Condensation and Your Enclosure

If the enclosure you're cooling operates outdoors, or may otherwise be affected by condensation, it may be wise to plan component layout to accommodate for any moisture that may form as the temperature inside the box falls below the dew point.

Cold air holds less moisture than warm air and the colder the surfaces within an enclosure, the less moisture it will take to show up as condensation. When air cools to the point where it can no longer hold water, as vapor, it condenses to a visible droplet form. That "point of condensation" is called the "dew point."

The initial and primary point of concern with our air conditioners is the "cold-side" heat-sink that's inside the enclosure when mounted. Because this heat-sink will often be the coldest spot in the enclosure it's the most likely to form condensation. Our ElectraCOOL™ outdoor rated (IP55) assemblies are designed to operate in moist environments and will not suffer from condensation. However, the other contents of the enclosure, particularly electronics and sensors, should be shielded or protected from condensate that may drip from the "cold-side" of the TE assembly. Mounting the air conditioner in an enclosure door, or side wall, is often a simple solution, particularly if a drip tray can be placed below the cold-side heat-sink.

Three things you can do to reduce potential condensation inside the box are insulate, control the temperature and keep the air circulating.

First and most importantly, be sure to insulate the enclosure with as much material as possible. We like rigid foam board, cut to fit snugly, seams taped. Add a barrier of DuPont™ Tyvek® if possible. Both of these products are available at most home stores. Together, they resist air infiltration and water intrusion and significantly reduce the heating effect of sunshine which makes for a more energy-efficient enclosure, or panel, because it's easier to keep cool (or warm) and to keep dry.

In many situations it's a good idea to consider using a thermostat or temperature controller to keep the temperature of the (cooled) air inside the box above the dew point. In this way minimal condensation can form and you will very likely be operating more efficiently. We offer single set point units like the Z31-A for cooling (or warming) and dual set-point units like the TLK38-S, that allows for both cooling and heating as necessary.

Finally, keep the air inside the enclosure circulating. Air cools off and condenses more quickly when it's motionless. Consider an additional fan or blower to assist the thermoelectric assembly with air handling.

The following table that shows the relationship between Relative Humidity and Air Temperature.

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Relative Humidity

Air Temperature in °C	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
30°C	10.5	12.9	14.9	16.8	18.4	20.0	21.4	22.7	23.9	25.1	26.2	27.2	28.2	29.1
29	9.7	12.0	14.0	15.9	17.5	19.0	20.4	21.7	23.0	24.1	25.2	26.2	27.2	28.1
28	8.8	11.1	13.1	15.0	16.6	18.1	19.5	20.8	22.0	23.2	24.2	25.2	26.2	27.1
27	8.0	10.2	12.2	14.1	15.7	17.2	18.6	19.9	21.1	22.2	23.3	24.3	25.2	26.1
26	7.1	9.4	11.4	13.2	14.8	16.3	17.6	18.9	20.1	21.2	22.3	23.3	24.2	25.1
25	6.2	8.5	10.5	12.2	13.9	15.3	16.7	18.0	19.1	20.3	21.3	22.3	23.2	24.1
24	5.4	7.6	9.6	11.3	12.9	14.4	15.8	17.0	18.2	19.3	20.3	21.3	22.3	23.1
23	4.5	6.7	8.7	10.4	12.0	13.5	14.8	16.1	17.2	18.3	19.4	20.3	21.3	22.2
22	3.6	5.9	7.8	9.5	11.1	12.5	13.9	15.1	16.3	17.4	18.4	19.4	20.3	21.2
21	2.8	5.0	6.9	8.6	10.2	11.6	12.9	14.2	15.3	16.4	17.4	18.4	19.3	20.2
20°C	1.9	4.1	6.0	7.7	9.3	10.7	12.0	13.2	14.4	15.4	16.4	17.4	18.3	19.2
19	1.0	3.2	5.1	6.8	8.3	9.8	11.1	12.3	13.4	14.5	15.5	16.4	17.3	18.2
18	0.2	2.3	4.2	5.9	7.4	8.8	10.1	11.3	12.5	13.5	14.5	15.4	16.3	17.2
17	-0.6	1.4	3.3	5.0	6.5	7.9	9.2	10.4	11.5	12.5	13.5	14.5	15.3	16.2
16	-1.4	0.5	2.4	4.1	5.6	7.0	8.2	9.4	10.5	11.6	12.6	13.5	14.4	15.2
15	-2.2	-0.3	1.5	3.2	4.7	6.1	7.3	8.5	9.6	10.6	11.6	12.5	13.4	14.2
14	-2.9	-1.0	0.6	2.3	3.7	5.1	6.4	7.5	8.6	9.6	10.6	11.5	12.4	13.2
13	-3.7	-1.9	-0.1	1.3	2.8	4.2	5.5	6.6	7.7	8.7	9.6	10.5	11.4	12.2
12	-4.5	-2.6	-1.0	0.4	1.9	3.2	4.5	5.7	6.7	7.7	8.7	9.6	10.4	11.2
11	-5.2	-3.4	-1.8	-0.4	1.0	2.3	3.5	4.7	5.8	6.7	7.7	8.6	9.4	10.2
10°C	-6.0	-4.2	-2.6	-1.2	0.1	1.4	2.6	3.7	4.8	5.8	6.7	7.6	8.4	9.2

To use this dew-point table simply find the ambient temperature in the first column and read across until you reach the column with the local relative humidity by percentage (%). At the intersection of those two values you find the temperature at which dew will appear.

For example, if the ambient air temperature is 25 °C and relative humidity is 75% then the dew point is **20.3 °C.** Condensation will begin to form on surfaces at that temperature, and below.

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