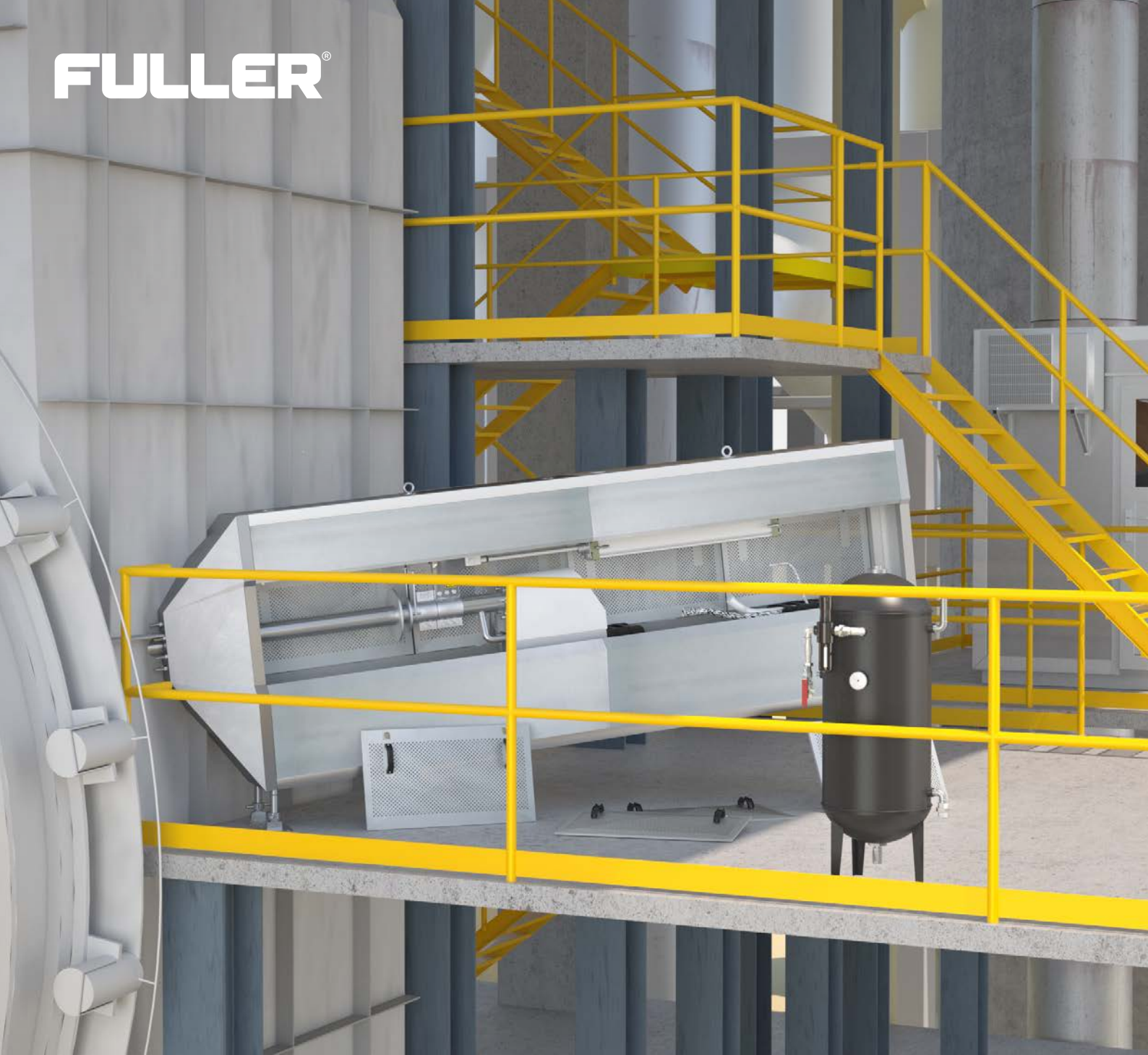


**FULLER®**



# **GAS ANALYSIS TECHNOLOGY**

**PROCESS OPTIMIZED**

# GAS ANALYSIS DESIGNED SPECIFICALLY FOR THE CEMENT INDUSTRY

OUR SYSTEMS COME WITH BUILT-IN PROCESS KNOW HOW

## Why Fuller gas analysis?

There are other suppliers of gas analysis equipment. However none of these vendors is focused like Fuller on supplying process equipment to the cement and minerals industry. We have more than 40 years of worldwide experience in designing market-leading gas analysis solutions specialized in optimizing production throughput, cost of operations and the safety of people and machinery. This position has only been possible due to our unique in-house access to process knowledge. Our Gas Analysis Technology team is proud to be part of solutions where we supply gas analysis equipment which increases the income of the cement producers and at the same time limits production emissions to a minimum.

## Rocket science will not work...

Through many years of experience in producing equipment for the cement and minerals market, we've learned that for field equipment such as gas analysis rocket science will not work. Complicated mechanical solutions to process-related problems have proven to fail again and again. In Fuller's Gas Analysis Technology, we believe in a simple, strong and reliable design. Our market leading KilnLoq™ probe One Pipe design [Patented] is a good example of this approach.



### Fuller Gas Analysis systems

Specialized gas analysis equipment for the cement industry

- 40 years of experience built in to the equipment
- Unique and patented designs available for process, safety and interlocking gas analysis
- Plug-&-play solutions for emission analysis in compliance with local legislation

# FOCUS ON THE EQUIPMENT USER

## Ease of maintenance

The success of any gas analysis solution installed on a cement production line will never be greater than the success of the maintenance department. If the maintenance department is unable to keep the equipment in trouble-free operation, the plant will never be in a position to utilize the potential data provided by the gas analysis equipment.

In order to support the success of the maintenance department, we have done our utmost to keep the design of our equipment very simple. This will support the fastest training, operation and easy maintenance of our equipment compared to any competitor. Anyone depending on a high-temperature gas analysis system operating in a potentially condensed dust-loaded process knows that any probe will eventually be blocked. We confront this issue and have designed systems which can be fully cleaned out in a matter of minutes without any dismantling.

## Quality of equipment

We use only high-quality materials and components. The quality is defined based on more than 50 years of experience with materials and a proven component track record. System designs for various applications will normally use common parts in order to reduce the total number of parts required, lessening the need to keep many parts on stock. All gas analysis systems undergo a full-size test and quality assurance program (ISO 9000) and no equipment leaves the production facility until such tests have been successfully passed.

## Run factor

In the final analysis, the run factor of the equipment is the key factor. Our unique designs and ability to integrate effective solutions and to adapt to specific process conditions enable us to offer equipment with the highest run factor available. Our in-house cement industry gas analysis experts are highly trained and capable of getting the most out of our Gas Analysis Technology.

### Leading process and equipment supplier to the cement industry

- Simple equipment design focused on easy maintenance
- Standardized equipment layout for common operation, maintenance and spare parts
- High-quality equipment with proven track record
- High level of process knowledge optimizes equipment utilization and adaption to process conditions
- Worldwide experience and service coverage



# PRODUCT PROGRAM

Our Gas Analysis Technology offers equipment specifically designed for pyro processing within the cement industry

## Process gas analysis

The process gas analysis program is primarily used to optimize pyro processes, thus reducing fuel consumption and optimizing production throughput. However, the equipment is also necessary to avoid process conditions which could potentially lead to production downtime and increased demand for maintenance. Further, the equipment can provide early indication of production quality issues and unwanted concentration of harmful volatiles. If process expert systems such as ECS/ProcessExpert are used for pyro control, process gas analysis equipment is necessary to provide fundamental data for the system.

**ROI: Depending on the type of production and pyro process, payback time for process analysis equipment is less than 200 days.**

*Typical components measured: O<sub>2</sub>, CO, CH<sub>4</sub>, CO<sub>2</sub>, NO, SO<sub>2</sub>  
(Others on request)*

## Safety and interlocking gas analysis

In order to provide a safe working environment on any pyro plant, potentially dangerous conditions must be monitored and safely dealt with. Failing to do so will endanger plant employees and may damage or destroy costly machinery, resulting in a long-term production shutdown. Specially designed safety equipment is therefore available, which utilizes true continuous analysis without purging periods and offers the option of redundancy. Special safety I/O's are available depending on the safety standard enforced, and direct interlocking options for process equipment is available.

**ROI: Interlocking of one potentially dangerous condition, e.g., high CO.**

*Typical components measured: O<sub>2</sub>, CO, CH<sub>4</sub>, THC  
(Others on request)*



# PRODUCT PROGRAM

## Emission gas analysis (CEMS)

Emission gas analysis is defined by local national legislation and performance standards. We are able to supply preconfigured solutions to meet European Union and US-EPA standards.

All of our solutions will be in compliance with standards and pre-approved during site testing of emission control equipment and emission analysis.

**ROI:** If the plant operating permit is based on emission values, utilization of an emission system is compulsory by law. If emission control equipment is in use, emission gas analysis can reduce operation cost, e.g., Hg abatement by activated carbon.

*Typical components measured: O<sub>2</sub>, CO, CH<sub>4</sub>, CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub>, THC, HCl, HF, NH<sub>3</sub>, H<sub>2</sub>O, Hg, Dust (PM), Opacity, Flow, Temp, Pressure (Others on request)*

## Service

A full service program is available. We offer pre-installation and commissioning services together with customer training on site or during the Factory Acceptance Test. We also highly recommend a re-training visit 1-3 months after the initial start-up, since, this has proven to be highly effective. We also offer a service contract program, named PlantLine™, which can be scheduled for gas analysis exclusively or coordinated with any other service program covering Fuller equipment. Analyzers can be repaired in our own specialized workshop, which carries a full range of spares for major brands. The turn-around time for an analyzer is guaranteed to be less than 12 days after it has been received.

The LiveConnect product provides remote preventive service and support over plant network or 3G communication. The LiveConnect setup will not jeopardize plant network safety or bridge firewalls and is fully controlled by the plant, enabling easy on/off operation where applicable. LiveConnect allows preventive maintenance and potential program updates to be handled remotely without site visits. It also supports on-line remote troubleshooting for the local maintenance organization.

## Fuller Gas Analysis program

- Full product program, covering all gas analysis applications
- Built-in process know-how
- Choose from a full range of available gas analysis components
- Integrated functionality and communication with ECS/ControlCenter™



# PYRO PROCESS GAS ANALYTICAL CONFIGURATION



**1** KILN INLET AND CALCINER EXIT



**2** PREHEATER



**3** STACK EMISSION

## We have solutions for any pyro process application

- Any non-condensing process control application up to 1400°C and 2000 g/m<sup>3</sup> of dust
- We offer the Best Available Technology (BAT) for production safety and process interlocking
- Full range of stack emission equipment capable of meeting any national or international standards or legislation
- Standard applications for Kiln Inlet, Calciner, Bypass, Preheater Exit, Stack and Coal Mill



# PROCESS ANALYSIS – BUILT FOR THE MOST DIFFICULT PROCESSES

Process conditions in the cement and minerals industries can be very harsh. Temperatures can reach up to 1400°C, and dust loads can be as high as 500-2000 g/m<sup>3</sup>. Strong and powerful equipment is required to operate in this kind of environment. Handling the temperature and dust load, however, is a well-defined engineering task which can be solved. The real challenge is the process implications and the possibility of gas condensing in the raw material. Condensing of gas in raw material may happen if, even for a short period, high concentrations of, e.g., volatiles occur in the process.

The result will be a sticky scaling on any surface exposed to the hot volatile-loaded gas. The engineering task to solve this problem is very complex, and no two pyro processes will be alike. The only two things which have proven to be certain in applying gas analysis to the cement industry are that there will from time to time be periods with unstable conditions and that during these periods any brand of probe will eventually get blocked. The question therefore is not if, but when a probe gets blocked by scaling, how do you handle it?

There are different solutions to the task available on the market. Fuller, however, is certain that the large sales success of the our KilnLoq probe is due to its simple and powerful design. Customers recognize the maintenance benefits of not having complex mechanical solutions involved such as, e.g., mechanical plungers or rotating probes.

Our probes are based on simple, strong and reliable designs. In the high temperature KilnLoq probe this can be seen in the air cannon-like One Pipe (Patented) layout of the probe. The One Pipe layout provides unmatched probe cleaning power, without any obstacle to prevent maximum cleaning effect. As it is a straight pipe, there are no material deposits or cleaning power loss in filter, pipes or bends: this allows the KilnLoq probe to be as powerful as an air cannon.

The additional benefit of this design is seen when process conditions cause the probe to block. Due to the One Pipe design, a full probe-length cleanout can be carried out in less than 2 minutes. This capability will get the probe up and running again faster than any other probe system on the market. It will also provide data to the operators in order to correct an unstable condition sooner than would otherwise be possible. Powerful air cannon-like probe cleaning keeps the number of probe blocking incidents at a minimum and allows constant supervision by monitoring the pressure in the probe during analysis.

An additional feature of the KilnLoq system is its capability to monitor potential scaling tendencies in the process and on the probe. This feature will support proactive measures by maintenance staff and operators and help keeping the process and probe system running without unnecessary production cuts.

## Fuller Process Gas Analysis systems

- Optimize production throughput and quality
- Minimise process operating cost and emissions
- Easiest and fastest full-length probe maintenance when blocked (Less than 3 min.)
- Highest probe run factor due to high-powered air cannon-like cleaning (Patented One Pipe design)
- Strong construction and simplicity of operation give long expected probe lifetime



# SAFETY – TAKE CARE OF PEOPLE AND EQUIPMENT

Given that safety is critical to any pyro process, we have developed solutions capable of handling even the toughest demands. All equipment for safety and interlocking purposes is based on a double probe layout. This allows one probe to be analysing while the other probe is being prepared to take over – enabling true continuous analysis without any blind periods.

For safety and interlocking applications only extractive analysis systems are used, since only in these systems can active sampling of live process gas can be confirmed by the active flow passing through the analyzers. We do use In Situ solutions in other applications, but not for safety and interlocking purposes. The extractive system is also very easily adapted to safety zone issues, and hot surfaces as seen on some In Situ analytical cells can be completely avoided.

## Fuller Safety and Interlocking Gas Analysis systems

- Ensures a safe working environment
- Protect equipment from damage
- Prevents production cuts
- True continuous gas analysis by double probe
- Direct machine safety interlocking interface



# EMISSION – PROTECT THE ENVIRONMENT

Emission analysis does not directly support the production of cement. However, as many cement production permits are granted based on emission limits and the implementation of on-line emission measurements, it is in the general a compulsory installation.

The emission system configuration can only be determined after a specific site evaluation in the context of the legal requirements, production permits and plant layout. Most systems are installed in the stack, and the emission application typically requires the utilization of both extractive and In Situ systems. The various analyzers are operated according to differently principles and require calibration to be effected according to specific procedures and time frames. All emission results must be reported to the authorities according to a specific normalized format, which also documents the operation and correct calibration of the analyzers. Since this task is often too demanding for the plant to handle an option for a plug-and-play solution has been developed.

This solution comes in a pre-built on-site unit housing the GASloq CUBE, which handles all needed analysis equipment through one common HMI interface. This setup will take care of the correct handling and operation of all the analytical equipment. This solution can further be extended with a reporting package, called ECS/StackGuide. This application collects all data in a normalized format according to equipment configuration in order to accumulate emission reports based on any averaged time span required.

The ECS/StackGuide can also provide full integration into the ECS/Control system, if installed, which expands the potential use of emission data even further. If a calibration routine is required as a part of a performance standard for the analysis system, the same HMI based system will be able to control and document the process.



## Fuller Emission Gas Analysis systems

- Guarantee compliance with national standards and plant permits
- Include all required gas analysis emission components to be measured
- Provide one common easily operated interface for all analyzers
- Plug-&-play solution for easy compliance and installation
- Fully compliant and integrated ECS/StackGuide solution for emission reporting
- Full program of dust, flow pressure and temperature measurements to normalize the emission analysis

# PROBE SYSTEMS

**KilnLoq™:** The workhorse of our process gas analysis program. Used for the most demanding process conditions.

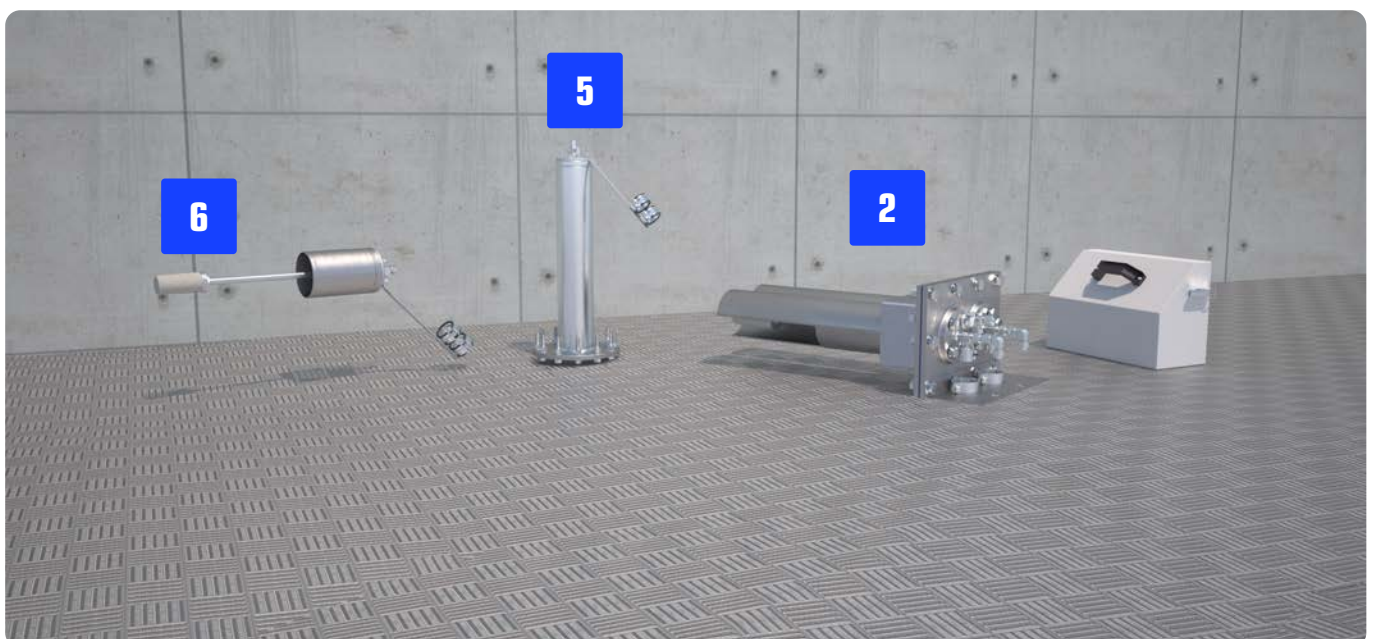
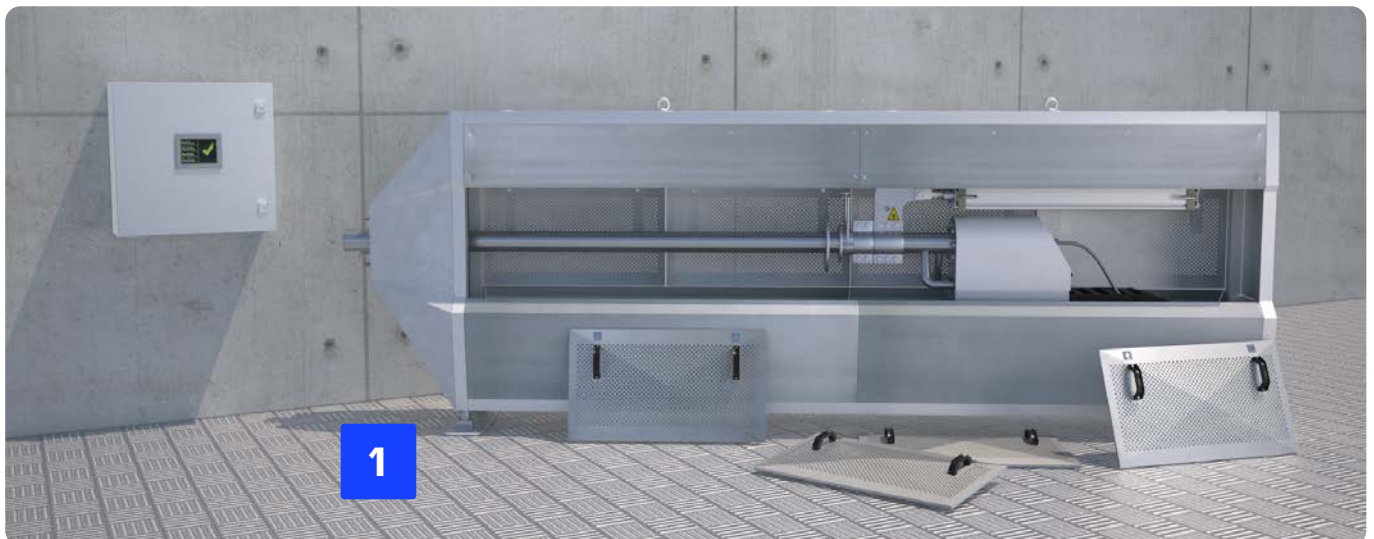
Because of the patented One Pipe design the probe can handle extreme scaling. Typical usage is in kiln inlets, calciner exits, hot bypasses, dryers and scarf kilns.

**SDOP/DDOP:** The probe is capable of single or dual configuration in order to match specified safety level and requirements for true continuous safety gas analysis. Typical usage in preheater exit or wet process kiln smoke chamber.

**FastLoq™ (Patent Pending):** Ultra-fast extractive probe, sample and analysis system based on diode laser technology. Response time less than 5 sec. Typical usage in preheater exit, minerals dryer kiln inlet.

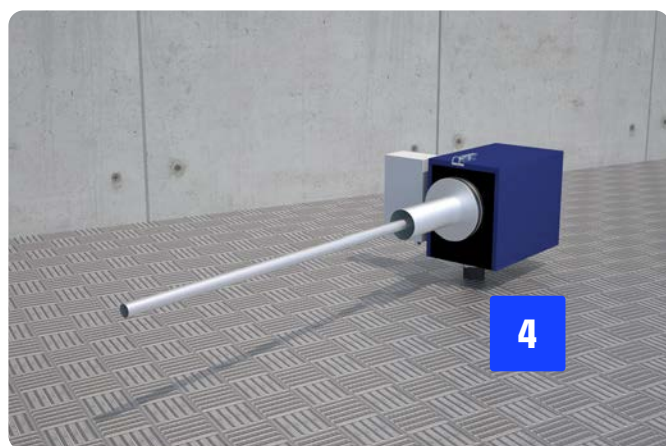
**SP2000:** Standard probe configured according to application. Typically used for emission measurements.

**SDSP/SDFP:** Specially designed for use in coal mill applications, e.g., filter and silo/bin measurements.



### Fuller Gas Analysis Probes

- Designed for optimum performance in the cement and minerals industries
- Layout based on a simple, strong and reliable design for easy maintenance and high run factor
- High-quality materials result in long expected lifetime
- Full range of probes for all applications



PROBE SYSTEMS						
	PROCESS TEMP. RANGE	DUST LOAD	PROBE INSERTION LENGTH	PROBE COOLING/ EXTRACTION DEVICE	PROBE HEATING	PROBE PURGING
1. KilnLoq HT	500-1400°C 930-2550°F	0-2000 g/m <sup>3</sup>	1000/2000/3000mm 39"/79"/118"	Yes/Yes	Yes	Yes
1. KilnLoq LT	0-500°C 32-930°F	0-2000 g/m <sup>3</sup>	1000/2000/3000mm 39"/79"/118"	No/(Yes)	Yes	Yes
2. SDOP/DDOP	0-500°C 32-930°F	0-400 g/m <sup>3</sup>	600mm 23"	No/No	No	Yes
3. FastLoq	0-500°C 32-930°F	0-400 g/m <sup>3</sup>	1000mm 39"	No/No	No	(Yes)
4. SP2000	0-500°C 32-930°F	0-400 g/m <sup>3</sup>	1000mm 39"	No/No	(Yes)	(Yes)
5. SDSP	0-200°C 32-400°F	0-2 g/m <sup>3</sup>	630mm 24"	No/No	No	(No)
6. SDFP	0-200°C 32-400°F	0-2 g/m <sup>3</sup>	230mm 9"	No/No	No	(No)

# GAS CONDITIONING – GASLOQ

The two GASloq™ gas conditioning system variations are designed to cover the demand for basic gas analysis (GASloq 600) and for more complex gas analysis tasks (GASloq 1200). Both systems have a standardized default configuration, which can be extended to integrate additional demand for analysis or connected utility equipment. Both systems can be supplied integrated into the GASloq CUBE site housing for plug-&-play installation on site.

The GASloq 600 and 1200 cabinets contains all equipment for gas analysis conditioning, electrical components, Industrial controller for system operation and external communication. From the GASloq cabinet the gas analytical system is operated via a HMI interface.

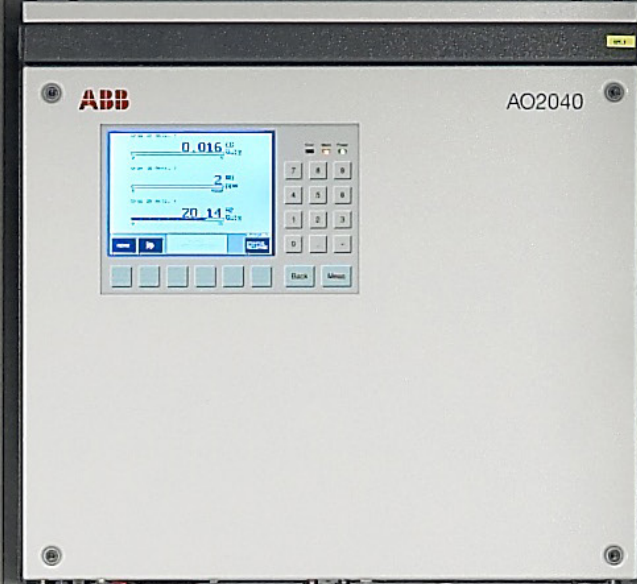
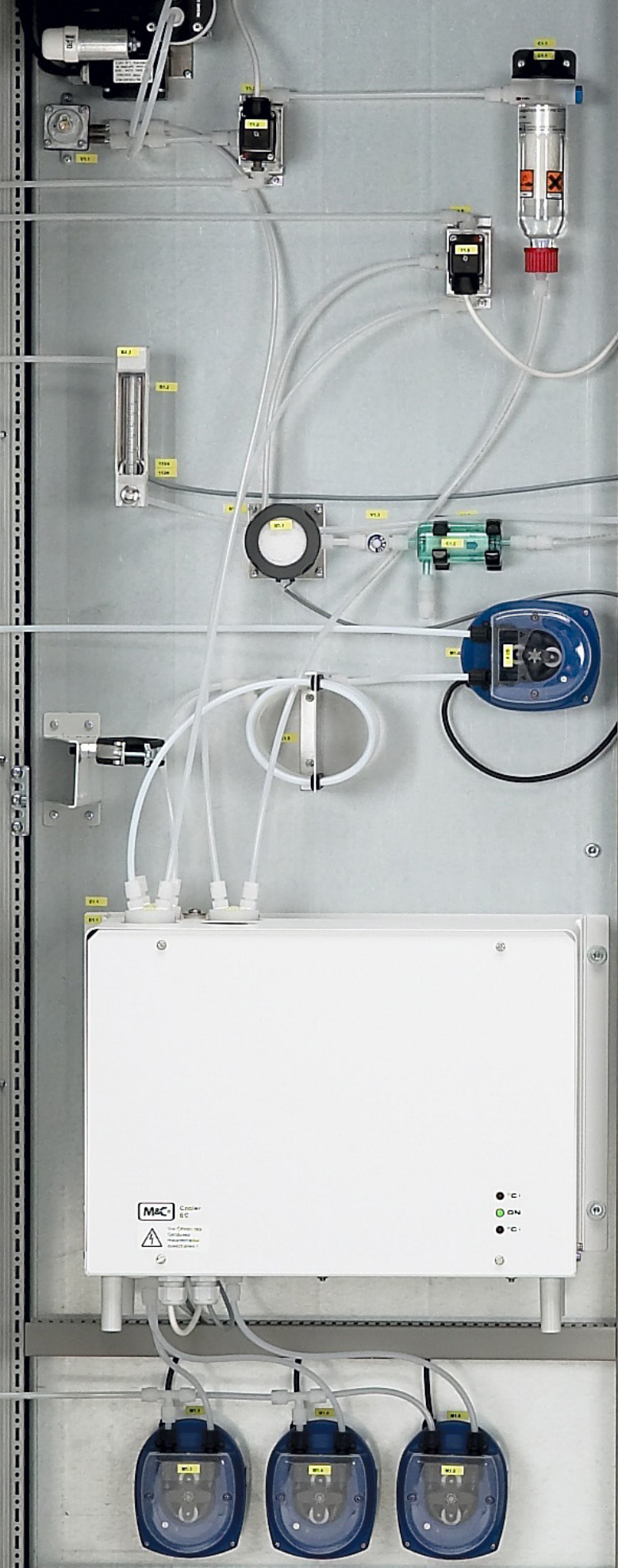
The gas conditioning components of the systems will be identical for almost all parts regardless of application. This means that for any given application where a GASloq 600 is used the gas pump or the cooler will always be identical in other applications where this system is used. The same goes for the GASloq 1200 cabinet. This reduces the need for storing spare part components since the same part can be used in several systems.

Basic operation and functionality for a GASloq 1200 will be identical for any GASloq 1200 system regardless of application. The same goes for the GASloq 600 system. This makes training of site personnel much easier and reduces the amount of time used for operation – because if you are capable of operating one GASloq system you are able to operate any other GASloq system.

Gas conditioning is offered in a range of different configurations. The standard is cold dry extractive analysis at 5°C. If sulphur gas content presents a potential problem, optional peroxide dosing can be added. For applications with high sulphur gas content where SO<sub>2</sub> is required for analysis a super chiller in the gas conditioning system to cool the gases down to -30°C.

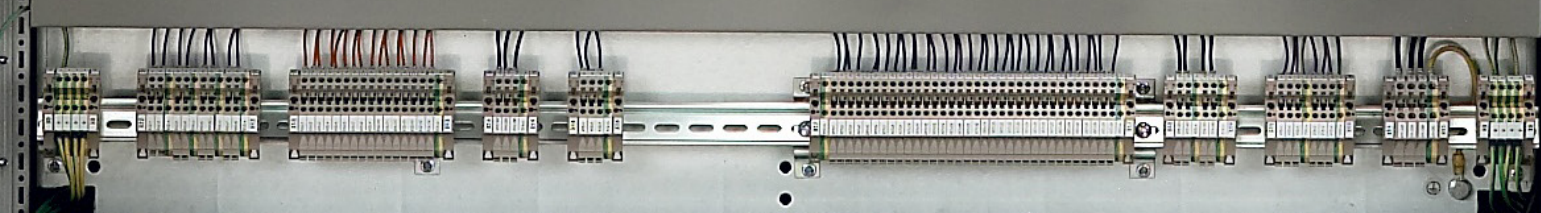
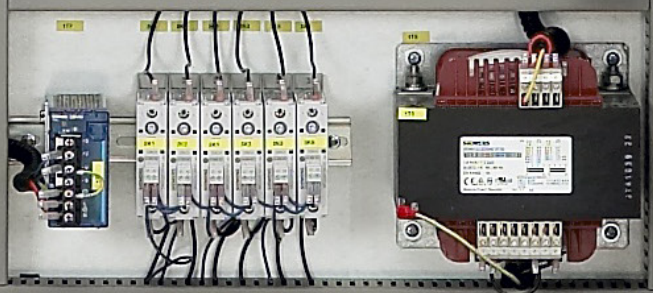
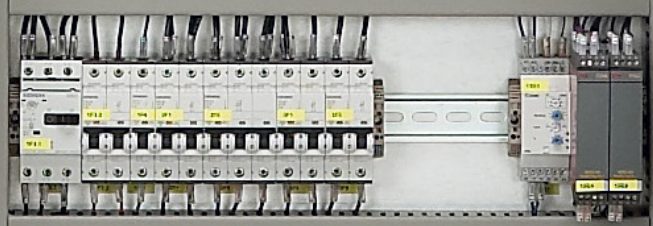


GAS CONDITIONING SYSTEM				
	CABINET (WXHXD)	AMBIENT TEMPERATURE (INDOOR, NO DUST/ VIBRATION)	CONTROLLER/ COMMUNICATION	GAS CONDITION OPTIONS
GASloq 600	600x2100x600mm 47"x83"x24"	5-35°C 41-95°F	Industrial control /3G Wireless Hard wire com.	- Cold/Dry 5°C gas conditioning
GASloq 1200	1200x2100x600mm 47"x83"x24"	5-35°C 41-95°F	Industrial controller/ TCP/IP, Profibus, Modbus, Fiber switch, 3G wireless Hard wire com.	- Cold/Dry 5°C gas conditioning - Peroxide dosing - Cold/Dry -30°C gas conditioning - Hot/Wet 192°C gas conditioning



### Fuller Gas Analysis GASloq systems

- High and low-end solutions for process and price adaption
- Built-in process knowledge increases run factor
- All solutions are built on the same platform for easy training and operation and common spares
- Optional LiveConnect remote service hardware for on-site support
- Offer various external communication standards such as Profibus, TCP/IP, ModBus to match plant control system platform



# PLUG-&-PLAY SITE HOUSING – GASLOQ CUBE:

GASloq CUBE site housing is a solution providing faster installation, ideal working conditions and optimized installation of the gas analytical equipment. GASloq CUBE Type N & L can be shipped directly to site, since it fits the size of a standard CSC container. GASloq CUBE Type 20' CSC is the site housing

built into a standard CSC 20' steel container. All gas analysis components are placed on the wall allowing easy maintenance. Test gas arrangement can be configured inside or outside the CUBE.



CUBES			
	[WXHXD]	AMBIENT TEMP. RANGE	AC AND HEATING
1. GASloq CUBE Type N	1800x2200x2200mm 70"x87"x87"	-20°C/ 45°C -4°C/ 113°F	Yes
2. GASloq CUBE Type L	2200x2200x3600mm 87"x87"x142"	-20°C/ 45°C -4°C/ 113°F	Yes
3. GASloq CUBE Type 20' CSC	2300x2300x6000mm 90"x90"x236"	-20°C/ 45°C -4°C/ 113°F	Yes

## Fuller Gas Analysis GASloq CUBE site housing

- Plug-&-play reduces civil construction work commissioning time
- Premade site housing GASloq CUBE provides best possible ambient conditions for analysis system
- Wall-mounted components for best serviceability and access
- Gas detection system installed for high personal safety



# ANALYZERS

We do not produce our own gas analyzer units. We make the gas analysis solutions capable of efficient operation in the most difficult process conditions encountered – the cement industry. As an independent supplier, we select the best analyzer for the job, e.g., ABB, Durag, MKS, NEO, Siemens and others. The best analyzer will be defined based on various aspects depending on the specific customer, the application in question and the potential preferences of the end user.

Also we are able to determine if the best analyzer will be based on the extractive or the In Situ method. As we are independent, you will not end up with the second-best analyzer just because we don't have the best model in our program.

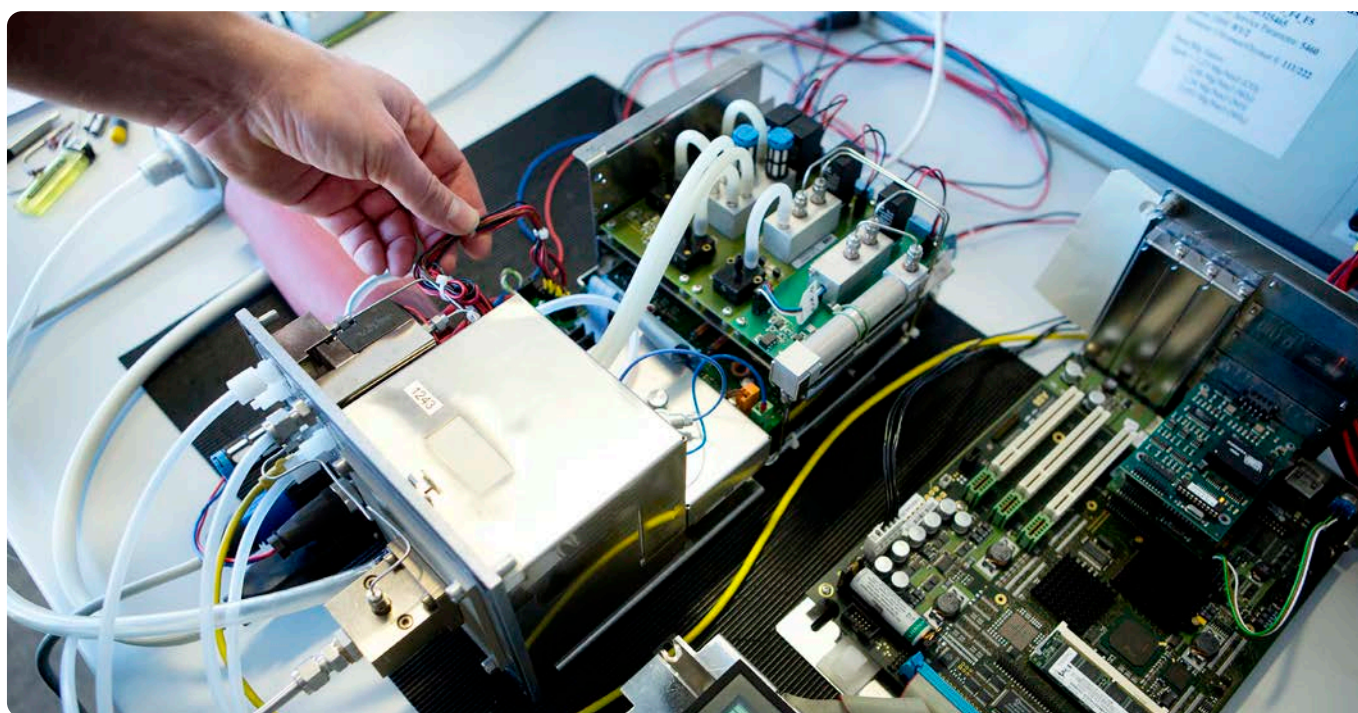
The most common gas analysis components measured are:

**Oxygen (O<sub>2</sub>)** is typically measured by electrochemical or paramagnetic analyzers. Oxygen is the most valuable measurement in connection with process measurement in pyro processes. Oxygen will allow the operators to optimize full consumption and reduce the emission footprint of the process. Oxygen analysis will also enable a more stable operation and thereby allow full production throughput. In emission analysis oxygen is also measured and used as a reference in connection with normalization. Finally oxygen is used to detect gas analysis system leakage integrity.

**Coal Monoxide (CO)** analysis is used in process analysis as an early warning of imbalance in a combustion process. The CO signal is used to interlock process operation in situation where the concentration reaches a critical level. In stack emission analysis requirements CO is normal. Finally CO is measured as a warning against self ignition in coal processing equipment and storage silos. The concentration of CO is measured by Infrared based analyzers.

**Nitro monoxide (NO)** and NO<sub>x</sub> is measured in process analysis as an indicator of the pyro process temperature development. NO<sub>x</sub> is also part of the most common emission gas analysis requirements. There are many different analyzers available for NO or NO<sub>x</sub> analysis. For process analysis normally only NO is required as this will be the dominant component of the NO<sub>x</sub> found in a given process. The concentration of NO and NO<sub>x</sub> is measured by Infrared, ultraviolet or chemiluminescence based analyzers.

**Sulfur Dioxide (SO<sub>2</sub>)** is a pyro process indicator of recirculation of volatiles in a given process. This is a very rewarding measurement in cement where it will identify any periods of increased risk of material buildup. In stack emission analysis requirements SO<sub>2</sub> is normal. The concentration of SO<sub>2</sub> is measured by infrared or ultraviolet measurement depending on concentration.



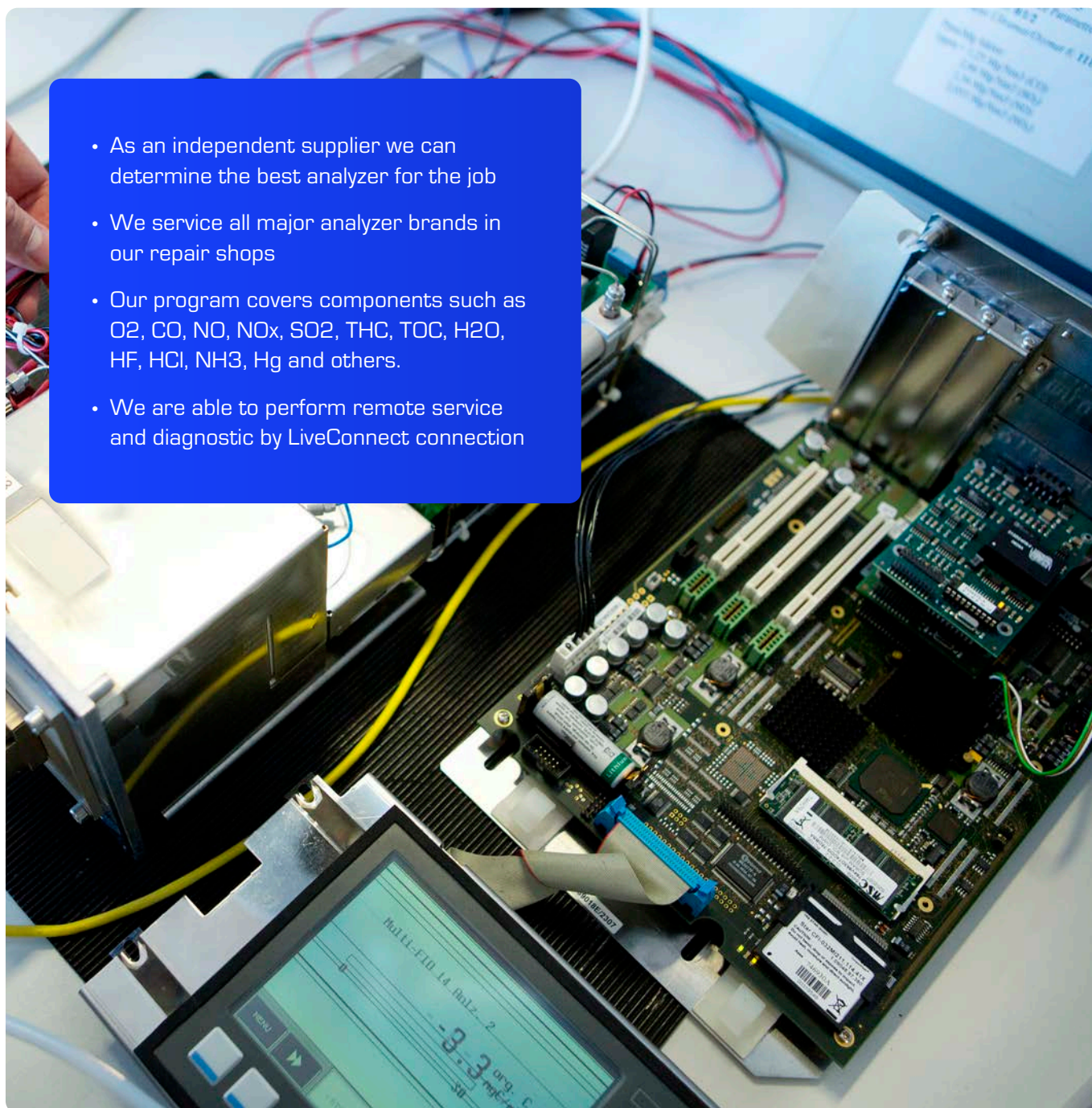
**NH<sub>3</sub>, HCl, HF** are all emission measurements. The concentrations of the gasses are often very low and the nature of the gas makes them difficult to analyze correctly. This demands for special analyzer configurations which not only takes the expected level into consideration but also local legislative demands. Often these components are measured by diode lasers or FTIR based analyzers.

**Total Hydro Carbons** measured as THC or TOC are commonly measured in pyro processes if waste burning is involved. The measurement method is typical Flame Ionization Detection (FID)

**Dust** is an emission measurement. The measurement is normally conducted In Situ in processes which are not condensing. The most common technologies are scattered light or cross duct opacity technologies. The choice of technology is based on legislation and expected dust concentration level.

**Mercury (Hg)** is analyzed as elementary mercury. This is measured when required by emission legislation. We are able to supply units measuring continually and online with specification of the oxidized part of the total Hg level. on concentration.

- As an independent supplier we can determine the best analyzer for the job
- We service all major analyzer brands in our repair shops
- Our program covers components such as O<sub>2</sub>, CO, NO, NO<sub>x</sub>, SO<sub>2</sub>, THC, TOC, H<sub>2</sub>O, HF, HCl, NH<sub>3</sub>, Hg and others.
- We are able to perform remote service and diagnostic by LiveConnect connection



# WE WILL MAKE IT HAPPEN



We are aware of the fact that choosing your supplier for your gas analysis needs is difficult. Many decisions based on evaluation of equipment - which is difficult to compare fully - is involved.

We have a complete range of products covering almost any pyro process application within the cement industry. With our strong track record we have accumulated a substantial knowledge base in our organization covering all aspects of production from raw material to final product. Our specialized gas analysis group will be more than happy to offer our gas analysis solutions and provide access to the entire Fuller organization in order to provide you the solution which offers the best benefit for your overall production goals.

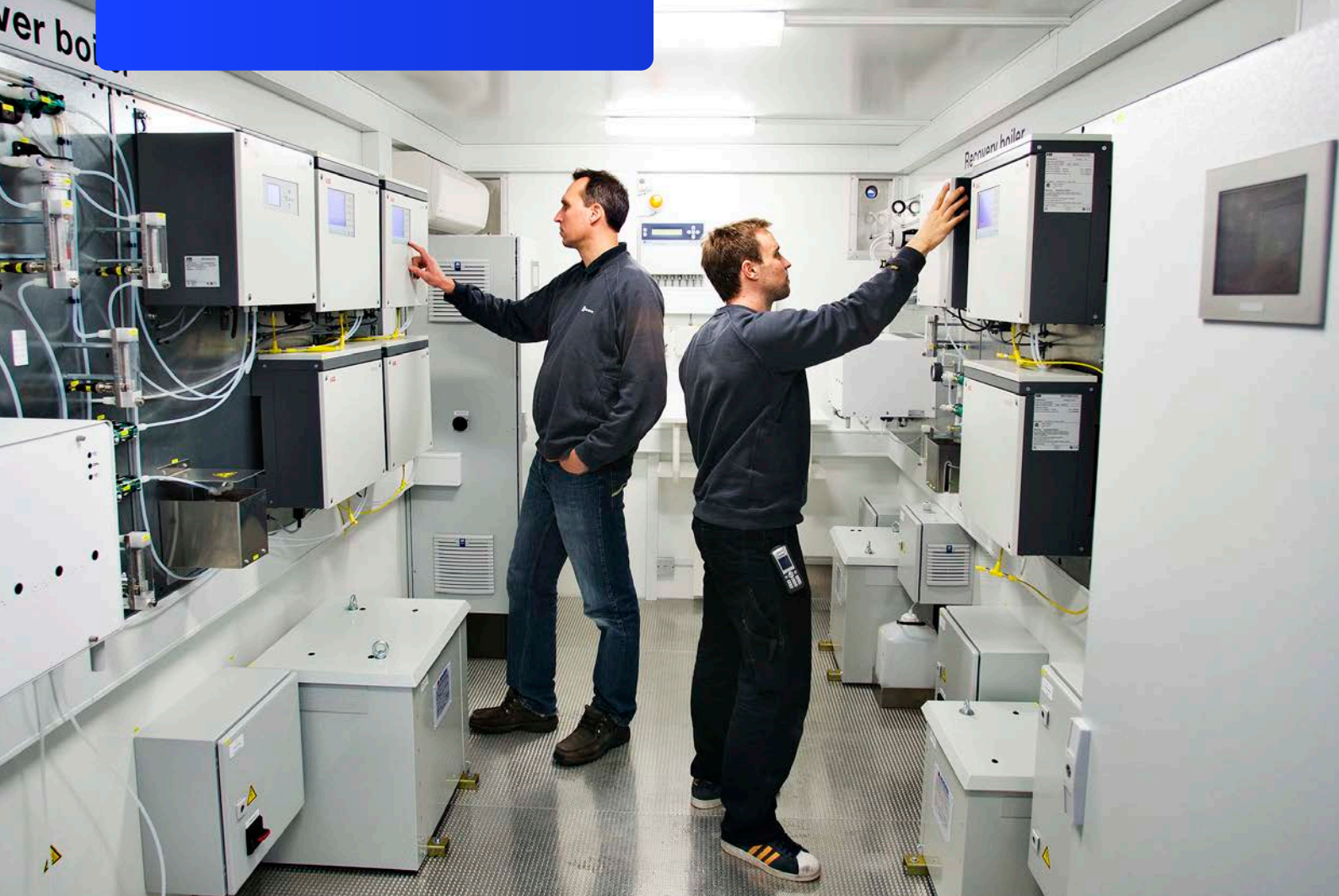
As an independent analyzer supplier with our own highly specialized gas analysis program we are not limited in choosing the best analyzer for the job. And as the only supplier of gas analysis solutions we originate from the cement and minerals industry. Our solutions are made for the cement industry. We know what it takes to get gas analysis to work in real life and we will make it happen if you choose us as your supplier.



**For more information, please contact  
gas@fuller.com**

Whatever your cement industry gas analysis needs may be, We have the experience and equipment to help.

Our experienced specialists can help you devise exactly the right solution for your plant. And our spares department and service and training experts offer a complete range of support.



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