INTRODUCTION TO SIVL

…for the transfer of Liquefied Gases and Extreme Temperature Fluids

Introduction to SIVL

SIVL is a highly developed transfer system for any extreme temperature fluid; it is most commonly used for the transfer of liquefied gases. Compared to even the best conventionally lagged pipes, SIVL is 10 - 30 times more efficient in reducing heat flow, therefore, saving money in operational costs.

SIVL is manufactured almost entirely of high-grade stainless steel; a durable asset that also reduces maintenance costs. The line has a hygienic finish (polished stainless steel) and is eminently suitable for use in food, medical and research establishments as well as in general industry.

The line's small diameter (76 mm) conserves space within the building and on pipe racks. Our SIVL consists of prefabricated line sections with on-site welded couplings between line sections. This design ensures maximum flexibility for future extension, modification and no need for continuous evacuation.

AS Scientific Products Ltd. design, manufacture, supply and install complete vacuum super insulated pipelines for liquefied gases. Pipeline installations are designed to meet customers' exact needs.

Each system configuration is selected to minimize the total number of sections and bends required with consideration given to such factors as; installation accessibility, shipping size limitations, flow rates, and allowable pressure drops etc. Vacuum insulated tees, elbows and valves are all incorporated within the installation, thus eliminating costly inefficient arrangements. For Heat loss please see Table 1.

AS Scientific Products Ltd.



Contact us: **Address:** 2 Barton Lane, Abingdon Science Park, Abingdon, Oxfordshire OX14 3NB
Email: enquiries@asscientific.co.uk **Fax:** + 44 (0) 1235 554125 **Telephone:** +44 (0) 1235 533060 **Website:** www.asscientific.co.uk

HEAT LOSS

Table 1: Heat Loss of the SIVL

Tube	Watts Meter	Elbow	Tee	Welded joint	Bayonet connection
15 mm Tube	0.16	0.24	0.24	1.50	1.50
1″ Tube	0.26	0.38	0.39	2.53	2.50
1″ Pipe	0.35	0.50	0.51	2.53	2.50
1½″ Tube	0.40	0.56	0.56	3.10	3.00
1½″ Pipe	0.50	0.71	0.71	3.10	3.00

Maximum Operating Pressure = 10.5 bar

Design

Bayonet connections

The bayonet connection is a close tolerance fit between male and female, forming a thin cylindrical cavity. During cryogenic transfer, gas from the process liquid is vaporized in the long narrow cavity forming a vapour seal, which is at process stream temperature at one end and ambient temperature at the other. The vapour seal isolates the mechanical seal from the cryogenic temperatures.

This unique feature minimizes heat - leak, reduces frosting and allows for rapid disconnection of the line.
In addition, bayonet connections provide an economic method of joining vacuum-insulated transfer lines. They allow for liquid savings because of low heat influx, decreased installation time, and lower field installation costs. Once installed, they require no maintenance, and the insulation suffers no deterioration during operation regardless of where the pipeline is installed.

Rigid pipelines

Rigid pipelines are the best for getting optimum quality of the liquid cryogen. In some cases it cannot be avoided that flexible parts have to be used. This leads to deterioration in the liquid quality as the corrugations cause a much higher pressure drop along the pipeline. Furthermore, the investment costs are much higher. AS Scientific Products Ltd. do supply flexible sections in the pipeline, however, only if absolutely necessary. To improve the quality of the liquid cryogen further, other provisions can be incorporated in the system such as phase separators, gas vents or subcoolers.



Contact us: **Address:** 2 Barton Lane, Abingdon Science Park, Abingdon, Oxfordshire OX14 3NB
Email: enquiries@asscientific.co.uk **Fax:** + 44 (0) 1235 554125 **Telephone:** +44 (0) 1235 533060 **Website:** www.asscientific.co.uk

INTRODUCTION TO SIVL

- Cooling capability of nitrogen

About 50% of the cooling capability of liquid nitrogen results from liquid boiling to vapour. Getting the nitrogen to the point of use as a liquid is therefore important.
Liquid nitrogen is delivered to the point of use by maintaining the storage tank at an elevated pressure. System heat leak frequently causes the pressurized liquid to become saturated at this elevated pressure. As the liquid flows from the tank in a normally horizontal delivery line, it begins to boil since it is flowing to a point of lower pressure. The fluid, now in two-phase flow, causes a pressure drop substantially greater than the pressure loss, which would result from the same mass flow as 100 % liquid. The increased line pressure loss causes even more vapour to be formed and the loss of compounds themselves.
As the boiling two-phase liquid reaches the end valve, the pressure is further reduced and the vapour component is increased, resulting in liquid / vapour pulsations.

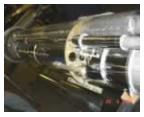
- Flexibility of the line

Each coupling provides access to the existing line …for additional drops or feeds to other equipment. These additional feeds are taken off without affecting the main line section vacuums. Similar, the line can be cut back to a coupling and rerouted without affecting the vacuum in the remaining line sections. When no longer required, the line can be dismantled and used elsewhere.

Installation Advantages

- Short installation time.

For manufacturing and physical reasons all transfer line installations are built in sections. From the insulation aspect, each section of the line is a sealed unit and therefore, to maintain continuity of insulation, the couplings between each section have been designed as bayonets with extremely low heat leak characteristics. They enable quick installation and disconnection, and solve special performance requirements in the vacuum insulated cryogenic transfer lines. A 50 - 60 m line is installed in two to three days depending on how easily the line hangers can be reached. No external insulation required, therefore, the start time is reduced. Liquid gas is flowing 4 hours after completion of the last weld.



Contact us: **Address:** 2 Barton Lane, Abingdon Science Park, Abingdon, Oxfordshire OX14 3NB
Email: enquiries@asscientific.co.uk **Fax:** + 44 (0) 1235 554125 **Telephone:** +44 (0) 1235 533060 **Website:** www.asscientific.co.uk

INTRODUCTION

Servicing Advantages

The line is virtually maintenance free (no crumbling insulation to be replaced every year or so). Any deterioration in vacuum will only affect that section and not the whole line.

Losses to the system

In the supply line, there are several kinds of losses to the system as follows:

- Straight line pressure drop. This is a function of flow rate, line length, line diameter and liquid in the tank. A system which is expected to deliver comparatively 'warm' liquid to the supply line should have a larger bore to attain the same pressure drop and flow rate. On the other hand, alternate surges of vapour and liquid usually result from an oversized line.

- Losses caused by turbulence in elbows and tees.

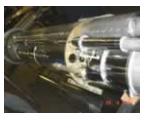
- Cool down losses. This depends upon type of line used and is a linear function of diameter and length.

- Hydrostatic head losses. If the flowing liquid is at its boiling point, there can be no syphon effect so there will be no recovery of upward heat loss on downward runs. Each vertical meter of upward run is equivalent to a line length of about 10 horizontal meters. Unavoidable vertical runs should be placed as far downstream as possible to minimize the compounded effects of two phase flow.

- Insulation or steady state losses. These losses are a function of the flow through the line and total heat leak through the insulation. Although this heat leak applies mostly to overall system thermal efficiency, it also can affect line pressure drop where it contributes appreciably to the generation of vapour and two-phase flow in the line.

Size Range of Line Sections

Line sections are made in lengths up to a maximum of 6 m and have a standard 16 gauge polished stainless outer tube of diameter 76.2 mm. The inner tube size is chosen for the required flow of liquid gas.



Contact us: **Address:** 2 Barton Lane, Abingdon Science Park, Abingdon, Oxfordshire OX14 3NB
Email: enquiries@asscientific.co.uk **Fax:** + 44 (0) 1235 554125 **Telephone:** +44 (0) 1235 533060 **Website:** www.asscientific.co.uk

INTRODUCTION

Construction and Testing

Super insulation is applied in clean factory conditions and sealed in each line section prior to shipment. Line sections are evacuated in the factory using large diffusion pumps fitted with liquid nitrogen cold traps or turbomolecular pumps. With this method, the line sections can be mounted directly on a pump giving a maximum pumping path length of 3.5 m. Even so, pumping times of seven days are normal to reduce the outgassing rate to an acceptable level.

After satisfactory completion of pumping, each line section is helium leak tested, using a mass spectrometer, to <3 x 10^-9 STD cc/sec air equivalent. Line sections are pressure tested to a minimum 10 % above design pressure.

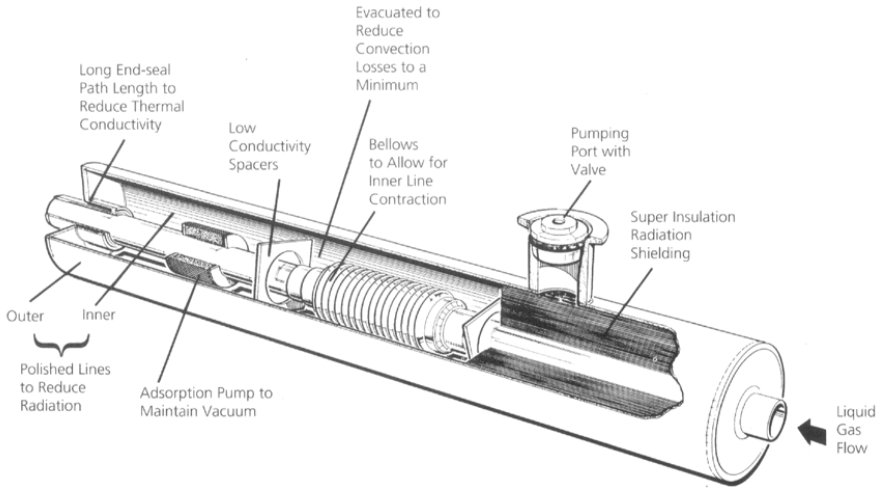
Each line section is cold tested before removal from the diffusion pump. A second helium leak test is then performed at 77oK. Line sections are thus thoroughly cold tested before they leave the factory.

Photographs of a typical handler installation in the semiconductor industry

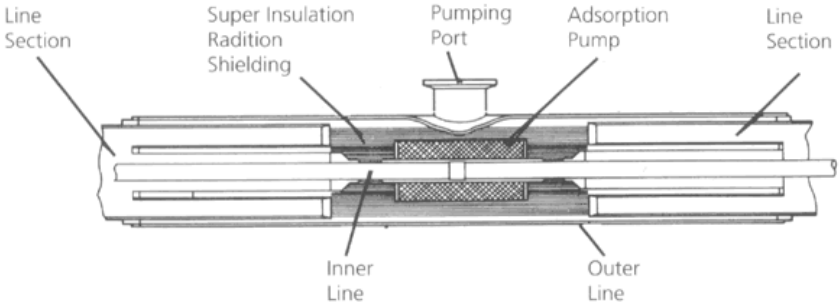
Contact us: **Address:** 2 Barton Lane, Abingdon Science Park, Abingdon, Oxfordshire OX14 3NB
Email: enquiries@asscientific.co.uk **Fax:** + 44 (0) 1235 554125 **Telephone:** +44 (0) 1235 533060 **Website:** www.asscientific.co.uk

INTRODUCTION

Line Section



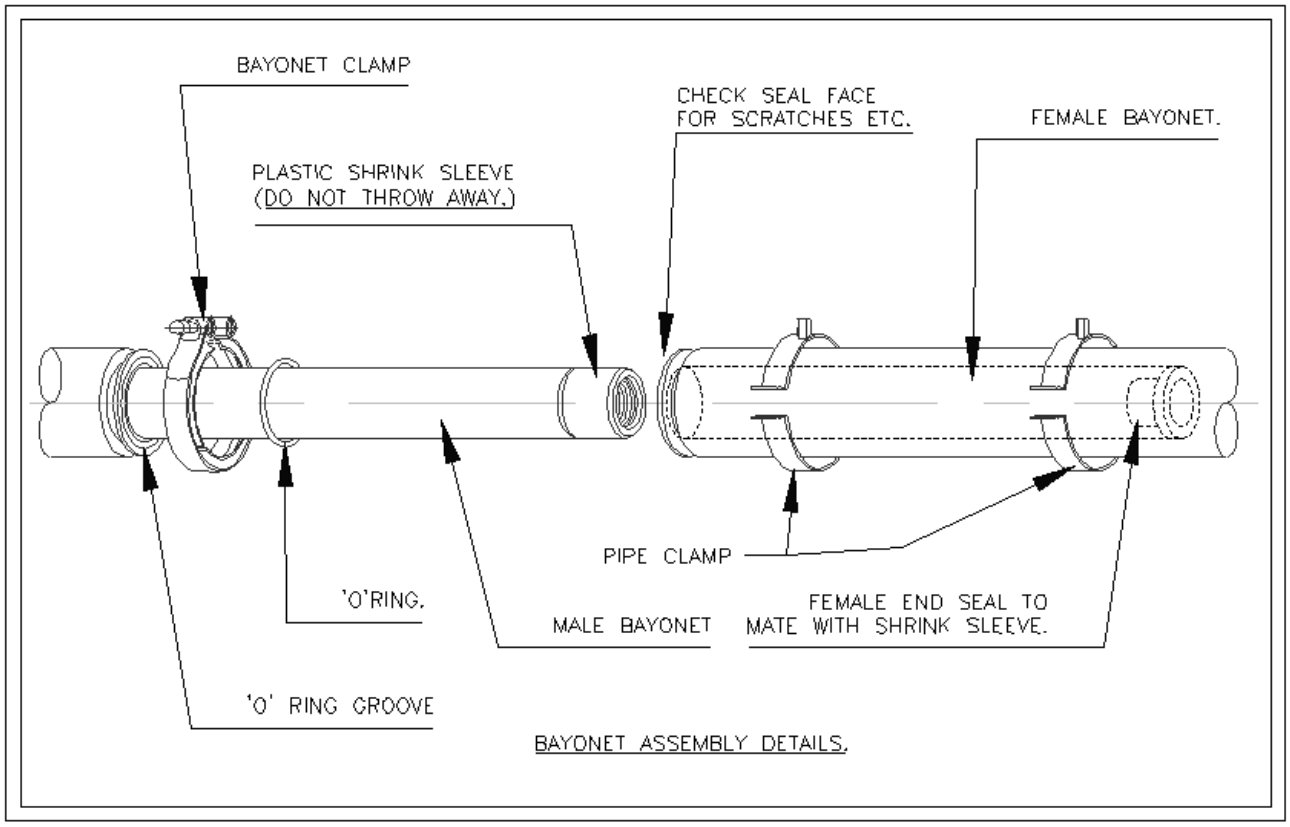
Welded Coupling



Scientific Products Ltd.

Contact us: **Address:** 2 Barton Lane, Abingdon Science Park, Abingdon, Oxfordshire OX14 3NB
Email: enquiries@asscientific.co.uk **Fax:** + 44 (0) 1235 554125 **Telephone:** +44 (0) 1235 533060 **Website:** www.asscientific.co.uk

BAYONET ASSEMBLY



Contact us: **Address:** 2 Barton Lane, Abingdon Science Park, Abingdon, Oxfordshire OX14 3NB
Email: enquiries@asscientific.co.uk **Fax:** + 44 (0) 1235 554125 **Telephone:** +44 (0) 1235 533060 **Website:** www.asscientific.co.uk