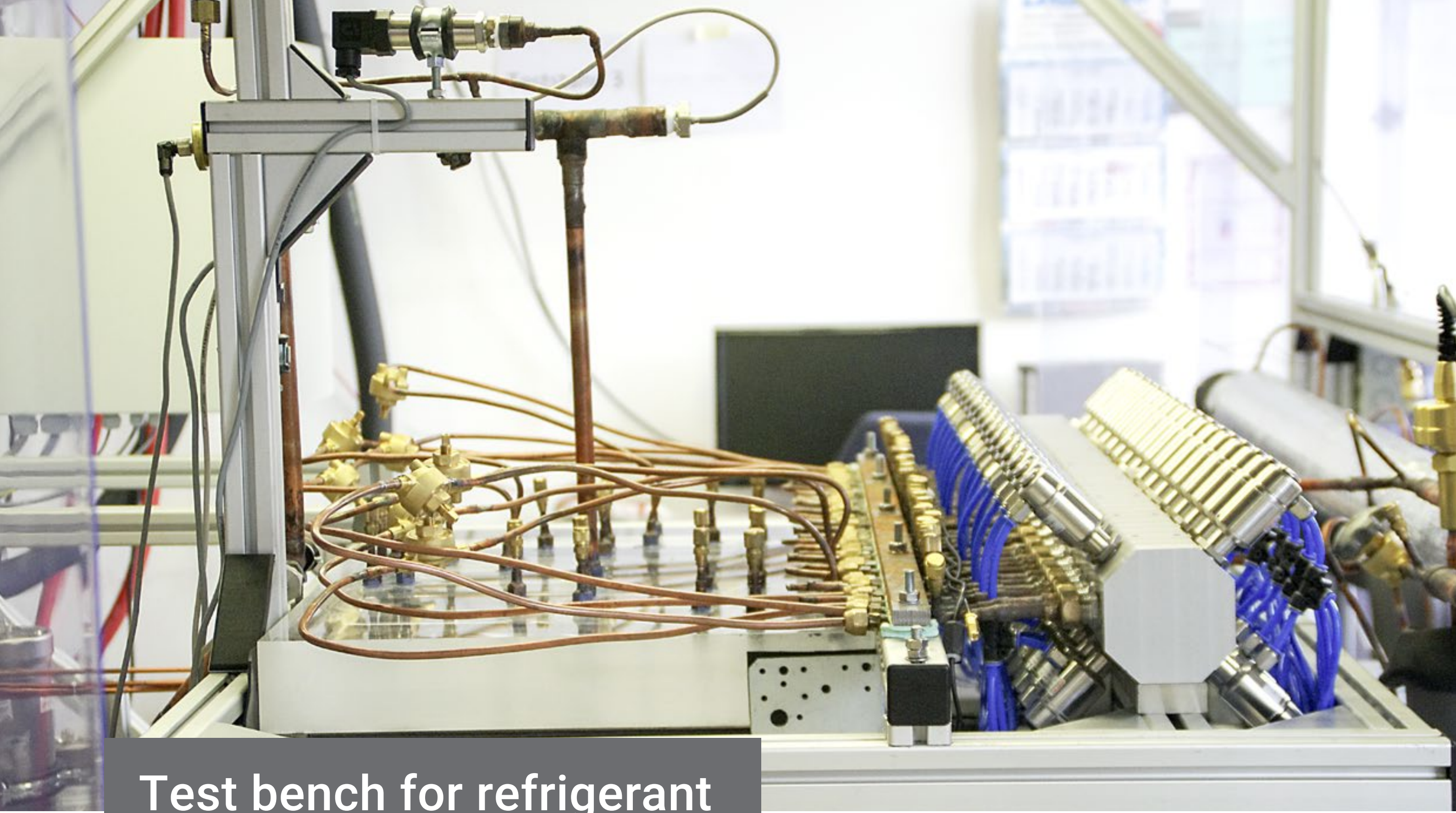


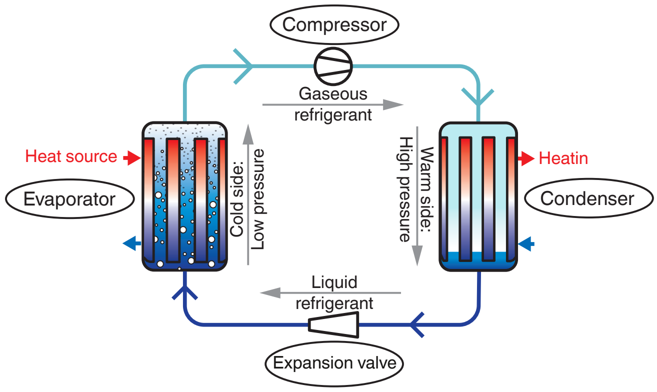
Test bench for refrigerant distribution in heat pumps

Globe valve manifold as a central element

Heat pumps enable the efficient supply of useful heat, including environmental heat (ambient air, ground). The Fraunhofer Institute for Solar Energy Systems ISE in Freiburg, Germany, has been carrying out extensive work in this area for several years – from material and component development through to system assessment and optimization.
The tests involved in a qualitative analysis of two-phase refrigerants are performed on a test bench whose key component is a custom-built globe valve manifold, developed jointly by GEMÜ and the Fraunhofer Institute ISE.
During the tests, the fluid distribution of refrigerant in heat pumps is examined.

Process description:

Heat pumps generally work by channelling fluids through a closed circuit. These fluids evaporate at low pressure with a low heat input and re-condense after being compressed at a higher pressure with heat dissipation.
A heat pump consists of an evaporator, a compressor, a condenser and an expansion valve. The compressor initially compresses the refrigerant, which in turn heats it up.
The refrigerant then cools, is liquefied and releases its heat into a heating circuit. The refrigerant is depressurised via an expansion valve, whereby it cools further. In the downstream evaporator, the cold refrigerant absorbs environmental heat (from the earth or air), is transformed into a gaseous state, and is then channelled back into the compressor.

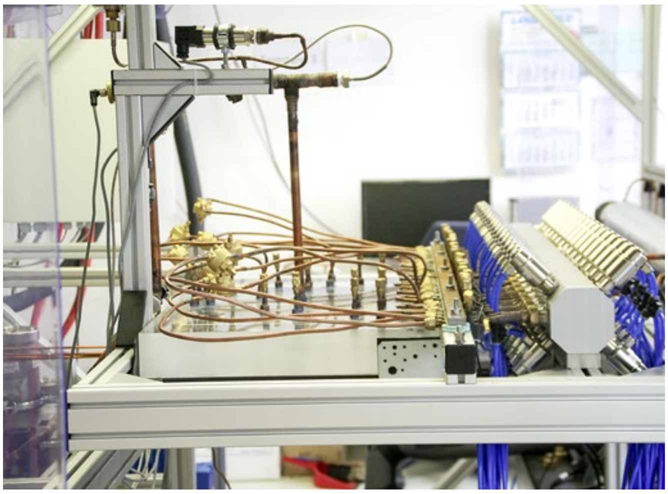


Refrigerant distribution in an air evaporator

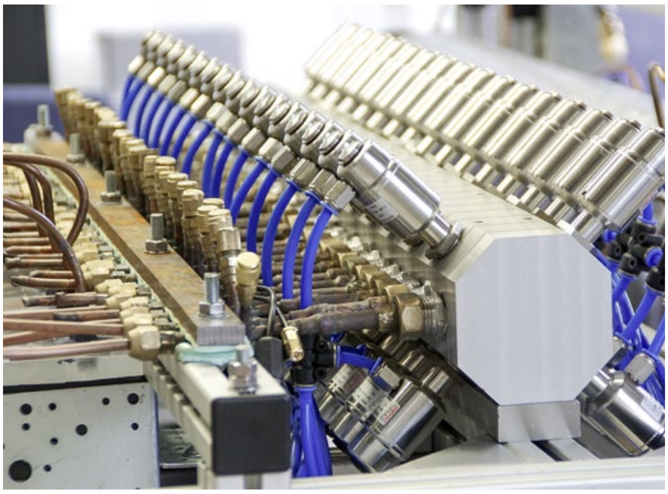
In heat pumps that use air, microchannel evaporators (MPE) are often used. These consist of several small channels that run in parallel. The refrigerant is channelled into the evaporator as a mixture of liquid and steam (two-phase refrigerant) at high speed from the expansion valve. For optimum evaporator performance, it is important to feed the two-phase refrigerant through these individual channels evenly. In the case of smaller microchannel evaporators, the final channels are oversupplied with refrigerant; in larger evaporators, the mass flow of refrigerant that enters as a free jet is cut off at the sharp edges of the panels, which means that insufficient refrigerant reaches the final channels. As a result, some channels are not used to their full capacity.
This uneven distribution can be prevented by using a refrigerant distributor. By loading the channels evenly, the maximum possible cooling capacity of the microchannel evaporator can be achieved

Function of the test bench/globe valve manifold

The fluid distributor for the refrigerant takes the form of a small, forked piping system, with one inlet and 32 outlets. These lead into the globe valve manifold from GEMÜ, which in turn has 32 inlets and 2 outlets. The multi-port valve consists of a total of 32 aluminium segments as the body and 64 GEMÜ 9550 pneumatic actuators. The segments are held together by two built-in threaded rods. The pneumatic actuators are operated via a fieldbus-controlled valve manifold. Thanks to the individual connection of all inlets and outlets on the globe valve manifold, the distribution quality of the two-phase refrigerant can be analysed at every individual channel, while expansion processes and flow regimes (flow characteristics) can also be examined.
Since the refrigerant used can warm up under the influence of ambient temperature, thereby increasing the pressure in the closed system, the multi-port valve is sealed up to 28 bar.



Test bench at the Fraunhofer Institute ISE



GEMÜ globe valve manifold with GEMÜ 9550 pneumatic actuators

GEMÜ globe valve manifold with GEMÜ 9550 pneumatic actuators

GEMÜ Gebr. Müller Apparatebau GmbH & Co. KG
Fritz-Müller-Straße 6–8 · 74653 Ingelfingen · Germany
Phone +49 (0)7940 123 0 · info@gemue.de