



## AOCH - AOCHM SERIES



**AOCHM SERIES**  
with hydraulic motor

**AOCH SERIES**  
with electric motor

### AIR COOLED

# OIL COOLERS

- Thermal capacity to 210hp (157Kw).
- Severe duty construction with OSHA guard.
- Serviceable Core®.
- Operating temperature of 300°F at 300 PSI.
- Electric or hydraulic drive.
- Optional: internal built-in bypass relief valve.
- Can be customized to fit your needs.
- Cools: Fluid power systems, rock crushers, presses, shears, lubrication equipment for paper machinery, gear drives, marine transmissions, etc.



## **AOCH SERIES with electric drive**

Industrial air-cooled oil coolers, high performance six row rolled or brazed tube industrial series heat exchangers with direct electric drive cooling fan, OSHA guard, and air directing louvers. Rated operating temperature of 400°F at 300 PSIG. Services standard flow rates from 4 to 250 GPM. Thermal capacity up to 210 hp (157Kw). NPT, flange, or SAE straight thread port connections. Optional built-in bypass relief valve 30 PSI or 65 PSI. Can be modified to meet your requirements. Suitable for most hydraulic oils, lubrications oils, synthetic compressor oils, ethylene glycol, and many other fluids compatible with listed material.



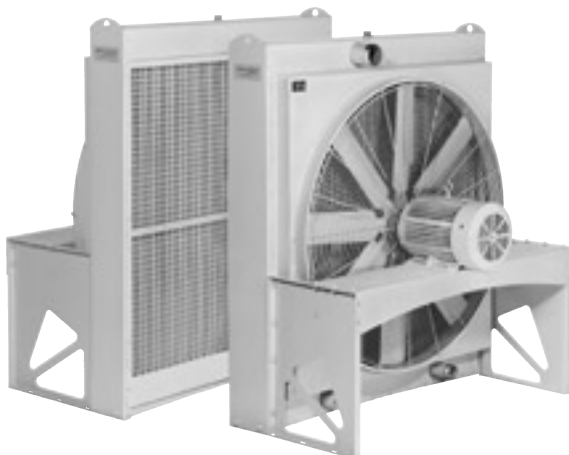
## **AOCHM SERIES with hydraulic drive**

Industrial air-cooled oil coolers with hydraulic fan drive, high performance six row rolled or brazed tube industrial series heat exchangers with direct electric drive cooling fan, OSHA guard, and air directing louvers. Rated operating temperature of 400°F at 300 PSIG. Services standard flow rates from 4 to 250 GPM. Thermal capacity up to 210 hp (157Kw). NPT, flange, or SAE straight thread port connections. Optional built-in bypass relief valve 30 PSI or 65 PSI. Can be modified to meet your requirements. Suitable for most hydraulic oils, lubrications oils, synthetic compressor oils, ethylene glycol, and many other fluids compatible with listed material.



## **AOCH & AOCHM SERIES with optional screen**

Same rugged features as standard AOCH & AOCHM Series with fabricated steel front screen in place of louvers.



## **AOCS Series WITH ELECTRIC DRIVE**

Severe duty air-cooled oil coolers, super capacity, rolled tube industrial series heat exchangers with direct electric drive cooling fan, OSHA guard, and heavy duty front screen. Rated operating temperature of 300°F at 200 PSIG. Standard flow rates from 10 to 600 GPM. NPT, ANSI flange, or SAE code 61 four bolt flange port connections. Optional built-in bypass relief valve 30 PSI or 65 PSI. Can be modified to meet your requirements. Suitable for most hydraulic oils, lubrications oils, synthetic compressor oils, ethylene glycol, and many other fluids compatible with listed material.

For larger cooling capacity (see page 157)

## HIGH PERFORMANCE TURBULATOR



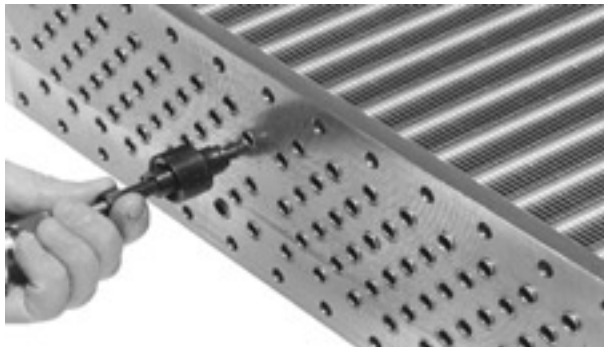
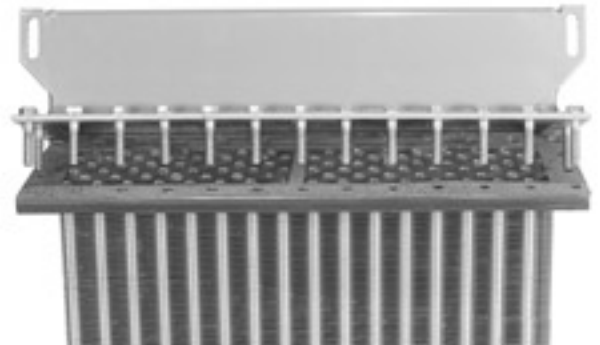
Exclusive American Industrial Turbulators (installed in every flow tube) increase heat transfer by more than 100%.

American Industrial Turbulators eliminate the laminar flow condition normally associated with other smooth tube heat exchangers. High viscosity hydraulic and lubricating oils are easily cooled by this new state-of-the-art turbulator.

## SERVICEABLE CORE®

Core covers disassemble for easy access and cleaning. Repairable design for applications that require limited down time. Roller expanded tube to tube-sheet joint.

100% mechanical bond. No braze or solder joint to fatigue fail, corrode, crack, etc.. No rubber grommets to replace. Positive gasket seal is field replaceable for field maintenance or repair.



## SUPERIOR COOLING FINNS

Copper tubes are mechanically bonded to highly efficient aluminum cooling fins. Die-formed fin collars provide a durable precision fit for maximum heat transfer.

Custom fin design forces air to become turbulent and carry heat away more efficiently than old flat fin designs.

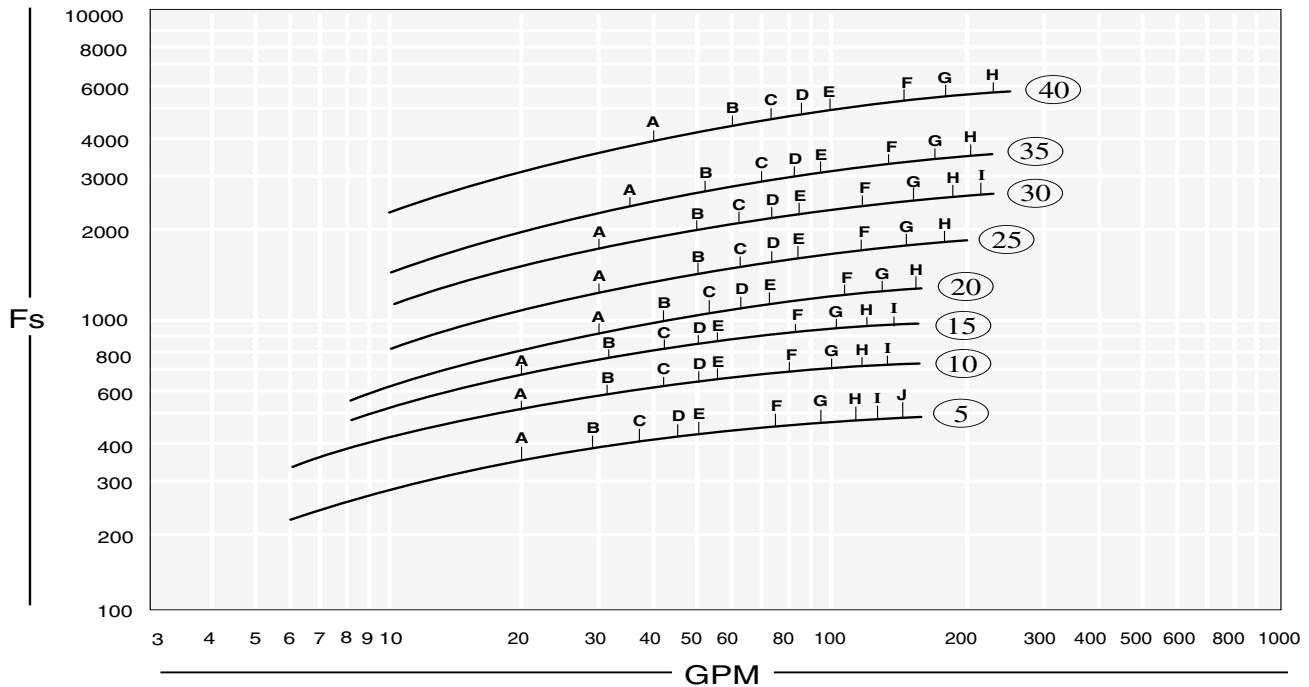
## CONSTRUCTION MATERIALS & RATINGS

Standard Construction Materials		Optional Construction Materials	Standard Unit Ratings	
Tubes	Copper	Carbon Steel, 90/10 Cu.Ni, 316L Stainless Steel	Operating Pressure	300 psig
Fins	Aluminum	Copper	Operating Temperature	300 °F
Turbulators	Steel	Brass		
Tube sheet	Steel	Brass, 316L Stainless Steel	Max. Flow Internal Relief	132 gpm
Removable Tanks	Steel	Brass, 316L Stainless Steel		
Connection pipes	Steel	Brass, 316L Stainless Steel	Max. Fan Over-speed	10 %
Cabinet & frame	Steel	316L Stainless Steel, Galvanized Steel		
Fan Blade	Aluminum	Plastic, Non-sparking, Steel	Max. Ambient Conditions	104 °F
Fan Guard	Zinc Plated			
Gasket	Hypalon Composite	Viton, Nitrile, Composites	Altitude	0-3300 ft.

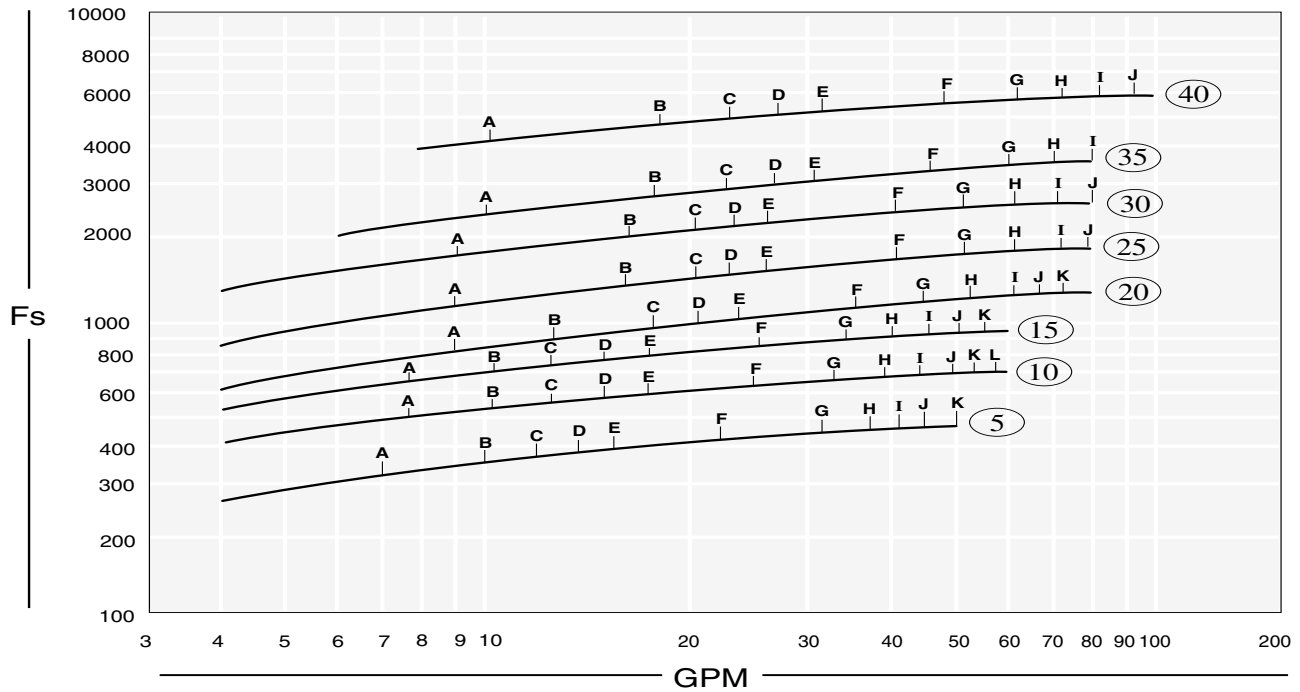
note: AIHTI reserves the right to make reasonable design changes without notice.

# AOCH & AOCHM Series performance

## ONE PASS



## TWO PASS



PERFORMANCE CALCULATION		OIL PRESSURE DROP (PSI) CODE			
$F_s =$	$\frac{\text{Horsepower to be removed (HP)} \times 2545 \times C_v}{\text{°F (Oil Leaving* - Ambient Air Entering)}} = \frac{\text{BTU}}{\text{hr °F}}$	A = 1 PSI	D = 4 PSI	G = 15 PSI	J = 30 PSI
		B = 2 PSI	E = 5 PSI	H = 20 PSI	K = 35 PSI
		C = 3 PSI	F = 10 PSI	I = 25 PSI	L = 40 PSI

\*Represents desired fluid leaving the cooler.

**Note:** When a model selection has been made, record whether the selection was from the one pass curve or the two pass curve so that the unit can be properly plumbed. Incorrect installation can seriously affect the performance.

# AOCH & AOCHM Series selection

## Sizing

The performance curves provided are for petroleum oil at 50 ssu viscosity. However, fluids with characteristics other than the above mentioned may be used by applying a correction factor.

## Heat Load

If the heat load is unknown, a horsepower value can be calculated by first determining the systems total potential. For a basic hydraulic system, it is helpful to know whether the system is open loop (with a large reservoir) or closed loop (normally on mobile equipment, with a very small reservoir). System potentials may be calculated quickly by using one of the two methods below.

There are some system parameters that will be required to properly accomplish the sizing calculations. Without system parameters, it is difficult to determine the optimal heat exchanger size. Normally many of the system parameters can be found on hydraulic schematics or on tags located on the actual equipment. Following are some basic parameters that you should try to acquire before attempting the sizing calculations. However, it is not necessary to have every parameter listed below.

- Main system flow rate (gpm) & operating pressure (psi).
- Electric motor HP driving hydraulic pump (if more than one add up the Hp for all).
- Desired temperature (°F).
- Fluid type (SAE 10, 20, 30, etc....).
- Ambient air temperature (warmest day).
- Desired fan drive (hydraulic, electric, 12-24V DC, etc...).
- BTU's or HP to be cooled (normally given for lubrication systems).
- Maximum pressure drop allowed through the heat exchanger.
- Space available for heat exchanger (LxWxH).
- External air condition (dirty, papers,etc).

## Method 1

Normally used for open loop circuits. Multiply the main hydraulic systems Electric Motor Name plate Horsepower by a heat removal factor (normally 30-50%).

Example: 50 HP motor x 0.3 = 15 HP heat load

## Method 2

Normally used when the HP input potential is unknown or for mobile applications where diesel engines operate the entire system.

Multiply system pressure by the flow rate of the main system divided by 1714 equals system potential (HP). Multiply the system HP by a heat removal factor (Normally 25-35%). Note: In some closed loop systems only a portion of the total system flow is directed through the heat exchanger. This may affect the cooler selection process substantially. You may contact our factory for additional technical assistance.

Example:  $\frac{(2000 \text{ psi} \times 60 \text{ gpm})}{1714} = [70 \text{ HP} \times .25] = 17.5 \text{ HP heat load}$

## Determining Fs value

To determine the proper size heat exchanger for your application, use the following equation to first determine the (Fs) factor:

$$F_s = \frac{\{\text{heat load (HP)} \times 2545 \times C_v\}}{\{\text{°F (oil leaving - air entering)}\}}$$

Example:

Heat load = 17.5 HP

$C_v = 1.14$  (SAE 20) determined from chart. [Located on page 5.]

Desired operating temperature = 120 °F

Ambient air temp. = 100 °F

$$F_s = \frac{\{17.5 \times 2545 \times 1.14\}}{\{120 \text{ °F} - 100 \text{ °F}\}} = 2539$$

## Selection

To select a model, locate the flow rate (GPM) at the bottom of the flow vs Fs graph. Proceed upward until the GPM flow rate intersects with the calculated Fs. The curve closest above the intersection point will meet these conditions.

Example: **Fs = 2539 = Model = AOCH, AOCHM - 35**  
**GPM = 60**  
**PASSES = 1**

## Pressure differentials

Determine the oil pressure drop from the curves as indicated. For viscosities other than 50 ssu, multiply the actual indicated pressure drop for your GPM flow by the value shown in the pressure differential curve for your viscosity value.

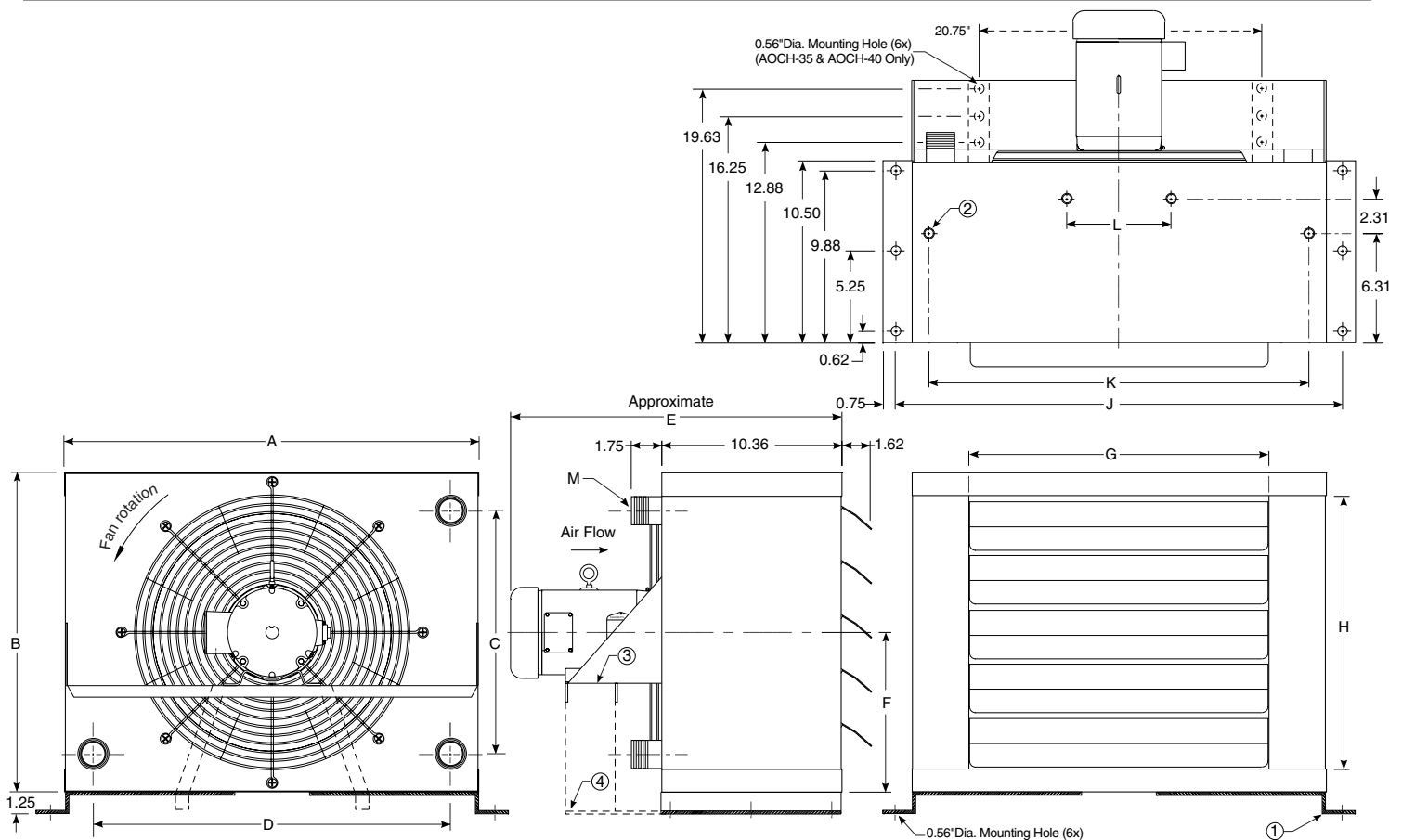
Example: Model 35 @ 60 gpm & 50 ssu -1 pass curve-  
 Indicated pressure drop 2.4 psi (Approx)  
 $\{2.4 \text{ psi} \times 2.8C_p \text{ (for SAE-20 oil)}\} = 6.72 \text{ corrected psi}$

Average Liquid Temperature	Cv VISCOSITY CORRECTION FACTORS																
	SAE 5	SAE 10	SAE 20	SAE 30	SAE 40	ISO 22	ISO 32	ISO 46	ISO 68	ISO 100	ISO 150	ISO 220	ISO 320	MIL-L-7808	POLYGLYCOL	PHOSPHATE ESTER	50% ETHYLENE GLYCOL & WATER
100	1.11	1.15	1.25	1.38	1.45	1.08	1.14	1.18	1.26	1.37	1.43	1.56	1.84	1.19	0.92	0.83	0.85
110	1.09	1.12	1.20	1.32	1.40	1.06	1.13	1.16	1.25	1.31	1.39	1.48	1.67	1.14	0.89	0.80	0.84
120	1.06	1.10	1.17	1.27	1.35	1.04	1.11	1.14	1.20	1.27	1.35	1.40	1.53	1.09	0.88	0.79	0.84
130	1.04	1.08	1.13	1.24	1.29	1.03	1.09	1.13	1.17	1.24	1.30	1.34	1.44	1.05	0.85	0.77	0.83
140	1.03	1.05	1.11	1.19	1.25	1.02	1.08	1.10	1.16	1.20	1.26	1.30	1.39	1.03	0.84	0.76	0.82
150	1.01	1.04	1.09	1.16	1.22	1.02	1.06	1.09	1.13	1.17	1.22	1.27	1.33	1.01	0.83	0.74	0.82
200	0.98	0.99	1.01	1.04	1.07	0.98	0.99	1.00	1.01	1.02	1.08	1.09	1.14	0.98	0.79	0.71	0.80
250	0.95	0.96	0.97	0.98	0.99	0.95	0.96	0.96	0.96	0.97	0.99	1.01	1.02	0.97	0.76	0.69	0.79

Average Liquid Temperature	Cp PRESSURE DROP CORRECTION FACTORS																
	SAE 5	SAE 10	SAE 20	SAE 30	SAE 40	ISO 22	ISO 32	ISO 46	ISO 68	ISO 100	ISO 150	ISO 220	ISO 320	MIL-L-7808	POLYGLYCOL	PHOSPHATE ESTER	50% ETHYLENE GLYCOL & WATER
100	2.00	2.40	4.40	6.40	8.80	1.07	1.53	1.82	2.54	4.19	6.44	9.38	13.56	1.26	3.00	3.50	0.730
110	1.70	2.10	3.60	5.10	6.70	1.04	1.45	1.72	2.35	3.73	5.70	8.33	11.63	1.20	2.40	2.90	0.720
120	1.50	1.80	3.00	4.20	5.60	1.02	1.38	1.60	2.15	3.26	4.91	7.23	9.73	1.14	2.10	2.50	0.709
130	1.40	1.60	2.60	3.40	4.50	0.99	1.30	1.49	1.94	2.80	4.14	6.19	7.80	1.08	1.90	2.20	0.698
140	1.30	1.50	2.23	2.90	3.70	0.97	1.23	1.38	1.75	2.38	3.47	5.20	6.11	1.03	1.90	2.00	0.686
150	1.20	1.30	1.90	2.50	3.10	0.95	1.17	1.30	1.61	2.04	2.90	4.35	4.77	0.98	1.70	1.90	0.676
200	0.93	0.96	1.20	1.40	1.60	0.89	0.99	1.08	1.18	1.33	1.59	1.74	1.95	0.90	1.20	1.30	0.635
250	0.81	0.82	0.92	0.97	1.05	0.85	0.93	0.96	1.03	1.11	1.21	1.22	1.23	0.83	1.00	1.05	0.556

note: AIHTI reserves the right to make reasonable design changes without notice.

# AOCH Series *dimensions*



**DIMENSIONS (inches)**

Model	A	B	C	D	E	F	G	H	J	K	L	M NPT	M SAE
AOCH - 5 - *	14.81	11.81	7.69	11.69	19.39	5.90	8.31	9.19	16.81	12.94	—	1.50	24 SAE
AOCH - 10 - *	19.00	13.13	8.88	15.88	19.48	6.56	12.50	10.50	21.00	17.13	—	1.50	1 7/8 -12UN-2B Thread
AOCH - 15 - *	20.38	15.75	11.50	17.25	19.48	7.88	13.88	13.12	22.38	18.50	—	1.50	
AOCH - 20 - *	23.81	18.38	14.00	20.56	19.48	9.19	17.19	15.75	25.81	21.81	—	2.00	
AOCH - 25 - *	26.68	23.63	19.25	23.56	23.58	11.81	20.19	21.00	28.68	24.81	—	2.00	32 SAE
AOCH - 30 - *	31.63	27.56	23.19	28.50	23.33	13.78	25.13	24.94	33.63	29.75	11.00	2.00	2 1/2 -12UN-2B Thread
AOCH - 35 - *	33.81	30.19	25.81	30.69	23.06	15.09	27.31	27.56	35.81	31.94	11.00	2.00	
AOCH - 40 - *	41.63	36.75	32.38	38.50	23.06	18.38	35.13	34.12	43.63	39.75	13.25	2.00	

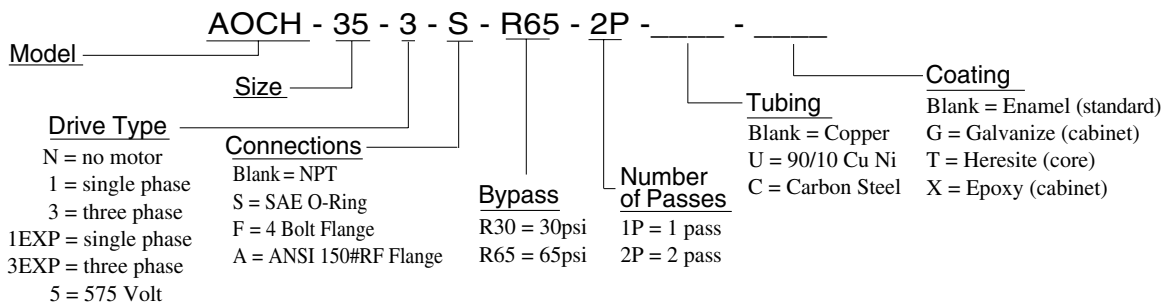
\* Represents options.

**Notes:**

- 1) Removable foot mounting brackets are supplied with unit at no additional charge.
- 2) 1/2-12 UNC-2B Tabs, 4 points, 8 points on models AOCH - 30,35 & 40 (top & bottom) for optional mounting purposes.
- 3) Motor mounting bracket is rotated 90 degrees on AOCH - 5 & 10 units.

- 4) Dotted line represents motor mounting bracket on AOCH-35 & 40.
- 5) Louvers are manually adjustable. However, all units are available with a screen front as an option (specify when ordering).
- 6) All units are available with an optional preset 30 or 65-psi pressure internal bypass valve. (see note "i" on page 155)
- 7) All units can be connected in one or two pass configuration. Refer to piping instructions for detailed operating and maintenance information.

**Example of a model:**



note: AIHTI reserves the right to make reasonable design changes without notice.



## AOCH ELECTRIC MOTOR DATA

Model	Horse Power	Phase	Hz	Volts	RPM	NEMA Frame	Enclosure Type	Full Load Amperes	Service Factor	Thermal Overload
AOCH - 5 - 1	1 / 2	1	60	115 / 208-230	3450	56	TEFC	8.4 / 4-4.2	1.15	NO
AOCH - 5 - 3	1 / 2	3	60 / 50	208-230 / 460-190 / 380	3450	56	TEFC	2.1-2.2 / 1.1-2.0 / 1.0	1.15	NO
AOCH - 5 - 5	1 / 2	3	60	575	3450	56	TEFC	.9	1.15	NO
AOCH - 10 - 1	1 / 2	1	60	115 / 208-230	3450	56	TEFC	8.4 / 4-4.2	1.15	NO
AOCH - 10 - 3	1 / 2	3	60 / 50	208-230 / 460-190 / 380	3450	56	TEFC	2.1-2.2 / 1.1-2.0 / 1.0	1.15	NO
AOCH - 10 - 5	1 / 2	3	60	575	3450	56	TEFC	.9	1.15	NO
AOCH - 15 - 1	1 / 2	1	60	115 / 208 / 230	1725	56	TEFC	8.8 / 4.2-4.4	1.15	NO
AOCH - 15 - 3	1 / 2	3	60 / 50	230 / 460-190 / 380	1725	56	TEFC	2.4 / 1.2	1.15	NO
AOCH - 15 - 5	1 / 2	3	60	575	1725	56	TEFC	.9	1.15	NO
AOCH - 20 - 1	1 / 2	1	60	115 / 208 / 230	1725	56	TEFC	8.8 / 4.2-4.4	1.15	NO
AOCH - 20 - 3	1 / 2	3	60 / 50	230 / 460-190 / 380	1725	56	TEFC	2.4 / 1.2	1.15	NO
AOCH - 20 - 5	1 / 2	3	60	575	1725	56	TEFC	.9	1.15	NO
AOCH - 25 - 1	1	1	60	115 / 208-230	1725	56	TEFC	13.4 / 6.8-6.7	1.15	NO
AOCH - 25 - 3	1	3	60 / 50	208-230 / 460-190 / 380	1725	56	TEFC	3.5-3.6 / 1.8-3.4 / 1.7	1.15	NO
AOCH - 25 - 5	1	3	60	575	1725	56	TEFC	1.45	1.15	NO
AOCH - 30 - 1	1	1	60	115 / 208-230	1725	56	TEFC	13.4 / 6.8-6.7	1.15	NO
AOCH - 30 - 3	1	3	60 / 50	208-230 / 460-190 / 380	1725	56	TEFC	3.5-3.6 / 1.8-3.4	1.15	NO
AOCH - 30 - 5	1	3	60	575	1725	56	TEFC	1.45	1.15	NO
AOCH - 35 - 1	CONSULT FACTORY									
AOCH - 35 - 3	3	3	60 / 50	208-230 / 460-190 / 380	1725	182T	TEFC	8 / 4-6.8 / 3.4	1.15	NO
AOCH - 35 - 5	3	3	60	575	1725	182T	TEFC	3.2	1.15	NO
AOCH - 40 - 1	CONSULT FACTORY N / A									
AOCH - 40 - 3	3	3	60 / 50	208-230 / 460-190 / 380	1725	182T	TEFC	8 / 4-6.8 / 3.4	1.15	NO
AOCH - 40 - 5	3	3	60	575	1725	182T	TEFC	3.2	1.15	NO

NOTE: Basic electric drive units are supplied with one of the corresponding above listed motors.

### ELECTRIC MOTOR NOTES:

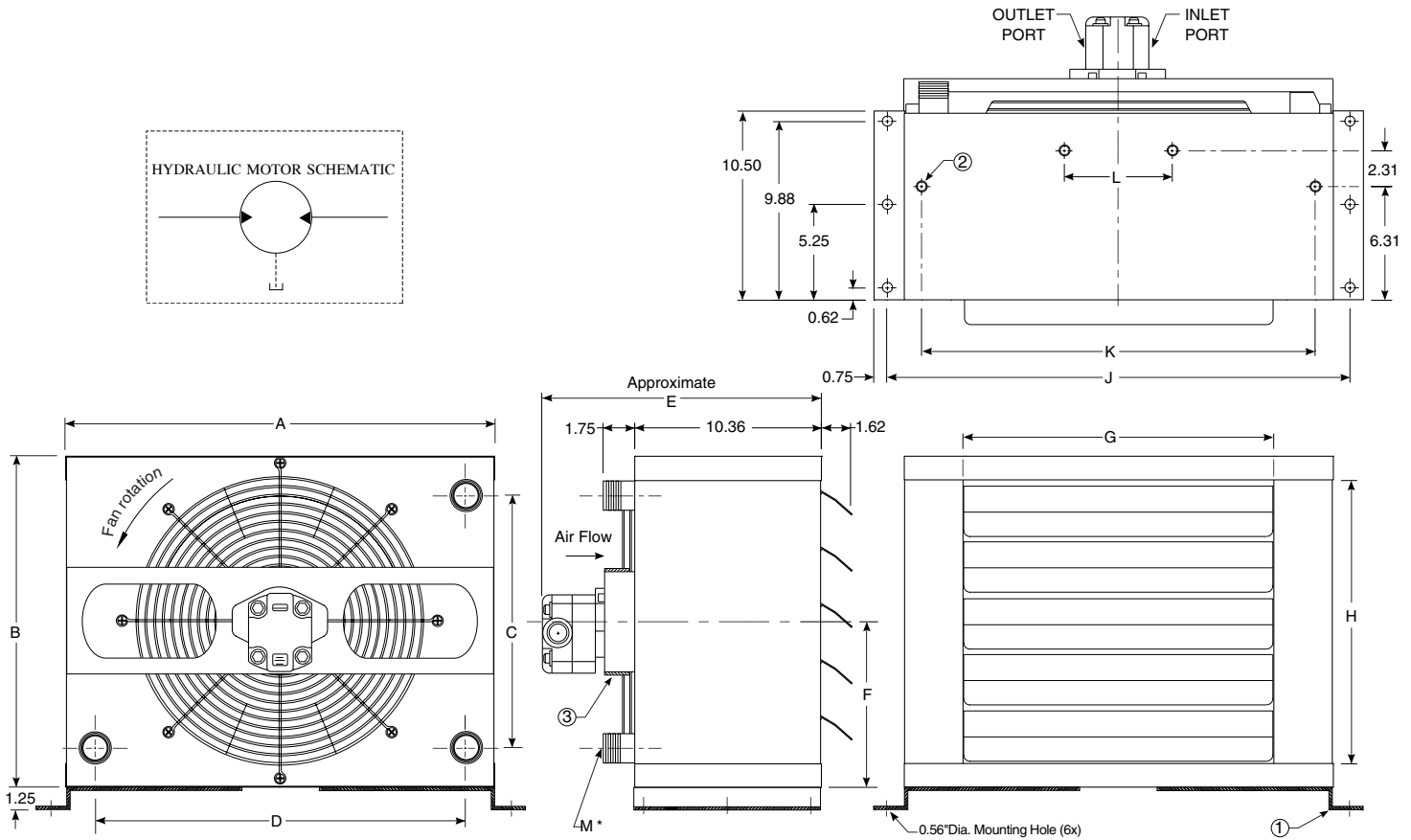
- 1) TEFC motors are available for all models.
- 2) Motor electrical ratings are an approximate guide and may vary between motor manufacturers. Consult ratings on motor data plate prior to installation and operation.
- 3) Explosion proof, high temperature, severe duty, chemical, IEC, Canadian Standards Association, and Underwriters Laboratory recognized motors are available upon request.
- 4) American Industrial reserves the right to enact changes to motor brand, type and ratings regarding horsepower, RPM,FLA,and service factor
- 5) Fan rotation is clockwise when facing the motor shaft.
- 6) The above motors contain factory lubricated shielded ball bearings; no additional lubrication is required.
- 7) **Abbreviation Index**  
 TEFC ..... Totally Enclosed, Fan Cooled  
 X-PROOF ..... Explosion Proof

### CLASS I, DIV. 1, GROUP D or CLASS II, DIV. 2, GROUP F & G EXPLOSION PROOF MOTOR DATA

Model	Horse Power	Phase	Hz	Volts	RPM	NEMA Frame	Enclosure Type	Full Load Amperes	Service Factor	Thermal Overload
AOCH - 5 - 1	1 / 2	1	60	115 / 230	3450	56	X-PROOF	6.8 / 3.4	1.0	YES
AOCH - 5 - 3	1 / 2	3	60	230 / 460	3450	56	X-PROOF	1.6 / .8	1.0	YES
AOCH - 10 - 1	1 / 2	1	60	115 / 230	3450	56	X-PROOF	6.8 / 3.4	1.0	YES
AOCH - 10 - 3	1 / 2	3	60	230 / 460	3450	56	X-PROOF	1.6 / .8	1.0	YES
AOCH - 15 - 1	1 / 2	1	60	115 / 230	1725	56	X-PROOF	8.8 / 4.4	1.0	YES
AOCH - 15 - 3	1 / 2	3	60	230 / 460	1725	56	X-PROOF	2.4 / 1.2	1.0	YES
AOCH - 20 - 1	1 / 2	1	60	115 / 230	1725	56	X-PROOF	8.8 / 4.4	1.0	YES
AOCH - 20 - 3	1 / 2	3	60	230 / 460	1725	56	X-PROOF	2.4 / 1.2	1.0	YES
AOCH - 25 - 1	1	1	60	115 / 230	1725	56	X-PROOF	13.4 / 6.7	1.0	YES
AOCH - 25 - 3	1	3	60	230 / 460	1725	56	X-PROOF	3.6 / 1.8	1.0	YES
AOCH - 30 - 1	1	1	60	115 / 230	1725	56	X-PROOF	13.4 / 6.7	1.0	YES
AOCH - 30 - 3	1	3	60	230 / 460	1725	56	X-PROOF	3.6 / 1.8	1.0	YES
AOCH - 35 - 3	3	3	60	230 / 460	1725	182	X-PROOF	8.8 / 4.4	1.0	YES
AOCH - 40 - 3	3	3	60	230 / 460	1725	182	X-PROOF	8.8 / 4.4	1.0	YES

NOTE: Basic electric drive units are supplied with one of the corresponding above listed motors.

# AOCHM Series *dimensions*



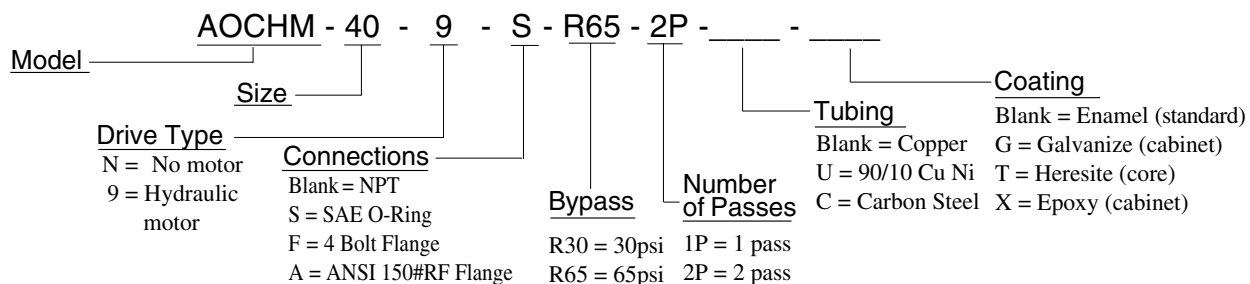
DIMENSIONS (inches)													
Model	A	B	C	D	E	F	G	H	J	K	L	M NPT	M SAE
AOCHM - 5 - *	14.81	11.81	7.69	11.69	15.21	5.90	8.31	9.19	16.81	12.94	—	1.50	24 SAE 1 7/8
AOCHM - 10 - *	19.00	13.13	8.88	15.88	15.21	6.56	12.50	10.50	21.00	17.13	—	1.50	-12UN-2B Thread
AOCHM - 15 - *	20.38	15.75	11.50	17.25	15.21	7.88	13.88	13.12	22.38	18.50	—	1.50	
AOCHM - 20 - *	23.81	18.38	14.00	20.56	15.21	9.19	17.19	15.75	25.81	21.81	—	2.00	
AOCHM - 25 - *	26.68	23.63	19.25	23.56	15.21	11.81	20.19	21.00	28.68	24.81	—	2.00	32 SAE 2 1/2
AOCHM - 30 - *	31.63	27.56	23.19	28.50	15.21	13.78	25.13	24.94	33.63	29.75	11.00	2.00	-12UN-2B Thread
AOCHM - 35 - *	33.81	30.19	25.81	30.69	15.21	15.09	27.31	27.56	35.81	31.94	11.00	2.00	
AOCHM - 40 - *	41.63	36.75	32.38	38.50	15.21	18.38	35.13	34.12	43.63	39.75	13.25	2.00	

\* Represents options.

## Notes :

- 1) Removable foot mounting brackets are supplied with unit at no additional charge.
- 2) 1/2-12 UNC-2B Tabs, 4 points, 8 points on models AOCHM - 30, 35 & 40 (top & bottom) for optional mounting purposes.
- 3) Motor mounting bracket is rotated 90 degrees on AOCHM - 5 & 10 units.
- 4) Louvers are manually adjustable. However, all units are available with a screen front as an option (specify when ordering).
- 5) All units are available with an optional preset 30 or 65-psi pressure bypass valve. (see note "I" on page 155)
- 6) All units can be connected in one or two pass configuration. Refer to piping instructions for detailed operating and maintenance information.

Example of a model:



note: AIHTI reserves the right to make reasonable design changes without notice.



## HYDRAULIC MOTOR DATA

Model	Motor RPM	Displacement in <sup>3</sup> /Rev	Required Flow		Min. pressure start / run PSIG	Case Drain	SAE Size	Side Port SAE O-Ring	Max. Continuous Pressure PSIG
			GPM	LPM					
AOCHM - 5 - *	3000	0.43	6.5	24.6	300	INT	A	#12 1-1/16-12	3000
AOCHM - 10 - *	3000	0.43	6.5	24.6	300	INT	A	#12 1-1/16-12	3000
AOCHM - 15 - *	1725	0.68	6.0	22.7	400	INT	A	#12 1-1/16-12	3000
AOCHM - 20 - *	1725	0.68	6.0	22.7	400	INT	A	#12 1-1/16-12	3000
AOCHM - 25 - *	1725	0.68	6.0	22.7	400	INT	A	#12 1-1/16-12	3000
AOCHM - 30 - *	1725	0.68	6.0	22.7	400	INT	A	#12 1-1/16-12	3000
AOCHM - 35 - *	1725	0.68	6.0	22.7	1000	INT	A	#12 1-1/16-12	3000
AOCHM - 40 - *	1725	0.68	6.0	22.7	1000	INT	A	#12 1-1/16-12	3000

NOTES: \* Represents options.

### HYDRAULIC MOTOR NOTES:

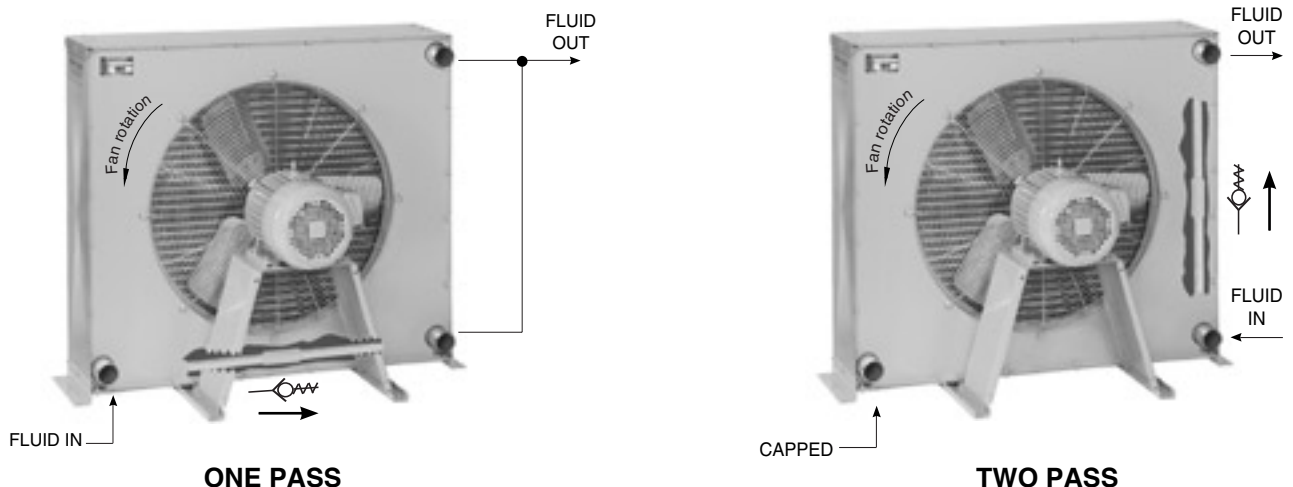
- Standard units are supplied with a bi-directional hydraulic gear motor for the fan drive. The gear motor requires an external case drain be used during operation. The external case drain should be connected directly to hydraulic reservoir or a return line with not greater than 10PSIG back pressure. (NOTE: *Failure to properly connect and use the external case drain during motor operation could result in motor failure and external leakage of hydraulic fluid.*)
- Hydraulic motor flow requirements are provided with an efficiency rating of approximately 85%. Pressure requirements are calculated theoretical minimum operating requirements.
- Shaft adapters are used to bridge the differences in length between the fan and hydraulic motor.
- Maximum degree of fluid contamination, class 18/15 according to ISO 4406. Therefore, it is recommended to use a filter with retention rating of B20>. For longer life, it is recommended to use class 17/14 achievable with filter B10>-100.
- Fan rotation is clockwise when facing the motor shaft.
- Optional displacement motors available upon request.
- American industrial reserves the right to enact changes to hydraulic motor, brand, type, ratings, port sizes, or any additional non-specified attribute for standard products without notice. All specific requirements will be honored without change pending availability.

### COMMON DATA

Model	Air Flow		Sound Level dB(A) @ 7ft	Liquid Volume		Weight Electric		Weight Hydraulic		Serviceable Core
	CFM	m <sup>3</sup> /s		gal.	cm <sup>3</sup>	lb	kg	lb	kg	
Model - 5 - *	780	.368	85	.88	3331	82	37	64	29	NO
Model - 10 - *	1110	.523	85	1.09	4126	91	41	73	34	NO
Model - 15 - *	1590	.750	80	1.29	4883	103	47	85	39	NO
Model - 20 - *	2168	1.023	80	1.70	6735	152	69	134	61	Yes
Model - 25 - *	3000	1.42	81	2.27	8592	175	79	157	71	Yes
Model - 30 - *	4095	1.93	84	2.86	10826	218	99	200	91	Yes
Model - 35 - *	5921	2.79	89	3.46	13097	351	159	233	106	Yes
Model - 40 - *	9609	4.54	91	4.72	17865	432	196	314	142	Yes

- NOTES: a) \* Represents the options for motor drive.  
 b) To estimate the sound level at distances other than 13 feet (4 meters) from the cooler, add 6 db for each halving of distance, or subtract 6 db for each doubling of the distance.

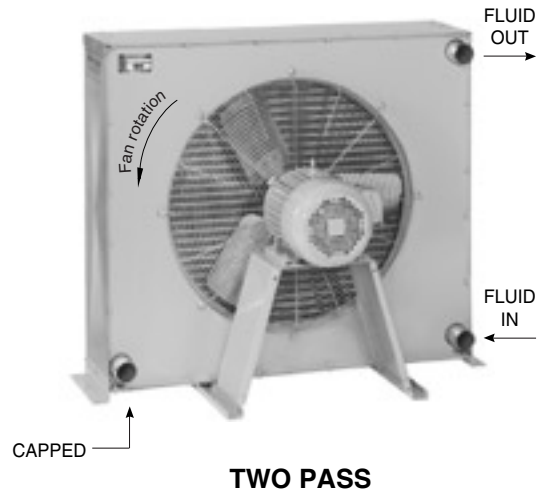
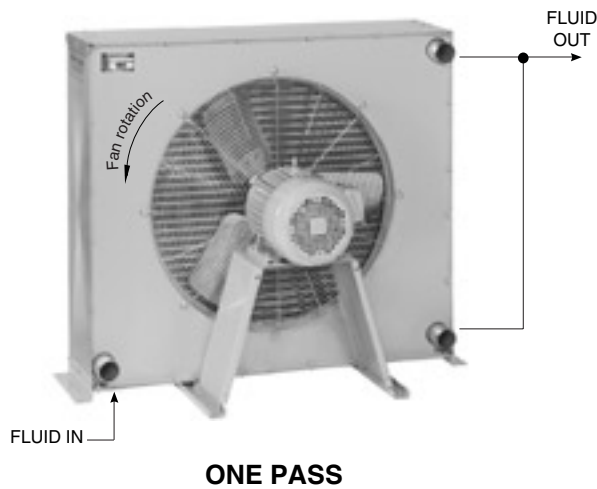
### PIPING HOOK UP *shown with relief valve*



note: AIHTI reserves the right to make reasonable design changes without notice.

# AOCH & AOCHM Series *installation & maintenance*

## PIPING HOOK UP



### Receiving / Installation

a) Inspect unit for any shipping damage before uncrating. Indicate all damages to the trucking firms' delivery person and mark it on the receiving bill before accepting the freight. Make sure that the core and fan are not damaged. Rotate the fan blade to make sure that it moves freely. The published weight information located in this brochure is approximate. True shipment weights are determined at the time of shipping and may vary. Approximate weight information published herein is for engineering approximation purposes and should not be used for exact shipping weight. *Since the warranty is based upon the unit date code located on the model identification tag, removal or manipulation of the identification tag will void the manufacturer's warranty.*

b) When handling the heat exchanger, special care should be taken to avoid damage to the core and fan. All units are shipped with wood skids for easy forklift handling

c) Standard Enamel Coating: American Industrial provides its standard products with a normal base coat of oil base air cure enamel paint. The enamel paint is applied as a temporary protective and esthetic coating prior to shipment. While the standard enamel coating is durable, American Industrial does not warranty it as a long-term finish coating. It is strongly suggested that a more durable final coating be applied after installation or prior to long-term storage in a corrosive environment to cover any accidental scratches, enhance esthetics, and further prevent corrosion. It is the responsibility of the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

d) Special Coatings: American Industrial offers as customer options, Air-Dry Epoxy, and Heresite (Air-Dry Phenolic) coatings at additional cost. American Industrial offers special coatings upon request, however American Industrial does not warrantee coatings to be a permanent solution for any equipment against corrosion. It is the responsibility of

the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

e) American Industrial recommends that the equipment supplied should be installed by qualified personnel who have solid understanding of system design, pressure and temperature ratings, and piping assembly. Verify the service conditions of the system prior to applying any air cooled heat exchanger series cooler. If the system pressure or temperature does not fall within the parameters on model rating tag located on the heat exchanger, contact our factory prior to installation or operation.

g) Heat exchanger should be securely fastened using the mounting foot brackets (included). All mounting holes should be used to secure unit into place. Optional horizontal mounting with vertical airflow is allowable by removing the foot brackets and using the (4 or 8) 1/2"-13 screw hard points located on the top and bottom panel for fastening. Heat exchanger unit must be set into a fabricated channel type frame with provision for additional motor support for heavy motors in conjunction with 1/2" frame fastening bolt points. Since the units are normally operated in the vertical position (horizontal airflow) reinforced motor support is suggested.

h) Connections should be made in "one pass" or "two pass" configurations exactly as indicated in the "piping hook up" illustration above. The process flow entering the "Fluid IN" port and exiting the "Fluid OUT" port eliminates air pockets and assures that the unit will stay completely flooded. Flexible hose can be applied to reduce the risk of core failure due to thermal expansion or system vibration. Piping alignment and support is required for hoses longer than four feet in length and for piping exerting more than 20 lbs of dynamic force. It is recommended that filtration be located ahead of the heat exchanger to prevent excessive backpressure and clogging.

# AOCH & AOCHM Series *installation & maintenance*

i) With respect to the heat exchangers nozzle size, flow line sizes should be sized to handle the appropriate flow rate and system pressure drop requirements, normally flow line rates of about 8-12 feet per second and inlet pressure less than 100psig are experienced. If the flow line size is larger than the heat exchanger nozzle size, additional pressure loss beyond the published pressure loss data may occur.

j) Electric motors should be connected only to supply source of the same characteristics as indicated on the electric motor information plate. Prior to starting, verify that the motor and fan spin freely without obstruction. Check carefully that the fan turns in the correct rotation direction (normally counter clockwise) from the motor side (fan direction arrow). Failure to operate the fan in the proper direction could reduce performance or cause serious damage to the heat exchanger or other components. Fan blades should be rechecked for tightness after the first 100 hours of operation.

k) It is important to apply the catalog recommended flow rate for the hydraulic motor that corresponds with the specific model being used. A case drain is required for hydraulic motor installation. Failure to connect case drain can result in motor failure. The proper flow rate and direction to the hydraulic motor are critical to ensure fan direction and RPM. Exceeding the recommended RPM could result in fan failure and cause severe damage to the heat exchanger. See fan rotation on installation diagram.

## Maintenance

Regular maintenance intervals based upon the surrounding and operational conditions should be maintained to verify equipment performance and to prevent premature component failure. Since some of the components such as, motors, fans, load adapters, etc... are not manufactured by American Industrial, maintenance requirements provided by the manufacture must be followed.

a) Inspect the entire heat exchanger and motor/fan assembly for loosened bolts, loose connections, broken components, rust spots, corrosion, fin/coil clogging, or external leakage. Make immediate repairs to all affected areas prior to restarting and operating the heat exchanger or its components.

b) Heat exchangers operating in oily or dusty environments will often need to have the coil cooling fins cleaned. Oily or clogged fins should be cleaned by carefully brushing the fins and tubes with water or a non-aggressive degreasing agent mixture (*Note: Cleaning agents that are not compatible with copper, brass, aluminum, steel or stainless steel should not be used*). A compressed air or a water stream can be used to dislodge dirt and clean the coil further. Any external dirt or oil on the electric motor and fan assembly should be removed. *Caution: Be sure to disconnect the electric motor from its power source prior to doing any maintenance.*

c) In most cases it is not necessary to internally flush the coil. In circumstances where the coil has become plugged

or has a substantial buildup of material, flushing the coil with water or a solvent may be done. Flushing solvents should be non-aggressive suitable for the materials of construction. Serviceable Core® models can be disassembled and inspected or cleaned if required.

d) Most low horsepower electric motors do not require any additional lubrication. However, larger motors must be lubricated with good quality grease as specified by the manufacture at least once every 6-9 months or as directed by the manufacture. T.E.F.C. air ventilation slots should be inspected and cleaned regularly to prevent clogging and starving the motor of cooling air. To maintain the electric motor properly see the manufactures requirements and specifications.

e) Fan blades should be cleaned and inspected for tightness during the regular maintenance schedule when handling a fan blade care must be given to avoid bending or striking any of the blades. Fan blades are factory balanced and will not operate properly if damaged or unbalanced. Damaged fan blades can cause excessive vibration and severe damage to the heat exchanger or drive motor. Replace any damaged fan with an American industrial suggested replacement.

f) Air cooled exchanger cabinets are constructed using 7ga. through 18ga. steel that may be bent back into position if damaged. Parts that are not repairable can be purchased through American Industrial.

g) Coil fins that become flattened can be combed back into position. This process may require removal of the coil from the cabinet.

h) It is not advisable to attempt repairs to brazed joints of a brazed construction coil unless it will be done by an expert in silver solder brazing. Brazed coils are heated uniformly during the original manufacturing process to prevent weak zones from occurring. Uncontrolled reheating of the coil may result in weakening of the tube joints surrounding the repair area. In many instances brazed units that are repaired will not hold up as well to the rigors of the system as will a new coil. American Industrial will not warranty or be responsible for any repairs done by unauthorized sources. Manipulation in any way other than normal application will void the manufactures warranty.

i) Solely at the request of customers, American Industrial provides direct acting internal inlet port to outlet port bypass relief valves as an additional safe guard against excessive flow and over pressurization of the heat exchanger. American Industrial purchases and applies high quality hydraulic system cartridge valves and components made available for hydraulic system use. However, American Industrial does not specify, recommend, suggest, guarantee, or warrantee the internal relief valve or its performance to safe guard the heat exchanger from damage or prevent failure due to excessive flow or over pressurization. It is the ultimately the sole responsibility of the customer/user to verify with the original equipment manufacture all conditions associated with applying an additional system relief valve prior to application.

# AOCH & AOCHM Series *installation & maintenance*

## Serviceable Core® Maintenance

Units containing a Serviceable Core® have bolted manifold covers that can be removed for cleaning or repair purposes.

### Servicing Sequence

American Industrial has gone to great lengths to provide components that are repairable. If the heat exchanger core requires internal cleaning or attention the following steps will explain what must be done to access the internal tubes. Be sure to order gasket kits or repair parts prior to removal and disassembly to minimize down time.

- a) To clean the internal tubes first remove all connection plumbing from the unit.
- b) Be sure the unit is drained of all water etc...
- c) Place the heat exchanger in an area that it can be accessed from all sides. Remove the core from the cabinet if required (AOCH, AOCS).
- d) Mark the cover ① and tube-sheet ③ for both covers so that they can be replaced into the same position when finished. Remove the manifold cover bolts ② and hardware and place them into a secure place.
- e) The manifold covers are tightly compressed and may need some prying to separate them from the gasket ⑥, physically remove the cover assemblies ① from both sides.
- f) The tubes ④ and turbulators ⑤ are now accessible for cleaning. Note: turbulators are installed on AOCH & AOCS cores only. If you need to remove the turbulator that runs through the tubing, it will be necessary to first squeeze the flattened end of the protruding turbulator ⑤, so that on end will fit through the tube. From the opposite end pull the turbulator ⑤ out. You may need to use pliers to grip and pull the turbulators ⑤ out, especially if there is debris lodged inside. As the turbulators ⑤ come out, most of the dirt will too, so be prepared. *It is suggested that gloves be worn when handling the turbulators ⑤ as they may be sharp.*

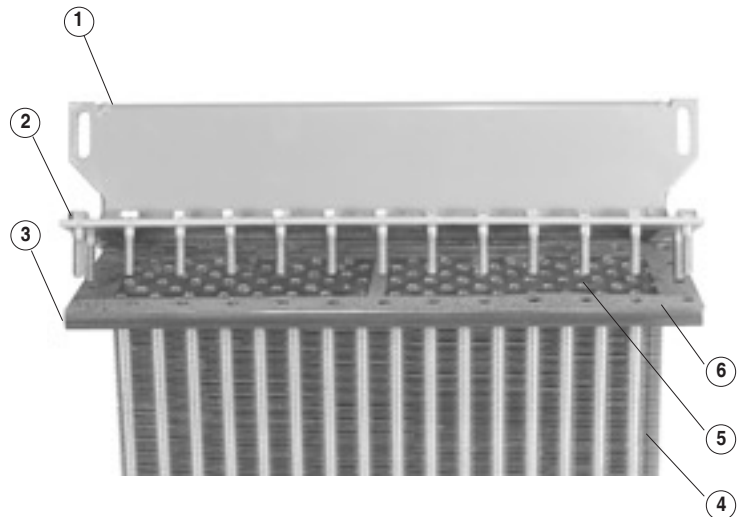
We suggest a mild water-soluble degreaser be used with a brush. Tubing I.D. is approximately .325 a plastic bristle brush on a rod will work best for cleaning the tubes ④. Steel brushes should be avoided since the steel is harder than the copper tubing and may heavily score the tubes ④ if used.

g) If there are any leaking tubes ④ you may plug them by carefully forcing a soft metal plug into the hole and tapping it tight. You may in some cases weld the leaking tube shut however, care should be taken since excessive heat may cause surrounding tube joints to loosen and leak.

h) When finished cleaning or repairing, be sure to replace ALL of the turbulators ⑤ back into any open tubes ④. When the turbulators ⑤ protrude from the opposite end flatten them again so they are tight and cannot be removed.

i) When finished reattach the manifold covers ① in the same position they were removed, using new gaskets ⑥, bolts ②, and hardware. We suggest using a torque wrench to final tighten the bolts ②.

j) *Torque Specifications: For 5/16" bolts 22-23 ft-lbs, for 3/8" bolts to 38-42 ft-lbs. Since bolts and hardware can physically fatigue during application we suggest new bolt kits be used when reassembling.*



*American Industrial's state-of-the-art manufacturing facility.*





## BM SERIES



BM - 201 thru BM - 322  
SERIES

BM - 101 & BM - 102  
SERIES

### AIR COOLED

# OIL COOLERS

- Mounts directly to TEFC electric motor.
- Fits NEMA frame sizes 48 through 365.
- Standard NPT or SAE connections.
- Operating temperature of 400°F & pressure of 300PSI.
- Cools case drains, hydraulic presses, bearings gear boxes, hydraulic tools, etc...

### MODELS TO ACCOMMODATE ELECTRIC MOTOR NEMA FRAME SIZES

48 - 184	213 - 256	254 - 286	324 - 365
BM - 101	BM - 201	BM - 301	BM - 321
BM - 102	BM - 202	BM - 302	BM - 322

# BM Series selection

## SIZING

To properly size a BM TEFC Motor air-cooled oil cooler for industrial equipment, you should first determine some basic parameters associated with your system.

## HEAT LOAD

In many instances the heat load must be determined by using a "total potential" method. This total potential or horse power method is the most common method, and is the simplest way to determine basic heat rejection requirements for hydraulic systems. The total potential is equal to the maximum operating flow and pressure that are generated by the system under full load. To determine the total potential (HP) use the following formula. Note: If the electric motor horsepower of the system prime mover is known, use it as your system potential.

$$HP = [ \text{System Pressure (PSI)} \times \text{System flow (GPM)} ] / 1714$$

Examples:

- (1) 7.5 HP 254T frame electric motor driving a pump = 7.50 HP potential
- (1) HP = (1250 PSI x 10 GPM) / 1714 = 7.30 HP or the total input potential

To determine the system heat load in BTU / HR we must use a percentage (v) of the system potential HP. The factor (v) can be calculated by adding up the actual inefficiencies of a system; however, for most applications a (v) value of 25% - 30% can be used.

Example: 7.50 HP x .30 = 2.25 HP heat

To convert the horsepower of heat into BTU/HR use the formula below:  
HP x 2542 = BTU/HR

Example: 2.25 HP Heat x 2542 = 5,729 BTU/HR

Applying into a return line

For most open loop systems with vane or gear type fixed delivery pumps. To calculate the Fs value required when applying the air/oil cooler into a return line use the formula below:

$$Fs = \frac{BTU / HR \times Cv}{T - t_{ambient}} \quad \text{Example} = \frac{5729 \times 1.08}{140 - 90} = 123.7 Fs$$

T = Desired system oil temperature leaving the cooler °F

t<sub>ambient</sub> = Ambient air temperature entering the cooler °F

Cv = Correction factor for oil viscosity. Example: ISO32 oil @ 140°F = 1.08

(see chart)

## APPLYING INTO A CASE LINE

In circumstances where the system is a closed loop, or when return line flow is not available, the case drain flow can be utilized to help cool the system. However, in many instances, the case drain flow alone will not be enough to reject all of the heat generated by the system. Case drain lines should not be treated as a normal return lines since the pressure drop allowable usually can vary from 2 - 10 PSI max. Check with your pump manufacturer for the appropriate pressure drop tolerance before applying any cooler. To size the system for case flow or case flow plus any additional flushing loops, please use the following method. Closed loop case drain operating temperatures are normally higher than open loop circuit return line temperatures.

Formula

$$Tc_{exit} = \{ T - [ Q / (\text{case flow gpm} \times 210) ] \}$$

Example

$$Tc_{exit} = \{ 155 - [ 5,729 / (3 \times 210) ] \} = 145.9$$

Tc<sub>exit</sub> = The corrected temperature of the oil exiting the cooler.

Fs =

$$\frac{Q \times Cv}{Tc_{exit} - t_{ambient}} = \frac{5,729 \times 1.08}{145.9 - 90} = 101.6$$

## SELECTION

To select a model, locate the flow rate (GPM) at the bottom of the flow vs Fs graph. Proceed upward until the GPM intersects with the calculated Fs. The curve closest above the intersection point will meet these conditions.

Examples:

Return Line Fs = 123.7	Case Drain Fs = 101.6
GPM = 10 "return line flow"	GPM = 3.0
Motor size = 324 frame	Motor size = 254T frame
Model = BM - 321	Model = BM - 302

## PRESSURE DROP

Determine the oil pressure drop from the curves as indicated. For viscosities other than 50 sus at operating, multiply the actual indicated pressure drop (psi) for your GPM by the value in the pressure differential chart for your viscosity.

Examples:

	GPM = 10	GPM = 3
Indicated pressure drop	1.4 PSI	1 PSI
Cp correction factor for ISO 32 oil @ 140°F	1.23	1.23
Pressure drop correction	1.4x1.23 = 1.72 psi	1.0x1.23 = 1.23 psi

## AIR FLOW CORRECTION CHART

In some instances our units are applied to motors or application where additional or less air flow is available than the flows used for our performance curves. In these instances you can use our air flow correction curves to determine if one of the existing models will work for your application.

Example:

Follow the preceding examples to properly determine your required Fs. Use the following formula to correct for the difference in air-flow rate. If the calculated Fs = 123.7 and the electric motor were a 1800 rpm 326 frame motor with 250 cfm of air flow, correct as shown. Select the correction factor Cf only from the curve that matches to your electric motor frame size properly. Note: Using a unit that is too small may damage your electric motor due to lack adequate of air flow.

Formula

$$Fs \times Cf = CFs \text{ (corrected)}$$

Example

$$CFs = 123.7 \times 1.50 \text{ (from curve)} = 185.6 CFs$$

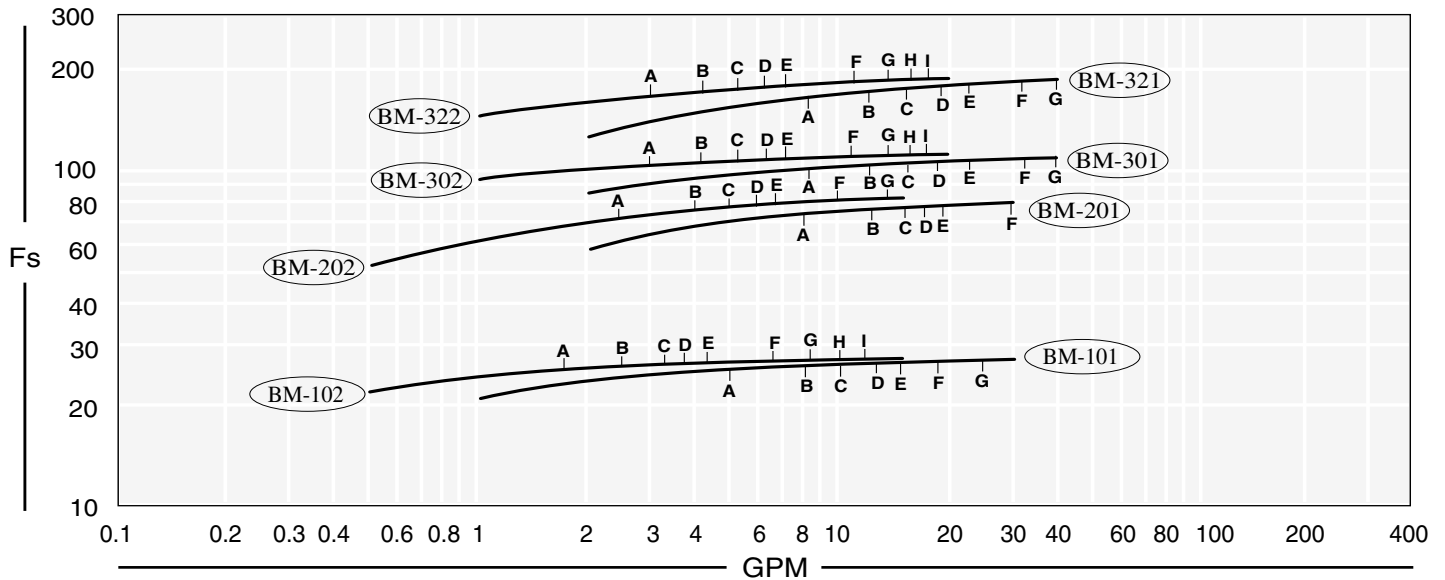
Average Liquid Temperature	Cv VISCOSITY CORRECTION FACTORS																
	SAE 5	SAE 10	SAE 20	SAE 30	SAE 40	ISO 22	ISO 32	ISO 46	ISO 68	ISO 100	ISO 150	ISO 220	ISO 320	MIL-L 7808	POLY-GLYCOL	PHOS-PHATE ESTER 50%	ETHYLENE GLYCOL & WATER
100	1.11	1.15	1.25	1.38	1.45	1.08	1.14	1.18	1.26	1.37	1.43	1.56	1.84	1.19	0.92	0.83	0.85
110	1.09	1.12	1.20	1.32	1.40	1.06	1.13	1.16	1.25	1.31	1.39	1.48	1.67	1.14	0.89	0.80	0.84
120	1.06	1.10	1.17	1.27	1.35	1.04	1.11	1.14	1.20	1.27	1.35	1.40	1.53	1.09	0.88	0.79	0.84
130	1.04	1.08	1.13	1.24	1.29	1.03	1.09	1.13	1.17	1.24	1.30	1.34	1.44	1.05	0.85	0.77	0.83
140	1.03	1.05	1.11	1.19	1.25	1.02	1.08	1.10	1.16	1.20	1.26	1.30	1.39	1.03	0.84	0.76	0.82
150	1.01	1.04	1.09	1.16	1.22	1.02	1.06	1.09	1.13	1.17	1.22	1.27	1.33	1.01	0.83	0.74	0.82
200	0.98	0.99	1.01	1.04	1.07	0.98	0.99	1.00	1.01	1.02	1.08	1.09	1.14	0.98	0.79	0.71	0.80
250	0.95	0.96	0.97	0.98	0.99	0.95	0.96	0.96	0.96	0.97	0.99	1.01	1.02	0.97	0.76	0.69	0.79

Average Liquid Temperature	Cp PRESSURE DROP CORRECTION FACTORS																
	SAE 5	SAE 10	SAE 20	SAE 30	SAE 40	ISO 22	ISO 32	ISO 46	ISO 68	ISO 100	ISO 150	ISO 220	ISO 320	MIL-L 7808	POLY-GLYCOL	PHOS-PHATE ESTER 50%	ETHYLENE GLYCOL & WATER
100	2.00	2.40	4.40	6.40	8.80	1.07	1.53	1.82	2.54	4.19	6.44	9.38	13.56	1.26	3.00	3.50	0.730
110	1.70	2.10	3.60	5.10	6.70	1.04	1.45	1.72	2.35	3.73	5.70	8.33	11.63	1.20	2.40	2.90	0.720
120	1.50	1.80	3.00	4.20	5.60	1.02	1.38	1.60	2.15	3.26	4.91	7.23	9.73	1.14	2.10	2.50	0.709
130	1.40	1.60	2.60	3.40	4.50	0.99	1.30	1.49	1.94	2.80	4.14	6.19	7.80	1.08	1.90	2.20	0.698
140	1.30	1.50	2.23	2.90	3.70	0.97	1.23	1.38	1.75	2.38	3.47	5.20	6.11	1.03	1.90	2.00	0.686
150	1.20	1.30	1.90	2.50	3.10	0.95	1.17	1.30	1.61	2.04	2.90	4.35	4.77	0.98	1.70	1.90	0.676
200	0.93	0.96	1.20	1.40	1.60	0.89	0.99	1.08	1.18	1.33	1.59	1.74	1.95	0.90	1.20	1.30	0.635
250	0.81	0.82	0.92	0.97	1.05	0.85	0.93	0.96	1.03	1.11	1.21	1.22	1.23	0.83	1.00	1.05	0.556

note: AIHTI reserves the right to make reasonable design changes without notice.



## BM SERIES



**PERFORMANCE CALCULATION**

$$F_s = \frac{\text{Horsepower to be removed (HP)} \times 2545 \times C_v}{\text{°F (Oil Leaving* - Ambient Air Entering)}} = \frac{\text{BTU}}{\text{hr °F}}$$

\*Represents desired fluid leaving the cooler.

**OIL PRESSURE DROP (PSI) CODE**

A = 1 PSI	D = 4 PSI	G = 15 PSI
B = 2 PSI	E = 5 PSI	H = 20 PSI
C = 3 PSI	F = 10 PSI	I = 25 PSI

**Note:**

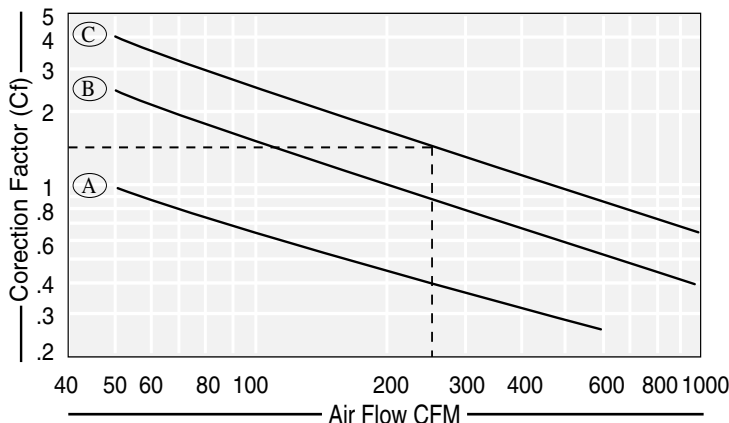
Performance curves are based upon petroleum oil at 50 sus. For average oil viscosities other than 50 sus, use the correction factors Cv & Cp located on page 3. If the above models can not meet your cooling needs, please refer to our fan cooled models.

### STANDARD CONSTRUCTION MATERIALS & RATINGS

Standard Construction Materials			
Tubes	Copper	Manifold	Steel
Fins	Aluminum	Mount. bracket	Steel
Turbulators	Steel	Cabinet	Steel

Standard Unit Ratings	
Operating Pressure	300 psig
Operating Temp.	400 °F

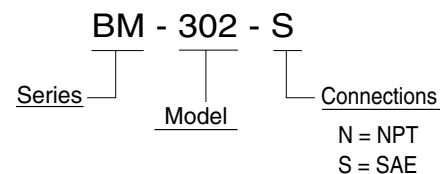
### Air Flow Correction Chart



### ELECTRIC MOTOR NEMA FRAME SIZES

Curve A	Curve B		Curve C
48 - 184	213 - 256	254 - 286	324 - 365
BM - 101	BM - 201	BM - 301	BM - 321
BM - 102	BM - 202	BM - 302	BM - 322

### EXAMPLE OF A MODEL



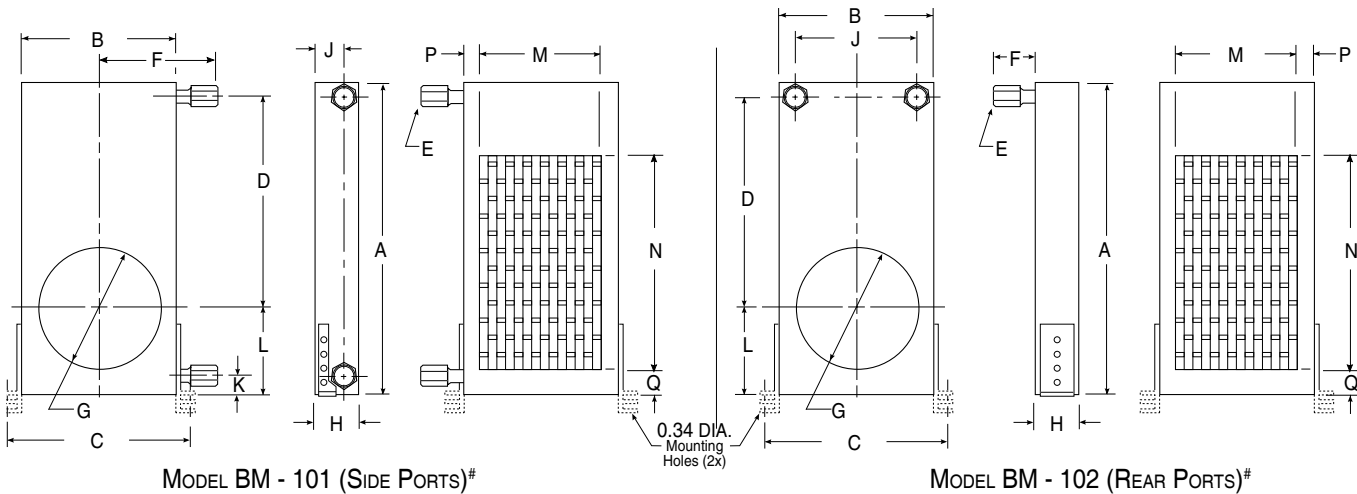
Use the following formula to correct for airflow rates for the given curves A,B, or C ( as it is shown in the above dotted line graph).

Formula  
 $F_s \times C_f = C F_s \text{ (corrected } F_s \text{)}$

Example  
 $123.7 \times 1.50 \text{ (from curve)} = 185.6 \text{ CFs}$

# BM Series dimensions

BM-101 or BM-102 can be used for electric motor NEMA frame size 48-184



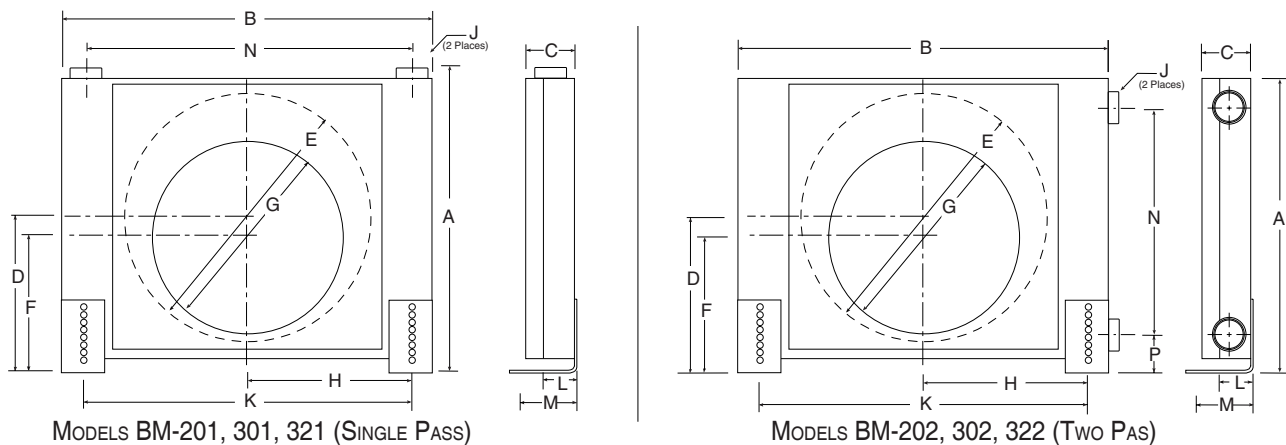
MODEL BM - 101 (SIDE PORTS)#

MODEL BM - 102 (REAR PORTS)#

## STANDARD DIMENSIONS (inches)

Model	A	B	C	D	E NPT	E SAE	F	G Dia.	H	J	K	L	M	N	P	Q	Weight LBS
BM - 101	15.75	9.00	10.25	8.50	.75	#12	7.75	7.00	2.22	.94	1.13	5.88	7.50	10.50	0.75	2.31	14.50
BM - 102							2.69			6.00	-						14.50

BM-201 thru BM-322 can be used for electric motor NEMA frame size 213-365

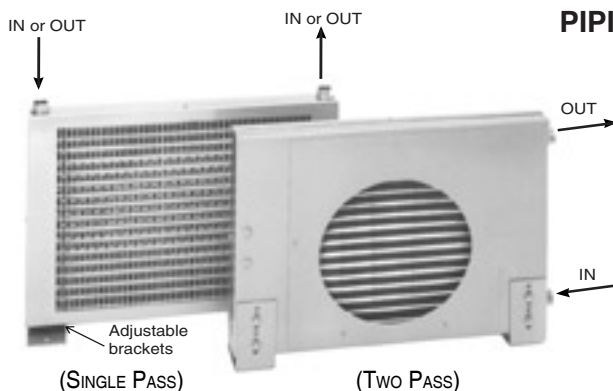


MODELS BM-201, 301, 321 (SINGLE PASS)

MODELS BM-202, 302, 322 (TWO PAS)

## STANDARD DIMENSIONS (inches)

Model	A	B	C	D	E Dia.	F	G Dia.	H	J NPT	J SAE	K	L	M	N	P	Weight LBS
BM - 201	14.90	16.50	2.75	7.33	12.62	5.13	8.00	7.38	.75	#12	14.75	.50	1.94	14.62	-	14
BM - 202	13.75	16.50	2.75	7.33	12.62	5.13	8.00	7.38	.75	#12	14.75	.50	1.94	8.00	3.19	14
BM - 301	19.50	24.80	2.75	9.75	14.62	8.19	12.00	10.72	.75	#12	21.44	.88	3.38	22.88	-	30
BM - 302	18.69	24.80	2.75	9.75	14.62	8.19	12.00	10.72	.75	#12	21.44	.88	3.38	14.00	2.62	30
BM - 321	19.50	24.80	2.75	9.75	17.00	9.75	14.62	10.72	.75	#12	21.44	.88	3.38	22.88	-	30
BM - 322	18.69	24.80	2.75	9.75	17.00	9.75	14.62	10.72	.75	#12	21.44	.88	3.38	14.00	2.62	30



## PIPING HOOK-UP

Note:

To obtain the best performance place the opening of the unit against the fan air intake of the motor. Use a gasket or calking compound around the joint to prevent air from leaking out from around the edges.

note: AIHTI reserves the right to make reasonable design changes without notice.

## Receiving / Installation

a) Inspect unit for any shipping damage before uncrating. Indicate all damages to the trucking firms' delivery person and mark it on the receiving bill before accepting the freight. Make sure that the core and fan are not damaged. Rotate the fan blade to make sure that it moves freely. *Since the warranty is based upon the unit date code located on the model identification tag, removal or manipulation of the identification tag will void the manufacturers warranty.*

c) Standard Enamel Coating: American Industrial provides its standard products with a normal base coat of oil base air cure enamel paint. The enamel paint is applied as a temporary protective and esthetic coating prior to shipment. While the standard enamel coating is durable, American Industrial does not warranty it as a long-term finish coating. It is strongly suggested that a more durable final coating be applied after installation or prior to long-term storage in a corrosive environment to cover any accidental scratches, enhance esthetics, and further prevent corrosion. It is the responsibility of the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

d) Special Coatings: American Industrial offers as customer options, Air-Dry Epoxy, and Heresite (Air-Dry Phenolic) coatings at additional cost. American Industrial offers special coatings upon request, however American Industrial does not warrantee coatings to be a permanent solution for any equipment against corrosion. It is the responsibility of the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

e) American Industrial recommends that the equipment supplied should be installed by qualified personnel who have solid understanding of system design, pressure and temperature ratings, and piping assembly. Verify the service conditions of the system prior to applying any air cooled heat exchanger series cooler. If the system pressure or temperature does not fall within the parameters on model rating tag located on the heat exchanger, contact our factory prior to installation or operation.

g) Heat exchanger should be securely fastened using the mounting foot brackets (included). All mounting holes should be used to secure unit into place.

h) Connections should be made in "one pass" or "two pass" configurations exactly as indicated in the "piping hook up" illustration. The process flow entering the "Fluid IN" port and exiting the "Fluid OUT" port eliminates air pockets and assures that the unit will stay completely flooded. Flexible hose can be applied to reduce the risk of core failure due to thermal expansion or system vibration. Piping alignment and support is required for hoses longer than four feet in length and for piping exerting more than 10 lbs of dynamic force. It is recommended that filtration be located ahead of the heat exchanger to prevent excessive backpressure and clogging.

i) With respect to the heat exchangers nozzle size, flow line sizes should be sized to handle the appropriate flow rate and system pressure drop requirements, normally flow line rates of about 8-12 feet per second and inlet pressure less than 100psig are experienced. If the flow line size is larger than the heat exchanger nozzle size, additional pressure loss beyond the published pressure loss data may occur.

j) Electric motors should be connected only to supply source of the same characteristics as indicated on the electric motor information plate. Prior to starting, verify that the motor and fan spin freely without obstruction. Check carefully that the fan turns in the correct rotation direction (normally counter clockwise) from the motor side (fan direction arrow). Failure to operate the fan in the proper direction could reduce performance or cause serious damage to the heat exchanger or other components.

k) Solely at the request of customers, American Industrial provides direct acting internal inlet port to outlet port bypass relief valves as an additional safe guard against excessive flow and over pressurization of the heat exchanger. American Industrial purchases and applies high quality hydraulic system cartridge valves and components made available for hydraulic system use. However, American Industrial does not specify, recommend, suggest, guarantee, or warrantee the internal relief valve or its performance to safe guard the heat exchanger from damage or prevent failure due to excessive flow or over pressurization. It is the ultimately the sole responsibility of the customer/user to verify with the original equipment manufacture all conditions associated with applying an additional system relief valve prior to application.

## Maintenance

Regular maintenance intervals based upon the surrounding and operational conditions should be maintained to verify equipment performance and to prevent premature component failure. Since some of the components such as, motors, fans, etc... are not manufactured by American Industrial, maintenance requirements provided by the manufacture must be followed.

a) Inspect the entire heat exchanger and motor/fan assembly for loosened bolts, loose connections, broken components, rust spots, corrosion, fin/coil clogging, or external leakage. Make immediate repairs to all affected areas prior to restarting and operating the heat exchanger or its components.

b) Heat exchangers operating in oily or dusty environments will often need to have the coil cooling fins cleaned. Oily or clogged fins should be cleaned by carefully brushing the fins and tubes with water or a non-aggressive degreasing agent mixture (*Note: Cleaning agents that are not compatible with copper, brass, aluminum, steel or stainless steel should not be used*). A compressed air or a water stream can be used to dislodge dirt and clean the coil further. Any external dirt or oil on the electric motor and fan assembly should be removed. *Caution: Be sure to disconnect the electric motor from its power source prior to doing any maintenance.*

c) In most cases it is not necessary to internally flush the coil. In circumstances where the coil has become plugged or has a substantial buildup of material, flushing the coil with water or a solvent may be done. Flushing solvents should be non-aggressive suitable for the materials of construction. Serviceable Core® models can be disassembled and inspected or cleaned if required.

e) Fan blades should be cleaned and inspected for tightness during the regular maintenance schedule when handling a fan blade care must be given to avoid bending or striking any of the blades. Fan blades are factory balanced and will not operate properly if damaged or unbalanced. Damaged fan blades can cause excessive vibration and severe damage to the heat exchanger or drive motor. Replace any damaged fan with an American industrial suggested replacement.

f) Air cooled exchanger cabinets are constructed using 7ga. through 18ga. steel that may be bent back into position if damaged. Parts that are not repairable can be purchased through American Industrial.

g) Coil fins that become flattened can be combed back into position. This process may require removal of the coil from the cabinet.

h) It is not advisable to attempt repairs to brazed joints of a brazed construction coil unless it will be done by an expert in silver solder brazing. Brazed coils are heated uniformly during the original manufacturing process to prevent weak zones from occurring. Uncontrolled reheating of the coil may result in weakening of the tube joints surrounding the repair area. In many instances brazed units that are repaired will not hold up as well to the rigors of the system as will a new coil. American Industrial will not warranty or be responsible for any repairs done by unauthorized sources. Manipulation in any way other than normal application will void the manufactures warranty.



## **INDUSTRIAL & MOBILE AIR COOLED**

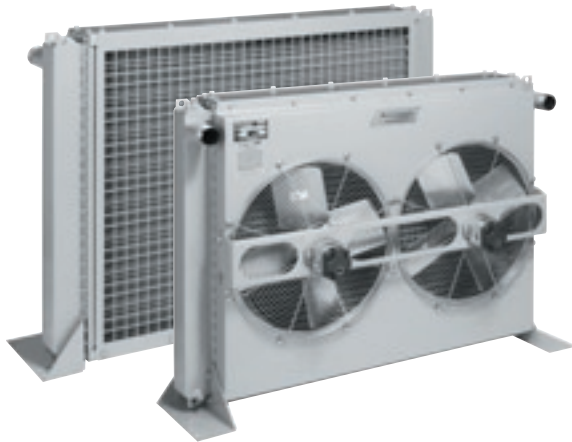
# **OIL COOLERS**

- Standard NPT or SAE models in stock.
- AC - DC or hydraulic fan drives.
- High quality serviceable air filter.
- Operating temperature of 300°F & pressure of 300 PSI.
- Can be customized to fit your needs.
- Adjustable mounting brackets included for easy installation.
- Cools: fluid power systems, injection molding machines, hydraulic presses, gear drives, torque convertors, machine tools, etc...



## ***EOC & EOCF with electric drive***

Mobile & industrial air-cooled oil coolers. Brazed or serviceable core ®, mobile and industrial series heat exchangers available with optional washable filter and integral relief valve, 30 PSI or 65 PSI. Standard single phase, three phase, 12 volt DC (21amp) or 24 volt DC (10.5 amp) motors with single or dual cooling fans. Rated operating temperature of 400°F at 300 PSIG. Standard flow rates to 180 GPM. Thermal capacity up to 225 hp (168 Kw). N PT or SAE strait thread O-ring port connections. Can be modified to meet your requirements. Suitable for most hydraulic oils, lubrication oils, synthetic compressor oils, ethylene glycol, and many other fluids compatible with listed materials.



## ***EOC & EOCF with hydraulic drive***

Mobile & industrial air-cooled oil coolers. Brazed or serviceable core ®, mobile and industrial series heat exchangers available with optional washable filter and integral relief valve, 30 PSI or 65 PSI. Standard hydraulic drive motor(s) with single or dual cooling fans. Rated operating temperature of 400°F at 300 PSIG. Standard flow rates to 180 GPM. Thermal capacity up to 225 hp (168 Kw). N PT or SAE strait thread O-ring port connections. Can be modified to meet your requirements. Suitable for most hydraulic oils, lubrication oils, synthetic compressor oils, ethylene glycol, and many other fluids compatible with listed materials.



***EOC 375 thru EOC 700***



***EOC 190 thru EOC 337***

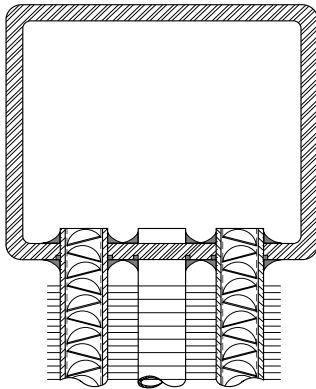




## HIGH PERFORMANCE TURBULATOR

Exclusive American Industrial Turbulators (installed in every flow tube) increase heat transfer by more than 100%.

American Industrial Turbulators eliminate the laminar flow condition normally associated with other smooth tube heat exchangers. High viscosity hydraulic and lubricating oils are easily cooled by this new state-of-the-art turbulator.



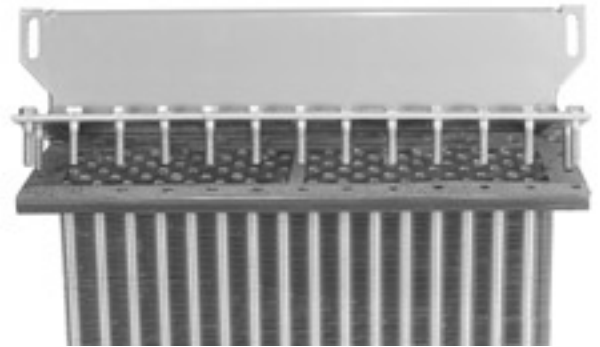
## TANKS EOC-190 - EOC-575

State-of-the-art 21st century high temperature brazing method insures permanent bond and positive contact of tube to manifold, eliminating leaks and providing maximum service life.

## SERVICEABLE CORE® EOC-700 only

Core covers disassemble for easy access and cleaning. Repairable design for applications that require limited down time. Roller expanded tube to tube-sheet joint.

100% mechanical bond. Positive gasket seal is field replaceable for field maintenance or repair.



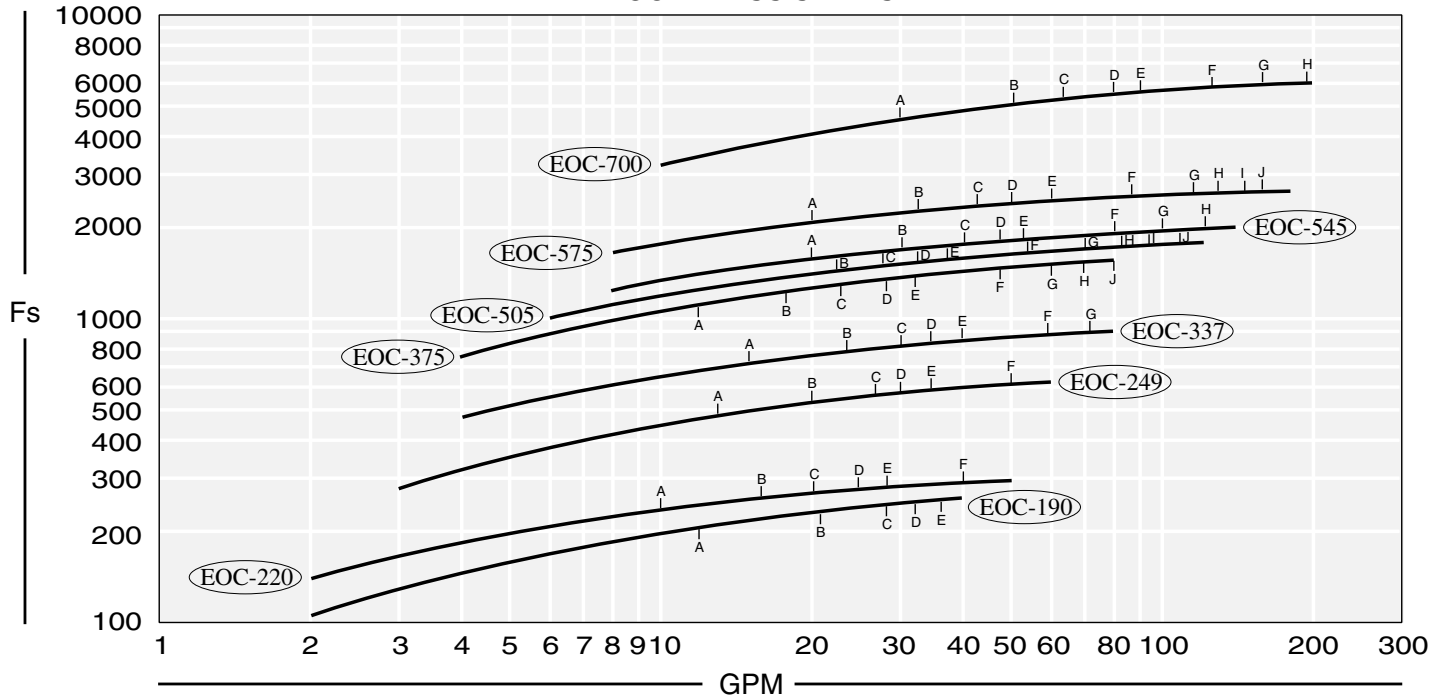
## CONSTRUCTION MATERIALS & RATINGS

Standard Construction Materials		Optional Construction Materials	Standard Unit Ratings	
Tubes	Copper	Carbon Steel	Operating Pressure	300 psig
Fins	Aluminum	Copper	Operating Temperature	300 °F
Turbulators	Steel	Brass	Max. Flow Internal Relief	38 gpm
Tank	Steel	Brass	Max. Fan Over-speed	10 %
Connection pipes	Steel	Brass	Max. Ambient Conditions	104 °F
Cabinet & frame	Steel	316L Stainless Steel, Galvanized Steel	Altitude	0-3300 ft.
Fan Blade	Aluminum with steel hub	Plastic, Non-sparking		
Fan Guard	Zinc plated steel	Zinc plated steel		

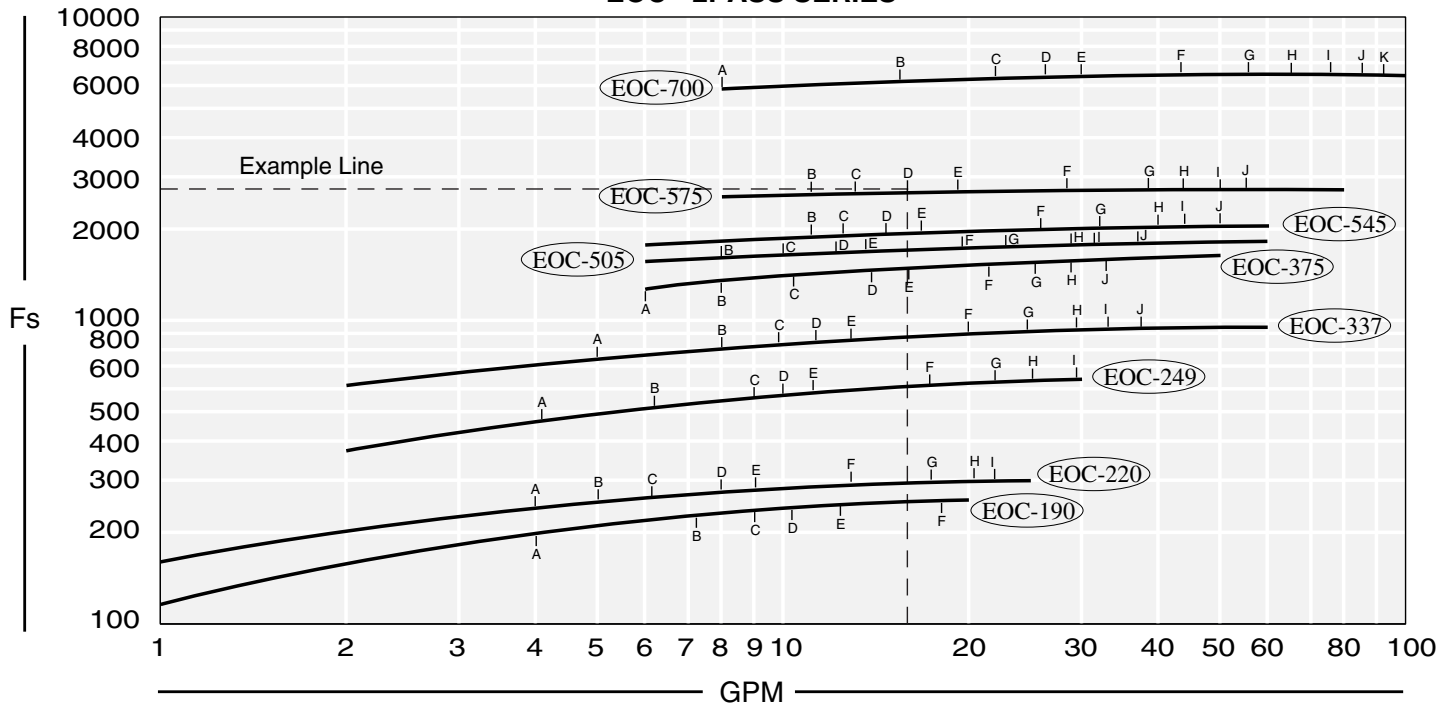


# EOC Series performance

## EOC - 1PASS SERIES



## EOC - 2PASS SERIES



PERFORMANCE CALCULATION	OIL PRESSURE DROP (PSI) CODE
$F_s = \frac{\text{Horsepower to be removed (HP)} \times 2545 \times C_v}{\text{°F (Oil Leaving* - Ambient Air Entering)}} = \frac{\text{BTU}}{\text{hr °F}}$	A = 1 PSI    D = 4 PSI    G = 15 PSI    J = 30 PSI B = 2 PSI    E = 5 PSI    H = 20 PSI    K = 35 PSI C = 3 PSI    F = 10 PSI    I = 25 PSI

\*Represents desired fluid leaving the cooler.

Note: When a model selection has been made, record whether the selection was from the one pass curve or the two pass curve so that the unit can be properly plumbed. Incorrect installation can seriously affect the performance.

## SIZING

To properly size a DC fan drive air-cooled oil cooler for mobile equipment, you should first determine some basic parameters associated with the system.

## HEAT LOAD

There are some system parameters that will be required to properly accomplish the sizing calculations. Without system parameters, it is difficult to determine the optimal heat exchanger size. Normally many of the system parameters can be found on hydraulic schematics or on tags located on the actual equipment. Following are some basic parameters that you should try to acquire before attempting the sizing calculations. However, it is not necessary to have every parameter listed below.

- Main system flow rate (gpm) & working pressure (psi).
- Electric motor HP driving hydraulic pump (if more than one add up the HP for all).
- Desired temperature (°F).
- Fluid type (SAE 10, 20, 30, etc....).
- Ambient air temperature (warmest day).
- Desired fan drive (hydraulic, electric, 12-24V DC, etc...).
- BTU's or HP to be cooled (normally given for lubrication systems).
- Maximum pressure drop allowed through the heat exchanger.
- Space available for heat exchanger (LxWxH).
- External air condition (dirty, papers, etc...).

In many instances the heat load must be determined by using a "total potential" method. This total potential or horsepower method is the most common method, and is the simplest way to determine basic heat rejection requirements for mobile hydraulic systems. The total potential is equal to the maximum operating flow and pressure that are generated by the system under full load. To determine the total potential

(HP) use the following formula.

$$HP = [ \text{System Pressure (PSI)} \times \text{System Flow (GPM)} ] / 1714$$

Example:

$$HP = (3000 \text{ PSI} \times 40 \text{ GPM}) / 1714 = 70 \text{ HP or the total input potential}$$

To determine the system heat load in BTU / HR we must use a percentage (v) of the system potential HP. The factor (v) can be calculated by adding up the actual inefficiencies of a system; however, for most applications a (v) value of 25% - 30% can be used.

Example:

$$70 \text{ HP} \times .25 = 17.5 \text{ HP heat}$$

To convert the horsepower of heat into BTU/HR use the formula below:

$$HP \times 2542 = \text{BTU/HR}$$

Example:

$$17.5 \text{ HP} \times 2542 = 44,538 \text{ BTU/HR}$$

## Applying into a return line

For most open loop systems with a vane or gear type fixed delivery pumps. To calculate the Fs value required when applying the air/oil cooler into a return line use the formula.

$$F_s = \frac{\text{Btu/ hr} \times C_v}{T - t_{\text{ambient}}} = \frac{44,538 \text{ Btu/hr} \times 1.13 C_v}{140^\circ\text{F} - 100^\circ\text{F}_{\text{ambient}}} = 1258 F_s$$

T = Desired system oil temperature leaving the cooler °F

t<sub>ambient</sub> = Ambient air temperature entering the cooler °F

Cv = Correction factor for oil viscosity.

Example: ISO68 oil @ 150°F = 1.13 (see chart below)

Average Liquid Temperature	Cp PRESSURE DROP CORRECTION FACTORS																
	SAE 5	SAE 10	SAE 20	SAE 30	SAE 40	ISO 22	ISO 32	ISO 46	ISO 68	ISO 100	ISO 150	ISO 220	ISO 320	MIL-L-7808	POLYGLYCOL	PHOSPHATE ESTER	50% ETHYLENE GLYCOL & WATER
100	2.00	2.40	4.40	6.40	8.80	1.07	1.53	1.82	2.54	4.19	6.44	9.38	13.56	1.26	3.00	3.50	0.730
110	1.70	2.10	3.60	5.10	6.70	1.04	1.45	1.72	2.35	3.73	5.70	8.33	11.63	1.20	2.40	2.90	0.720
120	1.50	1.80	3.00	4.20	5.60	1.02	1.38	1.60	2.15	3.26	4.91	7.23	9.73	1.14	2.10	2.50	0.709
130	1.40	1.60	2.60	3.40	4.50	0.99	1.30	1.49	1.94	2.80	4.14	6.19	7.80	1.08	1.90	2.20	0.698
140	1.30	1.50	2.23	2.90	3.70	0.97	1.23	1.38	1.75	2.38	3.47	5.20	6.11	1.03	1.90	2.00	0.686
150	1.20	1.30	1.90	2.50	3.10	0.95	1.17	1.30	1.61	2.04	2.90	4.35	4.77	0.98	1.70	1.90	0.676
200	0.93	0.96	1.20	1.40	1.60	0.89	0.99	1.08	1.18	1.33	1.59	1.74	1.95	0.90	1.20	1.30	0.635
250	0.81	0.82	0.92	0.97	1.05	0.85	0.93	0.96	1.03	1.11	1.21	1.22	1.23	0.83	1.00	1.05	0.556

Average Liquid Temperature	Cv VISCOSITY CORRECTION FACTORS																
	SAE 5	SAE 10	SAE 20	SAE 30	SAE 40	ISO 22	ISO 32	ISO 46	ISO 68	ISO 100	ISO 150	ISO 220	ISO 320	MIL-L-7808	POLYGLYCOL	PHOSPHATE ESTER	50% ETHYLENE GLYCOL & WATER
100	1.11	1.15	1.25	1.38	1.45	1.08	1.14	1.18	1.26	1.37	1.43	1.56	1.84	1.19	0.92	0.83	0.85
110	1.09	1.12	1.20	1.32	1.40	1.06	1.13	1.16	1.25	1.31	1.39	1.48	1.67	1.14	0.89	0.80	0.84
120	1.06	1.10	1.17	1.27	1.35	1.04	1.11	1.14	1.20	1.27	1.35	1.40	1.53	1.09	0.88	0.79	0.84
130	1.04	1.08	1.13	1.24	1.29	1.03	1.09	1.13	1.17	1.24	1.30	1.34	1.44	1.05	0.85	0.77	0.83
140	1.03	1.05	1.11	1.19	1.25	1.02	1.08	1.10	1.16	1.20	1.26	1.30	1.39	1.03	0.84	0.76	0.82
150	1.01	1.04	1.09	1.16	1.22	1.02	1.06	1.09	1.13	1.17	1.22	1.27	1.33	1.01	0.83	0.74	0.82
200	0.98	0.99	1.01	1.04	1.07	0.98	0.99	1.00	1.01	1.02	1.08	1.09	1.14	0.98	0.79	0.71	0.80
250	0.95	0.96	0.97	0.98	0.99	0.95	0.96	0.96	0.96	0.97	0.99	1.01	1.02	0.97	0.76	0.69	0.79

# EOC Series selection

## APPLYING INTO A CASE DRAIN LINE

In circumstances where the system is a closed loop or when return line flow is not available, the case drain flow can be utilized to help cool the system. However, in many instances, the case drain flow alone will not be enough to reject all of the heat generated by the system. Case drain lines should not be treated as a normal return lines since the pressure drop allowable usually can vary from 2-10 PSI max. Check with your pump manufacturer for the appropriate pressure drop tolerance before applying any cooler. To size the system for case flow or case flow plus any additional flushing loops, please use the following method.

Formula:

$T_{c_{exit}}$  = The corrected temperature of the oil exiting the cooler.

$$T_{c_{exit}} = \{ T - [ Q / (\text{case flow gpm} \times 210) ] \}$$

Example:

$$T_{c_{exit}} = \{ 150 - [ 44,538 / (8 \times 210) ] \} = 123.5$$

$$F_s = \frac{Q \times C_v}{T_{c_{exit}} - t_{ambient}} = \frac{44,538 \text{Btu/hr} \times 1.13 C_v}{123.5^\circ\text{F} - 100^\circ\text{F}} = 2,142$$

## Re-circulation Cooling Application (Kidney Loop)

When applying any American Industrial air-cooled heat exchanger into a re-circulation (filtration loop) some important differences should be noted. The standard air-cooled heat transfer calculation can be used however some preliminary calculations must be done prior to using the formula. Before applying the standard air-cooled heat transfer formula, the air oil cooler exiting temperature must be derived from.

Example Re-circulation Loop Application

Fluid - Oil SAE 5w

Flow - 15 GPM re-circulating

Desired Reservoir Temp - 125°F

Ambient Temp - 90°F

Input potential 60 HP

Heat to be removed 1/3 x 60HP = 20HP

Fan drive requirements 3/60/230-460 motor.

Step 1

$$\text{Formula 1} \quad \Delta T = \frac{\text{HP (to be removed)} \times 2545}{\text{Loop Flow (GPM)}}$$

Example

$$\Delta T = \frac{20\text{HP} \times 2545}{15\text{gpm} \times 210} = 16.6^\circ\text{F}$$

Step 2

$$\text{Formula 2} \quad F_s = \frac{\text{HP(to be removed)} \times 2545 \times \text{CV}}{(T1 - \Delta T) - \text{Ambient } ^\circ\text{F}}$$

Example

$$F_s = \frac{220\text{HP} \times 2545 \times 1.06}{(125 - 16.2) - 90^\circ\text{F}} = 2,869.9 F_s$$

Step 3

Selection from the heat energy dissipation chart (page 172.) EOC-575-3-2P

See example line 2pass curve.

## SELECTION

To select a model, locate the flow rate (GPM) at the bottom of the flow vs  $F_s$  graph. Proceed upward until the GPM intersects with the calculated  $F_s$ . The curve closest above the intersection point will meet these conditions.

Examples:

Return Line	Case Line	Recirculation Loop
$F_s = 1,258$	$F_s = 2,142$	$F_s = 2,869.9$
GPM = 40 "return flow"	GPM = 8 "case flow"	GPM = 15 "loop flow"
Model = EOC-375-4	Model = EOC-575-4-2P	Model = EOC-575-3-2P

## PRESSURE DROP

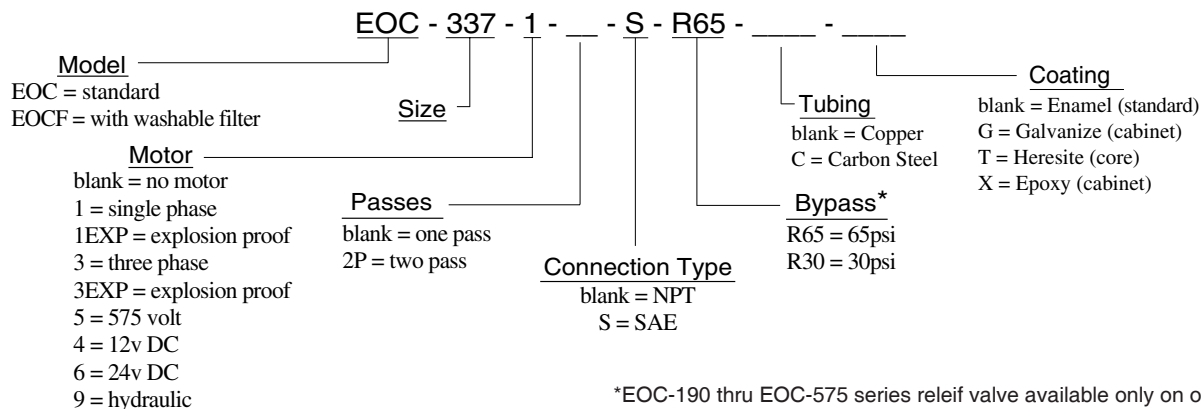
Determine the oil pressure drop from the curves as indicated. For viscosities other than 50 ssu, multiply the actual indicated pressure drop (psi) for your GPM by the  $C_p$  value in the pressure differential curve for your viscosity value.

Examples:

EOC-375	EOC-575-2P
@GPM = 40	@GPM = 8

Indicated pressure drop	7.8 PSI	4 PSI
$C_p$ correction factor (pg.173)	1.61	1.45
Corrected Pressure drop	12.56 PSI	5.8 PSI

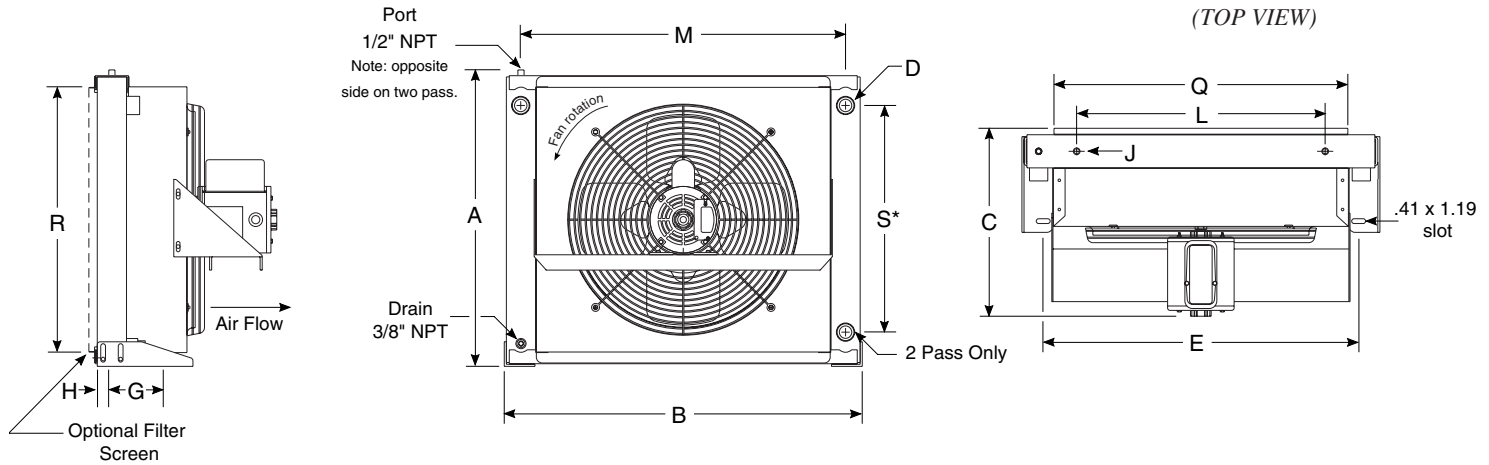
## EXAMPLE OF A MODEL



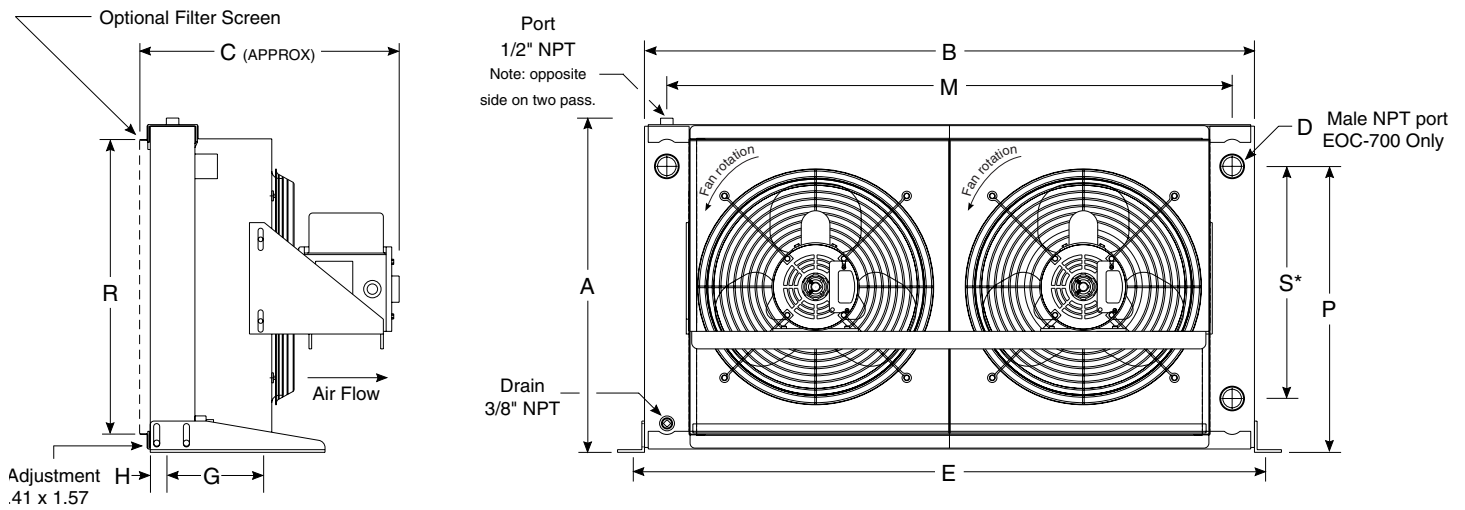
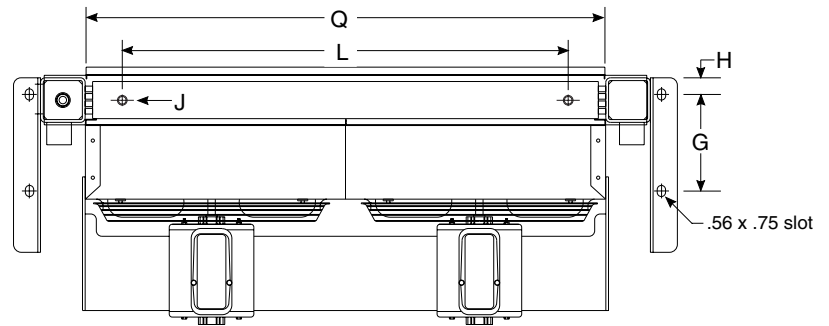
\*EOC-190 thru EOC-575 series relief valve available only on one pass unit.  
EOC-700 series relief valve available only on two pass unit.

# EOC & EOCF Series *dimensions with electric drive*

## MODEL EOC - 190 Through EOC - 337



## MODEL EOC - 375 Through EOC - 700



\* Dimension used only with two pass units

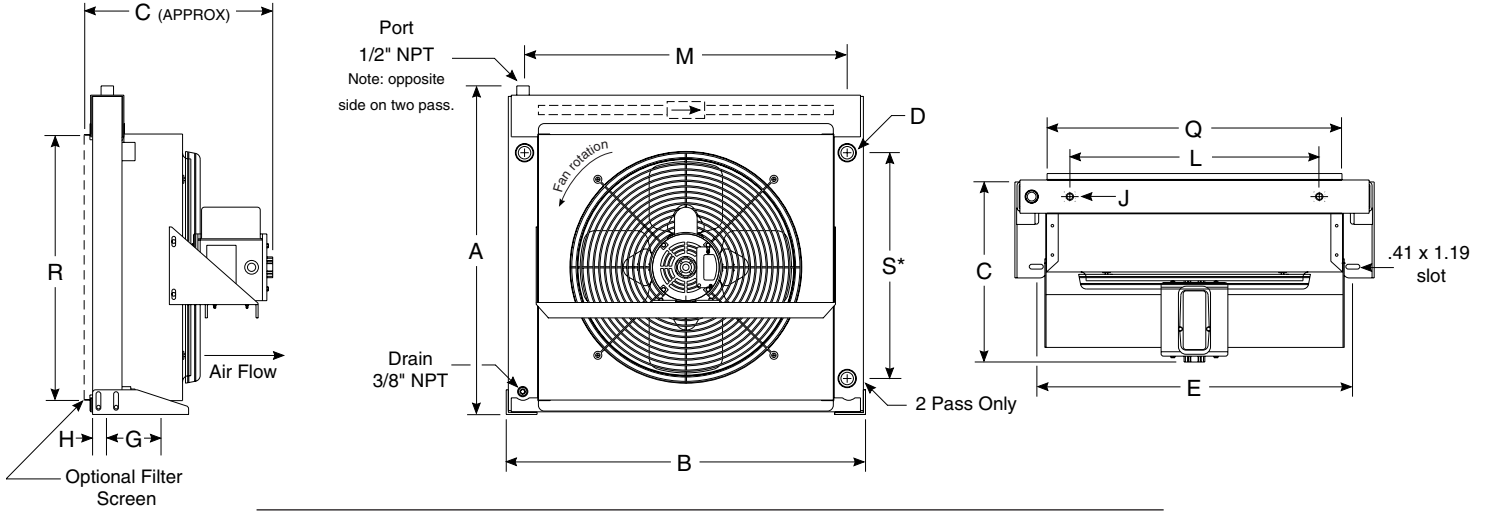
## COMMON DIMENSIONS

Model	A	B	C	D NPT	D SAE	E	G	H	J 1/2-13 tab	L	M	P	Q	R	S*
EOC - 190 - *	13.62	16.50	14.21	.75	#12	14.75	5.00	2.61	(4)	8.00	15.00	10.31	11.38	10.38	7.65
EOC - 220 - *	15.62	22.00	16.32	.75	#12	18.69	5.00	2.61		14.00	20.50	12.31	16.88	12.25	10.25
EOC - 249 - *	19.62	24.75	16.32	.75	#12	21.44	5.00	2.61		14.00	23.25	16.31	20.00	16.25	15.00
EOC - 337 - *	25.62	30.25	16.32	1.00	#16	26.97	5.00	2.61		21.25	28.75	22.31	25.00	22.38	19.38
EOC - 375 - *	18.50	39.00	17.75	1.25	#20	40.50	6.50	1.06		30.00	36.50	15.25	33.00	15.13	12.50
EOC - 505 - *	22.50	41.0	17.13	1.25	#20	42.50	6.50	1.12		30.00	38.50	19.25	34.75	19.63	16.50
EOC - 545 - *	30.50	42.00	17.32	1.50	#24	43.75	9.00	1.71		30.00	39.50	27.25	35.75	27.50	24.63
EOC - 575 - *	36.50	48.00	17.32	2.00	#32	49.75	9.00	1.71		36.00	45.50	32.75	41.75	33.50	29.25
EOC - 700 - *	38.38	51.00	21.23	2.00†	#32	52.75	9.00	1.62	(8)	-	48.50	34.00	43.50	34.50	32.50

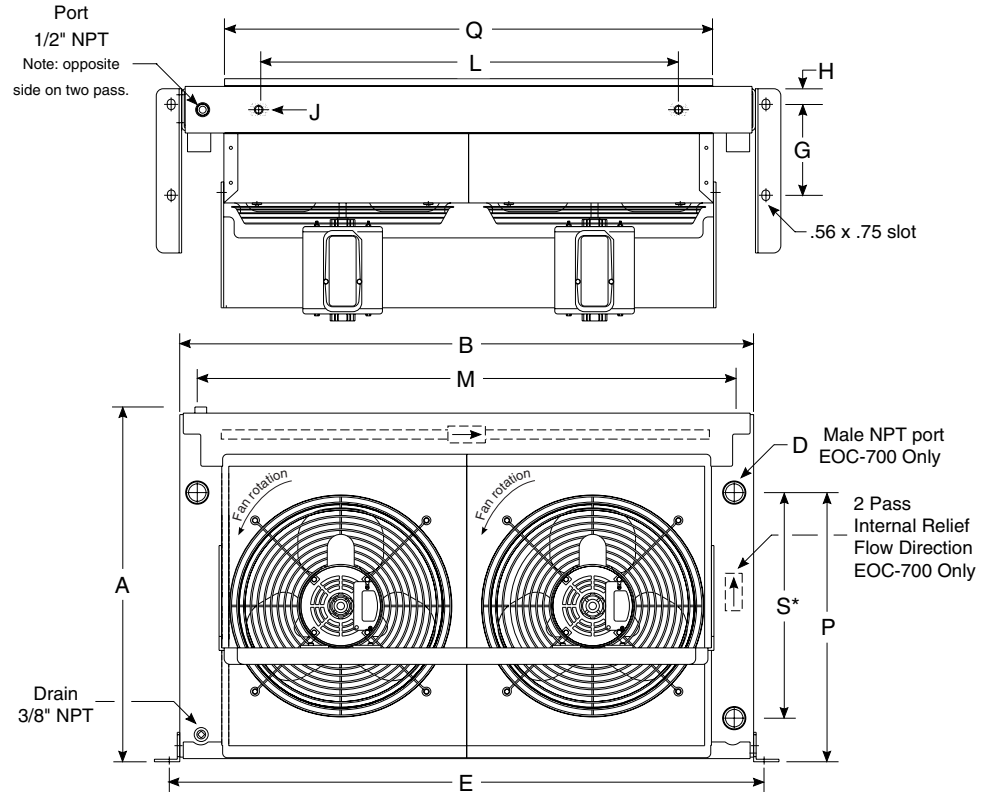
note: AIHTI reserves the right to make reasonable design changes without notice.

# EOC & EOCF Series *dimensions with bypass relief valve*

MODEL EOC - 190 through EOC - 337



MODEL EOC - 375 through EOC - 700



\* Dimension used only with two pass units

## COMMON DIMENSIONS

Model	A	B	C electric	C hydraulic	D NPT	D SAE	E	G	H	J 1/2-13 tab	L	M	P	Q	R	S*
EOC - 190 - *	16.00	16.50	14.21	12.20	.75	#12	14.75	5.00	2.61	(4)	8.00	15.00	10.31	11.38	10.38	7.65
EOC - 220 - *	18.00	22.00	16.32	14.64	.75	#12	18.69	5.00	2.61		14.00	20.50	12.31	16.88	12.25	10.25
EOC - 249 - *	22.00	24.75	16.32	14.19	.75	#12	21.44	5.00	2.61		14.00	23.25	16.31	20.00	16.25	15.00
EOC - 337 - *	28.00	30.25	16.32	14.64	1.00	#16	26.97	5.00	2.61		21.25	28.75	22.31	25.00	22.38	19.38
EOC - 375 - *	21.38	39.00	17.75	15.14	1.25	#20	40.50	6.50	1.06		30.00	36.50	15.25	33.00	15.13	12.50
EOC - 505 - *	25.38	41.0	17.13	15.14	1.25	#20	42.50	6.50	1.12		30.00	38.50	19.25	34.75	19.63	16.50
EOC - 545 - *	33.28	42.00	17.32	15.14	1.50	#24	43.75	9.00	1.71		30.00	39.50	27.25	35.75	27.50	24.63
EOC - 575 - *	39.38	48.00	17.32	15.29	2.00	#32	49.75	9.00	1.71		36.00	45.50	32.75	41.75	33.50	29.25
EOC - 700 - *	38.39	51.00	21.23	15.40	2.00†	#32	52.75	9.00	1.62	(8)	-	48.50	34.00	43.50	34.50	32.50

note: AIHTI reserves the right to make reasonable design changes without notice.



## EOC & EOCF ELECTRIC MOTOR DATA

Model	Horse Power	No. of Motors	Phase	Hz	Volts	RPM	NEMA Frame	Type	Full Load Amperes	Service Factor	Thermal Overload
EOC - 190 - 1	1 / 4	1	1	60 / 50	115/230 - 90/190	1725 - 1425	48	TEFC	3.2/1.6 - 2.8/1.4	1.15	NO
EOC - 190 - 3	1 / 4	1	3	60 / 50	230/460 - 190/380	1725 - 1425	48	TENV	1.3/.65 - 1.1/.55	1.15	YES
EOC - 190 - 5	1 / 4	1	3	60 / 50	575	1725 - 1425	48	TEFC	.65 - .60	1.15	NO
EOC - 220 - 1	1 / 4	1	1	60 / 50	115/230 - 90/190	1725 - 1425	48	TEFC	3.2/1.6 - 2.8/1.4	1.15	NO
EOC - 220 - 3	1 / 4	1	3	60 / 50	230/460 - 190/380	1725 - 1425	48	TENV	1.3/.65 - 1.1/.55	1.15	YES
EOC - 220 - 5	1 / 4	1	3	60 / 50	575	1725 - 1425	48	TEFC	.65 - .60	1.15	NO
EOC - 249 - 1	1 / 4	1	1	60 / 50	115/230 - 90/190	1725 - 1425	48	TEFC	3.2/1.6 - 2.8/1.4	1.15	NO
EOC - 249 - 3	1 / 4	1	3	60 / 50	230/460 - 190/380	1725 - 1425	48	TENV	1.3/.65 - 1.1/.55	1.15	YES
EOC - 249 - 5	1 / 4	1	3	60 / 50	575	1725 - 1425	48	TEFC	.65 - .60	1.15	NO
EOC - 337 - 1	1 / 4	1	1	60 / 50	115/230 - 90/190	1725 - 1425	48	TEFC	3.2/1.6 - 2.8/1.4	1.15	NO
EOC - 337 - 3	1 / 4	1	3	60 / 50	230/460 - 190/380	1725 - 1425	48	TENV	1.3/.65 - 1.1/.55	1.15	YES
EOC - 337 - 5	1 / 4	1	3	60 / 50	575	1725 - 1425	48	TEFC	.65 - .60	1.15	NO
EOC - 375 - 1	1 / 4	2	1	60 / 50	115/230 - 90/190	1725 - 1425	48	TEFC	3.2/1.6 - 2.8/1.4	1.15	NO
EOC - 375 - 3	1 / 4	2	3	60 / 50	230/460 - 190/380	1725 - 1425	48	TENV	1.3/.65 - 1.1/.55	1.15	YES
EOC - 375 - 5	1 / 4	2	3	60 / 50	575	1725 - 1425	48	TEFC	.65 - .60	1.15	NO
EOC - 505 - 1	1 / 4	2	1	60 / 50	115/230 - 90/190	1725 - 1425	48	TEFC	3.2/1.6 - 2.8/1.4	1.15	NO
EOC - 505 - 3	1 / 4	2	3	60 / 50	230/460 - 190/380	1725 - 1425	48	TENV	1.3/.65 - 1.1/.55	1.15	YES
EOC - 505 - 5	1 / 4	2	3	60 / 50	575	1725 - 1425	48	TEFC	.65 - .60	1.15	NO
EOC - 545 - 1	1 / 4	2	1	60 / 50	115/230 - 90/190	1725 - 1425	48	TEFC	3.2/1.6 - 2.8/1.4	1.15	NO
EOC - 545 - 3	1 / 4	2	3	60 / 50	230/460 - 190/380	1725 - 1425	48	TENV	1.3/.65 - 1.1/.55	1.15	YES
EOC - 545 - 5	1 / 4	2	3	60 / 50	575	1725 - 1425	48	TEFC	.65 - .60	1.15	NO
EOC - 575 - 1	1 / 4	2	1	60 / 50	115/230 - 90/190	1725 - 1425	48	TEFC	3.2/1.6 - 2.8/1.4	1.15	NO
EOC - 575 - 3	1 / 4	2	3	60 / 50	230/460 - 190/380	1725 - 1425	48	TENV	1.3/.65 - 1.1/.55	1.15	YES
EOC - 575 - 5	1 / 4	2	3	60 / 50	575	1725 - 1425	48	TEFC	.65 - .60	1.15	NO
EOC - 700 - 1	1	2	1	60	115 - 208/230	1725	56	TEFC	13.4/6.8 - 6.7	1.15	NO
EOC - 700 - 3	1	2	3	60 / 50	230/460 - 190/380	1725 - 1425	56	TEFC	3.5/3.6 - 1.8/3.4	1.15	YES
EOC - 700 - 5	1	2	3	60 / 50	575	1725 - 1425	56	TEFC	1.45	1.15	NO

## DC ELECTRIC MOTOR DATA

Model	Horse Power	Current	Volts	RPM	NEMA Frame	Enclosure Type	Full Load Amperes	Service Factor	Thermal Overload
EOC - 190 thru 575 - 1EXP	1 / 4	DC	12	1750	48	TENV	21	1.0	NO
EOC - 190 thru 575 - 3EXP	1 / 4	DC	24	1750	48	TENV	10.5	1.0	NO

## CLASS I, DIV. 1, GROUP D or CLASS II, DIV. 2, GROUP F & G EXPLOSION PROOF MOTOR DATA

Model	Horse Power	Phase	Hz	Volts	RPM	NEMA Frame	Enclosure Type	Full Load Amperes	Service Factor	Thermal Overload
EOC - 190 thru 575 - 1EXP	1 / 4	1	60	115 / 230	1725	48	X-PROOF	5.8 / 2.9	1.0	YES
EOC - 190 thru 575 - 3EXP	1 / 4	3	60	208-230 / 460	1725	48	X-PROOF	1.4-1.3 / .65	1.0	YES
EOC - 700 - 1EXP	1	1	60	115 / 230	1725	56	X-PROOF	13.4 / 6.7	1.0	YES
EOC - 700 - 3EXP	1	3	60	208-230 / 460	1725	56	X-PROOF	3.6 / 1.8	1.0	YES

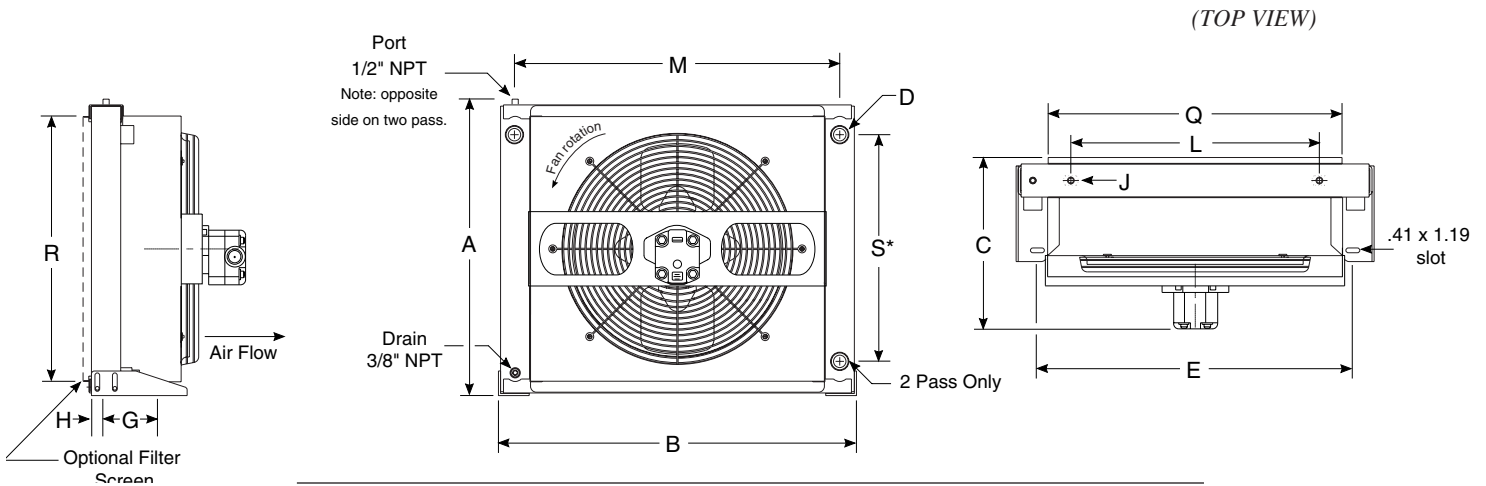
### ELECTRIC MOTOR NOTES:

- 1) TEFC motors are available for all models.
- 2) Motor electrical ratings are an approximate guide and may vary between motor manufacturers. Consult ratings on motor data plate prior to installation and operation.
- 3) Explosion proof, high temperature, severe duty, chemical, IEC, Canadian Standards Association, and Underwriters Laboratory recognized motors are available upon request.
- 4) American Industrial reserves the right to enact changes to motor brand, type and ratings regarding horsepower, RPM, FLA, and service factor for standard products without notice. All specific requirements will be honored without change.
- 5) Fan rotation is clockwise when facing the motor shaft.
- 6) The above motors contain factory lubricated shielded ball bearings.
- 7) **Abbreviation Index**  
 TEFC ..... Totally Enclosed, Fan Cooled  
 TEAO ..... Totally Enclosed, Air Over

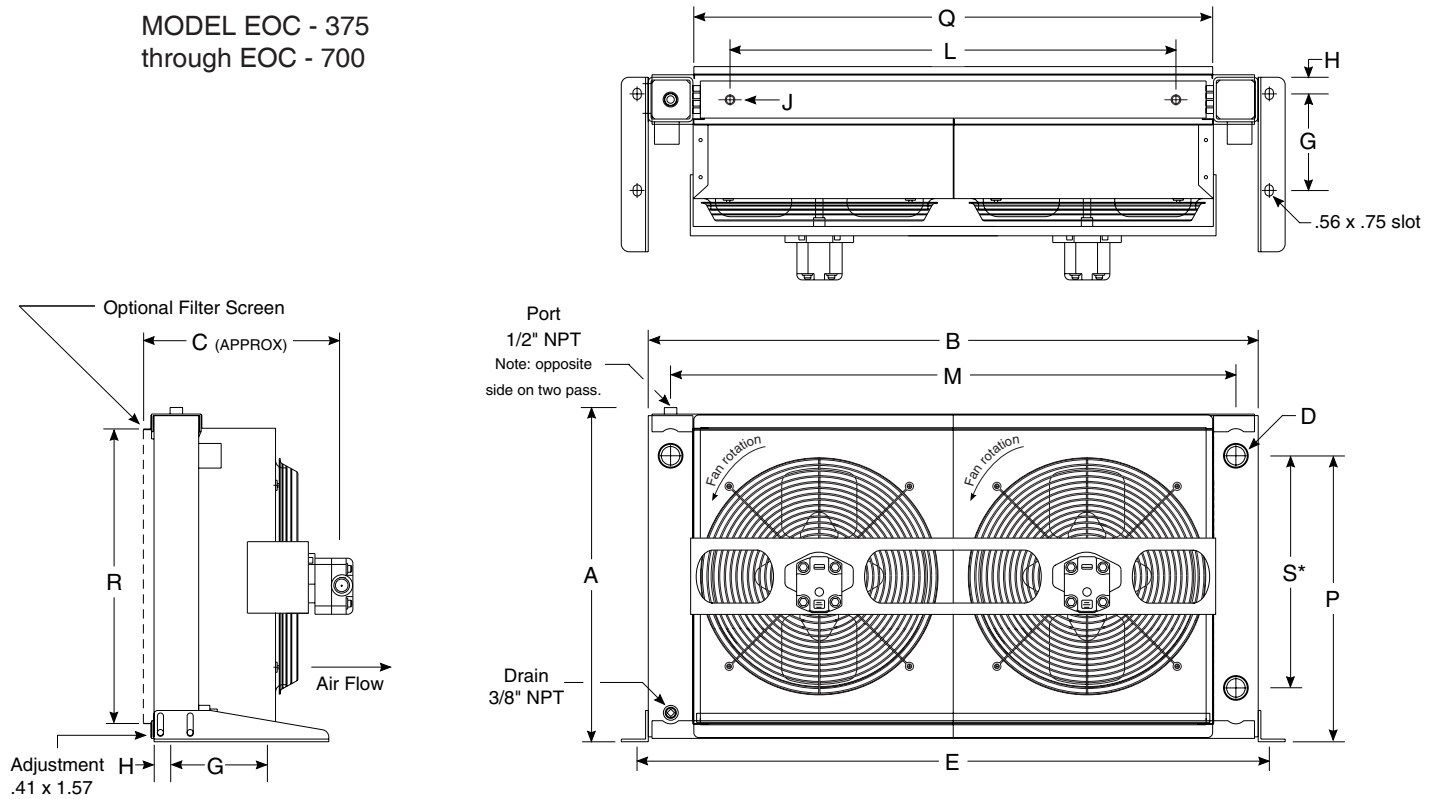


# EOC & EOCF Series *dimensions with hydraulic drive*

## MODEL EOC - 190 Through EOC - 337



## MODEL EOC - 375 through EOC - 700



## COMMON DIMENSIONS

Model	A	B	C	D NPT	D SAE	E	G	H	J 1/2-13 tab	L	M	P	Q	R	S*
EOC - 190 - *	13.62	16.50	12.20	.75	#12	14.75	5.00	2.61	(4)	8.00	15.00	10.31	11.38	10.38	7.65
EOC - 220 - *	15.62	22.00	14.64	.75	#12	18.69	5.00	2.61		14.00	20.50	12.31	16.88	12.25	10.25
EOC - 249 - *	19.62	24.75	14.19	.75	#12	21.44	5.00	2.61		14.00	23.25	16.31	20.00	16.25	13.67
EOC - 337 - *	25.62	30.25	14.64	1.00	#16	26.97	5.00	2.61		21.25	28.75	22.31	25.00	22.38	19.38
EOC - 375 - *	18.50	39.00	15.14	1.25	#20	40.50	6.50	1.06		30.00	36.50	15.25	33.00	15.13	12.50
EOC - 505 - *	22.50	41.0	15.14	1.25	#20	42.50	6.50	1.12		30.00	38.50	19.25	34.75	19.63	16.50
EOC - 545 - *	30.50	42.00	15.14	1.50	#24	43.75	9.00	1.71		30.00	39.50	27.25	35.75	27.50	24.63
EOC - 575 - *	36.50	48.00	15.29	2.00	#32	49.75	9.00	1.71		36.00	45.50	32.75	41.75	33.50	29.25
EOC - 700 - *	38.38	51.00	15.40	2.00 <sup>†</sup>	#32	52.75	9.00	1.62	(8)	-	48.50	34.00	43.50	34.50	29.81

note: AIHTI reserves the right to make reasonable design changes without notice. <sup>†</sup> male NPT port used

## HYDRAULIC MOTOR DATA

Model	No. of Motors	Motor Connections	RPM	Displacement IN <sup>3</sup> /Rev	Min.Oil Flow Required (GPM)	Min.Operation Pressure (PSI)	Maximum Pressure (PSI)	Size	Shaft
EOC-190	1	SAE-12 1 - 1/16 -12	1725	.43	3.75	200	3000	SAE A 2 Bolt	.625 Keyed Short
EOC-220									
EOC-249									
EOC-337									
EOC-375									
EOC-505									
EOC-545									
EOC-575	2								
EOC-700		.68	6.00	400					

### HYDRAULIC MOTOR NOTES:

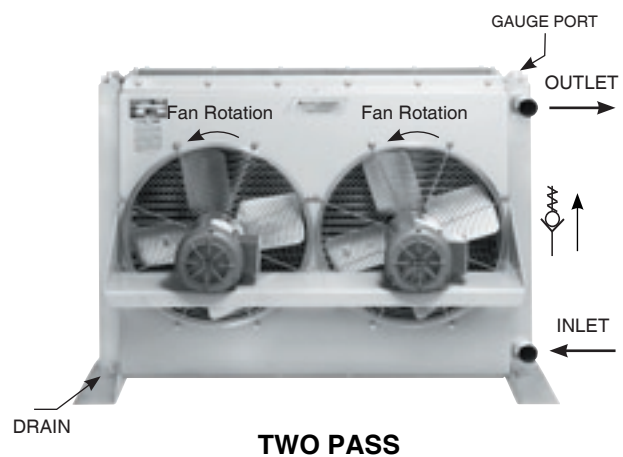
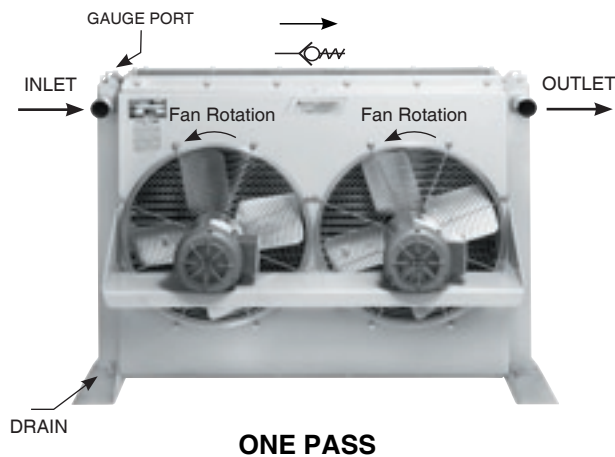
- Standard units are supplied with a bi-directional hydraulic gear motor for the fan drive. The gear motor requires an external case drain be used during operation. The external case drain should be connected directly to hydraulic reservoir or a return line with not greater than 10PSIG back pressure. (NOTE: *Failure to properly connect and use the external case drain during motor operation could result in motor failure and external leakage of hydraulic fluid.*)
- Hydraulic motor flow requirements are provided with an efficiency rating of approximately 85%. Pressure requirements are calculated theoretical minimum operating requirements.
- Shaft adapters are used to bridge the differences in length between the fan and hydraulic motor.
- Maximum degree of fluid contamination, class 18/15 according to ISO 4406. Therefore, it is recommended to use a filter with retention rating of B20>. For longer life, it is recommended to use class 17/14 achievable with filter B10>-100.
- Fan rotation is clockwise when facing the motor shaft.
- Optional displacement motors available upon request.
- American industrial reserves the right to enact changes to hydraulic motor, brand, type, ratings, port sizes, or any additional non-specified attribute for standard products without notice. All specific requirements will be honored without change pending availability.

### COMMON DATA

Model	Total Air Flow		Sound Level dB(A) @ 7ft	Liquid Volume		Weight Electric		Weight Hydraulic		Bypass Valve Adder (lbs)	Serviceable Core
	CFM	m <sup>3</sup> /s		gal.	cm <sup>3</sup>	lb	kg	lb	kg		
EOC-190	800	.376	68	.76	2877	49	22	44	20	5	NO
EOC-220	800	.376	68	.85	3217	64	29	59	27	5	NO
EOC-249	2000	.942	71	1.28	4845	87	39	82	37	5	NO
EOC-337	2500	1.177	81	1.85	7003	102	46	97	44	6	NO
EOC-375	4000	1.884	73	1.94	7343	142	64	130	59	6	NO
EOC-505	4000	1.884	73	2.50	9464	151	68	139	63	7	NO
EOC-545	4000	1.884	73	3.51	13287	163	74	151	68	7	NO
EOC-575	5000	2.355	83	4.34	16428	241	109	227	103	8	NO
EOC-700	9500	4.475	87	7.53	28504	428	194	414	188	8	YES

NOTES: To estimate the sound level at distances other than 7 feet (2.1 meters) from the cooler, add 6 db for each halving of distance, or subtract 6 db for each doubling of the distance.

## PIPING HOOK UP



### Receiving / Installation

a) Inspect unit for any shipping damage before uncrating. Indicate all damages to the trucking firms' delivery person and mark it on the receiving bill before accepting the freight. Make sure that the core and fan are not damaged. Rotate the fan blade to make sure that it moves freely. The published weight information located in this brochure is approximate. True shipment weights are determined at the time of shipping and may vary. Approximate weight information published herein is for engineering approximation purposes and should not be used for exact shipping weight. *Since the warranty is based upon the unit date code located on the model identification tag, removal or manipulation of the identification tag will void the manufacturer's warranty.*

b) When handling the heat exchanger, special care should be taken to avoid damage to the core and fan. All units are shipped with wood skids for easy forklift handling

c) Standard Enamel Coating: American Industrial provides its standard products with a normal base coat of oil base air cure enamel paint. The enamel paint is applied as a temporary protective and esthetic coating prior to shipment. While the standard enamel coating is durable, American Industrial does not warranty it as a long-term finish coating. It is strongly suggested that a more durable final coating be applied after installation or prior to long-term storage in a corrosive environment to cover any accidental scratches, enhance esthetics, and further prevent corrosion. It is the responsibility of the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

d) Special Coatings: American Industrial offers as customer options, Air-Dry Epoxy, and Heresite (Air-Dry Phenolic) coatings at additional cost. American Industrial offers special coatings upon request, however American Industrial does not warrantee coatings to be a permanent solution for any equipment against corrosion. It is the

responsibility of the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

e) American Industrial recommends that the equipment supplied should be installed by qualified personnel who have solid understanding of system design, pressure and temperature ratings, and piping assembly. Verify the service conditions of the system prior to applying any air cooled heat exchanger series cooler. If the system pressure or temperature does not fall within the parameters on model rating tag located on the heat exchanger, contact our factory prior to installation or operation.

g) Heat exchanger should be securely fastened using the mounting foot brackets (included). All mounting holes should be used to secure unit into place. Optional horizontal mounting with vertical airflow is allowable. Heat exchanger unit must be set into a fabricated channel type frame with provision for additional motor support for heavy motors. Since the units are normally operated in the vertical position (horizontal airflow) reinforced motor support is suggested.

h) Connections should be made in "one pass" or "two pass" configurations exactly as indicated in the "piping hook up" illustration above. The process flow entering the "Fluid IN" port and exiting the "Fluid OUT" port eliminates air pockets and assures that the unit will stay completely flooded. Flexible hose can be applied to reduce the risk of core failure due to thermal expansion or system vibration. Piping alignment and support is required for hoses longer than four feet in length and for piping exerting more than 20 lbs of dynamic force. It is recommended that filtration be located ahead of the heat exchanger to prevent excessive backpressure and clogging.

i) With respect to the heat exchangers nozzle size, flow line sizes should be sized to handle the appropriate flow rate and system pressure drop requirements, normally

flow line rates of about 8-12 feet per second and inlet pressure less than 100psig are experienced. If the flow line size is larger than the heat exchanger nozzle size, additional pressure loss beyond the published pressure loss data may occur.

j) Electric motors should be connected only to supply source of the same characteristics as indicated on the electric motor information plate. Prior to starting, verify that the motor and fan spin freely without obstruction. Check carefully that the fan turns in the correct rotation direction (normally counter clockwise) from the motor side (fan direction arrow). Failure to operate the fan in the proper direction could reduce performance or cause serious damage to the heat exchanger or other components.

k) It is important to apply the catalog recommended flow rate for the hydraulic motor that corresponds with the specific model being used. A case drain is required for hydraulic motor installation. Failure to connect case drain can result in motor failure. The proper flow rate and direction to the hydraulic motor are critical to ensure fan direction and RPM. Exceeding the recommended RPM could result in fan failure and cause severe damage to the heat exchanger. See fan rotation (page 180)

## Maintenance

Regular maintenance intervals based upon the surrounding and operational conditions should be maintained to verify equipment performance and to prevent premature component failure. Since some of the components such as, motors, fans, fan guards, etc... are not manufactured by American Industrial, maintenance requirements provided by the manufacture must be followed.

a) Inspect the entire heat exchanger and motor/fan assembly for loosened bolts, loose connections, broken components, rust spots, corrosion, fin/coil clogging, or external leakage. Make immediate repairs to all affected areas prior to restarting and operating the heat exchanger or its components.

b) Heat exchangers operating in oily or dusty environments will often need to have the coil cooling fins cleaned. Oily or clogged fins should be cleaned by carefully brushing the fins and tubes with water or a non-aggressive degreasing agent mixture (*Note: Cleaning agents that are not compatible with copper, brass, aluminum, steel or stainless steel should not be used*). A compressed air or a water stream can be used to dislodge dirt and clean the coil further. Any external dirt or oil on the electric motor and fan assembly should be removed. *Caution: Be sure to disconnect the electric motor from its power source prior to doing any maintenance.*

c) In most cases it is not necessary to internally flush the coil. In circumstances where the coil has become plugged or has a substantial buildup of material, flushing the coil with water or a solvent may be done. Flushing solvents

should be non-aggressive suitable for the materials of construction. Serviceable Core® models can be disassembled and inspected or cleaned if required.

d) Most low horsepower electric motors do not require any additional lubrication. T.E.F.C. air ventilation slots should be inspected and cleaned regularly to prevent clogging and starving the motor of cooling air. To maintain the electric motor properly see the manufactures requirements and specifications.

e) Fan blades should be cleaned and inspected for tightness during the regular maintenance schedule when handling a fan blade care must be given to avoid bending or striking any of the blades. Fan blades are factory balanced and will not operate properly if damaged or unbalanced. Damaged fan blades can cause excessive vibration and severe damage to the heat exchanger or drive motor. Replace any damaged fan with an American industrial suggested replacement.

f) Air cooled exchanger cabinets are constructed using 7ga. through 18ga. steel that may be bent back into position if damaged. Parts that are not repairable can be purchased through American Industrial.

g) Coil fins that become flattened can be combed back into position. This process may require removal of the coil from the cabinet.

h) It is not advisable to attempt repairs to brazed joints of a brazed construction coil unless it will be done by an expert in silver solder brazing. Brazed coils are heated uniformly during the original manufacturing process to prevent weak zones from occurring. Uncontrolled reheating of the coil may result in weakening of the tube joints surrounding the repair area. In many instances brazed units that are repaired will not hold up as well to the rigors of the system as will a new coil. American Industrial will not warranty or be responsible for any repairs done by unauthorized sources. Manipulation in any way other than normal application will void the manufactures warranty.

i) Solely at the request of customers, American Industrial provides direct acting internal inlet port to outlet port bypass relief valves as an additional safe guard against excessive flow and over pressurization of the heat exchanger. American Industrial purchases and applies high quality hydraulic system cartridge valves and components made available for hydraulic system use. However, American Industrial does not specify, recommend, suggest, guarantee, or warrantee the internal relief valve or its performance to safe guard the heat exchanger from damage or prevent failure due to excessive flow or over pressurization. It is the ultimately the sole responsibility of the customer/user to verify with the original equipment manufacture all conditions associated with applying an additional system relief valve prior to application.



# EOC & EOCF Series *installation & maintenance*

## Serviceable Core® Maintenance

Units containing a Serviceable Core® have bolted manifold covers that can be removed for cleaning or repair purposes.

### Servicing Sequence

American Industrial has gone to great lengths to provide components that are repairable. If the heat exchanger core requires internal cleaning or attention the following steps will explain what must be done to access the internal tubes. Be sure to order gasket kits or repair parts prior to removal and disassembly to minimize down time.

a) To clean the internal tubes first remove all connection plumbing from the unit.

b) Be sure the unit is drained of all water etc...

c) Place the heat exchanger in an area that it can be accessed from all sides. Remove the core from the cabinet if required. (EOC, AOCB, AOCS).

d) Mark the cover ① and tube-sheet ③ for both covers so that they can be replaced into the same position when finished. Remove the manifold cover bolts ② and hardware. We suggest using a torque wrench to final tighten the bolts ②.

e) The manifold covers are tightly compressed and may need some prying to separate them from the gasket ⑥, physically remove the cover assemblies ① from both sides.

f) The tubes ④ and turbulators ⑤ are now accessible for cleaning. Note: turbulators are installed on EOC, AOCB & AOCS cores only. If you need to remove the turbulator that runs through the tubing, it will be necessary to first squeeze the flattened end of the protruding turbulator ⑤, so that one end will fit through the tube. From the opposite end pull the turbulator ⑤ out. You may need to use pliers to grip and pull the turbulators ⑤ out, especially if there is debris lodged inside. As the turbulators ⑤ come out, most of the dirt will too, so be prepared. *It is suggested that gloves be worn when handling the turbulators ⑤ as they may be sharp.*

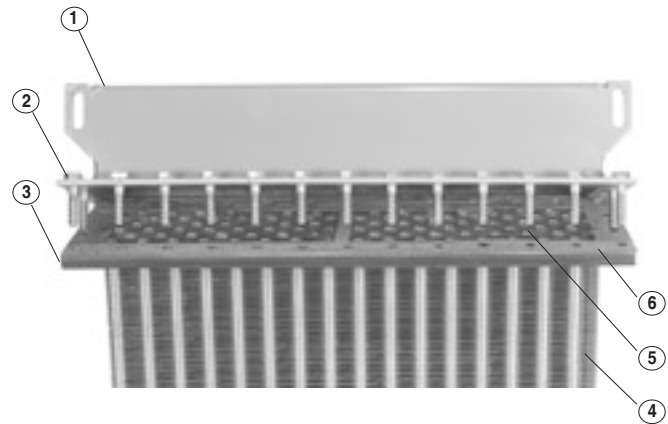
We suggest a mild water-soluble degreaser be used with a brush. Tubing I.D. is approximately .325 a plastic bristle brush on a rod will work best for cleaning the tubes ④. Steel brushes should be avoided since the steel is harder than the copper tubing and may heavily score the tubes ④ if used.

g) If there are any leaking tubes ④ you may plug them by carefully forcing a soft metal plug into the hole and tapping it tight. You may in some cases weld the leaking tube shut however, care should be taken since excessive heat may cause surrounding tube joints to loosen and leak.

h) When finished cleaning or repairing, be sure to replace ALL of the turbulators ⑤ back into any open tubes ④. When the turbulators ⑤ protrude from the opposite end flatten them again so they are tight and cannot be removed.

i) When finished reattach the manifold covers ① in the same position they were removed, using new gaskets ⑥, bolts ②, and hardware. We suggest using a torque wrench to final tighten the bolts ②.

j) *Torque Specifications: For 5/16" bolts 22-23 ft-lbs, for 3/8" bolts to 38-42 ft-lbs. Since bolts and hardware can physically fatigue during application we suggest new bolt kits be used when reassembling.*



*American Industrial's state-of-the-art manufacturing facility.*



# **American Industrial Heat Transfer Inc.**

**Manufacturers of Quality Heat Exchangers**

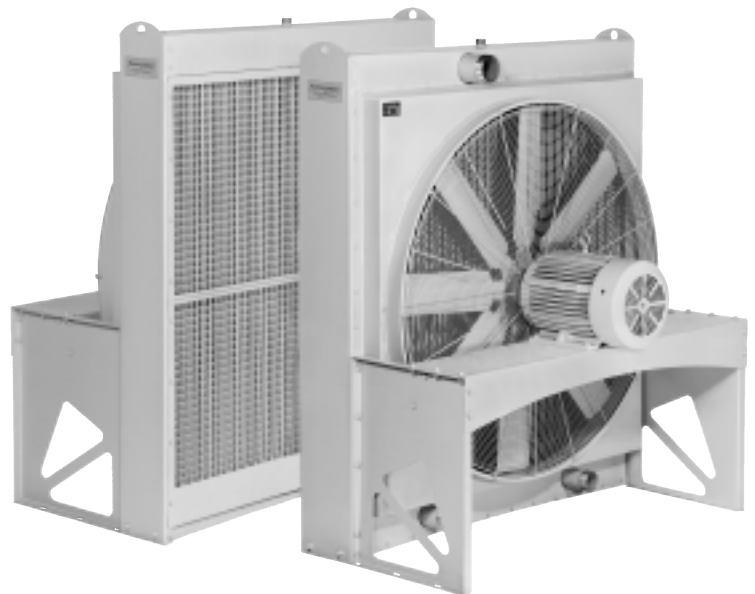


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## **INSTALLATION & MAINTENANCE MANUAL 2001**



**Shell & Tube Heat Exchangers**



**Air Cooled Heat Exchangers**

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Shell & tube maintenance & schematic .....	Page 4	AOM, BM, LP, AOMF piping hook-up .....	Page 11
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# SHELL & TUBE HEAT EXCHANGERS STANDARD FEATURES

## 1- MOUNTING BRACKET

Heavy gauge steel mounting brackets are adjustable in orientations to 360 degrees.

## 2- BONNET

Provides fluid into tubes with minimum restriction. One, two, or four pass interchangeability.

## 3- FLOW CAVITY

Generously sized to allow for minimum pressure drop and more uniform flow.

## 4- TUBES JOINT

Roller expanded tube joint to integral forged hub.

## 5- TUBES SHEET

Precision-machined tube-sheet provides for long lasting high strength service.

## 6- THREAD

CNC precision threading to provide accurate leakproof connections.

## 7- BAFFLES

CNC manufactured baffles to provide maximum turbulence and heat transfer with a minimum fluid pressure drop.

## 8- FINISH

Gray semigloss enamel suitable for outdoor service. Can be used as a base for additional coats.

## 9- SHELL & TUBE BUNDLE ASSEMBLY

CNC precision manufactured parts to guarantee a close fit between the baffles, tubes, and shell. Clearances are minimized to provide for maximum heat transfer.

## 10- HUB

Premium quality forging with full opening designed for minimum pressure drop.

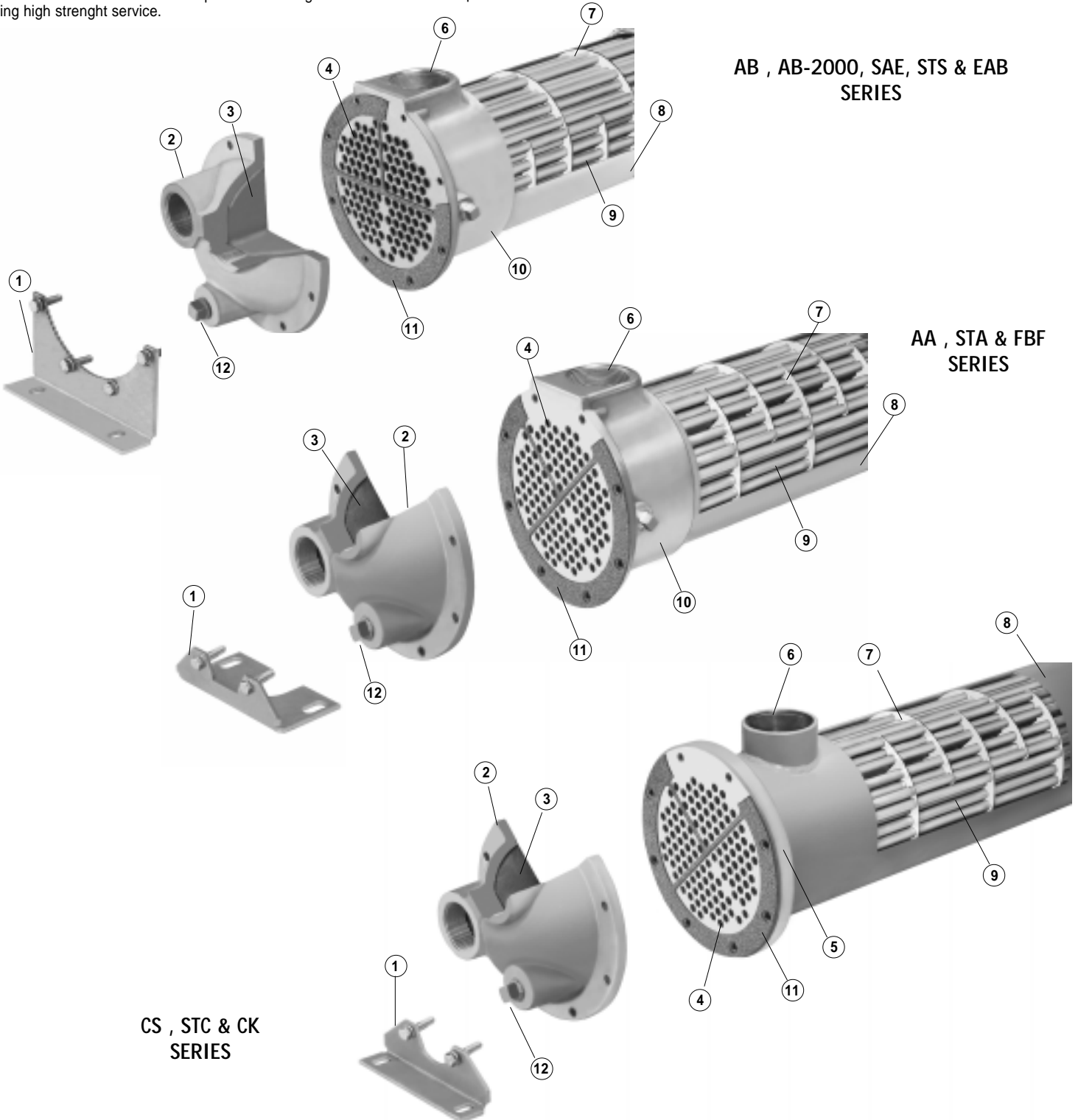
## 11- FULL FACE GASKET

Full-face composite gasket for maximum pressure and temperature.

## 12- DRAIN PORT

Drain ports allow for easy draining of tube side. Optional zinc anode can be inserted in place of plug.

Note: Standard Feature descriptions are qualified by and subject to product specifications which are available from American Industrial upon request.



AB , AB-2000, SAE, STS & EAB SERIES

AA , STA & FBF SERIES

CS , STC & CK SERIES

## Receiving

a) Inspect unit for any shipping damage before uncrating. Indicate all damages to the trucking firms' delivery person, and mark it on the receiving bill before accepting the freight. Make sure that there is no visible damage to the outside surface of the heat exchanger. *Since the warranty is based upon the unit date code located on the model identification tag, removal or manipulation of the identification tag will void the manufacturers warranty.*

b) When handling the shell & tube heat exchanger, special care should be taken to avoid dropping the unit since mishandling could cause the heat exchanger to crack and leak externally. Mishandling of the unit is not covered under the manufacturers warranty. All units are shipped with partial wood/corrugated cardboard containers for safe handling.

c) Standard Enamel Coating: American Industrial provides its standard products with a normal base coat of oil base air cure enamel paint. The enamel paint is applied as a temporary protective and esthetic coating prior to shipment. While the standard enamel coating is durable, American Industrial does not warranty it as a long-term finish coating. It is strongly suggested that a more durable final coating be applied after installation or prior to long-term storage in a corrosive environment to cover any accidental scratches, enhance esthetics, and further prevent corrosion. It is the responsibility of the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

d) Special Coatings: American Industrial offers as customer options, Air-Dry Epoxy, and Heresite (Air-Dry Phenolic) coatings at additional cost. American Industrial offers special coatings upon request, however American Industrial does not warrantee coatings to be a permanent solution for any equipment against corrosion. It is the responsibility of the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

## Installation

a) American Industrial recommends that the equipment supplied should be installed by qualified personnel who have solid understanding of system design, pressure and temperature ratings, and piping assembly. Verify the service conditions of the system prior to applying any shell & tube heat exchanger. If the system pressure or temperature does not fall within the parameters on model rating tag located on the heat exchanger, contact our factory prior to installation or operation.

b) Plan the installation to meet the requirements indicated on the piping installation diagram as illustrated (page 4). It is recommended to put the hot fluid to be cooled through the shell side and the cold fluid through the tube side. The indicated port assembly sequence in the diagram maximizes the performance, and minimizes the possibility of thermal shock. In instances where the fluids are required to be reversed, *hot fluid in the tubes and cold fluid in the shell* the heat exchanger will work with reduced performance.

c) When installing a series EAB heat exchanger (expansion bel-

low), it is recommended to use a shoulder bolt to allow the heat exchanger to move freely while expanding and contracting due to high differential temperatures.

d) It is recommended to use flexible hose wherever possible to reduce vibration and allow slight movement. However, hoses are not required. Hydraulic carrying lines should be sized to handle the appropriate flow and to meet system pressure drop requirements based upon the systems parameters, and not based upon the units supply and return connection size. We recommend that a low cracking pressure direct acting relief valve be installed at the heat exchanger inlet to protect it from pressure spikes by bypassing oil in the event the system experiences a high flow surge. If preventative filtration is used it should be located ahead of the cooler on both shell and tube side to catch any scale or sludge for the system before it enters the cooler. Failure to install filters ahead of the heat exchanger could lead to possible heat exchanger failure due to high pressure if the system filters plug.

e) Standard shell & tube coolers are built with a rolled tube-sheet construction. However, the differential operating temperature between the entering shell side fluid and the entering tube side fluid should not exceed 150°F. If this condition exists, a severe thermal shock could occur leading to product failure and mixing of the fluids. For applications with a differential temperatures of 150°F or more, we recommend using a series with a floating tube-sheet, u-tube, or expansion joint to reduce the potential for the effects of thermal shock.

g) Water requirements vary from location to location. If the source of cooling water is from other than a municipal water supply, it is recommended that a water strainer be installed ahead of the heat exchanger to prevent dirt and debris from entering and clogging the flow passages. If a water modulating valve is used it is recommended to be installed at the inlet to the cooler to regulate the water flow.

h) For steam service, or other related applications, please consult our engineering department for additional information.

## Maintenance

a) Inspect the heat exchanger for loosened bolts, connections, rust spots, corrosion, and for internal or external fluid leakage. Any corroded surfaces should be cleaned and recoated with paint.

b) *Shell side:* In many cases with clean hydraulic system oils it will not be necessary to flush the interior of the shell side of the cooler. In circumstances where the quality of hydraulic fluid is in question, the shell side should be disconnected and flushed on a yearly basis with a clean flushing oil/solvent to remove any sludge that has been deposited. For severe cases where the unit is plugged and cannot be flushed clean with solvent, the heat exchanger should be replaced to maintain the proper cooling performance.

c) *Tube side:* In many cases it will be necessary to clean the tube side of the heat exchanger due to poor fluid quality, debris, calcium deposits, corrosion, mud, sludge, seaweed, etc.... To clean

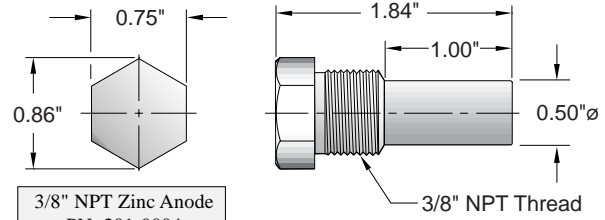
# SHELL & TUBE GENERAL INSTALLATION & MAINTENANCE

the tube side, flush with clean water or any good quality commercial cleaner that does not attack the particular material of construction. With straight tube heat exchangers you can use a rod to carefully push any debris out of the tubes.

d) **Zinc anodes** are normally used to reduce the risk of failure due to electrolysis. Zinc anodes are a sacrificial component designed to wear and dissolve through normal use. Normally, zinc anodes are applied to the water supply side of the heat exchanger. Depending upon the amount of corrosive action, one, two, three, or more anodes can be applied to help further reduce the risk of failure. American Industrial Heat Transfer, Inc. offers zinc anodes as an option, to be specified and installed at the request our customers. It is the responsibility of the customer to periodically check and verify the condition of the zinc anode and replace it as needed.

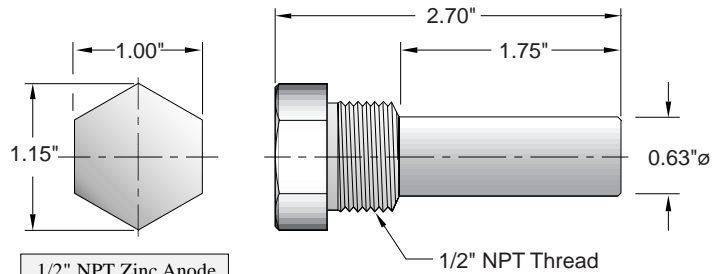
Applications vary due to water chemical makeup and quality, material differences, temperature, flow rate, piping arrangements, and machine grounding. For those reasons, zinc anodes do not follow any scheduled factory predetermined maintenance plan moreover they must be checked routinely by the customer, and a maintenance plan developed based upon the actual wear rate.

If substantial wear occurs or zinc dissolves without replacement, premature failure or permanent damage may occur to the heat exchanger. American Industrial does not warranty customer applications. It is the responsibility of the customer to verify and apply the proper system materials of construction and overall system requirements. Failures resulting from properly applied or misapplied use of zinc anode(s) into non-specified or specified applications will be the sole responsibility of the customer.



3/8" NPT Zinc Anode  
PN: 301-0004

AB-400 thru AB-1000  
AA-400 thru AA-1000  
CS-600 thru CS-1000



1/2" NPT Zinc Anode  
PN: 301-0003

AB-1200 thru AB-2000  
AA-1200 thru AA-1600  
CS-1200 thru CS-1700

e) A routine maintenance schedule should be developed and adjusted to meet your systems requirements based upon water quality, etc.... Failure to regularly maintain and clean your heat exchanger can result in a reduction in operational performance and life expectancy.

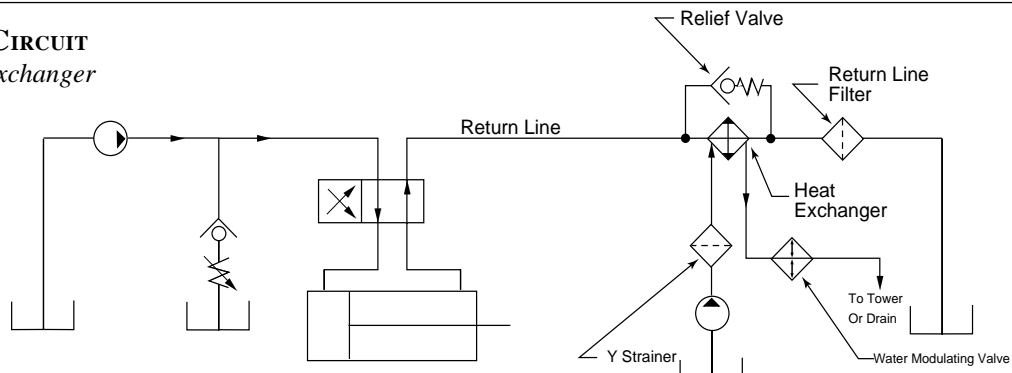
## TUBE SIDE PASSES

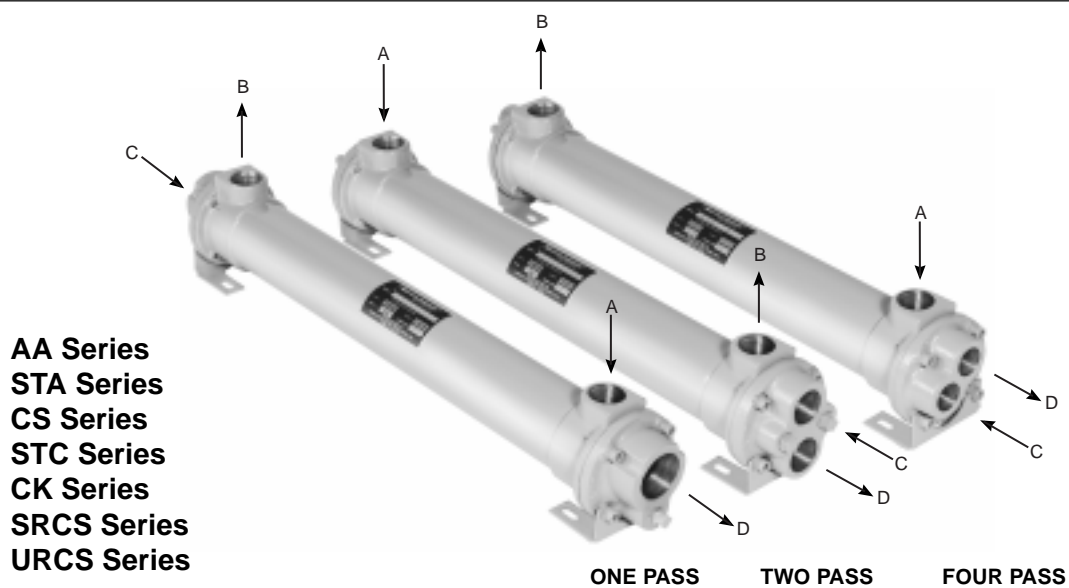
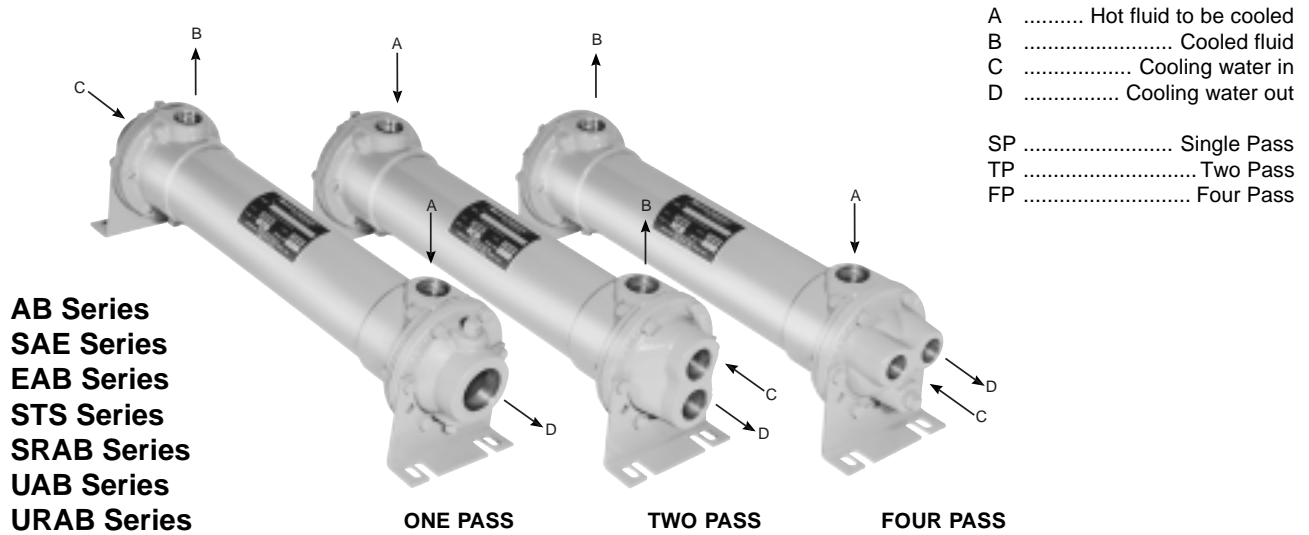
The number of passes (SP,TP &FP) refers to the number of runs back and forth of the cooling fluid on the tube side of the heat exchanger. Tube passes are normally determined by the rate (gpm) of water available to be used for cooling purposes (see table E). The purpose of multi-passes are to increase turbulence by increasing the velocity. **Normally tube side passes will not affect pricing.**

**TABLE E- Flow Rate for Tube Side**

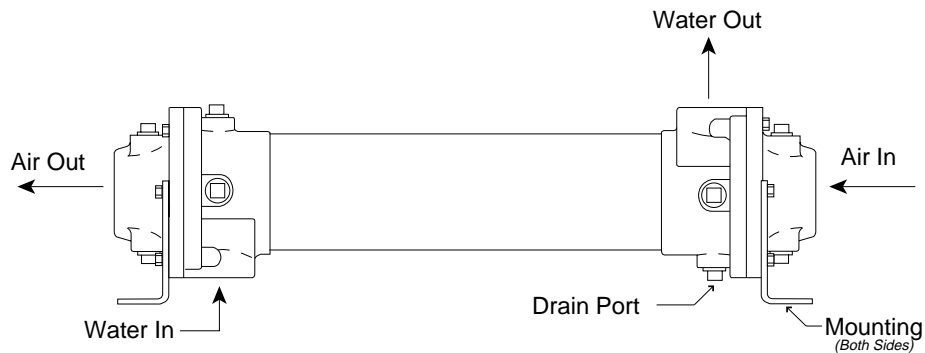
Shell dia .	Liquid Flow - Tube Side					
	SP		TP		FP	
	Min.	Max.	Min.	Max.	Min.	Max.
400	3.5	21	—	—	—	—
600	7.5	48	3.5	24	2	12
700	9	61	4.5	30	2.2	15
800	10	50	4.5	38	3	21
1000	20	120	10	70	5.0	37
1200	30	250	15	112	7.5	56
1600	57	460	29	180	14	90
1700	57	300	29	180	14	90
2000	90	650	45	320	25	160

## TYPICAL HYDRAULIC CIRCUIT with water cooled heat exchanger

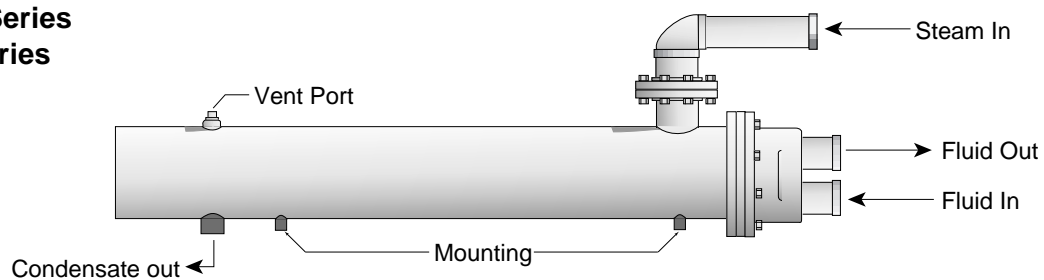




## ABR Series



## URCSR Series UCSR Series



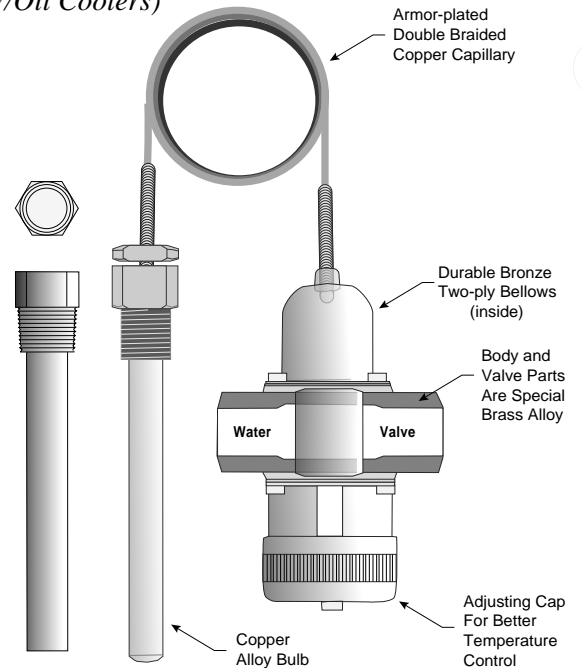


## THERMOSTATIC MODULATING WATER VALVE WITH BULB WELL ASSEMBLY

(for Shell & Tube Heat Exchangers And Air/Oil Coolers)

### SPECIFICATIONS

<b>Sizes</b>	0.375", 0.50", 0.75", 1.00", 1.25" FPT
<b>Fluid Pressure</b>	125psi (max.)
<b>Standard Temperature</b>	40° - 100° F., 60° - 140° F., 100° - 175° F., 125° - 200° F., 140° - 240° F., 200° - 275°F.
<b>Body</b>	Brass alloy casting
<b>Valve Parts</b>	Brass alloy
<b>Standard Capillary Length</b>	6' & 20' foot
<b>Standard Bulbs</b>	For 3/8" & 1/2" valve sizes: 5/8" x 6 with 3/4" union connections. For 3/4" & 1" valve sizes: 5/8" x 8-1/4" with 3/4" union connections. Stainless steel construction available.
<b>Standard Bulb Mounting</b>	3/4" NPT
<b>Seat Disk</b>	Buna-N-replaceable
<b>Seat Bead</b>	Stainless Steel - replaceable



### APPLICATION INFORMATION

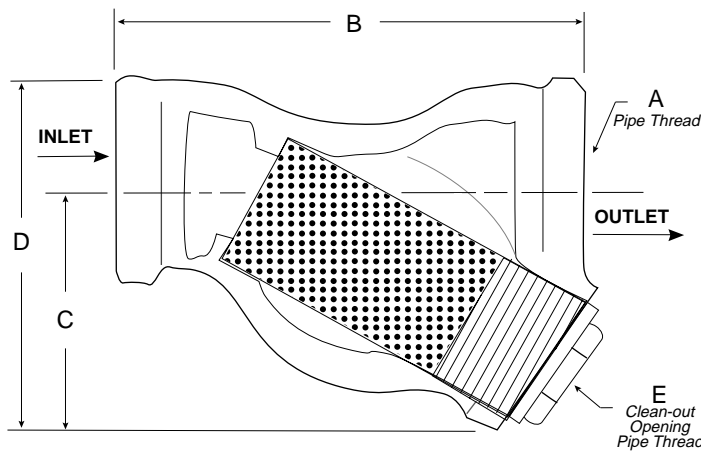
- Built for machine tool and hydraulic applications.
- Adjustable temperature range.
- Response to temperature changes.
- Direct acting bellows for longer service.

Note: Please consult factory if a non-cataloged temperature is required.

The type 56-T valve gives smooth regulation of water and other fluids. It's designed for rugged application. For example: hydraulic power packaging equipment, hydraulic presses, plastic molding equipment, and anywhere reliability in temperature control is demanded.

The type 56-T valve is a better designed product that won't leak or chatter. For dependability, every valve is factory tested three times in different temperature baths. They are direct acting with sturdy walls, and the inner spring is zinc coated. The seat beads are stainless steel to resist the erosive effects of *wire drawing* and provide durability for your needs. Additional features include mounting in any position, Buna-N seat disc, and manual flushing.

## "Y" STRAINER (for Shell & Tube Heat Exchangers And Air/Oil Coolers)



MODEL	SIZE A (NPT)	DIMENSIONS (Inches)				WT. (lbs.)
		B	C	D	E (NPT)	
18 - Y	0.38"	2.50"	2.63"	2.00"	0.25"	0.75
	0.50"	2.50"	2.63"	2.00"	0.25"	0.75
	0.75"	3.50"	3.75"	2.75"	0.50"	1.75
	1.00"	3.50"	3.75"	2.75"	0.50"	1.75
20 - Y	0.50"	4.00"	3.25"	2.50"	0.38"	1.75
	0.75"	4.00"	3.25"	2.50"	0.38"	1.75
	1.00"	4.75"	4.38"	3.38"	0.75"	4.00
	1.25"	6.00"	5.13"	3.88"	0.75"	4.75
	1.50"	6.00"	5.13"	3.88"	0.75"	4.75
	2.00"	8.13"	6.38"	4.63"	0.75"	13.00

PRESSURE RATINGS, ALL MODELS: 125lbs. per Sq.In.

### APPLICATIONS & SPECS. ("Y" Strainers)

These strainers are engineered for water or steam, and are adaptable for many other uses. Cleaning is accomplished by simply removing a pipe plug without disconnecting any piping. Or, if it is desirable to clean without interrupting service, a blow-off valve can be connected to the clean-out opening. **Note:** Pumps, control valves, traps, or other equipment controlling the flow of liquids or gases require proper protection with strainers for trouble free operation.

### 18 - Y BRASS STRAINERS

The 18 - Y strainer body is a red brass casting. Standard units have 50 mesh brass wire screens. Brazing connections are available on special order instead of pipe threads.

### 20 - Y STRAINERS

The 20 - Y strainer has a heavy cast iron body with machined pipe thread inlet and outlet (National Pipe Thread N.P.T.). It contains a strainer screen of 0.02" thick brass with 100, 1/16" perforations per inch.

## Receiving:

a) Inspect unit for any shipping damage before uncrating. Indicate all damages to the trucking firms' delivery person and mark it on the receiving bill before accepting the freight. Make sure that the core and fan are not damaged. Rotate the fan blade to make sure that it moves freely. *Since the warranty is based upon the unit date code located on the model identification tag, removal or manipulation of the identification tag will void the manufacturers warranty.*

b) When handling the heat exchanger, special care should be taken to avoid damage to the core and fan. All units are shipped with wood skids for easy forklift handling

c) Standard Enamel Coating: American Industrial provides its standard products with a normal base coat of oil base air cure enamel paint. The enamel paint is applied as a temporary protective and esthetic coating prior to shipment. While the standard enamel coating is durable, American Industrial does not warranty it as a long-term finish coating. It is strongly suggested that a more durable final coating be applied after installation or prior to long-term storage in a corrosive environment to cover any accidental scratches, enhance esthetics, and further prevent corrosion. It is the responsibility of the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

d) Special Coatings: American Industrial offers as customer options, Air-Dry Epoxy, and Heresite (Air-Dry Phenolic) coatings at additional cost. American Industrial offers special coatings upon request, however American Industrial does not warranty coatings to be a permanent solution for any equipment against corrosion. It is the responsibility of the customer to provide regular maintenance against chips, scratches, etc... and regular touch up maintenance must be provided for long-term benefits and corrosion prevention.

## Installation:

a) American Industrial recommends that the equipment supplied should be installed by qualified personnel who have solid understanding of system design, pressure and temperature ratings, and piping assembly. Verify the service conditions of the system prior to applying any air cooled heat exchanger series cooler. If the system pressure or temperature does not fall within the parameters on model rating tag located on the heat exchanger, contact our factory prior to installation or operation.

b) In order for the heat exchanger to properly function, installation should be made with minimum airflow obstruction distance of not less than twenty (20) inches on both fan intake and exiting side of the heat exchanger.

c) Process piping should be installed as indicated on the model diagram, with the process flow entering into the INLET port and exiting out the OUTLET port (see illustrations pages 9-10). Flexible hose or non rigid plumbing can be used to reduce the risk of failure due to thermal expansion of the core or hydraulic vibration. We suggest that preventative filtration should be located ahead of the cooler to catch any scale or sludge for the system before it enters the cooler.

For hydraulic oil coolers it is suggested that a three-way thermal

bypass valve or a direct acting low-pressure (30psi or 60psi) relief valve be installed at the inlet to the cooler to protect it in cold weather environments.

d) Flow line sizes should be sized to handle the appropriate flow to meet the system pressure drop requirements. If the nozzle size of the heat exchanger is smaller than the process line size an increased pressure differential at the heat exchanger may occur.

e) A brazed construction coil does not allow internal tube access. A serviceable core® will allow full accessibility to the internal tubes for cleaning and maintenance.

g) Electric motors should be connected only to supply source of the same characteristics as indicated on the electric motor information plate. Prior to starting, verify that the motor and fan spin freely without obstruction. Check carefully that the fan turns in the correct rotation direction (normally counter clockwise) from the motor side (fan direction arrow). Failure to operate the fan in the proper direction could reduce performance or cause serious damage to the heat exchanger or other components. Fan blades should be rechecked for tightness after the first 100 hours of operation.

h) It is important to apply the catalog recommended flow rate for the hydraulic motor that corresponds with the specific model being used. A case drain is required for hydraulic motor installation. Failure to connect case drain can result in motor failure. The proper flow rate and direction to the hydraulic motor are critical to ensure fan direction and RPM. Exceeding the recommended RPM could result in fan failure and cause severe damage to the heat exchanger. See fan rotation (pages 9-10)

## Maintenance

Regular maintenance intervals based upon the surrounding and operational conditions should be maintained to verify equipment performance and to prevent premature component failure. Since some of the components such as, motors, fans, load adapters, etc... are not manufactured by American Industrial, maintenance requirements provided by the manufacture must be followed.

a) Inspect the entire heat exchanger and motor/fan assembly for loosened bolts, loose connections, broken components, rust spots, corrosion, fin/coil clogging, or external leakage. Make immediate repairs to all affected areas prior to restarting and operating the heat exchanger or its components.

b) Heat exchangers operating in oily or dusty environments will often need to have the coil cooling fins cleaned. Oily or clogged fins should be cleaned by carefully brushing the fins and tubes with water or a non-aggressive degreasing agent mixture (*Note: Cleaning agents that are not compatible with copper, brass, aluminum, steel or stainless steel should not be used*). A compressed air or a water stream can be used to dislodge dirt and clean the coil further. Any external dirt or oil on the electric motor and fan assembly should be removed. *Caution: Be sure to disconnect the electric motor from its power source prior to doing any maintenance.*

c) In most cases it is not necessary to internally flush the coil. In circumstances where the coil has become plugged or has a substantial buildup of material, flushing the coil with water or a solvent may be done. Flushing solvents should be non-aggressive suit-

able for the materials of construction. Serviceable Core® models can be disassembled and inspected or cleaned if required.

d) Most low horsepower electric motors do not require any additional lubrication. However, larger motors must be lubricated with good quality grease as specified by the manufacture at least once every 6-9 months or as directed by the manufacture. T.E.F.C. air ventilation slots should be inspected and cleaned regularly to prevent clogging and starving the motor of cooling air. To maintain the electric motor properly see the manufactures requirements and specifications.

e) Fan blades should be cleaned and inspected for tightness during the regular maintenance schedule when handling a fan blade care must be given to avoid bending or striking any of the blades. Fan blades are factory balanced and will not operate properly if damaged or unbalanced. Damaged fan blades can cause excessive vibration and severe damage to the heat exchanger or drive motor. Replace any damaged fan with an American industrial suggested replacement.

f) Air cooled exchanger cabinets are constructed using 7ga. through 18ga. steel that may be bent back into position if damaged. Parts that are not repairable can be purchased through American Industrial.

g) Coil fins that become flattened can be combed back into position. This process may require removal of the coil from the cabinet.

## Brazed Core Maintenance

It is not advisable to attempt repairs to brazed joints of a brazed construction coil unless it will be done by an expert in silver solder brazing. Brazed coils are heated uniformly during the original manufacturing process to prevent weak zones from occurring. Uncontrolled reheating of the coil may result in weakening of the tube joints surrounding the repair area. In many instances brazed units that are repaired will not hold up as well to the rigors of the system as will a new coil. American Industrial will not warranty or be responsible for any repairs done by unauthorized sources. Manipulation in any way other than normal application will void the manufactures warranty.

## Serviceable Core® Maintenance

Units containing a Serviceable Core® have bolted manifold covers that can be removed for cleaning or repair purposes. Most AOCH or AOCS cores manufactured after January 1, 1998 are Serviceable Cores®.

### Servicing Sequence

American Industrial has gone to great lengths to provide components that are repairable. If the heat exchanger core requires internal cleaning or attention the following steps will explain what must be done to access the internal tubes. Be sure to order gasket kits or repair parts prior to removal and disassembly to minimize down time.

a) To clean the internal tubes first remove all connection plumbing from the unit.

b) Be sure the unit is drained of all water etc...

c) Place the heat exchanger in an area that it can be accessed from

all sides. Remove the core from the cabinet if required (AOCH, AOCS).

d) Mark the cover ① and tube-sheet ③ for both covers so that they can be replaced into the same position when finished. Remove the manifold cover bolts ② and hardware and place them into a secure place.

e) The manifold covers are tightly compressed and may need some prying to separate them from the gasket ≈, physically remove the cover assemblies ① from both sides.

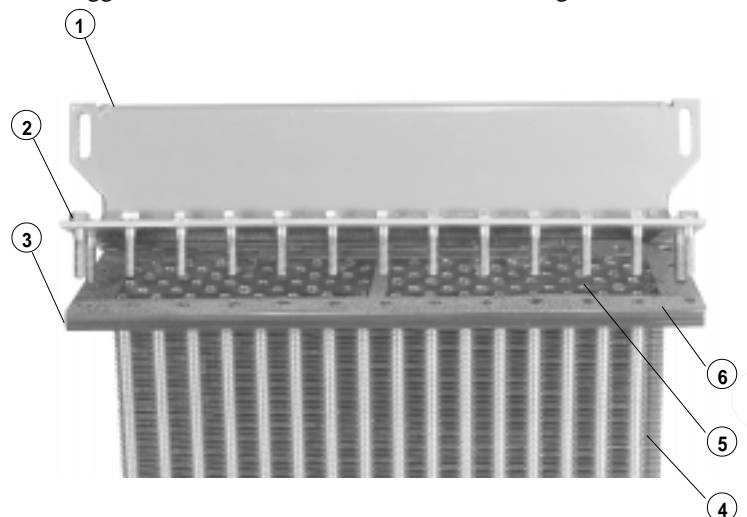
f) The tubes √ and turbulators ⑤ are now accessible for cleaning. Note: turbulators are installed on AOCH & AOCS cores only. If you need to remove the turbulator that runs through the tubing, it will be necessary to first squeeze the flattened end of the protruding turbulator ⑤, so that one end will fit through the tube. From the opposite end pull the turbulator ⑤ out. You may need to use pliers to grip and pull the turbulators ⑤ out, especially if there is debris lodged inside. As the turbulators ⑤ come out, most of the dirt will too, so be prepared. *It is suggested that gloves be worn when handling the turbulators ⑤ as they may be sharp.*

We suggest a mild water-soluble degreaser be used with a brush. Tubing I.D. is .325 a plastic bristle brush on a rod will work best for cleaning the tubes √. Steel brushes should be avoided since the steel is harder than the copper tubing and may heavily score the tubes √ if used.

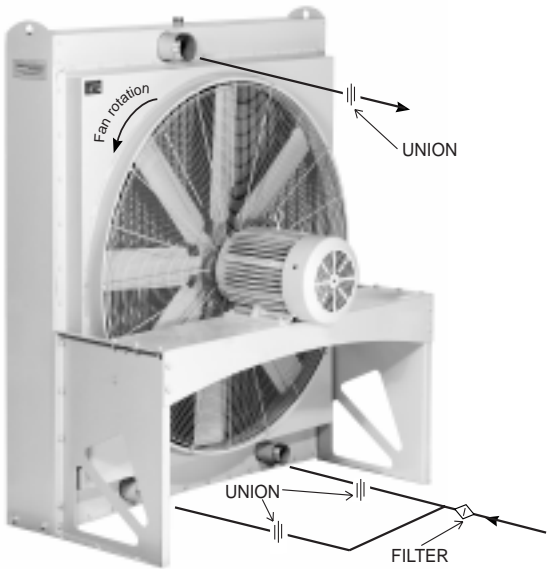
g) If there are any leaking tubes √ you may plug them by carefully forcing a soft metal plug into the hole and tapping it tight. You may in some cases weld the leaking tube shut however, care should be taken since excessive heat may cause surrounding tube joints to loosen and leak.

h) When finished cleaning or repairing, be sure to replace ALL of the turbulators ⑤ back into any open tubes √. When the turbulators ⑤ protrude from the opposite end flatten them again so they are tight and cannot be removed.

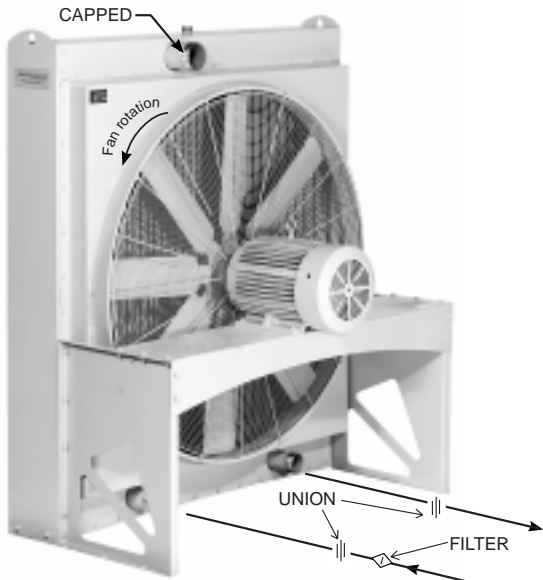
i) When finished reattach the manifold covers ① in the same position they were removed, using new gaskets ≈, bolts ②, and hardware. We suggest using a torque wrench to final tighten the bolts ②. *For 5/16" bolts 22-23 ft-lbs, for 3/8" bolts to 38-42 ft-lbs.* Since bolts and hardware can physically fatigue during application we suggest new bolt kits be used when reassembling.



# AIR COOLED HEAT EXCHANGER PIPING HOOK-UP

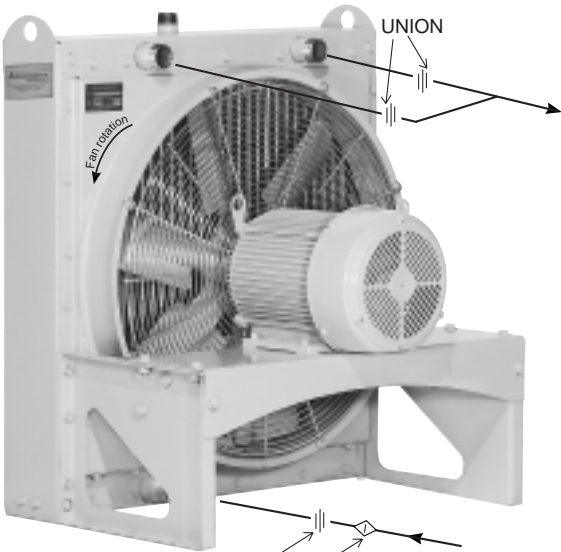


ONE PASS

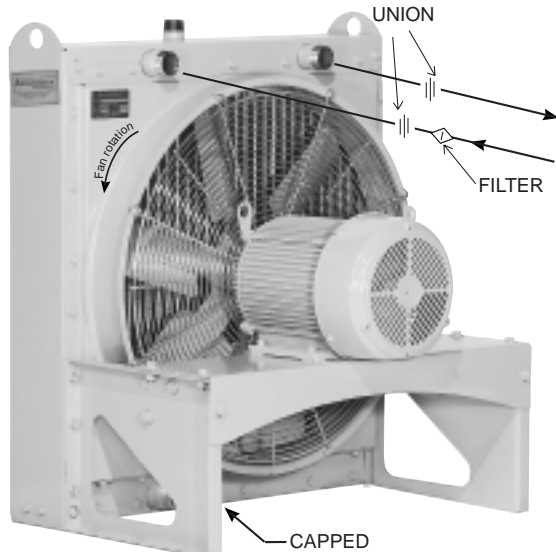


TWO PASS

**AOCS - 1005 through AOCS - 3015**

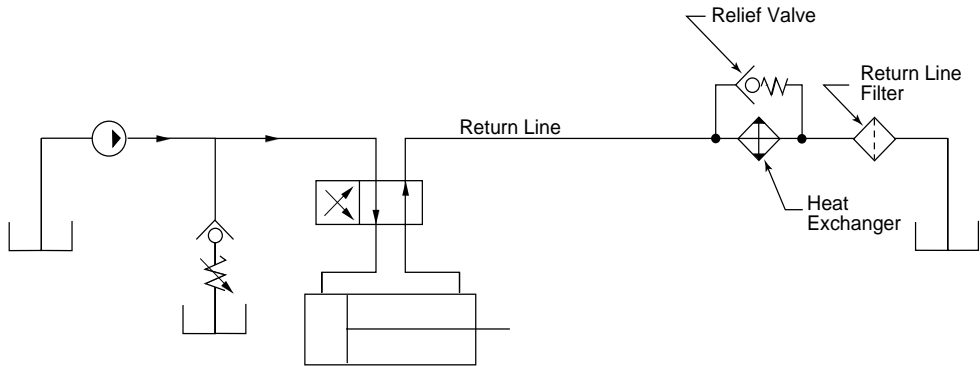


ONE PASS



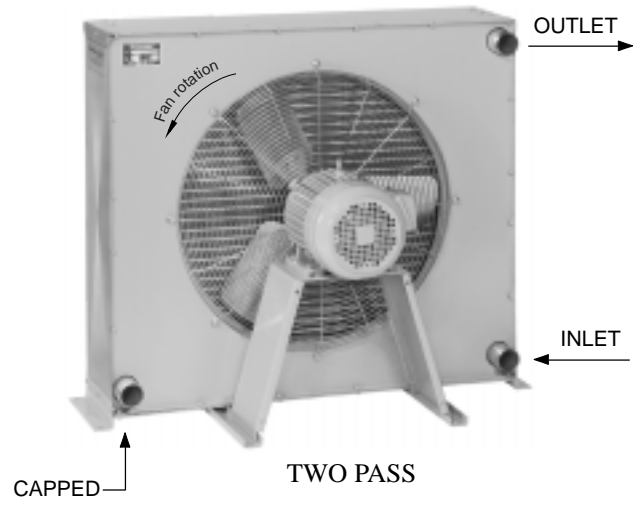
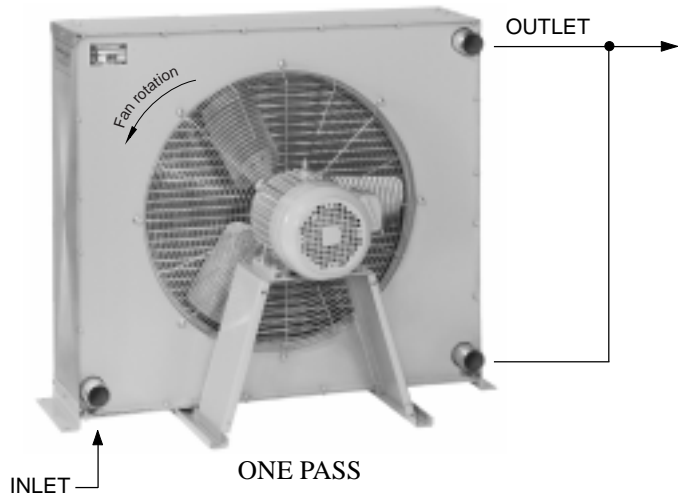
TWO PASS

**AOCS - 201 through AOCS - 603**

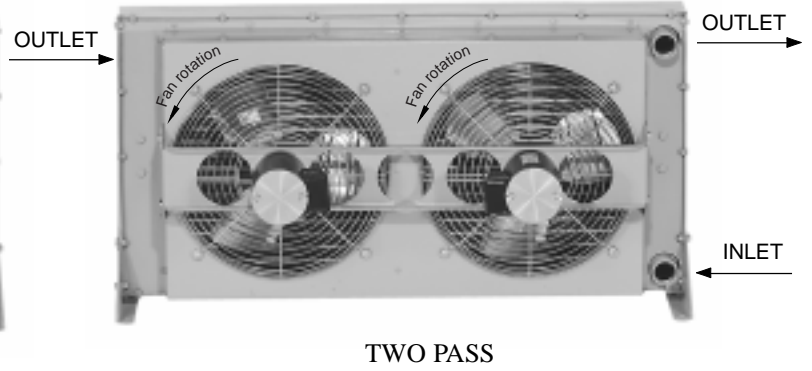
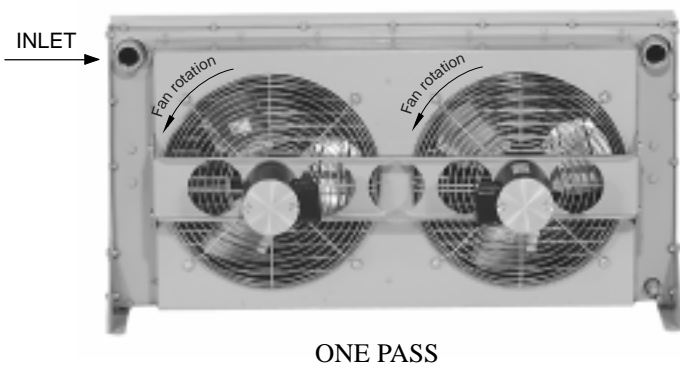


**TYPICAL HYDRAULIC CIRCUIT**  
*with air cooled heat exchanger*

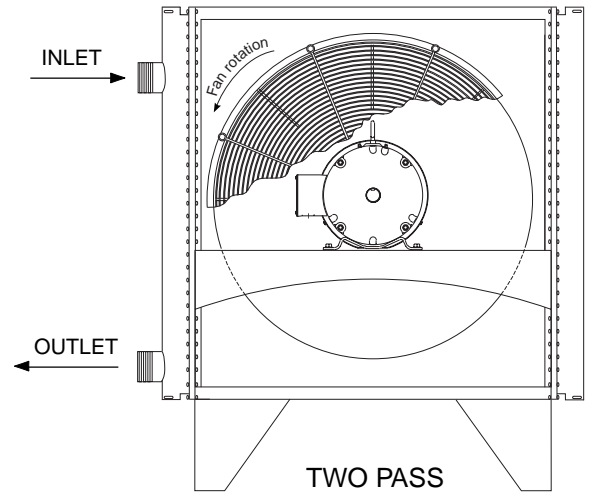
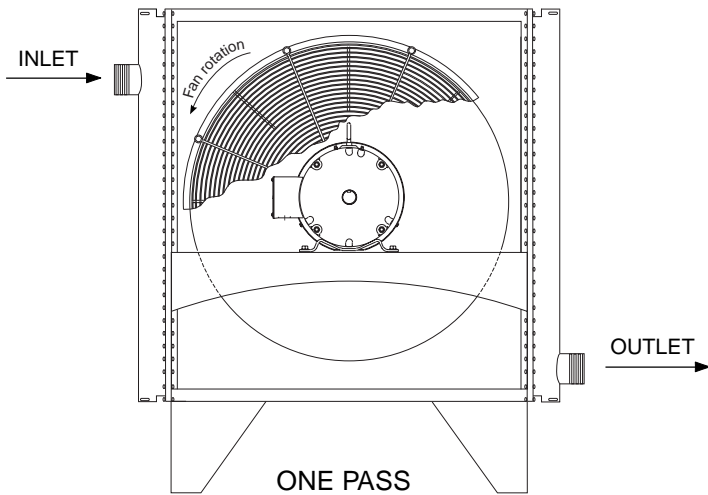
# AIR COOLED HEAT EXCHANGERS PIPING HOOK-UP



**AC, ACF & ACH Series**



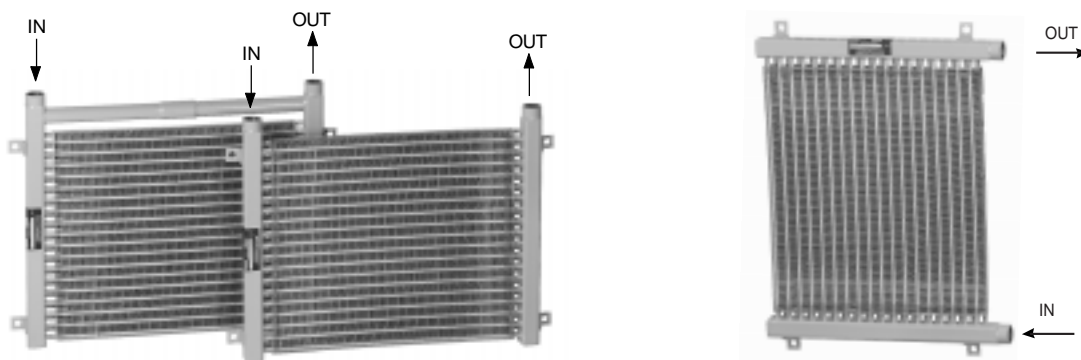
**EOC Series**



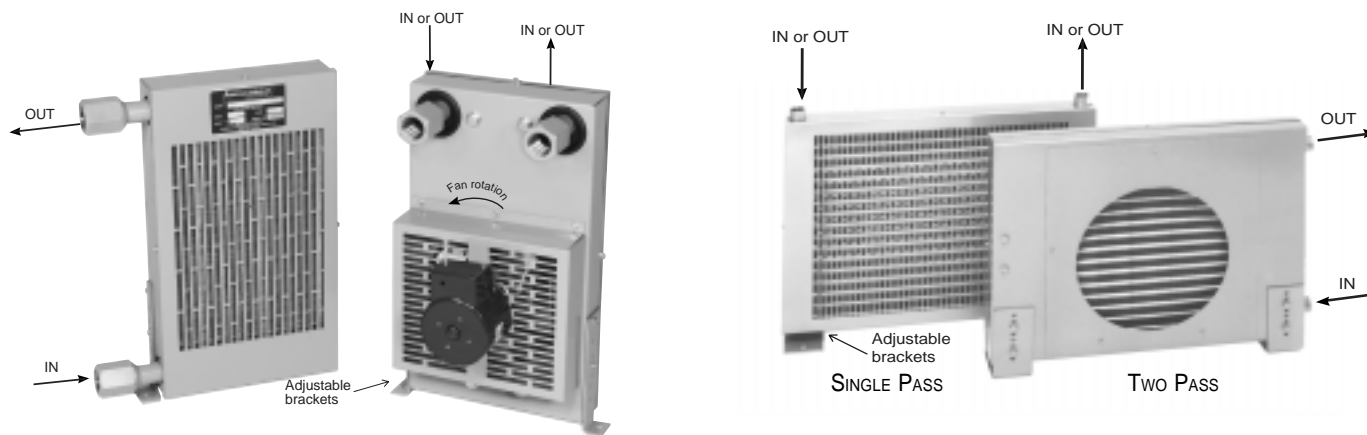
**ACA Series**



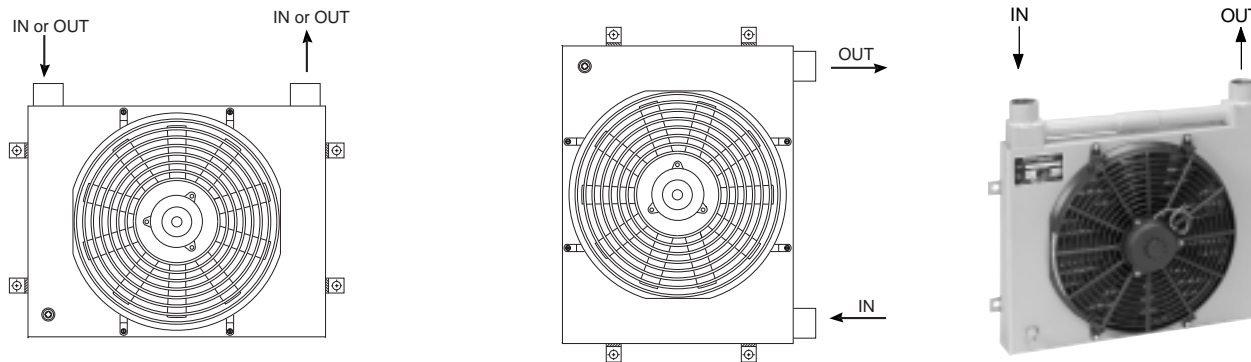
## AOM & AOMR Series



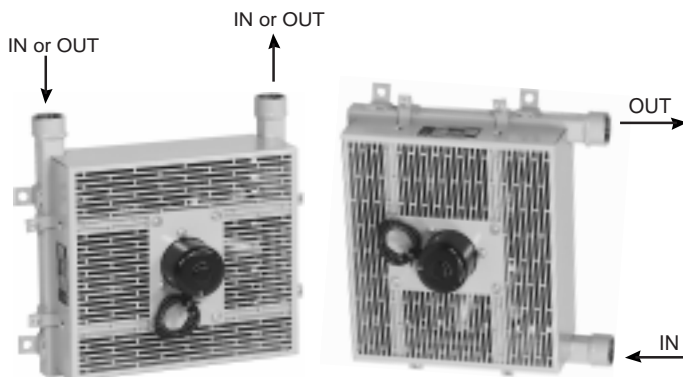
## BM Series



## LP Series



## AOMF



## ELECTRICAL TEMPERATURE CONTROLLER WITH BULB WELL ASSEMBLY (for Air/Oil Coolers)

### SPECIFICATIONS:

A) Material: Copper

B) Power Limits:

- 1) For three phase motor operation, use only with a magnetic starter, 125 VA max. (VA =volts x amps)
- 2) For pilot duty, 125 VA max.
- 3) For direct connection to motor:
 

120v AC/8.0 amps max	230v AC/5.1 amps max
277v AC/4.2 amps max	460v AC/2.0 amps max
- 4) Temperature operating range: 55°F to 175°F.

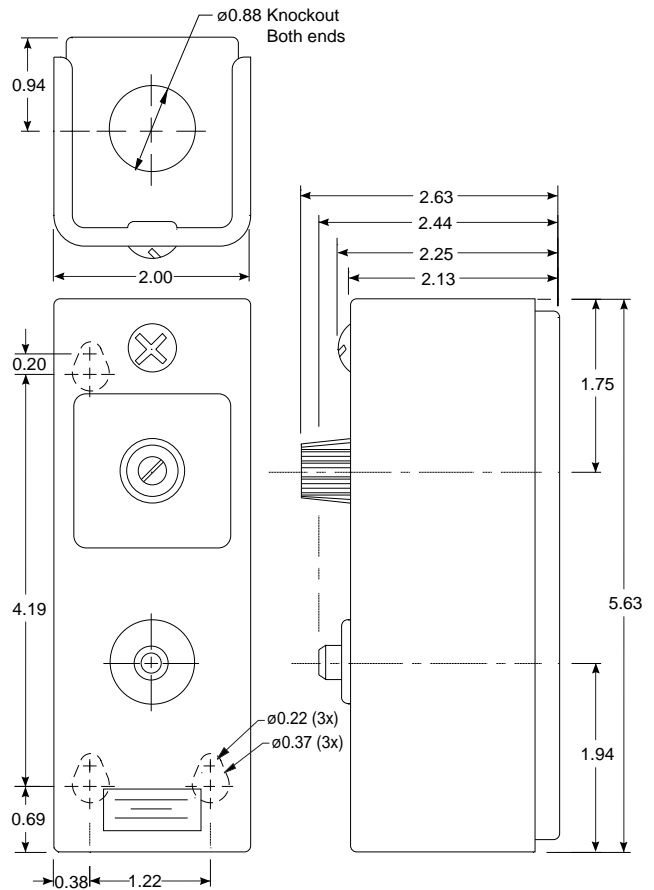
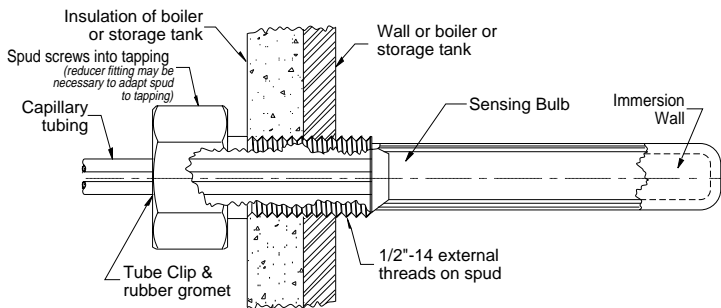
### APPLICATIONS (Temperature Controller)

The TC511 temperature controllers are designed to control the temperature of air or liquids in ducts, pipes, tanks, and boilers. Typical uses include control of dampers and valves in heating, cooling, or heating-cooling systems. The TC511 has 1 spdt switch. It makes or breaks a circuit on a change in temperature at the sensing bulb. Fast response models with adjustable differential are available for duct installation. They respond approximately 4 times faster than standard models.

### INSTALLATION

#### When installing this product:

1. Read instructions carefully. Failure to follow the instructions could damage the product or cause a hazardous condition.
2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.
3. Installer must be a trained, experienced service technician.
4. After installation is complete, check out product operation as provided in the instructions.



### ELECTRICAL RATINGS:

TC511 models with adjustable differential:  
 TC511 models with fixed differential -125 VA at 120/208/240/277 Vac.  
 MAXIMUM BULB PRESSURE: 50 psi (344.7 kPa) for direct immersions.

### LOCATION AND MOUNTING.

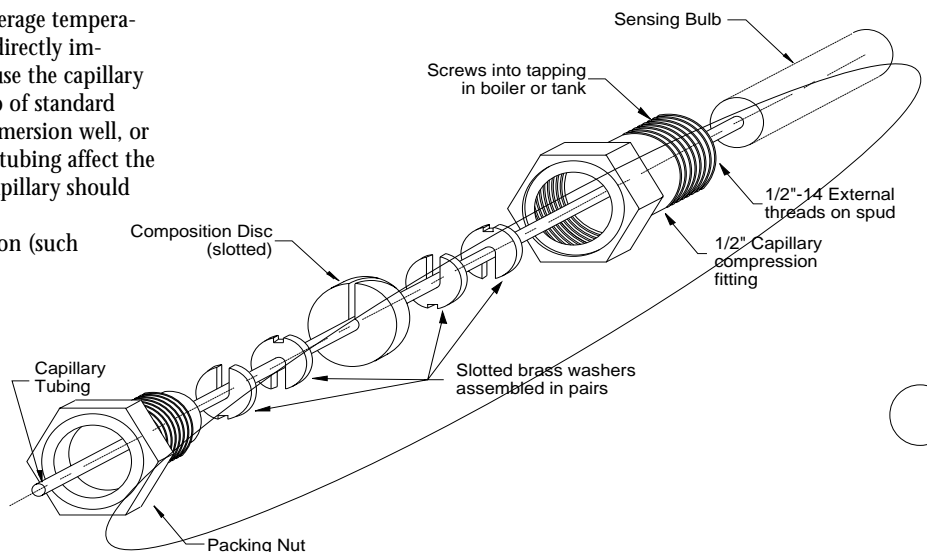
The controller may be installed in any convenient position. Mount it with 3 screws through the slotted holes in the back of the case. Be sure to consider the length of the capillary before mounting the controller.

Install the sensing element where it is exposed to the average temperature of the controlled medium. The sensing bulb may be directly immersed or mounted in a well. Fast response models must use the capillary holder furnished with the device. The remote sensing bulb of standard models should be held in place with a capillary holder, immersion well, or compression fitting. Sharp bends or kinks in the capillary tubing affect the efficiency of the controller and must be avoided. Excess capillary should be carefully coiled and left directly beneath the controller.

NOTE: When pressure fittings are used in areas of vibration (such as pipe lines) the bulb must be adequately supported.

### OPERATION

As the temperature of the controlled medium falls below the set point less differential, the TC511 switch makes terminal R to B and energizes a normally close solenoid valve to provide heat. In cooling applications, the TC511 makes terminal R to W as the temperature rises above the set point, energizing cooling equipment.



## STANDARD TERMS AND CONDITIONS OF SALE

April 1, 2000 Supersedes all prior "Standard Terms And Conditions Of Sale"

All sales by American Industrial Heat Transfer Inc. ("Seller") to the party to whom a Seller's Acknowledgment is addressed ("Purchaser") are subject to the following terms and conditions in addition to the terms and conditions contained in any acknowledgement or sales order confirming your order ("Seller's Acknowledgement"). Where terms of any such Seller's Acknowledgement conflict with the following terms and conditions, the terms and conditions of Seller's Acknowledgement shall control. These Terms and Conditions shall apply to all transactions between Seller and Purchaser unless superseded by new Terms and Conditions delivered by Seller or by the express terms and conditions contained in Seller's Acknowledgment.

**Acceptance.** All purchase orders are accepted by Seller at its General Offices in Zion, Illinois. Seller's acceptance of any purchase order it receives is expressly limited to the exact terms contained here and in this Seller's Acknowledgment. Additional or different terms contained in Purchaser's offer or any attempt by Purchaser to vary any of the terms here and in Seller's Acknowledgment shall be rejected but such proposal shall not operate as a rejection of Purchaser's offer unless such variances are in the terms of the description, quantity, price or delivery schedule of the goods or services to be provided hereunder, in which case such additional or different terms shall be deemed material and such offer shall be deemed accepted without said additional or different terms or attempted variations. Acceptance by Seller of any purchase order containing terms additional to or different from the terms contained in this Seller's Acknowledgment or containing modifications of the terms contained here and in Seller's Acknowledgment shall not be deemed as assent to those additional, different or modified terms. Purchaser's receipt of Seller's Acknowledgment without prompt written objection thereto, or Purchaser's acceptance of all or any part of the goods or services ordered from Seller, shall constitute assent by Purchaser to the terms contained here and in Seller's Acknowledgment. If this Seller's Acknowledgment shall be deemed an offer by Seller to sell goods or services to Purchaser, such offer is expressly limited to the exact terms contained herein. The dispatch of a purchase order by Purchaser shall then constitute Purchaser's acceptance of these Standard Terms and Conditions of Sale and Seller's Acknowledgment. If this Seller's Acknowledgment is deemed an offer as aforesaid, any proposal by Purchaser for additional or different terms or any attempt by Purchaser to vary any of the terms of this Seller's Acknowledgment in Purchaser's purchase order is hereby objected to and rejected; provided, however, that any such proposal by Purchaser shall not operate as a rejection of Seller's offer unless it contains variances in the terms of the description, quantity, price or delivery of the goods or services to be provided hereunder, in which case any such proposal shall be deemed material, and this Seller's Acknowledgment shall be deemed accepted without said additional or different terms or attempted variations.

**Payment Terms.** The full amount billed or contracted for is due and payable thirty (30) days from delivery of the goods or performance of services. A finance charge computed at the periodic rate of one and one-half percent (1.5%) per month (which is an annual rate of eighteen percent (18%)) on the unpaid balance will be made on accounts not paid when due, and Purchaser agrees to pay such charges and pay attorneys' fees if action is brought to collect from Purchaser. Unless otherwise specified, 100% of the price quoted for any tooling is to be paid with the placement of the order to Seller. Samples submitted shall be deemed approved and accepted if written notice of rejection is not received within thirty (30) days after date of submittal. Purchaser agrees that Seller shall have a possessory lien on all tools and other property of Purchaser which is in Seller's possession for the total amount owing by Purchaser to Seller for all tooling and other work and for all parts, materials and services of all kinds supplied or rendered by Seller to Purchaser, which lien shall be enforceable in the manner provided in the Uniform Commercial Code.

**Taxes.** Any tax which the Seller may be required to pay or collect through assessment or otherwise, under any existing or future law upon or with respect to the sale, purchase, delivery, transportation, storage, processing, use or consumption of any goods or services described herein, including, without limitation, taxes upon or measured by receipt from sales or services (but excluding taxes based upon the income of Seller), shall be for the account of Purchaser and be added to the price of such goods or services. Purchaser shall promptly pay the amount thereof to Seller upon demand but may in lieu of such payment, furnish to Seller evidence of the issuance of tax exemption certificates acceptable to the appropriate taxing authorities.

**Prices.** Except as otherwise provided, all price quotations are valid for thirty (30) days. Prices are based on costs prevailing on the date of quotation and, therefore, are subject to change at any time to reflect increased costs. Prices are quoted on samples, blueprints, or drawings on hand, and any modification thereof subjects this quotation to adjustment. Quotations are based on the continuous production of the quantity specified, smaller runs subject to increase in price. If higher quantity level is desired by Purchaser, Seller will render a quotation based upon the revised requirements set forth by Purchaser.

**Credit.** All orders are subject to the approval of Seller's Credit Department, and Seller may at any time refuse to make shipment or delivery if Purchaser fails to fulfill the terms and conditions of payment or fails to provide security satisfactory to Seller's Credit Department. Seller reserves right to refuse or cancel credit and require full payment prior to shipment. If in Seller's opinion the financial condition of Purchaser at any time does not justify continuation of production or shipment on the terms of payment specified, Seller may require full or partial payment in advance or such further assurance as Seller shall require to justify such continued production or shipment.

**Default in Payment and Bankruptcy of Purchaser.** If Purchaser fails to make payments on any agreement between Purchaser and Seller in accordance with Seller's terms, Seller, in addition to any other remedies available to it, may, at its option, (a) defer further shipments until such payments are made and satisfactory credit arrangements are reestablished, (b) cancel the unshipped balance of any order or (c) take any other action available under applicable law. In the event of any proceedings, voluntary or involuntary, in bankruptcy or insolvency by or against Purchaser, the inability of Purchaser to pay its debts as they become due, or in the event of the appointment, with or without Purchaser's consent, of an assignee for the benefit of creditors or of a receiver, then Seller shall be entitled, in its sole discretion, to cancel the unshipped balance of any order without any liability.

**Transportation Charges.** All prices, quotations, shipments and deliveries by Seller are F.O.B. Seller's plant and risk of loss passes to Purchaser once goods are tendered for such delivery. All transportation and other charges including handling fees are for the account of Purchaser, including any increase or decrease in such charges prior to shipment.

**Method of Shipment.** Method and route of shipment is at Seller's discretion, unless Purchaser supplies explicit instructions, which are subsequently accepted by Seller in writing. Seller does not assume responsibility for any damage directly or indirectly resulting from delays in delivery. When parts are broken or damaged in transit from Seller to Purchaser, it is considered the responsibility of Purchaser to file a claim with the carrier for said breakage or damage. If the method of shipment specified by Purchaser is deemed by Seller to be unavailable or otherwise unsatisfactory, Seller reserves right to use an alternate method or route or both whether or not at a higher cost to Purchaser. Seller shall promptly notify Purchaser of any such change. The risk of loss or damage to the goods shipped shall pass to the Purchaser when the goods are delivered to the carrier for shipment and Purchaser shall be responsible for insuring such goods thereafter.

**Producing or Shipping Point.** Seller reserves right to produce and ship all or any part of the goods specified in any order from any of its plants or facilities.

**Force Majeure.** Seller shall not be liable for any delay in the performance of orders, or in the delivery or shipment of goods, or for any damages suffered by Purchaser as a result of such delay when such delay is occasioned by causes beyond Seller's control. Such causes shall include but are not limited to an act of God or the public enemy, fire, explosion, flood, unusually severe weather, drought, war, riots, sabotage, vandalism, accident, embargo, government priority, government action or failure of the government to act when action is required, requisition or allocation or other action of any governmental authority, interruption of or delay in transportation, inadequacy or shortage or failure of supply of materials or equipment, breakdowns, non-scheduled shutdowns for repairs, plant accidents, labor shortage, strikes, labor trouble, or by compliance with any order or request of the United States Government or any officer, department, agency, instrumentality or committee thereof. It is understood and agreed that economic conditions affecting the ability or desirability of the performance of this agreement by either party shall not be deemed to constitute "force majeure" circumstances as contemplated by this paragraph. The Seller shall have the right to cancel the entire agreement with Purchaser or any part thereof in the event of the happening of any such cause beyond the Seller's control without any resulting liability.

**Good Delivery.** Shipments made by Seller within a reasonable time after the specified date of delivery shall constitute a good delivery. No right of cancellation shall accrue to Purchaser based on such a delivery.

**Permissible Variations.** Goods shipped by Seller shall be within the limits and sizes published by Seller, subject, however, to Seller's right to ship overages or underages in accordance with Seller's standard practices and goods shipped by Seller will be subject to standard variations provided such variations are non-functional or are not material in nature.

**LIMITED WARRANTY.** SELLER MAKES NO WARRANTIES EXPRESSED OR

## STANDARD TERMS AND CONDITIONS OF SALE (2/3)

IMPLIED, INCLUDING BUT NOT BY WAY OF LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY AND ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, ON ANY ORDER EXCEPT THAT SELLER WARRANTS TITLE TO ALL GOODS FURNISHED BY SELLER AND EXCEPT THAT SELLER WARRANTS FOR A PERIOD OF ONE YEAR FROM THE DATE MARK LOCATED ON THE SELLER'S IDENTIFICATION TAG THAT ALL GOODS DESCRIBED ON SELLER'S ACKNOWLEDGMENT OF PURCHASER'S PURCHASE ORDER WILL BE MANUFACTURED IN ACCORDANCE WITH THE SPECIFICATIONS, IF ANY, SET FORTH IN SAID PURCHASE ORDER AND EXPRESSLY ACCEPTED IN SELLER'S ACKNOWLEDGMENT SUBJECT TO SELLER'S STANDARD MANUFACTURING VARIATIONS AND PRACTICES. IN THE CASE OF COMPONENTS OR ACCESSORIES FURNISHED BY SUPPLIERS TO SELLER, PURCHASER'S WARRANTY FROM SELLER SHALL BE LIMITED TO THE WARRANTY OF THE COMPONENT OR ACCESSORY SUPPLIER. THE FOREGOING WARRANTIES ARE THE SOLE AND EXCLUSIVE WARRANTIES APPLICABLE TO THE GOODS DELIVERED, AND ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF MERCHANTABILITY, ARE HEREBY EXPRESSLY DISCLAIMED AND NEGATED. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, PURCHASER ACKNOWLEDGES THAT SELLER'S PRODUCTS ARE NOT PACKAGED OR PROTECTED FOR LONG PERIODS OF STORAGE AND THUS MAY CORRODE OR RUST OVER TIME.

**Damaged Goods.** If any goods should arrive at Purchaser's destination in a damaged condition or should a shortage occur, Purchaser shall immediately report the damage or shortage to the delivering carrier and to Seller. Any loss or shortage occasioned by damage or otherwise occurring in transit will be for account of Purchaser. Allegedly defective goods or parts are to be returned by Purchaser to a destination specified by Seller, freight charges prepaid by Purchaser. All repairs and replacements are subject to verification and inspection by Seller. Seller shall not be responsible for costs of de-installation and re-installation of goods or parts returned.

**Claims.** Claims respecting the condition of goods, compliance with specifications or any other matter affecting goods shipped to Purchaser must be made promptly and, unless otherwise agreed to in writing by Seller, in no event later than twenty-one (21) days after receipt of the goods by Purchaser. Purchaser shall set aside, protect and hold such goods without further processing until Seller has an opportunity to inspect and advise of the disposition, if any, to be made of such goods. In no event shall any goods be returned, reworked or scrapped by Purchaser without the express written authorization of Seller. If field service is rendered by the Seller at Purchaser's request and the alleged defect is found not to be with the Seller's product, component or accessory, the Purchaser shall pay for the time and expenses of the field representative. Bills for service, labor or other expenses that have been incurred by the Purchaser, their customer or agent, without approval or authorization by the Seller, will not be accepted. Changes or repairs attempted or made in the field without Seller's written authorization automatically void all warranties.

**LIMITATION OF PURCHASER'S REMEDIES.** PURCHASER'S REMEDIES WITH RESPECT TO ANY CLAIM ARISING OUT OF ANY ORDER, ANY GOODS DELIVERED PURSUANT TO ANY ORDER AND EXPRESSLY ACCEPTED IN SELLER'S ACKNOWLEDGMENT, OR SELLER'S PERFORMANCE IN CONNECTION WITH ANY ORDER, INCLUDING, WITHOUT LIMITATION, ANY CLAIM ARISING OUT OF ANY RECALL, DEFECT OR ALLEGED DEFECT IN ANY GOODS OR SERVICES FURNISHED BY SELLER, SHALL BE LIMITED EXCLUSIVELY TO THE RIGHT OF REPAIR OR REPLACEMENT OF SUCH GOODS OR SERVICES, AT SELLER'S OPTION. WITHOUT IN ANY WAY LIMITING THE GENERALITY OF THE FOREGOING, IN NO EVENT SHALL SELLER BE LIABLE FOR ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES, INCLUDING, WITHOUT LIMITATION, ANY LOSS OF ANTICIPATED PROFITS INCURRED BY PURCHASER WITH RESPECT TO ANY GOODS OR SERVICES FURNISHED BY SELLER, OR ANY DAMAGES ARISING FROM INJURIES TO PERSONS AS A RESULT OF PURCHASER'S OR A THIRD PARTY'S NEGLIGENCE. SELLER'S WARRANTY DOES NOT COVER FAILURES RESULTING FROM THE IMPROPER INSTALLATION, MOUNTING DESIGN OR APPLICATION OR FROM CORROSION. THE PROVISIONS OF THIS PARAGRAPH ARE A MATERIAL TERM OF THIS TRANSACTION.

**Warranty Procedures.** If Purchaser experiences a problem with Seller's goods and believes that it is covered by Seller's warranty, or Purchaser has equipment that needs to be repaired or replaced, contact Seller through Purchaser's local distributor. The basic information that Purchaser will need to begin the process is the complete nameplate data. Products will not be accepted for return unless an RGA (Return Goods Authorization) number has been assigned by Seller and the product for return or repair is shipped prepaid. Products returned for warranty evaluation must be complete (without missing components), and unaltered (not disassembled, manipulated cleaned or the like). The product(s) must have the original model tag fully intact. Products returned for warranty consideration are subject to a \$100 minimum fee plus any

additional handling charges in the event that the reason for the return is not covered by Seller's warranty. Additional handling fees are to cover the cost of failure analysis, testing and the like. All handling charges will be waived for products that are subject to a valid warranty claim. Products to be returned for warranty are to be shipped prepaid via Seller assigned carrier.

**Returns and Returns Procedures.** In order to return a product for credit, test, or repair, Purchaser must follow the procedures outlined in this paragraph and, in the case of repairs, the immediately following paragraph. Failure to follow return procedures could result in lost items, delays, additional service charges, warranty denial or refusal of shipment. All items being returned to Seller must be accompanied with an RGA (Return Goods Authorization) number for identification purposes. Products returned without a clearly marked RGA number will not be processed. RGA numbers can be obtained only through Seller. Products being returned for restock and credit must be complete (without missing components), unused, and within one year of original factory purchase. The products must have the original model tag fully intact. Returned products must be free of dents, customer applied paint, rust, or any permanent alterations of any type. Products shipped for restock are to be shipped prepaid. Heat exchangers being returned for credit are subject to a 30% restocking charge. Other items such as, without limitation, valves and temperature controls are subject to a 15%-50% restocking charge to be determined by the products' usage or salability. Restocking charges are applied to cover the cost or the retest and refitting equipment to new condition. Seller will issue credit only after a thorough inspection has been performed. NO DEBITS WILL BE HONORED UNTIL AFTER RETURN INSPECTION APPROVAL.

**Repairs.** Products being returned for repair, refit, test or similar matters must be drained completely prior to shipment. Purchaser must clearly label the product with information to identify the Purchaser and Seller's RGA number. Purchaser should also include a note with instructions for service, failure, nature of problem and the fluids that are used inside of the product. A base handling charge of \$100 will be applied for each product regardless of condition that it is in when returned for evaluation. Products being returned for evaluation must be shipped prepaid. Quotations for repair, test, cleaning, and similar matters will be issued shortly after return to Seller. All products returned shall be considered abandoned by Purchaser and may be scrapped if the Purchaser or shipper renders no disposition instructions after 45 days from notification by written quotation. Seller does not warranty any repaired products under any circumstances. Products repaired and the repairs are the sole responsibility of the owner of the products. Products sent to Seller for evaluation will be returned, upon request and at the owner's expense.

**Quality Assurance.** Seller shall have no obligation to ensure that any goods or services purchased from Seller meet any special quality assurance specifications and/or other requirements unless such specifications and/or other requirements are set forth in Purchaser's purchase order or separately provided in writing to Seller and, in either case, expressly accepted in this Seller's Acknowledgment and Purchaser represents that goods which it purchases from Seller will not be applied by Purchaser or resold by Purchaser for application to, any critical end use, including, without limitation, use in connection with or in any way related to the construction or operation of a nuclear facility unless the appropriate specification and/or other requirement for such end use is set forth in Purchaser's purchase order and is expressly accepted in a separate writing by Seller. In the event that any such goods or any services supplied by Seller in connection therewith are applied to a critical end use without the appropriate specification and/or other requirement therefor having been set forth in Purchaser's purchase order and expressly accepted in a separate writing by Seller, Purchaser shall indemnify and hold Seller harmless against any and all damages or claims for damages made by any person for any injury, fatal or nonfatal, to any person or for any damage to the property of any person incident to or arising out of such application, including, without limitation, any loss resulting from radioactive, toxic, explosive, or other hazardous properties of source material, special nuclear material, or by-product material as such terms are defined in the Atomic Energy Act of 1954 or any law amendatory thereof or regulations adopted pursuant thereto. The Seller reserves the right to improve its products through changes in design or material, as it may deem desirable without being obligated to incorporate such changes in products of prior manufacture.

**Cancellation.** Purchaser Orders cannot be cancelled without cause by Purchaser without the express written consent of the Seller. Should Purchaser attempt to cancel an order without cause, Purchaser shall reimburse Seller against all loss occasioned by such cancellation, including loss of anticipatory profits and liability for commitments made by Seller relating to the Purchase Order and shall purchase any existing inventory and work in process which Seller has in its possession to fulfill Seller's existing orders for Purchaser at the time of cancellation. As used herein, "cause" shall mean a material breach of Seller's duties and obligations hereunder and the failure to cure such breach after Purchaser notifies Seller of such breach and affords Seller a reasonable time to cure same.

# STANDARD TERMS AND CONDITIONS OF SALE (3/3)

**Confidentiality and Publicity.** Purchaser shall consider all information furnished by Seller to be confidential and shall not disclose any such information to any person, firm or corporation, other than Purchaser's or Seller's employees, subcontractors or government inspectors, unless authorized to do so by Seller in writing. Purchaser shall not disclose in any manner to third parties, including, without limitation to, advertising, or publishing concerns, Seller's identity or the identity of any subsidiaries or affiliates of Seller. Unless otherwise agreed to in writing, no commercial, financial or technical information disclosed in any manner or at any time by Purchaser to Seller shall be deemed secret or confidential and Purchaser shall have no rights against Seller with respect thereto except such rights as may exist under patent laws.

**Tooling.** If and to the extent any Purchase Order relates to the purchase of tools, jigs, die fixtures, equipment, drawings and specifications (collectively, "tooling") or specifically requires tooling for completion by Seller, then Seller shall at all times be and remain the owner of such tooling and shall bear the risk of loss and be responsible for insuring same. If any Purchase Order requires the development of such tooling, then the price quoted by Seller is based on a minimum production of a specified quantity of parts from such tooling and, in the event Purchaser does not ultimately purchase such quantity of parts, an equitable adjustment in the purchase price for products shall be made to reflect such lower quantity and Seller's unamortized cost of the tooling so produced. Seller's price quotation is based upon estimated usage of tooling but no representations or warranties are made by Seller that the tooling so built will ultimately be capable of producing product in accordance with such anticipated usage. Purchaser agrees to pay for changes in tooling made necessary by changes in specifications accepted by Seller, such changes to be made at Purchaser's risk. Parts produced from Purchaser's supplied tooling cannot be guaranteed by Seller. Purchaser provided tooling is not insured and Seller shall not be responsible or liable for any loss or damage thereto or for any materials or equipment owned or furnished by Purchaser. Purchaser shall be solely responsible for insuring such tooling and Purchaser waives any claim or right of subrogation it may have against Seller arising out of Seller's failure to insure such tooling. Seller reserves the right to charge Purchaser the reasonable costs and expenses of refurbishing any tooling if so required by Seller to fulfill any Purchase Order. When for a period of one (1) year no orders are received for parts to be produced from tooling, Seller may notify Purchaser in writing at Purchaser's last known address in Seller's files that tooling is no longer proprietary to Purchaser and, with respect to Purchaser supplied tooling, such tooling shall become Seller's property or, at Seller's option, Seller may return such tooling to Purchaser at Purchaser's expense.

**Prototypes.** If this Purchase Order relates to the production of a prototype by Seller for or on behalf of Purchaser, (a) such prototypes will be manufactured in accordance with Purchaser's specifications including material selection and (b) actual product produced by Seller may vary from such prototype in a non-material and non-functional manner. Seller's sole liability in the event it is unsuccessful in producing a prototype in accordance with Purchaser's specifications shall be limited to the purchase price paid by Purchaser with respect thereto. Purchaser shall be responsible for the cost of all tooling necessary for the development of the prototype as provided in the paragraph captioned "Tooling" above.

**Technical Assistance and Advice.** Seller's warranty shall not be enlarged and no obligation or liability shall arise out of Seller's rendering of technical assistance, technical advice facilities, service or recommendations made by Seller in connection with Purchaser's purchases of the goods hereunder. Said technical services, advice, assistance or recommendations made by Seller or any representative of Seller concerning any use or application of any goods furnished hereunder is believed to be reliable, but SELLER MAKES NO WARRANTY, EXPRESS OR IMPLIED, AND THE SAME ARE HEREBY EXPRESSLY DISCLAIMED as to the same and the results to be obtained. Purchaser assumes all responsibility for loss or damage resulting from the use of any such goods.

**Indemnification.** Purchaser agrees to indemnify, save harmless and defend Seller from and against any and all liability for loss, damage or injury to person or property in any manner arising out of or incident to the performance of any Seller's Acknowledgment or other sale by Seller or its servants, employees, agents or representatives. Without limiting the generality of the foregoing, Purchaser will indemnify and hold harmless Seller, its officers, employees, agents, successors, assigns, customers and users of its products from and against any and all losses, expenses, claims, suits and liabilities (including incidental and consequential damages and court costs and attorneys fees) arising as a result of any claim that the manufacture, use, sale or resale of goods delivered by Seller in accordance with Purchaser's specifications or designs infringes on any patent, utility model, industry design, copyright or other intellectual property rights in any country. Without limiting the generality of the paragraph captioned "LIMITATION OF PURCHASER'S REMEDIES" above, in the case of any claim of infringement or the sale of products is enjoined, Seller shall have no obligation to procure for Purchaser the right to continue using such products or to replace same with equivalent non-infringing products or to modify the products so they become non-

infringing.

**Setoffs.** Purchaser shall make no deduction or setoff for any claim arising out of or from any transaction with Seller nor shall Purchaser take any discount, credit or allowance without Seller's written consent.

**Assignment.** Purchaser shall not assign any order or any interest therein without the written consent of Seller. Any such actual or attempted assignment without Seller's prior written consent shall entitle Seller to cancel such order upon written notice to Purchaser.

**Termination.** Seller may terminate any order or any part thereof for any reason at Seller's convenience upon written notice to Purchaser. Upon such termination, Purchaser agrees to waive all claims for damages including, without limitation, any loss of anticipated profits, and to accept as its sole remedy for termination the reasonable additional costs of obtaining substitute goods of the same quantity and quality, provided that in no event shall such costs exceed the price of the order or part thereof so terminated as stated on Seller's Acknowledgment. Any claim for adjustment not asserted within sixty (60) days from the date of such termination shall be deemed to have been waived by Purchaser.

**Allocation of Risk.** Purchaser acknowledges that these Standard Terms and Conditions of Sale and Seller's Acknowledgment allocates risks with respect to goods and/or services sold to Purchaser and this risk allocation is reflected in the prices to be paid by Purchaser for said goods and/or services purchased hereunder. Purchaser warrants that it has read this provision, understands it and is bound by its terms.

**Packaging.** Seller will use all reasonable means to comply with any packaging, loading or bracing requirements specified in any order. Seller will charge for compliance with Purchaser's special requirements in accordance with Seller's price list for extras in effect at time of shipment. If no packaging, loading or bracing requirements are specified by Purchaser, Seller shall comply with the minimum requirements customarily applied by Seller to the method of transportation used for such goods.

**Entire Agreement.** These Standard Terms and Conditions of Sale and Seller's Acknowledgment and any other documents referred to on the face thereof constitute the entire agreement between Seller and Purchaser.

**Modification.** No addition or modification of the terms and conditions of these Standard Terms and Conditions of Sale and Seller's Acknowledgment shall be binding on Seller unless specifically agreed to by Seller in writing.

**Waiver.** Seller's failure to insist on performance of any of these Standard Terms and Conditions of Sale and Seller's Acknowledgment or to exercise any right or privilege or Seller's waiver of any breach hereunder shall not thereafter waive any other terms, conditions, or privileges, whether of the same or similar type.

**Governing Law.** Seller and Purchaser's agreement shall be governed by and interpreted in accordance with the laws of the State of Illinois of the United States of America. Manufacture, shipment and delivery are subject to any prohibition, restriction, priority, allocation, regulation or condition imposed by or on behalf of the United States of America or any other governmental body with appropriate jurisdiction which may prevent or interfere with fulfillment of any order.

**Re-orders.** Re-orders, if accepted by Seller, are considered as placed under the same terms and conditions as Purchaser's previous order, when such orders are not placed pursuant to a formal written proposal and acceptance.

**Disclosure.** Seller shall have the right to disclosure of the identity of Purchaser and the nature of the work Seller is performing on Purchaser's behalf to Seller's customers and prospective customers and in any promotional materials provided such disclosure does not contain any confidential and proprietary information concerning Purchaser.

**DISPUTES.** SELLER AND PURCHASER AGREE TO SUBMIT ANY DISPUTES REGARDING ANY ORDER, ANY GOODS DELIVERED PURSUANT TO ANY ORDER AND EXPRESSLY ACCEPTED IN SELLER'S ACKNOWLEDGMENT, OR SELLER'S PERFORMANCE IN CONNECTION WITH ANY ORDER, INCLUDING WITHOUT LIMITATION SELLER'S LIMITED WARRANTY OBLIGATION, TO MEDIATION BY AN INDEPENDENT MEDIATOR TO BE MUTUALLY AGREED UPON BY SELLER AND PURCHASER. THE COST OF SUCH MEDIATION SHALL BE BORNE EQUALLY BY SELLER AND PURCHASER. IN THE EVENT SUCH MEDIATION DOES NOT RESOLVE THEIR DISPUTE, SELLER AND PURCHASER AGREE TO SUBMIT SUCH DISPUTE TO AN INDEPENDENT ARBITRATOR, TO BE MUTUALLY AGREED UPON BY SELLER AND PURCHASER OR, OTHERWISE, CHOSEN BY THE MEDIATOR. SELLER AND PURCHASER AGREE THAT ALL MEDIATION AND ARBITRATION SHALL BE CONDUCTED IN ZION, ILLINOIS. THE NON-PREVAILING PARTY AT THE ARBITRATION SHALL PAY THE PREVAILING PARTY'S ATTORNEYS' FEES AND COSTS INCURRED IN PARTICIPATING IN THE ARBITRATION.





**ACA Series**

- Heavy-duty Serviceable Core® air cooled air after-coolers for compressor sizes up to 500 HP.



**AOCH Series** with screen & Serviceable Core®

- Industrial high capacity air/oil heat exchanger available in 8 standard sizes with electric or hydraulic drive.



**URCS Series**

- U-tube heat exchangers for steam services with removable tubes bundle in copper, 316L SS, or 90/10 Cu Ni.



**EOC Series** with electric motor & filter as an option.

- Versatile industrial/mobile grade heat exchanger available with optional filter, AC, DC, and hydraulic drives.



**AC,ACHM & ACF Series**

- Industrial air/oil heat exchanger available in 8 standard sizes with electric or hydraulic drive.



**CS Series**

- Heat exchangers in copper, 316L SS, or 90/10 Cu Ni.