

ESDU satexpress

EXPRESS program. User Guide

Unamended
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The Source for Critical Information and Insight™



ESDU

Where research meets design

Introduction to IHS ESDU EXPRESS computer program

Single-phase shell-and-tube heat exchangers:

Rapid Design, Rating, Revamp, Performance Prediction, Budget Costing



EXPRESS

- Developed under the guidance of the IHS ESDU Oil Industry Fouling Working Party - expert members represented 70% of the world's refining capacity.

EXPRESS

- Undertake rapid exchanger design
- Assess benefits of new technologies (e.g. helical baffles, tube inserts including Spirelf, Turbotal...)
- Evaluate fouling response of unit to changes in inlet temperatures and throughput
- Generate preliminary designs and budget cost estimates
- Identify suitable design alternatives incorporating exchanger operability considerations
- Checks quickly on whether or not existing equipment is suitable for the specified duties
- Evaluate design changes that may be made to revamp an existing exchanger
- Allows users to rapidly evaluate design opportunities
- Assists process engineers, heat exchanger designers and consultants in the selection, design and use of shell-and-tube heat exchangers



EXPRESSPlus

Also available - *EXPRESSPlus* - for refinery fouling engineers

- Analyse fouling data in pre-heat train exchangers
- Determine crude fouling threshold conditions
- Develop no-fouling designs
- Where no-fouling design not possible, assess opportunities for Helixchangers, inserts, etc.



EXPRESS – a different way to design

- o First look design
- o Enter minimum data from process flowsheet
 - o Duty
 - o Physical properties

Microsoft Excel - Preheat Train A duties.xls

File Edit View Insert Format Tools Data Window Help

Type a question for help

Reply with Changes... Egd Review...

100%

Arial 10

A2

CUTY DATA EXTRACTION FROM SIMULATOR					
E5					
Duty	Inlet Temperature °C	Outlet Temperature °C	Flowrate kg/s	Allowable Pressure kPa	Dr Fouling Resistance m² K/W
Hot Stream	168	163	210	120	0.0004
Cold Stream	145	152	145	50	0.0005
Physical Properties					
	Reference Temperature °C	Density kg/m³	Specific Heat kJ/kg K	Thermal Conductivity W/m K	Viscosity cps
Hot Stream Inlet		642	2.64	0.104	0.23
Hot Stream Outlet					
Cold Stream Inlet		700	2.51	0.116	0.67
Cold Stream Outlet					
EX8					
Duty	Inlet Temperature °C	Outlet Temperature °C	Flowrate kg/s	Allowable Pressure kPa	Dr Fouling Resistance m² K/W
Hot Stream	329.6		35	20	0.0012
Cold Stream	229.4	252.9	84.39	50	0.0006
Physical Properties					
	Reference Temperature °C	Density kg/m³	Specific Heat kJ/kg K	Thermal Conductivity W/m K	Viscosity cps
Hot Stream Inlet	210	830	2.6	0.1	7
Hot Stream Outlet	330	745	3.1	0.093	1.5
Cold Stream Inlet	150	713	2.48	0.116	1
Cold Stream Outlet	250	610	2.82	0.103	0.36
EX9					
Duty	Inlet Temperature °C	Outlet Temperature °C	Flowrate kg/s	Allowable Pressure kPa	Dr Fouling Resistance m² K/W
Hot Stream	242.1	228.4	159.955	150	0.003076
Cold Stream	170.2	188.4	129.477	200	n

Draw AutoShapes

Ready

NUM



Stream data

ESDU Express Pro - Untitled

File Project Edit Calculate Options Help

Preheat Train A.pri

Project Stream Data Geometry Nozzles Fouling Analysis Materials Cost Estimates

Fluid Name
 Hot Stream: Hot Stream
 Cold Stream: Cold Stream

Fluid Phase
 Hot Stream: ☒ Liquid ☐ Gas
 Cold Stream: ☒ Liquid ☐ Gas

Fluid Allocation
 Hot Stream: ☒ Shellside ☐ Tubeside
 Cold Stream: ☐ Shellside ☒ Tubeside

Duty

	Inlet Temperature °C	Outlet Temperature °C	Flowrate kg/s	Allowable Pressure Drop kPa	Fouling Resistance m ² K/W
Hot Stream					
Cold Stream					

Physical Properties

	Inlet/Outlet or Reference Temperature °C	Density kg/m ³	Specific Heat Capacity kJ/kg K	Thermal Conductivity W/m K	Viscosity cps
Hot Stream Inlet					
Hot Stream Outlet					
Cold Stream Inlet					
Cold Stream Outlet					

Over-surface
☐ Design Using Area Margin
 Area Margin: 10 %
[About Ref. Temps...](#)

Tube Wall
 Thermal Conductivity: W/m K Default: 48

Specify flowrate and both temperatures for one stream. Flowrate or one temperature can be left blank for other stream.

Untitled
 Rate/Revamp
 Stream Data
 Geometry
 Nozzles
 Fouling Analysis
 Materials
 Cost Estimates
 Response Plots - Absolute
 Response Plots - Deviation From Design F
 Crude Oil Fouling
 Specification Sheets



Stream data – paste in data

ESDU Express Pro - Untitled

File Project Edit Calculate Options Help

Preheat Train A.pri

Project Stream Data Geometry Nozzles Fouling Analysis Materials Cost Estimates

Fluid Name **Fluid Phase** **Fluid Allocation**

Hot Stream Hot Stream ☒ Liquid ☐ Gas ☒ Shellside ☐ Tubeside

Cold Stream Cold Stream ☒ Liquid ☐ Gas ☐ Shellside ☒ Tubeside

210

Duty	Inlet Temperature	Outlet Temperature	Flowrate	Allowable Pressure Drop	Fouling Resistance
	°C	°C	kg/s	kPa	m ² K/W
Hot Stream	329.6		35	20	0.0012
Cold Stream	229.4	252.9	84.39	50	0.0006

Physical Properties

	Inlet/Outlet or Reference Temperature	Density	Specific Heat Capacity	Thermal Conductivity	Viscosity
	°C	kg/m ³	kJ/kg K	W/m K	cps
Hot Stream Inlet	210	830	2.6	0.1	7
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Cold Stream Inlet	150	713	2.48	0.116	1
Cold Stream Outlet	250	610	2.82	0.103	0.36

Over-surface
☐ Design Using Area Margin
 Area Margin 10 %
[About Ref. Temps...](#)

Specify flowrate and both temperatures for one stream
 Flowrate or one temperature can be left blank for other stream

Tube Wall
 Thermal Conductivity W/m K Default: 48

Untitled
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Default (start) geometry set automatically

ESDU Express Pro - Untitled

File Project Edit Calculate Options Help

Preheat Train A.prj

Project Stream Data **Geometry** Nozzles Fouling Analysis Materials Cost Estimates

Tube Size: ☐ 5/8" ☒ 1" ☐ 1 1/4" ☐ Other...

Gauge: ☐ 25 ☐ 24 ☐ 23 ☐ 22 ☐ 20 ☐ 18 ☐ 16 ☐ 14 ☐ 12 ☐ Other...

Layout: ☒ 30 ☐ 45 ☐ 60 ☐ 90

Pitch Ratio: ☒ 1.25 ☐ 1.285 ☐ 1.33 ☐ 1.5

Front Header: ☒ A ☐ B ☐ C ☐ N ☐ D

Tube: O.D. mm I.D. mm Thickness mm Pitch mm

% Tubes Plugged Default: 0

Shell Type: ☒ E ☐ F

Rear Header: ☐ M ☐ U ☒ S ☐ T

No. Tube Passes: ☐ 1 ☐ 2 ☐ 4 ☐ 6 ☐ 8 ☐ Other...

Pairs of Sealing Strips

Shell Geometry Limits: Maximum Length m Default: 6 Maximum Shell Diameter m Default: 1

Shells in Series: Minimum $\frac{L}{D}$ Value Default: 0.8 No. Shells in Series Leave blank to calculate

Baffle Type: ☒ Single-segmental ☐ Helical ☐ Rod

Baffle Cut: ☐ 15% ☐ 17.5 ☐ 20 ☐ 22.5 ☒ 25 ☐ 27.5 ☐ 30 ☐ 32.5 ☐ 35 ☐ 37.5 ☐ 40 ☐ 42.5 ☐ 45 ☐ Other...

Baffle Space/Shell Diameter Ratio Default: Optimum

Shellside Method: ☐ Bell-Delaware ☒ Stream Analysis

Insert Type: ☒ Plain ☐ Twisted Tape ☐ Helical Coil ☐ HiTran ☐ Turbotal ☐ Spirelf

☐ Integral Low Fin Tubes

Baffle/End Plate (default: TEMA): Baffle Thickness mm Total Tube-sheet Thickness mm

Diametrical Clearances (default: TEMA): Bundle-to-Shell (Diametrical) mm Baffle-to-Shell (Diametrical) mm Tube-to-Baffle (Diametrical) mm Pass Partition mm

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- Rate/Revamp
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1" tubes
AES
30deg layout
2 tube passes
6m max. length
1m max. shell diameter
Segmental baffle, 25%
Plain tube
No insert
No fins
Default clearances and tubesheet