

Oxygen – Component of the air that we breathe and a dangerous substance!

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The air that we breathe contains 78% by volume of nitrogen, 21% by volume of oxygen and approximately 1% by volume of argon. The concentration of oxygen in the air is essential for human respiration and results in the positive image we have of oxygen.

Contrary to these positive images, however, oxygen concentrations above 21% can lead to hazards for humans. In many areas of industry and medicine, where technical or high-purity oxygen is being used, serious accidents associated with oxygen can occur. Oxygen is non-flammable but it is a fire promoter and thus a hazardous substance.

Material selection is important

In oxygen valves, pipe-lines and other plant components the selection of both non-metallic and metallic materials suitable for use in oxygen along with their proper handling are important issues from a safety viewpoint. Contaminants such as oils, fats or organic particles and the use of unsuitable materials must be avoided otherwise these can be ignited by, for example, pressure surges or very high flow velocities.

Due to the high oxygen concentration these reactions can lead to life-threatening burn-outs of the valves and other components.

Tests in accordance with existing technical standards regarding the suitability for oxygen applications are required for non-metallic materials used in oxygen valves, components or pipe lines. This includes sealing materials such as gland packings and gaskets as well as complete valves, hoses and components.

When considering any material for use in oxygen service the actual working duty and pattern of use must be taken into account as well as the maximum operating parameters (temperature and pressure) of the application. Where appropriate, these tests can also take into account use in liquid oxygen (LOX).



Such tests are carried out, for example, by the German Bundesanstalt für Materialforschung und -prüfung (BAM) in Berlin or commercial laboratories such as Wendell Hull & Associates USA.

The results summarized in the test report contain information about the maximum operating pressure and temperature for safe usage in compressed oxygen gas as well as information regarding use in liquid oxygen.

The results relate exclusively to the specific batch of the respective sample material or pattern used. **Such a test report is not an approval, no certificate and no license are issued.**

Valve manufacturers are recommended to test their complete valves or components at institutes such as those mentioned

above. Only then can the whole system be assessed in terms of safety for the intended oxygen application.

Information is key

End users must ensure for their part, that the gasket manufacturers and packing braiders are explicitly informed about the intended oxygen application during the order process and that the gland packings and gaskets are handled as carefully as is possible by the production processes of the manufacturers.

It is also their responsibility to check whether the present safety assessment (e.g. BAM test report) meets the requirements of the end user or operator. Usually gland packings and gaskets for oxygen use are separately manufactured



Flange severely damaged by ignition in oxygen.



Packing ring under UV light showing particulate contamination – a potential source of ignition.

(free from oil and grease), checked and individually packaged under special precautions. This information must be indicated on the package (e.g. imprint, label etc.).

In order to ensure the safety and availability of oxygen service valves and components a closed chain must be created starting from the production of the materials through their further processing into components (e.g. gland packings, gaskets etc.), safety assessment and ending with the assembly and usage in the plant.

The production processes and test procedures currently differ significantly from manufacturer to manufacturer as does the handling of this issue by the end users. In fact, there are no standards or rules available, which regulate this process unequivocally, except for the national and international standards specifying the test procedures for the safety assessment of materials, valves and components.

To remedy this unacceptable state of affairs, working groups with participants from packing and gasket manufacturers have already been formed including end-user participants (e.g. LINDE Engineering).

In the field of safety and environmental protection a significantly increased awareness needs to be created of the dangers of industrial oxygen applications. This includes careful selection of gland packings and gaskets to ensure the implementation of Best Available Techniques (BAT).

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