Colmac Heat Pipe Coils

Air-to-Air Heat Exchangers
For Commercial and Light Industrial Applications

Standard Configurations Up To
8 Rows Deep, 28 Tubes High, and 20 Feet Long

- Design
- Selection
- Application

Heat Recovery ◆ Frost and Temperature Control
Enhanced Dehumidification ◆ Indirect Evaporative Cooling

Colmac coils are rated in accordance with standard industry practice.

SPECIFY COLMAC QUALITY

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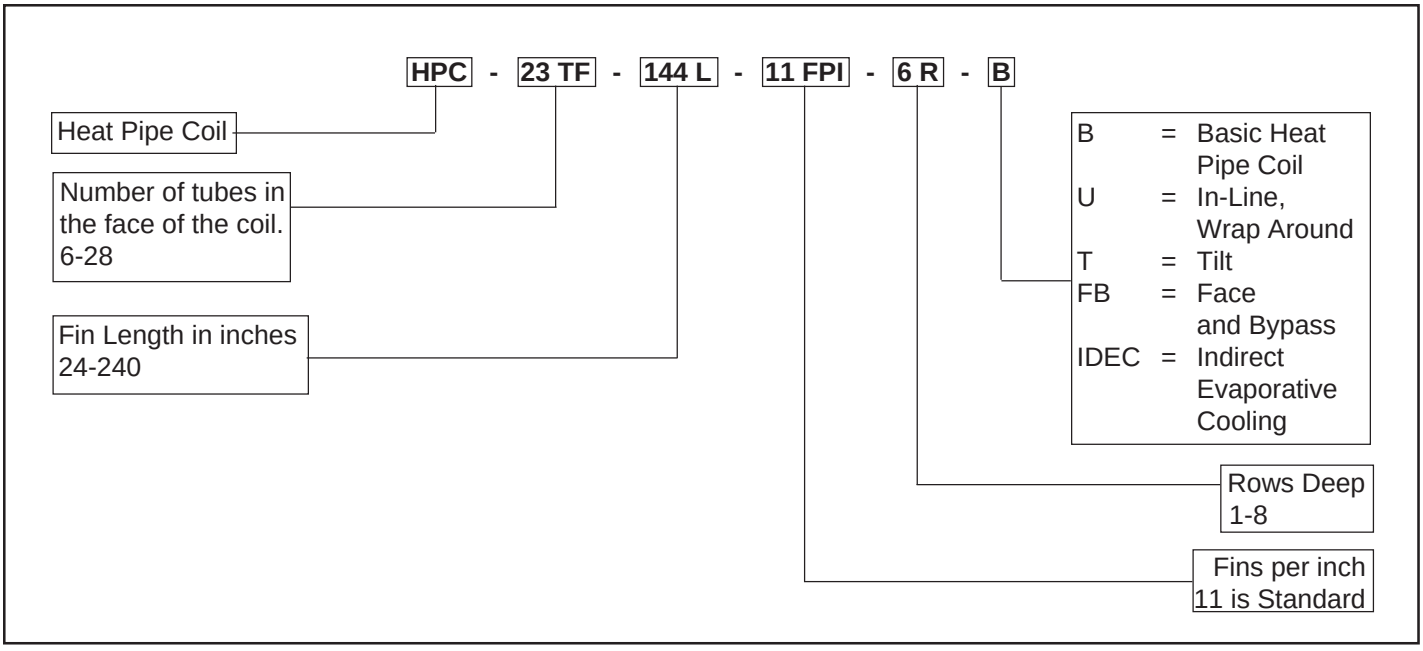
HEAT PIPE COIL NOMENCLATURE



THE COLMAC HEAT PIPE COIL

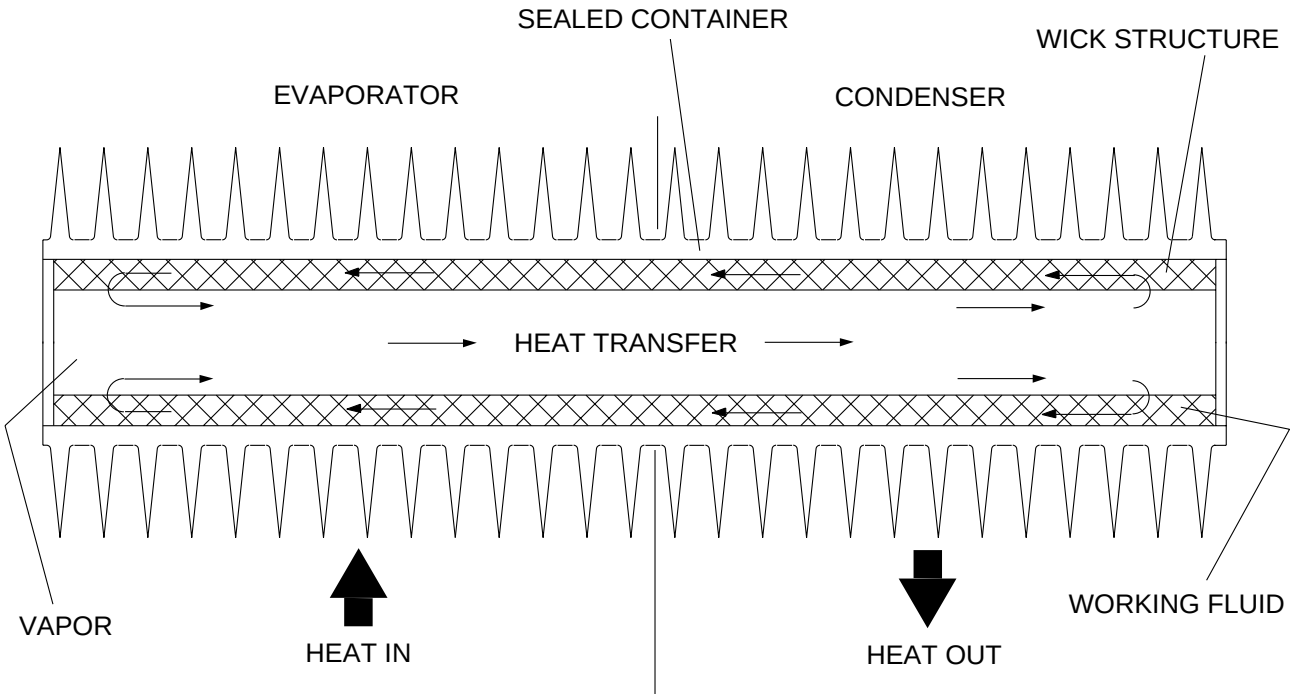
The Colmac heat pipe coil is on the leading edge of air-to-air heat transfer technology.

What makes a Colmac heat recovery system different from a conventional heat exchanger? The Colmac heat pipe coil. This remarkable heat exchanger is capable of transferring 1,000 times more energy than a solid copper bar, the best-known commercial conductor. What's more, there are no moving parts, no external fans, no connections to a fluid supply, no noise and no external power.

The Colmac heat pipe coil has taken this innovative technology and applied it to the task of saving energy for buildings and industry … energy from conditioned air in buildings … from wasted heat in HVAC systems or industrial processes … in fact savings from almost any waste heat or cooling application that you can imagine. In short, wherever Colmac heat pipe coil systems have been applied, the basic plant or process heat balance equation has been improved; the cost of the equipment is amortized in a very brief time.

HOW IT WORKS

The individual heat pipes that make up a Colmac heat pipe coil consist of three elements: A sealed pipe. A capillary wick structure. And a working fluid. Because the pipe is sealed under a vacuum, the working fluid is in equilibrium with its own vapor. The capillary wick distributes the working fluid over the inside of the pipe. Hot air flowing over one end of the pipe evaporates the working fluid. The vapor is then condensed at the cooler end, giving up its heat to the second air stream. The condensed vapor flows back to the evaporator, completing the cycle.



The Colmac heat pipe coil is made up of rows of individual finned heat pipes which extend horizontally across the total width of the exchanger and pass through a sealed center partition. The sealed partition separates the heat exchanger into two sections.

The heat pipe coil is typically installed across two side-by-side air ducts containing separate counterflow airstreams. In operation, exhaust air is discharged across one section of the exchanger, and supply air is ducted in a counterflow direction across the other section. Heat is transferred from the hot airstream to the cold airstream by the heat pipes. While Colmac heat pipe coils can recover up to 90% of exhausted energy under ideal conditions, the typical heat recovery performance of installed units is closer to 60% to 75%. This represents a tremendous savings of energy while yielding immediate and future dollar savings.

COLMAC HEAT PIPE COIL FEATURES

Integral Fin Design – Each heat pipe is made from one piece of material, with no discontinuities between fin and tube. This yields the maximum heat transfer possible with minimum pressure drop. It also eliminates the possibility of corrosion at the tube and fin interface.

Individual Heat Pipe – Each individual heat pipe is independent, ensuring the utmost in reliability and performance. Quality control includes individual testing and assembly of each heat pipe.

Complete Load Capability – Colmac heat pipe coils are designed to handle virtually any heating/cooling load without the need for gravity assist. The 1" internal diameter means that the Colmac heat pipe coil can be installed level for both summer and winter operation. No seasonal change-over is required.

Integral Capillary Wick – Colmac heat pipe coils have a capillary wick formed into their inside wall. The integral wick keeps the heat pipe performing under all load conditions, with no dry-out of the evaporator.

Extended Life – Units have no moving parts. Each Colmac heat pipe coil is permanently sealed to provide operation indefinitely within the prescribed temperature range.

No Cross-contamination – A sealed partition separates the supply from the exhaust airstreams preventing contamination of one airstream by the other.

Passive Energy Recovery – Colmac heat pipe coils require no external power for operation.

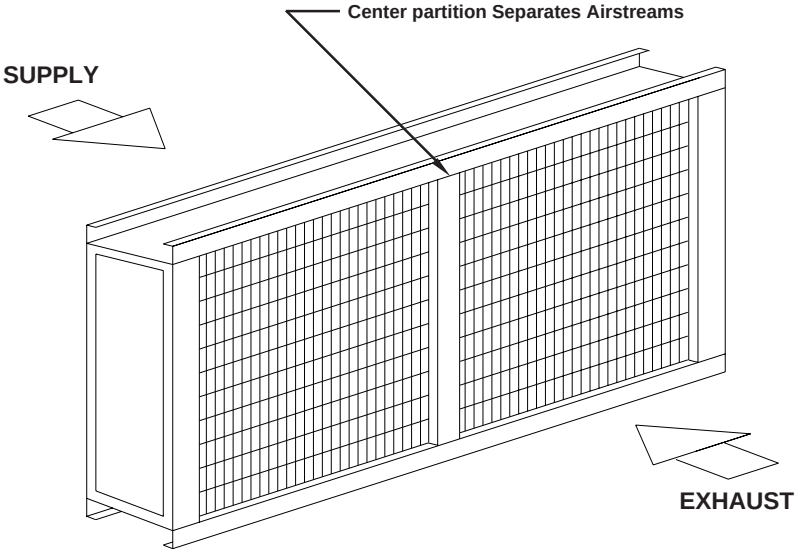
Minimum Maintenance – Since there are no moving parts, repairs are not needed. External cleaning only may be required, and with most systems cleaning is infrequent.

Compactness – The deepest standardly constructed Colmac heat pipe coil is only 17 inches in the direction of airflow. The compact design allows more space for other equipment.

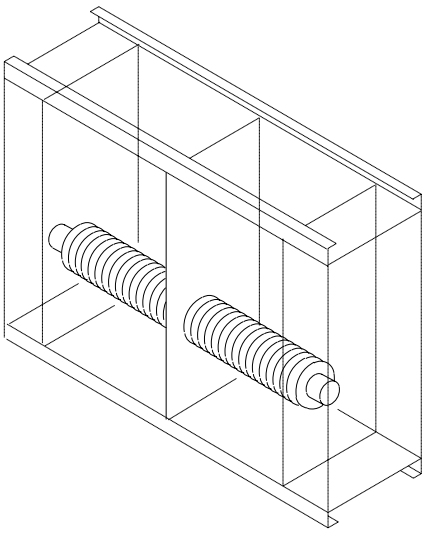
System Size Flexibility – Many sizes are available to accommodate the capacity of most any system.

System Performance Flexibility – A large selection of row depths, face areas and fin densities is available to meet the required energy recovery performance.

Bidirectional Heat Transfer – Colmac heat pipe coils can be used for both heating and cooling.

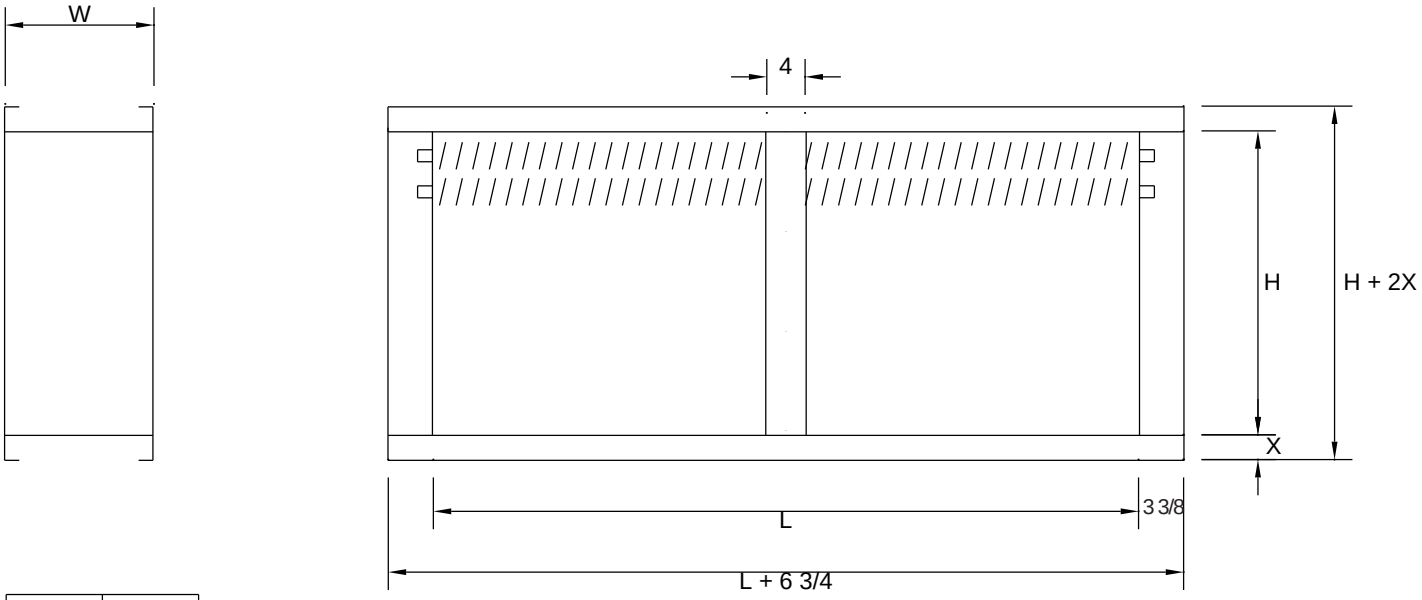


Individual Heat Pipes Make Up An Exchanger



COLMAC HEAT PIPE COIL DIMENSIONS

Heat pipe dimensions, designations and construction



ROWS	W
4	9 5/8
5	11 1/2
6	13 3/8
7	15 1/4
8	17 1/8

TUBES IN FACE	7	10	13	16	19	22	25	28
HEIGHT (H)	14 7/8	21 1/4	27 5/8	34	40 3/4	46 3/4	53 1/8	59 1/2

LENGTH (L)	< = 144	> 144
VALUE OF "X"	2	3

(for row depths of 4 or less, "X" = 1 1/2)

Heat pipe model designation	19 TF	144L	11FPI	6R
(EXAMPLE)	# TUBES IN FACE OF COIL	FIN LENGTH IN INCHES	FINS PER INCH	ROWS DEEP

Heat Pipe Construction			
Fin Density	11 fins per inch	Partition Thickness	16 gauge minimum
Row Depths	2 through 8	Partition Material	galvanized steel
Heat Pipe I.D.	1 inch	Frame Thickness	16 gauge minimum
Wall Thickness	.049" to .058"	Frame Material	galvanized steel
Tube Material	aluminum	End Cover Thickness	16 gauge minimum
Fin Thickness	.017 mean thickness	End Cover Material	galvanized steel
Fin Material	aluminum	Face Areas	2.5 through 99.2

COLMAC HEAT PIPE COIL FACE AREA AND WEIGHTS

The following charts show Colmac's standard size configurations. Colmac will build to any length or tubes in face within these charts to meet your heat pipe coil requirements.

Heat Pipe Coil Face Area

(Sq. Ft.)

FIN HEIGHT INCHES	TUBES IN FACE	FIN LENGTH IN INCHES																			
		24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240
14 7/8	7	2.5	3.7	4.9	6.2	7.4	8.7	9.9	11.2	12.4	13.6	14.9	16.1	17.4	18.6	19.8	21.1	22.3	23.6	24.8
21 1/4	10	3.5	5.3	7.1	8.9	10.6	12.4	14.2	15.9	17.7	19.5	21.3	23.0	24.8	26.6	28.3	30.1	31.9	33.6	35.4
27 5/8	13	4.6	6.9	9.2	11.5	13.8	16.1	18.4	20.7	23.0	25.3	27.6	29.9	32.2	34.5	36.8	39.1	41.4	43.7	46.0
34	16	5.7	8.5	11.3	14.2	17.0	19.8	22.7	25.5	28.3	31.2	34.0	36.8	39.7	42.5	45.3	48.2	51.0	53.8	56.7
40 3/8	19	6.7	10.1	13.5	16.8	20.2	23.6	26.9	30.3	33.6	37.0	40.4	43.7	47.1	50.5	53.8	57.2	60.6	63.9	67.3
46 3/4	22	7.8	11.7	15.6	19.5	23.4	27.3	31.2	35.1	39.0	42.9	46.8	50.6	54.5	58.4	62.3	66.2	70.1	74.0	77.9
53 1/8	25	8.9	13.3	17.7	22.1	26.6	31.0	35.4	39.8	44.3	48.7	53.1	57.6	62.0	66.4	70.8	75.3	79.7	84.1	88.5
59 1/2	28	9.9	14.9	19.8	24.8	29.8	34.7	39.6	44.6	49.6	54.5	59.5	64.5	69.4	74.4	79.3	84.3	98.3	94.2	99.2

Heat Pipe Coil Weights

(BASE UNIT)

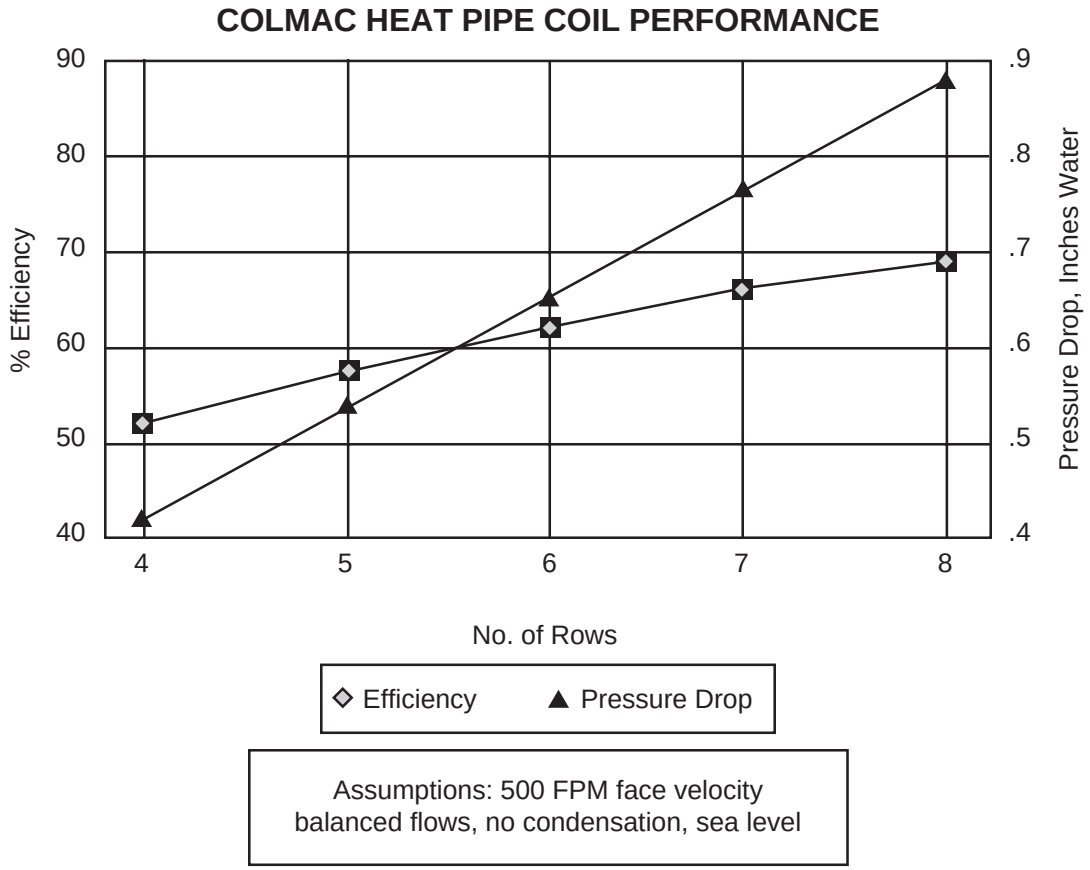
FIN HEIGHT INCHES	TUBES IN FACE	FIN LENGTH IN INCHES																			
		24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240
14 7/8	7	116	153	189	226	272	309	345	382	419	465	502	565	603	642	690	729	767	806	844
21 1/4	10	157	207	256	306	369	419	469	519	568	632	681	757	809	861	926	978	1029	1081	1133
27 5/8	13	198	261	324	387	466	529	592	655	718	798	851	950	1015	1080	1162	1227	1291	1356	1421
34	16	259	315	391	467	565	640	716	792	868	964	1040	1143	1221	1299	1397	1475	1554	1632	1710
40 3/8	19	280	369	459	548	660	750	839	929	1018	1131	1220	1336	1427	1518	1633	1724	1816	1907	1998
46 3/4	22	321	423	526	628	758	860	963	1065	1168	1297	1400	1528	1633	1738	1869	1973	2078	2182	2287
53 1/8	25	362	477	593	709	855	970	1086	1202	1318	1463	1579	1721	1839	1957	2104	2222	2340	2458	2575
59 1/2	28	403	531	660	789	932	1081	1210	1339	1468	1630	1759	1914	2045	2176	2340	2471	2602	2733	2864

WEIGHT CORRECTION FACTORS

ROWS DEEP	4	5	6	7	8
MULTIPLIER	.82	1.0	1.21	1.39	1.58

COLMAC HEAT PIPE COIL SELECTION

Colmac heat pipe coils are normally sized in a manner similar to other heating/cooling coils, using a face velocity of 500 feet per minute. At this velocity, pressure drops across the heat exchanger are modest when compared with other types of heat exchangers. If higher pressure drops can be tolerated, face velocities higher than 500 feet per minute can be used under proper conditions.



The graph above gives an approximate method for determining the efficiency of a Colmac heat pipe coil. The graph is valid for equal supply and exhaust air flows with a 500 feet per minute face velocity, at sea level with no condensation occurring. Sizing the heat pipe coil can be done with the help of the Heat Exchanger Face Area Table. Please note that heat exchanger sizing is done with standard cubic feet per minute (SCFM), which is the actual volume of air flow corrected to sea level and 70 degrees by the following formula:

SCFM = ACFM (530/(T + 460))

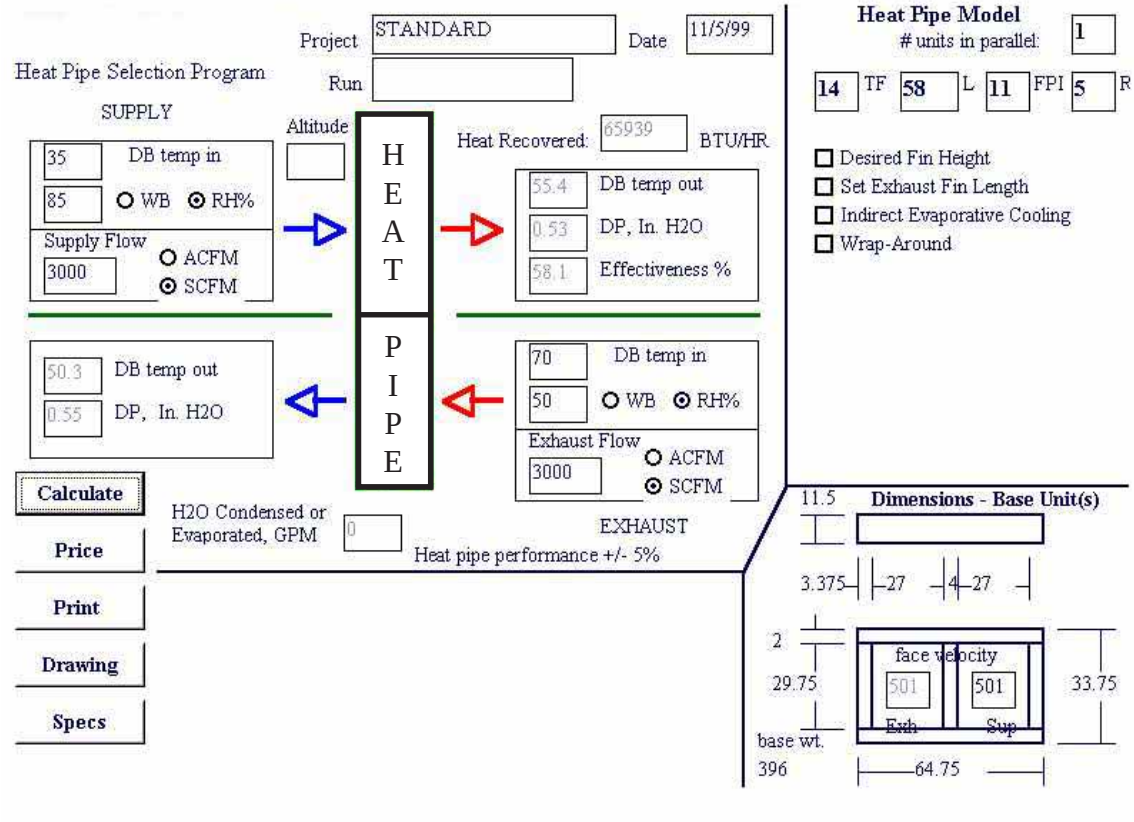
Where: T = temperature of air (deg F)

Additional correction will be needed if the application is not at sea level

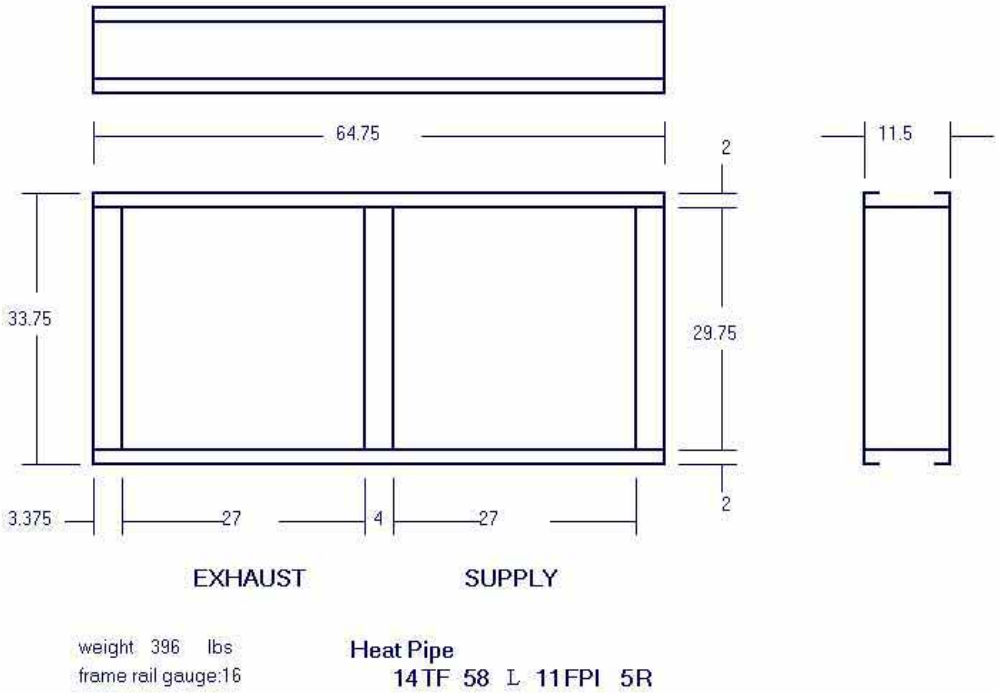
For actual applications that need more precise results, you will need to use Colmac's "Heat Pipe Pro", a Windows based Heat Pipe Selection software.

COLMAC "HEAT PIPE PRO" SOFTWARE

"Heat Pipe Pro" is a Windows based heat pipe coil selection, sizing, and pricing software. It will select an appropriate Colmac heat pipe coil model given flow and temperature input, or will give the exact performance of the heat pipe for a selected model. It performs precise psychrometric calculations and determines exactly how much control is required to prevent frost build up. It calculates indirect evaporative cooling and dehumidification applications as well. Heat pipe drawings, specifications, and pricing for the model selected are also included in the software.



BASIC DIMENSIONAL SUBMITTAL DRAWING



COLMAC HEAT PIPE COIL INSTALLATION

Installation Considerations

Flow configuration: The exchanger is of counterflow design. That is, the exhaust and supply airstreams flow in opposite directions through each respective side of the exchanger.

Leveling the exchanger: Energy recovery units shall be installed with:
(a) 1/4 inch per ft. exhaust end down when used for heating and ventilating only.
(b) 1/8 inch level end-to-end when used for heating, ventilating and cooling.

Supporting structure: The exchangers must be secured rigidly to not allow more than 1/8 inch bow end to end.

Duct design: The exchanger is manufactured with a center partition and frame such that standard duct flanges can be screwed to the frame. Sheet metal screws 3/8 inches long should be used. The duct design should be in accordance with good practice in establishing a uniform air flow across the entire coil surface. In addition, blades on face dampers should be perpendicular to the tubes.

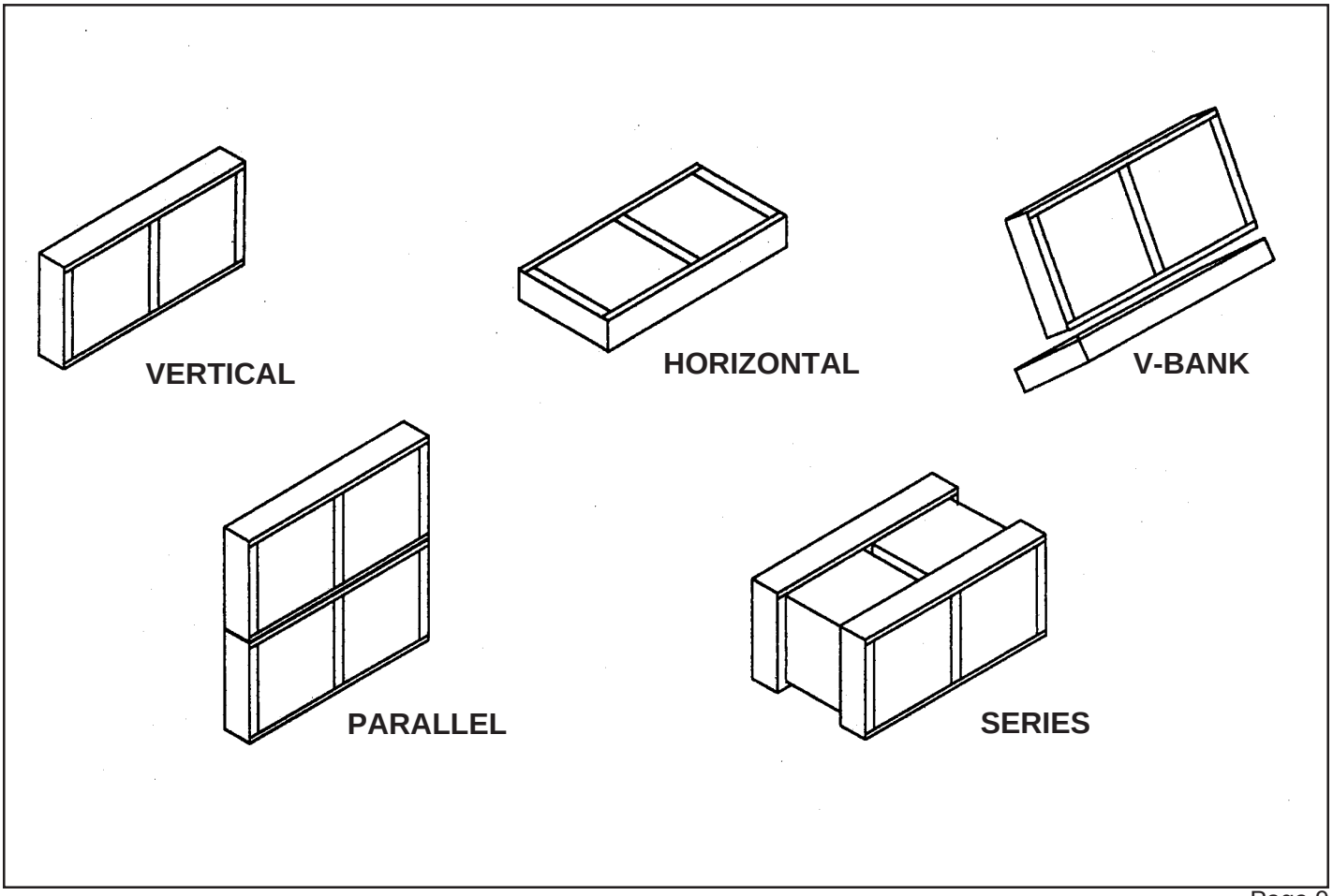
Filtration requirements: Performance specifications are based on clean air and a clean surface. Adequate filtration should be used in both exchanger airstreams to ensure optimum performance and minimum maintenance.

Access doors: Access to allow periodic inspection of the exchanger and to facilitate cleaning should be provided.

Drain pans: Drain pans are recommended under the entire exchanger both as a condensate collection system and for cleaning purposes.

Code requirements: The installation of the exchanger should conform to all codes, laws and regulations applying at jobsite.

COLMAC HEAT PIPE COIL ARRANGEMENTS

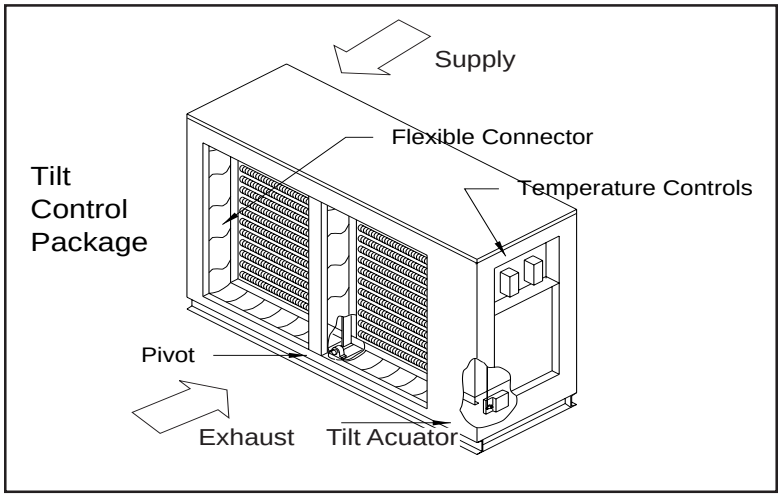


FROST AND TEMPERATURE CONTROL

It is sometimes desirable to control the performance of a heat pipe coil in order to prevent frost build-up on the exhaust side of the heat exchanger in the winter, or to prevent inadvertent heating of the supply air when cool make-up air is desired in the spring or fall. Colmac heat pipe coils have two very effective methods of temperature control:

TILT CONTROL

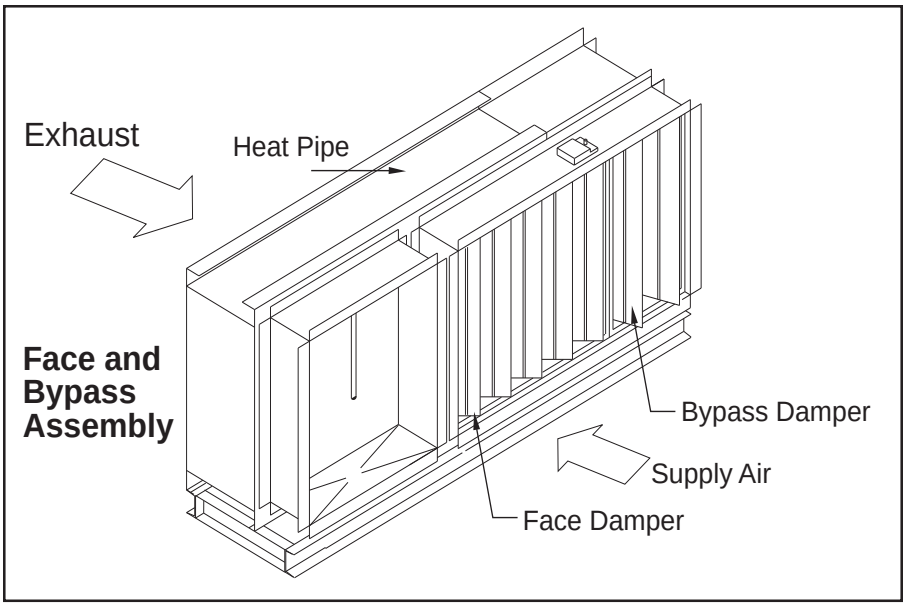
Because Colmac heat pipe coils depend on an internal evaporation/condensate cycle, their performance can be altered by using gravity to limit the effectiveness of the cycle. If the heat pipe is tilted such that the cool air end is lowered below the warm air end, the effectiveness of the heat pipe coil is diminished. The tilt can be adjusted to accomplish just the right amount of temperature control. The heat pipe coil is mounted on a central pivot; its tilt from the level is controlled by a mechanical actuator responding from the input from two proportional temperature controllers. The heat pipe coil is connected to ducts by short flexible duct connectors.



There is a common misconception that tilting a heat pipe coil increases its efficiency. It does not. Gravity can assist a small diameter heat pipe that "chokes" due to insufficient flow area. Because of its larger internal diameter, Colmac heat pipe coils have no such problem, and can handle any thermal load, summer or winter, without resorting to tilt. For temperature and frost control tilt is actually used to derate the performance of the heat pipe exchanger to achieve its desired effect.

FACE AND BYPASS DAMPERS

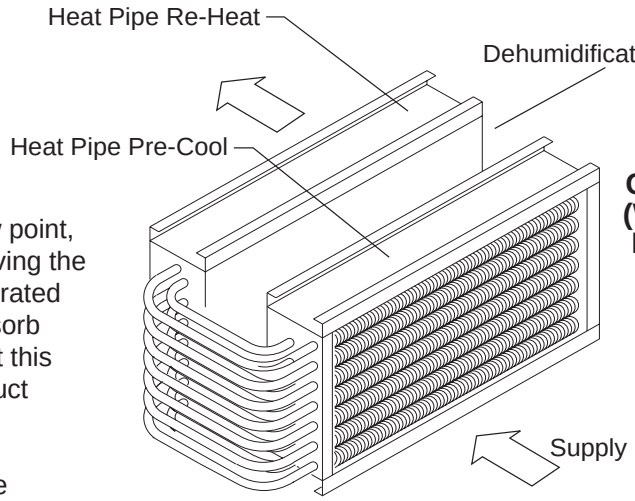
Face and bypass dampers are used throughout the industry, and can be used effectively with Colmac heat pipe coils to control frost and temperature. In the winter when supply air temperatures are cold enough to create frost on the exhaust air side, face dampers begin to close and allow cold supply air to bypass the coil. Face dampers also close to prevent heating of supply air in spring and fall when an economizer cycle is desired. While several frost control strategies are available, the most common is to adjust the tilt or the damper position on the temperature of the air leaving the exhaust side of the exchanger.



Both tilt control and face and bypass control have similar results. As the entire volume of cold supply air passes through the heat pipe coil, the overall temperature of the heat pipe is decreased. Somewhat more control needs to be exercised with face & bypass dampers, which results in slightly lower thermal performance in frosting conditions. However, because of its inherent design, tilt control offers slightly better economizer temperature control.

ENHANCED DEHUMIDIFICATION

An example of how the Colmac heat pipe coils can be used to solve air-to-air heat recovery problems is its use in conjunction with dehumidification coils.



COLMAC IN-LINE (WRAP-AROUND) HEAT PIPE COIL

Dehumidification coils cool air below its dew point, extracting water in the process. The air leaving the coil has less absolute humidity, but it is saturated with water vapor and has no capacity to absorb more water. It is common practice to reheat this cold, clammy air to avoid condensation in duct work and to make the air more comfortable.

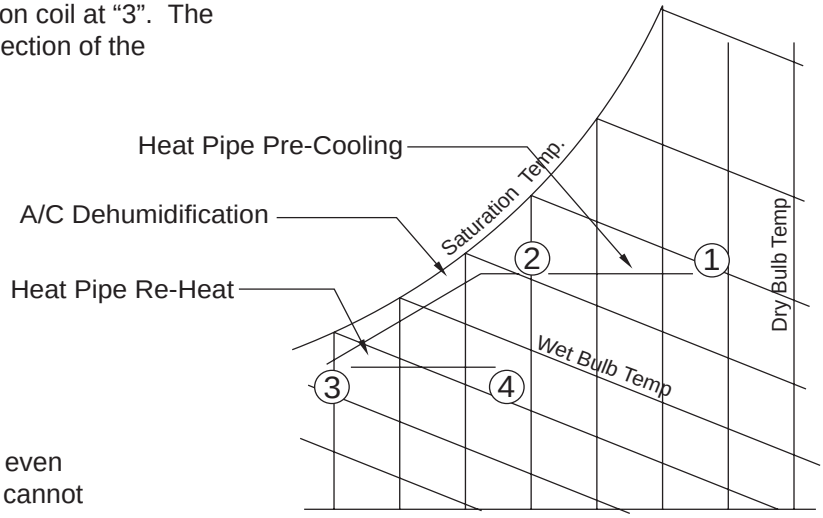
This additional expenditure of energy can be avoided by the use of Colmac heat pipe coils. In its in-line (wrap-around) configuration, the heat pipe actually wraps around the DX or chilled water dehumidification coil, with one section of the heat pipe coil upstream and one section downstream. Typically, a two row heat pipe coil is used.

Hot, humid air enters through the first heat pipe coil section. The heat pipe pre-cools this air prior to entering the dehumidification coil. This allows the coil to have a higher chilled water temperature for a given amount of cooling, or in the case of a DX coil, a lower compressor load. This cooling savings is in addition to the saving from the free reheat.

As the cool, dehumidified air emerges from the cooling coil, it passes through the second section of the heat pipe coil, where it is reheated to a temperature with a more comfortable relative humidity.

All of this is done without any expenditure of energy. The Colmac heat pipe coil simply exchanges precooling energy in the first section for reheat energy in the second section. The heat pipe coil modifies the "sensible heat ratio" of the air, transforming cool, muggy air into slightly warmer air with a much lower relative humidity.

The psychrometric chart below shows the effect of the Colmac heat pipe coil. Air entering at "1" is precooled by the heat pipe coil to the condition at "2". From here, the dehumidification coil brings the air to saturation and cools the air further, extracting water. The air leaves the dehumidification coil at "3". The muggy air at "3" then passes through the second section of the heat pipe coil, where it is reheated to a more comfortable condition at "4".



The Colmac "enhanced dehumidification" heat pipe coil is designed to be a sturdy, reliable unit. Individual "U" tubes are welded to each section of the heat pipe coil to ensure sound construction. Moreover, the individual tubes ensure that there is even distribution of working fluid in all heat pipes, which cannot be guaranteed in a manifolded construction. Connections between the heat pipe sections are compact and are located opposite to the dehumidification coil connections. The heat pipe coil can be sized either to closely wrap around the coil or to allow space between it and the cooling coil.

INDIRECT EVAPORATIVE COOLING

One of the most powerful applications of the Colmac heat pipe coil is indirect evaporative cooling (IDEC). IDEC is a way of capturing most of the cooling energy lost when conditioned air is exhausted from a building and is a way of cooling building make-up air without adding humidity. In either case, building make-up air is cooled by using the psychrometric potential of air exhausted from the building or outside air. Water is sprayed on this airstream, lowering its temperature towards its wet bulb temperature. The Colmac heat pipe coil carries this coolness and transfers it to the supply air stream, without the addition of humidity. IDEC is distinguished from evaporative (or swamp) cooling, which merely exchanges a drop in temperature for a rise in humidity.

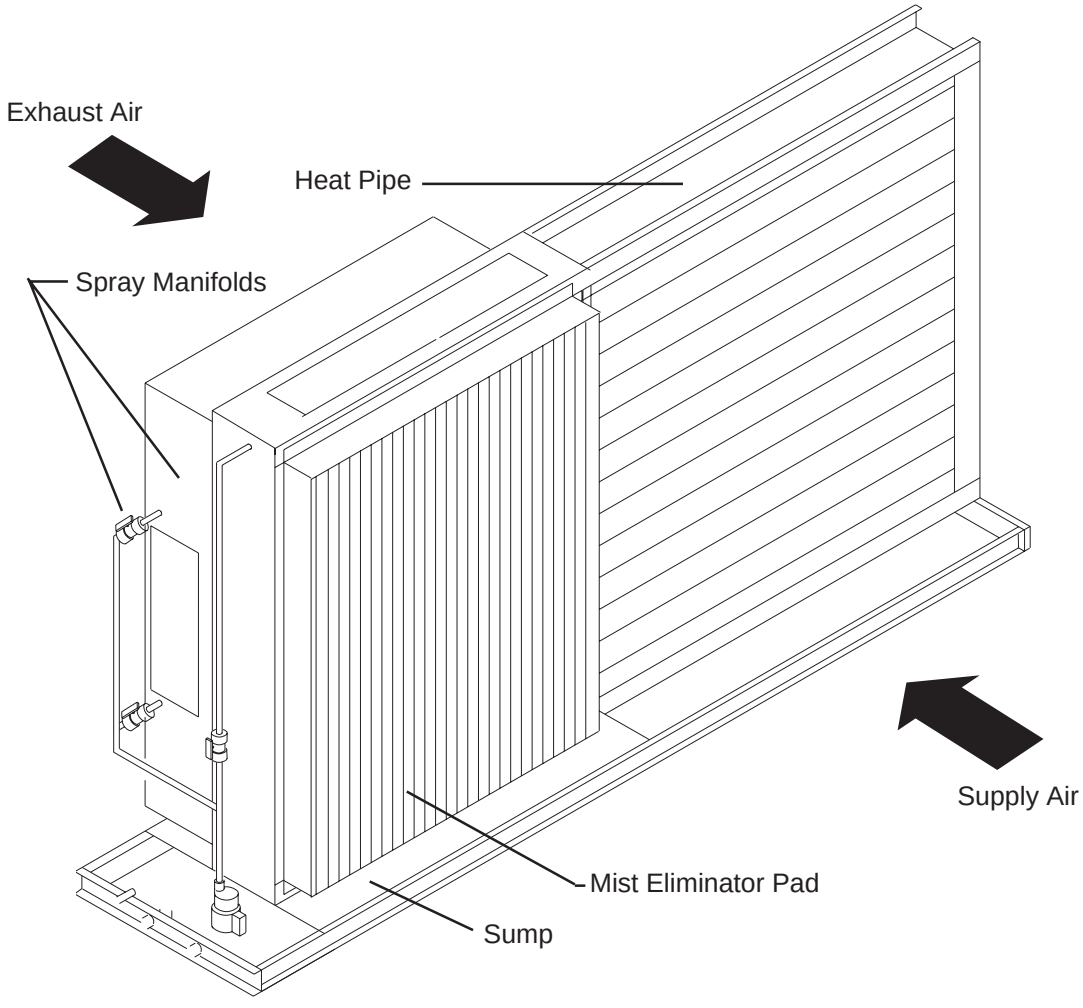
The Colmac indirect evaporative cooling systems are highly efficient, and take full advantage of the temperature potential of the exhausted airstream. Unlike other systems that use a "media" to saturate the air upstream of the heat exchanger, the Colmac indirect evaporative cooling system keeps the air saturated through the coil as the dry coolness is being supplied to the make-up air. This means that in a typical application, several more degrees of cooling can be supplied to the building make-up air.

An IDEC system can reduce the size, or sometimes eliminate the need for mechanical air conditioning equipment. In either case IDEC systems significantly reduce electric power consumption.

For instance, a conventional air-cooled mechanical system utilizing a compressor consumes approximately 1.5 kilowatts per ton of cooling capacity. A Colmac IDEC system, however, typically consumes only 0.25 to 0.90 kilowatts per ton.

Under the most adverse conditions, the Colmac IDEC system can cut power consumption by 20%. When wet bulb temperatures are favorable, power costs can be significantly reduced even further. Additional savings can often be achieved during colder periods through the recovery of the heat in the exhaust air. Actual power cost reductions will vary with local weather conditions, power prices and power demand charges, but payback periods can be as low as one year.

COLMAC IDEC HEAT PIPE COIL SYSTEM

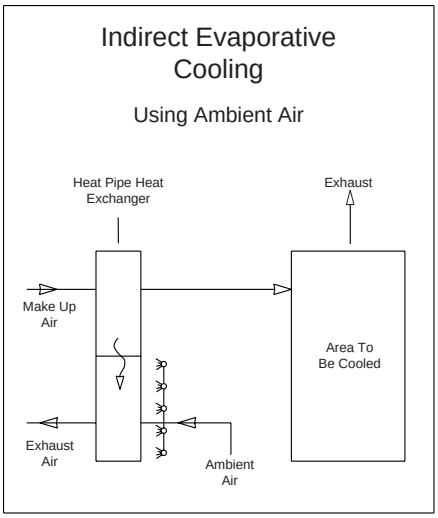


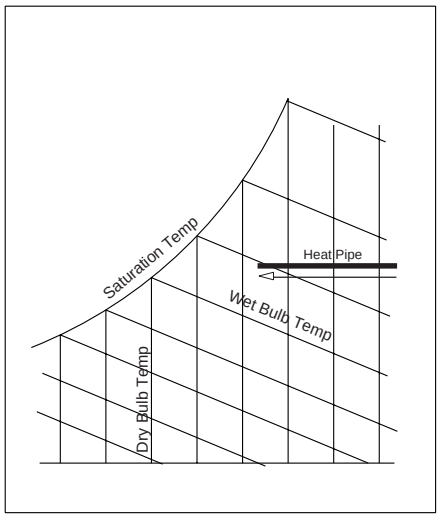
UTILIZING THE COLMAC IDEC HEAT PIPE COIL

There are three ways a Colmac IDEC heat pipe coil system can be utilized.

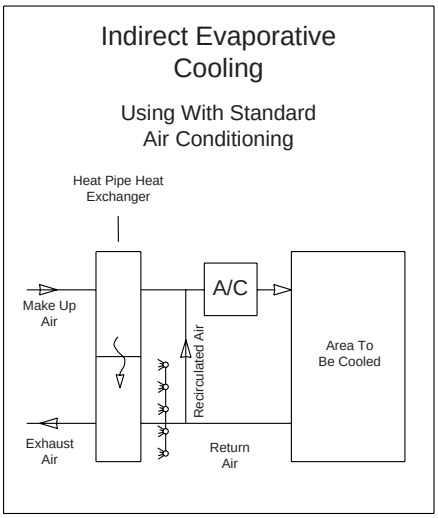
The first type of application is in an area that needs to be cooled 10 to 15 degrees without increasing the humidity, such as a manufacturing plant. In this situation, an IDEC system is connected to the area's ventilation ducts to lower the temperature of the incoming supply air. The same system can be used in the heating season to recover heat from exhaust air. The compactness and simplicity of the Colmac IDEC heat pipe coil system allows it to be installed easily, keeping first costs low.

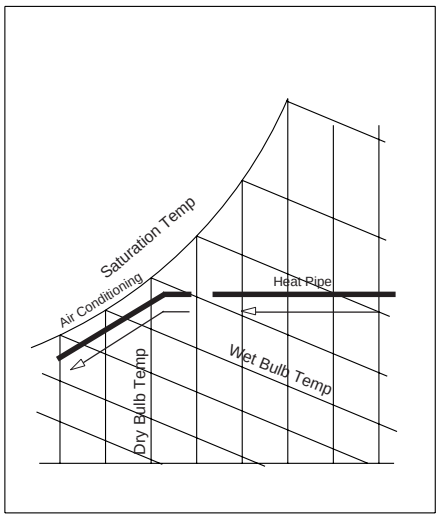
Operating costs are also low since a water supply and a small pump are all that is required. Pump motors are generally less than 1 hp and less than 1 gmp of water is evaporated.



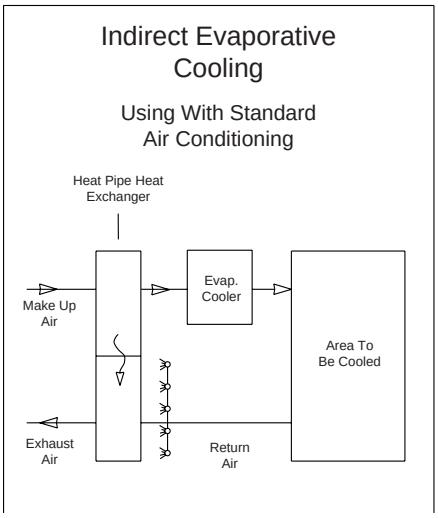


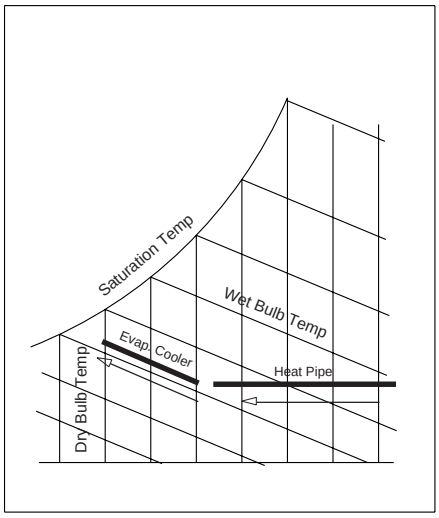
A second application combines a Colmac IDEC heat pipe coil system with conventional air conditioning. Conditioned building exhaust air is typically at 75 degrees with a relative humidity of 50%. The lower relative humidity of this air greatly increases its cooling potential. In this arrangement, most or all of the coolness of the exhaust air can be recaptured and supplied to the make-up air with a Colmac IDEC heat pipe coil system.





A third Colmac IDEC arrangement is commonly used in drier climates. This arrangement incorporates a Colmac IDEC heat pipe coil system with a direct evaporative cooler to cool the space as well as add moisture. Outside air first goes through the Colmac IDEC heat pipe coil system where it is cooled, and then is passed through the cooler where it is humidified and further cooled.





COLMAC HEAT PIPE COIL SPECIFICATIONS

1. General specifications

1.1 Furnish and install heat pipe coils for air-to-air heat exchanger types shown on the schedule, to be manufactured by Colmac Coil Manufacturing, Inc.

1.2 Heat pipe coils shall transfer heat between air streams flowing in a counter-flow arrangement.

1.3 Heat pipe coils shall be installed with 1/4-inch per foot tilt angle, hot end down, when used for heating and ventilating applications only or within 1/8-inch level end to end when used for heating, ventilating and cooling applications.

1.4 The heat pipe coil shall have no moving parts.

2. Construction

2.1 Heat pipes shall be constructed of 1-inch I.D. seamless, integrally finned aluminum tubing.

2.2 Heat pipes shall be arranged in the heat pipe coil with a maximum of 2-1/8 inches on center on the face and 1-7/8 inches on center row to row.

2.3 Heat pipe fin surface shall be integral to the heat pipe container wall and shall have a minimum of 0.017 inch mean fin thickness. Fins shall be tapered root to fin tip. Fin surface from the root to the fin tip shall have a minimum of 0.437 inches mean fin height.

2.4 Heat pipes shall have a capillary wick structure integral to the heat pipe container wall.

2.5 Heat pipes shall be of one piece construction. Two component heat pipes such as expanded tube to fin shall not be allowed.

2.6 Heat pipe working fluids shall be R-134a or be selected on the basis of heat pipe operating temperature and compatibility with heat pipe container material.

2.7 Heat pipes shall be individually processed, charged, hermetically sealed and factory tested.

2.8 Heat pipe coil structural frame shall be fabricated from a minimum of 16 gauge galvanized steel. The heat pipe coil shall be supplied with a minimum of 2-inch wide flanges on all four sides both front and back. Intermediate supports shall be furnished as required.

2.9 Heat pipe coils shall be provided with a partition to isolate the airstreams and prevent cross contamination. The partition shall be at the center unless otherwise specified. The partition shall be fabricated from a minimum of 16 gauge galvanized steel and shall extend beyond the finned surface with 4-inch flanges. Both front and back are to be flush with the frame.

2.10 End covers shall be provided to protect the heat pipe ends. End covers shall be fabricated from a minimum of 16 gauge galvanized steel.

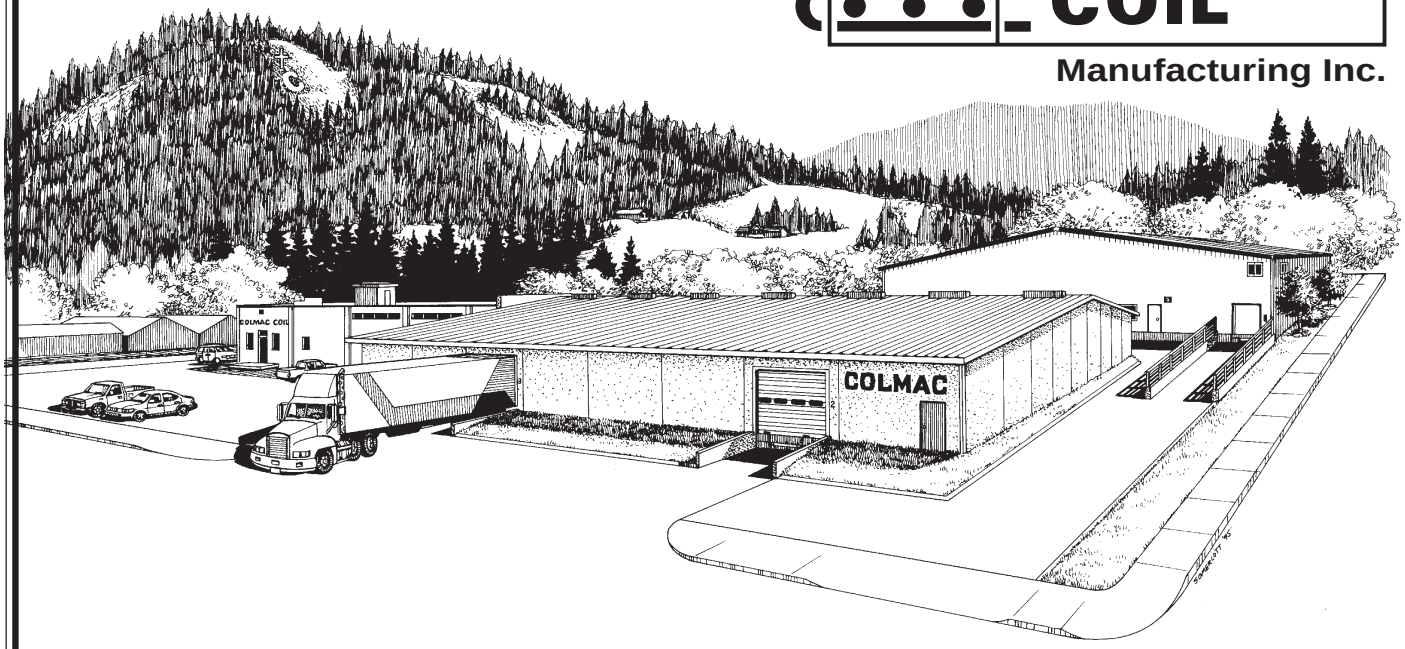
2.11 Heat pipe working fluids shall be classed as Group 1 in the American National Standard Code for Mechanical Refrigeration.

2.12 Additional specifications for other configurations available upon request.

NOTES

COLMAC COIL

Manufacturing Inc.



A Tradition of Quality

Colmac Coil was founded in 1971 and has been distinguished for its commitment to quality in the new and replacement coil markets with listings, certifications, and code markings such as ARI, ASME, UL, CSA, and CRN. Located in the Northwest USA, Colmac has grown to prominence as a trusted coil manufacturer with commercial/industrial heating & cooling, HVAC and refrigeration customers worldwide. Colmac has a network of over 250 factory representatives in over 80 sales offices around the world.

QUALITY COLMAC PRODUCTS

HEAT TRANSFER PRODUCTS

HVAC/Industrial/OEM

- Heating and Cooling Coils
- Fluid Coolers
- Heat Pipe Coils

HEAT PUMP WATER HEATERS

Commercial/Industrial

- Air-Source Heat Pump Water Heaters with Air Conditioning Benefit

REFRIGERATION PRODUCTS

Industrial/Commercial

- Evaporators - Air Coolers
- Air-Cooled Condensers
- Blast Freezers
- Tube Bundles
- Hydro Coolers
- Bunker Coils

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