

Learn How to Optimize Heat Exchanger Designs using Aspen Shell & Tube Exchanger

A self guided demo to get started with Aspen Shell & Tube Exchanger

Why use Aspen Shell & Tube Exchanger?

Aspen Shell & Tube Exchanger can be used to design all major industrial shell & tube exchanger equipment types in any combination of processes, including single phase heating or cooling and boiling or condensation. Typically, users save between 10-30% on equipment costs by effectively designing their exchangers using Aspen Exchanger Design & Rating.

Given a process requirement and physical property data, the program conducts a comprehensive design search to find the optimum cost arrangement capable of satisfying the process constraints. The program provides detailed exchanger geometry and performance details, as well as a specification sheet, setting plan, and tube layout drawings.

Completed designs can be transferred to Aspen Shell & Tube Mechanical for complete mechanical design to the requirements of ASME or other leading international design codes.

Objective

This tutorial is intended as “getting started” guide using Aspen Shell & Tube Exchanger to create, evaluate, and save designs. It offers a step-by-step explanation of how an equipment designer would use the standalone program.

The workflow is demonstrated by completing the design of a Shell & Tube exchanger for a crude preheat train process.

Specify Process and Property Data

Process and property data can be entered in three ways:

1. Manually
2. By using the physical property databanks provided within the program
3. By importing from a simulation case

TUTORIAL I - we will import data from an Aspen HYSYS case file

TUTORIAL II - we will enter process and property data manually

To download the required files for this exercise please visit Aspen Tech's Customer Support Site. (Refer to Knowledge Base Solution ID: 143029 at the following location <http://support.aspentech.com/webteamasp/KB.asp?ID=143029>)



Tutorial I



Download & Save Aspen HYSYS® File

Economics
Capital Cost Utility Cost
USD USD/Year off

Energy
Available Energy Savings
MW % of Actual off

Exchanger Feasibility
Unknown OK At Risk
6 **1** **0**

Flowsheet Case (Main) - Solver Active

Navigation Pane

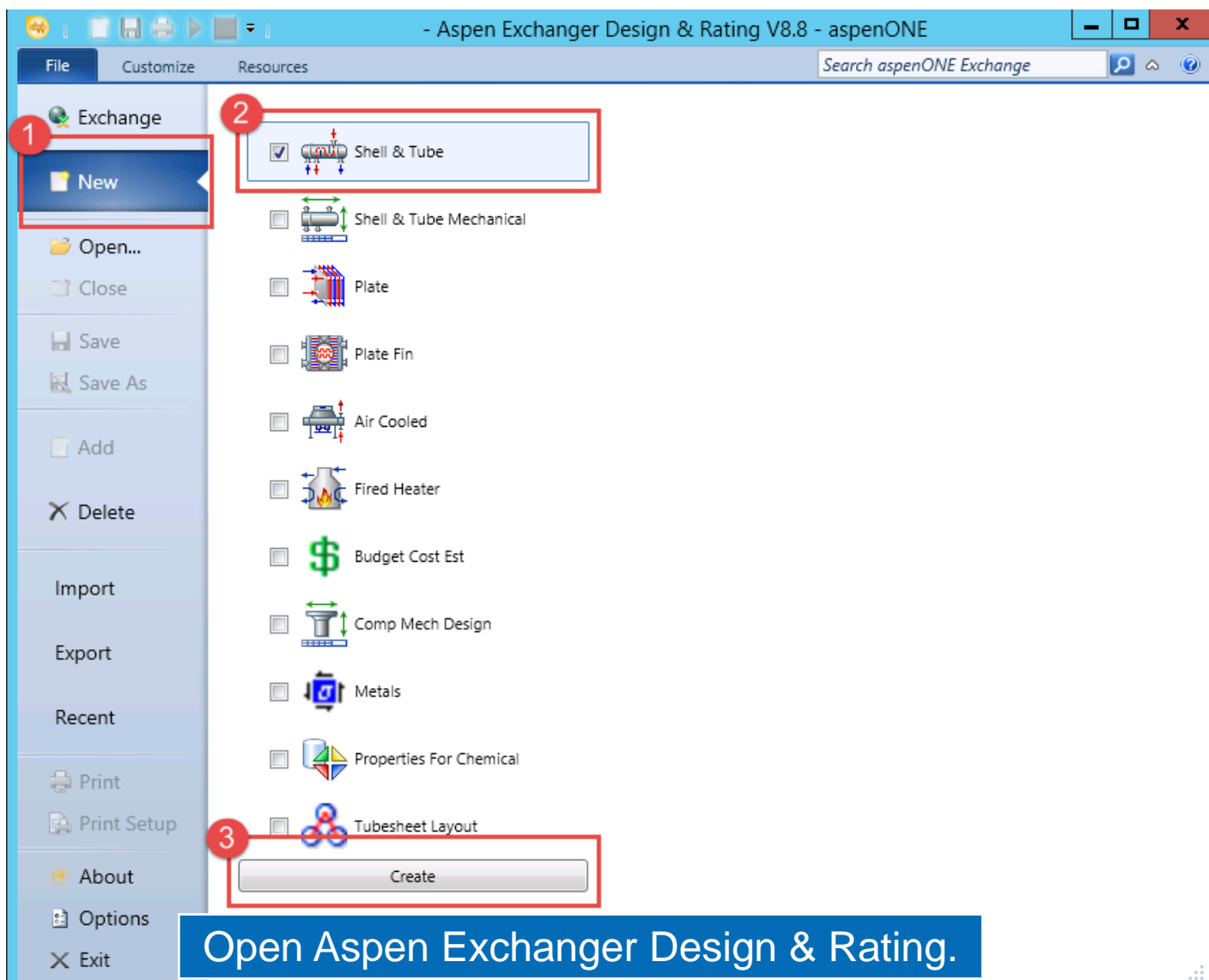
crude → toppa → e303 → e303out → e304 → e304out → e307 → e307out → e305 → e305out → e351 → e351out → e352 → e352out → e308 → e308out → furnace → furnace_out

toppa_out, resid-3, botpa, botpaout, gal, galout, resid-2-rec, resid-2, resid-4, resid-5, furnace_duty

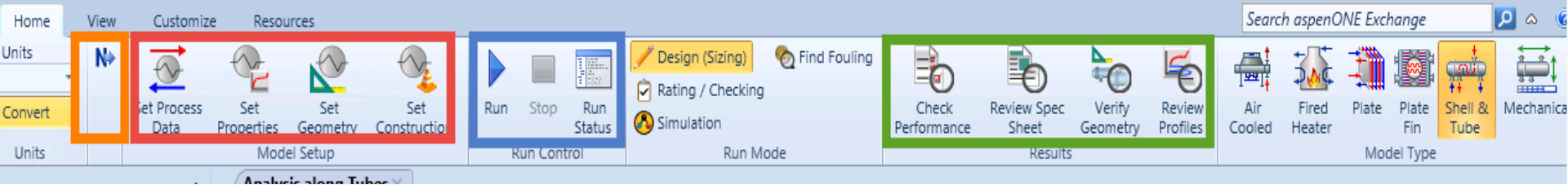
RCY-1

Download the file Preheat Train for Jump Start EDR.hsc, and save it on your desktop.

Open Aspen Shell & Tube Exchanger



Home Ribbon Work Flow



‘HOME RIBBON’ commands are used to guide us sequentially through the various stages of the heat exchanger design

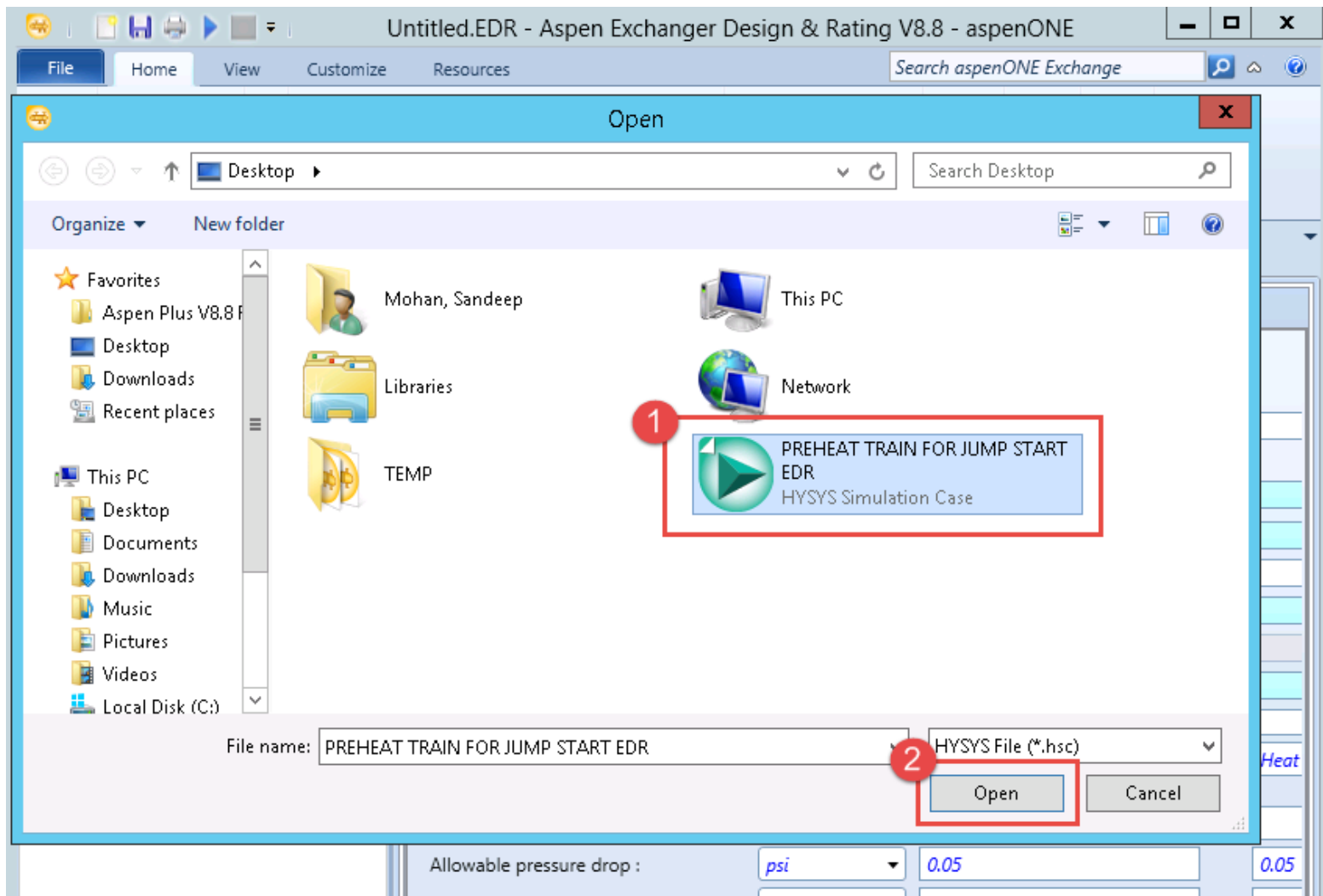
NEXT button guides us sequentially through the required input forms to complete the input for the problem.

MODEL SETUP contains commands to the main input forms.

RUN CONTROL contains key to run the design calculations.

RESULTS contains commands to the key results forms.

Import Process & Property Data from Aspen HYSYS



Click on File-Import and select 'Preheat Train for Jump Start EDR. hsc'.

Select the Heat Exchanger from Aspen HYSYS Flowsheet

Exchanger List

- e303
- e304**
- e307
- e305
- e351
- e352
- e308

Temperatures and Pressures for Stream Data

Inlet Stream		e303out	resid-2-rec
Outlet Stream		e304out	resid-3
Inlet Temperature	°C	128	188.1179
Outlet Temperature	°C	152	139.0348
Pressure 1	bar(abs)	20.5	17.70893
Pressure 2	bar(abs)	20	17.20893
Pressure 3	bar(abs)		
Composition		Known	Known

Number Of Points: 12

OK Cancel

Hot Stream (1)
Shell Side

In Out

Heat load Heat

0.05 0.05

0 0

Select the heat exchanger e304 from exchanger list in the simulation model.

Import PSF Data

Aspen HYSYS Version 8.8 (34.0.0.8834) generated PSF File - 2 data section(s) Units: Deg C

Process Data				
Stream Name	T(in), °C	T(out), °C	Import to	Use Properties
resid-2-rec->resid-3	188.12	139.03	Hot Side	All
e303out->e304out	128.00	152.00	Cold Side	All

Separate Process and Property Input

Save PSF File
OK
Cancel

Click OK to Import Data from Process Simulator Interface File(PSF).

Specify Fouling Resistance

The screenshot shows the AspenONE software interface. The 'Customize' tab is active, and the 'Set Process Data' menu item is highlighted with a red box and a red circle labeled '1'. The 'Process Data' dialog box for a 'Shell & Tube' exchanger is open. The 'Fouling resistance' field is highlighted with a red box and a red circle labeled '2'. A blue callout box contains the text: 'To better model real process conditions, adjust the fouling resistance.'

	Hot Stream (1)		Cold Stream (2)		
	Shell Side		Tube Side		
	In	Out	In	Out	
Fluid name:	resid-2-rec->resid-3		e303out->e304out		
Mass flow rate:	lb/h	230379	462963		
Temperature:	F	370.61	282.26	262.4	305.6
Vapor fraction:			0	0	
Pressure:	psi	256.85	249.59	297.33	290.08
Pressure at liquid surface in column:					
Heat exchanged:	BTU/h				
Exchanger effectiveness:					
Adjust if over-specified:		Heat load	Heat load		
Estimated pressure drop:	psi	7.25	7.25		
Allowable pressure drop :	psi	7.25	7.25		
Fouling resistance :	ft ² *h*F/BTU	0.002	0.001		

Select Dimensional Standards

The screenshot displays the Aspen Exchanger Design & Rating V8.8 software interface. The title bar reads "Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE". The ribbon includes tabs for File, Home, View, Customize, and Resources. The Home tab is active, showing options like Set Units (US), Convert, Set Process Data, Set Properties, Set Geometry, Set Construction, Run, Stop, Run Status, Design (Sizing), Rating / Checking, Simulation, Find Fouling, Check Performance, Review Spec Sheet, Verify Geometry, Review Profiles, and Model Type.

The EDR Navigator on the left shows a tree view with "Application Options" selected under "Input". A red circle with the number "1" highlights this selection. The main window displays the "Application Options Shell & Tube" dialog. The "General" section is highlighted with a red box, and a red circle with the number "2" points to the "Location of hot fluid" dropdown menu. The "Dimensional standard" is set to "SI".

Section	Property	Value
General	Calculation mode:	Design (Sizing)
	Location of hot fluid:	Shell side
	Select geometry based on this dimensional standard:	SI
	Calculation method:	Advanced method
Hot Side	Application:	Program
	Condenser type:	Set default
	Simulation calculation:	Set default
Cold Side	Application:	Liquid, no phase change
	Vaporizer type:	Set default
	Simulation calculation:	Set default
	Thermosiphon circuit calculation:	Set default

Specify the Dimensional standard for geometry selection and hot fluid location.

View Property Data

The screenshot displays the Aspen Exchanger Design & Rating V8.8 software interface. The title bar reads "Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE". The ribbon menu includes tabs for File, Home, View, Customize, and Resources. The "Set Properties" button in the "Model Setup" group is highlighted with a red box. The "EDR Navigator" on the left shows a tree view with "Property Data" expanded to "Hot Stream (1) Compositions". The main window displays the "Hot Stream (1) Compositions" dialog, showing a "Composition" tab with a "Physical property package" dropdown set to "User specified properties" and a "Hot side composition specification" dropdown set to "Weight flowrate or %".

Click on 'Set Properties' to view or enter Stream Property Data. In this case the property data is already filled in from the Aspen HYSYS file.

Set the Heat Exchanger Geometry

The screenshot shows the Aspen Exchanger Design & Rating V8.8 software interface. The title bar reads "Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE". The ribbon includes "File", "Home", "View", "Customize", and "Resources". The "Set Geometry" button is highlighted with a red box and a circled "1".

The "EDR Navigator" on the left shows the "Shell & Tube" section expanded, with "Geometry Summary" selected. The "Geometry Summary" dialog box is open, showing the following settings:

- Front head type: **A - channel & removable cover** (highlighted with a red box and circled "2")
- Shell type: **E - one pass shell**
- Rear head type: **S - floating head with backing device** (highlighted with a red box and circled "2")
- Exchanger position: **Horizontal**
- Shell(s): ID, OD, Series, Parallel (all empty)
- Tubes: Number (empty), Length (empty), OD: **0.75** in, Thickness: **0.083** in
- Tube Layout: New (optimum) layout, Tubes: 0, Tube Passes (empty), Pitch: **1** in, Pattern: **90-Square** (highlighted with a red box and circled "3")
- Baffles: Spacing (center-center): (empty) in, Type: **Single segmental**

Since this exchanger is used in a crude application it should be designed for easy disassembly and cleaning. The above selections are made to facilitate this.

View Design Specification

The screenshot shows the Aspen Exchanger Design & Rating V8.8 software interface. The ribbon at the top has the 'Set Construction' button highlighted with a red box. The 'EDR Navigator' on the left shows the 'Design Specifications' folder expanded. The 'Design Specifications' dialog box is open, showing the following settings:

Codes and Standards

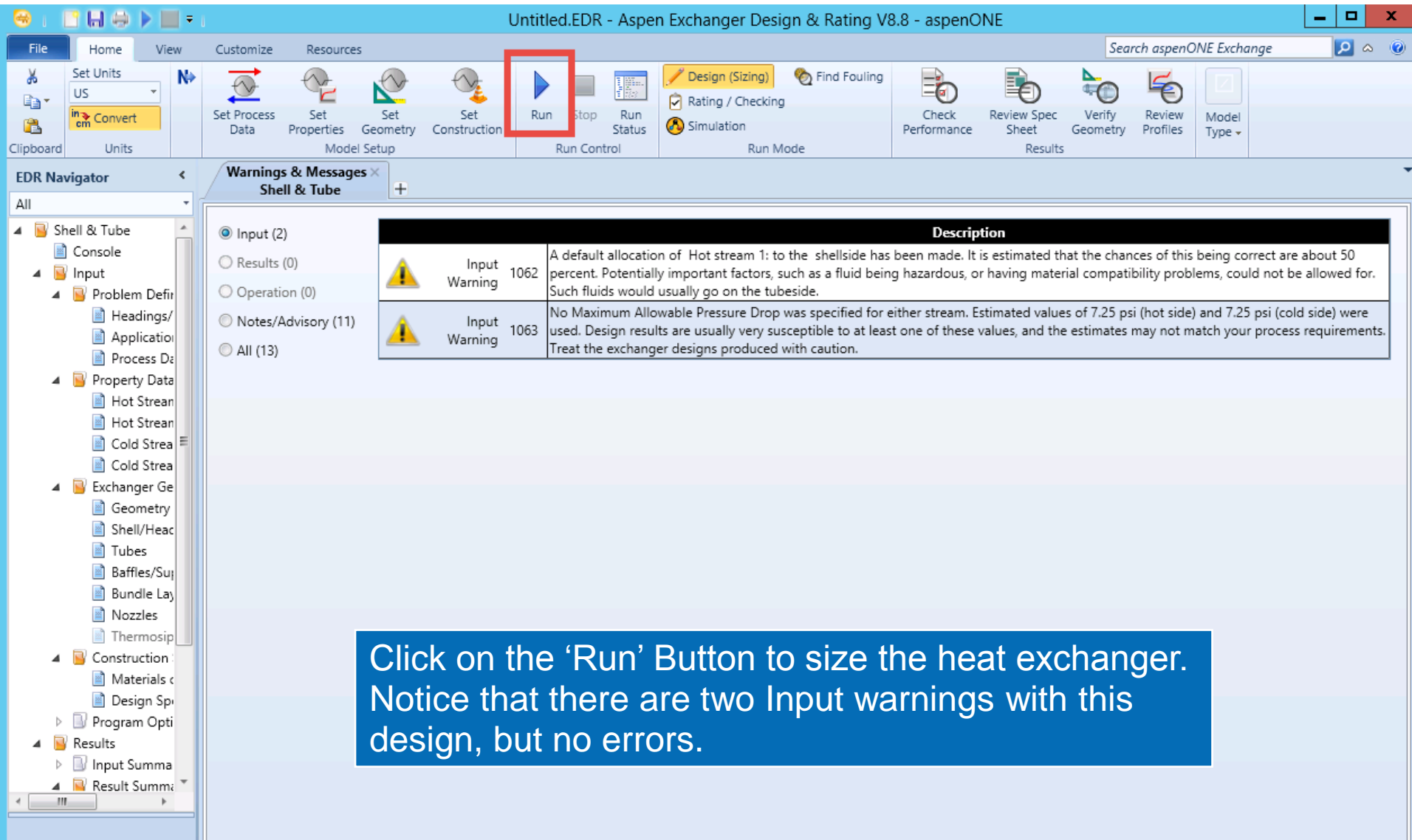
- Design Code: ASME Code Sec VIII Div 1
- Service class: Normal
- TEMA class: R - refinery service
- Material standard: ASME
- Dimensional standard: ANSI - American

Design Conditions

	Shell Side Hot Side	Tube Side Cold Side
Design pressure (gauge):	290.08	333.59
Design temperature :	437	374
Vacuum design pressure (gauge):		
Test pressure (gauge):		
Corrosion allowance :	0.125	0.125

A blue callout box at the bottom of the dialog box contains the text: "Click on 'Set Construction' to view or change the Design Specification. In this case we will use the default data."

Run Sizing Optimization



Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE

File Home View Customize Resources Search aspenONE Exchange

Clipboard Units Model Setup Run Control Run Mode Results

EDR Navigator

Warnings & Messages Shell & Tube



Input (2)

Results (0)

Operation (0)

Notes/Advisory (11)

All (13)

		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 7.25 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.

Click on the 'Run' Button to size the heat exchanger. Notice that there are two Input warnings with this design, but no errors.

Check Overall Performance

S&T-JG.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE

File Home View Customize Resources Search aspenONE Exchange

Set Units US Convert Design (Sizing) Rating / Checking Simulation Check Performance Review Spec Sheet Verify Geometry Review Profiles Air Cooled Fired Heater Plate Plate Shell & Tube Mechanical


EDR Navigator Performance Shell & Tube

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

Design (Sizing)	Shell Side		Tube Side	
	230379	0	462963	0
Total mass flow rate	lb/h	230379	462963	0
Vapor mass flow rate (In/Out)	lb/h	0	0	0
Liquid mass flow rate	lb/h	230379	462963	462963
Vapor mass quality		0	0	0
Temperatures	F	370.61	282.26	262.4
Dew point / Bubble point	F			305.59
Operating Pressures	psi	256.85	250.5	297.33
Film coefficient	BTU/(h*ft ² *F)	107.58		137.55
Fouling resistance	ft ² *h*F/BTU	0.002		0.0013
Velocity (highest)	ft/s	2.5		3.09
Pressure drop (allow./calc.)	psi	7.25 /	6.35	7.25 / 3.51
Total heat exchanged	BTU/h	11570850	Unit	AES 2 pass 2 ser 1 par
Overall clean coeff. (plain/finned)	BTU/(h*ft ² *F)	59.38 /	Shell size	38.3856 - 236.2205 in Hor
Overall dirty coeff. (plain/finned)	BTU/(h*ft ² *F)	49.69 /	Tubes	Plain
Effective area (plain/finned)	ft ²	7009.1 /	Insert	None
Effective MTD	F	33.84	No.	964 OD 0.75 Tks 0.083 in
Actual/Required area ratio (dirty/clean)		1.02 / 1.22	Pattern	90 Pitch 1 in
Vibration problem		No	Baffles	Single segmental Cut(%d) 15.48
RhoV2 problem		No	Total cost	212138 Dollar(US)

Heat Transfer Resistance

Shell side / Fouling / Wall / Fouling / Tube side

Shell Side  Tube Side

View TEMA Sheet

S&T-JG.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE

File Home View Customize Resources Search aspenONE Exchange

Set Units US Convert Units Model Setup Run Stop Run Status Design (Sizing) Find Fouling Check Performance Review Spec Sheet Verify Geometry Review Profiles Air Cooled Fired Heater Plate Plate Shell & Tube Mechanical

EDR Navigator TEMA Sheet Shell & Tube

TEMA Sheet

1	Company:					
2	Location:					
3	Service of Unit:	Our Reference:				
4	Item No.:	Your Reference:				
5	Date:	Rev No.:	Job No.:			
6	Size	38.38'- 236.22	in	Type AES	Horizontal	
7	Surf/unit(eff.)	7009.1	ft2	Shells/unit	2	
7				Surf/shell(eff.)	3504.6	
7					ft2	
8	PERFORMANCE OF ONE UNIT					
9	Fluid allocation	Shell Side		Tube Side		
10	Fluid name	resid-2-rec->resid-3		e303out->e304out		
11	Fluid quantity, Total	230379		462963		
12	Vapor (In/Out)	lb/h	0	0	0	
13	Liquid	lb/h	230379	230379	462963	
14	Noncondensable	lb/h	0	0	0	
15						
16	Temperature (In/Out)	F	370.61	282.26	262.4	
17	Dew / Bubble point	F			305.59	
18	Density Vapor/Liquid	lb/ft3	/ 51.149	/ 53.203	/ 48.119	
18					/ 47.055	
19	Viscosity	cp	/ 2.3539	/ 5.554	/ 1.0968	
19					/ 0.8056	
20	Molecular wt, Vap					
21	Molecular wt, NC					
22	Specific heat	BTU/(lb*F)	/ 0.5915	/ 0.5441	/ 0.5677	
22					/ 0.59	
23	Thermal conductivity	BTU/(ft*h*F)	/ 0.065	/ 0.068	/ 0.065	
23					/ 0.063	
24	Latent heat	BTU/lb				
25	Pressure (abs)	psi	256.85	250.5	297.33	
25					293.81	
26	Velocity (Mean/Max)	ft/s	1.85 / 2.5		3.01 / 3.09	
27	Pressure drop, allow./calc.	psi	7.25	6.35	7.25	
27					3.51	
28	Fouling resistance (min)	ft2*h*F/BTU	0.002		0.001	
28					0.0013	
28					Ao based	
29	Heat exchanged	11570850	BTU/h	MTD (corrected)	33.84	
29					F	

Verify Heat Exchanger Geometry

S&T-JG.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE

File Home View Customize Resources Search aspenONE Exchange

Set Units US Convert

Set Process Data Set Properties Set Geometry Set Construction Run Stop Run Status

Design (Sizing) Find Fouling Rating / Checking Simulation

Check Performance Review Spec Sheet Verify Geometry Review Profiles Model Type

EDR Navigator

- All
- Shell & Tube
 - Console
 - Input
 - Problem Definition
 - Property Data
 - Exchanger Geometry
 - Construction Specifications
 - Program Options
 - Results
 - Input Summary
 - Result Summary
 - Warnings & Messages
 - Optimization Path
 - Recap of Designs
 - TEMA Sheet
 - Overall Summary
 - Thermal / Hydraulic Summary
 - Mechanical Summary
 - Exchanger Geometry
 - Setting Plan & Tubesheet Layout
 - Cost / Weights
 - Calculation Details

Setting Plan & Tubesheet Layout Shell & Tube

Setting Plan Tubesheet Layout U-bend Schedule

Views on arrow A

285.561 Overall

201.378

14.1048

47.2441

141.7323

Pulling Length 212

2.9528

34.1

5.9055

2 Bolts Fixed

2.9528

34.1

5.9055

2 Bolts Sliding

Ref	OD	Wall	Standard	Notes	Design Data	Units	Shell	Channel	Computer
S1	8.625"	0.322"	150 ANS1 Slip on		Design Pressure	psi	290.07	333.58	Location
S2	8.625"	0.322"	150 ANS1 Slip on		Design Temperature	F	437	374	Service at Start
T1	8.625"	0.322"	150 ANS1 Slip on		Full Vacuum				From File
T2	8.625"	0.322"	150 ANS1 Slip on		Corrosion Allowance	in	0.125	0.125	Your Reference
					Test Pressure	psi	1	2	Name
					Number of Passes				Rev. No.
					Radioactivity				Job No.
					PWHT				Design Codes
					Internal Volume	ft ³	159.9068	23.9208	ASME Section VIII Div. 1
									TEMA R
									Customer Specifications

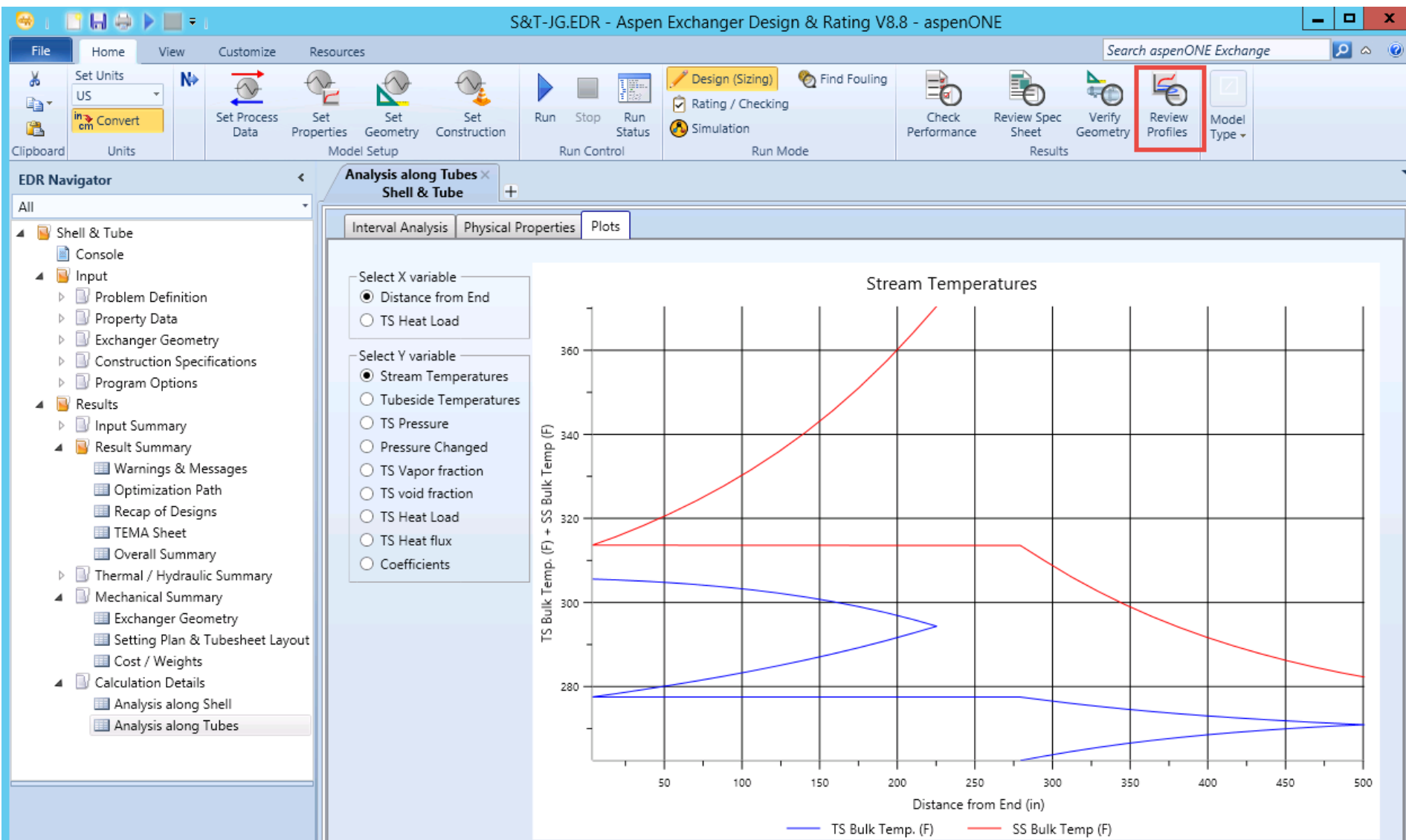
Aspen Shell & Tube Exchanger

Setting Plan

AES 38 - 236

Drawing Number

Review Profiles





Tutorial II



Heat Exchanger Specification Sheet

Values from this Heat Exchanger specification sheet would be used for the exercise.

Relevant values are highlighted in yellow.

Heat Exchanger Specification Sheet									
Company:									
Location:									
Service of Unit:					Our Reference: Aspen Shell & Tube Exchanger Stand-alone Task				
Item No.:					Your Reference:				
Date:		Rev No.:		Job No.:					
Size	/	in	Type	AES	Hor	Connected in	parallel	series	
Surf/unit(eff.)		ft2	Shells/unit			Surf/shell (eff.)			ft2
PERFORMANCE OF ONE UNIT									
Fluid allocation			Shell Side			Tube Side			
Fluid name			P3G1->P3G2			P3GA-Alt->P3GA-1			
Fluid quantity, Total			1122792			546607			
Vapor (In/Out)			0			0			
Liquid			1122792			546607			
Noncondensable			0			0			
Temperature (In/Out)			486.61			478.88			
Dew / Bubble point									
Density (Vap / Liq)			/ 42.537			/ 42.78			
Viscosity			/ 0.3588			/ 0.374			
Molecular wt, Vap									
Molecular wt, NC									
Specific heat			/ 0.6655			/ 0.662			
Thermal conductivity			/ 0.046			/ 0.046			
Latent heat									
Pressure (abs)			178.1			156.99			
Velocity									
Pressure drop, allow./calc.			21.76			21.76			
Fouling resistance (min)			0.0011			0.0011			
Heat exchanged			579242			MTD corrected			
Transfer rate, Service			Dirty			Clean			

Heat Exchanger Specification Sheet

Transfer rate, Service		Dirty		Clean		BTU/(h*ft ² *F)		
CONSTRUCTION OF ONE SHELL							Sketch	
			Shell Side		Tube Side			
Design/vac/test pressure:	psi	200	/	/	180	/	/	
Design temperature	F	554		554				
Number passes per shell								
Corrosion allowance	in							
Connections	In	in	1	16	/	-	1	
	Out		1	16	/	-	1	
ID	Intermediate		1	/	-	1	/	
Tube No.	OD	1	Tks-	Avg	in	Length	in	
Tube type	Plain	Material		Carbon Steel	Tube pattern	90	in	
Shell	Carbon Steel	ID	OD	in	Shell cover	Carbon Steel		
Channel or bonnet	Carbon Steel		Channel cover	Carbon Steel				
Tubesheet-stationary	Carbon Steel		Tubesheet-floating	Carbon Steel				
Floating head cover	Carbon Steel		Impingement protection	None				
Baffle-cross	Carbon Steel	Type	Double segmer	Cut(%d)	H	Spacing: c/c	in	
Baffle-long	-	Seal type						Inlet
Supports-tube	U-bend		Type					
Bypass seal	Tube-tubesheet joint		Exp.					
Expansion joint	-	Type						
RhoV2-Inlet nozzle	Bundle entrance		Bundle exit		lb/(ft*s2)			
Gaskets - Shell side	Flat Metal Jacket Fibe		Tube Side		Flat Metal Jacket Fibe			
Floating head	Flat Metal Jacket Fibe							
Code requirements	ASME Code Sec VIII Div 1			TEMA class		R - refinery service		
Weight/Shell	Filled with water					Bundle		
Remarks								

Set Process Data

Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE

File Home View **Customize** Resources Search aspenONE Exchange

Set Units US Convert Units Model Setup Run Control Run Mode Results Model Type

Set Process Data Set Properties Set Geometry Set Construction Run Stop Run Status Design (Sizing) Rating / Checking Simulation Find Fouling Check Performance Review Spec Sheet Verify Geometry Review Profiles

EDR Navigator

- All
- Shell & Tube
 - Console
 - Input
 - Problem Definition
 - Headings/Remarks
 - Application Options
 - Process Data
 - Property Data
 - Exchanger Geometry
 - Construction Specifications
 - Program Options
 - Results
 - Input Summary
 - Result Summary
 - Thermal / Hydraulic Summary
 - Mechanical Summary
 - Calculation Details

Process Data Shell & Tube

Process Data

Hot Stream (1) Shell Side Cold Stream (2) Tube Side

Fluid name:	P3G1->P3G2		P3GA-Alt->P3GA-1	
	In	Out	In	Out
Mass flow rate:	lb/h	1122792	546607	
Temperature:	F	486.61	478.88	466.52 482.6
Vapor fraction:				
Pressure:	psi	178.1	156.34	156.99 135.23
Pressure at liquid surface in column:				
Heat exchanged:	BTU/h			
Exchanger effectiveness:				
Adjust if over-specified:		Heat load	Heat load	
Estimated pressure drop:	psi	21.76	21.76	
Allowable pressure drop :	psi	21.76	21.76	
Fouling resistance :	ft ² *h*F/BTU	0.0011	0.0011	

Enter Data from the Heat Exchanger specification sheet.

Stream Properties Data

For Hot Stream and Cold stream properties use the data given here.

Hot Stream Properties at 178.1 psi		1	2	3
Temperature	F	486.61	476.57	466.52
Liquid density	lb/ft ³	42.537	42.862	43.181
Liquid specific heat	BTU/(lb*F)	0.6655	0.661	0.6565
Liquid viscosity	cp	0.3588	0.3785	0.3993
Liquid thermal cond.	BTU/(ft*h*F)	0.046	0.046	0.047
Liquid surface tension	lbf/ft	0.00068	0.00071	0.00073
Liquid molecular weight		245.767	245.767	245.767

Cold Stream Properties at 157.1 psi		1	2	3	4	5	6
Temperature	F	466.52	470.54	474.56	478.58	482.59	486.61
Liquid density	lb/ft ³	43.157	43.031	42.908	42.785	42.661	42.537
Liquid specific heat	BTU/(lb*F)	0.6566	0.6584	0.6602	0.662	0.6638	0.6656
Liquid viscosity	cp	0.3991	0.3907	0.3825	0.3743	0.3663	0.3587
Liquid thermal cond.	BTU/(ft*h*F)	0.047	0.047	0.046	0.046	0.046	0.046
Liquid surface tension	lbf/ft	0.00073	0.00072	0.00071	0.0007	0.00069	0.00068
Liquid molecular weight		245.7668	245.7668	245.7668	245.7668	245.7668	245.7668

Set Hot Stream Properties

The screenshot displays the Aspen Exchanger Design & Rating V8.8 software interface. The title bar reads "Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE". The ribbon menu includes "File", "Home", "View", "Custom", and "Resources". The "Resources" tab is active, showing icons for "Set Process Data", "Set Properties", "Set Geometry", and "Set Construction". A red box labeled "1" highlights the "Set Properties" icon. Below the ribbon, the "EDR Navigator" pane shows a tree view with "Hot Stream (1) Compositions" selected. The main workspace displays the "Hot Stream (1) Compositions" dialog box, which has a "Composition" tab. A red box labeled "2" highlights the "Physical property package" dropdown menu, which is currently set to "User specified properties". Other options in the dropdown include "Aspen Properties", "Aspen Plus", "Aspen HYSYS", "Aspen Plus 3", "Aspen HYSYS 3", "Aspen Plus 4", "Aspen HYSYS 4", "Aspen Plus 5", "Aspen HYSYS 5", "Aspen Plus 6", "Aspen HYSYS 6", "Aspen Plus 7", "Aspen HYSYS 7", "Aspen Plus 8", and "Aspen HYSYS 8". Below the dropdown, the "Hot side composition specification" is set to "Weight flowrate or %". There are also "Search Databank..." and "Delete Row" buttons.

Set Hot Stream Properties

Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE

Search aspenONE Exchange

File Home **New** Customize Resources

Set Units US **Convert** Set Process Data Set Properties Set Geometry Set Construction Run Stop Run Status Design (Sizing) Find Fouling Check Performance Review Spec Sheet Verify Geometry Review Profiles Model Type

Rating / Checking Simulation

EDR Navigator

All

Shell & Tube

Console

Input

Problem Definition

Property Data

Hot Stream (1) Compositions

Hot Stream (1) Properties

Cold Stream (2) Compositions

Cold Stream (2) Properties

Exchanger Geometry

Construction Specifications

Program Options

Results

Input Summary

Result Summary

Warnings & Messages

Optimization Path

Recap of Designs

TEMA Sheet

Overall Summary

Hot Stream (1) Properties Shell & Tube

Properties Phase Composition Component Properties Property Plots

Get Properties

Overwrite Properties

Restore Defaults

Pivot Table

Temperature Points

Number: 5

Temperatures: Specify points

Range: 486.61 478.88 F

Pressure Levels

Number: 2

Pressure: 178.1 psi

Add Set

Delete Set

	1	2	3	4	5
Temperature	F	486.61	476.57	466.52	
Liquid density	lb/ft3	42.537	42.862	43.181	
Liquid specific heat	BTU/(lb*F)	0.6655	0.661	0.6565	
Liquid viscosity	cp	0.3588	0.3785	0.3993	
Liquid thermal cond.	BTU/(ft*h*F)	0.046	0.046	0.047	
Liquid surface tension	lbf/ft	0.00068	0.00071	0.00073	
Liquid molecular weight		245.767	245.767	245.767	
Specific enthalpy	BTU/lb				
Vapor mass fraction					

Copy and paste the given Hot Stream properties.

Run Shell & Tube completed

100%

Set Hot Stream Properties

Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE

Search aspenONE Exchange

File Home View Customize Resources

Set Units US Convert

Set Process Data Set Properties Set Geometry Set Construction

Run Stop Run Status

Design (Sizing) Find Fouling

Rating / Checking Simulation

Check Performance Review Spec Sheet Verify Geometry Review Profiles Model Type

EDR Navigator

All

Shell & Tube

Console

Input

Problem Definition

Headings/Remarks

Application Options

Process Data

Property Data

Hot Stream (1) Composition

Hot Stream (1) Properties

Cold Stream (2) Composition

Cold Stream (2) Properties

Exchanger Geometry

Construction Specifications

Program Options

Results

Input Summary

Result Summary

Thermal / Hydraulic Summary

Mechanical Summary

Calculation Details

Hot Stream (1) Properties Shell & Tube

Properties Phase Composition Component Properties Property Plots

Get Properties

Overwrite Properties

Restore Defaults

Pivot Table

Temperature Points

Number: 5

Temperatures: Specify points

Range: 486.61 478.88 F

Pressure Levels

Number: 2

Pressures: 1478.1 156.34 psi

Add Set

Delete Set

	1	2	3	4	5
Temperature					
Liquid density					
Liquid specific heat					
Liquid viscosity					
Liquid thermal cond.					
Liquid surface tension					
Liquid surface friction					
Vapor mass fraction					
Vapor density					

For this exercise, we chose to specify hot stream properties only for the inlet pressure.

Set Cold Stream Properties

The screenshot displays the Aspen Exchanger Design & Rating V8.8 software interface. The title bar reads "Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE". The ribbon menu includes "File", "Home", "New", "Customize", and "Resources". The "New" tab is active, showing options like "Set Units", "Convert", "Set Process Data", "Set Properties", "Set Geometry", "Set Construction", "Run", "Stop", "Run Status", "Design (Sizing)", "Find Fouling", "Rating / Checking", "Simulation", "Check Performance", "Review Spec Sheet", "Verify Geometry", "Review Profiles", and "Model Type".

The "EDR Navigator" on the left shows a tree view with "Shell & Tube" selected. Under "Property Data", "Cold Stream (2) Compositions" is highlighted. The main workspace shows the "Cold Stream (2) Compositions" dialog box. A red box labeled "1" highlights the "New" button in the ribbon. Another red box labeled "2" highlights the "Physical property package" dropdown menu, which is set to "User specified properties". Below this, the "Cold side composition specification" is set to "Weight flowrate or %". There are also "Search Databank..." and "Delete Row" buttons.

At the bottom left, a status bar indicates "Run Shell & Tube completed". At the bottom right, the zoom level is set to 100%.

Set Cold Stream Properties

1

2

3

Copy and paste the given Cold Stream properties.

Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE

File Home View Customize Resources Search aspenONE Exchange

Set Units US in Convert Set Process Data Set Properties Set Geometry Set Construction Run Stop Run Status Design (Sizing) Rating / Checking Simulation Find Fouling Check Performance Review Spec Sheet Verify Geometry Review Profiles Model Type

EDR Navigator

All

Shell & Tube

Console

Input

Problem Definition

Property Data

Hot Stream (1) Compositions

Hot Stream (1) Properties

Cold Stream (2) Compositions

Cold Stream (2) Properties

Exchanger Geometry

Construction Specifications

Cold Stream (2) Properties Shell & Tube

Properties Phase Composition Component Properties Property Plots

Get Properties

Overwrite Properties

Restore Defaults

Pivot Table

Temperature Points

Number: 6

Temperatures: Specify points

Range: 466.52 482.6 F

Pressure Levels

Number: 2

Pressures: 156.99 135.23 psi

Add Set

Delete Set

	1	2	3	4	5	6	
Temperature	F	466.52	470.54	474.56	478.58	482.59	486.61
Liquid density	lb/ft3	43.157	43.031	42.908	42.785	42.661	42.537
Liquid specific heat	BTU/(lb*F)	0.6566	0.6584	0.6602	0.662	0.6638	0.6656
Liquid viscosity	cp	0.3991	0.3907	0.3825	0.3743	0.3663	0.3587
Liquid thermal cond.	BTU/(ft*h*F)	0.047	0.047	0.046	0.046	0.046	0.046
Liquid surface tension	lbf/ft	0.00073	0.00072	0.00071	0.0007	0.00069	0.00068
Liquid molecular weight		245.7668	245.7668	245.7668	245.7668	245.7668	245.7668
Specific enthalpy	BTU/lb						
Vapor mass fraction							
Vapor density	lb/ft3						
Vapor specific heat	BTU/(lb*F)						

Set Cold Stream Properties

Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE

Search aspenONE Exchange

File Home View Customize Resources

Set Units US Convert

Set Process Data Set Properties Set Geometry Set Construction

Run Stop Run Status

Design (Sizing) Find Fouling

Rating / Checking Simulation

Check Performance Review Spec Sheet Verify Geometry Review Profiles Model Type

EDR Navigator

Cold Stream (2) Properties Shell & Tube

Properties Phase Composition Component Properties Property Plots

Get Properties

Temperature Points

Number: 6

Temperatures: Specify points

Range: 466.52 482.6 F

Pressure Levels

Number: 2 Pressures: 135.23 psi

Add Set

Delete Set

Pivot Table

	1	2	3	4	5
Temperature					
Liquid density					
Liquid specific heat					
Liquid viscosity					
Liquid thermal cond.					
Liquid surface tension					
Vapor mass fraction					
Vapor density					

For this exercise, we chose to specify cold stream properties only for the inlet pressure.

Set Geometry

Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE

File Home View Customize Resources

Search aspenONE Exchange

Set Units US Convert

Set Process Data Set Properties **1** Set Geometry Set Construction

Run Stop Run Status

Design (Sizing) Find Fouling

Rating / Checking Simulation

Check Performance Review Spec Sheet Verify Geometry Review Profiles Model Type

EDR Navigator

Geometry Summary x Shell & Tube

2 ✓ Geometry Tube Layout

Front head type: A - channel & removable cover

Shell type: E - one pass shell

Rear head type: S - floating head with backing device

Exchanger position: Horizontal

Shell(s)

ID: in

OD: in

Series:

Parallel:

Tubes

Number:

Length: in

3 OD: 1 in

Thickness: 0.083 in

4

Tube Layout

New (optimum) layout

Tubes: 0

Tube Passes:

Pitch: 1.25 in

5 Pattern: 90-Square

Baffles

Spacing (center-center): in

Spacing at inlet: in

Type: Double segmenta

Tubes in window: Yes

Enter data from the Heat Exchanger specification sheet.

Enter Design Specification

The screenshot shows the Aspen Exchanger Design & Rating V8.8 software interface. The title bar reads "Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE". The ribbon includes tabs for File, Home, View, Customize, and Resources. The "Set Construction" button is highlighted with a red box and a red circle with the number "1".

The "EDR Navigator" on the left shows a tree view with "Design Specifications" selected under "Construction Specifications".

The "Design Specifications" dialog box is open, showing the following settings:

- Codes and Standards:**
 - Design Code: ASME Code Sec VIII Div 1
 - Service class: Normal
 - TEMA class: R - refinery service
 - Material standard: ASME
 - Dimensional standard: ANSI - American
- Design Conditions:**

	Shell Side Hot Side	Tube Side Cold Side
Design pressure (gauge):	psi 200	180
Design temperature:	F 554	554
Vacuum design pressure (gauge):	psi	
Test pressure (gauge):	psi	

The "Design Conditions" table is highlighted with a red box and a red circle with the number "2".

A blue callout box at the bottom of the dialog box contains the text: "Enter data from the Heat Exchanger specification sheet."

Run Sizing Optimization

The screenshot shows the Aspen Exchanger Design & Rating V8.8 software interface. The title bar reads "Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE". The ribbon includes tabs for File, Home, View, Customize, and Resources. The Run Control group contains buttons for Run, Stop, and Run Status, with the Run button highlighted by a red box. The Warnings & Messages panel is open, showing a warning for "Input 1243".

Input (1)		Description
	Input Warning 1243	The bundle band orientation has 3 pass partition lanes in line with the flow, which may give significant by-passing around the tube regions. Changing the orientation of the bundle would give 1 in-line lane(s) and reduced by-passing.

Click on the 'Run' Button to size the heat exchanger. Notice that there is a warning message with this design, but no errors.

Check Overall Performance

Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE

File Home View Customize Resources Search aspenONE Exchange

Clipboard Units Model Setup Run Control Run Mode Results

Set Units US in cm Convert Set Process Data Set Properties Set Geometry Set Construction Run Stop Run Status Design (Sizing) Rating / Checking Simulation Find Fouling Check Performance Review Spec Sheet Verify Geometry Review Profiles Model Type

Performance Shell & Tube


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

Note that the pressure drops are within allowable limits. Also note the area ratio of the heat exchanger.

Design (Sizing)		Shell Side		Tube Side	
Total mass flow rate	lb/h	1122792		546607	
Vapor mass flow rate (In/Out)	lb/h	0	0	0	0
Liquid mass flow rate	lb/h	1122792	1122792	546607	546607
Vapor mass quality		0	0	0	0
Temperatures	F	486.61	478.88	466.52	482.6
Dew point / Bubble point	F				
Operating Pressures	psi	178.1	160.38	156.99	136.65
Film coefficient	BTU/(h*ft2*F)	330.97		308.74	
Fouling resistance	ft2*h*F/BTU	0.0011		0.0013	
Velocity (highest)	ft/s	5.89		8.97	
Pressure drop (allow./calc.)	psi	21.76	/ 17.72	21.76	/ 20.34
Total heat exchanged	BTU/h	5781973		Unit AES 6 pass 2 ser 1 par	
Overall clean coeff. (plain/finned)	BTU/(h*ft2*F)	152.86	/	Shell size 45 - 240	in Hor
Overall dirty coeff. (plain/finned)	BTU/(h*ft2*F)	111.59	/	Tubes Plain	
Effective area (plain/finned)	ft2	7888.8	/	Insert None	
Effective MTD	F	6.63		No. 798 OD 1 Tks 0.083 in	
Actual/Required area ratio (dirty/clean)		1.01	/ 1.38	Pattern 90 Pitch 1.25 in	
Vibration problem		No		Baffles Double segmental Cut(%d) 19.44	
RhoV2 problem		No		Total cost 225628 Dollar(US)	

Heat Transfer Resistance

Shell side / Fouling / Wall / Fouling / Tube side

Shell Side  Tube Side

Warnings & Messages Optimization Path Recap of Designs TEMA Sheet Overall Summary Thermal / Hydraulic Summary Performance Heat Transfer Pressure Drop Flow Analysis Vibration & Resonance Analysis Methods Mechanical Summary

View TEMA Sheet

Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE

Search aspenONE Exchange

File Home View Customize Resources

Set Units US Convert

Set Process Data Set Properties Set Geometry Set Construction

Run Stop Run Status

Design (Sizing) Rating / Checking Simulation

Find Fouling

Check Performance Review Spec Sheet Verify Geometry Review Profiles Model Type

TEMA Sheet Shell & Tube

TEMA Sheet

1 Company:

2 Location:

3 Service of Unit: Our Reference:

4 Item No.: Your Reference:

5 Date: Rev No.: Job No.:

6 Size 45 - 240 in Type AES Horizontal Connected in 1 parallel 2 series

7 Surf/unit(eff.) 7888.8 ft2 Shells/unit 2 Surf/shell(eff.) 3944.4 ft2

8 PERFORMANCE OF ONE UNIT

9 Fluid allocation Shell Side Tube Side

30 Corrosion allowance in U.125 U.125

37 Connections In in 1 16 / - 1 8 / -

38 Size/Rating Out 1 14 / - 1 10 / -

39 Nominal Intermediate 1 14 / - 1 8 / -

40 Tube No. 798 OD 1 Tks Average 0.083 in Length 240 in Pitch 1.25 in

41 Tube type Plain #/in Material Carbon Steel Tube pattern 90

42 Shell Carbon Steel ID 45 OD 46 in Shell cover Carbon Steel

43 Channel or bonnet Carbon Steel Channel cover Carbon Steel

44 Tubesheet-stationary Carbon Steel Tubesheet-floating Carbon Steel

45 Floating head cover Carbon Steel Impingement protection None

46 Baffle-cross Carbon Steel Type Double segmental Cut(%d) 19.4444 V Spacing: c/c 7.75 in

47 Baffle-long - Seal Type Inlet 24.1565 in

48 Supports-tube U-bend 0 Type

Result Summary

- Warnings & Mess
- Optimization Pat
- Recap of Designs
- TEMA Sheet
- Overall Summary
- Thermal / Hydraulic
- Performance
- Heat Transfer

Here we can view details such as:

- Number of shells
- Shell ID
- Tube lengths, etc.

View Setting Plan

Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE

File Home View Customize Resources Search aspenONE Exchange

Clipboard Units Model Setup Run Control Run Mode Results

Set Units (US) Convert (in to cm) Set Process Data Set Properties Set Geometry Set Construction Run Stop Run Status Design (Sizing) Rating / Checking Simulation Find Fouling Check Performance Review Spec Sheet Verify Geometry Review Profiles Model Type

EDR Navigator

- Exchanger Geometry
 - Geometry Summary
 - Shell/Heads/Flanges/Tubesheets
 - Tubes
 - Baffles/Supports
 - Bundle Layout
 - Nozzles
 - Thermosiphon Piping
- Construction Specifications
 - Materials of Construction
 - Design Specifications
- Program Options
- Results
 - Input Summary
 - Result Summary
 - Warnings & Messages
 - Optimization Path
 - Recap of Designs
 - TEMA Sheet
 - Overall Summary
 - Thermal / Hydraulic Summary
 - Mechanical Summary
 - Exchanger Geometry
 - Setting Plan & Tubesheet Layout
 - Cost / Weights

Setting Plan & Tubesheet Layout x Shell & Tube

Setting Plan Tubesheet Layout U-bend Schedule

Views on arrow A

293.9609 Overall

200.0

15.375 17.0 16.25

17.0 48.0 144.0

212 Pulling Length

3.0 10 39.8 6.0 2 Bolts Fixed

3.0 39.8 6.0 10 2 Bolts Sliding

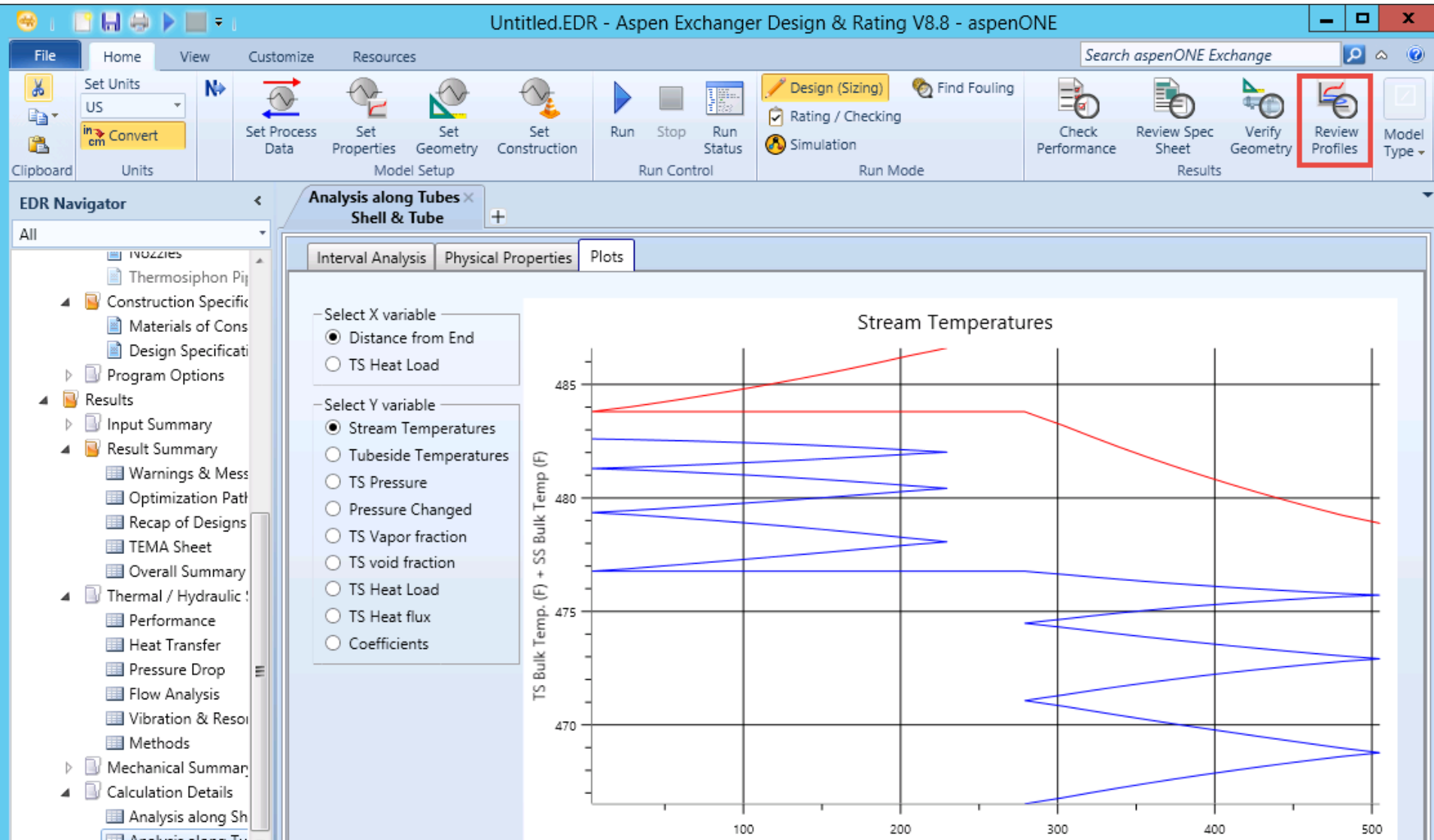
Set	OC	Wall	Standard	Notes	Design Data	Units	Shell	Channel	Comments
S1	16.0"	0.375"	150 ANS	Slip on	Design Pressure	psi	200	180	Location
S2	14.0"	0.375"	150 ANS	Slip on	Design Temperature	F	554	554	Service of User
T1	8.625"	0.322"	150 ANS	Slip on	Full Vacuum				Use No. Your Reference
T2	10.75"	0.365"	150 ANS	Slip on	Corrosion Allowance	in	0.125	0.125	Date See No. Job No.
					Test Pressure	psi			
					Number of Passes		1	6	Design Codes

Aspen Shell & Tube Exchanger

Setting Plan

AES 45 - 240

View Stream Temperature Profiles



View Pressure Profiles

Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE

File Home View Customize Resources Search aspenONE Exchange

Clipboard Units Model Setup Run Control Run Mode Results Model Type

EDR Navigator

- All
 - Thermosiphon Pip
 - Construction Specific
 - Materials of Cons
 - Design Specificati
 - Program Options
 - Results
 - Input Summary
 - Result Summary
 - Warnings & Mess
 - Optimization Pat
 - Recap of Designs
 - TEMA Sheet
 - Overall Summary
 - Thermal / Hydraulic :
 - Performance
 - Heat Transfer
 - Pressure Drop
 - Flow Analysis
 - Vibration & Reso
 - Methods
 - Mechanical Summar
 - Calculation Details
 - Analysis along Sh
 - Analysis along Tu

Analysis along Tubes x
Shell & Tube

Interval Analysis Physical Properties Plots

Select X variable

- Distance from End
- TS Heat Load

Select Y variable

- Stream Temperatures
- Tubeside Temperatures
- TS Pressure
- Pressure Changed
- TS Vapor fraction
- TS void fraction
- TS Heat Load
- TS Heat flux
- Coefficients

TS Pressure vs Distance from End

Distance from End (psi)	Line 1 (Top)	Line 2	Line 3	Line 4	Line 5	Line 6	Line 7	Line 8	Line 9	Line 10 (Bottom)
0	156	152.5	150.5	149.5	146	142.5	140	139.5	138.5	137
100	155.5	152	150	149	145.5	142	139.5	139	138	136.5
200	155	151.5	149.5	148.5	145	141.5	139	138.5	137.5	136
300	154.5	151	149	148	144.5	141	138.5	138	137	135.5
400	154	150.5	148.5	147.5	144	140.5	138	137.5	136.5	135
500	153.5	150	148	147	143.5	140	137.5	137	136	134.5

Modify Design

The screenshot displays the Aspen Exchanger Design & Rating V8.8 software interface. The title bar reads "Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE". The ribbon menu includes "File", "Home", "View", "Customize", and "Resources". The "Run Mode" section of the ribbon has "Rating / Checking" selected, indicated by a red circle with the number "1".

The "EDR Navigator" on the left shows a tree view with "Analysis along Tubes" selected. The main workspace is titled "Analysis along Tubes Shell & Tube" and contains a "Plots" tab. A plot titled "TS Pressure vs Distance from End" is shown, with the Y-axis labeled "TS Pressure (psi)" ranging from 140 to 156 and the X-axis ranging from 0 to 500. The plot shows several blue lines representing temperature profiles.

A "Change Mode" dialog box is open, asking "Use current design geometry in Rating / Checking mode?". The "Use Current" button is highlighted with a red circle and the number "2".

Now we will make some minor changes to the design. In order to do that, change the calculation mode to 'Rating/Checking'.

Round Off Baffle Spacing

Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE

File Home View Customize Resources Search aspenONE Exchange

Set Units (US) Convert (in to cm)

Set Process Data Set Properties Set Geometry Set Construction

Run Stop Run Status

Design (Sizing) Rating / Checking Simulation

Find Fouling Check Performance Review Spec Sheet Verify Geometry Review Profiles Model Type

EDR Navigator

All

Shell & Tube

Console

Input

Problem Definition

- Headings/Remarks
- Application Options
- Process Data

Property Data

- Hot Stream (1) Comp
- Hot Stream (1) Proper
- Cold Stream (2) Comp
- Cold Stream (2) Prope

Exchanger Geometry

- Geometry Summary
- Shell/Heads/Flanges/T
- Tubes

1 Baffles/Supports

Bundling Layout

- Nozzles
- Thermosiphon Piping

Construction Specification

- Materials of Construct
- Design Specifications

Program Options

Baffles/Supports Shell & Tube

Baffles Tube Supports Longitudinal Baffles Variable Baffle Pitches Deresonating Baffles

Baffle type: Double segmental

Tubes are in baffle window: Yes

Baffle cut % - inner/outer/intermediate: 11.1111 / 19 /

Align baffle cut with tubes: Yes

Multi-segmental baffle starting baffle: One piece

Baffle cut orientation: Vertical

Baffle thickness: 0.25 in

2 Baffle spacing center-center: 8 in

Baffle spacing at inlet: 24.1565 in at outlet: 24.1565 in

Number of baffles: 24

End length at front head (tube end to closest baffle): 27.4065 in

End length at rear head (tube end to closest baffle): 34.3435 in

Baffle OD to shell ID diametric clearance: 0.25 in

Round the baffle spacing to a nearest integer value.

Run Sizing Optimization

The screenshot shows the Aspen Exchanger Design & Rating V8.8 software interface. The 'Run' button in the 'Run Control' group is highlighted with a red box. The 'Warnings & Messages' window is open, displaying three warning messages for a Shell & Tube heat exchanger. The messages are categorized as 'Input Warning' and relate to baffle specifications, endspace length, and bundle band orientation.

Input (3)		Description
	Input Warning 1231	There is a full support baffle (blanking baffle) present (specified or default for S and T type rear heads), but the distance beyond this baffle has not been specified. The distance beyond the blanking baffle has been calculated as 10.187 in. For U-bends, this distance is the estimated support plate thickness 0.25 in. For S-type rear heads, the distance is two tubeplate thicknesses (3.125 in) plus the greater of 100mm or the estimated support plate thickness. For all other rear head types, the calculated distance beyond the blanking baffle is the tubeplate thickness plus the greater of 100mm or the estimated support plate thickness.
	Input Warning 1227	Shell&Tube has estimated a minimum endspace length of 20.25 in, for a nozzle inside diameter of 13.25 in. This is greater than the value 18.4065 in which was specified or calculated from an endlength of 21.6565 in. Check your input carefully.
	Input Warning 1243	The bundle band orientation has 3 pass partition lanes in line with the flow, which may give significant by-passing around the tube regions. Changing the orientation of the bundle would give 1 in-line lane(s) and reduced by-passing.

Click on 'Run' Button to size the heat exchanger.
Notice that there are few warning messages, but no errors.

Check Overall Performance

Untitled.EDR - Aspen Exchanger Design & Rating V8.8 - aspenONE

File Home View Customize Resources Search aspenONE Exchange

Set Units US in cm Convert

Set Process Data Set Properties Set Geometry Set Construction

Run Stop Run Status

Design (Sizing) Rating / Checking Simulation

Find Fouling

Check Performance Review Spec Sheet Verify Geometry Review Profiles Model Type

FDR Navigator Performance

Note that the pressure drops are within allowable limits and there are no vibration or Rho - V2 problems.

	Shell Side	Tube Side
Flow rate	1122792	546607
Flow rate (In/Out)	0	0
Flow rate	1122792	546607
Quality	0	0
	486.61	478.88
Dew point / Bubble point		
Operating Pressures	178.1	160.82
		156.99
		136.65
Film coefficient	338.24	308.75
Fouling resistance	0.0011	0.0013
Velocity (highest)	5.71	8.97
Pressure drop (allow./calc.)	21.76 / 17.28	21.76 / 20.34
Total heat exchanged	5781973	
Overall clean coeff. (plain/finned)	154.39 /	
Overall dirty coeff. (plain/finned)	112.41 /	
Effective area (plain/finned)	7888.8 /	
Effective MTD	6.63	
Actual/Required area ratio (dirty/clean)	1.02 / 1.4	
Vibration problem	No	
RhoV2 problem	No	

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

Additional Resources & Contacts

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

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