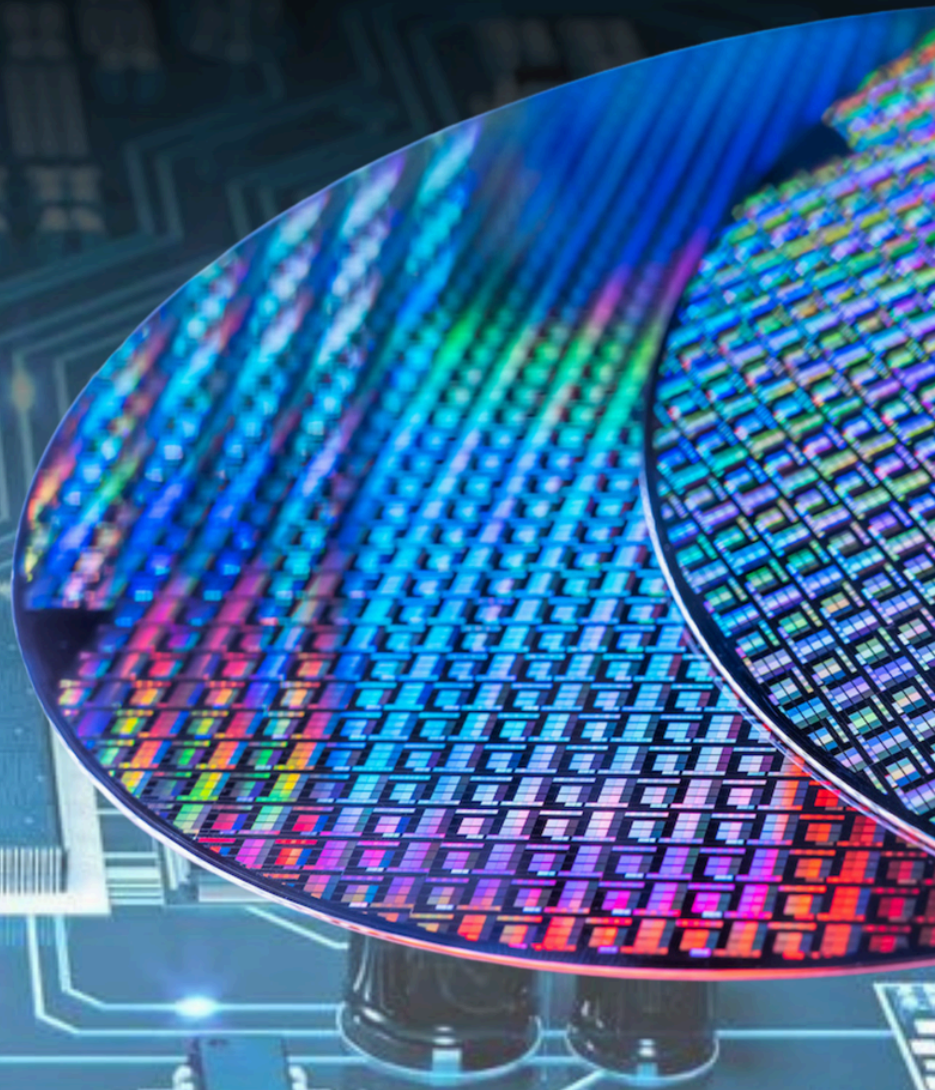




# *Liquid Nitrogen Solutions For* **SEMICONDUCTOR**



*Stay cool under pressure*  
[www.csm-cryogenic.com](http://www.csm-cryogenic.com)



## A Quick Take on Us

**Cryogenic Specialty Manufacturing (CSM)** is a leading designer and manufacturer of precision cryogenic systems and components, tailored for the semiconductor industry. Established in 1997 with expertise in **Cryogenic System Engineering**, and further expanded into **Super Insulation Technology** in 2014, we provide condensation-free liquid nitrogen solutions to address extreme thermal challenges in semiconductor wafer fabrication, advanced assembly & packaging, and final device testing.

Our cryogenic innovations support the progression of semiconductor technology to nanometer-scale nodes and beyond, empowering chipmakers to push the boundaries of device performance and miniaturization despite increasing physical constraints.

## The Next-Gen Cryogenic Technologies

### Cryotron Series

*- Cold Power for Cool Chips*



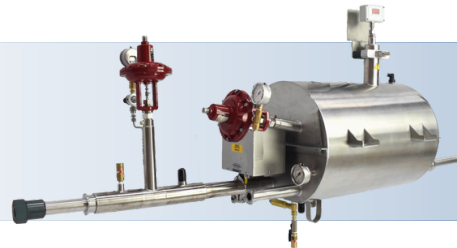
### Modular Piping Series

*- Confidence in Every Connection*



### CryoSeparator Series

*- Engineering Tomorrow's Thermal Efficiency*



### DewarMate Series

*- Your Dewar's Best Companion*



### Cryogenic Instrumentation

*- Master the Cold, Effortlessly*





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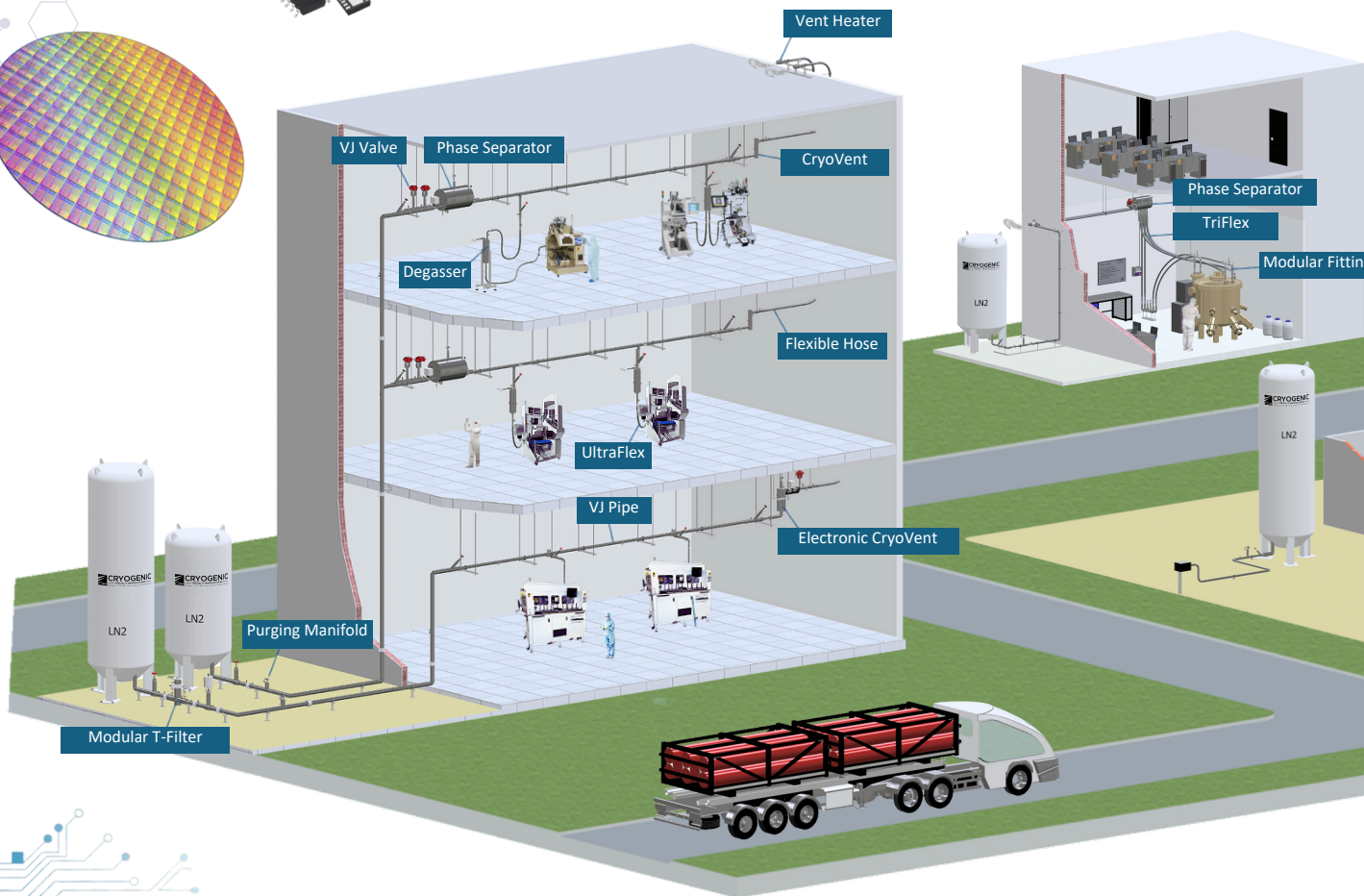
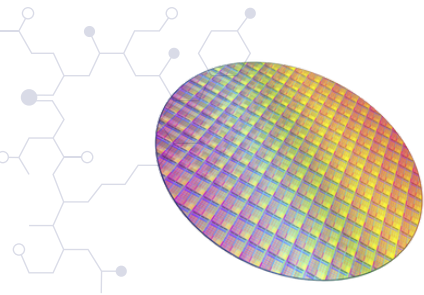
## The Power behind Your Success

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Our Services  
Global Sales and Technical Support

CSM Products in

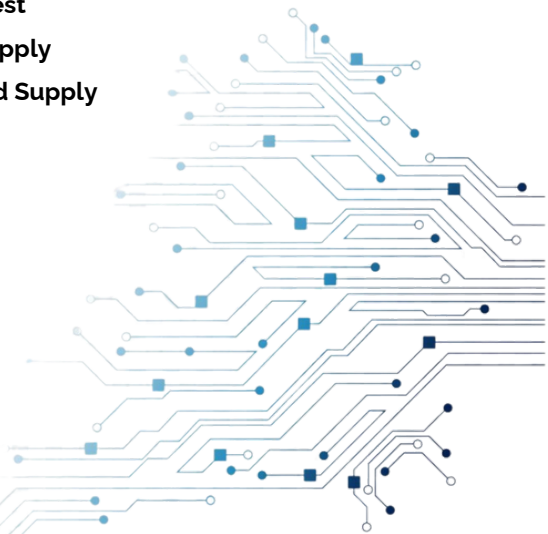
# Semiconductor Industry







- 
- ③ Assembly &  
 ④ Bulk Liquid S  
 ⑤ Cylinder Liqu



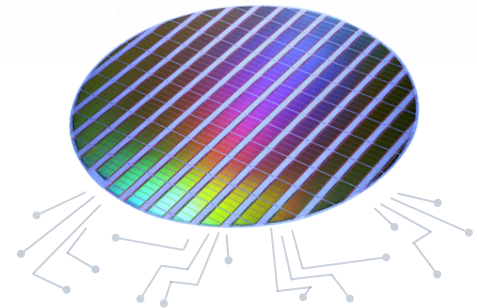
## Molecular Beam Epitaxy (MBE)

For advanced compound semiconductor and novel **material research**, maintaining precise cryopanel temperatures in MBE systems is mission-critical. CSM's TriFlex LN<sub>2</sub> delivery system delivers breakthrough performance:

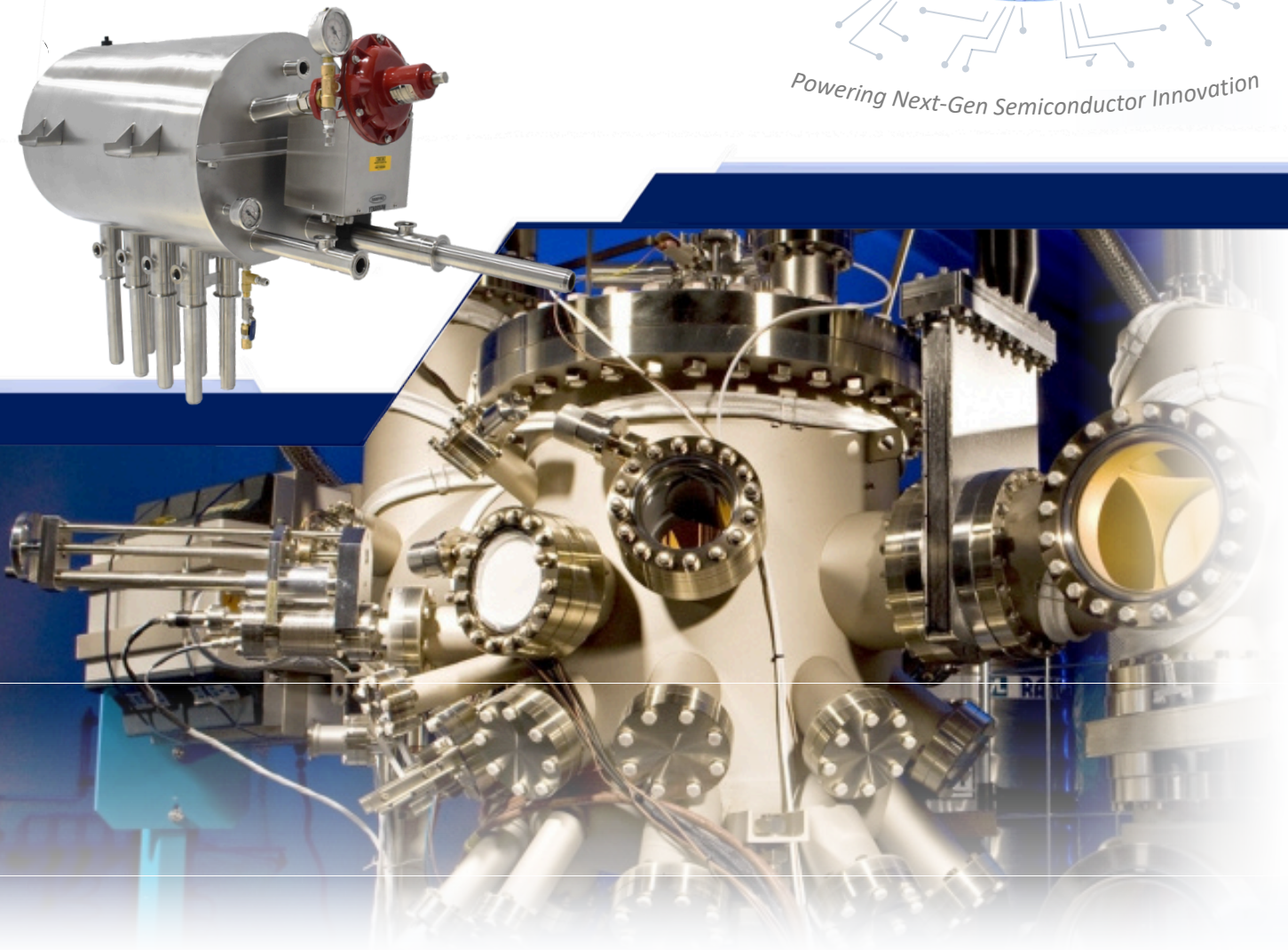
- ✓ Self-regulating, vapor-free LN<sub>2</sub> flow - maintains consistent -196°C cryopanel temperatures
- ✓ 30% LN<sub>2</sub> savings vs. conventional systems
- ✓ Eliminates dewar handling - completely closed-loop operation
- ✓ Enhanced safety - no pressurized dewars or manual transfers
- ✓ 20% lower operating costs

Why MBE Researchers choose CSM:

- ✓ Patented phase-control technology prevents vapor lock
- ✓ 24/7 temperature stability ( $\pm 0.5^\circ\text{C}$  demonstrated)
- ✓ Compatible with all major MBE chamber designs
- ✓ Reduces system downtime by 40% (maintenance-free operation)



*Powering Next-Gen Semiconductor Innovation*





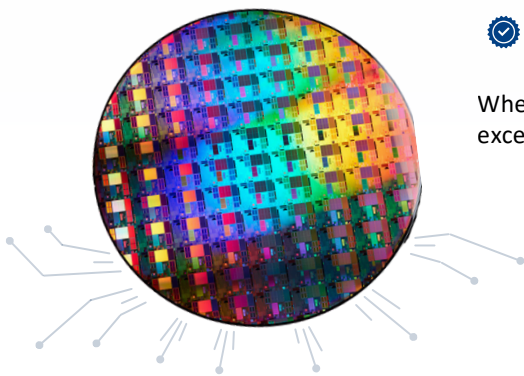
## Wafer Fabrication

As semiconductor nodes shrink to 3nm and below, advanced processes like cryokinetic wafer cleaning, Siltecta wafer slicing, and hydrogen purification demand ultra-cool LN<sub>2</sub> for system process cooling. CSM super-insulated products deliver unmatched thermal performance, minimizing heat leakage for maximum efficiency and safety.

In High-NA EUV lithography, where photomask inspection faces unprecedented challenges, LN<sub>2</sub> plays a pivotal role maintaining peak performance in 3nm photomask inspection and beyond:

- ✓ Thermal Stability: Counteracts laser-induced mask expansion, ensuring nanoscale alignment
- ✓ Condensation Control: Prevents moisture buildup that scatters EUV light.
- ✓ Noise Reduction: Cryogenic cooling enhances sensor sensitivity for defect detection

Where precision meets progress, CSM delivers the cryogenic edge for semiconductor excellence.



*Powering Next-Gen Semiconductor Innovation*





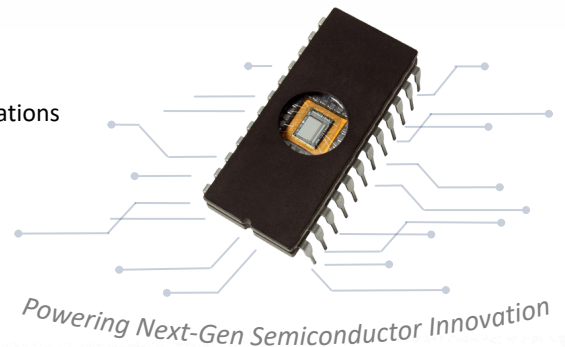
## Backend Chips Testing

In semiconductor backend product testing, thermal precision is paramount. CSM liquid nitrogen delivery system maintain ultra-stable low-temperature conditions at  $\pm 0.1^\circ\text{C}$  tolerance in devices under test (DUT) - where even a  $0.5^\circ\text{C}$  deviation can significantly impact test accuracy and yield.

CSM cryogenic solutions outperform competitive  $\text{LN}_2$  delivery systems, providing vapor-free, single-phase ultra-cold liquid nitrogen to test handlers—guaranteeing stable flow and 24/7 performance across all demand conditions.

Our technology ensures fully saturated cryogen delivery, enabling:

- ✓  $\pm 0.1^\circ\text{C}$  temperature accuracy – Minimizes yield loss through precision thermal control
- ✓ 20% higher production yields – Consistent cooling improves process reliability vs others
- ✓ 30%  $\text{LN}_2$  savings – Optimized flow reduces operating costs vs other's  $\text{LN}_2$  delivery
- ✓ Enhanced safety – Eliminates risks of two-phase flow and pressure fluctuations



## HALT/HASS Testing

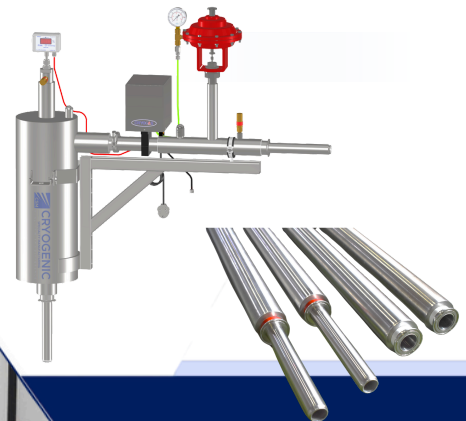
Liquid nitrogen ( $\text{LN}_2$ ) with boiling point  $-196^\circ\text{C}$  /  $-320^\circ\text{F}$  is a critical cooling medium in semiconductor environmental simulation test, particularly in thermal shock chambers and extreme cold testing. CSM superior quality vacuum insulated SIVL piping system is a game changer to fulfil new generation environment test chamber demands for ultra fast cooling rate in product reliability and stress test according to AEC-Q, MIL-STD, and JEDEC.

CSM's vacuum-insulated SIVL piping system sets the new standard for next-gen test chambers, delivering:

- ✓ 2X faster cooling – delivering ultra-cold single-phase  $\text{LN}_2$  with industry lowest heat leaks
- ✓ 1.5X higher yield with zero vapor lock - patented venting technology
- ✓ Turndown ratios up to 20:1 for high-cycle testing

**Applications:** Automotive electronics,  
Aerospace & Defense,  
Consumer electronics,

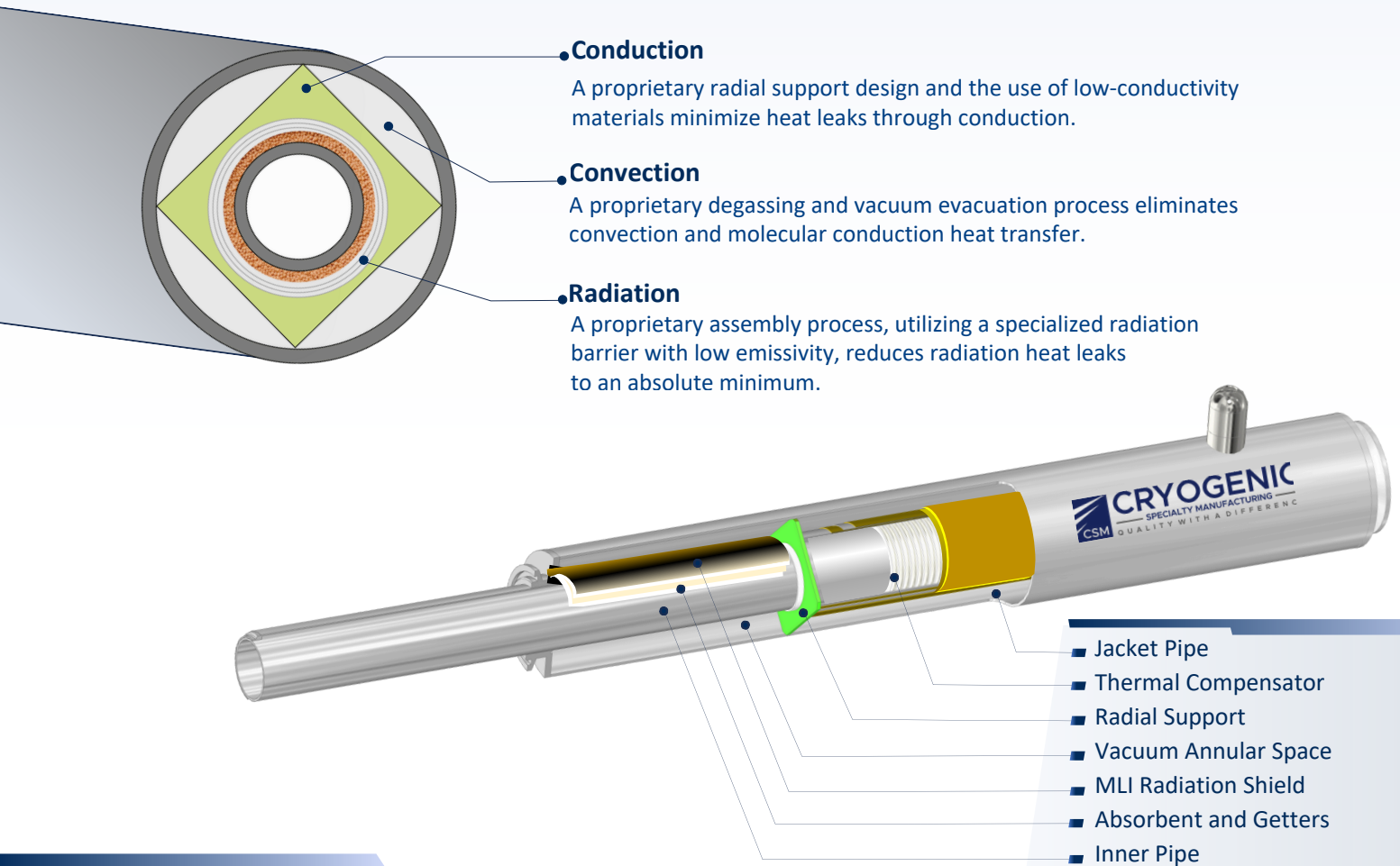
Power Electronics (GaN/SiC devices)  
Advanced Packaging TSV (2.5D/3D ICs)  
Quantum Computing Chips.





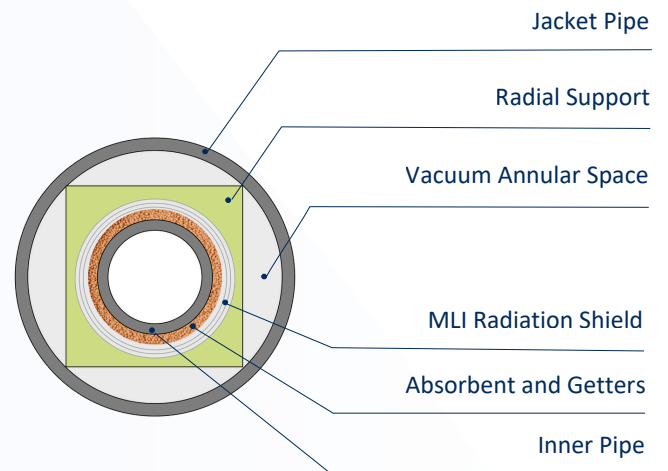
## Our Core Technology

# Super Insulation Technology



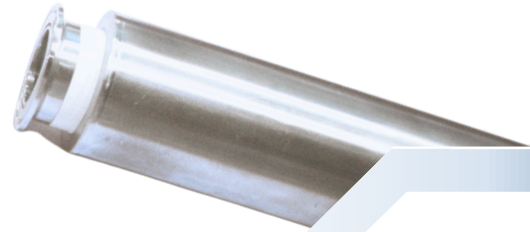
## Superior Quality

- ◆ 10 Years vacuum warranty
- ◆ <10 Micron warm vacuum
- ◆ Helium leak tested <  $1.0 \times 10^{-9}$  std.cc/s
- ◆ 20 Years product design life
- ◆ 5000 life cycles for compensator
- ◆ Proprietary H2 Getters
- ◆ Proprietary MoSieve absorbent
- ◆ Proprietary MLI material and layer density
- ◆ CFOS cleaning is standard

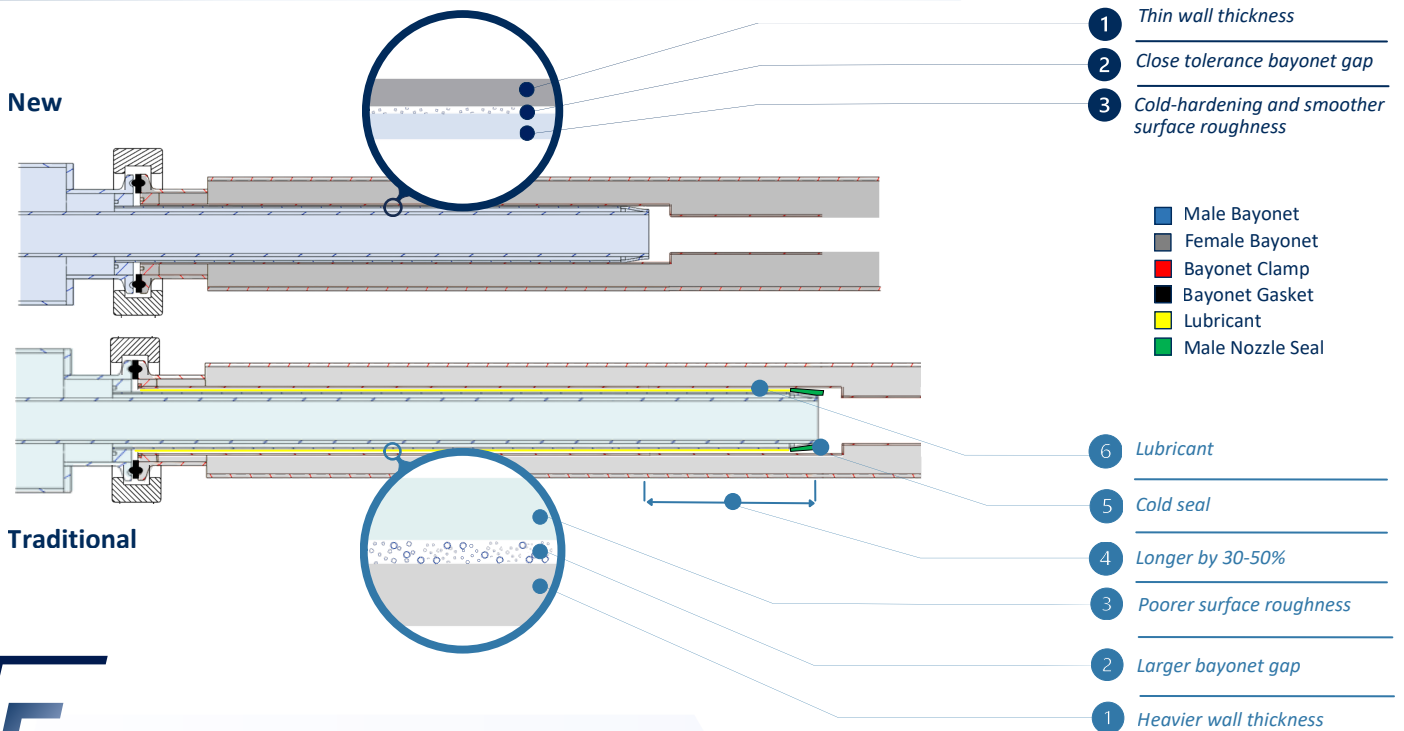




# Bayonet Connection Technology



## Comparison



## CSM Superior Performance

- 1 2X lower conductive heat leaks**  
Superior thermal barrier efficiency with innovative heat bridge with reduced wall thickness
- 2 3X lower gas convective heat leak**  
Narrower bayonets mating gap
- 3 No mating failure!**  
Proprietary metal-forming process maintains tube tolerance <10 microns
- 4 Easier assembly/disassembly!**  
Shorter bayonet mating length
- 5 No O-rings or PTFE seals at male nozzle!**  
Eliminates cryogenic embrittlement issues that lead to thermal barrier failure
- 6 Say goodbye to lubricants!**  
Our engineered tube surfaces provide permanent, trouble-free mating performance through nano-scale polishing and metallurgical hardening
- 7 All-weather design, including cleanroom compatibility**
- 8 Suitable for all installation orientations**



## Why the Right Choice Matters



### Extreme Temperature Gradient

LN<sub>2</sub> at -196 °C against atmospheric temperature of 26 °C



### Heat Leaks

Short section of uninsulated, or poorly insulated piping results in enormous heat leaks.



### Boil-off Loss

Small, seemingly negligible daily cryogen losses added up to massive annual operation cost.



### Overpressure Hazards

LN<sub>2</sub> absorbs heat, vaporizes rapidly and resulting in high pressure condition within the piping system.



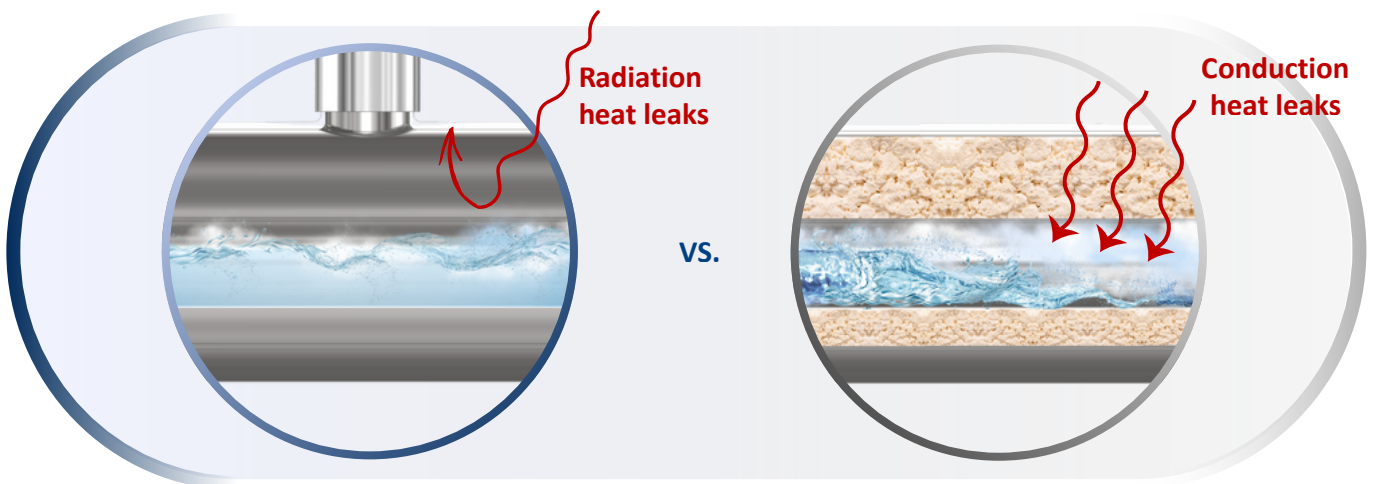
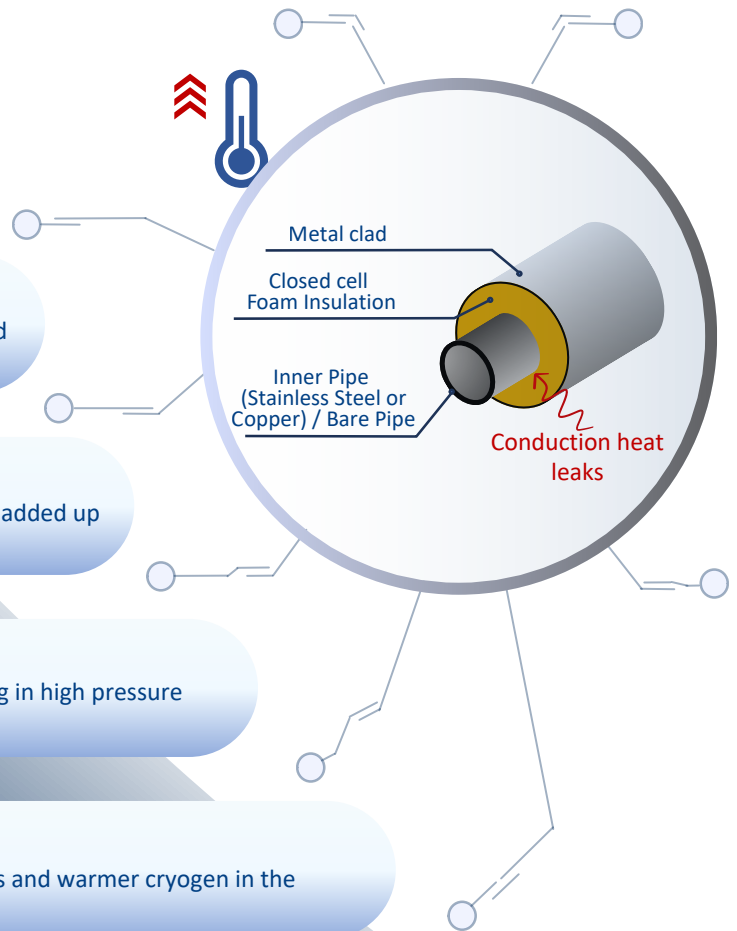
### Increase in Pressure Drop

Two-phase flow results in higher pressure drops and warmer cryogen in the piping system.



### Lower System Performance

Higher heat leaks and increased boil-off, reduced operation performance, safety risks, and higher operational cost.



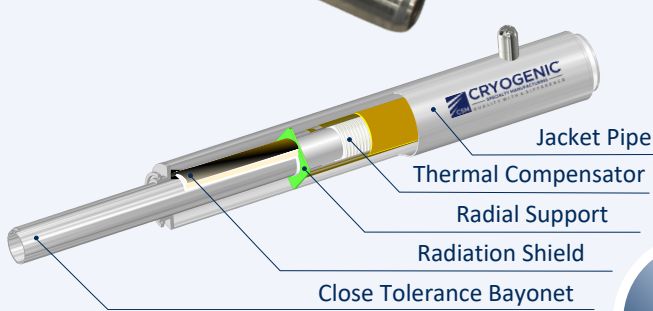
### CSM Super Insulation

Pure and cold liquid.  
Smoother liquid flow.

### Foam Insulation

Vapor-rich and **warm** liquid.  
Turbulent liquid flow.

## Value vs. Cost of Heat Leak



10

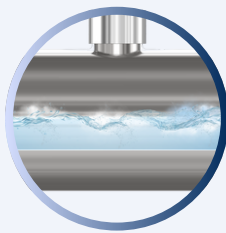
2

VS

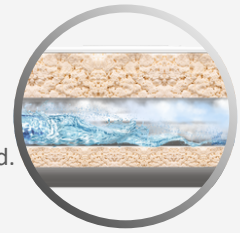
Metal clad  
Closed cell  
Foam Insulation

Inner Pipe (Stainless  
Steel or Copper) /  
Bare Pipe

Pure and cold liquid.  
Smoother liquid flow.



Vapor-rich and **warm** liquid.  
Turbulent liquid flow.

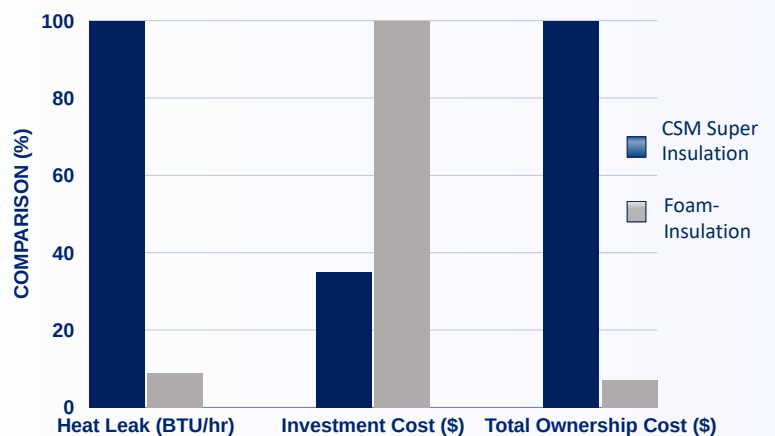


### Heat Leak Performance Comparison Chart

| Line Size  | Super Insulated Pipe<br>BTU/hr.ft (W/m) | Foam-Insulated Pipe<br>BTU/hr.ft (W/m) |               | Bare Pipe<br>BTU/hr.ft (W/m) |
|------------|-----------------------------------------|----------------------------------------|---------------|------------------------------|
|            |                                         | New                                    | After 5 Years |                              |
| 3/4" ODT   | 0.42 (0.73)                             | 7.9 (13.7)                             | 32.3 (55.9)   | 165 (285.6)                  |
| 1" IPS     | 0.49 (0.85)                             | 8.8 (15.2)                             | 44.2 (76.5)   | 280 (484.6)                  |
| 1 1/2" IPS | 0.52 (0.90)                             | 10.5 (18.2)                            | 52.7 (91.2)   | 397 (285.6)                  |
| 2" IPS     | 0.69 (1.19)                             | 12.2 (21.1)                            | 60.8 (21.1)   | 530 (687.1)                  |
| 3" IPS     | 1.2 (2.08)                              | 15.2 (26.3)                            | 76.1 (105.2)  | 769 (1330.9)                 |
| 4" IPS     | 1.4 (2.42)                              | 18.2 (31.5)                            | 90.8 (157.2)  | 1000 (1730.7)                |

- ✓ 10 to 100X greater thermal efficiency than competitive insulation technology.
- ✓ Excellent flow characteristics.
- ✓ Proprietary chemical getters ensures long lasting vacuum integrity.
- ✓ Lowest TCO.
- ✓ 10 Years Vacuum Warranty.

### TCO ANALYSIS



# Cryotron



## *Phase Separator, P*

Automated LN<sub>2</sub> level & pressure control – ensuring safer, more efficient semiconductor manufacturing operations

## *CryoVent, V*

Electronic-controlled vapor removal prevents pipeline vapor lock - eliminating flow stagnation risks in intermittent LN<sub>2</sub> applications while meeting stringent semiconductor safety standard

## *ChangeOver, X*

Uninterrupted LN<sub>2</sub> delivery with intelligent multi-dewar changeover control - ensuring continuous cryogenic supply for critical processes

## *Liquid Nitrogen Generator, G*

Small to large scale production (up to 400 L/day), high purity liquid to 99.99%



# Modular Piping

## Rigid-P and T

Super Insulated Pipe for the lowest heat leak and best flow characteristics

Available sizes : 1/2" to 4"  
Length : Up to 12 m



## SemiFlex

Alternative to rigid pipe modules, especially for long-distance piping systems where measurements are less precise

Available sizes : 1/2" to 2"  
Length : Up to 18 m



## UltraFlex

Lowest dynamic bending radius for liquid nitrogen transfer from dewar to equipment

Available sizes : 1/4", 3/8" and 1/2"  
Length : Up to 12 m



## TriFlex

Triaxial design delivers single phase vapor-free liquid nitrogen to critical applications

Available sizes : 1/2" to 2"  
Length : Up to 18 m



# Modular Piping



## ***PolyFlex***

Designed specially for Polycold Cryochiller applications

Available sizes : 3/8", 1/2" and 1"

Length : Up to 12 m

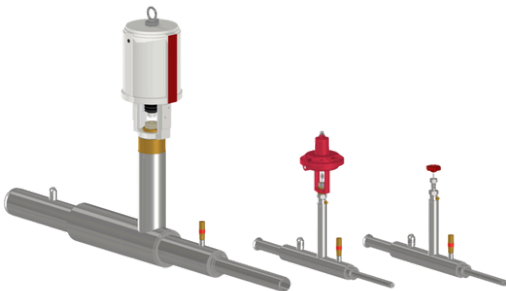


## ***Elbow and Tee***

Available in standard length dimension with various configuration options for greater selection and installation flexibility

Available sizes : 1/2" to 2"

Length : Standard

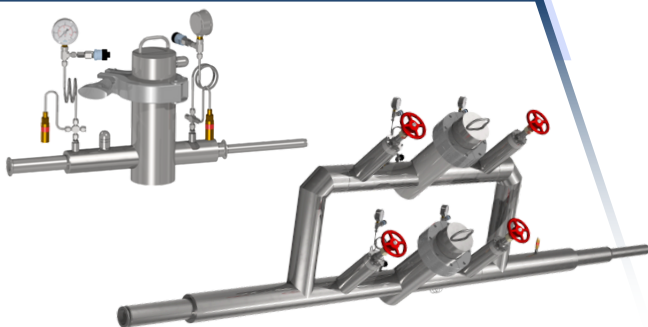


## ***Valve***

Vacuum-insulated valve with top-entry valve stem, available in T or Y configurations, supports manual and pneumatic actuation for cryogenic applications

Available sizes : 1/2" to 4"

Length : Standard



## ***Filter***

Vacuum insulated top-entry filter. Customizable manifolds with built-in redundancy

Available sizes : 1/2" to 4"

Length : Standard

# CryoSeparator

## Phase Separator, Atmospheric Pressure

Delivers low vapor single phase cryogen at atmospheric pressure, independent of supply pressure fluctuation

Available sizes : 22 L, 48 L  
No. of Outlets : 2, 4, 6, 8, 10, or 12



## Phase Separator, Adjustable Pressure

Allows the user to set desired output pressure within  $\pm 2.5$  psi

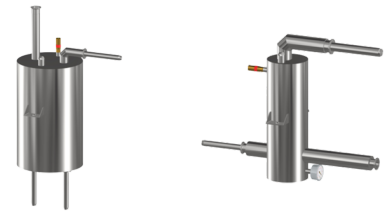
Available sizes : 22 L, 48 L, and 76 L  
No. of Outlets : 1, or 2  
Pressure : 1 to 8 bar (22 to 100 psi)



## Degasser

Ensure a single-phase, vapor-free cold LN<sub>2</sub> supply in the pipeline, remove vapor in both continuous or stagnant LN<sub>2</sub> flow conditions

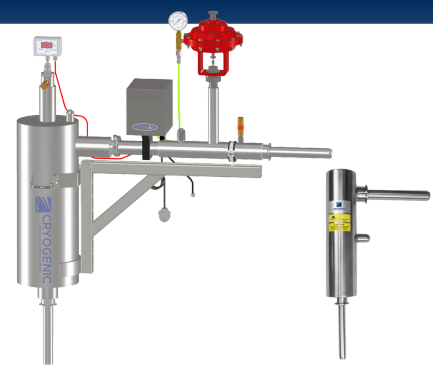
Available sizes : 2 L, 4 L, 8 L, and 22 L  
No. of Outlets : 1, 2, or 4



## CryoVent

Automatically removes LN<sub>2</sub> vapor during stagnant flow conditions to maintain supply integrity

Available sizes : 2 L, and 10 L  
Control Mechanism : Mechanical, or Electronic  
Venting Flow Rate : 200 Nm<sup>3</sup>/hr





## Why Choose Us?

We offer complete, single-source solution – from system design and manufacturing to installation, testing and commissioning.

Our systems features:

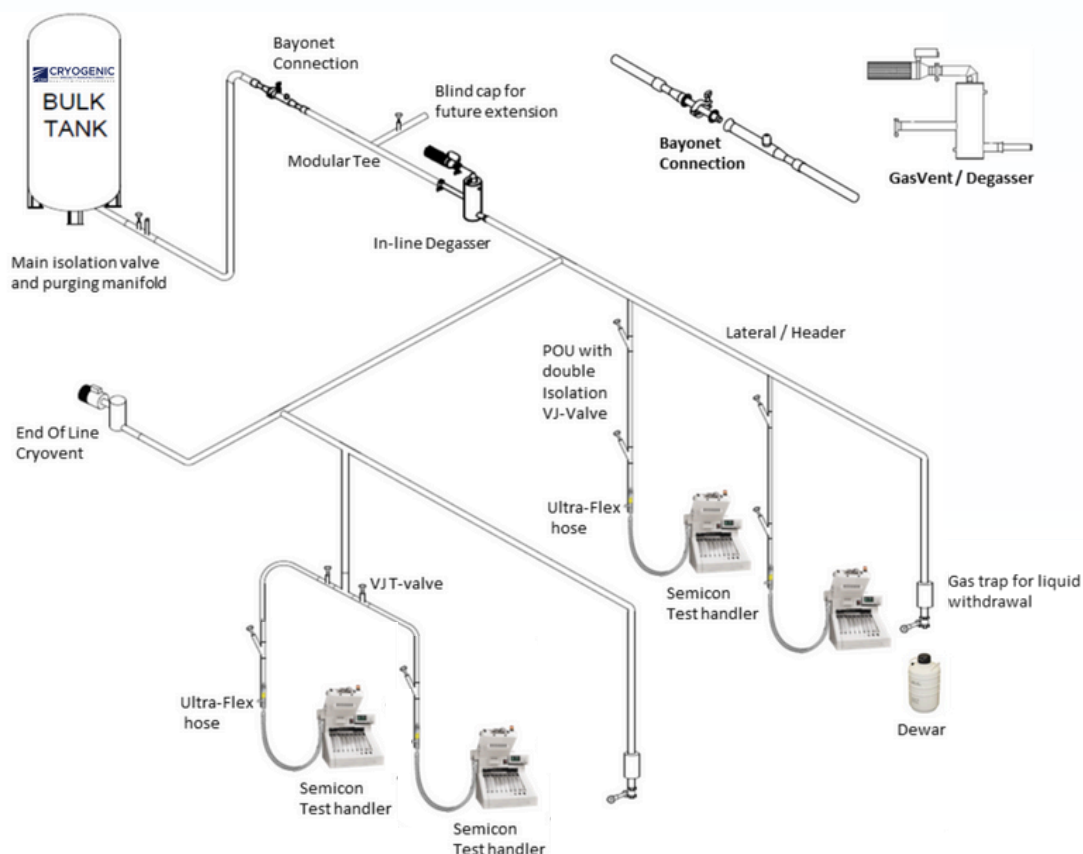
- ☑ Built-in safety monitoring (O<sub>2</sub> detection, emergency shutdown)
- ☑ Real-time performance tracking (temperature/pressure/flow)
- ☑ Seamless FMCS integration via MODBUS TCP/IP

With our proven expertise in cryogenic project management, **you benefit from:**

- ☑ Lowest overall project cost
- ☑ Minimal heat leak and LN<sub>2</sub> losses
- ☑ Lowest operational cost

## What We Offer?

- A 10 years warranty on all super insulated rigid module.
- On-site measurements.
- Most efficient layout of the super insulated piping system for your critical application.
- Detailed proposal describing every component of the super insulated piping system.
- Manufacturer's specifications of the system presented for your review.
- Isometric CAD drawing showing every detail of the proposed system.
- A Heat-Leak Guide to show LN<sub>2</sub> losses of current foam-insulated piping system.
- Break-even analysis on anticipated return on investment and long-term financial benefits to operation's bottom line.
- Cash flow analysis to show immediate effect on the system you will have on your plant operation.



# Worldwide Sales & Service



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E-mail: contact@fabrum.nz

- 
- Global Sales & Technical Support



## Manufacturing

CSM's 12,000 m<sup>2</sup> smart factory embodies our commitment to high-efficiency manufacturing and environmental sustainability.

- ✓ Green Manufacturing for sustainability
- ✓ Cutting-Edge Automation for precision and productivity
- ✓ ISO 9001 and 14001 certified

By integrating quality and innovation with sustainability, we deliver superior product performance while minimizing environmental impact!



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