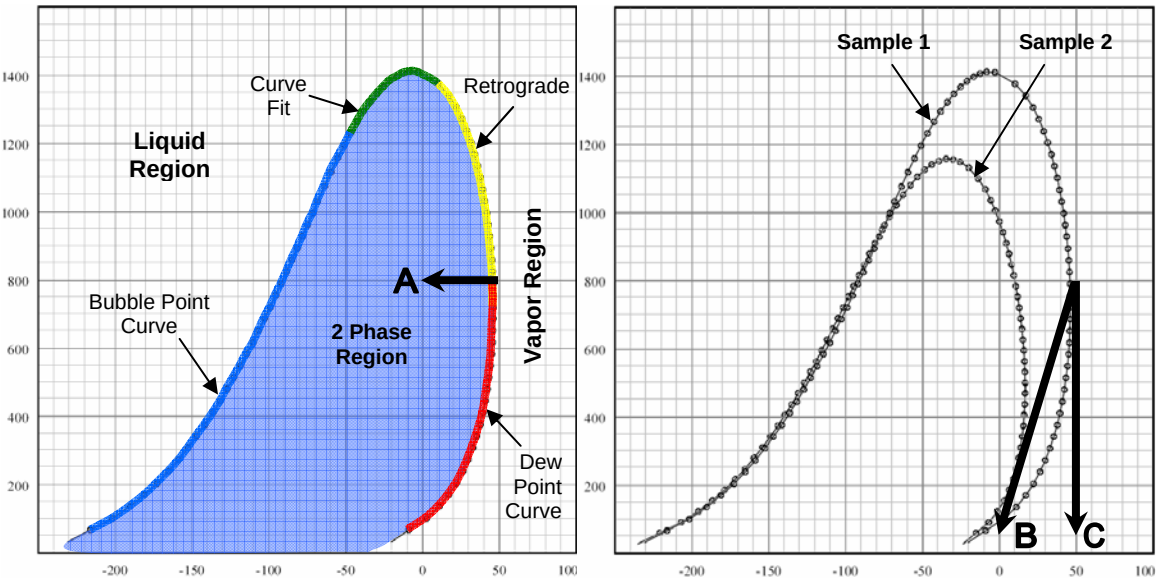
Tech Note:
Natural Gas – Phase Diagram Example

When an extractive sample conditioning system is used to measure pipeline gas, it is essential that the sample gas is representative of the gas in the pipeline. Condensation in the sample gas would alter the composition and must be avoided.

The Dew Point Curve:
The curve on the left below shows a typical phase diagram for natural gas. The Y axis indicates pressure and the X axis indicates temperature. When everything is operating properly, the gas is in the vapor region. The dew point curve (red curve) indicates where the liquids will begin to condense. For example, assume a pipeline is at 800 psi and 50 degrees F; the gas would be in the gas phase. If the temperature dropped to zero degrees, liquid would begin to form. If the temperature decreased more, additional liquid would form as gas properties go deeper into the 2-phase region. This is illustrated by arrow A in the diagram.



The graphs on the above right demonstrate the effects of gas composition on the phase diagram. The curve for gas sample 2 contains fewer heavy hydrocarbons than gas sample 1, and its dew point curve is shifted to the left (the dew point curve is dominated by the heavier hydrocarbons). Also note that at low pressures, hydrocarbon condensation is much less likely. Assume a temperature drop occurs from 50 degrees to zero which is accompanied by a pressure drop from 800 to 50psi. As illustrated by arrow B, the gas would end up in the vapor region.

Most pipeline operators prefer not to allow temperature drops at all because it is critical to keep the gas above the dew point line. In the case of an analyzer that requires an extracted sample of the gas, the pressure may need to be dropped in order to stay within the operating specs of the analyzer (e.g. the SS-Series analyzers require 10 psig or less). When the pressure is decreased, the Joule-Thomson effect causes a temperature decrease as well. If the pipeline is operating at 800 psi, for example, the temperature change is about 50 degrees (refer to arrow B again).

By using a heated regulator or a probe regulator, the result is an adiabatic (constant temperature) process like the one shown by arrow C. As shown, the gas actually moves farther away from the dew point line using this method, making condensation less likely in the sample conditioning system than in the pipeline.