1. Application area

These guidelines apply to all cold traps made of pipes (in the following: **cold traps**) and refrigerant pipes, i.e. the connection pipes to the cryo-generator, that are installed in Bühler Alzenau units.

2. Purpose

This works standard describes the activities, materials and preconditions required for a technically correct manufacturing and testing of cold traps and refrigerant pipes that are conform to the Pressure Equipment Directive (97/23/EC).

3. Basics

This standard describes the design, manufacturing and testing in accordance with the sound engineering practice. Criteria that indicate that a cold trap has to be designed, built and tested according to sound engineering practice are listed in the standard LHH-N 090.218.

Note: This standard can be used for **cold traps** with other structural shapes, if for:

Hazardous fluids: V</=1 l or p_s x V </= 25 bar x l (**p_s** = operating pressure)
Non-hazardous fluids: V</=1 l or p_s x V </= 50 bar x l (**V** = volume)

Other measures must be taken if these limit values are exceeded
(see LHH-N 090.012 und 090.013).

The limits for **refrigerant pipes** are:

Hazardous fluids: DN </= 25 (**DN** = nominal diameter)
Non-hazardous fluids: DN </= 32 and p_s x DN </= 1000 bar

4. Sound engineering practice

4.1 Layout and design

Operating pressure: p_s = **31 bar** (for Polycold cryo-generators, version from 2001)

4.1.1 *Pipes*

Copper pipes (DIN EN 12449): SF-Cu DHP-R 200
Dimensions: 8 x 1, 12 x 1, 15 x 1, 15 x 1,5 and 16 x 1

Stainless steel pipes (DIN EN ISO 1127): 1.4301 and 1.4541
Dimensions: 12 x 0,5, 12 x 1, 14 x 1 and 16 x 1

4.1.2 *Fittings*

Copper capillary brazing fittings according to DIN EN 1254-1

Stainless steel 1.4301 and 1.4541

4.2 Manufacturing of refrigerant pipes and cold traps

Brazing:

Brazing material: Fontargen AF 314 (BLOA Mat.-No. 102135879) for copper-to-copper and copper-to- stainless steel joints

- All pipe ends must be deburred very carefully and loose parts, e.g. shavings, must be removed.
- Thoroughly clean all surfaces to be connected to each other to bare metal (until the material is free of oxide layers).
- Working temperature at approx. 650°C. Do not exceed 700°C!
- During brazing and until cooling down of the joint to below 200°C the pipes must be purged with nitrogen or argon.

Cleaning:

- Remove flux residue!

Outer side: Clean with a damp cloth while the brazed joint is still hot.

Inner side: *Cold trap:* Rinse for 3 hours with warm water (approx. 80°C). A low flow rate is sufficient.

Refrigerant pipes: Remove the flux residue carefully (rinse). Carefully dry after cleaning.

Exceptional cases: During final assembly cleaning of inaccessible joints can be omitted.

4.3 Test

1. Water pressure test at 45 bar (1.43 x operating pressure) according to LHH-N 090.216. Pressure must be exerted for 30 minutes. The component complies with the requirements when there is no visible leak, the test pressure remains constant for the test duration and no permanent deformations are present.
2. Blow through with oil-free compressed air
3. Vacuum test: Evacuation of air to 1 x 10^{-2} mbar.

Warming the cold trap may help to speed up the test (removal of residual moisture).

4. Leak test with helium (HV2, see LHH-N 000.320).
5. Venting with nitrogen or inert gas.
6. Close openings!

Note: No pressure test is conducted on refrigerant pipes, but the entire system must be tested for leaks.

4.4 Traceability of cold traps

- Each cold trap must be identified by a serial number.
- The manufacturer has to keep test logs and archive them for a duration set by regulations.

4.5 Drawing specifications

Drawings must show the following specifications:

- Manufactured and tested according to LHH-N 090.219.
- The location of the serial number identification must be specified in the drawing.