Overview

The standardized Set GGA (Generator Gas Analyzer) has been specially designed for monitoring hydrogen-cooled turbo generators.

Benefits

Standardized complete system

- Simple and fast to configure
- Field-proven, harmonized and reliable set
- Low purchase price and economic operation
- Suitable for optimizing the efficiency of H_2-cooled turbo generators

Field-proven, reliable technologies

- High-precision and reliable purity monitoring of hydrogen
- Microchip-based thermal conductivity measurement
- Redundant measuring system
- SIL 1 certificate for the analysis hardware

Simple operation

- Intuitive menu prompting
- Configuration on large displays with plaintext
- Use of CO_2 and AR as inert gas possible

Application

This set is used in power generation applications.

Turbo generators in power plants are cooled with gas in order to increase their efficiency. In spite of the strict safety requirements hydrogen is used as a cooling gas. This offers huge advantages over air. These include considerably better cooling properties, lower friction loss on rotating parts, and a higher electrical breakdown strength. These features enable hydrogen to satisfy the requirements for the turbo generator to reach an optimum level of efficiency.

However, mixtures of hydrogen and air with a hydrogen content of anything from 4 to 77 % are explosive. For safety reasons, it is imperative that this is prevented during operation filling and emptying of the turbo generators. International standards (EN 60034-3 and IEC 842) state that redundant safety monitoring with two independent operating systems must be used for this.

In addition, contamination of the hydrogen cooling gas reduces the efficiency of the turbo generator, as it leads to considerably higher friction loss. For a 970 MW generator, a difference of 4% is equivalent to a 0.8 MW difference in power. There are also good reasons related to cost-effectiveness why the cooling gas should be continuously monitored for contamination.

The Set GGA is a complete solution for monitoring hydrogen-cooled turbo generators, with the dual benefit of being simple to handle and having low initial investment costs.

Design

The Set GGA is available in the following versions:

- Generator Gas Analyzer (GGA)
- GGA with test gas skid
- GGA with test gas skid and installation frame

Analyzers

The GGA contains two CALOMAT 6E analyzers (19" rack unit versions). From the gas sampling system right through to the gas outlet, these are completely separate from one another, thereby ensuring full redundancy.

The CALOMAT 6E is a continuous gas analyzer for determining H_2 and He in binary or quasi-binary gas mixtures.

To measure the hydrogen and inert gases continuously, the exact thermal conductivity of the sample gas mixture is measured and the concentration calculated from this. Only binary gas mixtures can be directly measured.

The CALOMAT 6E is used to measure 0 to 100 % CO_2/Ar in air, 0 to 100 % H_2 in CO_2/Ar or 80 to 100 % H_2 in air, in the context of monitoring hydrogen-cooled turbo generators, on account of its high measuring range dynamics.

The units are approved for use in ATEX Zone 2. Gas mixtures may also be fed in according to the definition of Zone 1. In terms of tightness and compressive strength, the measuring cell and entire physical structure of the gas path, from inlet to outlet, are certified up to 55 000 hPa . This is much higher than the pressure that arises when oxyhydrogen gas is ignited.

A flame arrestor at the sample gas inlet provides additional safety.

The integrated LCD display shows the measured values, status bar and measuring ranges simultaneously.

The T90 time is less than 5 s. This means that the delay between the measurement and displaying the result is very short.

Tests carried out under harsh field conditions have indicated that the 3-week drift of the measurement results is less than 0.1 %. Combined with a repeatability value of 0.1 %, this ensures that the measurement results gathered will be both accurate and precise.

Analyzer cabinet

Another feature of the GGA is a protective cabinet for the analyzers. This provides a compact location where the system can be easily installed, and offers protection against dust and water. The system is approved in accordance with IP54 degree of protection.

The cabinet measures 616 x 615 x 600 mm (H x D x W) and is made from painted sheet steel.

A key advantage of this type of construction is that it eliminates the need for a restricted breathing enclosure, allowing maintenance to be carried out without any difficulty. If a restricted breathing enclosure is required, it must be ensured that the system is operated in an airtight room. Restoring the restricted breathing enclosure once maintenance procedures have been performed is a costly and time-consuming process.

To keep operating and maintenance costs low, the GGA set supports natural cabinet ventilation and a filter element provides protection against particles of dirt. Purging with instrument air is not necessary.

Set GGA

Test gas skid

The analyzers and analyzer cabinet are supplied as part of the basic configuration of the set. As an option, however, it is also possible to obtain a suitable test gas skid on a mounting plate.

The test gas skid is responsible for preparing the extracted sample ready for analysis. This ensures that the sample, calibration and inert gases are fed into the analyzers at the right pressure and flow rate, and without having been mixed with other gases.

The skid is fully equipped with a flame arrestor, stopcock ball valve, stainless steel overflow regulator, single-stage pressure reducer, stainless steel 5-way transfer ball valve, all-metal flow meter for air, 1-channel isolating switch amplifier and installation material. The flowmeters are designed to transmit a limit monitoring signal. The connection is made on-site.

The test gas skid guarantees that all the requirements in terms of safety, quality and simplicity are satisfied when connecting sample, calibration and inert gases.

Installation frame

The installation frame is a supplementary feature of the set. It enables free-standing installation of the analyzer cabinet and test gas skid.

The installation frame is supplied in a fully assembled state (including feet). Its overall height is 2 000 mm.

Function

There are three distinct processes in monitoring hydrogen-cooled turbo generators: normal operation, filling and emptying. The measuring task entails preventing a gas mixture of hydrogen and air outside the specified limits, or detecting the risk of this happening in good time, as well as monitoring the hydrogen purity.

During normal operation, the purity of the generator cooling gas is monitored. If the purity falls below a specific limit (e.g. < 95 % H_2), a message is output. The monitored range is 80 to 100 % H_2 in air.

Filling the generator is a two-stage procedure: first, the air in the generator is replaced by inert gas (argon or CO_2), and then this is replaced by hydrogen. During this, the concentration trends of the gases are measured and the replacement processes monitored. To prevent explosive mixtures from being formed, it is necessary to monitor the measuring range of 0 to 100 % inert gas in air in the first step and 0 to 100 % H_2 in inert gas in the second step.

The procedure is performed in reverse when emptying the generator: The hydrogen is first replaced with inert gas and the generator is then filled with air. The measuring tasks remain unchanged in this case. Here it is necessary to monitor the measuring ranges of 0 to 100 % H_2 in inert gas first, and then 0 to 100 % inert gas in air.

Technical specifications

Climatic conditions	
Ambient temperature	5 ... 50 °C
Relative humidity	70%, non-condensing
Corrosive atmosphere	No
Gas inlet conditions	
Calomat 6E	
• Sample gas pressure	800 ... 1 100 hPa (absolute)
• Sample gas flow	30 ... 90 l/h (0.5 … 1.5 l/min)
Test gas skid	
• Sample gas pressure	55 000 hPa (absolute)
• Sample gas flow	30 … 90 l/h (0.5 … 1.5 l/min)
Power supply	
Supply 1	200 ... 240 V AC, 48 ... 63 Hz
Supply 2	100 ... 120 V AC, 48 ... 63 Hz
Supply 3	24 V DC for switch amplifiers
Type of connections	
Pipe material	Stainless steel
Connections/components	• Metric (6 mm) • Imperial (¼")
Cabling	
Electrical design	According to IEC
Type of cables	Non-armored cables
Cable ID	No single core labeling
Installation	
Site	Interior
Ex-zone analyzer	ATEX II, 3G

System design	
Version	Cabinet
Degree of protection	IP54
Automatic calibration	No
Signal outputs	4 ... 20 mA/floating contact max. 24 V AC/DC 1 A
With sample gas return flow	On request
Measuring response	Based on sample gas pressure 1 013 hPa absolute, 0.5 l/min sample gas flow and 25 °C ambient temperature
Output signal fluctuation	< ± 0.75% of the smallest possible measuring range according to rating plate, with electronic damping constant of 1 s (σ = 0.25%)
Zero point drift	< 1%/week of the smallest possible span according to rating plate
Measured-value drift	< 0.5%/of the smallest possible span according to rating plate
Repeatability	< 1% of the current measuring range
Detection limit	1% of the current measuring range
Linearity error	< ± 1% of the current measuring range
Influencing variables	Based on sample gas pressure 1 013 hPa absolute, 0.5 l/min sample gas flow and 25 °C ambient temperature
Ambient temperature	< 1%/10 K referred to smallest possible span according to label
Accompanying gases	Deviation from zero point
Sample gas flow	< 0.1% of the smallest possible span according to rating plate with a change in flow of 0.1 l/h within the permissible flow range
Sample gas pressure	< 1% of the current measuring range with a pressure change of 100 hPa
Auxiliary power	< 0.1% of the current measuring range with rated voltage ± 10%

Generator gas analyzer

Analysis	**Measuring point designation**			**Generator gas analyzer**			
	Concentration			**Unit**	**Measured component**	**Measuring range**	
Component	**Min.**	**Typical**	**Max.**			**Small**	**Large**
Ar/CO_2 in air	0		100	vol. %	Yes	0	100
H_2 in Ar/CO_2	0		100	vol. %	Yes	0	100
H_2 in air	80		100	vol. %	Yes	80	100
Sample temperature		50		°C			
Dust content		0		mg/m^3			
H_2O dew point		-50		°C			
Aggregate state, sample[1)]	Gaseous						

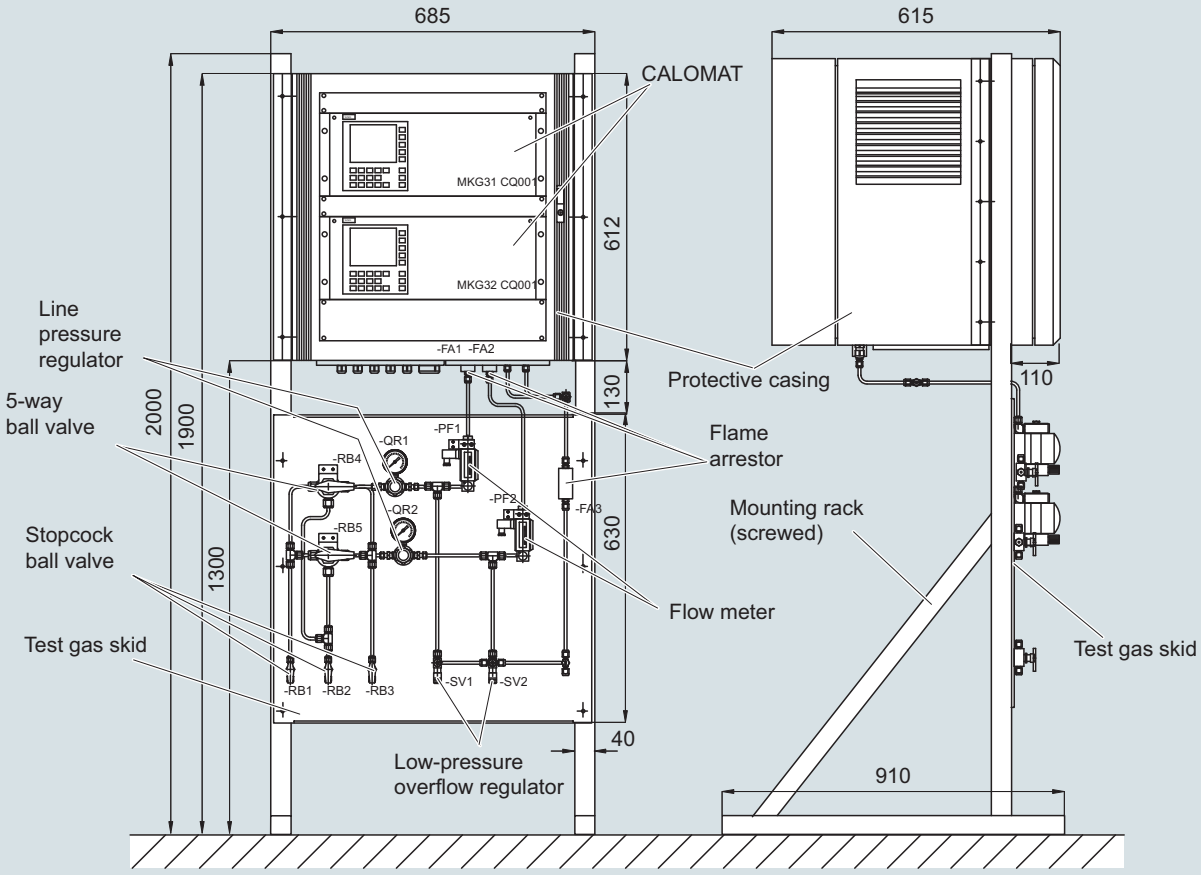
[1)] Standard state at 20 °C, 101.3 kPa

Analytical Application Sets
Continuous monitoring of hydrogen-cooled generators

Set GGA

Selection and ordering data	Article No.													Cannot be combined
Set GGA ↗	**7MB1950-**	■	■	■	**0**	■	**-**	■	■	■	■			
↗ Click on the Article No. for the online configuration in the PIA Life Cycle Portal.														
Gas connections														
6 mm pipe		**0**												
1/4" pipe		**1**												
Version														
H_2 monitoring (turbo generators)			**G**	**A**										
Add-on electronics														
Without					**0**									
Auxiliary power														
100 ... 120 V AC, 47 ... 63 Hz							**0**							
200 ... 240 V AC, 47 ... 63 Hz							**1**							
Variants														
Set GGA, cable glands M20x1.5 power supply with cable diameter of 6 ... 12 mm								**A**						
Set GGA, with test gas skid, cable glands M20x1.5 power supply with cable diameter of 6 ... 12 mm (sampling unit on stainless steel plate), delivery batch in 2 parts								**B**						
Set GGA, cable glands M25x1.5 power supply with cable diameter of 14 ... 18 mm								**C**						
Set GGA, with test gas skid factory-assembled on mounting frame, cable glands M20x1.5 power supply with test gas skid (PA on stainless steel plate), ready mounted on frame, delivery batch 1 part								**E**						
Explosion protection														
Certificate: ATEX II 3G, flammable and non-flammable gases									**B**					
Documentation														
German										**0**				
English										**1**				
French										**2**				
Spanish										**3**				

Dimensional drawings



Set GGA, dimensions in mm, figure corresponds to 7MB1950-0GA00-1EB0