

Vacuum Super Insulated Line – Technical Specification

1. General description

The line consists of an inner medium pipe and a surrounding jacket pipe, the inner pipe being supported against the outer pipe by special spacers. Approx. 20 layers of a super insulation sheet of aluminium foil/glass silk are wound round the inner pipe as radiation protection. In the intermediate space a vacuum is generated, equal to or better than 10^{-4} mbar (in the warm state), so that heat transmission through convection is not possible and the insulation loss is ≤ 1 Watt/m. *)

Furthermore, metal hydride cartridges are built in which act as “getter pumps” and thus maintain the vacuum over a long period. *)

In order to measure the insulating vacuum during operation without having to open the vacuum space a “gas frictional sensor” is welded in (quality control test).

During generation of the vacuum and activation of the getter cartridges at approx. 450°C the inner and outer pipe are baked out at approx. 150°C . *)

Shrinkage caused through the low temperatures is compensated by welded-in compensators.

The line components are supplied to the building site partly prefabricated, welded on the spot and tested for leaks with helium.

For these line types it is important that the surface area and diameter are designed to be as small as possible so that the dwell time is short and the associated rate of heat inflow through radiation is also kept to a minimum. Thus the greater the surface area and diameter the greater are the losses through gas formation. For this reason thin-walled pipes (minimises cooling losses) are used which do not necessarily conform to the standard series.

*) If the lines are connected to a continuously running vacuum pump the metal hydride cartridges and baking out are not necessary. In this case the quality of the insulating vacuum depends on the vacuum pump used.

2. Technical regulations and design

As long as the vacuum super insulated lines are in contact only with nitrogen in the liquid or gaseous state and the internal diameter of the product pipes is ≤ 32 mm, they are not subject to the obligation of testing and certification.

However, for calculation, design and manufacture of these lines the following regulations or technical specifications are applicable:

TRR 100 for calculation, design and manufacture

AD-leaflet W10 for material selection

DIN 2413 for calculation of the maximum permissible internal pressure in pipes of stainless steel

The line components are joined using the TIG welding process under an inert gas atmosphere, mechanically (orbital) or manually, by qualified welders.

Each weld seam is subjected to a leakage test with helium after completion. Testing is carried out for a leakage rate of $< 10^{-6}$ mbar l·s⁻¹ using the sniffling method (product pipe) and $< 10^{-9}$ mbar l. s⁻¹ using the integral method (complete system).

If there is a risk of liquid being trapped this line section is safeguarded against an unacceptable pressure increase by a safety valve.

3. Materials used

Line DN 10/15/25 PN 10

Inner pipe dia. 28 x 1.5 / 18 x 1.5 / 18 x 1 / 12 x 1 made of 1.4301/1.4541

Outer pipe dia. 76.1 x 2 / 53 x 1.5 made of 1.4301/1.4541

Compensators DN 10.15, 25 PN 16 made of 1.4571

90 ° - elbow dia. 28 x 1.5 / 18 x 1.5 / 12 x 1 made of 1.4301/1.4541

90 ° - elbow dia. 76.1 x 2 / 53 x 1.5 made of 1.4301/1.4541

Special supports of glass-fibre reinforced plastic

Cover plates made of 1.4301/1.4541

20 layers of aluminium foil with intermediate layers of glass silk as radiation protection

Cartridges filled with getter material

Evacuation supports made of 1.4541/1.4301

Holding and fixing material made of stainless steel or galvanized steel

If required approval documents for the raw materials with 3.1 B certificates can be made available at an additional cost of 60 € per item.

Subject to technical alterations in the interests of technical progress without notice.