Shell-and-Tube Exchanger Preliminary Size: Area, Shell and Tubes

Required area, shell diameter and number of tubes for a first shell-and-tube design from duty, overall coefficient, mean temperature difference, tube size and pitch.

Input parameters

Unit system: SI

Parameter	Value	Unit
Heat duty	2,000.0	kW
Fouled overall coefficient	600.00	W/(m²·K)
Mean temperature difference (F·LMTD)	20.000	K
Tube outside diameter	25.000	mm
Pitch ratio P_T/d_o	1.2500	
Tube layout	Triangular (C_L = 0.87)	
Tube passes	Two (C_TP = 0.90)	
Tube length	6.0000	m

Calculated results

Parameter	Value	Unit
Required outside area	166.67	m²
Shell diameter	0.65239	m
Number of tubes	353.92	
Tube count constant	0.90000	
Layout constant	0.87000	

Notes for this case

• A first estimate to select a standard (TEMA) shell and tube count, which is then rated (for example by the Kern or Bell–Delaware method). C_TP allows for the tubes lost to passes and clearance.

Formula and method

$$A_o = \frac{Q}{U_f \Delta T_m}, \quad D_s = 0.637 \sqrt{\frac{C_L}{C_{TP}}} \left[\frac{A_o P_R^2 d_o}{L} \right]^{1/2}, \quad N_t = 0.785 \frac{C_{TP}}{C_L} \frac{D_s^2}{P_R^2 d_o^2}$$

Variables

Q	Heat duty	W
U_f	Fouled overall coefficient	W/(m²·K)
ΔT_m	Mean temperature difference (F·LMTD)	K
d_o	Tube outside diameter	m
P_R	Pitch ratio P_T/d_o	-
layout	Tube layout	-
N_p	Tube passes	-
L	Tube length	m
A_o	Required outside area	m²
D_s	Shell diameter	m

N_t	Number of tubes	-
C_{TP}	Tube count constant	-
C_L	Layout constant	-

Method and standards

Geometric estimate of shell size and tube count.

Assumptions and limits

- Plain tubes, full bundle; the constants are approximate.

Report details

Report reference	FCC-4D8G-FD0K (the same inputs always give the same reference)
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/chemical/process-heat-exchangers/shell-tube-preliminary-sizing

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.