



NH Series[™]

**NHTC / NHPC
ELECTRODE
STEAM HUMIDIFIER**

Engineering Manual

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SPECIFICATION LABEL LOCATION

The Specification Label for your NH Series humidifier is located on the bottom of the unit. You will find it attached to the skirt that separates the electrical and plumbing compartments on the electrical compartment side.

RECORD OF REVISIONS

For each revision, put the revised pages in your manual and discard the superseded pages. Write the revision number and revision date, date put in manual, and the incorporator's initials in the applicable columns on the Record of Revisions.

Revision Number	Revision Date	Date Put In Manual	By	Revision Number	Revision Date	Date Put In Manual	By

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INTRODUCTION



Figure 1. NHTC

1. INTRODUCTION

The NHTC humidifier is controlled by Nortec's Patented Auto adaptive Water Management Control System. This system allows the humidifiers to adapt to basically any potable incoming water and changes that occur to the water supply. This eliminates the need to readjust drain timers, changes complete cylinders or time consuming adjustment of electrode spacing's. The system also adjusts the drain rate of the humidifier to reduce the amount of drain water exiting the humidifier as water conditions change. This reduces energy loss due to excessive draining of hot water and extends cylinder life since less water and minerals enter the humidifier.

The following is a brief description of how the Auto-Adaptive water Management System works.

The electrode steam system produces pure uncontaminated steam with variable output through electronic power control of the electrodes. Water borne minerals remain in the cylinder and are periodically flushed out through the automatic cylinder drain. On NHTC and NHPC models the drain automatically empties the steam cylinder if it is not operated for three days. Solid mineral scale sinks to the bottom of the cylinder which, when filled with residue, is easily removed and replaced.

A. PROPORTIONAL + INTEGRAL AUTO-ADAPTIVE CONTROL SYSTEM FOR THE NHTC/ NHPC

- (1) NORTEC's patented P+I Auto-Adaptive control system allows the unit to operate at an optimal low water level using the same fixed electrode spacing regardless of the incoming water conditions. Boiling of the water allows the minerals in the water to remain behind in the cylinder. This raises the contained water conductivity to a value higher than the incoming water. The P+I Auto-Adaptive control system monitors and adjusts the contained water conductivity as these changes occur.
- (2) The humidifiers are designed to produce full steam output at the lowest possible electrode coverage to obtain maximum cylinder life.
- (3) The units operate between A and D of the main steam output demand. Accordingly, the current flow between the electrodes in the cylinder is maintained between these pre-established limits programmed into the P+I Auto-Adaptive control system.
- (4) As the water boils away and the electrode coverage is reduced, the steam output is also reduced slightly. A pre-determined design parameter of every NORTEC cylinder is the known time (T_o) (time optimum) that it takes to boil down from A to D of output (also referenced to as amp trigger points) at a pre-designed contained water conductivity. (See Figure 2.)
- (5) Whenever the conductivity in the cylinder water is lower than the designed conductivity, the (T_a) (time actual) to boil down from A to D will be longer than the T_o . (See Figure 3.)

- (6) As the water is boiled away, the minerals left behind increase the conductivity of the water in the cylinder. As soon as the conductivity is greater than design, the T_a to boil from A to D will be shorter than T_o and a drain cycle is initiated.
- (7) The fill valve always opens during timer drains, adding cold water to mix with the hot water from the cylinder during automatic drain cycles. This tempering process is required to meet plumbing codes.
- (8) As can be seen from a typical sequence depicted in Figure 4, the P+I Auto-Adaptive system allows the unit to be self-regulating. It drains only when necessary and only the amount of water to maintain optimum operating conditions.
- (9) Relying on the proportional (P) feedback only to decide how much to drain is like guessing what is happening based on a 'snapshot' only. By taking into consideration a series of "snapshots": (one from each of the past ten cycles for example), the control system has more data on which to base its decision to drain. The integral (I) part of the P+I Auto-Adaptive system provides this added feedback.
- (10) The proportional (P) and integral (I) factors have been weighted as to the relative influence each will have when the NHTC/NHPC calculates a drain. The preprogrammed weighing was derived through extensive field and laboratory tests. When supply water conductivity is extremely high (requiring substantially more drains), the NHTC/NHPC will see the pattern developing in cycles stored in memory. It will then initiate additional drains to adjust the contained water conductivity.
- (11) If low conductive water conditions occur, the P+I control will reduce the drains necessary to maintain optimum operating conditions within the cylinder. If extreme water conditions are encountered, the NHTC/NHPC can be reprogrammed with factory instructions to compensate.
- (12) NORTEC's P+I Auto-Adaptive control system has been designed to benefit users who demand very tight control of the relative humidity. It maintains steam output above the B level, even during auto drains. (See Figure 4.)
- (13) The P+I Auto-Adaptive control system allows the humidifier to maintain tighter humidity control without the problem of rh depression during drain cycles that occur with other humidifiers. This results in more consistent space rh levels, even with a simple on/off control system.

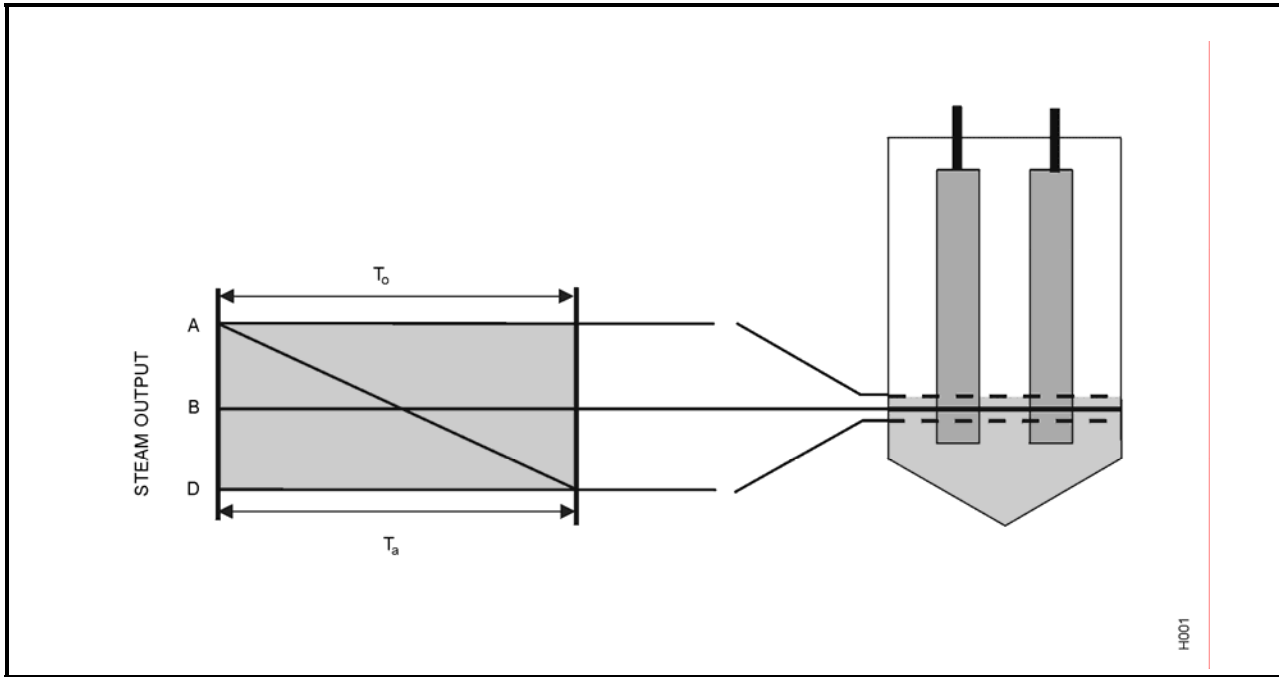


Figure 2. Optimum Boiling Time

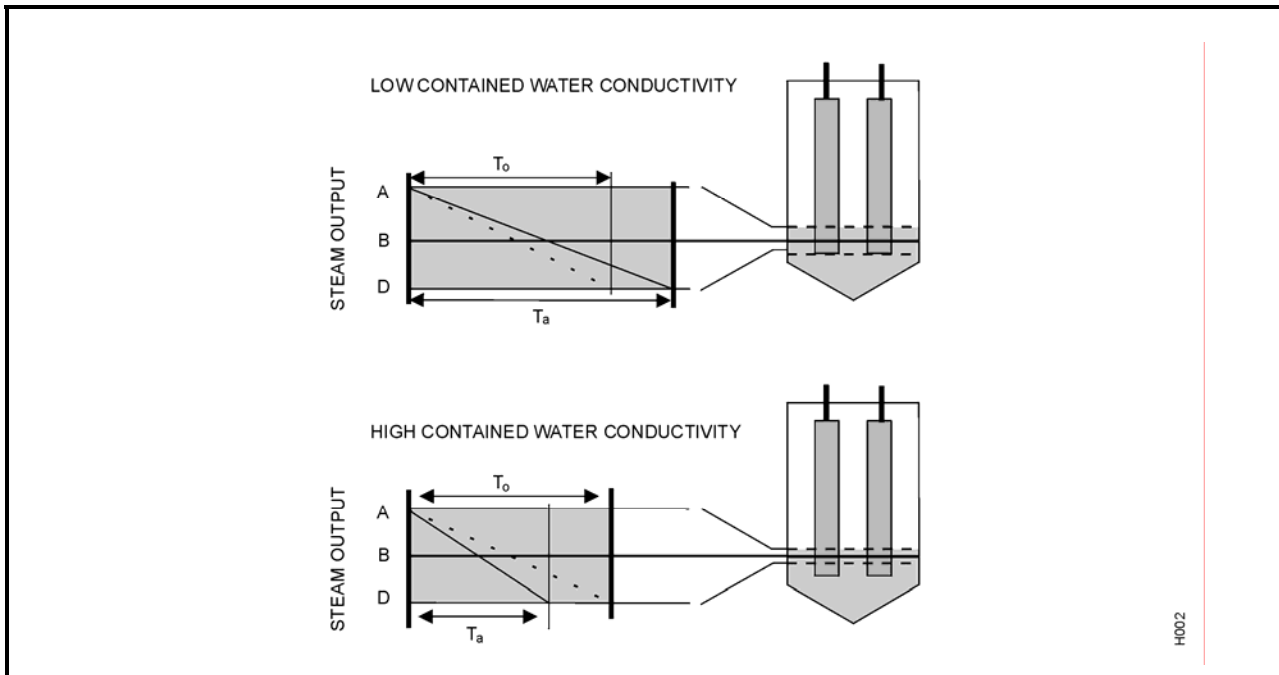


Figure 3. Conductivity

B. NH CAPACITY ADJUSTMENT

- (1) Each NORTEC NH Series humidifier is rated at its maximum output capacity. By means of the alphanumeric display and keypad on the NHTC/NHPC, the humidifiers can be adjusted to obtain an output between 20% and 100% of its rated capacity.

C. DRAIN CYCLE AND CYLINDER LIFE

(1) Water Type Used (Potable or Softened)

- (a) The electrode steam product line is one of the most efficient humidifier systems since it uses the minerals in the water to conduct electricity. If no minerals are present no current can pass from one electrode to another, thus no steam production can occur.
- (b) Although the electrode steam humidifier is ideal for potable water, it should not be used with pure reverse osmosis or deionized water since the conductivity is too low.

(2) Water Conditions vs Cylinder Life

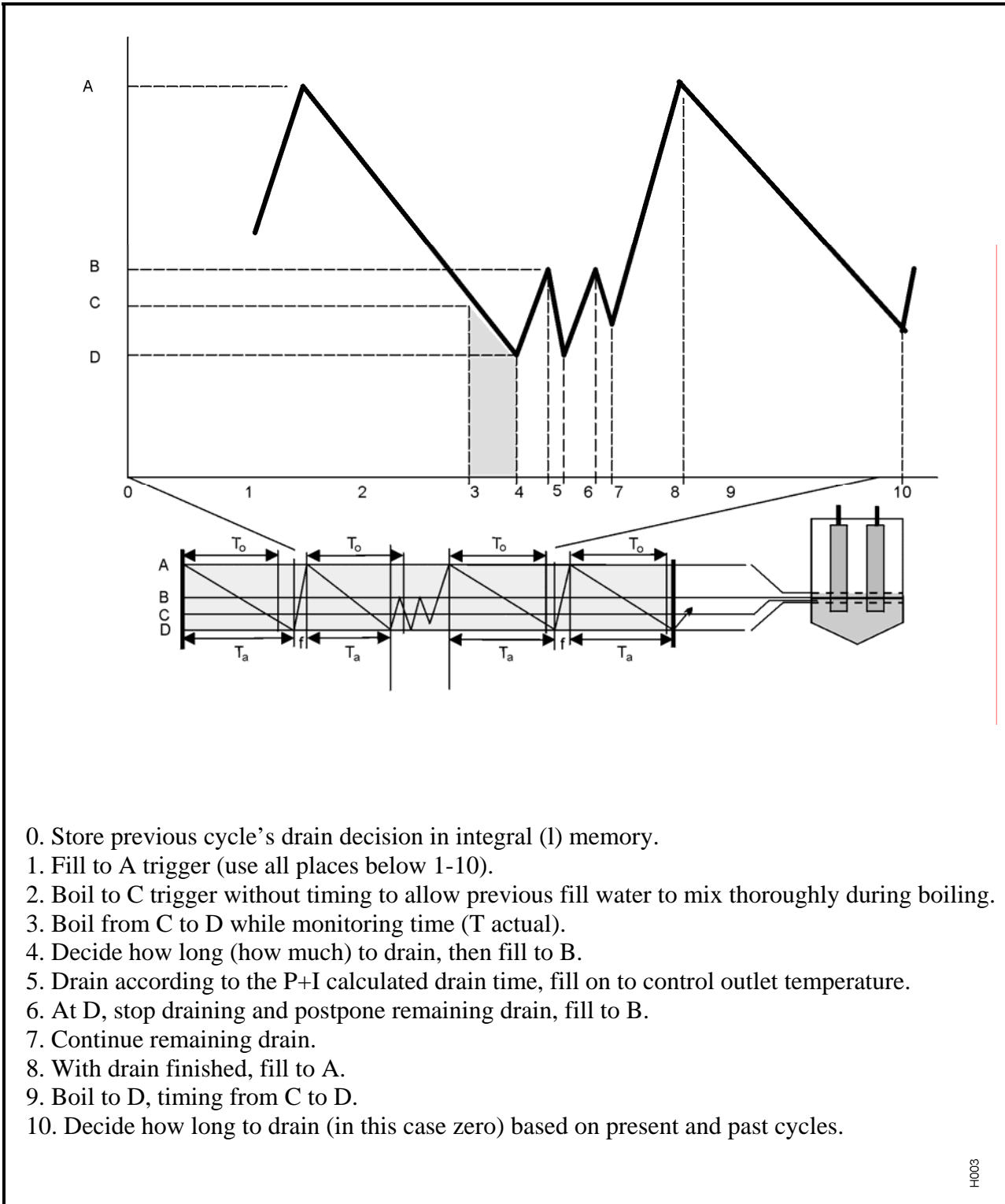
- (a) The NH Series is designed to adapt to most potable or softened water supplies. Since the output of all NH Series humidifiers is pure, clean steam, minerals originally in the incoming water are left behind in the steam cylinder. Many of these minerals will be removed during short flush cycles within the cylinder. Therefore, the water chemistry, the unit running time, and output capacity setting ultimately determines the cylinder life. (See Figure .)

(3) Output vs Cylinder Life

- (a) As minerals build-up on the electrodes in the cylinder of the NORTEC NH Series humidifier, the patented P+I Auto-Adaptive control system automatically raises the water level slightly in the cylinder. This exposes fresh electrode surface to the water and maintains peak output and efficiency from the humidifier. Once the
- (b) electrode surface is completely encrusted by the minerals, the user is alerted to change the cylinder. Other humidifiers' performance degrades gradually as the minerals build-up. The NH Series maintains maximum efficiency then the cylinder is replaced. (See Figure .)

(4) Water Conditions vs Drain Rate

- (a) The P+I Auto-Adaptive control system automatically adjusts the drain rate to maintain the design water conductivity required for proper operation. This ensures regular flushing of minerals which become concentrated in the water, and minimizing wastage of hot water. The humidifier automatically adjusts its drain rate with changes in incoming water conductivity through the Auto-adaptive water management system.



H003

Figure 4. Typical Auto-Adaptive Operation

It is important to note that the drain rate shown includes the make-up water, mixed with the drain water, which tempers the drain water to 140°F (60°C) or less.

NOTE

The electrode steam process provides optimum efficiency because all resistance to current passage is converted to usable energy. Unlike cal-rod or infrared humidifiers which convert some of their capacities into unusable heat.

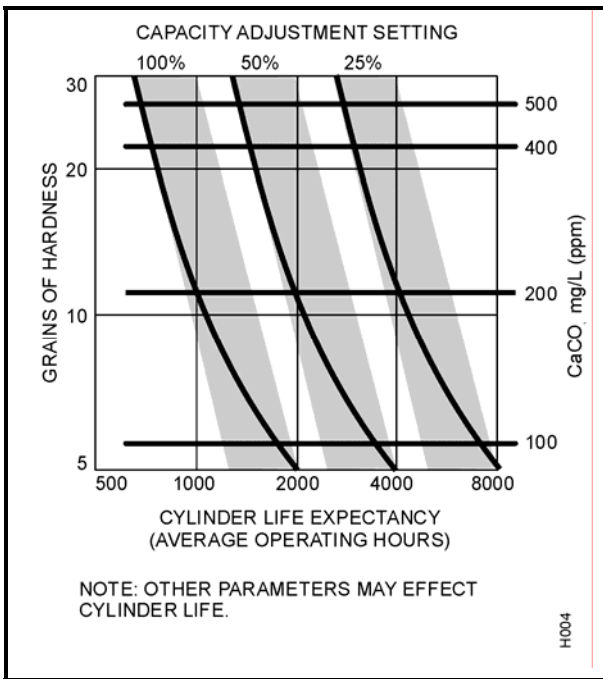


Figure 5. Capacity Setting & Cylinder Life

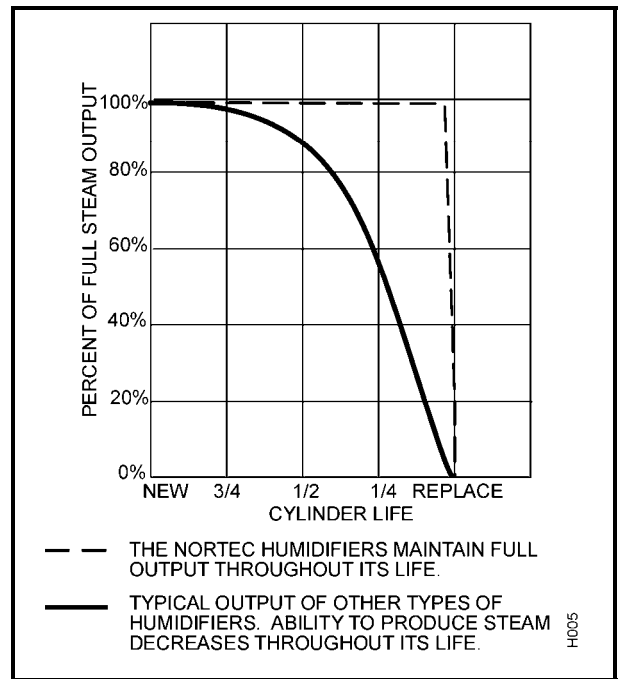


Figure 6. Output vs Service Life

3. PRE-INSTALLATION EQUIPMENT VERIFICATION

A. GENERAL

- (1) Ensure the available voltage and phase correspond with humidifier voltage and phase as indicated on the humidifier's specification label.
- (2) Ensure that the external fuse disconnect is sufficient size to handle the rated amperage as indicated on the humidifier's specifications label. Refer to local building codes.
- (3) Report any discrepancy immediately to the site engineer.
- (4) Location and mounting is described in Chapter 10-10.
- (5) For typical installation see Figures 6 & 7.

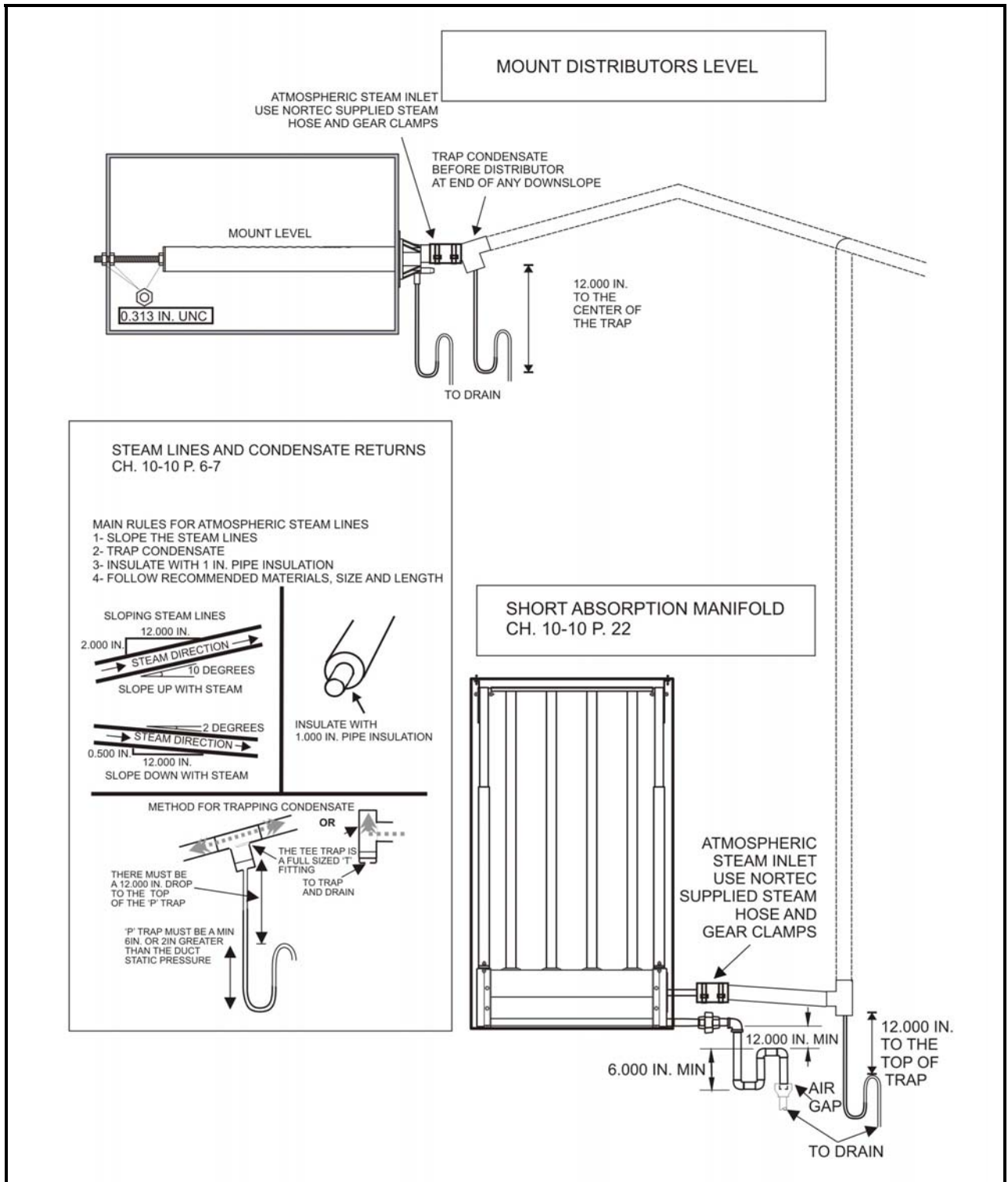


Figure 6. Typical NHRS Installation (Sheet 1 of 2)

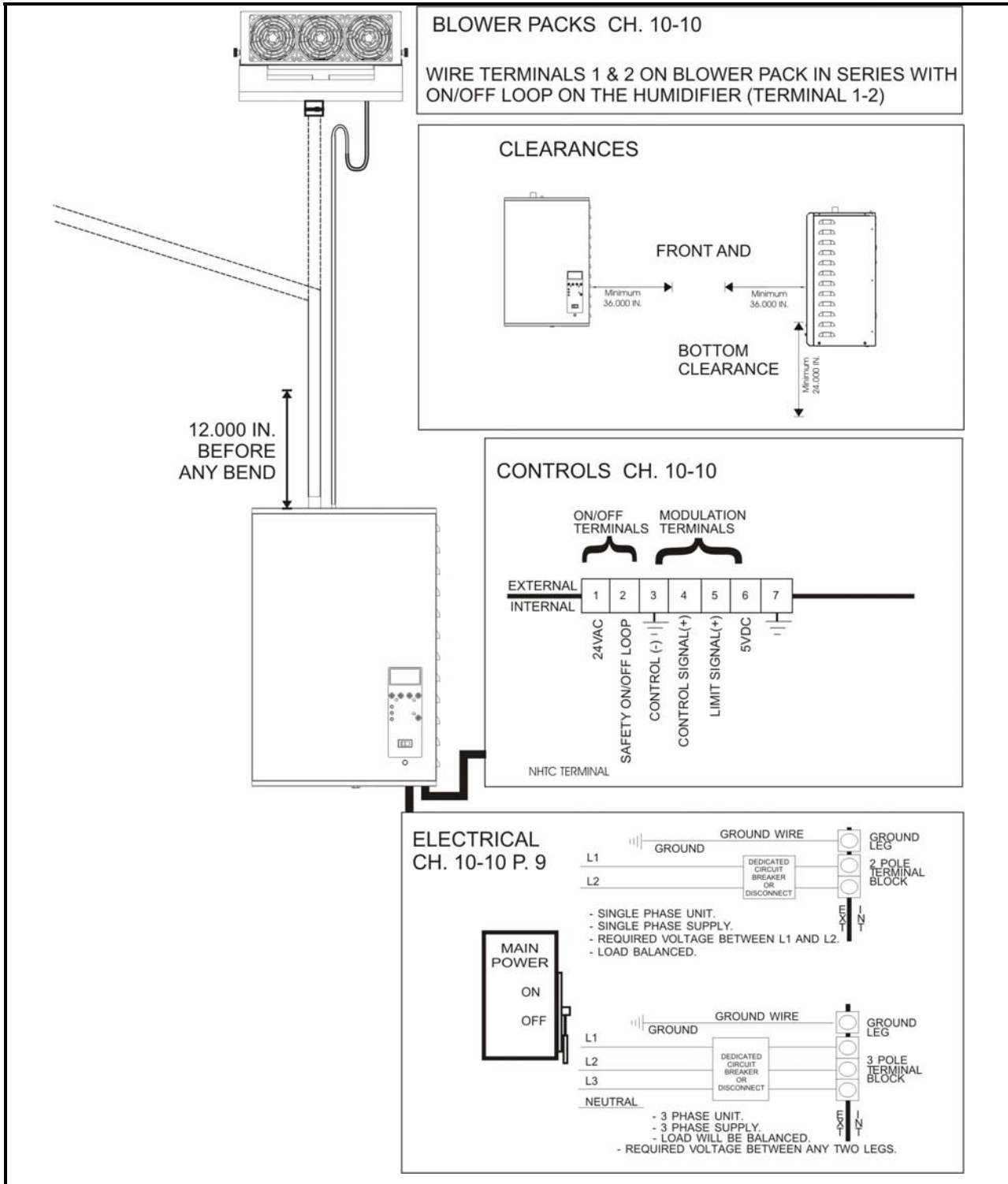


Figure 7. Typical NHRS Installation (Sheet 2 of 2)

10-10

**HUMIDITY,
STEAM ABSORPTION
AND
DISTRIBUTION**

HUMIDITY, STEAM ABSORPTION AND DISTRIBUTION

1. HUMIDITY

A. ESTIMATING THE HUMIDIFICATION LOAD

Note: The humidification load can easily be calculated by using Nortec's Humidification Engineering and Load-sizing Program (HELP). The software can be downloaded at www.humidity.com

- (1) Relative humidity is the percentage of moisture in the volume of air at a given temperature, compared to the maximum amount of moisture that the volume of air can hold at the same temperature and atmospheric pressure. As air becomes warmer, it can absorb more moisture per unit volume. Therefore a quantity of air containing a specific amount of moisture will have different values of relative humidity as the temperature changes.
- (2) It is this process that causes dry air in building. As cold incoming air is heated, its relative humidity value drops. Therefore moisture must be added to attain an acceptable level of humidity within the building. Determining how much moisture must be added is the object of this brochure. Table 2 simplifies the calculations which are described here in detail.

B. LOAD CALCULATION SUMMARY

- (1) In order to determine the humidification load three basic values need to be known:
 - (a) The design conditions of the humidified space, i.e., the temperature and humidity required.
 - (b) The conditions of the incoming air, i.e., the temperature and humidity available.
 - (c) Incoming air volume and secondary conditions that can affect the humidification load.
- (2) Data and calculations required to estimate humidification load are described in Tables 1, 2 and 3.

C. TEMPERATURE AND HUMIDITY REQUIRED

- (1) The design temperature and humidity of a space depends mostly upon the job being performed. Once the design temperature and humidity have been established, the required moisture can be found in gr/ft^3 from Table 3. Remember always to take the worst case (highest temperature, highest humidity).
- (2) *Formula 1*

For example:

The press room of a printing plant should be kept at 76 - 80° F with 43% - 47% rh

Therefore, the worst case is 80° F, 47% rh.

From Table 3 the required moisture is $11.04 \text{ gr}/\text{ft}^3 \times 47\% = 5.19 \text{ gr}/\text{ft}^3$

D. TEMPERATURE AND HUMIDITY AVAILABLE

- (1) The outdoor conditions tell us the moisture available in the incoming air. Approximate values can be obtained from Table 4 and combined with Table 3 to find moisture available. Once again we must take the worst case (here, it is lowest temperature, lowest humidity). As can be seen, the contribution of moisture from the outside air is almost zero.

Table 1. Outdoor/Indoor Relative Humidity Conversion Chart

Outdoor relative humidity	100%	2	4	5	6	7	9	12	17	19	23	29	36	43	52
	95%	2	3	4	6	7	9	12	16	17	22	28	34	41	50
	90%	2	3	4	5	6	8	11	15	16	21	26	31	39	48
	85%	2	3	4	5	6	8	11	14	15	20	24	29	37	45
	80%	2	3	4	5	6	7	10	13	15	19	23	27	35	42
	75%	2	3	4	4	5	7	10	12	14	18	22	26	33	39
	70%	1	2	3	4	5	6	9	11	13	17	20	24	31	36
	65%	1	2	3	4	4	5	8	10	12	15	19	23	29	34
	60%	1	2	3	3	4	5	7	9	11	14	17	21	26	31
	55%	1	1	3	3	4	4	7	8	10	13	16	19	24	29
	50%	1	1	2	3	3	4	6	8	9	12	14	18	22	26
	45%	1	1	2	3	3	4	6	7	8	11	13	16	20	24
	40%	1	1	2	2	3	4	5	7	7	10	12	14	18	21
	35%	1	1	2	2	2	4	5	6	6	9	10	12	15	18
	30%	0	1	2	2	2	3	4	5	6	7	9	11	13	15
	25%	0	1	1	1	2	3	3	4	5	5	7	9	11	13
20%	0	1	1	1	2	2	3	3	4	5	5	7	9	10	
15%	0	0	1	1	1	1	2	3	3	4	4	5	6	8	
10%	0	0	0	1	1	1	2	2	2	3	3	3	4	6	
5%	0	0	0	0	0	0	1	1	1	2	2	2	3	3	
0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		-20°	-10°	-5°	0°	+5°	+10°	+15°	+20°	+25°	+30°	+35°	+40°	+45°	+50°

Chart shows what the residual indoor RH would be at 70°F under varying outdoor conditions if a proper humidification system were not installed in the building. Studies indicate that the recommended RH should be between 40% and 60% for optimum benefits to the occupants.

Table 2. Load Calculation Summary Sheet

Determine the moisture required in the space (Table 3)

Grains from Table 3 at space temp. _____ x Indoor RH = A _____ gr/ft³

Determine the moisture level of incoming air (Table 4)

Grains from Table 4 at space temp. _____ x Outdoor RH = B _____ gr/ft³

Therefore: moisture to be added: (moisture) M - A - B _____ gr/ft³ → M _____ gr/ft³

Determine the volume of air to be humidified. Choose the largest value.

- Natural ventilation: Volume x number of air changes. _____ ft³/hr
- Exhaust air: CFM x 60 min/hr _____ ft³/hr
- Make-up air: CFM x 60 min/hr _____ ft³/hr → C _____ ft³/hr

Therefore: Gross humidification load = L (load) = $\frac{M \times C}{7,000}$ = _____ lbs/hr → L _____ lbs/hr

NOTES: 1. 7,000 grains = 1 pound
 2. If HVAC system uses economizer cycle, check load using formula 6.

Table 3. Grains of Water Per Cubic Foot – Saturated Air (100% rh)

°C	°F	Grains	°C	°F	Grains	°C	°F	Grains	°C	°F	Grains	°C	°F	Grains	°C	°F	Grains
-23	-10	.29	4	40	2.86		58	5.41		76	9.75	35	95	17.28		114	29.34
	-5	.35		41	2.97		59	5.60		77	10.06		96	17.80		115	30.13
-18	0	.48		42	3.08	16	60	5.80		78	10.40		97	18.31	49	120	34.38
	8	.61		43	3.20		61	6.00		79	10.80		98	18.85		125	39.13
-12	10	.78		44	3.32		62	6.20	27	80	11.04		99	19.39	54	130	44.41
-9	15	.99	7	45	3.44		63	6.41		81	11.40	38	100	19.95		135	50.30
-7	20	1.24		46	3.56		64	6.62		82	11.75		101	20.52	60	140	56.81
-4	25	1.56		47	3.69	18	65	6.85		83	12.11		102	21.11		145	64.04
-1	30	1.95		48	3.83		66	7.07		84	12.49		103	21.71	66	150	72.00
	31	2.04		49	3.97		67	7.31	29	85	12.87		104	22.32		155	80.77
	32	2.13	10	50	4.11		68	7.57		86	13.27	41	105	22.95	71	160	90.43
	33	2.21		51	4.26		69	7.80		87	13.67		106	23.60		165	101.00
	34	2.29		52	4.41	21	70	8.10		88	14.08		107	24.26	77	170	112.60
2	35	2.38		53	4.56		71	8.32		89	14.51		108	24.93		175	125.40
	36	2.47		54	4.72		72	8.59	32	90	14.94		109	25.62	82	180	139.20
	37	2.56	13	55	4.89		73	8.87		91	15.39	43	110	26.34		185	154.30
	38	2.66		56	5.06		74	9.15		92	15.84		111	27.07	88	190	170.70
	39	2.76		57	5.23	24	75	9.45		93	16.31		112	27.81		195	188.60
										94	16.79		113	28.57			

(2) *Formula 2*

Assume our printing plant is located in Denver, Colorado. From Table 4, the worst case is -10° F with 37% rh

*From Table 3:
0.29 gr/ft³ x 37% rh = 0.11 gr/ft³*

Combining this result with that of Moisture Required (A) we see that we will need 5.19 - 0.11 = 5.08 grains of moisture for every cubic foot of outside air brought in.

E. INCOMING AIR VOLUME

- (1) The following outlines the steps necessary to determine the amount of outside air being brought into the humidified space and the corresponding amount of moisture required. There are three basic means by which outside air is introduced into the humidified space. These are:
 - (a) Through natural ventilation, for example, opening and closing doors and windows, and by infiltration through cracks and openings in the building construction.
 - (b) Through mechanical ventilation, for example, the introduction of make-up air, or the exhausting of stale air by the building HVAC system.
 - (c) Through the economizer section of the HVAC system - if this feature is included in the system.
- (2) For maximum accuracy, all three should be estimated and the largest chosen.

Table 4. Design Outdoor Conditions

State	City	°C	Dry Bulb °F	JANUARY Relative Humidity (% RH)			Dry Bulb °F	JULY Relative Humidity (% RH)			°C
				7:30 A.M.	1:30 P.M.	7:30 P.M.		7:30 A.M.	1:30 P.M.	7:30 P.M.	
Alabama	Birmingham	-12	10	81	61	66	95	84	56	68	35
	Mobile	-12	10	--	--	--	95	90	64	78	35
Arizona	Flagstaff	-23	-10	83	58	--	90	77	36	--	32
	Phoenix	-4	25	75	47	39	105	53	31	23	41
	Yuma	-1	30	56	37	27	110	51	31	23	44
Arkansas	Little Rock	-15	5	80	67	68	95	85	55	59	35
California	Eureka	-1	30	87	--	77	90	92	--	80	32
	Fresno	-4	25	93	80	66	105	61	36	20	41
	Los Angeles	2	35	63	46	51	90	85	50	54	32
	Sacramento	-1	30	90	82	70	100	76	46	28	38
	San Diego	2	35	76	58	60	85	86	68	65	29
	San Francisco	2	35	84	68	70	85	92	75	78	29
Colorado	Denver	-23	-10	54	37	41	95	55	27	30	35
	Grand Junction	-26	-15	77	64	64	95	48	27	22	35
	Pueblo	-29	-20	67	44	48	95	73	34	35	35
Connecticut	New Haven	-18	0	75	65	69	95	77	64	74	35
Delaware	Wilmington	-18	0	77	62	70	95	80	52	69	35
District of Columbia	Washington	-18	0	73	56	64	95	78	52	64	35
Florida	Jacksonville	-4	25	89	56	75	95	85	57	76	35
	Miami	2	35	87	59	75	91	83	64	76	33
Georgia	Atlanta	-12	10	80	64	69	95	83	57	68	35
	Augusta	-12	10	84	59	69	98	83	55	69	37
	Savannah	-7	20	83	58	72	95	85	61	80	35
Idaho	Boise	-23	-10	82	75	74	95	54	34	23	35
	Lewiston	-20	-5	79	73	71	95	64	37	25	35
Illinois	Cairo	-18	0	81	69	--	98	83	57	--	37
	Chicago	-23	-10	81	70	75	95	78	51	55	35
	Peoria	-23	-10	83	72	77	96	81	53	58	35
Indiana	Fort Wayne	-23	-10	84	75	81	95	84	53	58	35
	Indianapolis	-23	-10	83	72	78	95	84	54	60	35
	Terre Haute	-18	0	82	70	76	95	77	50	56	35
Iowa	Davenport	-26	-15	--	--	--	95	--	--	--	35
	Sioux City	-29	-20	78	67	72	95	86	55	54	35
Kansas	Dodge City	-23	-10	78	57	61	95	77	45	52	35
	Topeka	-23	-10	78	64	67	100	85	54	54	38
Kentucky	Louisville	-18	0	78	68	69	95	77	52	57	35
Louisiana	New Orleans	-7	20	85	67	73	95	84	64	72	35
	Shreveport	-7	20	83	67	66	100	86	56	62	38
Maine	Portland	-21	-5	81	65	74	90	78	58	76	32
Maryland	Baltimore	-18	0	72	68	56	95	71	52	65	35
Massachusetts	Boston	-18	0	72	59	67	92	72	55	70	33
Michigan	Detroit	-23	-10	82	71	77	95	74	50	56	35
	Grand Rapids	-23	-10	85	78	80	95	76	51	54	35
Minnesota	Duluth	-32	-25	78	74	74	93	87	61	66	33
	Minneapolis	-29	-20	82	72	75	95	82	54	54	35
Mississippi	Vicksburg	-12	10	82	65	67	95	87	61	70	35
Missouri	Kansas City	-23	-10	78	64	66	100	76	48	47	38
	St. Louis	-18	0	77	65	68	95	73	50	55	35
Montana	Billings	-32	-25	67	73	60	90	65	40	33	32
	Butte	-29	-20	76	70	71	95	82	36	33	35
Nebraska	North Platte	-29	-20	80	62	66	85	84	50	46	29
	Omaha	-23	-10	82	68	73	95	80	51	51	35
Nevada	Reno	-21	-5	82	67	54	95	72	25	20	35
New Hampshire	Concord	-26	-15	78	60	69	90	80	49	69	32

Table 4. Design Outdoor Conditions (cont)

State	City	°C	Dry Bulb °F	JANUARY Relative Humidity (% RH)			Dry Bulb °F	JULY Relative Humidity (% RH)			°C
				7:30 A.M.	1:30 P.M.	7:30 P.M.		7:30 A.M.	1:30 P.M.	7:30 P.M.	
New Jersey	Atlantic City	-15	5	79	68	74	95	81	72	82	35
	Newark	-18	0	72	79	65	95	75	51	65	35
	Trenton	-18	0	73	62	68	95	77	55	68	35
New Mexico	Albuquerque	-18	0	68	51	46	95	59	33	28	35
New York	Albany	-23	-10	75	63	71	93	79	52	64	34
	Buffalo	-21	-5	79	72	78	93	78	53	63	34
	New York	-18	0	72	61	66	95	75	58	68	35
	Rochester	-21	-5	81	73	79	95	80	50	60	35
North Carolina	Asheville	-18	0	82	59	69	93	88	56	73	34
	Raleigh	-12	10	82	57	69	95	86	55	72	35
North Dakota	Bismarck	-34	-30	77	71	75	95	85	52	49	35
Ohio	Cincinnati	-18	0	82	70	74	95	84	52	60	35
	Cleveland	-18	0	81	72	79	95	79	52	58	35
	Columbus	-23	-10	83	71	76	95	78	52	60	35
	Toledo	-23	-10	79	72	75	95	76	52	59	35
Oklahoma	Oklahoma City	-18	0	79	62	65	101	80	49	51	38
Oregon	Baker	-21	-5	83	81	78	90	69	68	36	32
	Portland	12	10	87	82	78	90	86	63	48	32
Pennsylvania	Harrisburg	-18	0	72	49	65	95	78	51	62	35
	Philadelphia	-18	0	74	65	68	95	78	52	64	35
	Pittsburgh	-18	0	77	67	63	95	80	52	63	35
	Scranton	-21	-5	80	67	--	95	77	50	--	35
Rhode Island	Providence	-18	0	73	60	67	93	79	57	73	34
South Carolina	Charleston	-9	15	87	55	76	95	88	64	82	35
	Columbia	-12	10	81	57	65	95	83	56	68	35
South Dakota	Huron	-29	-20	79	72	76	95	86	52	49	35
	Rapid City	-29	-20	71	69	67	95	71	42	40	35
Tennessee	Knoxville	-18	0	83	65	69	95	83	55	66	35
	Memphis	-18	0	82	67	73	95	85	55	59	35
Texas	Amarillo	-23	-10	71	51	52	100	77	43	42	38
	Corpus Christi	-7	20	88	66	75	95	93	58	68	35
	Dallas	-12	10	81	62	62	100	79	50	47	38
	El Paso	-12	10	63	45	39	100	60	37	30	38
	Houston	-7	20	85	66	73	95	90	58	66	35
	San Antonio	-7	20	82	60	59	100	88	49	45	38
Utah	Salt Lake City	-23	-10	80	71	72	95	56	27	23	35
Vermont	Burlington	-23	-10	81	69	78	90	76	54	67	32
Virginia	Richmond	-9	15	84	60	68	95	81	57	72	35
Washington	Seattle	-9	15	86	80	74	85	86	63	47	29
	Walla Walla	-21	-5	80	74	78	95	50	33	22	35
West Virginia	Charleston	-18	0	79	64	70	95	88	53	67	35
	Parkersburg	-23	-10	82	66	74	95	80	52	65	35
Wisconsin	Green Bay	-26	-15	75	68	73	95	85	58	64	35
	Milwaukee	-26	-15	76	70	73	95	81	58	64	35
Wyoming	Cheyenne	-26	-15	59	48	55	95	73	36	40	35
Province	City										
Alberta	Calgary	-34	-29		71		87		34		31
	Edmonton	-34	-29		75		86		42		30
	Grande Prairie	-42	-43		80		84		38		29
	Lethbridge	-36	-32		66		91		30		33
	Medicine Hat	-34	-30		73		96		31		36
British Columbia	Estevan Point	-8	17		84		87		32		31
	Fort Nelson	-40	-40		79		94		32		34
	Penticton	-18	0		81		85		44		29
	Prince George	-38	-37		82		73		53		23
	Prince Rupert	-12	11		87		80		54		27
	Vancouver	-9	15		87		80		41		27

Table 4. Design Outdoor Conditions (cont)

Province	City	°C	Dry Bulb °F	JANUARY Relative Humidity (% RH)			Dry Bulb °F	JULY Relative Humidity (% RH)			°C
				7:30 A.M.	1:30 P.M.	7:30 P.M.		7:30 A.M.	1:30 P.M.	7:30 P.M.	
Manitoba	Brandon	-34	-29		73		90		50		32
	Churchill	-40	-40		76		79		57		26
	The Pas	-37	-35		77		85		54		29
	Winnipeg	-34	-29		78		90		50		32
New Brunswick	Campbellton	-28	-18		77		87		54		31
	Fredericton	-27	-16		72		89		47		32
	Moncton	-24	-12		82		88		52		31
	Saint John	-24	-12		82		81		62		27
Newfoundland	Corner Brook	-23	-10		84		84		47		29
	Gander	-21	-5		76		85		45		29
	Goose Bay	-32	-26		85		86		42		30
	St. John's	-17	1				79		60		26
N.W.T.	Frobisher	-43	-45		77		63		67		17
	Resolute	-45	-49		71		54		81		12
	Yellowknife	-45	-49		82		78		50		26
Nova Scotia	Halifax	-18	0		83		83		50		28
	Sydney	-17	1		84		84		56		29
	Yarmouth	-15	5		83		76		70		24
Ontario	Thunder Bay	-33	-27		80		86		52		30
	Hamilton	-18	0		75		91		52		33
	Kaspuksasing	-34	-30		79		87		52		31
	Kingston	-24	-11				85		69		29
	Kitchener	-19	-3		84		88		58		31
	London	-18	0		80		90		53		32
	North Bay	-29	-20		77		87		46		31
	Ottawa	-27	-17				90		50		32
	Peterborough	-25	-13		77		90		53		32
	Sioux Lookout	-36	-33		78		65		69		18
	Sudbury	-29	-20		81		89		44		32
	Timmins	-36	-33		79		90		45		32
	Toronto	-19	-3		82		90		56		32
	Windsor	-16	-3				92		51		31
Sault St. Marie	-29	-20				88		48		29	
P.E.I.	Charlottetown	-21	-6		86		84		57		29
Quebec	Knob Lake	-40	-40		79		55		70		13
	Mont Joli	-24	-11		75		62		71		17
	Montreal	-27	-16				88		58		31
	Port Harrison	-39	-39		76						
	Quebec City	-28	-19		81		86		60		30
	Sept-Iles	-33	-27				80		47		27
	Sherbrooke	-28	-18				87		58		31
Trois Rivieres	-28	-18				88		58		31	
Saskatchewan	Prince Albert	-41	-41		77		88				31
	Regina	-37	-34		81		92				33
	Saskatoon	-37	-34		76		90				32
	Swift Current	-34	-29		79		93				34
Yukon Territory	Dawson	-49	-56		76		57		60		14
	Whitehorse	-43	-45		80		78		40		26

- (3) Using the natural ventilation method requires knowing the volume of the humidified space and the type of construction. A tightly constructed building will have a least one air change per hour. A loosely constructed building will have at least one and one half changes per hour, and this same building with a large amount of incoming or exiting traffic will have at least two air changes per hour.

(a) *Formula 3*

Assume our print shop has a floor area of 100' x 100' with a 20' ceiling with a large amount of traffic. This requires

$$100' \times 100' \times 20' \times 2 = 400,000 \text{ ft}^3/\text{hr.}$$

Using our example, the moisture required is

$$\frac{400,000 \times 5.08}{7000 \text{ grains/lb}} = 290 \text{ lbs/hr}$$

- (4) Using make-up air:

(a) *Formula 4*

Assume our print shop has a 15,000 CFM HVAC system and uses 10% make-up air during winter. The amount of outside make-up air entering the HVAC system will, therefore, be 10% of 15,000 CFM = 1,500 CFM. The moisture required will be

$$\frac{1,500 \times 5.08 \times 60 \text{ min/hr}}{7,000 \text{ grains/lb}} = 65 \text{ lbs/hr}$$

(Refer to Figure 1.)

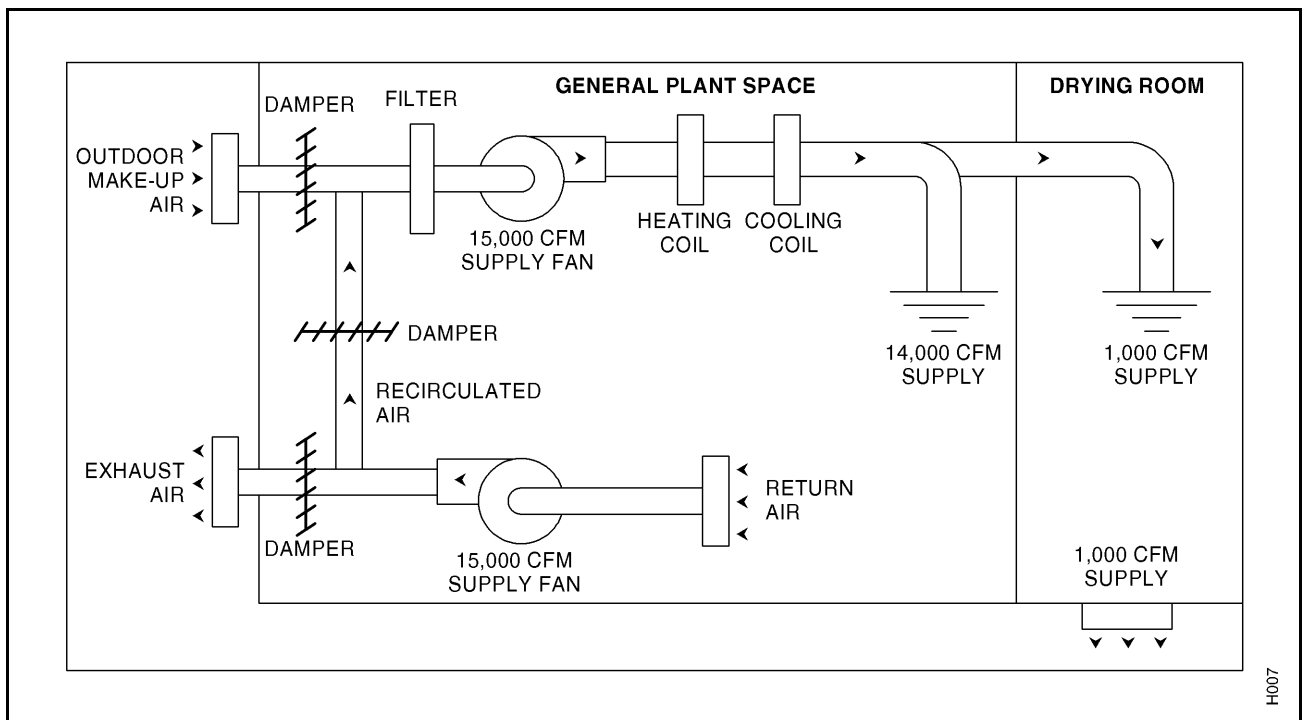


Figure 1. Schematic of a Typical Print Shop HVAC System

(5) Using an exhaust air fan:

(a) *Formula 5*

Assume the print shop has a 1,000 CFM fan to exhaust a drying room. The moisture required to humidify the drying room only is

$$\frac{1,000 \times 5.08 \times 60 \text{ min/hr}}{7,000 \text{ grains/lb}} = 44 \text{ lbs/hr}$$

(Refer to Figure 1.)

(6) Using an economizer cycle:

(a) Care should be taken in sizing humidification load when an economizer cycle is incorporated into a building HVAC system. The purpose of an economizer cycle is to provide building cooling using outside air, rather than the building refrigeration system when outside air conditions permit.

(b) The economizer cycle senses and compares outdoor air temperature and return air temperature during the cooling season.

(c) When the HVAC system calls for cooling and the outdoor air temperature is low enough – typically 55°F or lower – the outside air and exhaust air dampers are positioned to provide the required supply air temperature to maintain cooling, and the recirculated air damper is positioned to maintain the required supply air volume. When the outdoor air temperature is higher than the supply air temperature required to maintain cooling but is lower than the return air temperature, the make-up air and exhaust air dampers are 100% open. The recirculation air damper closes, and the building refrigeration system provides the portion of cooling load that cannot be provided by outside air intake.

(d) From this it can be seen that it is possible to introduce 100% outside air into a building during the cooling season.

(e) *Formula 6*

For example, if our print shop were using 100% outdoor air at 55°F and 40% rh, then the moisture required is

$$5.19 - (4.89 \times 40\% \text{ rh}) = 3.23 \text{ gr/ft}^3$$

Therefore, on a 15,000 CFM system, the humidification load will be

$$\frac{15,000 \times 3.23 \times 60 \text{ min/hr}}{7,000 \text{ grains/lb}} = 415 \text{ lbs/hr}$$

(f) In the above examples, the largest humidification load was due to the economizer cycle at 415 lbs/hr.

(7) Using cooling or refrigeration loads:

(a) As air is cooled, it loses its ability to hold moisture. If it is cooled enough, some of the moisture will condense out. This is known as cooling load. Cooling load calculations can be important for process applications or refrigeration applications to product dehydration.

(b) *Formula 7*

Assume that during the summer the HVAC system is in the cooling mode. The air leaving the cooling coil is at 55°F and 90% rh. In order to maintain the desired 47% rh in the space, moisture must be added using the following formula:

$$\text{Desired space } 80^{\circ}\text{F } 47\% \text{ rh} = 5.19 \text{ gr/ft}^3$$

(Formula 1)

$$\frac{55^{\circ}\text{F } 90\%}{\text{Grains to add}} = \frac{4.89 \times 0.90}{\text{Grains to add}} = \frac{4.40 \text{ gr/ft}^3}{\text{Grains to add}} = 0.79 \text{ gr/ft}^3$$

$$\frac{15,000 \times 0.79 \times 60 \text{ min/hr}}{7,000 \text{ grains/lb}} = 101.57 \text{ lbs/hr}$$

- (8) In considering Process and Environment, in Tables 5 through 7 you will find conditions and processes that may affect your calculation and should be addressed.
- (a) Table 5 shows the outdoor temperature at which the rh would cause condensation on the windows to the outside. Should your outdoor conditions make this a possibility, an outdoor setback sensor may be a solution.
 - (b) Table 6 describes the moisture gain of various material and if your process or environment includes a great amount of these materials that are constantly introduced to the area, its affects must be considered.
 - (c) Table 7 identifies many recommended indoor conditions for various locations and processes, these can be of use when deciding what conditions would be most beneficial in your application.
 - (d) In Figure 2, you will find the ASHRAE psychrometric chart describing the enthalpy of dry air and the effects to and from rh in the air.

Table 5. Inside Relative Humidities At Which Moisture Will Condense On Windows

Outside Temperature		Inside Temperature (°F/°C)					Outside Temperature		Inside Temperature (°F/°C)				
°F	°C	60/ 15.5	65/ 18.3	70/ 21	75/ 23.8	80/ 26.6	°F	°C	60/ 15.5	65/ 18.3	70/ 21	75/ 23.8	80/ 26.6
Single Windows, Still Air							Single Windows, Wind						
-50	-45	9	9	9	8	8	-50	-45	4	3	3	3	2
-40	-40	12	12	11	10	10	-40	-40	5	4	4	4	3
-30	-34	16	14	14	13	13	-30	-34	7	6	6	6	5
-20	-29	20	18	18	17	16	-20	-29	10	9	9	8	7
-10	-23	25	23	22	21	20	-10	-23	14	13	12	11	10
0	-18	32	29	27	25	24	0	-18	20	18	16	15	13
10	-12	39	36	33	31	29	10	-12	28	24	22	20	18
20	-7	47	43	40	37	35	20	-7	36	32	30	26	24
30	-1	57	52	50	45	42	30	-1	48	41	38	34	30
40	4	70	63	60	53	50	40	4	62	54	49	43	40

NOTE: Bold areas indicate that moisture will be in the form of frost on windows.

Table 5. Inside Relative Humidities At Which Moisture Will Condense On Windows (cont)

Outside Temperature		Inside Temperature (°F/°C)					Outside Temperature		Inside Temperature (°F/°C)				
°F	°C	60/ 15.5	65/ 18.3	70/ 21	75/ 23.8	80/ 26.6	°F	°C	60/ 15.5	65/ 18.3	70/ 21	75/ 23.8	80/ 26.6
Double Windows, Still Air							Double Windows, Wind						
-50	-45	34	34	34	33	32	-50	-45	23	26	26	26	25
-40	-40	38	38	36	36	35	-40	-40	32	30	30	29	28
-30	-34	42	42	41	40	38	-30	-34	36	34	34	32	31
-20	-29	47	46	46	44	42	-20	-29	41	39	38	35	35
-10	-23	52	50	49	48	46	-10	-23	46	45	42	42	39
0	-18	57	55	55	52	50	0	-18	52	49	47	46	44
10	-12	62	60	59	57	54	10	-12	58	56	53	52	49
20	-7	69	66	63	62	59	20	-7	65	63	59	58	54
30	-1	76	73	71	68	65	30	-1	72	70	66	64	60
40	4	84	80	79	74	71	40	4	80	78	73	70	67

NOTE: Bold areas indicate that moisture will be in the form of frost on windows.

Table 6. Regain of Hygroscopic Materials

Industry	Materials	Relative Humidity - %									
		10	20	30	40	50	60	70	80	90	
Baking	Crackers	2.1	2.8	3.3	3.9	5.0	6.5	8.3	10.9	14.9	
	Flour	2.6	4.1	5.3	6.5	8.0	9.9	12.4	15.4	19.1	
	White Bread	0.5	1.7	3.1	4.5	6.2	8.5	11.1	14.5	19.0	
Leather	Sole Oak, Tanned	5.0	8.5	11.2	13.6	16.0	18.3	20.6	24.0	29.2	
Printing	Paper – Comm. Ledger – 75% Rag 1% Ash	3.2	4.2	5.0	5.6	6.2	6.9	8.1	10.3	13.9	
	Paper M.F. Newsprint – 24% Ash	2.1	3.2	4.0	4.7	6.1	7.2	8.7	10.6		
	Paper White Bond Rag – 1% Ash	2.4	3.7	4.7	5.5	6.5	7.5	8.8	10.8	13.2	
	Paper Writing – 3% Ash	3.0	4.2	5.2	6.2	7.2	8.3	9.9	11.9	14.2	
Textile	Cotton – Absorbent	4.8	9.0	12.5	15.7	18.5	20.8	22.8	24.3	25.8	
	Cotton – American-cloth	2.6	3.7	4.4	5.2	5.9	6.8	8.1	10.0	14.3	
	Cotton – Sea Isle-roving	2.5	3.7	4.6	5.6	6.6	7.9	9.5	11.5	14.1	
	Hemp – Manila and Sisal	2.7	4.7	6.0	7.2	8.5	9.9	11.6	13.6	15.7	
	Jute – Average Grade	3.1	5.2	6.9	8.5	10.2	12.2	14.4	17.1	20.2	
	Linen – Dried Spun – Yarn	3.6	5.4	6.5	7.3	8.1	8.9	9.8	11.2	13.8	
	Rayon – Celulose – Acetate – Fibre	0.8	1.1	1.4	1.9	2.4	3.0	3.6	4.3	5.3	
	Rayon – Cupramonium – Average Skein	4.0	5.7	6.8	7.9	9.2	10.8	12.4	14.2	10.0	
	Rayon – Viscose Nitrocel	4.0	5.7	6.8	7.9	9.2	10.8	12.4	14.2	16.0	
	Silk – Raw Chevenes-Skein	3.2	5.5	6.9	8.0	8.9	10.2	11.9	14.3	18.8	
Wool – Australian-Marino-Skein	4.7	7.0	8.9	10.8	12.8	14.9	17.2	19.9	23.4		
Tobacco	Cigarette	5.4	8.6	11.0	13.3	16.0	19.5	25.0	33.5	50.0	
Wood	Timber – Average	3.0	4.4	5.9	7.6	9.3	11.3	14.0	17.5	22.0	
	Glue – Hide	3.4	4.8	5.8	6.6	7.6	9.0	10.7	11.8	12.5	
Miscellaneous	Charcoal-Steam Activated	7.1	14.3	22.8	26.2	28.3	29.2	30.0	31.1	32.7	
	Gelatin	0.7	1.6	2.8	3.8	4.9	6.1	7.6	9.3	11.4	
	Silica Gel	5.7	9.8	12.7	15.2	17.2	18.6	20.2	21.5	22.6	
	Soap	1.9	3.8	5.7	7.6	10.0	12.9	16.1	19.8	23.8	
	Starch	2.2	3.8	5.2	6.4	7.4	8.3	9.2	10.6	12.7	

NOTE: Moisture content expressed in per cent of dry weight of the substance at various relative humidities – Temperature 75°F.

Table 7. Design Indoor Conditions For Various Places, Products and Processes

Product and/or Process	Temperature		Relative Humidity %RH
	°F	°C	
Abrasives Manufacturing	78	25	50
Bowling Alleys	73 – 75	23 – 24	50 – 55
Billiard Rooms	73 – 75	23 – 24	40 – 50
Bread			
Flour and Powdered Product Storage	70 – 80	21 – 27	60
Fermentation (Bread Dough)	80	27	75
Retarding of Doughs	32 – 40	0 – 4	85
Final Proof	95 – 120	35 – 49	85 – 90
Counterflow Cooling	75	24	80 – 85
Brewing			
Hop Storage	29 – 32	2 – 0	50 – 60
Yeast Culture Room	--	--	80
Candy			
Chocolate Pan Supply Air	55 – 62	13 – 17	45 – 55
Enrober Room	80 – 85	27 – 29	25 – 30
Chocolate Cooling Tunnel Supply Air	40 – 45	4 – 7	70 – 85
Hand Dippers	62	17	45
Moulded Goods Cooling	40 – 45	4 – 7	70 – 85
Chocolate Packing Room and Finished Stock Storage	65	18	50
Centers Tempering Room	75 – 80	24 – 27	30 – 35
Marshmallow Setting Room	75 – 78	24 – 26	40 – 45
Grained Marshmallow (deposited in starch) Drying	110	43	40
Gum (deposited in starch) Drying	125 – 150	52 – 66	15 – 25
Sanded Gum Drying	100	38	25 – 40
Gum Finished Stock Storage	50 – 65	10 – 18	65
Sugar Pan Supply Air (engrossing)	85 – 105	29 – 41	20 – 30
Polishing Pan Supply Air	70 – 80	21 – 27	40 – 50
Pan Rooms	75 – 80	24 – 27	30 – 35
Nonpareil Pan Supply Air	100 – 120	38 – 49	20
Hard Candy Cooling Tunnel Supply Air	60 – 70	16 – 21	40 – 55
Hard Candy Packing	70 – 75	21 – 24	35 – 40
Hand Candy Storage	50 – 70	10 – 21	40
Caramel Rooms	70 – 80	21 – 27	40
Raw Material Storage			
Nuts (insect)	45	7	65 – 75
Nuts (rancidity)	34 – 38	1 – 3	65 – 75
Eggs	30	-1	85 – 90
Chocolate (flats)	65	18	50
Butter	20	-7	
Dates, Figs, etc.	40 – 45	4 – 7	65 – 75
Corn Syrup	90 – 100	32 – 38	–
Liquid Sugar	75 – 80	24 – 27	30 – 40
Comfort Air Conditioners	75 – 80	24 – 27	50 – 60
Ceramics			
Refractory	110 – 150	43 – 66	50 – 90
Molding Room	80	27	60 – 70
Clay Storage	60 – 80	16 – 27	35 – 65
Decalcomania Production and Decorating room	75 – 80	24 – 27	48
Cereal Packaging	75 – 80	24 – 27	45 – 50
Cheese Curing			
Cheddar	45 – 55	7 – 13	85 – 90
Swiss	60	16	80 – 85
Blue	48 – 50	9 – 10	95
Brick	60 – 65	16 – 18	90
Limburger	60 – 65	16 – 18	95
Camembert	53 – 59	12 – 15	90

Table 7. Design Indoor Conditions For Various Places, Products and Processes (cont)

Product and/or Process	Temperature		Relative Humidity %RH
	°F	°C	
Clean Rooms – Computer Rooms			
Computer Room	70 – 80	21 – 27	40 – 60
Clean Room – General	70 – 74	21 – 23	40 – 60
Clean Room – Critical	71.5 – 72.5	22 – 22.5	43 – 47
Distilling			
Grain Storage	60	16	35 – 40
General Manufacturing	0 – 75	16 – 24	45 – 60
Aging	65 – 72	18 – 22	50 – 60
Electrical Products			
Coil and Transformer Winding	72	22	15
X-ray Tube Assembly	68	20	40
Instruments Manufacture and Laboratory	70	21	50 – 55
Thermostat and Humidistat Assembly and Calibration	76	24	50 – 55
Close Tolerance Assembly	72	22	40 – 45
Meter Assembly and Test	76	24	60 – 63
Fuse and Cutout Assembly, Capacitor Winding and Paper Storage	73	23	50
Conductor Wrapping with Yarn	75	24	65 – 70
Lightning Arrestor Assembly	68	20	20 – 40
Thermal Circuit Breaker Assembly and Test Water Wheel Generators Thrust	76	24	30 – 60
Runner Hopping	70	21	30 – 50
Processing Selenium and Copper Oxide Plates	74	23	30 – 40
Fruit Storage			
Apples	30 – 40	-1 – 4	90
Apricots	31 – 32	-1 – 0	90 – 95
Grapefruits (California)	58 – 60	14 – 16	85 – 90
Grapefruits (Florida)	50	10	85 – 90
Grapes (Eastern)	31 – 32	-1 – 0	85
Grapes (Western)	30 – 31	-1	90 – 95
Lemons	58 – 60	14 – 16	86 – 88
Oranges (California)	40 – 44	4 – 7	85 – 90
Oranges (Florida)	32 – 34	0 – 1	85 – 90
Peaches and Nectarines	31	-1	90
Plums	30 – 32	-1 – 0	90 – 95
Specialty Citrus Fruit	38 – 40	3 – 4	90 – 95
Fur Storage	40 – 50	4 – 10	55 – 65
Gum			
Manufacture	77	25	33
Rolling	68	20	63
Stripping	72	22	53
Breaking	74	23	47
Wrapping	74	23	58
Hospitals			
Operating, Cystoscopic and Fracture Rooms	68 – 76	20 – 24	50
Patient Rooms	75	24	40 – 50
Intensive Care Unit	75	24	40
Administrative and Service Areas	70 – 80	21 – 27	30 – 50
Leather			
Drying	70 – 120	21 – 49	75
Storage, Winter Room Temperature	50 – 60	10 – 16	40 – 60
Lenses (Optical)			
Fusing	75	27	45
Grinding	80	27	80

Table 7. Design Indoor Conditions For Various Places, Products and Processes (cont)

Product and/or Process	Temperature		Relative Humidity %RH
	°F	°C	
Libraries and Museums			
Normal Reading and Viewing Rooms	70 – 74	21 – 23	40 – 50
Rare Manuscript Storage Vaults	70 – 72	21 – 22	45
Art Storage Areas	65 – 72	17 – 22	50
Matches			
Manufacture	72 – 74	22 – 23	50
Drying	70 – 75	21 – 24	60
Storage	60 – 62	16 – 17	50
Meat and Fish			
Beef (Fresh)	32 – 34	0 – 1	88 – 92
Beef, Fish, Lamb and Pork (Frozen)	-10 – 0	-23 – -18	90 – 95
Fish (Fresh)	33 – 35	1 – 3	90 – 95
Lamb and Pork (Fresh)	32 – 34	0 – 1	85 – 90
Mushrooms			
Sweating-out Period	120 – 140	49 – 60	–
Spawn Added	60 – 75	16 – 24	Nearly Sat.
Growing Period	48 – 60	9 – 16	80
Storage	32 – 35	0 – 2	80 – 85
Oil Paints: Paint Spraying	60 – 90	16 – 32	80
Pharmaceuticals			
Manufactured Powder Storage and Packaging Area	75	24	35
Milling Room, Table Compressing and Coating	75	24	35
Effervescent Tablets and Powders	75	24	20
Hypodermic Tablets	75	24	30
Colloids	70	21	30 – 50
Cough Drops	80	27	40
Glandular Products	76	24	5 – 10
Ampoule Manufacturing	75	24	35 – 50
Gelatin Capsules and Storage	76	24	35
Microanalysis	76	24	50
Biological Manufacturing and Liver Extracts	76	24	35
Serums	76	24	50
Animal Rooms	75 – 80	24 – 27	50
Plastics			
Manufacturing Areas Thermosetting	80	27	35 – 30
Molding Compounds	75 – 80	24 – 27	45 – 65
Cellophane Wrapping			
Plywood			
Hot Pressing (Resin)	90	32	60
Cold Pressing	90	32	15 – 25
Printing			
Platemaking	75 – 80	24 – 27	45 Max
Lithographic Press Room	76 – 80	24 – 27	43 – 47
Letterpress and Web Offset Press Rooms and Paper Storage	76 – 80	24 – 27	50
Paper Storage (Multicolor Sheet Feed Lithography)	76 – 80	24 – 27	5 – 8 Higher than Press Room
Rubber Dipped Goods			
Cementing	80	27	25 – 30
Dipping Surgical Articles	75 – 90	24 – 32	25 – 30
Storage Prior to Manufacture	60 – 75	16 – 24	40 – 50
Laboratory (ASTM Standard)	73.4	23	50
Tea Packaging	65	18	65

Table 7. Design Indoor Conditions For Various Places, Products and Processes (cont)

Product and/or Process	Temperature		Relative Humidity %RH
	°F	°C	
Textiles			
Opening and Picking			
Cotton	75 – 80	24 – 27	55 – 70
Man-Made	70 – 75	21 – 24	50 – 55
Carding			
Cotton	75 – 80	24 – 27	50 – 55
Wool	75 – 80	24 – 27	60 – 70
Man-Made	70 – 75	21 – 24	50 – 60
Silver and Ribbon Lapping			
Cotton	75 – 80	24 – 27	55 – 60
Man-Made	70 – 75	21 – 24	55 – 65
Combing			
Cotton	75 – 80	24 – 27	55 – 65
Wool	75 – 80	24 – 27	65 – 75
Man-Made	70 – 75	21 – 24	55 – 65
Drawing			
Cotton and Wool	75 – 80	24 – 27	50 – 60
Man-Made	70 – 75	21 – 24	50 – 60
Roving			
Cotton	75 – 80	24 – 27	50 – 60
Man-Made	70 – 75	21 – 24	50 – 60
Spinning			
Cotton	75 – 80	24 – 27	35 – 60
Wool	75 – 80	24 – 27	50 – 55
Man-Made	70 – 75	21 – 24	50 – 65
Winding and Spooling			
Cotton	75 – 80	24 – 27	55 – 65
Wool	75 – 80	24 – 27	55 – 60
Man-Made	70 – 75	21 – 24	60 – 65
Twisting			
Cotton	75 – 80	24 – 27	50 – 65
Man-Made	70 – 75	21 – 24	50 – 65
Warping			
Cotton	75 – 80	24 – 27	55 – 70
Wool	75 – 80	24 – 27	50 – 65
Man-Made	70 – 75	21 – 24	50 – 65
Knitting			
Cotton	76	24	60 – 65
Man-Made	76	24	50 – 60
Weaving			
Cotton	75 – 80	24 – 27	70 – 85
Wool	75 – 80	24 – 27	50 – 60
Man-Made	70 – 75	21 – 24	60 – 70
Tobacco			
Cigar and Cigarette Making	70 – 75	21 – 24	55 – 65
Softening	90	32	85 – 88
Stemming and Stripping	75 – 85	24 – 29	70 – 75
Filler Tobacco Casing and Conditioning	75	24	75
Filler Tobacco Storage and Preparation	78	26	70
Wrapper Tobacco Storage and Conditioning	75	24	75

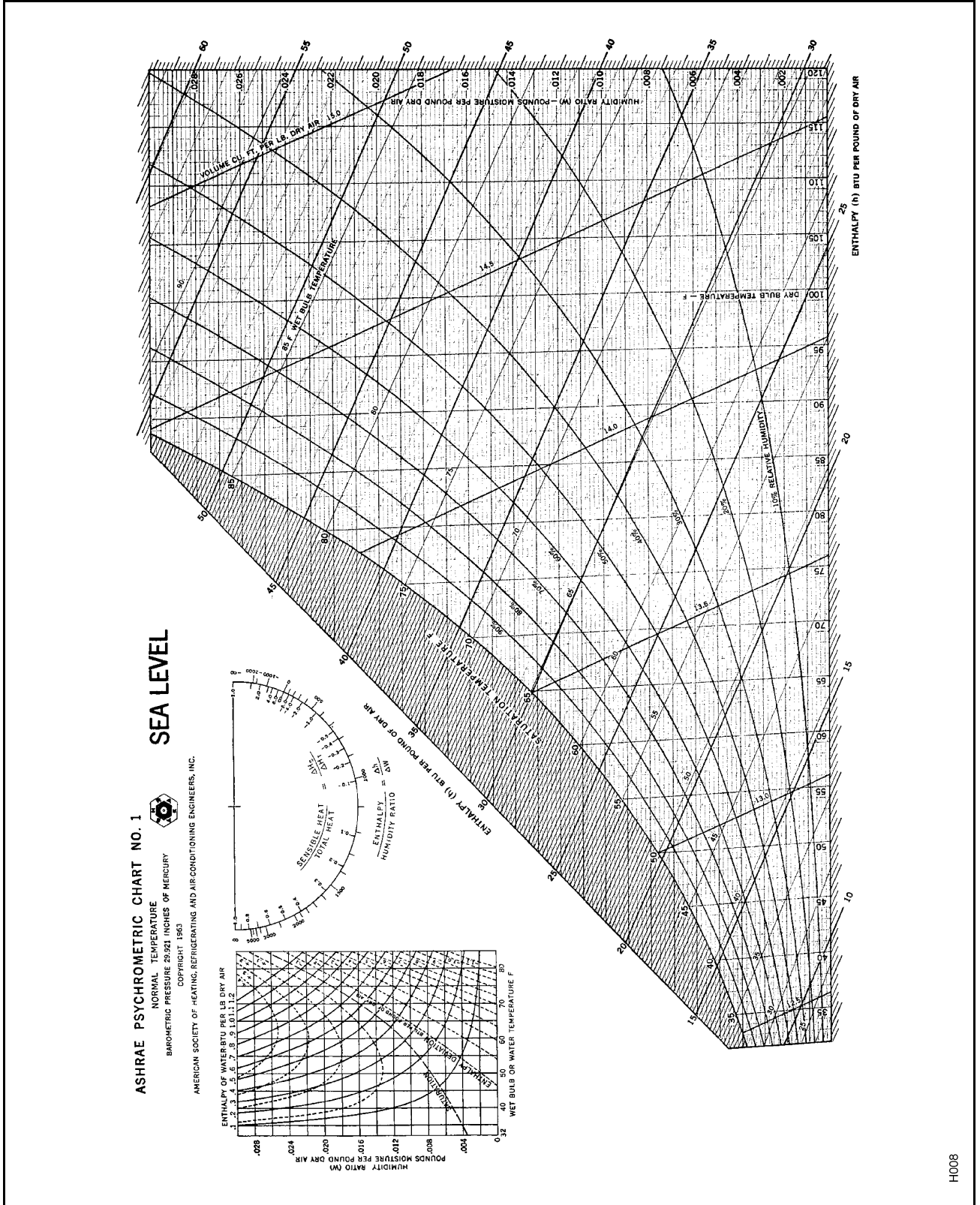


Figure 2. Psychrometric Chart

2. STEAM ABSORPTION AND DISTRIBUTION

A. VARIABLES THAT AFFECT ABSORPTION DISTANCES

- (1) This manual will help in the design of a steam distribution system to provide the optimum performance from the humidifier and absorption of steam within the duct system.
- (2) Experience has shown that absorption of steam is affected primarily by the psychrometric conditions of the air based on how much residual capacity at a given air volume and temperature exist to hold the moisture being introduced.
- (3) To properly introduce steam into an air stream, five variables must be known:
 - (a) Temperature (°F or °C). If the air temperature varies, pick the lowest temperature.
 - (b) Highest humidity level before the distributor (%rh).
 - (c) The amount of moisture being added resulting in a change of rh in the duct or plenum (Δ %rh).
 - (d) Minimum velocity of the air (FPM).
 - (e) The size of the duct or plenum (cross section area).
- (4) As a guide, Table 8 shows how each variable affects the absorption distance.
- (5) Table 9 shows examples of typical absorption distances in air handling systems.
- (6) Referring to Figure 3, 'D' can vary between 1 to 20 feet depending on the airflow's:
 - (a) Velocity (V)
 - (b) Temperature (T)
 - (c) Humidity (H)
- (7) When (V) is 500 fpm, (T) is high (90 to 130°F) and (H) is low (10% to 30% rh) the 'D' will be 1 to 2 feet. As the (H) goes up 'D' becomes longer. Similarly, as (T) goes down, 'D' goes up. High velocity also increases 'D' by moving the steam further down stream before it can mix. Multiple distributors will shorten the steam absorption distance.

Table 8. Variables That Affect Absorption Distances

Variables	Effect On Absorption Distance (NOTE: ↑ Increase ↓ Decrease)
Air Temperature ↑	↓
Air Temperature ↓	↑
Air Humidity ↑	↑
Air Humidity ↓	↓
Large Increase of RH	↑
Small Increase of RH	↓
High Air Velocity (1000 fpm or above)	↑
Low air Velocity (between 100 and 500 fpm)	↓
Small Duct or Plenum (short distributor)	↑
Large Duct or Plenum (long distributor)	↓

Table 9. Typical Absorption Distances, Single Distributor, 100 lbs/hr Humidifier

FPM	°F	°C	% RH	FT	CM	Typical System
(V)	(T)		(H)	(D)		
500	70	21	30	3.0	91	Air handler before coils
500	55	13	80	4.5	137	Air handler after cooling
900	70	21	30	3.5	107	Supply air duct, on cool, no heat
900	55	13	70	6.0	183	Supply air duct, on cool
1000	55	13	90	8.0	244	Supply air duct, on cool with high humidity
1000	110	43	10	2.5	76	Supply air duct, on heating with low humidity
1000	70	21	45	4.0	123	Return air duct conditions
2000	55	13	45	10.0	305	Supply air duct higher pressure system
5000	140	60	10	2.0	61	After operating heating coil

(V) = Velocity at distributor location (T) = Temperature at distributor location
(D) = Absorption distance (visible steam) (H) = Humidity level after steam is absorbed

NOTE: This chart is for reference only; multiple distributors can reduce absorption distances.

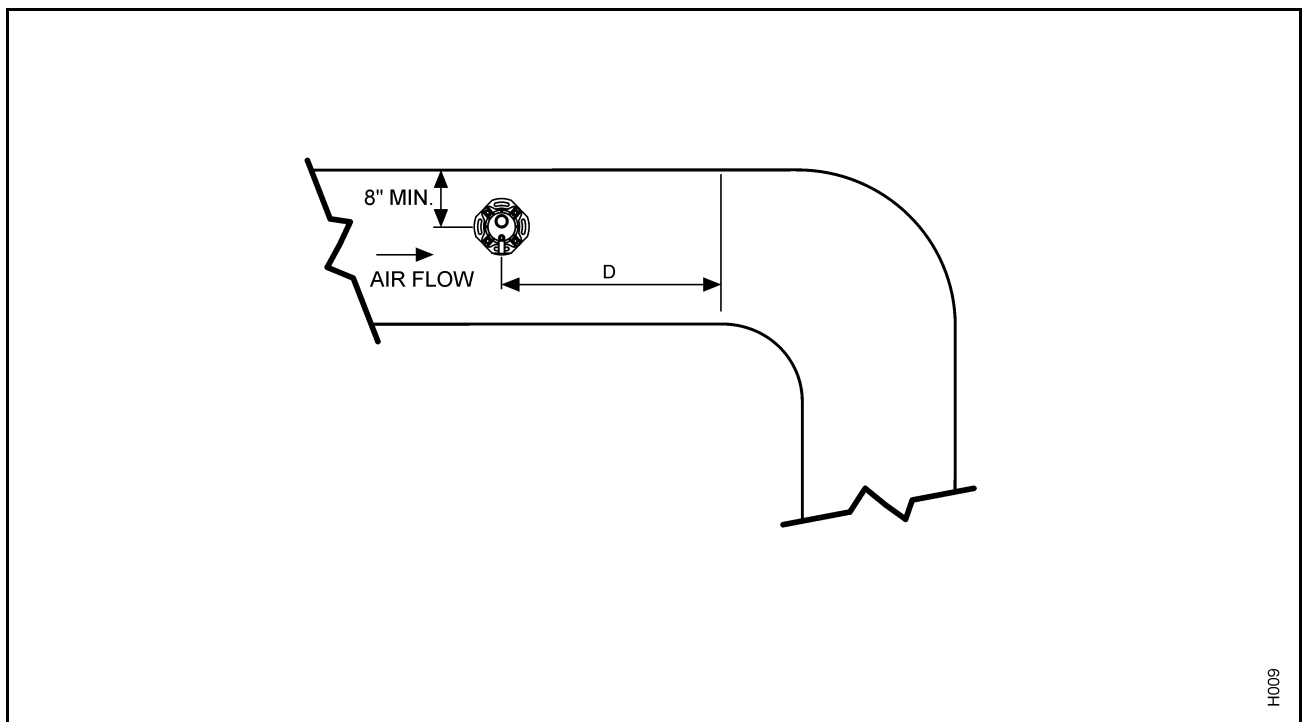


Figure 3. Steam Distributor Location

B. CALCULATING THE DOWN STREAM HUMIDITY LEVEL

- (1) Table 10 indicates the amount of water that each 1000 CFM of duct air holds in pounds of water per hour at various combinations of air temperature and relative humidity. Subtract the water vapour in the duct air before the steam distributor from the maximum allowed after the distributor. The chart indicates how many lbs/hr of water can be added to 1000 CFM of airflow.

Table 10. Water (lbs/hr) Contained in 1000 CFM of Air

°F	10%	20%	30%	40%	50%	60%	70%	80%	85%
50	3.52	7.04	10.56	14.06	17.60	21.12	24.65	26.16	29.92
55	4.19	8.38	12.57	16.76	20.95	25.14	29.33	33.52	35.62
60	4.97	9.94	14.91	19.88	24.85	29.82	34.79	39.76	42.25
65	5.85	11.74	17.61	23.48	29.35	35.22	41.09	46.96	49.73
70	6.94	13.80	20.82	27.78	34.70	41.64	48.58	55.52	58.99
75	8.10	16.20	24.30	32.40	40.50	48.60	56.70	64.80	68.85
80	9.46	18.92	28.36	37.84	47.30	56.76	66.22	75.68	80.41
85	11.03	22.08	33.09	44.12	55.15	66.18	77.21	88.24	93.75
90	12.80	25.60	38.40	51.20	64.00	76.80	89.60	102.4	108.80
95	14.81	29.62	44.43	59.24	74.05	88.86	103.67	118.48	125.89
100	17.10	34.20	51.20	68.40	85.50	102.60	119.60	136.80	145.54

- (2) The following are two examples:

Example 1:

3000 CFM air handler with 60°F and 30% rh air before the steam distributor.

Calculate the maximum rate of steam addition without exceeding 80% rh in the duct.

60° & 80% = 39.76 lbs/hr

60° & 30% = 14.91 lbs/hr

24.85 lbs/hr can be added to 1000 CFM

x 3 (3000CFM)

74.55 lbs/hr can be added to 3000 CFM

If the load calculation of this system requires a 100 lbs/hr unit, then due to the above possible conditions, the project requires a modulating high limit humidistat to limit the humidifier output to a maximum of 74 lbs/hr and maintain 80% rh.

Example 2:

Humidification load is 30 lbs/hr. To avoid exceeding 80% rh in the duct, calculate the minimum allowable CFM at 55°F. Duct conditions are 55°F and 50% rh.

55° & 80% = 33.53 lbs/hr

55° & 50% = 20.95 lbs/hr

12.57 lbs/hr can be added to 1000 CFM

(30 lbs/hr ÷ 12.57) x 1000 = 2386 CFM minimum

NOTE

Maximum capacity of the NHTC/NHPC humidifier can be limited through the keypad.

C. CONTROL OF DUCT OR PLENUM SATURATION

- (1) NORTEC always recommends the use of a high limit humidistat set at 85% relative humidity in combination with an air-proving switch to assure air movement. Both of these controls are wired in series across the primary control terminals of the humidifiers so that should either of these conditions not be satisfied the humidifiers cannot operate.
- (2) Low temperature, shallow ducts or branch ducts might require a field supplied condensate drain pan and should be accessible to service and inspection (See Figure 4.).
- (3) The most effective method of ensuring controlled absorption distances is to install a modulating high limit humidistat. By controlling the down stream [after distributor(s)] humidity levels and modulating the humidifier's output, one of the variables affecting absorption distance is now a constant. NORTEC recommends modulating high limit humidistats on all economizer systems, VAV, VVT, and systems, which are primarily cooling.

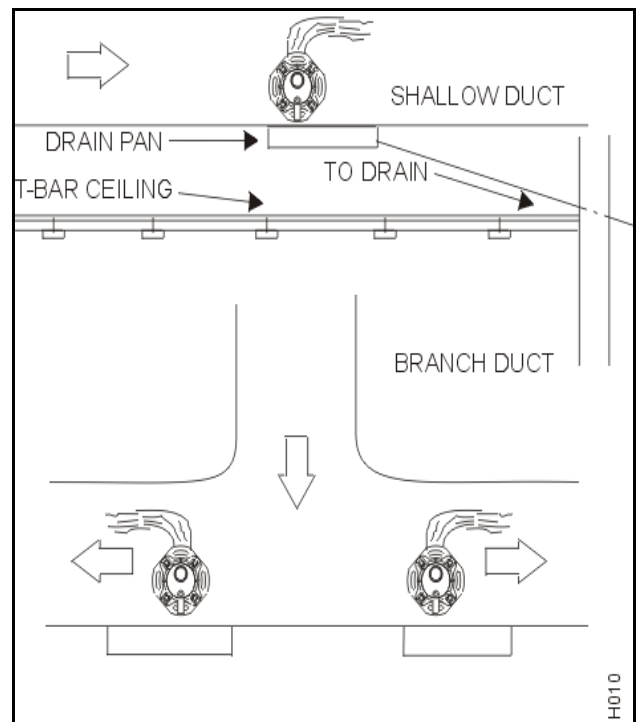


Figure 4. Condensate Drain Pan

3. STEAM RUNS AND CONDENSATE RETURNS

A. STEAM RUNS

- (1) Steam runs between the humidifier and the distributors can be accomplished by using flexible NORTEC steam hose or insulated copper pipe. The longer the steam run, including elbows, the lower the efficiency of the system. The more elbows and turns, the higher the losses become. The humidifier should be as close as possible to the distributor and the steam run should be as direct as possible.
- (2) Guidelines for installation are:
 - (a) Locate humidifier as close as possible to the duct system.
 - (b) NORTEC steam hose should only be used on short steam runs below 10 feet.
 - (c) Minimize elbows and turns.
 - (d) Ensure that no condensate produced in the steam line will remain trapped. Steam naturally flows upward and condensate naturally flows downward. Always slope the steam run towards the steam source at a 15° pitch no more (See Figure 5.).
 - (e) Oversize condensate line and steam line of long runs (consult your representative).
 - (f) See material recommended for use in Table 11. To eliminate corrosion, NORTEC does not recommend the use of steel piping.
 - (g) Consult Table 12 and Table 13 for steam and condensate sizing guidelines when using steam distributors.

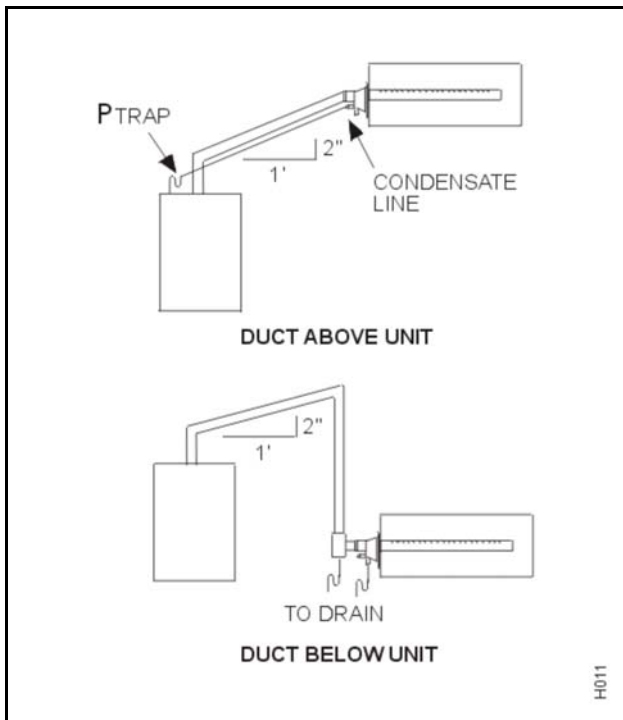


Figure 5. Proper Slope

see Fig 9 for proper P Trap design and installation

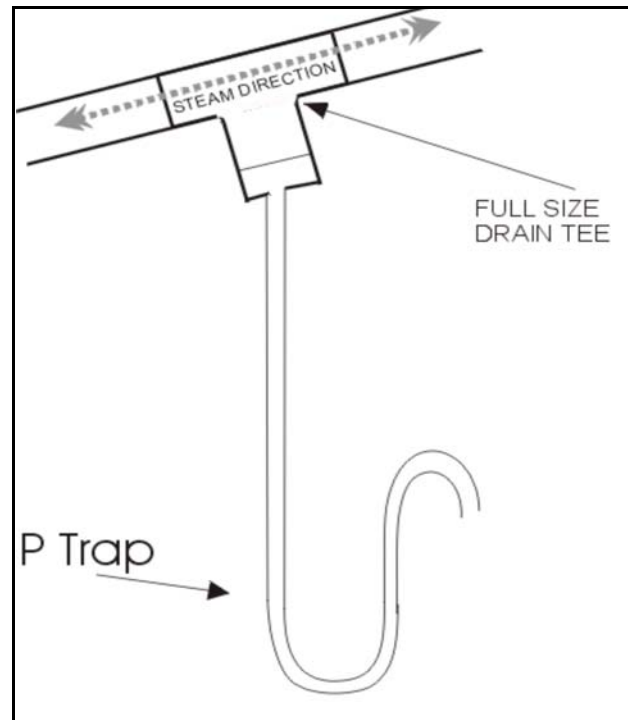


Figure 6. Drain Tee

Table 11. Steam Line Material

	Steam Hose	Copper Tube	Stainless Steel Tube
Short run < 10 feet (3 m)	yes	yes	yes
Long run > 10 feet (3 m)		yes	yes

NOTE: Steel, Iron and aluminum tubing or pipe must not be used for the steam distribution lines with these humidifiers. Plastic tubing and pipe also must not be used for steam distribution lines.

Table 12. Recommended Material and Size for Steam Run

Load		Steam Run		Steam Line Material	Steam Line Description
lb/hr	kg/hr	ft	m		
0-30	0-13	0-10	0-3	Copper Tube	¾" MED-L Tubing (f" OD)
0-30	0-13	10 +	3 +	Copper Tube	1" MED-L Tubing (1c" OD)
0-30	0-13	0-10	0-3	Stainless Steel Tube	f" Tube x 0.049" thick.
0-30	0-13	10 +	3 +	Stainless Steel Tube	1c" Tube x 0.049" thick.
30-100	13-45	0-20	0-6	Copper Tube	1½" MED-L Tubing (1e" OD)
30-100	13-45	20 +	6 +	Copper Tube	2" MED-L Tubing (2c" OD)
30-100	13-45	0-20	0-6	Stainless Steel Tube	1¾" Tube x 0.065" thick.
30-100	13-45	20 +	6 +	Stainless Steel Tube	2" Tube x 0.065" thick.

NOTE: Options shown in a **bold-italic font** require that reducers be used at both ends. These extra large sizes are to allow for better condensation removal in long steam runs. These sizes do not permit the use of hose couplings to connect either humidifier or distributors.

NOTE: Insulate all copper or stainless steel steam lines with minimum one inch high temperature insulation.

Table 13. Recommended Condensate Line at Distributor(s)

Dispersion Method	Condensate Hose	Copper Tube	Stainless Steel Tube
1 x Steam Distributor	d" NORTEC 1328840	¼" MED-L Tubing (d" OD)	d" Tube 0.049" thick.
3 x Steam Distributor*	d" NORTEC 1328840	½" MED-L Tubing (f" OD)	e" Tube 0.049" thick

NOTE: When using more than one distributor, the condensate line should be trapped before it is joined together.

- (3) NORTEC recommends the use of insulated hard copper steam lines on distances of more than 10 feet and no more than 3 elbows (90°). The use of flexible steam hose on runs of more than 10 feet can reduce these recommended distances in Table 14 by as much as 25%. Steam hose can crimp and cause back pressure.

Table 14. Maximum Recommended Length of Steam Runs

Unit Size	Steam Output	Distance	Possible Losses
NH-005	5 lbs/hr	8 feet	1.0 lbs/hr
NH-010	10 lbs/hr	15 feet	1.5 lbs/hr
NH-020	20 lbs/hr	20 feet *	2.0 lbs/hr
NH-030	30 lbs/hr	25 feet *	2.5 lbs/hr
NH-050	50 lbs/hr	40 feet **	4.0 lbs/hr
NH-075	75 lbs/hr	50 feet **	5.0 to 10.0 lbs/hr
NH-100	100 lbs/hr	50 feet **	5.0 to 10.0 lbs/hr
NH-150	150 lbs/hr	50 feet/cylinder **	5.0 to 10.0 lbs/hr
NH-200	200 lbs/hr	50 feet/cylinder **	5.0 to 10.0 lbs/hr
* Use one inch copper steam supply for longer runs. ** Use two inch copper steam supply for longer runs.			
NOTES: 1. This table gives the maximum recommended length of steam run by unit size. 2. The use of any steam line other than copper or NORTEC supplied steam hose will void the warranty and may adversely effect the operation of the humidifier.			

- (4) Steam lines should slope upwards from the humidifier to the steam distributor. (See Figure 7.)
- (5) Flexible steam hose, if used, must be supported to avoid crimps, bends, and sags. (Please consult local agent if proper slopes are not available.)
- (6) If the steam supply line must be routed below the humidifier location, a condensate trap 'tee' will be required to prevent blockage at the low point in the steam line. Run the condensate hose to the nearest floor drain after trapping. (See Figure 8.)
- (7) Long steam runs with improper slopes can produce spitting at the distributor because the steam is travelling at a high velocity and will push condensate out the distributor. If a slope of 2" for every 12" of steam run cannot be achieved, then condensate must be removed before the distributor. (See Figure 4.)

B. CONDENSATE RETURN

- (1) Each steam distributor has a built-in condensate return. (See Figure 9.) Flexible condensate return hose (available from NORTEC) is recommended for routing condensate back into the humidifier's fill cup, or to a drain. A short length of d" OD copper tubing is supplied by NORTEC when routing condensate hose back to the fill cup. Similarly, a short length of d" condensate hose is supplied to serve as a flexible coupling with field-supplied copper condensate line. Long condensate runs should be drained to a floor drain to prevent excessive condensate water from entering the cylinder.

NOTE

Excessively long steam runs (over 20 feet) may require the use of ½" OD condensate return lines – supplied by others.

- (2) Use vertical condensate leg of distributor only. Do not over-tighten clamp.
- (3) Drip stations on steam mains must be located at all low points in the system, at each elevation change and or directional change.
- (4) Horizontal runs of steam must have a 2" rise per foot (10°) when flow is going away from drip station and the steam run is to fall ½" per foot (2°) when flow is going towards drip station.
- (5) In a horizontal run of the steam main, drip stations must be located at regular intervals of 20 feet.
- (6) The drip station itself is a section of piping connected to the bottom of the main. A full size tee must be used to create a drip station to allow the condensate to fall in the drip station.

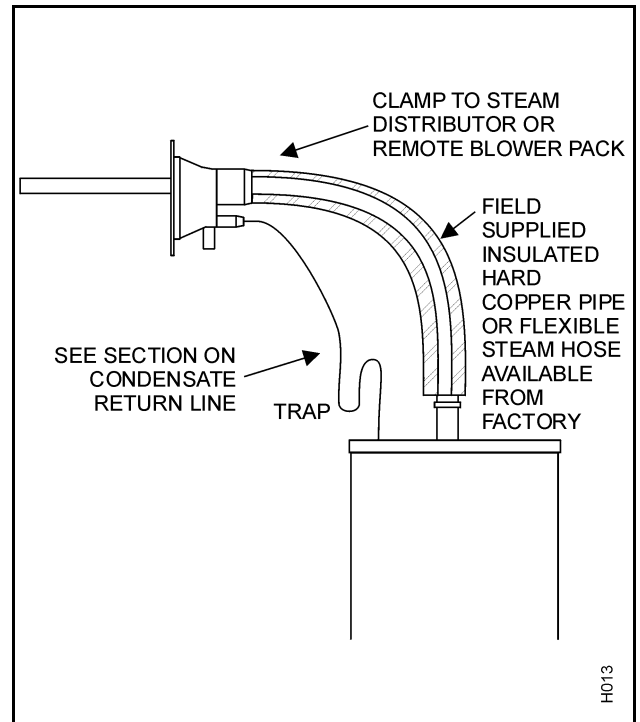


Figure 7. Steam Line Connection

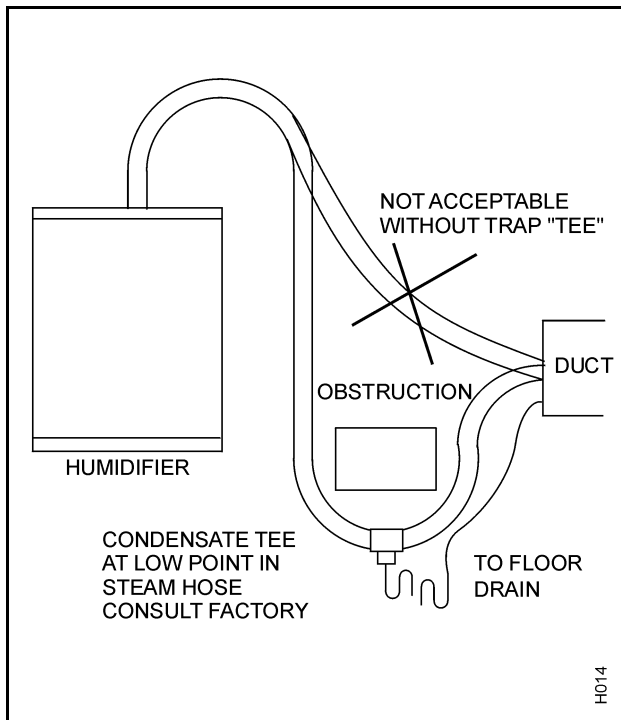


Figure 8. Condensate Tee At Any Low Point In Steam Line

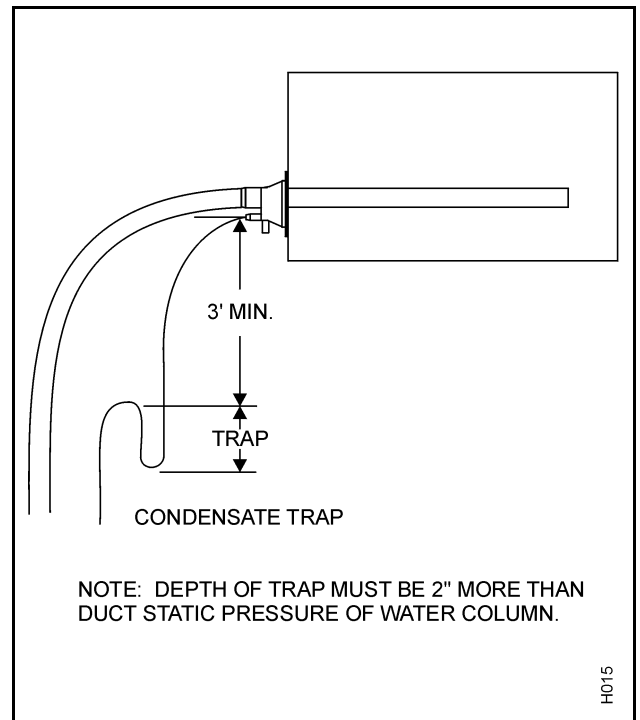


Figure 9. Trap To Prevent Steam In Condensate Line

- (7) Vertical drop of the drip station should be 1.5 times the diameter of the steam main but no less than 12".
- (8) Install the P trap at the bottom of the drip station. The P trap height is to be a minimum of 6 inches or 2 " greater than the static pressure in the duct.
- (9) All distributors must be individually trapped.

4. STEAM DISTRIBUTORS (ASD, BSD, CSD)

A. STEAM DISTRIBUTORS

- (1) NORTEC's steam distributors, in use for over twenty years, are a proven design to suit applications for the introduction of atmospheric steam.
- (2) Features and benefits of steam distributors are:
 - (a) Expanded diameter of tube to reduce steam velocity and the potential for condensate carryover into the duct.
 - (b) Positive removal of condensate.
 - (c) Lower mass of metal (stainless steel), which reduces 'radiator effect and condensate' and results in higher efficiency of humidifier output while reducing condensate formation.
 - (d) Designed specifically for atmospheric steam generation.
 - (e) Modular so that the exact quantity of distributors can be configured to meet specific application requirements. This reduces system complexity and installation costs.

B. DISTRIBUTOR CHARACTERISTICS

- (1) NORTEC steam distributors are constructed of stainless steel and include in low point condensate return to prevent the condensate from collecting in the steam distributor. This enables entrained condensate to settle to the bottom of the steam distributor where it is removed by the condensate return. These features allow the NORTEC steam distributors to be installed level in the duct, thereby utilizing the full available width of the duct. (See Figure 10.)

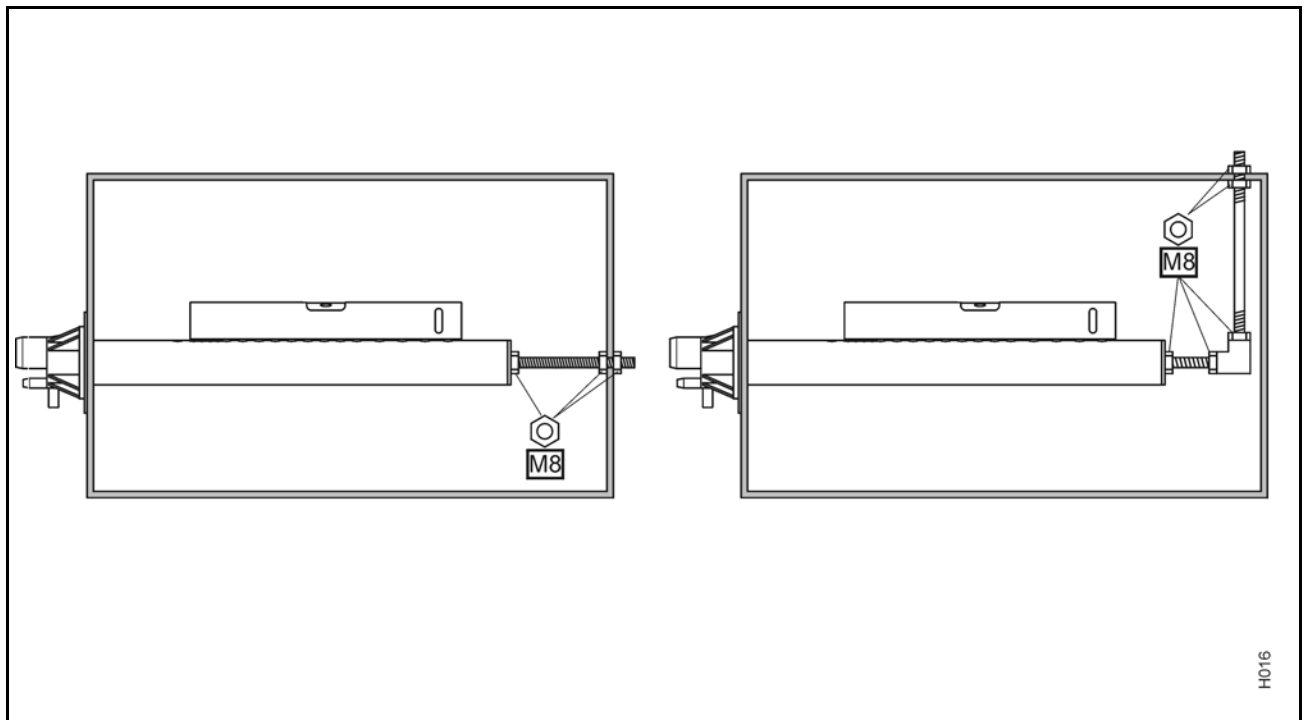


Figure 10. Levelling the Distributor

- (2) Ensure the total capacity of the humidifier is not higher than the allowable maximum steam capacity of the following distributors:
- (a) ASD: 25 lbs/hr (9 kg/hr)
 - (b) BSD: 35 lbs/hr (13 kg/hr)
 - (c) CSD: 115 lbs/hr (45 kg/hr)


C. DISTRIBUTOR LOCATIONS AND MOUNTING

- (1) NORTEC distributors can be mounted in air handlers, supply air ducts or return air ducts. Return air ducts should only be considered if all of the return air enters the building again and is not exhausted by the air handling device. Distributors should be mounted center or low within the duct or plenum. (See Figure 11.) Laminar airflow is best. Down stream obstruction must be considered. The non-absorbed steam may affect devices like smoke detectors down stream. Total steam absorption must be accomplished before filters and silencers.
- (2) Distributors come complete with a mounting plate. (See Figure 12.) Most ducts and plenums are rigid enough to support the distributor.
- (3) Longer distributors (more than 36") and distributors mounted on lighter gage sheet metal which cannot support the distributor level in the duct will need to be supported on the end. (See Figure 10.)

D. MULTIPLE DISTRIBUTOR APPLICATIONS


- (1) The use of multiple steam distributors can reduce the absorption distance in most situations. Distributors can be manifolded together to create a grid to achieve shorter absorption distances. (Consult agent and/or see Nomogram Figure 13.)

CAUTION




THESE INSTALLATION GUIDELINES APPLY FOR DUCT VELOCITIES UNDER 2000 FT/ MIN (610 M/MIN), PLEASE CONSULT FACTORY FOR HIGHER VELOCITIES

CAUTION



PLEASE MAKE SURE NO OBSTACLES (ELBOW, FILTER, OR DIFFUSER) ARE LOCATED AFTER THE DISTRIBUTOR IN THE DIRECTION OF THE AIRFLOW CLOSER THAN THE ABSORPTION DISTANCE CALCULATED FOR YOUR APPLICATION.

CAUTION



FOR APPLICATIONS WITH HIGH STATIC PRESSURES PLEASE CONSULT FACTORY

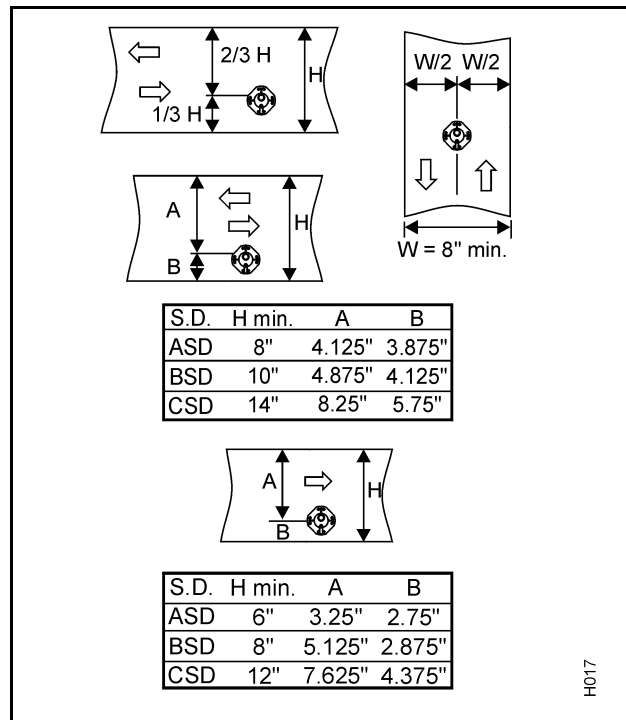


Figure 11. Single Steam Distributor Installation – Minimum Clearance

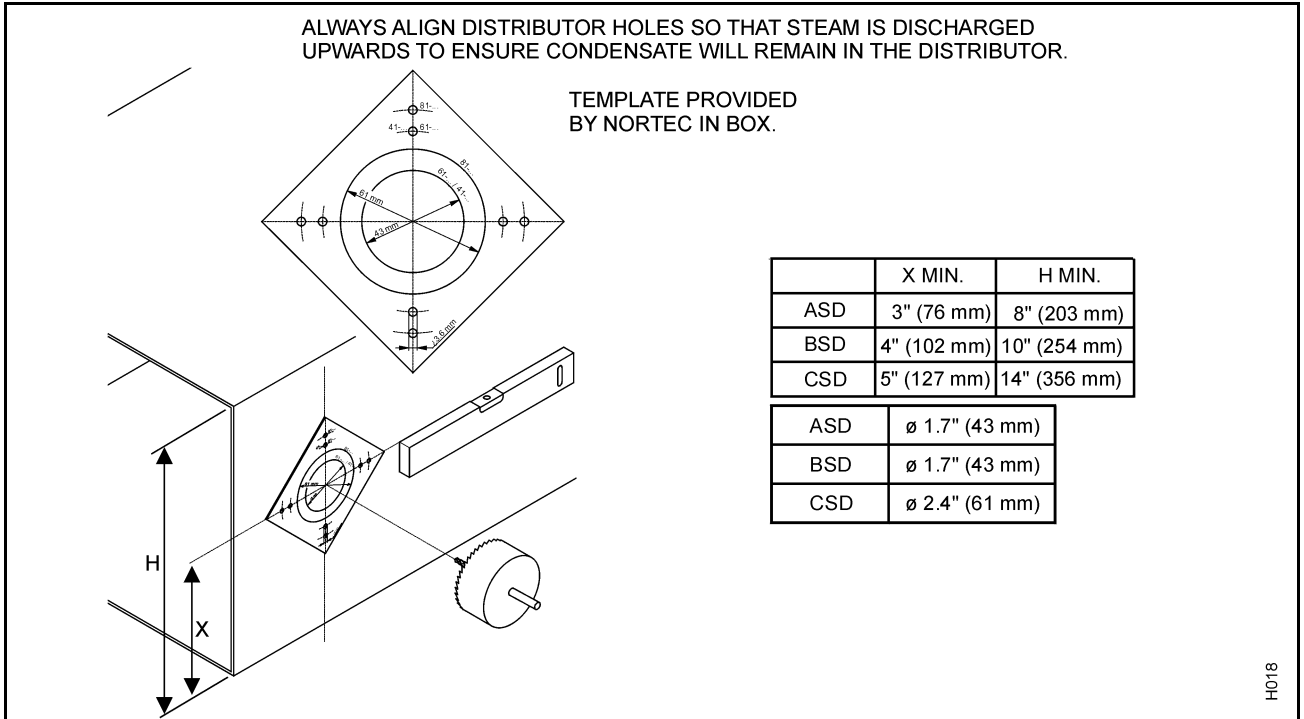


Figure 12. Cutting Duct For Mounting

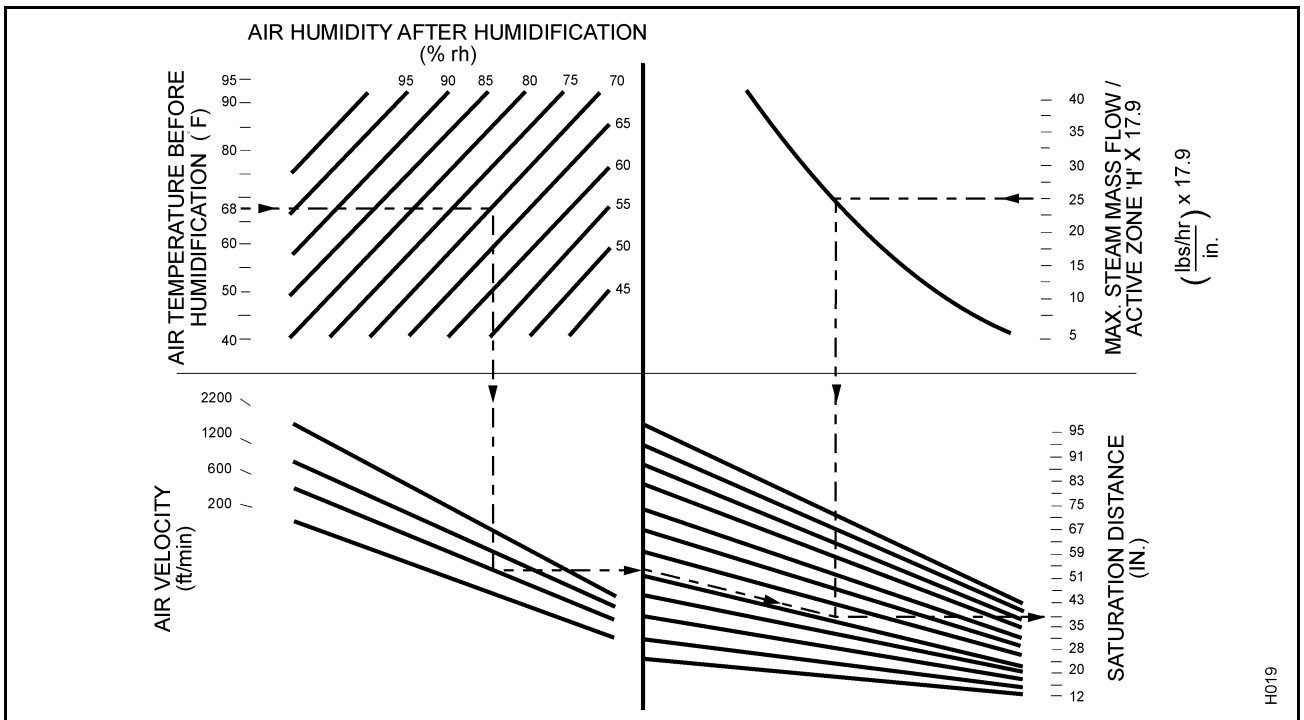


Figure 13. Humidification Distance Nomogram

CAUTION



UNLESS YOU KNOW THE EXACT ABSORPTION DISTANCE REQUIRED FOR THE STEAM ABSORPTION INTO THE AIR STREAM, THE DISTRIBUTOR SHOULD BE LOCATED AT LEAST 8-10 FT (2-3 M) AWAY FROM ANY OBSTACLE IT MAY CONDENSE ON (ELBOW, DIFFUSER, FILTER, ETC.)

(2) Duct vertical clearance requirements for standard steam distributors are as follows:

- (a) ASD - 8 in. vertical duct height for 1st ASD
- 5.5 in. additional duct height for each additional ASD
= ROUND DOWN ('DuctHeight' - 8")/5.5) + 1
- (b) BSD - 10 in. vertical duct height for 1st BSD
- 6.375 in. additional duct height for each additional BSD
= ROUND DOWN ('DuctHeight' - 10")/6.375) + 1
- (c) CDS - 14 in. vertical duct height for 1st CSD
- 9 in. additional duct height for each additional CSD
= ROUND DOWN ('DuctHeight' - 14")/9) + 1

NOTE

These requirements apply to vertical arrangements of multiple distributors ONLY. Diagonal arrangements utilize an alternative method.

E. LOCATION OF STEAM DISTRIBUTORS WITHIN AN AIR HANDLER

- (1) Humidify after the heating coil (H/C) so that absorption will occur in the 3 to 4 feet before the cooling coil (C/C). If steam carries over and condenses on the coil, any excess water will be drained away. There is little chance of condensation on the blower, blower motor, or fan isolation components, especially if you use a modulating high limit humidistat. All steam distributors should be 8" from the H/C and evenly spaced. If wetting is a problem, add more steam distributors. (See Nomogram Figure 13 and Figure 14).

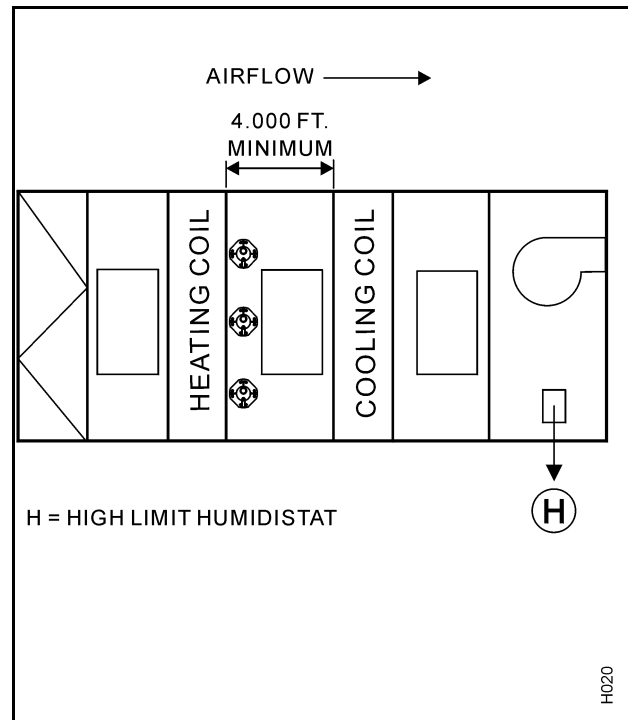


Figure 14. Best Location for Multiple Steam Distributors in AHU

F. DISTRIBUTOR ABSORPTION DISTANCE

- (1) The water vapor discharged from the steam distributor must be adequately mixed with air to prevent condensation on downstream components. The nomogram in figure 13 will

determine the number of steam distributors that must be use for short saturation distances.

- (2) If the 'Saturation Distance' for one steam distributor is not sufficient, add more steam distributors until the minimum saturation distance is attained. (See Figure 13.)
- (3) To determine the number of distributors required, complete the following list:
 - (a) Air humidity after humidification _____ %rh. (A high limit humidistat should be set at 80 – 85% to prevent wetting of ducts.)
 - (b) Air temperature before humidification _____.
 - (c) Air velocity in duct _____ ft/min.
 - (d) Maximum steam mass flow _____ lbs/hr.
 - (e) Active zone H of steam distributor _____ in. (See Figure 13.)

NOTE

The manufacturer recommends the appropriate distance modification factors when filters or humidification sensors are installed downstream. For applications that are outside of the Nomogram's range, please consult a NORTEC representative.

G. TYPICAL APPLICATIONS

- (1) Representations of typical applications are found in Figure 15 and Figure 16.

H. DISTRIBUTOR DIMENSIONS

- (1) Distributor dimensions for the various distributor models can be found in Chapter 10-30.

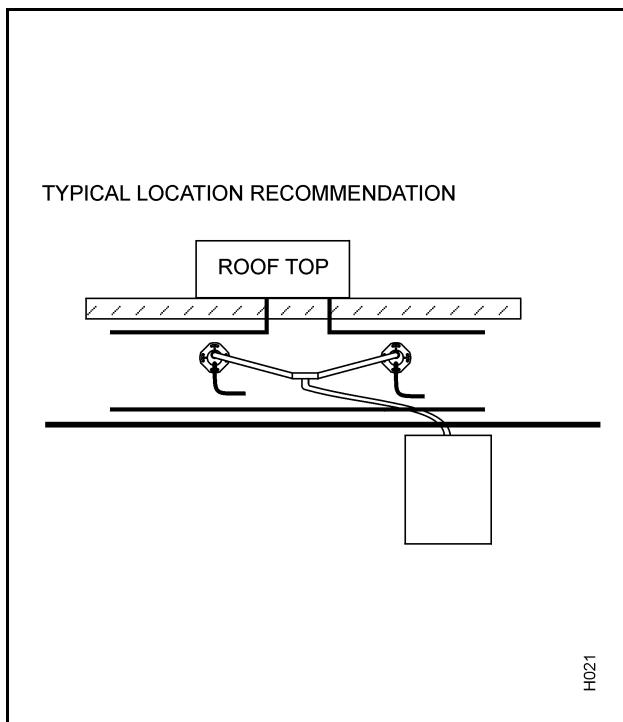


Figure 15. Roof Top Units 2-20 Tons – Typical Location

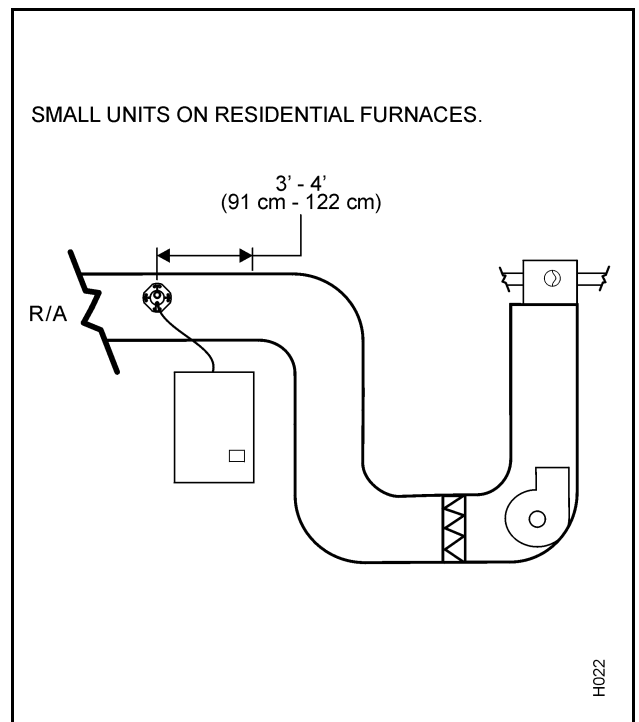


Figure 16. Small Units On Residential Furnaces

5. SHORT ABSORPTION MANIFOLD (SAM-e)

A. GENERAL

- (1) NORTEC's best performing steam absorption system for use in Air Handling Units and duct systems where short steam absorption distance is critical.
- (2) The SAM-e, Figure 17, distributes clean steam, precisely controlled, uniformly into the entire air stream, void of any condensate spray. Steam distribution takes place via distributor tubes with integrated nozzles. The steam is kept dry as condensate is drained through the main header.
- (3) The stainless steel distribution tubes are typically mounted vertically but can also be mounted horizontally (10° slope) for vertical airflow applications. The distribution tubes come equipped with evenly spaced stainless steel nozzles providing optimum steam distribution, over the entire length of the tube.
- (4) The nozzles extend into the center of the distribution tube ensuring only condensate free steam is released. (See Figure 18.) Condensate drains out of the distribution tubes, through the header, eliminating the need for jacketed tubes. A permanent bond between the nozzle and distribution tube is made when the nozzle is pressed into the tube. The nozzles and tubes have the same thermal expansion characteristics guaranteeing a permanent union. The specifically sized orifices ensure consistent output from each nozzle.



Figure 17. SAM-e Tubes

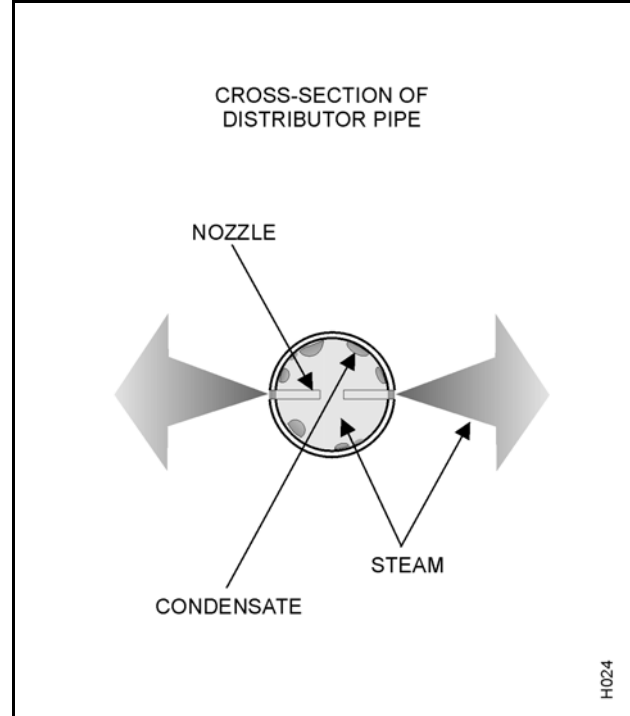


Figure 18. Cross-Section of Distributor Pipe

- (5) The features of the short absorption manifold are:
 - (a) Inlets/Outlets located on same side, one access point required.
 - (b) All stainless steel distributors and nozzles ensure permanent bond.
 - (c) Stainless steel header with rubber grommet seals for easy installation of distribution tubes.
 - (d) Adjustable mounting frame available for quick and easy installation.
 - (e) Available with 3", 6", 9", or 12" center-to-center distributor spacing.
 - (f) Atmospheric steam source.
 - (g) Two year limited warranty.

B. DETERMINING THE STEAM ABSORPTION DISTANCE

NOTE

Visit www.humidity.com to download our Humidification Engineering & Loadizing Program (H.E.L.P.) to help you calculate the absorption distance.

- (1) Injecting steam into the air requires a certain amount of time before the steam is absorbed completely.
- (2) In a moving air stream, this time results in the steam moving a fixed distance from the manifold before it is fully absorbed.
- (3) Knowing the absorption distance will ensure that steam will not condense on any critical components following the steam distribution area.
- (4) The system should be designed to eliminate the possibility of wetting internal components by positioning the manifold in the optimum location and by keeping the absorption distance to a minimum.
- (5) The absorption distance can be calculated using the Z ratio. The Z ratio and the following method may be used as a guide to calculate the absorption in various air handlers, and ducts with different conditions. It can be calculated as follows:

$$Z = \frac{(RH_{ah} - RH_{bh})}{(100 - RH_{bh})}$$

RH_{ah} = Percentage of relative humidity after humidification.

RH_{bh} = Percentage of relative humidity before humidification.

Example 1:

- 55°F (12.8°C)/ 12% RH - Conditions before humidification.
- 20 000 CFM (33 980 m³/h)
- 400 lbs/hr (181 kg/hr) load

Using the H.E.L.P. Software or a psychrometric chart you can find that the humidity conditions after adding 400 lbs/hr (181 kg/h) of steam, are 55°F (12.8°C) 61% rh.

Thus giving:

$$RH_{bh} = 12\%$$

$$RH_{ah} = 61\%$$

$$Z = (61 - 12) / (100 - 12) = 0.56$$

(6) Absorption Distances:

- 3" centers = 7" (18 cm)
- 6" centers = 9" (23 cm)
- 9" centers = 12" (31 cm)
- 12" centers = 18" (46 cm)

(7) Reference Figures 19, 20, 21 and 22 to determine the center-to-center spacing required.

NOTES

1. The absorption distance data is based on 55°F (13°C) minimum temperature before humidification.
2. Data is based on velocities between 200 fpm (101 cm/s) and 2500 fpm (1270 cm/s).
3. Absorption distance: This is the distance between the SAM-e and the first obstruction (coil, elbow, damper, etc.) and the first obstruction steam may hit. Traces of steam may pass this obstruction, but will not condense, leaving obstructions dry.
4. If any of the duct AHU conditions are changed, the absorption distance may change due to increase or decrease in duct temperatures, amount of fresh air, various outside conditions, set point requirements, etc. If this occurs, re-calculate the absorption distance, and determine if the SAM-e needs to be modified or relocated.

C. STATIC AIR PRESSURE

(1) Table 15 shows the static pressure loss created by a SAM-e in various velocities.

Table 15. Air Pressure Loss in AHU/Duct

Air Velocity fpm (cm/s)	Air Pressure Loss (inches of water column)			
	SAM-e Tube Spacing			
	3" (7.6 cm)	6" (15.2 cm)	9" (22.7 cm)	12" (30.5 cm)
500 (255)	0.01 (0.02)	0.01 (0.02)	No measurable data	
750 (383)	0.03 (0.08)	0.01 (0.02)		
1000 (510)	0.05 (0.013)	0.02 (0.05)		
1250 (638)	0.07 (0.18)	0.03 (0.08)		
1500 (765)	0.09 (0.23)	0.04 (0.10)	0.01	0.01
1750 (893)	0.10 (0.25)	0.06 (0.15)	0.01	0.01
2000 (1020)	0.12 (0.30)	0.08 (0.20)	0.01	0.01

D. CONDENSATE LOSSES

(1) The SAM-e will condense some of the steam generated by the NORTEC humidifiers. To compensate for this loss in capacity, we must increase the calculated humidification load accordingly. Refer to Table 16.

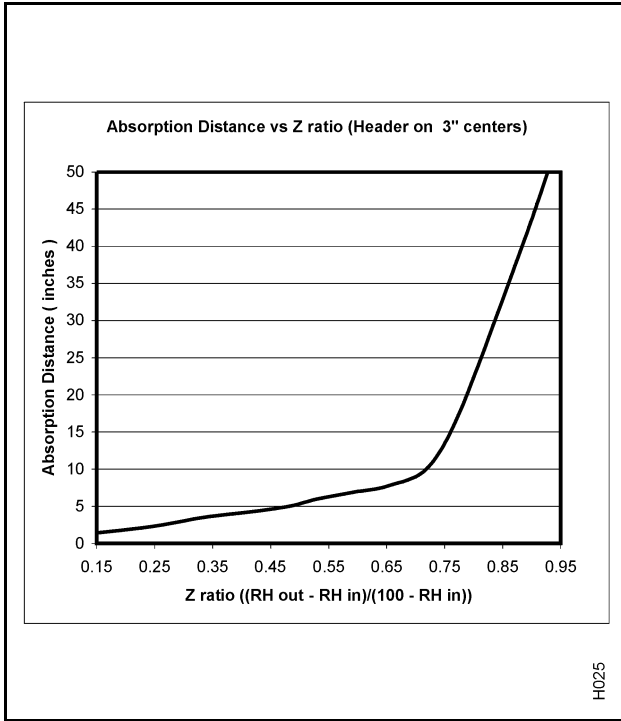


Figure 19. Absorption Distance – 3" Centers

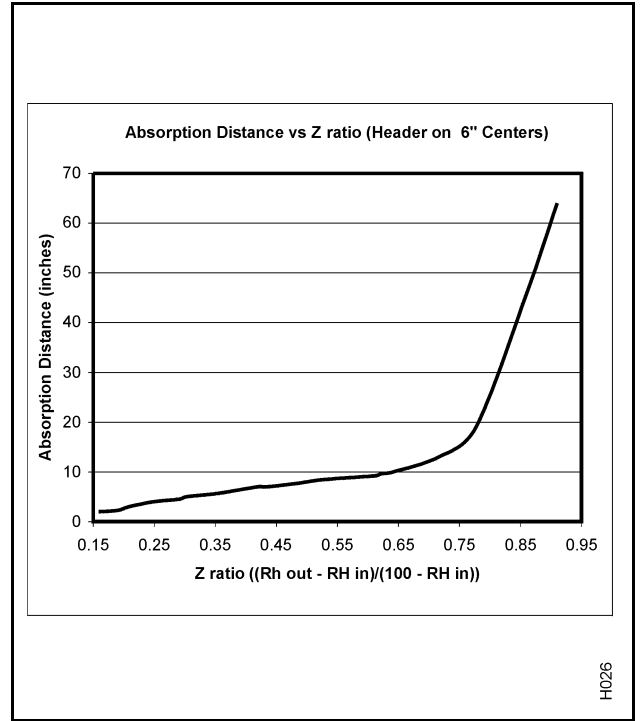


Figure 20. Absorption Distance – 6" Centers

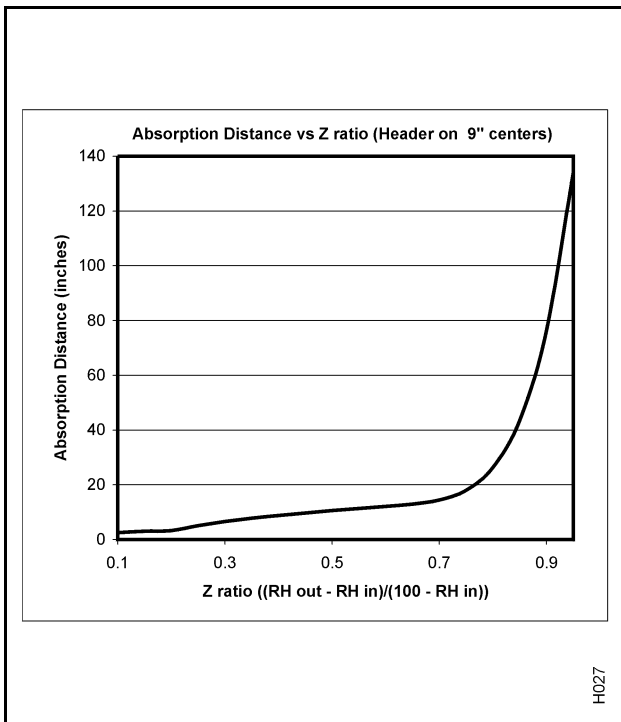


Figure 21. Absorption Distance – 9" Centers

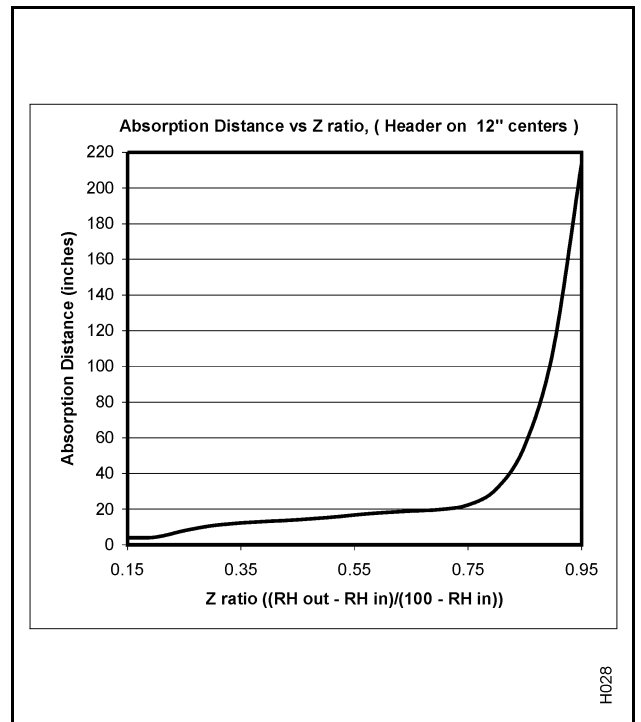


Figure 22. Absorption Distance – 12" Centers

- (2) NORTEC recommends the installation of a condensate drain on the steam inlet run prior to entering the SAM-e.

Table 16. Condensate Loss

Air Velocity fpm (cm/s)	Condensate Losses (% of Maximum Capacity)	
	55°F	70°F
500 (255)	15%	12%
1000 (510)	20%	15%

NOTE: These values may increase or decrease due to many unknown conditions or variables. This is only a guideline.

E. CORRECT CHOICE OF PRODUCT APPLICATIONS (WITHIN SAM-e)

- (1) The SAM-e has been designed exclusively for use in building ventilation duct systems, where manufacturing, processing and hi-tech activities are conducted. Applications that do not conform to the design parameters are not recommended and will be at the user's own risk. NORTEC produces a wide range of different humidification systems to suit virtually all normal applications, and will be happy to recommend the most appropriate system to suit each particular requirements.

F. SAM-e DIMENSIONS

- (1) Dimensions for the SAM-e and mini SAM-e can be found in Figure 6 and Figure 7 in Chapter 10-30.

G. SAM-e HEADER SELECTION

- (1) NORTEC offers different ranges of manifolds to cover capacities and duct sizes. The absorption distance and capacity required will determine the center to center spacing between each steam tube on the header. There are four options: 3" (7.6 cm), 6" (15.2 cm), 9" (22.9 cm) or 12" (30.5 cm). The smaller the spacing, the more tubes the header can accommodate, thus giving a better absorption distance and greater capacity. (See Tables 17 to 20.)
- (2) The header remains the same for in-duct or outside duct mounting, for atmospheric steam, and for vertical or horizontal flow applications. (See Figure 23.)
- (3) Atmospheric manifolds with a capacity over 801 lbs/hr (362 kg/hr) will include a second steam inlet on the header. Consult factory submittal drawings for specific details.
- (4) Select the header part number associated with your duct or air handling unit's width.
For example, if the duct width is 80" (198.11 cm), select part number 150-3279 for 3" (7.6 cm) center-to-center spacing.

H. SAM-e STEAM TUBE SELECTION

- (1) Constructed of 1.5" (3.81 cm) OD 304 stainless steel tubing, the steam tubes can accommodate duct heights between 18" (45.72 cm) - 144" (365.76 cm) for in-duct header mounting. For smaller duct applications, a mini SAM-e can accommodate sizes starting at 12" (30.5 cm) wide x 8" (20.3 cm) high. (See Figure 20.) Each steam tube has a different amount of stainless steel nozzles to evenly disperse steam into the duct or air handling unit. The nozzles take the steam from the center of the tube, eliminating any need for jacket heating, and a temperature switch. All the accumulating condensate is drained vertically down to the main header, and then out the condensate drain. NORTEC's unique 'slip in' installation method makes for a very quick and effortless assembly. (See Figure 24.)

- (2) There is a selection of four types of steam tubes. Each are capable of distributing different capacities. To select the steam tube for your application refer to Table 17.

Type A	15 lbs/hr	(7 kg/hr)
Type B	35 lbs/hr	(16 kg/hr)
Type B+	55 lbs/hr	(25 kg/hr)
Type C	75 lbs/hr	(34 kg/hr)

- (3) The humidifiers maximum capacity and SAM-e header will determine the steam tube type required. The selected header will determine how many steam tubes are required, refer to Tables 18, 19, 20 and 21. Remember to calculate your condensate losses.

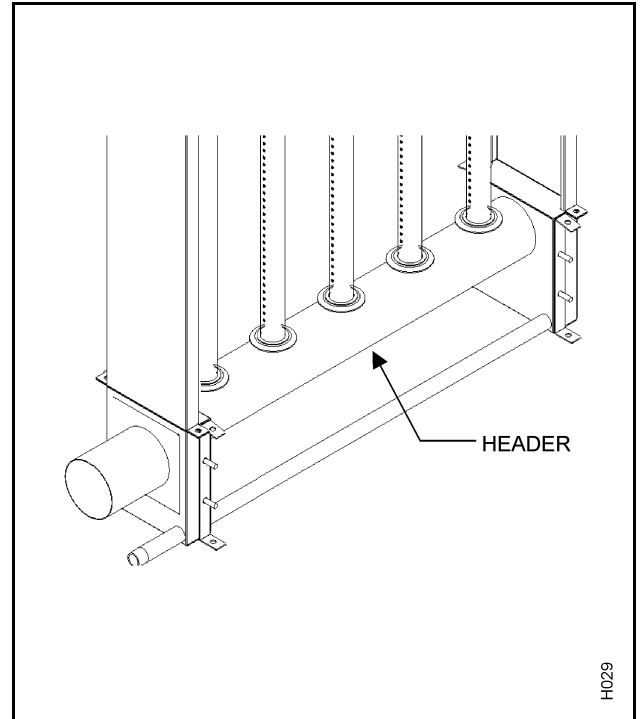


Figure 23. SAM-e Header

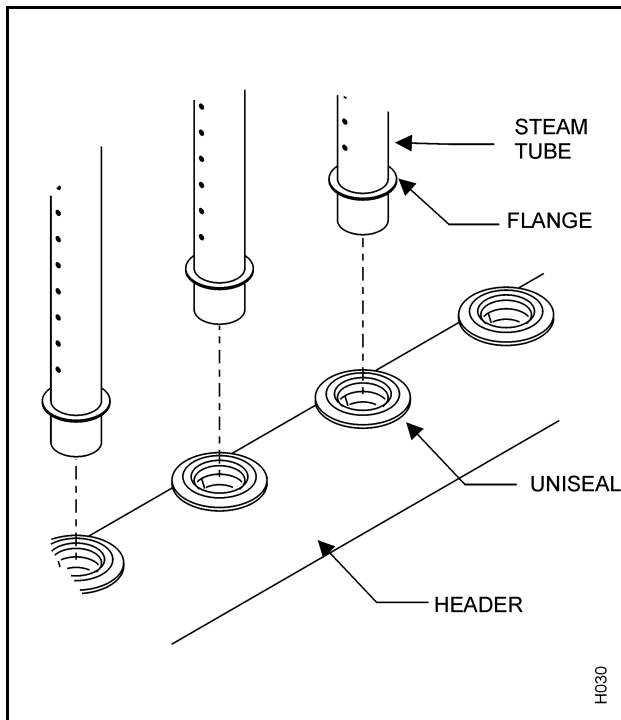


Figure 24. SAM-e Tubes

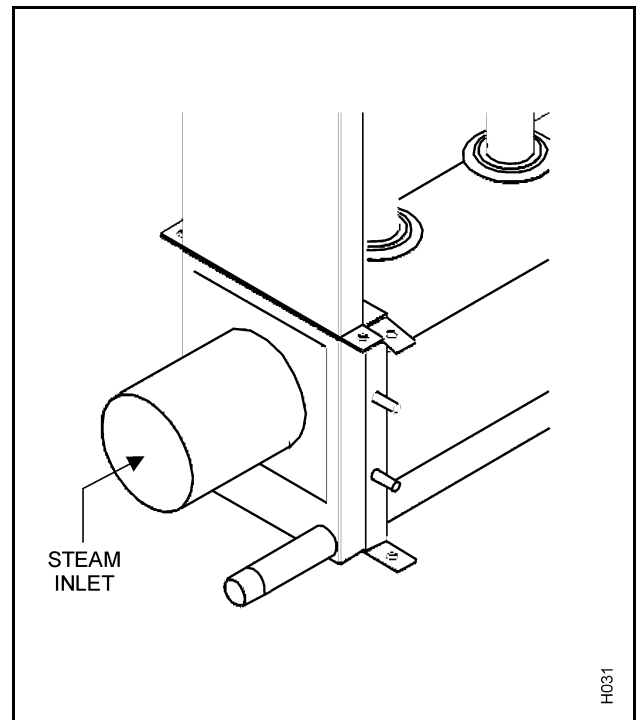


Figure 25. Steam Inlet

I. SAM-e STEAM INLET CONFIGURATION SELECTION

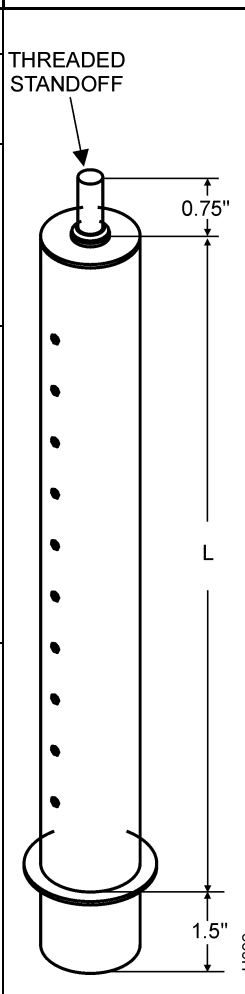
(1) Atmospheric Steam (NH, GS, SE)

- (a) The steam inlet, Figure 25, is determined by the selected humidifier. Refer to submittals, Chapter 10-30 to determine the size of steam outlet required.
- (b) For a typical SAM-e installation, see Figure 26.

J. MINI SAM-e

- (1) For the mini SAM-e installation, refer to Tables 18, 19, 20 and 21 for headers, tubes and inlet configuration.

Table 17. SAM-e Tube Matrix

*In-Duct Height in. (cm)	TYPE A 15 lbs/hr (7 kg/hr)	TYPE B 35 lbs/hr (16 kg/hr)	TYPE B+ 55 lbs/hr (25 kg/hr)	TYPE C 75 lbs/hr (34 kg/hr)	'L' Dimension in. (cm)	In-duct Optional Mounting Frame	Outside- Duct Optional Mounting Frame	Steam Tube Profile
18 (45.7)	1503388	N/A	N/A	N/A	5.5 (14.0)	1504697	1504697	
24 (61.0)	1503389	1503411	N/A	N/A	11.5 (29.2)		1503469	
30 (76.2)	1503390	1503412	1509391	N/A	17.5 (44.5)	1503469		
36 (91.4)	1503391	1503413	1509392	1503440	23.5 (59.7)	1503470		
42 (106.7)	1503392	1503414	1509393	1503441	29.5 (74.9)			
48 (121.9)	1503393	1503415	1509394	1503442	35.5 (90.2)			
54 (137.2)	1503394	1503416	1509395	1503443	41.5 (105.4)			
60 (152.4)	1503395	1503417	1509396	1503444	47.5 (120.7)			
66 (167.6)	1503396	1503418	1509397	1503445	53.5 (136.9)	1503471		
72 (182.9)	1503397	1503419	1509398	1503446	59.5 (151.1)			
78 (198.1)	1503398	1503420	1509399	1503447	65.5 (166.4)			
84 (213.4)	1503399	1503421	1509400	1503448	71.5 (181.5)			
90 (228.6)	1503400	1503422	1509401	1503449	77.5 (196.9)			
96 (243.8)	1503401	1503423	1509402	1503450	83.5 (212.1)	1503472		
102 (259.1)	1503402	1503424	1509403	1503451	89.5 (227.3)			
108 (274.3)	1503403	1503425	1509404	1503452	95.5 (242.6)			
114 (289.6)	1503404	1503426	1509405	1503453	101.5 (257.8)			
120 (304.8)	1503405	1503427	1509406	1503454	107.5 (273.1)			
126 (320.0)	1503406	1503428	1509407	1503455	113.5 (288.3)	1503472		
132 (335.3)	1503407	1503429	1509408	1503456	119.5 (303.5)			
138 (350.5)	1503408	1503430	1509409	1503457	125.5 (318.8)			
144 (365.8)	1503409	1503431	1509410	1503458	131.5 (334.0)			

NOTE: *Add 6" (15.2 cm) to In-Duct Height for Outside-Duct Mounting of Header.

Table 18. Mini SAM-e Headers – 3"

Duct Width in. (cm)	Steam Tubes Qty	Header Part Number	Maximum Capacity Atmospheric lbs/hr (kg/hr)		
			MA	MB	MC
12 (30.5)	3	1509811	30 (14)	60 (27)	90 (41)
18 (45.7)	5	1509812	50 (23)	100 (45)	150 (68)
24 (60.9)	7	1509813	70 (32)	140 (64)	210 (95)

Table 19. Mini SAM-e Headers – 6"

Duct Width in. (cm)	Steam Tubes Qty	Header Part Number	Maximum Capacity Atmospheric lbs/hr (kg/hr)		
			MA	MB	MC
12 (30.5)	2	1509814	20 (9)	40 (18)	60 (27)
18 (45.7)	3	1509832	30 (14)	60 (27)	90 (41)
24 (60.9)	4	1509833	40 (18)	80 (36)	120 (54)

Table 20. Mini SAM-e Tubes

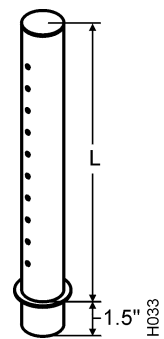
*In-Duct Height in. (cm)	TYPE MA 10 lbs/hr (25 kg/hr)	TYPE MB 20 lbs/hr (9 kg/hr)	TYPE MC 30 lbs/hr (14 kg/hr)	In-duct Optional Mounting Frame	'L' Dimension in. (cm)	Steam Tube Profile
8 (20.3)	1509788	N/A	N/A	Not Required	4½" (11.4)	
10 (25.4)	1509789	N/A	N/A		6½" (16.5)	
12 (30.5)	1509790	1509797	1509804		8½" (21.6)	
14 (36.6)	1509791	1509798	1509805		10½" (26.7)	
16 (40.6)	1509792	1509799	1509806		12½" (31.8)	
18 (45.7)	1509793	1509800	1509807		14½" (36.8)	
20 (50.8)	1509794	1509801	1509808		16½" (41.9)	
22 (55.9)	1509795	1509802	1509809		18½" (47.0)	
24 (60.0)	1509796	1509803	1509810		20½" (52.1)	

Table 21. Mini Inlet Configurations – For Atmospheric Steam Unit

SAM-e Steam Inlet	Part Number
1" OD	1509839
1¾" OD	1509837
2 X 1¾" OD	1509838

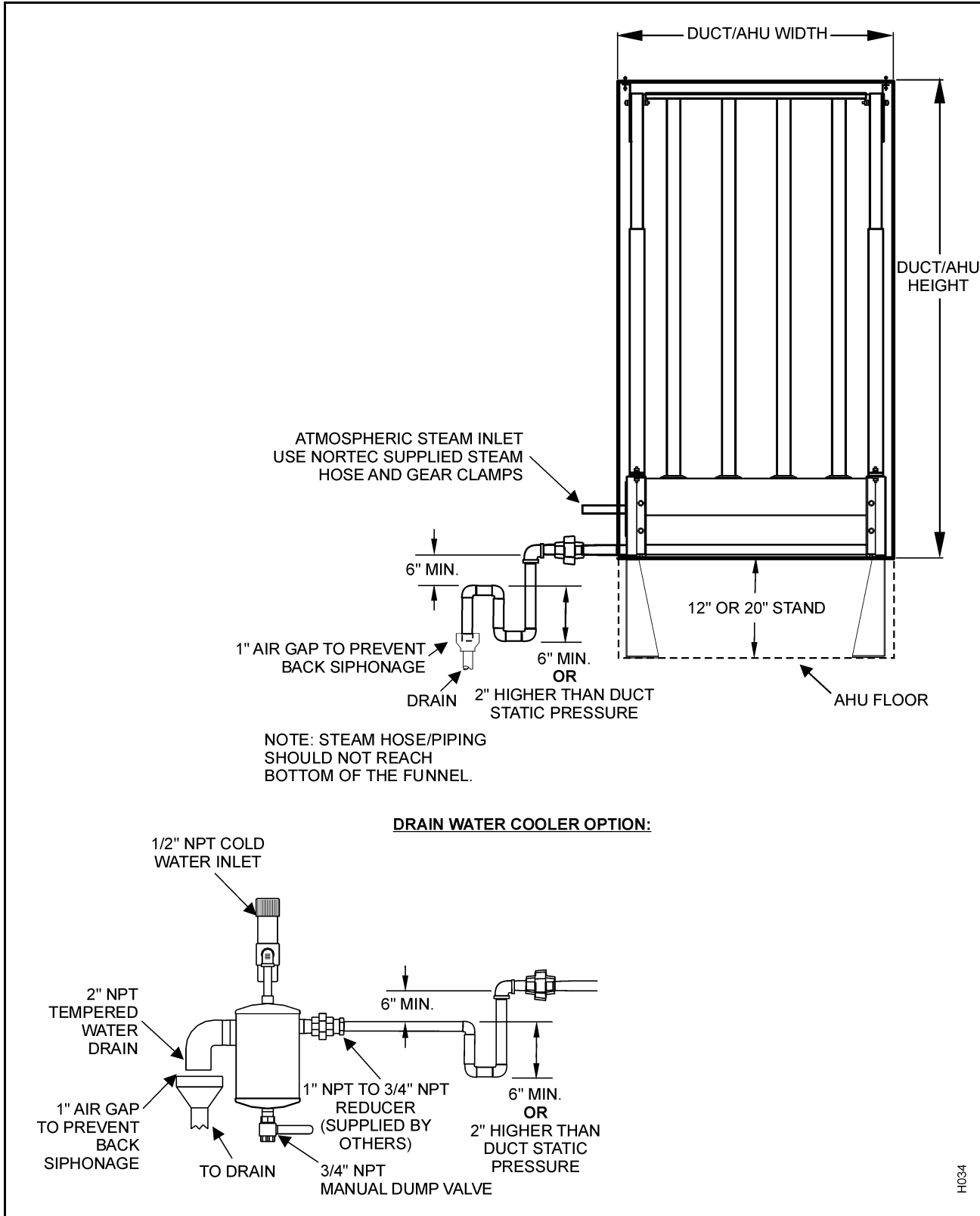


Figure 26. Typical SAM-e Installation for Atmospheric Steam Applications

6. BLOWER PACKS (BOBP, RMBP)

WARNING



STEAM DISTRIBUTOR ON THE BUILT-ON AND REMOTE BLOWER PACKS HAVE A HOT SURFACE THAT COULD RESULT IN BURNS IF TOUCHED. NORTEC RECOMMENDS MOUNTING AT LEAST 8 FEET ABOVE THE FLOOR.

A. BLOWER PACKS

- (1) Optional blower packs are used to distribute steam to localized areas such as computer rooms or in areas that do not have a built-in air distribution system.
- (2) Blower packs are available integrally mounted on humidifier BOBP, (See Figure 27.) or detached and field-piped and wired to humidifier RMBP. (See Figure 28.)
- (3) Blower packs consist of a matching powder coated steel cabinet containing: three axial blowers with finger guards powered by 120 VAC or line voltage humidifiers, with built-in multi-tap transformer (when necessary), fuse, high temperature plastic distributor with stainless steel lid, horizontal and vertical adjustment knobs for directional control, built-in thermostat to activate blowers, speed control rocker switch and safety loop relay.
- (4) Refer to Table 22 for ceiling and frontal clearances required for blower packs. Dimensions apply to both built-on and remote-mounted versions of blower packs.
- (5) Mount remote blower pack(s) using factory supplied wall mounting bracket with clearances as recommended in Table 22.

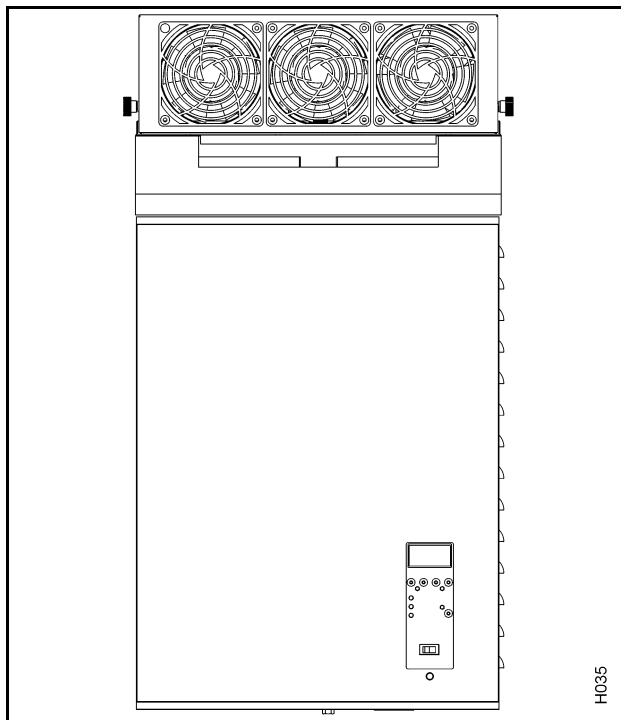


Figure 27. NH Series Humidifier With Built-On Blower Pack

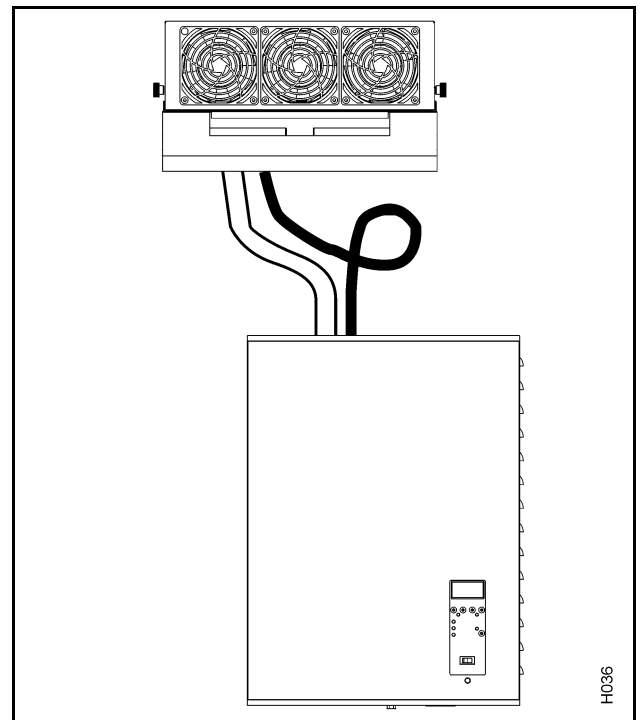


Figure 28. NH Series Remote Mounted Blower Pack

Table 22. Ceiling and Frontal Clearances for Blower Packs

NH Series Model	Minimum Number Of Blower Packs	Minimum Ceiling Clearance in. (cm)	Minimum Front Clearance in. (cm)
005	1	18 (45)	30 (76)
010	1	18 (45)	30 (76)
020	1	18(45)	36 (91)
030	1	18 (45)	72 (183)
050	1	36 (91)	84 (213)
075	1	42 (106)	144 (366)
100	1	48 (122)	156 (396)
150	2*	42 (106)	144 (396)
200	2*	48 (122)	156 (396)

NOTES: 1. Remote mounted only. Four remote mounted blower packs are recommended on the 200 model.
 2. Clearances based on 72°F at 35% RH.

7. CONTROLS

A. GENERAL

- (1) NORTEC humidifiers all accept on/off controls for their security loop. Many NORTEC humidifiers can also accept modulating or transducer signals for control (See the features section for each specific model).

CAUTION



REGARDLESS OF SELECTING ON/OFF OR MODULATING CONTROL METHOD, NORTEC HUMIDIFIERS MUST HAVE CLOSED CIRCUIT ACROSS ITS ON/OFF SECURITY LOOP CONTROL TERMINAL TO OPERATE. NORTEC HIGHLY RECOMMENDS THE USE OF A HIGH LIMIT HUMIDISTAT AND AN AIR PROVING SWITCH IN SERIES FOR THIS FUNCTION.

B. ON/OFF CONTROLS

- (1) On/Off controls are used in all NORTEC humidifier security loops. The digital humidistat can also be used as a space humidity controller. These controls include:
 - (a) Air Proving Switch – duct mounted, pressure differential switch, adjustable set point from 0.07 IWC to 12.0 IWC, good for positive, negative or differential pressure applications, stops humidifier if duct air pressure is not sensed. Turns humidifier off if air handler fails.
 - (b) Duct Mounted Digital Humidistat – control or high limit, adjustable set point from 15-90% rh with accuracy fixed at $\pm 3\%$ at 25°C, operating range of 0-95% rh, closes on humidity drop for control and opens on rise for high limit duct application.
 - (c) Wall Mounted Digital Humidistat – control or high limit, adjustable set point from 15-90% rh with accuracy fixed at $\pm 3\%$ at 25°C, operating range of 0-95% rh, closes on humidity drop for control and opens on rise for high limit application.
 - (d) On/Off Controls Supplied by Others – Can be used as long as they have a dry set of contacts capable of passing a 24-VAC, 2-A maximum signal.

C. MODULATING CONTROLS

- (1) Modulating Controls are used to send a modulating demand signal to the NORTEC humidifier. Different models can accept different signals (see features section for each specific model) NORTEC supplied controllers send a 0-10 VDC demand signal. This signal can be used as a control and in some models can also be used as a modulating high limit. These controls include:
 - (a) Wall Mounted Digital Humidistat with Integrated Sensor – control or high limit, adjustable set point from 15-90% rh with accuracy fixed at $\pm 3\%$ at 25°C, outputs a 0-10 VDC signal.
 - (b) Wall Mounted Digital Humidistat Without Sensor – control or high limit, adjustable set point from 15-90% rh with accuracy fixed at $\pm 3\%$ at 25°C, outputs a 0-10 VDC signal. Requires a remote transducer sensor supplying a 2-10 VDC signal.
 - (c) Duct Mounted Digital Humidistat With Sensor – This package comes with both a remote sensor and a wall mounted controller without sensor. Control or high limit, adjustable set point from 15-90% rh with accuracy fixed at $\pm 3\%$ at 25°C, outputs a 0-10 VDC signal.

- (d) Modulating Demand Signal Supplied by Others – A signal that is a linear demand signal that rises on need for humidity can be used in conjunction with NORTEC humidifiers. See features section for a list of which models can accept which signal)

D. OUTDOOR TEMPERATURE SETBACK

- (1) The outdoor temperature setback sensor is used to prevent condensation on windows or other surfaces that are adjacent to outdoor air. This sensor can be used in conjunction with the NORTEC controls mentioned above (both the on/off and modulating demand signal controllers) The sensor allows the controller to override the set point to prevent the humidifier from humidifying when condensation could be possible. (See Figure 29.) Locate the temperature sensor near the fresh air intake. This will ensure accurate representation of the outdoor air temperature.

E. TRANSDUCER SENSORS

- (1) Transducer Sensors are signals sent back to either a controller or back to the humidifier. Limited models can accept a direct transducer signal. (See features section for each specific model) The sensors include:
- (a) Wall Mounted Humidity Transducer – Sensor, output of 2-10 VDC, range of 0 to 95% rh.
 - (b) Duct Mounted Humidity Transducer – Sensor, output of 2-10 VDC, range of 0 to 95% rh.
 - (c) Transducer Sensor By Others – Humidity sensors that rise linearly with the sensed rh in the room.

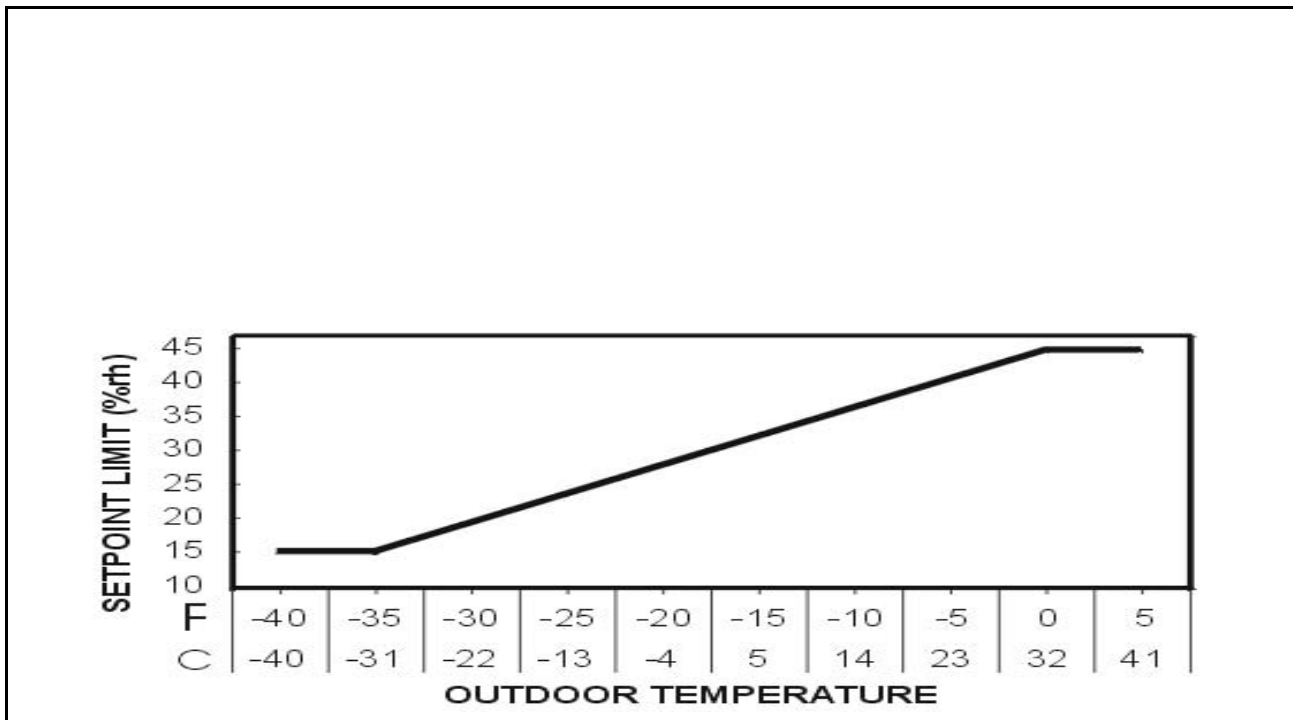


Figure 29. Set Point Versus Outdoor Temperature

F. POSITIONING CONTROLS AND SENSORS

- (1) When positioning controls and sensors, ensure other factors do not influence these devices and give incorrect inputs to the unit. Some of these influences are:
 - (a) The wall humidistat should not be installed on an outside wall or hot or cold surface.
 - (b) The sensor should be installed away from any heat source and away from direct sunlight and away from any water vapor producing source.
 - (c) The wall surface should be flat and clean.
 - (d) Any draft originating from the wall interior should be prevented from interacting with the humidity sensor. A vapor barrier should be installed.
 - (e) Location of sensor must be representative of space humidity therefore avoid drafts, temperature variation or overhangs that may prevent the sensor from sensing an accurate representation of the space humidity.
 - (f) Duct sensors should be placed in a location that assures any and all absorption has been accomplished.

G. NORTEC ONLINE

- (1) NORTEC OnLine enables secure, internet based monitoring, simplifies interoperability and automated email service notification. Using standard Internet Explorer, version 6.0 or newer, NORTEC OnLine provides both monitoring and control, from any location with Internet access, for a period of one year. (See Figure 30.) During the service period, NORTEC OnLine will also generate automatic e-mails when scheduled service is required and/or abnormal operation occurs. Up to three customer(s) e-mail addresses may be added to the automatic notification feature, to provide instant notification.
- (2) NORTEC OnLine factory technicians will remotely view each humidifier weekly and record key status information, which will be used for an annual report to the key customer contact. This contact will also receive notification of corrections, or service recommendations from the NORTEC OnLine technician responding to automated e-mail notifications.
- (3) The factory-installed NORTEC OnLine controller is located internally to the humidifier.
- (4) Key features of NORTEC Online include:
 - (a) Graphical representation of humidifier performance
 - (b) Enable/disable humidifier
 - (c) Adjust %rh set point(s), if equipped
 - (d) Adjust manual Limited Capacity
 - (e) Automated e-mail advisories for scheduled service or abnormal conditions
 - (f) Up to fifty incidents, of factory direct support and follow-up
 - (g) First year of remote access includes factory direct monitoring
 - (h) Weekly checks by NORTEC OnLine factory technicians
 - (i) Remote factory diagnostics and programming capability
 - (j) Individual account access to www.norteconline.com.
 - (k) Monitor up to seventy parameters from each humidifier

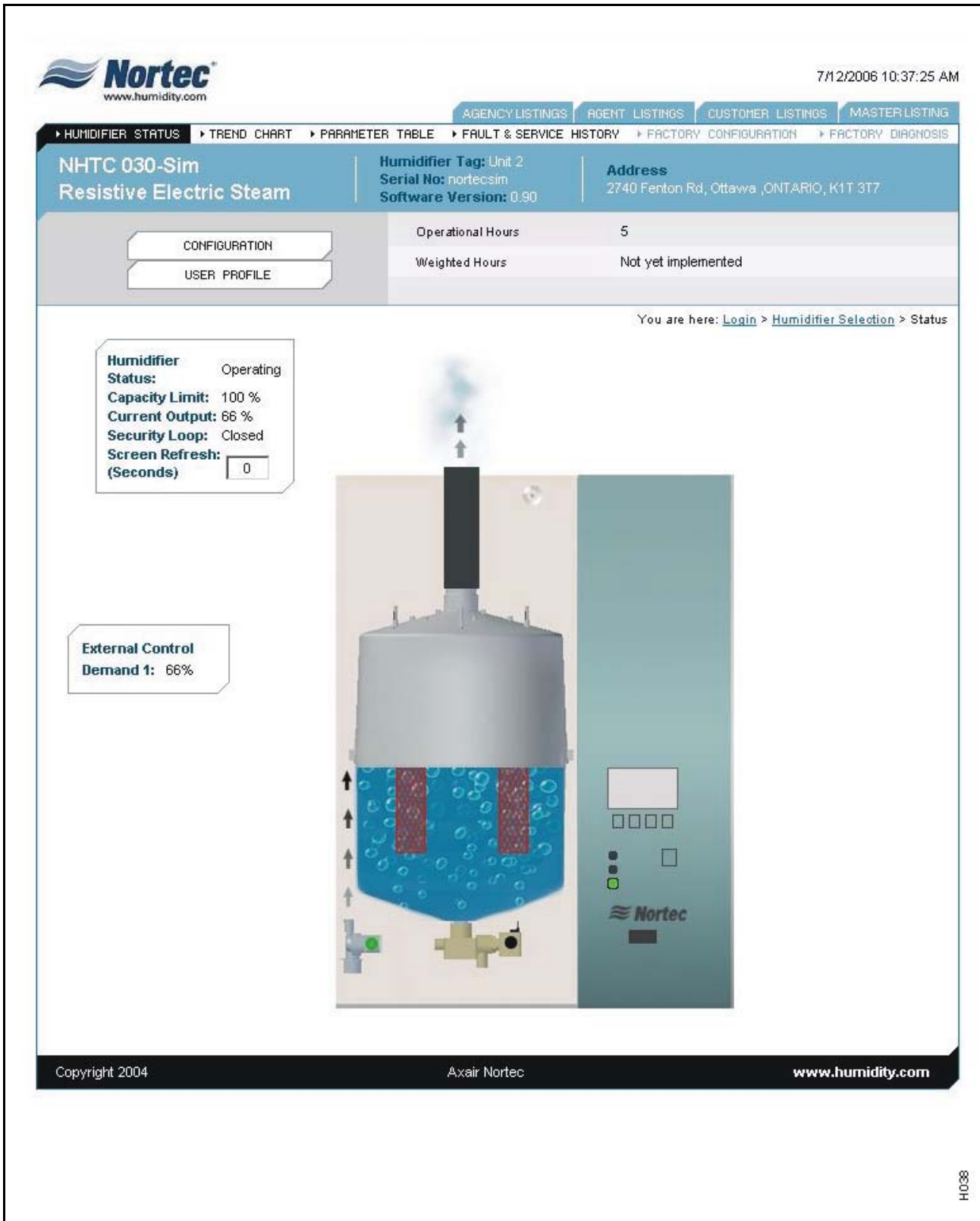


Figure 30. NORTEC OnLine Monitoring

- (l) Access to service history
 - (m) Option to add up to seven slave humidifiers to each NORTEC OnLine module
 - (n) Monitor up to eight humidifiers (one master, seven slaves) with one Internet connection
 - (o) Up to three years of coverage can be purchased at time of order
 - (p) Secure 128-bit Internet connectivity (SSL)
- (5) Different networking configurations may be achieved and are mostly dependant on the type of network present at the site. Specify at the time of order using the form in Figure 31. Connection options include:
- (a) Static IP connection
 - (b) DHCP (dynamic IP)
 - (c) GPRS connection
 - (d) Dial-up modem connection.

H. NORTEC LINKS

- (1) Provides a network connection to a BMS system using one of the following protocols:
- (a) BACnet IP
 - (b) BACnet MSTP
 - (c) LonWorks
 - (d) Modbus (Standard on the NHTC and NHTC Outdoor)
 - (e) Johnson N2.
- (2) NORTEC Links provides monitoring and control allowing humidifier(s) to communicate to your Building Management System (BMS). The controller is factory installed and is located internally to the humidifier. NORTEC Links can be integrated with NHTC, NHSC/DI, GSTC/SETC technologies. Simply specify at time of order, using the form in Figure 32, what operating protocol you are using BACnet IP, BACnet MSTP, LonWorks, Modbus or Johnson N2.
- (3) Some features of NORTEC links are:
- (a) Digital feedback for unit standby/humidifying mode.
 - (b) Digital feedback for service required.
 - (c) Digital feedback for fault indication.
 - (d) System demand display.
 - (e) Control enable/disable.
- (4) Combined with direct sensor connection to either the humidifiers or BMS it is also capable of:
- (a) Control room set point
 - (b) Control high limit set point
 - (c) Control room %rh
 - (d) Control high limit %rh.

I. TYPICAL INSTALLATION LAYOUT FOR NHTC/NHPC

- (1) The following are examples of typical control installation possibilities. There are many more configurations possible, be sure to consider the application and positioning as a priority. Figures 33, 34, 35, and 36 show typical control installation.

J. NORTEC CONTROLLER DIMENSIONS

- (1) See dimensions in Chapter 10-30.

NORTEC ONLINE CONFIGURATION FORM
Please complete the information below.

Attention: _____ **Date:** _____
Company: _____ **Fax #:** _____
From: _____ **Page:** _____ of _____
Subject: NORTEC Online Information

G FOR YOUR INFORMATION

G RESPONSE REQUESTED

Agent P.O. Number: _____

Sales Order Number: _____

Desired NORTEC Online Connection Type:

- Static IP connection
- DHCP (dynamic IP)
- GPRS connection
- Dial-up modem connection

Settings for Static IP Connection:

Module IP Address: _____
 Subnet Mask: _____
 Default Gateway Address: _____
 Primary DNS: _____
 Secondary DNS: _____

Setting for GPRS Connection:

User Name: _____
 Password/PIN Code: _____
 APN String: _____
 Connection String: _____

Settings for Dial-up Modem Connection:

User Name: _____
 Password: _____
 Phone Number to dial: _____

Be sure to include complete dial-up number string such as area code if necessary.

Humidifier Ordering

Humidifier Model/Size	Unit Designation	Desired Unit Order
		Lead Humidifier Unit 1
		Unit 2
		Unit 3
		Unit 4
		Unit 5
		Unit 6
		Unit 7
		Unit 8

Email Addresses for Event Notification:

Email Contact 1: _____
 Email Contact 2: _____
 Email Contact 3: _____

End User Information

Time Zone: _____
 Company Name: _____
 Address: _____

 Phone Number: _____
 Main Contact Person: _____

Figure 31. NORTEC Online Configuration Form

NORTEC LINKS FORM
Please complete the information below.

Attention: _____ **Date:** _____
Company: _____ **Fax #:** _____
From: _____ **Page:** _____ of _____
Subject: NORTEC Links Information

G FOR YOUR INFORMATION

G RESPONSE REQUESTED

MESSAGE

Agent P.O. Number: _____ Sales Order Number: _____

Desired NORTEC Links Option:

- BACnet/IP
- BACnet/MSTP
- Johnson N2
- LonWorks

Settings for BACnet/IP only:

Default Gateway Address: _____
 Network Number: _____
 Subnet Mask: _____
 Module IP Address: _____

Humidifier Ordering:

Humidifier Model/Size	Desired Unit Order
	Lead Humidifier Unit 1
	Unit 2
	Unit 3
	Unit 4
	Unit 5
	Unit 6
	Unit 7
	Unit 8
	Unit 9
	Unit 10
	Unit 11
	Unit 12
	Unit 13

For all GS/SE humidifiers equipped with NORTEC Links and NH units with BACNET/IP.

Figure 32. NORTEC Links Form

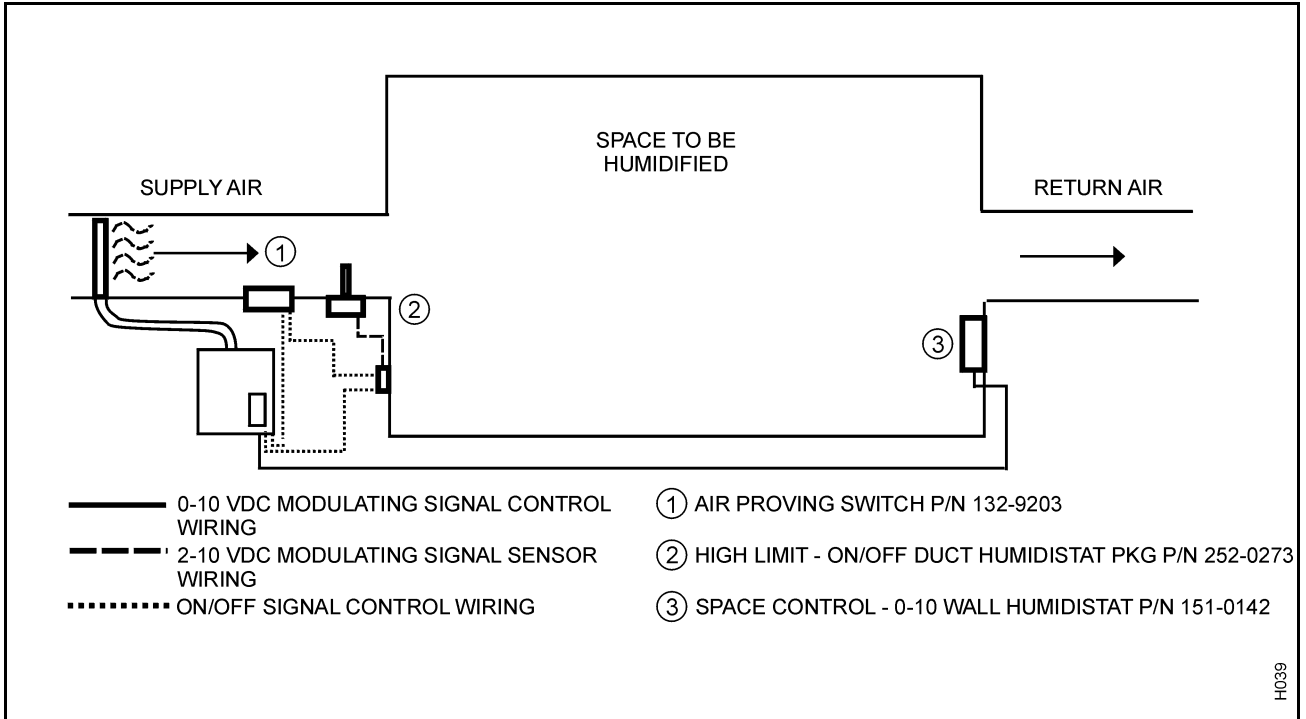


Figure 33. Humidifier Controlled by Air Proving, On/Off Duct Mounted High Limit and Modulating Wall Mounted Space Controller

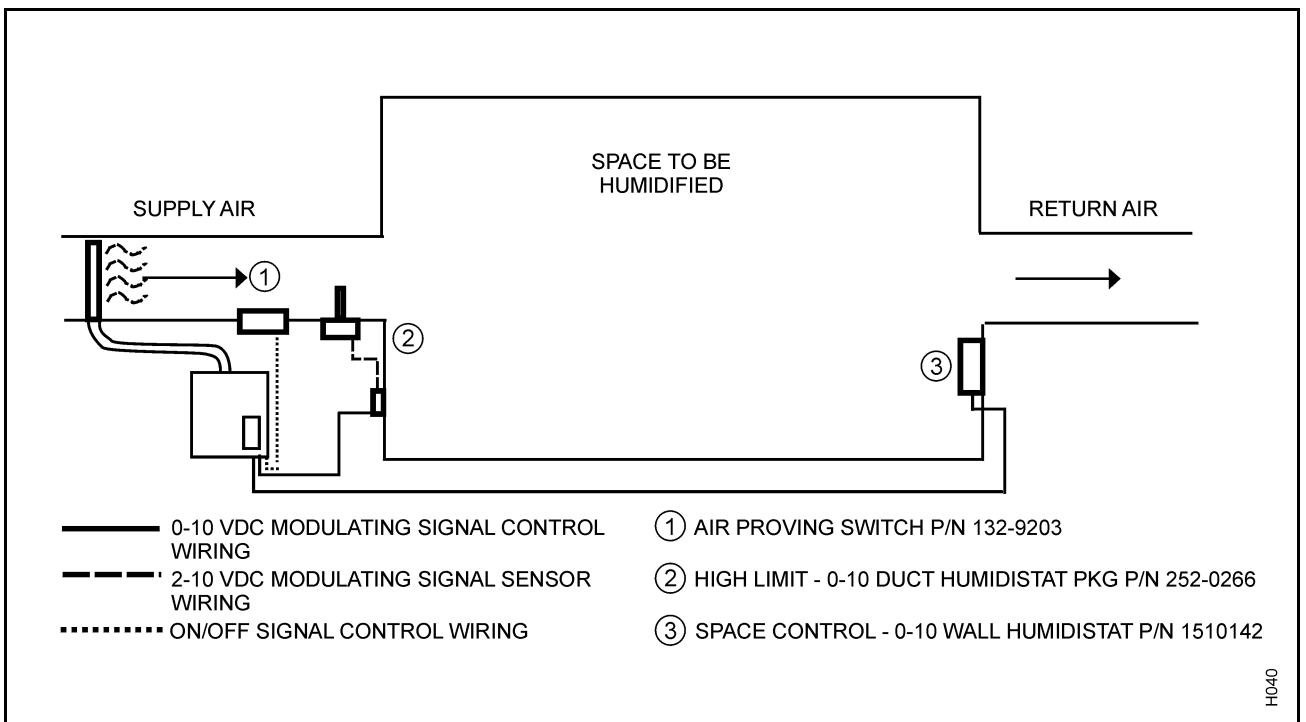


Figure 34. Humidifier Controlled by Air Proving, Modulating Duct Mounted High Limit and Modulating Wall Mounted Space Controller

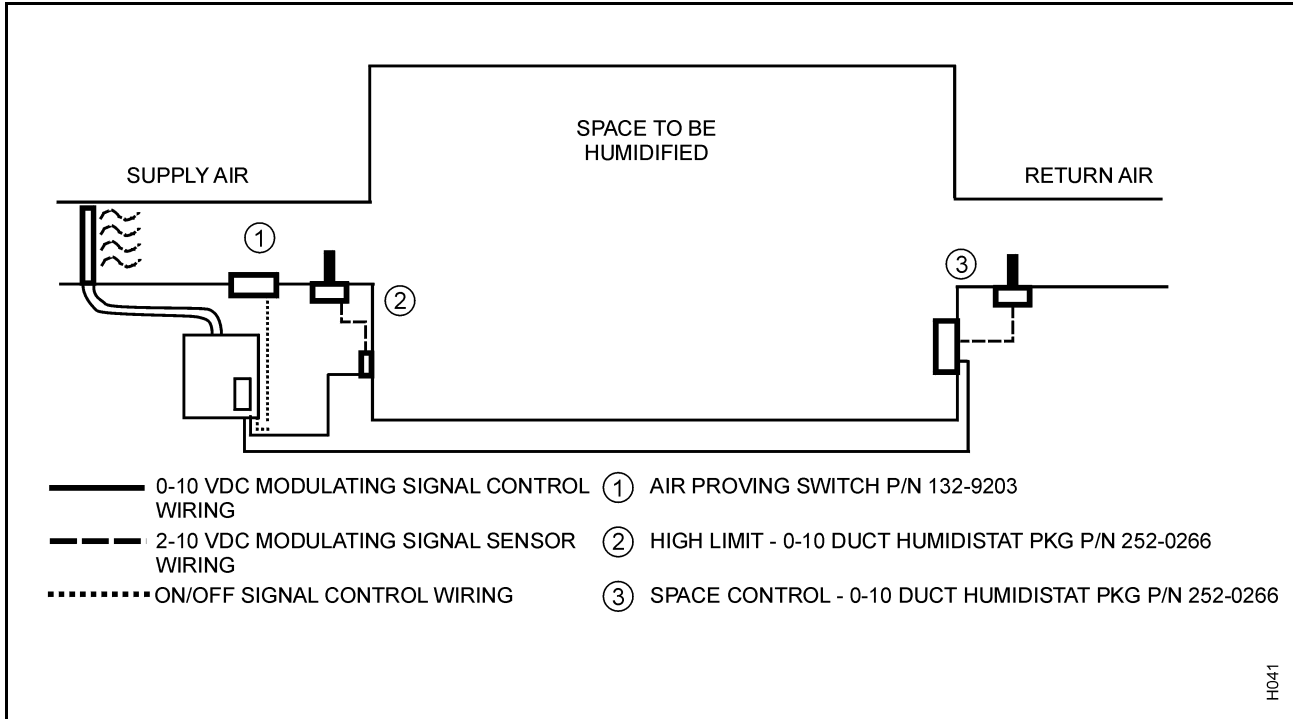


Figure 35. Humidifier Controlled by Air Proving, Modulating Duct Mounted High Limit and Modulating Wall Mounted Return Air Sensor with Wall Mounted Controller

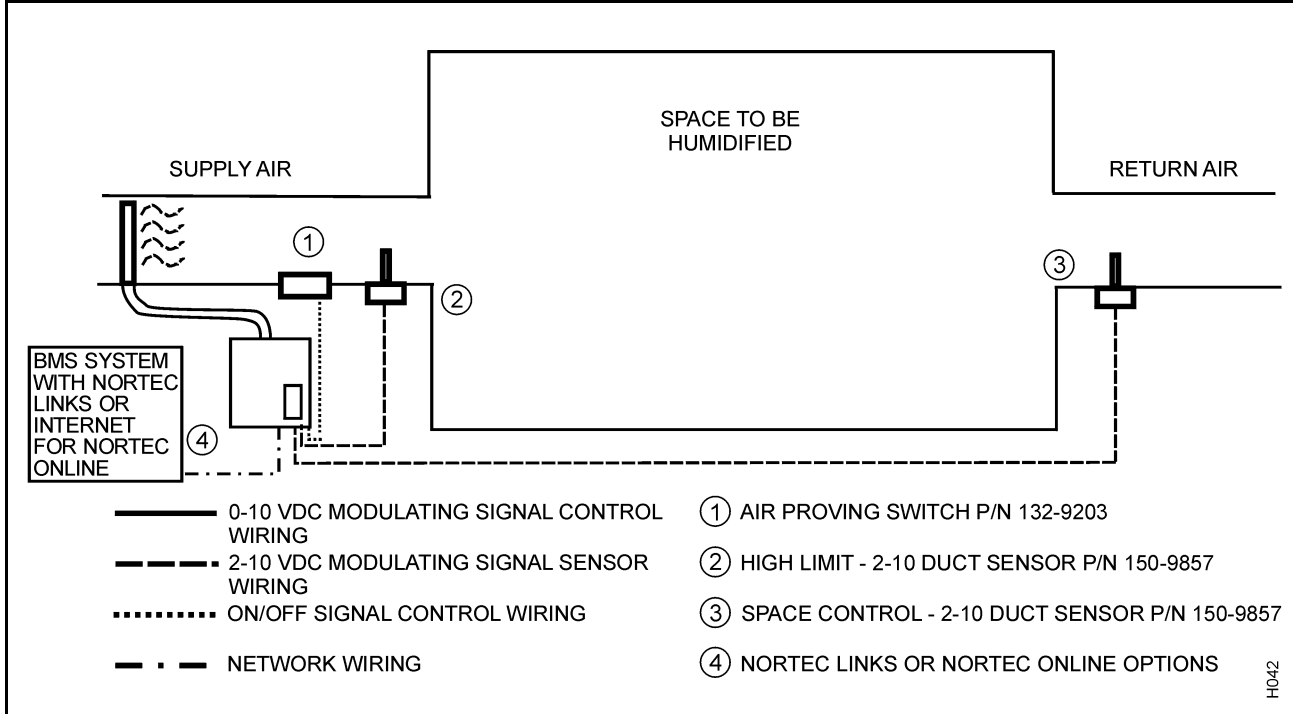


Figure 36. Humidifier Controlled by Air Proving, Duct Mounted High Limit Sensor and Modulating Duct Mounted Return Air Sensor with Networking Option

10-20

SPECIFICATIONS

SPECIFICATIONS

1. HUMIDIFIERS

A. GENERAL

(1) Work Included

- (a) NORTEC NH Series electrode steam humidifier(s) as indicated on drawing(s) and as indicated on schedule(s).
- (b) Complete and operable humidification system (which meets applicable building codes).
- (c) Equipment start-up and project inspection by qualified factory trained representative.

(2) Submittals

- (a) Submit product data under provisions of Section 15010. Include product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes. Include rated capacities, operating weights, furnished specialties, and accessories.
- (b) Include piping details, plans, elevations, sections, details of components, and dispersion tubes. Submit wiring diagrams including power, signal, and control wiring.

(3) References

- (a) Certifications, C-UL_US Listed.
- (b) ISO 9001-2000.
- (c) ANSI/NFPA 70 – National Electrical Code.
- (d) ARI 640, 'Standard for Commercial and Industrial Humidifiers'.
- (e) ASHRAE SSPC 135 BACnet, ANSI/EIA 709.1 LonTalk.

(4) Warranty

- (a) Product shall be warranted to be free from defects in material and workmanship for a period of two years after installation or 30 months from manufacturers ship date, whichever date is earlier. If operating with NORTEC web-based service program warranty is extended to 42 months from ship date.

B. PRODUCTS

(1) Electrode Steam Humidification System – NORTEC Model NHTC

- (a) NORTEC NHTC electrode steam generating system using regular type potable water supply.
- (b) Packaged unit, wall mounted, requiring steam distributor(s) or Short Absorption Manifold(s) for mounting into AHU/duct(s) or Remote/Built-On Mounted Blower Pack(s) for direct space applications. Refer to Humidifier Dispersion Options in paragraph B.(4).
- (c) Atmospheric pressure steam generation and mineral separation contained within an electrode steam cylinder(s). Resistive element technology and boiler steam (pressure steam) technology not acceptable. The disposable electrode steam cylinder shall have:
 - 1 Published life expectancy.

- 2 Published replacement pricing.
 - 3 Cylinder seams must be spin welded to ensure long-term water tightness and leak resistance.
 - 4 Integral electronics to ensure safe operation.
 - 5 High water sensor circuitry to prevent over filling.
 - 6 Efficient operation over a wide range of water conditions.
 - 7 Simple maintenance without disassembly or removal of humidifier. No specialized tools required.
 - 8 Full output and maximum energy efficiency through entire cylinder life.
 - 9 'Drain through bottom' to ensure highest mineral concentration is effectively removed. Simple skimmers are not acceptable.
 - 10 Large perforated strainer at drain outlet to prevent blockage of drain valve or drain lines.
 - 11 Tool-less primary electrical connection for use with factory installed, spring loaded, gold plated connectors.
 - 12 Safety characteristics ensuring no current flow with absence of water, independent of safety controls. Resistive element not acceptable.
- (d) Unit(s) to be complete with:
- 1 'Total Controller' microprocessor to control all humidifier functions with interface capabilities for remote communication technologies, including Internet or BMS requirements.
 - 2 Advanced water management utilizing the patented Proportional plus Integral Autoadaptive control system for optimal energy efficiency, water usage and cylinder life.
 - 3 Microprocessor controlled fill valve and drain valve allowing automatic water management.
 - 4 Internal drain water tempering to ensure maximum 140°F (60°C) drain water.
 - 5 Integral fill cup with minimum 1-inch (25-mm) air gap to prevent back siphoning.
 - 6 Smart cylinder EPROM for improved operation providing:
 - a Cylinder identification with model, data, and capacity.
 - b Cylinder self diagnostics ensuring safe operation.
 - c End of cylinder life status.
 - d Cylinder run time in hours.
 - 7 Full cylinder indication and pre-notification of automatic shutdown at end of cylinder life.
 - 8 Automatic pulse feature to clean any obstruction from the drain solenoid valve when needed.
 - 9 Automatic off-season shut-down (after 3 days of 'no call') will completely drain the cylinder(s) and automatically restart on call for humidity. Adjustable on/off and time sequence. Provides extended cylinder life, while ensuring stagnant water does not remain in the system.

- 10 Accepts a signal from BMS/BAS system or modulating humidistat.
- 11 Single or dual channel signal acceptance.
- 12 Isolated plumbing and electrical compartment with cabinet made of 18-gauge powder coat paint finish and 20 gauge plumbing electrical door. Modular plumbing and electrical fully assembled and pre-wired (no field assembly required).
- 13 Removable door (no special tools required) to allow user full front access of plumbing and electrical sections.
- 14 Plumbing door interlock safety switch to allow power interruption when installing or servicing the humidifier.
- 15 Standard of acceptance NORTEC NHTC Series.
- 16 C-UL_US listed.
- 17 Spec

(2) Humidifier Controls (NHTC and NHTC Outdoor)

- (a) Total Controller microprocessor with the following features or functions:
 - 1 Full function user interface with touch type keypad and backlit alphanumeric graphic display with trend log.
 - 2 Real time clock indicating date and time with battery back up.
 - 3 Built-in controller with adjustable set point, proportional range, and integral for use with humidity transducers.
 - 4 Acceptance of industry standard (analogue continuous control demand signal [0-5 VDC] [1-5] [0-10 VDC] [0-20 mA] [4-20 mA]) relative humidity transducers.
 - 5 Keypad programming to configure, monitor and control humidifier parameters on graphic backlit display
 - a Relative humidity set point and actual conditions in space from humidity transducer.
 - b Relative humidity set point and actual conditions in duct for variable air volume (VAV) applications from humidity transducer.
 - c Relative humidity high limit set point and actual from humidity transducer.
 - d System demand in lbs/hr (kg/hr).
 - e On screen service history with date stamp.
 - f On screen fault history with troubleshooting list and date stamped.
 - g On screen attention indication.
 - h Security loop status open/close.
 - i Control Channel 1 demand %.
 - j Control Channel 2 demand %.
 - k Control mode (single or dual modulation).
 - l Control type (demand or rh proportional, rh proportional + integral).

- m Manual capacity output adjustment range of 20-100%.
- n Humidifier model, capacity, software version.
- o Cylinder model # and capacity rating.
- p Humidifier run time weighted hours.
- q Date and time (year, month, day, hour and minute).
- r Stand by heating to increase steam production response time.
- s Rapid modulation capability reduces response time upon start-up.
- t Short cycling detection and correction diagnostics.
- u Foam detection and correction capability.
- v Scroll through start-up and troubleshooting checklist on graphical display.
- w Self-diagnostics during start-up to system test to prevent unsafe operation of the unit(s).
- x User adjustable drain/flush frequency.

HUMIDIFIER CONTROLS NHPC

(b) Proportional Controller microprocessor with following features or functions:

- 1 Graphic function display with user interface with touch type key pad.
- 2 Acceptance of industry standard [analogue continuous control demand signal [0-1Vdc] [1-5Vdc] [0-10 Vdc] [2-10 Vdc] [0-16 Vdc] [0-20 mA]
- 3 Keypad/Display to monitor and control humidifier parameters.
 - a System demand in lbs/hr (kg/hr).
 - b Security loop status open/close.
 - c Control Channel 1 demand %.
 - d Manual capacity output adjustment range of 20-100%.
 - e Self-diagnostics during start-up to system test to prevent unsafe operation of the Unit[s].
 - f Control signal type.
 - g Software version.

(c)

- 1 Internal communications via Modbus RTU protocol provides monitoring and control allowing humidifier(s) to communicate to Building Management System (BMS). Supporting a RS485 port with a configuration of 9600bps, 8-bits, no parity, one stop bit shall support the following variables:
 - a Change Cylinder – Indicates cylinder needs to be replaced (read).
 - b Channel 1 Input – Humidifier input value being supplied to channel 0-100% (read/write).
 - c Channel 1 Set point – Control channel 1 setpoint for relative humidity in space 0-100% (read/write).
 - d Channel 2 Input – Humidifier input value being supplied to channel 0-100% (read/write).

- e Channel 2 Set point – Control channel 2 setpoint for relative humidity in space 0-100% (read/write).
- f System Demand – Indicates humidifier system demand based on input signal calculations 0-100% (read).
- g Demand/rh_Configuration Parameter – Configures humidifier to accept demand or %rh signal(s) (read/write).
- h Remote fault Indication – System fault indication and alarm status (read).
- i Network Sensors – Allows network-enabled sensing or control (read/write).
- j Remote Disable – Provides remote humidifier enable/disable system control. (read/write).
- k Remote Service Indication – Provides remote humidifier service indication (read).
- l Remote Status Indication – Provides remote humidifier on/standby system status indication (read).

(3) Remote Monitoring And Control Options (NHTC and NHTC OUTDOOR only)

Reference: Section 15900 - Building Controls and Automation

- (a) NORTEC OnLine web based monitoring and control from any location with Internet access, using standard Internet Explorer, version 6.0 or newer.
- (b) NORTEC OnLine remote monitoring hardware using secure <DHCP Ethernet Connection> or <Static IP Ethernet Connection> or <Dial-up Internet Connection> or <GPRS wireless Internet Connection> Internet communication protocols.
- (c) NORTEC OnLine Monitoring Service (NOMeS) with weekly humidifier examination by factory direct technicians for first year, renewable/extendable up three consecutive years.
- (d) One additional year (third year), extended humidifier warranty when renewed/extended for third year of NORTEC OnLine Monitoring Service (NOMeS).
- (e) Packaged accessory, factory installed and ready for customer supplied <Ethernet> or <Modem> communication connection.
- (f) Package will include the listed items in either paragraph (f) 1 through 17 or paragraph (g) 1 through Z:
 - 1 Internet accessible graphical representation of humidifier performance.
 - 2 Remotely enable/disable humidifier.
 - 3 Remotely adjust rh% set point(s), if equipped.
 - 4 Remotely adjust 'limited capacity'.
 - 5 Automated e-mail advisories for scheduled service or abnormal conditions.
 - 6 Up to three customer e-mail addresses available for automated e-mail advisories.
 - 7 Up to 50 incidents, of factory direct support and follow-up per humidifier.
 - 8 First year of remote access includes factory direct monitoring.
 - 9 Weekly checks by NORTEC OnLine factory technicians.
 - 10 Remote factory diagnostics and programming capability.

- 11 Individual account access to www.norteconline.com.
 - 12 Monitor up to seventy parameters from each humidifier.
 - 13 Access to service history.
 - 14 Option to add up to <seven> or <six NMTC> 'slave' humidifiers to each NORTEC OnLine module.
 - 15 Monitor up to <eight humidifiers (one master, seven slaves)> or <seven humidifiers (one master, six slaves)> with one <Ethernet> or <Modem> connection.
 - 16 Up to three years of coverage can be purchased at time of order, extending humidifier limited warranty to three years.
 - 17 Communication using secure 256-bit Internet connectivity (SSL) and Jabber protocol.
- (g) NORTEC Links remote building management system capability using BACnet MSTP, BACnet /IP LonTalk, or Johnson N2 networks for monitoring and controlling. The package will include:
- 1 Variable definitions, addresses, and values.
 - 2 For complete function capabilities refer to 1.B.(2)(a)6.
 - 3 Monitor up to 13 humidifiers (one master, 12 slaves) using a single interface.
 - 4 External Interface File (XIF) for LonWorks integration.
 - 5 Protocol Implementation Conformance Statement (PICS) for BACnet integration.
 - 6 BACnet Interoperability Building Blocks (BIBBS) for BACnet Services.
 - 7 User graphic with trending charts, complete with all humidifier details. Refer to 1.B.(2)(a)6.

(4) Humidifier Dispersion Options

- (a) Single Tube(s) Steam Dispersion with condensate drain – NORTEC Model(s) ASD, BSD, CSD
- 1 Allows for direct introduction of steam into a duct system or air handling unit. Distributor tube is made of stainless steel and can be installed in a horizontal, upflow, or downflow duct applications.
 - 2 Steam inlet connection size is f" (22.2 mm) O.D for ASD, BSD models and 1¾" (44.5 mm) for CSD model.
 - 3 Rated capacities per single dispersion tube(s) model - ASD up to 25 lbs/hr, BSD up to 35 lbs/hr and CSD up to 115 lbs/hr.
 - 4 All single tube(s) distributors have an integral condensate return, allows for condensate produced at the distributor to be drained through a d" (9.5 mm) drain leg either back to the humidifier or to a convenient floor drain.
- (b) Wall Mounted Direct Steam Dispersion System – NORTEC Model(s) RMBP or BOBP (for NHTC and NHPC only)
- 1 Packaged unit, wall mounted allows for direct space/room humidification when steam introduction into a ducted system is not feasible.

- 2 The factory assembled blower pack includes an integral steam distributor, three tubeaxial (box) fans, fusing, wall mounting bracket, and air proving safety circuitry.
 - 3 Primary and control voltage terminal blocks facilitate field connections between the humidifier.
 - 4 Blower pack may be remote mount or built-on the humidifier.
- (c) Short Absorption Manifold – NORTEC Model SAM-e
- 1 Short Absorption Manifold designed for atmospheric steam humidifiers or pressurized steam from a boiler, to directly inject the steam into ducted air for humidification.
 - a Absorption distance characteristic shall prevent water accumulation on any induct surfaces beyond ___in. (___mm) downstream of the steam dispersion panel.
 - b Steam dispersion panel consisting of a (one) horizontal stainless steel header supplying steam to a bank of closely spaced 3" (7.6 cm) or 6" (15.2 cm) or 9" (22.9 cm) or 12" (30.5 cm) vertical tubes, as necessary to meet absorption distance requirements, and to reduce condensation losses.
 - c Single horizontal stainless steel header to provide steam to vertical distributor tubes and to reduce condensation losses. Dual header systems creating unnecessary condensation, or systems needing to be installed on a partition or requiring blank off plates are not acceptable.
 - d Header design is primarily round tube to minimize pressure drop. Square headers are not acceptable.
 - e Steam inlet and condensate return located on the same side and at the bottom of the header to allow single point entry and floor mounting.
 - f Headers and tubes are 304 stainless steel construction.
 - g Vertical stainless steel distribution tubes to promote condensate evacuation. Horizontal distributor tubes are not accepted.
 - h Distribution tubes shall include threaded standoffs for trouble free attachment to factory supplied support bracket.
 - i Stainless steel nozzle inserts ensure condensate free steam is discharged from the center of the distribution tubes. Systems without nozzle inserts, or other than stainless steel, are not acceptable.
 - j Stainless steel nozzle inserts shall have metered orifices, sized to provide even distribution of the discharged steam, spaced for optimum steam absorption.
 - k Nozzles of dissimilar metals are likely to dislodge due to inconsistent rates of expansion and therefore not accepted.
 - l Adjustable mounting frame available for quick and easy installation.

C. EXECUTION

(1) Examination

- (a) Examine ducts, air handling units, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

- (b) Examine roughing-in for piping systems to verify actual locations of piping connections before humidifier installation.
- (c) Proceed with installation only after unsatisfactory conditions have been corrected.

(2) Installation

- (a) Install humidifiers and steam dispersion panels per manufacturers' instructions.
- (b) Seal humidifier dispersion-tube duct penetrations with flange.
- (c) Install with required clearance for service and maintenance.

(3) Commissioning

- (a) System verification testing is part of the commissioning process. Verification testing shall be performed by the contractor and witnessed and documented by the commissioning authority. Refer to section 01810, Commissioning, for system verification tests and commissioning requirements; or
- (b) Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing. Responsibilities include:
 - 1 Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2 Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
 - 3 Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

(4) Testing

- (a) System testing is accomplished through either of the following methods:
 - 1 System verification testing is part of the commissioning process. Verification testing shall be performed by the contractor and witnessed and documented by the commissioning authority. Refer to section 01810, Commissioning, for system verification tests and commissioning requirements; or
 - 2 Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing. Responsibilities include:
 - a Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - b Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
 - c Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

(5) Training

- (a) Equipment training can be accomplished in one of the following two ways:

- 1 Training of the owner's operation and maintenance personnel is required in co-operation with the commissioning authority. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the commissioning authority after submission and approval of formal training plans. Refer to System Demonstrations, section 01670, for contractor training requirements. Refer to section 01810, Commissioning, for further contractor training requirements; or
- 2 Engage a factory-authorized service representative to train owner's maintenance personnel to adjust, operate, and maintain humidifiers.
 - a Train owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 - b Review data in maintenance manuals. Refer to Division 1 Section Contract Closeout.
 - c Review data in maintenance manuals. Refer to Division 1 Section Operation and Maintenance Data.
 - d Schedule training with owner, through architect, with at least seven days advance notice.

10-30 SUBMITTALS

1. SUBMITTAL DESCRIPTIONS

A. INTRODUCTION

- (1) The information found in this section is general in nature and consists of part numbers, product descriptions and options, dimensions, specifications and equipment features.

B. NH UNIT

- (1) The different wiring connections to the humidifier unit can be found in Figure 2. All wiring is to be in accordance with existing national and local electrical codes.
- (2) Performance data for single and double units can be found in Figure 3, Figure 4, and Figure 5.
- (3) NH Series unit options and common accessories universal are found in Tables 1 and 2.

C. DISTRIBUTORS

- (1) A description of the accessories for the steam distributor can be found in Table 3.
- (2) Dimensions for the steam distributor are found in Figure 6, Figure 7, Figure 8.

D. SAM-e

- (1) This section identifies the dimensions for the various configurations and components that make up a SAM-e installation.
- (2) General dimensions for the SAM-e and Mini SAM-e are found in Figures 9 and 10.
- (3) For an in-duct/AHU installation without mounting frame refer to Figure 11.
- (4) For an in-duct/AHU installation with mounting frame refer to Figure 12.
- (5) For an outside duct installation without mounting frame refer to Figure 13.
- (6) For an outside duct installation with mounting frame refer to Figure 14.
- (7) For a vertical duct installation refer to Figure 15.
- (8) For outside duct mounting cover plates refer to Figure 16.
- (9) For atmospheric SAM-e adapter dimensions refer to Figure 17.
- (10) For atmospheric steam header and adapter configuration refer to Figure 18.

E. BLOWER PACK

(1) Remote Blower Packs

- (a) Remote blower packs are powered from the NH humidifier from a primary voltage terminal block provided and fed from the leaving side of the unit contactor to operate blower pack in conjunction with unit operation. A matching terminal block is incorporated in the blower pack. Field wiring is required

between the NH unit and remote blower pack terminal blocks or can be powered by a separate 120V supply.

- (b) Disk thermostat mounted on the top of steam distributor will start the fan when steam is generated and will allow to cool down the blower pack when there is no call for humidity.
- (c) A minimum of two (2) 050-100 RMBP's are required with the NH-150 or NH-200 units. It is recommended that four (4) RMBP's be used to reduce the steam absorption distances.
- (d) It is recommended that a minimum of two (2) remote blower packs be used on NH 075-100 units to reduce the steam absorption distances.
- (e) For recommended ceiling and frontal clearances, see Chapter 10-10.
- (f) For blower pack dimensions refer to Figure 19, Figure 20, Figure 21.

(2) Built-On Blower Pack (NHTC and NHPC only)

- (a) Built-on blower packs are factory mounted and wired to operate in conjunction with the humidifier. Factory installed and wired manual reset thermostat will not allow humidifier operation if blower pack becomes overheated.
- (b) Built-on blower packs are not available on NH 150-200. Remote blower packs can be used with these units, multiple blower packs are required on NH 150-200.
- (c) Built-ON Blower Pack, Wall Mounted Direct Steam Distribution System. Allows for direct space/room humidification when steam introduction into a ducted system is not feasible. The factory assembled Built-On Blower Pack includes an integral steam distributor, three direct drive fans for quiet operation, fan adjustable louvers for installation flexibility, fusing and safety circuitry with fan airflow rate at a total of 330 cfm.
- (d) It is recommended that a minimum of two (2) remote blower packs be used on NH 075-100 units to reduce the steam absorption distances.
- (e) For recommended ceiling and frontal clearances, see Chapter 10-10. Note minimum frontal clearance is 36" (91 cm).
- (f) For blower pack dimensions refer to Figure 19, Figure 20, and Figure 21.

F. CONTROLS

- (1) NHTC/NHPC humidifiers can be easily modified to accept a control signal from a modulating humidity controller as supplied by others. Controller must have a built-in adjustable %rh set point. Signal from controller must increase with a drop in sensed %rh below set point. Humidifier will respond by controlling unit output between 0% and 100% of rated capacity to match changes in load requirements.
- (2) Double circuit humidifiers (NH 150-200) will require two external controllers by others to enable each circuit to operate independently of the other. Alternatively,

coupled circuits can be specified. Coupled circuits will enable the two circuits to be operated from one controller without compromising the safety features of the humidifier (order Part No.146-9000).

- (3) The humidifier shall be controlled directly using a humidity sensor (transducer) supplied by others. The sensor will be field wired to the humidifier for a direct control at the humidifier. The same sensor(s) can be shared in parallel to a Building Automation System for monitoring purposes. Allows keypad setpoint of rh and display of actual sensed rh on the NHTC's graphical display.
- (4) Double circuit humidifiers (NHTC 150-200) will require two external sensors by others to enable each circuit to operate independently of the other. Alternatively, coupled circuits can be specified. Coupled circuits will enable the two circuits to be operated from one sensor without compromising the safety features of the NHTC humidifier (order Part No.146-9000).
- (5) All controls are available from the factory as options. If controls were not ordered with the humidifier, they may be purchased/supplied by others. The following information is relevant to all controls, factory supplied or otherwise.
- (6) A, B and C are to be wired in series (only one path for current) across terminals 1 and 2 on the low voltage control terminal strip, or replaced with a jumper wire for constant operation.
 - (a) The Control On/Off Humidistat is wired to make on drop in humidity, break on rise. Set to desired %rh.
 - (b) The High Limit On/Off Humidistat is wired to make on drop in humidity, break on rise. Set to a higher set point (max. 85%rh) as a safety to prevent saturation.
 - (c) The Air Proving On/Off Switch is wired to make when sensing air flow, break when no air flow. As a safety to prevent saturation when no air flow.
- (7) The factory offers various versions of A, B and C to suit each application. In general, A is essential, whereas B and C are highly recommended.
- (8) Field wiring from humidistat to humidifier and between devices should be 18 AWG or heavier.
- (9) The low voltage control terminal strip is provided in the electrical compartment. The internal side is factory wired. The external side is to be field wired, unless the external controls have been cabinet mounted at the factory.
- (10) Each unit is supplied with a wiring diagram adhered to the inside face of the cabinet door.

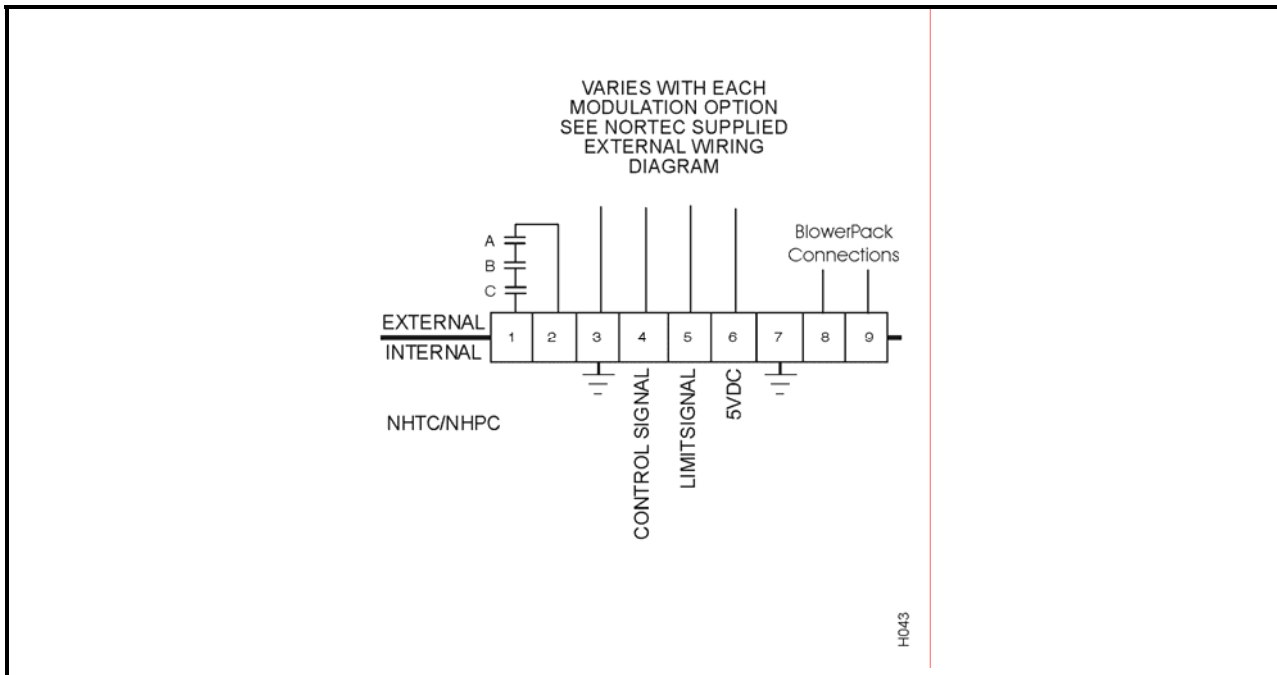


Figure 1. Low Voltage Control Terminal Strip

- (11) A and B: Mount any wall humidistat (control or high limit) over a standard electrical box at a height similar to a typical thermostat. Any wall humidistat should be in a location representative of the overall space being humidified and not in the path of a blower pack or an air supply grille.
- (12) A: Mount any duct control humidistat in a location representative of the overall air humidity, usually the return duct. Do not mount it directly in front of the steam distributor or in a turbulent or mixing zone. Mount it where the air's humidity and temperature are uniform and representative air is over-humidified or approaching saturation.

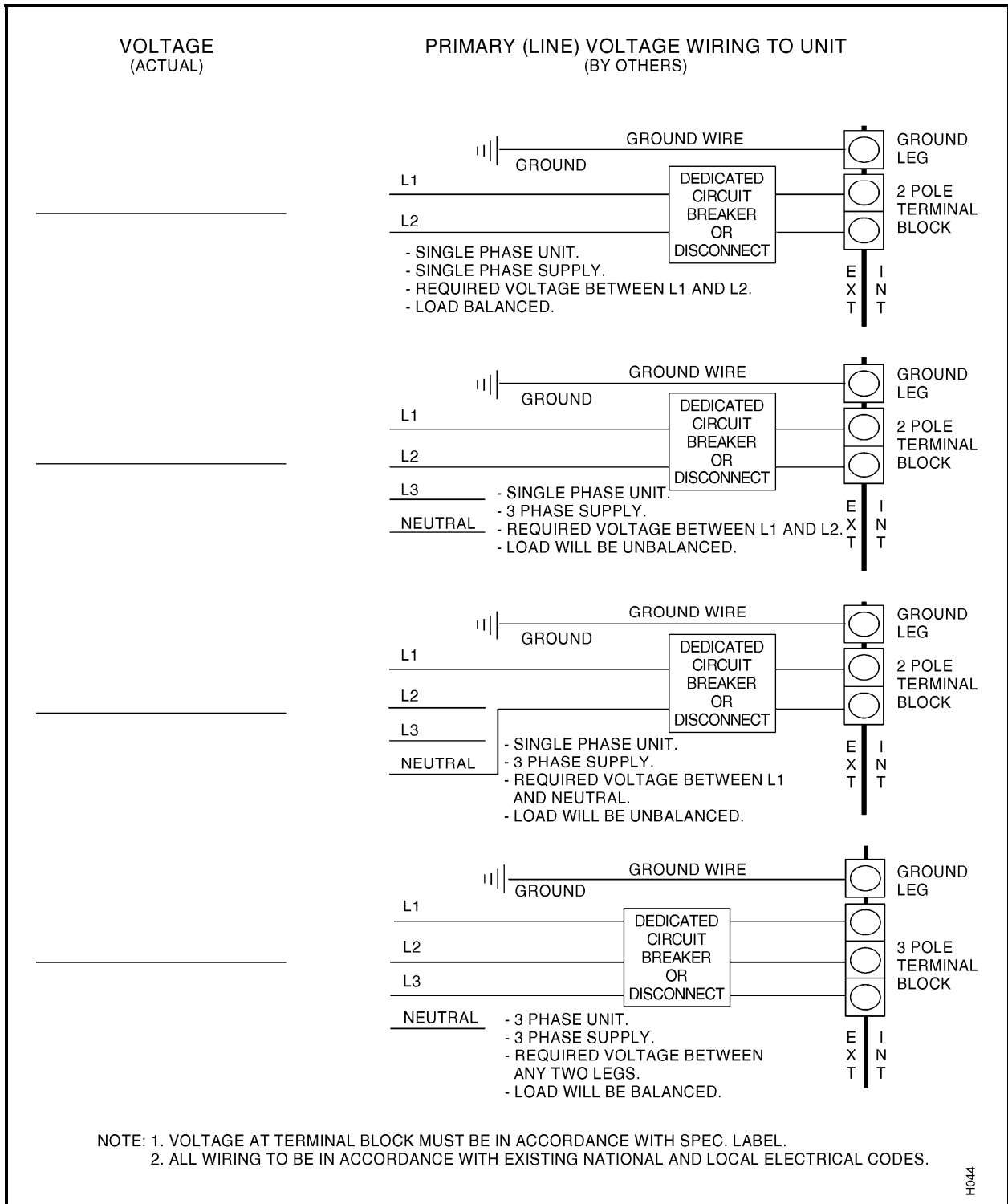


Figure 2. Primary (Line) Voltage Wiring to Unit

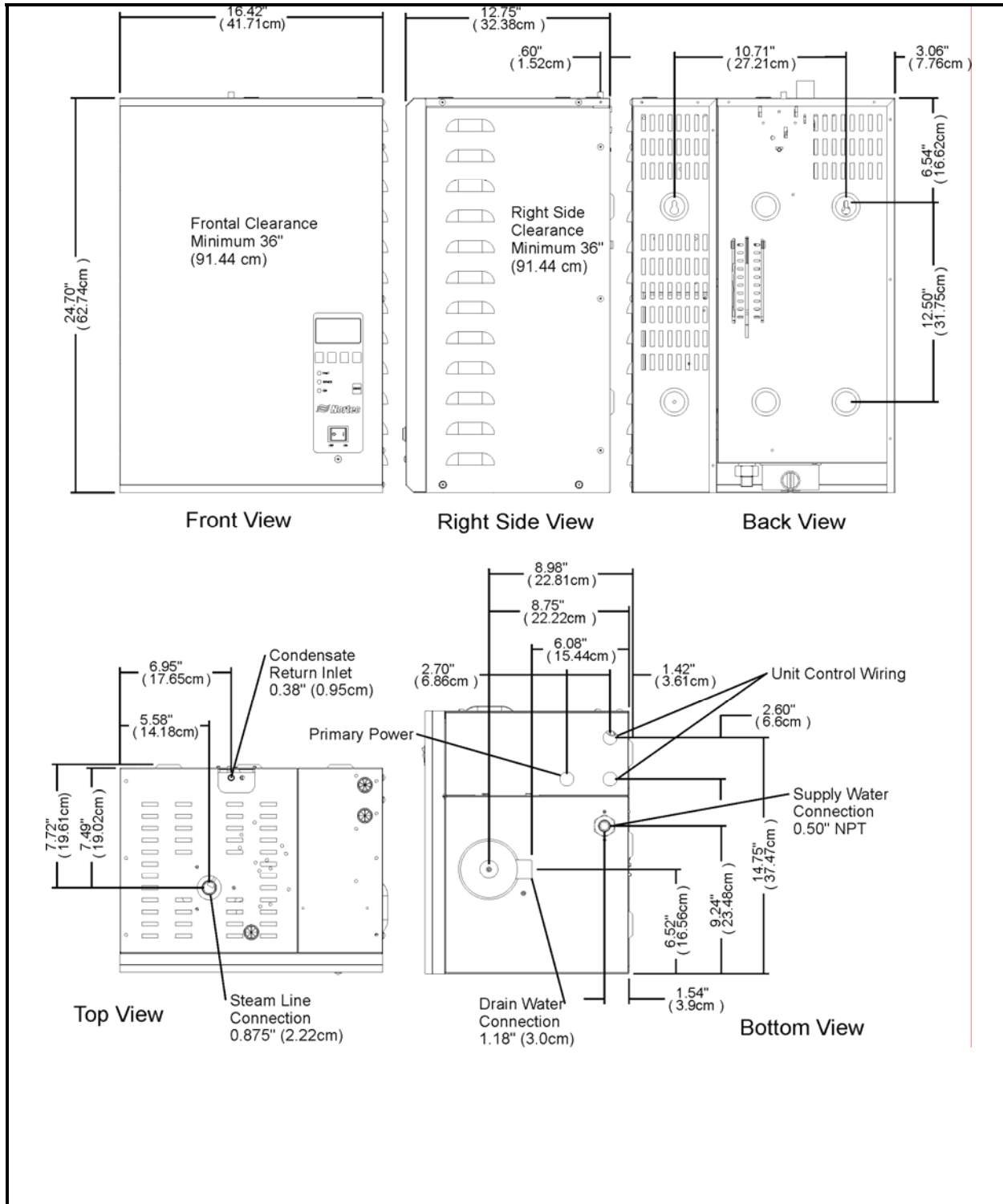


Figure 3. Physical Data – NHTC/NHPC 005-030

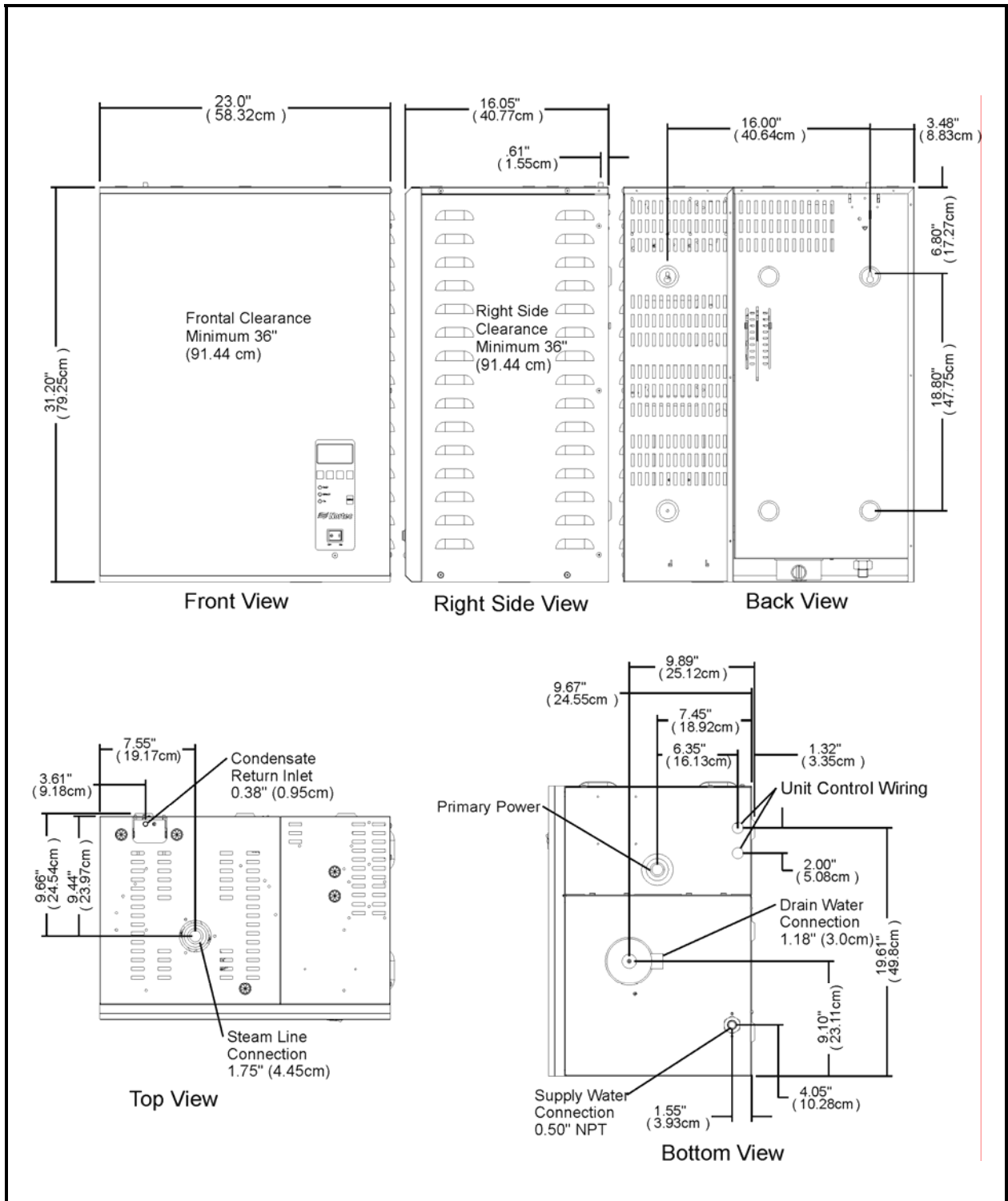


Figure 4. Physical Data – NHTC/NHPC 050-100

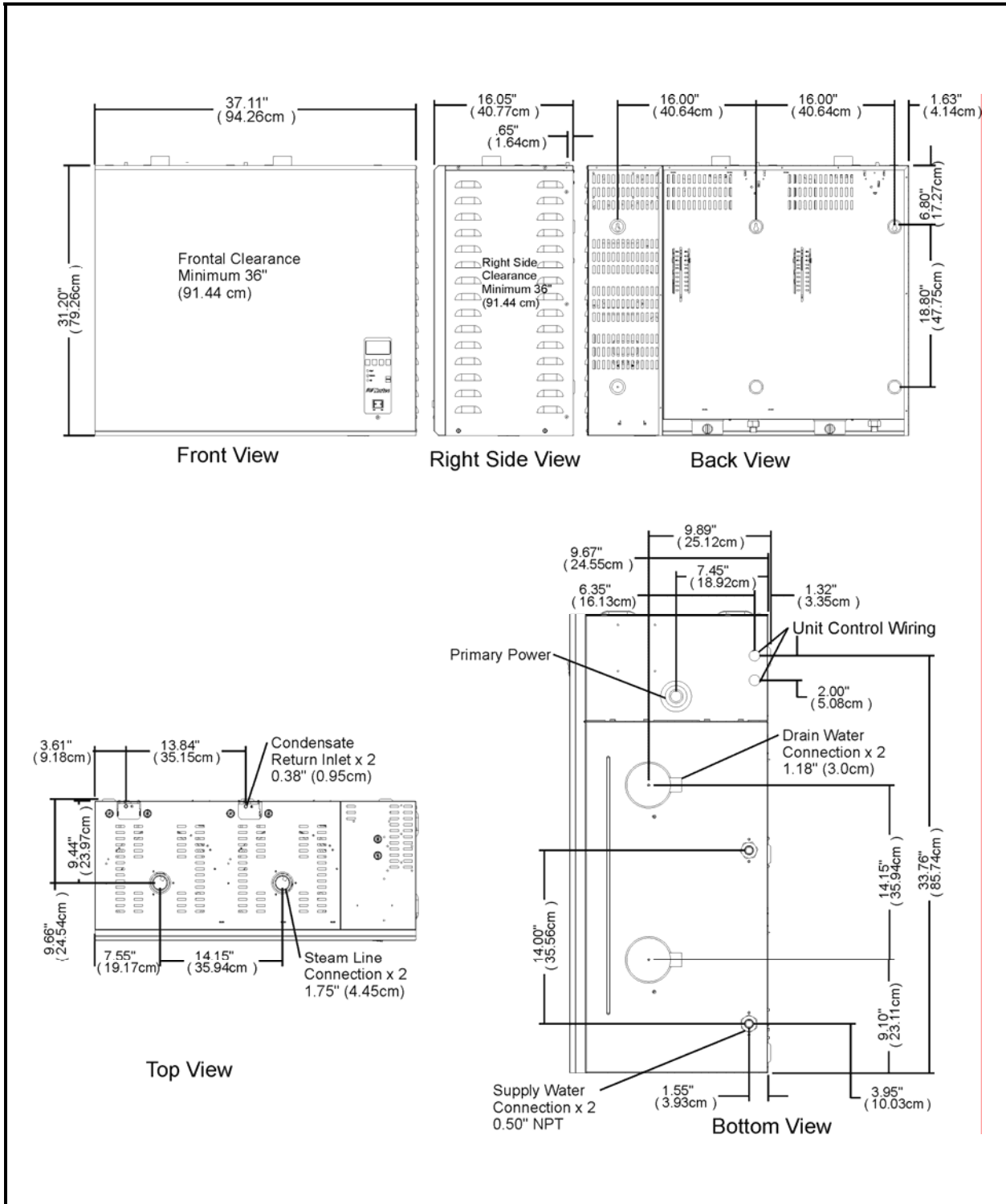
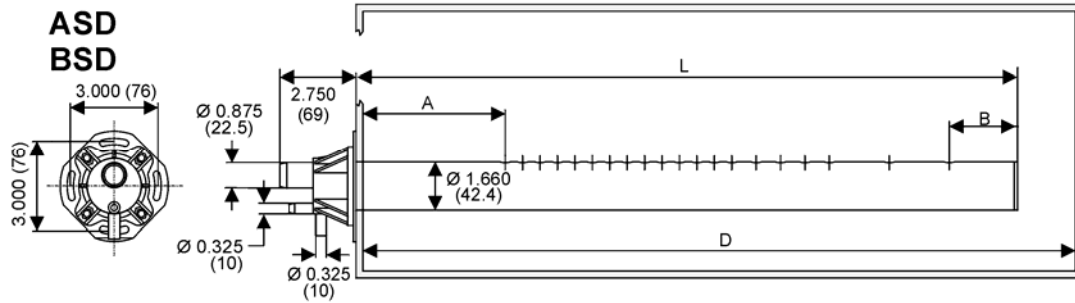


Figure 5. Physical Data – NHTC/NHPC 150-200



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Unit Model	NH 005-020	NH 030	NH 045-100	NH 135-200
Distributor Model	ASD	BSD	CSD	CSD
No. of Cylinders	1	1	1	2
No. of Outlets/Cylinder	1	1	1	2
OD of Cylinder Outlet (NHTC,P,B)	f"	f"	f"	1¾"
OD of Cylinder Outlet (NHSC/DI)	1¾"	1¾"	1¾"	1¾"

Distributor Model	Dimensions – in.(mm)			Minimum Duct
	A	B	L	Length – in. (mm)
				D
ASD 12	2 (51)	1.75 (44)	10 (254)	12 (305)
ASD18	2 (51)	1.75 (44)	16 (406)	18 (457)
ASD 24	2.25 (57)	1.75 (44)	20 (508)	24 (609)
ASD 30	2.25 (57)	1.75 (44)	26 (660)	30 (762)
ASD 36	2.25 (57)	1.75 (44)	32 (813)	36 (914)
ASD 42	2.5 (64)	2 (51)	38 (965)	42 (1066)
ASD 48	2.5 (64)	2 (51)	44 (1118)	48 (1219)
ASD 54	2.5 (64)	2 (51)	50 (1270)	54 (1371)
ASD 60	3 (76)	2.5 (64)	56 (1422)	60 (1524)
ASD 66	3 (76)	2.5 (64)	62 (1575)	66 (1676)

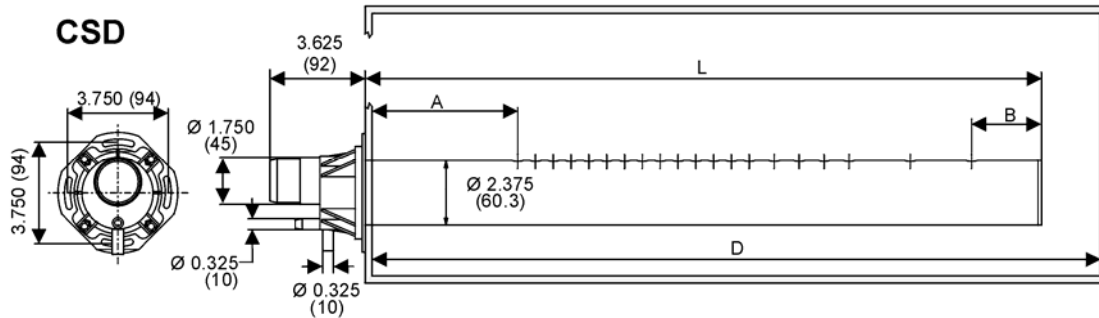
Figure 6. Distributor Dimensions (Sheet 1 of 3)

Distributor Model	Dimensions – in (mm)			Minimum Duct Length – in. (mm)
	A	B	C	
BSD 12	2 (51)	1.75 (44)	10 (254)	12 (305)
BSD 18	2 (51)	1.75 (44)	16 (406)	18 (457)
BSD 24	2.25 (57)	1.75 (44)	20 (508)	24 (609)
BSD 30	2.25 (57)	1.75 (44)	26 (660)	30 (762)
BSD 36	2.25 (57)	1.75 (44)	32 (813)	36 (914)
BSD 42	2.5 (64)	2 (51)	38 (965)	42 (1066)
BSD 48	2.5 (64)	2 (51)	44 (1118)	48 (1219)
BSD 54	2.5 (64)	2 (51)	50 (1270)	54 (1371)
BSD 60	3 (76)	2.5 (64)	56 (1422)	60 (1524)
BSD 66	3 (76)	2.5 (64)	62 (1575)	66 (1676)
BSD 72	3 (76)	2.5 (64)	68 (1727)	72 (1828)
BSD 78	4 (102)	3.5 (89)	47 (1880)	78 (1981)
BSD 84	4 (102)	3.5 (89)	80 (2032)	84 (2133)
BSD 90	4 (102)	3.5 (89)	86 (2184)	90 (2286)
BSD 96	4 (102)	3.5 (89)	92 (2337)	96 (2438)
BSD 102	4 (102)	3.5 (89)	98 (2489)	102 (2590)

NOTES:

1. ASD Maximum rated output 25 lbs/hr (11.4 kg/hr).
2. BSD Maximum rated output 35 lbs/hr (15.9 kg/hr).
3. CSD Maximum rated output 115 lbs/hr (52.3 kg/hr).
4. Steam Distributors tube made of stainless steel.
5. Steam inlet and end cap made of fine rated plastic.
6. Distributor is adjustable for horizontal or downflow application.

Figure 7. Distributor Dimensions (Sheet 2 of 3)

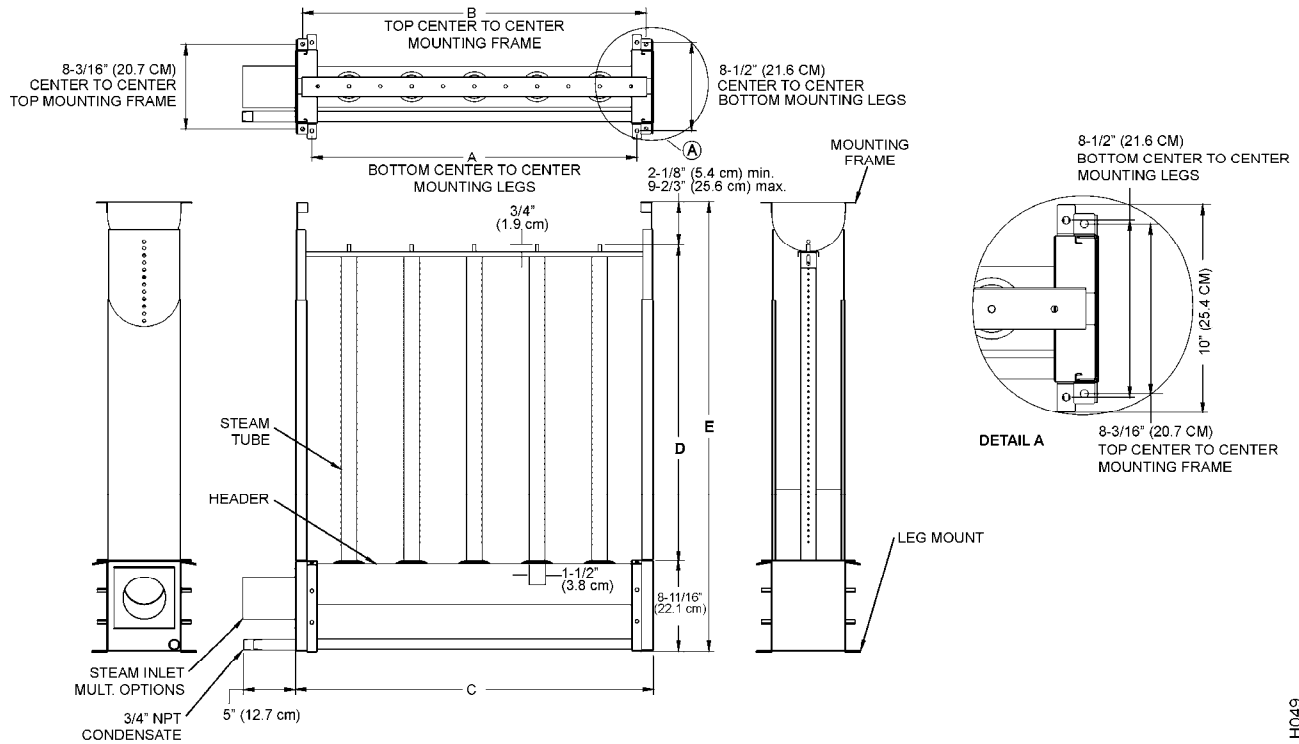


NOTE: All measurements are in inches with the metric equivalent in millimeters in brackets.

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Distributor Model	Dimensions – in (mm)			Minimum Duct Length – in. (mm)
	A	B	C	
CSD 24	1.75 (44)	1.55 (39)	20 (508)	24 (305)
CSD 30	2 (51)	2 (51)	26 (406)	30 (457)
CSD 36	2 (51)	2 (51)	32 (508)	36 (609)
CSD 42	2.25 (57)	2 (51)	38 (660)	42 (762)
CSD 48	2.25 (57)	2 (51)	44 (813)	48 (914)
CSD 54	2.25 (57)	2 (51)	50 (965)	54 (1066)
CSD 60	2.5 (64)	2.5 (64)	56 (1118)	60 (1219)
CSD 66	2.5 (64)	2.5 (64)	62 (1270)	66 (1371)
CSD 72	2.5 (64)	2.5 (64)	68 (1422)	72 (1524)
CSD 78	3 (76)	2.5 (64)	74 (1575)	78 (1676)
CSD 84	3 (76)	2.5 (64)	80 (1727)	84 (1828)
CSD 90	4 (102)	3 (76)	86 (1880)	90 (1981)
CSD 96	4 (102)	3 (76)	92 (2032)	96 (2133)
CSD 102	4 (102)	3 (76)	98 (2184)	102 (2286)
CSD 108	4 (102)	3 (76)	104 (2337)	108 (2438)
CSD 114	5 (127)	4.5 (114)	110 (2489)	114 (2590)
CSD 120	5 (127)	4.5 (114)	116 (2945)	120 (3046)
CSD 126	5 (127)	4.5 (114)	122 (3097)	126 (3198)
CSD 132	6 (152)	5.5 (140)	128 (3249)	132 (3350)
CSD 138	6 (152)	5.5 (140)	134 (3401)	138 (3502)
CSD 144	6 (152)	5.5 (140)	140 (3553)	144 (3654)

Figure 8. Distributor Dimensions (Sheet 3 of 3)



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Duct Width		A		B		C		Duct Height		D (Tube Height)		E min.		E max.	
in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm
18	45.7	13 1/8	33.3	14 7/8	37.8	16 1/4	41.3	18	45.7	6.25	15.9	17.063	43.3	24.604	62.5
24	61.0	19 1/8	48.6	20 7/8	53.0	22 1/4	56.5	24	61.0	12.25	31.1	23.063	58.6	30.604	77.7
30	76.2	25 1/8	63.8	26 7/8	68.3	28 1/4	71.8	30	76.2	18.25	46.4	29.063	73.8	36.604	93.0
36	91.4	31 1/8	79.1	32 7/8	83.5	34 1/4	87.0	36	91.4	24.25	61.6	35.063	89.1	42.604	108.2
42	106.7	37 11/8	94.3	38 7/8	98.7	40 1/4	102.2	42	106.7	30.25	76.8	41.063	104.3	48.604	123.5
48	121.9	43 1/8	109.5	44 7/8	114.0	46 1/4	117.5	48	121.9	36.25	92.1	47.063	119.5	54.604	138.7
54	137.2	49 1/8	124.8	50 7/8	129.2	52 1/4	132.7	54	137.2	42.25	107.3	53.063	134.8	60.604	153.9
60	152.4	55 1/8	140.0	56 7/8	144.5	58 1/4	148.0	60	152.4	48.25	122.6	59.063	150.0	66.604	169.2
66	167.6	61 1/8	155.3	62 7/8	159.7	64 1/4	163.2	66	167.6	54.25	137.8	65.063	165.3	72.604	184.4
72	182.9	67 1/8	170.5	68 7/8	174.9	70 1/4	178.4	72	182.9	60.25	153.0	71.063	180.5	78.604	199.7
78	198.1	73 1/8	185.7	74 7/8	190.2	76 1/4	193.7	78	198.1	66.25	168.3	77.063	195.7	84.604	214.9
84	213.4	79 1/8	201.0	80 7/8	205.4	82 1/4	208.9	84	213.4	72.25	183.5	83.063	211.0	90.604	230.1
90	228.6	85 1/8	216.2	86 7/8	220.7	88 1/4	224.2	90	228.6	78.25	198.8	89.063	226.2	96.604	245.4
96	243.8	91 1/8	231.5	92 7/8	235.9	94 1/4	239.4	96	243.8	84.25	214.0	95.063	241.5	102.604	260.6
102	259.1	97 1/8	246.7	98 7/8	251.1	100 1/4	254.6	102	259.1	90.25	229.2	101.063	256.7	108.604	275.9
108	274.3	103 1/8	261.9	104 7/8	266.4	106 1/4	269.9	108	274.3	96.25	244.5	107.063	271.9	114.604	291.1
114	289.6	109 1/8	277.2	110 7/8	281.6	112 1/4	285.1	114	289.6	102.25	259.7	113.063	287.2	120.604	306.3
120	304.8	115 1/8	292.4	116 7/8	296.9	118 1/4	300.4	120	304.8	108.25	275.0	119.063	302.4	126.604	321.6
126	320.0	121 1/8	307.7	122 7/8	312.1	124 1/4	315.6	126	320.0	114.25	290.2	125.063	317.7	132.604	336.8
132	335.3	127 1/8	322.9	128 7/8	327.3	130 1/4	330.8	132	335.3	120.25	305.4	131.063	332.9	138.604	352.1
138	350.5	133 1/8	338.1	134 7/8	342.6	136 1/4	346.1	138	350.5	126.25	320.7	137.063	348.1	144.604	367.3
144	365.8	139 1/8	353.4	140 7/8	357.8	142 1/4	361.3	144	365.8	132.25	335.9	143.063	363.4	150.604	382.5

Figure 9. SAM-e General Dimensions

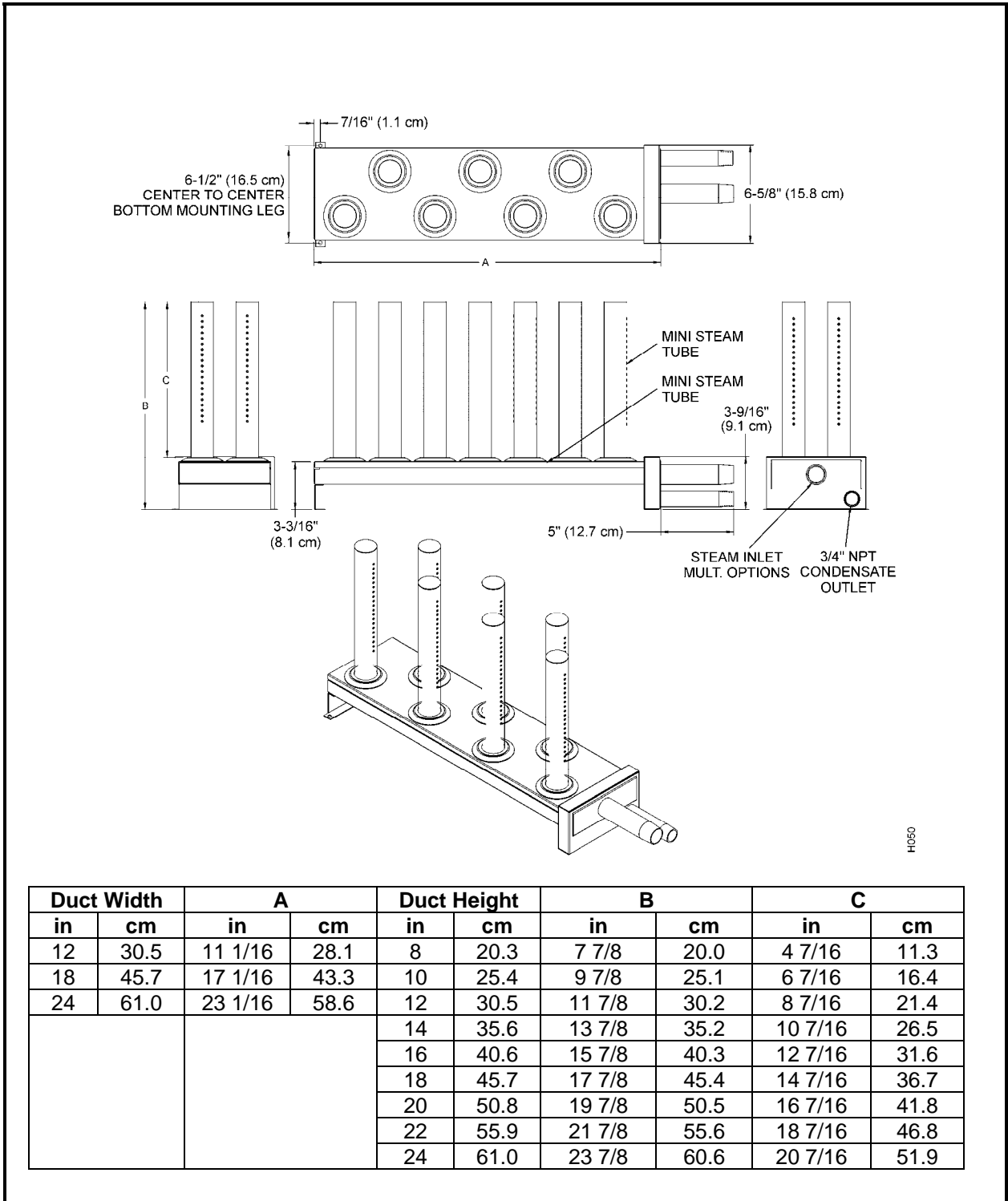


Figure 10. General Mini SAM-e Dimensions

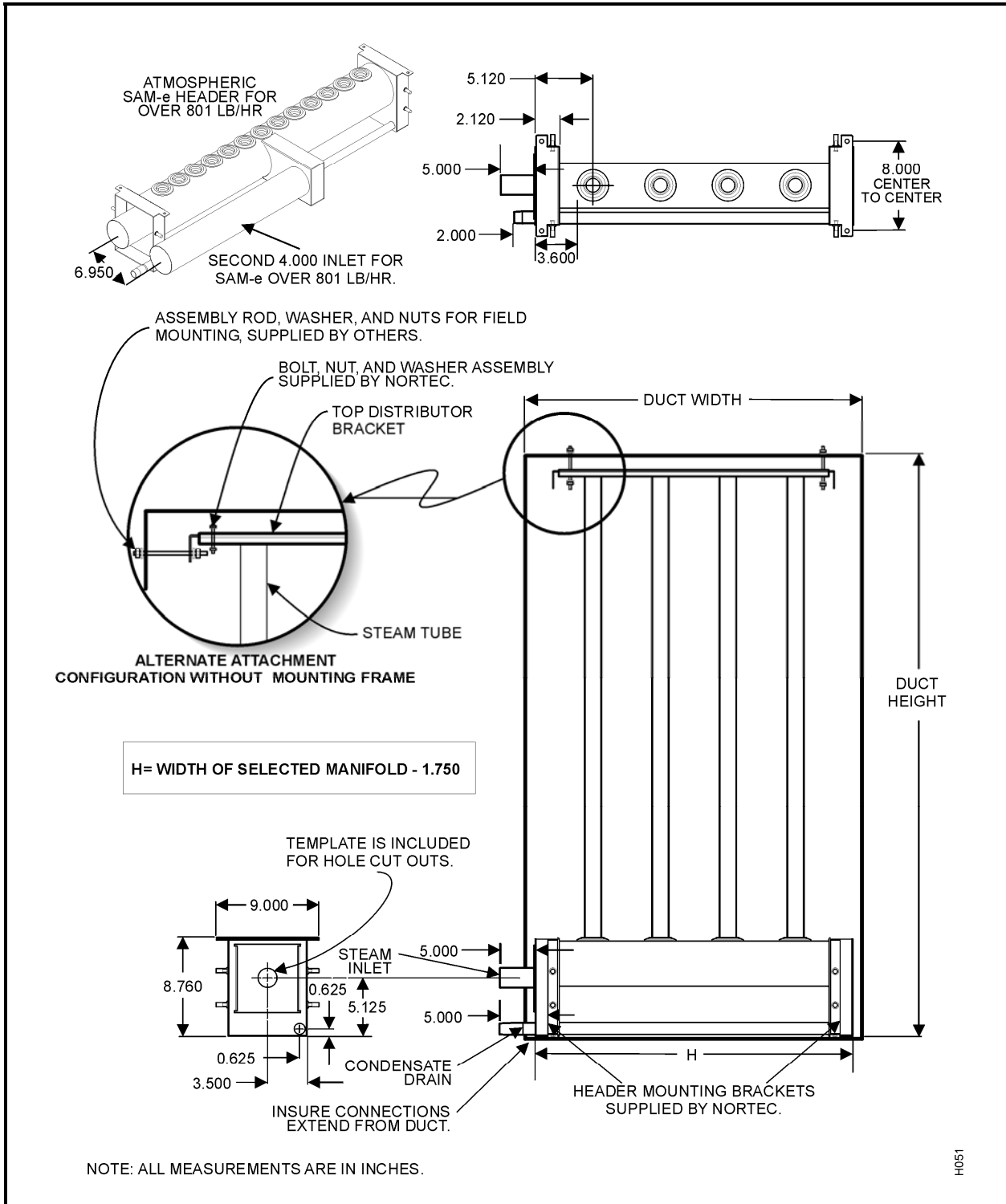


Figure 11. In-Duct / AHU Installation Without Mounting Frame Installation

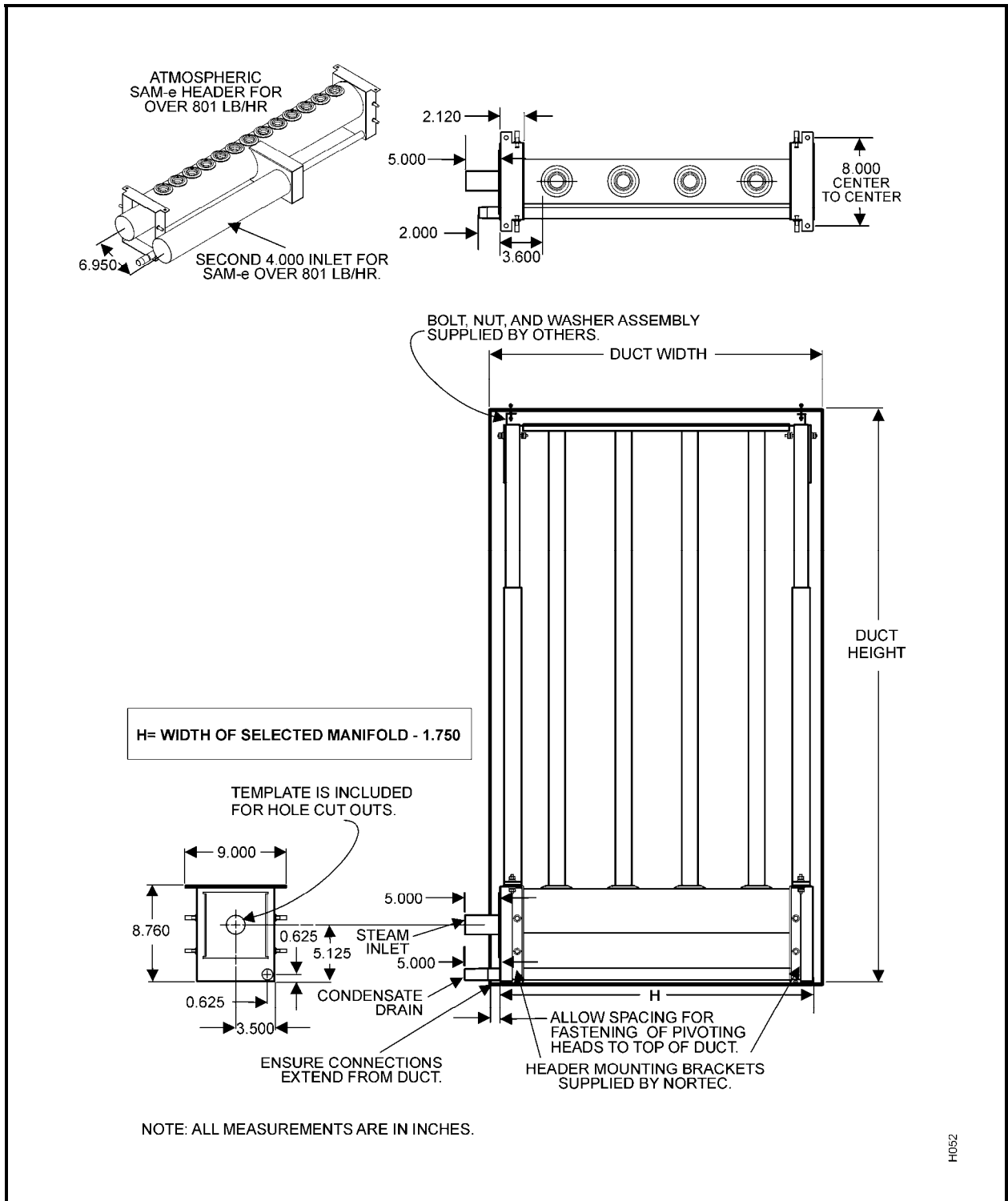


Figure 12. In-Duct / AHU Installation With Mounting Frame Installation

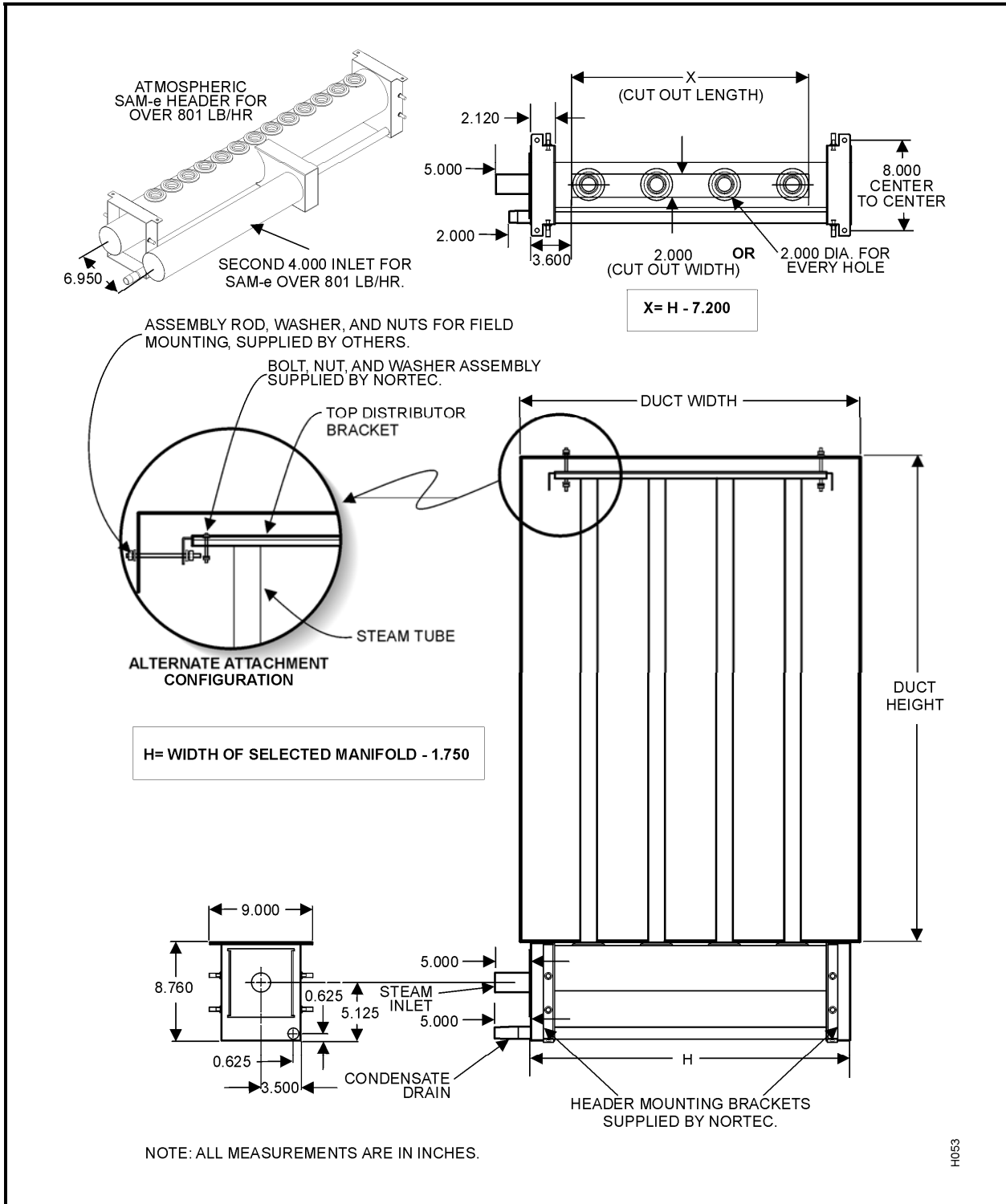


Figure 13. Outside Duct Installation Without Mounting Frame Installation

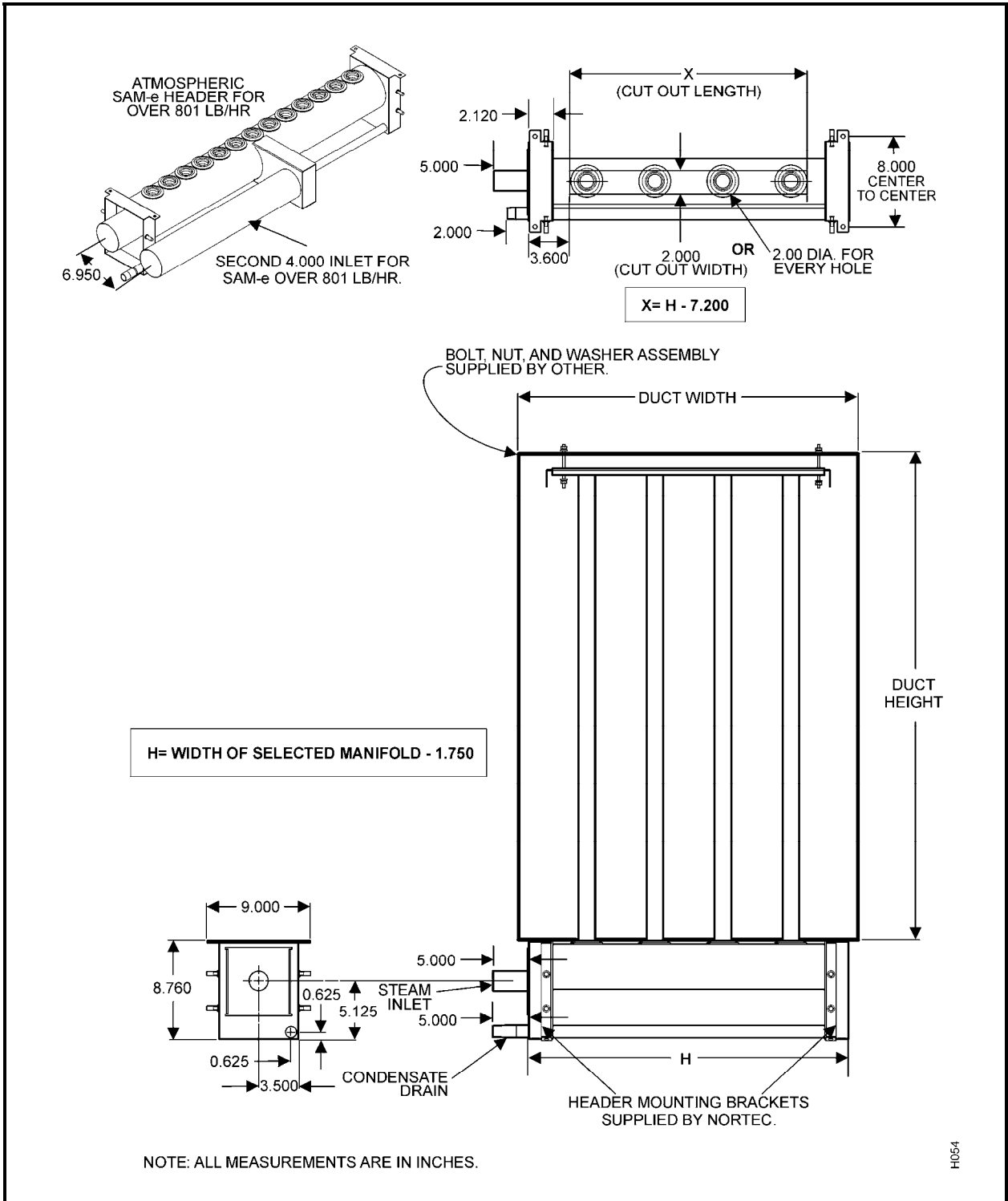


Figure 13. In-Duct / AHU Installation With Mounting Frame Installation

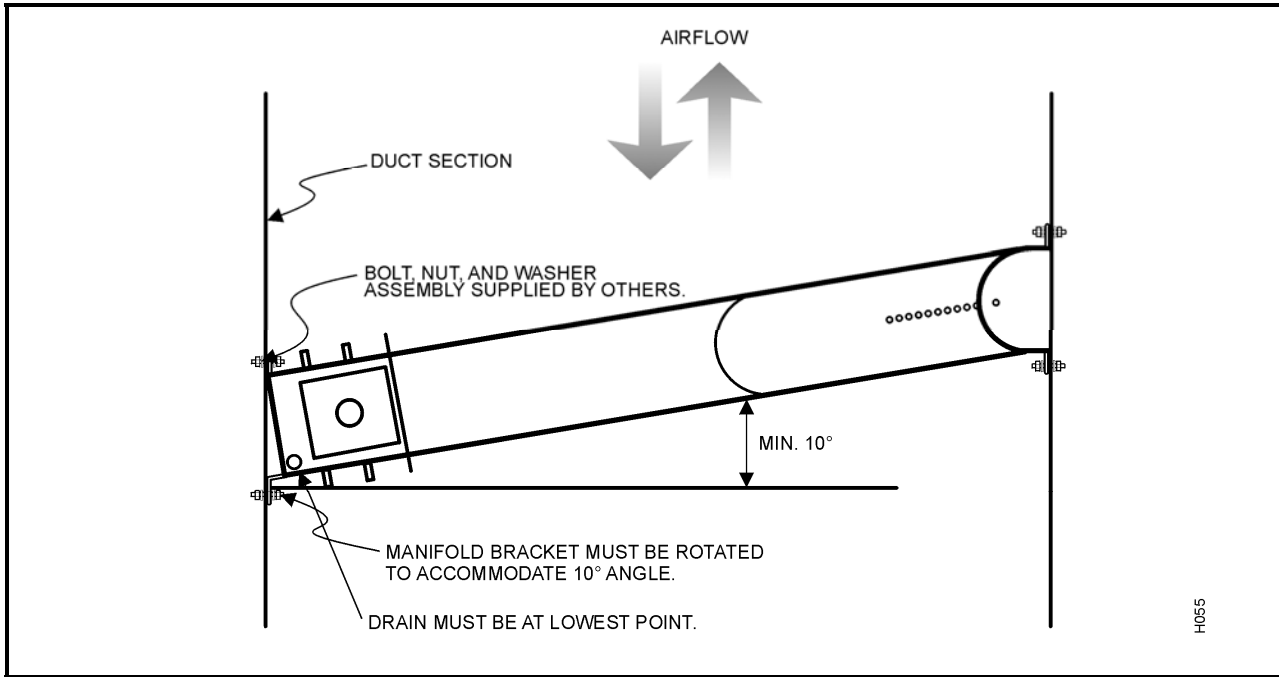


Figure 14. Vertical Duct Installation

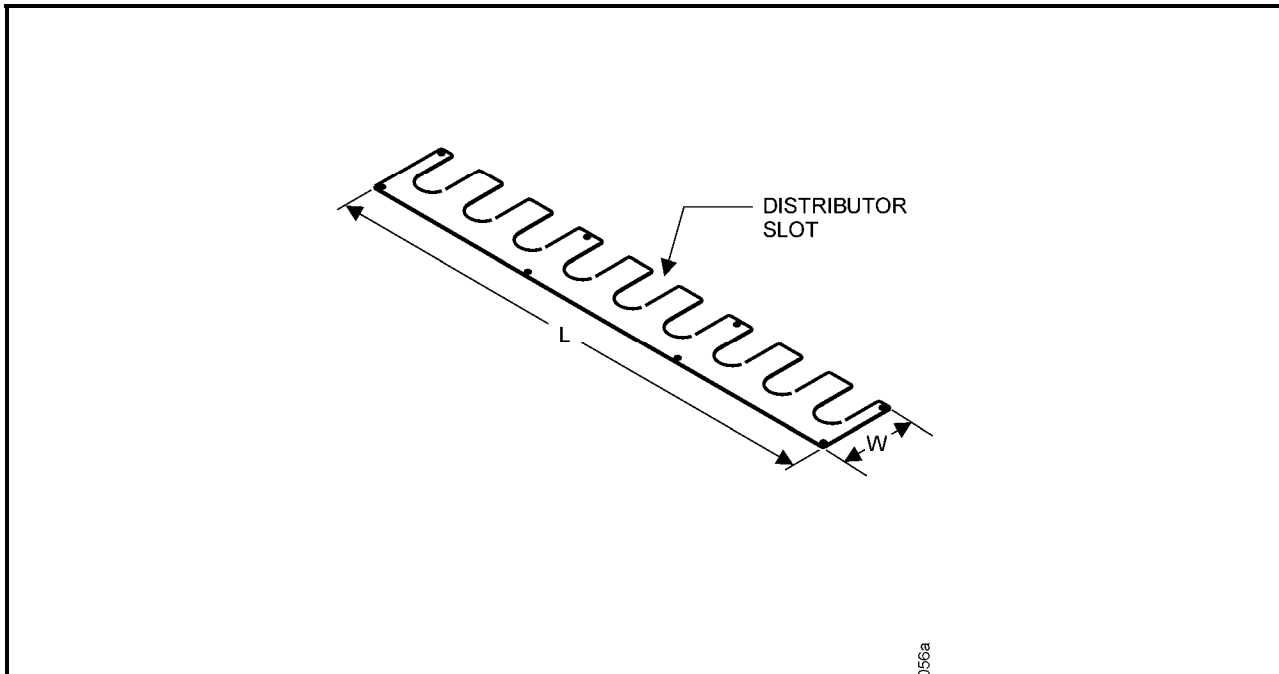


Figure 15. Outside Duct Mounting Cover Plates

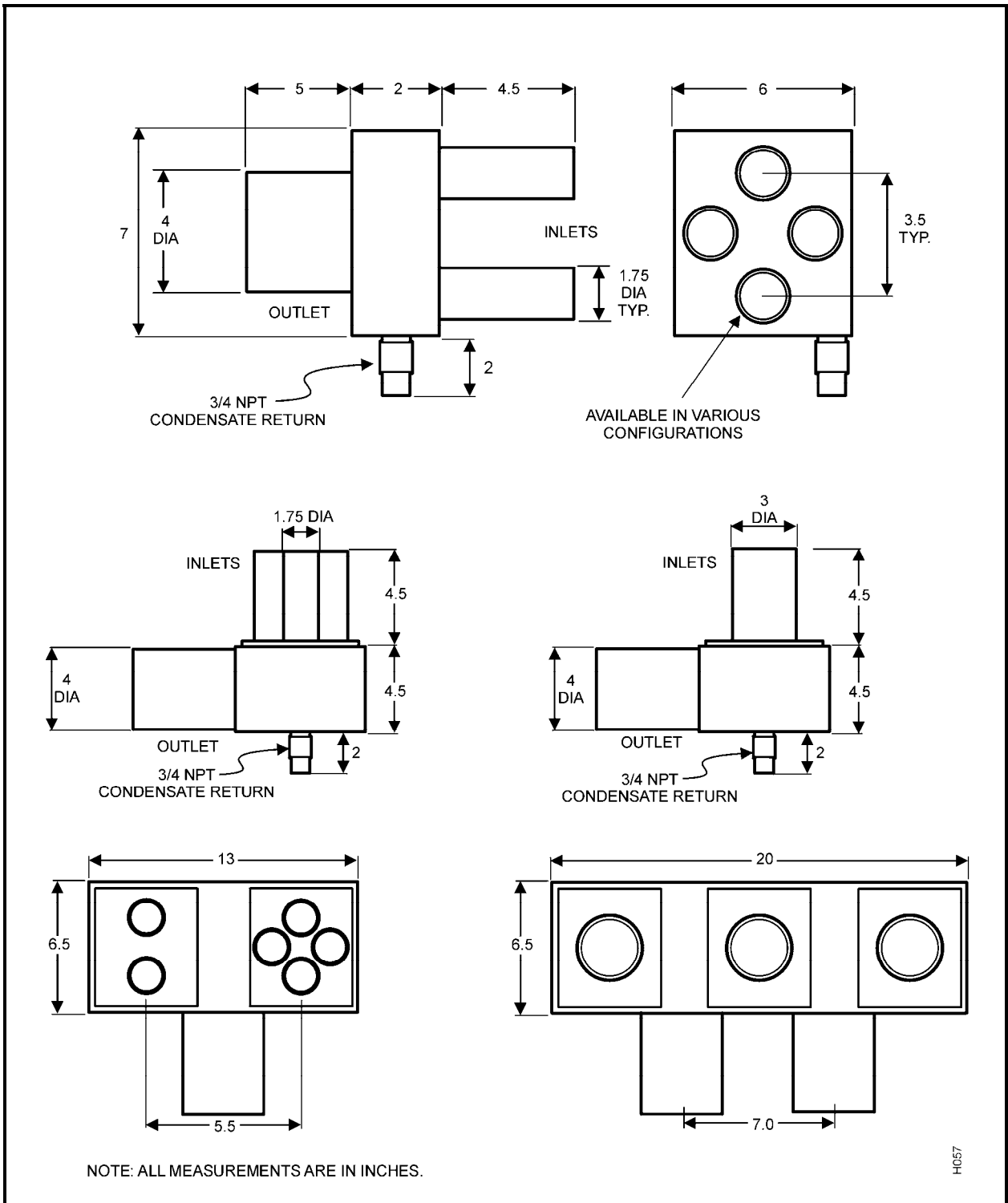


Figure 16. Atmospheric SAM-e Adapter Dimensions

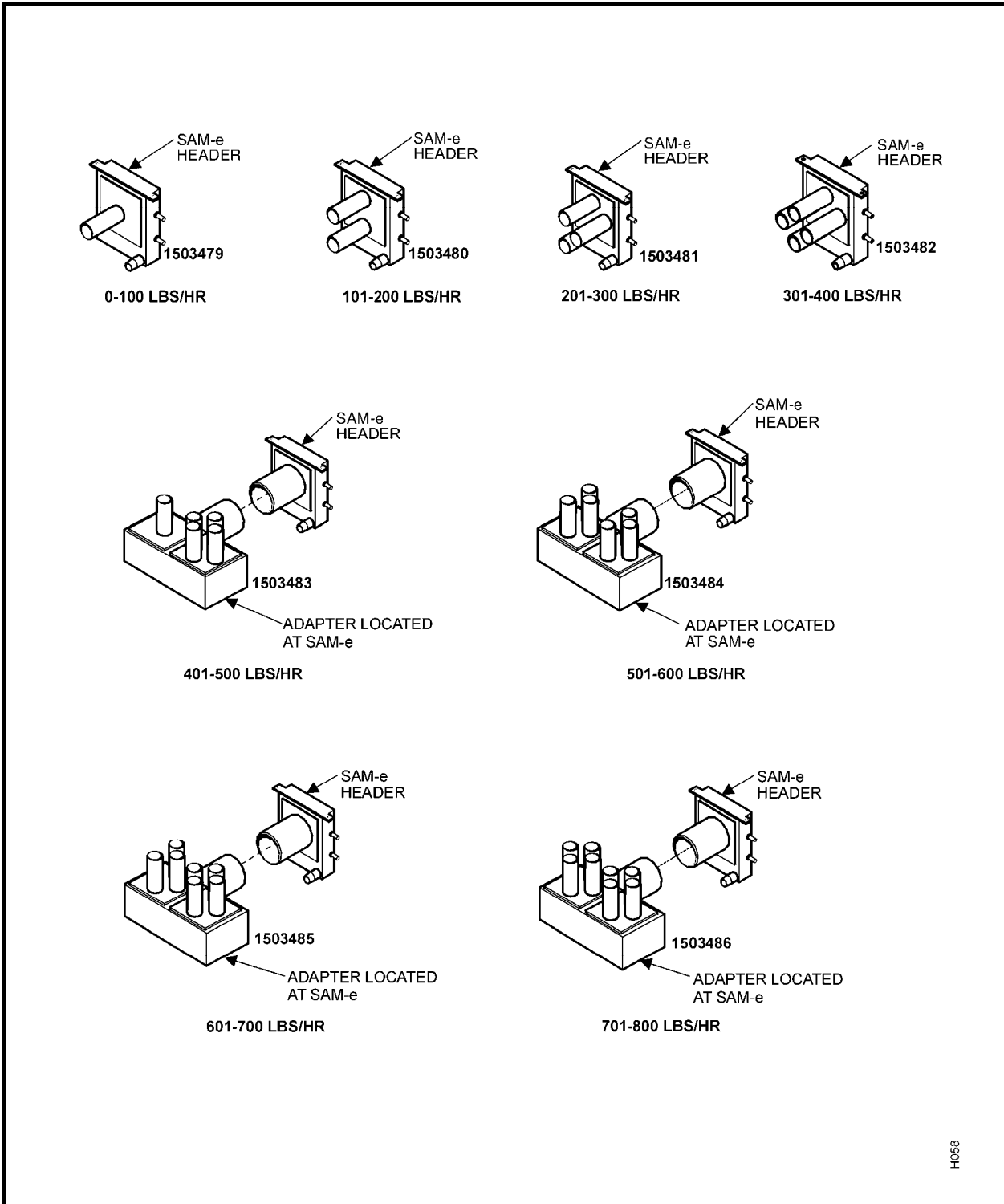


Figure 17. Atmospheric Steam Header and Adapter Configuration

Overhead And Frontal Clearances For Blower Packs

NH Model	Min. No. Of Blower Packs	Min. Overhead Clearance Inches (cm)	Min. Front Clearance Inches (cm)
005	1	18 (45)	30 (76)
010	1	18 (45)	30 (76)
020	1	18 (45)	36 (91)
030	1	18 (45)	72 (183)
050	1	36 (91)	84 (213)
075	1	42 (106)	144 (366)
100	1	48 (122)	156 (396)
150	2*	42 (106)	144 (366)
200	2*	48 (122)	156 (396)

* Remote mounted only. Four remote mounted blower packs are recommended on the 200 model.

Nominal conditions 72° F, 35% RH.

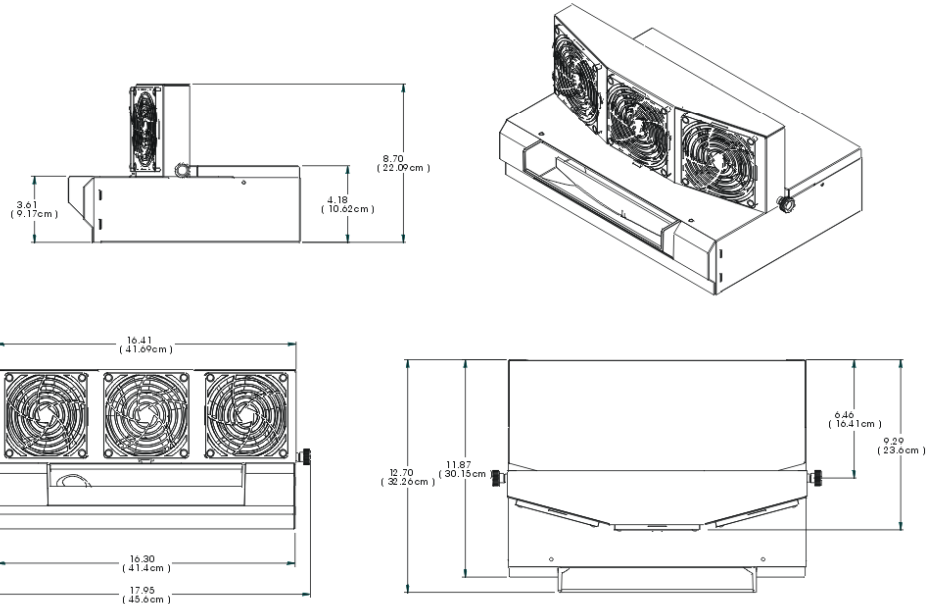


Figure 18. Physical Data for Remote Mounted Blower Pack

Note: Allow a minimum 12"(31cm) clearance on both right and left side.

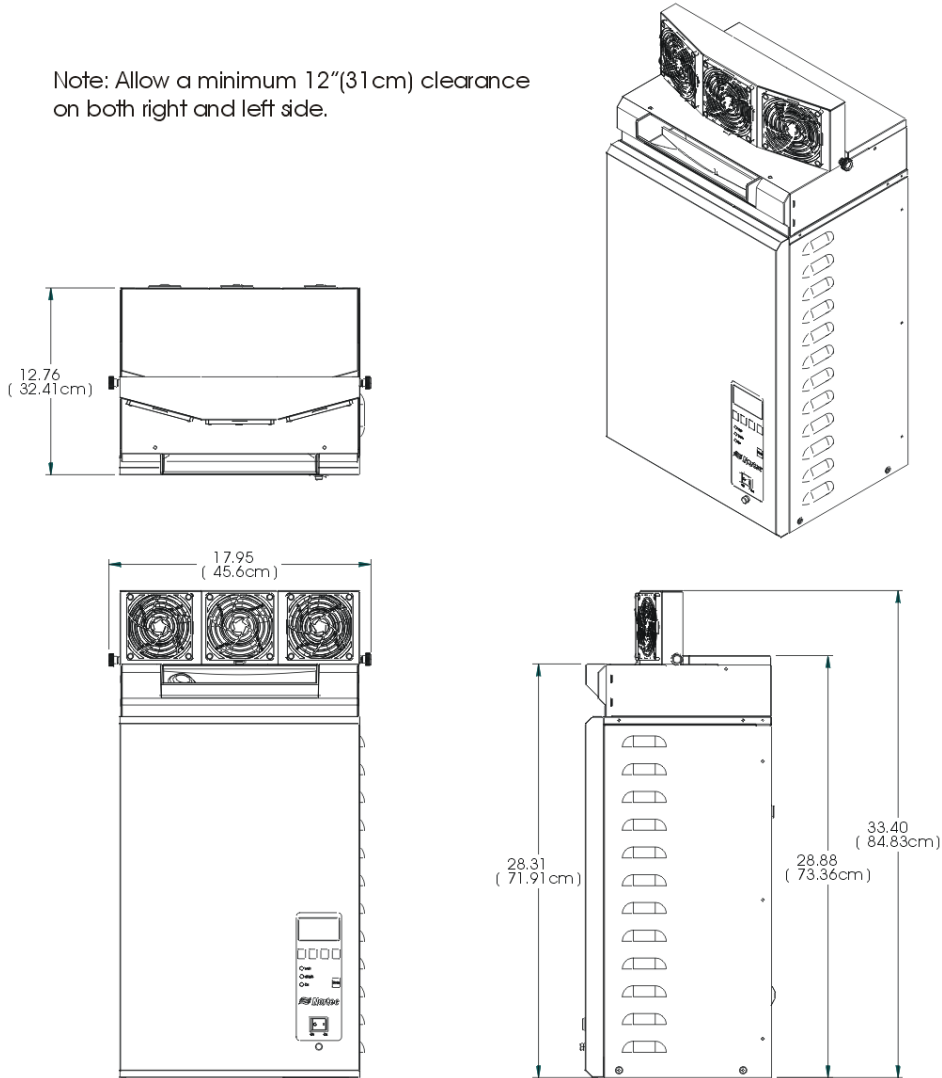
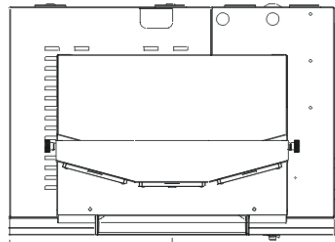


Figure 19. Physical Data Units with Optional Built-On Blower Packs

Note: Allow a minimum 12"(31cm) clearance on both right and left side.



11.49
(29.18cm)

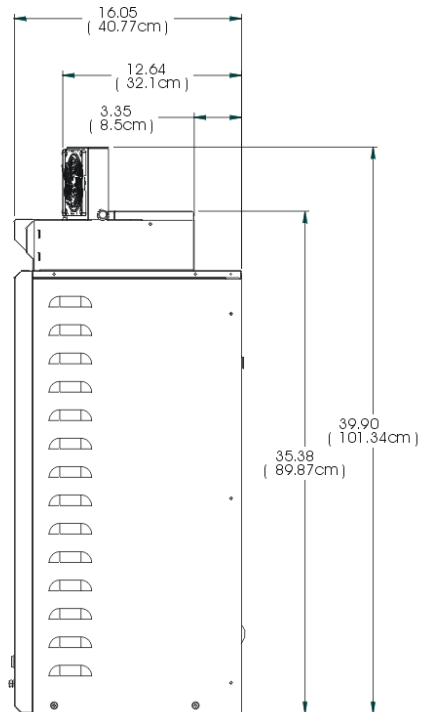
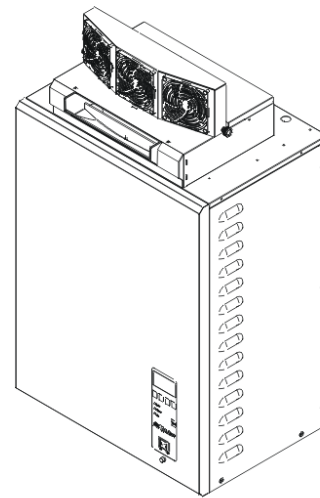
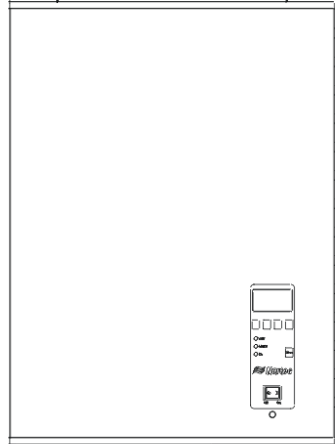
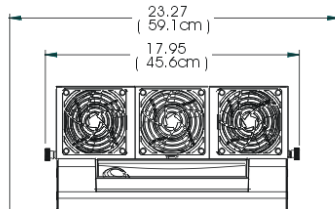
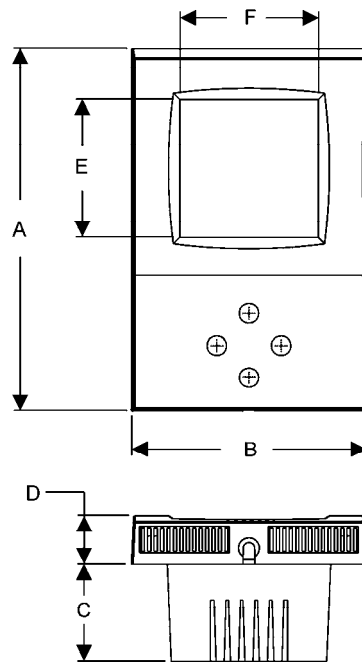


Figure 20. Physical Data Units with Optional Built-On Blower Packs



H061

Wall Digital Humidistat Dimensions

A		B		C		D		E		F	
in.	cm	in.	cm	in.	cm	in.	cm	in.	cm	in.	cm
4.4	12.2	2.9	7.2	1.2	3.0	0.6	1.6	1.7	4.3	1.7	4.3

Figure 21. Wall Digital Humidistat

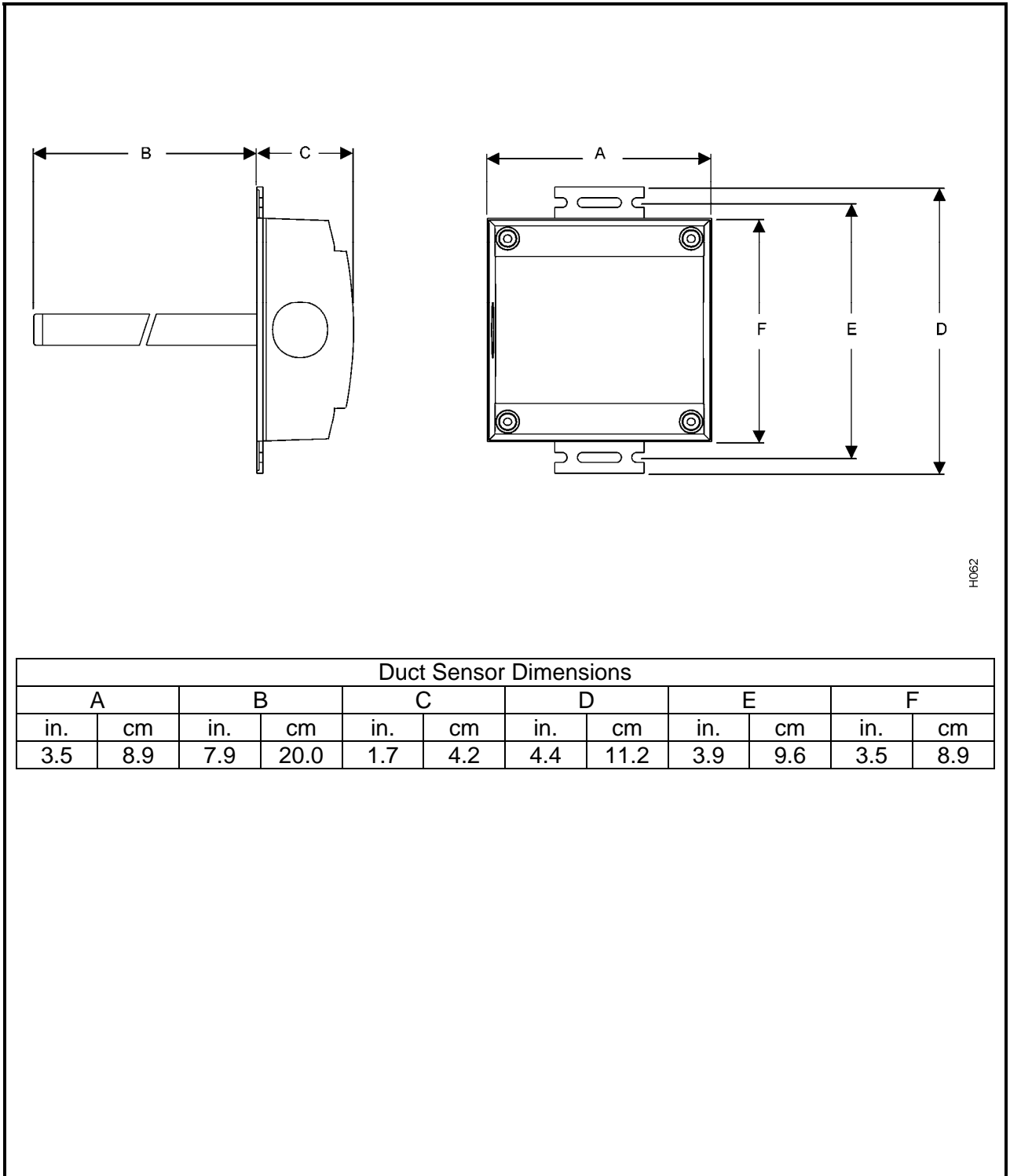


Figure 22. Duct Sensor

2. SUBMITTALS

A. INTRODUCTION

- (1) The following pages are intended to be used by the engineer to determine the component quantities required.

B. INSTALLATION COMPONENT SELECTION

- (1) The following Tables 1 through 15 will enable the engineer to select components for this installation.

Table 1. NH Series Unit Options

Part No.	Description	Qty
2522160	FILLCUP EXTENSION KIT NHTC/NHPC - 2 Required for 150 or 200	
2522162	DRAIN WATER COOLER 005-020, to temper drain water below 120°F (49°C)	
2522163	DRAIN WATER COOLER 030, to temper drain water below 120°F (49°C)	
2522164	DRAIN WATER COOLER 050-075, to temper drain water below 120°F (49°C)	
2522165	DRAIN WATER COOLER 100, to temper drain water below 120°F (49°C)	
2522166	DRAIN WATER COOLER 150, to temper drain water below 120°F (49°C)	
2522167	DRAIN WATER COOLER 200, to temper drain water below 120°F (49°C)	
2522168	FOAM DETECTION NHTC HARDWARE	
2522169	FOAM DETECTION NHPC HARDWARE	
2522170	REMOTE FAULT INDICATION NHTC/NHPC	
1469535	HIGH HUMIDITY ALARM PACKAGE ON/OFF high limit duct stat w/indicator	
1469536	LOW HUMIDITY ALARM PACKAGE ON/OFF low limit duct stat w/indicator	
1469537	HIGH HUMIDITY ALARM PACKAGE ON/OFF high limit wall stat w/indicator	
1469538	LOW HUMIDITY ALARM PACKAGE ON/OFF low limit wall stat w/indicator	
2522172	FACTORY PROVIDED EXTERNAL DRAIN AIR-GAP - REDUCER	
146-9000	COUPLED CIRCUIT FOR DOUBLE UNIT	
2522800	KEEPWARM, ALLOWING WATER TEMPERATURE IN THE CYLINDER TO BE MAINTAINED AT 160°F (70°) FOR QUICK RESPONSE UPON A CALL FOR HUMIDITY. NHTC OPTION ONLY.	
2522803	UNIT NETWORKING NHTC AND NHTC OUTDOOR UP TO 1600 LBS/HR ONE PACKAGE REQUIRED FOR EACH ADDITIONAL SLAVE HUMIDIFIER DOUBLE UNIT 150/200 COUNTS AS 2 PACKAGES	

Table 2. Common Accessories Universal

Part No.	Description	Qty
1458807	DOUBLE CHECK VALVE FOR WATER INLET LINE	
1429527	DRAIN WATER SUMP PUMP (HIGH TEMPERATURE)	
1329505	IN-LINE WATER FILTER 5 micron filter	
1469595	POCKET HYGRO-THERMOMETER DIGITAL DISPLAY	
1329561	REPLACEMENT WATER FILTERS 1 micron	
1329506	REPLACEMENT WATER FILTERS 5 micron	

Table 3. Steam Distributors

Part No.	Description	Qty
1506165	DISTRIBUTOR SST ASD 12	
1506166	DISTRIBUTOR SST ASD 18	
1506167	DISTRIBUTOR SST ASD 24	
1506168	DISTRIBUTOR SST ASD 30	
1506169	DISTRIBUTOR SST ASD 36	
1506170	DISTRIBUTOR SST ASD 42	
1506171	DISTRIBUTOR SST ASD 48	
1506172	DISTRIBUTOR SST ASD 54	
1506173	DISTRIBUTOR SST ASD 60	
1506174	DISTRIBUTOR SST ASD 66	
1506175	DISTRIBUTOR SST BSD 12	
1506176	DISTRIBUTOR SST BSD 18	
1506177	DISTRIBUTOR SST BSD 24	
1506178	DISTRIBUTOR SST BSD 30	
1506179	DISTRIBUTOR SST BSD 36	
1506180	DISTRIBUTOR SST BSD 42	
1506181	DISTRIBUTOR SST BSD 48	
1506182	DISTRIBUTOR SST BSD 54	
1506183	DISTRIBUTOR SST BSD 60	
1506184	DISTRIBUTOR SST BSD 66	
1506185	DISTRIBUTOR SST BSD 72	
1506186	DISTRIBUTOR SST BSD 78	
1506187	DISTRIBUTOR SST BSD 84	
1506188	DISTRIBUTOR SST BSD 90	
1506189	DISTRIBUTOR SST BSD 96	

Table 3. Steam Distributors (cont)

Part No.	Description	Qty
1506190	DISTRIBUTOR SST BSD 102	
1506191	DISTRIBUTOR SST CSD 24	
1506192	DISTRIBUTOR SST CSD 30	
1506193	DISTRIBUTOR SST CSD 36	
1506194	DISTRIBUTOR SST CSD 42	
1506195	DISTRIBUTOR SST CSD 48	
1506196	DISTRIBUTOR SST CSD 54	
1506197	DISTRIBUTOR SST CSD 60	
1506198	DISTRIBUTOR SST CSD 66	
1506199	DISTRIBUTOR SST CSD 72	
1506200	DISTRIBUTOR SST CSD 78	
1506201	DISTRIBUTOR SST CSD 84	
1506202	DISTRIBUTOR SST CSD 90	
1506203	DISTRIBUTOR SST CSD 96	
1506204	DISTRIBUTOR SST CSD 102	
1506205	DISTRIBUTOR SST CSD 108	
1506206	DISTRIBUTOR SST CSD 114	
1506207	DISTRIBUTOR SST CSD 120	
1506208	DISTRIBUTOR SST CSD 126	
1506209	DISTRIBUTOR SST CSD 132	
1506210	DISTRIBUTOR SST CSD 138	
1506211	DISTRIBUTOR SST CSD 144	

Table 4. Steam Distributor Accessories

Part No.	Description	Qty
Large Size Steam Distribution Accessories (>33 lb/hr)		
1329633	STEAM SUPPLY LINE TEE 1e" x 1e" x 1e" OD	
1329664	LARGE STEAM SUPPLY HEADER 1 INTO 3 1e" OD connections	
1859602	SPLITTING MANIFOLD 1 INTO 2 1½" to f" x f" OD	
1859603	SPLITTING MANIFOLD 1 INTO 3 1e" to f" x f" x f" OD	
1329643	BALANCING VALVE MANUAL FOR 1e" LINE	

Table 4. Steam Distributor Accessories (cont)

Part No.	Description	Qty
Small Size Steam Distribution Accessories (<33 lb/hr)		
1329642	BALANCING VALVE MANUAL TYPE FOR f" LINE	
1329663	SMALL STEAM SUPPLY HEADER 1 INTO 3 f" x f" x f" x f"	
1329662	STEAM SUPPLY LINE TEE f" x f" x f" OD	
1328810	INSULATED FLEXIBLE STEAM SUPPLY HOSE Actual f" ID fits with ASD and BSD type steam distributors, used with models 030 and smaller humidifiers. NOTE It is recommended that all runs of steam piping be run in hard copper with ½" thick foam insulation and that flexible steam hose always be used to make a flexible coupling to the steam distributor and the cylinder steam outlet.	Feet
1328820	INSULATED FLEXIBLE STEAM SUPPLY HOSE Actual 1¼" ID fits with CSD type steam distributors, used with models 050 to 200 humidifiers. NOTE It is recommended that all runs of steam piping be run in hard copper with ½" thick foam insulation and that flexible steam hose always be used to make a flexible coupling to the steam distributor and the cylinder steam outlet.	Feet
1328840	CONDENSATE RETURN HOSE Rubber, d" ID, fits over d" OD copper tube condensate leg on all steam distributors, factory supplied/installed with built on blower packs. Copper can be used for condensate lines provided that condensate hose always be used to make a flexible coupling to the steam distributor.	Feet
1329634	SMALL STEAM SUPPLY HOSE CONDENSATE TRAP TEE f" x f" x d" OD, must be used at low points in steam supply hose to prevent condensate build-up that would result in blockage, or to remove excessive condensate can be routed to fill cup if humidifier is below trap, or to any floor drain.	
1329635	LARGE STEAM SUPPLY HOSE CONDENSATE TRAP TEE 1e" x 1e" x d" OD, must be used at low points in steam supply hose to prevent condensate build-up that would result in steam blockage, or to remove excessive condensate due to long steam lines, condensate can be routed to fill cup for recycling if humidifier is below trap, or to any floor drain.	
Other Accessories		
1507846	STEAM LINE REDUCER 1¾" to f" Copper	
1508165	STEAM LINE REDUCER 1¾" to f" Stainless Steel	

Table 5. SAM-e Header

Part No.	Description	Qty
1503269	3" CENTERS, 18" (45.7 cm) WIDE 3 Steam tubes	
1503270	3" CENTERS, 24" (61.0 cm) WIDE 5 Steam tubes	
1503271	3" CENTERS, 30" (76.2 cm) WIDE 7 Steam tubes	
1503272	3" CENTERS, 36" (91.4 cm) WIDE 9 Steam tubes	
1503273	3" CENTERS, 42" (106.7 cm) WIDE 11 Steam tubes	
1503274	3" CENTERS, 48" (121.9 cm) WIDE 13 Steam tubes	
1503275	3" CENTERS, 54" (137.2 cm) WIDE 15 Steam tubes	
1503276	3" CENTERS, 60" (152.4 cm) WIDE 17 Steam tubes	
1503277	3" CENTERS, 66" (167.6 cm) WIDE 19 Steam tubes	
1503278	3" CENTERS, 72" (182.9 cm) WIDE 21 Steam tubes	
1503279	3" CENTERS, 78" (198.1 cm) WIDE 23 Steam tubes	
1503280	3" CENTERS, 84" (213.4 cm) WIDE 25 Steam tubes	
1503281	3" CENTERS, 90" (228.6 cm) WIDE 27 Steam tubes	
1503282	3" CENTERS, 96" (243.8 cm) WIDE 29 Steam tubes	
1503283	3" CENTERS, 102" (259.1 cm) WIDE 31 Steam tubes	
1503284	3" CENTERS, 108" (274.3 cm) WIDE 33 Steam tubes	
1503285	3" CENTERS, 114" (289.6 cm) WIDE 35 Steam tubes	
1503286	3" CENTERS, 120" (304.8 cm) WIDE 37 Steam tubes	
1503287	3" CENTERS, 126" (320.0 cm) WIDE 39 Steam tubes	
1503288	3" CENTERS, 132" (335.3 cm) WIDE 41 Steam tubes	
1503289	3" CENTERS, 138" (350.5 cm) WIDE 43 Steam tubes	

Table 5. SAM-e Header (cont)

Part No.	Description	Qty
1503290	3" CENTERS, 144" (365.8 cm) WIDE 45 Steam tubes	
---	3" CENTERS, 144+" (365.8+ cm) WIDE Consult factory	
1503309	6" CENTERS, 18" (45.7 cm) WIDE 2 Steam tubes	
1503310	6" CENTERS, 24" (61.0 cm) WIDE 3 Steam tubes	
1503331	6" CENTERS, 30" (76.2 cm) WIDE 4 Steam tubes	
1503312	6" CENTERS, 36" (91.4 cm) WIDE 5 Steam tubes	
1503313	6" CENTERS, 42" (106.7 cm) WIDE 6 Steam tubes	
1503314	6" CENTERS, 48" (121.9 cm) WIDE 7 Steam tubes	
1503315	6" CENTERS, 54" (137.2 cm) WIDE 8 Steam tubes	
1503316	6" CENTERS, 60" (152.4 cm) WIDE 9 Steam tubes	
1503317	6" CENTERS, 66" (167.6 cm) WIDE 10 Steam tubes	
1503318	6" CENTERS, 72" (182.9 cm) WIDE 11 Steam tubes	
1503319	3" CENTERS, 78" (198.1 cm) WIDE 12 Steam tubes	
1503320	6" CENTERS, 84" (213.4 cm) WIDE 13 Steam tubes	
1503321	6" CENTERS, 90" (228.6 cm) WIDE 14 Steam tubes	
1503322	6" CENTERS, 96" (243.8 cm) WIDE 15 Steam tubes	
1503323	6" CENTERS, 102" (259.1 cm) WIDE 16 Steam tubes	
1503324	6" CENTERS, 108" (274.3 cm) WIDE 17 Steam tubes	
1503325	6" CENTERS, 114" (289.6 cm) WIDE 18 Steam tubes	
1503326	6" CENTERS, 120" (304.8 cm) WIDE 19 Steam tubes	
1503327	6" CENTERS, 126" (320.0 cm) WIDE 20 Steam tubes	

Table 5. SAM-e Header (cont)

Part No.	Description	Qty
1503328	6" CENTERS, 132" (335.3 cm) WIDE 21 Steam tubes	
1503329	6" CENTERS, 138" (350.5 cm) WIDE 22 Steam tubes	
1503330	6" CENTERS, 144" (365.8 cm) WIDE 23 Steam tubes	
---	6" CENTERS, 144+" (365.8+ cm) WIDE Consult factory	
1506789	9" CENTERS, 36" (91.4 cm) WIDE 3 Steam tubes	
1506790	9" CENTERS, 48" (121.9 cm) WIDE 5 Steam tubes	
1506791	9" CENTERS, 60" (152.4 cm) WIDE 7 Steam tubes	
1506792	9" CENTERS, 72" (182.9 cm) WIDE 9 Steam tubes	
1506794	9" CENTERS, 84" (213.4 cm) WIDE 11 Steam tubes	
1506795	9" CENTERS, 96" (243.8 cm) WIDE 13 Steam tubes	
1506796	9" CENTERS, 108" (274.3 cm) WIDE 15 Steam tubes	
1507729	9" CENTERS, 120" (304.8 cm) WIDE 17 Steam tubes	
1507730	9" CENTERS, 132" (335.3 cm) WIDE 19 Steam tubes	
1507731	9" CENTERS, 144" (365.8 cm) WIDE 21 Steam tubes	
---	9" CENTERS, 144+" (365.8+ cm) WIDE Consult factory	
1506797	12" CENTERS, 36" (91.4 cm) WIDE 3 Steam tubes	
1506798	12" CENTERS, 48" (121.9 cm) WIDE 4 Steam tubes	
1506799	12" CENTERS, 60" (152.4 cm) WIDE 5 Steam tubes	
1506800	12" CENTERS, 72" (182.9 cm) WIDE 6 Steam tubes	
1506801	12" CENTERS, 84" (213.4 cm) WIDE 7 Steam tubes	
1506802	12" CENTERS, 96" (243.8 cm) WIDE 8 Steam tubes	

Table 5. SAM-e Header (cont)

Part No.	Description	Qty
1506803	12" CENTERS, 108" (274.3 cm) WIDE 9 Steam tubes	
1506804	12" CENTERS, 120" (304.8 cm) WIDE 10 Steam tubes	
1506805	12" CENTERS, 132" (335.3 cm) WIDE 11 Steam tubes	
1506806	12" CENTERS, 144" (365.8 cm) WIDE 12 Steam tubes	
---	12" CENTERS, 144+" (365.8+ cm) WIDE Consult factory	

Table 6. Adjustable Mounting Frame for SAM-e

Part No.	Description	Qty
1504697	MOUNTING FRAME SAM-e 9" to 15"	
1503469	MOUNTING FRAME SAM-e 16" to 27"	
1503470	MOUNTING FRAME SAM-e 28" to 51"	
1503471	MOUNTING FRAME SAM-e 52" to 99"	

Table 7. SAM-e Tube Matrix

Part No.	Description	Qty
1503388	TYPE A, 18" (45.7 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503389	TYPE A, 24" (61.0 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503390	TYPE A, 30" (76.2 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503391	TYPE A, 36" (91.4 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503392	TYPE A, 42" (106.7 cm) WIDE 15 lbs/hr (7 kg/hr)	
1506393	TYPE A, 48" (121.9 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503394	TYPE A, 54" (137.2 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503395	TYPE A, 60" (152.4 cm) WIDE 15 lbs/hr (7 kg/hr)	

Table 7. SAM-e Tube Matrix (cont)

Part No.	Description	Qty
1503396	TYPE A, 66" (167.6 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503397	TYPE A, 72" (182.9 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503398	TYPE A, 78" (198.1 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503399	TYPE A, 84" (213.4 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503400	TYPE A, 90" (228.6 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503401	TYPE A, 96" (243.8 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503402	TYPE A, 102" (259.1 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503403	TYPE A, 108" (274.3 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503404	TYPE A, 114" (289.6 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503405	TYPE A, 120" (304.8 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503406	TYPE A, 126" (320.0 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503407	TYPE A, 132" (335.3 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503408	TYPE A, 138" (350.5 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503409	TYPE A, 144" (365.8 cm) WIDE 15 lbs/hr (7 kg/hr)	
1503411	TYPE B, 24" (61.0 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503412	TYPE B, 30" (76.2 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503413	TYPE B, 36" (91.4 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503414	TYPE B, 42" (106.7 cm) WIDE 35 lbs/hr (16 kg/hr)	
1506415	TYPE B, 48" (121.9 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503416	TYPE B, 54" (137.2 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503417	TYPE B, 60" (152.4 cm) WIDE 35 lbs/hr (16 kg/hr)	

Table 7. SAM-e Tube Matrix (cont)

Part No.	Description	Qty
1503418	TYPE B, 66" (167.6 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503419	TYPE B, 72" (182.9 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503420	TYPE B, 78" (198.1 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503421	TYPE B, 84" (213.4 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503422	TYPE B, 90" (228.6 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503423	TYPE B, 96" (243.8 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503424	TYPE B, 102" (259.1 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503425	TYPE B, 108" (274.3 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503426	TYPE B, 114" (289.6 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503427	TYPE B, 120" (304.8 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503428	TYPE B, 126" (320.0 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503429	TYPE B, 132" (335.3 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503430	TYPE B, 138" (350.5 cm) WIDE 35 lbs/hr (16 kg/hr)	
1503431	TYPE B, 144" (365.8 cm) WIDE 35 lbs/hr (16 kg/hr)	
1509391	TYPE B+, 30" (76.2 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509392	TYPE B+, 36" (91.4 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509393	TYPE B+, 42" (106.7 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509394	TYPE B+, 48" (121.9 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509395	TYPE B+, 54" (137.2 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509396	TYPE B+, 60" (152.4 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509397	TYPE B+, 66" (167.6 cm) WIDE 55 lbs/hr (25 kg/hr)	

Table 7. SAM-e Tube Matrix (cont)

Part No.	Description	Qty
1509398	TYPE B+, 72" (182.9 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509399	TYPE B+, 78" (198.1 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509400	TYPE B+, 84" (213.4 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509401	TYPE B+, 90" (228.6 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509402	TYPE B+, 96" (243.8 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509403	TYPE B+, 102" (259.1 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509404	TYPE B+, 108" (274.3 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509405	TYPE B+, 114" (289.6 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509406	TYPE B+, 120" (304.8 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509407	TYPE B+, 126" (320.0 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509408	TYPE B+, 132" (335.3 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509409	TYPE B+, 138" (350.5 cm) WIDE 55 lbs/hr (25 kg/hr)	
1509410	TYPE B+, 144" (365.8 cm) WIDE 55 lbs/hr (25 kg/hr)	
1503440	TYPE C, 36" (91.4 cm) WIDE 75 lbs/hr (34 kg/hr)	
1503441	TYPE C, 42" (106.7 cm) WIDE 75 lbs/hr (34 kg/hr)	
1503442	TYPE C, 48" (121.9 cm) WIDE 75 lbs/hr (34 kg/hr)	
1503443	TYPE C, 54" (137.2 cm) WIDE 75 lbs/hr (34 kg/hr)	
1503444	TYPE C, 60" (152.4 cm) WIDE 75 lbs/hr (34 kg/hr)	
1503445	TYPE C, 66" (167.6 cm) WIDE 75 lbs/hr (34 kg/hr)	
1503446	TYPE C, 72" (182.9 cm) WIDE 75 lbs/hr (34 kg/hr)	
1503447	TYPE C, 78" (198.1 cm) WIDE 75 lbs/hr (34 kg/hr)	

Table 7. SAM-e Tube Matrix (cont)

Part No.	Description	Qty
1503448	TYPE C, 84" (213.4 cm) WIDE 75 lbs/hr (34 kg/hr)	
1503449	TYPE C, 90" (228.6 cm) WIDE 75 lbs/hr (34 kg/hr)	
1503450	TYPE C, 96" (243.8 cm) WIDE 75 lbs/hr (34 kg/hr)	
1503451	TYPE C, 102" (259.1 cm) WIDE 75 lbs/hr (34 kg/hr)	
1503452	TYPE C, 108" (274.3 cm) WIDE 75 lbs/hr (34 kg/hr)	
1503453	TYPE C, 114" (289.6 cm) WIDE 75 lbs/hr (34 kg/hr)	
1503454	TYPE C, 120" (304.8 cm) WIDE 75 lbs/hr (34 kg/hr)	
1503455	TYPE C, 126" (320.0 cm) WIDE 75 lbs/hr (34 kg/hr)	
1503456	TYPE C, 132" (335.3 cm) WIDE 75 lbs/hr (34 kg/hr)	
1503457	TYPE C, 138" (350.5 cm) WIDE 75 lbs/hr (34 kg/hr)	
1503458	TYPE C, 144" (365.8 cm) WIDE 75 lbs/hr (34 kg/hr)	
NOTE: Add 6" (15.2 cm) to in-duct height for outside-duct mounting of header.		

Table 8. SAM-e Inlet and Adapter Configurations

Part No.	Description	Qty
1503479	Inlet Adapter Kit 1, SAM-e, 100 lbs/hr 1.75"	
1503480	Inlet Adapter Kit 2, SAM-e, 200 lbs/hr 2x1.75"	
1503481	Inlet Adapter Kit 3, SAM-e, 300 lbs/hr 3x1.75"	
1503482	Inlet Adapter Kit 4, SAM-e, 400 lbs/hr 4x1.75"	
1503483	Inlet Adapter Kit 5, SAM-e, 500 lbs/hr 5x1.75"	
1503484	Inlet Adapter Kit 6, SAM-e, 600 lbs/hr 6x1.75"	
1503485	Inlet Adapter Kit 7, SAM-e, 700 lbs/hr 7x1.75"	
1503486	Inlet Adapter Kit 8, SAM-e, 800 lbs/hr 8x1.75"	
<p>NOTES:</p> <ol style="list-style-type: none"> 1. Inlet/Adapter: Allows direct connection of the humidifier steam outlets to the SAM-e. Therefore, there is no adapter located at the humidifier. 2. Consult SAM-e Shop Drawings for more details. 3. All adapters come complete with hose/clamp connections for all outlets. 4. All electrode humidifiers must run individual steam lines directly to SAM-e. 		

Table 9. Remote Blower Pack

Part No.	Description	Qty
2530893	Remote Blower Pack 5 - 30 lbs/hr 110-120V	
2530891	Remote Blower Pack 5 - 30 lbs/hr 208V	
2530889	Remote Blower Pack 5 - 30 lbs/hr 220-240V	
2530892	Remote Blower Pack 5 - 30 lbs/hr 277V	
2530888	Remote Blower Pack 5 - 30 lbs/hr 380V	
2530887	Remote Blower Pack 5 - 30 lbs/hr 440-480V	
2530886	Remote Blower Pack 5 - 30 lbs/hr 550-600V	
2530900	Remote Blower Pack 50 - 100 lbs/hr 110-120V	
2530898	Remote Blower Pack 50 - 100 lbs/hr 208V	
2530897	Remote Blower Pack 50 - 100 lbs/hr 220-240V	
2530899	Remote Blower Pack 50 - 100 lbs/hr 277V	
2530896	Remote Blower Pack 50 - 100 lbs/hr 380V	
2530895	Remote Blower Pack 50 - 100 lbs/hr 440-480V	
2530894	Remote Blower Pack 50 - 100 lbs/hr 550-600V	

Table 10. Built-On Blower Pack

Part No.	Description	Qty
2522142	Built-on Blower Pack, NHTC/NHPC 005 120V	
2522143	Built-on Blower Pack, NHTC/NHPC 010-030 208V	
2522144	Built-on Blower Pack, NHTC/NHPC 010-030 220-240V	
2522145	Built-on Blower Pack, NHTC/NHPC 010-030 277V	
2522147	Built-on Blower Pack, NHTC/NHPC 010-030 380V	
2522148	Built-on Blower Pack, NHTC/NHPC 010-030 440-480V	
2522149	Built-on Blower Pack, NHTC/NHPC 010-030 550-600V	
2524849	Built-on Blower Pack, NHTC/NHPC 050-100 208V	
2524850	Built-on Blower Pack, NHTC/NHPC 050-100 220-240V	
2524851	Built-on Blower Pack, NHTC/NHPC 050-100 277V	
2524852	Built-on Blower Pack, NHTC/NHPC 050-100 308V	
2524853	Built-on Blower Pack, NHTC/NHPC 050-100 440-480V	
2524854	Built-on Blower Pack, NHTC/NHPC 050-100 550-600V	

Table 11. Controls – ON/OFF

Part No.	Description	Qty
2520259	DIGITAL HUMIDISTAT WALL MOUNTED ON/OFF On/off wall mounted humidistat applicable as control humidistat or high limit 10% to 90% RH range with 5% non-adjustable differential.	Control ____ High Limit ____
2520273	DIGITAL HUMIDISTAT DUCT MOUNTED ON/OFF PACKAGE On/off duct mounted humidistat, applicable as a control humidistat or high limit, 15% to 90% RH range with 4% non-adjustable differential.	Control ____ High Limit ____
132-9109	PRESSURE ELECTRIC SWITCH On/off, remote mounted, 3 to 20 PSIG range, factory set to 13 PSIG with 2 to 6 PSIG fully adjustable differential, factory set to 3 PSIG. For use with pneumatic humidistat (by others).	
132-9203	AIR PROVING On/off duct mounted, pressure differential switch, 0.07 IWC to 12.0 IWC fully adjustable operating range, good for positive, negative or differential pressure applications, stops humidifier if no differential pressure is sensed.	
146-9000	COUPLED CIRCUITS Factory internally wired in parallel to enable control of double circuit unit from one set of external controls. Applies to NHTC 150 and 200 models only.	
NOTE: NORTEC NH Series humidifiers must have a closed circuit across terminals 8 and 10. NORTEC highly recommends the use of a high limit humidistat and air proving switch in series for this function.		

Table 12. Modulating Control By NORTEC

Part No.	Description	Qty
2520266	DIGITAL WALL CONTROLLER WITH DUCT SENSOR PACKAGE This is a digital LCD setpoint controller with a duct mounted humidity sensor used for modulating high limit or control.	Control ____ High Limit ____
2520261	DIGITAL WALL CONTROLLER WITHOUT INTEGRAL SENSOR This is a digital LCD setpoint controller to be used with one or all of the following remote sensors: remote wall sensor, remote duct sensor and outdoor duct mounted temperature sensor.	Control ____ High Limit ____
1510142	DIGITAL WALL CONTROLLER WITH INTEGRAL SENSOR This is a digital LCD setpoint controller with a wall mounted humidity sensor used for humidity control in the space.	Control ____ High Limit ____
2520263	OUTDOOR DUCT MOUNT TEMPERATURE SET BACK This sensor can be mounted directly onto the fresh air intake of the ventilation duct. The humidistat controller reads the outdoor temperature and resets the humidity control setpoint to prevent condensation in windows or building structures. Use with modulating controllers above.	
1509857	REMOTE DUCT SENSOR This humidity sensor can be mounted directly onto the return ventilation as the main controlling sensor. It can also be used as a supply high limit sensor. It must be used in conjunction with any other controller for remote sensing.	
1509858	REMOTE WALL SENSOR This humidity sensor can be mounted on a wall as the main controlling sensor. It must be used in conjunction with any other controller for remote sensing.	

Table 13. Modulating Demand Signal By Others Single Channel

Part No.	Description	Qty
2523060	0 - 5 Vdc single channel Demand signal acceptance	
2523062	0 - 20 mA single channel Demand signal acceptance	
2523064	4 - 20 mA single channel Demand signal acceptance	
2523066	0 - 10 Vdc single channel Demand signal acceptance	
2523090	0 - 16 Vdc single channel Demand signal acceptance	
2523092	1 - 5 Vdc single channel Demand signal acceptance	
2523094	2 - 10 Vdc single channel Demand signal acceptance	
2523096	0 - 20 Vdc single channel Demand signal acceptance	

Table 14. Modulating Demand Signal By Others Dual Channel

Part No.	Description	Qty
2523061	0 - 5 Vdc dual channel Demand signal acceptance	
2526063	0 - 20 mA dual channel Demand signal acceptance	
2523065	4 - 20 mA dual channel Demand signal acceptance	
2523089	0 - 10 Vdc dual channel Demand signal acceptance	
2523091	0 - 16 Vdc dual channel Demand signal acceptance	
2523093	1 - 5 Vdc dual channel Demand signal acceptance	
2523095	2 - 10 Vdc dual channel Demand signal acceptance	
2523097	0 - 20 Vdc dual channel Demand signal acceptance	

NOTE: : NHPC does not accept dual signal control

Table 15. Modulation By Others: Transducer Signal (NHTC AND NHTC OUTDOOR ONLY)

Part No.	Description	Qty
2523100	0 - 5 Vdc single channel Transducer signal acceptance	
2523101	0 - 5Vdc dual channel Transducer signal acceptance	
2523102	0 - 20 mA single channel Transducer signal acceptance	
2523104	0 - 20 mA dual channel Transducer signal acceptance	
2523105	4 - 20 mA single channel Transducer signal acceptance	
2523107	4 - 20 mA dual channel Transducer signal acceptance	
2523110	0 - 10 Vdc single channel Transducer signal acceptance	
2523111	0 - 10 Vdc dual channel Transducer signal acceptance	
2523112	0 - 16 Vdc single channel Transducer signal acceptance	
2523113	0 - 16 Vdc dual channel Transducer signal acceptance	
2523114	1 - 5 Vdc single channel Transducer signal acceptance	
2523115	1 - 5 Vdc dual channel Transducer signal acceptance	
2523116	2 - 10 Vdc single channel Transducer signal acceptance	

2523117	2 - 10 Vdc dual channel Transducer signal acceptance	
2523118	0 - 20 Vdc single channel Transducer signal acceptance	
2523119	0 - 20 Vdc dual channel Transducer signal acceptance	

Table 16. NORTEC OnLine Options (NHTC only)

Part No.	Description	Qty
1509780	NORTEC ONLINE Static IP Option for NHTC	
1509781	NORTEC ONLINE DHCP Option for NHTC	
1509782	NORTEC ONLINE GPRS Option for NHTC	
1509783	NORTEC ONLINE Dial-Up Option for NHTC	
1509784	NORTEC ONLINE Slave Option for NHTC	

Table 17. NORTEC Links Options (NHTC only)

Part No.	Description	Qty
2525534	NORTEC LINKS 2 FOR NHTC BACnet/IP	
2527106	NORTEC LINKS 2 FOR NHTC BACnet/MSTP	
2527108	NORTEC LINKS 2 FOR NHTC Johnson N2	
2527107	NORTEC LINKS 2 FOR NHTC LonWorks	
2522194	NORTEC LINKS 2 FOR NHTC Slave	

NOTES:: NHTC Total Controller has the Modbus communication built into the PCB Processor for remote monitoring and control using only BAS/BMS support Modbus

Table 18. NH Series Fusing Options

Part No.	Description	Qty
2522468	FUSING NHTC/PC 020-030/208-240/3	
2522470	FUSING NHTC/PC 005-020/120-277/1	
2522471	FUSING NHTC/PC 010-020/380-600/1	
2522472	FUSING NHTC/PC 020-030/440-600/3	
2522474	FUSING NHTC/PC 050-075/208-240/3	
2522475	FUSING NHTC/PC 050-075/40-600/3	
2522476	FUSING NHTC/PC 100/208-240/3	
2522477	FUSING NHTC/PC 100/440-480/3	

2522478	FUSING NHTC/PC 100/550-600/3	
2522479	FUSING NHTC/PC 150/208-240/3	
2522480	FUSING NHTC/PC 150/440-600/3	
2522481	FUSING NHTC/PC 200/208-240/3	
2522482	FUSING NHTC/PC 200/440-480/3	
2522483	FUSING NHTC/NHPC 200/550-600/3	

C. SCHEDULE

Humidifier Information

Zone Label _____ Zone Load _____ Humidifier Output _____ External Protection _____
 Humidifier Label _____ Humidifier Model _____ Voltage/Phase (VAC) _____ Requirement (A) _____

Control Information

	Demand		On/Off		Transducer	
	By Nortec	By Others	By Nortec	By Others	By Nortec	By Others
Space Control						
High Limit						
Air Proving	By Nortec		By Others		None (Blower Pack)	

Distributor Information

Blower Pack Built On **G** Remote Mounted **G** None (Duct) **G**
 Duct Information Width _____ Length _____ Vertical Airflow **G**
 Distributor ASD/BSD/CSD? _____ SAM-e
 No. Of Distributors _____ Header Length _____ No. of Tubes _____
 Length _____ Types of Tubs _____ Length _____

WARRANTY

- (1) Walter Meier Inc. and/or Walter Meier Ltd. (hereinafter collectively referred to as THE COMPANY), warrant for a period of two years after installation or 30 months from manufacturer's ship date, whichever date is earlier, that THE COMPANY's manufactured and assembled products, not otherwise expressly warranted (with the exception of the cylinder), are free from defects in material and workmanship. No warranty is made against corrosion, deterioration, or suitability of substituted materials used as a result of compliance with government regulations.
- (2) THE COMPANY's obligations and liabilities under this warranty are limited to furnishing replacement parts to the customer, F.O.B. THE COMPANY's factory, providing the defective part(s) is returned freight prepaid by the customer. Parts used for repairs are warranted for the balance of the term of the warranty on the original humidifier or 90 days, whichever is longer.
- (3) The warranties set forth herein are in lieu of all other warranties expressed or implied by law. No liability whatsoever shall be attached to THE COMPANY until said products have been paid for in full and then said liability shall be limited to the original purchase price for the product. Any further warranty must be in writing, signed by an officer of THE COMPANY.
- (4) THE COMPANY's limited warranty on accessories, not of the companies manufacture, such as controls, humidistats, pumps, etc. is limited to the warranty of the original equipment manufacturer from date of original shipment of humidifier.
- (5) THE COMPANY makes no warranty and assumes no liability unless the equipment is installed in strict accordance with a copy of the catalog and installation manual in effect at the date of purchase and by a contractor approved by THE COMPANY to install such equipment.
- (6) THE COMPANY makes no warranty and assumes no liability whatsoever for consequential damage or damage resulting directly from misapplication, incorrect sizing or lack of proper maintenance of the equipment.
- (7) THE COMPANY makes no warranty and assumes no liability whatsoever for damage resulting from freezing of the humidifier, supply lines, drain lines, or steam distribution systems.
- (8) THE COMPANY makes no warranty and assumes no liability whatsoever for equipment that has failed due to ambient conditions when installed in locations having climates below 14°F (-10°C) during January or above 104°F (40°C) during July. (See Table 1: Weather Design Data above).
- (9) THE COMPANY retains the right to change the design, specification and performance criteria of its products without notice or obligation.

INSTALLATION DATE (MM/DD/YYYY)

MODEL #
SERIAL #
CYLINDER #



Cylinder Replacement Date (MM/DD/YYYY)



Authorized Agent:

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