Main Input Data for rating Shell and Tubes Heat Exchangers

No.	Symbol	Description	Value	Unit
		Shell side fluid		
		Tube side fluid		
1	D_s	Inside shell diameter, See Fig. 1		m
2	d_o	Tube outside diameter		m
3	L_{tw}	Tube wall thickness		m
4	d_i	Inside tube diameter, $d_i=d_o-2L_{tw}$		m
5	k_w	Tube wall thermal conductivity		W/m.K
6	L_{tp}	Tube layout pitch, See Table 1		m
7	θ_{tp}	Tube layout characteristic angle, See Table 1		Deg.
8	L_{to}	Overall nominal tube length, See Fig. 2		m
9	L_{ti}	Baffled tube length, See Fig. 2		m
10	L_{ta}	Effective tube length, See Fig. 2		m
11	B_c	Baffle cut as percent of D_s, See Fig. 1		%
12	L_{bc}	Central baffle spacing (optional), See Fig. 3		m
13a	L_{bi}	Inlet baffle spacing (optional), See Fig. 3		m
13b	L_{bo}	Outlet baffle spacing (optional), See Fig. 3		m
14	CN	Shell-side nozzle, impingement protection		code
15	N_{tt}	# of tubes or holes in tube-sheet for U tubes		---
16	N_{tp}	Number of tube passes		---
17	N_{ss}	Number of sealing strips (pairs), See Fig. 4		---
18	CB	Tube bundle type (FX, UT, SRFH, PFH, PTFH), See Table 2		code
19	L_{tb}	Tube OD-to baffle hole clearance (diametral), See Fig. 5		mm
20	L_{sb}	Inside shell-to-baffle clearance (diametral), See Fig. 6		mm
21	L_{bb}	Inside shell-to-tube bundle bypass clearance, See Fig. 1		mm
21a	L_p	By pass lane, See Fig. 1		mm
22	T_{si}	Inlet temperature for shell side fluid		°C
23	T_{so}	Outlet temperature for shell side fluid		°C
23a	$T_{s,av}$	Average shell side temperature		°C
24	T_{ti}	Inlet temperature for tube side fluid		°C
25	T_{to}	Outlet temperature for tube side fluid		°C
25a	$T_{t,avg}$	Average tube side temperature		°C

No.	Symbol	Description	Value	units
26	$\dot{m}_s$	Shell-side fluid mass flow rate		kg/s
27	ρ_s	Density of shell side fluid		kg/m^3
28	k_s	Thermal conductivity of shell side fluid		W/(m.K)
29	C_{ps}	Specific heat of shell side fluid		J/(kg.K)
30	μ_s	Viscosity of shell side fluid		Pa.s
30a	Pr_s	Prandtl number for shell side fluid		--
31	R_{fo}	Fouling factor for shell side		m^2C/W
32	$\dot{m}_t$	Tube side mass flow rate		kg/s
33	ρ_t	Density of tube side fluid		kg/m^3
34	k_t	Thermal Conductivity of tube side fluid		W/(m.K)
35	C_{pt}	Heat Capacity of tube side fluid		J/(kg.K)
36	μ_t	Viscosity of tube side fluid		Pa.s
36a	Pr_t	Prandtl number for tube side fluid		--
37	R_{fi}	Tube side fouling		m^2C/W
38	h_s	Initial guess for shell side heat transfer coefficient		$W/(m^2.K)$
39	h_t	Initial guess for tube side heat transfer coefficient		$W/(m^2.K)$
40	$\Delta P_{s,max}$	Maximum allowable pressure drop for shell side		kPa
41	$\Delta P_{t,max}$	Maximum allowable pressure drop for tube side		kPa
42	$V_{s,max}$	Maximum allowable velocity for shell side flow		m/s
43	$V_{t,max}$	Maximum allowable velocity for tube flow		m/s
44	T_w	Wall Temperature		°C
45	$\mu_{s,w}$	Wall viscosity for the shell side		Pa.s
46				

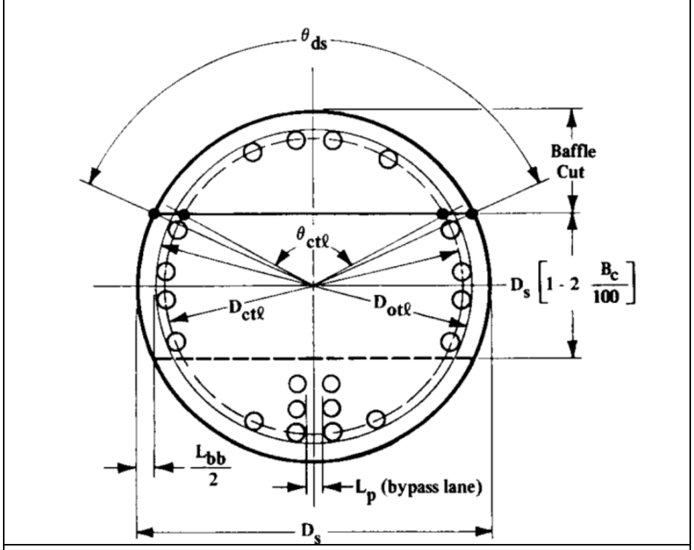
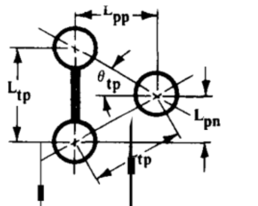
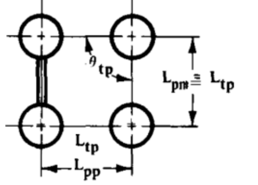
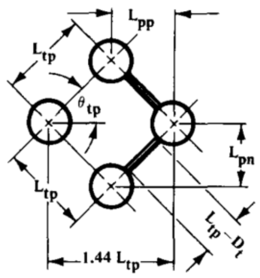


Fig. 1 Basic baffle geometry

Table (1) Tube layout geometries

Cross flow ⟶	θ_{tp}	L_{pn}	L_{pp}
	30°	$0.5L_{tp}$	$0.866L_{tp}$
	90°	L_{tp}	L_{tp}
	45°	$0.707L_{tp}$	$0.707L_{tp}$

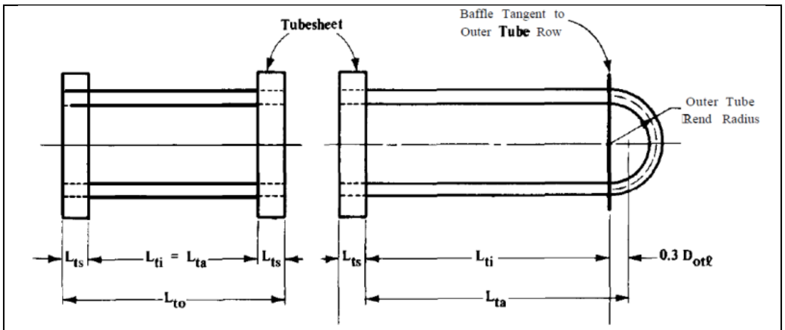


Fig. 2 Tube length definitions

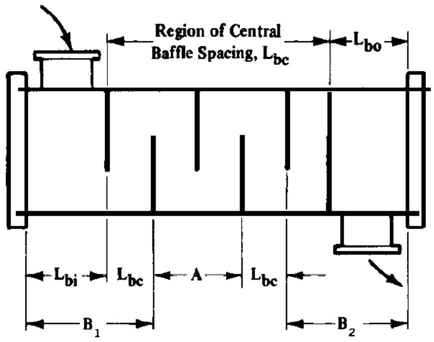


Fig. 3 Schematic of baffle distribution

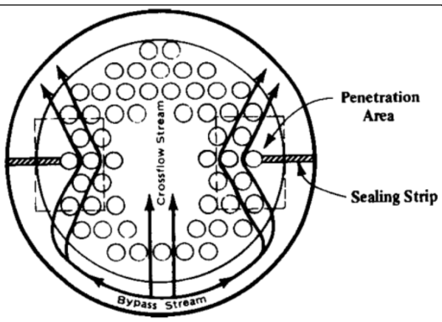


Fig. 4 Typical flow pattern in by pass stream with sealing strips (N_{ss}=1)

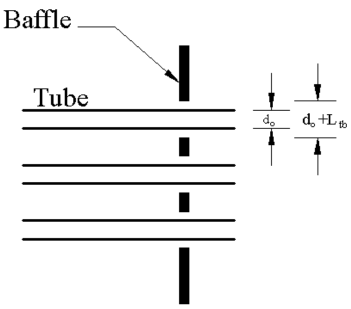


Fig. 5 Tube baffle clearance

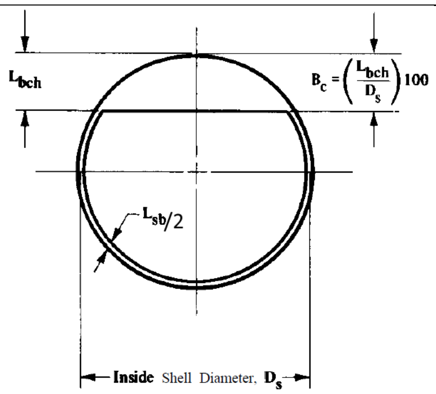


Fig. 6 Baffle cut and baffle shell clearance

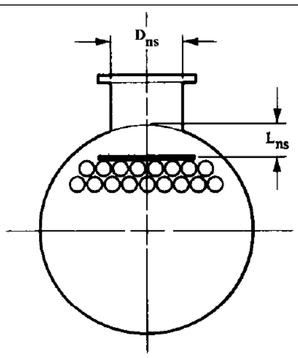


Fig. 7 Impingement plate arrangement

Table 2 Item 18 CB tube bundel construction
Item 18: CB (code), tube bundle construction types. The shell-side calculation method as presented here will handle the following tube bundle types (TEMA Standards). Only brief description is included here for convenience. For illustrative drawings and additional comments, see Sec. 4.2. 1. Fixed tubesheet, code FX 2. U-tube bundles, code UT 3. Split-ring floating-head bundle, code SRFH 4. Packed floating-head bundle, code PFH 5. Pull-through floating-head bundle, code PTFH The main effect the bundle construction type has on the shell-side calculations is the bypass clearance between the shell inside diameter and the tube bundle-
tube field circumscribed circle D_{otl} (see item 21). The main characteristics of the tube bundle construction types are briefly summarized below, reflecting selection from several aspects. UT is the least expensive construction, as it needs only one tubesheet and is the best for tube expansion requirements. Only an even number of tube passes is possible. Mechanical tube-side cleaning in U bends is impractical or difficult. The tube bundle is removable, and shell-side mechanical cleaning is possible. Replacement of defective tubes cannot be made. FX is the next least expensive construction, but it is limited by tube expansion requirements (expansion bellows); it needs two tubesheets. Only chemical cleaning of the shell side is possible. Replacement of defective tubes is easy. SRFH is used for applications where U-tube construction is not desirable and thermal expansion excludes a fixed tubesheet. Shell-side cleaning by mechanical means is desired at infrequent intervals (complete disassembly of the rear head is necessary). More tubes per shell diameter can be accommodated than with the PTFH type; there is also much less bypass area. Defective tubes can be replaced or plugged easily. PFH is similar to SRFH except that tubesheet packing may cause problems. PTFH is used when frequent shell-side cleaning is necessary. It is the easiest type for pulling the bundle for shell-side cleaning, at the sacrifice of less tubes in a given shell diameter and the need for sealing strips.