grid
Shell Baffle Orientation	You can choose whether the baffles are aligned horizontally or vertically along the inner shell wall.
Baffle cut (Area%)	You can specify the percent area where the liquid flows through relative to the cross sectional area of the shell. The baffle cut is expressed as a percent of net free area. The net free area is defined as the total cross-sectional area in the flow direction parallel to the tubes minus the area blocked off by the tubes (essentially the percentage of open area).
Baffle Spacing	You can specify the space between each baffle.

Tube

Selecting the Tube radio button allows you to specify the tube geometry information in each shell.

Figure 4.45



The Dimensions group allows you to specify the following tube geometric parameters:

Field	Description
Outer Tube Diameter (OD) **Inner Tube Diameter (ID)** **Tube Thickness**	Two of the three listed parameters must be specified to characterize the tube width dimensions.
Tube Length	Heat transfer length of one tube in a single Heat Exchanger shell. This value is not the actual tube length.

In the Tube Properties group, the following metal tube heat transfer properties must be specified:

- Tube Fouling Factor
- Thermal Conductivity
- Wall Specific Heat Capacity, Cp
- Wall Density

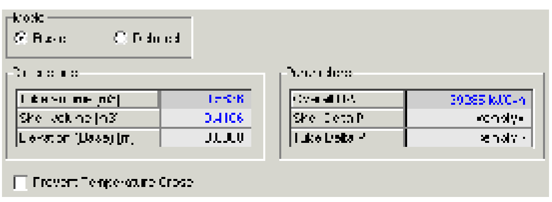
Parameters Page

The Parameters page of the Rating tab is used to define rating parameters for the Dynamic Rating model. On the Parameters page, you can specify either a Basic model or a Detailed model. For the Basic model, you must define the Heat Exchanger overall UA and pressure drop across the shell and tube. For the Detailed model, you must define the geometry and heat transfer parameters of both the shell and tube sides in the Heat Exchanger operation. In order for either the Basic or Detailed Heat Exchanger Model to completely solve, the Parameters page must be completed.

Basic Model

When you select the Basic model radio button on the Parameters page in Dynamic mode, the following view appears.

Figure 4.46



The Dimensions group contains the following information:

- Tube Volume
- Shell Volume
- Elevation (Base)

The tube volume, shell volume, and heat transfer area are calculated from Shell and Tube properties specified by selecting the Shell and Tube radio buttons on the Sizing page. The elevation of the base of the Heat Exchanger can be specified but does not impact the steady state solver.

The Prevent Temperature Cross checkbox is used to activate additional model options when checked. These additional model options prevent temperature crosses by automatically reducing the heat transfer rate slowly.

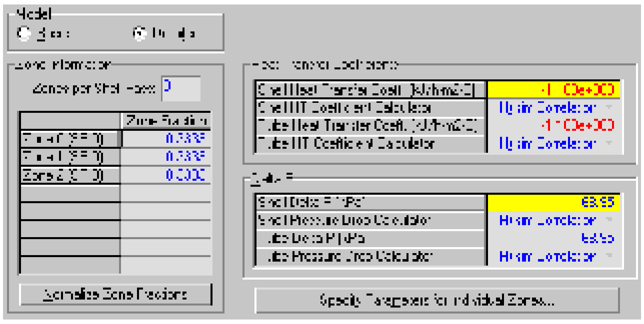
The Parameters group includes the following Heat Exchanger parameters. All but the correction factor, F, can be modified:

Field	Description
Overall UA	The product of the Overall Heat Transfer Coefficient, and the Total Area available for heat transfer. The Heat Exchanger duty is proportional to the log mean temperature difference, where UA is the proportionality factor. The UA can either be specified, or calculated by HYSYS.
Tubeside and Shellside Delta P	The pressure drops (DP) for the tube and shell sides of the exchanger can be specified here. If you do not specify the DP values, HYSYS calculates them from the attached stream pressures.

Detailed Model

The Detailed model option allows you to specify the zone information, heat transfer coefficient, and Delta P details. When you select the Detailed model radio button on the Parameters page, the following view appears.

Figure 4.47



Zone Information

HYSYS can partition the Heat Exchanger into discrete multiple sections called zones. Because shell and tube stream conditions do not remain constant across the operation, the heat transfer parameters are not the same along the length of the Heat Exchanger. By dividing the Heat Exchanger into zones, you can make different heat transfer specifications for individual zones, and therefore more accurately model an actual Heat Exchanger.

In the Zone Information group you can specify the following:

Field	Description
Zones per Shell Pass	Enter the number of zones you want for one shell. The total number of zones in a Heat Exchanger shell is calculated as: $Total\ Zones = Total\ Shell\ Passes \cdot Zones$
Zone Fraction	The fraction of space the zone occupies relative to the total shell volume. HYSYS automatically sets each zone to have the same volume. You can modify the zone fractions to occupy a larger or smaller proportion of the total volume. Click the Normalize Zone Fractions button in order to adjust the sum of fractions to equal one.

Heat Transfer Coefficients

The Heat Transfer Coefficients group contains information regarding the calculation of the overall heat transfer coefficient, UA, and local heat transfer coefficients for the fluid in the tube, h_i, and the fluid surrounding the tube, h_o. The heat transfer coefficients can be determined in one of two ways:

- The heat transfer coefficients can be specified using the rating information provided on the Parameters page and the stream conditions.
- You can specify the heat transfer coefficients.

For fluids without phase change, the local heat transfer coefficient, h_i, is calculated according to the Sieder-Tate correlation:

$$h_i = \frac{0.027k_m}{D_i}\left(\frac{D_iG_i}{\mu_i}\right)^{0.8}\left(\frac{C_{p,i}\mu_i}{k_m}\right)^{1/3}\left(\frac{\mu_i}{\mu_{i,w}}\right)^{0.14} \qquad (4.24)$$

where:

G_i = *mass velocity of the fluid in the tubes (velocity*density)*

μ_i = *viscosity of the fluid in the tube*

$\mu_{i,w}$ = *viscosity of the fluid inside tubes, at the tube wall*

$C_{p,i}$ = *specific heat capacity of the fluid inside the tube*

The relationship between the local heat transfer coefficients, and the overall heat transfer coefficient is shown in **Equation (4.25)**.

$$U = \frac{1}{\left[\frac{1}{h_o} + r_o + r_w + \frac{D_o}{D_i}\left(r_i + \frac{1}{h_i}\right)\right]} \tag{4.25}$$

where:

U = overall heat transfer coefficient

h_o *= local heat transfer coefficient outside tube*

h_i *= local heat transfer coefficient inside tube*

r_o *= fouling factor outside tube*

r_i *= fouling factor inside tube*

r_w *= tube wall resistance*

D_o *= outside diameter of tube*

D_i *= inside diameter of tube*

The Heat Transfer coefficients group contains the following information:

Field	Description
Shell/Tube Heat Transfer Coefficient	The local Heat Transfer Coefficients, h_o and h_i, can be specified or calculated.
Shell/Tube HT Coefficient Calculator	The Heat Transfer Coefficient Calculator allows you to either specify or calculate the local Heat Transfer Coefficients. Specify the cell with one of following options: • **Shell & Tube**. The local heat transfer coefficients, h_o and h_i, are calculated using the heat exchange rating information and correlations. • **U specified**. The local heat transfer coefficients, h_o and h_i, are specified by you.

Delta P

The Delta P group contains information regarding the calculation of the shell and tube pressure drop across the exchanger. In Steady State mode, the pressure drop across either the shell or tube side of the Heat Exchanger can be calculated in one of two ways:

- The pressure drop can be calculated from the rating information provided in the Sizing page and the stream conditions.
- The pressure drop can be specified.

The Delta P group contains the following information:

Field	Description
Shell/Tube Delta P	The pressure drop across the Shell/Tube side of the Heat Exchanger can be specified or calculated.
Shell/Tube Delta P Calculator	The Shell/Tube Delta P Calculator allows you to either specify or calculate the shell/tube pressure drop across the Heat Exchanger. Specify the cell with one of following options: • **Shell & Tube Delta P Calculator**. The pressure drop is calculated using the Heat Exchanger rating information and correlations. • **User specified**. The pressure drop is specified by you. • **Non specified**. This option is only applicable in Dynamic mode. Pressure drop across the Heat Exchanger is calculated from a pressure flow relation.

Detailed Heat Model Properties

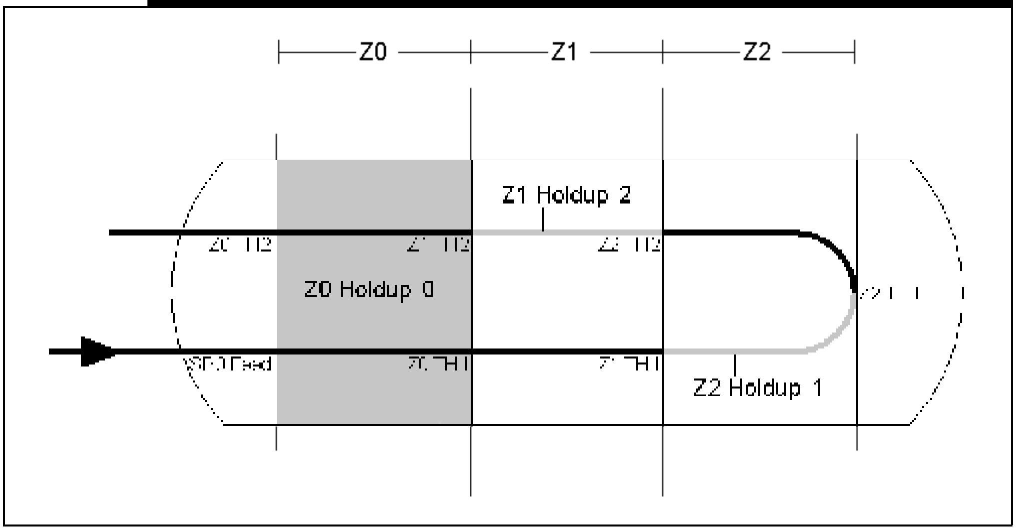
When you click the Specify Parameters for Individual Zones button, the Detailed Heat Model Properties view appears. The Detailed Heat Model Properties view displays the detailed heat transfer parameters and holdup conditions for each zone.

HYSYS uses the following terms to describe different locations within the Heat Exchanger.

Location Term	Description
Zone	HYSYS represents the zone using the letter "Z". Zones are numbered starting from 0. For instance, if there are 3 zones in a Heat Exchanger, the zones are labeled: Z0, Z1, and Z2.
Holdup	HYSYS represents the holdup within each zone with the letter "H". Holdups are numbered starting from 0. "Holdup 0" is always the holdup of the shell within the zone. Holdups 1 through n represents the n tube holdups existing in the zone.
Tube Location	HYSYS represents tube locations using the letters "TH". Tube locations occur at the interface of each zone. Depending on the number of tube passes per shell pass, there can be several tube locations within a particular zone. For instance, 2 tube locations exist for each zone in a Heat Exchanger with 1 shell pass and 2 tube passes. Tube locations are numbered starting from 1.

Consider a shell and tube Heat Exchanger with 3 zones, 1 shell pass, and 2 tube passes. The following diagram labels zones, tube locations, and hold-ups within the Heat Exchanger:

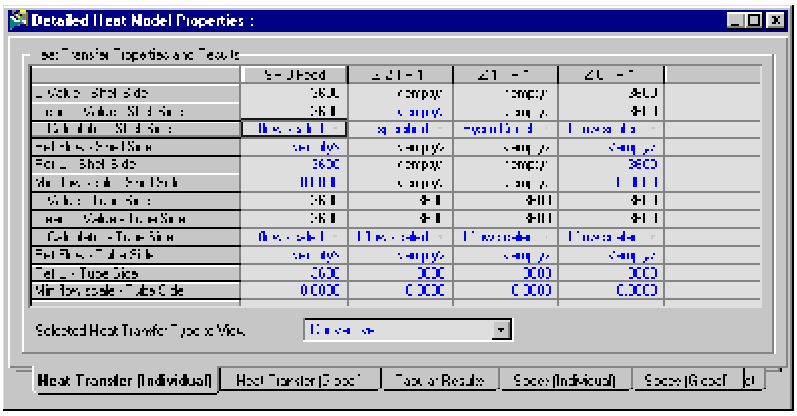
Figure 4.48



Heat Transfer (Individual) Tab

Information regarding the heat transfer elements of each tube location in the Heat Exchanger appears on the Heat Transfer (Individual) tab. Heat transfer from the fluid in the tube to the

Figure 4.49



fluid in the shell occurs through a series of heat transfer resistances or elements. There are two convective elements, and one conductive element associated with each tube location.

This tab organizes all the heat transfer elements for each tube location in one spreadsheet. You can choose whether Conductive or Convective elements will appear by selecting the appropriate element type in the Heat Transfer Type drop-down list.

The following is a list of possible elements for each tube location:

Heat Transfer Element	Description
Convective Element	The Shell Side element is associated with the local heat transfer coefficient, h_o, around the tube. The Tube Side is associated with the local heat transfer coefficient, h_i, inside the tube.These local heat transfer coefficients can be calculated by HYSYS or modified by you.
Conductive Element	This element is associated with the conduction of heat through the metal wall of the tube. The conductivity of the tube metal, and the inside and outside metal wall temperatures appear. You can modify the conductivity.

Heat Transfer (Global) Tab

The Heat Transfer (Global) tab displays the heat transfer elements for the entire Heat Exchanger. You can choose whether the overall Conductive or Convective elements are to appear by selecting the appropriate element type in the Heat Transfer Type drop-down list.

Tabular Results Tab

You can choose whether the flow path is shell or tube side by selecting the appropriate flow path in the Display which flow path? drop-down list.

The Tabular Results tab displays the following stream properties for the shell and tube fluid flow paths. The feed and exit stream conditions appear for each zone.

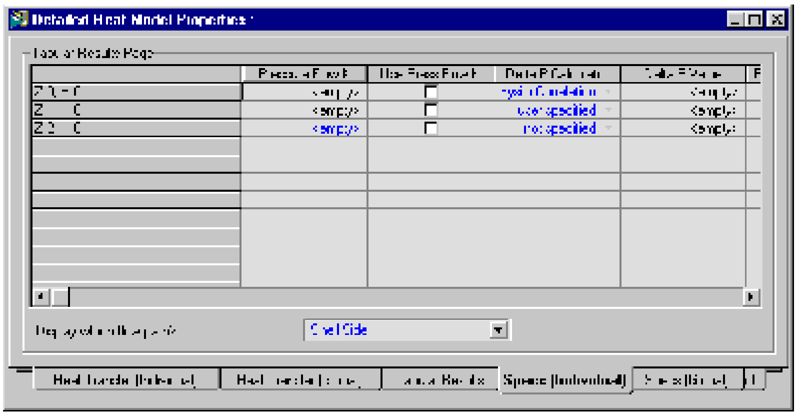
- Temperature
- Pressure
- Vapour Fraction
- Molar Flow
- Enthalpy
- Cumulative UA
- Cumulative Heat Flow
- Length (into Heat Exchanger)

Specs (Individual) Tab

You can choose whether the shell or tube side appears by selecting the appropriate flow path in the Display which flow path? drop-down list.

The Specs (Individual) tab displays the pressure drop specifications for each shell and tube holdup in one spreadsheet.

Figure 4.50



The Pressure Flow K and Use Pressure Flow K columns are applicable only in Dynamic mode.

Specs (Global) Tab

The Specs (Global) tab displays the pressure drop specifications for the entire shell and tube holdups. The Pressure Flow K and Use Pressure Flow K columns are applicable only in Dynamic mode.

You can choose whether the shell or tube side appears by selecting the appropriate flow path in the Display which flow path? drop-down list.

Plots Tab

The information displayed on the Plots tab is a graphical representation of the parameters provided on the Tabular Results tab. You can plot the following variables for the shell and tube side of the Heat Exchanger:

- Vapour Fraction
- Molar Flow
- Enthalpy
- Cumulative UA
- Heat Flow
- Length

Nozzles Page

The Nozzles page contains information regarding the elevation and diameter of the nozzles. The Fidelity license is required to use the Nozzle features found on this page. Refer to **Section 1.6 - HYSYS Dynamics** in the **HYSYS Dynamic Modeling** guide for more information.

The placement of feed and product nozzles on the Detailed Dynamic Heat Exchanger operation has physical meaning. The exit stream's composition depends on the exit stream nozzle's location and diameter in relation to the physical holdup level in the vessel. If the product nozzle is located below the liquid level in the vessel, the exit stream draws material from the liquid holdup. If the product nozzle is located above the liquid level, the exit stream draws material from the vapour holdup.

If the liquid level sits across a nozzle, the mole fraction of liquid in the product stream varies linearly with how far up the nozzle the liquid is.

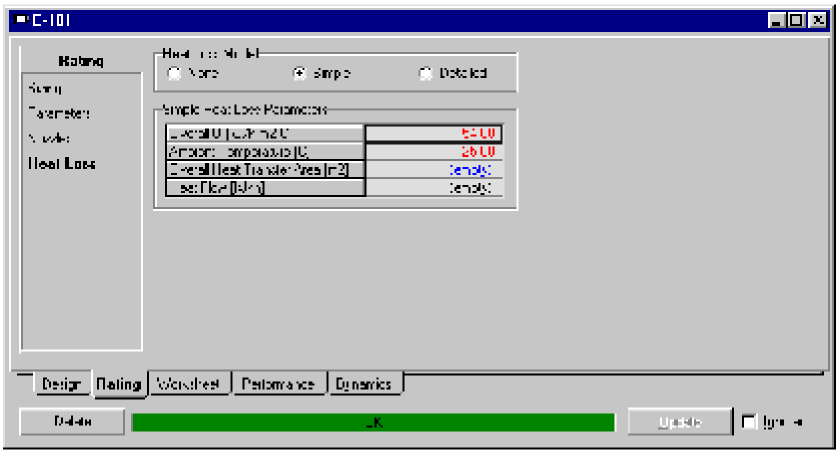
Essentially, all vessel operations in HYSYS are treated the same. The compositions and phase fractions of each product stream depend solely on the relative levels of each phase in the holdup and the placement of the product nozzles, so a vapour product nozzle does not necessarily produce pure vapour. A 3-phase separator may not produce two distinct liquid phase products from its product nozzles.

Heat Loss Page

The Heat Loss page contains heat loss parameters which characterize the amount of heat lost across the vessel wall. You can choose either to have no heat loss model, a Simple heat loss model or a Detailed heat loss model.

Simple Heat Loss Model

Figure 4.51



When you select the Simple radio button, the following parameters appear:

- Overall U
- Ambient Temperature
- Overall Heat Transfer Area
- Heat Flow

Detailed Heat Loss Model

The Detailed model allows you to specify more detailed heat transfer parameters. The Fidelity license is required to use the Detailed Heat Loss model found on this page. Refer to **Section 1.6 - HYSYS Dynamics** in the **HYSYS Dynamic Modeling** guide for more information.

4.3.5 Worksheet Tab

Refer to **Section 1.3.1 - Worksheet Tab** for more information.

The Worksheet tab contains a summary of the information contained in the stream property view for all the streams attached to the Heat Exchanger unit operation.

To view the stream parameters broken down per stream phase, open the Worksheet tab of the stream property view.

The PF Specs page is relevant to dynamics cases only.

4.3.6 Performance Tab

The Performance tab has pages that display the results of the Heat Exchanger calculations in overall performance parameters, as well as using plots and tables.

The Performance tab contains the following pages:

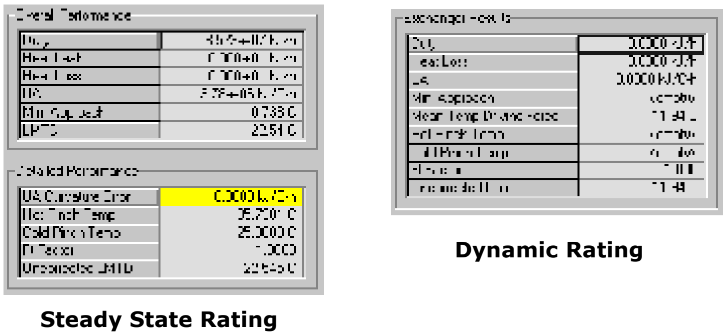
- Details
- Plots
- Tables
- Setup
- Error Msg

Details Page

The information from the Details page appears in the figure below.

The appearance of this page is slightly different for the Dynamic Rating model.

Figure 4.52



Overall Performance Group

The Overall and Detailed performance groups contain the following parameters that are calculated by HYSYS:

Parameter	Description
Duty	Heat flow from the hot stream to the cold stream.
Heat Leak	Loss of cold side duty due to leakage. Duty gained to reflect the increase in temperature.
Heat Loss	Loss of the hot side duty to leakage. The overall duty plus the heat loss is equal to the individual hot stream duty defined on the Tables page.
UA	Product of the Overall Heat Transfer Coefficient, and the Total Area available for heat transfer. The UA is equal to the overall duty divided by the LMTD.
Minimum Approach	The minimum temperature difference between the hot and cold stream.
Mean Temp Driving Force	The average temperature difference between the hot and cold stream.
LMTD	The uncorrected LMTD multiplied by the Ft factor. For the Weighted Rating Method, the uncorrected LMTD equals the effective LMTD.

Parameter	Description
UA Curvature Error	The LMTD is ordinarily calculated using constant heat capacity. An LMTD can also be calculated using linear heat capacity. In either case, a different UA is predicted. The UA Curvature Error reflects the difference between these UAs.
Hot Pinch Temperature	The hot stream temperature at the minimum approach.
Cold Pinch Temperature	The cold stream temperature at the minimum approach.
F_t Factor	The LMTD (log mean temperature difference) correction factor, F_t, is calculated as a function of the Number of Shell Passes and the temperature approaches. For a counter-current Heat Exchanger, F_t is 1.0. For the Weighted rating method, F_t = 1.
Uncorrected LMTD	(Applicable only for the End Point method) - The LMTD is calculated in terms of the temperature approaches (terminal temperature differences) in the exchanger, using the **Equation (4.26)**.

Uncorrected LMTD equation:

$$\Delta T_{LM} = \frac{\Delta T_1 - \Delta T_2}{\ln(\Delta T_1 / (\Delta T_2))} \tag{4.26}$$

where:

$$\Delta T_1 = T_{hot,\,out} - T_{cold,\,in}$$

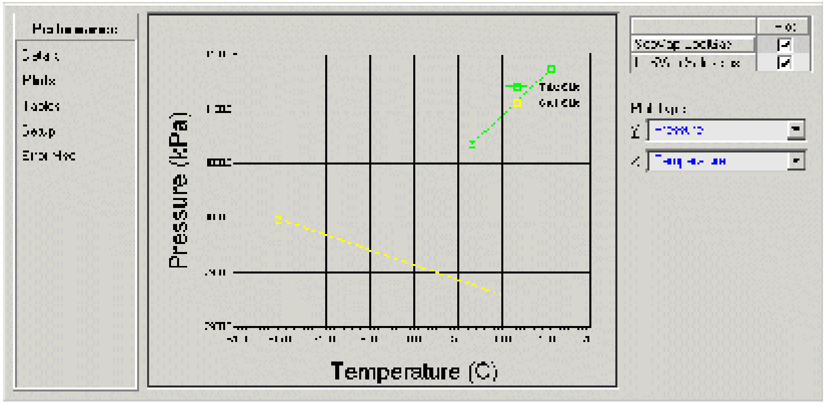
$$\Delta T_2 = T_{hot,\,in} - T_{cold,\,out}$$

Plots Page

You can modify the appearance of the plot via the Graph Control view. Refer to **Section 10.4 - Graph Control** in the **HYSYS User Guide** for more information.

You can plot curves for the hot and/or cold fluid. Use the Plot checkboxes to specify which side(s) of the exchanger should be plotted.

Figure 4.53



The following default variables can be plotted along either the X or Y-axis:

- Temperature
- UA
- Delta T
- Enthalpy
- Pressure
- Heat Flow

Select the combination from the Plot Type drop-down list. To Plot other available variables, you need to add them on the Setup page. Once the variables are added, they are available in the X and Y drop-down lists.

Tables Page

On the Tables page, you can view (default variables) interval temperature, pressure, heat flow, enthalpy, UA, and vapour fraction for each side of the Exchanger in a tabular format. Select either the Shell Side or Tube Side radio button.

To view other available variables, you need to add them on the Setup page. Variables are displayed based on Phase Viewing Options selected.

Setup Page

The Setup page allows you to filter and add variables to be viewed on the Plots and Tables pages .

The variables that are listed in the Selected Viewing Variables group are available in the X and Y drop down list for plotting on the Plots page. The variables are also available for tabular plot results on the Tables page based on the Phase Viewing Options selected.

Error Msg Page

The Error Msg page contains a list of the warning messages on the Heat Exchanger. You cannot add comments to this page. Use it to see if there are any warnings in modeling the Heat Exchanger.

4.3.7 Dynamics Tab

If you are working exclusively in Steady State mode, you are not required to change any information on the pages accessible through the Dynamics tab.

The Dynamics tab contains the following pages:

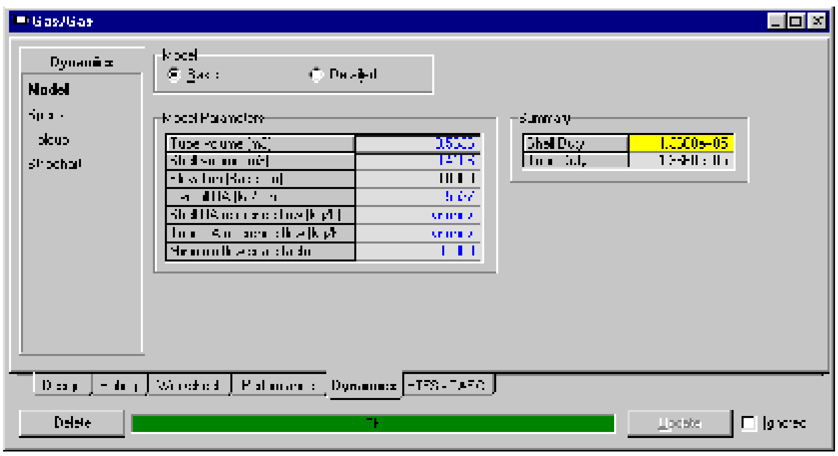
- Model
- Specs
- Holdup
- Stripchart

Any information specified on the Rating tab also appears in the Dynamics tab.

Model Page

In the Model page, you can specify whether HYSYS uses a Basic or Detailed model.

Figure 4.54



Basic Model

The Model Parameters group contains the following information for the Heat Exchanger unit operation:

Field	Description
Tube/Shell Volume	The volume of the shell and tube must be specified in the Basic model.
Elevation	The elevation is significant in the calculation of static head around and in the Heat Exchanger.
Overall UA	Product of the Overall Heat Transfer Coefficient and the Total Area available for heat transfer. The Heat Exchanger duty is proportional to the log mean temperature difference, where UA is the proportionality factor. The UA must be specified if the Basic model is used.
Shell/Tube UA Reference Flow	Since UA depends on flow, these parameters allow you to set a reference point that uses HYSYS to calculate a more realistic UA value. If no reference point is set then UA is fixed. If the UA is specified, the specified UA value does not change during the simulation. The UA value that is used, however, does change if a Reference Flow is specified. Basically, as in most heat transfer correlation's, the heat transfer coefficient is proportional to the $(\text{mass flow ratio})^{0.8}$. The equation below is used to determine the UA used: $$UA_{\text{used}} = UA_{\text{specified}} \times \left(\frac{\text{mass flow}_{\text{current}}}{\text{mass flow}_{\text{reference}}}\right)^{0.8} \quad (4.27)$$ Reference flows generally help to stabilize the system when you do shut downs and startups as well.
Minimum Flow Scale Factor	The ratio of mass flow at time *t* to reference mass flow is also known as flow scaled factor. The minimum flow scaled factor is the lowest value which the ratio is anticipated at low flow regions. This value can be expressed in a positive value or negative value. • A positive value ensures that some heat transfer still takes place at very low flows. • A negative value ignores heat transfer at very low flows. A negative factor is often used in shut downs if you are not interested in the results or run into problems shutting down an exchanger. If the Minimum Flow Scale Factor is specified, the **Equations (4.27)** uses the $\left(\frac{\text{mass flow}_{\text{current}}}{\text{mass flow}_{\text{reference}}}\right)^{0.8}$ ratio if the ratio is greater than the Min Flow Scale Factor. Otherwise the Min Flow Scale Factor is used.

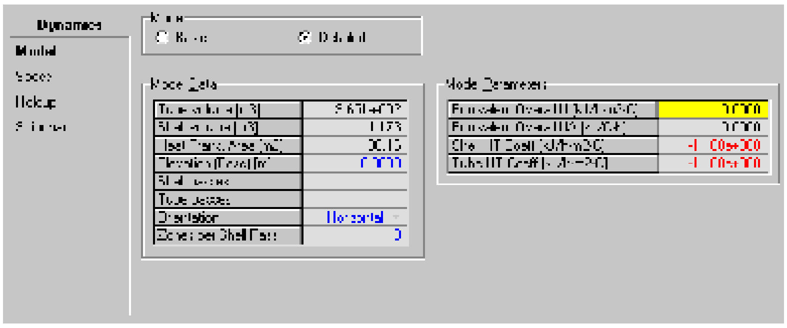
In some cases you can use a negative value for minimum flow scale factor. If you use -0.1, then if the scale factor goes below 0.1, the Minimum Flow Scale Factor uses 0.

The Summary group contains information regarding the duty of the Heat Exchanger shell and tube sides.

Detailed Model

When you select the Detailed radio button, a summary of the rating information specified on the Rating tab appears.

Figure 4.55



The Model Data group contains the following information:

Field	Description
Tube/Shell Volume	The volume of the shell and tube is calculated from the Heat Exchanger rating information.
Heat Transfer Area	The heat transfer area is calculated from the Heat Exchanger rating information.
Elevation	The elevation is significant in the calculation of static head around and in the Heat Exchanger.
Shell/Tube Passes	You can specify the number of tube and shell passes in the shell of the Heat Exchanger. In general, at least 2n tube passes must be specified for every n shell pass. The exception is a counter-current flow Heat Exchanger which has 1 shell pass and one tube pass

Field	Description
Orientation	The orientation may be specified as a vertical or horizontal Heat Exchanger. The orientation of the Heat Exchanger does not impact the steady state solver. However, it used in the dynamic Heat Exchanger in the calculation of liquid level in the shell.
Zones per Shell Pass	Enter the number of zones you would like for one shell pass. The total number of zones in a Heat Exchanger shell is calculated as: $$Total\ Zones = \#\ \text{of}\ Shells \cdot \frac{Zones}{Shell\ Pass}$$

The Model Parameters group contains the local and overall heat transfer coefficients for the Heat Exchanger. Depending on how the Heat Transfer Coefficient Calculator is set on the Parameters page of the Rating tab, the local and overall heat transfer coefficients can either be calculated or specified in the Model Parameters group.

HT Coefficient Calculator Setting	Description
Shell & Tube	Overall heat transfer coefficient, U, is calculated using the exchanger rating information.
U Specified	Overall heat transfer coefficient, U, is specified by you.

The Startup Level group appears only if the Heat Exchanger is specified with a single shell and/or tube pass having only one zone. The Startup level cannot be set for multiple shell and/or tube pass exchangers for multiple shell or tube passes. You can specify an initial liquid level percent for the shell or tube holdups. This initial liquid level percent is used only if the simulation case re-initializes.

Specs Page

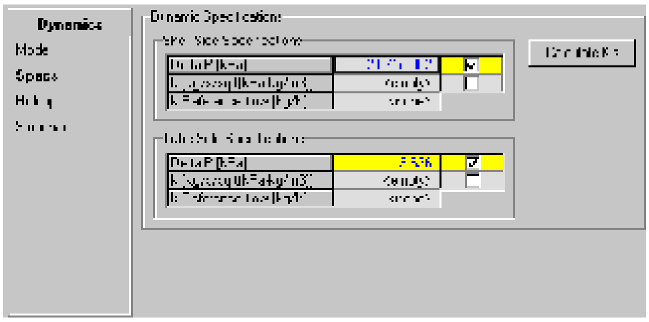
The Specs page contains information regarding the calculation of pressure drop across the Heat Exchanger.

The information displayed on the Specs page depends on the model (Basic or Detailed) selected on the Model page.

Basic Model

When you select the Basic model radio button on the Model page, the Specs page appears as follows.

Figure 4.56



The pressure drop across any pass in the Heat Exchanger operation can be determined in one of two ways:

- Specify the pressure drop.
- Define a pressure flow relation for each pass by specifying a k value.

The following parameters are used to specify the pressure drop for the Heat Exchanger.

Dynamic Specification	Description
Shell/Tube Delta P	The pressure drop across the Shell/Tube side of the Heat Exchanger may be specified (checkbox active) of calculated (checkbox inactive).

At low flow range, it is recommended that the k reference flow is taken as 40% of steady state design flow for better pressure flow stability.

Dynamic Specification	Description
k	Activate this option if to have the Pressure Flow k values used in the calculation of pressure drop.
k Reference Flow	If the pressure flow option is chosen the k value is calculated based on two criteria. If the flow of the system is larger than the k Reference Flow, the k value remains unchanged. If the flow of the system is smaller than the k Reference Flow the k value is given by: $k_{used} = k_{specified} \times Factor$ *where:* *Factor = value is determined by HYSYS internally to take into consideration the flow and pressure drop relationship at low flow regions.*

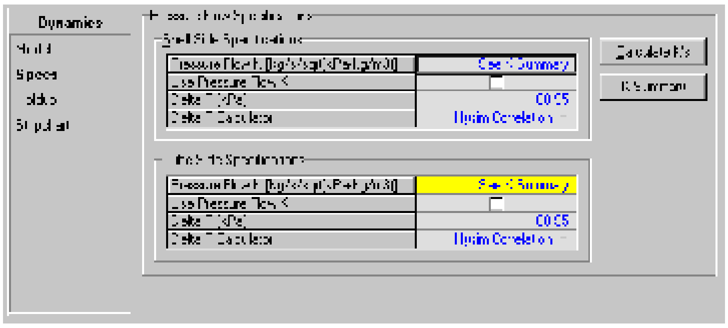
Effectively, the k Reference Flow results in a more linear relationship between flow and pressure drop, and this is used to increase model stability during startup and shutdown where the flows are low.

Use the Calculate k button to calculate a k value based on the Delta P and k Reference flow. Ensure that there is a non zero pressure drop across the Heat Exchanger before you click the Calculate k button.

Detailed Model

When you select the Basic model radio button on the Model page, the Specs page appears as follows.

Figure 4.57



The following parameters are used to specify the pressure drop for the Heat Exchanger.

Dynamic Specification	Description
Pressure Flow k	The k-value defines the relationship between the flow through the shell or tube holdup and the pressure of the surrounding streams. You can either specify the k-value or have it calculated from the stream conditions surrounding the Heat Exchanger. you can "size" the exchanger with a k-value by clicking the Calculate K's button. Ensure that there is a non zero pressure drop across the Heat Exchanger before the Calculate k button is clicked.
Pressure Flow Option	Activate this option to have the Pressure Flow k values used in the calculation of pressure drop. If the Pressure Flow option is selected, the Shell/Tube Delta P calculator must also be set to non specified.

Dynamic Specification	Description
Shell/Tube Delta P	The pressure drop across the Shell/Tube side of the Heat Exchanger may be specified or calculated.
Shell/Tube Delta P Calculator	The Shell/Tube Delta P calculator allows you to either specify or calculate the shell/tube pressure drop across the Heat Exchanger. Specify the cell with one of the following options: • **Shell & Tube Delta P Calculator**. The pressure drop is calculated using the Heat Exchanger rating information and correlations. • **user specified**. The pressure drop is specified by you. • **not specified**. This option is only applicable in Dynamic mode. Pressure drop across the Heat Exchanger is calculated from a pressure flow relationship. You must specify a k-value and activate the Pressure Flow option to use this calculator.

Refer to the section on the **Detailed Heat Model Properties** for more information on Detailed Heat Model Properties view.

Clicking the K Summary button opens the Detailed Heat Model Properties view.

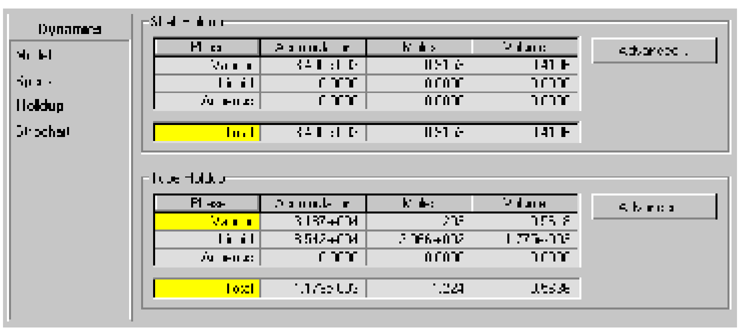
Holdup Page

The Holdup page contains information regarding the shell and tube holdup properties, composition, and amount.

Basic Model

When you select the Basic model radio button on the Model page, the Holdup page appears as follows.

Figure 4.58



The Shell Holdup group and Tube Holdup group contain information regarding the shell and tube side holdup parameters. For each phase contained within the volume space of the unit operation, the following is specified:

Holdup Details	Description
Accumulation	Rate of change of material in the holdup for each phase.
Moles	Amount of material in the holdup for each phase.
Volume	The holdup volume of each phase.

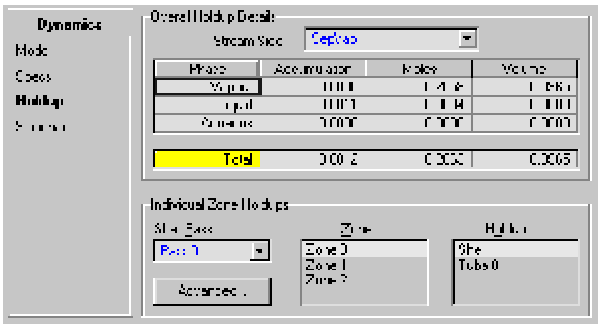
Refer to **Section 1.3.7 - Advanced Holdup Properties** in the **HYSYS Dynamic Modeling** guide for more information.

Click the Advanced button to access the view that provides more detailed information about the holdup of that unit operation.

Detailed Model

When you select the Detailed model radio button on the Model page, the Holdup page appears as follows.

Figure 4.59



The Overall Holdup Details group contains information regarding the shell and tube side holdup parameters. For each phase contained within the volume space of the unit operation, the following is specified:

Holdup Details	Description
Accumulation	Rate of change of material in the holdup for each phase.

Holdup Details	Description
Moles	Amount of material in the holdup for each phase.
Volume	The holdup volume of each phase.

The Individual Zone Holdups group contains detailed holdup properties for every layer in each zone of the Heat Exchanger unit operation.

In order to view the advanced properties for individual holdups, you must first choose the individual holdup.

Refer to **Section 1.3.7 - Advanced Holdup Properties** in the **HYSYS Dynamic Modeling** guide for more information.

Click the Advanced button to access the view that provides more detailed information about the holdup of that unit operation.

To choose individual holdups you must specify the Zone and Layer in the corresponding drop-down lists.

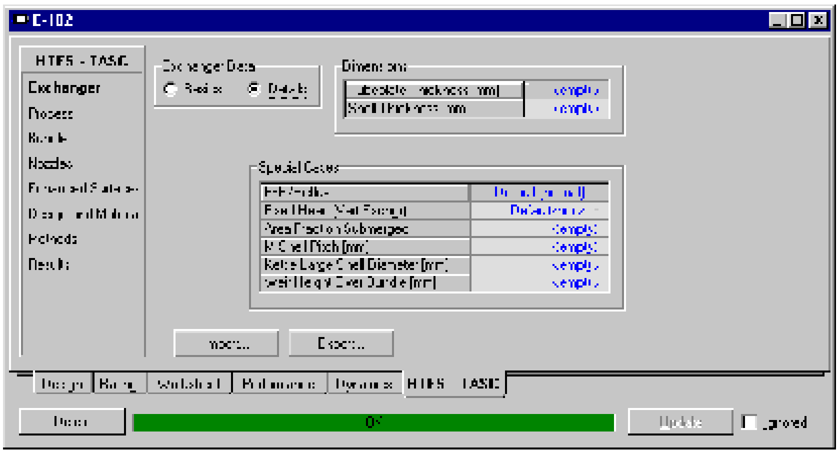
Stripchart Page

The Stripchart page allows you to select and create default strip charts containing various variable associated to the operation. Refer to **Section 1.3.4 - Stripchart Page/Tab** for more information.

4.3.8 HTFS-TASC Tab

When you select the HTFS - Engine model on the Parameters page of the Design tab, the HTFS-TASC tab appears as shown in the figure below:

Figure 4.60



The HTFS-TASC tab contains the following pages:

- Exchanger
- Process
- Bundle
- Nozzles
- Enhanced Surfaces
- Design and Material
- Methods
- Results

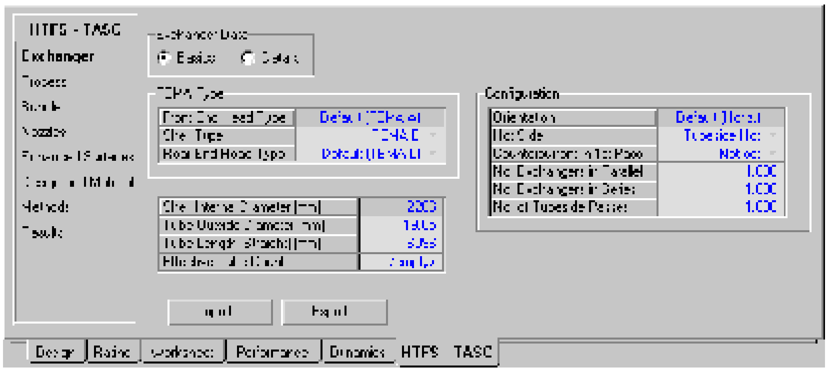
The HTFS-TASC tab also contains two buttons:

- **Import**. Allows you to import values from TASC into the pages of the tab.
- **Export**. Allows you to export the information provided within this tab to TASC.

Exchanger Page

The Exchanger page allows you to input parameters that define the geometric configuration of the Heat Exchanger.

Figure 4.61



After entering a basic configuration of the Heat Exchanger, you can specify detailed information.

Basics Data

For the Basics data, you can enter the following information:

Refer to the **TASC Thermal Reference** guide for more information about the selections available.

Entry	Description
Front End Head Type	You can select the type of front end head for your heat exchanger using the drop-down list. The type of head selected has no significant effect on the heat exchanger thermal or pressure drop performance, as calculated by TASC. It only affects the heat exchanger weight.
Shell Type	You can select the type of shells for the heat exchanger using the drop-down list.
Rear End Head Type	You can select the type of rear end head for your heat exchanger using the drop-down list.
Shell Internal Diameter	You can enter the internal diameter of the shell in this cell.
Tube Outside Diameter	You can enter the outside diameter of the tube in this cell.
Tube Length (Straight)	You can enter the length of the tube in this cell.

If you did not enter any value in this cell, TASC derives an exact tube count while setting up the Tube Bundle Layout.

Entry	Description
Effective Tube Count	You can enter the number of tubes in the heat exchanger in this cell.
Orientation	You can select from three types of orientation for your heat exchanger in the drop-down list: • Default (Horiz.) • Horizontal • Vertical
Hot Side	You can select which side is the hot side in your heat exchanger from the drop-down list. There are three selections: • Not yet set • Tubeside hot • Shell-side hot
Countercurrent in 1st Pass	You can select whether countercurrent occurs in the first pass from the drop-down list. There are three selections: • Not set • Yes • No (co-current)
No. Exchangers in Parallel	You can specify how many heat exchangers are parallel to the current heat exchanger in this cell.
No. Exchangers in Series	You can specify how many heat exchangers are in series to the current heat exchanger in this cell.
No. of Tubeside Passes	You can specify how many tubeside passes occur in the heat exchanger in this cell.

Details Data

For the Details data, you can enter the following information:

Refer to the **TASC Thermal Reference** guide for information about the selections available.

Entry	Description
Tubeplate Thickness	You can specify the tubeplate thickness in this cell.
Shell Thickness	You can specify the shell thickness in this cell.
FFE/Reflux	You can select the special type of exchanger using the drop-down list. There are four selections: • Default (normal) • Normal exchanger • Falling Film Evap • Reflux Condenser

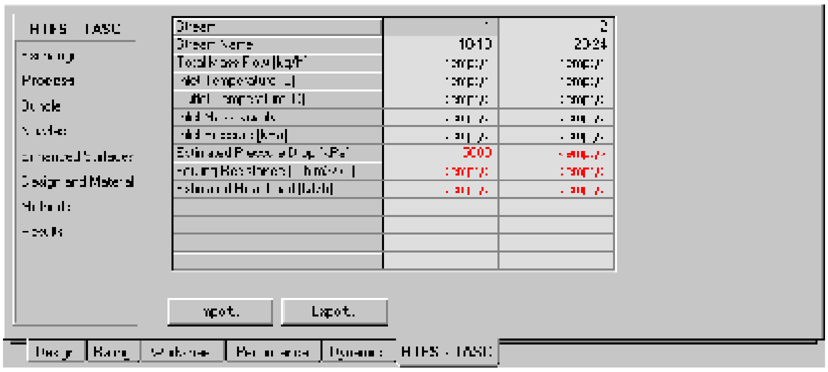
Entry	Description
Fixed Head (Vert Exchgr)	You can select the location of the fixed end head from the drop-down list. There are three selections: • Default/horiz • Top • Bottom The Top and Bottom selections only apply to vertical shells.
Area Fraction Submerged	You can enter the area fraction on the tubes that may be submerged under condensate in this cell. This value only applies to horizontal shellside condensers and if there is a lute or geometric feature that causes tubes to be submerged.
M Shell Pitch	You can enter the shell pitch for double-pipe U-tube exchangers or Multitube hairpin exchangers in this cell. The value is used to determine the U-bend heat transfer area.
Kettle Large Shell Diameter	You can enter the internal diameter of the larger part of the shell of a kettle reboiler in this cell.
Weir Height Over Bundle	You can enter the height of the weir above the top of the bundle in this cell. This value is used to define the head of liquid providing the driving force for re-circulation within a kettle.

If no value is entered, HYSYS assumes the value is zero. The top of the weir is assumed to be level with the top of the outer tube limit circle of the bundle.

Process Page

The Process page allows you to specify the estimate pressure drop, fouling resistance, and heat load.

Figure 4.62



The estimated heat load is used as a starting point to do the simulation calculation.

Bundle Page

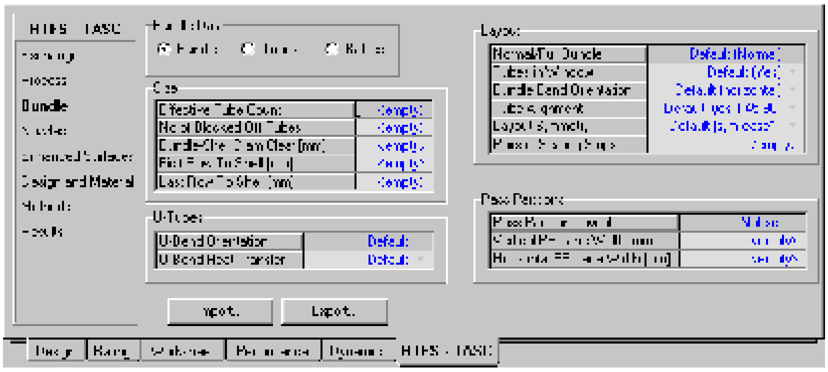
The Bundle page allows you to specify the bundle, tube, and baffles configurations. The radio buttons in the Bundle Data group controls which configuration appears on the page.

- Bundle
- Tubes
- Baffles

Bundle Configuration

If you select the Bundle radio button in the Bundle Data group, the Bundle page appears as shown in the figure below:

Figure 4.63



The configuration information you can specify for the bundle is sorted into four groups:

- Size
- U-Tubes
- Layout
- Pass Partitions

Size Group

The Size group allows you to specify information used to calculate the size of the bundle.

The Effective Tube Count field is linked to the Effective Tube Count field on the Exchanger page. Any changes in either fields propagates to the other.

Specification	Description
Effective Tube Count	Number of tubes in the heat exchanger.
No of Blocked Off Tubes	Number of blocked off tubes.
Bundle-Shell DIam Clear	Diametral clearance between the tube bundle (outer limit diameter) and the shell wall. This value is used to determine the fraction of the shellside flow which by passes around the bundle. For zero clearance, enter **0**.
First Row to Shell	Specify the distance between the centres of the first row tubes to the shell. The first tube row is that nearest the inlet nozzle.
Last Row to Shell	Specify the distance between the centres of the last row tubes to the shell. The last tube row is that furthest from the inlet nozzle.

U-Tubes Group

The U-tubes group allows you to select the configuration of the U-tubes.

Refer to the **TASC Thermal Reference** guide for information about the selections available.

Specification	Description
U-Bend Orientation	You can select the type of U-bend orientation from the drop-down list. There are three selections: • Default • Horizontal • Vertical
U-Bend Heat Transfer	You can select whether to include or exclude the heat transfer that occurs in the U-tube using the drop-down list. There are three selections: • Default • Allow for U-bend • Ignore U-bend

Layout Group

The Layout group allows you to specify information used to design the layout of the bundle.

Refer to **TASC Thermal Reference** guide for information about the selections available.

Specification	Description
Normal/Full Bundle	You can select what type of bundle to use from the drop-down list. There are three selections: • Default (Normal) • Normal Bundle • Full Bundle
Tubes in Window	You can select whether you want tubes in the window or not from the drop-down list. There are three selections: • Default (Yes) • Yes • No
Bundle Band Orientation	You can select the bundle band orientation from the drop-down list. There are three selections: • Default (horizontal) • Horizontal • Vertical
Tube Alignment	You can select the tube alignment from the drop-down list. There are four selections: • Default (if yes 45 90) • Fully aligned • Unaligned • Part aligned
Layout Symmetry	You can select the layout symmetry from the drop-down list. There are four selections: • Default (sym.case 1) • Symmetry (case 1) • Symmetry (case 2) • Not enforced
Pairs of Sealing Strips	Number of pairs of sealing strips.

Pass Partitions Group

The Pass Partitions group allows you to specify information used to configure the pass partition.

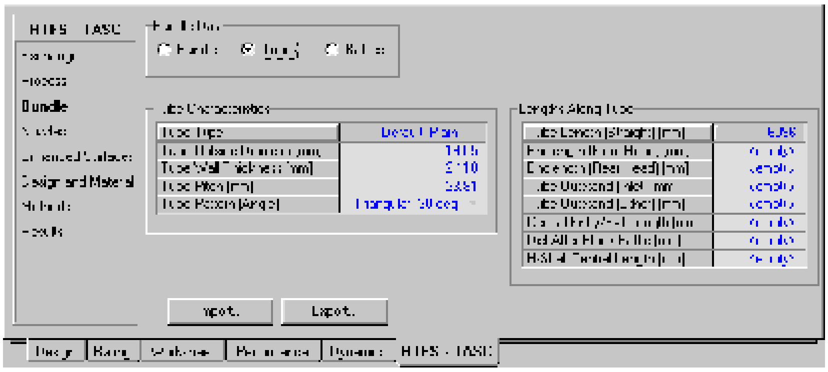
Refer to the **TASC Thermal Reference** guide for information about the selections available.

Specification	Description
Pass Partition Layout	You can select the type of pass partition from the drop-down list. There are four selections: • Not set • H Banded • Double Banded • Ribbon Banded
Vertical PP Lane Width	Vertical pass partition lane width.
Horizontal PP Lane Width	Horizontal pass partition lane width.

Tubes Configuration

If you select the Tubes radio button in the Bundle Data group, the Bundle page appears as shown in the figure below:

Figure 4.64



The configuration information you can specify for the tubes is sorted into two groups:

- Tube Characteristics
- Lengths Along Tube

Tube Characteristics Group

The Tube Characteristics group allows you to specify the configuration for the tube.

Refer to the **TASC Thermal Reference** guide for information about the selections available.

Specification	Description
Tube Type	You can select the type of tube you want from the drop-down lists: • Default (Plain) • Plain Tubes • Lowfin Tubes • Longitudinal Tubes
Tube Outside Diameter	Outside diameter of the tube.
Tube Wall Thickness	Thickness of the tube's wall.
Tube Pitch	The tube's pitch.
Tube Pattern (Angle)	You can select the pattern of the tube from the drop-down list: • Default (Triangular) • Triangular (30 deg) • Rotated square (45) • Roated triang. (60) • Square (90 deg)

Lengths Along Tube Group

The Lengths Along Tube group allows you to specify the lengths of each tube section.

Specification	Description
Tube Length	Length of the tube.
Endlength (Front Head)	Length of the front head of the tube.
Endlength (Rear Head)	Length of the rear head of the tube.
Tube Outstand (Inlet)	The distance the tube inlet end protrudes beyond the face of a tube sheet.
Tube Outstand (Other)	The distance the tube rear end protrudes beyond the face of a tube sheet.
Central Entry/Exit Length	The distance between the centres of the Flow Baffles on either side of a central inlet or outlet nozzle.

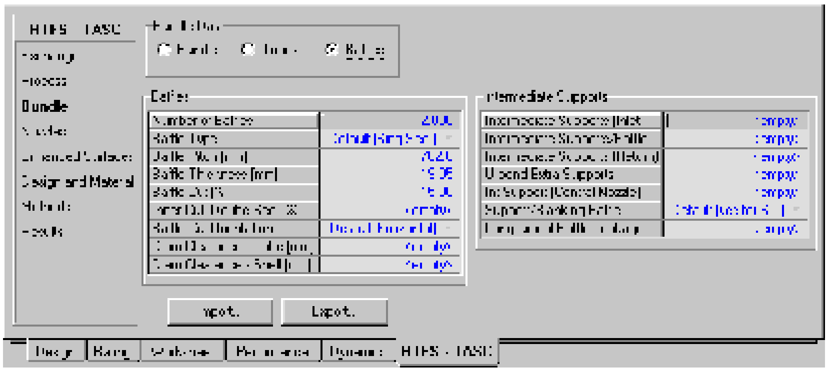
HYSYS assumes the two baffle spacings are equal if no value is entered.

Specification	Description
Dist. After Blank Baffle	The distance between the tube and the blank baffle.
H-Shell Central Length	Length of the central region in an H-shell. This value is the distance between two halves of the axial baffle in an H-shell. HYSYS assumes the value to be double the mean length of the end spaces at the ends of the exchanger if no value is entered.

Baffles Configuration

If you select the Baffles radio button in the Bundle Data group, the Bundle page appears as shown in the figure below:

Figure 4.65



The configuration information you can specify for the baffles is sorted into two groups:

- Baffles
- Intermediate Supports

Baffles Group

The Baffles group allows you to specify the configuration of the baffles.

Refer to the **TASC Thermal Reference** guide for information about the selections available.

Specification	Description
Number of Baffles	Number of baffles.
Baffle Type	Select the baffle type from the drop-down list: • Default (Sing.Seg.) • Single Segmental • Double Segmental • Unbar/Low pr.drop • Rodbaffled
Baffle Pitch	The value of the baffle pitch. The baffle pitch is the baffle spacing plus the baffle thickness.
Baffle Thickness	The baffle thickness.
Baffle Cut	The percentage of baffle cut.
Inner Cut (Double Seg)	The percentage of inner cut. This is only applicable to Double Segmental baffle type.
Baffle Cut Orientation	Select the orientation of the baffle cut using the drop-down list: • Default (horizontal) • Vertical • Horizontal
Diam. Clearance - Tube	Diametral clearance between the tube and the baffle hole. For a zero clearance, enter **0**.
Diam. Clearance - Shell	Diametral clearance between the baffles and the shell wall. For a zero clearance, enter **0**.

Intermediate Support Group

The Intermediate Support group allows you to specify the tube supports, other than flow baffles, that help remove the risk of vibration damage.

Specification	Description
Intermediate Supports (Inlet)	Number of intermediate supports in the inlet endspace. This endspace corresponds to the inlet endlength.
Intermediate Supports/Baffle	Number of intermediate supports between each pair of flow baffles.
Intermediate Supports (Return)	Number of intermediate supports in the endspace corresponding to the outlet (return) endlength.
U-bend Extra Supports	Number of tube supports on the U-bend.

Refer to the **TASC Thermal Reference** guide for information about the selections available.

Specification	Description
Int. Supports (Central Nozzle)	Number of intermediate supports for nozzles (not over inlet or return endspace).
Support/Blanking Baffle	Select whether there is a support of blanking baffle at the rear end head: • Default (Yes for S T) • Yes • No
Longitudinal Baffle Leakage	An estimate of the percentage of the shellside flow which leaks across the longitudinal baffle. This value is only relevant to the F, G, or H shell types.

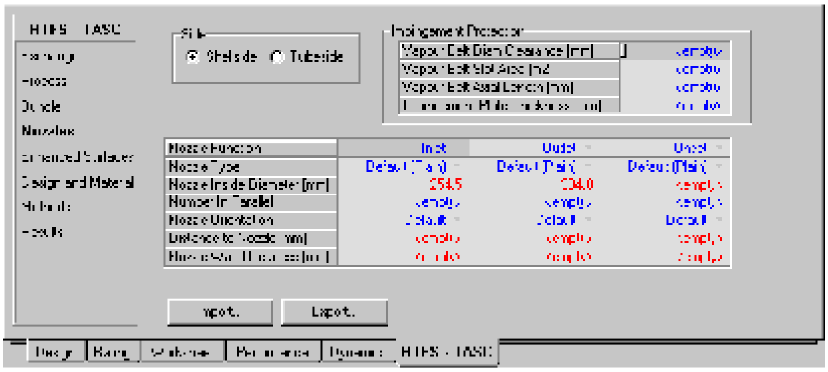
Nozzles Page

The Nozzles page allows you to specify the nozzles in the shellside and tubeside. The radio buttons in the Side Data group controls which side appears on the page.

Shellside Configuration

If you select the Shellside radio button in the Size group, the Nozzles page appears as shown in the figure below:

Figure 4.66



The following table lists and describes the configuration information that you can specify for the nozzles in shellside.

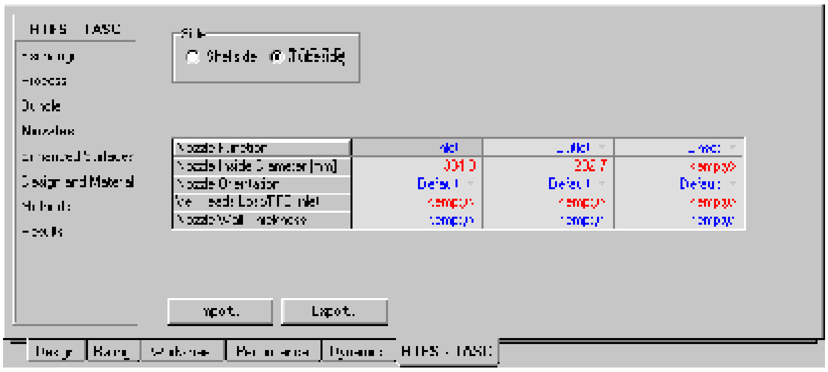
Refer to the **TASC Thermal Reference** guide for information about the selections available.

Specification	Description
Vapour Belt Diam Clearance	Diametral annular clearance (difference in diameters) between the outside of the shell and the vapour belt.
Vapour Belt Slot Area	The total flow area of all the slots leading through the shell wall (from the vapour belt into the shell).
Vapour Belt Axial Length	The axial length of the exchanger occupied by (the inside of) the belt.
Impingement Plate Thickness	The thickness of the impingement plate.
Nozzle Function	You can specify up to three types of nozzle function. Select the nozzle function from the drop-down list: • Unset • Inlet • Outlet • Intermediate • Liquid Outlet • Vapour Outlet
Nozzle Type	Select the nozzle types from the drop-down list: • Default (Plain) • Plain • Plain + Imp Plate • Vapour Belt
Nozzle Inside Diameter	The inside diameter of the nozzle.
Number In Parallel	Number of nozzles in parallel on one shell.
Nozzle Orientation	Select the nozzle orientation from the drop-down list: • Default • Top of Shell • RHSide of Shell • Bottom of Shell • LHSide of Shell
Distance to Nozzle	The axial distance along the shell to the nozzle centre line, measured from the inner surface of the tubesheet at the front (fixed) head.
Nozzle Wall Thickness	The wall thickness of the nozzle.

Tubeside Configuration

If you select the Tubeside radio button in the Size group, the Nozzles page appears as shown in the figure below:

Figure 4.67



The configuration information you can specify for the nozzles in tubeside is described in the table below:

Refer to the **TASC Thermal Reference** guide for information about the selections available.

Specification	Description
Nozzle Function	You can specify up to three types of nozzle function. Select the nozzle function from the drop-down list: • Unset • Inlet • Outlet • Intermediate • Liquid Outlet • Vapour Outlet
Nozzle Inside Diameter	The inside diameter of the nozzle.
Nozzle Orientation	Select the nozzle orientation from the drop-down list: • Default • Top of Shell • RHSide of Shell • Bottom of Shell • LHSide of Shell

Specification	Description
Vel Head Lost/FFE Inlet	Number of velocity heads lost in a device (used to achieve uniform flow distribution of the liquid in-flow to all the tubes of a falling film evaporator).
Nozzle Wall Thickness	The wall thickness of the nozzle.

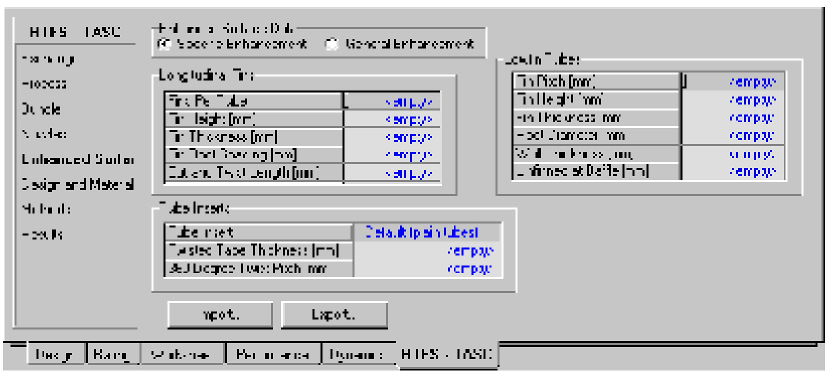
Enhanced Surface Page

The Enhanced Surface page allows you to perform model calculations on the exchanger that are not explicitly modeled by TASC. There are two enhanced options on the page, and you can select which enhanced option you want using the radio buttons in the Enhanced Surface Data group.

Specific Enhanced Option

If you select the Specific Enhanced radio button in the Enhanced Surface Data group, the Enhanced Surface page appears as shown in the figure below.

Figure 4.68



The variables you can specify for the Specific Enhanced option are sorted into three groups:

- Longitudinal Fins
- Lowfin Tubes
- Tube Inserts

Longitudinal Fins Group

The Longitudinal Fins group allows you to specify the configuration of the longitudinal fins.

Specification	Description
Fins Per Tube	Number of fins are on each tube.
Fin Height	Height of each fin.
Fin Thickness	Thickness of each fin.
Fin Root Spacing	The root spacing of each fin.
Cut and Twist Length	The cut and twist length.

Lowfin Tubes Group

The Lowfin Tubes group allows you to specify the configuration of the lowfin tubes.

Specification	Description
Fin Pitch	The lowfin fin pitch.
Fin Height	The height of each fin.
Fin Thickness	The thickness of each fin.
Root Diameter	The lowfin tube root diameter.
Wall Thickness	The lowfin tube wall thickness.
Unfinned at Baffle	Length of unfinned tubing at a baffle.

Tube Inserts Group

The Tube Inserts group allows you to specify the configuration of the tube inserts.

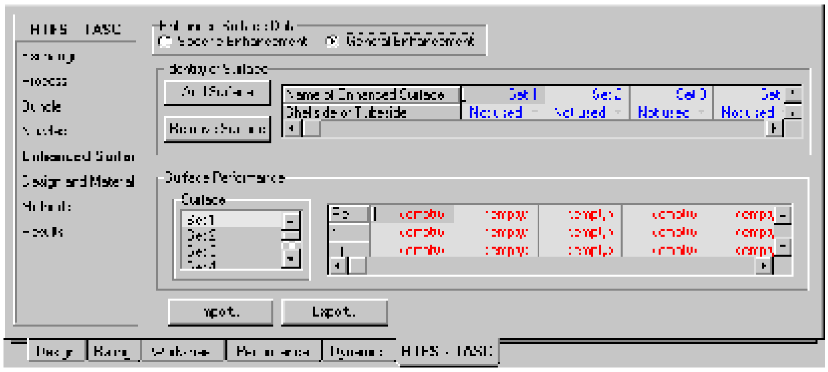
Refer to the **TASC Thermal Reference** guide for information about the selections available.

Specification	Description
Tube Insert	Select the type of tube inserts from the drop-down list: • Default (plain tubes) • None (plain tubes) • Twisted tape
Twisted Tape Thickness	The twisted tape thickness. The value only applies if you selected twisted tape for the tube insert.
360 Degree Twisted Pitch	The distance between each 360 degree twist of a twisted tape insert.

Specific Enhanced Option

If you select the General Enhanced radio button in the Enhanced Surface Data group, the Enhanced Surface page appears as shown in the figure below:

Figure 4.69



The variables you can specify for the General Enhanced option is sorted into two groups:

- Identity of Surface
- Surface Performance

Identity of Surface Group

The Identity of Surface group allows you to create surfaces for both the shellside and tubeside.

Specification	Description
Add Surface	Allows you to add/create a surface.
Remove Surface	Allows you to remove the last surface.
Name of Enhanced Surface	Contains the name of the surface created. HYSYS automatically names the surface as "Set" followed by a number. The number value is incremented by 1 for each new surface created.
Shellside or Tubeside	Select which side the surface created on from the drop-down list: • Not used • Shellside • Tubeside

Refer to the **TASC Thermal Reference** guide for information about the selections available.

Surface Performance Group

The Surface Performance group allows you to specify the configuration of each surface.

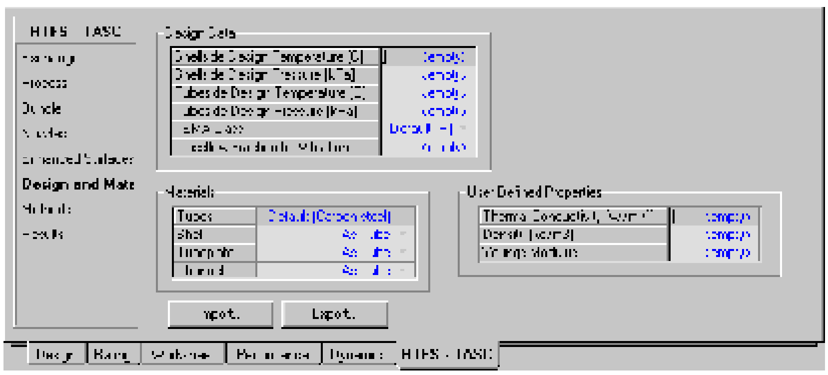
Specification	Description
Surface	Contains the list of surfaces created. Any values entered in the table located at the right of the list apply only to the surface you selected in the list.
Re	The Reynolds Number for the corresponding surface.
f	The friction factor for the corresponding surface.
Cj	The heat transfer factor (Colburn j factor) for the corresponding surface.

Design and Material Page

The Design and Material page allows you to specify design values, material types, and some properties for the Heat Exchanger. The information on this page is sorted into three groups:

- Design Data
- Materials
- User Defined Properties

Figure 4.70



Design Data Group

The Design Data group allows you to specify the following variables:

Refer to the **TASC Thermal Reference** guide for information about the selections available.

Specification	Description
Shellside Design Temperature	Design temperature on the shellside.
Shellside Design Pressure	Design pressure on the shellside.
Tubeside Design Temperature	Design temperature on the tubeside.
Tubeside Design Pressure	Design pressure on the tubeside.
TEMA Class	Select the TEMA class from the drop-down list: • Default (R) • R • C • B • Not TEMA
Crossflow Fraction for Vibration	The fraction from the shellside flow in the cross flow which causes vibration.

Materials Group

The Materials group allows you to select the material type for the heat exchanger. HYSYS lets you select the material for four parts of the heat exchanger: Tubes, Shell, Tubeplate, and Channel. You can select the material type from the drop-down list provided for each part.

User Defined Properties Group

The User Defined Properties group allows you to specify values for the following properties:

Specification	Description
Thermal Conductivity	The thermal conductivity of the tube material. This value overrides the calculated value based on the tube material selected.
Density	Density for all the exchanger materials. This value overrides the calculated value based on the selected materials for each part of the exchanger.
Youngs Modulus	The Young's Modulus. This value overrides the calculated value based on the tube material selected.

Methods Page

The Methods page allows you to specify the process methods and constraints of the heat exchanger. The Methods and Constraints group contains three radio buttons:

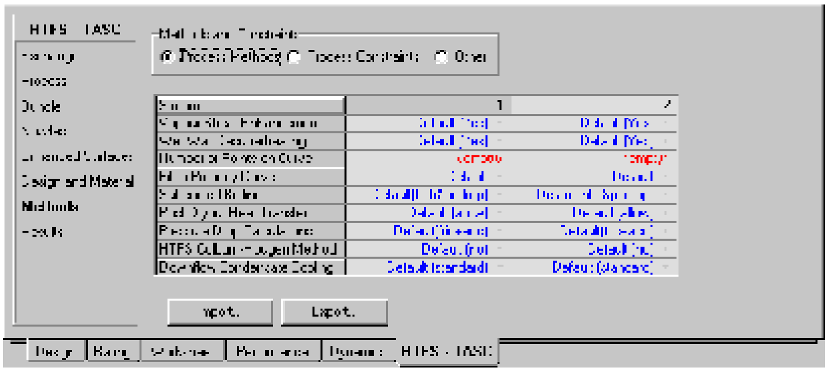
- Process Methods
- Process Constraints
- Other

The variables displayed on this page depend on the radio button you selected in the Methods and Constraints group.

Process Methods Variables

If you select the Process Methods radio button from the Methods and Constraints group, the Methods page appears as shown in the figure below:

Figure 4.71



The table below lists the variables available for the process method:

Refer to the **TASC Thermal Reference** guide for information about the selections available.

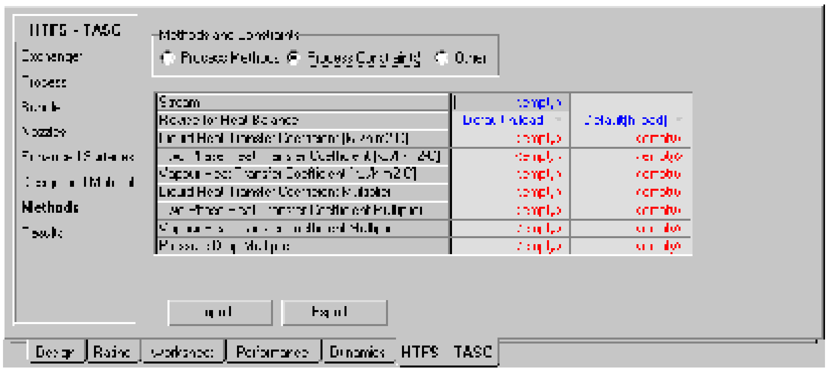
Method	Description
Vapour Shear Enhancement	Select whether the process stream has vapour shear enhancement from the drop-down list: • Default (Yes) • Yes • No
Wet Wall Desuperheating	Select whether the process stream has wet wall desuperheating from the drop-down list: • Default (Yes) • Yes • No
Number of Points on Curve	Specify the number of points on the TASC stream heat load curve in this field. The minimum value is **6** and the maximum value is **12**.
Fit to Property Curve	Select whether the results fit the property curve from the drop-down list: • Default • A input / calc. • Use best fit

Method	Description
Subcooled Boiling	Select whether there is subcooled boiling from the drop-down list: • Default(ht.tr&pr.drop) • Allow in heat.tr&pr.drop • Allow in heat tran. only • Allow in press. drop only • Not allowed for
Post Dryout Heat Transfer	Select whether there is post dryout heat transfer from the drop-down list: • Default (allow) • Allow for • Assume Boiling
Pressure Drop Calculations	Select the type of pressure drop calculations from the drop-down list: • Default (fric+acc) • Frict+Acc+Gravitation • Friction+Accel
HTFS Colburn-Hougen Method	Select whether to apply HTFS Colburn-Hougen method from the drop-down list: • Default (no) • Yes • No
Downflow Condensate Cooling	Select the type of downflow condensate cooling from the drop-down list: • Default (standard) • Falling Film • Standard Method

Process Constraints Variables

If you select the Process Constraints radio button from the Methods and Constraints group, the Methods page appears as shown in the figure below:

Figure 4.72



The table below contains a list of the constraints available in the operation:

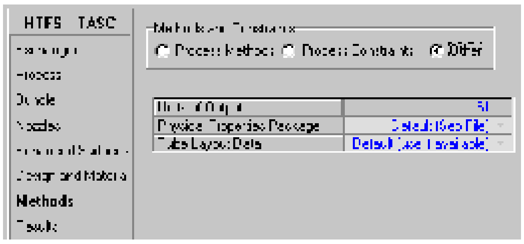
Refer to the **TASC Thermal Reference** guide for information about the selections available.

Constraints	Description
Revise for Heat Balance	Select the type of revise for heat balance from the drop-down list: • Default (h.load) • Heat Load • Outlet Temp. • Inlet Temp. • Flowrate
Liquid Heat Transfer Coefficient	Amount of liquid heat transfer coefficient.
Two Phase Heat Transfer Coefficient	Amount of two phase heat transfer coefficient.
Vapour Heat Transfer Coefficient	Amount of vapour heat transfer coefficient.
Liquid Heat Transfer Coefficient Multiplier	The liquid heat transfer coefficient multiplier.
Two Phase Heat Transfer Coefficient Multiplier	The two phase heat transfer coefficient multiplier.
Vapour Heat Transfer Coefficient Multiplier	The vapour heat transfer coefficient multiplier.
Pressure Drop Multiplier	The pressure drop multiplier.

Other Variables

If you select the Other radio button from the Methods and Constraints group, the Methods page appears as shown in the figure below.

Figure 4.73



The table below contains a list of variables available in the operation.

Refer to the **TASC Thermal Reference** guide for information about the selections available.

Variables	Description
Units of Output	Select the type of unit for the output from the drop-down list: • Default (as Input) • SI • British/US • Metric • unused option
Physical Property Package	Select the type of physical property package from the drop-down list: • Default (Sep.File) • In Lineprinter O/p • Separate File • No Output
Tube Layout Data	Select the type of tube layout data from the drop-down list: • Default (use if available) • Use if available • Revise from input • Ignore layout data