Simplified Delaware Method: Shell-Side Coefficient and Pressure Drop

Shell-side film coefficient from the Simplified Delaware j_H curve and pressure drop from its friction factor fits, for 20 % cut segmental baffles.

Input parameters

Unit system: SI

Parameter	Value	Unit
Shell-side mass flow	90,000	kg/h
Shell inside diameter	500.00	mm
Tube outside diameter	19.050	mm
Tube pitch	23.810	mm
Tube layout	Triangular	
Baffle spacing	200.00	mm
Number of baffles	20.000	
Shell-side fluid viscosity	0.70000	mPa·s
Viscosity ratio bulk to wall	1.2000	
Specific heat	4.1800	kJ/(kg·K)
Thermal conductivity	0.62000	W/(m·K)
Density	995.00	kg/m³

Calculated results

Parameter	Value	Unit
Equivalent diameter	13.764	mm
Flow area across the bundle	0.019992	m²
Mass flux	1,250.5	kg/(m²·s)
Reynolds number (equivalent diameter)	24,590	
Modified Colburn factor	58.290	
Shell-side heat transfer coefficient	4,517.9	W/(m²·K)
Friction factor at B/d_s = 1, ft²/in²	0.003071	
Friction factor at B/d_s = 0.2, ft²/in²	5.6063e-04	
Shell-side friction factor	0.17111	
Shell-side pressure drop (without nozzles)	99.988	kPa

Notes for this case

- Simplified Delaware method (Wolverine Engineering Data Book curve fits): 20 % cut segmental baffles, TEMA clearances and one pair of sealing strips per ten tube rows, with a built-in safety factor of about 25 % on h_o.

Formula and method

$$j_H = 0.5\left(1+\frac{B}{d_s}\right)\left(0.08Re^{0.6821}+0.7Re^{0.1772}\right), \quad h_o = j_H\frac{k}{D_e}Pr^{1/3}\phi$$

$$\Delta P_f = \frac{f G^2 d_s (n_b + 1)}{2 \rho D_e \phi}, \quad f = 144 \left[f_1 - 1.25 \left(1 - \frac{B}{d_s} \right) (f_1 - f_2) \right]$$

Variables

$\dot{m}$	Shell-side mass flow	kg/s
d_s	Shell inside diameter	m
D_o	Tube outside diameter	m
P_T	Tube pitch	m
layout	Tube layout	-
B	Baffle spacing	m
n_b	Number of baffles	-
μ	Shell-side fluid viscosity	Pa·s
μ/μ_w	Viscosity ratio bulk to wall	-
c_p	Specific heat	J/(kg·K)
k	Thermal conductivity	W/(m·K)
ρ	Density	kg/m³
D_e	Equivalent diameter	m
a_s	Flow area across the bundle	m²
G	Mass flux	kg/(m²·s)
Re	Reynolds number (equivalent diameter)	-
j_H	Modified Colburn factor	-
h_o	Shell-side heat transfer coefficient	W/(m²·K)
f_1	Friction factor at B/d_s = 1, ft²/in²	-
f_2	Friction factor at B/d_s = 0.2, ft²/in²	-
f	Shell-side friction factor	-
ΔP_f	Shell-side pressure drop (without nozzles)	Pa

Method and standards

Simplified Delaware shell-side correlations with Kern's equivalent diameter.

Assumptions and limits

- 20 % cut segmental baffles, plain or low-fin tubes; shells 8–42 in.

Report details

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

This calculator online

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Reopens the calculator with the inputs of this report.