TECH TIP #19

HOW DO YOU KEEP STEAM COILS FROM FREEZING?

Courtesy Coil Company–www.coilcompany.com

STEAM COILS TO HEAT AIR FROM SUB-FREEZING TEMPERATURES (BELOW 32°F)

When heating outdoor air from temperatures below 32°F, provision must be made to prevent freezing of the condensate in coil tubes.

Outdoor air may be as low as or lower than 20°F below zero and must be heated to 35° to 45° before being introduced to the reheat coil which will bring temperatures up to 160° to 180° for use for ventilation, comfort heating or process application range.

The design of the low temperature or preheat coil differs from that of the conventional or reheat coil in a number of ways. It should have inner steam tubes to carry the steam full length of the outer or finned tubes to prevent cold spots across coil face.

Preheat coil is the general term for coils handling air below 32°F and is designed to bring temperatures above 35°F before introduction of air to the reheat coil which raises temperature to 160° or 180°F range or higher.

If possible, the tubes in the preheat coil should be vertical to provide complete gravity drainage of condensate to the condensate header.

When use of vertical tubes is not practical due to height limitation, horizontal tubes with inner distributor tube are acceptable. Tubes, however, should be pitched ⅛" to ¼" per foot to condensate outlet for drainage.

For the general configuration of the horizontal and vertical tube preheat coil see drawings page 10. The steam chamber supplies steam to the inner tubes which have small orifice holes full length.

This supplies equal steam volume to the far end of the tube and prevents cold spots which could promote freeze-up.

The outer tube returns the hot condensate to the header condensate chamber for delivery to the condensate trap system and return to the boiler.

Use of distributor type (DT) preheat coils does not insure against coil freeze-up damage. Many factors such as pressure drop in coil, air in coil or plugged orifices in distributor tubes may all cause condensate to build up in tubes and freeze.

Accumulation of air and non-condensable gases in tubes may restrict flow of condensate and result in freeze-up and tube rupture.

Any time the pressure within a preheat coil falls below that in the return piping, condensate may build up in the tubes and freeze-up is imminent if air across coil is below 32°F. This condition may be corrected by a vacuum breaker to maintain coil above return line pressure.

Use of a vacuum pump on return main to hold return line pressure below coil pressure is most effective.

Do not discharge condensate from preheat coils into overhead return lines.

Always provide a strainer in steam line to distributor tube coils to protect the small orifice holes on inner tube from plugging due to scale and sediment.

An additional freeze-up prevention measure is the condensate temperature sensing hook-up shown on page 11.

Preheat coils are usually one row deep.

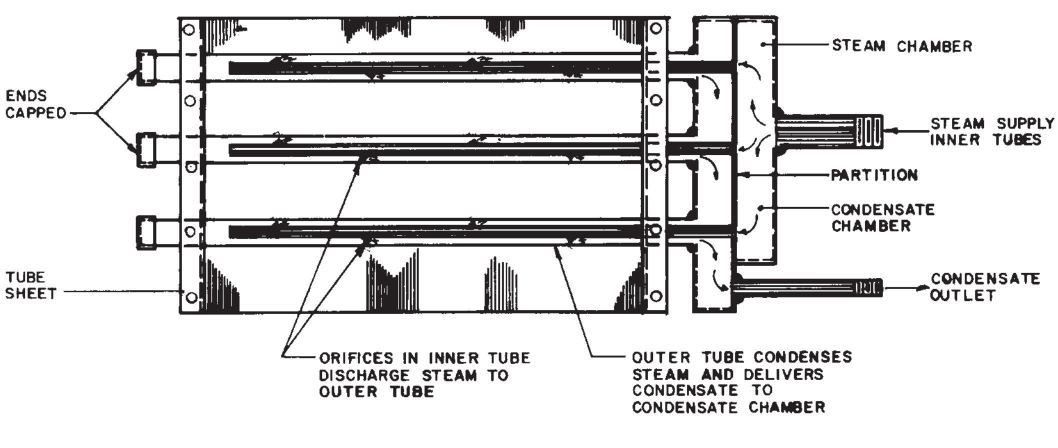
Reheat coils are generally two rows deep.

Air may be introduced to either side of steam coils since steam and condensate are theoretically at same temperature.

In many cases steam distributor coils (DT) are specified for temperatures above 32°F, particularly when fin length is over 60" and steam supply is modulated and steam at reduced pressure must be delivered to far end.

HORIZONTAL TUBE DT* STEAM COIL

Essential components of the (DT*) Steam Distributor coil.



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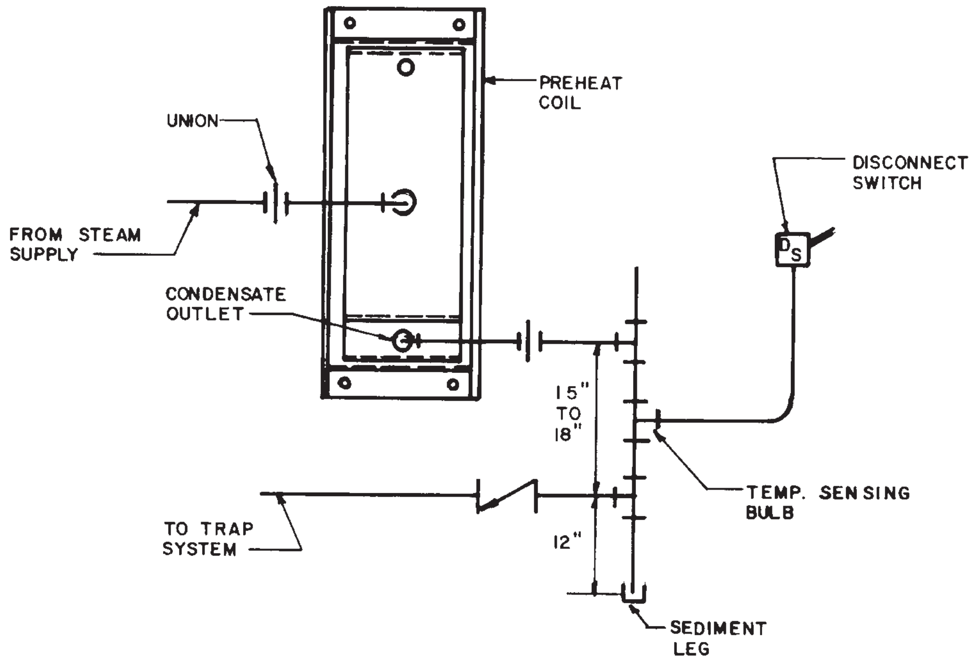
TECH TIP #19 (Cont.)

TYPICAL HOOK-UP FOR FREEZE PROTECTION OF PREHEAT STEAM COILS

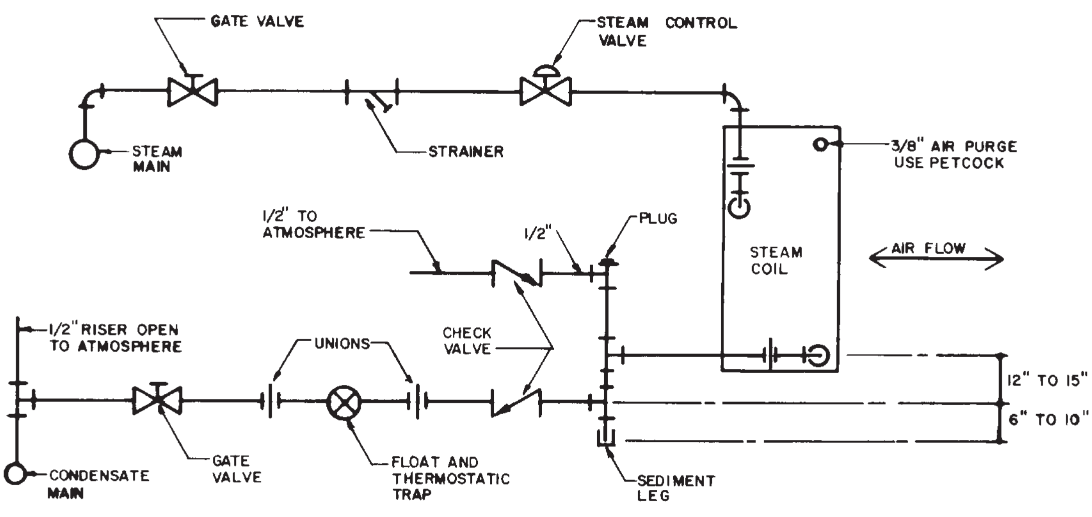


Temperature sensing bulb is located in Tee. Disconnect switch is used to control blower motor and close fresh air damper when condensate temperature drops below any set temperature between 45° and 60°F.

Use same hook-up for vertical tube coils.
See drawings for coil configuration on page 10.

COIL PIPING — LOW PRESSURE SYSTEM

For pressures of 0# Ga. to 15# Ga. corresponding to 212° to 250°F.



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TECH TIP #20

HOW CAN I SIZE A UNIT HEATER?

Copy these two pages for individual load calculations on jobs. Contact Federal for help.

Sterling Commercial / Industrial Heat Loss

This quick heat loss method will allow you to select a heating system for most applications in warehouses and factories. This form is for estimates only. For more accurate selection refer to the ASHRAE Handbooks.

1. Determine the inside temperature to be maintained and subtract the winter low temperature.
NOTE: Negative numbers should be added to inside temperature figures.

__________ - __________ = __________
inside temp. — winter low temp. — **design temp. (Δt)**

2. Figure the volume of the room in cubic feet and multiply by the number of air changes per hour. (Usually 1 to 2). Then divide by 55.

__________ x __________ x __________ ÷ 55 = __________
Volume in cu. ft. — Air Changes — design temp. (Δt) — **infiltration heat loss**

3. Calculate the square feet of wall area and multiply by the proper "U" factor from the Building Material Chart.

__________ x __________ x __________ = __________
sq. ft. of wall — "U" factor — Δt — **wall heat loss**

4. Calculate the square feet of window area and multiply by the proper "U" factor from the Building Material Chart.

__________ x __________ x __________ = __________
sq. ft. of windows — "U" factor — Δt — **window heat loss**

5. Calculate the square feet of door area and multiply by the proper "U" factor from the Building Material Chart.

__________ x __________ x __________ = __________
sq. ft. of doors — "U" factor — Δt — **door heat loss**

6. Calculate the square feet of ceiling area and multiply by the proper "U" factor from the Building Material Chart.

__________ x __________ x __________ = __________
sq. ft. of ceiling — "U" factor — Δt — **ceiling heat loss**

7. Add all heat loss figures. (2,3,4,5 & 6)

____
total BTUH output

8. Divide by .80 for BTUH input required.

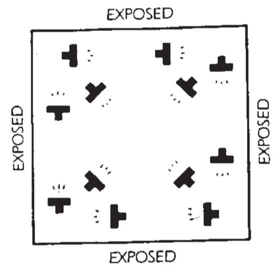
__________ ÷ .80 = __________
total BTUH output — steady state efficiency — **BTUH input required**

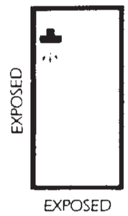
Building Material	"U" Factor
WALLS	
Poured concrete 80#/cu. ft.	
8-inch	0.25
12-inch	0.18
Concrete Block, hollow cinder aggregate	
8-inch	0.39
12-inch	0.36
Gravel aggregate	
8-inch	0.52
12-inch	0.47
Concrete Block, w/4-inch facebrick	
Gravel, 8-inch	0.41
Cinder, 8-inch	0.33
Metal	
(un-insulated)	1.17
w/1-inch blanket insulation	0.22
w/3-inch blanket insulation	0.08
ROOFING	
Corrugated Metal (un-insulated)	1.50
w/1-inch bolt or blanket	0.23
w/1 1/2-inch bolt or blanket	0.16
w/3-inch bolt or blanket	0.08
Flat Metal	
w/3/8-inch built-up roofing	0.90
w/1-inch blanket insulation under deck	0.21
w/2-inch blanket insulation under deck	0.12
Wood/ 1" /	
(un-insulated) w/ 3/8-inch built-up roofing	0.48
w/1-inch blanket insulation	0.17
Wood/ 2" /	
(un-insulated) w/3/8-inch built-up roofing	0.32
w/1-inch blanket insulation	0.15
Concrete slab/ 2" /	
(un-insulated) w/3/8-inch built-up roofing	0.30
w/1-inch insulation board	0.16
Concrete slab/ 3" /	
(un-insulated) w/3/8-inch built-up roofing	0.23
w/1-inch insulation board	0.14
Gypsum slab/ 2" /	
(un-insulated) w/1/2-inch gypsum board	0.36
w/1-inch insulation board	0.20
Gypsum slab/ 3" /	
(Un-insulated) w/1/2-inch gypsum board	0.30
w/1-inch insulation board	0.18
WINDOWS	
Vertical, single-glass	1.13
Vertical, double-glass, 3/16- inch air space	0.69
Horizontal, single-glass (sky light)	1.40
DOORS	
Metal — single sheet	1.20
Wood, 1-inch	0.64
2-inch	0.43

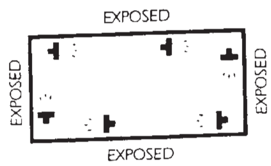
TECH TIP #20 (Cont.)

Choosing the Mounting Height

Unit heaters should be mounted no lower than 8 feet above the floor. Units smaller than 100,000 btuh should be mounted no higher than 12'. For larger units mounted higher than 15', downturn nozzles should be considered.







Approximate Throw of Standard Propeller Unit Heaters

mounting height	Size Unit - BTU Input x 1000													
	30	45	60	75	100	125	150	175	200	225	250	300	350	400
8'	33	33	33	40	60	65	70	75	80	85	90	105	110	120
10'	28	28	28	35	54	56	60	64	68	72	78	90	95	100
12'					44	46	49	57	61	65	68	80	84	90
15'							45	49	52	56	60	70	74	80
20'									46	50	54	63	66	70

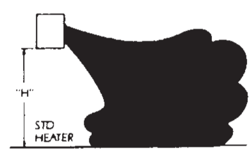
Positioning Unit Heaters

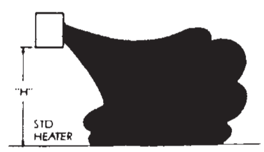
Using several smaller units rather than a few large large units creates more even heating. Position heaters to set up a directional air flow and insure that the entire room gets heat. Concentrate discharge air along cold exposed walls.

Unit heaters throw should be overlapped by 20% to insure even heating. Consider barriers, like shelves, boxes machinery or fixtures, which interrupt air flow. Avoid direct air discharge on occupants.

__________ / __________ x 1.2 = __________

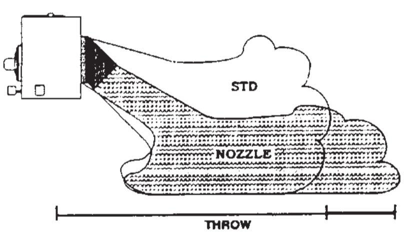
ft. of perimeter wall / throw of selected units / number of units required





Using Downturn Nozzles

When using the above throw chart consider mounting height and the resulting air throw of the unit. The drawing shows the effect of using a downturn nozzle to extend throw. Nozzles overcome some of the problem with high mounting requirements and recover some heated air that has risen to the ceiling. As a rule of thumb 30° nozzles extend unit heater throw 5%, 45° nozzles add 10%, and 60° nozzles add 20%.



Our 90° nozzles can direct air down from heights up to 30'. Typically they help block entry of cold air at large doors. For unusually high mounting positions push warm air to the floor, using a 2 stage thermostat to first run 'fan only' then bring on the burner as the second stage.

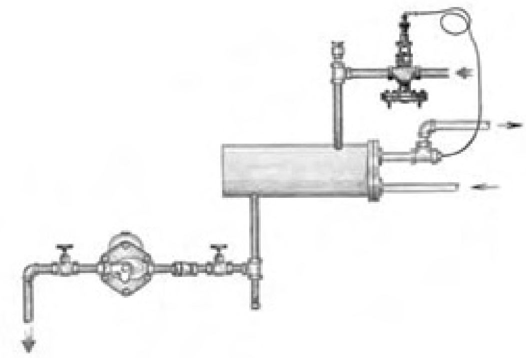
The wye splitter sends warm air in two directions. It can overcome obstructions such as rows of shelving or machines, directing heat to two areas. Using the wye a single Beacon/Morris unit heater can provide cover from two bay doors.

Using Blower Units

Blower unit heaters must be used anywhere ducts are connected to a unit heater. Beacon/Morris blower unit heaters can provide static pressures up to .2" WC. Blower units also offer sound reductions of 5 to 15% over comparable prop units.

Unit heaters should never be installed within corrosive or flammable atmospheres. Areas that contain halogenated hydrocarbons, such as chlorine, shorten heater life and void your warranty. These spaces may be heated by ducting warm air from a unit heater located in a safe, non-contaminated, adjacent area.

TECH TIP #21



WATER HAMMER IN STEAM-TO-WATER HEAT EXCHANGERS

When steam is the heating medium in a shell and tube heat exchanger, it is important that the condensate be immediately removed from the steam space. If condensate, which has cooled below the steam temperature, is trapped in the shell of the exchanger and hot steam enters during opening of the control valve water hammer will occur. Water hammer pressures can exceed 2000 psi, even in an exchanger where the steam pressure is less than 15 psi. Obviously the thin wall of the copper tubes are not designed to take this kind of hammering. Failures in the tubing will result if this problem is not corrected quickly.

We will not attempt to explain in detail all the possible reasons for water hammer; but here are the most likely suspects if you hear the tubes banging.
Condensate can remain in the shell (or tubes if steam is inside the tubes) of a heat exchanger as a result of:

1. Improperly sized steam trap. It is critical that the trap be sized for the worst case differential pressure, which is more than likely the normal operating pressure with a modulating control valve.

2. Improperly sized condensate return line, either out of the steam space or downstream of the steam trap.

3. No steam side vacuum breaker. Sometimes you will see a swing check valve installed so that a vacuum will pull the flapper back to the heat exchanger to allow air into break the vacuum. Vacuum problems are notorious for causing tube bundle failures.

4. Incorrect elevation of the unit in relation to the main condensate return line. In layman's terms, the outlet of the trap must flow downhill at all times into the condensate return pump or main condensate return line. NO UPSIDE DOWN P-TRAPS WILL WORK!!!!

5. A quick closing control valve (especially solenoid valves) or a pump that stops can cause a sudden reversal of flow in the piping.

ADVANCED TECHTIPS...If you hear a loud banging like a steel hammer on bare steel pipe in your steam (or water piping) system don't ignore it. The longer you wait, the more expensive it will be to repair or the more severely someone will get hurt. We can provide in house training on water hammer elimination or even send you to school at our premier steam system trainer, Spirax Sarco, right in the factory!

TECH TIP #22

Table is based on formula:
Q = 1.28 x A x (D)²

CAPACITY OF ROUND TANKS

Dia.	Gals.	Area Sq. Ft.	Diam.	Gals.	Area Sq. Ft.	Diam.	Gals.	Area Sq. Ft.	Diam.	Gals.	Area Sq. Ft.
1'	5.87	.785	4'	94.00	12.566	11'	710.90	95.03	22'	2843.60	380.13
1' 1"	6.89	.922	4' 1"	97.96	13.095	11' 3"	743.58	99.40	22' 3"	2908.60	388.82
1' 2"	8.00	1.069	4' 2"	102.00	13.635	11' 6"	776.99	103.87	22' 6"	2974.30	397.61
1' 3"	9.18	1.227	4' 3"	106.12	14.186	11' 9"	811.14	108.43	22' 9"	3040.80	406.49
1' 4"	10.44	1.396	4' 4"	110.32	14.748	12'	846.03	113.10	23'	3108.00	415.48
1' 5"	11.79	1.576	4' 5"	114.61	15.321	12' 3"	881.65	117.86	23' 3"	3175.90	424.56
1' 6"	13.22	1.767	4' 6"	118.97	15.90	12' 6"	918.00	122.72	23' 6"	3244.60	433.74
1' 7"	14.73	1.969	4' 7"	123.42	16.50	12' 9"	955.09	126.78	23' 9"	3314.00	443.01
1' 8"	16.32	2.182	4' 8"	127.95	17.10	13'	992.91	132.73	24'	3384.10	452.39
1' 9"	17.99	2.045	4' 9"	132.56	17.72	13' 3"	1031.50	137.89	24' 3"	3455.00	461.86
1' 10"	19.75	2.640	4' 10"	137.25	18.35	13' 6"	1070.80	142.14	24' 6"	3526.60	471.44
1' 11"	21.58	2.885	4' 11"	142.02	18.99	13' 9"	1110.80	148.49	24' 9"	3598.90	481.11
2'	23.50	3.142	5' 8"	188.66	25.22	14'	1151.50	153.94	25'	3672.00	490.87
2' 1"	25.50	3.409	5' 9"	194.25	25.97	14' 3"	1193.00	159.48	25' 3"	3745.80	500.74
2' 2"	27.58	3.687	5' 10"	199.92	26.73	14' 6"	1235.30	165.13	25' 6"	3820.30	510.71
2' 3"	29.74	3.976	5' 11"	205.67	27.49	14' 9"	1278.20	170.87	25' 9"	3895.60	527.77
2' 4"	31.99	4.276	6"	211.51	28.27	15'	1321.90	176.71	26'	3971.60	530.93
2' 5"	34.31	4.587	6' 3"	229.50	30.68	15' 3"	1366.40	182.65	26' 3"	4048.40	541.19
2' 6"	36.72	4.909	6' 6"	248.23	35.18	15' 6"	1411.50	188.69	26' 6"	4125.90	551.55
2' 7"	39.21	5.241	6' 9"	267.69	35.78	15' 9"	1457.40	198.83	26' 9"	4204.10	562.00
2' 8"	41.78	5.585	7"	287.88	38.48	16'	1504.10	201.06	27'	4283.00	572.66
2' 9"	44.43	5.940	7' 3"	308.81	41.28	16' 3"	1551.40	207.39	27' 3"	4362.70	583.21
2' 10"	47.16	6.305	7' 6"	330.48	44.18	16' 6"	1599.50	213.82	27' 6"	4443.10	593.96
2' 11"	49.98	6.681	7' 9"	352.88	47.17	16' 9"	1648.40	220.35	27' 9"	4524.30	604.81
3'	52.88	7.069	8'	376.01	50.27	19'	2120.90	283.53	28'	4606.20	615.75
3' 1"	55.86	7.467	8' 3"	399.80	53.46	19' 3"	2177.10	291.04	28' 3"	4688.80	626.80
3' 2"	58.92	7.876	8' 6"	424.48	56.75	19' 6"	2234.00	298.65	28' 6"	4772.10	637.94
3' 3"	62.06	8.296	8' 9"	449.82	60.13	19' 9"	2291.70	306.35	28' 9"	4856.20	649.18
3' 4"	65.28	8.727	9'	475.89	63.62	20'	2350.10	314.16	29'	4941.00	660.52
3' 5"	68.58	9.168	9' 3"	502.70	67.20	20' 3"	2409.20	322.06	29' 3"	5026.60	671.96
3' 6"	71.97	9.621	9' 6"	530.24	70.88	20' 6"	2469.10	330.06	29' 6"	5112.90	683.49
3' 7"	75.44	10.085	9' 9"	558.51	74.66	20' 9"	2529.60	338.16	29' 9"	5199.90	695.13
3' 8"	78.99	10.559	10'	587.52	78.54	21'	2591.00	346.36	30'	5287.70	706.86
3' 9"	82.62	11.045	10' 3"	617.26	82.52	21' 3"	2653.00	354.66	30' 3"	5376.20	718.69
3' 10"	86.33	11.541	10' 6"	640.74	86.59	21' 6"	2715.80	363.05	30' 6"	5465.40	730.62
3' 11"	90.13	12.048	10' 9"	678.95	90.76	21' 9"	2779.30	371.54	30' 9"	5555.40	742.64

To find the capacity of tanks greater than shown above, find a tank of one-half the size desired, and multiply its capacity by four, or find one one-third the size desired and multiply its capacity by 9.

TECH TIP #23

WATER VOLUME IN A PIPING SYSTEM

To calculate the volume of water in a hydronic system, list the length of pipe in a system by size. Divide the length by the factor to calculate volume. Example: Find the water volume in 200' of 4" steel pipe.

Volume = 200 ft. / 1.5 ft per gallon = 133 gallons

VOLUME OF WATER IN PIPE
LINEAL FEET PER GALLON

Size	Steel	Copper
½"	63.5	82.5
¾"	36.0	40.0
1"	22.2	23.3
1¼"	12.8	15.3
1½"	9.5	10.8
2"	5.8	6.2
2½"	4.0	4.0
3"	2.6	2.8
4"	1.5	1.6
5"	1.0	1.0
6"	.7	.7

TECH TIP #24

SWIMMING POOL HEATING

Heating a swimming pool can be an ongoing maintenance headache, unless a few rules are followed closely. We have recapped a few of the rules that we have determined over the years.

1. Make sure that the chlorine is added to the system on the downstream side of the heating source (either a pool boiler or heat exchanger), sand filters, and pumping equipment. The chemicals are injected into the line at high concentrations and this heavily concentrated solution must have a chance to dilute before it goes into the equipment. Typically this insertion takes place just before reentry into the pool.

2. Since most pools are held a temperature about 82° F, it is very important that a procedure be in place to make sure that the inlet water temperature to any gas fired pool heater never falls below 105° F. 105° F is the condensing temperature for a typical copper finned tube type of pool heater. Failure to keep the inlet water temperature above the condensing temperature will cause the flue gases to condense and the subsequent water will drip onto the heat exchanger causing corrosion. This corrosive acid can eat through a heat exchanger in a matter of a few weeks...and will most likely void the pool heater warranty. Consult with our boiler experts for how to prevent the problem.

3. When using a steam source in a heat exchanger to heat the pool heater, a few very important construction details need to be followed in the materials used in the heat exchanger. The tubesheet needs to be either a solid brass or alternative material to combat the common problem of galvanic corrosion between the typical steel tubesheet and copper tubing.

ADVANCED TECHTIP...Contact our office for further information and possibly a jobsite visit if needed. Pool heaters can be very troublesome...let us help you get off to a good start on your next pool job, or help you correct deficiencies in a current system.

TECH TIP #25

HOW TO ORDER PARTS FOR VALVES, PUMPS, ETC.

More valuable time is wasted on both ends of the phone by not having complete and correct information when calling to check on repair parts. Here're a few pointers on what is normally required to get the correct parts and where to typically find the information.

CONTROL VALVES...Most HVAC valves will have a brass tag on the neck of the valve. Sometimes it is under valve insulation. Remember to get the information off the actuator. Many of us have experience in "backtracking" into the control valve, but all the information you can collect will help us figure out what that tagless valve is.

PUMPS...Most pumps will have a nameplate mounted on the pump itself, usually near the top of the pump volute. Write down all the information off the tag, because we sometimes have to read between the lines. Frequently we are given the info off the motor on the pump. Nine times out of ten the motor info will not be of any help in identifying pump parts. The exception to the motor information is to make sure you have the Hp, voltage, rpm, phase and enclosure. If the tag is missing, measure the pump suction and discharge sizes and with the above motor info we can often figure a new pump.