

Compressibility Factor

Fall 2009

To: Engineering Development Branch

From: Engineering Division

Subject: Compressibility Factor

A mixture of 50 mol% argon (Ar) and 50 mol% carbon dioxide (CO₂) is used to purge the welding environment of oxygen (O₂) in our MIG welding process. The delivery pressure ranges between 100 to 750 psia (at room temperature) depending upon how much gas we need. The gas mixture is prepared by delivering 2 liters/min of Ar to a "tee" junction, along with some amount of CO₂. Initially, the technicians added 2 liters/min of CO₂ but the composition did not meet the 50% requirement. One technician suggested that the CO₂ was non-ideal and that this was contributing to the erroneous mixture composition. There was also some discussion as to whether Ar behaved as an ideal gas although there was not any definitive conclusion. It was concluded, however, that the Peng-Robinson Equation of State adequately describes the behavior of Ar under the desired conditions. There is an apparatus in our laboratory that can be utilized to measure compressibility factors ($z=PV/nRT$) for pure components and mixtures. Please collect and use laboratory data for CO₂ and the mixture, and use the Peng-Robinson Equation of State for Ar to determine the required volumetric flowrate of CO₂ and the final volumetric flowrate of the mixture over the delivery pressure range. In addition, please comment on the appropriateness of the Peng-Robinson Equation of State and its mixing rule for this gas system that could be utilized for future applications if we want to adjust the mixture composition.

We look forward to receiving your report.