

# Improve Fidelity of your Process Models by Sizing Rigorous Heat Exchanger Models

Using Aspen Plus®

# Objective

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This guide will demonstrate how you can increase the fidelity of your process model by using Rigorous Heat Exchanger models generated using the Heat Exchanger sizing feature in Aspen Plus.

We will cover the following types of heat exchanger units:

- Shell & Tube heat exchanger
- Air Cooled heat exchanger

For this exercise we use the Aspen Plus model titled: “Shell&Tube for InteractiveSizing.bkp”.

To download the required files for this exercise please visit Aspen Tech’s customer support site.(Refer to Knowledge Base Solution ID: 143031 at the following location <http://support.aspentech.com/webteamasp/KB.asp?ID=143031> )



# Shell & Tube Exchanger

A large, light gray, stylized graphic of a shell and tube exchanger is positioned in the background. It features a large, rounded U-shaped shell on the right side, with several vertical tubes of varying heights extending from the shell's opening towards the left. The tubes are arranged in a row, with the tallest tube in the center and shorter tubes on either side, creating a symmetrical pattern.

# Demonstration Workflow

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Here is the order of tasks this guide will walk you through:

1. Open Aspen Plus Process Model
2. Locate the simple heat exchanger model
3. Convert the simple model to a rigorous heat exchanger model
4. Check the design for any risks or warnings
5. Review key design results (performance, spec. sheet, weight, length, etc.)

# Open the Process Model

The screenshot displays the Aspen Plus V8.8 software interface. The main workspace shows a process flowsheet for a Shell & Tube heat exchanger. The process includes several units: a separator (SEPARATR), a compressor (COMPR), and two heat exchangers (AIRCOOL and another one at the bottom). The flowsheet shows the flow of feed, air, oil, water, and various products (OFFGAS, AIR-OUT, NGL-COOL, NGL-PROD, GAS-PROD, OIL-COLD, WATER). A blue banner at the bottom of the workspace reads: "Open 'Shell & Tube for Interactive Sizing.bkp'".

The top right of the interface shows the file name: "Shell&Tube for Interactive Sizing.bkp - Aspen Plus V8.8...". The menu bar includes File, Home, Economics, Dynamics, Equation Oriented, View, Customize, Resources, Modify, and Format. The toolbar contains various icons for rotating, flipping, reconnecting, joining, breaking, rerouting, inserting, and aligning objects. The "Modify" menu is open, showing options like "GLOBAL", "Show All", "Lock Flowsheet", "View Parent", "Export", "View Child", "Move Selection", and "Import".

The "Economics" panel shows Capital Cost (USD) and Utility Cost (USD/Year) with a toggle switch set to "off". The "Energy" panel shows Available Energy Savings (MW) and % of Actual with a toggle switch set to "off". The "EDR Exchanger Feasibility" table shows the following data:

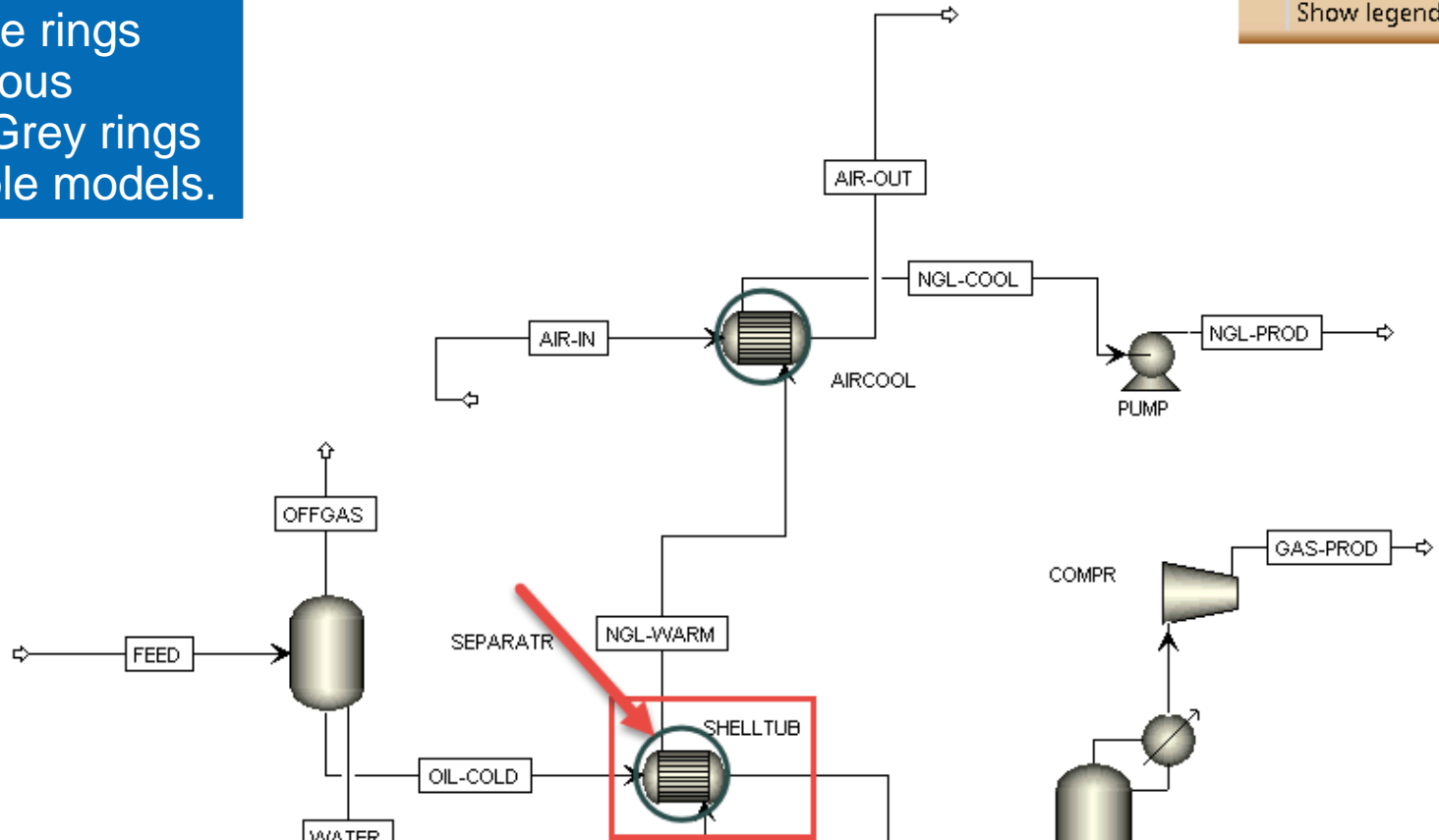
EDR Exchanger Feasibility		
Unknown	OK	At Risk
2	0	0

# Locate the Heat Exchanger

<b>Economics</b> Capital Cost      Utility Cost _____      _____ USD      USD/Year <input type="checkbox"/> off		<b>Energy</b> Available Energy Savings _____      _____ MW      % of Actual <input type="checkbox"/> off		<b>EDR Exchanger Feasibility</b> Unknown      OK      At Risk <b>2</b> <b>0</b> <b>0</b>			<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
				1 2			

Main Flowsheet x +

Note that Blue rings indicate rigorous models and Grey rings indicate simple models.



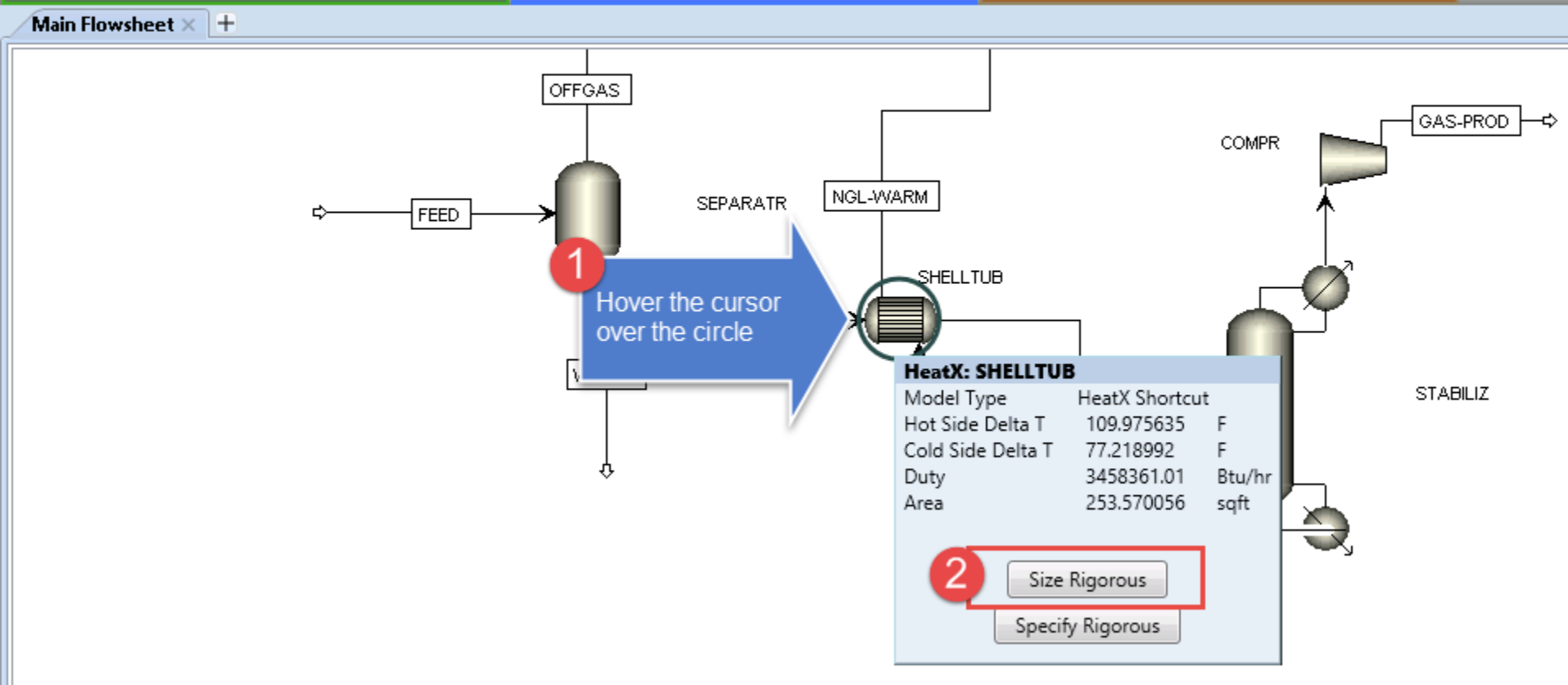
- Show model status
- Show risk status
- Show legend

# Run Simulation

The screenshot displays the Aspen Plus software interface. The top menu bar includes File, Home, Economics, Dynamics, Equation Oriented, View, Customize, Resources, Modify, and Format. The 'Run' button, represented by a blue play icon, is highlighted with a red box in the simulation toolbar. Below the toolbar, three summary panels are visible: Economics (Capital Cost: USD, Utility Cost: USD/Year), Energy (Available Energy Savings: MW, % of Actual), and EDR Exchanger Feasibility (Unknown: 2, OK: 0, At Risk: 0). The main flowsheet area shows a process diagram with units including FEED, OFFGAS, SHELLTUB, AIRCOOL, AIR-IN, AIR-OUT, NGL-COOL, PUMP, NGL-PROD, COMPR, and GAS-PROD. A blue callout box at the bottom of the flowsheet area contains the text: "Click the 'Run' button to run the simulation."

# Convert to Rigorous Model

Economics		Energy		EDR Exchanger Feasibility		
Capital Cost	Utility Cost	Available Energy Savings		Unknown	OK	At Risk
USD	USD/Year	MW	% of Actual	2	0	0
<input type="checkbox"/> off		<input type="checkbox"/> off				





# Select the Exchanger Type

Sizing to Create Rigorous Exchanger

Select Exchanger Type

1  Shell & Tube  Kettle Reboiler  Thermosyphon  
 Air Cooled

Size Exchanger

2  Size Interactively  Size Interactively using Template

Template File

3

# Size the Heat Exchanger

✓ Geometry ✓ Process ✓ Errors & Warnings ✓ Run Status

Calculation mode: **Design (Sizing)**    Recent    Previous     Setting Plan     Tube Layout

**Configuration**

TEMA Type: **B -**    **E -**    **M -**

Tube layout option: New (optimum) layout

Location of hot fluid: Shell side

Tube OD \ Pitch: in    0.75    \    0.9375

Tube pattern: 30-Triangular

Tubes are in baffle window: Yes

Baffle type: Single segmental

Baffle cut orientation: Horizontal

Default exchanger material: Carbon Steel    1

**Size**

Specify some sizes for Design: No

Shell ID \ OD: in       \      

Tube length: in      

Baffle spacing center-center: in      

Number of baffles:      

Number of tube \ passes:       \      

Shells in series:      

Shells in parallel:      

**Overall Results**

Excess surface (%):      

Dp-ratio Shellside \ Tubeside:      

Total cost (all shells): Dollar(US)

**Stream Temperatures**

Click on 'Size' to develop the rigorous heat exchanger model.

Size    Accept Design    Save    Cancel

# Review the Design

EDR Sizing Console - Size Shell&Tube

1  Geometry  Process  Errors & Warnings  Run Status

Calculation mode: *Design (Sizing)* Recent Previous Setting Plan

**Configuration**

TEMA Type: *B -* *E -* *M -*

Tube layout option: *New (optimum) layout*

Location of hot fluid: *Shell side*

Tube OD \ Pitch: *in* *0.75* \ *0.9375*

Tube pattern: *30-Triangular*

Tubes are in baffle window: *Yes*

Baffle type: *Single segmental*

Baffle cut orientation: *Horizontal*

Default exchanger material: *Carbon Steel* *1*

**Size**

Specify some sizes for Design: *No*

Shell ID \ OD: *in* \

Tube length: *in*

Baffle spacing center-center: *in*

Number of baffles:

Number of tube \ passes: \

Shells in series:

Shells in parallel:

**Overall Results**

Excess surface (%): 1

Dp-ratio Shellside \ Tubeside: *0.8235* \ *0.1329*

Total cost (all shells): *Dollar(US)* 19713

2

BEM

Shell side

0.75 \ 0.9375

30

Yes

Single segmental

H

Carbon Steel

No

12.09 \ 12.75

230.315

5.315

40

110 \ 1

1


1

1

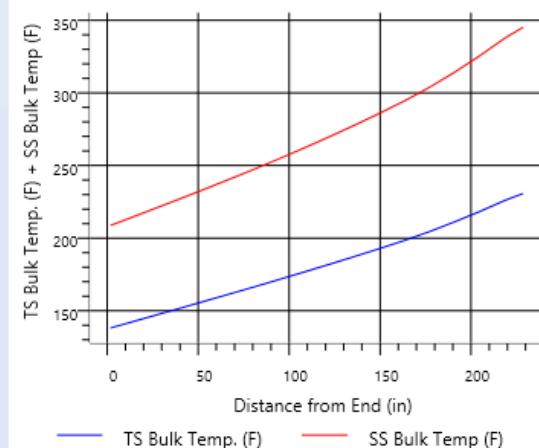
0.8235 \ 0.1329

19713

Review the geometry of the heat exchanger.



**Stream Temperatures**



TS Bulk Temp. (F) + SS Bulk Temp. (F)

Distance from End (in)

TS Bulk Temp. (F) SS Bulk Temp. (F)

# Review the Design

Geome **1**  Process  Errors & Warnings  Run Status

	HotSide		ColdSide		Recent		Previous	
					HotSide	ColdSide	HotSide	ColdSide
Calculation mode:	Design (Sizing)							
<b>Process Conditions</b>								
Mass flow rate:	lb/h	46789	58026		46789	58026		
Inlet pressure:	psi	300	305		300	305		
Outlet pressure:	psi	295.55	300.5		296.33	304.04		
Inlet Temperature:	F	345.33	138.08		345.33	138.08		
Outlet Temperature:	F				208.63	230.77		
Inlet vapor fraction:		1.8937E-06	0		0	0		
Outlet vapor fraction:					0	0.1445097		
Heat exchanged:	BTU/h	4217236			4217236			
<b>Process Input</b>								
Allowable pressure drop :	psi	4.45	7.25		4.45	7.25		
Fouling resistance :	ft <sup>2</sup> *h*F/BTU	0	0		0	0		
<b>Calculated Results</b>								
Pressure drop:	psi				3.66	0.96		









Review the process conditions of the heat exchanger (e.g. Stream Pressure Drops, etc.).

# Review the Design

EDR Sizing Console - Size Shell&Tube

✓ Geometry ✓ Process ✓ Errors & Warnings ✓ Run Status

○ Input (3)  
○ Results (0)  
○ Operation (0)  
○ Notes/Advisory (5)  
**● All (8)**

Description		
	Input Warning 1062	A default allocation of Hot stream 1: to the shellside has been made. It is estimated that the chances of this being correct are about 50 percent. Potentially important factors, such as a fluid being hazardous, or having material compatibility problems, could not be allowed for. Such fluids would usually go on the tubeside.
	Input Warning 1063	No Maximum Allowable Pressure Drop was specified for either stream. Estimated values of 4.45 psi (hot side) and 7.25 psi (cold side) were used. Design results are usually very susceptible to at least one of these values, and the estimates may not match your process requirements. Treat the exchanger designs produced with caution.
	Input Warning 1179	You did not input any fouling resistances. Fouling will reduce the calculated exchanger duty, or increase the exchanger size needed to achieve the specified duty.
	Note 1860	The consolidated process conditions for Stream 1, prior to the main calculations, give a heat load of -4217235 BTU/h, for a flow of 46789 lb/h, with outlet temperature 208.63 F and quality (vapor mass fraction) 0.
	Note 1860	The consolidated process conditions for Stream 2, prior to the main calculations, give a heat load of 4217235 BTU/h, for a flow of 58026 lb/h, with outlet temperature 230.28 F and quality (vapor mass fraction) 0.1470668.
	Advisory 1446	The Advanced calculation has converged after 19 iterations
	Note 1701	Design calculation successfully completed.
	Note 1925	The outlet temperature of stream 2 has changed from the initially specified value 230.28 F, to 230.77 F. These temperatures relate respectively to the estimated outlet pressure 300.5 psi, and the calculated outlet pressure 304.04 psi. Design and Checking calculations are based on fixed heat load: temperatures can change when pressures change. If you want to avoid this change in temperature, set the estimated outlet pressure to 304.04 psi and repeat the calculation.

Look for any warnings or errors.

In this case, since there are no operational warnings, we chose to accept the design.

Size Accept Design Save Cancel

# Open the EDR Browser

The screenshot displays the Aspen Plus software interface. On the left, the 'Simulation' tree is visible, with 'EDR Browser' highlighted under the 'BLOCKS' section. The main window shows a process flowsheet with units including FEED, SEPARATR, SHELLTUB, AIRCOOL, NGL-COOL, PUMP, NGL-PROD, OFFGAS, WATER, OIL-COLD, OIL-HOT, STABILIZ, COMPR, and GAS-PROD. The top panel shows 'Economics' (Capital Cost: USD, Utility Cost: USD/Year, off), 'Energy' (Available Energy Savings: MW, % of Actual, off), and 'EDR Exchanger Feasibility' (Unknown: 2, OK: 0, At Risk: 0).

**Economics**

Capital Cost	Utility Cost
USD	USD/Year
	<input type="checkbox"/> off

**Energy**

Available Energy Savings
MW
% of Actual
<input type="checkbox"/> off

**EDR Exchanger Feasibility**

Unknown	OK	At Risk
2	0	0

**Main Flowsheet**

Simulation Tree:

- Simulation
  - Setup
  - Property Sets
  - Analysis
  - Flowsheet
  - Streams
  - Blocks
    - AIRCOOL
    - COMPR
    - PUMP
    - SEPARATR
    - SHELLTUB
      - Setup
      - Options
      - EDR Options
      - EDR Browser**
      - Geometry
      - TQ Curves
      - Hot HCurves

Properties Panel:

- Properties
- Simulation**
- Safety Analysis
- Energy Analysis

To review key design results, click on 'EDR Browser'

# Check Performance


Set Units: SI | Convert Values | Next | Set Process Data | Set Properties | Set Geometry | Set Construction | Connected | Run | Stop | Run Status | Design (Sizing) | Find Fouling | Check Performance | Review Spec Sheet | Verify Geometry | Review Profiles

Capital: \_\_\_ USD | Utilities: \_\_\_ USD/Year | Energy Savings: \_\_\_ MW (\_\_\_%) | Exchangers - Unknown: 2 | OK: 0 | Risk: 0

Main Flowsheet x SHELLTUB (HeatX) - EDR Browser x +

Overall Performance | Resistance Distribution | Shell by Shell Conditions | Hot Stream Composition | Cold Stream Composition

Design (Sizing)		Shell Side		Tube Side		
Total mass flow rate	kg/s	5.8955		7.3113		
Vapor mass flow rate (In/Out)	kg/s	0	0	0	1.0565	
Liquid mass flow rate	kg/s	5.8955	5.8955	7.3113	6.2547	
Vapor mass quality		0	0	0	0.1445097	
Temperatures	C	174.07	98.13	58.94	110.43	
Dew point / Bubble point	C	256.75	174.07	230.42	58.94	
Operating Pressures	bar	20.68427	20.43158	21.02901	20.96256	
Film coefficient	W/(m <sup>2</sup> *K)	1827.4		1079.9		
Fouling resistance	m <sup>2</sup> *K/W	0		0		
Velocity (highest)	m/s	1.5		2.24		
Pressure drop (allow./calc.)	bar	0.30684	/	0.25269	0.5	/
Total heat exchanged	kW	1236		Unit	BEM	1 pass
Overall clean coeff. (plain/finned)	W/(m <sup>2</sup> *K)	657.8	/	Shell size	307	- 5850
Overall dirty coeff. (plain/finned)	W/(m <sup>2</sup> *K)	657.8	/	Tubes	Plain	
Effective area (plain/finned)	m <sup>2</sup>	38	/	Insert	None	
Effective MTD	C	49.98		No.	110	OD 19.05
Actual/Required area ratio (dirty/clean)		1.01	/	1.01	Tks	2.11
Vibration problem		No		Pattern	30	Pitch 23.81
RhoV2 problem		No		Baffles	Single segmental	
				Total cost	19713	Dollar(US)

Heat Transfer Resistance  
Shell side / Fouling / Wall / Fouling / Tube side  
Shell Side  Tube Side

Click on 'Check Performance' to review overall performance results such as stream temperatures, pressure drops, any vibrational problems, etc.

# Review Spec Sheet

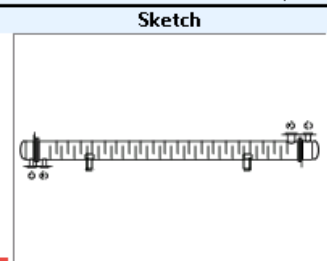
Set Units: SI | Convert Values | Next | Set Process Data | Set Properties | Set Geometry | Set Construction | Connected | Run | Stop | Run Status | Design (Sizing) | Find Fouling | Check Performance | **Review Spec Sheet** | Verify Geometry | Review Profiles

Capital: \_\_\_ USD | Utilities: \_\_\_ USD/Year | Energy Savings: \_\_\_ MW (\_\_\_%) | Exchangers - Unknown: 2 | OK: 0 | Risk: 0

Main Flowsheet | SHELLTUB (HeatX) - EDR Browser

TEMA Sheet

1	Company:												
2	Location:												
31	<b>CONSTRUCTION OF ONE SHELL</b>												
32		Shell Side					Tube Side						
33	Design/Vacuum/test pressure	bar	23	/	/	24	/	/					
34	Design temperature	C	210			210							
35	Number passes per shell		1			1							
36	Corrosion allowance	mm	3.18			3.18							
37	Connections	In	mm	1	152.4	/	-	1	76.2	/	-		
38	Size/Rating	Out		1	76.2	/	-	1	101.6	/	-		
39	ID	Intermediate		/	/	/	/	/	/	/	-		
40	Tube No.	110	OD	19.05	Tks Average	2.11	mm	Length	5850	mm	Pitch	23.81	mm
41	Tube type	Plain	#/m		Material	Carbon Steel		Tube pattern	30				
42	Shell	Carbon Steel	ID	307.09	OD	323.85	mm	Shell cover	-				
43	Channel or bonnet	Carbon Steel						Channel cover	-				
44	Tubesheet-stationary	Carbon Steel						Tubesheet-floating	-				
45	Floating head cover	-						Impingement protection	None				
46	Baffle-cross	Carbon Steel	Type	Single segmental	Cut(%d)	29.85364		H Spacing: c/c	135	mm			
47	Baffle-long	-	Seal Type					Inlet	252.98	mm			
48	Supports-tube	U-bend		0	Type								
49	Bypass seal		Tube-tubesheet joint		Expanded only (2 grooves)(App.A 'i')								
50	Expansion joint	-	Type	None									
51	RhoV2-Inlet nozzle	216	Bundle entrance	308	Bundle exit	608				kg/(m*s2)			
52	Gaskets - Shell side	-	Tube side		Flat Metal Jacket Fibe								
53	Floating head	-											
54	Code requirements	ASME Code Sec VIII Div 1			TEMA class	R - refinery service							
55	Weight/Shell	1250.8	Filled with water	1638.6	Bundle	669.4				kg			
56	remarks												



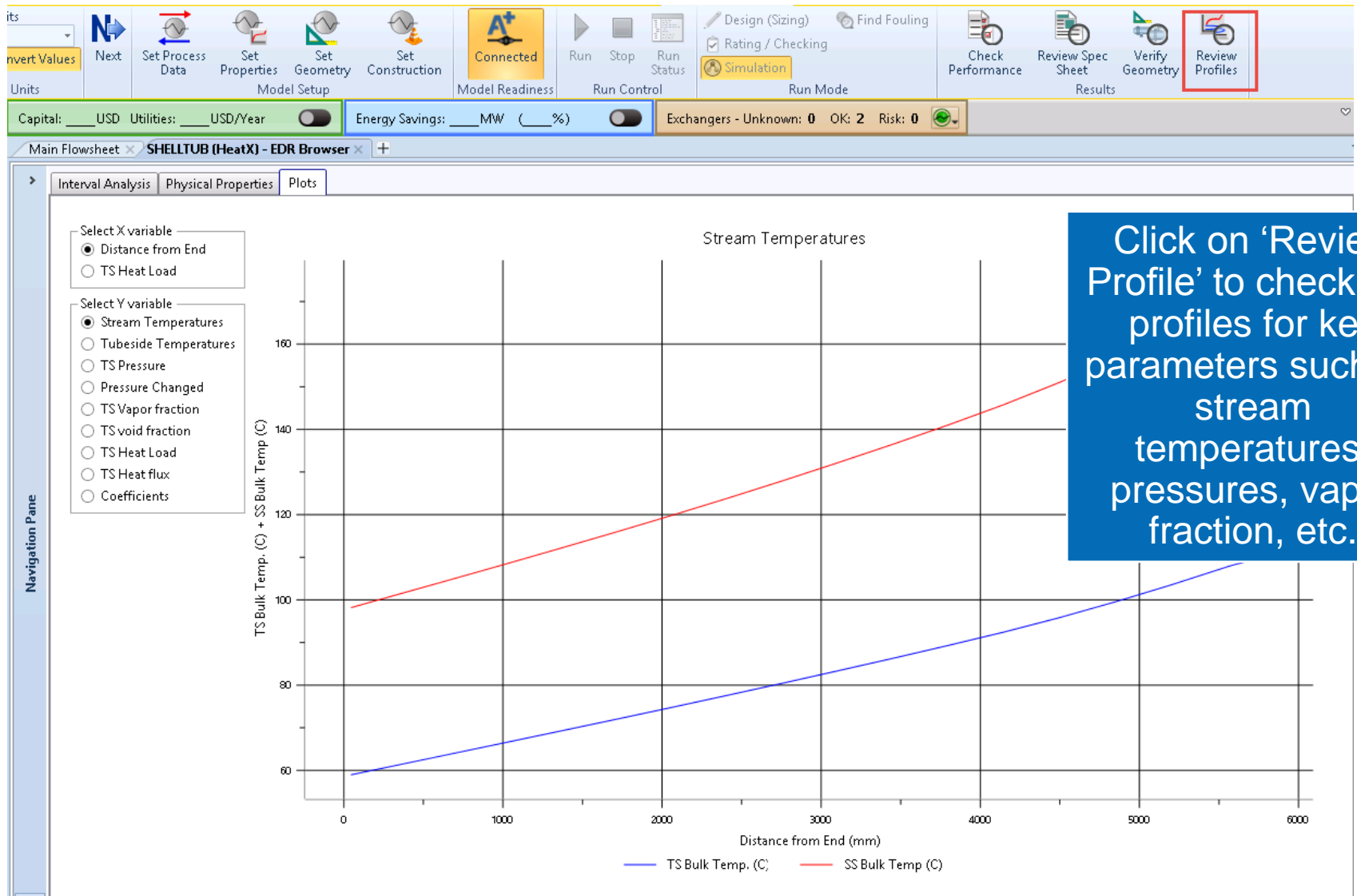
Click on 'Review Spec Sheet' to review TEMA sheet for details including lengths, weights, etc.



# Verify Geometry

The screenshot shows the Aspen HYSYS software interface. The top toolbar contains several icons, with the 'Verify Geometry' icon (a magnifying glass over a gear) highlighted with a red box. Below the toolbar, a status bar displays project information: Capital: \_\_\_ USD, Utilities: \_\_\_ USD/Year, Energy Savings: \_\_\_ MW (\_\_\_%), and Exchangers - Unknown: 0, OK: 2, Risk: 0. The main window shows a technical drawing of a shell and tube heat exchanger. The drawing includes a side view with dimensions: 247, 122, 150, 5495, 385, 122, 1170, 3510, 5510, and 312. Labels T1, S1, S2, and T2 are present. A 'Pulling Length' is indicated. Two detail drawings of bolt connections are shown: '2 Bolts Fixed' and '2 Bolts Sliding', both with dimensions 75, 70, 280, and 150. The left sidebar shows 'Setting Plan', 'Tubesheet Layout', and 'U-bend Schedule' tabs. A blue banner at the bottom reads: 'Click on 'Verify Geometry' to review the Setting Plan and Tubesheet Layout.'

# Review Profiles





# Air Cooled Heat Exchanger



# Demonstration Workflow

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Below is the order of tasks we will follow next:

1. Open Aspen Plus Process Model
2. Locate the simple heat exchanger model
3. Convert the simple model to a rigorous heat exchanger model
4. Check the design for any risks or warnings
5. Change the design to address any warnings
6. Review key design results (performance, spec. sheet, weight, length, etc.)

# Open the Process Model

The screenshot displays the Aspen Plus V8.8 software interface. The title bar shows the file name "Shell&Tube for Interactive Sizing.bkp - Aspen Plus V8.8...". The menu bar includes File, Home, Economics, Dynamics, Equation Oriented, View, Customize, Resources, Modify, and Format. The Modify menu is open, showing options like GLOBAL, Show All, Lock Flowsheet, View Parent, Export, View Child, Move Selection, and Import. The Economics panel shows Capital Cost (USD) and Utility Cost (USD/Year) with a toggle switch set to "off". The Energy panel shows Available Energy Savings (MW) and % of Actual with a toggle switch set to "off". The EDR Exchanger Feasibility panel shows Unknown (2), OK (0), and At Risk (0). The main workspace displays a process flowsheet with units like FEED, SEPARATR, AIR-IN, AIRCOOL, AIR-OUT, NGL-COOL, PUMP, NGL-PROD, OFFGAS, NGL-WARM, WATER, OIL-COLD, COMP, and GAS-PROD. A blue banner at the bottom of the workspace reads "Open 'Shell & Tube for Interactive Sizing.bkp'".

# Locate the Heat Exchanger

## Economics

Capital Cost

Utility Cost

USD

USD/Year

off

## Energy

Available Energy Savings

MW

% of Actual

off

## EDR Exchanger Feasibility

Unknown

OK

At Risk

2

0

0

1

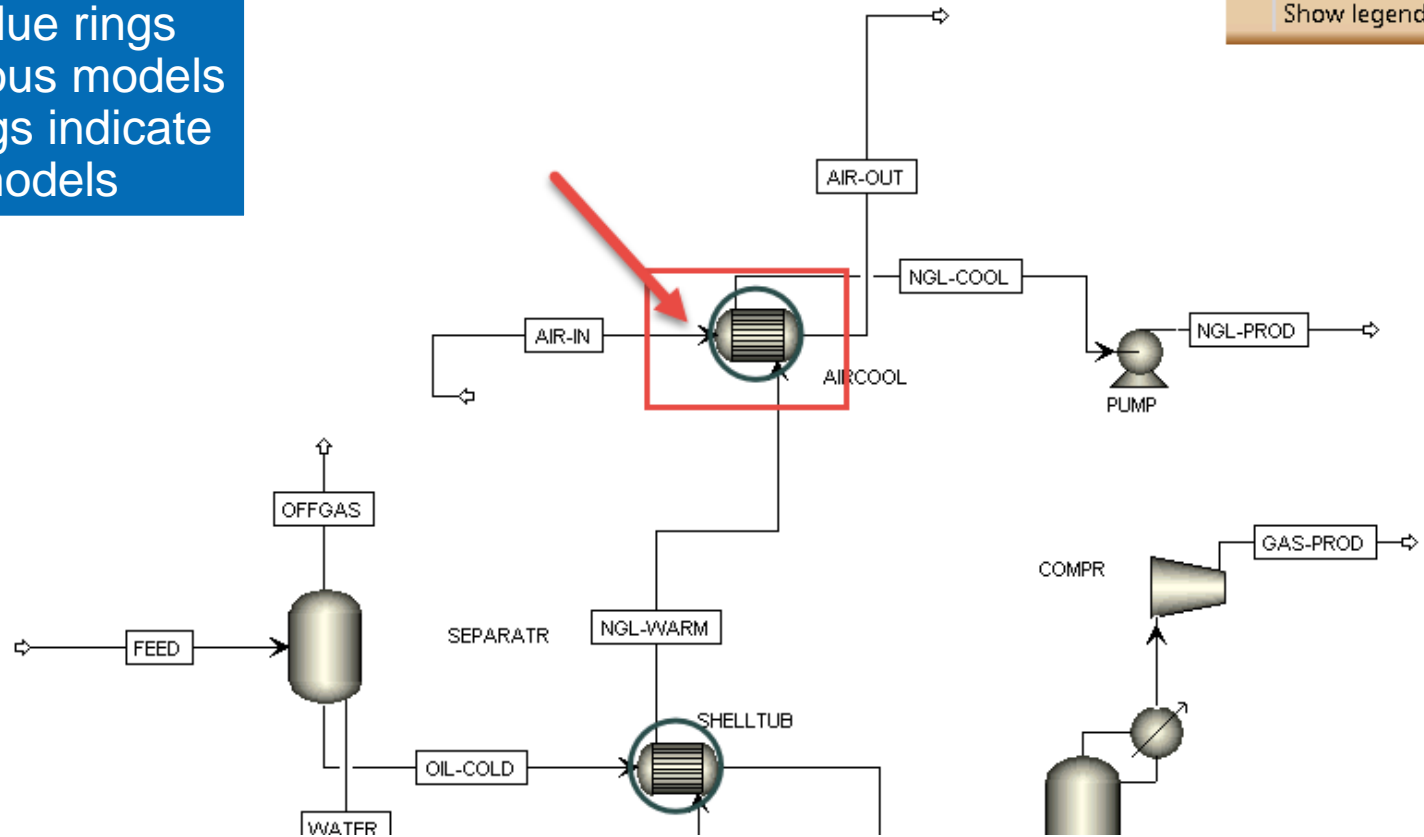
2



- ✓ Show model status
- Show risk status
- Show legend

Main Flowsheet x +

Note that Blue rings indicate rigorous models and Grey rings indicate simple models



# Run Simulation

The screenshot displays the Aspen Plus software interface. The top ribbon is set to 'Flowsheet' and includes tabs for File, Home, Economics, Dynamics, Equation Oriented, View, Customize, Resources, Modify, and Format. The 'Run' button, represented by a blue play icon, is highlighted with a red box and a red arrow. Other buttons in the ribbon include Next, Step, Stop, Reset, Control Panel, and Reconcile. The interface also features a search bar for 'aspensONE Exchange' and various analysis tools like Stream Analysis, Heat Exchanger, Pressure Relief, Sensitivity, Azeotrope Search, PRD Rating, Data Fit, Distillation Synthesis, Flare System, and Safety Analysis.

Below the ribbon, there are three summary panels:

- Economics:** Capital Cost (USD), Utility Cost (USD/Year), and a toggle switch for 'off'.
- Energy:** Available Energy Savings (MW, % of Actual) and a toggle switch for 'off'.
- EDR Exchanger Feasibility:** A table showing 'Unknown', 'OK', and 'At Risk' counts.

Unknown	OK	At Risk
2	0	0

The main area shows a process flowsheet titled 'Main Flowsheet'. It includes a 'FEED' stream entering a tank, an 'OFFGAS' stream exiting, an 'AIR-IN' stream entering an 'AIRCOOL' heat exchanger, and an 'AIR-OUT' stream exiting. The 'AIRCOOL' is connected to a 'SHELLTUB' heat exchanger. The 'SHELLTUB' is connected to a 'PUMP' and a 'COMPR' (compressor). The 'PUMP' outputs 'NGL-COOL' and 'NGL-PROD' streams, and the 'COMPR' outputs a 'GAS-PROD' stream.

**Click the 'Run' button to run the simulation.**

# Convert to Rigorous Model

**Economics**  
Capital Cost  
Utility Cost  
USD USD/Year  off

**Energy**  
Available Energy Savings  
MW % of Actual  off

**EDR Exchanger Feasibility**  
Unknown OK At Risk  
**2 0 0**

Main Flowsheet x +

**HeatX: AIRCOOL**

Model Type	HeatX Shortcut
Hot Side Delta T	95.49948 F
Cold Side Delta T	60.16303 F
Duty	2663155.87 Btu/hr
Area	249.999859 sqft

1 Hover the cursor over the circle

2



# Select the Exchanger Type

The image shows a software dialog box titled "Sizing to Create Rigorous Exchanger". It contains the following elements:

- Select Exchanger Type:** Three radio button options: "Shell & Tube", "Kettle Reboiler", and "Thermosyphon". The "Air Cooled" option is selected and highlighted with a red box and the number 1.
- Size Exchanger:** Two radio button options: "Size Interactively" (selected) and "Size interactively using Template". The "Size Interactively" option is highlighted with a red box and the number 2.
- Template File:** A text input field and a "Browse" button.
- Convert:** A button at the bottom right, highlighted with a red box and the number 3.

# Size the Heat Exchanger

EDR Sizing Console - Size AirCooled

✓ Geometry ✓ Process ✓ Errors & Warnings ✓ Run Status

Program calculation mode: *Design with fixed outside flow* Recent Previous  Setting Plan

**Configuration**

Fan configuration: *Forced*

Tube OD \ pitch: *in* 1 \ 2.3622

Tube layout angle: *Degrees* 30

Fin type: *G-finned*

Fin tip diameter: *in* 2.25

Fin frequency: *#/in* 11

Mean fin thickness: *in* 0.011

Tube material: *Carbon Steel*

**Size**

Specify some sizes in design: *No*

Bays per unit:

Number of bundles \ fans per bay:  \

Tube length: *ft*

Bay width: *in*

Number of tube rows:

Number:

**Overall Results**

Excess surface (%)

Dp-ratio tubeside \ airside:  \

Click on 'Size' to develop the rigorous heat exchanger model.

Size Accept Design Save Cancel

Tubeside Ca

um temp (F)

0.04

0.02

0

-0.04

-0.04 -0.02

# Review the Design

EDR Sizing Console - Size AirCooled

1  Geometry  Process  Errors & Warnings  Run Status

Program calculation mode: *Design with fixed outside flow*

**Configuration**

Fan configuration: *Forced*

Tube OD \ pitch: *in* 1 \ 2.3622

Tube layout angle: *Degrees* 30

Fin type: *G-finned*

Fin tip diameter: *in* 2.25

Fin frequency: *#/in* 11

Mean fin thickness: *in* 0.011

Tube material: *Carbon Steel*

**Size**

Specify some sizes in design: *No*

Bays per unit: [ ]

Number of bundles \ fans per bay: [ ] \ [ ]

Tube length: *ft* [ ]

Bay width: *ft* [ ]

Number of tube rows: [ ]

Number of tubes \ passes: [ ] \ [ ]

**Overall Results**

Excess surface (%): 1

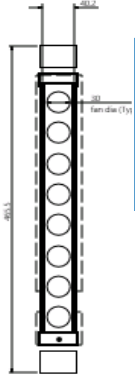
Dp-ratio tubeside \ airside: 0.76 \ 0.12

Equipment \ annual operating cost: *Dollar(US)* 26090 \ 236

Recent Previous

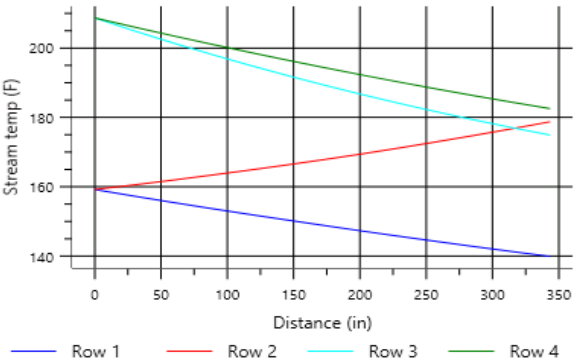
Recent	Previous
Forced	
1 \ 2.3622	\
30	
G-finned	
2.25	
11	
0.011	
Carbon Steel	
1	
1 \ 8	\
29.5276	
3.8386	
4	
68 \ 3	\
1	
0.76 \ 0.12	\
26090 \ 236	\

Setting Plan Tube Layout



Review the geometry of the heat exchanger.

**Tubeside Calculation Details**



Stream temp (F)

Distance (in)

Row 1 Row 2 Row 3 Row 4

Size Accept Design Save Cancel

# Review the Design

EDR Sizing Console - Size AirCooled

1

✓ Geomet ✓ Process ✓ Errors & Warnings ✓ Run Status

	Tubeside	Airside	Recent Hotside	Recent Coldside	Previous Hotside	Previous Coldside
Program calculation mode:	Design with fixed outside flow		Design with fixed outside flow			
<b>Process Conditions</b>						
Mass flow rate:	lb/h	46789	102458	46789	102458	
Inlet Pressure:	psi	300		300	NA	
Outlet Pressure:	psi			297.25	NA	
Inlet temperature:	F	208.7	85	208.7	85	
Outlet temperature:	F			139.92	162.11	
Inlet vapor fraction:		0		0	NA	
Outlet vapor fraction:				0	NA	
Heat Load:	BTU/h	1903150		1902897	NA	
Initial Heat Load:	BTU/h			1903150	NA	
<b>Process Input</b>						
Allowable pressure drop:	psi	3.63	0.029	3.63	0.029	
Fouling resistance:	ft <sup>2</sup> *h*F/BTU	0	0	0	0	
<b>Calculated Results</b>						
Pressure drop:	psi			2.75	0.004	

Review the process conditions of the heat exchanger. (e.g. Stream Pressure Drops, etc.)

# Review the Design

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✓ Geometry ✓ Process ✓ Errors & Warnings ✓ Run Status

○ Input (1)  
○ Results (0)  
○ Operation (1)  
○ Notes/Advisory (0)  
 All (2)

		Description
	Input Warning 640	No Allowable Pressure Drop was specified for the tubeside stream, so an estimate was used. Design results are often very susceptible to this value, and the estimate may not match your process requirements. Treat the exchanger designs produced with caution.
	Operation Warning 4524	The fan coverage 38.60633% is less than the API 661 recommended value 40%. The program has continued, using the value calculated. Please check the output carefully. Increase the number or the diameter of the fans in a bay or/and decrease the number or the size of the bundles in a bay if necessary.

In this case, note that there is an Operation Warning.  
We will now try some changes to the design to address this issue. To make any changes, click 'Accept Design' and then open the 'EDR Browser'.

Size **Accept Design** Save Cancel

# Open the EDR Browser

The screenshot displays the Aspen Plus software interface. The top menu bar includes File, Home, Economics, Dynamics, Equation Oriented, View, Customize, Resources, Modify, and Format. The Simulation panel on the left shows a tree view of blocks, with 'EDR Browser' highlighted in a red box. The main workspace shows a process flow diagram with various units like AIRCOOL, SEPARATR, and COMPRESSOR. A blue banner at the bottom of the workspace contains the text: 'For making changes to the design, click on 'EDR Browser'.'

**Economics**

Capital Cost	Utility Cost
USD	USD/Year
	<input type="checkbox"/> off

**Energy**

Available Energy Savings	
MW	% of Actual
	<input type="checkbox"/> off

**EDR Exchanger Feasibility**

Unknown	OK	At Risk
1	0	1

**Simulation**

- Setup
- Property Sets
- Analysis
- Flowsheet
- Streams
- Blocks
  - AIRCOOL
    - Setup
    - Options
    - EDR Options
    - EDR Browser**
    - Geometry
    - TQ Curves
    - Hot HCurves
    - Cold HCurves
    - User Subroutines
    - Dynamic
    - Block Options
    - EO Modeling
    - Thermal Results
    - Geometry Results
    - EDR Shell&Tube P...

# Tweak the Design

The screenshot displays the Aspen Plus software interface for an Exchanger Design project. The top ribbon includes tabs for File, Home, Economics, Dynamics, Equation Oriented, Flow, Customize, and Sources. The ribbon contains toolbars for Units, Model Setup, Model Readiness, Run Control, and Run Mode. The main workspace is divided into several panels:

- Economics:** Capital Cost (USD), Utility Cost (USD/Year), and a toggle switch for 'off'.
- Energy:** Available Energy Savings (MW, % of Actual) with a toggle switch for 'off'.
- EDR Exchanger Feasibility:** A table showing Unknown, OK, and At Risk status for three categories, with values 1, 0, and 1 respectively.

The main workspace shows the 'AIRCOOL (HeatX) - EDR Browser' with a navigation pane on the left. The 'Geometry' and 'Tube Layout' tabs are active. The 'Unit' section is expanded, showing the following parameters:

Parameter	Value
Bays per unit:	1
Bundles per bay:	1
Fans per bay:	9
Fan diameter:	0.762 m
Exchanger frame type:	Standard
Tube side to outside flow orientation:	Counter-current
Fan configuration:	Forced

The 'Tubes' section shows the following parameters:

Parameter	Value
Tube OD/ID:	25.4 / 22.1
Tube wall thickness:	1.65
Tube length:	9
Fin type:	G-finned
Fin tip diameter:	57.15
Fin frequency:	433
Mean fin thickness:	0.28

The 'Tube Layout' section shows the following parameters:

Parameter	Value
Number of tubes per bundle:	68
Bundle type:	Staggered-even rows to r
Tube rows per pass:	7
Tube layout angle:	30

A blue callout box at the bottom of the screen states: "We change the number of fans per bay to 9."

# Check the Design

The screenshot displays the Aspen HYSYS software interface. At the top, the 'Model Readiness' section shows a 'Connected' status with a red circle '3' next to it. Below this, the 'Economics' and 'Energy' tabs are visible. The 'EDR Exchanger Feasibility' section shows a table with columns 'Unknown', 'OK', and 'At Risk', and rows with values '1', '1', and '0'. The 'EDR Browser' window is open, showing a tree view on the left with 'Warnings & Messages' selected (marked with a red circle '1'). The main area of the browser shows a table of warnings (marked with a red circle '2'):

		Description
	Input Warning 619	Specified effective tube length 28.6227 ft differs from the calculated effective tube length 28.6057 ft. The program has continued calculations using the specified value but please check the results carefully.
	Input Warning 8001	Input for Tube support width, 0.9842 in is beyond the expected range, from 3.937 in to 393.7008 in

A blue callout box at the bottom right contains the text: "Note that the new design does not generate any Operational Warnings, therefore we chose to go ahead with this design."



# Run Simulation

The screenshot displays the Aspen Plus software interface. The title bar shows the file name "Shell&Tube for Interactive Sizing.bkp - Aspen Pl...". The ribbon menu includes "File", "Home", "Economics", "Dynamics", "Equation Oriented", "View", "Customize", "Resources", "Modify", and "Format". The "Dynamics" tab is active, and the "Run" button is highlighted with a red arrow. The "Run" section of the ribbon includes buttons for "Next", "Run", "Step", "Stop", "Reset", "Control Panel", and "Reconcile".

The right-hand panel contains three sections:

- Economics**: Capital Cost (USD), Utility Cost (USD/Year), and a toggle switch set to "off".
- Energy**: Available Energy Savings (MW, % of Actual), and a toggle switch set to "off".
- EDR Exchanger Feasibility**: A table showing the status of exchangers.

EDR Exchanger Feasibility		
Unknown	OK	At Risk
1	0	1

The central workspace shows a process flow diagram with a "Navigation Pane" on the left. The diagram includes a separator (SEPARATR), an air cooler (AIRCOOL), and a pump (PUMP). The air cooler is highlighted with a blue circle. The flow diagram shows "FEED" entering a separator, with "OFFGAS" exiting upwards. "AIR-IN" enters the air cooler, and "AIR-OUT" exits upwards. "NGL-WARM" enters the air cooler from the bottom, and "NGL-COOL" exits to the right. "NGL-PROD" exits the pump to the right, and "GAS-PROD" exits the separator to the right.

A blue banner at the bottom of the workspace contains the text: "Click the 'Run' button to run the simulation."

# Check Performance

Set Units: US | Convert Values | Next | Set Process Data | Set Properties | Set Geometry | Set Construction | Connected | Run | Stop | Run Status | Design with fixed outside flow | Design with varying outside flow | Rating / Checking | Simulation 1 | Check Performance | Review Spec Sheet | Verify Geometry | Review Profiles

**Economics** | **Energy** | **EDR Exchanger Feasibility**

Capital Cost: USD | Utility Cost: USD/Year | Available Energy Savings: MW, % of Actual | EDR Exchanger Feasibility: Unknown: 1, OK: 1, At Risk: 0

Main Flowsheet: AIRCOOL (HeatX) - EDR Browser

Overall Performance | Resistance Distribution | Tube Side Composition

Simulation		Outside		Tube Side	
Total mass flow rate	lb/h	100937		46789	
Vapor mass	lb/h	100937	100937	0	0
Liquid mass	lb/h	0	0	46789	46789
Vapour mass quality		1	1	0	0
Temperature	F	85	162.73	208.7	139.99
Dew point / Bubble point temperatures	F				
Humidity ratio					
Operating pressure	inH2O / psi	406.91	406.91	300	297.25
Film coefficients	BTU/(h*ft <sup>2</sup> *F)	120.67		217.31	
Fouling resistance	ft <sup>2</sup> *h*F/BTU	0		0	
Velocity (highest)	ft/s	7.87	9	2.42	4.51
Pressure drop (allow./calc.)	psi / psi	0.029	0.004	3.63	2.75
Total heat exchanged	BTU/h	1901040		1901040	
Overall bare coef. (dirty/clean)	BTU/(h*ft <sup>2</sup> *F)	76.6	76.6	0.065	0.065
Effective MTD	F	48.7		29.5276	
Effective surface (bare tube)	ft <sup>2</sup>	509.6		2.25	
Effective surface (total)	ft <sup>2</sup>	11970.2		0.011	
Area ratio: actual/required		1		11 #/in	

Heat Transfer Resistance: Outside / Fouling / Wall / Fouling / Tube side

Outside: [Progress Bar] Tube side

Click on 'Check Performance' to review overall performance results, such as stream temperatures, pressure drops, etc.

# Review Spec Sheet

Set Units: US | Convert Values | Next | Set Process Data | Set Properties | Set Geometry | Set Construction | Connected | Run | Stop | Run Status | Design with fixed outside flow | Design with varying outside flow | Rating / Checking | Simulation | Check Performance | **Review Spec Sheet** | Verify Geometry | Review Profiles

**Economics** | **Energy** | **EDR Exchanger Feasibility**

Capital Cost: USD | Utility Cost: USD/Year | Available Energy Savings: MW, % of Actual | Unknown OK At Risk: 1 1 0

Main Flowsheet x AIRCOOL (HeatX) - EDR Browser x +

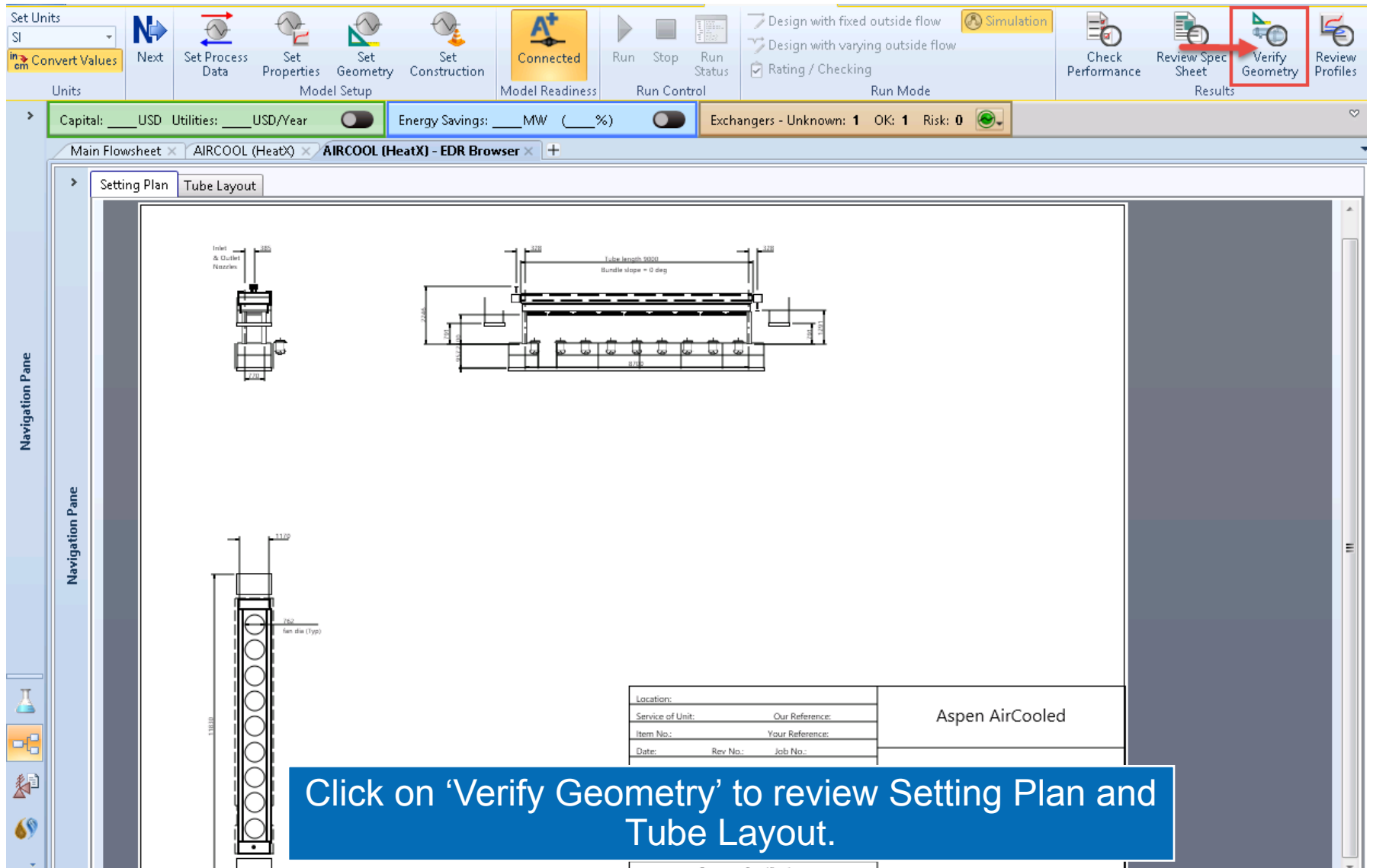
API Sheet

## Air-Cooled Heat Exchanger Specification Sheet

1	Company:						
2	Location:						
3	Service of Unit:	Our Reference:					
4	Item No.:	Your Reference:					
5	Date:	Rev No.:	Job No.:				
6	Size & Type	31.4961 / 3.937 ft	Type	Forced	Number of Bays	1	
7	Surf./Unit-Finned Tube	11970.2 ft <sup>2</sup>	Bare area/bundle	509.6 ft <sup>2</sup>	Area ratio	23.49	
8	Heat exchanged	1901040 BTU/h	MTD, Eff	48.7	F		
9	Transfer Rate-Finned	3.26	Bare Service	76.6	Clean	76.6 BTU/(h*ft <sup>2</sup> *F)	
39	<b>MISCELLANEOUS</b>		Outlet nozzle ( 1 )	2.624 in	Material		
40	Struct. Mount.	Special Nozzles	OD	2.25 Tks	0.011 in		
41	Surf. Prep	Rating	No	11 #/in	Design Temp	F	
42	Louvers	TI	PI	Code			
43	Vibration Switches	Chem Cleaning	Stamp	Specs			
44	<b>MECHANICAL EQUIPMENT</b>						
45	Fan Mfr. Model	Driver, Type	Speed Reducer, Type				
46	No./Bay	9 RPM	Mfr. & Model				
47	Dia.	2.5 ft	Blade(s)	No./Bay			
48	Pitch	Angle	RPM	Rating		hp	
49	Blade(s)	Hub	Enclosure	Ratio			
50	hp/Fan	0.1 hp	MinAmb	V/Phase/Hz	/ /	Support	
51	Control Action on Air Failure-		Louvers				
52	Degree Control of Outlet Process Temperature						
53	Recirculation		Steam Coil	No			
54	Plot Area	ft <sup>2</sup>	Drawing No.	Wt. Bundle	5728.2	Wt. Unit	5728.2 lb
55	Notes:						

Click on 'Review Spec Sheet' to review API sheet for details including number of fans, power consumption, weights, etc.

# Verify Geometry



Capital: \_\_\_ USD Utilities: \_\_\_ USD/Year Energy Savings: \_\_\_ MW (\_\_\_%) Exchangers - Unknown: 1 OK: 1 Risk: 0

Main Flowsheet x AIRCOOL (HeatX) x AIRCOOL (HeatX) - EDR Browser x +

Setting Plan Tube Layout

Inlet & Outlet Nozzles

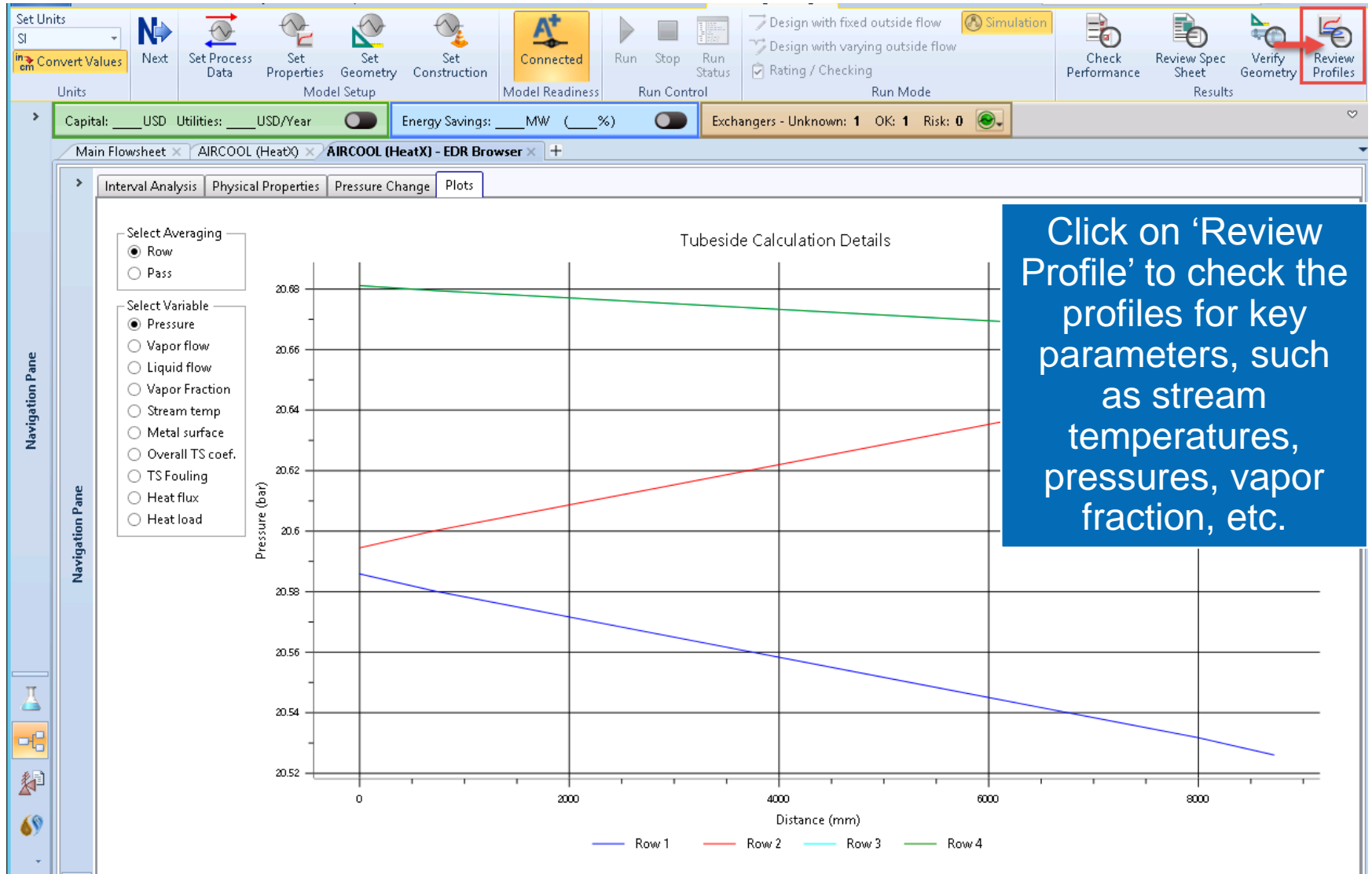
Tube length 9000 Bundle slope = 0 deg

fan dia (Typ)

Location:		Aspen AirCooled
Service of Unit:	Our Reference:	
Item No.:	Your Reference:	
Date:	Rev No.:	Job No.:

Click on 'Verify Geometry' to review Setting Plan and Tube Layout.

# Review Profiles



# Additional Resources & Contacts

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- AspenTech Support Website (<http://support.aspentech.com>)
- AspenTech Courseware Available in Classroom and Online Versions
- AspenTech Business Consultants

Contact Name	Contact Email
Sandeep Mohan	Sandeep.Mohan@aspentech.com