

## Mirror Depression • High Sample Temperature • EdgeTech Model 300 •

### The Challenge:

An oxygen production plant located in Hangzhou City, Zhejaian Province, China purchased an EdgeTech Model 300 three-stage TEC (Thermo Electric Cooler) for a dryer application with an expected dew point range of +20°F to -75°C. The challenges were: the high sample temperature (+160°C) and low expected dew point of -75°C. This represents a mirror cooling range requirement of 235°C. The three-stage TEC has a depression capability of 90°C. What to do...

### What is Mirror Depression?

By definition, “depression” means lowering. This is exactly what it means with respect to the TEC that acts as the heart of our (EdgeTech’s) chilled mirror technology. The TEC is the device that cools the mirror, forming dew on its surface when the dew point is reached.

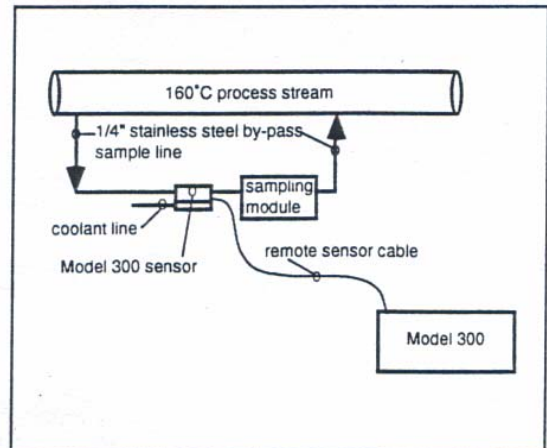
TECs come in various ranges of cooling capability (i.e. depression specifications). Depression is the range of temperature, from the temperature of the sensor base to the cooling capability of the TEC. The sensor temperature could be ambient or the sample temperature or even the temperature of the coolant flowing through a sensor cooling jacket. EdgeTech offers three depression ranges (from 25°C ambient temperature):

- One-stage: 45°C depression
- Two-stage: 60°C depression
- Three-stage: 90°C depression

### The EdgeTech Solution:

In this application, it is clear that the depression capability of the three-stage TEC is not sufficient to determine the dew point from the highest temperature (+160°C) to the lowest possible dew point (-75°C). Two installation adjustments will solve the problem:

- 1.) A representative sample is drawn from the process through a three foot ¼” stainless steel tube. Sample temperature drops to approximately ambient conditions at 25°C. Ambient (25°C) is above the highest expected dew point of 20°C, so line condensation will not occur.



If condensation were a problem, heat tape on the line, to keep the sample temperature above condensation temperature; would be recommended. In this case however it is not needed.

Remember, unlike thin film capacitance technologies, chilled mirror dew point is not affected by changes in temperature; EdgeTech chilled mirror dew point is an absolute measurement.

2.) To achieve a  $-75^{\circ}\text{C}$  dew point, a further temperature drop is needed. The Chinese gas production plant can use a sensor coolant (ethylene glycol) to drop the temperature of the sensor to  $0^{\circ}\text{C}$ , which becomes the "top" end of the depression range.

The TEC has a  $90^{\circ}\text{C}$  cooling capability, if we are starting at  $25^{\circ}\text{C}$  ambient.

A TEC will lose  $1^{\circ}\text{C}$  for every  $3^{\circ}\text{C}$  drop in ambient. In this case, we drop the temperature from the ambient of  $25^{\circ}\text{C}$  to  $0^{\circ}\text{C}$ , or a total of  $25^{\circ}$ . Therefore, the TEC will lose about  $8^{\circ}\text{C}$  cooling capability. At  $0^{\circ}\text{C}$ , a three-stage TEC has a depression capability of approximately  $82^{\circ}\text{C}$  or  $-82^{\circ}\text{C}$ . In this case, we are well within the lowest expected dew point of  $-75^{\circ}\text{C}$ .

For this application, the various parameters are balanced to achieve the desired result. In any application, we simply substitute the values to achieve the desired result.

