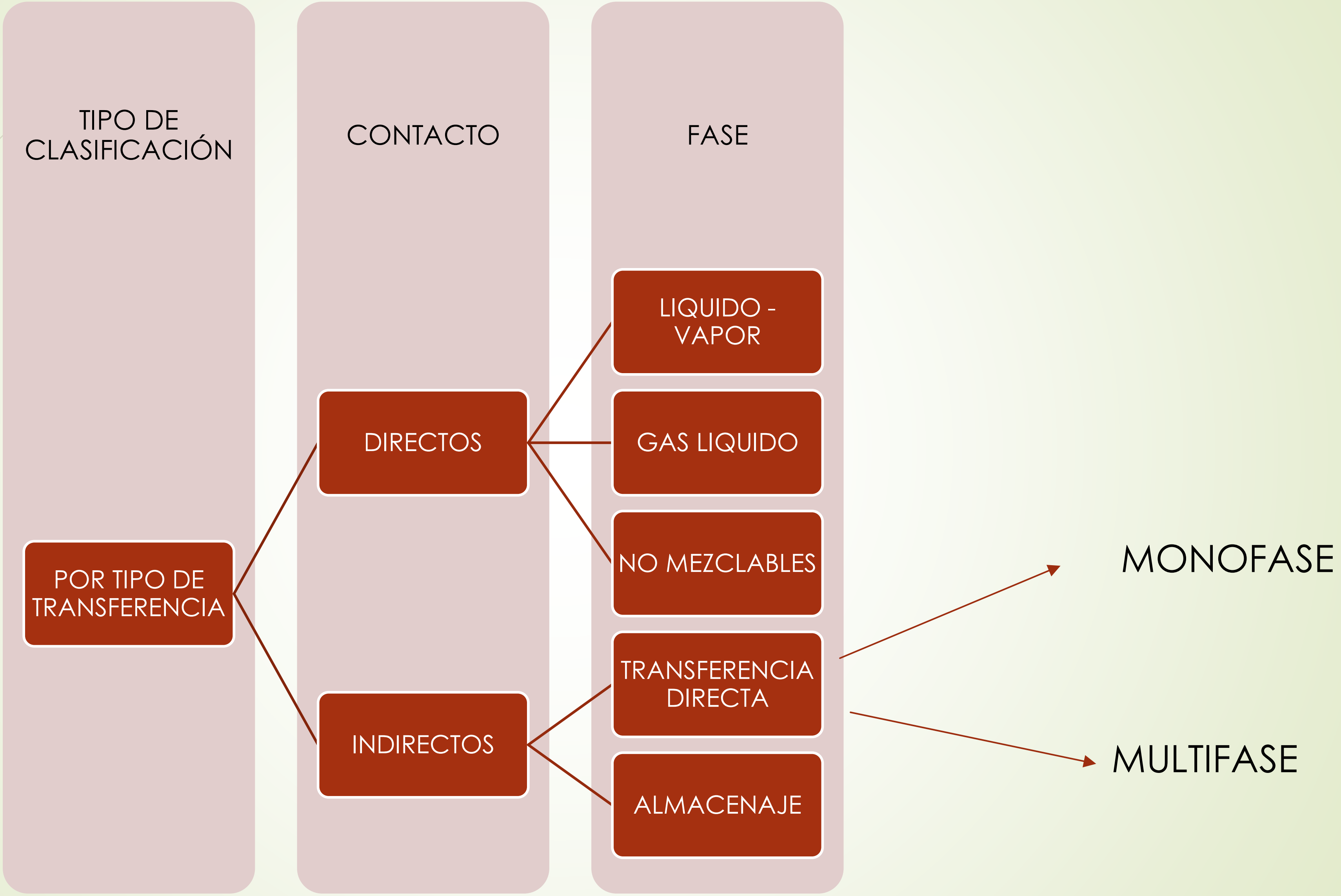
EQUIPOS E INSTALACIONES INDUSTRIALES

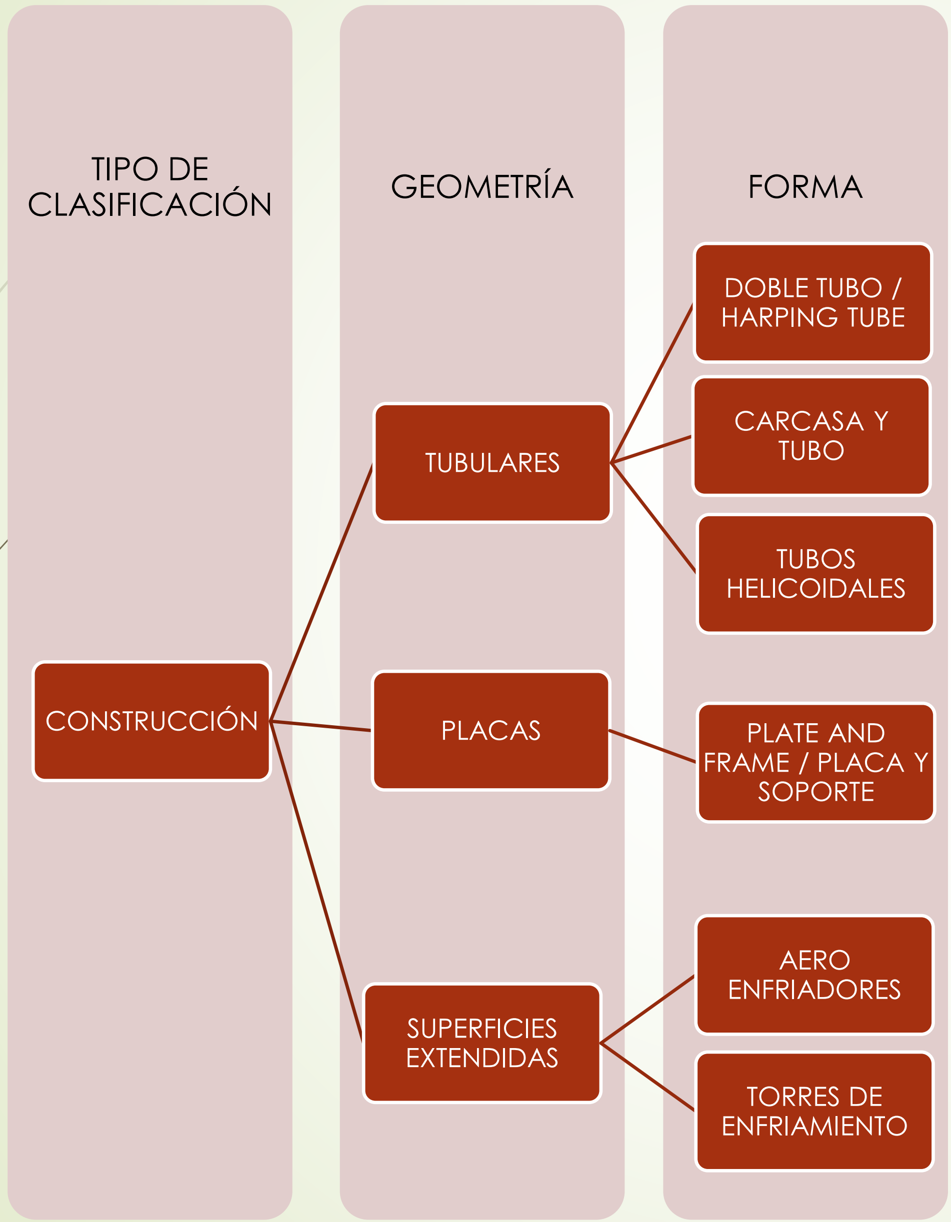
PROFESOR: ING. JORGE NOZICA
PROFESOR: ING. HÉCTOR PÉREZ
PROFESOR: ING. LETICIA SIMONCINI

INTERCAMBIADORES DE CALOR

INTERCAMBIADORES DE CALOR CLASIFICACIÓN GENERAL

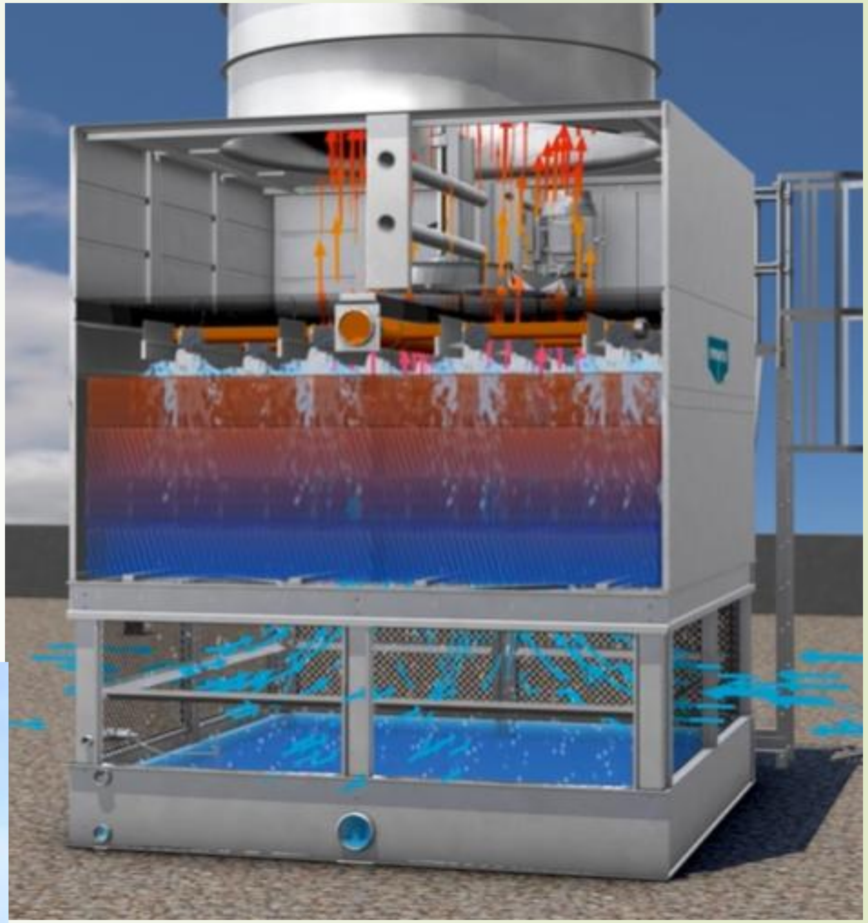


CLASIFICACIÓN DE FABRICACIÓN



CONTACTO DIRECTO

- TORRE DE ENFRIAMIENTO – COOLING TOWER

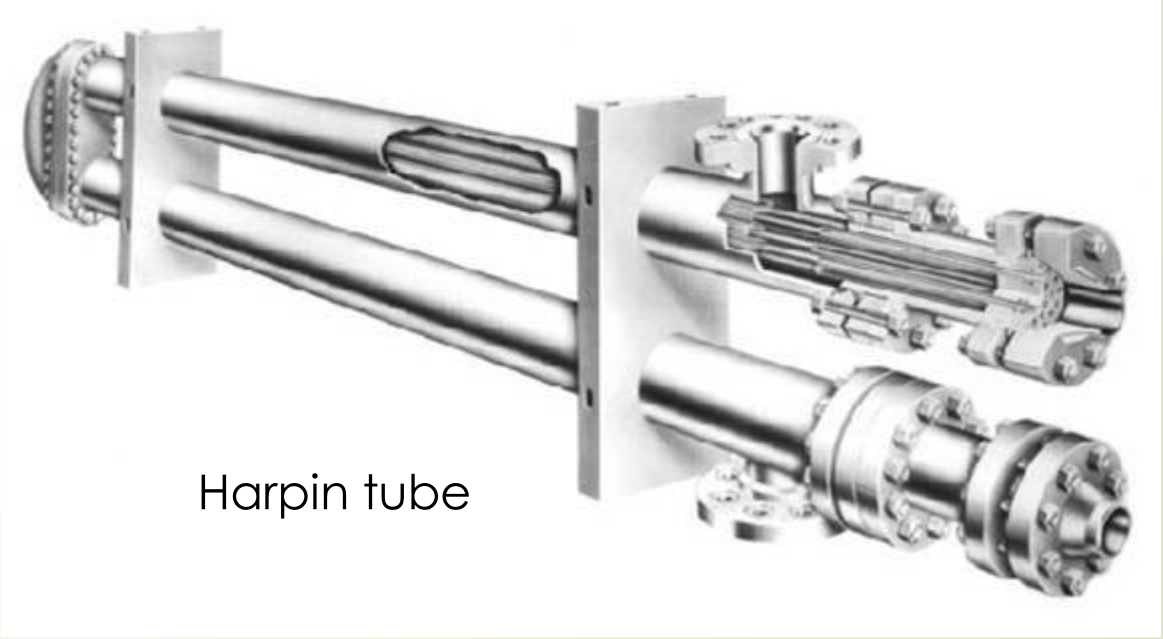


CONTACTO INDIRECTO

- AERO ENFRIADORES

INTERCAMBIADORES TUBO EN TUBO Y HARPIN TUBE

Doble ánulo



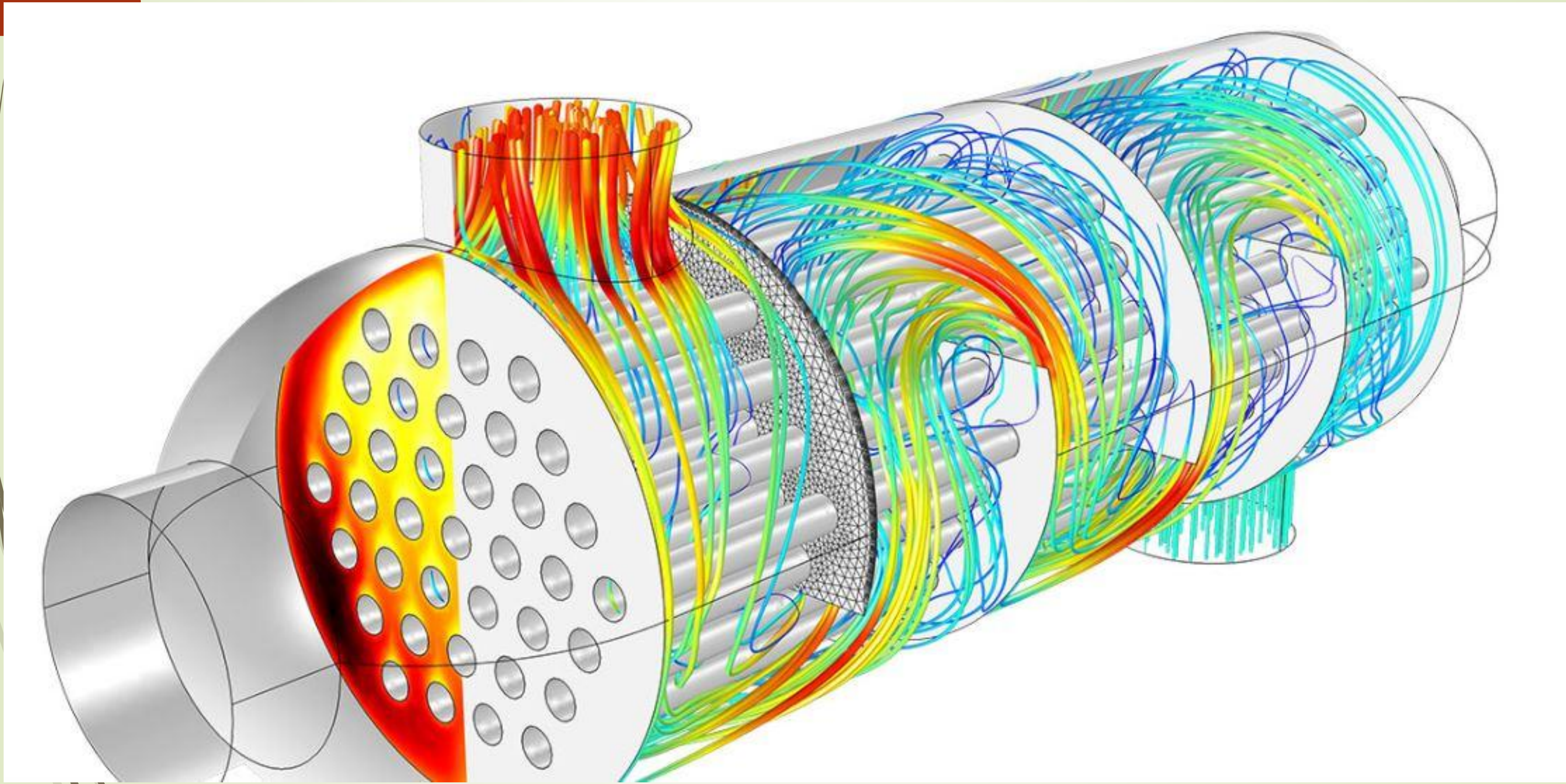
Harpin tube

INTERCAMBIADORES DE CALOR

- INTERCAMBIADOR DE CALOR

CARCASA Y TUBO (C&T)

INTERCAMBIADOR C&T



DISEÑO TÈRMICO Y DISEÑO MECÁNICO

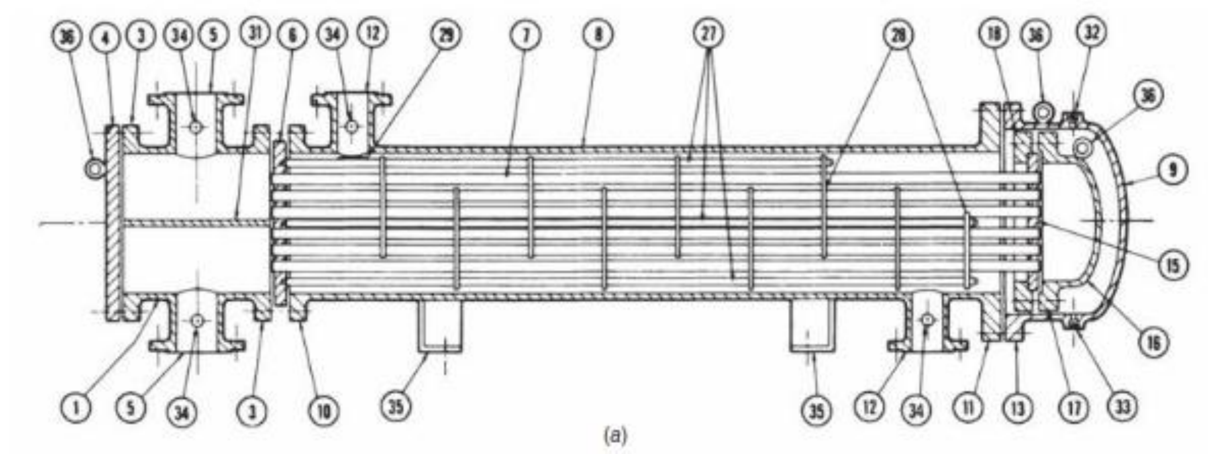
DISEÑO TÉRMICO

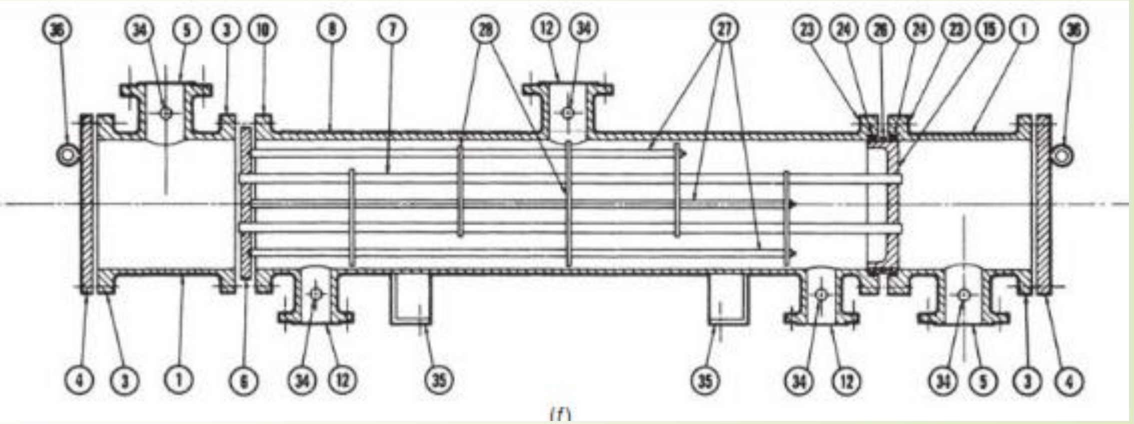
- Coeficientes peliculares (hio – ho) – función de nª adimensionales
- Coeficiente global U (tabla 11-3 / 11-4 / 11-5 Perry ‘s Chemical Engineers Handbook)
- Resistencias adicionales (fouling factors)
- Diferencia de temperatura efectiva (ΔTln)
- Área de intercambio
- Carga térmica Q = U x A x DT (kcal/h / kw)
- Pre dimensionamiento geométrico de tubos y carcasa
- Pérdida de carga
- Condiciones de operación: Temperaturas, presiones, tipo de fluidos

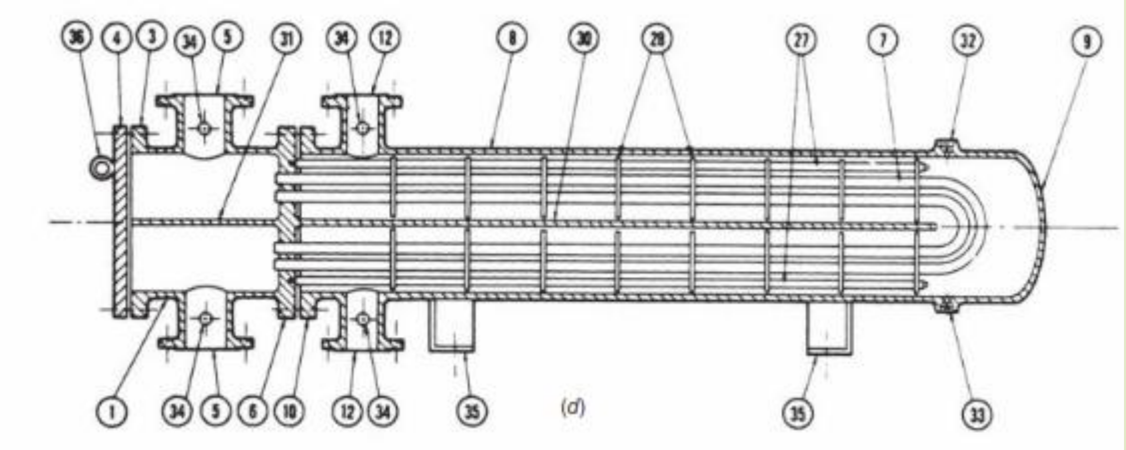
DISEÑO TÈRMICO Y DISEÑO MECÁNICO

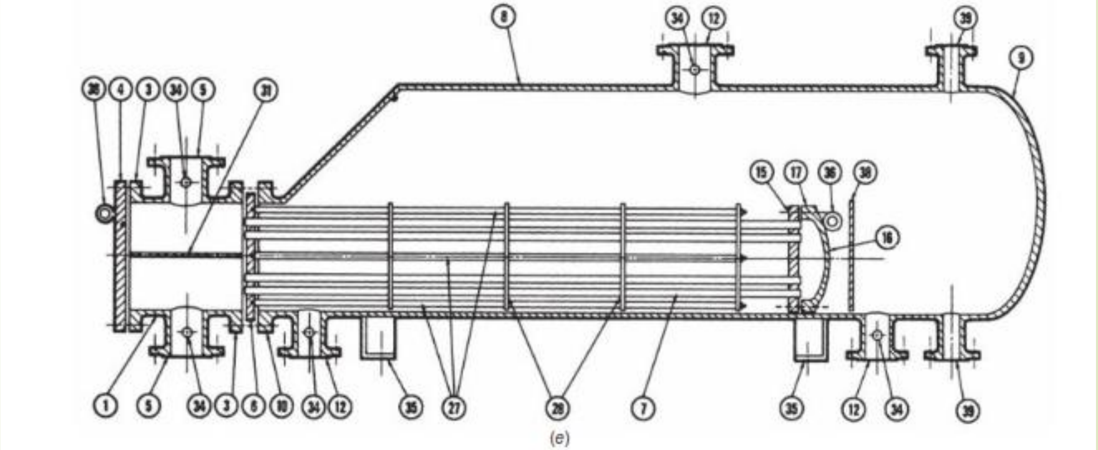
- DISEÑO MECÁNICO
  - Espesores de carcasa
  - Verificación de tubos (tabla 11-12 Perry's Chemical Engineers Handbook)
  - Tube sheet (placa porta tubos)
  - Bafles
  - Bridas
  - Pernos
  - Aislación

NORMAS TEMA









1. Stationary Head—Channel
2. Stationary Head—Bonnet
3. Stationary Head Flange—Channel or Bonnet
4. Channel Cover
5. Stationary Head Nozzle
6. Stationary Tubesheet
7. Tubes
8. Shell
9. Shell Cover
10. Shell Flange—Stationary Head End
11. Shell Flange—Rear Head End
12. Shell Nozzle
13. Shell Cover Flange
14. Expansion Joint
15. Floating Tubesheet
16. Floating Head Cover
17. Floating Head Flange
18. Floating Head Backing Device
19. Split Shear Ring
20. Slip-on Backing Flange
21. Floating Head Cover—External
22. Floating Tubesheet Skirt
23. Packing Box Flange
24. Packing
25. Packing Gland
26. Lantern Ring
27. Tie Rods and Spacers
28. Transverse Baffles or Support Plates
29. Impingement Plate
30. Longitudinal Baffle
31. Pass Partition
32. Vent Connection
33. Drain Connection
34. Instrument Connection
35. Support Saddle
36. Lifting Lug
37. Support Bracket
38. Weir
39. Liquid Level Connection

Alcance y Nomenclatura de Norma TEMA

- DIÁMETRO DE CARCASA 100” (2540mm)
- Pd < 3000 psi (210 bar)
- Espesor de carcasa 3” (76mm)

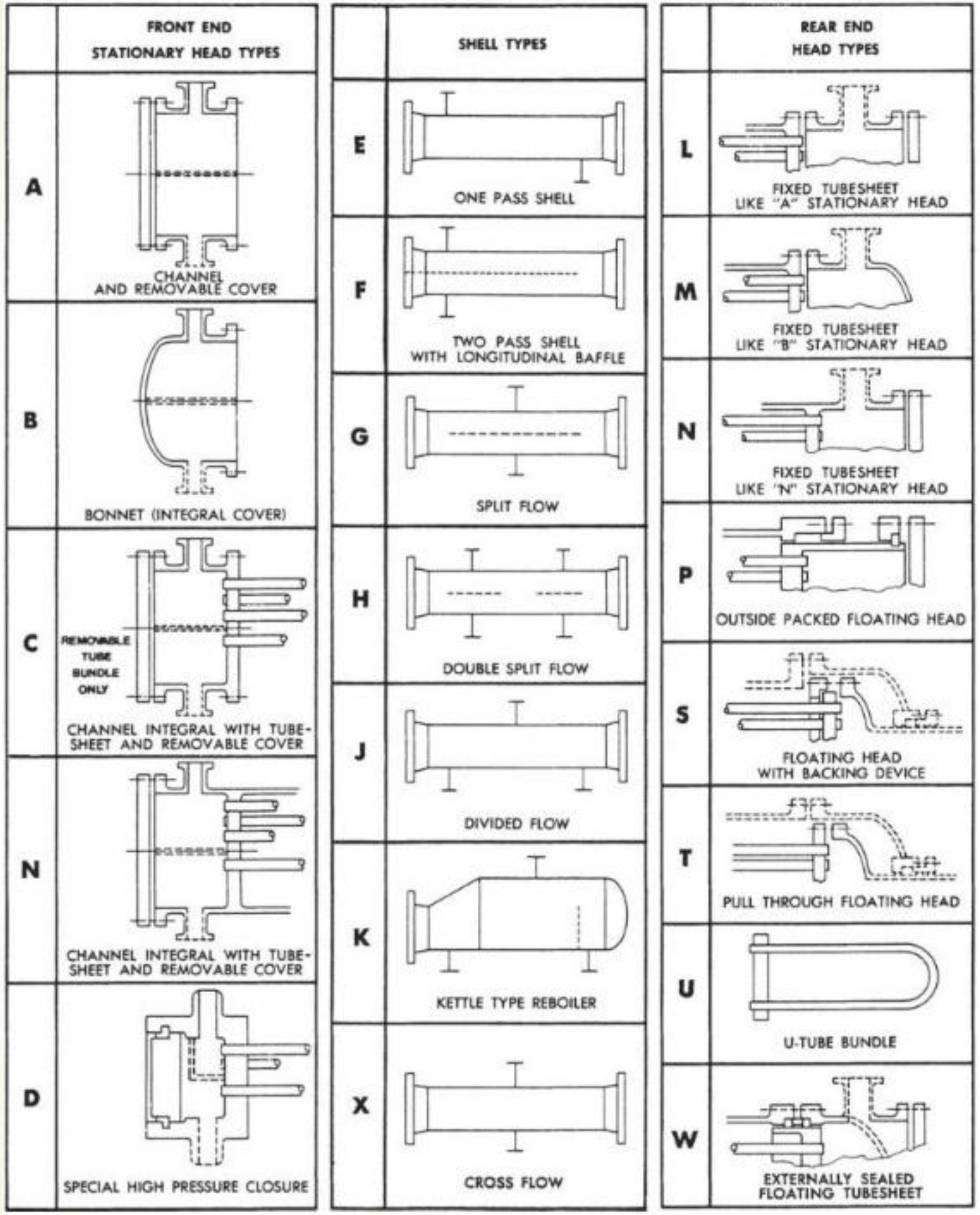
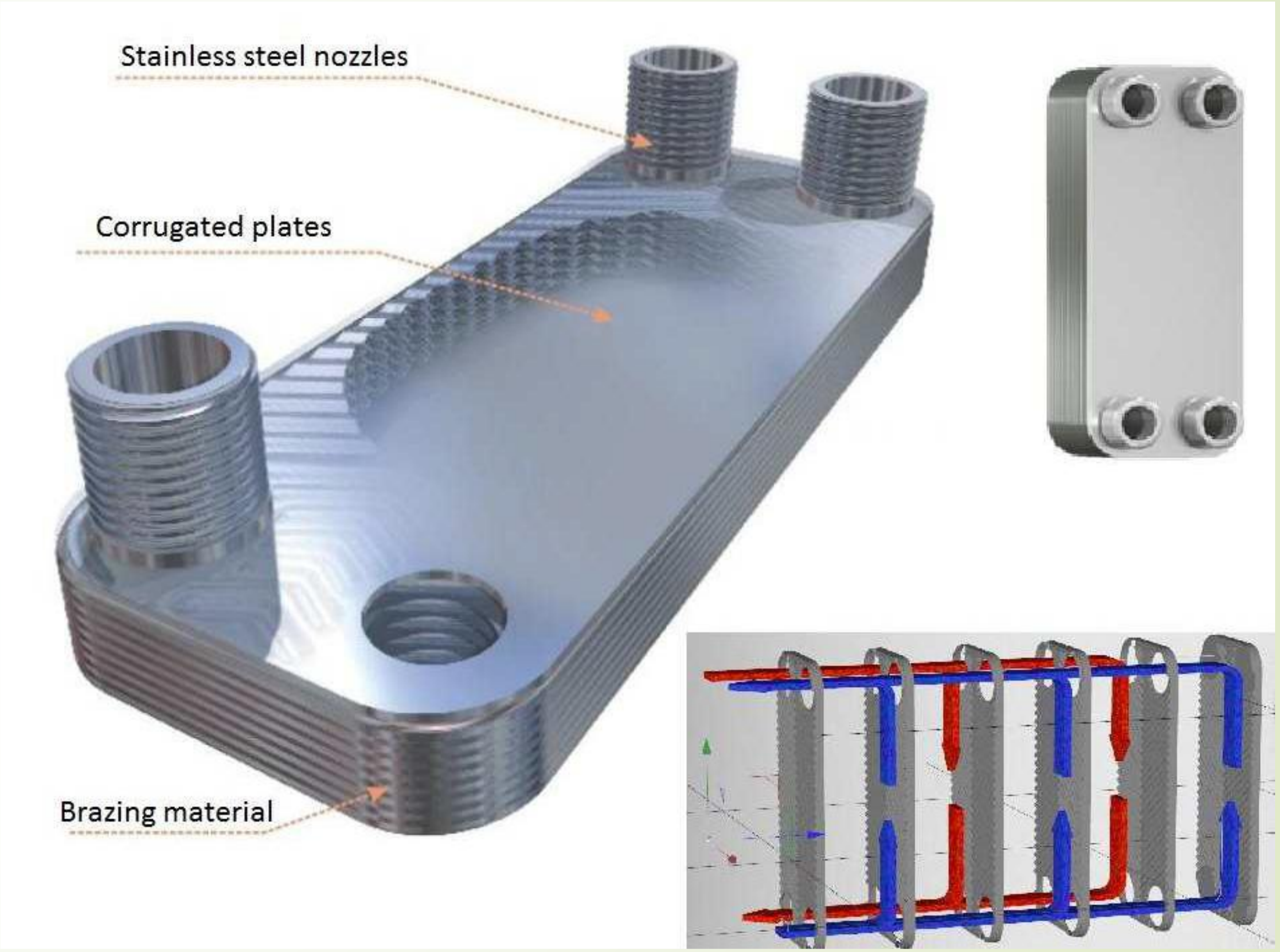


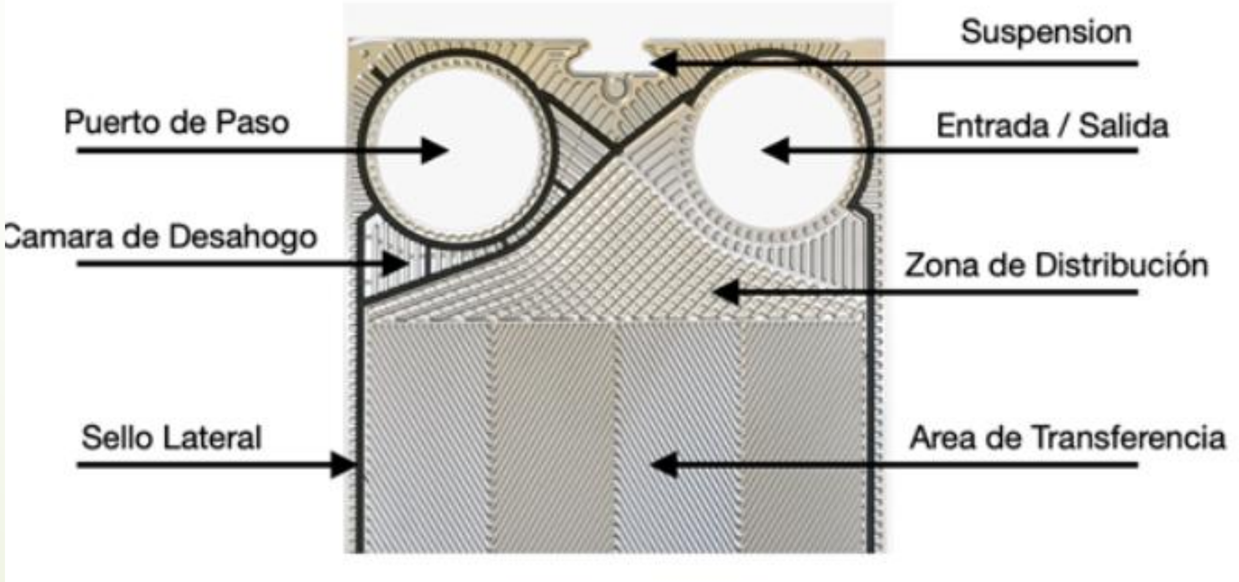
FIG. 11-35 TEMA-type designations for shell-and-tube heat exchangers. (*Standards of Tubular Exchanger Manufacturers Association, 6th ed., 1978.*)

INTERCAMBIADORES A PLACAS

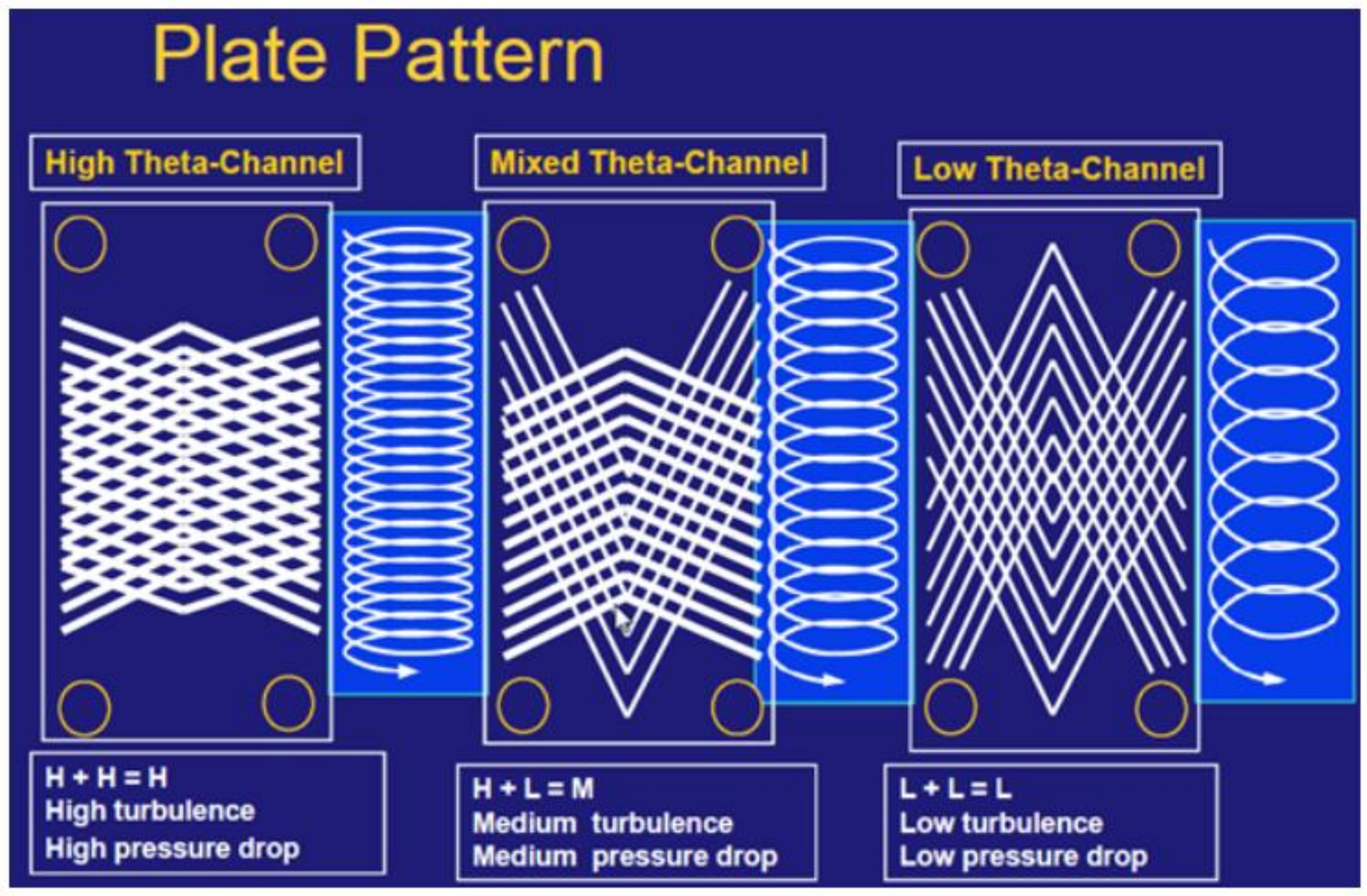


https://www.youtube.com/watch?v=2ydy48AKd8c

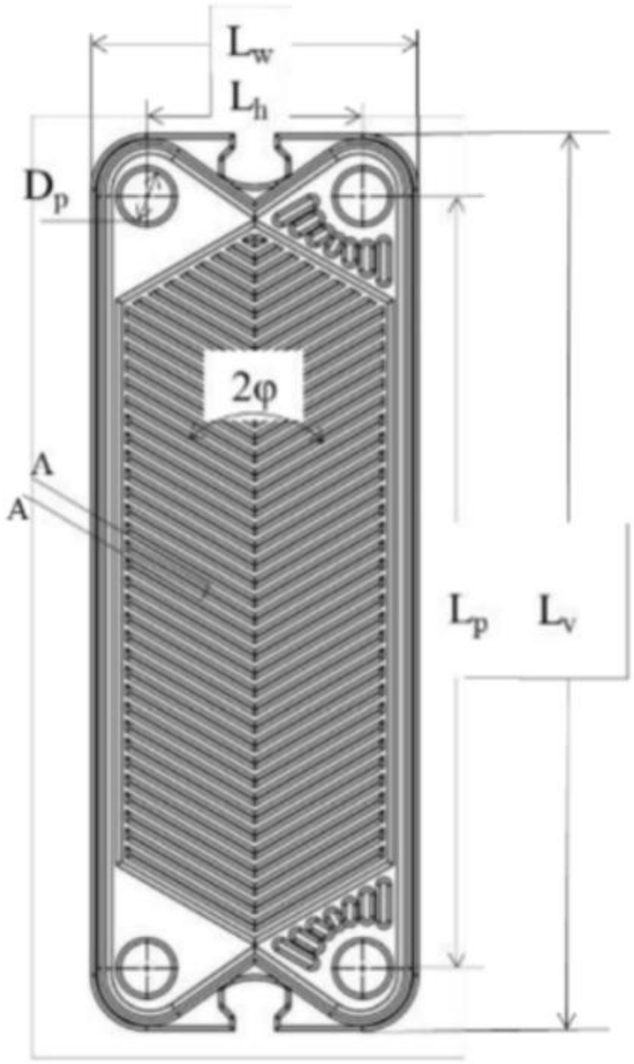
Principios


Suspension
Puerto de Paso
Entrada / Salida
Camara de Desahogo
Zona de Distribución
Sello Lateral
Area de Transferencia

Patrones de flujo



Especificaciones



Medidas de la placa

Distancia Horizontal entre puertos (Lh)= _______________ mm

Distancia Vertical entre puertos (Lp)= _______________ mm

Longitud de la placa (Lv)= _______________ mm

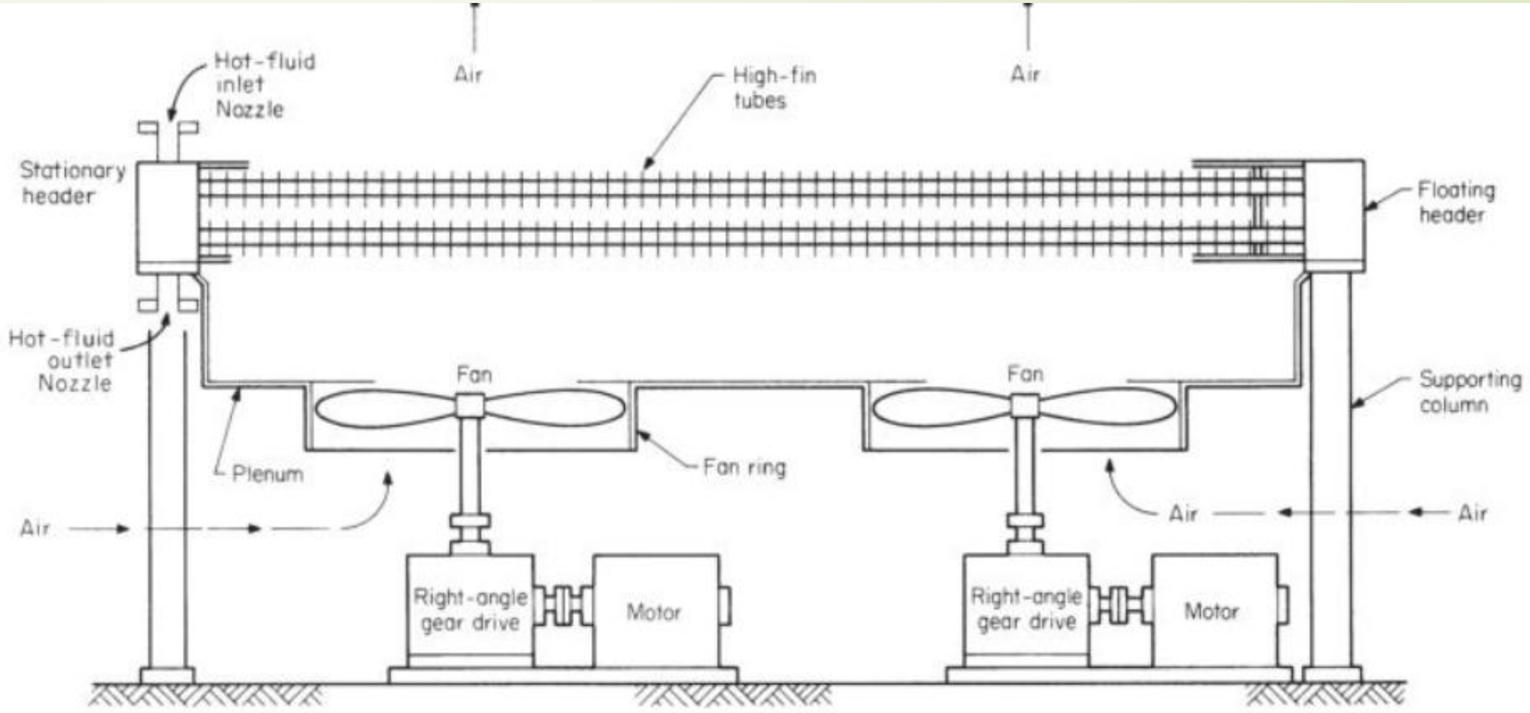
Ancho de la placa (Lw)= _______________ mm

Diámetro del puerto (Dp)=. _______________ mm

Aero enfriadores

- Superficies extendidas finas
- Coeficientes peliculares muy disímiles

$hoAoe \approx hiAi$



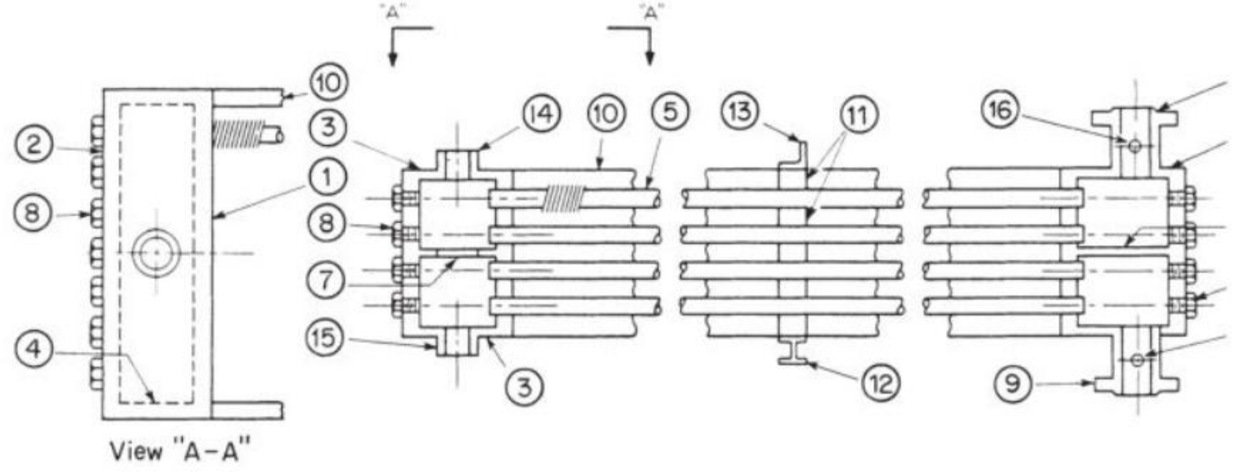


FIG. 11-44 Typical construction of a tube bundle with plug headers: (1) tube sheet; (2) plug sheet; (3) top and bottom plates; (4) end plate; (5) tube; (6) pass partition; (7) stiffener; (8) plug; (9) nozzle; (10) side frame; (11) tube spacer; (12) tube-support cross member; (13) tube keeper; (14) vent; (15) drain; (16) instrument connection. (*API Standard 661.*)

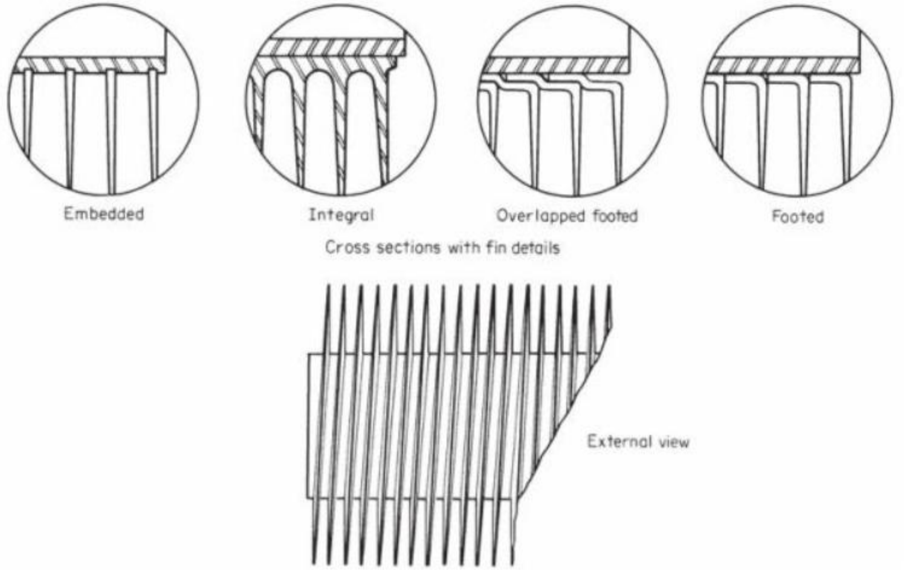
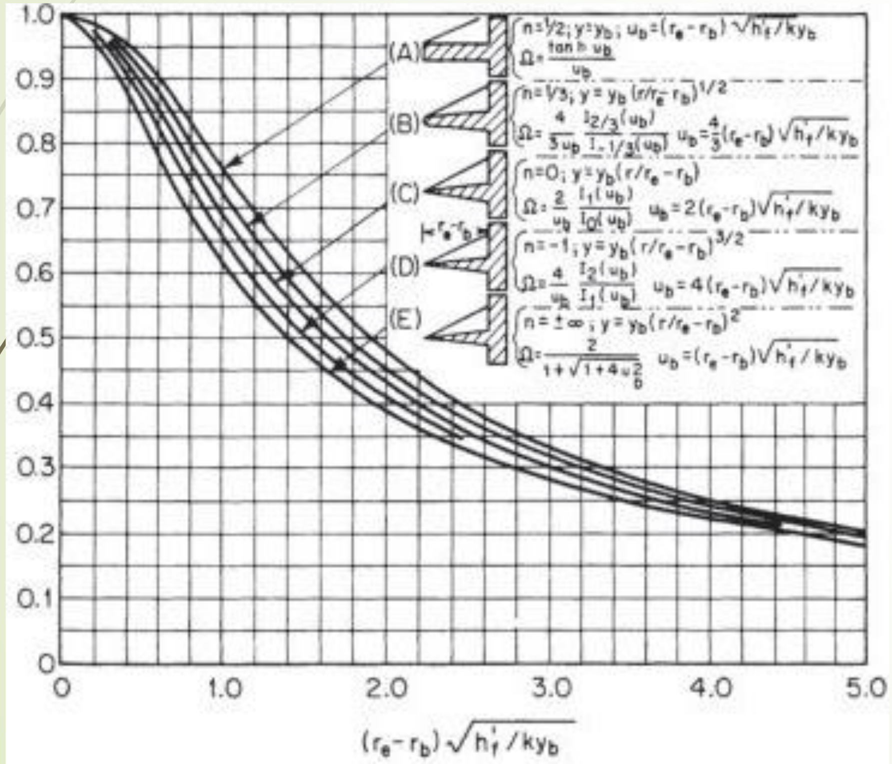
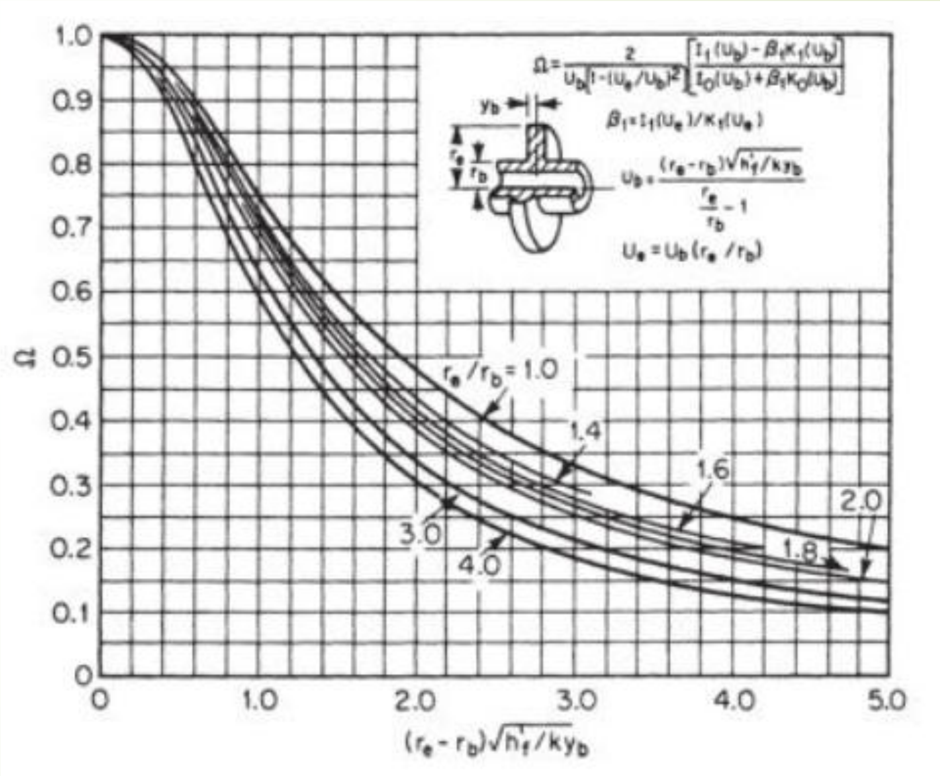


FIG. 11-45 Finned-tube construction.

$$A_{oe} = A_{uf} + A_f \Omega$$

Aoe: área efectiva de transferencia total
Auf: árae de transferencia de tubo liso
Af: área de aletas
Ω: eficiencia de aleta





$Q = U \times Aoe \times \Delta T$ efectivo
$\Delta Te = \Delta Tln \times f$
F= factor de corrección de diferencia de temperatura (ajuste a modelo de flujo)
F=0,91 1 paso
F=0,96 2 pasos
F=0,99 3 pasos (Perry's)

TABLE 11-5 Overall Coefficients for Air-Cooled Exchangers on Bare-Tube Basis

Btu/(°F · ft² · h)

Condensing	Coefficient	Liquid cooling	Coefficient
Ammonia	110	Engine-jacket water	125
Freon-12	70	Fuel oil	25
Gasoline	80	Light gas oil	65
Light hydrocarbons	90	Light hydrocarbons	85
Light naphtha	75	Light naphtha	70
Heavy naphtha	65	Reformer liquid streams	70
Reformer reactor effluent	70	Residuum	15
Low-pressure steam	135	Tar	7
Overhead vapors	65		

Gas cooling	Operating pressure, lb./sq. in. gage	Pressure drop, lb./sq. in.	Coefficient
Air or flue gas	50	0.1 to 0.5	10
	100	2	20
	100	5	30
Hydrocarbon gas	35	1	35
	125	3	55
	1000	5	80
Ammonia reactor stream			85

Bare-tube external surface is 0.262 ft²/ft.
Fin-tube surface/bare-tube surface ratio is 16.9.
To convert British thermal units per hour-square foot-degrees Fahrenheit to joules per square meter-second-kelvins, multiply by 5.6783; to convert pounds-force per square inch to kilopascals, multiply by 6.895.