



STIRLING
CRYOGENICS

Stirling Hydrogen Liquefaction Systems

Production of 5 to 400 kg of LH₂ per day

History

Stirling Cryogenerators have been widely used in the 1960's and '70's for the production of LH₂ at various institutes and research laboratories all over the world. In material science small scale production was used to study the properties and behavior of LH₂ and its effect on materials.

In scientific devices, Stirling Cryogenerators have been used as LH₂ re-liquefiers to create cold neutron sources and to run H₂/D₂ distillation columns. Today, some of these vintage machines are still in use, for instance the one at the National Institute of Cryogenic and Isotope Separation in Romania which was installed in 1973. Late 2023, a new LH₂ re-liquefier has been installed parallel to the existing one still in use.

After the 1980's, numerous systems have been supplied by Stirling Cryogenics using a cold helium loop for applications such as space chambers and LH₂ cold neutron sources.

A recent project is the re-liquefaction system for the LH₂ inventory of the cold neutron source at the Reactor Institute Delft of the Delft Technical university. For the RID, Stirling Cryogenics designed and built a system providing 900 W of cooling power at 20K, in a redundant set-up and with a variable heat load from 10 to 120%.



2019 Stirling Cryogenics Hydrogen Re-liquefier for Cold Neutron Source at RID
Photo Courtesy Reactor Institute Delft, The Netherlands



1973 Stirling Cryogenics Hydrogen Re-liquefier
Photo Courtesy ICSI, Romania

Today

With the accelerated interest in a carbon free society over the last few years, hydrogen and thus liquid hydrogen have gotten to the center of attention again. Many large green H₂ gas production facilities are being build or planned, part of which is to be liquefied.

Based on the same trusted Stirling Cryogenerators used over 40 years, Stirling Cryogenics has designed a range of system sizes ranging from a small laboratory scale unit producing 5 kg/day up to 400 kg/day containerized systems. All only needing H₂ gas and electric power as input, producing converted para LH₂ into a transfer vessel.

Hydrogen Liquefier Set-up

For liquefaction of hydrogen, the two-stage Stirling Cryogenerator is used to reach a temperature of 20K. This Cryogenerator is available as 1-cylinder machine for liquefaction of 5 kg/day and as 4-cylinder machine for 30 kg/day. Integrating multiple parallel 4-cylinder machines LH₂ systems up to 200 kg/day are assembled fitting in a 40 feet container.

Using multiple liquefiers in one system offers the advantage of redundancy.

The design concept of the larger Stirling systems is that all Cryogenerators will run independently from each other. Should one of the Cryogenerators be off-line, the liquefaction capacity of the other machines remains available.

A Stirling Cryogenics LH₂ system will include all necessary internal piping, instrumentation, a transfer vessel and system control. All systems are built according ATEX or other relevant coding.

Optionally, catalytic ortho-para conversion, containerization and GH₂ inlet gas purification can be offered. Alternatively, Stirling Cryogenerators can be supplied as modules to a system integrator building the total system.

Besides the production of LH₂ from gas production, the two-stage Stirling Cryogenerator can also be used as a re-liquefier for boil-off gas coming from a storage tank preventing the blow-off of cold GH₂.

This can be achieved either by direct re-liquefaction of the cold gas, or by a cold He loop transporting cooling power from the Cryogenerator into the storage tank.



Containerized liquefaction system