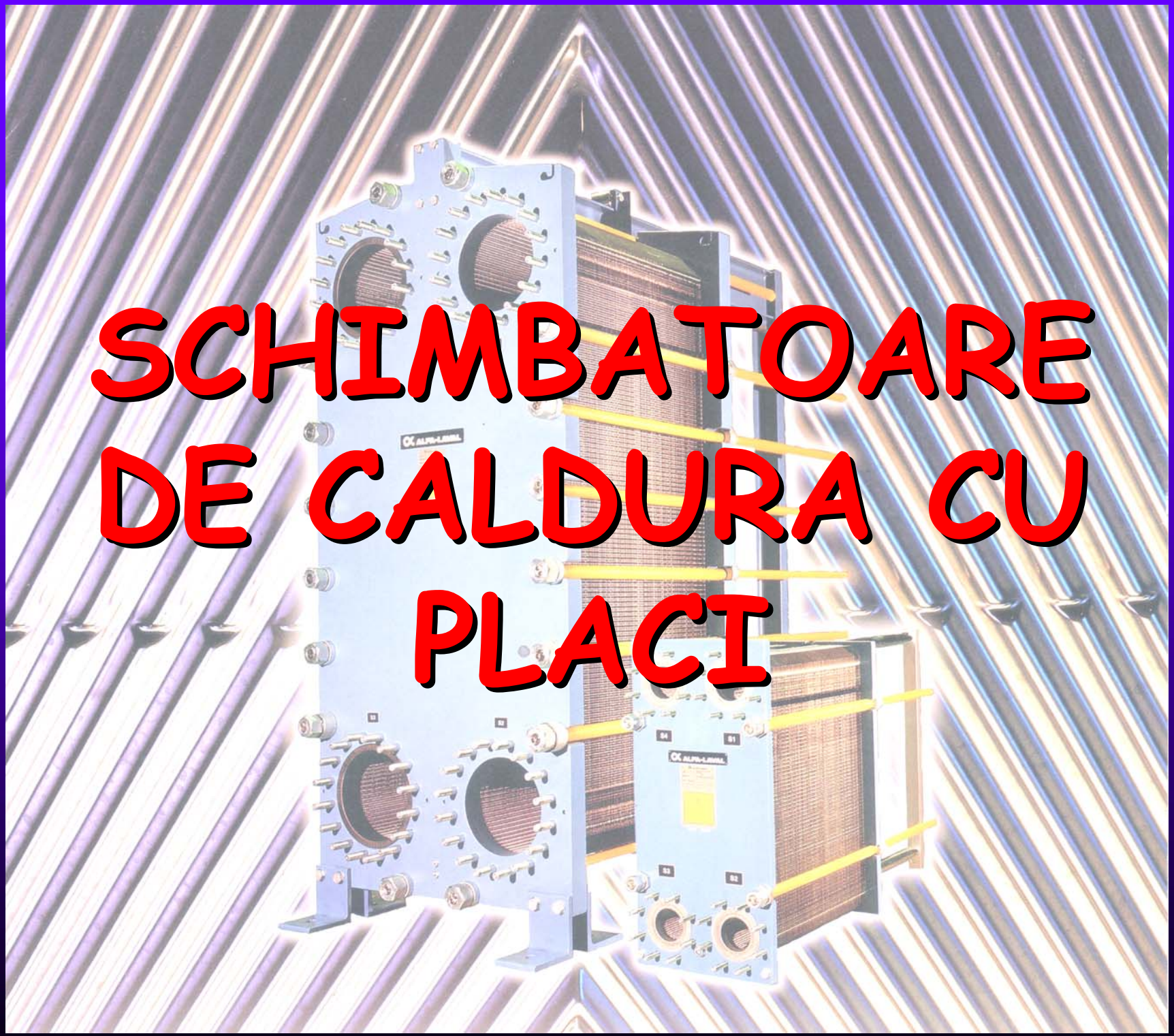
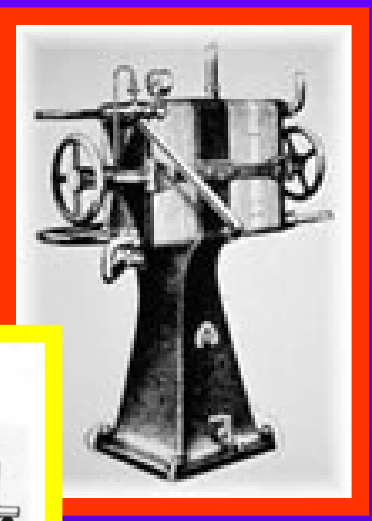
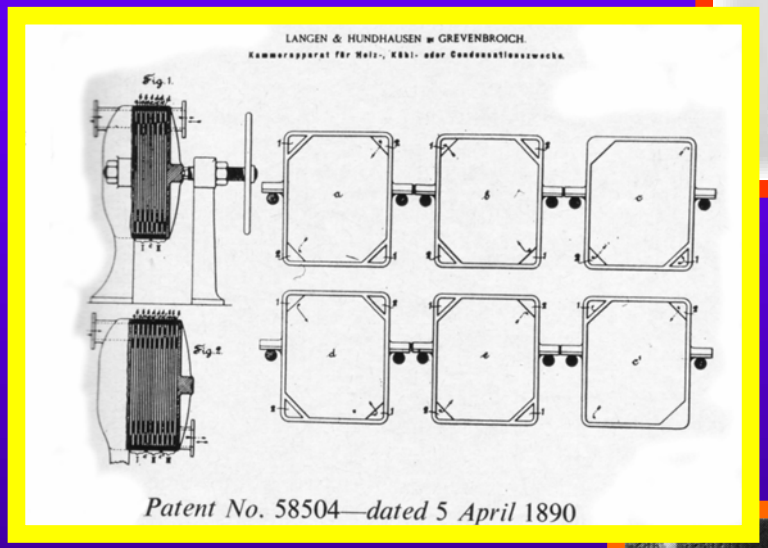


SCHIMBATOARE DE CALDURA CU PLACI

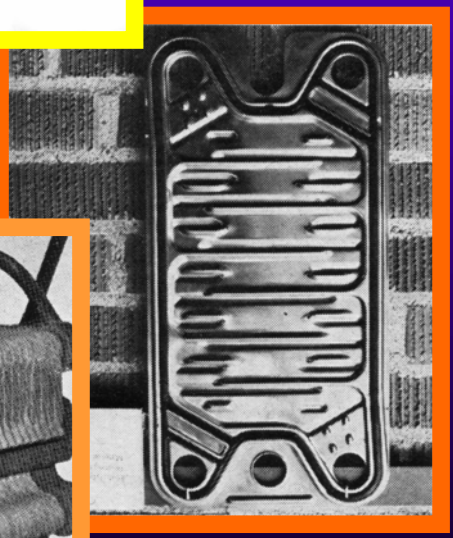
SCHIMBATOARE DE CALDURA CU PLACI

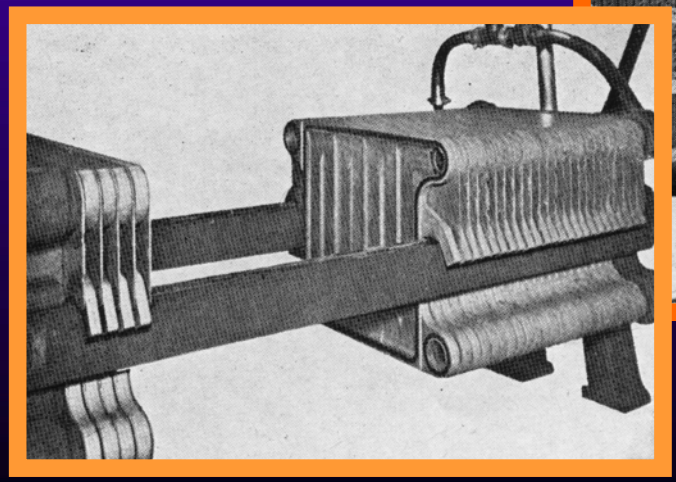
- Concept datand de la sfarsitul sec. XIX;
- Propuse initial pentru necesitatile industriei laptelui;
- 1923 – comercializarea industriala a SCP de catre Richard Seligman, fondatorul APV Int.
- 1930 – primele placi din otel inoxidabil;
- Limitate la 2 bar si 60°C





Patent No. 58504—dated 5 April 1890





SCHIMBATOARE DE CALDURA CU PLACI

CLASIFICARE

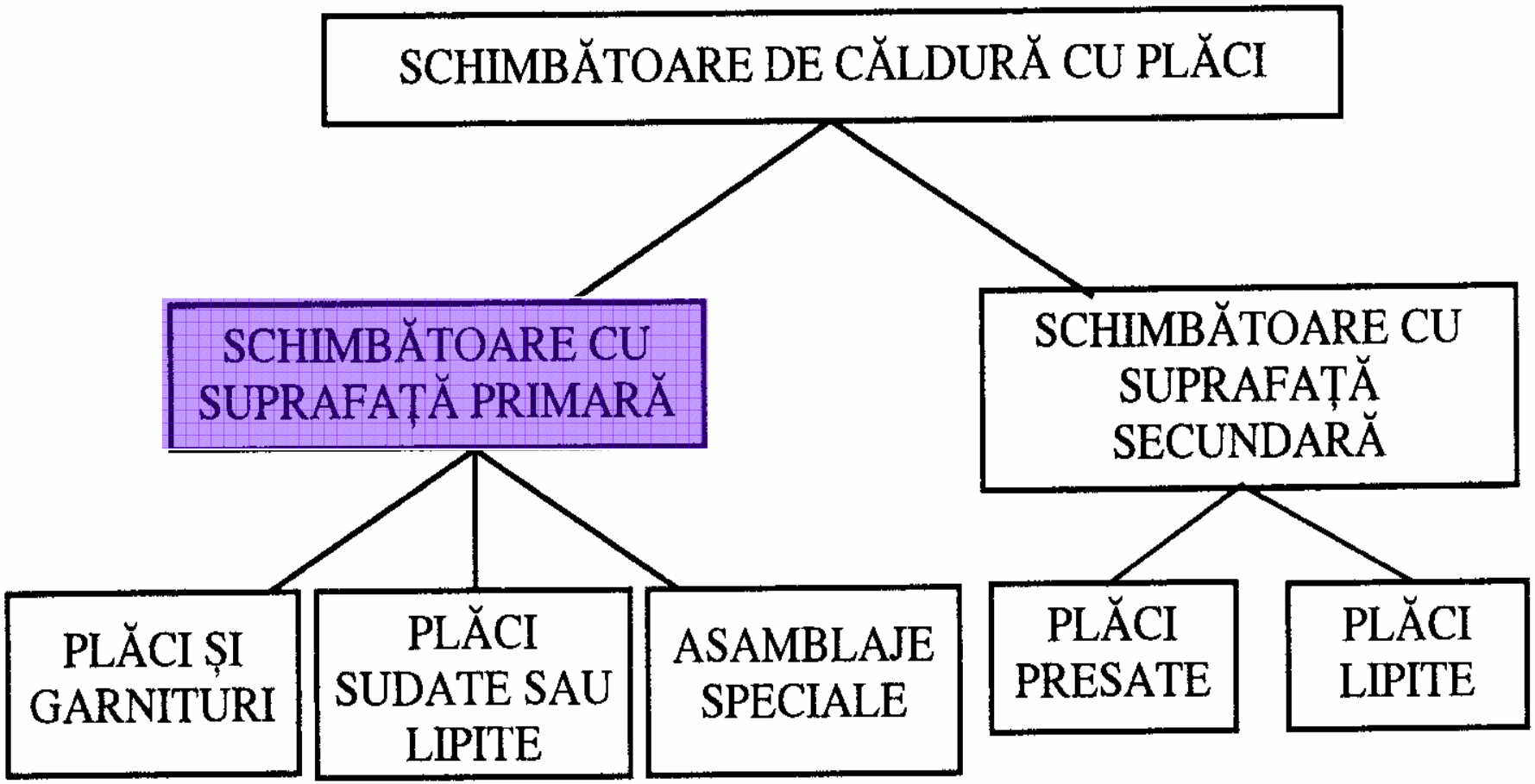
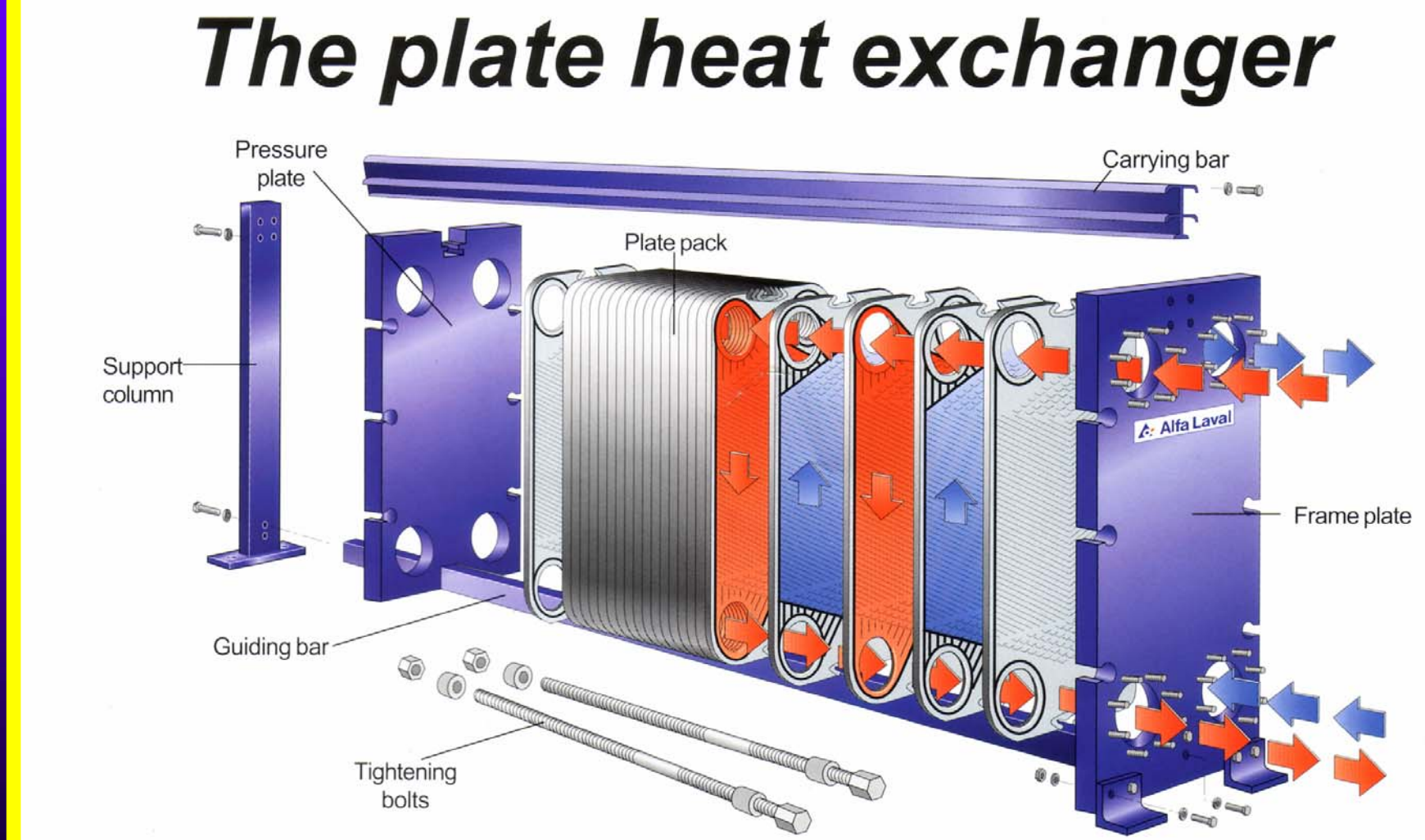


Fig. 5.1. Clasificarea schimbătoarelor cu plăci

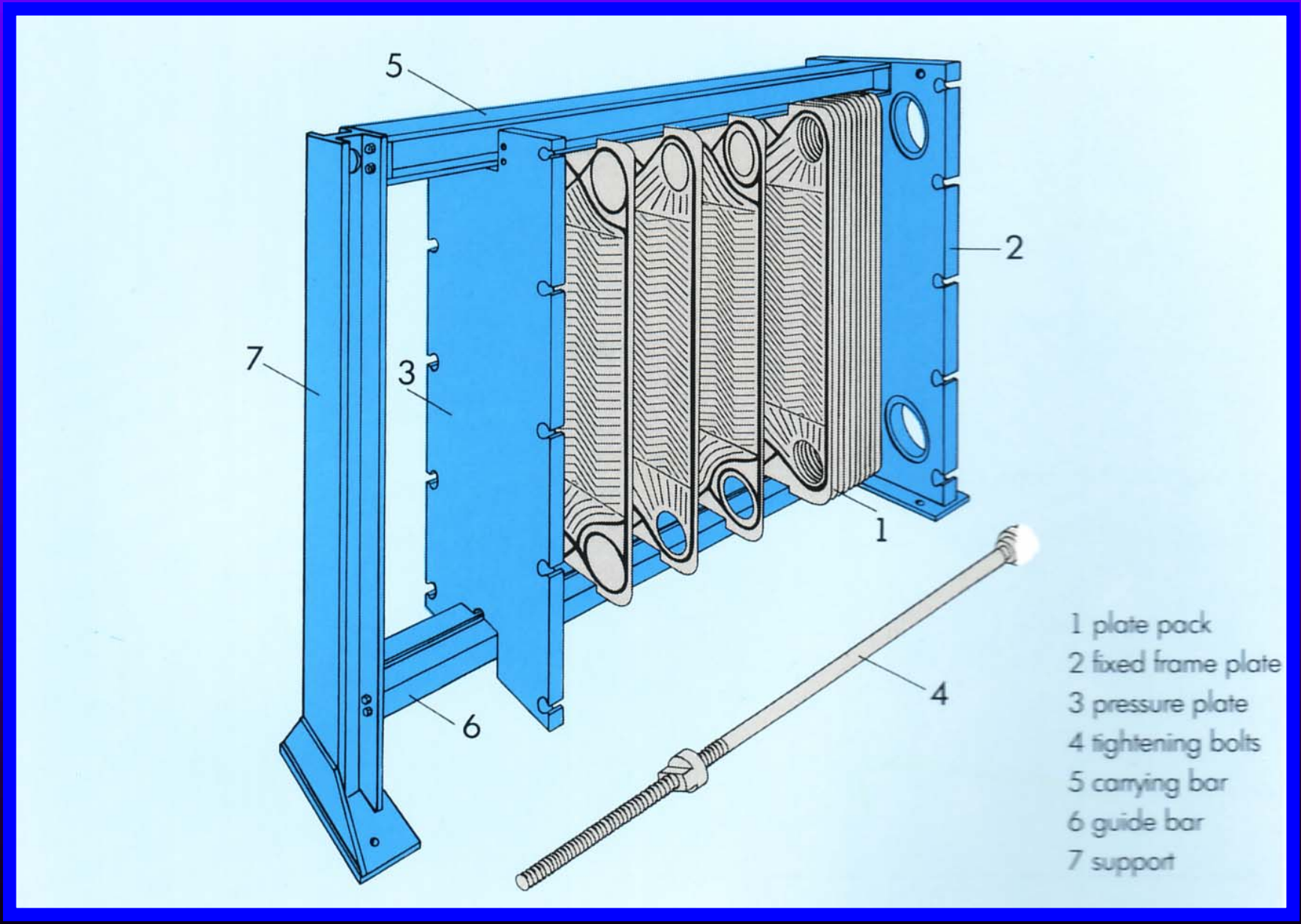
SCHIMBATOARE DE CALDURA CU PLACI

SC cu placi si garnituri: parti componente



SCHIMBATOARE DE CALDURA CU PLACI

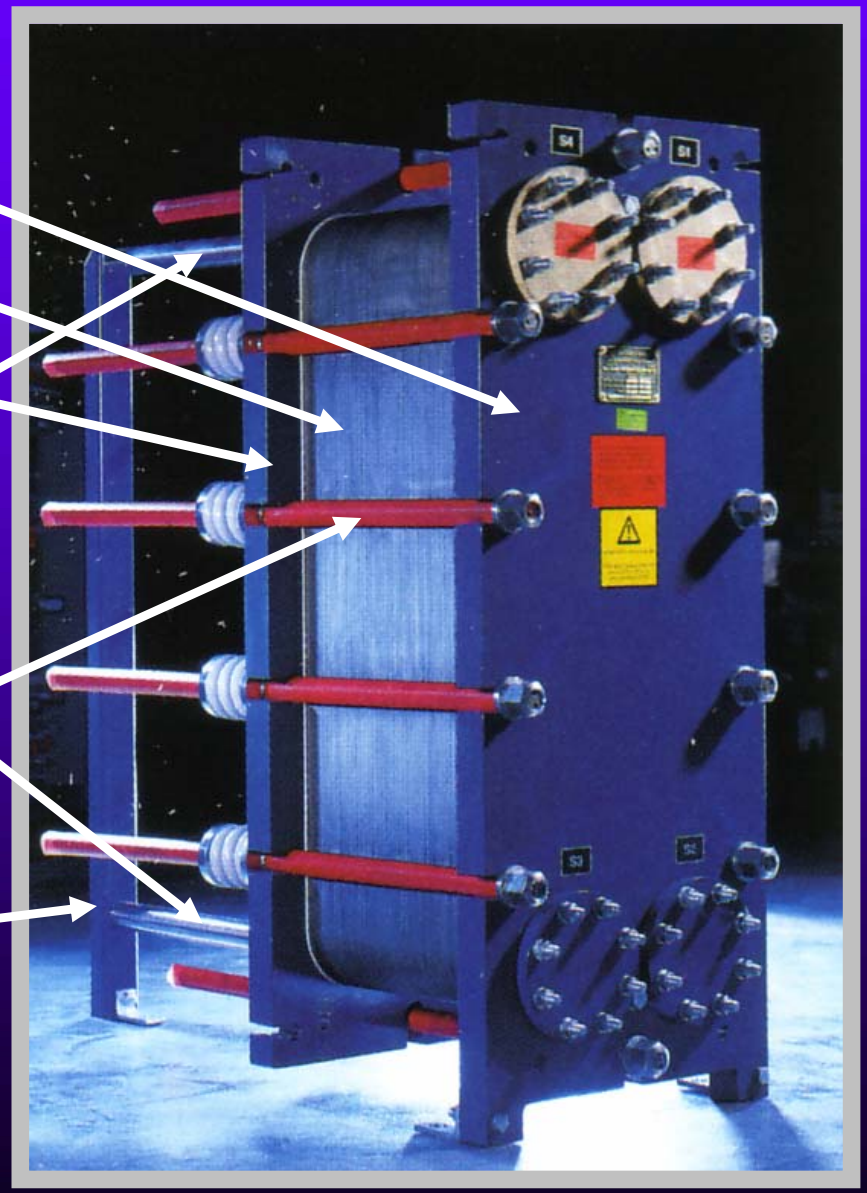
SC cu placi si garnituri: parti componente



SCHIMBATOARE DE CALDURA CU PLACI

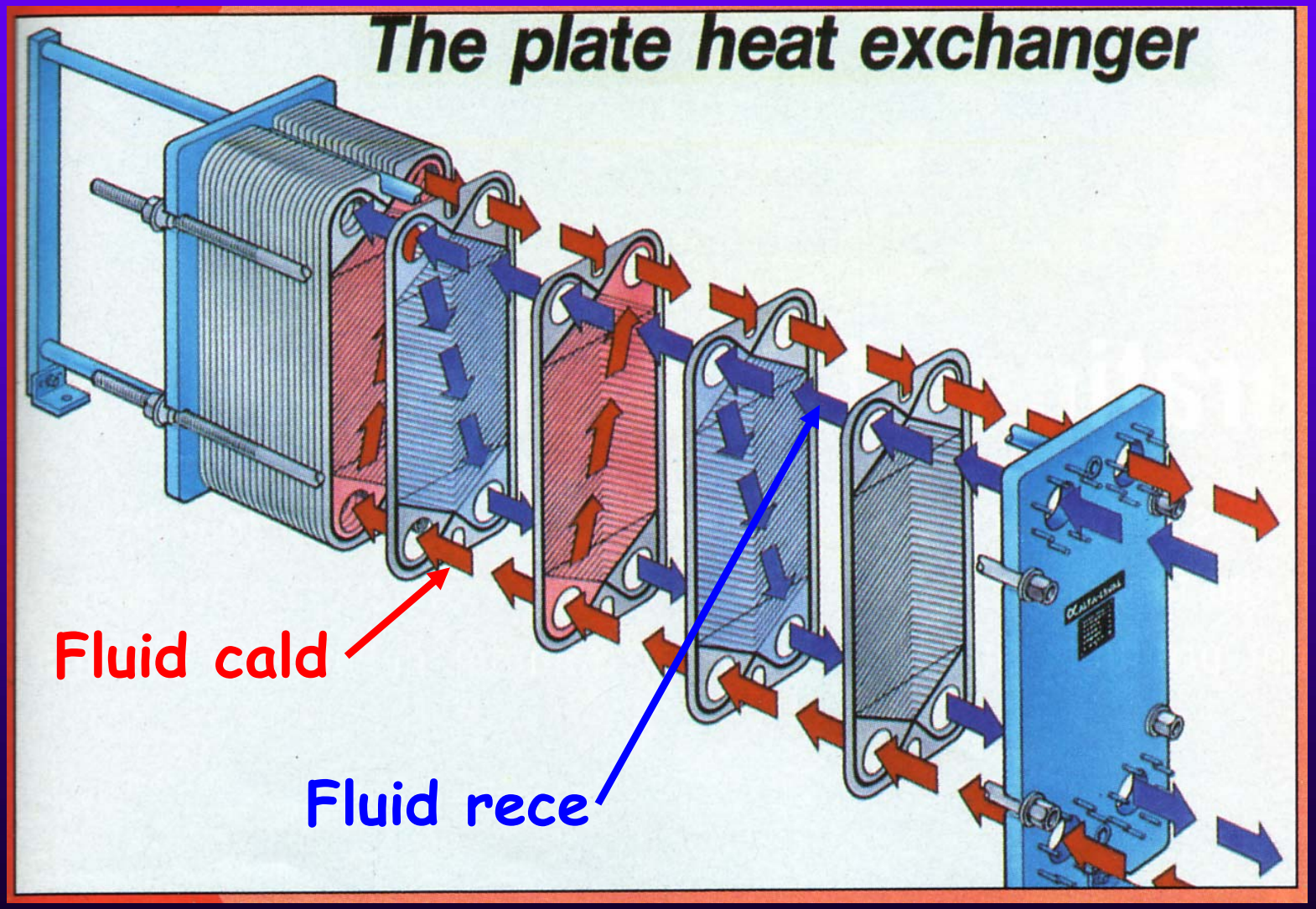
SC cu placi si garnituri: parti componente

- Placa fixa
- Pachetul de placi
- Placa mobila
- Bara de sustinere
- Bara de ghidaj
- Suruburi de strangere
- Suport



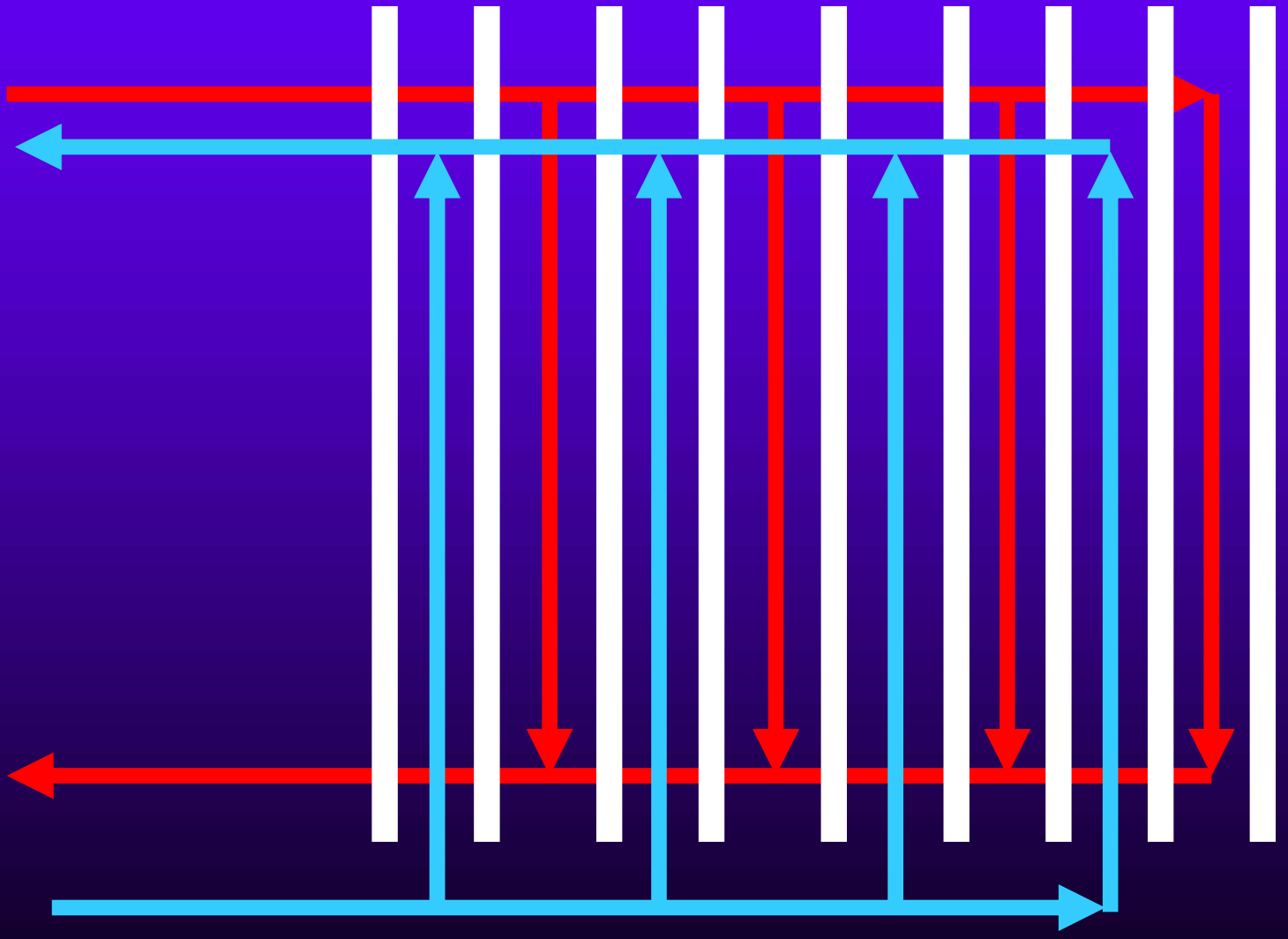
SCHIMBATOARE DE CALDURA CU PLACI

Principiu de functionare



SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de circulatie

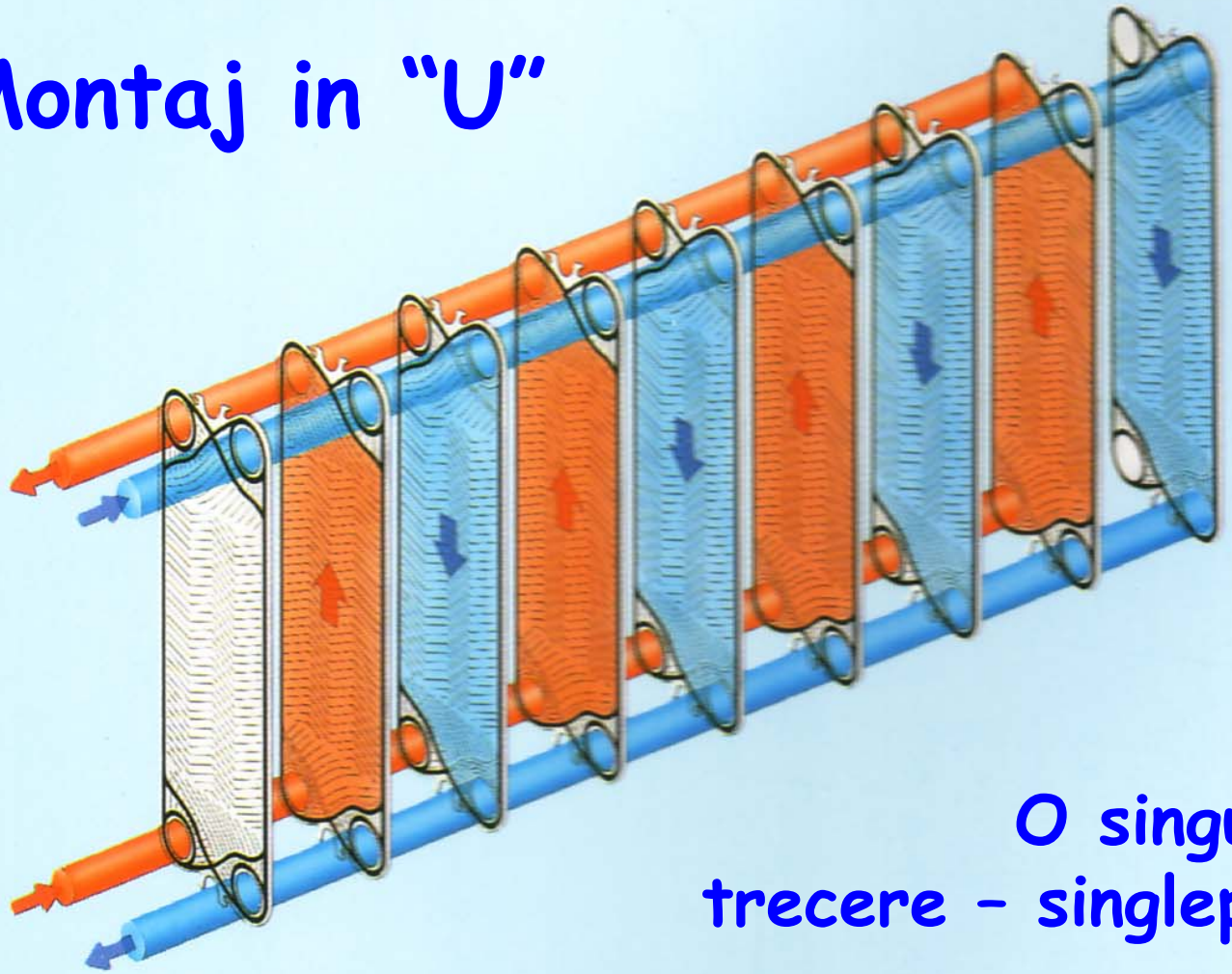


U

SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de circulatie

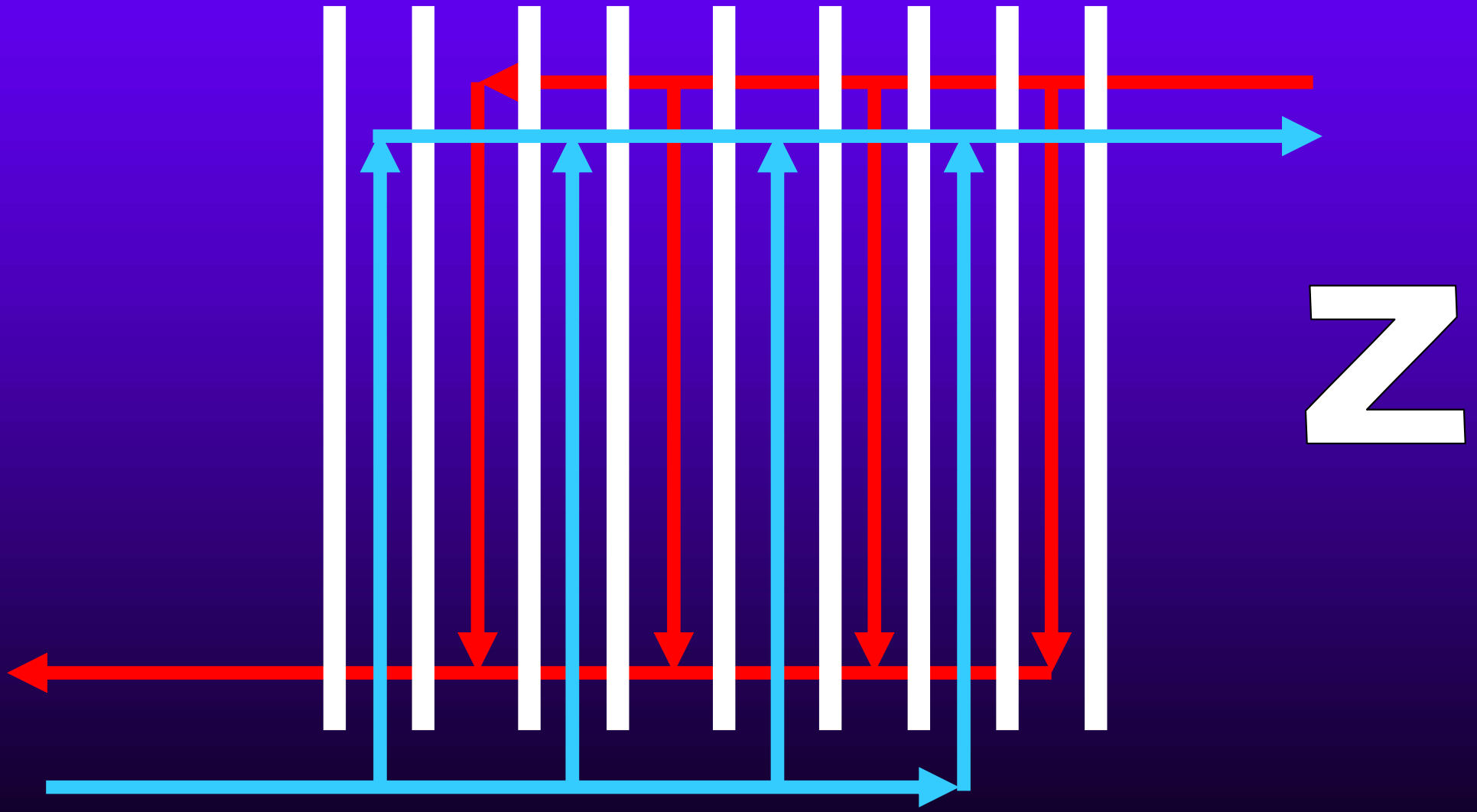
Montaj in "U"



O singura trecere – singlepass

SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de circulatie

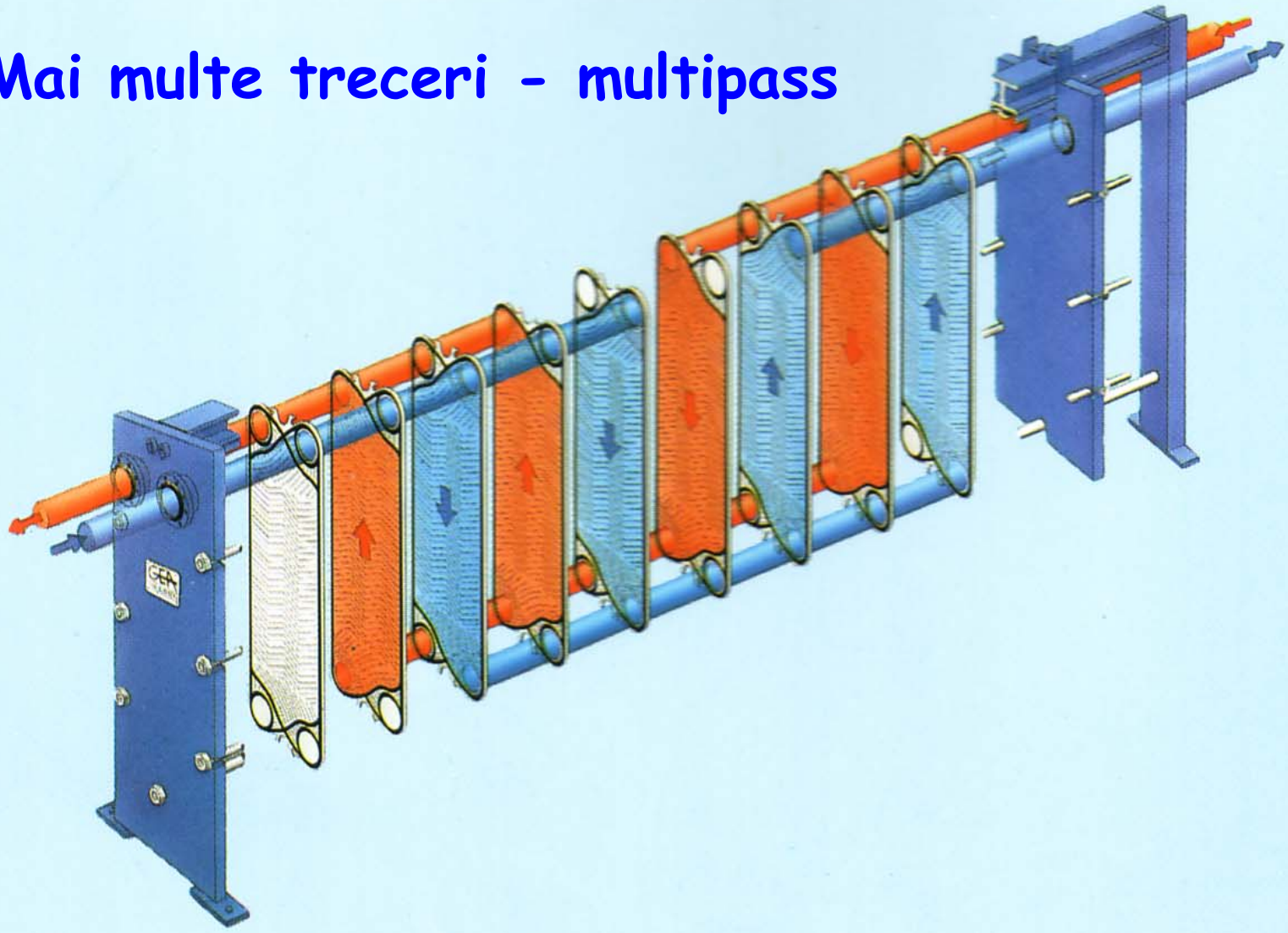


Z

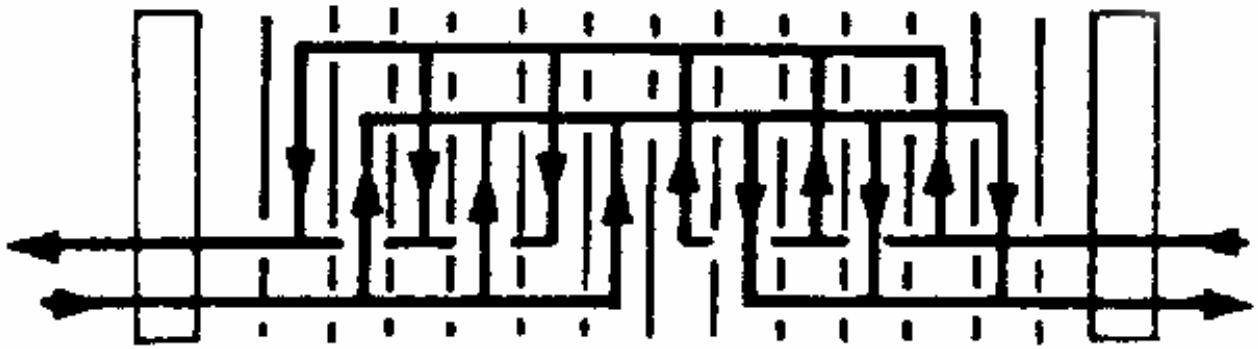
SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de circulatie

Mai multe treceri - multipass



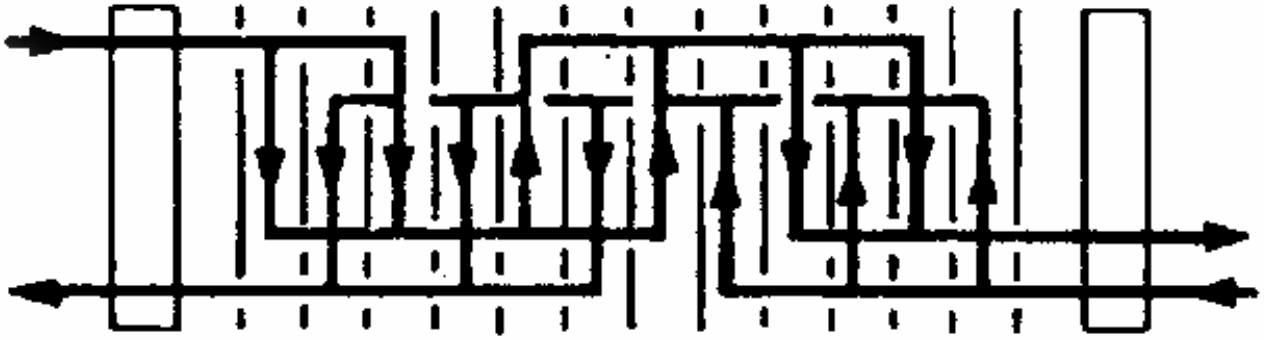
Tipuri de circulatie multipass



Numar egal de treceri pentru ambele fluide

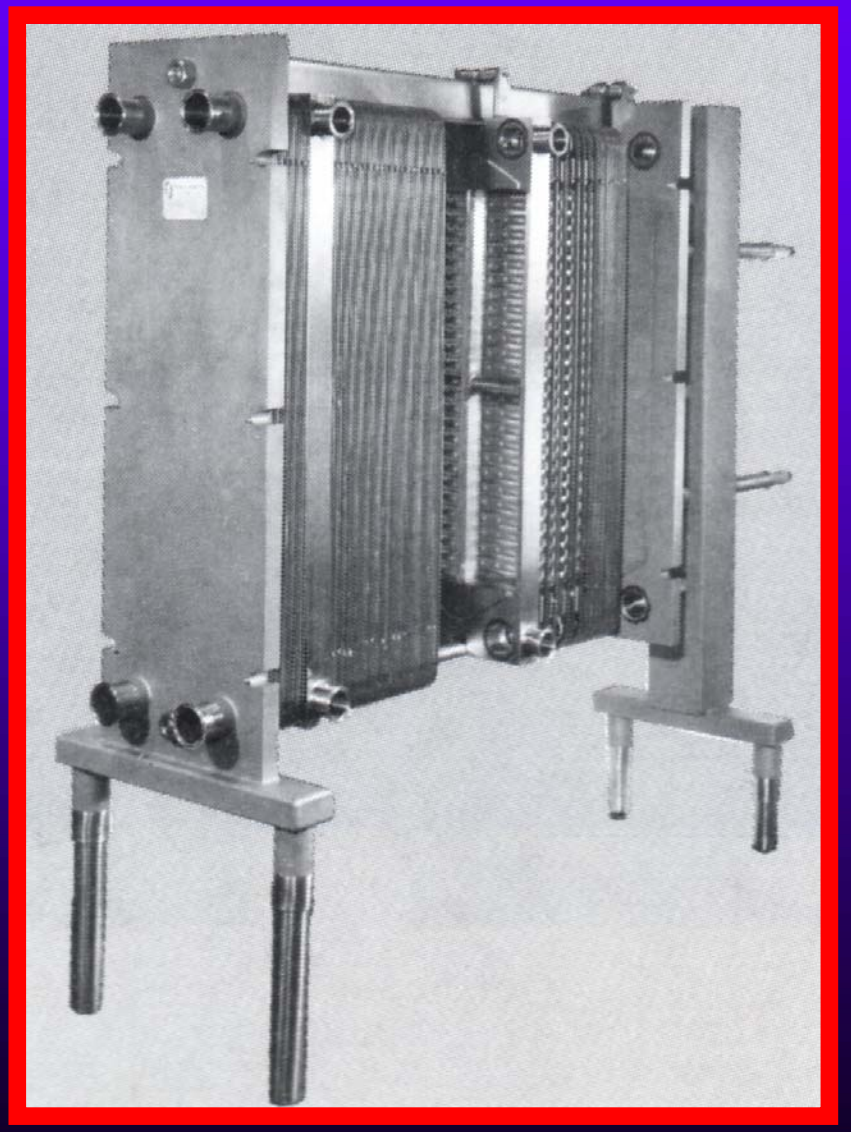
Tipuri de circulatie multipass

Numar diferit de treceri pentru fiecare fluid



SCHIMBATOARE DE CALDURA CU PLACI

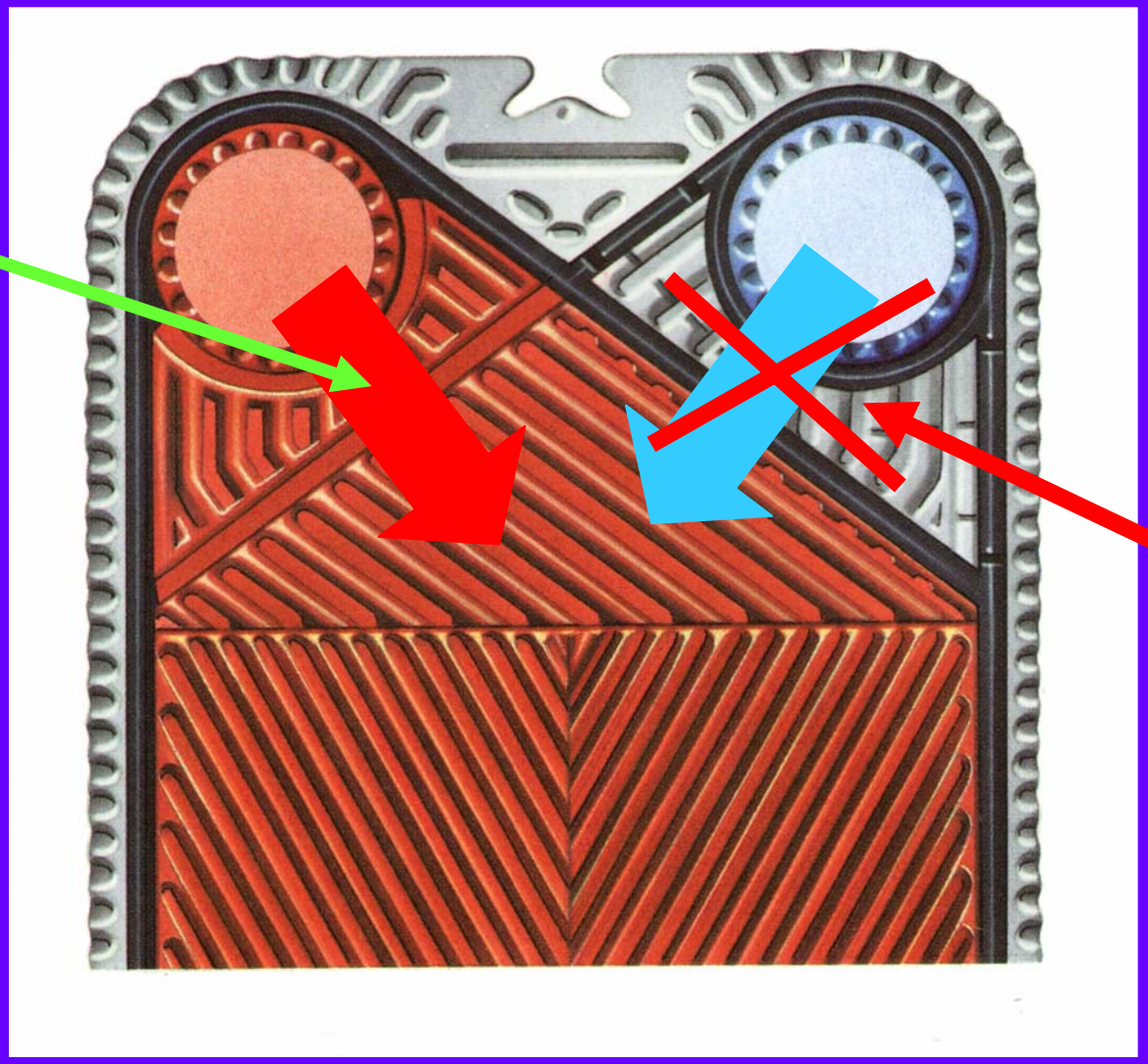
Cu functiuni multiple



SCHIMBATOARE DE CALDURA CU PLACI

Etansare si dirijare fluide

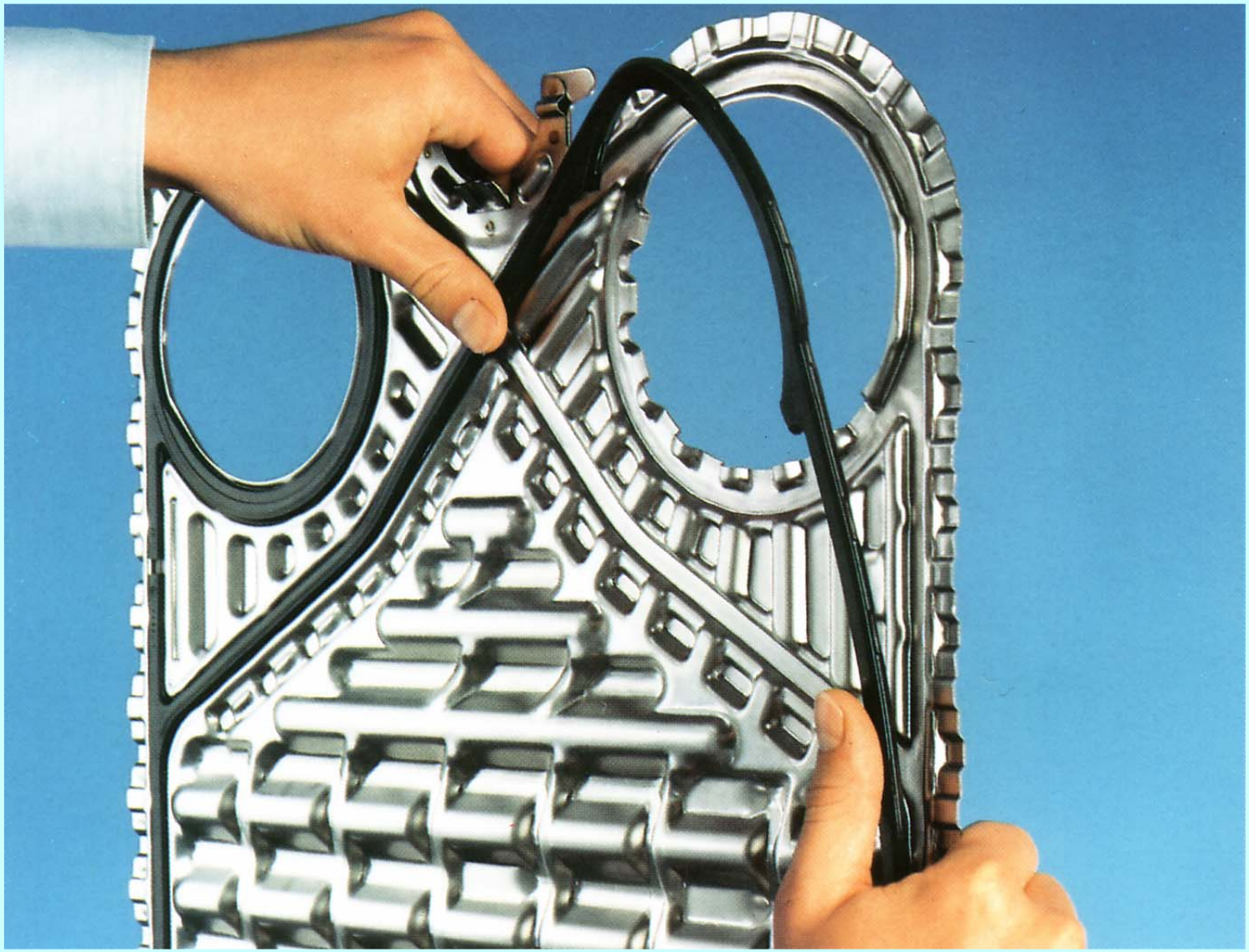
PERMIS



NEPERMIS

SCHIMBATOARE DE CALDURA CU PLACI

Garnituri



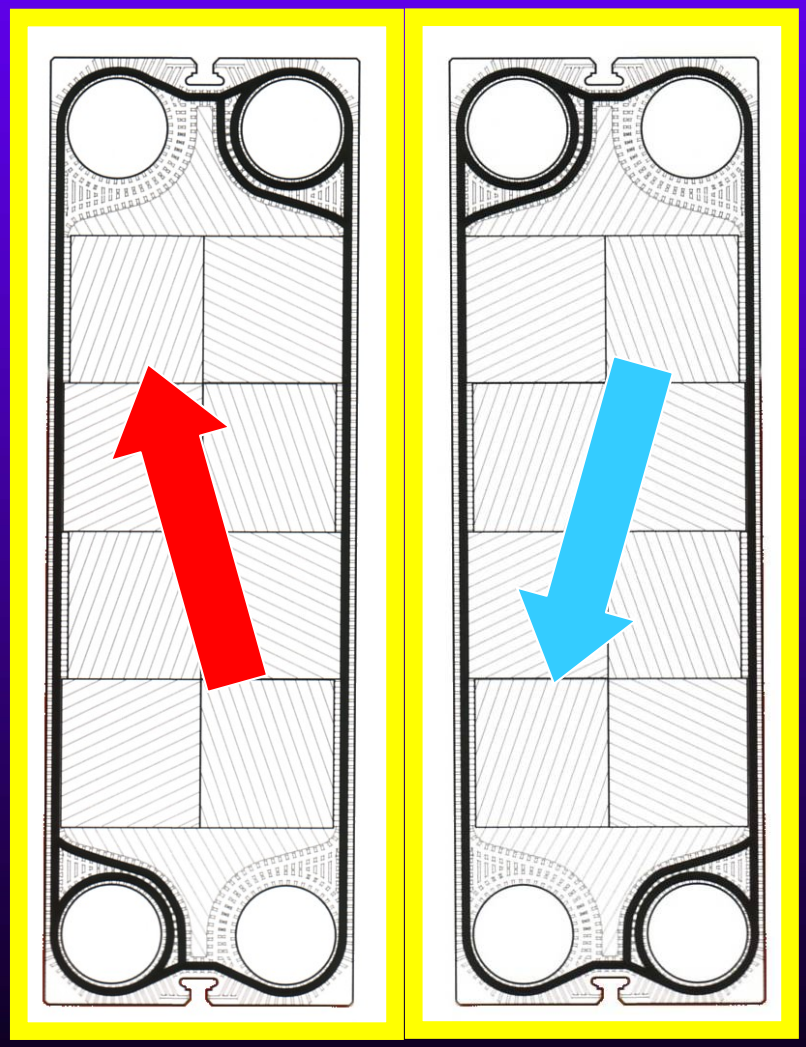
SCHIMBATOARE DE CALDURA CU PLACI

Garnituri

Material garnitura	T max. [°C]	Aplicatii
Acrilonitril	135	Materii grase
Izobutan-izopropan	150	Aldehide, cetone, esteri
Etena-propena	150	Produse chimice
Fluorocarbon	175	Uleiuri vegetale si animale
Fibre de azbest presate	260	Solventi organici

SCHIMBATOARE DE CALDURA CU PLACI

Garnituri



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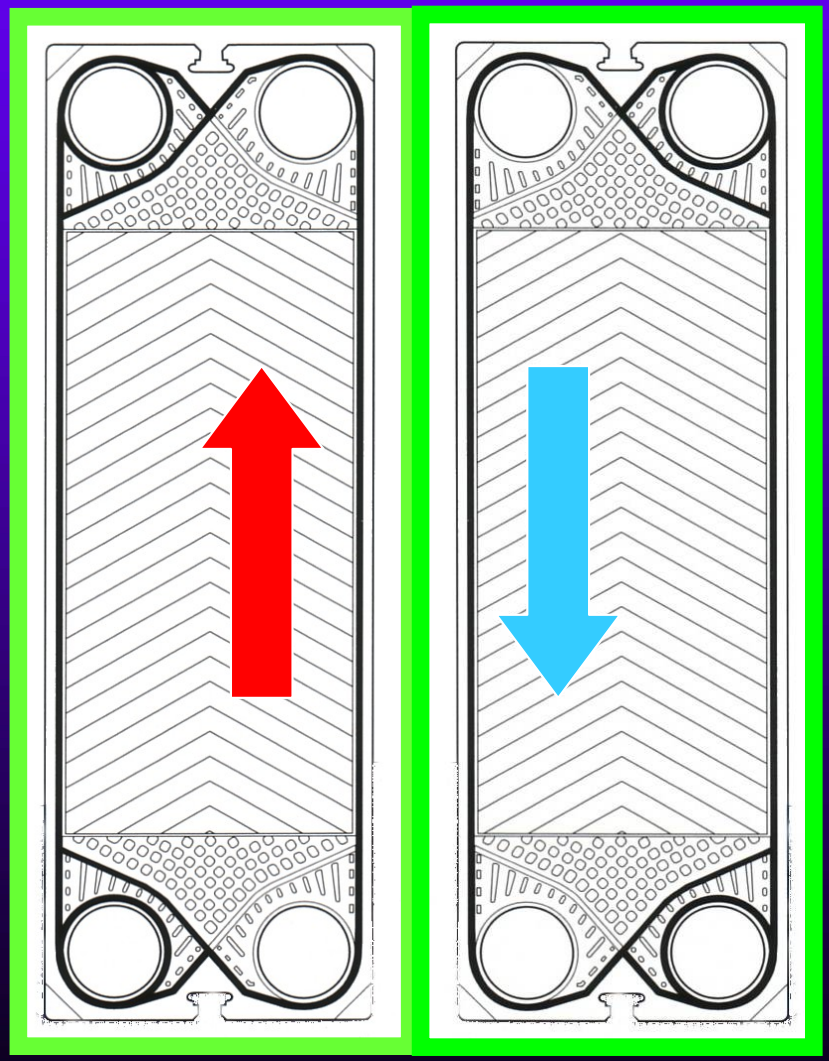
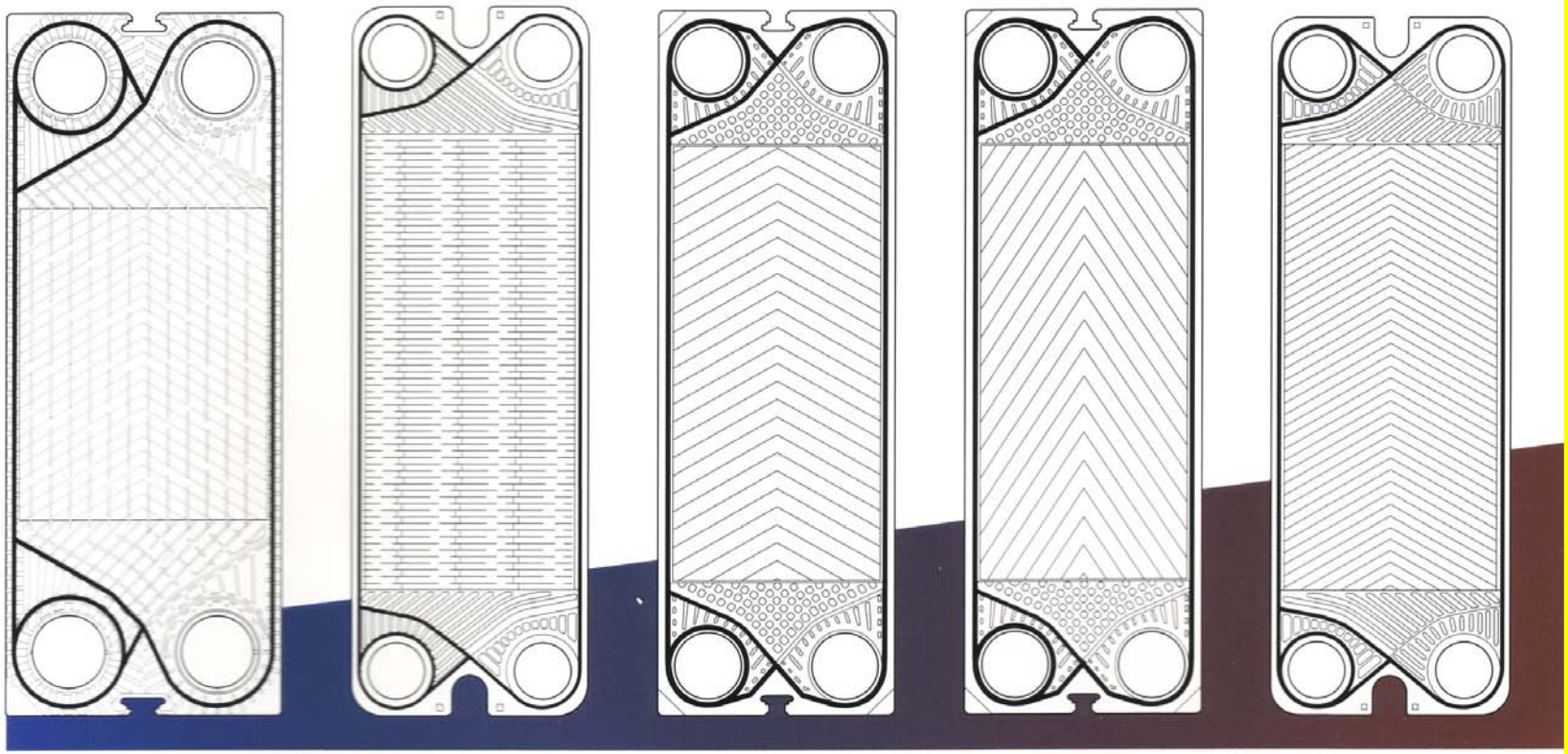


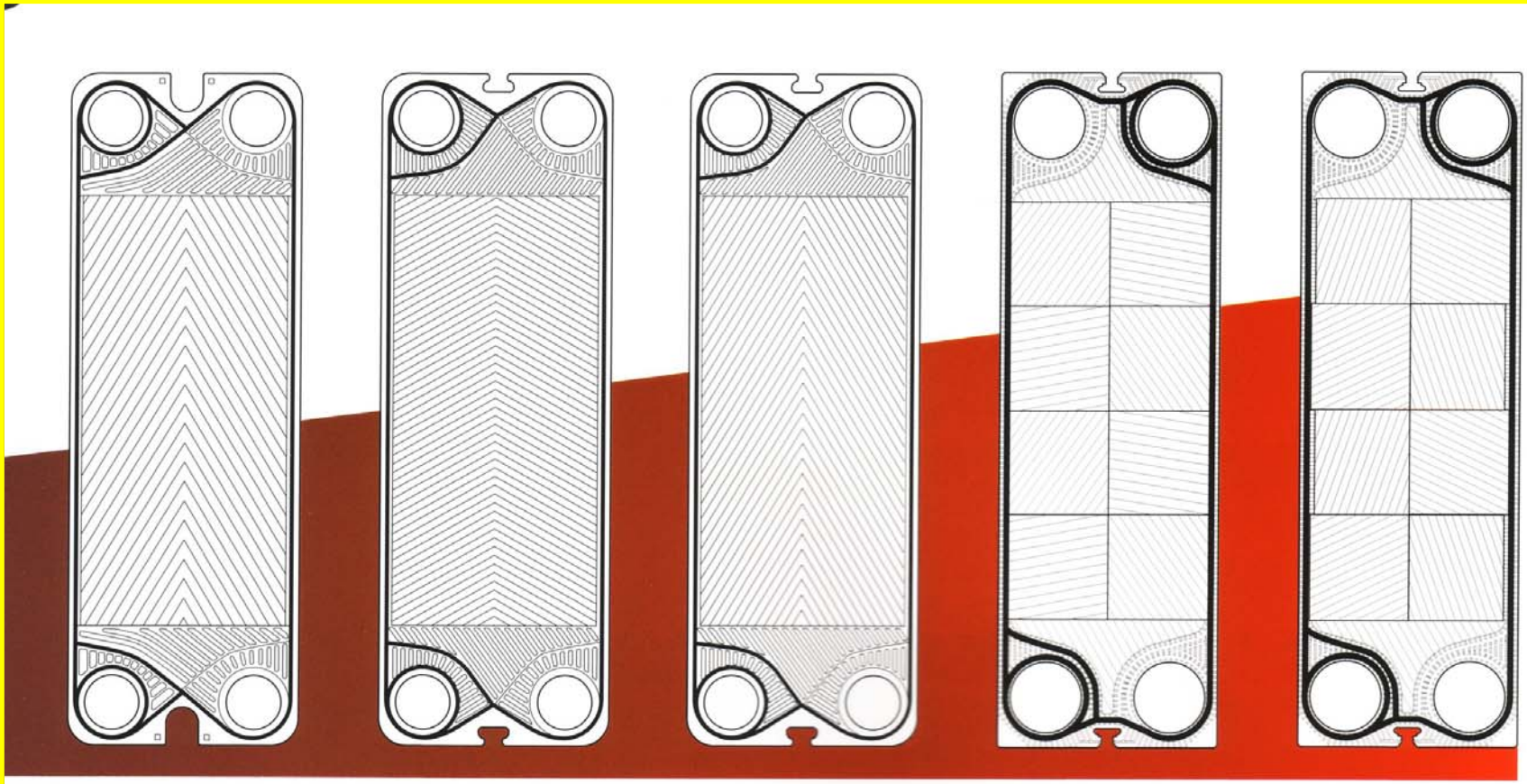
SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de placi



SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de placi

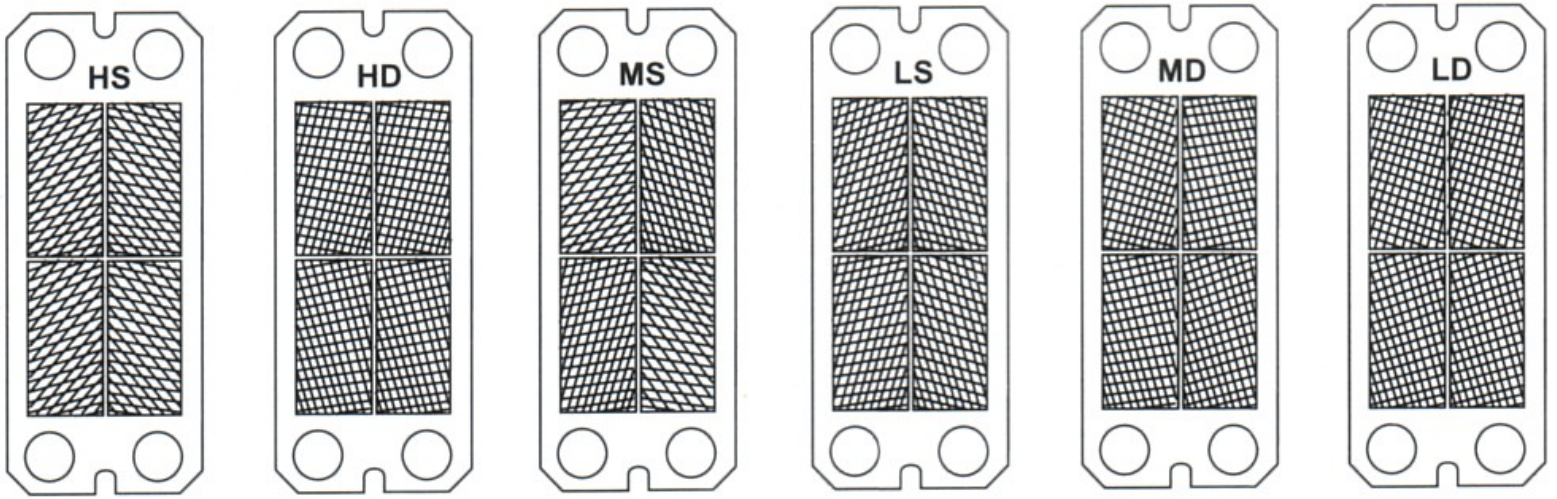


SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de placi

SWEP's unique patented design

SWEP's patented plate design allows six combinations of plate pairs.



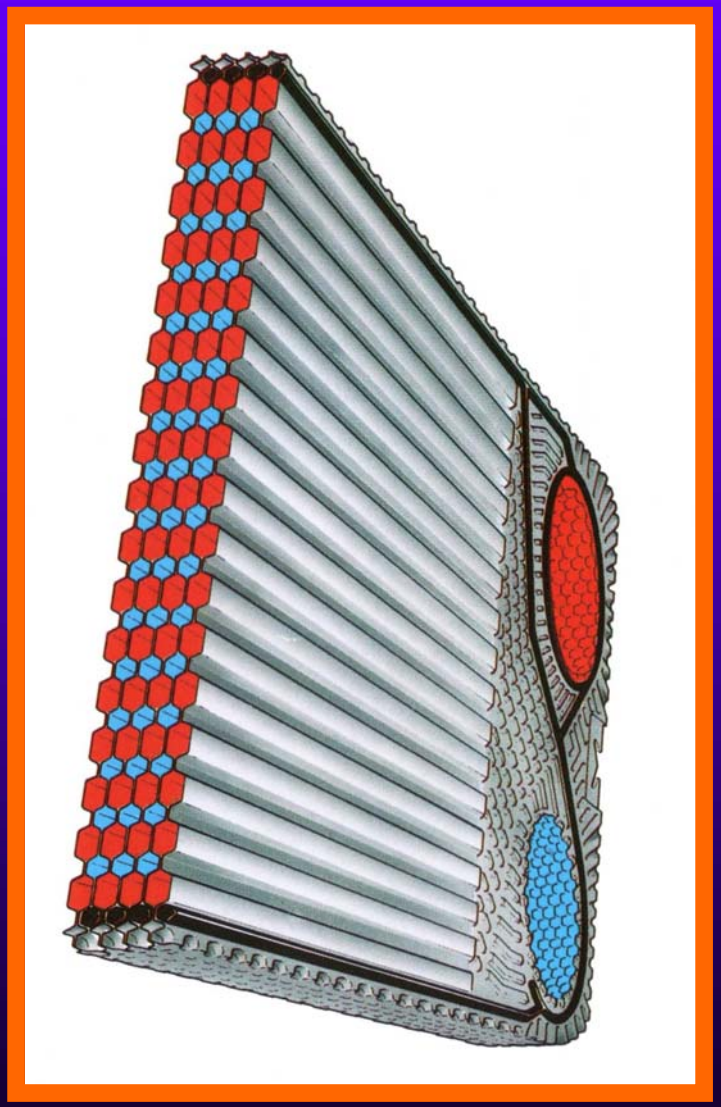
high theta, same direction	high theta, different directions	medium theta, same direction	low theta, same direction	medium theta, different directions	low theta, different directions

SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de placi

Placi tubulare FLOW-FLEX

- Utilizate pentru sarcini asimetrice (debite mult diferite de fluide, de ex.)
- Sunt lipsite de vibratii
- Folosite pentru fluide cu fibre sau particule solide



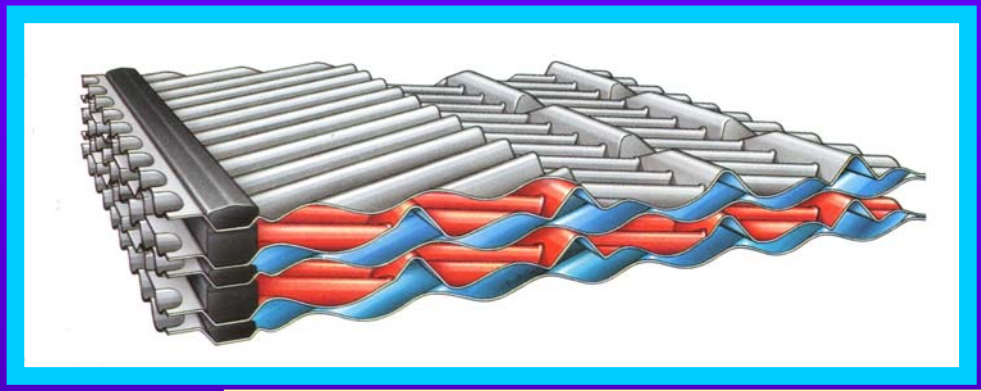
SCHIMBATOARE DE CALDURA CU PLACI

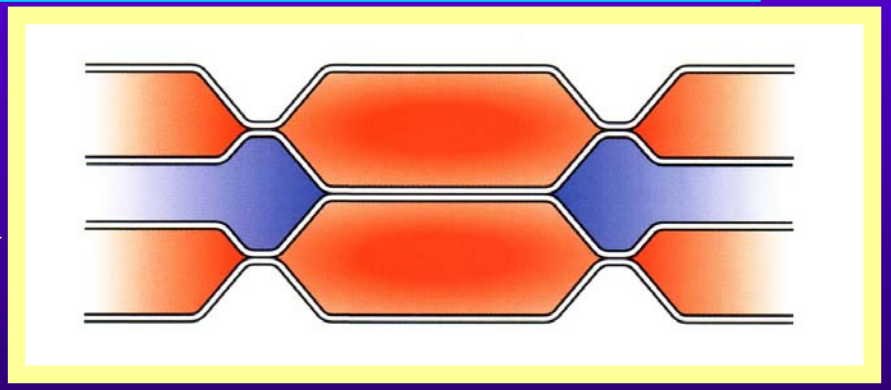
Tipuri de placi

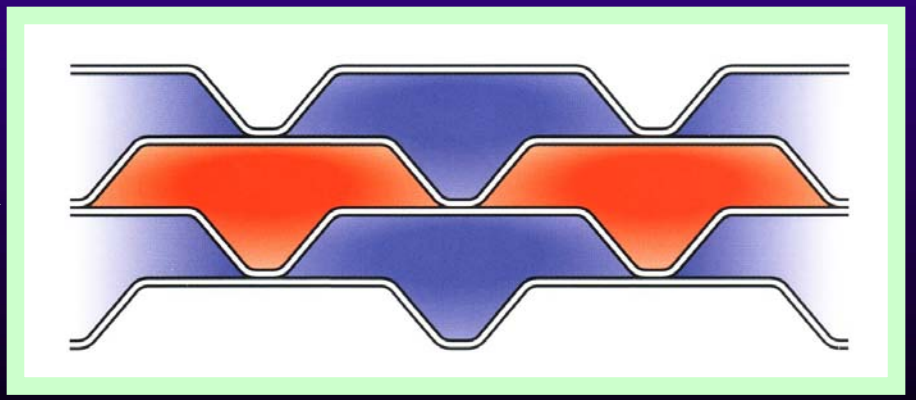
Placi cu interstitiu mare (16 mm)

- Se utilizeaza pentru lichide foarte viscoase, cu fibre, cu particule solide;
- Forma ondulatiilor asigura o turbulenta foarte mare;
- Se pot aseza in pachet pentru a forma canale:

- Largi – Inguste;
- Medii – Medii.





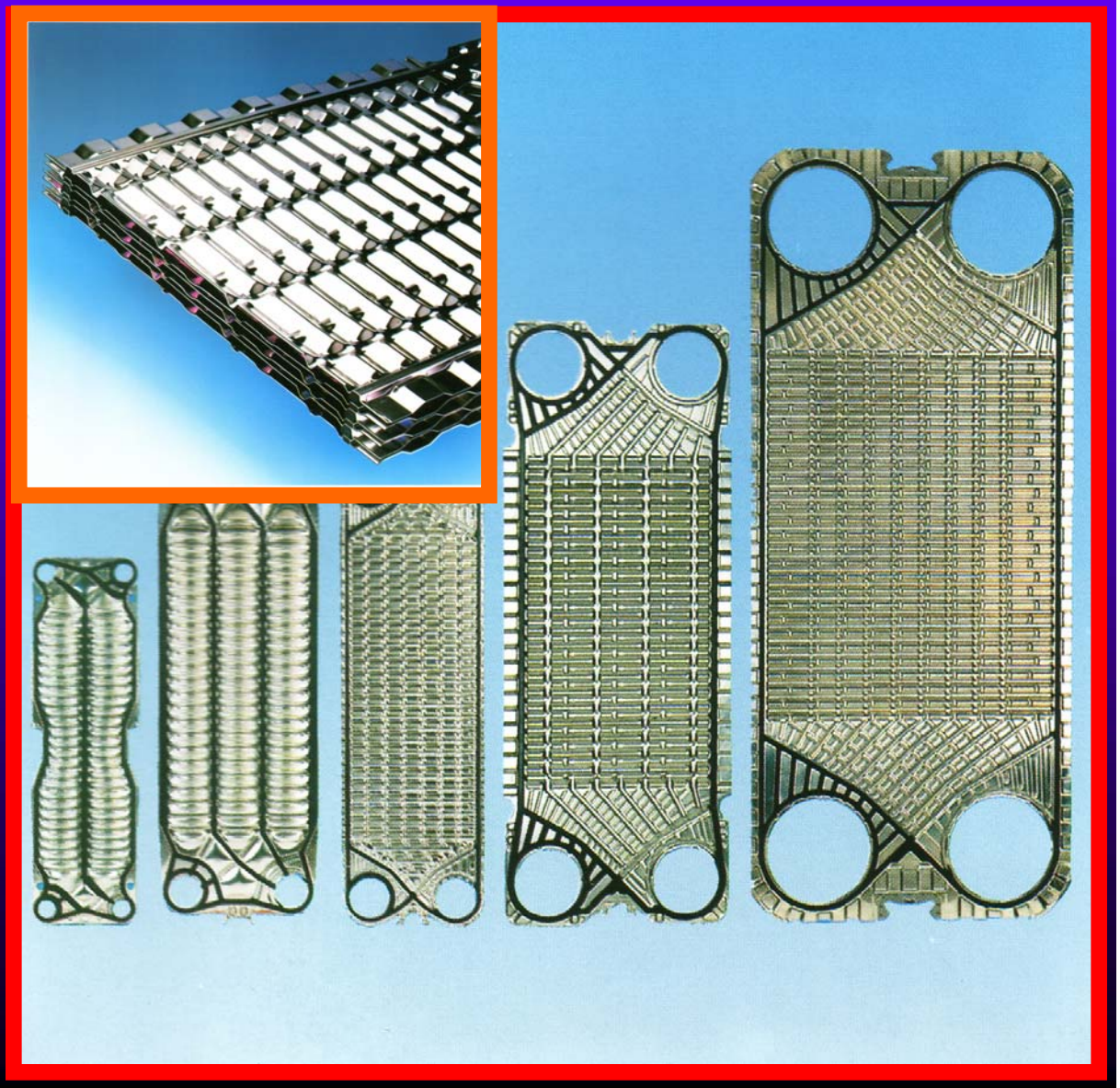


SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de placi

Placi FREE FLOW

- Interstitiu pana la 12 mm;
- Recomandate pentru produse:
- Continand solide;
- Continand cristale;
- Continand paste;
- Cu viscozitate mare.



SCHIMBATOARE DE CALDURA CU PLACI

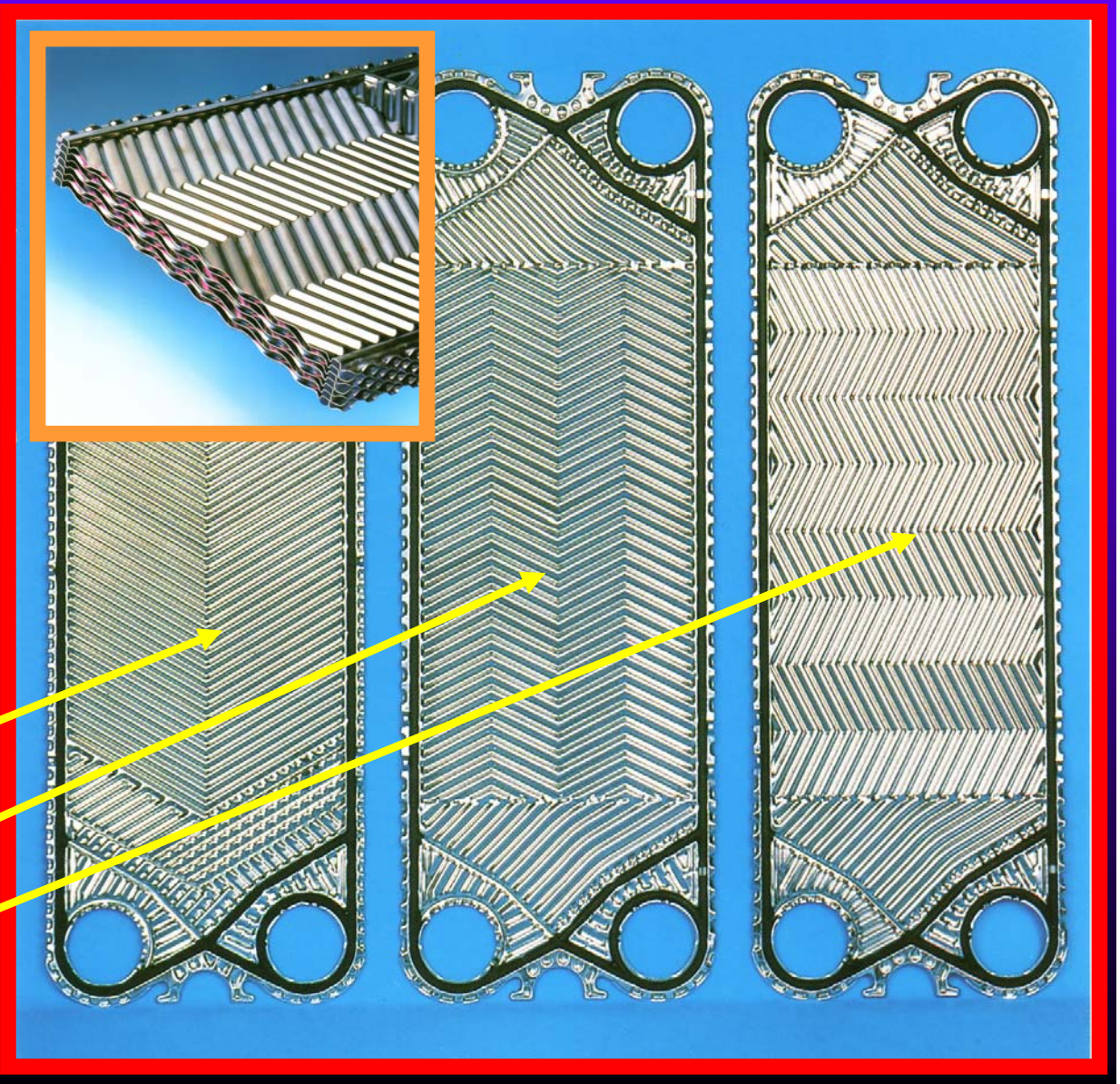
Tipuri de placi

GEA

Placi VARITHERM

- Placile din pachet pot avea profile diferite;
- Se formeaza canale de geometrii variate, cu multe puncte de contact intre placi;
- Au avantajul unei incarcari termice variabile, nefiind necesara supradimen-sionarea SCP.

M H V

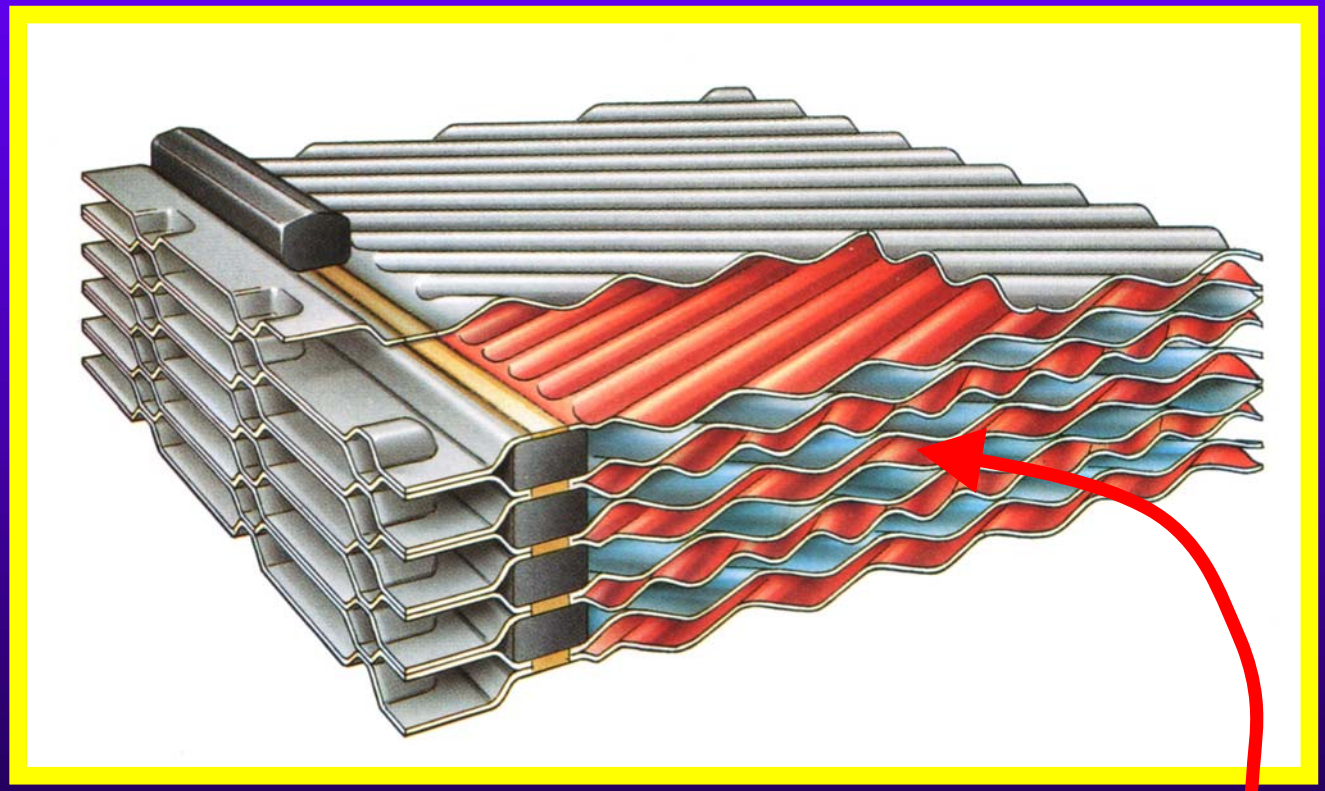


SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de placi

Placi jumelate (TWIN)

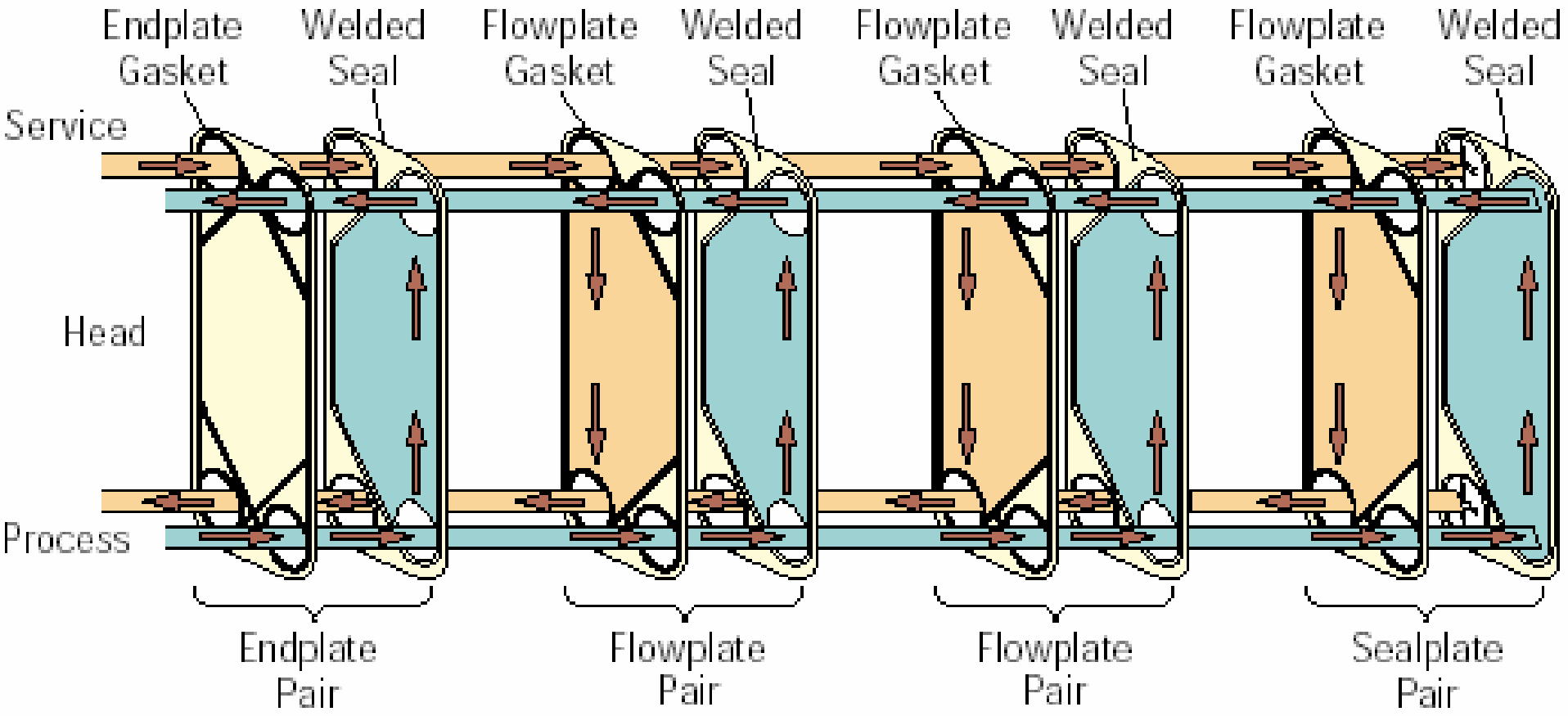
- Utilizate pentru fluide agresive;
- Canalele prin care circula fluidul agresiv sunt realizate din placi sudate;
- Canalele sudate alterneaza cu canale clasice, cu garnituri.



SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de placi

Schimbator de caldura cu placi jumelate

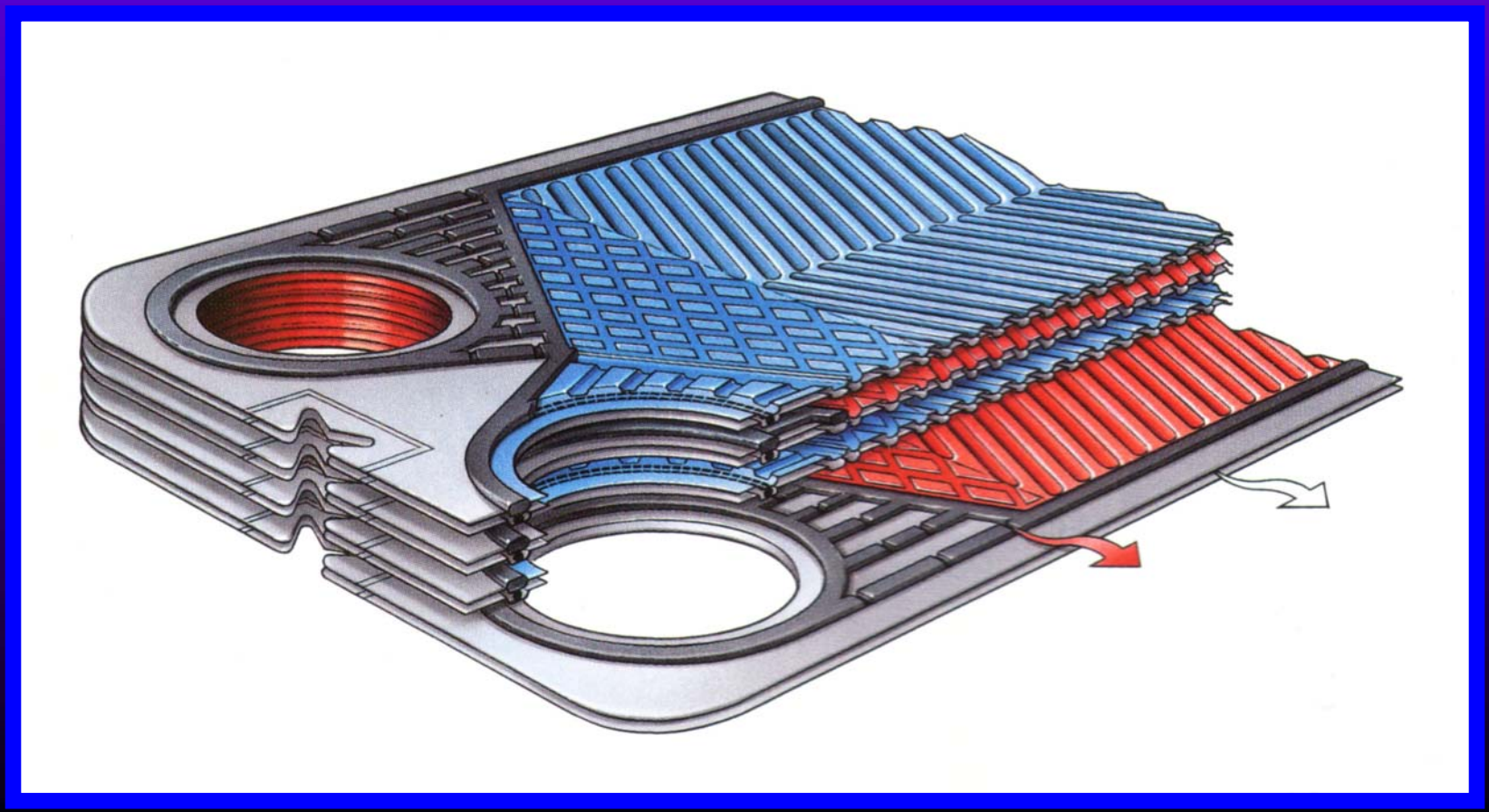


SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de placi

Placi cu pereti dubli

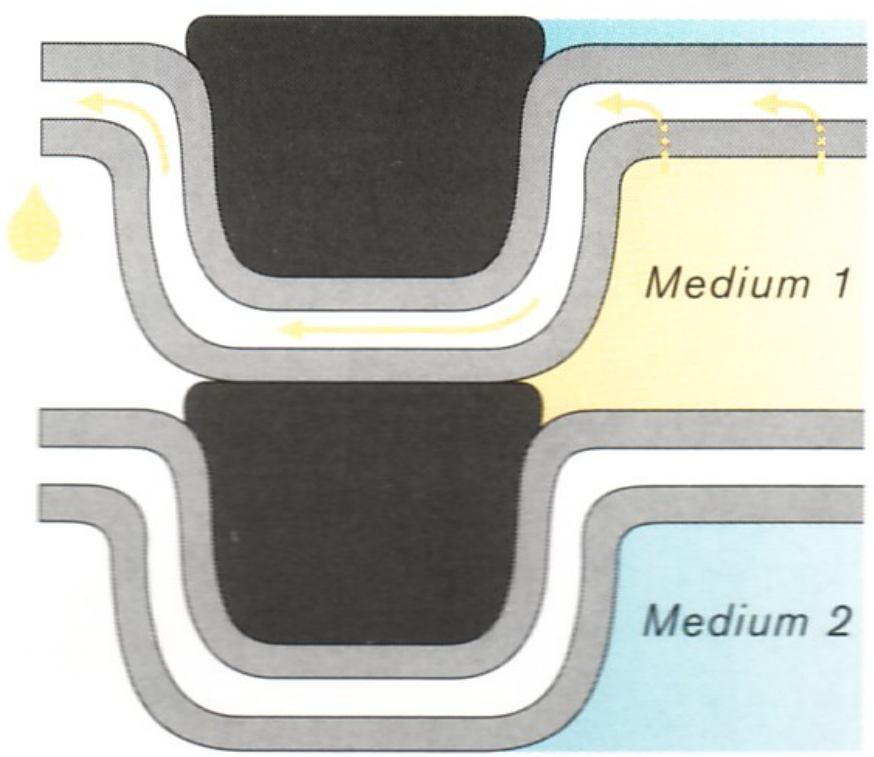
- Pentru medii a caror amestecare este periculoasa (contaminare, reactii ostile etc.);
- In caz de scurgere, fluidele nu se amesteca.



SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de placi

Placi cu pereti dubli



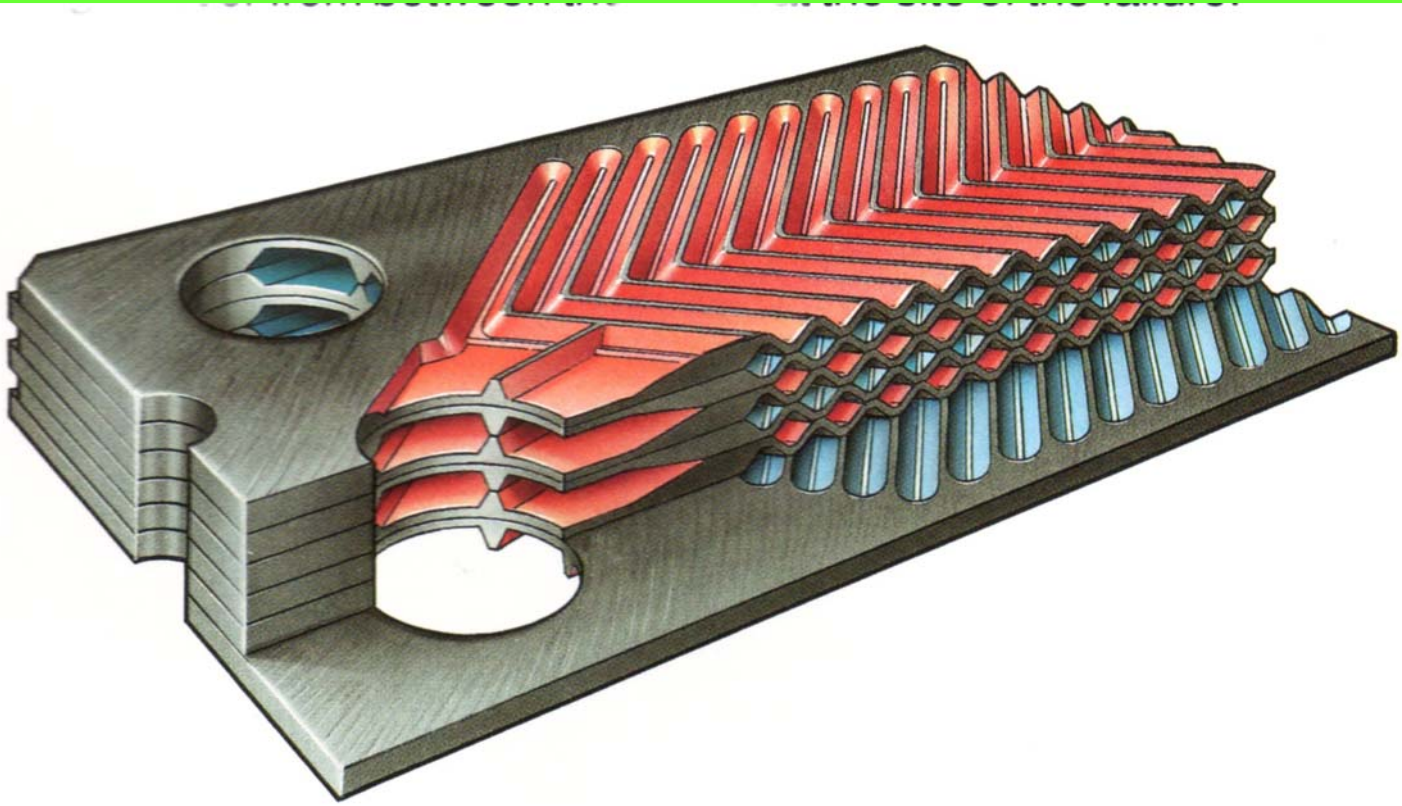
Even if medium 1 should leak, it cannot mix with medium 2.

SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de placi

Placi din grafit

- Pentru fluide foarte corozive



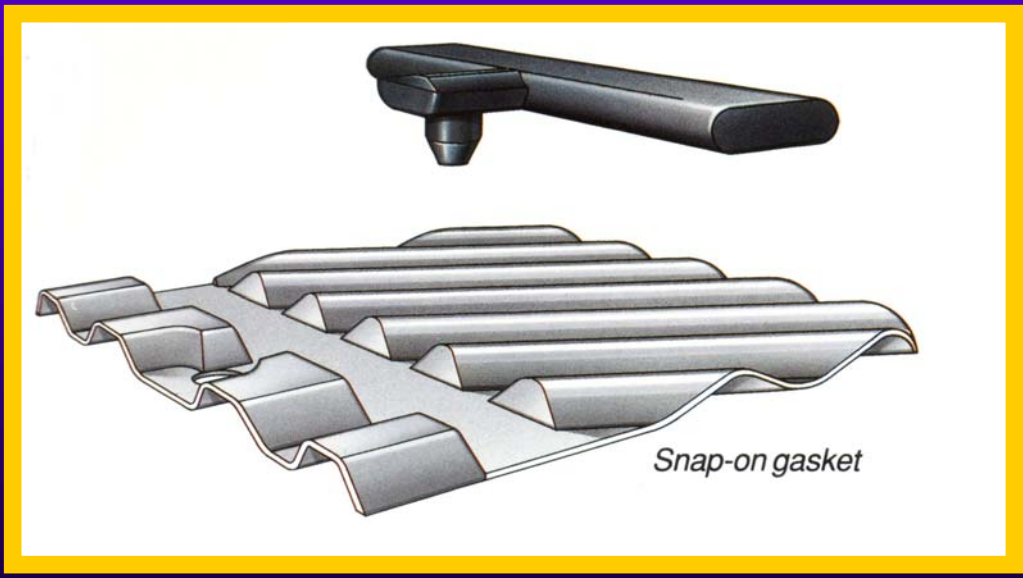
SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de placi

Placi cu garnituri nelipite

- Elimina dezavantajele legate de lipirea garniturilor: strat neuniform de clei, neetanseitati.

Cu bratari de fixare



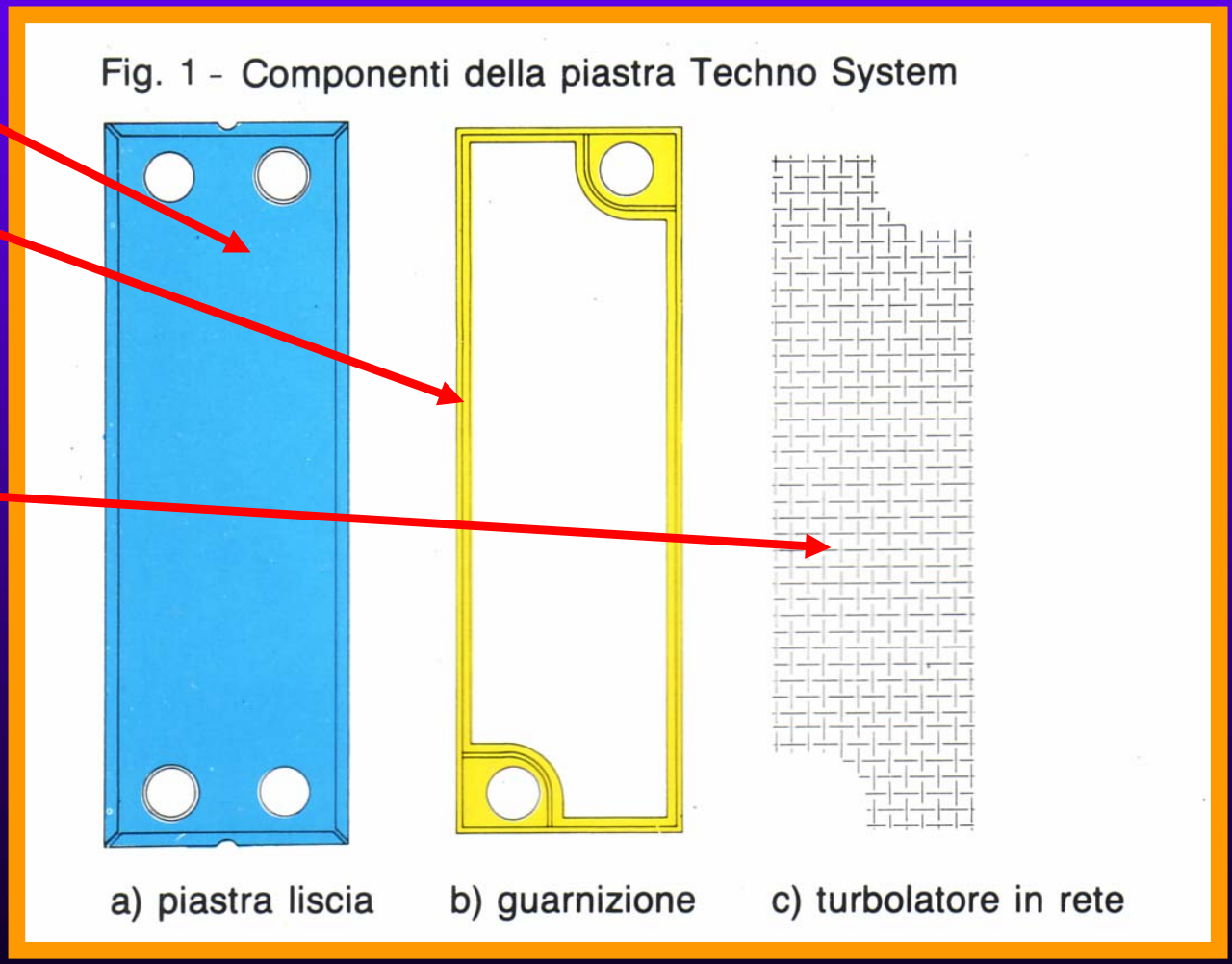
Cu stifturi de fixare

SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de placi

Placi cu suprafata secundara

- Placa plana
- Garnitura
- Promotor de turbulenta (plasa)

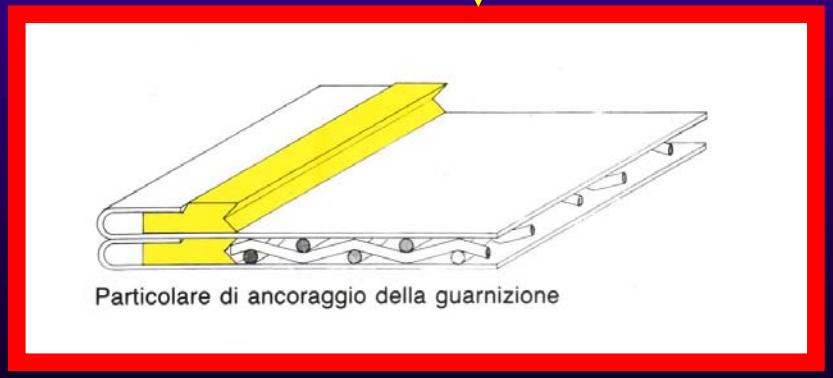


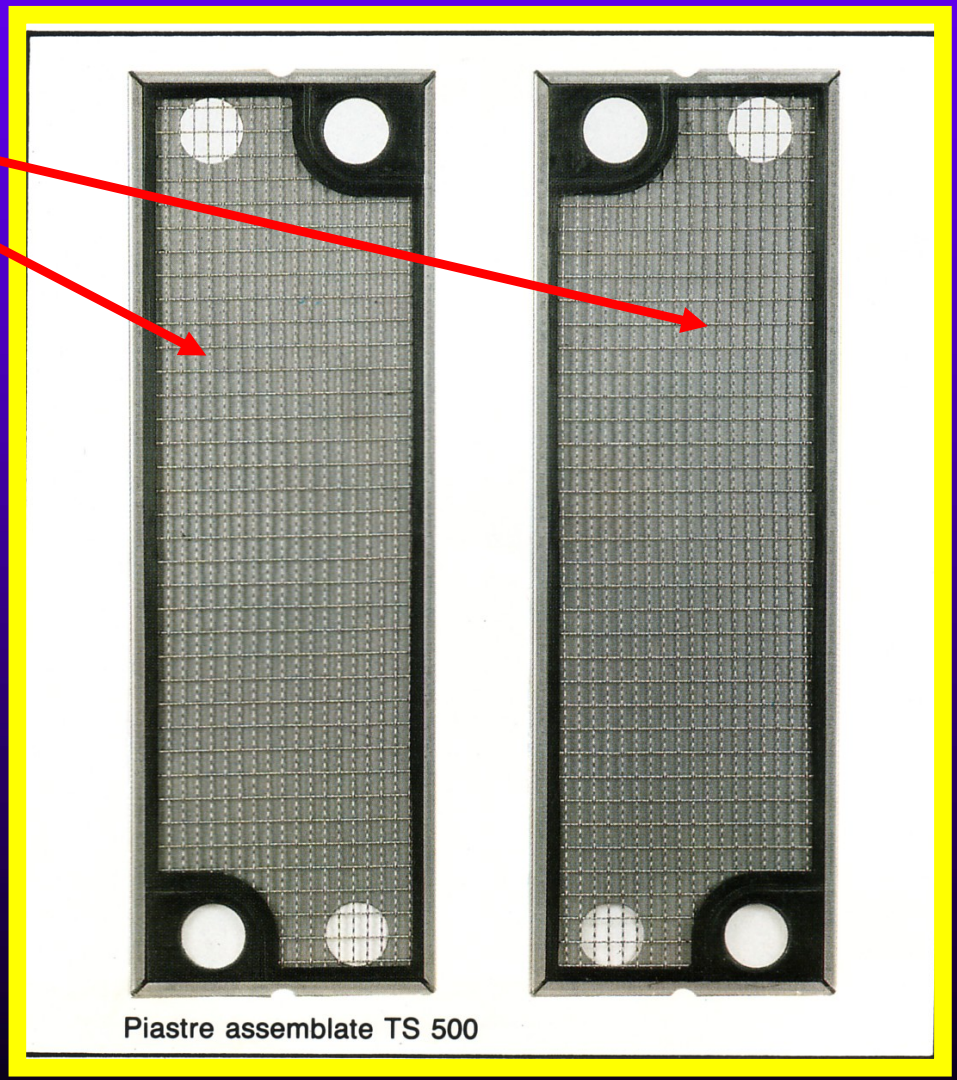
SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de placi

Placi cu suprafata secundara

- Placi asamblate
- Detaliu garnitura



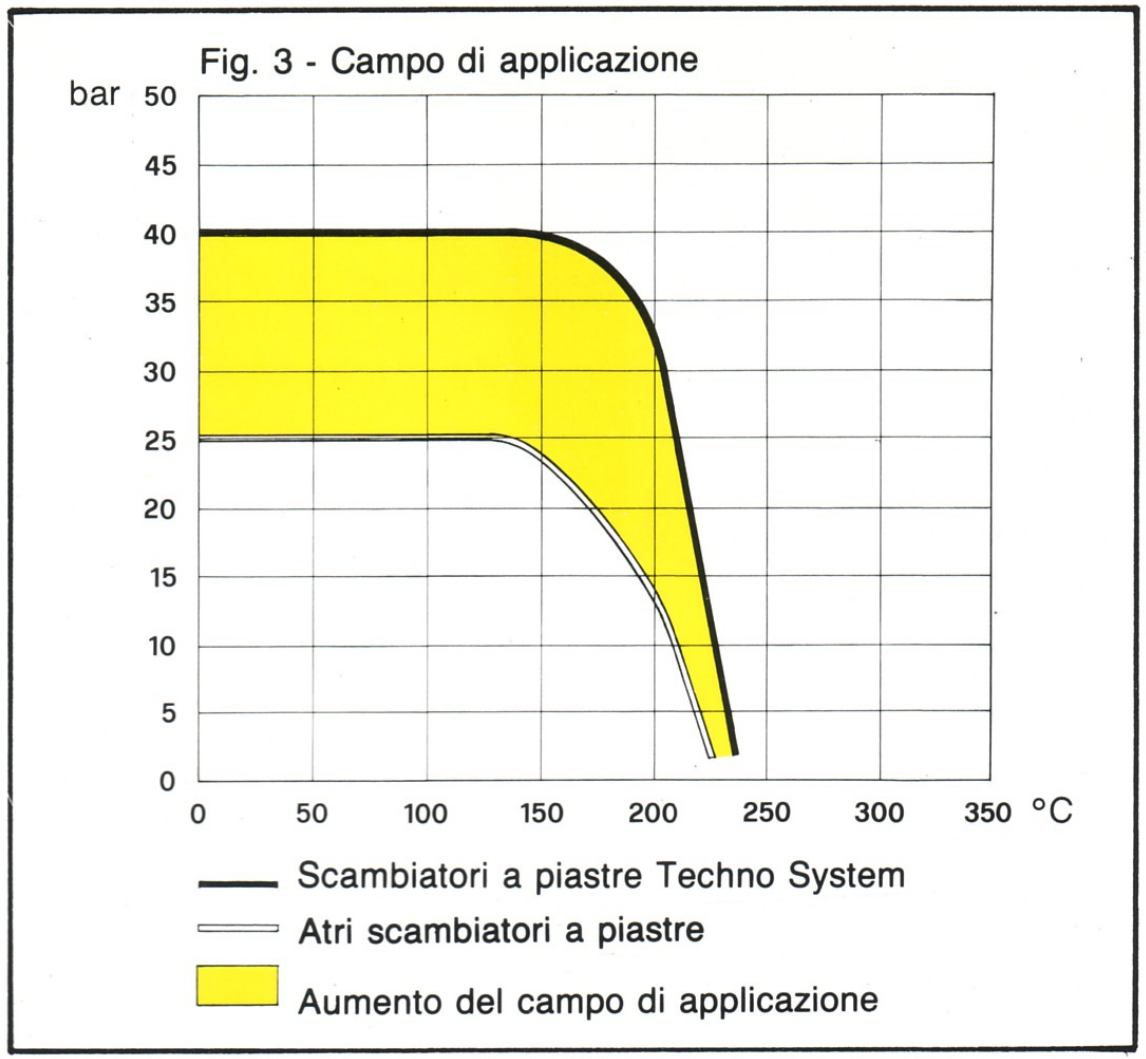


SCHIMBATOARE DE CALDURA CU PLACI

Tipuri de placi

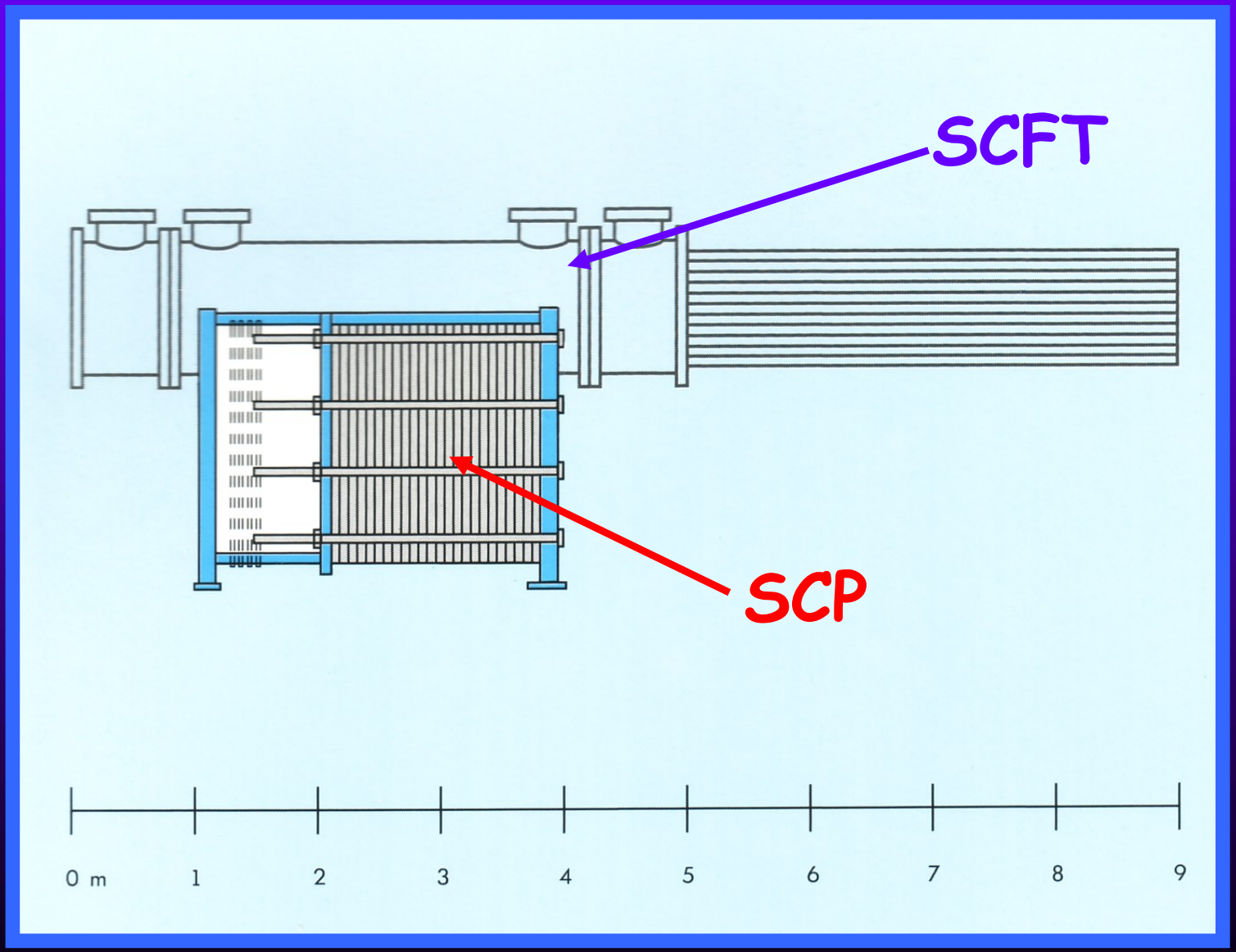
Placi cu suprafata secundara

- Interval de lucru
- Tipodimensiuni



SCHIMBATOARE DE CALDURA CU PLACI

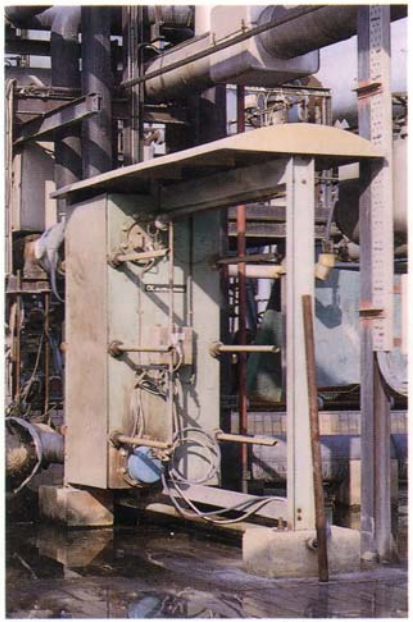
Spatiu necesar comparativ cu SCFT



SCHIMBATOARE DE CALDURA CU PLACI

APLICATII

Hoechst AG in Frankfurt-Griesheim, West Germany, selected the Diabon F graphite plate heat exchanger for its excellent corrosion resistance when cooling a highly corrosive hydrochloric acid solution.



Tioxide France in Calais, France, chose plate heat exchangers with welded plate pairs and anodic protection to cool concentrated 100°C (212°F) sulphuric acid.

At DSM, Beek, the Netherlands, plate heat exchangers from Alfa-Laval serve as reactor jacket water coolers in the polypropylene plant.

SCHIMBATOARE DE CALDURA CU PLACI

APLICATII

ACNA, a member of the Montedison Group, located in Cengio, Italy, chose four Flow-Flex plate heat exchangers for cooling contaminated air to remove dangerous chemical residues.

At Courtaulds North America in Axis, Alabama, plate heat exchangers maintain the correct temperature of the washing baths in the viscose plant.

SCHIMBATOARE DE CALDURA CU PLACI

APLICATII

FREE FLOW FA 192, sugar factory

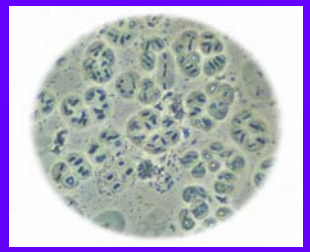
Three Wide-gap plate heat exchangers with automatic backflushing heat mixed juice with boiler vapour at the Industrielle Sucrerie de Bourbon on La Réunion.

SCHIMBATOARE DE CALDURA CU PLACI

APLICATII

SCHIMBATOARE DE CALDURA CU PLACI

APLICATII



A plate heat exchanger installed as a fermenter cooler at the Usina de Serra distillery in São Paulo, Brazil.

At Sandoz AG in Basel, Switzerland, these three Double-wall plate heat exchangers in the biotechnology pilot plant heat and cool toxic waste products using city water.

SCHIMBATOARE DE CALDURA CU PLACI

APLICATII

SCHIMBATOARE DE CALDURA CU PLACI

APLICATII

- Pentru racirea – soc a laptelui cald, in vederea protejarii proteinelor;
- Grosime placa: 0,4 mm;
- Otel inoxidabil;
- Recomandat pentru capacitati de 600 – 8000 L/h

SCHIMBATOARE DE CALDURA CU PLACI

APLICATII

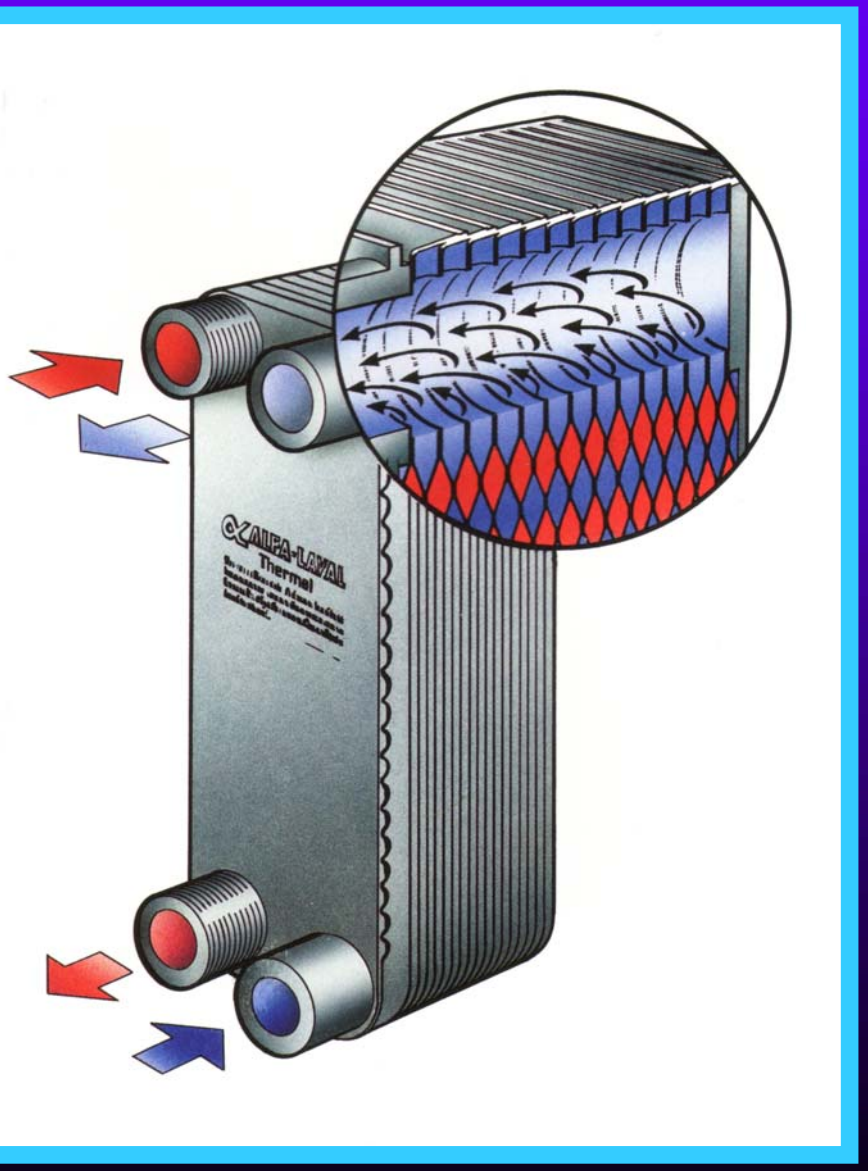
SCHIMBATOARE DE CALDURA CU PLACI NEDEMONTABILE

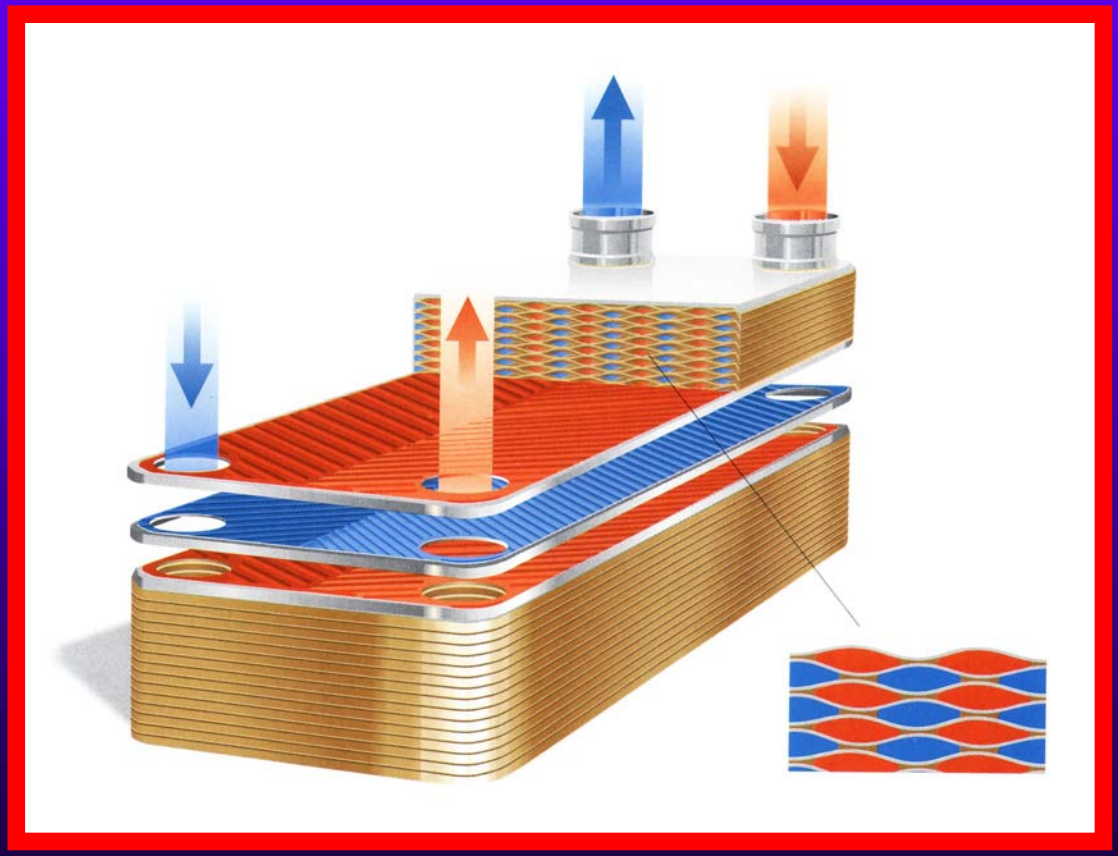
SCP brazate (Brazed PHE)

- Elementele de etansare (garniturile) lipsesc;
- Placile sunt asamblate intre ele prin **LIPIRE** (cuprare, alamire) sau prin **SUDARE**;
- Pot lucra pana la 40 ÷ 50 bari (4 ÷ 5 MPa) si 450 ÷ 500 °C.

SCHIMBATOARE DE CALDURA CU PLACI

NEDEMONTABILE





SCHIMBATOARE DE CALDURA CU PLACI

NEDEMONTABILE

AVANTAJE:

- Rezista la T si P mai ridicate decat SCP cu garnituri;
- Sunt mai compacte;
- Nu necesita fundatii speciale, putand fi fixate direct pe conductele de agenti termici;

SCHIMBATOARE DE CALDURA CU PLACI

NEDEMONTABILE

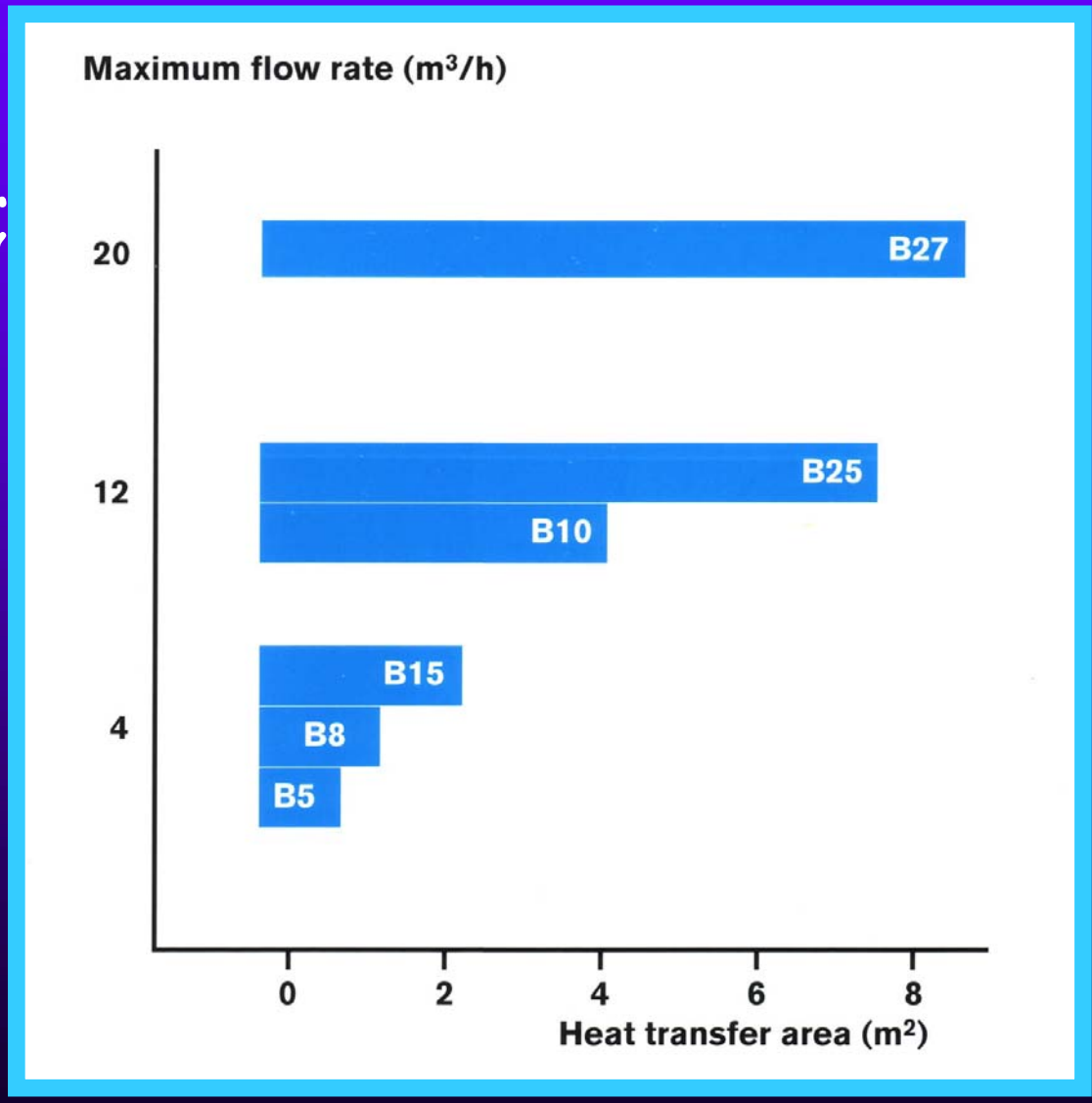
AVANTAJE:

- Coeficienti ridicati de transfer termic: 5000 – 7500 W/(m^{2}xK);
- Turbulenta creata de profilul placilor nu permite depunerea solidelor in suspensie;
- Pot lucra intr-un domeniu larg de temperaturi: **-195 ÷ 225 °C**;

SCHIMBATOARE DE CALDURA CU PLACI NEDEMONTABILE

DEZAVANTAJE:

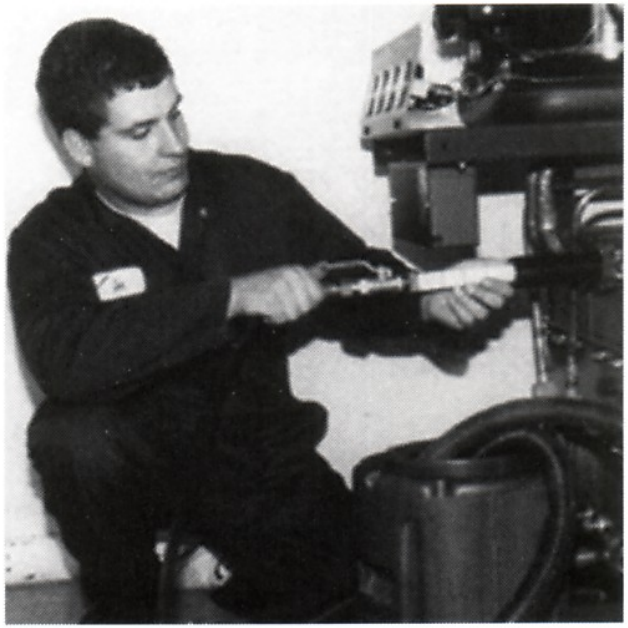
- Nu sunt demontabile;
- Nu permit modularizarea (suprafete de transfer termic fixe pe tipodimensiuni);
- Curatirea este dificila.



SCHIMBATOARE DE CALDURA CU PLACI

NEDEMONTABILE

- Curatirea necesita aparatura speciala



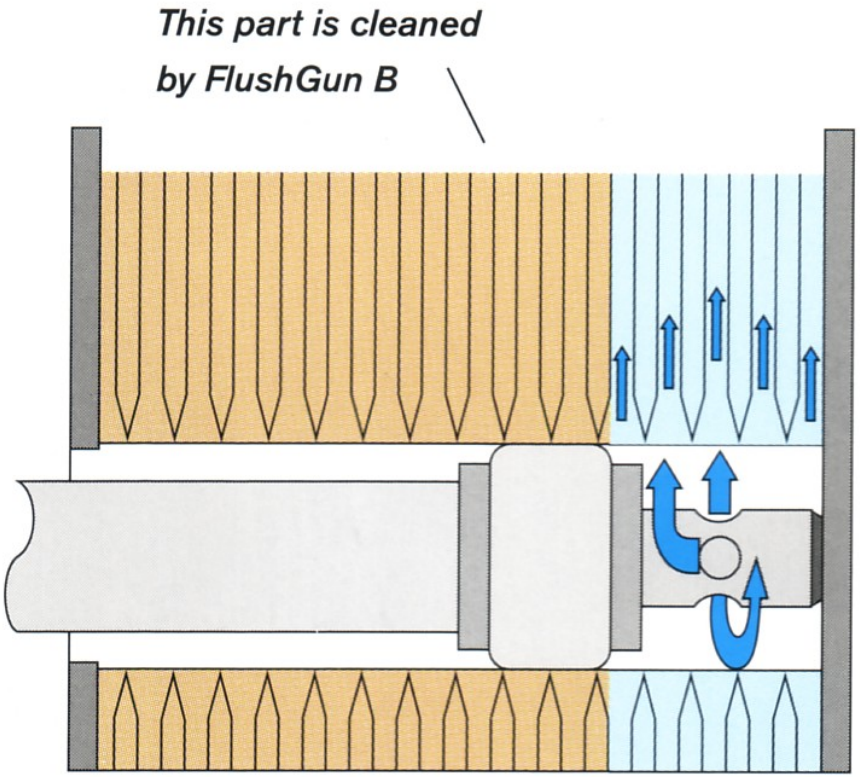
As long as you have access to the front of your CBE, it's easy to clean with the FlushGun.

Type of fouling	Cleaning agent
• scaling (carbonates) • sludge • rust	**Acid flush** not stronger than sulfamic, citric, acetic or phosphoric, max. 10% concentration in water; do NOT use hydrochloric or sulfuric!
• dirt & sand particles • fibrous materials • grease • plastics	**Detergent soak** household detergent and hot (60°C/140°F) water

SCHIMBATOARE DE CALDURA CU PLACI

NEDEMONTABILE

- Curatirea necesita aparatura speciala

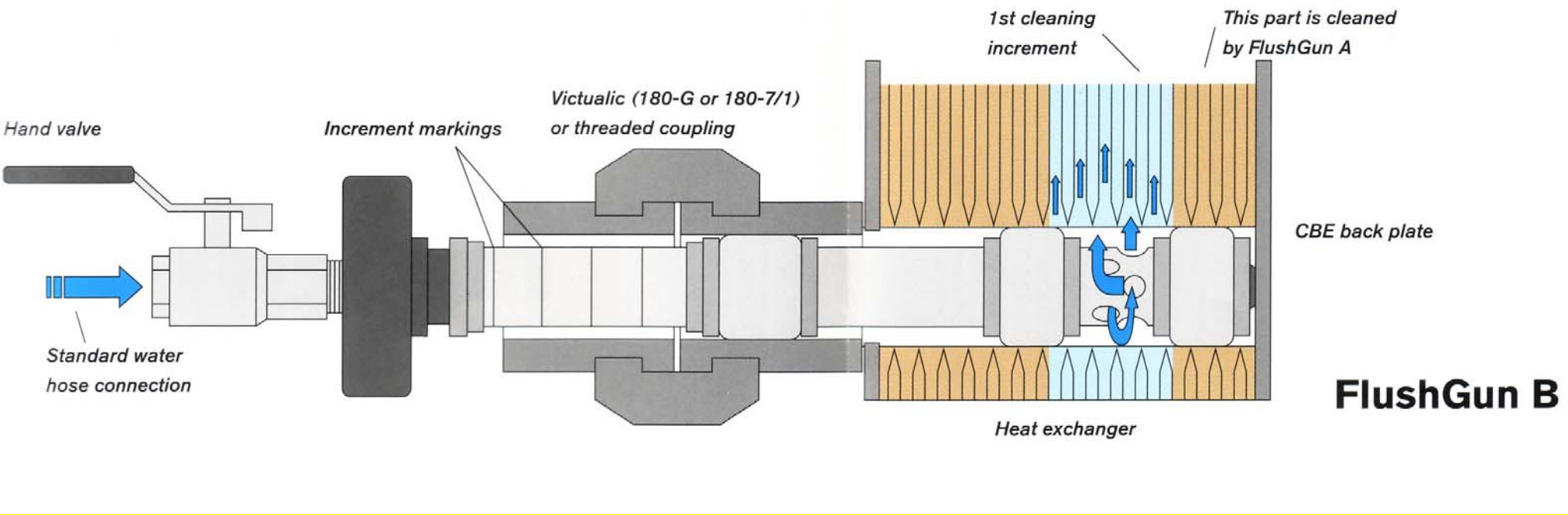


FlushGun A

SCHIMBATOARE DE CALDURA CU PLACI

NEDEMONTABILE

- Curatirea necesita aparatura speciala



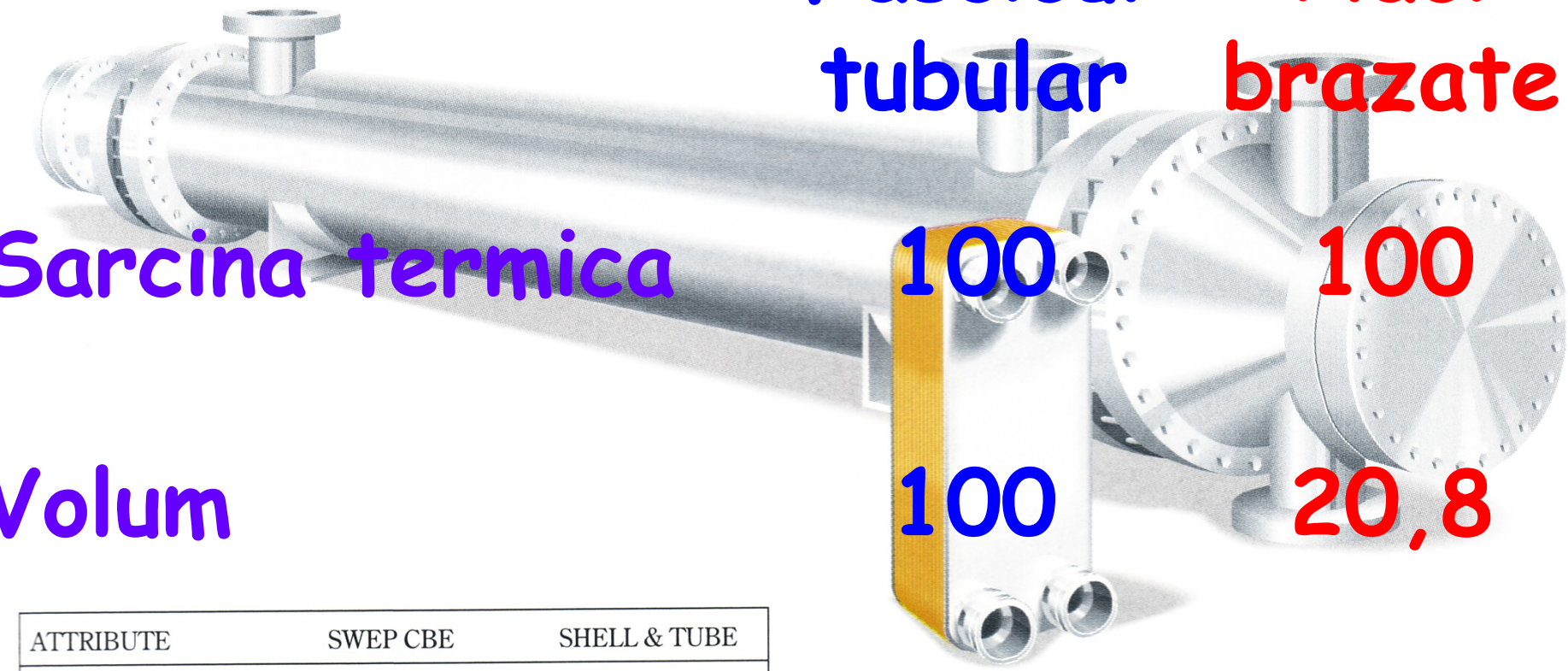
SCHIMBATOARE DE CALDURA CU PLACI NEDEMONTABILE

APLICATII:

- Instalatii de vaporizare-condensare a refrigerentilor;
- Prelucrarea solventilor corozivi;
- Prelucrarea solutiilor de amine;
- Prelucrarea saramurilor, a amoniacului lichid, a solutiilor cu clor, a alcoolilor, a acizilor.

SCHIMBATOARE DE CALDURA CU PLACI

NEDEMONTABILE



	Fascicul tubular	Placi brazate
Sarcina termica	100	100
Volum	100	20,8
Masa	100	15,5

ATTRIBUTE	SWEP CBE	SHELL & TUBE
Capacity (as condenser)	66 kW	66 kW
Operational weight	20 kg	129 kg
Length x Depth	520 x 114 mm	2248 x 200 mm

Calcul termic

- Etapele calculului sunt similare celor de la SCFT;
- Se tine cont de geometria canalelor;
- Cu cresterea numarului de placi (cresterea A) scade viteza agentilor termici;
- Calculul termic trebuie insotit si de calculul hidraulic;
- Daca ΔP calculat > ΔP impus, se alege alt tip de placa.

SCHIMBATOARE DE CALDURA CU PLACI

Calcul termic

Date initiale

Calcul bilant termic

Nr. canale $N_c = 1$

Calcul A

Calcul viteze fluide

Calcul Reynolds fluide

Calcul Nusselt fluide

Calcul α_1, α_2 fluide

Calcul K

Calcul flux termic real

$q_{rc} = q_{ra}$?

DA

NU

$N_c = N_c + 1$

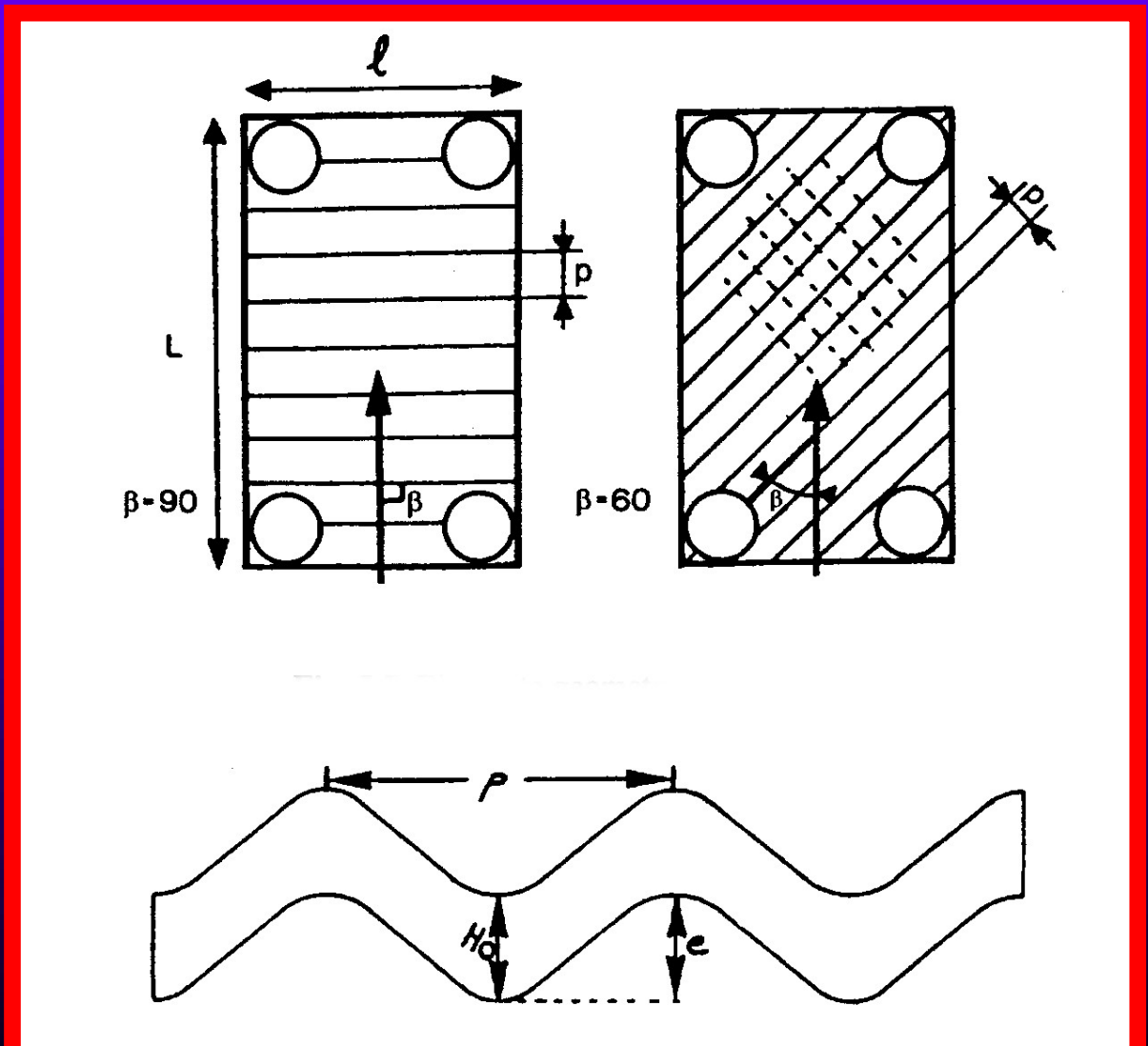
rezultate

SCHIMBATOARE DE CALDURA CU PLACI

Calcul termic

Elemente de calcul ale unei placi:

- β – unghiul de ondulare;
- p – pasul de ondulare, m;
- H_0 – inaltimea de ondulare, m;
- L – lungimea placii, m;
- l – latimea placii, m;
- S_P – suprafata de transfer termic a unei placi, m^2.



Calcul termic

- **Diametrul hidraulic:**

$$d_h = \frac{4A}{P_u} = \frac{4 \cdot l \cdot H_0}{2 \cdot (l + H_0)} \cong 2 \cdot H_0 \ \ [m] \ \ (l >> H_0)$$

- **Criteriul Nusselt:**

$$Nu = a \cdot Re^b \cdot Pr^c \cdot \left(\frac{Pr}{Pr_p} \right)^{0,25} = \frac{\alpha \cdot d_h}{\lambda}$$

SCHIMBATOARE DE CALDURA CU PLACI

Calcul termic

Valorile constantelor a şi b ($p/H_0=2$)

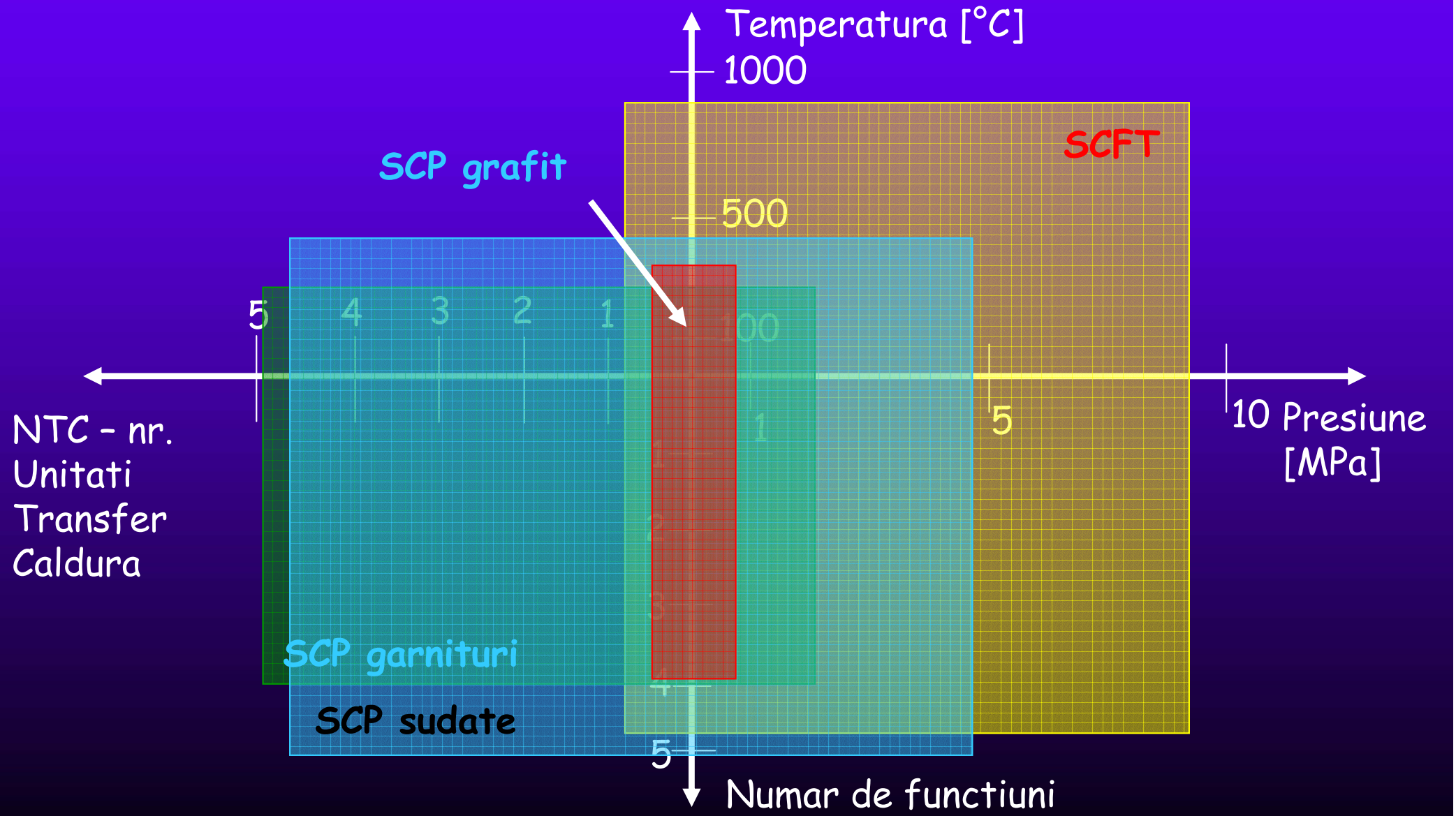
β	a	b	Domeniul Re
30	0,021 0,77	0,54 0,64	120 < Re < 1000 1000 < Re < 14600
45	1,67 0,405	0,54 0,70	300 < Re < 2000 2000 < Re < 20000
60	0,57 1,12	0,70 0,60	150 < Re < 600 600 < Re < 16000
72	1,45	0,58	200 < Re < 4000
90	0,98	0,63	300 < Re < 14000

Valorile constantelor a şi b ($pH_0 = 3,33$)

β	a	b	Domeniul Re
15	0,122	0,685	40<Re<12600
30	0,254	0,638	45<Re<14600
45	0,347	0,653	50<Re<14600
60	0,344	0,705	45<Re<13200
75	0,338	0,698	45<R2<12500
90	0,270	0,700	50<Re<15000

SCHIMBATOARE DE CALDURA CU PLACI

Comparatie SCP - SCFT



SCHIMBATOARE DE CALDURA CU PLACI

Comparatie SCP - SCFT

	SCPG	SCPB	SCFT
K [$W.m^{-2}.K^{-1}$]	3500 – 7000	3500 – 7000	500 - 3500
Dimensiuni	10 – 50 %	10 – 50 %	100 %
Eficacitate	95 – 98 %	95 – 98 %	70 – 90 %
Etanseitate	FB, corectabila	FB, greu detectabila	FB, greu detectabila
T max. [°C]	160	250 – 300	> 500
P max. [MPa]	2	3,2	> 100
M_V max. [mc/h]	4000	2000	F de tip
ΔT max. [K]	1 – 2	2 – 3	5 – 10
Pret	Scazut	Mediu	Scazut