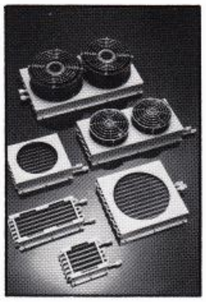
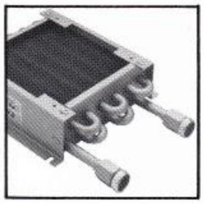
THERMATRON

THERMAL MANAGEMENT FOR ELECTRONICS

HIGH RELIABILITY, COMPACT LIQUID-TO-AIR HEAT EXCHANGERS

High-Reliability Liquid-to Air Copper Circuit Heat Exchangers — 720 Series


720 Series
Heat Exchangers


Model 720
Heat Exchanger

Thermatron Engineering 720 Series compact copper circuit heat exchangers provide maximum reliability heat transfer for closed-loop liquid cooling for commercial computer systems, medical and industrial lasers, instruments, industrial power supplies, and other demanding electronics applications. The 720 series is available in 12 models (with or without fans) using a copper tube liquid circuit. Designed for use with tap or chilled water, the 720 Series can also be used with certain other inert coolant liquids and gases (refer to the 730 Series stainless steel heat exchangers, below, for units compatible with deionized water systems and chemically aggressive coolants and gases).

The standard 720 Series heat exchanger models are manufactured to computer grade reliability standards. Coolant circuits are all copper tubing with metallically bonded copper fins; frame is of fabricated aluminum complete with fan plenum and mounting fasteners. Joints are silver brazed and assemblies are pressure rated to 150 PSIG. All 720 Series heat exchangers are hot water flushed and Cobratec™ treated internally for long-term corrosion resistance. Finish is scratch-resistant gray lacquer. Terminations are MIL-SPEC stainless steel flare fittings; stub tubes and hose bead terminations are also available.

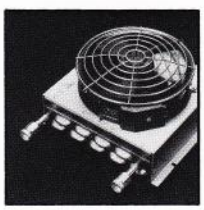
Custom 720 designs are produced by Thermatron Engineering for specific dimensional and performance requirements.

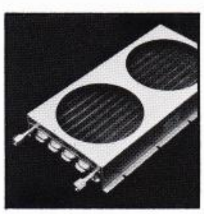
720 SERIES *Performance with Air & Water*

Heat Exchanger Part Number		Core Geometry	Fan Model & (Quantity) 115 VAC 50/60 Hz Standard	Standard Air Flow & Air Pressure Drop	Typical Water Flow & Pressure Drop	Heat Dissipation (Watts) when: Water temp in-Air temp in=			
W/O Fan	W/Fan(s)					10°C	30°C	50°C	70°C
720	720M1	(12) Core Tubes	Muffin XL™ (1)	65 CFM @.12"H_2O	1 GPM @ 2.5 PSID	210w	630w	1050w	1470w
		All in Series			2 GPM @ 5 PSID	250w	750w	1250w	1750w
721	721M2	(12) Core Tubes	Muffin XL™ (2)	130 CFM @.12"H_2O	1 GPM @ 3 PSID	400w	1200w	2000w	2800w
		All in Series			2 GPM @ 7 PSID	450w	1350w	2250w	3150w
722	722F1	(20) Core Tubes	Feather™ (1)	190 CFM @.13"H_2O	1 GPM @ 4 PSID	580w	1740w	2900w	4060w
		All in Series			2 GPM @ 11 PSID	640w	1920w	3200w	4480w
723	723F2	(20) Core Tubes	Feather™ (2)	380 CFM @.13"H_2O	1 GPM @ 4.5 PSID	1080w	3240w	5400w	7560w
		All in Series			2 GPM @ 14 PSID	1220w	3660w	6100w	8540w
724	724C1	(28) Core Tubes	Caravel™ (1)	220 CFM @.15"H_2O	1 GPM @ 1 PSID	880w	2640w	4400w	6160w
		Two Parallel Circuits			2 GPM @ 2 PSID	1050w	3150w	5250w	7350w
725	725C2	(28) Core Tubes	Caravel™ (2)	440 CFM @.15"H_2O	1 GPM @ 2 PSID	1590w	4770w	7950w	11,100w
		Two Parallel Circuits			2 GPM @ 4 PSID	1940w	5820w	9700w	13,600w

NOTE: Please refer to Heat Exchanger Size Selection Procedure or consult the factory for performance points not listed above.

High-Reliability Liquid-to-Air Stainless Steel Heat Exchangers — 730 Series


Model 732F1
Heat Exchanger
(w/fan)


Model 735
Heat Exchanger

Ultra-clean coolant circuit requirements for water-cooled optic systems, deionized water coolants for medical and industrial lasers, and protection from aggressive gases and other coolants can be achieved by specifying Thermatron Engineering 730 Series high-reliability stainless steel heat exchangers for liquid cooling systems. The 730 Series is available in 12 models with or without fans.

The standard 730 Series heat exchanger models are manufactured to computer grade reliability standards. Tubing and all manifold circuitry are constructed of 316L stainless steel with metallically bonded copper fins; frame is of fabricated aluminum with gold irridite finish complete with fan plenum and mounting fasteners. Joints are precision TiG welded and assemblies are pressure rated to 150 PSIG. All 730 Series heat exchangers receive internal cleaning treatment with an array of acidic, alkaline, and deionized water flushes at high temperature and flow to assure coolant loop purity. Internal passivation is also available. Terminations are MIL-SPEC stainless steel flare fittings, stub tubes, or hose beads.

Custom 730 designs are produced by Thermatron Engineering for specific dimensional and performance requirements.

730 SERIES *Performance with Air & Water*

Heat Exchanger Part Number		Core Geometry	Fan Model & (Quantity) 115 VAC 50/60 Hz Standard	Standard Air Flow & Air Pressure Drop	Typical Water Flow & Pressure Drop	Heat Dissipation (Watts) when: Water temp in-Air temp in=			
W/O Fan	W/Fan(s)					10°C	30°C	50°C	70°C
730	730M1	(12) Core Tubes	Muffin XL™ (1)	65 CFM @.12"H_2O	1 GPM @ 3 PSID	200w	600w	1000w	1400w
		All in Series			2 GPM @ 9 PSID	240w	720w	1200w	1680w
731	731M2	(12) Core Tubes	Muffin XL™ (2)	130 CFM @.12"H_2O	1 GPM @ 4 PSID	380w	1140w	1900w	2660w
		All in Series			2 GPM @ 12 PSID	430w	1290w	2150w	3010w
732	732F1	(20) Core Tubes	Feather™ (1)	190 CFM @.13"H_2O	1 GPM @ 6 PSID	560w	1680w	2800w	3920w
		All in Series			2 GPM @ 17 PSID	610w	1830w	3050w	4270w
733	733F2	(20) Core Tubes	Feather™ (2)	380 CFM @.13"H_2O	1 GPM @ 7 PSID	1040w	3120w	5200w	7280w
		All in Series			2 GPM @ 21 PSID	1170w	3510w	5850w	8190w
734	734C1	(28) Core Tubes	Caravel™ (1)	220 CFM @.15"H_2O	1 GPM @ 2 PSID	840w	2520w	4200w	5880w
		Two Parallel Circuits			2 GPM @ 5 PSID	1010w	3030w	5050w	7070w
735	735C2	(28) Core Tubes	Caravel™ (2)	440 CFM @.15"H_2O	1 GPM @ 3 PSID	1530w	4590w	7650w	10,700w
		Two Parallel Circuits			2 GPM @ 7 PSID	1860w	5580w	9300w	13,000w

NOTE: Please refer to Heat Exchanger Size Selection Procedure or consult the factory for performance points not listed above.

THERMATRON ENGINEERING, INC.
687 Lowell Street, Methuen, MA 01884 USA • PHONE: (978) 687-8844 • FAX: (978) 687-2477
E-Mail: info@thermatroneng.com • Web Site: http://www.thermatroneng.com

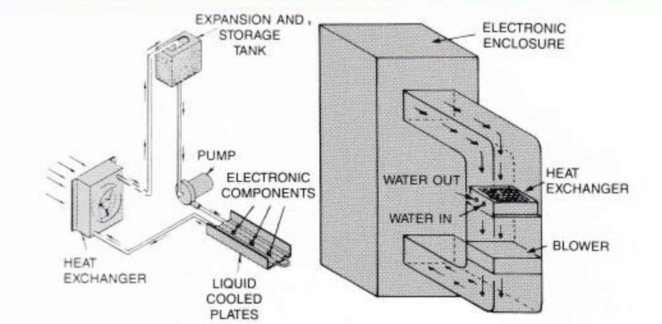
Heat Exchangers

Liquid and air enter a heat exchanger at different temperatures and exit with shared temperatures. The resultant heat transfer can be used to cool the liquid to a temperature near that of the incoming air. Conversely, a heat exchanger can be used in reverse, to cool the air to a temperature near that of the incoming liquid.

Typical Operation

In a typical closed loop liquid cooling system using water or other fluid as the coolant, the heat exchanger is commonly combined with one or more liquid-cooled plates. The heat-producing devices are typically mounted on these plates. Heat is transferred from the devices to the plate and then to the fluid. The liquid coolant circulates between the plates and the heat exchanger, transferring the heat to the heat exchanger where it is transferred to the air.

Alternately in a typical closed loop air cooling system cool water is supplied to the heat exchanger and (filtered) air is circulated between an electronic enclosure and a heat exchanger which then transfers the heat to water flowing through the tubes. Often the heat exchanger is placed inside the enclosure with cooled exit air blown directly through PC card racks, power devices, etc. This system permits closed loop air cooling and prevents entry of contaminated intrusion air.



Typical Liquid Cooling System **Typical Air Cooling System**

Heat Exchanger Size Selection Procedure

Heat exchangers and their associated fans must be carefully selected and matched to meet the needs of the cooling system. It is critical, then, to know what the heat transfer requirements are and what equipment will transfer the heat load effectively. Heat exchanger performance is a strong function of surface area (size and design of heat exchanger) and the initial temperature difference, or "ITD" between liquid and air entering the heat exchanger. Thus, larger heat exchangers operating at high ITD's dissipate the most heat. Raising coolant flow rates to approximately 2.0 GPM also helps to boost heat exchanger efficiency.

To select an appropriate heat exchanger:

1.) Calculate the heat transfer performance requirement (Θ)

$$\Theta = \frac{Q}{ITD} = \frac{Q}{Tw_{in} - TA_{in}}$$

where Q = required heat dissipation rate (watts)

Tw_{in} = inlet water temp (°C). Note, when cooling the water, this is the maximum water temperature desired in the system.

TA_{in} = inlet air temp (°C). Note, when cooling the air, this is the maximum air temperature desired in the system.

2.) Using the performance curves for either 720 Series or 730 Series heat exchangers, draw a horizontal line at the Q/ITD value included in 1.). Choose any model heat exchanger whose performance lies above this line.

3.) Using water pressure drop curves for either 720 or 730 Series heat exchangers, find the ΔP of the associated water flow rate of the heat exchanger model selected in 2.).

If this pressure drop is within the system's pumping capability, the selection process is completed.

If the pressure drop is greater, then three options are possible:

a.) Select a larger heat exchanger; its higher thermal performance will allow operation at a lower water flow rate which results in a lower pressure drop.

b.) If space is not available to use a larger heat exchanger, then use a different fan with higher CFM to increase the heat exchanger's thermal performance beyond that shown with a standard fan. Heat exchanger thermal performance is approximately linear with air CFM. This, in turn, allows operation at a lower water flow rate, thus lowering the pressure drop. Please consult the factory for alternate fan products, voltages, bearing systems, etc.

c.) Finally, if use of a high CFM air mover is not feasible, it is possible in some cases to design a special water flow circuit and manifolding to reduce the system pressure drop. Please contact the factory for engineering assistance.

4.) If desired, exit water and exit air temperatures can be approximated by energy balance =

$$Tw_{out} = Tw_{in} - \frac{Q}{264\ (GPM)} \quad (^\circ C)$$

$$TA_{out} = TA_{in} + \frac{Q}{0.62\ (CFM)} \quad (^\circ C)$$

Example: Assume the following heat transfer parameters:

(assume copper circuit acceptable)

Required heat (power) dissipation = 2.8 kilowatts = 2800 watts

Incoming water temperature = 84°C

Incoming air temperature = 21°C

1.) $\Theta = \frac{2800\ \text{watts}}{84^\circ C - 21^\circ C} = 44.4\ \frac{W}{^\circ C}$

2.) Referring to the Thermal Performance curves for the 720 Series (Figure 1), it is evident that the following models are acceptable:

Model 721 at 2.0 GPM or higher water flow rate

Model 722,723,724,725 at any water flow rate above 1.0 GPM.

3.) Now referring to the Pressure Drop curves for the 720 Series (Figure 1). Model 721 requires a 7 PSI pressure drop at 2.0 GPM. If the pumping system can accept this pressure drop, Model 721 is adequate for the task. If the pressure drop is too high, select Model 722 at 1.0 GPM, pressure drop 4 PSI. Similarly, Model 724 at 1.0 GPM offers still less pressure drop, 1.0 PSI. Both Models 722 and 724 offer additional thermal capacity over Model 721 which will lower system temperatures.

Note: These application notes make the assumption that the water temperature is higher than that of the air. Since the thermal process is usually reversible, these heat exchangers can be used to cool air if the inlet water temperature is below that of the air. The same equation above can be used by subtracting the cooler temperature from the hotter one and determining the thermal performance in the same manner described above. The information presented refers to systems transferring heat between water and air. Information relating heat exchanger performance to other fluids can be obtained from the factory.

720 SERIES
APPROXIMATE PERFORMANCE ON AIR AND WATER

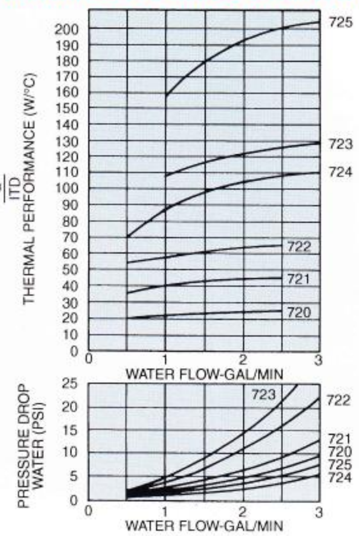


Figure 1

730 SERIES
APPROXIMATE PERFORMANCE ON AIR AND WATER

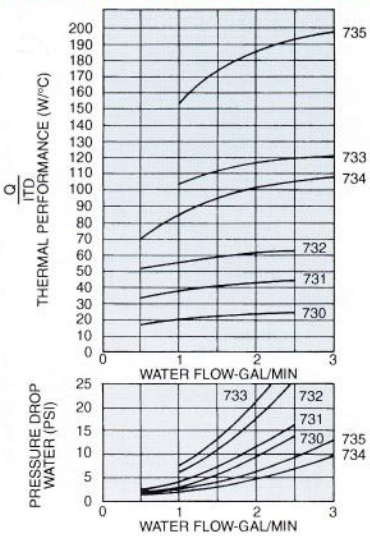
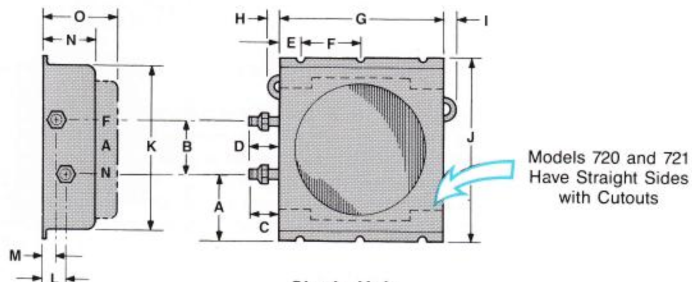


Figure 2

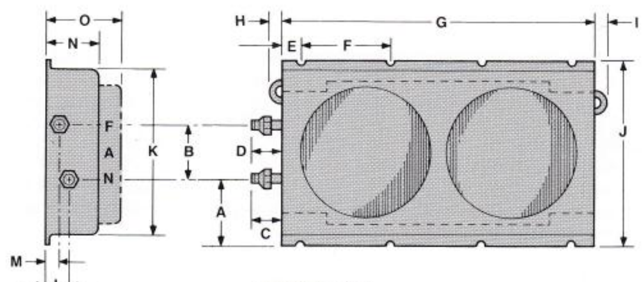
THERMATRON ENGINEERING, INC.
687 Lowell Street, Methuen, MA 01884 USA • PHONE: (978) 687-8844 • FAX: (978) 687-2477
E-Mail: info@thermatroneng.com • Web Site: http://www.thermatroneng.com

Size Specifications Standard

Heat Exchanger



Single Unit



Double Unit

Liquid Connection 37° Flare Fitting Nut and Sleeve

Model No. (No Fan)	⚠1 Model No. (W/Fan)	A	B	C	D	E	F	G	H	I	J	K	L	M	N	⚠2 O	WEIGHT No Fan (lbs)	WEIGHT With Fan (lbs)	⚠3 FITTING SIZES (37° Flare Fitting Nut & Sleeve)
720	720M1	1.21	3.75	1.60	1.60	.40	2.50	5.80	.69	.80	5.79	4.96	.40	.40	1.84	3.38	2.2	3.5	3/8 O.D. Tube, 9/16 X 18 Thread
721	721M2	1.21	3.75	1.34	1.34	.75	4.50	10.50	.69	.80	5.79	4.96	.40	.40	1.84	3.38	3.7	6.3	3/8 O.D. Tube, 9/16 X 18 Thread
722	722F1	7.72	.38	1.30	2.30	.72	4.03	9.50	.49	.38	9.00	8.00	1.13	.50	2.50	4.68	5.0	6.5	3/8 O.D. Tube, 9/16 X 18 Thread
723	723F2	7.72	.38	1.30	2.30	1.00	7.75	17.50	.49	.38	9.00	8.00	1.13	.50	2.50	4.68	9.6	12.6	3/8 O.D. Tube, 9/16 X 18 Thread
724	724C1	5.50	1.12	1.63	1.63	.72	5.03	11.50	.36	.36	12.00	11.00	.63	1.28	2.12	5.72	7.6	12.0	1/2 O.D. Tube, 3/4 X 16 Thread
725	725C2	5.50	1.12	1.63	1.63	1.03	6.50	21.56	.36	.36	12.00	11.00	.63	1.28	2.12	5.72	14.6	23.4	1/2 O.D. Tube, 3/4 X 16 Thread
730	730M1	1.16	3.75	1.70	1.70	.64	4.00	5.28	.30	1.00	5.84	5.16	1.05	1.05	1.84	3.38	2.2	3.5	3/8 O.D. Tube, 9/16 X 18 Thread
731	731M2	1.16	3.75	1.70	1.70	1.25	4.00	10.50	.05	.75	5.84	5.16	1.05	1.05	1.80	3.34	3.7	6.3	3/8 O.D. Tube, 9/16 X 18 Thread
732	732F1	.88	6.75	1.70	1.70	2.00	4.00	8.00	.30	1.00	9.00	8.12	1.25	1.25	2.60	4.78	5.0	6.5	3/8 O.D. Tube, 9/16 X 18 Thread
733	733F2	.88	6.75	1.70	1.70	2.03	4.00	16.10	.30	1.00	9.00	8.12	1.25	1.25	2.60	4.78	9.6	12.6	3/8 O.D. Tube, 9/16 X 18 Thread
734	734C1	5.03	1.88	1.70	1.70	1.00	4.00	10.00	.30	1.00	12.06	11.20	.60	1.25	2.63	6.23	7.6	12.0	1/2 O.D. Tube, 3/4 X 16 Thread
735	735C2	5.03	1.88	1.70	1.70	1.05	6.00	20.10	.30	1.00	12.06	11.20	.60	1.25	2.63	6.23	14.6	23.4	1/2 O.D. Tube, 3/4 X 16 Thread

All dimensions in inches.

⚠1 Fan Type — 115 VAC 1/60 Hz
720/730 Single Muffin™ XL
722/732 Single Feather™
724/734 Single Caravel™

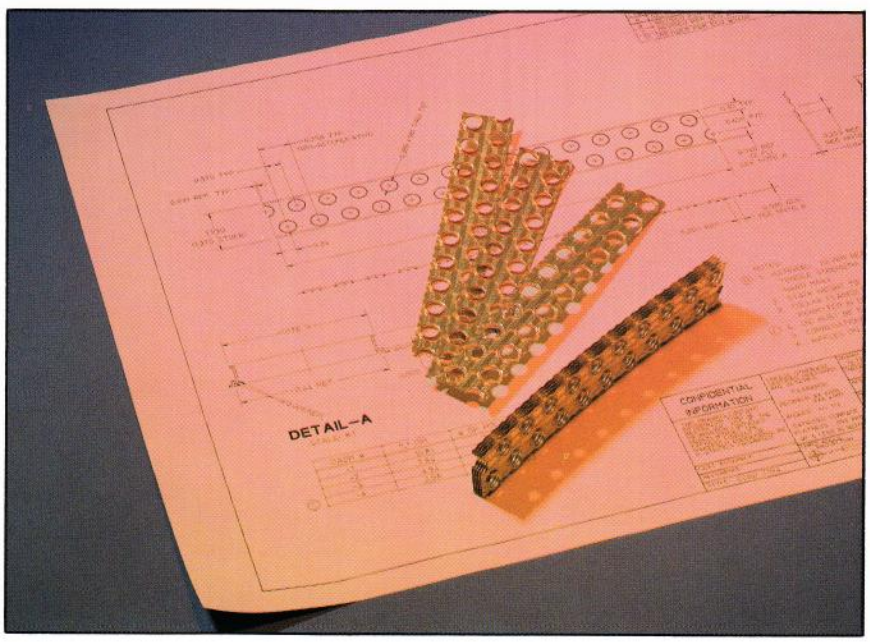
721/731 Two Muffin™ XL Fans
723/733 Two Feather™ Fans
725/735 Two Caravel™ Fans

⚠2 Without Finger Guard

⚠3 All units also available with straight tube and hose bead terminations, 90 degree bends, etc.

Please contact the factory for assistance

The Thermatron Engineering state-of-the-art riffled and corrugated full-collar copper fin provides added heat transfer surface area and excited air flows. Standard on all 720 Series and 730 Series heat exchangers, this unique fin geometry improves thermal performance over straight fin designs, and represents continued product development to provide enhanced heat rejection capability in ever-smaller packages.



THERMATRON ENGINEERING, INC.
687 Lowell Street, Methuen, MA 01884 USA • PHONE: (978) 687-8844 • FAX: (978) 687-2477
E-Mail: info@thermatroneng.com • Web Site: http://www.thermatroneng.com