

# Modern calibration gas supply systems for low emission-applications

By Jens Asmuth

The new EURO III/IV and ULEV/S-ULEV exhaust gas regulations also affect the concept of operating and calibration gas supply systems to a great extent. In order to transfer low calibration or span gas concentrations in the lower ppm level from the gas cylinder to the analyser without changes in concentration, the gas supply system must fulfil certain minimum requirements. Hale Hamilton has reacted to the future demands on exhaust measuring techniques by developing a new test gas supply concept for exhaust measurement as a turnkey solution.

## 1 Technical safety requirements for gas installations

The Technische Richtlinien Gase (TRG 280) (technical gas regulations) which control the storage and operation of pressurised gas systems in Germany serve as a basis for the technical safety regulations for the installation of central operating and calibration gas supply systems. Often, customer demands are in conflict with the surrounding conditions such as separation distances for flammable and fire accelerating gases or the necessary ventilation measures with temperature control at 15°C for test gases.

It is therefore necessary to take safety regulations into consideration during the construction phase, as safety measures such as the installation of special gas safety cabinets according to DIN 12925, Part 2, or of complete gas supply containers may otherwise be necessary later. Furthermore, special concepts must be developed to ensure correct ventilation and flame-proof safety measures which meet existing safety requirements. Other additional demands

such as those of the employer's liability insurance association, works fire brigade, etc., for such items as gas emergency shut-down systems or gas warning systems must also be included during planning.

Here are some of the most important points:

- a safety distance of 2m must be kept between flammable and fire accelerating gases
- no ignition sources in the gas storage zone (fireproof zone)
- storage rooms in buildings must be ventilated and fire resistant
- no pressurised gas cylinders in working rooms or below ground level
- protection against gas cylinder damage
- emergency shut-down for flammable and fire accelerating gases.

## 2 Choice of material

Another important point for the installation of calibration gas supply systems is the correct choice of material for the appropriate gases.

In recent years there has been a clear tendency to use stainless steel valves and pipes for all gases, which means a high degree of flexibility when connecting the various gas media for the system. In other words, the standard use of stainless steel makes it possible to use all types of gases in the system without material compatibility problems.

If low calibration gas concentrations are used, there is also a demand for different

surface finishes for the various gas supply systems. This is where the Hale Hamilton concept excels, **Figure 1**. In order to guarantee low calibration gas concentrations right up to the analyser, all components in the gas stream must be made of stainless steel and have the best possible surface finish (electro-polished). The dead volume of the pipes and components is also an important quality factor.

Therefore, not only the pipes but also the components must be produced as an electro-polished version in order to minimise the adsorption of the gases.

The manufacture of the regulators and valves as a springless system reduces the adsorption and desorption of the low emission gases. Special treatment in order to build up an oxide layer after electropolishing reduces the decay of NO<sub>x</sub> gases for example on the inside surfaces of the pipes.

The normal Teflon pipes are also a further large area of diffusion.

Tests have shown that, over a length of 1m of Teflon pipe at a pressure of 5 bar, up to 13ppm of oxygen diffuse into the respective medium. Therefore, it can be assumed that Teflon pipes are not suitable for low test gas concentrations.

The solution is to use flexible stainless steel capillary pipes of 1/8" diameter, and short lengths of these can also be produced in an electro-polished version.

## 3 Minimisation of dead volumes and potential leaks

The right choice of components (high-purity stainless steel components) is a decisive factor for ensuring that the system is leak-proof. Only metal-to-metal sealed pressure regulators and diaphragm valves have the necessary low dead volume and leak rate of 1 x 10<sup>-9</sup> mbar 1/sec helium, measured using a mass spectrometer.

The additional internal electro-polishing of the components guarantees that the surfaces meet the requirement of avoiding adsorption as mentioned above.

You will find the figures mentioned in this article in the German issue of MTZ 7-8/2000 beginning on page xxx.

**Moderne Kalibriergasversorgungsanlagen für Low Emission-Anwendungen**

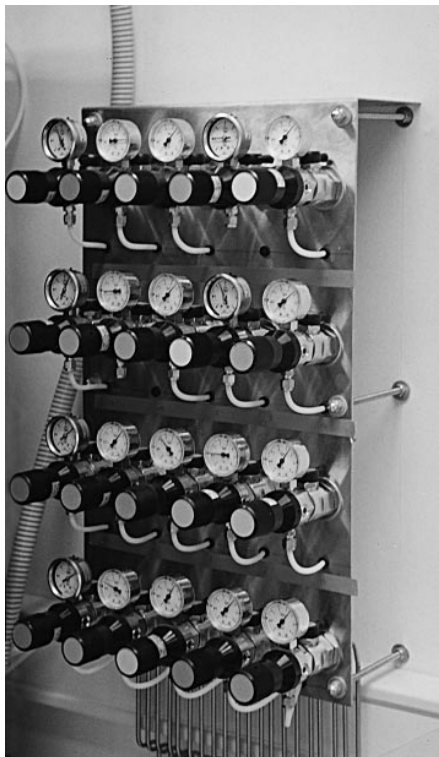


Figure 1: Sampling of calibration gas in the control room

The use of orbitally welded joints along the pipe installation ensures that the optimum performance is achieved with respect to leak rates. This in turn allows longer pipe runs to be installed. Other types of connection should be minimised. The main aim must, however, always be to keep the pipe system as short as possible in order to minimise the dead volume

Together with the principle of producing a gas supply system with the smallest possible pipe system, the adsorption and desorption of  $\text{NO}_x$ , CO and THC gases in particular can be avoided to a great extent.

#### 4 Automation of supply systems

Another important point in the low emission concept is the automation of the system.

In the age of computers, it is only a matter of time before calibration gas supply systems can be automated at an acceptable price, especially as only limited test stand personnel are instructed in the operation of gas supply systems and most equipment on the test stand is already computer based.

Many test stand operators are familiar with

the problem that, with regard to ISO 9000, the monitoring of the delivered and used gases can only be carried out manually, which makes it difficult to track down concentration changes.

The advantages of a gas monitoring system are as follows:

- increased operational and system safety
- optimisation of work processes
- reduced operating costs
- permanent monitoring by network or online via the Internet.

Furthermore, the operators of test stands or other important departments should in future be able to refer to present or past parameters of the system, such as gas usage, operating times and gas supply cycles.

For this purpose, Hale Hamilton has developed gas monitoring software with which the gas supply system can be monitored on the Windows NT user level in the network and which includes gas management for the monitoring of gas consumption, **Figure 2**.

Together with the appropriate sensor-controlled regulator stations and supply panels, the following parameters can be called up and monitored:

- pressure-sensor monitoring of gas cylinders, pipes and supply points
- automatic purging processes via pneumatic or solenoid valves
- automatic system purging
- monitoring of gas consumption by sensors and automatic e-mail order processing after a gas alarm
- statistical evaluation of gas consumption
- automatic pressure test for safety reasons
- emergency shut-down functions
- permanent running control also via the Internet
- online service support.

It is essential that these requirements are taken into consideration when planning a modern operating and calibration gas supply system on a low emission basis and that a fully qualified company carries out the installation.

The main criteria when choosing a qualified company are:

- good references from companies for existing systems
- special department for planning and developing calibration gas supply systems
- installation personnel with proof of nec-

essary qualifications

- necessary equipment: orbital welding machine, leak tester in a high-purity version
- quality safety certificate (ISO 9000, 3.1b material certificate, etc.)
- test protocols of systems already installed.

Appropriate testing and documentation of the system guarantee that future measuring standards can also be met and that the supply system remains future-orientated.