In the name of research

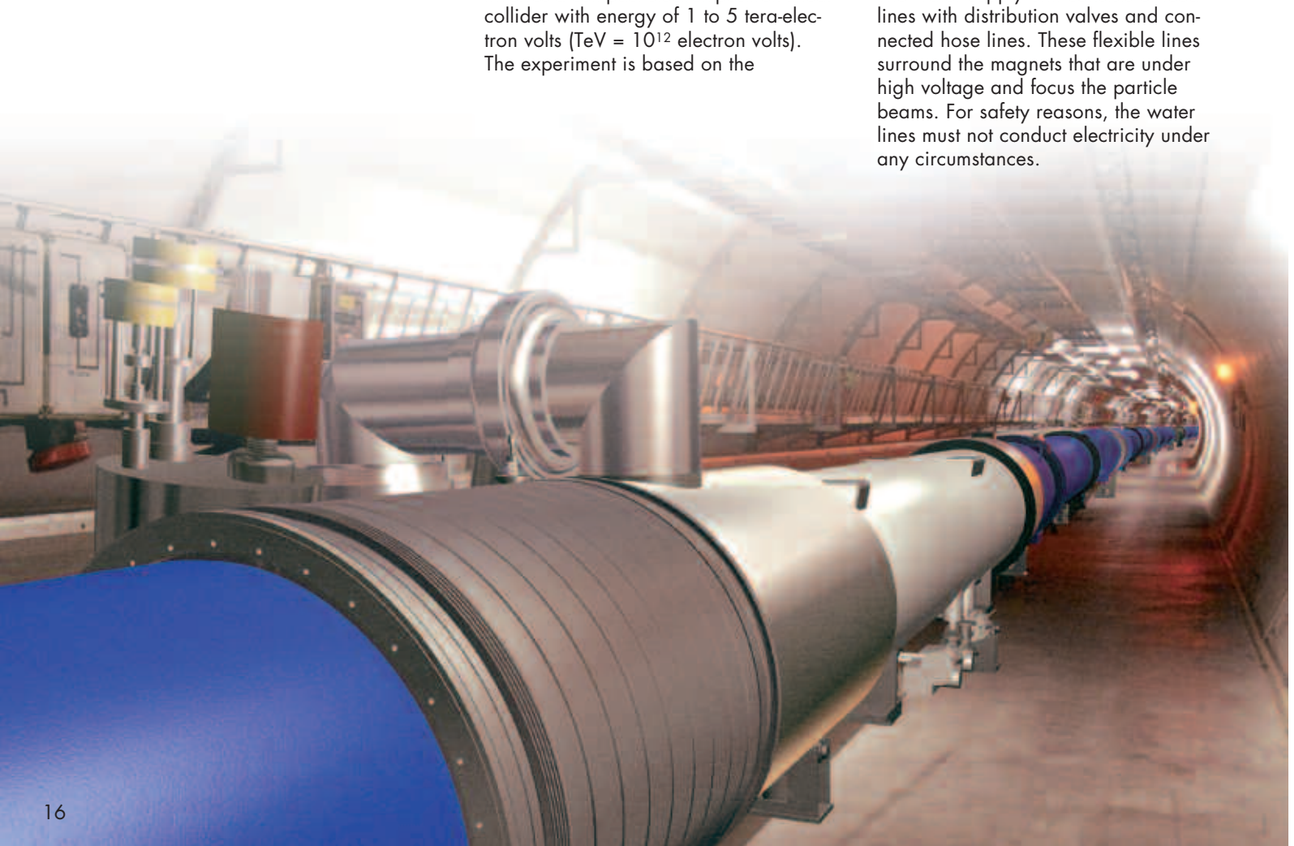
Jacques Vaudroz, Product Application Engineer

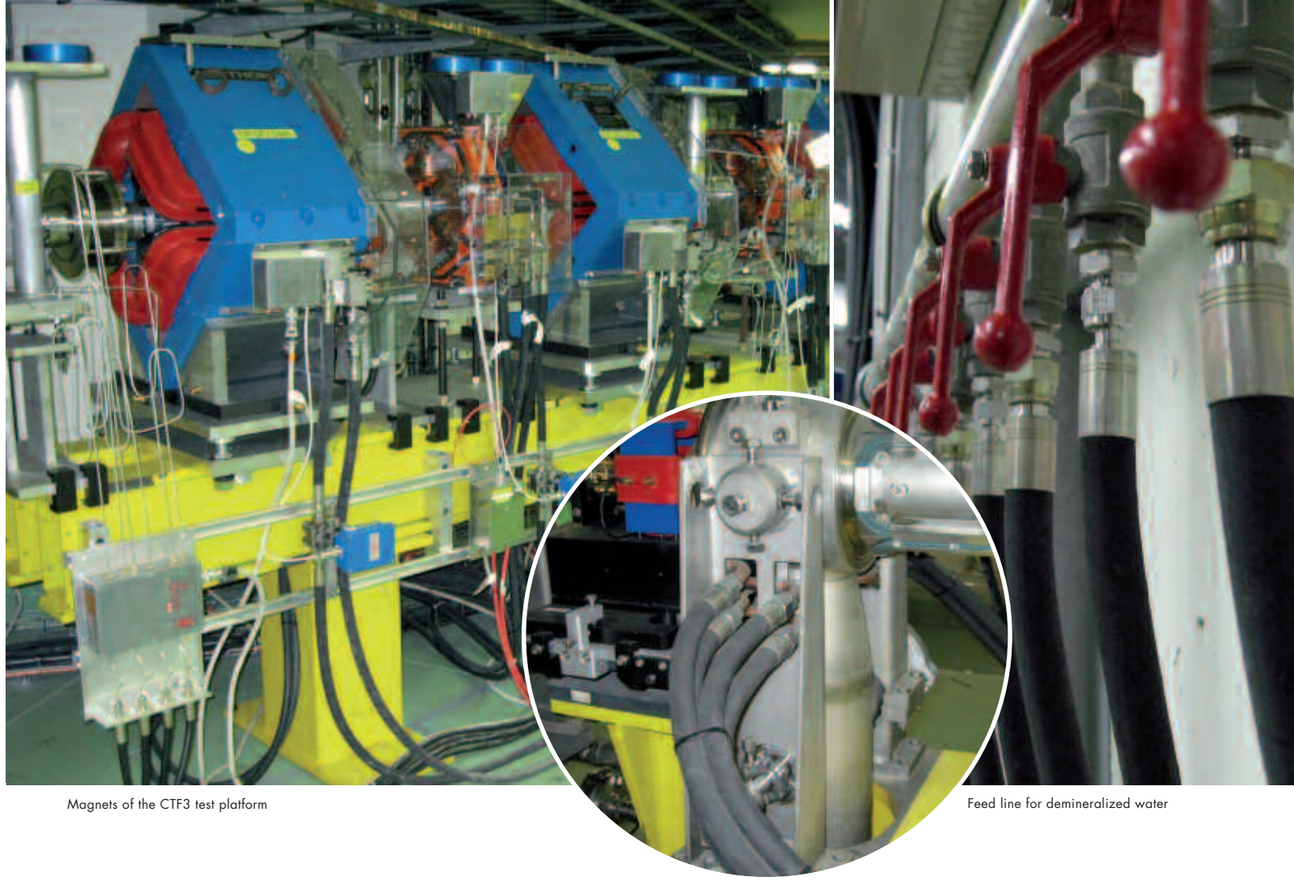
In order to keep the magnets of the CTF3 particle accelerator at CERN at a constant temperature of +30 °C, hose lines connected to a demineralized water supply system are used for cooling. But how is it possible to achieve resistance against radioactivity, demineralized water, ozone and hydrolysis while simultaneously ensuring good electrical insulation? Angst+Pfister recommended hoses made of special EPDM with KEVLAR® meshing.

CERN (European Organization for Nuclear Research) is the world's largest and most renowned scientific laboratory for particle physics. Its main focus of research is fundamental physics. With the aid of highly complex instruments, physicists are researching the smallest building blocks of matter – elementary particles – and are using particle collision to decipher the physical laws of the universe. The experiments are essentially conducted on the basis of international collaboration by teams of physicists from around the world. CERN was founded in 1954. It currently has 20 member states and is located near Geneva close to the Swiss/French border.

One experiment being run by CERN, called CLIC (Compact Linear Collider), involves a compact electron-positron linear collider with energy of 1 to 5 tera-electron volts (TeV = 10^{12} electron volts). The experiment is based on the principle of an accelerator with two particle beams. One particle beam operating with low energy but high intensity is launched in parallel with a main high-energy particle beam with the aim of producing the radio frequency power needed to accelerate the main particle beam. The test platform of the CLIC, the CTF3 (CLIC Test Facility 3), aims to prove that such a radio frequency power can be produced. The CTF3 project started in 2001 and is slated to continue until at least 2010.

The acceleration sections and the associated waveguides in the CTF3 are kept at a constant temperature of +30 °C. To achieve this, demineralized water is pumped from the water supply unit of CERN to the highly radioactive areas. The water supply unit consists of feed lines with distribution valves and connected hose lines. These flexible lines surround the magnets that are under high voltage and focus the particle beams. For safety reasons, the water lines must not conduct electricity under any circumstances.





Magnets of the CTF3 test platform

Feed line for demineralized water

Meshed NBR hoses were used before, but this solution proved to be inadequate. The NBR mixture was not sufficiently resistant to high-energy radiation, demineralized water and ozone. The influence of mechanical stress thus caused cracks to form over time. In addition, the meshing exhibited poor resistance to hydrolysis. Use of a fiberglass meshing was likewise unsuccessful because it did not withstand pressing and the hoses became leaky. CERN turned to Angst+Pfister to find an adequate solution.

The solution

After studying the specifications, a decision was made to use an Angst+Pfister hose made of special EPDM with an inner liner made of KEVLAR® fibers. The EPDM compound was specifically developed for this application. It not only offers the advantage of providing electrical resistance of >10^9 Ω, but is also resistant to radioactivity, demineralized water and ozone – even when under mechanical strain. The KEVLAR® meshing stands out for its excellent resistance to hydrolysis and features very good mechanical properties.
In addition, this product is designed to withstand a pressure of 12 MPa. This corresponds to safety factor 6 with regard to operating pressure.

Another advantage of the hose from Angst+Pfister is that it complies with fire prevention standard NF F 16-101, class I4, as well as with CERN's TIS/IS 41 safety regulations concerning fire protection and the radiation resistance of non-metallic materials. CERN was impressed by the many advantages of the combination of insulating EPDM with KEVLAR® meshing and thus chose this solution.

Extra advantage: Mobile hose press

Since all hoses for the demineralized water supply unit have a specific length, hoses, fittings and swage ferrules are delivered separately to CERN. The hose lines are assembled on site with the aid of HM UNIFLEX mobile hose presses provided by Angst+Pfister.

More application possibilities

KEVLAR®-lined EPDM hoses are being successfully deployed with the CTF3 particle accelerator as well as in other CERN systems including the large hadron collider. They are ideal as hose lines for demineralized and deionized water and are thus often used in all types of cooling circuits where good electrical insulation is required. Possible application areas include electromagnetic systems, transformers and electrical industrial ovens, as well as the automobile and railroad industries. The hoses are deliverable from stock, and special designs are also available. In addition, Angst+Pfister maintains an extensive range of press fittings and clamp jaws. We naturally can also fabricate ready-to-install hoses.

Contact us. Together we can find the ideal solution.

Your contact:
Jacques Vaudroz
Angst+Pfister SA, 1219 Genève-Le Lignon, Switzerland
Telephone: +41 22 979 28 33
E-mail: j.vaudroz@angst-pfister.com