Johns Manville

Engineering & Technical Bulletin

80-1-ISD Condensation Control on Air Conditioning Ducts

Condensation of water vapor can occur on ducts going through any location if the dew point temperature of the ambient air is higher than the operating temperature of the HVAC system. Although this situation could be present in ducts in any location, particular attention should be given to ducts exposed to outside or unconditioned air, such as ducts in attics and crawl spaces.

For ducts in conditioned spaces, it is normal HVAC design to maintain a conditioned ambient temperature of 75°F and relative humidity of 50% or below with a supply air or operating temperature in the range of 55°F to 60°F, thus reducing by design the need for duct insulation since the dew point temperature of the conditioned space would be equal or less than 55°F.

Under actual conditions, variations in the rate of ventilation, number of people and equipment, could increase the dew point temperature of the conditioned space above the operating temperature. A typical example would be in a building with supply ducts going through return air plenums where usage of the conditioned space has been changed to conference areas instead of regular office work.

Attached are condensation parameters and the calculation procedure to determine the required insulation needed to prevent condensation.

Also attached is a table from which the ambient dew point temperature can be obtained knowing the dry bulb temperature and relative humidity. The dew point temperature below the line indicates condensation is likely to occur.

Condensation Parameters

1. Temperature of air in the duct or operating temperature.

2. Condition of air in the space where ducts are located.

   a. dry bulb temperature
   b. relative humidity
   c. dew point temperature

3. Duct location.

General Formula to Calculate Minimum Insulation Thickness Required to Prevent Condensation

$$tk = kR_s \frac{(T_{DP} - T_{OP})}{(T_{ADB} - T_{DP})}$$

tk = Insulation thickness (in)

k = Thermal conductivity $\left[\frac{Btu \bullet in}{(hr \bullet ft^2 \bullet °F)}\right]$

R_S = Surface temperature resistance $\left[\frac{(hr \bullet ft^2 \bullet °F)}{Btu}\right]$

T_{DP} = Dew point temperature (°F)

T_{OP} = Operating temperature (°F)

T_{ADB} = Ambient dry bulb temperature (°F)

The typical values for:

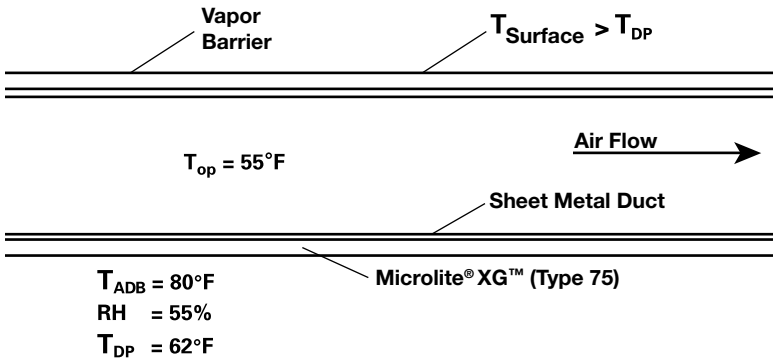
T_{OP} = 55°F cooling; 140°F heating

R_S = 1.32 $\frac{(hr \bullet ft^2 \bullet °F)}{Btu}$ (reflective surface, still air)

By setting tk = 0 and solving the equation for T_{OP}, it has been determined that the minimum condition for which insulation would be required is when T_{OP} is equal to the dew point temperature. Therefore, at standard barometric pressure and normal cooling operating conditions, insulation would be required when $T_{DP} \geq 55°F$.

Example

For those conditions where the operating temperature is less than or equal to the dew point temperature, the required insulation can be calculated as follows:



Solving for insulation thickness:

$$tk = kR_S \frac{(T_{DP} - T_{OP})}{(T_{ADB} - T_{DP})}$$

$$= (0.29)(1.32)\frac{(62-55)}{(80-62)}$$

$$= 0.15 \text{ inches}$$

Assumptions		
T_{ADB}	=	80°F
Relative Humidity	=	55%
T_{DP}	=	62°F (from table)
T_{OP}	=	55°F
k	=	0.29 Microlite XG (Type 75)
R_S	=	1.32 $\frac{(hr \bullet ft^2 \bullet °F)}{Btu}$

The results show that 0.15 inches of insulation is required in order to avoid condensation. Although this is not very thick, the point is that without any insulation, this duct will sweat and cause problems, e.g. stained ceilings and wet floors.

Since water vapor would be free to penetrate fiber glass insulation, a vapor barrier is required in order to prevent condensation within the insulation and possible damage to the product.

Heating Season

Condensation during the heating season is rare but can occur inside the duct where solar energy is used for heating or in return ducts going through unconditioned spaces. Also, in dry climates where humidifiers are used in the supply air, condensation can occur if the duct is exposed to the outside air.

Dew-Point Temperature Chart

Dry-bulb temp. °F	Percent relative humidity 10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
5	-35	-30	-25	-21	-17	-14	-12	-10	-8	-6	-5	-4	-2	-1	1	2	3	4	5
10	-31	-25	-20	-16	-13	-10	-7	-5	-3	-2	0	2	3	4	5	7	8	9	10
15	-28	-21	-16	-12	-8	-5	-3	-1	1	3	5	6	8	9	10	12	13	14	15
20	-24	-16	-11	-8	-4	-2	2	4	6	8	10	11	13	14	15	16	18	19	20
25	-20	-15	-8	-4	0	3	6	8	10	12	15	16	18	19	20	21	23	24	25
30	-15	-9	-3	2	5	8	11	13	15	17	20	22	23	24	25	27	28	29	30
35	-12	-5	1	5	9	12	15	18	20	22	24	26	27	28	30	32	33	34	35
40	-7	0	5	9	14	16	19	22	24	26	28	29	31	33	35	36	38	39	40
45	-4	3	9	13	17	20	23	25	28	30	32	34	36	38	39	41	43	44	45
50	-1	7	13	17	21	24	27	30	32	34	37	39	41	42	44	45	47	49	50
55	3	11	16	21	25	28	32	34	37	39	41	43	45	47	49	50	52	53	55
60	6	14	20	25	29	32	35	39	42	44	46	48	50	52	54	55	57	59	60
65	10	18	24	28	33	38	40	43	46	49	51	53	55	57	59	60	62	63	65
70	13	21	28	33	37	41	45	48	50	53	55	57	60	62	64	65	67	68	70
75	17	25	32	37	42	46	49	52	55	57	60	62	64	66	69	70	72	74	75
80	20	29	35	41	46	50	54	57	60	62	65	67	69	72	74	75	77	78	80
85	23	32	40	45	50	54	58	61	64	67	69	72	74	76	78	80	82	83	85
90	27	36	44	49	54	58	62	66	69	72	74	77	79	81	83	85	87	89	90
95	30	40	48	54	59	63	67	70	73	76	79	82	84	86	88	90	91	93	95
100	34	44	52	58	63	68	71	75	78	81	84	86	88	91	92	94	96	98	100
105	38	48	56	62	67	72	76	79	82	85	88	90	93	95	97	99	101	103	105
110	41	52	60	66	71	77	80	84	87	90	92	95	98	100	102	104	106	108	110
115	45	56	64	70	75	80	84	88	91	94	97	100	102	105	107	109	111	113	115
120	48	60	68	74	79	85	88	92	96	99	102	105	107	109	112	114	116	118	120
125	52	63	72	78	84	89	93	97	100	104	107	109	111	114	117	119	121	123	125

Johns Manville

717 17th St.
Denver, CO 80202
(800) 654-3103
specJM.com

North American Sales Offices, Insulation Systems

Eastern Region
P.O. Box 158
Defiance, OH 43512
(800) 334-2399
Fax: (419) 784-7866

Western Region & Canada
P.O. Box 5108
Denver, CO 80217
(800) 368-4431
Fax: (303) 978-4661

80-1-ISD 10-08 (Replaces 2-07)

Printed on recycled paper.