

SUMMARY

We speak of a vacuum when pressures are lower than the surrounding pressure (negative pressure). In certain cases, these situations can cause risks such as overheating, overpressure and backfilling. If the right precautions are taken, these risks are reduced to nil.

OBJECTIVE

The purpose of this protocol is to provide guidelines in order to work with vacuum in a safe and controlled manner.

LEGAL FRAMEWORK

Working with pressure is arranged in the 'guidelines on Pressure equipment', directive 97/23/EG (PED).

RISKS

- Overheating of electrical components due to decreased heat dissipation in a vacuum.
- Overpressure when the vacuum chamber is heated (stoking up, for example).
- Overpressure resulting from the application of cryogenic fluids such as liquid nitrogen, liquid helium and the like, due to the chance of leakages.
When applying, for example, liquid hydrogen, extra security measures are, of course, required.
- Overpressure due to a chemical reaction.
- Overpressure due to failure to connect the vacuum pump properly.
- So-called 'backfilling' of the system due to gas supplied from a gas cylinder.
- Pumping harmful gases. The effects of the pumped gases on the oils in the vacuum pump have to be taken into account as well.

VACUUM

a vacuum when pressures are lower than the surrounding pressure. (negative pressure).

DEFINITION OF A VACUUM SYSTEM

A vacuum system consists of, among other things, a vacuum chamber, piping, a vacuum pump and measuring equipment. The pressures present are expressed in bar.

Vacuum chamber with negative pressure

Pressures lower than the surrounding pressure. Minimal overpressure (<0.1 bar) may be allowed in case of flushing upon opening the system to the surrounding pressure.

Negative pressure vacuum systems are required to be secured with an overpressure security mechanism in case there is a chance of overpressure due to the construction.

Vacuum chamber with positive pressure

When there are pressures higher than the surrounding pressure (> 0.5 bar overpressure), the set-up will be defined as a pressure room with vacuum option. If this is the case, the set-up has to comply with the 'guidelines on Pressure equipment', pressure equipment directive 97/23/EG (PED).

OVERPRESSURE

Though standard components are sometimes designed for pressures up to 10 bar, components such as valves are often only able to manage a differential pressure of about 1 bar. Vacuum pumps work with a maximum starting pressure of about 1.5 bar. If there is a chance of overpressure, it is required to build in a security mechanism.

There are various methods to do so:

- Blind flange without a clamp. Keeping it in place by means of weights or holding it for a short when starting to create the vacuum.
- Standard valves with spring protection.
- Burst valve. High vacuum seal with safety glass. Single use only.

Guidelines

- Use standard components of well-established suppliers.
- With brittle components or undefined materials, use a screen.
- For windows, glass components, plexiglass chambers and the like, only use standard components and where necessary, apply splinter protection.
- If components are personally designed, you are required to make extensive calculations with a 'sufficient' safety factor.
- When overpressure cannot be ruled out completely, you are obliged to install a pressure release fitting on the system. This is usually a breaking plate with a breaking section of 0.6 - 0.8 bar.
- Use personal protection equipment (such as safety goggles / face protection).