

# SRS Tech Note

---

## Hydrogen atmospheres for electric power generators

J. Willison

December 12, 2017

Hydrogen gas is used in electric power generators to improve their cooling and to reduce losses due to friction and viscosity. Binary gas analyzers are used to monitor the atmosphere in these power generators and insure the safe filling and emptying of the potentially explosive atmosphere.

In air at 14.7 psia, mixtures of hydrogen between 4% and 75% are explosive. So, adding hydrogen to a generator filled with air will create an explosive atmosphere. Similarly, purging a hydrogen filled generator with air will also create an explosive atmosphere.

To safely fill generator with hydrogen, the air is first replaced with carbon dioxide. Then, while filling the generator with hydrogen, at no time will there be an explosive atmosphere created. Similarly, to remove hydrogen from a generator, carbon dioxide is used as a purge gas, again avoiding the chance to create an explosive atmosphere.

Carbon dioxide is used as a purge gas for several reasons: It liquefies under pressure (and so a lot of gas can be put in a cylinder), and there is no mixture of air and hydrogen which has the same thermal conductivity, or speed of sound, as the purge gas, as would be the case if nitrogen was used. (Three percent hydrogen in air “looks” like pure nitrogen to a binary gas analyzer.)

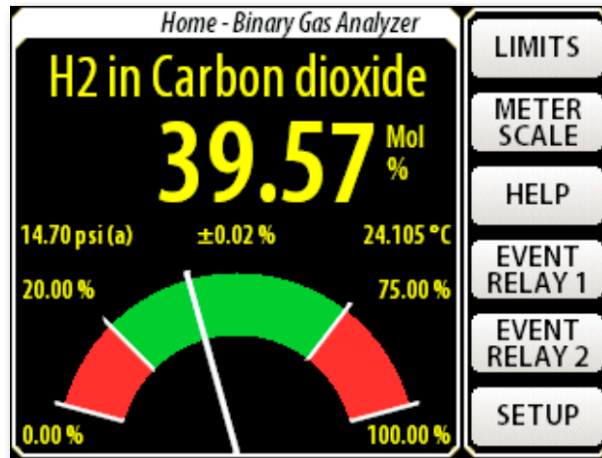
Historically, thermal conductivity (TC) based binary gas analyzers have been used to monitor these purge and fill cycles. However, TC based analyzers require a reference gas flow, need frequent recalibration, and are slow to respond.

### The BGA244 Binary Gas Analyzer

The BGA244 binary gas analyzer, which measures the gas composition by measuring the speed of sound in the gas mixture, requires no reference gas flow, never needs to be recalibrated, and makes four measurements per second. The BGA is capable of measuring thousands of gas mixtures.



Typically, the BGA244 would measure the gas flow leaving the generator casing. The gas analyzer can report air in carbon dioxide (for the initial purge with carbon dioxide), carbon dioxide in hydrogen (for the fill with hydrogen, and the purge of hydrogen with carbon dioxide), and carbon dioxide in air (for the final purge of the generator before opening for maintenance).



*Binary Gas Analyzer mode*

#### **A final safety note**

The BGA244 is not ATEX rated. In this example, no flammable gas mixtures are being created. Even if there were, under normal operating conditions the BGA244 cannot ignite the gas being analyzed. However, when the instrument is used with flammable or explosive gas mixtures we recommend the use of flame arrestors on both gas ports as an added measure of safety.