



CRYOGENIC

SPECIALTY MANUFACTURING
QUALITY WITH A DIFFERENCE

Liquid Nitrogen Dosing

BEVERAGE | FOOD | PERSONAL CARE | CHEMICAL



Stay cool under pressure
www.csm-cryogenic.com

Table of Content

Page No.

Liquid Nitrogen Dosing Introduction	3
Benefits of Liquid Nitrogen Dosing	4
The process of Liquid Nitrogen Dosing	5
Impact on Product, Shelf Life, and Packaging Quality	6
Vacuum Paneling	7
Packaging Rigidity	8
Super Insulation Technology	9
Challenges in Super Insulated Technology	10
Heat Transfer in LN ₂ Doser	11
Liquid Nitrogen Piping Solutions	12
Rigid Vacuum Jacketed Pipe	13
Flexible Vacuum Jacketed Pipe	13
LN ₂ System Enquiry Form	14
NovoDoser	15
NovoDoser Technological Benefits	16
Dosing Valve - Pneumatic vs Electric	17
Liquid Level Control	18
NovoDoser Models Overview	19
NovoDoser L series 500FD	21
NovoDoser L series 800SC	23
NovoDoser L series 2000DSC	25
NovoDoser H series 800SC	27
NovoDoser H series 2000DSC	29
NovoDoser Q series 2000DSC	31
NovoDoser M series 1000M	33
MiniDose	35
AsepticDoser	37
Cryogenic Transfer Hose	39
Ultra-Flex	41
Semi-Flex <i>Static</i>	43
Semi-Flex <i>Dynamic</i>	45
Cryo-Flex	47
Triax-Flex	49
Cryogenic Transfer Pipe	51
StatiRigid-T	55
Vacuum Insulated Connections	57
Bayonet – <i>Close Tolerance</i>	57
Modular Valves	59
Modular Fittings	61
Conditioning Equipment	63
Phase Separator – <i>Atmospheric Pressure</i>	63
Phase Separator – <i>Adjustable Pressure</i>	65
Degasser DG, <i>Pipeline</i>	67
CryoVent, <i>Mechanical</i>	69
Vent Heater	71
Accessories	73
Modular T-Filter	73
Dewar Changeover	75
Dewar Auto-Filling, ADF10	77
Cryo-Stic	79
Cryogenic Components	81
Technical Data	85
Liquid Gases Physical Properties	86
Nitrogen Vapor Release Chart	87
Unit Conversion Table	88
Nitrogen Viscosity	90

Liquid Nitrogen (LN₂) Dosing

Liquid Nitrogen LN₂ Dosing in Food & Beverage, Personal care product packaging: enhancing quality, shelf-life, consumer satisfaction, and environmentally friendly



Introduction:

Maintaining product quality and extending shelf life are critical objectives in the food, beverage & personal care industry. To achieve these goals, innovative techniques are continuously being developed. One such technique gaining popularity is liquid nitrogen dosing, which involves the controlled injection of liquid nitrogen into product containers during the packaging process.

Liquid nitrogen dosing is considered one of the most significant cryogenic technology adaptation, which not only benefit many industries in their cost reduction and quality improvement in product packaging, but also the environment.

This write-up explores the benefits, process, impact, and potential considerations of liquid nitrogen dosing on food & beverage packaging, highlighting its ability to enhance quality, extend shelf life, and meet consumer expectations. Additionally, it will discuss how liquid nitrogen dosing can contribute to packaging rigidity and lightweighting, further optimizing packaging solutions in other industries.



Benefits of Liquid Nitrogen Dosing:

Liquid nitrogen dosing offers a wide range of advantages for product packaging. Let's explore some of the key benefits:

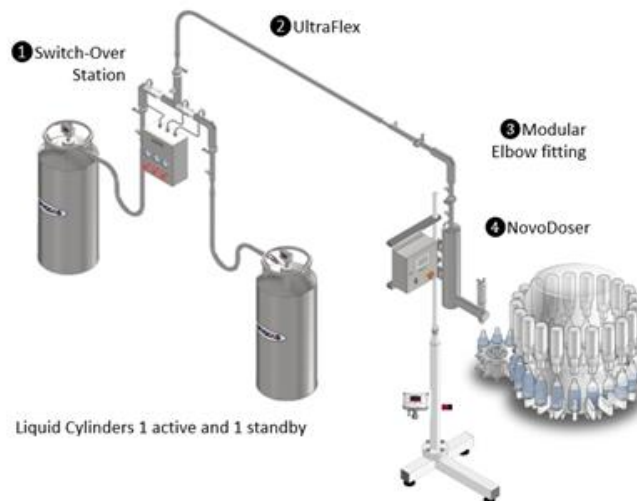
- 1. Preservation of Freshness and Taste:** By displacing oxygen, liquid nitrogen dosing effectively prevents oxidation and the growth of spoilage microorganisms. This preservation technique helps maintain the freshness, taste, color, and nutritional value of beverages. It is particularly beneficial for oxygen-sensitive products like juices, wines, teas, nuts, flavored health supplements, and carbonated drinks.
- 2. Nitrogenation for Beverage Products:** Nitrogenation enhances product creaminess and creates a captivating cascading bubble effect during pouring. Nitrogenation also reduce dissolved oxygen content in the product.
- 3. Improved Packaging Rigidity:** The expansion of liquid nitrogen into gas within the container creates internal pressure, resulting in a firmer and sturdier packaging structure. This increased rigidity enhances the container's ability to withstand external forces, reducing the risk of damage during transportation and storage.
- 4. Mitigation of Vacuum Paneling:** Vacuum paneling, a common issue in hot-filled product packaging, can lead to deformation when the vapor inside the container condenses, creating a vacuum paneling effect. LN2 dosing effectively mitigates this risk by introducing liquid nitrogen into the headspace, countering the formation of vacuum and maintaining the integrity of the packaging.
- 5. Lightweighting and Sustainability:** Liquid nitrogen dosing supports lightweighting efforts in packaging design. The internal pressure generated by the expansion of liquid nitrogen allows for the reduction of material thickness while preserving the structural integrity of the container. This approach reduces environmental impact by using fewer raw materials, lowers shipping costs, and contributes to overall sustainability in product packaging. This innovation benefits not only the food and beverage industry but also sectors like personal care, chemicals, and various other products that utilize plastic or metallic packaging materials.

Liquid nitrogen dosing is a versatile and effective solution for enhancing packaging quality, providing benefits ranging from preservation and contamination risk reduction to improved packaging rigidity and sustainability. By embracing this technology, manufacturers can deliver high-quality products while meeting consumer expectations for freshness, taste, and environmental responsibility.

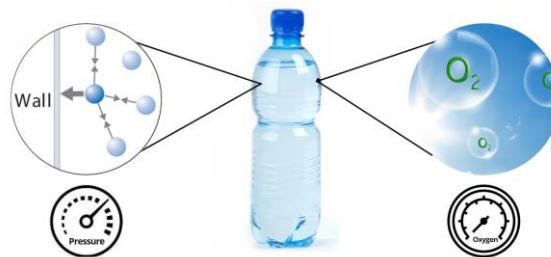


The Process of Liquid Nitrogen Dosing:

Liquid nitrogen dosing involves injecting a precisely controlled amount of liquid nitrogen into beverage containers before sealing. The process begins by transferring the liquid nitrogen from a storage container to a dosing system. The liquid nitrogen is then injected by the dosing system into the container.



As the liquid nitrogen warms up, it turns into gas and expands, creating pressure inside the container and pushing out any remaining air or oxygen. This displacement process eliminates the presence of oxygen, which is crucial for preserving the product's quality and extending its shelf life.



To ensure accuracy and consistency, dosing systems utilize advanced sensors and automated controls. These components regulate the injection volume and timing, allowing beverage manufacturers to customize the dosing process according to specific requirements for each product, container size, and production line speed. Modern liquid nitrogen dosing systems are designed to integrate seamlessly into existing packaging lines, making implementation efficient and cost-effective.

It is essential to note that the dosing process requires careful consideration and optimization for each specific product and manufacturing process. Factors such as product composition, container material, package design, filling line speed, and temperature should be taken into account to achieve optimal results. Collaborating with experts and conducting thorough trials is necessary to determine the ideal dosing parameters for each beverage type.

Impact on Product, Shelf Life and Packaging Quality:

Inerting

Liquid nitrogen dosing significantly contributes to enhancing the quality and extending the shelf life of beverages. By **displacing oxygen**, it reduces the risk of oxidation, which can degrade the flavor, color, and nutritional value of the product. Oxygen-sensitive beverages, such as juices, wines, and certain carbonated drinks, particularly benefit from this preservation method. By **minimizing oxidative** reactions, liquid nitrogen dosing helps maintain the beverage's sensory attributes, ensuring a fresh and appealing taste for an extended period.



Moreover, the creation of an **inerting** or oxygen reduction environment inside the container prevents the growth of spoilage microorganisms, which can lead to product deterioration and microbial spoilage. By inhibiting bacterial and fungal growth, liquid nitrogen dosing helps maintain the food and beverage products **microbiological stability**. This not only extends the shelf life of the product but also ensures that it remains safe for consumption.

Nitrogenation

Liquid nitrogen dosing simplify **nitrogenation** process for new generation of craft-beverages. It is an economical alternative to traditional nitrogen aluminum cans with widget for nitrogenated products such as nitro-coffee, nitro-stout, nitro-beer. LN₂ nitrogenation enhances product properties such as creaminess and creates a captivating cascading bubble effect during pouring.



Traditional Widget Cans
Expensive



Non-Widget Cans
Economical

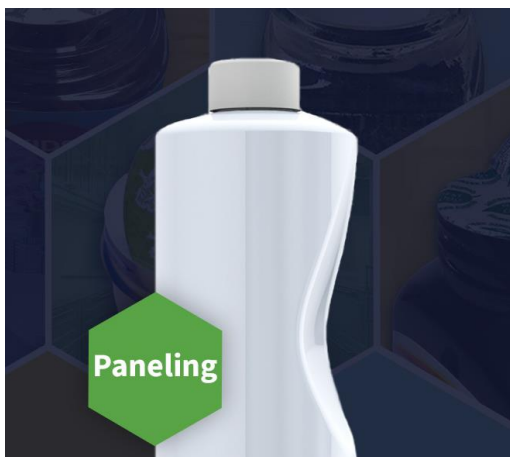


LN2 Dosing



Nitrogenated Product

Vacuum Paneling



Liquid nitrogen dosing is one of the most cost effective and proven technique in overcoming beverage container paneling issue. **Paneling** occurs when the pressure inside a product container becomes less than the ambient air pressure outside, causing the walls to partially collapse inward. The result is an aesthetically unappealing product package with a distorted shape and badly puckered or wrinkled labels.

Research has shown that a consumer's first reaction to a bottle affected by paneling is often, "There must be something wrong with it."

Cause #1 - Temperature / Pressure Change

When air is heated, it expands. Conversely, when air inside a closed container is cooled, it contracts, reducing the internal pressure and triggering the conditions that can cause paneling.

This is most noticeable in the case of bottles or cans that are hot filled and sealed/seamed before cooling. As the product cools, the contents and/or the air in the headspace contract, creating a negative pressure within the bottle. This negative pressure can cause the side panels to suck in to compensate for the loss of product volume.



Cause #2 - Oxygen Absorption / Reaction

It is possible that oxygen in the headspace of the bottle is being absorbed in the bottle's contents. Oxygen may also be reacting with one or more of the product's ingredients. Since oxygen comprises about 16 percent of the volume of air, reducing its concentration can significantly reduce the bottle's internal pressure, leading to bottle paneling.

Cause #3 - Environmental Conditions

- To avoid paneling issues, environmental conditions, such as altitude, temperature and relative humidity, also need to be taken into account.
- When a product is packaged at an elevation of over 5,000 feet, for example, its internal pressure will be equal to the external atmospheric pressure, which is considerably lower than that at sea level. If the product is later sold at sea level, the difference in internal and external pressures can cause paneling.

Dosing the product headspace with liquid nitrogen to create a positive pressure or remove oxygen before the container is sealed is simple and cost effective to mitigate vacuum paneling.

Packaging Rigidity



Liquid nitrogen dosing also improves **packaging rigidity**, which enhances the overall quality and durability of the beverage containers. The internal pressure created by the expansion of liquid nitrogen during the dosing process adds strength and stability to the packaging structure. This rigidity reduces the risk of **vacuum paneling**, damage, such as leaks or deformation, and improves the container's ability to withstand external forces during handling and transportation.

Lightweighting

Furthermore, liquid nitrogen dosing supports **lightweighting** efforts in beverage packaging. By generating internal pressure, it allows for the use of thinner and lighter packaging materials without compromising structural integrity. This lightweighting approach contributes to sustainability by reducing the consumption of raw materials, energy requirements during production, and transportation costs. It aligns with the industry's focus on environmental responsibility while maintaining the necessary packaging performance.



Considerations and Implementation:

Successful implementation of liquid nitrogen dosing requires careful consideration of several factors. These include product compatibility with low temperatures liquid nitrogen, container integrity, and suitability for withstanding pressure changes. Additionally, equipment maintenance requirements should be taken into account to ensure the continued efficiency and reliability of the dosing system. Collaborating with experts in the field and conducting comprehensive testing on the specific beverage and packaging are necessary to achieve optimal results.

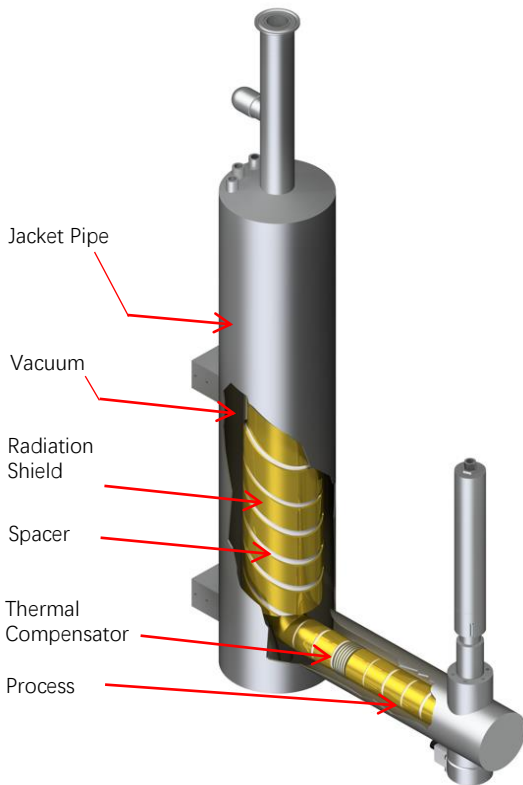
While the use of liquid nitrogen involves additional costs, such as procuring the liquid nitrogen and the initial investment in dosing equipment, these expenses are often offset by the benefits gained, including extended shelf life, improved product quality, enhanced packaging rigidity, and lightweighting advantages.

Conclusion:

Liquid nitrogen dosing is a powerful technique that enhances the quality, extends the shelf life, and improves the consumer appeal of beverages. By displacing oxygen, preventing contamination, and supporting packaging rigidity and lightweighting, this innovative process enables manufacturers to meet consumer demands for freshness, taste, aesthetics, and sustainability. As the beverage industry continues to prioritize product quality, consumer satisfaction, and environmental responsibility, liquid nitrogen dosing emerges as a valuable solution for enhancing the overall beverage packaging experience.

Super Insulation Technology

Super Insulation Technology Revolutionizing Efficiency and Performance of LN₂ Dosing



Introduction

Operating at an incredibly low temperature of -196°C (-77 Kelvin), LN₂ Dosing relies on advanced cryogenic technology that is commonly utilized in various industries, including biomedical, healthcare, semiconductor, green energy, and aerospace. An essential aspect of LN₂ Dosing is the effective insulation required to maintain these ultra-low temperatures. This is where super insulation technology, particularly Multi-Layer Insulation (MLI), has emerged as a groundbreaking solution, revolutionizing the efficiency and performance of LN₂ dosing systems.

Multi-layer Insulation MLI:

Super insulation technology refers to a class of advanced insulation materials and techniques designed to achieve exceptional thermal insulation properties. MLI, a widely utilized form of super insulation, consists of multiple layers of thin, reflective films separated by low-conductivity spacers. These layers effectively impede the transfer of heat through conduction, convection, and radiation, ensuring the preservation of extremely low temperatures in cryogenic applications.

Benefits of Super Insulation:

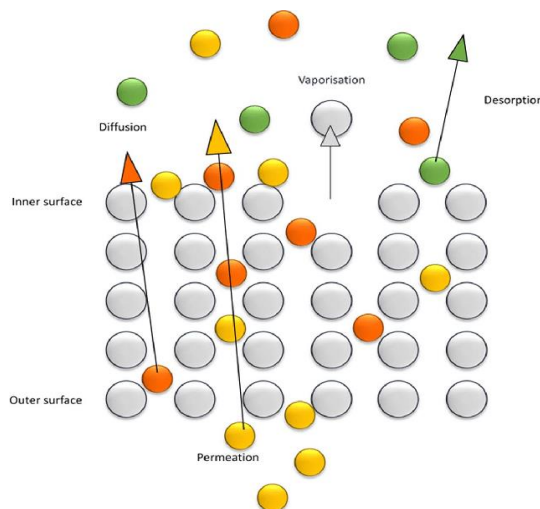
- 1. Reduced Heat Transfer:** Super insulation materials, particularly MLI, are engineered to minimize heat transfer by reflecting thermal radiation and reducing conductive pathways. The multiple layers of reflective films in MLI create a highly efficient barrier that significantly reduces heat flow, preserving the liquid nitrogen within the dosing equipment under various temperatures conditions such as cold or hot filling process, or during hot sanitization CIP or SIP process.
- 2. Increased Energy Efficiency:** By limiting heat loss, super insulation technology improved energy efficiency of LN₂ dosing equipment, lowering its operating cost by reducing LN₂ consumption, making it an economically viable choice for industries to adopt LN₂ dosing technology without the need for heavy capital investment on liquid nitrogen infrastructure for generation, storage & transfer.
- 3. Improved Dose Precision:** MLI technology improved the thermal stability of LN₂, reduce the evaporation, allow for longer storage times, maintain LN₂ in pure liquid form with consistent density, hence the dose accuracy.
- 4. System compactness:** The low weight and thickness of MLI enable the design of compact and lightweight LN₂ dosing systems. This translates into highly compact LN₂ dosing system that require smallest installation foot-print, occupying minimum space in filling machine, reduce overall COP and CIP cost in beverage production. Lighter overall weight also means less mechanical load stress to filling and capping machine.
- 5. Improved personnel and process safety:** Super insulation technology enhances personnel safety in liquid nitrogen handling, avoiding cold burn injury. Super insulation is contamination-free compared to polyurethane foam insulation, which degrades over time and sheds foam particles, causing excessive contamination to the production environment.

Challenge in Super Insulated Technology

When liquid nitrogen is transported through a vacuum jacketed pipe (VJP) system, heat transfer can occur due to imperfections or defects in the vacuum jacket design, construction or gradual loss of insulation performance due to hydrogen and other molecules outgassing within the vacuum insulation system.

There are 4 main mechanisms which contribute to outgassing:

1. Vaporisation of the actual surface material itself
2. Desorption — this is the reverse process of adsorption; the release of molecules bound at the surfaces of the material
3. Diffusion — this is the movement of molecules from the inner structure of the material to the surface
4. Permeation — this is the movement of molecules from the external atmosphere through the jacket pipe wall to the vacuum surface



Outgassing

Outgassing, which is the process by which gases trapped within the VJP system are released over time. As the gases within the VJP system are released, they can reduce the vacuum pressure within the system, which can result in a reduction in the thermal insulation performance of the VJP. This is because the vacuum pressure within the VJP system is critical to its thermal insulation properties. A high vacuum level (lower vacuum pressure) reduces the thermal conduction between the inner and outer pipes, which helps to maintain the temperature of the transported fluid.

To mitigate the effects of outgassing, CSM use materials that have low outgassing rates, maintain high vacuum quality within the VJP system, and perform proper cleaning and degassing of the materials used in the VJP. In addition, VJP manufacturers may also incorporate getter & molecular sieve materials into the VJP system.

Getters & Molecular Sieve

Getters & molecular sieves are materials that are used in vacuum jacketed pipes (VJPs) to absorb or trap gases, including those released through outgassing, to help maintain the vacuum quality within the VJP system and preserve its thermal insulation properties. However, if the getters become exhausted, their ability to absorb or trap gases is diminished, which can lead to a loss of insulation performance in the VJP.

Exhaustion of getters can occur due to a variety of factors, including exposure to gases that cannot be absorbed or trapped by the getter material, gas saturation, or simply the natural degradation of the getter material over time.

When a getter becomes exhausted, it can no longer effectively absorb or trap gases, and any remaining gases within the VJP system can begin to degrade the vacuum quality. This can lead to an increase in thermal conduction between the inner and outer pipes.

Heat Transfer in LN₂ Doser

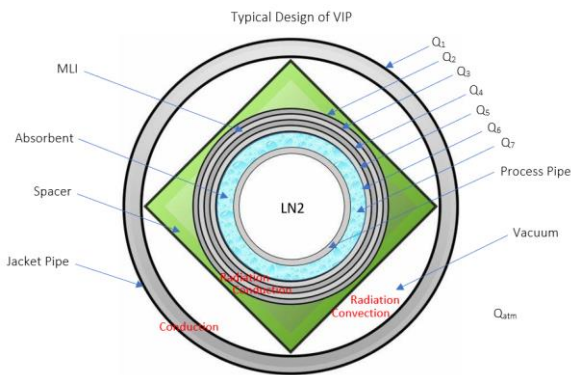
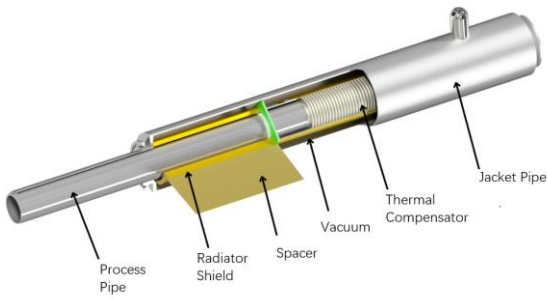
Transfer of thermal energy at extremely low temperatures, involving conduction, convection, and radiation in cryogenic systems

Introduction:

The primary challenge in LN₂ dosing is for an efficient and cost-effective method to minimize heat transfer. All liquid seek an equilibrium with surrounding temperature. Cryogen such as liquid nitrogen at -320°F (-196 °C) seeks to reach an equilibrium with the atmospheric temperature surrounding the transfer pipe, resulting in heat evaporation loss.

Design of Super Insulation:

The inner vessel and pipe which carries the cryogenic liquid is wrapped with multiple layers of super-insulation materials, consisting of alternating layers of radiant heat barrier material and non-conductive spacer material. The MLI density is 25 layers/cm with total of 40 to 50 layers. Also, the vacuum annulus space contains hydrogen getter and molecular sieve materials to absorb gas and moisture molecules to further improve the vacuum life-time. Most importantly, the space between the two stainless vessel is evacuated and then sealed in a static vacuum system or by a on-site vacuum pump in dynamic vacuum system.



$$Q_7 < Q_6 < Q_5 < Q_4 < Q_3 < Q_2 < Q_1 < Q_{atm}$$

Heat Transfer Modes:

Heat is transferred in the following ways:

- Conduction — The heat is conducted through lateral support and residual gas conduction

$$Q_{cond} = -kA \frac{dT}{dx} \approx kA \frac{T_1 - T_2}{l}$$

- Convection — The gas molecule between outer and inner surface convection heat into the liquid cryogen

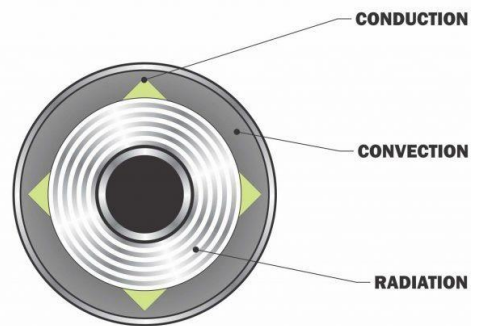
$$Q_{conv} = hA(T_{surf} - T_{surr})$$

- Radiation — The radiation heat transfer from 300K outer surface to 77K inner surface

$$Q_{rad} = \frac{\sigma A (T_1^4 - T_2^4)}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1}$$

- Total heat transfer across this element by all possible mode of heat transfer is summarized as below:

$$Q_T = Q_{Gas} + Q_{Solid} + Q_{Conv} + Q_{Rad}$$



Liquid Nitrogen Piping Solution

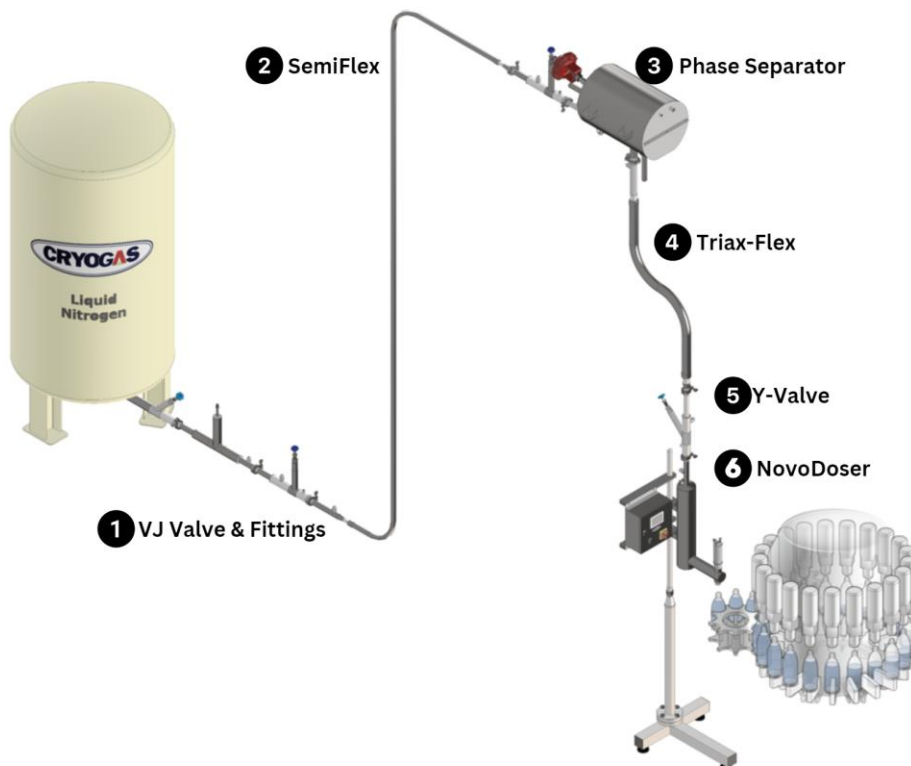
Introduction

The transfer liquid nitrogen over any distance in a plant, whether indoors or outdoors, requires special piping insulation. Issues that need to be considered in cryogenic liquid (cryogen) transfer includes the economic loss of cryogen through evaporation and quality degradation of the cryogen delivered at the point of use.

Under normal operational circumstances, the liquid in the system is constantly vaporizing into gaseous nitrogen due to constant heat leak. The accumulated gas in the pipeline will result in excessive gas within the transfer system which causes:

1. LN2 doser starve of liquid nitrogen, resulted in inconsistent dosing accuracy
2. Excessive vapor phase resulted in higher gas content in liquid and affect dose accuracy
3. Inconsistent delivery of liquid nitrogen due to plug and slug flow conditions
4. Increased in operating cost due to higher heat loss
5. Variation in cool-down time from one point to another
6. Diminished cryogen cooling capacity, warmer liquid with higher enthalpy

A typical LN2 piping system using Semi-Flex products



Rigid Vacuum Jacketed Pipe

Rigid VJP is easier to install than traditional foam insulated copper pipe and is designed to be maintenance-free for a minimum of 10 years, with no system heat leaks performance deterioration over that period. Pipe sections are joined with vacuum-insulated bayonet connectors that provide frost-free connections.

The thermal barrier between the inner and outer lines are so effective that the outer pipe remains at room temperature even while -196°C (-320°F) liquid nitrogen is flowing through the inner line. Rigid VJP can also be exposed to direct sunlight without affecting the system's performance.

CSM provides various pipe standard option of rigid VJP, such as Rigid-T (ASTM/EN tube sizes) with C-series bayonet connection; and Rigid-P (ASTM pipe sizes) with B-series bayonet or Welded connection.

Flexible Vacuum Jacketed Pipe

Pre-engineered modular flexible vacuum jacketed transfer hose has added advantage over the rigid VJP, especially when system upgrade is frequently done. This option is cost saving as the flexibility of the pipe reduces the necessity for precise system layout measurements. It allows the whole system to be easily reused if use-point locations and plant layout are changed. Flexible can be added if required to the existing system without major rework expenses. Additionally, flexible VJP can be coiled for shipment by air freight, thus eliminate the need for expensive logistics.

CSM provides various flexible VJP options to suit different flexibility requirement. Semi-Flex is a semi-rigid VJP but spool length up to 18 meters with modest bend radius for on site installation without necessary to use an elbow. Cryo-Flex is more flexible but limited to shorter spool length below 4 meters, usually use as tie-in hose to bulk storage tank or equipment, or a flexible section to overcome offset or misalignment in a Rigid VJ Piping system.



Semi-Flex liquid nitrogen piping system

LN2 system Enquiry Form

Date: _____

Project:			
Client:			
Plant Location:			
Expected Start Date of Project:		Expected Date for System Handover:	
1. Pipeline System Information			
1.1 LN2 Storage Tank: (1) Capacity: _____ Liter (2) Pressure: _____ barG			
1.2 Tank Withdrawal Valve: <input type="checkbox"/> Vacuum Jacketed <input type="checkbox"/> Non-Vacuum Jacketed			
1.3 Piping length: _____ meter			
1.4 Type of Piping: <input type="checkbox"/> Rigid <input type="checkbox"/> Flex			
1.5 Vacuum Insulation Type: <input type="checkbox"/> Static <input type="checkbox"/> Dynamic			
1.6 Point of Use: (1) Quantity: _____ nos (2) Tie-in Flex hose Length: _____ meter (3): Pressure required _____ barG			
1.7 Conditioning Equipment: <input type="checkbox"/> Phase separator <input type="checkbox"/> Electronic Cryovent <input type="checkbox"/> Mechanical Cryovent			
2. Process Equipment Information			
2.1 Application Type: <input type="checkbox"/> Semicon <input type="checkbox"/> Life Sciences Others: _____			
2.2 Brand & Model Info:			
2.3 Required Flowrate for each machine: _____ kg/hr			
2.4 Quantity: _____ nos			
3. Cleanroom Information			
3.1 Pipe routing: <input type="checkbox"/> SubFab <input type="checkbox"/> Below Raise Floor <input type="checkbox"/> Above Ceiling <input type="checkbox"/> Under Ceiling			
3.1 Ceiling Height: _____ meter		Raise Floor Height: _____ meter	
3.2 Working Height above the Ceiling: _____ meter;		Ceiling type: <input type="checkbox"/> Walkable <input type="checkbox"/> Non-walkable	
3.3 Roof Height: _____ meter			
3.4 Production Area: _____ m ²			
4. Project General Information			
4.1 Type of application: <input type="checkbox"/> semiconductor <input type="checkbox"/> Life sciences Others: _____			
4.2 Date Process Equipment arrive at site: __/__/____			
4.3 Hand over date of LN2 supply system: __/__/____			
4.4 Key contact person coordinating for LN2 supply system specification and purchase (Tender):			
4.5 Drawings required: Equipment Layout <input type="checkbox"/> Building <input type="checkbox"/> Pipe routing <input type="checkbox"/> System P&ID <input type="checkbox"/>			
5. Customer Information			
5.1 Name:			
5.2 Contact No:			
5.3 Email:			

NovoDoser

New Generation Precision Doser



NovoDoser Technological Benefits

Introduction:

The history and development of LN2 (liquid nitrogen) dosing can be traced back several decades. Here is an overview of the key milestones and advancements in LN2 dosing:

1. Early Adoption and Industrial Application:

Liquid nitrogen dosing first gained prominence in the food and beverage industry, specifically in the bottling and packaging of carbonated beverages. In the 1960s and 1970s, companies started using LN2 dosing to displace oxygen from bottles before sealing them, thereby extending the shelf life of the beverages and preserving their carbonation.

2. Advancements in Dosing Technology:

As the demand for LN2 dosing grew, technological advancements took place to improve dosing precision and efficiency. In the early days, LN2 was manually injected into containers in continuous mode, with limited controllability. However, with the advent of automation and the development of dedicated dosing systems, dosing controllability, accuracy and reliability significantly improved. With the advancement of automation and control technologies in 2000s, LN2 dosing systems started integrating with sophisticated control systems. This integration allowed for precise control over dosing parameters, such as dosing time, dosing volume, and flow rates. Real-time data monitoring and analysis further enhanced process optimization and quality assurance. The adoption of IOT technology in 2020s further enhance dosing system multiple device connectivity and cloud data storage.

3. Introduction of Precision Dosing Systems:

In the 1990s, precision LN2 dosing systems specifically designed for industrial applications became available. These systems incorporated features such as automated control, precise dosing volumes, and real-time monitoring. The introduction of these advanced systems allowed for more efficient dosing processes and better product quality control. The introduction of precision electric dosing valve in 2010s improve the dosing accuracy and consistency to a new level.

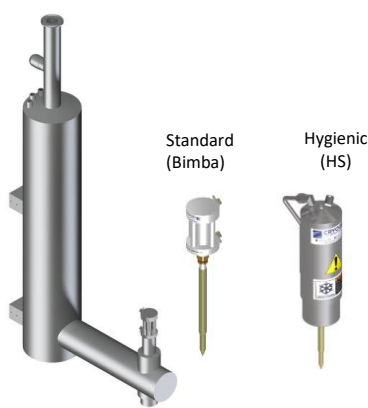
4. Expansion into Various Industries:

Over time, LN2 dosing found applications beyond the food and beverage industry. It began to be utilized in pharmaceuticals, electronics, automotive, and other sectors where precise dosing and controlled environments were crucial. LN2 dosing proved beneficial for applications such as inerting, blanketing, cooling, shrink fitting, and surface demolding in contact lens production.

5. Improved Safety Measures:

As LN2 is a cryogenic liquid with extremely low temperatures, safety measures and regulations surrounding LN2 dosing evolved. Safety features like pressure relief valves, leak detection systems, and enhanced operator training became standard practices to mitigate the risks associated with handling and storing LN2.

Dosing Valve - Pneumatic Vs Electric



Pneumatic Dosing Valve



Electric Dosing Valve

Benefits of Pneumatic Valves:

1. High force and torque capabilities: Pneumatic valves can generate significant force and torque, making them suitable for applications that require strong actuation. They can handle high-pressure fluids or gases and provide reliable control over larger flow rates.
2. Safety in hazardous environments: Pneumatic valves are often preferred in environments where electrical devices may pose safety risks, such as explosive or flammable atmospheres. Since they operate purely on compressed air, they eliminate the risk of electrical sparks or short circuits.
3. Fail-safe operation: In the event of a power failure, pneumatic valves typically default to a safe position, ensuring system integrity and preventing potential hazards. This fail-safe feature adds an extra layer of safety and reliability to pneumatic systems.

Benefits of Electric Valves:

1. Fast and precise operation: Solenoid valves offer quick response times, allowing for rapid opening and closing of the valve. This enables precise control over the dosing.
2. Energy efficiency: Solenoid valves consume minimal power when in operation. They only require electrical energy during the brief periods when the valve is actuated. The energy cost is lower compared to pneumatic system.
3. Long life cycle: Solenoid valves are typically having lesser wear & tear parts. This translate to much longer life cycle, better accuracy and consistency dosing in the entire working life span.

It's important to note that the selection of solenoid valves or pneumatic valves depends on the specific requirements of the application. Factors such as operating conditions, response time, and control precision should be considered when choosing the appropriate valve type for a given system.

Liquid Level Control



Mechanical Float Level Control
NovoDoser LP



Electro-Pneumatic Level Control
NovoDoser HP

Benefits of Mechanical Float Level Control:

1. Simplified level control mechanism: The absence of instruments to calibrate simplifies operation and system settings, eliminating any risks associated with instrument failure.
2. Consistent level control: Float valves ensure a consistent head pressure, resulting in precise dosing accuracy and improved repeatability.
3. Reduced maintenance: With no need to purchase, store, troubleshoot, or replace level instruments, maintenance efforts and costs are significantly minimized.

Benefits of Instrument Level Control:

1. Supply pressure flexibility – suitable for liquid supply pressure from 30 psi to 100psi
2. Customizable head pressure: With instrument level control, operators have the flexibility to select and adjust the head pressure according to specific production requirements. This includes considerations such as hot filling, cold filling, and minimizing dose splashing, among others.
3. Enhanced liquid level display: The presence of level instruments enables more advanced level control, providing accurate level display and remote monitoring capabilities.
4. Integration for quality management: Instrument level control facilitates seamless integration with system data, allowing for efficient collection of liquid level information. This data can then be utilized for production quality monitoring and management purposes.

NovoDoser®

Liquid Nitrogen Dosing

A new generation liquid nitrogen doser with frost-free operation, food grade austenitic stainless steel material, hygienic wash-down design in compliance to stringent HACCP requirement



EA Head (Electric)

How it Works

LN2 is supplied to the doser by a vacuum insulated pipe and flows into the dosing head. Sensor will detect the container and send pulses to the controller. Controller will command the dosing head to dispense the required amount of LN2 into the container. LN2 droplets quickly evaporate and expand 700 X into gaseous N2 equivalent, filling the container headspace with inert N2 gas at the desired pressure.

Applications

- **Container Rigidity** – Enhance bottle or can's strength and eliminate paneling especially in hot filling process
- **Container Light-weighting** – Reduce packaging cost and environmental carbon footprint
- **Oxygen Exclusion** – Reduce residual oxygen in product headspace to prevent oxidation to the product
- **Extend Product Shelf Life** – N2 in product packaging can extend product shelf life longer
- **Replace Traditional MAP** – Increase inerting efficiency and effectiveness compared to inert gas flushing
- **Nitro-infused Beverage** – Nitro-infusion gives the drink its thick and creamy texture, enhanced mouthfeel and flavor

Ergonomic Features and Benefits

- **Frost-free Nozzle** – Self-generating GN2 for dosing head blanketing
- **Consistent Container Pressure** – Deliver accurate dosing $\pm 1\%$
- **Lowest LN2 Consumption** – Discrete dosing, for speed up to 2500* containers per minute
- **Lowest LN2 Losses** – Proprietary vacuum insulation with lowest heat leak 0.1 LPH
- **Minimized Product Splash** – Lowest dose pressure in its class, 0.3 psi
- **Sub-cooled LN2** – Ensuring constant LN2 density for accurate dosing
- **Corrosion Resistant** – 316L material grade of construction for doser body
- **Highest Hygiene Design** – All external surface has rounded corners and sloped design for easy wash-down
- **Lowest Maintenance** – Ultra long life cycle dosing valve > 60 million; and IP 65 rated sensors & electrical cables
- **Ease of Installation** – Compact size for easy installation in limited space
- **Applications Flexibility** – Compatible with soft-dose and micro-dose technology for hot fill, powder, and granular applications
- **Multi-lingual HMI** – English, Spanish, Chinese, etc
- **5 Years Vacuum Warranty** – Lowest cost of ownership



ES Head (Electronic)

NovoDoser® Specifications

Body Type	L series	H series	Q series
Material	Stainless Steel 300 Series	Stainless Steel 300 Series	Stainless Steel 300 Series
Head Pressure	0.3psi	0.55psi	1.05psi
Nozzle Blanketing	Self-Generate N2	Self-Generate N2	Self-Generate N2
Steady State Consumption	< 0.026 gal / hour (< 0.1 liter / hour)	< 0.029 gal / hour (< 0.11 liter / hour)	< 0.035 gal / hour (< 0.13 liter / hour)
Body Dimension*	36"H x 5"W (910 x 129mm)	42"H x 5"W (1070 x 129mm)	58"H x 5"W (1474 x 129mm)
Dosing Head Arm Reach	18" (457mm)	18" (457mm)	31" (788mm)
Weight	30lbs (14kg)	35lbs (16kg)	44lbs (19kg)
Utilities: Liquid Nitrogen Supply	22 psi (1.5 bar)	30 ~ 100 psi (2.0 ~ 6.5 bar)	22 psi (1.5 bar)
Gaseous N ₂	60 - 100 psi	60 - 100 psi	60 - 100 psi
Electrical	110-220VAC	110-220VAC	110-220VAC

* Dosing Head Dimension: **Pneumatic** – Bimba Head: 2.5"H x 1.5"W (62 x 38mm) ; HS Head: 14" x 2.5"W (356 x 64mm)
Electric – EA Head : 6.4"H x 2"W (162 x 45mm) ; ES Head : 9.7"H x 1.6"W (247 x 40mm)

Controller Specifications

Model	500FD	800SC	2000DSC
PLC Platform	Siemens S7-1200	Siemens S7-1200	Siemens S7-1200
HMI (LCD touch screen)	4.3" Color	4.3" Color	7.0" Color
Dose Duration, 1ms interval	20 to 1500 ms	15 to 1500 ms	5 to 1500 ms
Dose Volume, mg/dose	15 to 1400	10 to 1400	5 to 1400
Dose Accuracy	± 3%	± 2%	± 1%
Max. Discrete Dosing	500 CPM	800 CPM	2000 CPM
Fixed Delay	✓	✓	✓
Speed Compensation		✓	✓
Dose Compensation		✓	✓
Dynamic Dose	✓		
Encoder Compatible			✓
Nozzle Pre-Cooling	Manual	Manual	Automatic
Dose Head Purging	Optional (Manual)	Automatic	Automatic
Nozzle Defrost	Optional (Manual)	Automatic	Automatic
User's Filler Signal Interface			Optional
Modbus RTU User Interface	✓	✓	✓
Mobile Remote Monitoring (Wi-Fi / Lan)			✓
Smart Maintenance			✓
Overall Equipment Effectiveness	✓	✓	✓
Recipe Storage	5	5	12
Dosing Head	Pneumatic / Electric	Pneumatic / Electric	Pneumatic / Electric
Certifications	CE, IP65	CE, IP65	CE, IP66



NovoDoser®

L series 500FD

A new generation liquid nitrogen doser with frost-free operation, food grade austenitic stainless steel material, hygienic wash-down design in compliance to stringent HACCP requirement

Specifications

- Discrete dosing up to 500 CPM
- Controller with Siemen S7-1200 PLC platform
- NEMA 4X IP65 stainless steel enclosure
- HMI comes with TFT color touch screen
- Minimum dose duration 20mS
- Accurate dose weight $\pm 3\%$
- No container No dose function
- Smart-maintenance to allow user plan the maintenance schedule
- Direct LN2 feed pressure up to 30psi (2.0 Bar)
- Dynamic dose with 10 container pockets settings for dose duration and dose delay, specially for filler with batch filling
- Recipe storage up to 5 recipes
- 316L material construction higher corrosion resistance
- Optional HS Pneumatic Hygienic Dosing Head wash-down design
- ModBus user interface
- Multi-lingual HMI: English, Spanish, Chinese, etc

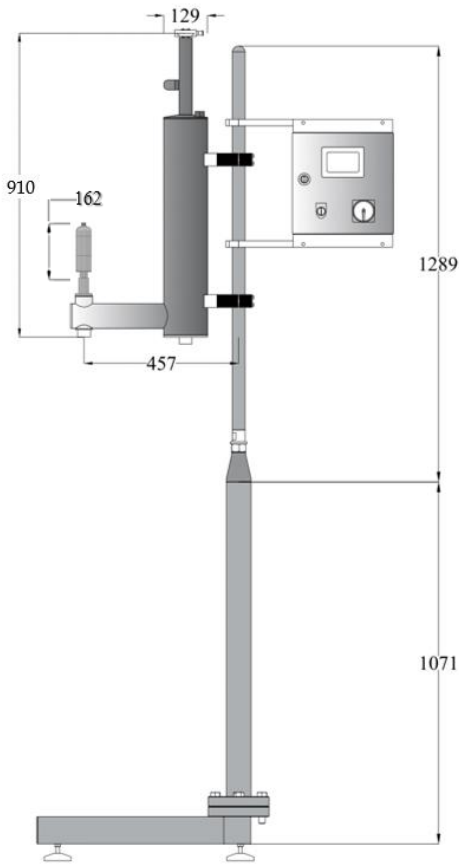
Ergonomic Features and Benefits

- **Frost-free Nozzle** – Self-generating GN2 for dosing head blanketing
- **Lowest LN2 Consumption** – Discrete dosing, for speed up to 500 containers per minute
- **Lowest LN2 Losses** – Proprietary vacuum insulation with lowest heat leak 0.1 LPH
- **Minimized Product Splash** – Lowest dose pressure in its class, 0.3 psi
- **Sub-cooled LN2** – Ensuring constant LN2 density for accurate dosing
- **Corrosion Resistant** – 316L material grade of construction for doser body
- **Highest Hygiene Design** – All external surface has rounded corners and sloped design for easy wash-down
- **Lowest Maintenance** – Ultra long life cycle dosing valve > 60 million; and IP 65 rated sensors & electrical cables
- **Ease of Installation** – Compact size for easy installation in limited space
- **Applications Flexibility** – Compatible with soft-dose and micro-dose technology for hot fill, powder, and granular applications
- **5 Years Vacuum Warranty** – Lowest cost of ownership

NovoDoser® L series 500FD

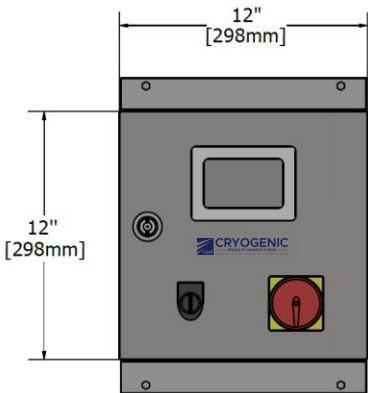
Dimensions

Material	Stainless Steel 300 Series
Head Pressure	0.3psi
Nozzle Blanketing	Self-Generated N2
Steady State Consumption	< 0.026 gal (0.10 liter) / hour
Body Dimension	36"H x 5"W (910 x 129mm)
Dosing Head Dimension	EA Head 6.4"H x 2"W (162x45mm)
Dosing Head Arm Reach	18" (457mm)
Weight	30lbs (14kg)
Utilities	Liquid Nitrogen : 22 psi Gaseous N ₂ : 60 - 100 psi Electrical : 110-220VAC



500FD Controller Specifications

PLC Platform	Siemens S7-1200
HMI (LCD touch screen)	4.3" Color
Dose Duration, 1ms int.	20 to 1500 ms
Dose Volume, mg/dose	15 to 1400
Dose Accuracy	± 2%
Max. Discrete Dosing	500 CPM
Dynamic Dose 10 pockets	✓
Fixed Delay	✓
Quick Service Purging	Optional (Manual)
Nozzle Defrost	Optional (Manual)
Nozzle Pre-Cooling	Manual
Modbus RTU User Interface	✓
Overall Equipment Effectiveness	✓
Recipe Storage	5
HS Hygienic Dosing Head	Optional
Certifications	CE, IP65



NovoDoser®

L series 800SC

A new generation liquid nitrogen doser with frost-free operation, food grade austenitic stainless steel material, hygienic wash-down design in compliance to stringent HACCP requirement



Specifications

- Discrete dosing up to 800 CPM
- Controller with Siemen S7-1200 PLC platform
- NEMA 4X IP65 stainless steel enclosure
- HMI comes with TFT color touch screen
- Minimum dose duration 15mS
- Accurate dose weight +/-2%
- No container No dose function
- Smart-maintenance to allow user plan the maintenance schedule
- Direct LN2 feed pressure up to 30psi (2.0 Bar)
- ModBus user interface
- Alarm log to assist system trouble shooting and performance monitoring
- Recipe storage up to 5 recipes
- 316L material construction higher corrosion resistance
- Optional HS Pneumatic Hygienic Dosing Head wash-down design
- Multi-lingual HMI: English, Spanish, Chinese, etc

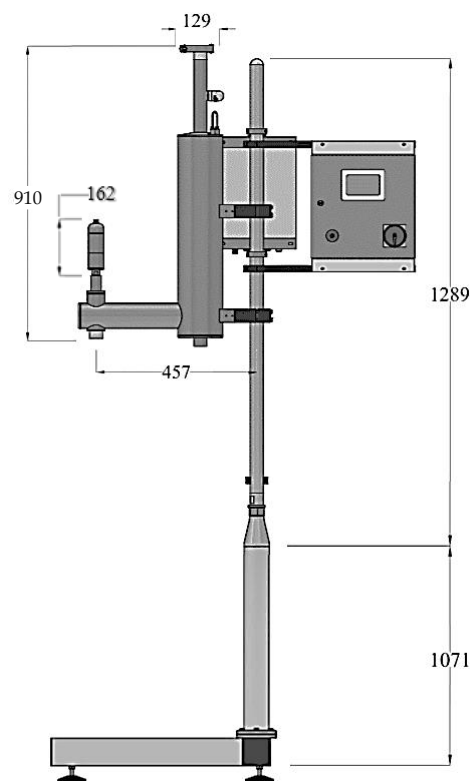
Ergonomic Features and Benefits

- **Frost-free Nozzle** – Self-generating GN2 for dosing head blanketing
- **Lowest LN2 Consumption** – Discrete dosing, for speed up to 800 containers per minute
- **Lowest LN2 Losses** – Proprietary vacuum insulation with lowest heat leak 0.1 LPH
- **Minimized Product Splash** – Lowest dose pressure in its class, 0.3 psi
- **Sub-cooled LN2** – Ensuring constant LN2 density for accurate dosing
- **Corrosion Resistant** – 316L material grade of construction for doser body
- **Highest Hygiene Design** – All external surface has rounded corners and sloped design for easy wash-down
- **Lowest Maintenance** – Ultra long life cycle dosing valve > 60 million; and IP 65 rated sensors & electrical cables
- **Ease of Installation** – Compact size for easy installation in limited space
- **Applications Flexibility** – Compatible with soft-dose and micro-dose technology for hot fill, powder, and granular applications
- **5 Years Vacuum Warranty** – Lowest cost of ownership

NovoDoser® L series 800SC

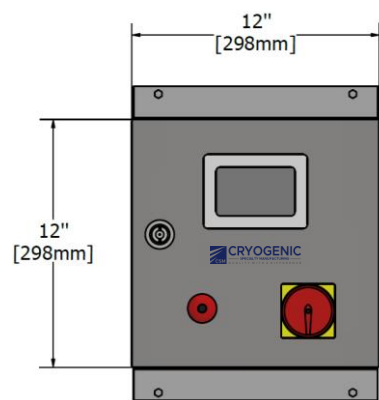
Dimensions

Material	Stainless Steel 300 Series
Head Pressure	0.3psi
Nozzle Blanketing	Self-Generated N2
Steady State Consumption	< 0.026 gal (0.10 liter) / hour
Body Dimension	36"H x 5"W (910 x 129mm)
Dosing Head Dimension	EA Head 6.4"H x 2"W (162x45mm)
Dosing Head Arm Reach	18" (457mm)
Weight	30lbs (14kg)
Utilities	Liquid Nitrogen : 22 psi Gaseous N ₂ : 60 - 100 psi Electrical : 110-220VAC



800SC Controller Specifications

PLC Platform	Siemens S7-1200
HMI (LCD touch screen)	4.3" Color
Dose Duration, 1ms int.	15 to 1500 ms
Dose Volume, mg/dose	10 to 1400
Dose Accuracy	± 2%
Max. Discrete Dosing	800 CPM
Fixed Delay	✓
Speed Compensation	✓
Dose Compensation	✓
Quick Service Purging	✓
Nozzle Defrost	Automatic
Nozzle Pre-Cooling	Manual
Modbus RTU User Interface	✓
Overall Equipment Effectiveness	✓
Recipe Storage	5
HS Hygienic Dosing Head	Optional
Certifications	CE, IP65



NovoDoser®

L series 2000DSC

A new generation liquid nitrogen doser with frost-free operation, food grade austenitic stainless steel material, hygienic wash-down design in compliance to stringent HACCP requirement

Specifications

- Discrete dosing up to 2000 CPM
- Controller with Siemen S7-1200 PLC platform
- NEMA 4X IP65 stainless steel enclosure
- HMI comes with TFT color touch screen
- Minimum dose duration 5mS
- Accurate dose weight +/-1%
- No container No dose function
- Smart-maintenance to allow user plan the maintenance schedule
- Direct LN2 feed pressure up to 30psi (2.0 Bar)
- ModBus user interface
- Alarm log to assist system trouble shooting and performance monitoring
- Recipe storage 10 recipes or more
- 316L material construction higher corrosion resistance
- HS Pneumatic Hygienic Dosing Head wash-down design, IP65 rated
- Multi-lingual HMI: English, Spanish, Chinese, etc



Ergonomic Features and Benefits

- **Frost-free Nozzle** – Self-generating GN2 for dosing head blanketing
- **Lowest LN2 Consumption** – Discrete dosing, for speed up to 2000* containers per minute
- **Lowest LN2 Losses** – Proprietary vacuum insulation with lowest heat leak 0.1 LPH
- **Minimized Product Splash** – Lowest dose pressure in its class, 0.3 psi
- **Sub-cooled LN2** – Ensuring constant LN2 density for accurate dosing
- **Corrosion Resistant** – 316L material grade of construction for doser body
- **Ease of Maintenance** – Achievable by system smart maintenance and remote monitoring
- **Highest Hygiene Design** – All external surface has rounded corners and sloped design for easy wash-down
- **Lowest Maintenance** – Ultra long life cycle dosing valve > 60 million; and IP 65 rated sensors & electrical cables
- **Ease of Installation** – Compact size for easy installation in limited space
- **Applications Flexibility** – Compatible with soft-dose and micro-dose technology for hot fill, powder, and granular applications
- **5 Years Vacuum Warranty** – Lowest cost of ownership

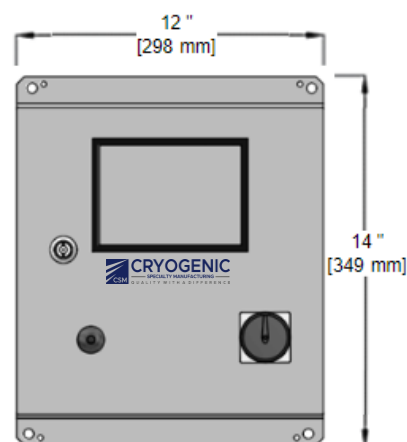
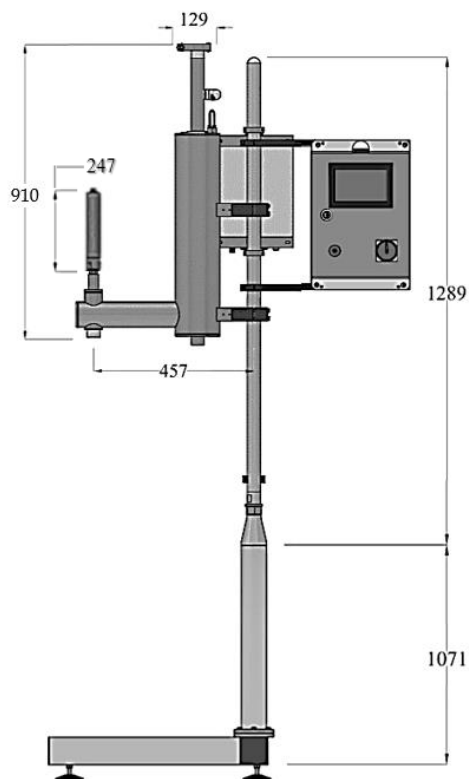
NovoDoser® L series 2000DSC

Dimensions

Material	Stainless Steel 300 Series
Head Pressure	0.3psi
Nozzle Blanketing	Self-Generated N2
Steady State Consumption	< 0.026 gal (0.10 liter) / hour
Body Dimension	36"H x 5"W (910 x 129mm)
Dosing Head Dimension	ES Head 9.7" x 1.6"W (247 x 40mm)
Dosing Head Arm Reach	18" (457mm)
Weight	30lbs (14kg)
Utilities	Liquid Nitrogen : 22 psi Gaseous N2 : 60 - 100 psi Electrical : 110-220VAC

2000DSC Controller Specifications

PLC Platform	Siemens S7-1200
HMI (LCD touch screen)	7.0" Color
Dose Duration, 1ms int.	5 to 1500 ms
Dose Volume, mg/dose	5 to 1400
Dose Accuracy	± 1%
Max. Discrete Dosing	2000 CPM
Fixed Delay	✓
Speed Compensation	✓
Dose Compensation	✓
Encoder Compatible	✓
Quick Service Purging	✓
Nozzle Auto Defrost	Automatic
Nozzle Pre-Cooling	Automatic
User's Filler Signal Interface	Optional
Modbus RTU User Interface	✓
Mobile Remote Monitoring (Wi-Fi / Lan)	✓
Smart Maintenance	✓
Overall Equipment Effectiveness	✓
Recipe Storage	12
HS Hygienic Dosing Head	✓
Certifications	CE, IP66



NovoDoser®

H series 800SC

A new generation liquid nitrogen doser with frost-free operation, food grade austenitic stainless steel material, hygienic wash-down design in compliance to stringent HACCP requirement



Specifications

- Discrete dosing up to 800 CPM
- Controller with Siemen S7-1200 PLC platform
- NEMA 4X IP65 stainless steel enclosure
- HMI comes with TFT color touch screen
- Minimum dose duration 15mS
- Accurate dose weight +/-2%
- No container No dose function
- Smart-maintenance to allow user plan the maintenance schedule
- Direct LN2 feed pressure up to 30psi (2.0 Bar)
- ModBus user interface
- Alarm log to assist system trouble shooting and performance monitoring
- Recipe storage up to 5 recipes
- 316L material construction higher corrosion resistance
- Optional HS Pneumatic Hygienic Dosing Head wash-down design
- Multi-lingual HMI: English, Spanish, Chinese, etc

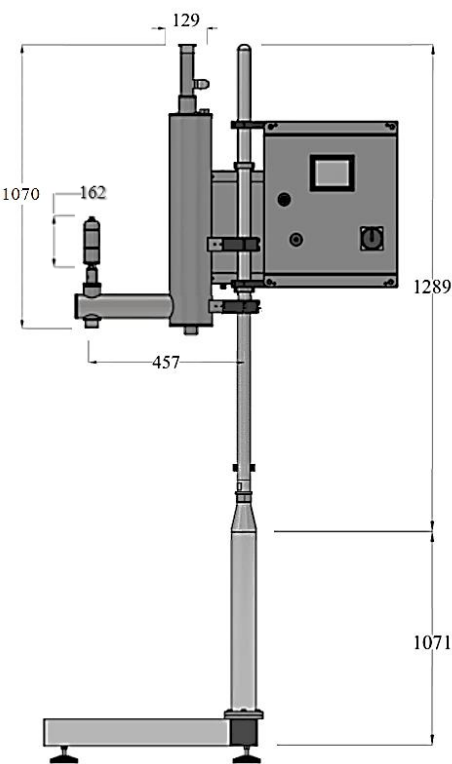
Ergonomic Features and Benefits

- **Frost-free Nozzle** – Self-generating GN2 for dosing head blanketing
- **Lowest LN2 Consumption** – Discrete dosing, for speed up to 800 containers per minute
- **Lowest LN2 Losses** – Proprietary vacuum insulation with lowest heat leak 0.1 LPH
- **Minimized Product Splash** – Lowest dose pressure in its class, 0.3 psi
- **Sub-cooled LN2** – Ensuring constant LN2 density for accurate dosing
- **Corrosion Resistant** – 316L material grade of construction for doser body
- **Highest Hygiene Design** – All external surface has rounded corners and sloped design for easy wash-down
- **Lowest Maintenance** – Ultra long life cycle dosing valve > 60 million; and IP 65 rated sensors & electrical cables
- **Ease of Installation** – Compact size for easy installation in limited space
- **Applications Flexibility** – Compatible with soft-dose and micro-dose technology for hot fill, powder, and granular applications
- **5 Years Vacuum Warranty** – Lowest cost of ownership

NovoDoser® H series 800SC

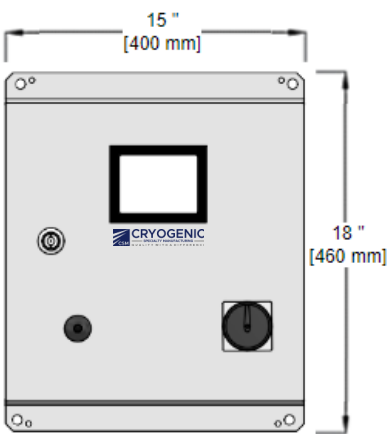
Dimensions

Material	Stainless Steel 300 Series
Head Pressure	0.15 ~ 0.55 psi
Nozzle Blanketing	Self Generated N2
Steady State Consumption	< 0.029 gal (0.11 liter) / hour
Body Dimension	42"H x 5"W (1070 x 129mm)
Dosing Head Dimension	EA Head 6.4"H x 1.8"W (162x45mm)
Dosing Head Arm Reach	18" (457mm)
Weight	35lbs (16kg)
Utilities	Liquid Nitrogen : 30 ~ 100 psi Gaseous N2 : 60 - 100 psi Electrical : 110-220VAC



800SC Controller Specifications

PLC Platform	Siemens S7-1200
HMI (LCD touch screen)	4.3" Color
Dose Duration, 1ms int.	15 to 1500 ms
Dose Volume, mg/dose	10 to 1400
Dose Accuracy	± 2%
Max. Discrete Dosing	800 CPM
Fixed Delay	✓
Speed Compensation	✓
Dose Compensation	✓
Quick Service Purging	✓
Nozzle Defrost	Automatic
Nozzle Pre-Cooling	Manual
Modbus RTU User Interface	✓
Overall Equipment Effectiveness	✓
Recipe Storage	5
HS Hygienic Dosing Head	Optional
Certifications	CE, IP65



NovoDoser®

H series 2000DSC

A new generation liquid nitrogen doser with frost-free operation, food grade austenitic stainless steel material, hygienic wash-down design in compliance to stringent HACCP requirement

Specifications

- Discrete dosing up to 2000 CPM
- Controller with Siemen S7-1200 PLC platform
- NEMA 4X IP65 stainless steel enclosure
- HMI comes with TFT color touch screen
- Minimum dose duration 5mS
- Accurate dose weight +/-1%
- No container No dose function
- Smart-maintenance to allow user plan the maintenance schedule
- Direct LN2 feed pressure up to 30psi (2.0 Bar)
- ModBus user interface
- Alarm log to assist system trouble shooting and performance monitoring
- Recipe storage up to 12 recipes
- 316L material construction higher corrosion resistance
- Optional HS Pneumatic Hygienic Dosing Head wash-down design
- Multi-lingual HMI: English, Spanish, Chinese, etc



Ergonomic Features and Benefits

- **Frost-free Nozzle** – Self-generating GN2 for dosing head blanketing
- **Lowest LN2 Consumption** – Discrete dosing, for speed up to 800 containers per minute
- **Lowest LN2 Losses** – Proprietary vacuum insulation with lowest heat leak 0.1 LPH
- **Minimized Product Splash** – Lowest dose pressure in its class, 0.3 psi
- **Sub-cooled LN2** – Ensuring constant LN2 density for accurate dosing
- **Corrosion Resistant** – 316L material grade of construction for doser body
- **Highest Hygiene Design** – All external surface has rounded corners and sloped design for easy wash-down
- **Lowest Maintenance** – Ultra long life cycle dosing valve > 60 million; and IP 65 rated sensors & electrical cables
- **Ease of Installation** – Compact size for easy installation in limited space
- **Applications Flexibility** – Compatible with soft-dose and micro-dose technology for hot fill, powder, and granular applications
- **5 Years Vacuum Warranty** – Lowest cost of ownership

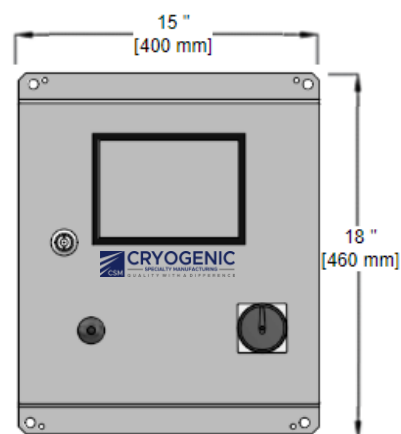
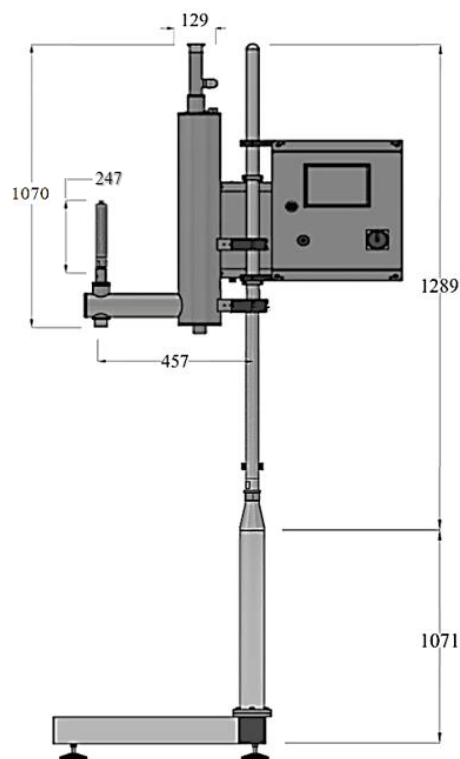
NovoDoser® H series 2000DSC

Dimensions

Material	Stainless Steel 300 Series
Head Pressure	0.15 ~ 0.55 psi
Nozzle Blanketing	Self Generated N2
Steady State Consumption	< 0.029 gal (0.11 liter) / hour
Body Dimension	42"H x 5"W (1070 x 129mm)
Dosing Head Dimension	ES Head 9.7" x 1.6"W (247 x 40mm)
Dosing Head Arm Reach	18" (457mm)
Weight	35lbs (16kg)
Utilities	Liquid Nitrogen : 30 ~ 100 psi Gaseous N2 : 60 - 100 psi Electrical : 110-220VAC

2000DSC Controller Specifications

PLC Platform	Siemens S7-1200
HMI (LCD touch screen)	7.0" Color
Dose Duration, 1ms int.	5 to 1500 ms
Dose Volume, mg/dose	5 to 1400
Dose Accuracy	± 1%
Max. Discrete Dosing	2000 CPM
Fixed Delay	✓
Speed Compensation	✓
Dose Compensation	✓
Encoder Compatible	✓
Quick Service Purging	✓
Nozzle Auto Defrost	Automatic
Nozzle Pre-Cooling	Automatic
User's Filler Signal Interface	Optional
Modbus RTU User Interface	✓
Mobile Remote Monitoring (Wi-Fi / Lan)	✓
Smart Maintenance	✓
Overall Equipment Effectiveness	✓
Recipe Storage	12
HS Hygienic Dosing Head	✓
Certifications	CE, IP66





NovoDoser®

Q series 2000DSC

A new generation liquid nitrogen doser with frost-free operation, food grade austenitic stainless steel material, hygienic wash-down design in compliance to stringent HACCP requirement

Specifications

- Discrete dosing up to 2000 CPM
- Controller with Siemen S7-1200 PLC platform
- NEMA 4X IP65 stainless steel enclosure
- HMI comes with TFT color touch screen
- Minimum dose duration 5mS
- Accurate dose weight $\pm 1\%$
- No container No dose function
- Smart-maintenance to allow user plan the maintenance schedule
- Direct LN2 feed pressure up to 30psi (2.0 Bar)
- ModBus user interface
- Alarm log to assist system trouble shooting and performance monitoring
- Recipe storage up to 4 recipes
- 316L material construction higher corrosion resistance
- Optional HS Pneumatic Hygienic Dosing Head wash-down design
- Multi-lingual HMI: English, Spanish, Chinese, etc

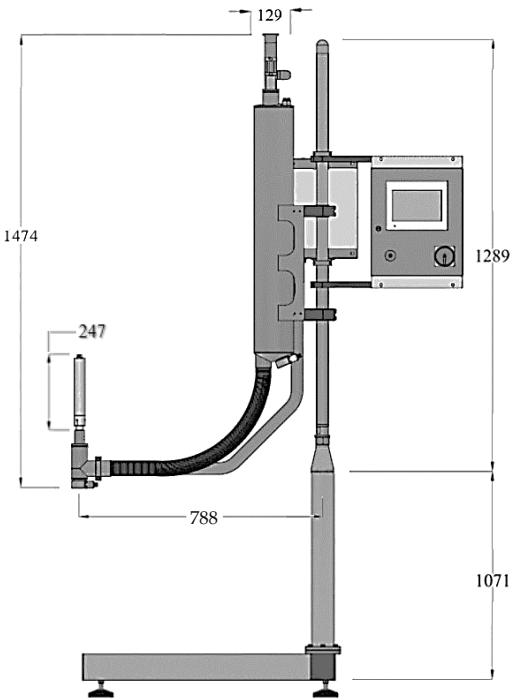
Ergonomic Features and Benefits

- **Frost-free Nozzle** – Self-generating GN2 for dosing head blanketing
- **Lowest LN2 Consumption** – Discrete dosing, for speed up to 800 containers per minute
- **Lowest LN2 Losses** – Proprietary vacuum insulation with lowest heat leak 0.1 LPH
- **Minimized Product Splash** – Lowest dose pressure in its class, 0.3 psi
- **Sub-cooled LN2** – Ensuring constant LN2 density for accurate dosing
- **Corrosion Resistant** – 316L material grade of construction for doser body
- **Highest Hygiene Design** – All external surface has rounded corners and sloped design for easy wash-down
- **Lowest Maintenance** – Ultra long life cycle dosing valve > 60 million; and IP 65 rated sensors & electrical cables
- **Ease of Installation** – Compact size for easy installation in limited space
- **Applications Flexibility** – Compatible with soft-dose and micro-dose technology for hot fill, powder, and granular applications
- **5 Years Vacuum Warranty** – Lowest cost of ownership

NovoDoser® Q series 2000DSC

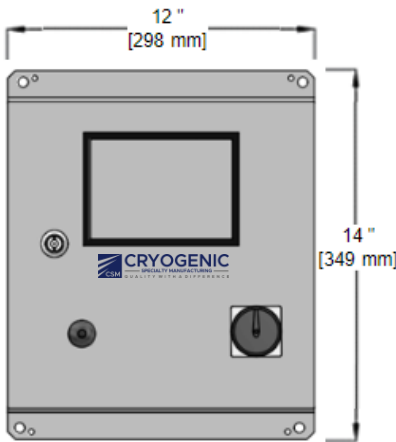
Dimensions

Material	Stainless Steel 300 Series
Head Pressure	1.05 psi
Nozzle Blanketing	Self Generated N2
Steady State Consumption	< 0.035 gal (0.13 liter) / hour
Body Dimension	58"H x 5"W (1474 x 129mm)
Dosing Head Dimension	ES Head 9.7" x 1.6"W (247 x 40mm)
Dosing Head Arm Reach	31" (788mm)
Weight	44lbs (19kg)
Utilities	Liquid Nitrogen : 22 psi Gaseous N2 : 60 - 100 psi Electrical : 110-220VAC



2000DSC Controller Specifications

PLC Platform	Siemens S7-1200
HMI (LCD touch screen)	7.0" Color
Dose Duration, 1ms int.	5 to 1500 ms
Dose Volume, mg/dose	5 to 1400
Dose Accuracy	± 1%
Max. Discrete Dosing	2000 CPM
Fixed Delay	✓
Speed Compensation	✓
Dose Compensation	✓
Encoder Compatible	✓
Quick Service Purging	✓
Nozzle Auto Defrost	Automatic
Nozzle Pre-Cooling	Automatic
User's Filler Signal Interface	Optional
Modbus RTU User Interface	✓
Mobile Remote Monitoring (Wi-Fi / Lan)	✓
Smart Maintenance	✓
Overall Equipment Effectiveness	✓
Recipe Storage	12
HS Hygienic Dosing Head	✓
Certifications	CE, IP66



NovoDoser®

M series 100M

A low cost liquid nitrogen doser with frost-free vacuum insulation, food grade austenitic stainless steel material. Suitable for R&D laboratory and small batch automatic production line



Specifications

- Manual dosing using foot switch
- Controller with Siemen PLC platform
- IP65 stainless steel enclosure
- HMI with membrane press button for ease of operation
- Integrated level gauge for ease of level monitoring
- Minimum dose duration 15mS
- Accurate dose weight +/-5%
- 304L material construction higher corrosion resistance
- Electro-pneumatic or electronic dosing head
- Upgradable to 500FD controller for automatic dosing mode with the following features:
 - ✓ Auto-dosing mode with container sensor
 - ✓ discreet doing mode (No container-No dose) up to 40CPM
 - ✓ Optional dynamic dose with 4 container pockets settings for dose duration and dose delay, specially for filler with batch filling function
 - ✓ Multi-lingual HMI: English, Chinese, Spanish etc

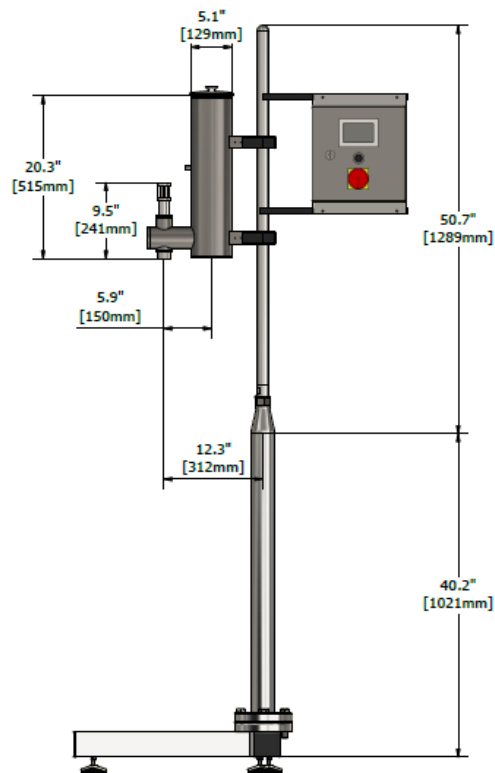
Ergonomic Features and Benefits

- **Frost-free Nozzle** – with IP65 self regulating heater
- **Lowest LN2 Losses** – Proprietary vacuum insulation with lowest heat leak 0.1 LPH
- **Minimized Product Splash** – Lowest dose pressure in its class, 0.1 - 0.3 psi
- **Sub-cooled LN2** – Ensuring constant LN2 density for accurate dosing
- **Corrosion Resistant** – 304L material grade of construction for doser body
- **Hygiene Design** – All external surface has rounded corners and sloped design for easy wash-down
- **Lowest Maintenance** – Ultra long life cycle dosing valve > 10 million
- **Ease of Installation** – Compact size for easy installation in limited space
- **Applications Flexibility** – Compatible with soft-dose and micro-dose technology for hot fill, powder, and granular applications
- **2 Years Vacuum Warranty** – Lowest cost of ownership

NovoDoser® M series 100M

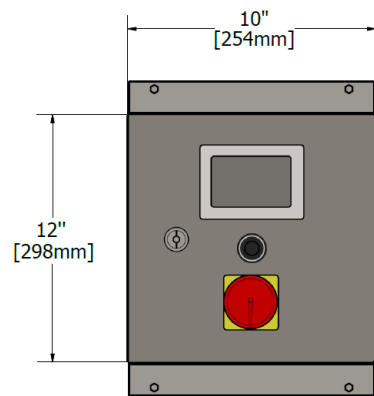
Dimensions

Material	Stainless Steel 300 Series
Head Pressure	0.1 - 0.3psi
LN2 Supply	Manual filling
Steady State Consumption	< 0.03 gal (0.05 liter) / hour
Body Dimension	20"H x 5"W (515 x 129mm)
Dosing Head Dimension	EA Head 9.5"H x 2"W (241x50mm)
Dosing Head Arm Reach	6" (150mm)
Weight	22lbs (10kg)
Utilities	Liquid Nitrogen : 22 psi Gaseous N2 : 60 - 100 psi Electrical : 110-220VAC



100M Controller Specifications

PLC Platform	Siemens
HMI (Soft Key)	1" x 3" Mono
Dose Duration, 1ms int.	15 to 1500 ms
Dose Volume, mg/dose	10 to 2000
Dose Accuracy	± 5%
Dosing Signal	Foot Switch
Fixed Delay	✓
Nozzle Defrost	Manual
Certifications	CE, IP65



MiniDoser®

Liquid Nitrogen Dosing



MiniDoser™ is an Ultra-Compact doser, requiring the smallest installation foot print in most food production fillers. It has the capability to dose large volume of liquid nitrogen to inert full containers with high-volume headspace. Applications for food inerting are such as peanuts, potato chips and snacks

How it Works

LN2 is supplied to the doser by a vacuum insulated pipe and flows into the dosing head. Sensor will detect the container and send pulses to the controller. Controller will command the dosing head to dispense the required amount of LN2 into the container. LN2 droplets quickly evaporate and expand 700 X into gaseous N2 equivalent, filling the container headspace with inert N2 gas at the desired pressure.

Applications

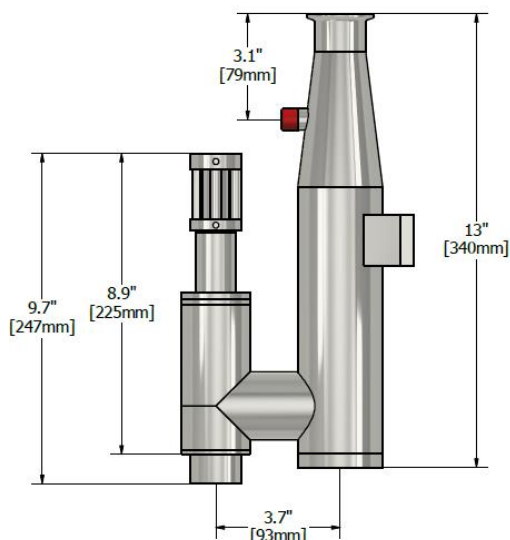
- **Oxygen Exclusion** – Reduce residual oxygen in product headspace to prevent oxidation to the product
- **Extend Product Shelf Life** – N2 in product packaging can extend product shelf life longer
- **Replace traditional MAP** – increase production efficiency and effectiveness compared to inert gas flushing in MAP peanuts, potato chips and snacks

Ergonomic Features and Benefits

- **Frost-free nozzle** – Self-generating GN2 for dosing head blanketing
- **Consistent Container Pressure** – delivers accurate dosing $\pm 2\%$
- **Lowest LN2 Consumption** – Discrete dosing, NO-container-NO dose capability
- **Lowest LN2 Losses** – Proprietary vacuum insulation with lowest heat leak 0.1 LPH
- **Minimized Product Splash** – Soft-dose nozzles prevent product splash, maintain line hygiene and reduce COP / CIP cleaning frequency
- **Ease of Maintenance** – Achievable by system maintenance alarm and remote monitoring
- **Corrosion Resistant** – 304L material grade of construction for doser body
- **Highest Hygiene Design** – All external surface has rounded corners and sloped design for easy wash-down
- **Lowest Maintenance** – Ultra long life cycle dosing valve > 30 million
- **Ease of Installation** – Compact size for easy installation in limited space
- **Applications Flexibility** – Compatible with soft-dose and micro-dose technology for hot fill, powder, and granular applications
- **5 years vacuum warranty** – lowest cost of ownership

MiniDoser® Specifications

Material	Stainless Steel 300 Series
Head Pressure	0.4 ~ 3 psi
Steady State Consumption	< 0.03 gal (0.1 liter) / hour
Body Dimension	13"H x 2.5"W (340 x 63mm)
Dosing Head Dimension	EA Head 9.5"H x 2"W (241 x 50mm)
Dosing Head Arm Reach	3.7" (93mm)
Weight	6 lbs (3kg)
Utilities	Liquid Nitrogen : 22 psi Gaseous N2 : 60 - 100 psi Electrical : 110-220VAC



Controller Specifications

Model	500FD	800SC	2000DSC
PLC Platform	Siemens S7-1200	Siemens S7-1200	Siemens S7-1200
HMI (LCD touch screen)	4.3" Color	4.3" Color	7.0" Color
Dose Duration, 1ms interval	20 to 1500 ms	15 to 1500 ms	5 to 1500 ms
Dose Volume, mg/dose	10 to 1400	10 to 1400	5 to 1400
Dose Accuracy	± 3%	± 2%	± 1%
Max. Discrete Dosing	500 CPM	800 CPM	2000 CPM
Fixed Delay	✓	✓	✓
Speed Compensation		✓	✓
Dose Compensation		✓	✓
Dynamic Dose	✓		
Encoder Compatible			✓
Nozzle Pre-Cooling	Manual	Manual	Automatic
Nozzle Defrost	Optional (Manual)	Automatic	Automatic
User's Filler Signal Interface			Optional
Modbus RTU User Interface	✓	✓	✓
Mobile Remote Monitoring (Wi-Fi / Lan)			✓
Smart Maintenance			✓
Overall Equipment Effectiveness	✓	✓	✓
Recipe Storage	5	5	12
Dosing Head	Bimba / EA	Bimba / EA	EA / ES
Certifications	CE, IP65	CE, IP65	CE, IP66

AsepticDoser®

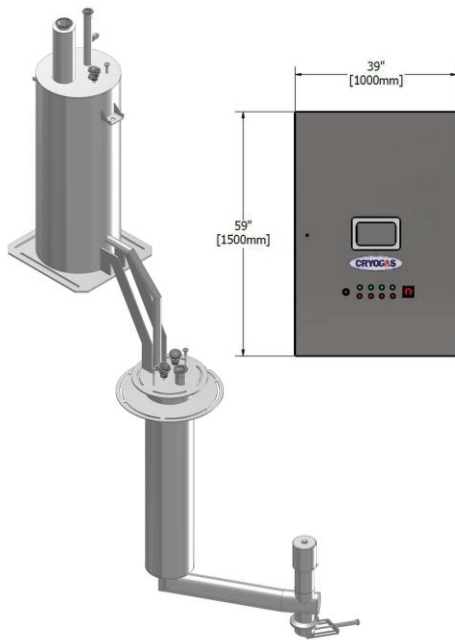
A sterile, low pressure liquid nitrogen doser that provides rapid sterilization. Available in either wet steam or dry heat sterilization. Comes with frost-free operation, stainless steel 316L pharma-grade material construction. Equipped with single or redundant 0.2 micron gas filters for efficient dosing of aseptic filling lines, from low to high production line speeds.

Applications

- **Container Rigidity** – enhance bottle or can's strength and eliminate paneling especially in hot filling process
- **Container Light-weighting** – reduce packaging cost and environmental carbon footprint
- **Oxygen Exclusion** – Reduce residual oxygen in product headspace to prevent oxidation to the product
- **Extend Product Shelf Life** – N₂ in product packaging can extend product shelf life longer

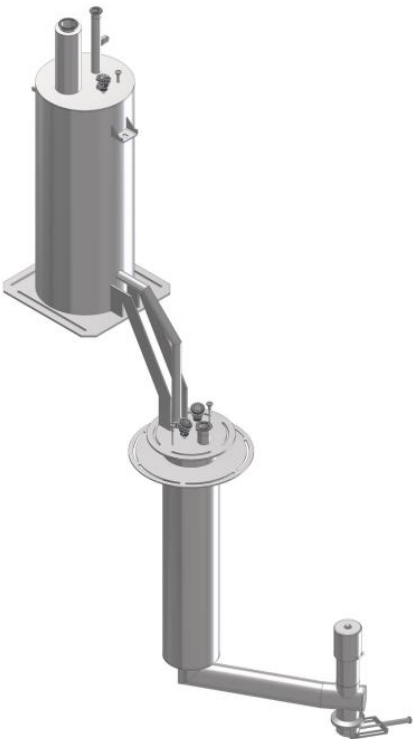
Ergonomic Features and Benefits

- **Sterile and Low-Pressure Dosing:** The Aseptic LN₂ Doser offers aseptic and low-pressure liquid nitrogen dosing, making it ideal for a variety of industries, including pharmaceuticals, biotechnology, and food processing.
- **Continuous Stream Dosing:** Designed to run in a continuous dose mode, the Aseptic LN₂ Doser provides a constant stream of liquid nitrogen for uninterrupted dosing operations, ensuring optimal efficiency.
- **Precise Dosage Control:** With an accuracy of $\pm 3\%$ in dose weight, the system ensures consistent and precise dosing, reducing waste and improving overall product quality.
- **Self-Monitoring and Alarm Outputs:** The system features continuous self-monitoring, providing real-time data to operators and alerting them in case of any deviations or irregularities through alarm outputs and visual beacon indicators.
- **User-Friendly PLC Platform:** CSM Aseptic LN₂ Doser is equipped with a Siemens S7-1200 PLC platform, offering intuitive and efficient control over the dosing process, ensuring ease of operation and quick setup.
- **User Interface:** The system is complemented with a Siemens 6" color touchscreen, providing operators with a user-friendly and informative interface for convenient control and monitoring.
- **Automatic sterilization & sanitization:** The Aseptic system is equipped with steam, hot gas, chemical sterilization & sanitization process. The entire process steps are programmed with automatic sequence to ease the operation. The process data are logged, monitored and validated by proprietary algorithm to ensure compliance.
- **Automatic CIP Protection:** The Aseptic LN₂ Doser is equipped with CIP (Clean-in-Place) process. This feature prevents moisture from entering the dosing head, minimizing the risk of freeze-ups and ensuring a smooth and hassle-free cleaning process. The doser system is designed to withstand high-pressure washdowns and aggressive chemical cleanups, ensuring its longevity and reliability.



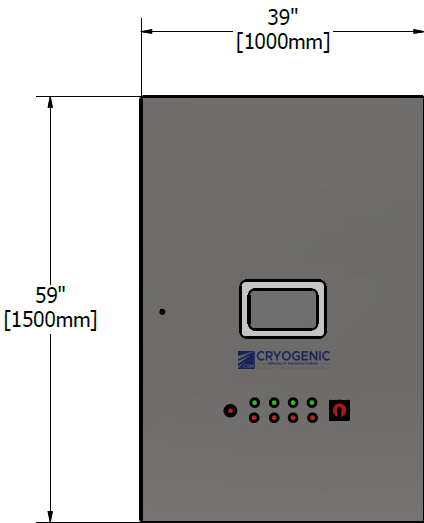
AsepticDoser® 3001DSC Dimensions

Material	Stainless Steel Series 316L
Head Pressure	0.3psi
Nozzle Blanketing	Self Generated N2
Steady State Consumption	< 0.03 gal (0.1 liter) / hour
Body Dimension	37"H x 5"W (930 x 129mm)
Dosing Head Dimension	Aseptic Head 9.5"H x 2"W (241 x 50mm)
Dosing Head Arm Reach	Customized to filler
Weight	Approx 170lbs (80 kg)
Utilities	Liquid Nitrogen : 80 psi Gaseous N2 : 60 - 100 psi Electrical : 110-220VAC



3001DSC Controller Specifications

PLC Platform	Siemens S7-1200
HMI (LCD touch screen)	7.0" Color
Dose Duration, 1ms int.	5 to 1000 ms
Dose Volume, mg/dose	5 to 1400
Dose Accuracy	± 3%
Max. Discrete Dosing	2000 CPM
Fixed Delay	✓
Speed Compensation	✓
Dose Compensation	✓
Encoder Compatible	✓
Nozzle Pre-Cooling	✓
Chemomatic Sanitization	✓
Thermomatic Sterilization	✓
Nozzle Auto Defrost	✓
User Signal Interface	✓
Modbus User Interface	✓
Ethernet User Interface	✓
Smart Maintenance	✓
Recipe Storage	unlimited
AS Aseptic Dosing Head	✓
Certifications	CE, IP65



Cryogenic Transfer Hose



Semi-Flex



Cryo-Flex



Ultra-Flex

CSM provide transfer hoses with various flexibility to suit different piping needs and applications.

All hoses come with static vacuum as standard and dynamic vacuum as option. Static vacuum hose is vacuum sealed at the factory, providing many years of trouble free vacuum insulation. All hoses come with high quality wear resistant stainless steel outer braid or kink resistant spiral wrap protection cover.

Semi-Flex

Semi-Flex, a semi-rigid bendable pipe with optimal flexibility is suitable for long distance piping system application, an alternative to traditional rigid piping. It's lightweight stainless steel construction reduces cool-down losses to an absolute minimum. Available in sizes of DN16 (1/2") & DN25 (1") and lengths ranging from 6m to 30m.

Cryo-Flex

Cryo-Flex is designed to meet high flow capacity without compromising its flexibility. Mainly used to overcome misalignment in rigid piping system; and as a final tie-in to equipment.

Cryo-Flex are available in many sizes from DN16 up to DN50 to meeting almost all the standard or custom requirements.

Ultra-Flex

Ultra-Flex is a ultra-flexible vacuum insulated hose with low to medium flow applications. It has the lowest dynamic bend radius among all cryogenic hoses in the market. Mainly used to transfer liquid nitrogen from dewar to equipment.

Cryo-Flex are available with sizes from DN8 up to DN12 to meet most the applications.

Features and Benefits

- Superior vacuum insulation eliminates moisture, condensation and frost build-up
- Due to very low heat gain, liquid nitrogen losses can be reduced by 10 to 20 times
- Product flexibility facilitates installation especially above ceilings and below raised floors

Semi-Flex / Cryo-Flex Technical Specifications

Model	Inner Flex Pipe Size	Nominal Jacket OD*	Min. Bend Radius (SemiFlex)	Actual Flow Dia.	Max Lgth	Hole Required to Accommodate Pump Out**	Bayonet Clamp OD (F)	Nominal OD with Braid	Weight / Length (SemiFlex)
F16	DN 16 (16.2mm)	DN40 (52.1mm)	200mm (450mm)	16.2mm	6 m ~ 30m	100mm (4")	51mm	53mm	2.3kg/m (1.44kg/m)
F25	DN 25 (25.1mm)	DN50 (62.8mm)	300mm (550mm)	25.1mm		100mm (4")	64mm	63mm	3.18 kg/m (1.94kg/m)
F32	DN32 (34.2mm)	DN65 (81.2mm)	450mm	34.2mm		120mm (4.5")	64mm	82mm	4.5 kg/m
F40	DN40 (40.0mm)	DN100 (120mm)	600mm	40.0mm		150mm (6")	91mm	120mm	7.9 kg/m
F50	DN50 (50.1mm)	DN100 (120mm)	720mm	50.1mm		180mm (7")	120mm	120 mm	8.2 kg/m

*Not including pump out **Pump out with no Thermocouple (TC)

Semi-Flex / Cryo-Flex Performance Data

Model	Cool Down (SemiFlex)			Static Heat Leak		LN2 Bayonet Pair Heat Leak	
	KJ/m	Kg/m*	lb of LN2/ft*	BTU/hr/ft	Watt/m	BTU/hr	WATT
F16	64 (22)	0.43 (0.15)	0.29 (0.10)	1.4	1.3	4.0	1.2
F25	125 (59)	0.84 (0.40)	0.56 (0.27)	1.5	1.4	8.1	2.4
F32	135	0.90	0.60	1.6	1.5	7.8	2.3
F40	252	1.68	1.13	1.8	1.7	9.2	2.7
F50	292	1.95	1.31	1.7	1.6	11.3	3.3

*LN2 at 3 Bar (45psi) @ -181deg C

Semi-Flex / Cryo-Flex LN2 Flow Guide Line

Model	*Nominal Flowrate @ ΔP 0.1Bar			*Maximum Flowrate @ ΔP 0.3Bar		
	gpm	lpm	kg/hr	gpm	lpm	kg/hr
F16	1.2	4.7	200	2.1	8.2	350
F25	4.3	16.3	700	7.4	28.0	1200
F32	9.8	37.3	1600	18.4	70.0	3000
F40	14.7	56.0	2400	25.8	98.0	4200
F50	27.0	102.7	4400	51.0	193.7	8300

- Based on liquid nitrogen at 6.0Bar (90psi) saturation pressure for 30m (100ft) piping length, exclude pressure drop due to elevation changes
- Above flow rate is based on corrugation profile of CryoFlex. SemiFlex flow rate to multiply with factor 0.9

Semi-Flex / Cryo-Flex Pressure Drop (bar/meter)*

Model	Flow (kg/hr)						
	450	1200	2200	5500	11400	17000	23000
F16	0.0155	0.109	0.369				
F25	0.0011	0.008	0.027	0.167	0.718		
F32		0.0015	0.005	0.0319	0.137	0.304	
F40			0.0024	0.0152	0.065	0.144	0.265
F50			0.00064	0.0040	0.0171	0.0380	0.069

*Pressure drop numbers listed is based on liquid nitrogen at 6.0 Bar (90psi) saturation pressure, do not account for elevation changes. CSM recommends pressure drop be kept to 0.3 bar or less.



Ultra-Flex

U-flex transfer hose offers high flexibility, sturdy & kink-resistant spiral wrap outer jacket, suitable for rough handling usage such as cryogenic liquid cylinder (LGC / dewar) refilling; and liquid withdrawal from pressurized dewar to test handler.

Smooth spiral wrap design ensures zero risk of hand injury due to wire piercing commonly occur in traditional wire braided hose

[All Ultra-Flex comes with CSM renowned customer service, from conceptual design to implementation, and are backed by a one year warranty

Ultra-Flex Transfer Hose

Ultra-Flex *transfer* hose is a ultra-flexible, vacuum insulated LN2 transfer hose with high flexibility. It has the lowest dynamic bend radius among all cryogenic hoses in the market.

Due to its lightweight stainless steel construction, cool-down loss can be reduced to an absolute minimum.

Ultra-Flex hoses are protected by a tough and anti-kink stainless steel spiral wrap outer covering, its non wire braid prevent potential operator injury due to sharp wire found in traditional braided sleeve.

Typical hoses are manufactured with pipe thread ends or female flare 1/2" JIC/CGA fittings or C5 bayonet. These hoses are used in a wide variety of applications including tool connections with portable dewars supplying LN2 to test handlers, LN2 doser, or any moving reservoirs and custom OEM applications.



Ultra-Flex application in Test Handlers

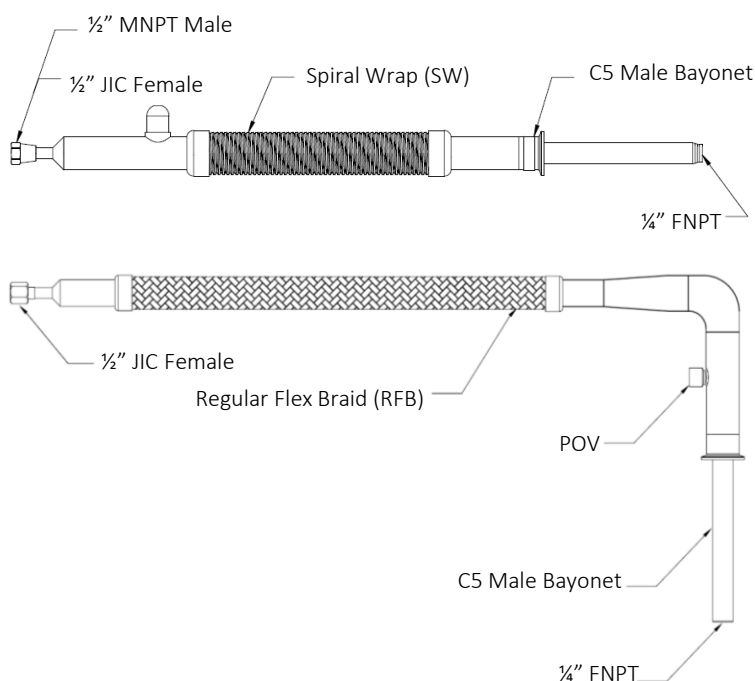
Features and Benefits

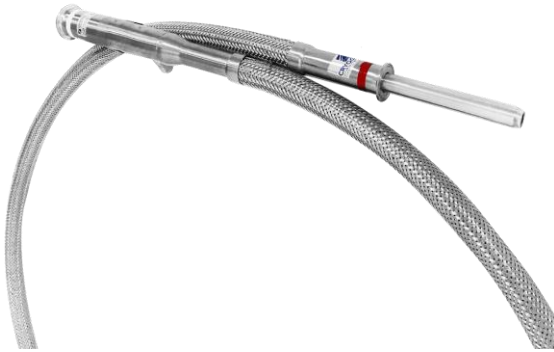
- Tees, elbows, bayonets and valves can be incorporated with Ultra-Flex transfer hose for a customized LN2 piping system application
- Both flexible and rigid sections can be combined as one spool
- Select hoses are stocked for immediate delivery
- Super insulation and proprietary chemical getters ensures long lasting vacuum integrity
- Each hose is evacuated (10⁻⁶ torr), helium leak checked (1 x10⁻⁹ std cc/sec) and liquid nitrogen cold shocked before shipping
- Vacuum insulation eliminates frost, ice and related safety hazards

Ultra-Flex Specifications

Model	UF8	UF12
Inner Diameter (I.D.)	DN 8 5/16" (8.2 mm)	DN 12 ½" (12.1 mm)
Outer Diameter (O.D.)	DN 25 (39.0 mm)	DN 32 (49 mm)
Steady State Heat Leak	2.7 btu/hr/ft (2.6 watts/meter)	3.2 btu/hr/ft (3.0 watts/meter)
Bayonet Heat Leak	4.3 btu/hour (1.2 watts)	4.3 btu/hour (1.2 watts)
Max. Operating Pressure	150 psi (10.3 bar)	150 psi (10.3 bar)
Weight	0.7 lbs/ft (1.1 kg/m)	0.8 lbs/ft (1.2 kg/m)
Min. Flexible Bend Radius	8" (203 mm)	10" (254 mm)
Min. Static Bend Radius	6" (152 mm)	8" (203 mm)
Vacuum Insulation Type	Static Vacuum with MLI, Absorbent and Getters	
Protective Outer Covering	SW - Spiral Wrap (Standard) RFB - Regular Flex Braid (Option)	
Material Construction	Stainless Steel Series 300	
Standard Testing	Dimensional Check He leak checked 1 x 10 - 9 cc/s	
Optional	Pneumatic pressure test, Vacuum retention testing, LN2 cold shock, pre-material certs., X-ray, ASME B31.3 certification, CFOS cleaning for O2 services	

Typical Ultra-Flex Transfer Hose





Semi-Flex Static

Pre-engineered modular Semi-Flex transfer hose has added advantage over the traditional rigid VJP, especially when system upgrade is frequently done. This option is cost saving as the flexibility of the pipe reduces the necessity for precise system layout measurements. It allows the whole system to be easily reused if use-point locations and plant layout are changed. Semi-Flex can be added if required to the existing system without major rework expenses.

Semi-Flex facilitate users to design and construct their own LN2 delivery system with minimum piping engineering experience or knowledge.

All Semi-Flex comes with CSM renowned customer service, from conceptual design to implementation, and are backed by a 5 year vacuum warranty; 1 year defect warranty

Semi-Flex Static Transfer Hose

Semi-Flex, a semi-rigid bendable pipe with optimal flexibility is suitable for long distance piping system application, an alternative to traditional rigid piping. It's lightweight stainless steel construction reduces cool-down losses to an absolute minimum.

Semi-Flex hoses are protected by a high quality and wear resistant stainless steel braided outer covering. Typical hoses are manufactured with pipe thread ends or bayonet connection.

These hoses are used in a wide variety of applications as main transfer hose for LN2 such as food freezing, semiconductor test handlers, MBE and LN2 dosing applications.

Related Products:



Modular Valve



Modular Tee

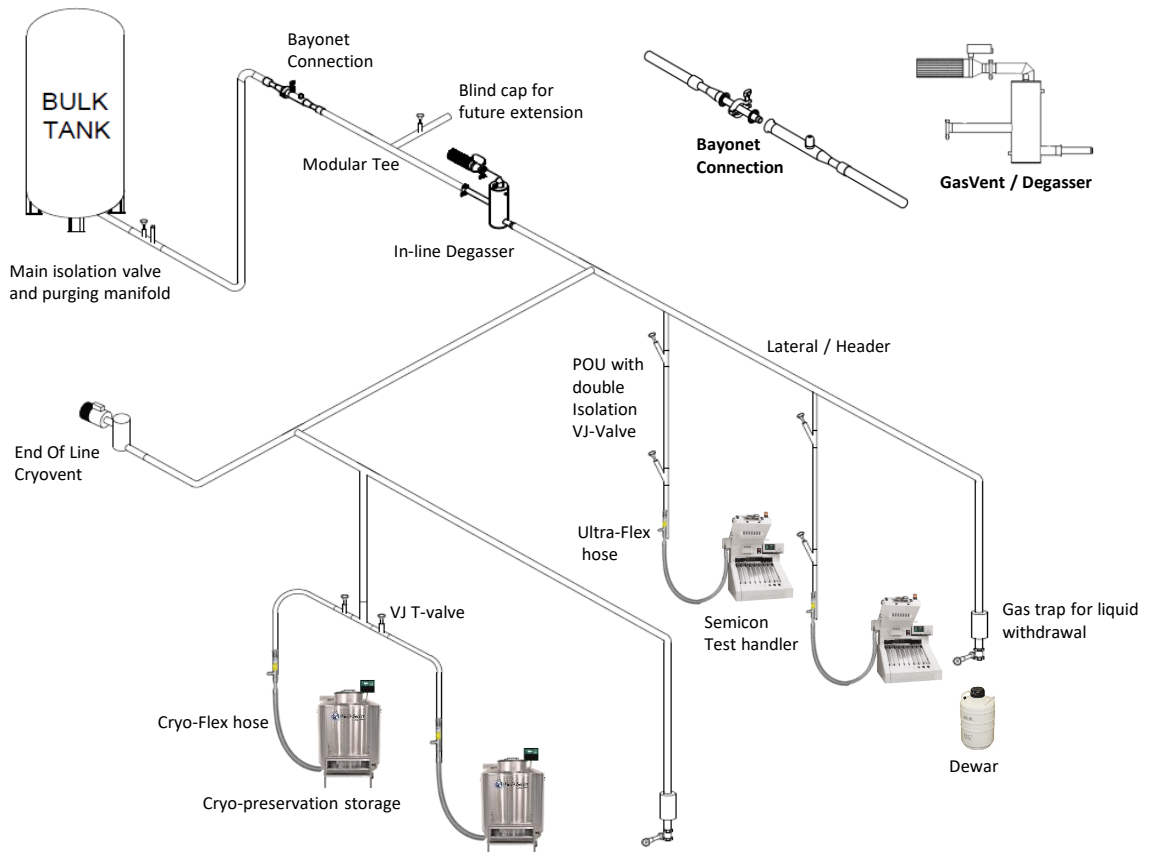
Features and Benefits

- Semi-Flex can be coiled for shipment by air freight, thus eliminate the need for expensive logistics
- Tees, elbows, bayonets and valves can be incorporated with *Semi-Flex* transfer hose for a customized LN2 piping system application
- Select hoses are stocked for immediate delivery
- Super insulation and proprietary chemical getters ensures long lasting vacuum integrity
- Each hose is evacuated (10⁻⁶ torr), helium leak checked (1 x10⁻⁹ std cc/sec) and liquid nitrogen cold shocked before shipping
- Vacuum insulation eliminates frost, ice and related safety hazards

Semi-Flex Static Specifications

Model	SF16	SF25	SF32	SF40	SF50
Inner Diameter	DN 16 ¾" (16.2 mm)	DN 25 1" (25.1 mm)	DN 32 1⅜" (34.2 mm)	DN 40 1 ½" (40 mm)	DN 50 2" (50.1 mm)
Outer Diameter	DN 40 (52.1 mm)	DN 50 (62.8 mm)	DN 65 (81.2 mm)	DN 100 (120 mm)	DN 100 (120 mm)
Steady State Heat Leak	1.4 btu/hr/ft (1.3 watts/m)	1.5 btu/hr/ft (1.4 watts/m)	1.6 btu/hr/ft (1.5 watts/m)	1.8 btu/hr/ft (1.7 watts/m)	1.7 btu/hr/ft (1.6 watts/m)
Bayonet Heat Leak	4.0 btu/hr (1.2 watts)	8.1btu/hr (2.4 watts)	8.1 btu/hr (2.4 watts)	9.2 btu/hr (2.7 watts)	11.3 btu/hr (3.3 watts)
Max. Operating Pressure	200 psig (13.8 bar)	200 psig (13.8 bar)	200 psig (13.8 bar)	200 psig (13.8 bar)	200 psig (13.8 bar)
Weight	1.0 lbs/ft (1.4 kg/m)	1.3 lbs/ft (1.9 kg/m)	3.0 lbs/ft (4.5 kg/m)	5.3 lbs/ft (7.9 kg/m)	5.5 lbs/ft (8.2 kg/m)
Min. Bend Radius (Static)	12" (30 cm)	16" (40 cm)	18" (45 cm)	24" (60 cm)	28" (72 cm)
Vacuum Insulation Type	Static or Dynamic Vacuum				
Maximum Length	Single Spool 59 ft (18.00 m)				
Protective Outer Covering	RFB - Regular Flex Braid				
Material Construction	Stainless Steel Series 300				
Standard Testing	Dimensional Check He leak checked 1 x 10 - 9 cc/s				
Optional	Pneumatic pressure test, Vacuum retention testing, LN2 cold shock, pre-material certs., X-ray, ASME B31.3 certification, CFOS cleaning for O2 services				

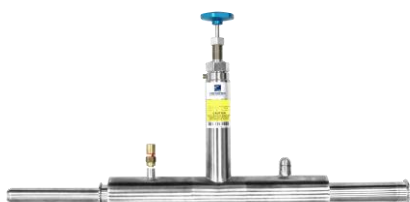
Semi-Flex Static, Pre-engineered Modular Vacuum System





All Semi-Flex comes with CSM renowned customer service, from conceptual design to implementation, and are backed by a 5 year vacuum warranty; 1 year defect warranty

Related Products:



Modular T- valve



Modular Tee with Jumper Hose & Zone Valve in dynamic vacuum set up

Semi-Flex Dynamic

Pre-engineered modular Semi-Flex transfer hose has added advantage over the traditional rigid VJP, especially when system upgrade is frequently done. This option is cost saving as the flexibility of the pipe reduces the necessity for precise system layout measurements. It allows the whole system to be easily reused if use-point locations and plant layout are changed. Semi-Flex can be added if required to the existing system without major rework expenses.

Semi-Flex facilitate users to design and construct their own LN2 delivery system with minimum piping engineering experience or knowledge.

Semi-Flex Dynamic Transfer Hose

Semi-Flex, a semi-rigid bendable pipe with optimal flexibility is suitable for long distance piping system application, an alternative to traditional rigid piping. It's lightweight stainless steel construction reduces cool-down losses to an absolute minimum.

Semi-Flex hoses are protected by a high quality and wear resistant stainless steel braid outer covering. Typical hoses are manufactured with pipe thread ends or bayonet connection.

These hoses are used in a wide variety of applications as main transfer hose for LN2 such as food freezing, semiconductor test handlers, MBE and LN2 dosing applications.

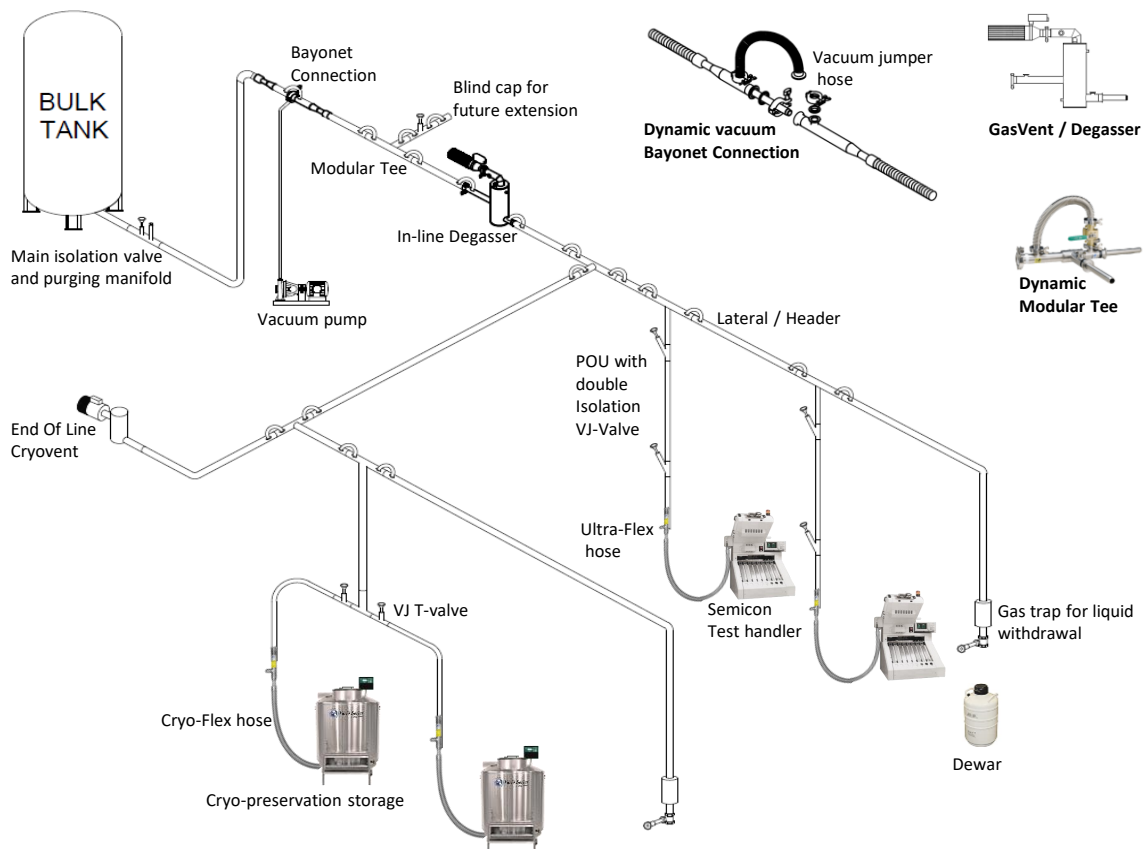
Features and Benefits

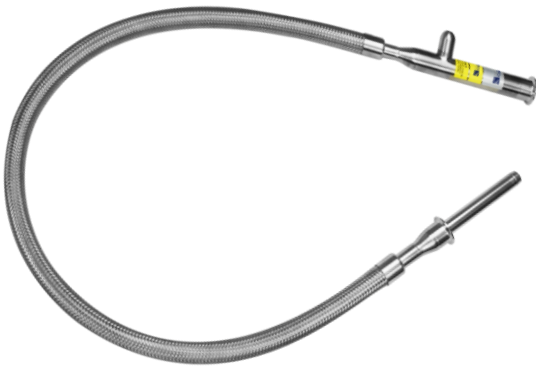
- Tees, elbows, bayonets and valves can be incorporated with *Semi-Flex* transfer hose for a customized LN2 piping system
- Both flexible and rigid sections can be combined as one spool
- Select hoses are stocked for immediate delivery
- Special MLI system ensure fast pump down speed to < 10⁻⁴ Torr
- Each hose is helium leak checked (1 x10⁻⁹ std cc/sec) and liquid nitrogen cold shocked before shipping
- Vacuum insulation eliminates frost, ice and related safety hazards

Semi-Flex Dynamic Specifications

Model	SF16	SF25	SF32	SF40	SF50
Inner Diameter	DN 16 ¾" (16.2 mm)	DN 25 1" (25.1 mm)	DN 32 1½" (34.2 mm)	DN 40 1 ½" (40 mm)	DN 50 2" (50.1 mm)
Outer Diameter	DN 40 (52.1 mm)	DN 50 (62.8 mm)	DN 65 (81.2 mm)	DN 100 (120 mm)	DN 100 (120 mm)
Steady State Heat Leak	1.4 btu/hr/ft (1.3 watts/m)	1.5 btu/hr/ft (1.4 watts/m)	1.6 btu/hr/ft (1.5 watts/m)	1.8 btu/hr/ft (1.7 watts/m)	1.7 btu/hr/ft (1.6 watts/m)
Bayonet Heat Leak	4.0 btu/hr (1.2 watts)	8.1btu/hr (2.4 watts)	8.1 btu/hr (2.4 watts)	9.2 btu/hr (2.7 watts)	11.3 btu/hr (3.3 watts)
Max. Operating Pressure	200 psig (13.8 bar)	200 psig (13.8 bar)	200 psig (13.8 bar)	200 psig (13.8 bar)	200 psig (13.8 bar)
Weight	1.0 lbs/ft (1.4 kg/m)	1.3 lbs/ft (1.9 kg/m)	3.0 lbs/ft (4.5 kg/m)	5.3 lbs/ft (7.9 kg/m)	5.5 lbs/ft (8.2 kg/m)
Min. Bend Radius (Static)	12" (30 cm)	16" (40 cm)	18" (45 cm)	24" (60 cm)	28" (72 cm)
Vacuum Insulation Type	Static or Dynamic Vacuum				
Maximum Length	Single Spool 59 ft (18.00 m)				
Protective Outer Covering	RFB - Regular Flex Braid				
Material Construction	Stainless Steel Series 300				
Standard Testing	Dimensional Check He leak checked 1 x 10 - 9 cc/s				
Optional	Pneumatic pressure test, Vacuum retention testing, LN2 cold shock, pre-material certs., X-ray, ASME B31.3 certification, CFOS cleaning for O2 services				

Semi-Flex Dynamic, Pre-engineered Modular Vacuum System





Cryo-Flex

Flexible transfer hose mainly used to overcome misalignment in rigid piping system; and as a final tie-in from rigid piping to equipment such as bulk tank & process equipment

All hoses come with static vacuum as standard or dynamic vacuum as option. Static vacuum hose is vacuum sealed at the factory, providing many years of trouble free vacuum insulation



All Cryo-Flex products come with CSM renowned customer service, from conceptual design to implementation, and are backed by a 3 year vacuum warranty; 1 year defect warranty

Related Products:



Dynamic Vacuum option

Cryo-Flex Transfer Hose

Cryo-Flex is a vacuum insulated stainless steel flexible hose designed to meet high flow capacity without compromising its flexibility.

Engineered as modular section with close tolerance bayonet connections. It can be used on its own, or as part of StatiRigid sections for misalignment offset. Cryo-Flex pipe is evacuated and sealed at the factory as a static vacuum and is available in dynamic vacuum.

Cryo-Flex are available in wide variety of sizes from DN16 up to DN50 to meet most the standard or custom requirements.

CSM offers a complete line of components such as in-line venting devices, phase separators and gas traps to maximize the system performance.

Cryo-Flex is used in a wide variety of applications including biotech, cryogenic storage, food and beverage, nanotech, environmental temperature chambers and R&D applications.

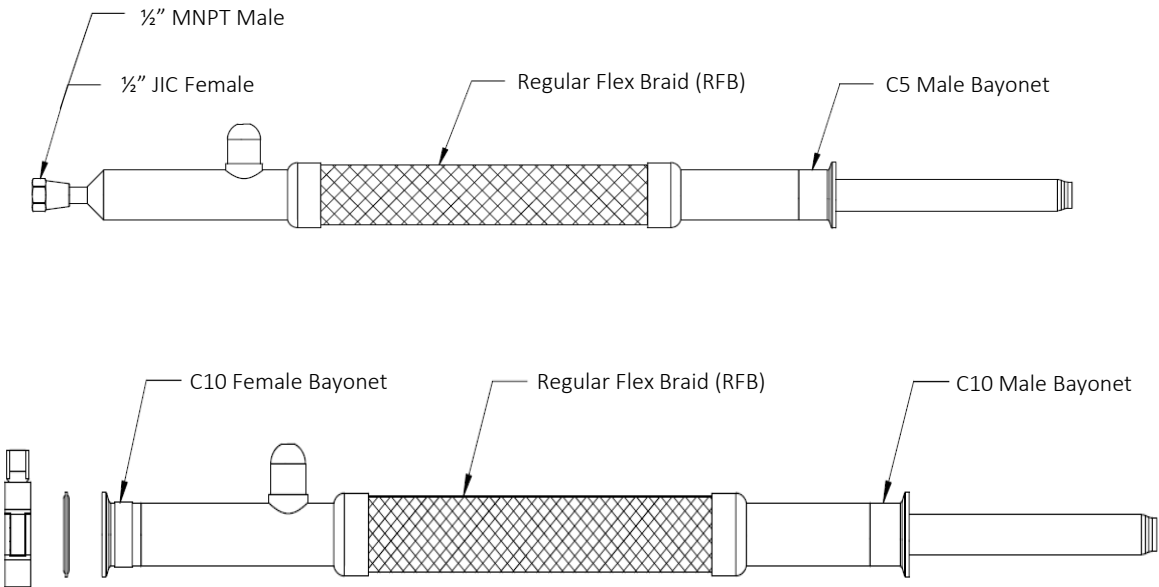
Features and Benefits

- Superior vacuum insulation eliminates moisture, condensation and frost build-up
- Due to very low heat gain, liquid nitrogen losses can be reduced by 10 to 20 times
- Quick delivery of LN2 to equipment improves cooling performance and production cycle time.
- Flexibility of Cryoflex facilitates installation especially above drop tile ceilings and below raised test floors

Cryo-Flex Specifications

Model	CF16	CF25	CF32	CF40	CF50
Inner Diameter	DN 16 ¾" (16.2 mm)	DN 25 1" (25.1 mm)	DN 32 1¼" (34.2 mm)	DN 40 1 ½" (40 mm)	DN 50 2" (50.1 mm)
Outer Diameter	DN 40 (52.1 mm)	DN 50 (62.8 mm)	DN 65 (81.2 mm)	DN 100 (120 mm)	DN 100 (120 mm)
Steady State Heat Leak	1.4 btu/hr/ft (1.3 watts/m)	1.5 btu/hr/ft (1.5 watts/m)	1.4 btu/hr/ft (1.4 watts/m)	1.8 btu/hr/ft (1.7 watts/m)	1.7 btu/hr/ft (1.6 watts/m)
Bayonet Heat Leak	4.0 btu/hr (1.2 watts)	8.1btu/hr (2.4 watts)	8.1 btu/hr (2.4 watts)	9.2 btu/hr (2.7 watts)	11.3 btu/hr (3.3 watts)
Max. Operating Pressure	200 psig (13.8 bar)	200 psig (13.8 bar)	200 psig (13.8 bar)	200 psig (13.8 bar)	200 psig (13.8 bar)
Weight	1.6 lbs/ft (2.4 kg/m)	2.1 lbs/ft (3.2 kg/m)	3.0 lbs/ft (4.5 kg/m)	5.3 lbs/ft (7.9 kg/m)	5.5 lbs/ft (8.2 kg/m)
Min. Bend Radius (Static)	8" (20 cm)	12" (30 cm)	18" (45 cm)	24" (60 cm)	28" (72 cm)
Vacuum Insulation Type	Static or Dynamic Vacuum				
Maximum Length	Max. single line length 33' (10 m)				
Protective Outer Covering	RFB - Regular Flex Braid				
Flow Rate / Pressure Drop	Consult factory				
Material Construction	Stainless Steel Series 300				
Standard Testing	Dimensional Check He leak checked 1 x 1 0 - 9 cc/s				
Optional	Pneumatic pressure test, Vacuum retention testing, LN2 cold shock, pre-material certs., X-ray, ASME B31.3 certification, CFOS cleaning for O2 services				

Typical Cryo-Flex Transfer Hose





Triax-Flex™

Triax-Flex transfer hose specifically designed to eliminate two-phase flow of LN2 to use points. Fully stainless steel construction with highest flexibility in the industry.

Modular sections allow for easy of assembly and disassembly and provide greater flexibility in piping system arrangement

Available in Static or Dynamic Vacuum System



All Triax-Flex products comes with CSM renowned customer service, from conceptual design to implementation, and are backed by a one year warranty

Related Products:



Modular T- valve



Modular Tee with Jumper Hose & Zone Valve in dynamic vacuum set up

Triax-Flex Transfer Hose

Triax-Flex® transfer hose when use together with atmospheric Phase Separator system delivers liquid nitrogen (LN2) in pure liquid form at atmospheric pressure. This system ultimately eliminates two-phase flow to use points by constantly venting gaseous vapor to the atmosphere via phase separator. By separating vapor and venting them prior to liquid delivery, only sub-cooled LN2 will be delivered to each use point through gravity.

Triax-Flex® are commonly used in applications where single-phase liquid is critical to the production process such as MBE, LN2 Doser, Cryopreservation or any critical process that demands pure LN2 supply.

Triax-Flex® is available in either static or dynamic vacuum insulation. For Dynamic Triax-Flex®, it requires an external pump to continuously evacuate its vacuum annular space to ensure its vacuum insulation integrity. Both static and dynamic systems come with Triax female bayonet connection, elbow, tee, valve or customize connections e.g. A5, A10 or TAL, to the point of use.

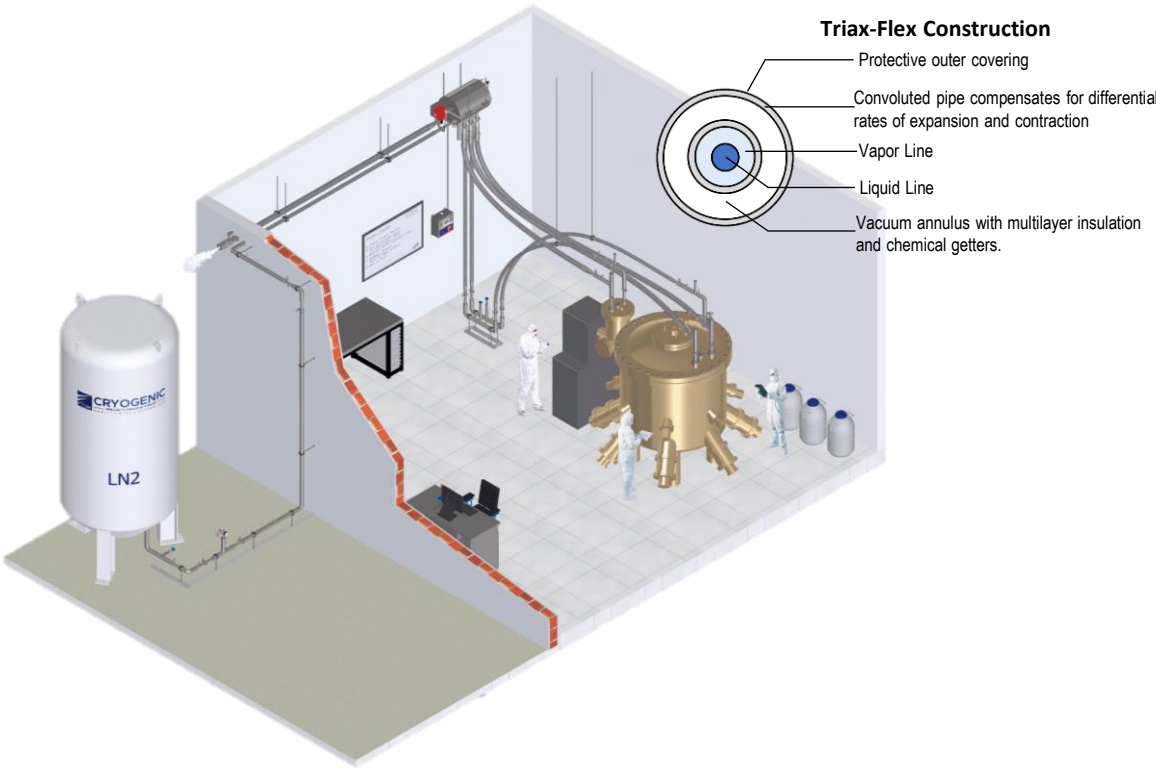
Features and Benefits

- Superior vacuum insulation eliminates moisture, condensation and frost build-up
- Due to very low heat gain, liquid nitrogen losses can be reduced by 10 to 20 times
- Quick delivery of LN2 to equipment improves cooling performance and production cycle time.
- Bendable nature facilitates installation in tight spaces such as research laboratory

Triax-Flex Specifications

Hose Model	TF16	TF25	TF32
Inner Diameter (I.D.)	DN 16 5/8" (16.2 mm)	DN 25 1" (25.1 mm)	DN 32 1-3/8" (34.2 mm)
Outer Diameter (O.D.)	DN 40 (52.1 mm)	DN 50 (62.8 mm)	DN 65 (81.2 mm)
Steady State Heat Leak	1.4 btu/hr/ft (1.3 watts/m)	1.5 btu/hr/ft (1.5 watts/m)	1.6 btu/hr/ft (1.5 watts/m)
Bayonet Heat Leak	4.0 btu/hour (1.2 watts)	8.1 btu/hour (2.4 watts)	8.1 btu/hour (2.4 watts)
Max. Operating Pressure	200 psi (13.8 bar)	200 psi (13.8 bar)	200 psig (13.8 bar)
Weight	1.6 lbs/ft (2.4 kg/m)	2.1 lbs/ft (3.2 kg/m)	3.0 lbs/ft (4.5 kg/m)
Min. Bend Radius (Flexible)	12" (300 mm)	16" (400 mm)	24" (450 mm)
Min. Bend Radius (Static)	10" (250mm)	12" (300 mm)	20" (500 mm)
Vacuum Insulation Type	Static or Dynamic Vacuum		
Protective Outer Covering	RFB - Regular Flex Braid. SW - Spiral Wrap		
Flow Rate / Pressure Drop	Consult factory		
Material Construction	Stainless Steel Series 300		
Standard Testing	Dimensional Check He leak checked 1 x 10 - 9 cc/s		
Optional	Pneumatic pressure test, Vacuum retention testing, LN2 cold shock, pre-material certs., X-ray, ASME B31.3 certification, CFOS cleaning for O2 services		

Typical Triax-Flex Installation in MBE



Cryogenic Transfer Pipe



StatiRigid-P

Constructed in modular sections with smooth inner bore *pipe* size, StatiRigid comes with periodic internal bellows to minimize pressure drop and improve flow characteristics. It has the lowest heat leak and lowest cooldown loss in its class.

Suitable for use in a wide variety of industrial applications such as Electronic Assembly & Test, Food & Beverage, Petrochemical, Industrial Gas Plant, LNG etc.

StatiRigid Pipe & Tube

Engineered as modular sections, these stainless steel coaxial vacuum insulated piping spools are joined together with close tolerance bayonet connections, forming a complete cryogenic transfer system.

Each section is evacuated, sealed and tested for vacuum integrity to ensure minimal heat gain. StatiRigid-P comes with internal bellows at required intervals to serve as thermal expansion compensators according to EJMA calculation. The pipe comes with smooth inner bore to minimize pressure drop and improve flow characteristics.

Installation for StatiRigid can be done easily both indoor and outdoor, by incorporating flexible sections strategically to offset misalignments.

CSM offers a complete line of components including in-line venting devices, phase separators and gas traps to maximize the cryogenic system performance.



StatiRigid-T



Close Tolerance Bayonet

Features and Benefits

- StatiRigid pipe is easy to install due to its modular design
- Greater thermal efficiency compared to foam insulated pipes by more than 10 times
- Excellent flow characteristics make StatiRigid an ideal as main supply pipe and as header pipe
- Super insulation and proprietary chemical getters ensures long lasting vacuum integrity
- Fabricated by mechanized welding system process ensuring consistent weld quality

StatiRigid Technical Specifications

Model	Inner Rigid Pipe Size	Nominal Jacket OD*	Actual Flow Diameter	Standard Overall Lengths	Hole Required to Accommodate Pump Out**	Bayonet Clamp OD (F)	Weight / Length
R5T	¾" ODT 19.05mm	2" PS (60.3mm)	16.6mm	6' (1.8m) 10' (3.0m) 15' (4.5m) 20' (6.0m) 40' (12.0m)	4" (100mm)	51mm	2.0lb/ft (3.0kg/m)
R5P	½" PS 21.3mm	2" PS (60.3mm)	18.0mm		4" (100mm)	65mm	2.2lb/ft (3.3kg/m)
R10T	1-1/8"ODT 29.00mm	2.5" PS (73.0mm)	26.6mm		5 " (120mm)	65mm	3.1lb/ft (4.6kg/m)
R10P	1" PS 33.4mm	3" PS (88.9mm)	30.0mm		5 " (120mm)	78mm	4.0lb/ft (5.9kg/m)
R15P	1 ½" PS (48.3mm)	3 ½" PS (101.6mm)	1.770" PS (45mm)		6" (150mm)	91mm	4.9lb/ft (7.3kg/m)
R20P	2" PS (60.3mm)	3 ½" PS (101.6mm)	2.245" PS (57mm)		7 " (180mm)	120mm	5.2lb/ft (7.8kg/m)
R30P	3" PS (88.9mm)	5" PS (141.3mm)	3.334" PS (85mm)		8" (200mm)	145mm	9.7lb/ft (14.4kg/m)

*Not including POV pump out valve , **Pump out valve with no Thermocouple (TC)

StatiRigid Performance Data

Model	Cool Down			Static Heat Leak		LN2 Bayonet Pair Heat Leak	
	KJ/m	Kg/m*	lb of LN2/ft	**BTU/hr/ft	**Watt/m	**BTU/hr	**Watt
R5T	59	0.4	0.26	0.42	0.40	4.0	1.2
R5P	85	0.6	0.38	0.45	0.43	8.1	2.4
R10T	88	0.6	0.39	0.49	0.47	8.1	2.4
R10P	139	0.9	0.62	0.50	0.48	7.8	2.3
R15P	204	1.4	0.91	0.52	0.50	9.2	2.7
R20P	256	1.7	1.15	0.71	0.69	11.3	3.3
R30P	482	3.2	2.15	1.25	1.20	16.7	4.9

*LN2 at 3 Bar (45psi) @ -181deg C

**LN2 at 5 Bar (72psi)

StatiRigid LN2 Flow Guide Line

Model	Nominal Flowrate @30m, ΔP 0.1Bar			Maximum Flowrate @30m, ΔP 0.3Bar		
	gpm	lpm	kg/hr*	gpm	lpm	kg/hr*
R5T	3.1	11.7	500	5.2	19.8	850
R5P	3.7	14.0	600	6.1	23.3	1000
R10T	9.2	35.0	1500	17.8	67.7	2900
R10P	13.5	51.3	2200	24.6	93.3	4000
R15P	38.1	144.7	6200	73.7	280.0	12000
R20P	73.7	280.0	12000	128.9	490.0	21000
R30P	214.9	816.7	35000	380.7	1446.7	62000

* Based on liquid nitrogen at 6.0Bar (90psi) saturation pressure for 30m (100ft) piping length, exclude pressure drop due to elevation changes

StatiRigid Pressure Drop (bar/meter)*

Model	Flow (kg/hr)							
	450	1200	2200	3400	11400	17000	23000	34000
R5T	0.0028	0.0185	0.060	0.142				
R5P	0.00194	0.0126	0.041	0.096				
R10T		0.0018	0.0056	0.0129	0.140			
R10P		0.00094	0.0030	0.0069	0.074	0.162	0.295	
R15P			0.0004	0.0009	0.0093	0.0204	0.037	0.080
R20P				0.00028	0.0028	0.0061	0.0109	0.0237
R30P					0.00036	0.00077	0.0014	0.0030

*Note: 1. LN2 at 3 Bar (45psi) @ -181deg C
2. Pressure drop numbers listed do not account for elevation changes. CSM recommends pressure drop be kept to 0.3 bar or less
3. This table is intended to be used as a guide only and should not be substituted for a complete analysis.

StatiRigid-P Sizing Chart

The following table can be used as an initial estimate of required pipe size. It is strongly suggested that a detailed analysis of the actual expected pressure drop be considered with respect to the allowable pressure drop for the process of interest.

Equivalent Length of Pipe Meters (Ft)										
LPH	15m 50'	30m 100'	45m 150'	60m 200'	75m 250'	90m 300'	105m 350'	120m 400'	135m 450'	150m 500'
450	R5T	R5T	R5T	R5T	R5T	R5T	R5T	R5T	R5T	R5T
900	R5T	R5T	R5T	R5T	R5P	R5P	R10T	R10T	R10T	R10T
1400	R5T	R5P	R10T	R10T	R10T	R10T	R10P	R10T	R10T	R10T
1800	R5T	R10T	R10T	R10T	R10T	R10T	R10P	R10T	R10T	R10T
2300	R10T	R10T	R10T	R10T	R10T	R10T	R10P	R10P	R10P	R10P
3400	R10T	R10T	R10T	R10P	R10P	R10P	R15P	R15P	R15P	R15P
4500	R10T	R10T	R10P	R15P	R15P	R15P	R15P	R15P	R15P	R15P
5700	R10T	R10P	R15P	R15P	R15P	R15P	R15P	R15P	R15P	R15P
6800	R10P	R15P	R15P	R15P	R15P	R15P	R15P	R15P	R15P	R15P

Notes: 1.This table is intended to be used as a guide only and should not be substituted for a complete analysis.
2.Suggested sizes assume an allowable pressure drop of 0.3 bar (4.5psi).
3.Equivalent length of pipe (metre) = Length of pipe + (1.5 x # of elbows and tees) + (12 x # of valves)
Example: System requires 2300 LPH through a pipe system that has 45m of pipe, 4 elbows, 2 tees and 1 valve.
Equivalent length of pipe = 45 + 1.5m x (4 +2) + 12m x (1) = 66m (200ft). Table look-up with 2300 LPH and 66m thus suggested pipe size is R10T (29mm ID).
4. Add 0.07 bar (1psi) pressure drop for every 0.9 metre (3ft) of vertical rise with LN2.

Liquid Nitrogen Properties						
	WEIGHT		GAS		LIQUID	
	Pound (Lb)	Kilograms (Kg)	Cubic Feet (SCF)	Cubic Meters (Nm3)	Gallons (Gal)	Liters (L)
1 Pound	1.0	0.4536	13.803	0.3627	0.1481	0.5606
1 Kilogram	2.205	1.0	30.42	0.7996	0.3262	1.2349
1 SCF Gas	0.07245	0.3286	1.0	0.02628	0.01074	0.04065
1 Nm3 Gas	2.757	1.2506	38.04	1.0	0.4080	1.5443
1 Gal Liquid	6.745	3.060	993.11	2.447	1.0	3.785
1 L Liquid	1.782	0.8083	24.60	0.6464	0.2642	1.0

Nm3 (normal cubic meter) measured at 1 atmosphere and 0°C.
SCF (Standard Cubic Feet) gas measured at 1 atmosphere and 21°C.
Liquid measured at 1 atmosphere and boiling temperature.
All values rounded to nearest 4/5 significant numbers.

AT ATMOSPHERIC PRESSURE:
Boiling Temperature: -196°C -320°F
Heat of Vaporization: 198.8 KJ/Kg (85.6 BTU/lb)
Liquid Density: 0.806 Kg/L (6.745 lb/gal)



Rigid-T

Rigid-T comes with high-purity tubes compliance to semiconductor or Biopharmaceutical specification with minimum contamination to customer process.

The spool fabrication is done in a clean and controlled environment with orbital welding procedure.

Both inner & outer pipe surface are polished, degreased, ultrasonic cleaned, and final-rinsed with high purity RO water, before it is used in process application.

All Rigid-T products come with CSM renowned customer service, from conceptual design to implementation, and are backed by a 5 year or optional extended 10 years vacuum warranty



Rigid-T with Degasser to biomedical freezer

Rigid-T with Ultraflex hose to cryokinetic semicon wafer cleaning equipment



Rigid-T

Engineered as modular sections, these stainless steel coaxial vacuum insulated piping spools are joined together with close tolerance bayonet connections, forming a complete cryogenic transfer system.

Each section is evacuated, sealed and tested for vacuum integrity to ensure minimal heat gain. Rigid-T comes with internal bellows at required intervals to serve as thermal expansion compensators according to EJMA 10,000 cycle fatigue calculation.

Installation for Rigid-T can be done easily both indoor and outdoor, by incorporating flexible sections strategically to offset misalignments.

CSM offers a complete line of components including in-line venting devices, phase separators and gas traps to maximize the cryogenic system performance.

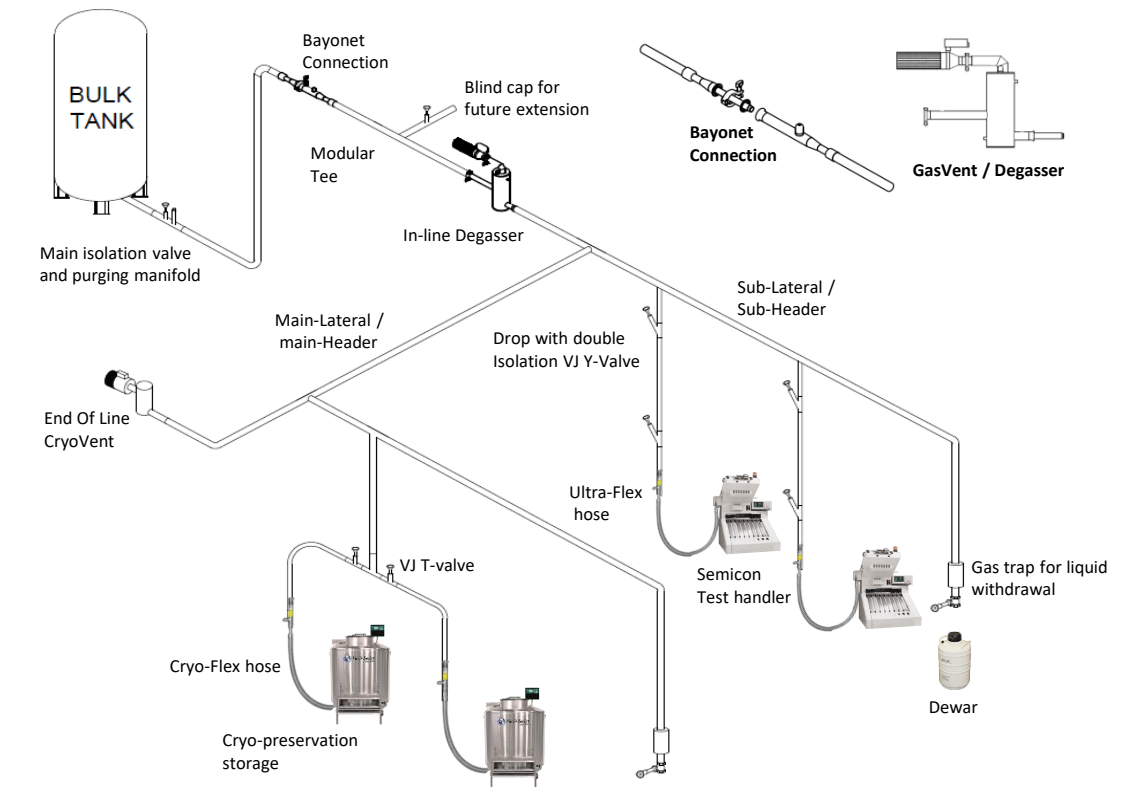
Features and Benefits

- Fabricated by orbital welding to ensure process integrity
- Polished outer jacket provides clean pipe surface for cleanroom requirement
- Rigid-T pipes are durable, easy to install and practically maintenance free
- Excellent flow characteristics make Rigid-T an ideal for pipe mains
- Super insulation and proprietary chemical getters ensures long lasting vacuum integrity

Rigid-T Specifications

Model	R2T	R5T	R10T	R15T
Process Tube	0.5" ODT (12.7 mm OD)	0.75" ODT (19.05 mm OD)	1.125" ODT (29 mm OD)	1.5" ODT (38.1 mm OD)
Jacket Pipe (Sch 5)	1.5" IPS (48.3 mm OD)	2" IPS (60.3 mm OD)	2.5" IPS (73.03 mm OD)	3" IPS (88.9 mm OD)
Steady State Heat Leak	0.17 btu/hr/ft (0.16 watts/m)	0.42 btu/hr/ft (0.40 watts/m)	0.49 btu/hr/ft (0.47 watts/m)	0.62 btu/hr/ft (0.59 watts/m)
Bayonet Heat Leak	6.1 btu/hr (1.8 watts)	4.0 btu/hr (1.2 watts)	8.1 btu/hr (2.4 watts)	7.8 btu/hr (2.3 watts)
Max. Operating Pressure	150 psig (10.3 bar)	150 psig (10.3 bar)	150 psig (10.3 bar)	150 psig (10.3 bar)
Weight (exclude Bayonet)	1.8 lbs/ft (2.7 kg/m)	2.0 lbs/ft (3.0 kg/m)	3.1 lbs/ft (4.6 kg/m)	4.4 lbs/ft (6.5 kg/m)
Vacuum Insulation Type	Static or Dynamic Vacuum			
Maximum Length	Max. single line length 40' (12.2 m)			
Material Construction	Stainless Steel Series 300			
Standard Testing	Dimensional Check Heat leak checked 1 x 10 - 9 cc/s			
Optional	Pneumatic pressure test, Vacuum retention testing, LN2 cold shock, pre-material certs., X-ray, ASME B31.3 certification, CFOS cleaning for O2 services			

Typical Rigid-T, Engineered Modular Piping System





Bayonet Connections

Close Tolerance Bayonets

Close tolerance with extreme low heat leak, frost and condensation free vacuum insulated bayonet connections, designed for cryogenic systems down to 4 kelvin.



All Bayonet Connections come with CSM renowned customer service, from conceptual design to implementation, and are backed by a one year warranty

Vacuum Insulated Bayonets

CSM uses a highly efficient cryogenic connection for vacuum insulated piping systems. Constructed in stainless steel, the bayonet connection utilizes an extremely close tolerance design between the male and female bayonet to minimize convective heat transfer. The thin-walled bayonet reduces overall conductive heat transfer compared to other competitive products. This bayonet tube insertion length is increased with better heat barrier to eliminate condensation or frosting at the clamp joints due to high humidity environment. These design features translate to lowest heat leak and preserve liquid cryogen quality..

Typical Applications

- Vacuum Insulated Rigid Lines.
- Vacuum Insulated Flex Lines.
- Vacuum Jacketed Modular Valve or Fitting components.

Features and Benefits

- Frost and condensation free connections
- Minimization of heat leak
- Easy to install or disassemble, both at cold and warm condition
- Compatible with hygienic type clamping system for leak free operation
- Can be installed in any orientation
- Bayonets can be assembled much quicker compared to traditional welding joint, significantly lowering your installation costs



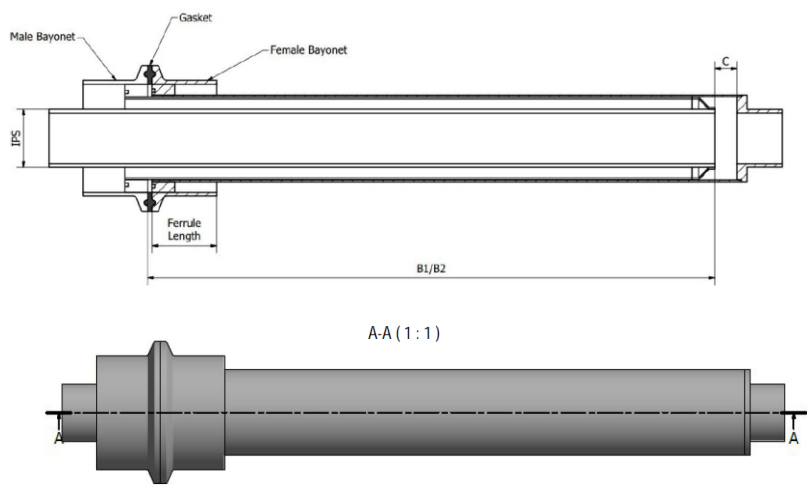
Modular Static Vacuum Tee

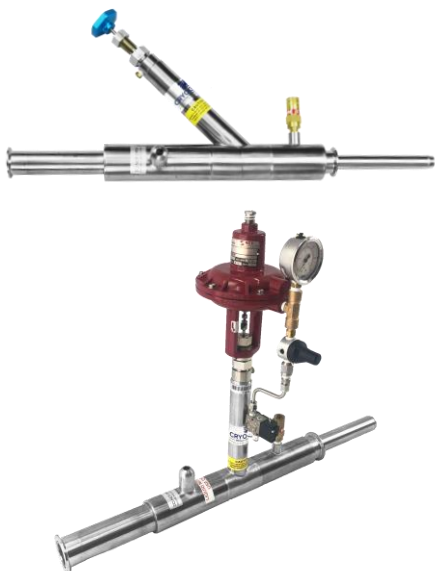
Bayonet Specifications

Sizes	Max Design Pressure psi (bar)	Male Weight lbs (kg)	Female Weight lbs (kg)	Bayonet Heat Leak BTU / Hr (W)	Inner & Outer Jacket Pipe Construction
C2	200 (14)	0.09 (0.04)	0.15 (0.07)	6.1 (1.8)	S/S300
C5	200 (14)	0.44 (0.20)	0.46 (0.21)	4.0 (1.2)	S/S300
C10	200 (14)	0.75 (0.34)	0.79 (0.36)	8.1 (2.4)	S/S300
C15	200 (14)	1.12 (0.51)	1.10 (0.50)	7.8 (2.3)	S/S300
B5	200 (14)	0.53 (0.24)	0.49 (0.22)	8.1 (2.4)	S/S300
B10	200 (14)	1.28 (0.58)	1.21 (0.55)	7.8 (2.3)	S/S300
B15	200 (14)	2.18 (0.99)	2.16 (0.98)	9.2 (2.7)	S/S300
B20	200 (14)	2.80 (1.27)	2.65 (1.20)	11.3 (3.3)	S/S300
B30	200 (14)	6.13 (2.78)	5.53 (2.51)	16.7 (4.9)	S/S300

Bayonet Dimensions

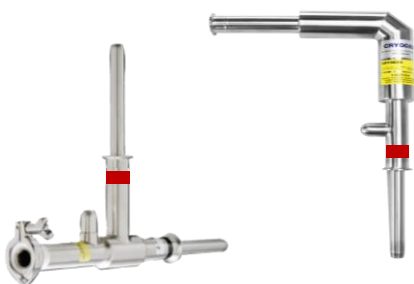
Bayonet Type	Bayonet Size	Inner Pipe Diameter	Ferrule size (Clamp F)	Dimensions	
				B1 (Special)	B2 (Standard)
C2	3/8"ODT	3/8", 1/2" OD (8, 12.7mm)	KF16 / KF25	4 ³ / ₁₆ " (105mm) RIBER 7 ¹ / ₁₆ " (155mm) Dr. Eberl	-
C5	3/4" ODT	3/4"OD (19.1mm)	1 1/2" (51mm)	7 ¹ / ₁₆ " (180mm)	8-5/8" (220mm)
C10 / B5	1 1/8" ODT / 1/2"PS	1 1/8"OD (29.0mm) 1/2"NB (21.3mm)	2" (64mm)	7 ¹ / ₁₆ " (180mm) 8-5/8" (220mm)	10-0" (250mm)
C15 / B10	1 1/2"ODT / 1"PS	1 1/2"OD (38.1mm) 1"NB (33.4mm)	2 1/2"(78mm)	9-5/8" (245mm)	11- ¹³ / ₁₆ " (300mm)
B15	1 1/2"PS	1 1/2"NB (48.3mm)	3" (91mm)	-	14-0" (363mm)
B20	2"PS	2"NB (60.3mm)	4" (119mm)	-	15 3/4" (390mm)
B30	3"PS	3"NB (88.9mm)	5" (145mm)	-	15 3/4" (479.5mm)





All Modular Valves
 come with CSM
 renowned customer
 service, from
 conceptual design to
 implementation, and
 are backed by a one
 year warranty

Related Products:



Modular Fittings

Modular Valves

Pre-engineered modular valve has added advantage over the traditional rigid VJP, especially when use with Semi-Flex system. This option provide simplicity and cost saving as it reduces the necessity for precise system layout measurements. It also allows the valve to be easily reused if use-point locations and plant layout are changed.

Modular valve facilitate users to design and construct their own LN2 delivery system with minimum piping engineering experience or knowledge.

Vacuum Insulated Modular Valves

CSM vacuum insulated valves are recommended when system efficiency and elimination of frost, ice and moisture are essential. The initial cost is greater for the vacuum insulated option, but the savings outweigh the investment in less than a year.

By using a vacuum insulated valve, one can expect a maintenance free operation that does not require frequent replacement of PU foam insulation. Vacuum insulated Modular Valve guarantees extremely low heat leak for minimum liquid boil-off compared to foam-insulated valve by at least 20 times. Thus liquid vaporization loss is reduced and liquid quality is maintained up to the point of use.

Modular valves are commonly used in both Stati-Rigid and Semi-Flex piping systems with Dynamic or Static vacuum technology.

Benefits and Features

- Available in T or Y pattern for horizontal or vertical installation
- Pneumatic actuators can be ordered on valves for remote control
- Low operation torque for bubble tight shut-off
- Cryogenic stem packing with live loaded design to compensate thermal contraction & expansion to prevent premature leakage
- Integral bonnet purge thermal relief port to eliminate extra fittings requirement and corresponding leak point
- Plug to stem stabilizer to ensure longer life cycle for the valve seat
- Replaceable KEL-F seat seal for lower maintenance & repair cost on the valve
- Contoured flow plugs available for flow regulation
- 5 years vacuum warranty for static vacuum

Modular Valves Specifications

Model	Valve Size	MAWP	Flow Coefficient CV		Cooldown Mass lbs (kg)		Valve Heat Leak @20 K BTU / Hr (W)	Bayonet Heat Leak BTU / Hr (W)	Valve Construction
			Y-Valve	T-Valve	Y-Valve	T-Valve			
C504	C2	150 psig	N/A	1.1	N/A	0.1 (0.05)	2.4 (0.7)	6.1 (1.8)	S/S300
C204	C5	300 psig	5.7	2.6	0.5 (0.2)	0.7 (0.3)	4.5 (1.4)	4.0 (1.2)	S/S300
C208	C10	300 psig	25	16.3	1.8 (0.8)	3.3 (1.5)	10.4 (3.1)	8.1 (2.4)	S/S300
C212	C15	300 psig	42	31	6.2 (2.8)	9.1 (4.2)	21.8 (6.4)	7.8 (2.3)	S/S300
C216	B20	300 psig	59.4	42.3	10.5 (4.8)	13.5 (6.2)	27.3 (8.0)	11.3 (3.3)	S/S300

Valve Sizing Flow Calculations:

Basic Liquid Flow Formula

$$C_v = Q_L \sqrt{\frac{SG}{\Delta P}}$$

C_v = Flow Coefficient
 Q_L = Flow (GPM)

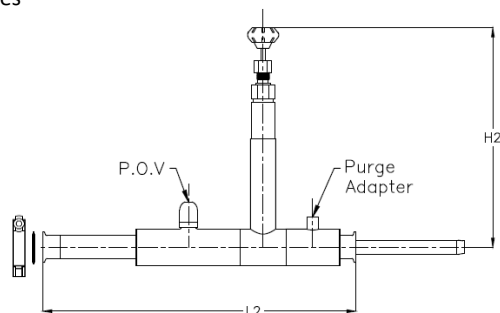
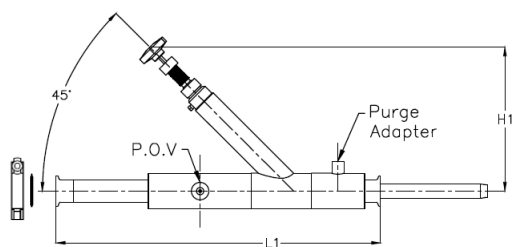
SG = Specific Gravity
 ΔP = Pressure Drop (PSIA)

Modular Valves Dimension

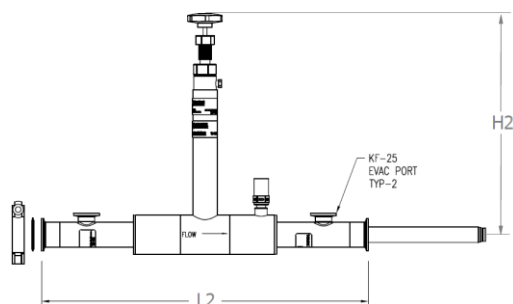
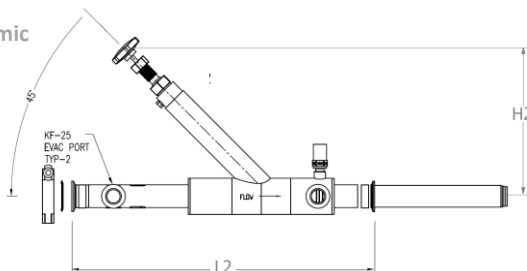
Model	Valve Size	Y-Valve		T-Valve	
		H1 valve open	L1	H2 valve open	L2
C504	C2	-	-	8.4" (213mm)	13.8" (350mm)
C204	C5	10.2" (259mm)	21.7" (550mm)	14.4" (365mm)	21.7" (550mm)
C208	C10	13.4" (340mm)	28.1" (713mm)	17.4" (441mm)	29.5" (750mm)
C212	C15	17.2" (437mm)	-	22.5" (572mm)	-
C216	B20	17.2" (437mm)	-	22.5" (572mm)	-

*Other configurations are available please contact us for more inquiries

Static



Dynamic





Modular Fittings

Pre-engineered modular fittings has added advantage over the traditional rigid VJP, especially when use with Semi-Flex system. This option provide simplicity and cost saving as it reduces the necessity for precise system layout measurements. It also allows the fitting to be easily reused if use-point locations and plant layout are changed.

Modular fittings facilitate users to design and construct their own LN2 delivery system with minimum piping engineering experience or knowledge.

All Modular Fittings come with CSM renowned customer service, from conceptual design to implementation, and are backed by a one year warranty

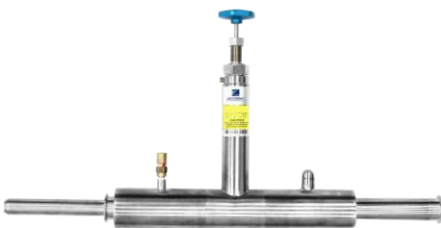
Vacuum Insulated Modular Fittings

CSM vacuum insulated fittings are recommended when system efficiency and elimination of frost, ice and moisture are essential. The initial cost is greater for the vacuum insulated option, but the savings outweigh the investment in less than a year.

The vacuum insulated Modular Fitting guarantees extremely low heat leak for minimum gas boil-off compared to foam-insulated fitting by at least 20 times. Thus, not only can liquid loss be reduced but the quality of liquid can be maintained at the same time.

Modular fittings are commonly used in both rigid and flexible types of vacuum jacketed piping systems, whether in Dynamic or Static vacuum technology.

Related Products:



Modular Valve

Features and Benefits

- Readily available in stock for immediate delivery
- Available in Tee, Elbow and other configurations for ease of selection
- Ease of installation, no welding or field cutting required
- Vacuum insulated modular fittings are maintenance free up to 10 years with no performance deterioration over that period
- 5 years vacuum warranty for static vacuum

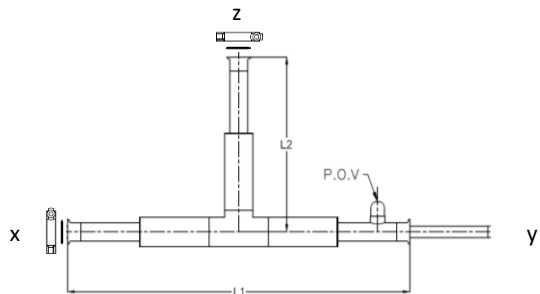
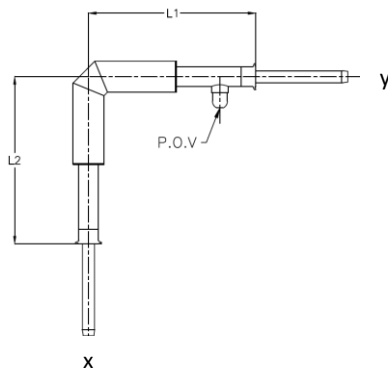
Modular Fitting Specifications

Model	C5	C10
Process Tube	0.75" ODT (19.05 mm OD)	1.125" ODT (29 mm OD)
Jacket Pipe	1.5" IPS (48.3 mm OD)	2.0" IPS (60.3 mm OD)
Steady State Heat Leak	0.32 btu/hr/ft (0.31 watts/m)	0.47 btu/hr/ft (0.45 watts/m)
Bayonet Heat Leak	4.0 btu/hr (1.2 watts)	8.1 btu/hr (2.4 watts)
Max. Operating Pressure	150 psig (10.3 bar)	150 psig (10.3 bar)
Vacuum Insulation Type	Static or Dynamic Vacuum	
Material Construction	Stainless Steel Series 300	
Standard Testing	Dimensional Check He leak checked 1 x 1 0 - 9 cc/s	
Optional	Pneumatic pressure test, Vacuum retention testing, LN2 cold shock, pre-material certs., X-ray, ASME B31.3 certification, CFOS cleaning for O2 services	

Modular Fitting Dimensions

Configuration*		C5		C10	
Item	x - y	L1	L2	L1	L2
Elbow	F x F	12.8" (326mm)	12.8" (326mm)	13.4" (340mm)	13.4" (340mm)
	F x M	12.8" (326mm)	12.8" (326mm)	13.4" (340mm)	13.4" (340mm)
	M x M	12.8" (326mm)	12.8" (326mm)	13.4" (340mm)	13.4" (340mm)
Item	x - y - z	L1	L2	L1	L2
Tee	F x F x F	28.8" (732mm)	13.9" (353mm)	30.0" (764mm)	14.0" (355mm)
	F x F x M	28.8" (732mm)	13.9" (353mm)	30.0" (764mm)	14.0" (355mm)
	F x M x F	28.8" (732mm)	13.9" (353mm)	30.0" (764mm)	14.0" (355mm)
	F x M x M	28.8" (732mm)	13.9" (353mm)	30.0" (764mm)	14.0" (355mm)
	M x M x F	28.8" (732mm)	13.9" (353mm)	30.0" (764mm)	14.0" (355mm)
	M x M x M	28.8" (732mm)	13.9" (353mm)	30.0" (764mm)	14.0" (355mm)
	F x F x NPT	28.8" (732mm)	9.8" (250mm)	30.0" (764mm)	9.8" (250mm)
	F x M x NPT	28.8" (732mm)	9.8" (250mm)	30.0" (764mm)	9.8" (250mm)
	M x M x NPT	28.8" (732mm)	9.8" (250mm)	30.0" (764mm)	9.8" (250mm)

*Other configurations are available please contact us for more inquiries





Phase Separator

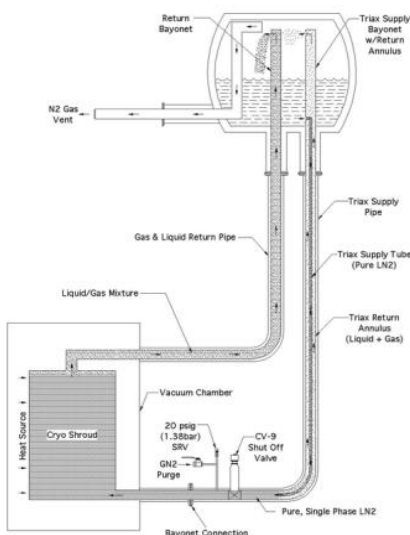
Atmospheric Pressure

Stainless steel, over-head horizontal type vacuum jacketed cryogenic conditioning system designed to store LN₂ at atmospheric pressure condition. Once the system has been set up, the liquid Level is controlled automatically by the controller.

Compatible with Triax piping system to transport pure LN₂ from the Phase Separator, with no gaseous nitrogen will pass through your equipment

All Phase Separators comes with CSM renowned customer service, from conceptual design to implementation, and are backed by a one year warranty

Phase Separator Closed Loop Application



Phase Separator

A CSM atmospheric type of Phase Separator is mainly used in specialized applications that demand extremely high quality, low pressure liquid nitrogen. CSM Phase Separator is a vacuum insulated reservoir holding tank for liquid nitrogen with a differential pressure level control system that operates with a proportional inlet valve.

The Phase Separator is continuously full of liquid nitrogen under atmospheric conditions. Typical applications include direct feed to a LN₂ doser or closed Loop liquid nitrogen circulation system typically found in MBE (Molecular Beam Epitaxy) system application.

Liquid nitrogen is fed from bulk storage tank to phase separator by StatiRigid or Semi-Flex piping system.

Features and Benefits

- Differential pressure controls and a proportional inlet valve helps to maintain a constant liquid level at +/- 5%
- Provides a ready supply of vapor free pure liquid nitrogen to critical applications
- Available in 22 and 46 litre operating capacity with bottom outlets from 2 to 12 outlets. Higher capacity for custom application available
- It comes with special designed universal outlet connections, which allow either connections interchangeable with liquid feed Triax pipes or vapor return Triax pipes. This feature improve installation flexibility in a multiple pairs of closed loop piping system

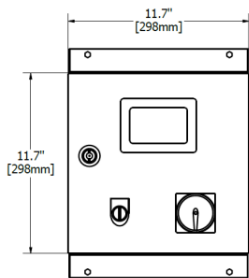
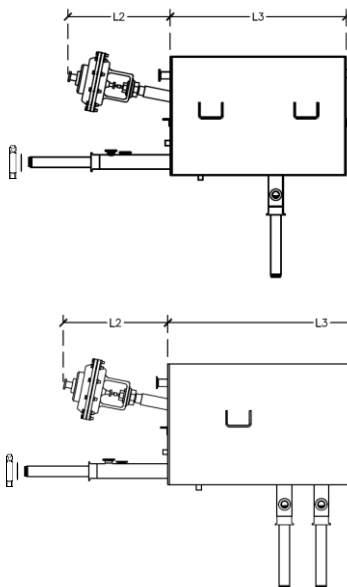
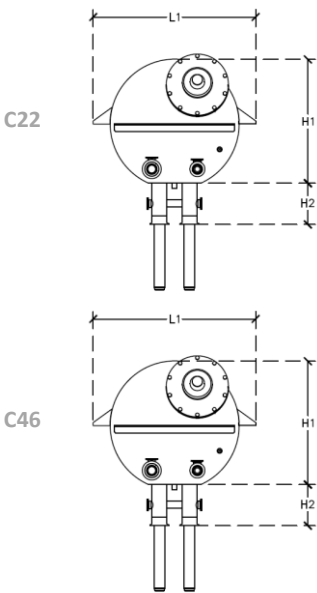
Phase Separator Specifications

Model	C22.2	C22.4	C22.6	C46.8	C46.10	C46.12
Operating Capacity*	6 gal (22L)	6 gal (22L)	6 gal (22L)	12 gal (46L)	12 gal (46L)	12 gal (46L)
Full capacity	10 gal (36L)	10 gal (36L)	10 gal (36L)	20 gal (78L)	20 gal (78L)	20 gal (78L)
Outlets (bottom)	2 (C10)	4 (C10)	6 (C10)	8 (C10)	10 (C10)	12 (C10)
Max. Inlet Pressure	125 psig (9 bar)	125 psig (9 bar)	125 psig (9 bar)	125 psig (9 bar)	125 psig (9 bar)	125 psig (9 bar)
Max. Back Pressure	22 psig (1.5 bar)	22 psig (1.5 bar)	22 psig (1.5 bar)	22 psig (1.5 bar)	22 psig (1.5 bar)	22 psig (1.5 bar)
Vessel MAWP	150 psig (10 bar)	150 psig (10 bar)	150 psig (10 bar)	150 psig (10 bar)	150 psig (10 bar)	150 psig (10 bar)
Max. Withdrawal Rate	10 gal/min (38LPM)	10 gal/min (38LPM)	10 gal/min (38LPM)	20 gal/min (76LPM)	20 gal/min (76LPM)	20 gal/min (76LPM)
Weight – Empty	115 lbs (52 kg)	115 lbs (52 kg)	115 lbs (52 kg)	177 lbs (80 kg)	177 lbs (80 kg)	177 lbs (80 kg)
Weight – Full	154 lbs (70 kg)	154 lbs (70 kg)	154 lbs (70 kg)	259 lbs (117 kg)	259 lbs (117 kg)	259 lbs (117 kg)
Vacuum Insulation	Static	Static/Dynamic	Static/Dynamic	Static/Dynamic	Static/Dynamic	Static/Dynamic
Level Control	Differential Pressure with PID valve					
System Utilities	Electricity: 80 – 240 VAC, GN2 @40 psig (2.7 bar)					
Certifications	NEMA 4X, CE					
Materials	Stainless Steel Series 300					
Standard Testing	Dimensional Check He leak checked 1 x 10 - 9 cc/s					
Optional	Pneumatic pressure test, Vacuum retention testing, LN2 cold shock, pre-material certs., CFOS cleaning for O2 services, X-ray, ASME coded pressure vessels BPVC Section VIII					

*Factory preset operating capacity, field adjustable by user depend on liquid flow output requirement and in-coming liquid saturation characteristic

Phase Separator C22/C46 Dimensions

Model	H1	H2	L1	L2	L3
C22	16.4" (417mm)	5.5" (140mm)	21.6" (549mm)	14.2" (361mm)	24.4" (620mm)
C46	16.4" (417mm)	5.5" (140mm)	21.6" (549mm)	14.2" (361mm)	41.7" (1060mm)



Controller Dimensions



Phase Separator

Pressure Adjustable

Stainless steel, over-head horizontal type vacuum jacketed cryogenic conditioning system designed to store LN₂ at user required pressure setting. Once the system has been set up, the liquid Level and pressure is automatically control by the controller. The controller comes with a HMI to allow user to set their required pressure.

Phase Separator - Pressure Adjustable

Pressure adjustable Phase Separator is used for stepping down the pressure of liquid nitrogen in the pipe line. This is done by venting out excessive vapor while maintaining a constant liquid supply capacity for downstream consumption. The result is a high quality, low pressure liquid nitrogen with precise temperature control at the user's point of use.

CSM Phase Separator is a vacuum insulated reservoir holding tank for liquid nitrogen with a pressure & level control system. The controller will operate its inlet proportional control valves to regulate the liquid level, and another vent proportional valve to regulate the user's required set pressure.

All Phase Separators comes with CSM renowned customer service, from conceptual design to implementation, and are backed by a one year warranty

Related Products:



Vent Heater

Typical Applications

- Test Handlers in semiconductor IC Assembly and Test
- Environmental Chambers
- Bottling Lines and Packaging
- Food Freezing

Features and Benefits

- Consistent liquid nitrogen delivery, dramatically improving process control and efficiency.
- User friendly operator controls with level & pressure alarm
- Vacuum jacketed vessel for frost-free operation.
- User adjustable output pressure for all models.
- HMI with digital display of liquid level and pressure readings
- Modbus output available

Phase Separator Specifications

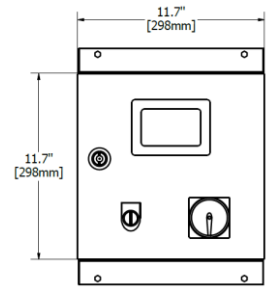
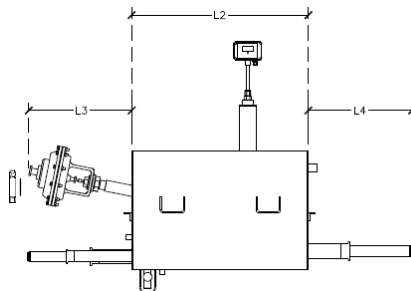
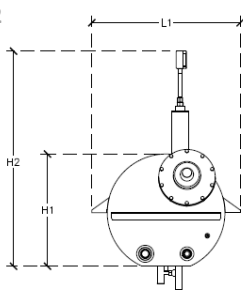
Model	C22P	C48P	C76P
Operational Capacity* / Full capacity	6 gallons (22L) 10 gal (36L)	12.6 gallons (48L) 20 gal (76L)	20 gallons (76L) 32 gal (120L)
Outlets (horizontal)	1 (C10)	2 (C10)	1 (C10 or C15)
Max. Inlet Pressure	130 psig (8.6 bar)	145 psig (10 bar)	145 psig (10 bar)
Max. Back Pressure	58 psig (4 bar)	87 psig (6 bar)	87 psig (6 bar)
Vessel MAWP	130 psig (8.6 bar)	145 psig (10 bar)	145 psig (10 bar)
Max. Withdrawal Rate	5 gallons/minute (18LPM)	28 gallons/minute (106LPM)	40 gallons/minute (150LPM)
Weight – Empty – Full	108 lbs (49 kg) 146 lbs (66 kg)	132 lbs (60 kg) 225 lbs (102 kg)	Consult Factory
Level Control Sensor	Capacitance		
Vacuum Insulation	Static Vacuum only		
System Utilities	Electricity: 80 – 240 VAC, GN2 @40 psig (2.7 bar)		
Certifications	NEMA 4X, CE		
Materials	Stainless Steel Series 300		
Standard Testing	Dimensional Check He leak checked 1 x 10 - 9 cc/s		
Optional	Pneumatic pressure test, Vacuum retention testing, LN2 cold shock, pre-material certs., CFOS cleaning for O2 services, X-ray, ASME coded pressure vessels BPVC Section VIII		

*Factory preset operating capacity, field adjustable by user depend on liquid flow output requirement and in-coming liquid saturation characteristic

Phase Separator Dimensions

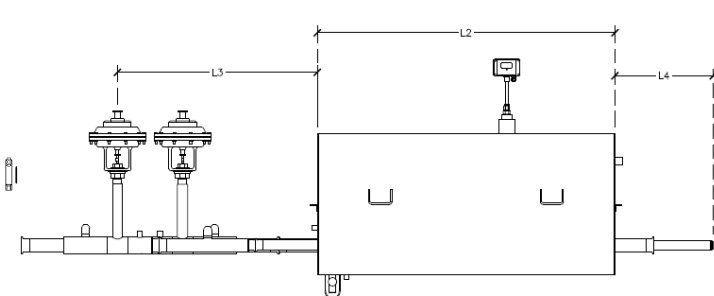
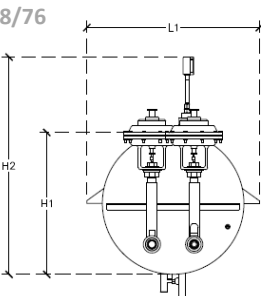
Model	H1	H2	L1	L2	L3	L4
C22	16.4" (417mm)	31.5" (799mm)	21.6" (549mm)	24.4" (620mm)	14.2" (361mm)	14.3" (364mm)
C48	21.7" (550mm)	33.5" (850mm)	25.8" (655mm)	33.9" (860mm)	23.1" (585mm)	14.3" (364mm)
C76	21.7" (550mm)	33.5" (850mm)	25.8" (655mm)	43.3" (1100mm)	29.1" (739mm)	14.3" (364mm)

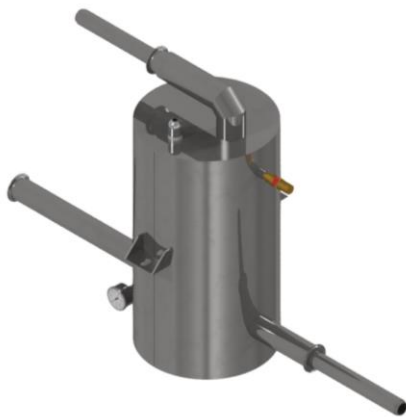
C22



Controller Dimensions

C48/76





Degasser DG8

[All Degasser comes with CSM renowned customer service, from conceptual design to implementation, and are backed by a one year warranty

Degasser

Pipeline

The pipeline degasser removes gas by slowing down the liquid flow velocity, ensuring that the exit liquid supply is pure. It is typically installed either in-line or at the end of the pipeline before connecting to equipment. The degasser is modular and pre-engineered for easy installation and flexible arrangement within a piping system

Degasser

Due to a constant heat leak and pressure drop between the storage tank and the consumer use points, a portion of the liquid nitrogen in the pipeline will evaporate into gas or vapor. As the liquid passes through the degasser, the gas is removed, ensuring high-quality liquid is delivered to the use points. This is done by mechanically separating the boil-off gas from the liquid.

The degasser is maintenance-free and does not require any field adjustments. Its operation requires no electrical power, sensors, pneumatics, or electronics. The pre-engineered degasser has a capacity of delivering liquid nitrogen flow consumptions up to 200 L/h, with higher capacities available upon request.

Related Products:



Vent Heater

Typical Applications

- This product is suitable for cooling down piping without venting gas through the equipment
- It can be used as phase separators in combination with a back-pressure valve when no electric power or pneumatics are available

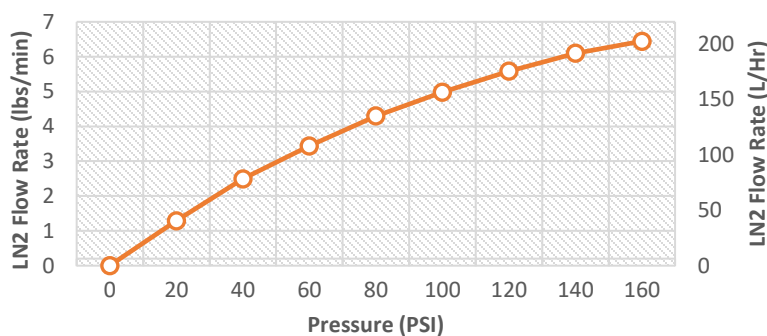
Features and Benefits

- The degasser is available with either bayonet or pipe threaded termination
- It uses a bayonet connection to facilitate future expansion of the piping system
- The degasser ensures consistent and efficient liquid supply from bulk storage to the end application
- It maintains liquid in the piping system at all times

Pipeline Degasser Specifications

Degasser Model	DG2	DG8	DG22
Vessel Capacity	0.5 gal (2L)	2 gal (8L)	6 gal (22L)
Type	In-line / End of Line	In-line	In-line
Control Principle	Mechanical/Buoyancy Force		
Venting Capacity	1.5 Nm ³ /hr Max (Fix Orifice)		
Insulation	Static vacuum with Multi-Layer Insulation		
Cleanliness Level	Cleaned oil and grease-free Oxygen clean on request		
Maximum Operating Pressure	200 psig (13.8 bar)		
Material Construction	Stainless Steel Series 300		
Standard Testing	Dimensional Check He leak checked 1 x 10 ⁻⁹ cc/s		
Optional	Pneumatic pressure test, Vacuum retention testing, LN2 cold shock, pre-material certs., X-ray, ASME B31.3 certification, CFOS cleaning for O2 services		

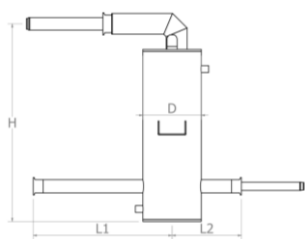
DG2 Flow Rate*



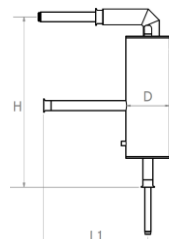
*Depending on liquid supply quality or liquid storage saturated pressure, i.e. gas & liquid mixture ratio. Larger saturation results in lesser liquid flow output

Dimensions

P/N	H	L1	L2	D
DG2-H-C5F/C5M-DD	22.5" (571mm)	15.7" (400mm)	7.9" (200mm)	6.6" (168mm)
DG8-H-C10F/C10M-DD	24.3" (617mm)	21.3" (540mm)	12.2" (310mm)	11.8" (300mm)
DG2-B-C5F/C5M-DD	25.6" (649mm)	15.7" (400mm)	-	6.6" (168mm)



In-line Degasser



End-of-line Degasser



All Cryovents
 come with CSM
 renowned customer
 service, from
 conceptual design to
 implementation, and
 are backed by a one
 year warranty

CryoVent

Mechanical

The Cryovent is designed to remove excess vapor from cryogenic piping systems when the liquid stops flowing, ensuring that your cryogenic system is always filled with liquid. It is modular and pre-engineered for easy installation and flexible arrangement in any piping system.

Cryovent

The cryovent is installed to enhance the liquid delivery performance of a piping system. Under normal operational circumstances, the liquid in the system is constantly vaporizing into gaseous nitrogen due to a constant heat leak. If the accumulated gas in the pipeline is not removed, it will block the liquid flow to the use points. The Cryovent plays an important role in removing the gas from the pipeline by automatically venting it to the atmosphere.

The Cryovent uses a mechanical (buoyancy) control principle. It allows only gas/vapor to vent while retaining the liquid medium in the pipeline. This ensures that quality liquid is readily available at all times in the pipeline, improving the liquid delivery efficiency. The Cryovent is maintenance-free and requires no field adjustments. Its operation requires no electrical power, sensors, pneumatics, or electronics.

Related Products:



Vent Heater

Typical Applications

- This device functions as both a gas venting and pre-cooling device in a vacuum-jacketed piping system
- It is suitable for use with inert gases such as liquid nitrogen and argon. Optional CFOS cleaning is available for oxygen service

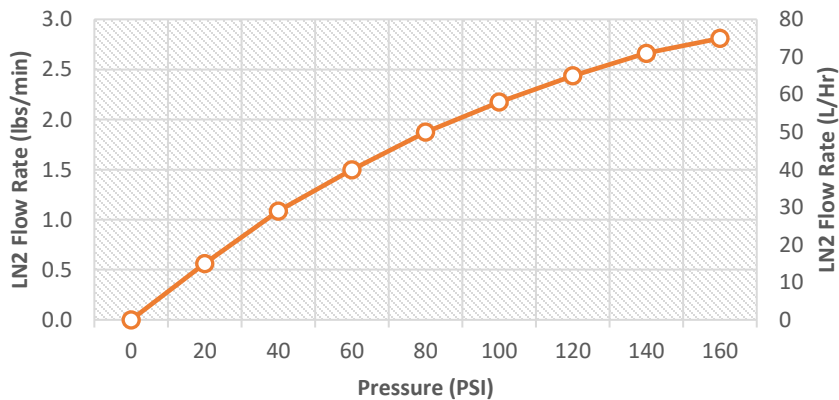
Features and Benefits

- The cryovent is available with either bayonet or pipe threaded termination
- It uses a bayonet connection to facilitate future expansion of the piping system
- The cryovent ensures consistent and efficient liquid supply from bulk storage to the end application
- It maintains the liquid level in the piping system at all times

Cryovent Specifications

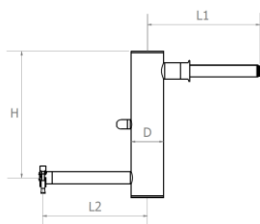
Cryovent Model	CV2	CV5
Capacity	0.6 gal (2L)	1.4 gal (5L)
Control Principle	Mechanical/Buoyancy	
Venting Capacity	1.5 Nm ³ /hr (Theoretical Max)	
Orifice Size	Fixed Orifice	
Insulation	Static vacuum with Multi-Layer Insulation; or Dynamic vacuum	
Cleanliness Level	Cleaned oil and grease-free Oxygen clean on request	
Maximum Operating Pressure MAWP	200 psig (13.8 bar)	
Material Construction	Stainless Steel Series 300	
Standard Testing	Dimensional Check He leak checked 1 x 10 ⁻⁹ cc/s	
Optional	Pneumatic pressure test, Vacuum retention testing, LN2 cold shock, pre-material certs., X-ray, ASME B31.3 certification, CFOS cleaning for O2 services	

CV2 Flow Rate

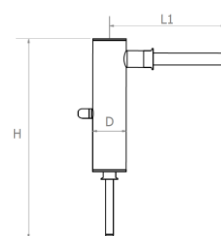


Dimensions

Model	H	L1	L2	D
CV2-H-C5F	18.1" (460.1mm)	11.9" (302mm)	12.8" (326mm)	4.0" (102mm)
CV2-H-C10F	16.9" (429.5mm)	11.9" (302mm)	12.6" (320mm)	4.0" (102mm)
CV2-B-C5M	24.2" (614mm)	11.9" (302mm)	-	4.0" (102mm)
CV2-B-C10M	25.7" (654mm)	11.9" (302mm)	-	4.0" (102mm)



Cryovent, Horizontal



Cryovent, Vertical



VHA

[All Vent Heaters come with CSM renowned customer service, from conceptual design to implementation, and are backed by a one year warranty

Related Products:



VH10A

Vent Heater

Vent-Heater is use for outdoor venting or indoor vent line termination in a large enclosed area with proper air exchange.

Provides ice-free termination, minimizing safety hazards such as falling ice, water drips, large ice accumulation, and roof damage. The protective outer mesh shields personnel from the high-temperature heater located inside

Vent Heater

Cryovent exhaust heater is designed to fit on the bayonet outlet of a CSM Cryovent and Phase Separator where the cold discharge gas needs to be warmed prior to venting. Typically used to eliminate long-distance vent lines, the need for insulation or venting into exhaust ducts.

When liquid in the piping system is constantly vaporizing, the vapor exiting the venting device outlet may cause condensation and eventually, frosting. This can be prevented by using a vent heater to provide a heated pathway for the cryogenic vapor exiting the vent outlet, as cold nitrogen vapor is warmed to halt the creation of ice and condensation. This creates a safe environment while minimizing potential pipe strain associated with a non-heated Cryovent.




Typical Applications

- Vent outlet for Cryovent and Degasser
- Vent outlet at Phase Separators
- End of venting pipe line

Features and Benefits

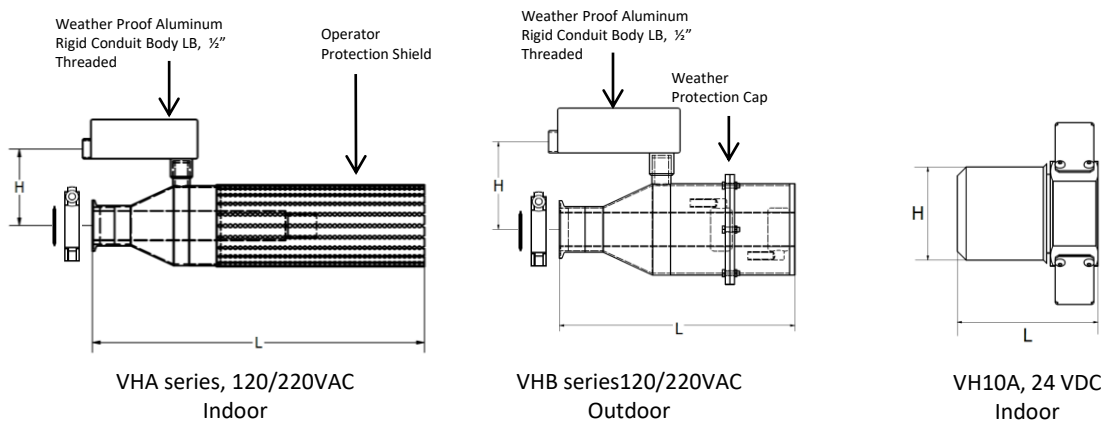
- Can be installed on the bayonet connection outlet of any liquid nitrogen keepful device
- Eliminates ice formation on vent piping
- Eliminates the need for foam insulation on vent piping
- Eliminates the need for a large free space for vent piping
- Provides ice-free termination, minimizing safety hazards such as falling ice, water drips, large ice accumulation, and roof damage
- The protective outer mesh shields personnel from the high-temperature heater located inside

Vent Heater Specifications

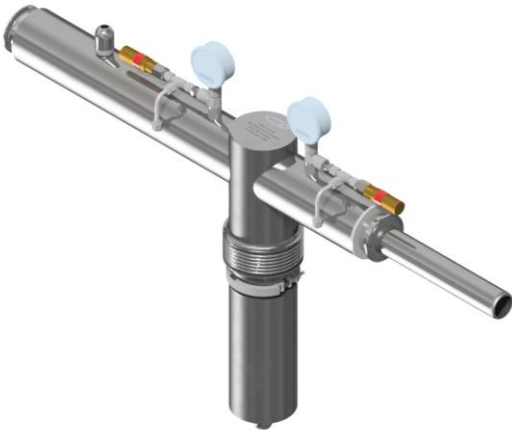
Vent heater Model	VH	VH10A
Material Construction	Stainless Steel Series 300	Aluminium
Application	Indoor  / Outdoor 	Indoor 
Power	150Watt – 450Watt (subject to customer application)	20 W
Voltage/ Amp	24VDC / 110 VAC / 220 VAC (customer to define upon order)	24VDC
Power Connection	Standard Aluminum Rigid Conduit Body LB, ½" Threaded	M12
Standard Testing	Dimensional Check Heater functional test	

Vent Heater Dimensions

P/N	Application	H	L
VH10A-24DC	Indoor	2.1" (53mm)	3.1"(80mm)
VHA-C5F	Indoor	3.0" (80mm)	10.0" (250mm)
VHA-C10F	Indoor	3.9" (100mm)	15.0" (380mm)
VHA-C15F	Indoor	5.0" (127mm)	15.0" (380mm)
VHB-C5F	Outdoor	3.0" (80mm)	10.0" (250mm)
VHB-C10F	Outdoor	3.9" (100mm)	11.3" (286mm)
VHB-C15F	Outdoor	5.0" (127mm)	15.0" (380mm)



Modular T-Filter[®]



All Cryogenic T-Filter come with CSM renowned customer service, from conceptual design to implementation, and are backed by a one year warranty

Pre-engineered Modular T-filter, to filter incoming liquid nitrogen for pure liquid supply. Vacuum insulated with lowest heat leak and lower liquid nitrogen losses compared to traditional non-vacuum insulated Y-filter. Also, it has high safety feature to prevent operator from cold burns.

How it Works

Modular T-filter is available with bayonet connection and is easily integrated into existing vacuum jacketed piping system effortlessly.

T-filter is also available in a switch-over station (S.O.S) for uninterrupted liquid nitrogen supply during filter maintenance or element change-out. The S.O.S consist of two T-filter, one active and one standby. When the filter in active use is due for service, the operator can manually switch over the liquid flow to the standby filter.

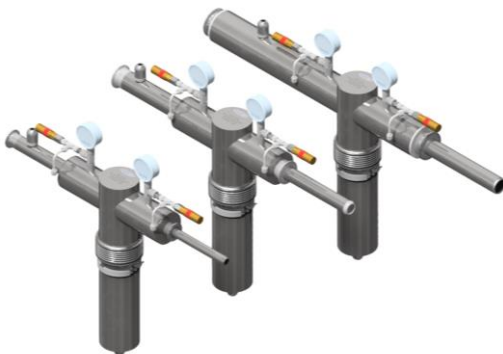
This T-filter station is available in automatic switch-over function using pressure differential instruments to monitor the filter element working condition. A differential pressure more than 1.5 bar indicates a filter element blockage and needs cleaning or replacement. The fully vacuum insulated design guarantees low heat leak compared to foam-insulated type with 30 times lesser liquid boil-off. Besides ensuring better liquid flow and quality, it also helps to save LN2 losses, equivalent to less than 3 months of capital payback.

Typical Applications

- To remove particle or debris from liquid stream that may pose problems to downstream piping, valves, instrumentation and production process.
- Suitable for of LIN, LAR or LOX

Features and Benefits

- Easy to replace filter element. There is no foam insulation to break & re-foam
- Installation is quick and easy. No costly on-site foam insulation work is needed
- Saving of liquid nitrogen usage between 300kg to 500kg per day, thanks to its vacuum jacketed feature compared to traditional non-vacuum insulated Y-filter
- Frost-free and condensation free operation, suitable for cleanroom & HACCP work area
- Requires less footprint due to top entry filter element design

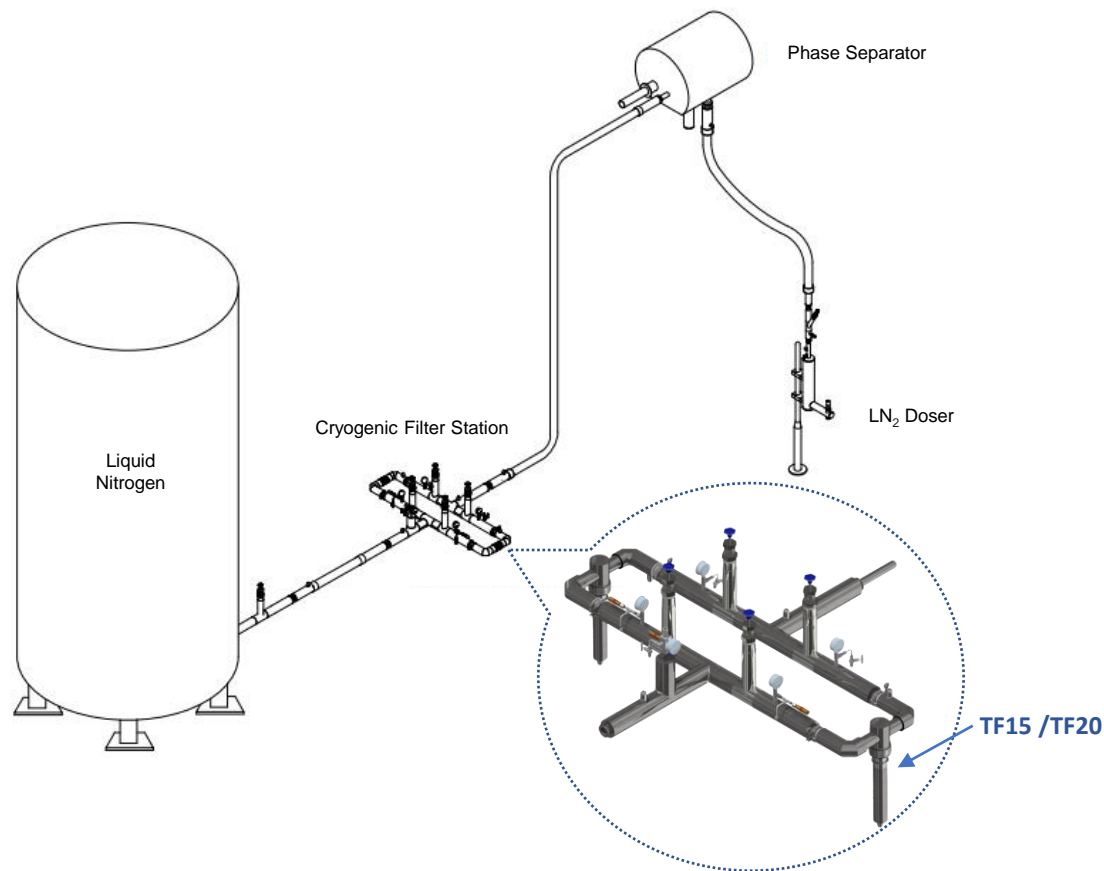


Cryogenic T-Filter - Available Connection Types

Modular T-Filter® Specifications

Model	TF10	TF15	TF20
Pipe size	½", 1"	1.5"	2"
Pore size, micrometre (um)	10um, 40um, 100um		
Filter Element Material Grade	SS316L (1.4404)		
Max Flow Capacity	1600LPH	3200LPH	4500LPH
Connection size	Bayonet C5, C10	Bayonet C15, B15, W15	Bayonet B20, W20
Steady State Heat Loss	2 btu/hr/ft (1.8 watts)	4 btu/hr/ft (3.8 watts)	8 btu/hr/ft (7.2 watts)
Vacuum Insulation Type	Static Vacuum with MLI, Absorbent and Getters; Dynamic Vacuum as option		
Maximum Operating Pressure	150 psig (10 bar)		
Housing Material	Stainless Steel Series 300		
Switch Over	Manual or Automatic Control		
Monitoring System	Analog Gauge (Manual System) or Alarm Switch (Automatic System)		
Standard Testing	Dimensional Check He leak checked 1 x 10 - 9 cc/s		
Optional	Pneumatic pressure test, Vacuum retention testing, LN2 cold shock, pre-material certs., X-ray, ASME B31.3 certification, CFOS cleaning for O2 services		

Typical Cryogenic Switch-Over Filter Station® for LN2 Supply



Dewar Changeover®



Automated or
Manual Changeover
System

[All Dewar
Changeover System
come with CSM
renowned customer
service, from
conceptual design to
implementation, and
are backed by a one
year warranty

Pre-engineered, valve manifold station, easily expandable when the LGC demand increases. Vacuum insulated with lowest heat leak and lower liquid nitrogen losses compared to traditional foam insulated LGC manifold station. Also, its highest safety feature prevents operator from cold burns.

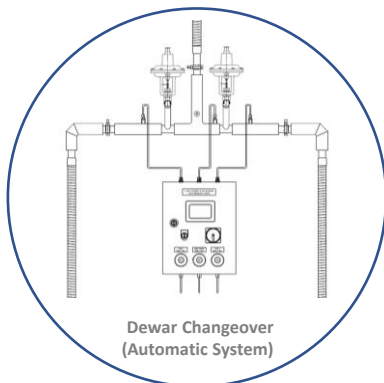
How it Works

Uninterrupted liquid nitrogen supply with LGC is achievable with a dewar changeover system. The station consist of two sides, one active supply and one standby. When the active supply is depleted, the operator only need to manually switch over the supply to the standby tank. Automatic changeovers are available as option for unattended operation.

This dewar changeover system comes with necessary instruments to monitor liquid nitrogen pressure and level in the cylinder. This allows operator to verify the liquid nitrogen volume to avoid premature changeout and wastage.

CSM dewar changeover system is fully vacuum insulated, guarantees extremely low heat leak compared to foam-insulated station – at least 20 times reduction in liquid boil-off. This ensures consistent liquid supply quality to point-of-use. Lower boil-off translates to savings in LN2 consumption, equivalent to at least 6 months period of equipment capital payback.

Related Products:



Dewar Changeover
(Automatic System)

Typical Applications

- Liquid withdrawal applications using LGC, especially uninterrupted liquid supply is paramount to production need
- Suitable for of LIN, LAR or LOX

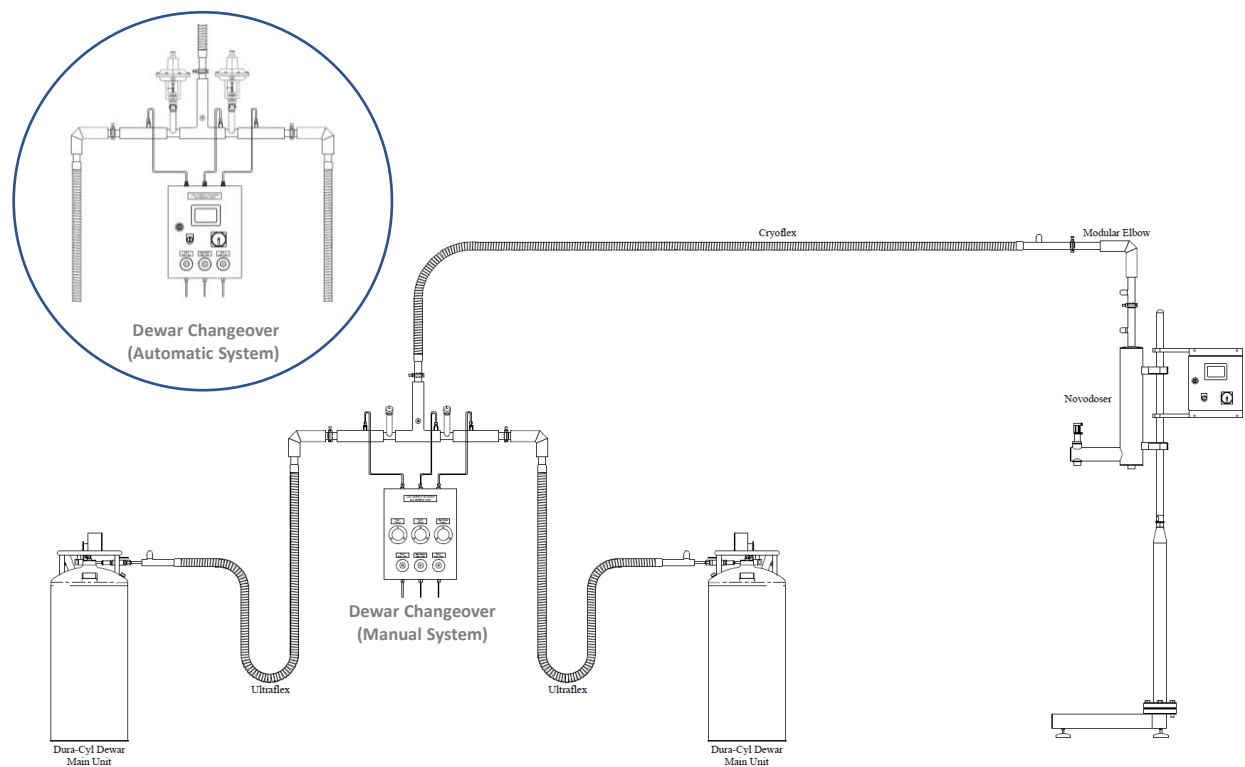
Features and Benefits

- Minimal liquid supply downtime for higher productivity
- Available in 1x1, 2x2, 4x4 liquid cylinder configurations
- Frost-free and condensation free operation with vacuum insulation system.
- Prevent premature liquid cylinder changeouts through proper monitoring
- Compact size enables ease of installation in limited spaces

Dewar Changeover System® Specifications

Model	DC5	DC10
Inner Diameter	0.75" ODT (19.05 mm OD)	1.125" ODT (29 mm OD)
Outer Diameter	1.5" IPS (48.3 mm OD)	2.0" IPS (60.3 mm OD)
Steady State Heat Loss	1 btu/hr/ft (.96 watts/m)	2 btu/hr/ft (1.9 watts/m)
Bayonet Heat Loss	6.5 btu/hour (1.9 watts)	12 btu/hour (3.5 watts)
VJ Valve Heat Loss @20 K	2.4 btu/hour (0.7 watts)	4.5 btu/hour (1.4 watts)
Vacuum Insulation Type	Static Vacuum with MLI, Absorbent and Getters	
Maximum Operating Pressure	150 psig (10 bar)	
Material Construction	Stainless Steel Series 300	
Changeover Control Type	Manual or Automatic	
Monitoring System	Analog Gauge (Manual System) or Alarm Switch (Automatic System)	
Standard Testing	Dimensional Check He leak checked 1 x 1 0 - 9 cc/s	
Optional	Pneumatic pressure test, Vacuum retention testing, LN2 cold shock, pre-material certs., X-ray, ASME B31.3 certification, CFOS cleaning for O2 services	

Typical Dewar Changeover System® for LN2 Supply



ADF10 Dewar Auto-Filling[®]



Dewar Auto-Filling System

[Dewar Auto-Filling System comes with CSM renowned customer service, from conceptual design to implementation, and are backed by a one year warranty

Pre-engineered Dewar Auto-Filling System is to allow unattended filling of LN2 dewar. The system comes with all the necessary safety features to prevent liquid nitrogen safety hazard like asphyxiation and cold burn, normally associated with manual filling process.

How it Works

CSM Dewar Automatic Fast Filling System ADF10 Model comes with automatic control to allow unattended filling of liquid cylinders. This is an extremely fast filling system in the market today.

It operates by two high pressure & high flow cryogenic solenoid valve for liquid supply & vapor venting. A thermistor sensor is used to detect liquid nitrogen overflow to prompt an superfast automatic shut-off the moment liquid cylinder is full.

Beside thermistor signal Input, ADF10 could also receive optional signal from other instruments such as weighing scale, oxygen level monitoring sensor, emergency over-ride signal to shut-off the LN2 flow.

The ADF10 comes with 2 lengths of flexible hoses for easy connection between the ADF and dewar. If there is any leakage detected due to poor fitting connection between the hose and dewar, the ADF will not start the filling process.

Option is available for premium quality vacuum insulated hose to minimize heat leak and avoid cold burn incidence to the operator.

Typical Applications

- Unattended dewar filling of cryogenic fluids
- Suitable for LIN and LAR

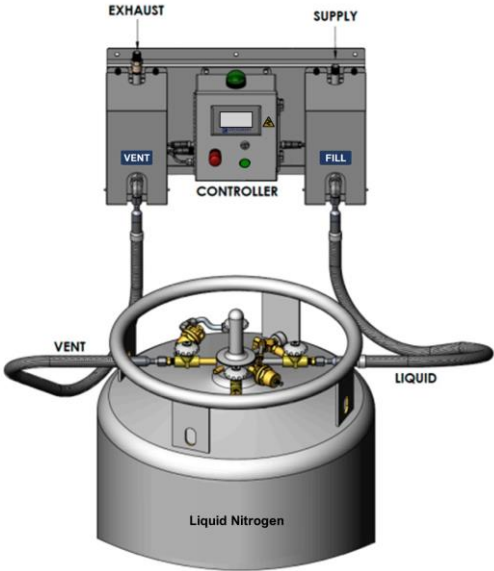
Features and Benefits

- Accurate cryogenic sensing for faster, safer, and reliable fill sensing technology to automatically shut off the fill cycle.
- Easy, single button operation for convenient filling operation.
- Vent safety interlock ensure filling & vent lines are properly installed before system starts filling
- Higher filling output and higher operation safety
- Compact size enables ease of installation in limited spaces

Dewar Auto-Filling® Specifications

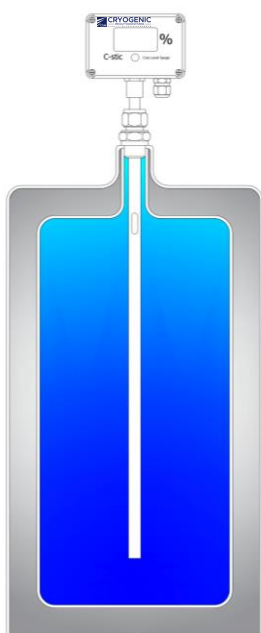
Model	ADF10
Min / Max Operating Pressure	22-300 psig (1.5 – 20.0 bar)
Max Filling Time	10 LPM (Less than 20 min for 160L dewar)
Solenoid Valve, Size (Cv)	½" (3.5)
Safety Shut down Signal input 1	Liquid Nitrogen Overflow
Safety Shut down Signal input 2	Pipe connection leakage detection
Safety Shut down Signal input 3	Emergency shut down override button
Safety Shut down Signal input 4	Oxygen level monitoring sensor
Alarm dry output, 24VDC	2 nos
Case Material Construction	Stainless Steel Series 304L
Electrical Enclosure	Weather Tight
Filling Control Type	Automatic
Utilities	Electrical 110 ~230VAC, Single Phase
Dimension (mm)	381(H) x 660(L) x 254(D)
Weight (kg)	25
Standard Testing	Pressure Leak Test 10 Bar
Optional	LN2 functional test Vacuum insulated flexible hose

Typical Dewar Filling System®





All Cryo-Stics come with CSM renowned customer service, from conceptual design to implementation



Cryo-Stic

Cryo-Stic is used as a direct replacement for mechanical float gauges. Provides continuous and accurate measurement than mechanical or pressure devices within +/-1% (over full scale). The thermal barrier helps prevent influence of cold temperatures on electronics.

Cryo-Stic

The C-Stic is a very robust level meter specially for storage of liquified gases, like nitrogen, oxygen, argon, carbon dioxide and nitrous oxide. It provides an easy to mount, accurate and reliable liquid level digital reading. Cryo-Stic measures the capacitance of the sensor. i.e dielectric properties of the liquified gas between two stainless steel electrodes. These electrodes produces signal to sensor head, which in turn converts level signal to digital data. Level data is communicated to a gauge mounted directly on sensor, or remotely attached via cable. Designs also available for LNG, cryofreezer, LPG. Also, containers can be transported without gauge in place. This reduces chances of damage which prolongs life of product.

Typical Applications

- For cryogenic liquid storage tanks
- For liquid petroleum gas
- Cryofreezer

Features and Benefits

- Accurate measurements improves overall system efficiency.
- Higher flexibility than a thermal device, enables continuous measurement of liquid level
- Remote monitoring options for data acquisition
- No moving parts enhances reliability and durability, thus preventing unnecessary damage to Cryo-Stic device.
- Flexible gauge mounting options, can be mounted directly on sensor or remotely attached via cable.

Cryo-Stic Specifications

Cryo-Stic Model	CLG-2
Material Construction	Aluminium Enclosure
Components	Level Gauge
Display	3-digit LCD (in % full)
Power	2 x AA type battery or external 24 VDC
Voltage/ Amp	4 – 20mA / 0 – 5V output
Power Connection	9 pin connector
Communication	Continuous Reading Optical and Acoustic Alarms LED Status Indicators
Gauge Temperature	Operating gauge: -20 to 60 Deg. Celsius
Mounting	Directly on sensor or wall mount by cable
Standard Testing	Functional Test

Cryo-Stic Application





All Cryogenic components come with CSM renowned after sales service, from maintenance, repair and warranty support. Backed by Just-In-Time local stock and a one year manufacturer warranty

Cryogenic Components

Besides vacuum jacketed products, we stock & supply extensive non-vacuum jacketed cryogenic fluid components to support your cryogenic system need. Every item in our stock has been preselected and validated through years of usage, experience and knowledge in Cryogenic system. This will save you time, money and associated safety hazard in doing your own test & evaluation.

Pressure Regulator: There are two types of pressure regulators commonly used in cryogenic application, pressure reducing or back pressure control.

Pressure reducing regulator is suitable for use at point of use to reduce liquid nitrogen supply pressure to the desired inlet pressure of equipment or tool. It is often needed in a piping system with multiple point of use and with different supply pressure requirement. It provides the users with flexibility to set the required usage pressure.




Back pressure regulator is often used together with pressure reducing regulator to control the pressure build-up in a cryogenic system due to heat leaks by regulating the venting pressure.

Thermal Relief Valves: Critical component to prevent over pressure due to system heat leak. Liquid nitrogen will vaporized and expand 700X in volume due to heat leaks into the system. Over pressurization hazard is eliminated with strategic use of TRV, especially at locations where LN2 could potentially trapped due to the system operation. It is usually set at a pressure higher than the typical line operating pressure but lower than the line maximum allowable pressure (MAWP).

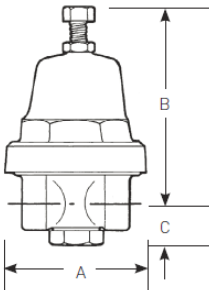
Valves: CSM stocks a variety of cryogenic valves. To qualify its usage in a Cryogenic system, the valves design and material of construction must fulfill requirement for low temperature, thermal compensation in expansion & contraction, thermal-relief and operator safety. Example valves we stock are ball valve with downstream vent hole, check valve, globe valve, solenoid valve.



Cryogenic Regulators

Model		Max. Inlet Pressure	Outlet Pressure Range	Size (inch)	Maximum Capacity
A-32 Bronze		600 psig (41.4 bar)	2 – 600 psig (0.1 – 41.4 bar)	¼" – ⅜"	2027 SCFH (54 Nm³h)
A-36 Brass		600 psig (41.4 bar)	10 – 400 psig (0.7 – 27.6 bar)	⅜"	2027 SCFH (54 Nm³h)
B Bronze		720 psig (49.6 bar)	5 – 250 psig (0.3 – 17.2 bar)	¼" – 2"	282 – 341940 SCFH (8 – 9164 Nm³h)

Model	Size" (mm)	Dimensions		
		A" (mm)	B" (mm)	C" (mm)
A32	¼" (8)	2 ¼" (57.15)	3 ⅜" (80.96)	⅝" (15.88)
A32	⅜" (10)	2 ¼" (57.15)	3 ⅜" (80.96)	⅝" (15.88)
A36	⅜" (10)	2 ⅞" (61.91)	4 ½" (114.30)	1" (25.40)
B	⅜" (10)	3 ⅞" (98.43)	4 ⅞" (104.78)	1 ¾" (44.45)
B	½" (15)	4 ½" (114.30)	4 ½" (114.30)	2 ⅞" (53.98)



Construction

Bronze forged body and spring chamber; bronze trim and diaphragms; Teflon seat disc and diaphragm gasket; stainless steel pressure spring; All parts commercially cleaned for cryogenic service. Available in 1/4", 3/8", 1/2" FPT inlet/outlets.



Caution!

Cryogenic regulators allow LN2 to flow in only one direction. Therefore, the system should be evaluated to determine if an additional safety relief valve is required.

Temperature Rating

70 to -196 deg C (+150°F to -320°F)

Pressure Setting

Factory set upon request

Spring range available:

1 to 50 psi

35 to 75 psi

55 to 120psi

Safety Relief Valves

Model	Inlet Size (A)	Seat Material	Set Pressure (Colour code)	PRV flow at 110% set pressure.	Dimension (height B)
PRV-4-22-B	¼"	F	22 psig (yellow)	0.783 SCFM	2.6"
PRV-4-35-B	¼"	F	35 psig (purple)	0.783 SCFM	2.6"
PRV-4-50-B	¼"	F	50 psig (white)	0.783 SCFM	2.6"
PRV-4-100-B	¼"	F	100 psig (gray)	0.783 SCFM	2.6"
PRV-4-150-B	¼"	T	150 psig (red)	0.783 SCFM	2.6"
PRV-4-230-B	¼"	T	230 psig (blue)	0.783 SCFM	2.6"
PRV-4-350-B	¼"	T	350 psig (orange)	0.783 SCFM	2.6"
CRVD-8-18-B	½"	T	18 psig (red)	0.783 SCFM	3.5"

Remarks (Seat Material):

F for Fluorosilicone for PRV and SS styles for 15-139psi;
T for PTFE for PRV and SS styles for 140-600psi

Construction

Fully constructed with brass material from the body, seat retainer, adjusting screw to pipe away adapter; and stainless steel spring.



Warning!

Inspection and maintenance of pressure relief valves is very important. Failure to properly inspect and maintain pressure relief valves could result in personal injuries or property damage. The useful safe service life of a pressure relief valve may be significantly affected by the service environment.

Always ensure sufficient thermal barrier during installation to avoid PRV from freezing and causing failure. Contact us for appropriate candy stick.

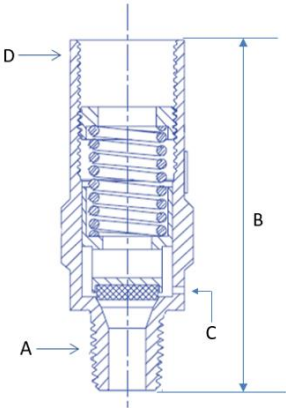
Pipe Away Option, D

P- Pipeaway included and attached, D. No drain hole in relief valve.

Drain Hole Option, C

Relief valves without pipeaway typically provided with drain holes, C.

Part Number Example: PRV-4-22C-B

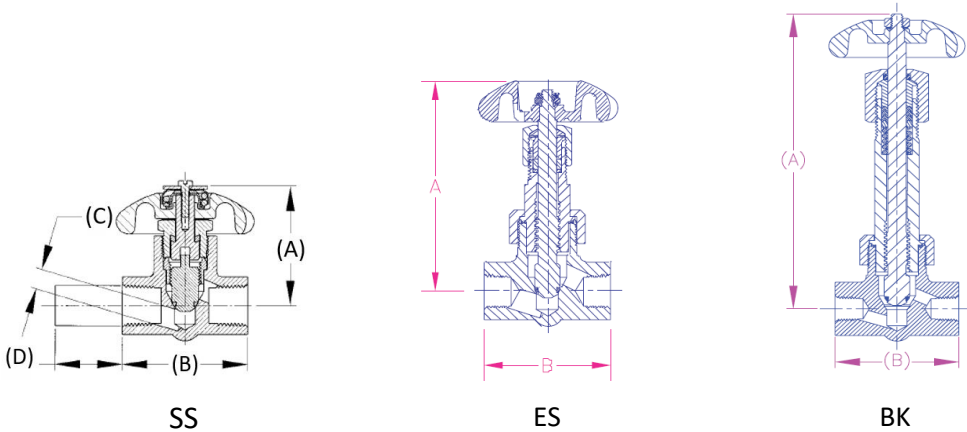


Features

- All valves are cleaned and packaged for oxygen service per CGA G-4.1.
- Bubble tight at 95% of set pressure.
- Easy to read color coded psig / bar labels.
- Unique tamper resistant adjusting screw.
- Adapters provide standard pipe thread connections for venting gas to the outdoors.
- Repeatable performance.
- 100% factory tested.
- Temperatures Range -320° to +165° F.

Cryogenic Globe Valves

Model	Inlet/Outlet Connection	Height (A)	Body Width (B)	Material	Cv Factor
SS-4	¼" F.NPT	2 ¾"	2.5"	Brass	0.72
ES-6	⅜" F.NPT	4"	2.5"	Brass	1.10
BK-6	⅜" F.NPT	6.5"	2.5"	Brass	1.10
BK-8	½" F.NPT	6.5"	2.5"	Brass	1.10



Construction

Body & Bonnet: Brass
 Stem: Stainless Steel
 Seat Disc: CTFE
 Handwheel: Aluminium
 Packing & Bonnet Gasket: PTFE



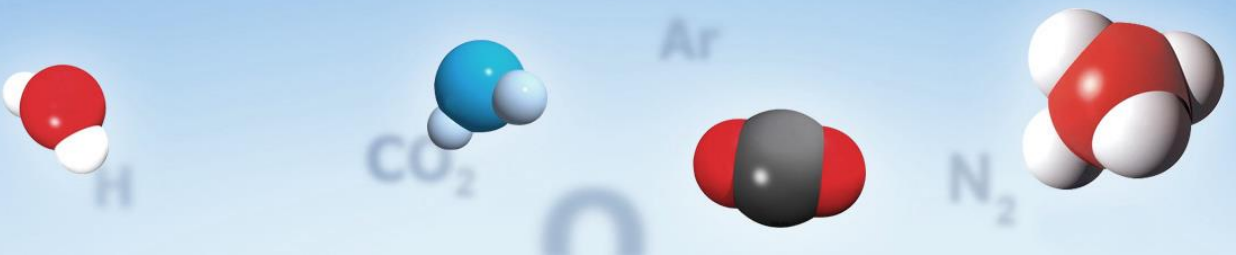
Warning!

Always install thermal relief valve between two isolation valve!
 Always wear glove and appropriate PPE to protect against cold burn hazard.
 If the valve is frozen shut or frozen open, do not attempt to force open by wrench. Allow the valve to defrost completely before operate.

Features & Benefits:

- Spring loaded stem seal automatically adjusts for any gasket wear, eliminate constant need to retighten packing nut.
- Non-rising stem and low profile allow the valve to fit into tight areas and still provide easy access.
- Unique pressure-sealed moisture barrier helps prevent freeze up at cryogenic temperatures.
- Conical swivel seal design helps prevent seat galling from over-torquing.
- Cleaned for oxygen service per CGA G-4.1.
- Maximum working pressure is 600 PSIG.
- Working temperature range is -196 to 75 °C (-320°F to +165°F).

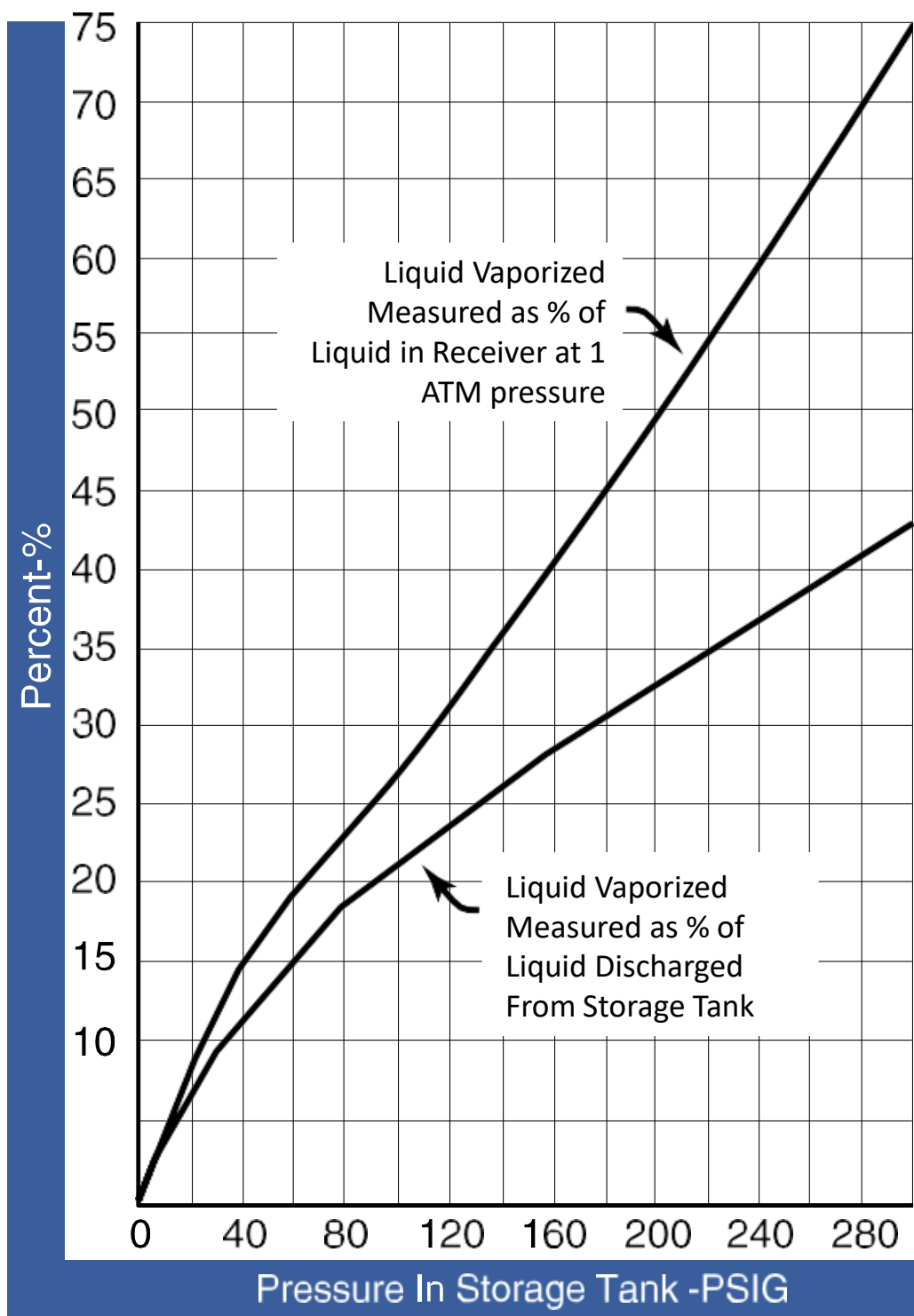
Technical Data



Liquid Gases Physical Properties

Name of Gas Chemical Symbol Molecular Weight Color Odor Taste	Oxygen O ₂ 31.9988 None None None	Nitrogen N ₂ 28.0134 None None None	Argon Ar 39.948 None None None	Helium He 4.0026 None None None	Methane CH ₄ 16.043 None None None	Hydrogen H ₂ 2.01594 None None None
Spec. Gravity (Air=1) 70°F. 1 Atm.	1.105	0.9669	1.395	0.13796	.5539	0.0695
Density lb Per cu ft 70°F 1 Atm.	0.08281	0.07245	0.1034	0.01034	0.0415	0.005209
Spec Vol. cu ft per lb 70°F 1 Atm.	12.076	13.803	9.671	96.71	24.096	192.0
Density Sat'd Vapor, lb per cu ft 1 Atm.	0.27876	0.2874	0.35976	1.0434	.1134	0.083133
Normal Boiling Point °F	-297.33	-320.36	-302.55	-452.1	-258.7	-423.0
Heat of Vaporization BTU per Pound	91.7	85.6	70.1	9	223.3	191.7
Critical Pressure Atmospheres, Abs. lb per sq in, Abs.	50.14 736.9	33.54 492.9	48.34 710.4	2.26 33.2	666.88	12.98
Critical Temp. °F	-181.08	-232.40	-188.12	-450.31	-116.67	190.8
Triple Point Pressure Atmosphere, Abs. lb per sq in, Abs.	0.00145 0.0213	0.1238 1.189	0.68005 9.994	None	1.7032	-399.96 0.071
Triple Point Temp. °F	-361.83	-346.01	-308.8	None	-296.45	-434.56
Specific Heat Const. Press	0.2199 @77°F	0.2488 @77°F	0.1244 @77°F	1.2404 @77°F	0.5339 @80°F	3.4202 @77°F
Ratio Specific Heats	1.396 @80.3°F	1.4014 @70°F	1.6665 @86°F	1.6671 @77°F	1.305 @80°F	1.405 @77°F
Coeff. Viscosity, Micropoises @77°F	206.39	177.96	226.38	198.5	112	89.37
Thermal Conductivity, 32°F BTU/(sq ft)(Hr.)(°F/ft)	0.0142	0.0139	0.00980	0.08266 @40°F	0.0193 @70°F	0.0973
Ionization Potential, Volts	13.6	14.5	15.7	24.5		13.5
Excitation Potentials: First Resonance Potential, Volts	9.1	6.3	11.56	20.91		10.2
Metastable Potentials, Volts			11.66 11.49	19.77		

Nitrogen Vapor Release Chart



Unit Conversion Table

Nitrogen						
	Weight		Gas		Liquid	
	Pounds (lbs.)	Kilograms (kg)	Cubic Feet (SCF)	Cubic Meters (Nm3)	Gallons (Gal)	Liters (L)
1 Pound	1	0.4536	13.803	0.2657	0.1481	0.5606
1 Kilogram	2.205	1	30.42	0.7796	0.3262	1.2349
1 SCF Gas	0.07245	0.03286	1	0.02628	0.01074	0.04065
1 Nm3 Gas	2.757	1.2506	38.04	1	0.408	1.5443
1 Gal Liquid	6.745	3.06	93.11	2.447	1	3.785
1 L Liquid	1.782	0.8083	24.6	0.6464	0.2642	1

Oxygen						
	Weight		Gas		Liquid	
	Pounds (lbs.)	Kilograms (kg)	Cubic Feet (SCF)	Cubic Meters (Nm3)	Gallons (Gal)	Liters (L)
1 Pound	1	0.4536	12.076	0.3174	0.1050	0.3977
1 Kilogram	2.205	1	26.62	0.6998	0.2316	0.8767
1 SCF Gas	0.08281	0.03756	1	0.02628	0.008691	0.0329
1 Nm3 Gas	3.151	1.4291	38.04	1	0.3310	1.2528
1 Gal Liquid	9.527	4.322	115.1	3.025	1	3.785
1 L Liquid	2.517	1.1417	30.38	0.7983	0.2642	1

Argon						
	Weight		Gas		Liquid	
	Pounds (lbs.)	Kilograms (kg)	Cubic Feet (SCF)	Cubic Meters (Nm3)	Gallons (Gal)	Liters (L)
1 Pound	1	0.4536	9.671	0.2543	0.08600	0.3255
1 Kilogram	2.205	1	21.32	0.5605	0.18957	0.7176
1 SCF Gas	0.1034	0.04690	1	0.02628	0.008893	0.03366
1 Nm3 Gas	3.933	1.7840	38.04	1	0.3382	1.2802
1 Gal Liquid	11.630	5.276	112.5	2.957	1	3.785
1 L Liquid	3.072	1.393	29.71	0.7812	0.2642	1

SCF (Standard Cubic Foot) gas measured at 1 atmosphere and 70°F. Liquid measured at 1 atmosphere and boiling temperature. Nm 3 (normal cubic meter) measured at 1 atmosphere and 0°C. All values rounded to nearest 4/5 significant numbers.

Unit Conversion Table

Helium						
	Weight		Gas		Liquid	
	Pounds (lbs.)	Kilograms (kg)	Cubic Feet (SCF)	Cubic Meters (Nm3)	Gallons (Gal)	Liters (L)
1 Pound	1	0.4536	96.71	2.542	0.9593	3.631
1 Kilogram	2.205	1	213.2	5.603	2.115	8.006
1 SCF Gas	0.01034	0.004690	1	0.02628	0.009919	0.03754
1 Nm3 Gas	0.3935	0.17847	38.04	1	0.3775	1.4289
1 Gal Liquid	1.0423	0.4728	100.80	2.649	1	3.785
1 L Liquid	0.2754	0.1249	26.63	0.6998	0.2642	1

Methane						
	Weight		Gas		Liquid	
	Pounds (lbs.)	Kilograms (kg)	Cubic Feet (SCF)	Cubic Meters (Nm3)	Gallons (Gal)	Liters (L)
1 Pound	1	0.4536	24.058	0.67986	0.28366	1.0734
1 Kilogram	2.205	1	53.048	1.4991	0.62548	2.3667
1 SCF Gas	0.0414	0.0188	1	0.028259	0.011744	0.044437
1 Nm3 Gas	1.465	0.6645	35.386	1	0.41557	1.5725
1 Gal Liquid	3.53	1.6	84.925	2.3999	1	3.7839
1 L Liquid	0.9329	0.4231	22.444	0.63425	0.26463	1

Hydrogen						
	Weight		Gas		Liquid	
	Pounds (lbs.)	Kilograms (kg)	Cubic Feet (SCF)	Cubic Meters (Nm3)	Gallons (Gal)	Liters (L)
1 Pound	1	0.4536	192.00	5.047	1.6928	6.408
1 Kilogram	2.205	1	423.3	11.126	3.733	14.128
1 SCF Gas	0.005209	0.002363	1	0.02628	0.008820	0.03339
1 Nm3 Gas	0.19815	0.08988	38.04	1	0.3355	1.2699
1 Gal Liquid	0.5906	0.2676	113.41	2.981	1	3.785
1 L Liquid	0.15604	0.07078	29.999	0.7881	0.2642	1

SCF (Standard Cubic Foot) gas measured at 1 atmosphere and 70°F. Liquid measured at 1 atmosphere and boiling temperature. Nm 3 (normal cubic meter) measured at 1 atmosphere and 0°C. All values rounded to nearest 4/5 significant numbers.

Nitrogen Viscosity (Equilibrium Stage)

State	Temperature			Pressure		Dynamic (Absolute) Viscosity					Kinematic Viscosity	
	[K]	[°C]	[°F]	[MPa]	[bara]	[μPa s]	[cP]	[lbf s/ft ² *10 ⁻⁶]	[lbm/ft s*10 ⁻⁶]	[lbm /ft h]	[cSt], [m2/s*10-6]	[ft2/s*10-6]
Liquid at equilibrium	63.15	-210	-346	0.013	0.125	311.6	0.3116	6.508	209.4	0.7538	0.3593	3.867
	69	-204	-335	0.033	0.332	230.9	0.2309	4.821	155.1	0.5584	0.2739	2.948
	75	-198	-325	0.076	0.76	176.8	0.1768	3.692	118.8	0.4276	0.2164	2.33
	79	-194	-317	0.122	1.22	150.7	0.1507	3.148	101.3	0.3646	0.1887	2.031
	85	-188	-307	0.229	2.29	121.3	0.1213	2.534	81.52	0.2935	0.1575	1.695
	89	-184	-299	0.331	3.31	106.2	0.1062	2.218	71.35	0.2569	0.1415	1.524
	95	-178	-289	0.541	5.41	88	0.088	1.838	59.14	0.2129	0.1225	1.319
	99	-174	-281	0.726	7.26	78.42	0.07842	1.638	52.7	0.1897	0.1128	1.214
	105	-168	-271	1.08	10.8	65.29	0.06529	1.364	43.87	0.1579	0.0993	1.069
	109	-164	-263	1.38	13.8	57.79	0.05779	1.207	38.83	0.1398	0.09185	0.9887
	115	-158	-253	1.94	19.4	47.29	0.04729	0.9877	31.78	0.1144	0.08172	0.8796
	121	-152	-242	2.64	26.4	36.51	0.03651	0.7625	24.53	0.08832	0.07166	0.7713

Nitrogen Viscosity (Supercritical Phase)

State	Temperature			Pressure		Dynamic (Absolute) Viscosity					Kinematic Viscosity	
	[K]	[°C]	[°F]	[MPa]	[bara]	[μPa s]	[cP]	[lbf s/ft ² *10 ⁻⁶]	[lbm/ft s*10 ⁻⁶]	[lbm /ft h]	[cSt], [m2/s*10-6]	[ft2/s*10-6]
Liquid	100	-173	-280	5	50	84.51	0.08451	1.765	56.79	0.2044	0.1186	1.277
Supercritical Phase	600	327	620	5	50	29.88	0.02988	0.6241	20.08	0.07229	1.088	11.71
	1100	827	1520	5	50	44.33	0.04433	0.9259	29.79	0.1072	2.941	31.66
	1600	1327	2420	5	50	56.48	0.05648	1.18	37.95	0.1366	5.427	58.42
Liquid	200	-73.2	-99.7	10	100	17.7	0.0177	0.3697	11.89	0.04282	0.09	0.9555
	300	26.9	80.3	10	100	19.96	0.01996	0.4169	13.41	0.04829	0.1787	1.923
	400	127	260	10	100	23.51	0.02351	0.491	15.8	0.05687	0.2896	3.117
Supercritical Phase	500	227	440	10	100	26.99	0.02699	0.5637	18.14	0.06529	0.4184	4.504
	600	327	620	10	100	30.28	0.03028	0.6325	20.35	0.07326	0.5635	6.066
	1100	827	1520	10	100	44.49	0.04449	0.9293	29.9	0.1076	1.5	16.14
	1600	1327	2420	10	100	56.48	0.05648	1.18	37.95	0.1366	2.745	29.55



CRYOGENIC

SPECIALTY MANUFACTURING

QUALITY WITH A DIFFERENCE

CSM Technology for Maximum Liquid Nitrogen Efficiency

