Basco Type 500 Heat Exchangers

Type 500 Commercial Standard Models

3" – 8" Diameters, Straight and U-Tubes

Type 500 Standard Materials

Shell	Steel Pipe or Tubing
Tubes	Copper, Admiralty or 90/10 CuNi
Tubesheets	Steel, Stainless or 90/10 CuNi
Bonnets	Cast Iron
Baffles	Carbon Steel
Gaskets	Compressed Fiber

Commercial standard model and modified model with special shellside flanges shown. Several modifications are available without adding manufacturing delays.

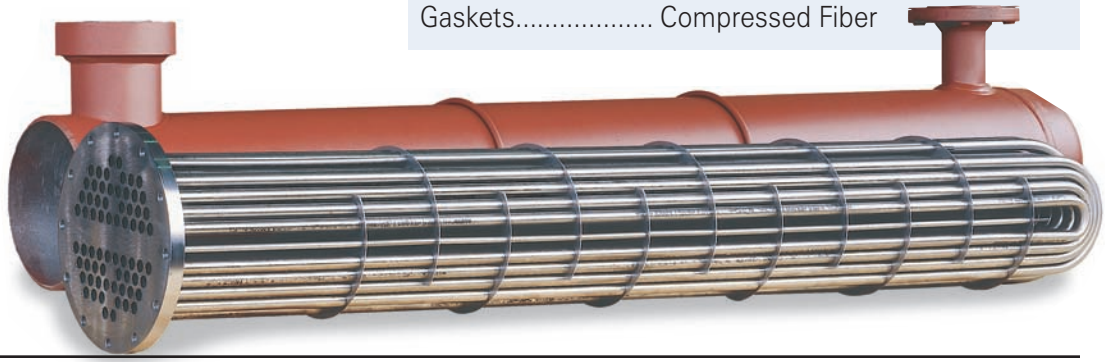
Type 500 Stainless Steel Models

3" – 8" Diameters, Straight and U-Tubes

Type 500 S Materials

Shell	Welded 304 Stainless
Tubes	304 Stainless Steel
Tubesheets	304 Stainless Steel
Bonnets	Cast 304 Stainless
Baffles	304 Stainless Steel
Gaskets	Compressed Fiber

Model shown is removable tubesheet U-tube with type 304 Stainless Steel tubing. Fixed bundle models also available.



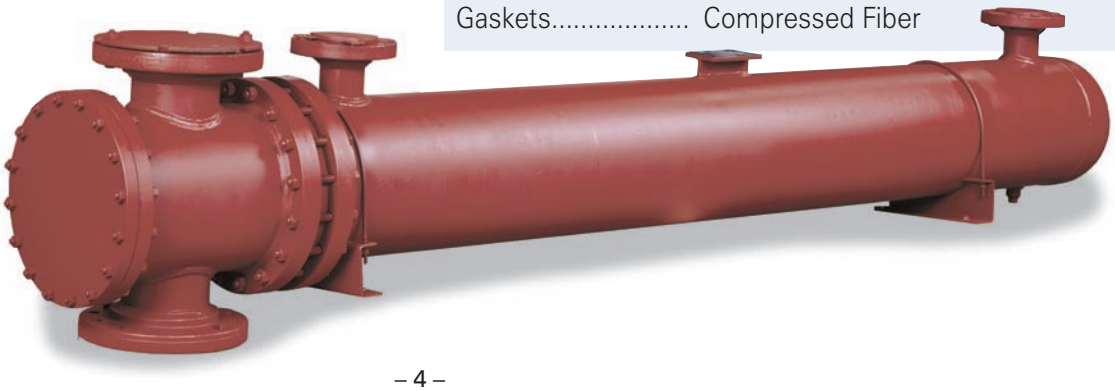
Type 500 ASME/TEMA-C Models

5" – 12" Diameters, Straight and U-Tubes

ASME/TEMA-C Materials

Shell	Carbon Steel
Tubes	Copper, Admiralty, 90/10 CuNi, SS
Tubesheets	Carbon Steel, 90/10, SS
Bonnets	Carbon Steel, Cast Ductile Iron
Baffles	Carbon Steel, SS
Gaskets	Compressed Fiber

ASME Code models are available from 5" diameter and up. TEMA-C models are available in straight and U-tube designs through 12" diameter.



Common Specifications

Standard Straight-Tube Type 500 Heat Exchangers

Model	Shell Dia.	No. Tubes 1/4"	3/8"	5/8"	Surface 1/4"	3/8"	5/8"	Connection Size – (Max Flow) Shell	1-Pass	2-Pass	4-Pass
03014	3-1/4"	60	24	NA	4.6	2.7	-	1	1-1/2	1	1
03024					7.8	4.8	-		(47)	(23)	(12)
04014					7.9	5.0	-				
04024	4-1/2"	104	44	NA	13.6	8.6	-	1-1/2	2	1-1/4	3/4
04036					20.4	12.2	-		(86)	(43)	(22)
05014					13.7	9.1	5.3				
05024	5-1/4"	180	80	28	23.6	15.7	9.1	1-1/2	2-1/2	1-1/2	1
05036					35.4	24	13.6		(160)	(80)	(40)
06024					34.5	22.8	13.0				
06036	6-1/4"	264	116	40	51.8	34.2	19.5	2	3	2	2
06048					69.1	45.6	26		(230)	(115)	(57)
06060					86.4	57	32.5				
08024					-	45.6	24.9				
08036					-	68.3	37.3				
08048	8-5/8"	NA	232	76	-	91.1	49.7	3	3	2-1/2	2
08060					-	114	62.1		(461)	(231)	(115)
08072					-	136.7	74.5				

ASME Code Straight-Tube Type 500 Heat Exchangers

Model	Shell Dia.	No. Tubes 3/8"	5/8"	Surface 1/4"	3/8"	5/8"	Connection Size – (Max Flow) Shell	1-Pass	2-Pass	4-Pass
05024	5-1/4"	80	28	-	15.7	28	1-1/2	2-1/2	1-1/2	1
per foot					7.8	4.5		(160)	(80)	(40)
06024	6-1/4"	116	40	-	22.8	13	2	3	2	1-1/2
per foot					11.4	6.5		(230)	(115)	(57)
08024	8-5/8"	232	76	-	45.6	24.9	3	3	2-1/2	2
per foot					22.8	12.4		(461)	(231)	(115)

ASME/TEMA-C Straight-Tube Heat Exchangers

Model	Shell Dia.	No. Tubes 3/8"	5/8"	Surface 1/4"	3/8"	5/8"	Connection Size – (Max Flow) Shell	1-Pass	2-Pass	4-Pass
05024	5-1/4"	72	20	-	14	6.5	1-1/2	2-1/2	1-1/2	1
per foot					7.8	4.5		(160)	(80)	(40)
06024	6-1/4"	104	36	-	20.4	11	2	3	2	1-1/2
per foot					10.2	5.9		(230)	(115)	(57)
08024	8-5/8"	208	68	-	40.9	22.2	3	3	2-1/2	2
per foot					20.4	11.1		(461)	(231)	(115)
10120	10-3/4"	344	116	-	338	190	4 FL	6 FL	4 FL	2-1/2
per foot					34	19		(630)	(315)	(158)
12120	12-3/4"	516	172	-	507	281	6 FL	6 FL	4 FL	3
per foot					51	28		(935)	(465)	(234)

Standard Type 500 U-Tube Heat Exchangers

Model	Shell Dia.	No. Tubes 3/8"	5/8"	Surface 1/4"	3/8"	5/8"	Connection Size – (Max Flow) Shell	1-Pass	2-Pass	4-Pass
05048	5-1/4"	34	8	-	27	11	1-1/2	-	1-1/2	1
per foot					6.8	2.7		-	(44)	(22)
06048	6-1/4"	52	14	-	51	18.5	2	-	2	1-1/2
per foot					10.2	4.6		-	(77)	(38)
08048	8-5/8"	104	34	-	82	44.5	3	-	2-1/2	2
per foot					20.5	11.2		-	(185)	(93)

ASME/TEMA-C U-Tube Heat Exchangers

Model	Shell Dia.	No. Tubes 3/8"	5/8"	Surface 1/4"	3/8"	5/8"	Connection Size – (Max Flow) Shell	1-Pass	2-Pass	4-Pass
10120	10-3/4"	174	58	-	350	195	4 FL	-	4 FL	2-1/2
per foot					34	19		-	(316)	(158)
12120	12-3/4"	260	88	-	527	297	6 FL	-	4 FL	3
per foot					51	29		-	(480)	(240)

*Max tube length: 3/8" OD - 12 feet; 5/8" OD - 20 feet. Max flow based on 8 fps. Corrosion allowance: 1/16" both sides on TEMA-C models. Flanges are 150# ANSI Raised-Face

Product Nomenclature

Size (inches)	05 Shell Dia.	024 Tube Length

Overall length, shell port center distance and mounting hole locations can be adjusted by adding or subtracting the actual tube length differential.

Standard Ratings

Design Pressure	Std Units	TEMA-C/ASME
Shellside	300 psi	150 psi
Tubeside	150 psi	150 psi

Design Temp 300°F, Stainless higher

Test Pressure
All units are either pneumatically or hydrostatically tested.

Shells - Steel or 304 Stainless pipe to ASME specification. Shells are cleaned prior to assembly.

Tubes - Copper, roller expanded into tubesheet in 1/4", 3/8" or 5/8" OD. Also available in Admiralty, 304, 316 Stainless Steel or 90/10 CuNi.

Tubesheets - Quality steel to ASME specifications. Precision machined for excellent sealing. Stainless Steel and 90/10 CuNi also available in all sizes.

Baffles - Hot-rolled punched steel for enhanced strength and reliability. Engineered for correct fit to reduce tube wall damage from high velocity fluids. Also available in Brass and 304 Stainless Steel.

Heads - Cast or fabricated construction. Available in 1, 2, or 4-pass designs to meet ASME specifications. Designed to provide excellent gasket sealing. Options include fabricated heads from Steel, 304 Stainless, and 90/10 CuNi. Cast heads are available in Iron, cast 304 Stainless, or cast Bronze. Zinc anodes can be supplied for added protection.

Connections - Tubeside or shellside threaded or flanged in sizes 3", 4", 5", 6" and 8". Additional connections can be provided as option on all models.

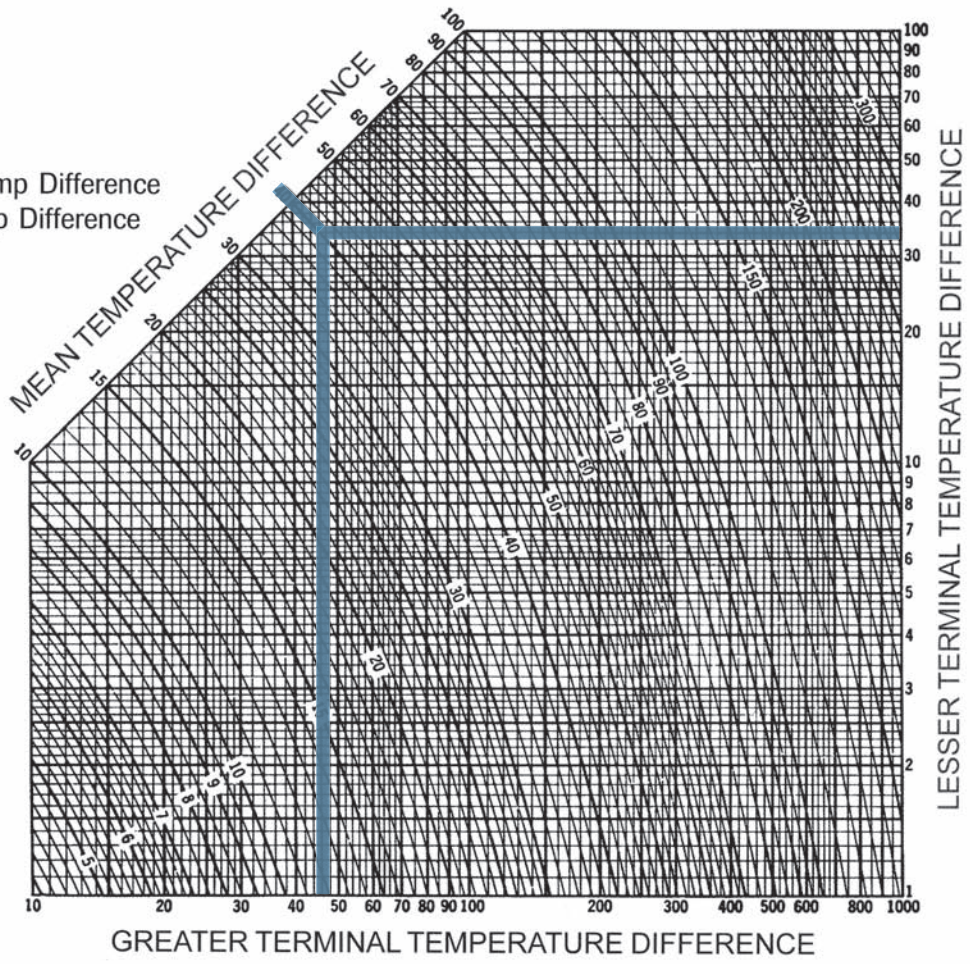
Codes - ASME, ASME/TEMA-C are available and stamped accordingly. Code Version 1 has ductile iron bonnets and tubing for shell. Code Version 2 has fabricated heads and pipe for shell.

Finish - Exterior surfaces are cleaned and painted with a high quality red oxide primer.

Selection Sizing

$$LMTD = \frac{(GTTD - LTTD)}{LogN\left(\frac{GTTD}{LTTD}\right)}$$

GTTD = Greater Terminal Temp Difference
LTTD = Lesser Terminal Temp Difference



P

R \ P	0.5	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.6	0.7	0.8	0.9	1.0
0.2								.99	.99	.98	.97	.94	.90	.84	.71
0.4							.99	.98	.97	.95	.92	.85	.70		
0.6						.99	.98	.96	.94	.92	.84				
0.8					.99	.98	.96	.94	.91	.87					
1.0					.98	.97	.94	.91	.86	.77					
2.0			.99	.97	.94	.84	.74								
3.0			.97	.93	.83										
4.0		.99	.95	.85											
5.0		.98	.91												
6.0		.96	.85												
8.0		.93													
10.0	.99	.88													
12.0	.98	.72													
14.0	.97														
16.0	.95														
18.0	.94														
20.0	.91														

$$R = \frac{T_1 - T_2}{t_2 - t_1}$$

$$P = \frac{t_2 - t_1}{T_1 - t_1}$$

Locate Correction Factor at Intersection of "R" and "P"

Corrrection for LMTD when Using Multi-Pass Heat Exchangers.

Multi-pass heat exchangers cannot take full advantage of counter-current flow, which changes the LMTD for the application.

To correct the LMTD, multiply the value obtained from the above graph by the correction factor obtained from this correction graph. If the P and R values intersect outside the graph, consult the factory to discuss your specific application.

T_1 ..... Hot Fluid Inlet Temp, °F
T_2 ..... Hot Fluid Outlet Temp, °F

t_1 ..... Cold Fluid Inlet Temp, °F
t_2 ..... Cold Fluid Outlet Temp, °F

Sample Calculation To Select the Right Type 500 Heat Exchanger.

Conditions

Process Fluid ..... 20 GPM of SAE 10 Oil to be cooled from 140° to 120°F.
Cooling Medium .... Water at 85°F. Assume a 10° maximum temperature rise.
Cooler Design..... 4-Pass design is selected to conserve water and energy usage.

Thermal Duty Determination

Q = ΔT • Thermal Duty Value (Chart) • GPM (or air SCFM)
Q = (140-120) • 204 • 20
Q = 81,600 Btuh (Btu's per hour)

Determine Cooling Water Flow Required

Q = Δt(allowable temp rise) • Flow Constant • GPM

$$\frac{Q}{\Delta T \bullet \text{Flow Constant}} = \text{GPM} = \frac{81{,}000}{10 \bullet 500}$$

$$= 16.3 \text{ GPM}$$

Determine Exchanger Surface Required

$$\text{Area} = \frac{Q}{U \bullet \text{Log Mean Temp Difference}}$$

Q = 81,600 Btuh

"U-Value" is obtained from the chart. For light oil the range is from 70-100. Assuming the oil to be typical machine lubricant with moderate fouling characteristics we will use 80 as a conservative U-Value.

Calculate LMTD from graph on facing page

140°	—	120°	(Oil ΔT)
-95°	—	-85°	(Water ΔT)
45°	—	35°	

Thus.. greater temperature difference = 45°
lesser temperature difference = 35°

Reading from the graph, LMTD = 40°F

$$\text{Area} = \frac{Q}{U \bullet \text{LMTD}} = \frac{81{,}600 \text{ Btuh}}{80 \bullet 40}$$

$$= 25.5 \text{ sq. ft.}$$

Select a Type 500 Heat Exchanger

Refer to the Common Specification chart on page five. Notice that Model 05036 has 24 square feet of surface and is too small for the application.

Model 06036 has 116 tubes and contains 34 sq. ft. of tube surface. Now assure the max flow rate is not exceeded. The previous calculated flow rate is 16.3 GPM. The 06036 has a maximum flow rate of 57 GPM. This is acceptable.

In the event that the required flow rate exceeds the maximum flow rate for the heat exchanger, a larger model is required.

Calculating Actual Heat Exchanger Length

You can calculate the actual length of the heat exchanger required to satisfy a given set of conditions. The typical tube surface contained per linear foot of tubing is:

1/4" Tubing ..... 0.0655 sq. ft per ft. of tubing
3/8" Tubing ..... 0.0982 sq. ft per ft. of tubing
5/8" Tubing ..... 0.1636 sq. ft per ft. of tubing

$$\text{Linear feet of tubing required} = \frac{\text{Area Required}}{\text{No. of Tubes} \bullet \text{Area Per Foot}}$$

Using the previous example…

$$\text{Linear Feet} = \frac{26 \text{ sq. ft.}}{116 \text{ tubes} \bullet 0.0982} = 2.28 \text{ feet}$$

Calculating Tube Side Velocity

You can calculate the velocity of the fluid flowing through the tubes. Velocity should fall between 2 and 6 feet per second and not exceed 8 feet per second. Velocity factors for standard tubing are:

1/4" Tubing ..... 9.66 velocity factor, (Vf)
3/8" Tubing ..... 4.02 velocity factor, (Vf)
5/8" Tubing ..... 1.47 velocity factor, (Vf)

Using the previous example…

$$\text{Velocity (ft./sec.)} = \frac{16.3 \text{ (GPM)} \bullet 4.02 \text{ (Vf)} \bullet 4 \text{ (Passes)}}{116 \text{ (No. of Tubes)}}$$

$$= 2.26 \text{ feet per second in the tubes}$$

Common Heat Transfer Formulas

Btuh	=	Btu/min. • 60
Btuh	=	Horsepower • 2,545
Btuh	=	Kw • 3,413
Btuh Oil	=	GPM (Oil) • 204 • ΔT
Btuh Water	=	GPM (Water) • 500 • ΔT
LMTD °F	=	LMTD °C • 1.8

TYPICAL THERMAL DUTY VALUES

Liquid Type	Constant Value		Spec. Gravity		Spec. Heat		°C Liters/min		°F Gallons/min
Water	500	x	1.0	x	1.0	=	238	or	500
50% Ethlene Glycol	500	x	1.04	x	.83	=	203	or	428
Oil (150 SSU)	500	x	.85	x	.48	=	97	or	204
Air	4.58	x	-	x	.241	=	110 SCFM		

TYPICAL OVERALL U-VALUES

Hot Fluid	Cooling Fluid	U-Value (typical)
Steam	Water	300-500
Steam	Light Oil (SAE 10)	70-100
Steam	Heavy Oil	40-50
Steam	Air	30-40
Water	Water (85°F)	275-325
Oil (SAE 10)	Water (85°F)	70-100
Oil (SAE 30)	Water (85°F)	60-80
50% Glycol	Water	150-180

Note: Higher U-Values apply to clean, low viscosity flows. Use lower U-Values for higher pressure, dirty or viscous fluids as they tend to foul a heat exchanger.