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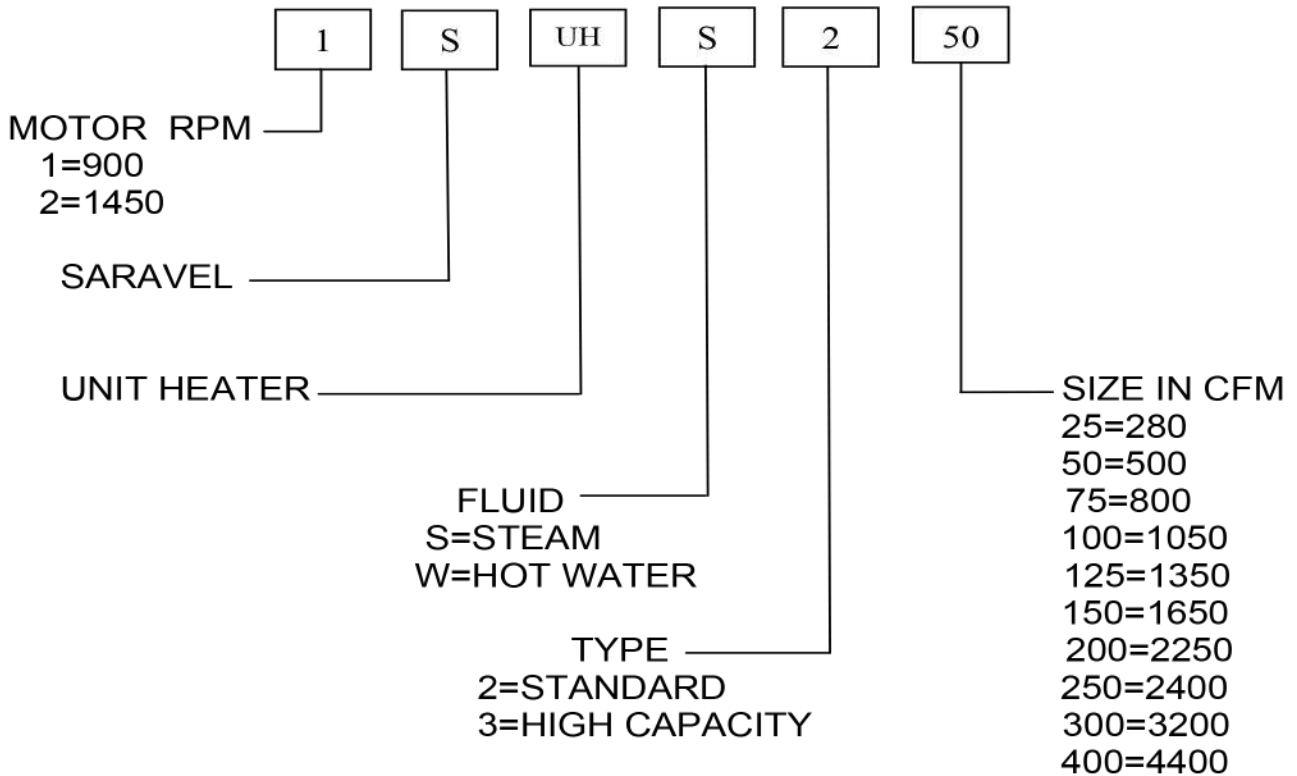


**SARAVEL
UNIT HEATERS**



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NOMENCLATURE





SARAVEL unit heaters may be selected for hot water, steam, or hot oil applications, from 10 different models in two categories namely:

- 1) STANDARD
- 2) HIGH CAPACITY.

With these features SARAVEL unit heaters cover the entire range of commercial, industrial, and institutional applications with a wide choice of capacities which permit tremendous versatility in design and engineering application.

Units are designed for optimum air throw through individually adjustable louvers to permit altering the direction of air flow. The provisions for lifting and hoisting the units also serve as installation features. The unit casing can be easily dismantled allowing access to the coil for cleaning purposes. In addition the following design features are incorporated into the construction of SARAVEL unit heaters:

UNIT CASING

Unit casing is fabricated from heavy gage galvanized steel sheet and finished with air dried hammer paint.

Choice of casing materials includes brass, aluminum, and stainless steel.

COILS

Standard models feature seamless 5/8" O.D. seamless Copper tube expanded into die-formed aluminum fin plates.

Standard models are recommended for hot water applications with temperatures not exceeding 130 °C and steam applications with pressures less than 30PSIG up to 200 PSIG.

Choices of aluminum or copper fins are offered in spiral or fin plate form.

FANS

All fans are direct driven propeller type fabricated of aluminum or galvanized steel sheets. All fan blades are statically balanced. Fan blades are situated in a drawn.

MOTORS

Electric motors are 3 phase-380V-50Hz or single phase220V-50Hz available at 1450 RPM or 950 - RPM. Spark proof motors are offered as optional items for applications where flammable or volatile gases might leak into the area. Collar which allows uniform air intake and distribution onto the coils.

**UNIT HEATER SELECTION****Steam Application**

An industrial building is 150ft (45.7m) long, 75ft (22.9m) wide, and 30ft (9.1m) high. The heat loss through the walls, roof, floor and windows is 350,000 BTU/hr. The following are the given design data:

Indoor Temperature..... 70 °F

Outdoor Temperature..... 30 °F

Entering Air Temperature..... 40 °F

Steam pressure available..... 5 psig

Building exhaust..... 20,000 CFM

Find the volume of the building in ft³ using the following formula:

$$ft^3 = LWH$$

Where L = building length, ft; W = building width, ft; H = building height ft. Therefore:

$$\text{Volume} = 150 \times 75 \times 30 = 337,500 \text{ ft}^3$$

The heat loss caused by infiltration can be determined by estimating the air changes per hour (ft³/hr) caused by leakage of air into and out of the building.

Typically for industrial buildings one or two air changes is common. It can be supposed that one air change takes place, thus the heat required to raise the temperature of the infiltration air, H_i, from 30 °F to 70 °F can be calculated with the following formula:

$$H_i = \frac{ft^3/hr}{55} \times (\Delta T)$$

$$H_i = \frac{337,500(70 - 30)}{55} = 245,000 \text{ BTU/hr}$$

The total heat loss, H_t, without exhaust ventilation for this building is:

$$H_t = 350,000 + 245,000 = 595,000 \text{ BTU/hr}$$

When air is exhausted from a building, an equivalent amount of air must be supplied by infiltration or ventilation. In either case, an amount of air equal to that exhausted must be heated from the outside temperature. With an exhaust rate of 20,000 CFM, the heat required, H_e, is:

$$H_e = \frac{60 \times 20,000(70 - 30)}{55} = 873,000 \text{ BTU/hr}$$

Where H_e is the heat required to raise the temperature of the air that replaces the exhaust air.

To determine the total heat loss from a building when both infiltration and exhaust occur, add the larger of the

Two heat requirements infiltration or exhaust-to the heat loss caused by transmission through the building walls and roof. Since in this building, H_e > H_i therefore.

$$HT = 350,000 + 873,000 = 1,223,000 \text{ BTU/hr}$$

The standard ratings for SARAVEL unit heaters are based on 30 psig steam and 60 °F entering air temperature. Using the correction factor* of 0.873 for steam at 40 °F entering air and 5 psig steam from TABLE 9 the converted heating capacity is:

$$HT = \frac{1,223,000}{0.873} = 1,400,000 \text{ BTU/hr}$$

Suppose 6 units are to be installed, the heating load per unit is:

$$1,400,000 / 6 \text{ units} = 233,000 \text{ BTU/hr}$$

From the ratings table for Steam unit heaters in TABLE 4, select 2SUH S2-300 which has a capacity of 264500 BTU/hr at 5 psig steam pressure which can adequately match the heating load per unit.

***Correction Factor Note:**

If the entering air temperature is the standard 60 °F and the steam pressures available are 5, 15, and 30 psig, correction factor need not be applied. The unit ratings can be read directly from TABLE 4.

CFM @ 60° F

Since standard ratings are based on 60 °F entering air temperature, in order to obtain the CFM delivery in this case for 40 °F entering air temperature, a CFM correction factor should be applied. Enter TABLE 11 at 40 °F entering air temperature to read the CFM correction factor.

CFM correction factor from TABLE 11 = 1.04

Basic CFM from TABLE 4 = 3200

$$\text{CFM}@40^\circ\text{F} = 3200 \times 1.04 = 3328$$

Calculate the final air temperature

The final air temperature can be obtained by the following equation:

$$\text{Inlet air temp.} + \frac{\text{Converted BTU rating}}{\text{CFM}@60^\circ\text{F} \times 1.085} = \text{Final temp}$$

$$40^\circ\text{F} + \frac{264500 \times 0.873}{3328 \times 1.085} = 104^\circ\text{F}$$



Calculate the amount of condensate formed

To determine the rate of condensate formation per unit, multiply the rated capacity by the steam correction factor found previously and divide by the latent heat of steam at the given pressure

$$\text{Condensate (lb/hr)} = (264500 \times 0.873) / 960.54 = 240 \text{ lb/hr}$$

UNIT HEATER SELECTION

Hot Water Application

Select a hot water unit heater to deliver 100 MBH with the following design conditions:

- Total heating load.....100MBH
- Entering Water Temp., (EWT).....200 °F
- Entering Air Temp., (EAT).....50 °F
- Space Design Temp.70 °F
- Water Temperature Drop, (DT)..... 20 °F

Determine GPM:

$$\text{GPM} = \frac{BTU / hr}{500\Delta T}$$

$$= \frac{100,000}{500 \times 20} = 10\text{GPM}$$

The ratings for SARAVEL hot water unit heaters are based on the standard condition of 60 °F EAT and 180 °F EWT, any condition other than such necessitates the use of appropriate correction factors. From TABLE 10 under 50 of EAT and 200 °F EWT, the correction factor is 1.265.

Determine equivalent load at standard condition (600 FEAT, 1800 F EWT):

$$\frac{100,000}{1.265} = 79,000 \text{ BTU / hr}$$

Select the unit at the equivalent load and calculated GPM by referring to TABLE 1. The selection indicates a Model 1SUHW2-150. Next determine the BTU/ hr at 10 GPM, and multiply the resulting BTU/hr by the correction factor:

$$77500 \times 1.265 = 98038 \text{ BTU/hr}$$

The GPM remains constant.

Calculate the water temperature drop

$$\Delta T = \frac{BTU / hr}{GPM \times 500} = \frac{98038}{10 \times 500} = 19.5^\circ \text{F}$$

Calculate the pressure drop

The pressure drop at 10GPM can be determined in TABLE 1 as 0.2 feet of water.

Calculate the final air temperature

CFM correction factor TABLE 11 = 1.02

Basic CFM from TABLE 1 = 1650

$$\text{CFM@60 °F} = 1650 \times 1.02 = 1683$$

$$\text{Inlet air temp.} + \frac{\text{converted BTU rating}}{\text{CFM @ 60 °F} \times 1.085} = \text{Final temp.}$$

$$50^\circ \text{F} + \frac{98038}{1683 \times 1.085} = 104^\circ \text{F}$$



6 STANDARD MODEL-HOT WATER RATINGS

TABLE 1. HOT WATER UNIT HEATER RATINGS-900 RPM

180 °F ENTERING WATER AND 60 °F ENTERING AIR						
Model No. HP (KW)	LOAD BTU/Hr (KW)	CFM (M3/Hr)	WATER FLOW GPM (LPM)	FINAL AIR TEMP. °F (°C)	WATER TEMP DROP °F (°C)	PRESSURE DROP Ft.H2O (m.H2O)
1SUHW2-25 1/10 (0.07)	19500(5.6)	280 (475)	5(19)	125(52)	8(4)	0.1(0.03)
	20500(5.9)		7(27)	128(53)	6(3)	0.2(0.06)
	21000(6.1)		9(34)	130(55)	5(3)	0.3(0.10)
1SUHW2-50 1/6 (0.124)	30000(8.7)	500 (850)	5(19)	114(46)	12(7)	0.1(0.03)
	32000(9.2)		8(30)	119(48)	8(4)	0.3(0.10)
	33000(9.6)		10(38)	121(50)	7(4)	0.4(0.12)
1SUHW2-100 1/4 (0.18)	54500(15.8)	1050 (1780)	8(30)	108(42)	14(8)	0.2(0.06)
	58000(16.8)		11(42)	111(44)	11(6)	0.3(0.10)
	60000(17.4)		14(53)	113(45)	9(5)	0.5(0.15)
1SUHW2-150 1/4 (0.18)	77500(22.5)	1650 (2800)	10(38)	103(40)	16(9)	0.2(0.06)
	83000(24.0)		14(53)	106(41)	12(7)	0.4(0.12)
	86500(25.0)		18(68)	108(42)	10(6)	0.5(0.15)
1SUHW2-250 1/4 (0.18)	112500(32.6)	2400 (4075)	12(45)	103(40)	19(11)	0.2(0.06)
	116500(33.8)		14(53)	105(41)	17(10)	0.4(0.90)
	122000(35.3)		18(68)	107(42)	14(8)	0.4(0.12)

TABLE 2. HOT WATER UNIT HEATER RATINGS-1450 RPM

180 °F ENTERING WATER AND 60 °F ENTERING AIR						
Model No. HP (KW)	LOAD BTU/Hr (KW)	CFM (M3/Hr)	WATER FLOW GPM (LPM)	FINAL AIR TEMP. °F (°C)	WATER TEMP DROP °F (°C)	PRESSURE DROP Ft.H2O (m.H2O)
2SUHW2-75 1/4 (0.18)	136000(10.5)	800 (1360)	5(19)	102(39)	15(8)	0.1(0.03)
	39000(11.3)		7(27)	105(41)	11(6)	0.2(0.06)
	41500(12.0)		10(38)	108(42)	9(5)	0.4(0.12)
2SUHW2-125 1/2 (0.37)	63500(18.4)	1350 (2290)	8(30)	103(40)	16(9)	0.2(0.06)
	68000(19.7)		11(42)	106(41)	13(7)	0.3(0.10)
	70500(20.4)		14(53)	108(42)	10(6)	0.3(0.10)
2SUHW2-200 1/2 (0.37)	102000(29.5)	2250 (3820)	9(34)	102(39)	23(13)	0.1(0.03)
	109500(31.7)		12(45)	105(41)	19(11)	0.2(0.06)
	115000(33.3)		15(57)	107(42)	16(9)	0.3(0.10)
2SUHW2-300 3/4 (0.55)	147000(42.6)	3200 (5435)	14(53)	102(39)	22(12)	0.2(0.06)
	153500(44.5)		17(64)	104(40)	19(11)	0.3(0.10)
	158500(45.9)		20(76)	106(41)	16(9)	0.4(0.12)
2SUHW2-400 3/4 (0.55)	198000(57.4)	4400 (7470)	18(68)	101(38)	23(13)	0.2(0.06)
	205000(59.4)		21(79)	103(40)	20(11)	0.3(0.10)
	211000(61.1)		24(91)	104(40)	18(10)	0.4(0.12)



STANDARD MODEL-STEAM RATINGS

TABLE 3. STEAM UNIT HEATER RATINGS-900RPM

60 °F ENTERING AIR					
Model No. HP (KW)	LOAD BTU/Hr (KW)	CFM (M3/Hr)	STEAM PRESSURE PSIG (Bar)	FINAL TEMP °F (°C)	CODENSATE Lbs./Hr (Kg/Hr)
1SUHS2-25 1/10 (0.07)	36300(10.6)	280 (475)	30(2.0)	179(82)	39(18)
	39600(11.6)		45(3.0)	190(88)	43(20)
	42200(12.4)		60(4.0)	199(93)	47(21)
1SUHS2-50 1/6 (0.124)	57300(16.8)	500 (850)	30(2.0)	166(74)	62(28)
	62400(18.3)		45(3.0)	175(79)	68(31)
	66600(19.5)		60(4.0)	183(84)	73(33)
1SUHS2-100 1/4 (0.18)	105900(31.0)	1050 (1780)	30(2.0)	153(67)	114(52)
	115300(33.8)		45(3.0)	161(72)	126(57)
	123100(36.1)		60(4.0)	168(76)	136(62)
1SUHS2-150 1/4 (0.18)	141200(41.4)	1650 (2800)	30(2.0)	139(59)	152(69)
	153700(45.1)		45(3.0)	146(63)	167(76)
	164100(48.1)		60(4.0)	152(67)	181(82)
1SUHS2-250 1/4 (0.18)	225800(66.2)	2400 (4075)	30(2.0)	147(64)	243(110)
	245800(72.0)		45(3.0)	154(68)	268(122)
	262400(76.9)		60(4.0)	161(72)	289(131)

TABLE 4. STEAM UNIT HEATER RATINGS-1450RPM

60 °F ENTERING AIR					
Model No. HP (KW)	LOAD BTU/Hr (KW)	CFM (M3/Hr)	STEAM PRESSURE PSIG (Bar)	FINAL TEMP °F (°C)	CODENSATE Lbs./Hr (Kg/Hr)
2SUHS2-75 1/4 (0.187)	74700(21.9)	800 (1360)	30(2.0)	146(63)	80(36)
	81300(23.8)		45(3.0)	154(68)	89(40)
	86800(25.4)		60(4.0)	160(71)	96(43)
2SUHS2-125 1/2 (0.37)	126800(37.2)	1350 (2290)	30(2.0)	146(63)	136(62)
	138000(40.4)		45(3.0)	154(68)	150(68)
	147300(43.1)		60(4.0)	160(71)	162(73)
2SUHS2-200 1/2 (0.37)	217900(63.9)	2250 (3820)	30(2.0)	149(65)	234(106)
	237200(69.5)		45(3.0)	157(69)	259(117)
	253300(74.2)		60(4.0)	164(73)	279(127)
2SUHS2-300 3/4 (0.55)	298100(87.3)	3200 (5435)	30(2.0)	146(63)	321(146)
	324500(95.1)		45(3.0)	153(67)	354(161)
	346400(101.5)		60(4.0)	160(71)	382(173)
2SUHS2-400 3/4 (0.55)	403900(118.4)	4400 (7470)	30(2.0)	145(63)	434(197)
	439700(128.9)		45(3.0)	152(67)	479(217)
	469400(137.6)		60(4.0)	158(70)	517(234)



8 HIGH CAPACITY MODEL-HOT WATER RATINGS

TABLE 5. HOT WATER UNIT HEATER RATINGS-900 RPM

180 °F ENTERING WATER AND 60 °F ENTERING AIR						
Model No. HP (KW)	LOAD BTU/Hr (KW)	CFM (M3/Hr)	WATER FLOW GPM (LPM)	FINAL AIR TEMP. °F (°C)	WATER TEMP DROP °F (°C)	PRESSURE DROP Ft.H2O (m.H2O)
1SUHW3-25 1/10 (0.07)	26000(7.5)	280 (475)	7(27)	146(63)	8(4)	0.2(0.06)
	27000(7.8)		9(34)	148(64)	6(3)	0.3(0.10)
	27500(8.0)		11(42)	150(66)	5(3)	0.4(0.12)
1SUHW3-50 1/6 (0.124)	41000(11.8)	500 (850)	7(27)	136(58)	12(7)	0.2(0.06)
	42500(12.3)		9(34)	139(60)	10(6)	0.3(0.10)
	44000(12.7)		11(42)	141(61)	8(4)	0.4(0.12)
1SUHW3-100 1/4 (0.18)	74000(21.5)	1050 (1780)	8(30)	125(52)	19(11)	0.2(0.06)
	79000(23.0)		11(42)	129(54)	15(8)	0.3(0.10)
	82000(23.5)		14(53)	131(55)	12(7)	0.4(0.12)
1SUHW3-150 1/4 (0.18)	104500(30.3)	1650 (2800)	10(38)	118(48)	21(12)	0.2(0.06)
	112500(32.6)		14(53)	123(51)	16(9)	0.3(0.10)
	117500(34.0)		18(68)	126(52)	13(7)	0.4(0.12)
1SUHW3-250 1/4 (0.18)	152500(44.2)	2400 (4075)	12(45)	118(48)	26(14)	0.2(0.06)
	158000(45.8)		14(53)	121(50)	23(13)	0.3(0.10)
	166500(48.2)		18(68)	124(51)	19(11)	0.4(0.12)

TABLE 6. HOT WATER UNIT HEATER RATINGS-1450 RPM

180 °F ENTERING WATER AND 60 °F ENTERING AIR						
Model No. HP (KW)	LOAD BTU/Hr (KW)	CFM (M3/Hr)	WATER FLOW GPM (LPM)	FINAL AIR TEMP. °F (°C)	WATER TEMP DROP °F (°C)	PRESSURE DROP Ft.H2O (m.H2O)
2SUHW3-75 1/4 (0.187)	53000(15.3)	800 (1360)	7(27)	121(49)	16(9)	0.2(0.06)
	56000(16.2)		9(34)	124(51)	13(7)	0.3(0.10)
	58500(17.0)		12(42)	127(53)	10(6)	0.5(0.15)
2SUHW3-125 1/2 (0.37)	87000(25.2)	1350 (2290)	8(30)	119(48)	22(12)	0.2(0.06)
	93500(27.1)		11(42)	124(51)	17(9)	0.3(0.10)
	98000(28.4)		14(53)	127(53)	14(8)	0.4(0.12)
2SUHW3-200 1/2 (0.37)	145000(42.7)	2250 (3820)	12(45)	120(49)	25(14)	0.2(0.06)
	155500(45.1)		15(57)	124(51)	21(12)	0.3(0.10)
	159500(46.2)		17(64)	125(52)	19(11)	0.4(0.12)
2SUHW3-300 3/4 (0.55)	200000(58.0)	3200 (5435)	14(53)	118(48)	29(16)	0.2(0.06)
	210000(61.0)		17(64)	120(49)	25(14)	0.3(0.10)
	218000(63.2)		20(76)	123(51)	22(12)	0.4(0.12)
2SUHW3-400 3/4 (0.55)	272000(78.8)	4400 (7470)	18(68)	117(47)	31(17)	0.2(0.06)
	283500(82.2)		21(79)	119(48)	28(16)	0.3(0.10)
	293000(85.0)		24(91)	121(50)	25(14)	0.4(0.12)



HIGH CAPACITY MODEL-STEAM RATINGS

TABLE 7. STEAM UNIT HEATER RATINGS-900RPM

60 °F ENTERING AIR					
Model No. HP (KW)	LOAD BTU/Hr (KW)	CFM (M3/Hr)	STEAM PRESSURE PSIG (Bar)	FINAL TEMP °F (°C)	CODENSATE Lbs./Hr (Kg/Hr)
1SUHS3-25 1/10 (0.07)	40000(11.7)	280 (475)	30(2.0)	192(89)	43(20)
	43600(12.8)		45(3.0)	203(95)	47(21)
	46500(13.6)		60(4.0)	213(101)	51(23)
1SUHS3-50 1/6 (0.124)	63700(18.7)	500 (850)	30(2.0)	177(81)	68(31)
	69300(20.3)		45(3.0)	188(87)	76(34)
	74000(21.7)		60(4.0)	196(91)	82(37)
1SUHS3-100 1/4 (0.18)	118500(34.7)	1050 (1780)	30(2.0)	164(73)	127(58)
	129000(37.8)		45(3.0)	173(78)	141(64)
	137700(40.4)		60(4.0)	181(83)	152(69)
1SUHS3-150 1/4 (0.18)	159100(46.6)	1650 (2800)	30(2.0)	149(65)	171(78)
	173200(50.8)		45(3.0)	157(69)	189(86)
	184900(54.2)		60(4.0)	163(73)	204(93)
1SUHS3-250 1/4 (0.18)	253400(74.3)	2400 (4075)	30(2.0)	157(69)	272(123)
	275800(80.8)		45(3.0)	166(74)	300(136)
	294500(86.3)		60(4.0)	173(78)	325(147)

TABLE 8. STEAM UNIT HEATER RATINGS-1450RPM

60 °F ENTERING AIR					
Model No. HP (KW)	LOAD BTU/Hr (KW)	CFM (M3/Hr)	STEAM PRESSURE PSIG (Bar)	FINAL TEMP °F (°C)	CODENSATE Lbs./Hr (Kg/Hr)
2SUHS3-75 1/4 (0.187)	83800(24.6)	800 (1360)	30(2.0)	156(69)	90(41)
	91300(26.8)		45(3.0)	165(74)	99(45)
	97400(28.5)		60(4.0)	172(78)	107(49)
2SUHS3-125 1/2 0.37	142300(41.7)	1350 (2290)	30(2.0)	157(69)	153(69)
	154900(45.4)		45(3.0)	166(74)	169(77)
	165300(48.4)		60(4.0)	173(78)	182(83)
2SUHS3-200 1/2 (0.37)	244300(71.6)	2250 (3820)	30(2.0)	160(71)	263(119)
	265900(77.9)		45(3.0)	169(76)	290(131)
	283900(83.2)		60(4.0)	176(80)	313(142)
2SUHS3-300 3/4 (0.55)	334700(98.1)	3200 (5435)	30(2.0)	156(69)	360(163)
	364400(106.8)		45(3.0)	165(74)	397(180)
	389000(114.0)		60(4.0)	172(78)	429(195)
2SUHS3-400 3/4 (0.55)	453800(133.0)	4400 (7470)	30(2.0)	155(68)	488(221)
	494000(144.8)		45(3.0)	163(73)	538(244)
	527400(154.6)		60(4.0)	170(77)	581(264)



TABLE 9. STEAM CORRECTION FACTORS*

ENT. AIR TEMP. ° F	STEAM PRESSURE IN POUNDS PER SQUARE INCH(PSI)															
	0	2	5	10	15	20	30	40	50	60	80	100	125	150	175	200
-30	1.133	1.163	1.200	1.258	1.308	1.348	1.420	1.482	1.532	1.585	1.654	1.717	1.792	1.847	1.903	1.956
-20	1.082	1.113	1.153	1.211	1.258	1.301	1.373	1.431	1.483	1.528	1.605	1.670	1.740	1.801	1.855	1.903
-10	1.036	1.066	1.107	1.164	1.212	1.254	1.325	1.384	1.436	1.481	1.558	1.623	1.693	1.755	1.808	1.856
0	0.989	1.020	1.060	1.117	1.166	1.207	1.278	1.338	1.389	1.434	1.512	1.576	1.647	1.708	1.762	1.810
10	0.942	0.973	1.013	1.071	1.118	1.161	1.233	1.292	1.342	1.388	1.465	1.530	1.601	1.660	1.715	1.764
20	0.896	0.926	0.967	1.024	1.073	1.114	1.186	1.244	1.296	1.341	1.418	1.483	1.553	1.615	1.669	1.717
30	0.849	0.880	0.920	0.977	1.026	1.067	1.139	1.198	1.250	1.294	1.372	1.436	1.506	1.568	1.622	1.670
40	0.802	0.833	0.873	0.930	0.978	1.021	1.092	1.151	1.202	1.248	1.325	1.390	1.461	1.521	1.575	1.628
45	0.779	0.810	0.850	0.907	0.955	0.997	1.069	1.128	1.180	1.224	1.302	1.366	1.436	1.496	1.552	1.601
50	0.756	0.786	0.827	0.884	0.932	0.974	1.045	1.104	1.156	1.201	1.273	1.343	1.414	1.474	1.529	1.576
55	0.732	0.763	0.803	0.861	0.908	0.951	1.023	1.081	1.133	1.178	1.255	1.320	1.390	1.451	1.505	1.553
60	0.709	0.740	0.780	0.837	0.885	0.927	1.000	1.058	1.109	1.154	1.231	1.297	1.367	1.427	1.482	1.531
65	0.686	0.716	0.757	0.814	0.862	0.904	0.976	1.034	1.086	1.131	1.209	1.273	1.343	1.407	1.459	1.506
70	0.662	0.693	0.733	0.791	0.838	0.881	0.935	1.011	1.063	1.108	1.186	1.250	1.320	1.380	1.435	1.484
75	0.639	0.670	0.710	0.767	0.815	0.857	0.930	0.988	1.040	1.084	1.163	1.226	1.297	1.357	1.412	1.460
80	0.616	0.646	0.687	0.744	0.792	0.834	0.906	0.965	1.016	1.061	1.139	1.203	1.273	1.335	1.389	1.436
85	0.592	0.623	0.663	0.720	0.768	0.811	0.883	0.941	0.993	1.038	1.116	1.180	1.251	1.310	1.365	1.414
90	0.569	0.600	0.640	0.696	0.745	0.787	0.860	0.918	0.969	1.014	1.093	1.156	1.226	1.288	1.342	1.390
100	0.522	0.553	0.593	0.650	0.698	0.732	0.813	0.871	0.923	0.968	1.045	1.110	1.181	1.240	1.295	1.344
110	0.467	0.506	0.547	0.603	0.652	0.694	0.766	0.825	0.867	0.921	0.988	1.063	1.134	1.194	1.248	1.297
120	0.429	0.460	0.500	0.556	0.605	0.647	0.720	0.778	0.830	0.874	0.952	1.027	1.086	1.147	1.201	1.251
140	0.336	0.366	0.407	0.464	0.512	0.554	0.626	0.685	0.737	0.781	0.858	0.923	0.993	1.055	1.108	1.156
160	0.242	0.273	0.313	0.370	0.418	0.460	0.533	0.591	0.642	0.688	0.765	0.831	0.901	0.961		1.065
180	0.149	0.179	0.220	0.277	0.325	0.367	0.439	0.498	0.550	0.594	0.671	0.737	0.808	0.868	0.921	0.970
200	0.056	0.085	0.127	0.183	0.232	0.274	0.345	0.405	0.455	0.501	0.577	0.643	0.713	0.775	0.829	0.876

*Standard ratings are based on 30 psig steam pressure @60 of Entering Air Temperature
Corrected Load =Rating from Table 3,4,7 and 8 X Correction factor from Table 9

TABLE 10. HOT WATER CORRECTION FACTORS

ENTERING AIR TEMPERATURE ° F	ENTERING WATER TEMPERATURE ° F										
	150	160	170	180	190	200	210	220	230	240	250
30	1.035	1.115	1.210	1.295	1.380	1.465	1.545	1.640	1.720	1.810	1.895
40		1.025	1.105	1.195	1.275	1.360	1.440	1.535	1.620	1.700	1.785
50	0.840	0.930	1.050	1.090	1.175	1.265	1.345	1.430	1.510	1.600	1.690
60	0.743	0.835	0.920	1.000	1.080	1.165	1.240	1.325	1.405	1.500	1.580
70	0.650	0.745	0.825	0.905	0.980	1.070	1.150	1.235	1.315	1.395	1.480
80	0.570	0.650	0.735	0.815	0.895	0.980	1.060	1.140	1.220	1.300	1.380
90	0.475	0.560	0.640	0.720	0.805	0.885	0.965	1.050	1.130	1.210	1.280
100	0.395	0.475	0.560	0.710	0.790	0.875	0.955	1.035	1.115	1.115	1.185

TABLE 11. CFM CORRECTION FACTORS

ENTERING AIR TEMPERATURE °F											
-10	0	10	20	30	40	50	60	70	80	90	100
1.155	1.130	1.105	1.082	1.060	1.040	1.020	1.000	0.982	0.964	0.945	0.930

TABLE 12. STANDARD HOT WATER MODEL DIMENSIONS

UNIT	A	B	C	D	E	F	E1	E2	F1	F2	G	H	K	L	WEIGHT(Kg)
1SUHW2-25	445	460	525	350	3/4"	3/4"	360	103	85	70	400	400	345	205	36
1SUHW2-50	465	580	525	350	1"	1"	366	105	99	68	520	400	455	145	39
1SUHW2-100	555	690	535	350	1"	1"	447	105	103	68	630	400	555	205	49
1SUHW2-150	630	740	575	400	1 1/4"	1 1/4"	519	108	108	65	680	450	595	205	60
1SUHW2-250	735	920	575	400	1 1/4"	1 1/4"	610	108	123	65	860	450	655	225	74
2SUHW2-75	465	580	525	350	3/4"	3/4"	370	103	95	70	520	400	455	205	42
2SUHW2-125	555	740	525	350	1"	1"	448	105	103	68	680	400	595	205	52
2SUHW2-200	735	920	575	400	1"	1"	614	105	119	68	860	450	655	205	65
2SUHW2-300	810	1020	590	400	1 1/4"	1 1/4"	687	108	123	65	960	450	745	255	81
2SUHW2-400	970	1075	590	400	1 1/2"	1 1/2"	838	110	128	62	1015	450	755	255	105

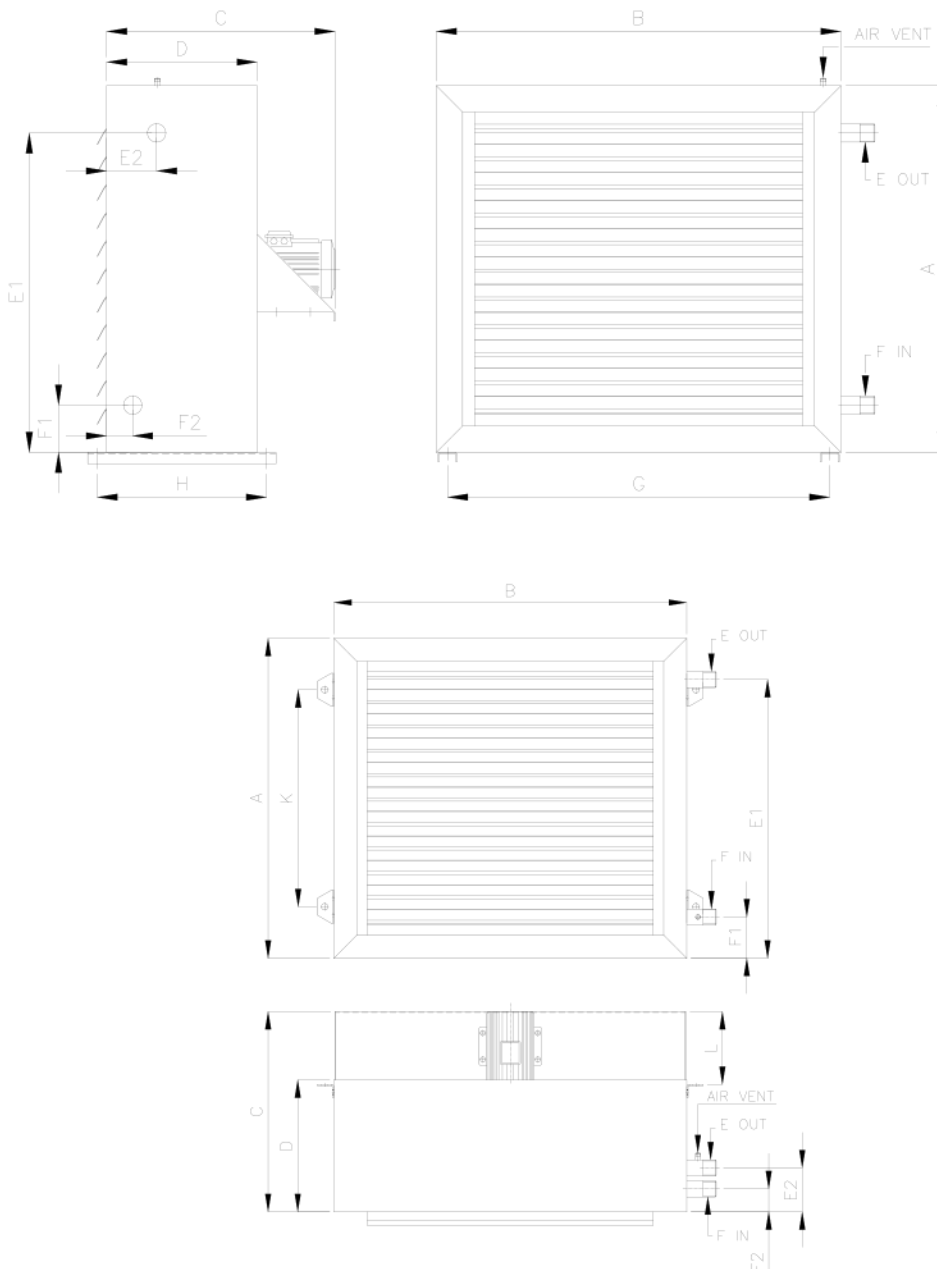


FIGURE 1. STANDARD HOT WATER UNIT HEATER

TABLE 13. STANDARD STEAM MODEL DIMENSIONDS

UNIT	A	B	C	D	E	F	E1	E2	F1	F2	G	H	K	L	WEIGHT(Kg)
1SUHS2-25	445	460	525	350	1"	3/4"	85	103	245	70	400	400	345	205	36
1SUHS2-50	465	580	525	350	1 1/4"	3/4"	95	104	250	68	520	400	455	145	39
1SUHS2-100	555	690	535	350	1 1/2"	1"	103	107	260	64	630	400	555	205	49
1SUHS2-150	630	740	575	400	1 1/2"	1"	104	107	301	64	680	450	595	205	60
1SUHS2-250	735	920	575	400	2"	1 1/4"	123	132	374	70	860	450	655	225	74
2SUHS2-75	465	580	525	350	1 1/4"	3/4"	95	104	235	68	520	400	455	205	42
2SUHS2-125	555	740	525	350	1 1/2"	1"	104	107	260	64	680	400	595	205	52
2SUHS2-200	735	920	575	400	2"	1 1/4"	123	132	374	70	860	450	655	205	65
2SUHS2-300	810	1020	590	400	2"	1 1/4"	123	132	415	70	960	450	745	255	81
2SUHS2-400	970	1075	590	400	2"	1 1/4"	129	132	493	70	1015	450	755	255	105

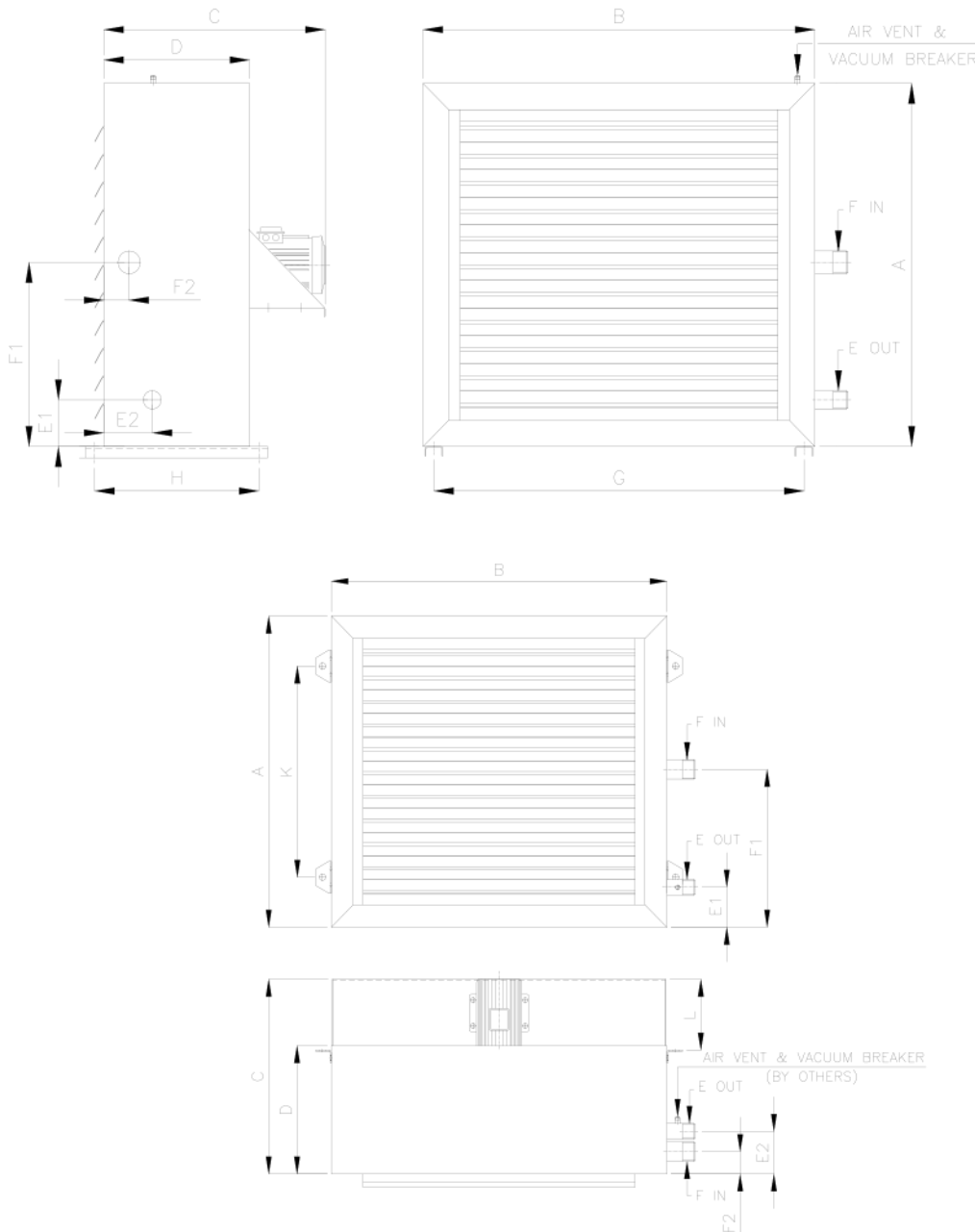


FIGURE 2. STANDARD STEAM UNIT HEATER

TABLE 14. HIGH CAPACITY HOT WATER MODEL DIMENSIONS

UNIT	A	B	C	D	E	F	E1	E2	F1	F2	G	H	K	L	WEIGHT(Kg)
1SUHW3-25	445	460	575	400	3/4"	3/4"	345	107	100	216	400	450	345	155	65
1SUHW3-50	465	580	575	400	1"	1"	365	107	100	216	520	450	455	95	67
1SUHW3-100	555	690	585	400	1"	1"	450	107	100	216	630	450	555	155	90
1SUHW3-150	630	740	575	400	1 1/4"	1 1/4"	507	107	120	216	680	450	595	205	119
1SUHW3-250	735	920	575	400	1 1/4"	1 1/4"	603	107	130	216	860	450	655	225	138
2SUHW3-75	465	580	575	400	3/4"	3/4"	365	107	100	216	520	450	455	155	68
2SUHW3-125	555	740	575	400	1"	1"	450	107	100	216	680	450	595	155	96
2SUHW3-200	735	920	575	400	1"	1"	603	107	130	216	860	450	655	205	133
2SUHW3-300	810	1020	590	400	1 1/4"	1 1/4"	685	107	125	216	960	450	745	255	162
2SUHW3-400	970	1075	590	400	1 1/2"	1 1/2"	846	107	120	216	1015	450	755	255	204

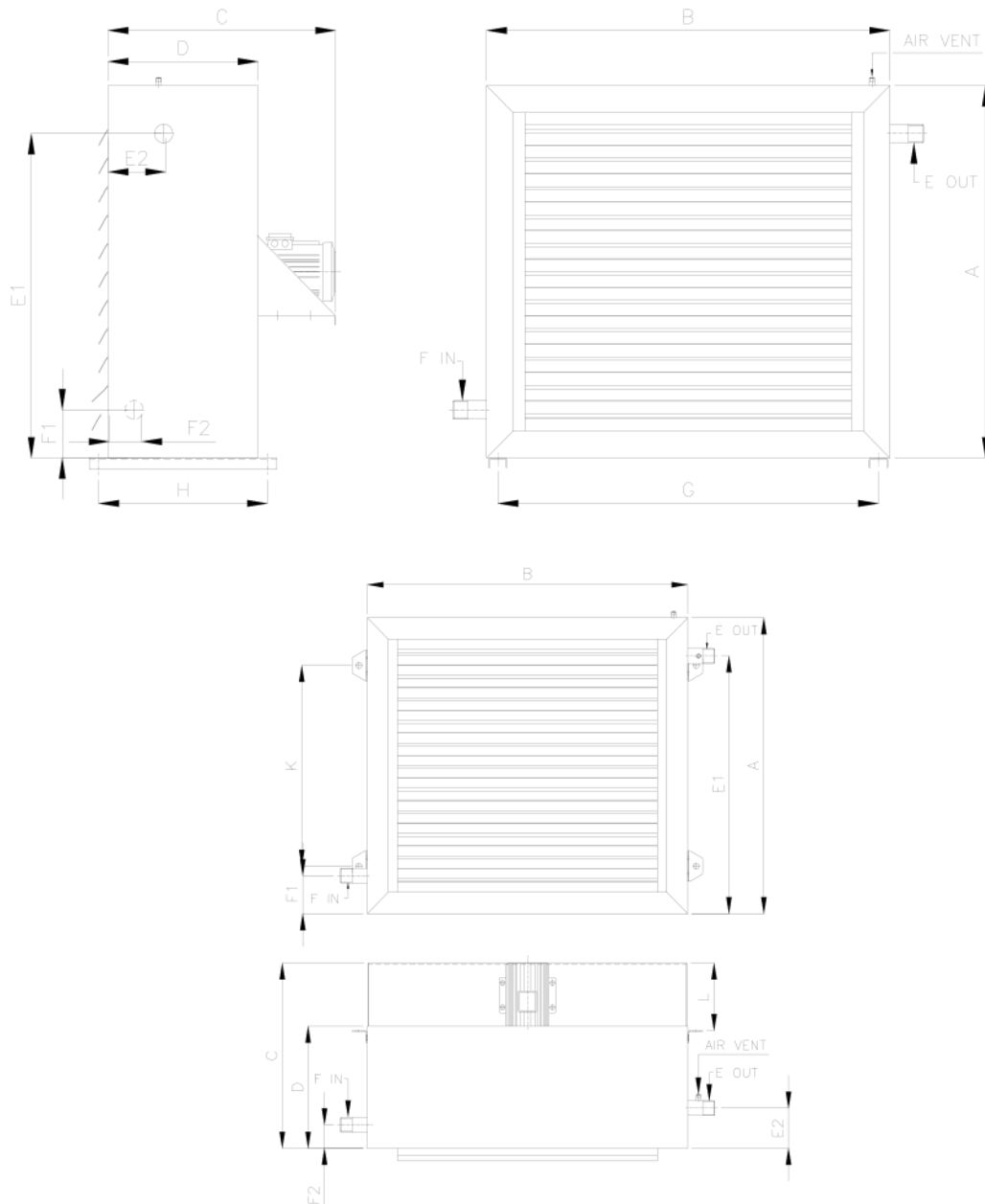


FIGURE 3. HIGH CAPACITY HOT WATER UNIT HEATER

TABLE 15. HIGH CAPACITY STEAM MODEL DIMENSIONS

UNIT	A	B	C	D	E	F	E1	E2	F1	F2	G	H	K	L	WEIGHT(Kg)
1SUHS3-25	445	460	575	400	1"	3/4"	100	107	225	216	400	450	345	155	65
1SUHS3-50	465	580	575	400	1 1/4"	3/4"	100	107	235	216	520	450	455	95	67
1SUHS3-100	555	690	585	400	1 1/2"	1"	100	107	280	216	630	450	555	155	90
1SUHS3-150	630	740	575	400	1 1/2"	1"	120	107	315	216	680	450	595	205	119
1SUHS3-250	735	920	575	400	2"	1 1/4"	130	107	370	216	860	450	655	225	138
2SUHS3-75	465	580	575	400	1 1/4"	3/4"	100	107	235	216	520	450	455	155	68
2SUHS3-125	555	740	575	400	1 1/2"	1"	100	107	280	216	680	450	595	155	96
2SUHS3-200	735	920	575	400	2"	1 1/4"	120	107	270	216	860	450	655	205	133
2SUHS3-300	810	1020	590	400	2"	1 1/4"	125	107	405	216	960	450	745	255	162
2SUHS3-400	970	1075	590	400	2"	1 1/4"	120	107	485	216	1015	450	755	255	204

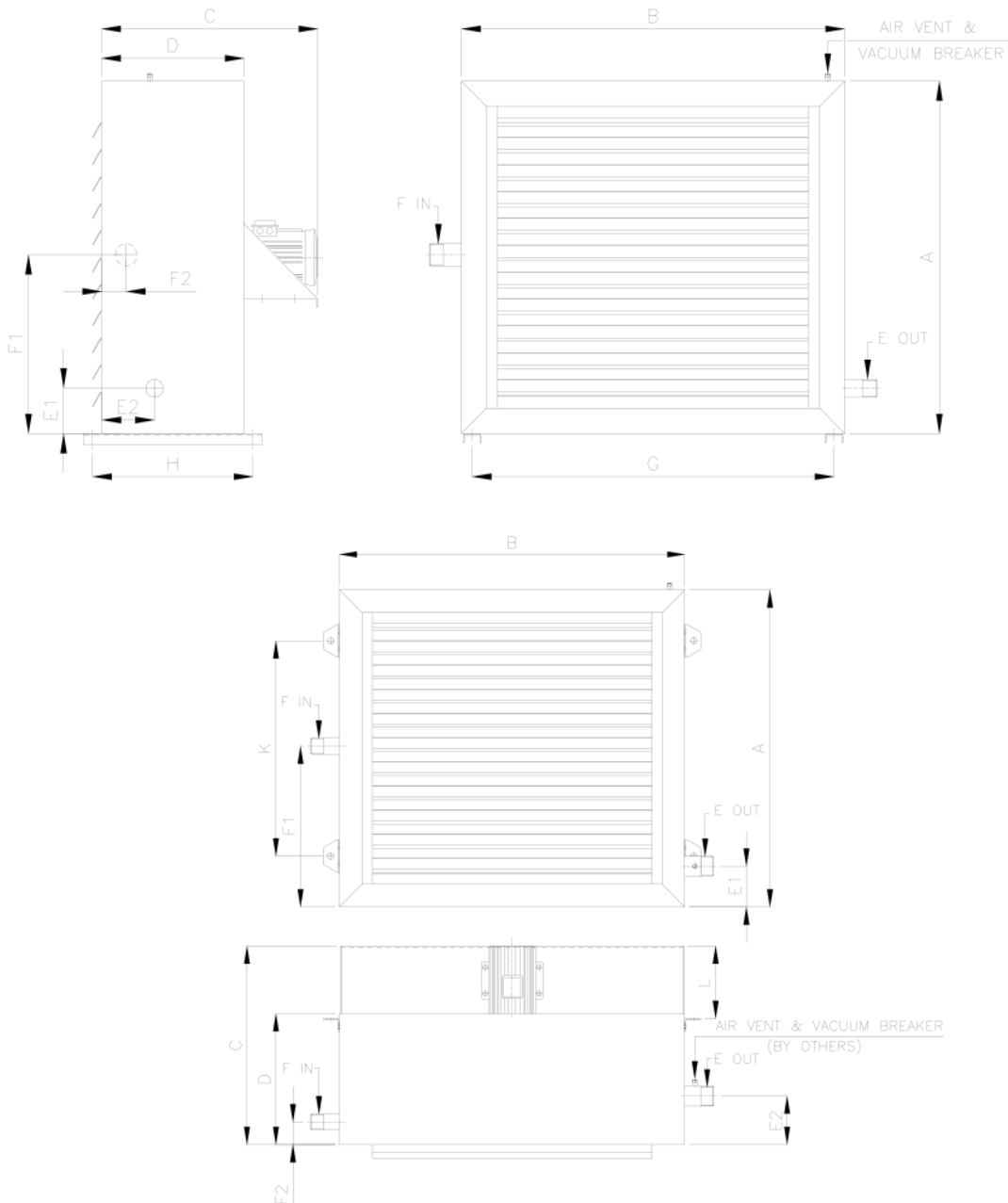


FIGURE 4. HIGH CAPACITY STEAM UNIT HEATER

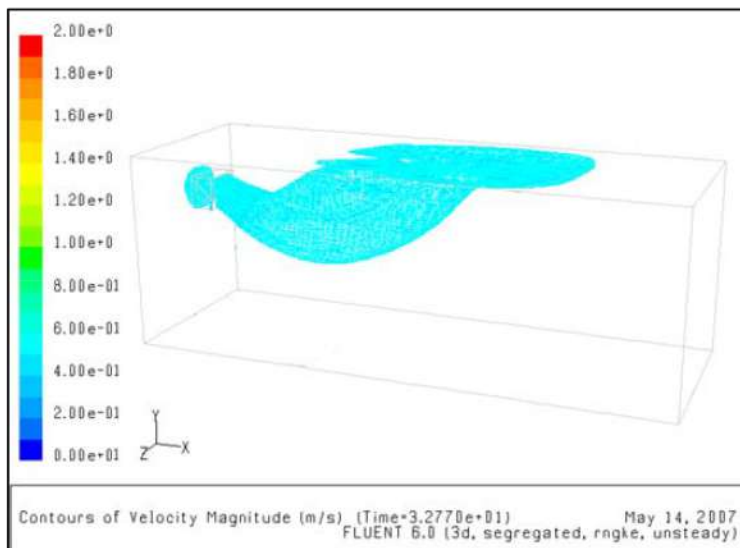
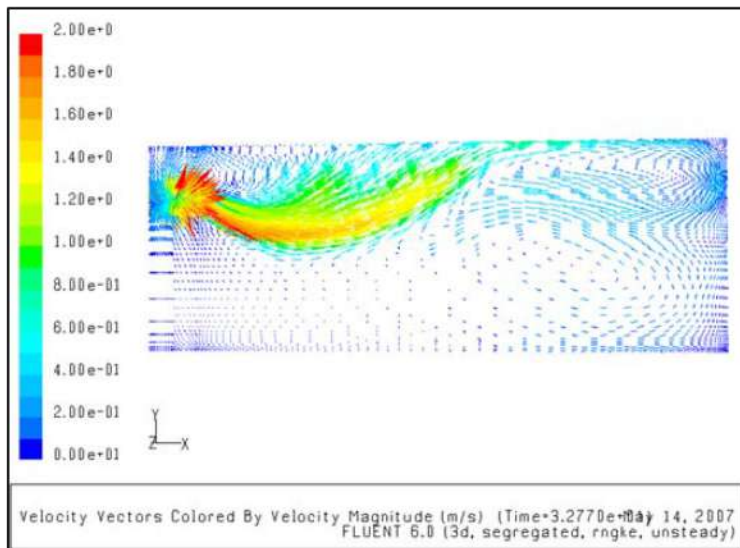
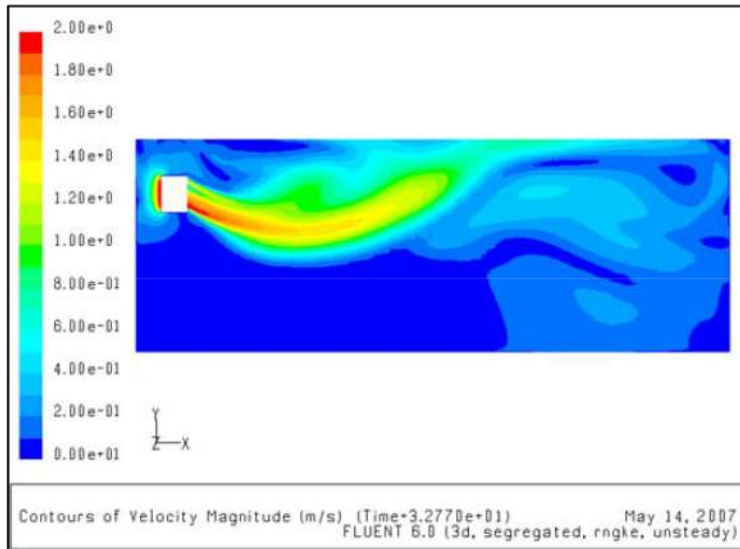
One of the most important problems in air conditioning industry is knowing about how air is being distributed through air opening of devices in ventilated spaces.

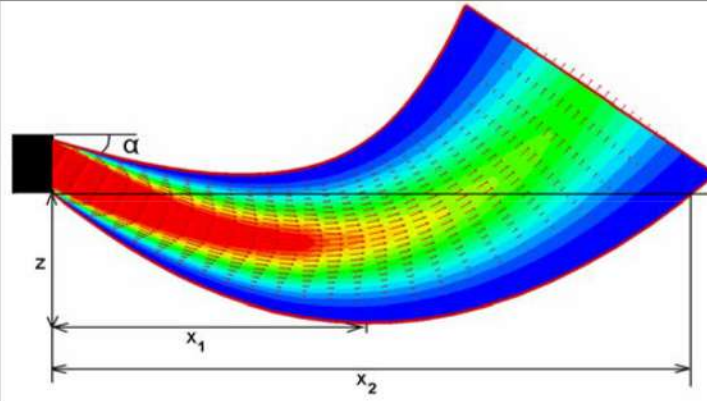
This air distribution affects comfort condition of occupants by influencing air velocity, air temperature and quality of air ventilation to avoid air traps and air temperature stratifications. It could be observed that also temperature and relative humidity were desired in some spaces, too high or too low velocity of air has caused discomfort for the occupants. For example excessive air velocity causes draft which is a localized feeling of warmth of a portion of the body. In the other hand, too low velocities cause temperature stratification (domination of buoyancy forces and forming different temperature layers). It also causes air traps and undesirable increase in concentration of CO_2 or odors in some locations of ventilated space.

For predicting the air movement of unit heater devices numerical simulations as long as many experimental measurements were performed. Using hot-wire thermal anemometry air velocity was measured in many points in space around unit heaters. Numerical analysis in 3-D full scale simulation using RNG $k-\epsilon$ turbulence model were performed to predict behavior of air flow in different location of ventilated spaces. CFD results were validated against experimental measured data and simulations and grids were refined till a satisfactory compliance was achieved. The final results can be observed in figures and tables of this page and the following page.

The results of these simulations and measurements can be used to optimize the ventilation design to avoid drafts, temperature stratification and excessive energy consumption. Moreover, air velocity can be controlled to be under maximum acceptable level of 50 fpm in occupied zone in order not to cause occupant discomfort. For this reason the occupied zone should be outside the sketched zone of the air jet in the following page (defined by z and x 's).

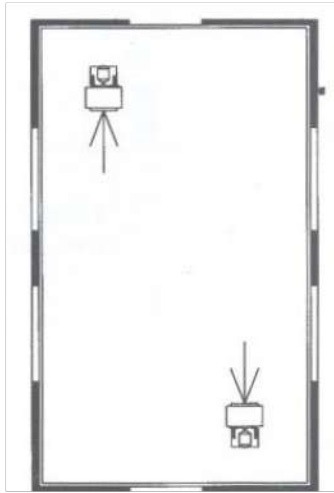
The global pattern of air distribution is depending on air initial velocity, air temperature difference with the environment it enters and the geometry of the ventilated space. However if there is no block in nearby zone that affects the air flow considerably, the behavior of the air jet is very similar to free jets. The results of air flow behavior can be predicted using the table in the following page.





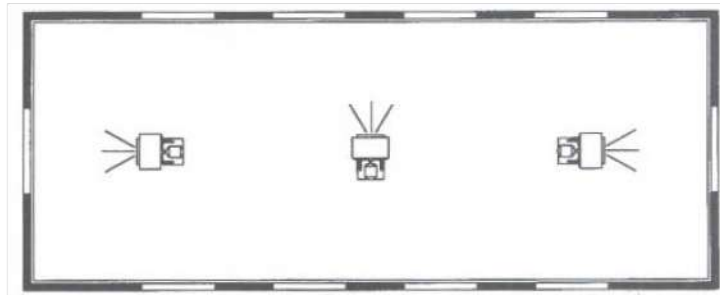
180 °F ENTERING WATER AND 60 °F ENTERING AIR

Model	CFM	Δt	Z(m)			X_1 (m)			X_2 (m)		
			Throw Angle (α°)			Throw Angle (α°)			Throw Angle (α°)		
			15	30	45	15	30	45	15	30	45
SUH-25	280	40	0.25	0.66	1.35	1.01	1.47	1.89	1.92	2.96	4.10
		55	0.21	0.53	1.07	0.78	1.18	1.63	1.52	2.44	3.40
		70	0.16	0.45	0.86	0.67	1.04	1.40	1.29	2.08	2.81
SUH-50	500	40	0.32	0.82	1.70	1.24	1.77	2.30	2.37	3.56	4.87
		55	0.31	0.67	1.34	0.98	1.46	1.98	1.89	2.95	4.11
		70	0.21	0.66	1.10	0.83	1.25	1.63	1.62	2.53	3.49
SUH-75	800	40	0.74	1.86	3.88	2.73	3.91	5.20	5.33	7.86	10.76
		55	0.80	1.51	3.17	2.25	3.21	4.28	4.31	6.49	9.04
		70	0.50	1.73	2.67	1.88	2.80	3.88	3.71	5.62	7.74
SUH-100	1050	40	0.68	1.69	3.53	2.48	3.55	4.71	4.84	7.13	9.75
		55	0.72	1.38	2.86	2.04	2.93	3.90	3.91	5.90	8.21
		70	0.46	1.57	2.41	1.70	2.54	3.48	3.37	5.10	7.05
SUH-125	1350	40	0.94	2.35	4.91	3.45	4.97	6.63	6.74	9.97	13.70
		55	1.00	1.91	4.06	2.86	4.04	5.39	5.46	8.20	11.45
		70	0.63	2.17	3.41	2.37	3.56	5.08	4.70	7.11	9.73
SUH-150	1650	40	0.98	2.43	5.09	3.57	5.16	6.88	6.99	10.34	14.22
		55	1.03	1.98	4.22	2.96	4.19	5.59	5.67	8.50	11.87
		70	0.65	2.25	3.54	2.46	3.70	5.30	4.87	7.38	10.08
SUH-200	2250	40	0.83	2.07	4.33	3.04	4.37	5.81	5.94	8.77	12.02
		55	0.89	1.69	3.55	2.51	3.57	4.76	4.81	7.23	10.08
		70	0.56	1.92	2.99	2.09	3.13	4.39	4.14	6.26	8.60
SUH-250	2400	40	0.95	2.37	4.97	3.48	5.03	6.70	6.81	10.08	13.85
		55	1.01	1.93	4.11	2.89	4.09	5.45	5.52	8.29	11.57
		70	0.64	2.19	3.45	2.40	3.60	5.15	4.75	7.19	9.84
SUH-300	3200	40	1.00	2.49	5.22	3.66	5.29	7.06	7.16	10.61	14.59
		55	1.06	2.03	4.33	3.04	4.29	5.73	5.81	8.72	12.18
		70	0.67	2.30	3.63	2.53	3.80	5.45	5.00	7.57	10.33
SUH-400	4400	40	1.08	2.69	5.64	3.96	5.72	7.65	7.74	11.48	15.81
		55	1.14	2.20	4.69	3.29	4.63	6.18	6.28	9.42	13.16
		70	0.72	2.48	3.94	2.73	4.11	5.96	5.40	8.18	11.15



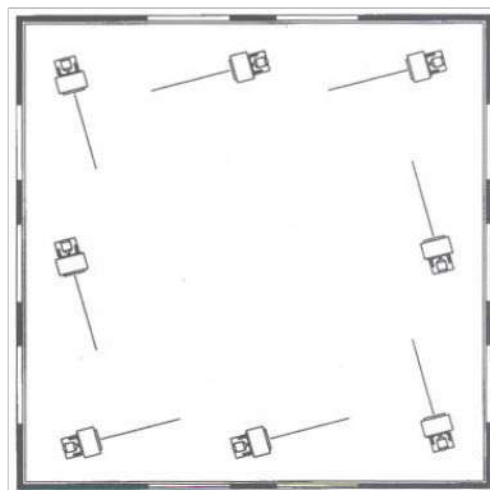
WAREHOUSE BUILDING

Unit heaters can provide maximum heat coverage of an area with a minimum number of units.



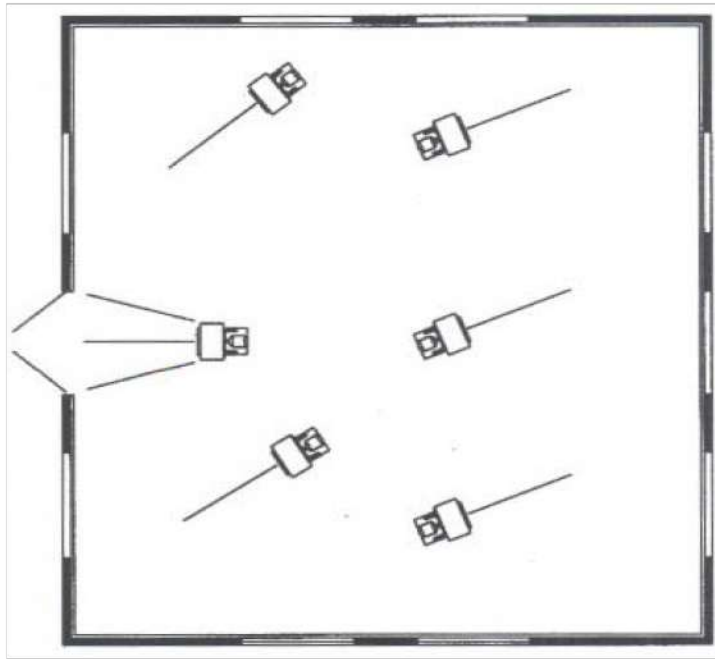
NARROW BUILDING

Heat spread from unit heaters covers entire floor space and blankets cold outside walls with warm air.



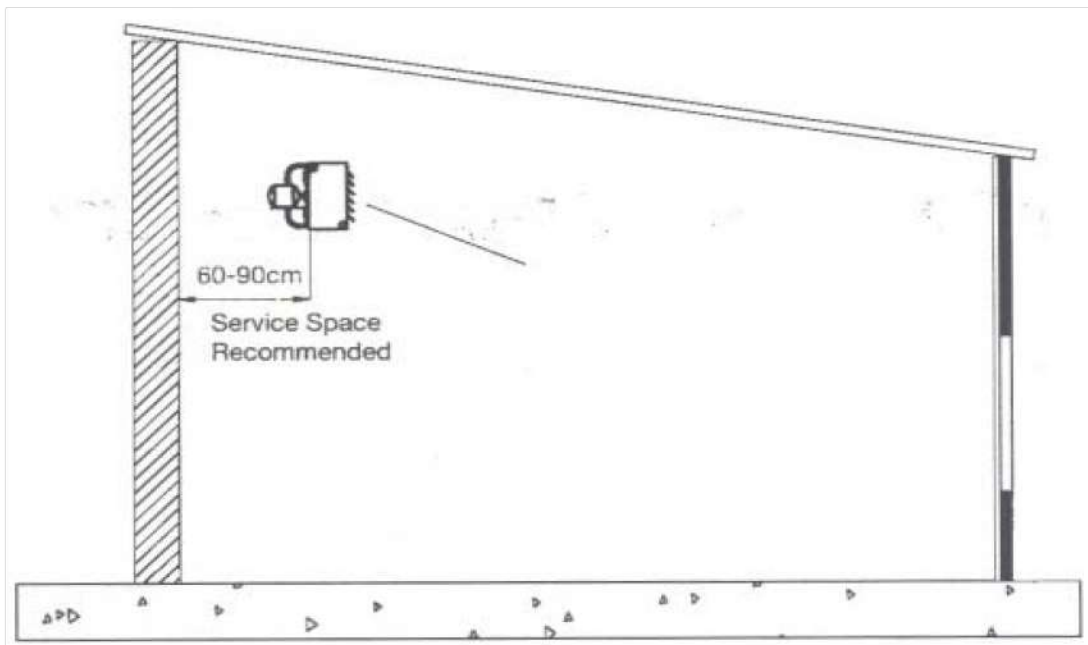
MILL- TYPE BUILDING

Here each unit heater supports the horizontal air stream from another to produce circulatory air movement around the exterior wall of the building where heat loss is greatest.



MANUFACTURING FACILITY

Units are arranged so they do not blow directly at workers. Their air streams are directed down aisles, into open spaces on the floor, or along exterior wall of the building. An additional unit blows directly at the entrance whereby the cold stream from outside is immediately heated.



MONITOR- TYPE BUILDING

Wall mounted units deliver air to the floor space below in the direction of the window where the heat loss is significant.

MOUNTING SUGGESTIONS

Horizontal units may be hung from rods with threaded ends according to FIGURE 6. The rods may be welded to structural steel above or bolted to plates which are designed specifically for this purpose. L shaped brackets on the side panels of vertical units facilitate hanging the units accordingly.

Alternative means of mounting the units is to build a base frame according to FIGURE 7. The frame may be welded to structural steel columns accordingly or welded to a plate which in turn is bolted on to the structural steel.

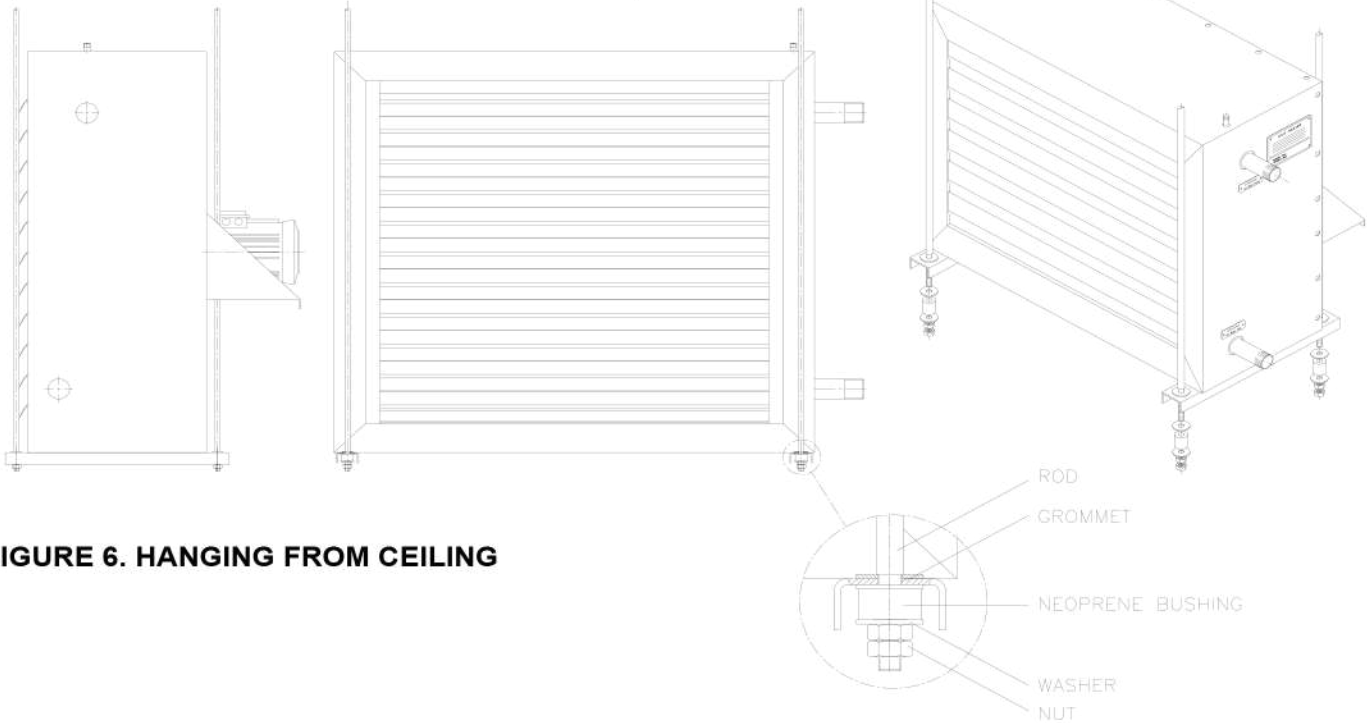


FIGURE 6. HANGING FROM CEILING

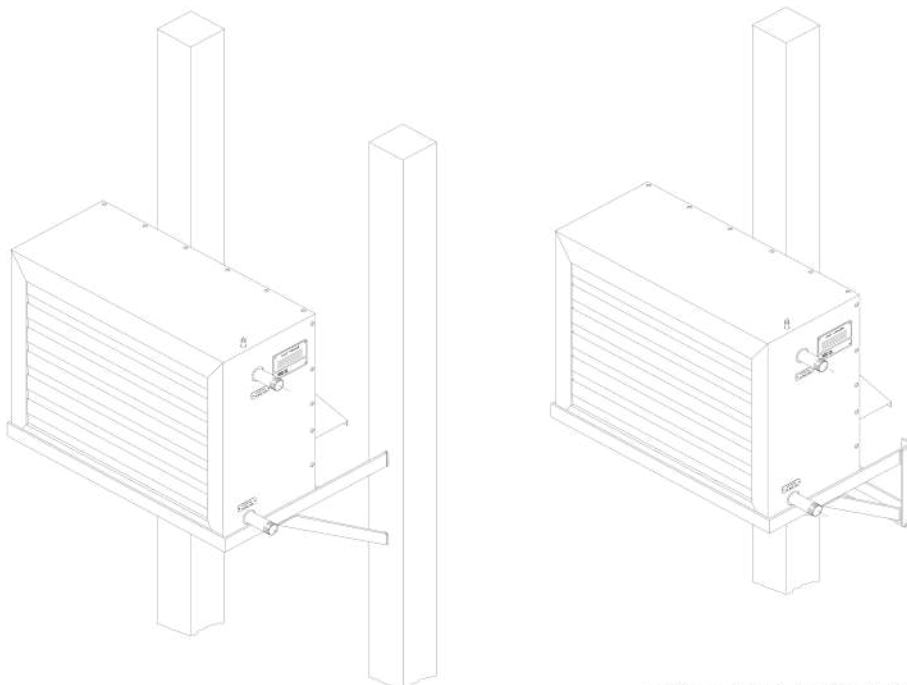


FIGURE 7. MOUNTING TO COLUMNS

PIPING SUGGESTIONS

As the function of a unit heater is to transfer heat from steam or hot water to the surrounding space, it is necessary that the steam or hot water be delivered to the unit and removed from it, in the required quantity and condition. The piping of the unit heaters must conform strictly to the system requirements, while at the same time permitting the heaters to function as intended. The following are a few piping guidelines which must be observed when designing piping systems for unit heaters.

1. Pipe size should be adequate to handle both steam and condensate, under the maximum load condition. With steam unit heaters the steam piping must be sized to carry a full supply of steam to the unit to take the place of that condensed. In hot water systems, piping should be sized properly to handle required flow (GPM) of water.
2. When installing steam unit heaters the supply line should be pitched towards the steam main in order to prevent condensate in the main from draining through the heater, where it might reduce capacity and cause noise. With hot water unit heater both supply and return branch lines should be pitched towards the unit.
3. The condensate line from steam unit heater should provide a minimum drop of 300 mm (12") below.

The heater, so that the head of water required to overcome the resistances of check valves. Traps and strainers will not cause condensate to remain in the heater.

4. Rapid condensation of steam, specially during heating- up periods, is characteristic of steam unit heaters. Steam traps with ample capacity to handle the condensate when the unit is operating under maximum steam pressure and minimum entering air temperature plus a suitable safety factor should be selected.
5. Dirt pockets at the outlet of steam unit heaters are essential, and strainers with 1.5mm (1/16") perforations are recommended as additional means of retaining dirt and scale which might affect operation of check valves and traps.
6. The vertical connection to the air vent should be at least 3/4" pipe thread, to permit separation of the air from the water.
7. To ensure optimum performance of the unit heaters at the rated capacity, all supply mains and branch connections the units should be insulated.
8. Piping and unit heaters should be supported independently.

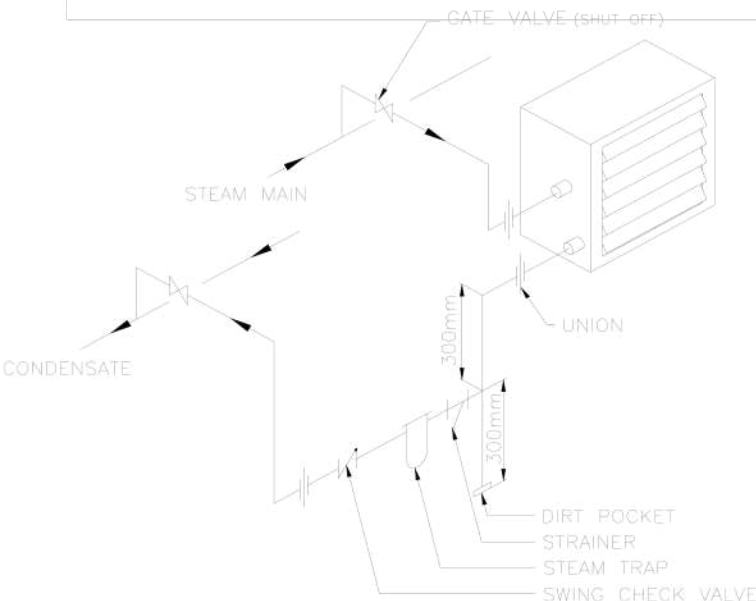


FIGURE 8. STEAM HEATING SYSTEMS

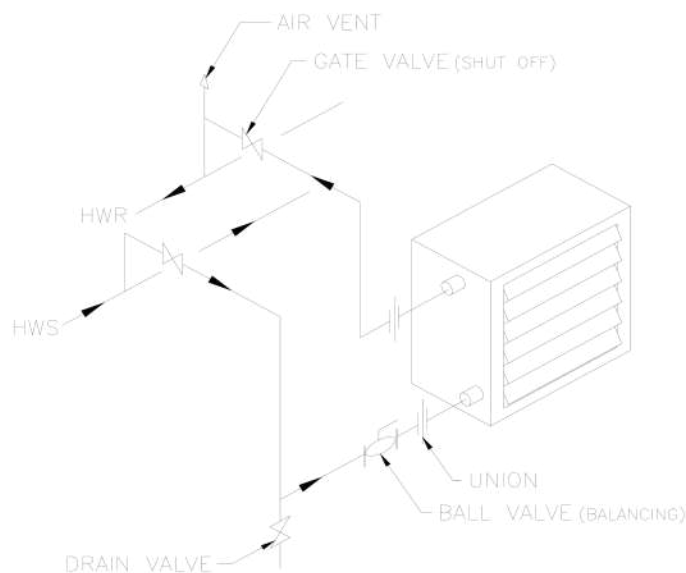


FIGURE 9. HOT WATER SYSTEMS

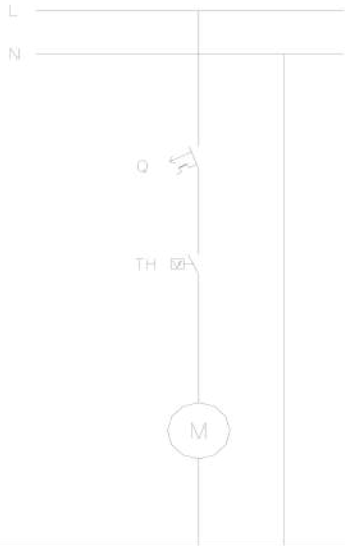


FIGURE 10. TYPICAL WIRING DIAGRAM FOR SINGLE PHASE ELECTRIC MOTOR (ONE UNIT)

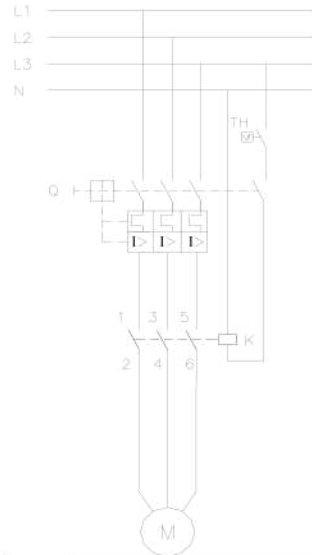


FIGURE 13. TYPICAL WIRING DIAGRAM FOR THREE PHASE ELECTRIC MOTOR

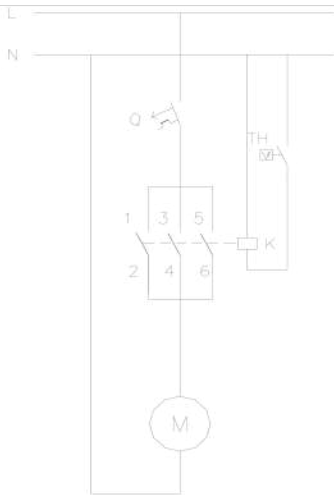


FIGURE 11. TYPICAL WIRING DIAGRAM FOR SINGLE PHASE ELECTRIC MOTOR (WITH ELECTRIC MOTOR LARGER THAN 3/4 H.P.)

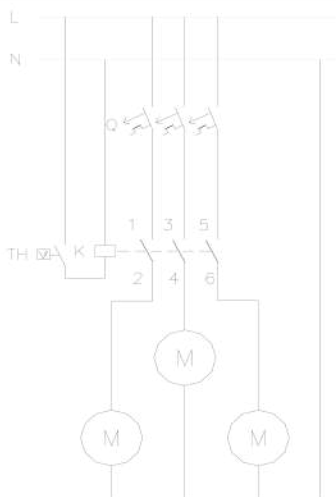
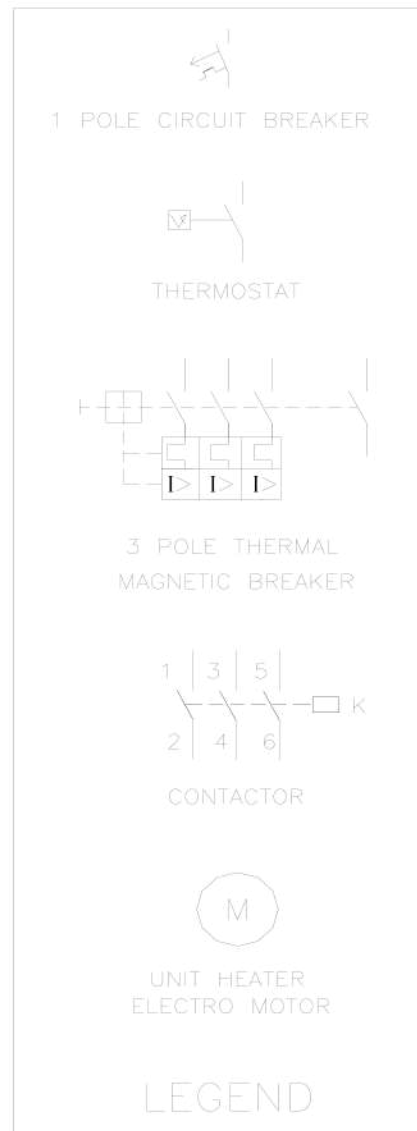


FIGURE 12. TYPICAL WIRING DIAGRAM FOR SINGLE PHASE UNIT HEATER (MULTIPLE UNITS)



UNIT CASINGS

The standard unit casing shall be constructed of folded 1.25 or 1.50mm galvanized steel sheets.

The casing interior and exterior shall be painted with 30-40µm hammer finish after final assembly.

Individual louvers shall be adjustable to permit the various directions of air discharged.

COILS

Coils shall be constructed of galvanized steel sheet casings with seamless 5/8" Copper or 1/2" steel tubes

Standard coil shall be suitable for hot water applications with temperatures not exceeding 130 °C and steam applications with pressures less than 30 PSIG. Standard coils shall be constructed of 2 rows seamless 5/8" copper tube expanded into die-formed aluminum fin plates with a fin density of 8FPI.

All coils shall be pressure tested with 325 PSIG compressed air in an illuminated tank according to ASHRAE 15 Standard (Safety Code for Mechanical Refrigeration)

All coil connections shall be external MPT. Flanged connections are optional.

FANS

All fans shall be die formed from aluminum or galvanized steel sheet and shall be statically balanced. Fans shall be keyed to the electric motor shaft via a cast iron hub.

MOTORS

Electric motors shall be 3 phase-380V-50Hz or single phase-220V-50Hz available at 1450 RPM or 950 RPM. Single phase electric motors shall be IP-23, air over motor with class B insulation. Three phase electric motors shall be IP-54, totally enclosed-fan ventilated (TEFV) with insulation rated at class B. Electric motors with degree of protection of IP-55 and IP-54 with class F shall be optional.



FORMULAS/CONVERSION FACTORS

1. Condensate (LB/HR) = $\frac{\text{actual BTU / hr}}{\text{Latent Heat of steam at PSIG}}$
2. Specific heat of air from 0°F to 150°F = 0.24 BTU/LB°F
3. Weight of one cubic foot of air at 70°F = 0.075 LB
4. BTU/HR = CFM X Air Temp Rise (F) X 1.08
(Note: 1.08 = 0.24 X 0.075 X 60)
5. Water temp. drop (°F) = $\frac{\text{actual BTU/hr}}{500 \times \text{USGPM}}$
6. CFM at FAT = CFM at 70°F × $\left(\frac{460 + \text{FAT}}{460 + 70} \right)$
7. CFM at 70°F = CFM at FAT × $\left(\frac{460 + 70}{460 + \text{FAT}} \right)$
8. Air Temp. Rise (F) = $\frac{\text{actual BTU/hr}}{1.08 \times \text{CFM}}$
9. Final Air Temp. (F) = EAT + Temp. Rise
10. 1 Boiler Horsepower = 33,478.8 BTU/HR at 70 psi
11. 1 Boiler Horsepower = 30 LB/HR of feed water at 100°F converted to steam at 70 psi
12. 1 U.S. Gallon of water = 8.34 pounds of water
13. 1 Imperial Gallon of water = 10 pounds of water
14. 1 psi pressure drop = 2.76 inches of water
15. 1 KW = 3,414 BTU/HR.
16. 1 U.S. Gallon = 0.83267 Imperial Gallons
17. 1 U.S. Gallon = 3.785 Liters
18. °C = 5/9 (F - 32)

ABBREVIATIONS USED

1. BTU = British thermal unit
2. MBH = BTU/HR X 1000
3. EAT = Entering Air Temperature
4. FAT = Final Air Temperature
5. USGPM = U.S. Gallons Per Minute
6. PD = Liquid Pressure Drop
7. PSIG = Pounds per Sq. In. Gauge Pressure
8. L1T = Liquid Temperature Drop
9. CFM = Cubic Feet per Minute
10. FPM = Feet per Minute
11. COND. = Condensate



SARAVEL CORP. also specializes in custom designed unit heaters. Pictured above is a vertically mounted, down blast unit heater designed to deliver 466 MBH, 12000 CFM under standard conditions at 950 RPM, specially designed for air port hangers.