

# Hydrogen-Cooled Electric Generators

## All Quartz-Crystal Moisture Analyzers

### Application

Moisture contamination is measured in the hydrogen gas used to cool large stationary electric generators.

### Problem

Hydrogen is used to cool the bearings and other rotating parts of large stationary electric generators. Hydrogen is the best choice for a cooling gas because of its unique combination of high thermal conductivity and low viscosity. In order to maintain these favorable properties, the hydrogen must be kept dry. Moisture is a contaminant that both reduces the thermal conductivity and increases the viscosity of the gas. The presence of moisture indicates that either the system was not purged adequately after the last maintenance cycle or that there is an ambient leak, which can be a very hazardous condition.

### Equipment

Any quartz-crystal based moisture analyzer is suitable for this application provided the sample pressure meets the analyzer's minimum inlet requirement. The choice of analyzer should be based upon both the hazardous area classification and whether or not the customer desires a display.

Electrolytic sensors are not suitable due to the recombination errors that always occur in hydrogen atmospheres. Metal-oxide probes should also be avoided as the reducing hydrogen atmosphere may react with the probe's oxide layer resulting in a loss of both sensitivity and calibration stability.

### Procedure

The cooling hydrogen is continuously circulated through the generator and then through a molecular sieve dryer. In order to be certain that the hydrogen is dry, the sample tap is installed in the return line from the generator to the dryer.

A second measuring point, at the dryer outlet, will provide a control signal for dryer switching. This additional measurement will maximize dryer life, provide an indication of dryer efficiency, and minimize the possibility of a dryer upset effecting the generator's operation.

### How Previously Handled

Everything from lithium chloride hygrometers, in-line psychrometers, electrolytic moisture sensors, and aluminum oxide probes have been tried in the past. These technologies have typically proven to require high maintenance or to be highly unreliable

due to the basic technology or the effects of hydrogen on the different analytical techniques.

### Advantages

With a quartz-crystal based moisture analyzer the actual moisture concentration in the cooling gas is easily, and accurately measurable. These analyzers are highly reliable and require little maintenance. All the models listed above include on-line verification to ensure the user of the analyzer's accuracy upon demand. In addition, the performance of this technology is very stable over long periods of time thereby increasing operator confidence in the system.

### Typical Operating Specifications

Moisture Range  
5 ppmv to 500 ppmv  
Operating Pressure  
0.5\* to 75 psig (0.05\* to 5.2 barg)

**\*Please Note:** The minimum operating pressure requirement of the analyzers ranges from 6 to 50 psig (0.41 to 3.45 barg) depending upon the model. Higher pressures will require use of an optional pressure reducer.



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