Press Release

O-RING
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RICHTER

23.01.2017

Extended testing possibilities:
CO_2 immersion at elevated temperatures

The effects of carbon dioxide on elastomer seals and other materials in the refrigeration circuit are of increasing interest to manufacturers and users of air conditioning technology. The Richter O-ring test laboratory also offers storage in carbon dioxide at elevated temperatures. Test temperatures up to 180°C and pressures up to 200 bar are possible.

The damaging effect of chlorofluorocarbons (CFCs) on the ozone layer in the stratosphere was recognised as early as 1974. Until then, CFCs were the preferred agent for chillers, but were also used as propellants for aerosol cans. The discovery of the hole in the ozone layer in the early 1980s led to a change in thinking, which resulted in a complete ban on CFCs in the Montreal Protocol of 1987. Refrigerant alternatives quickly had to be sought. Although fluorocarbons such as R134a no longer had an ozone depletion potential (ODP = 0), their global warming potential (GWP) was still relatively high (> 1000). The GWP value provides information on the global warming potential of a substance in relation to the global warming potential of CO_2. CO2 has a GWP value of 1.

Since 2011, an EU directive has banned the use of HFCs with a GWP value > 150 in air conditioning systems of all new vehicle types registered in the EU.

In October 2016, 200 countries further agreed to phase down the use of HFCs with high GWP, more developed countries by 85% from 2019 to 2036, emerging countries by 80 to 85% from 2024 to 2047. The next generation of refrigerants, such as R1234yf (HFOs), meet this requirement.

Although they no longer have any ozone depletion potential and a low GWP value, they are increasingly controversial in terms of safety, especially in the automotive sector, due to their flammability and the possible formation of highly toxic hydrofluoric acid.

Therefore, there is a clearly recognisable trend towards CO_2 (R744) as a refrigerant. However, this is technically very challenging, as high system pressures and special sealing elements are required in the refrigeration systems. The functionality and reliability of seals is of particular importance here.

CO_2 immersion tests at room temperature and pressures of less than 50 bar have been carried out in Großbottwar since 2001. The filling quantity was defined by weight. Since there is a gas and liquid phase in the pressure vessels developed in-house, the test specimens can be tested in one of the respective phases by positioning them differently.

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The test specimens are stored in accordance with DIN ISO 1817. In addition, there are special internal test instructions. These also include the experience of many years in order to determine the actual effects of the carbon dioxide on the seal and not to create damage patterns, such as explosive decompression, which can occur if the gas relaxes too quickly after the test. After immersion, the test specimens are subject to further tests, such as hardness, density, tensile test, etc., for which the Richter O-ring test laboratory is accredited. A uniform test instruction is in progress at the laboratories working with CO2 (R744).

By autumn 2016, Berghof Products + Instruments GmbH from Eningen had procured five high-pressure autoclaves, which are now available to our customers for a wide range of elastomer tests in CO_2. One of the autoclaves is equipped with a pressure and temperature sensor so that it can be used as a reference in certain cases to additionally safeguard the test sequence. A special alarm and extraction system for CO2 ensures the safety of the employees.

Likewise, storage in CO_2-oil mixtures in accordance with customer specifications is usually carried out in a 1:1 ratio.

Figure 1: CO_2 high-pressure autoclave in an open convection oven

Figure 2: CO_2 high-pressure autoclave, in the picture a version without temperature and pressure sensor

Figure 2: Workplace with CO_2 high-pressure autoclave with pressure and temperature sensors for continuous recording of these parameters. The autoclave is located in a controlled heating block.

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