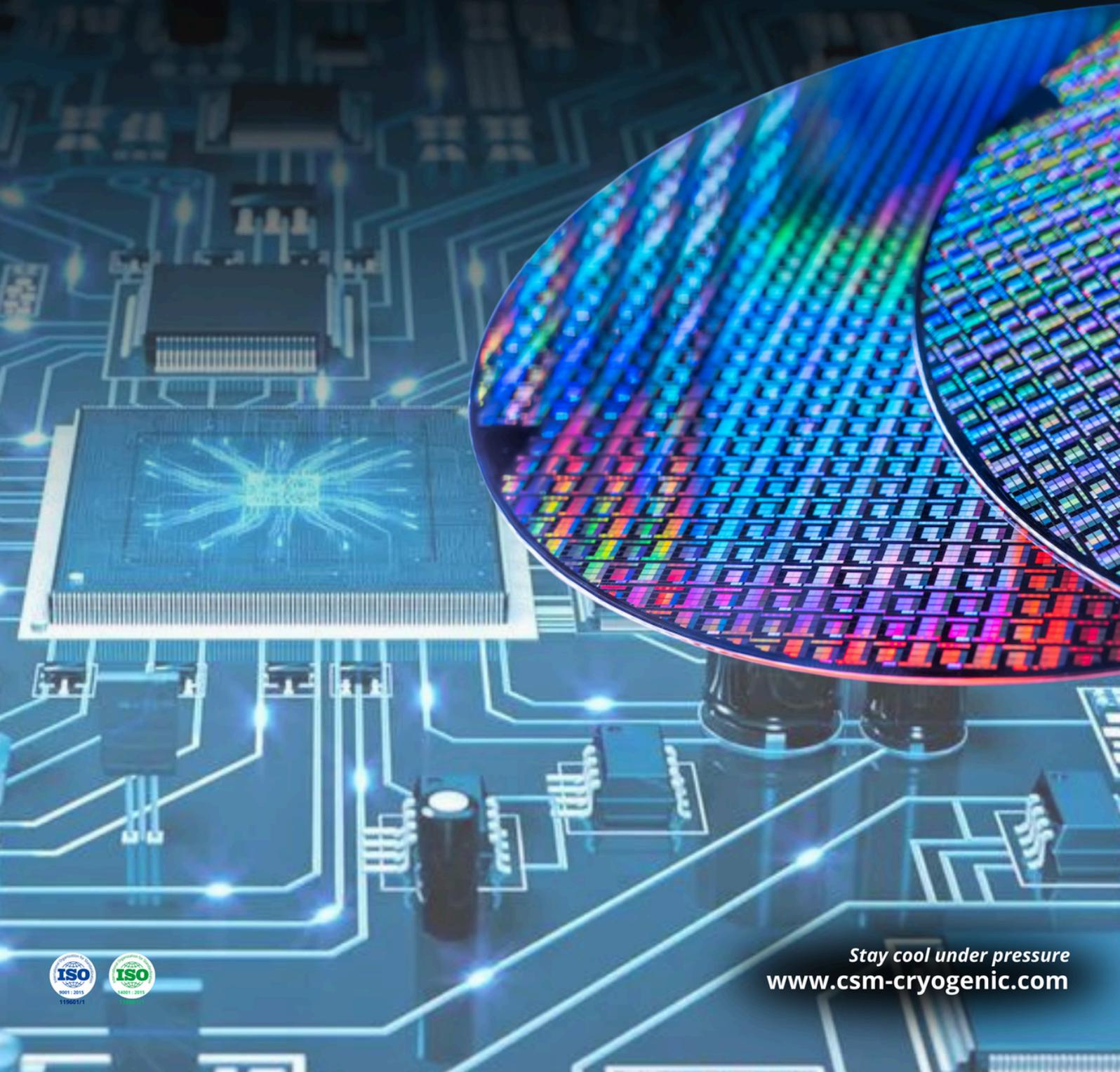




*Liquid Nitrogen Solutions For*  
**SEMICONDUCTOR**



*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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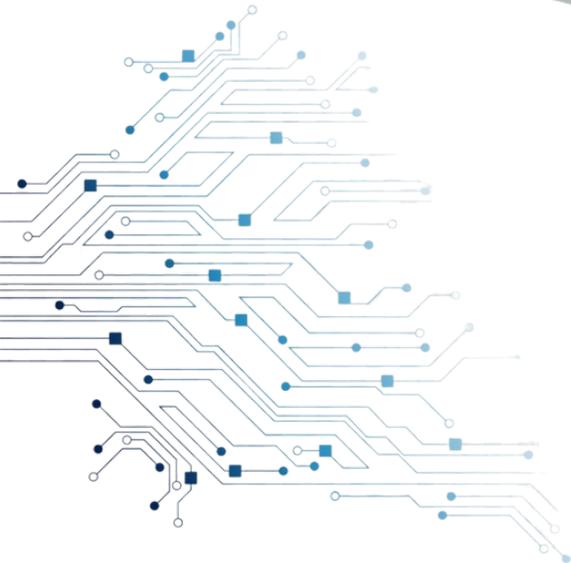
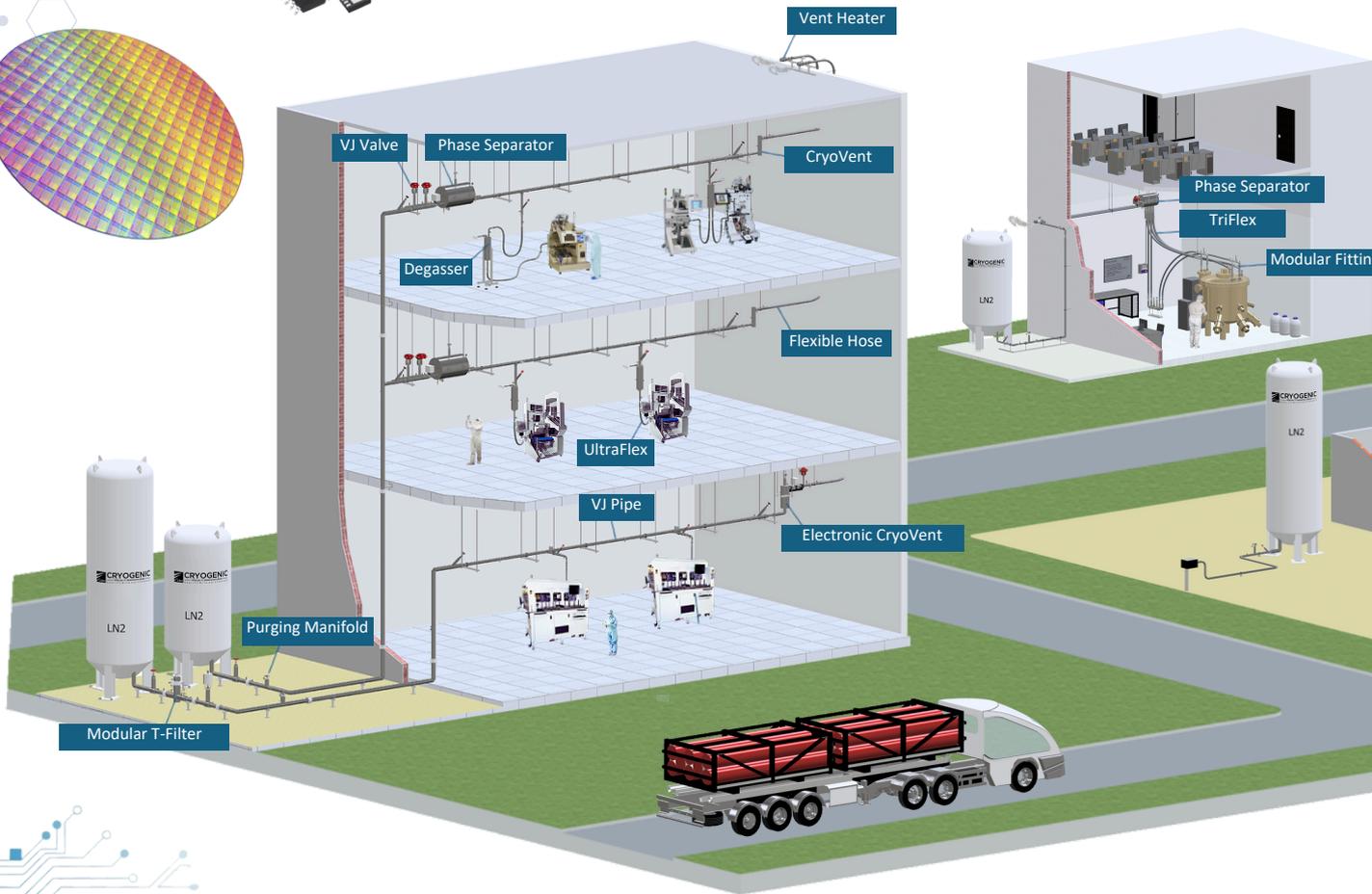
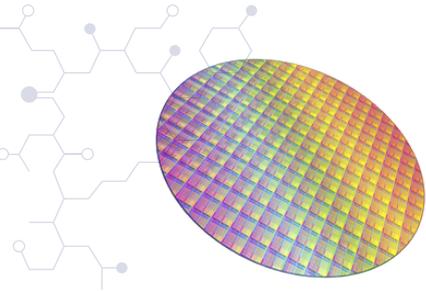
## The Power behind Your Success

Our Services  
Global Sales and Technical Support

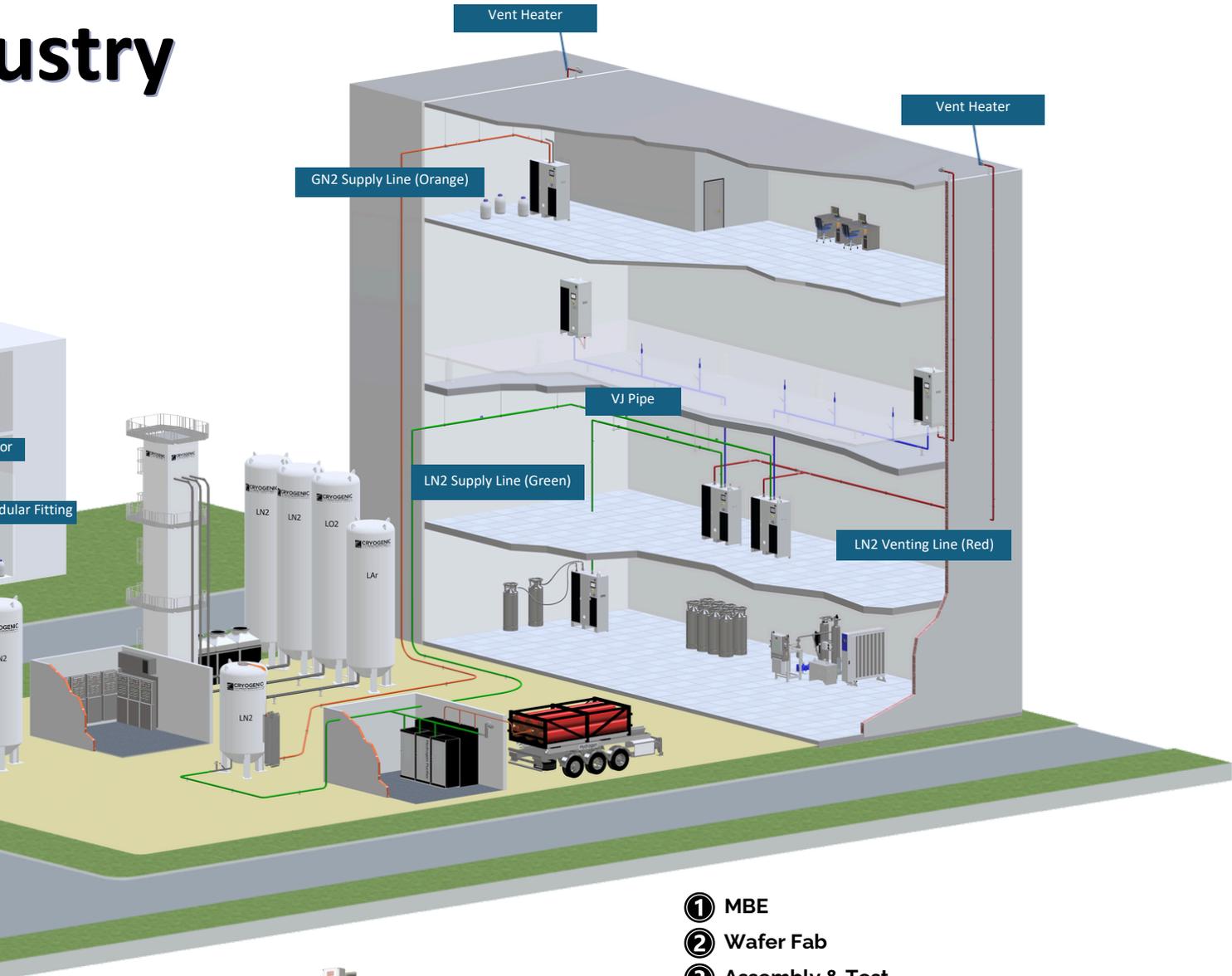
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# CSM Products in

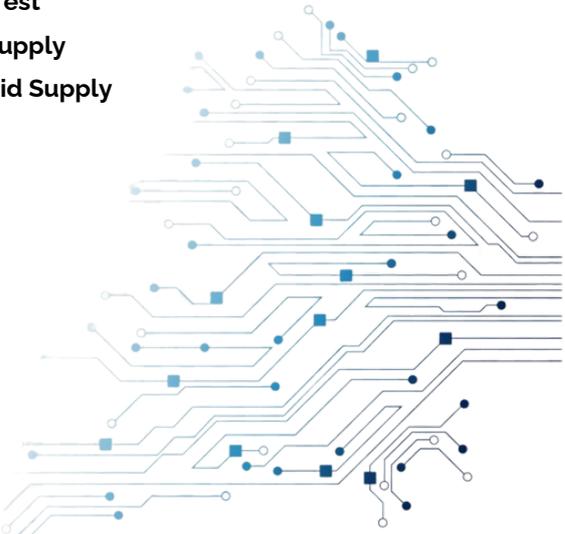
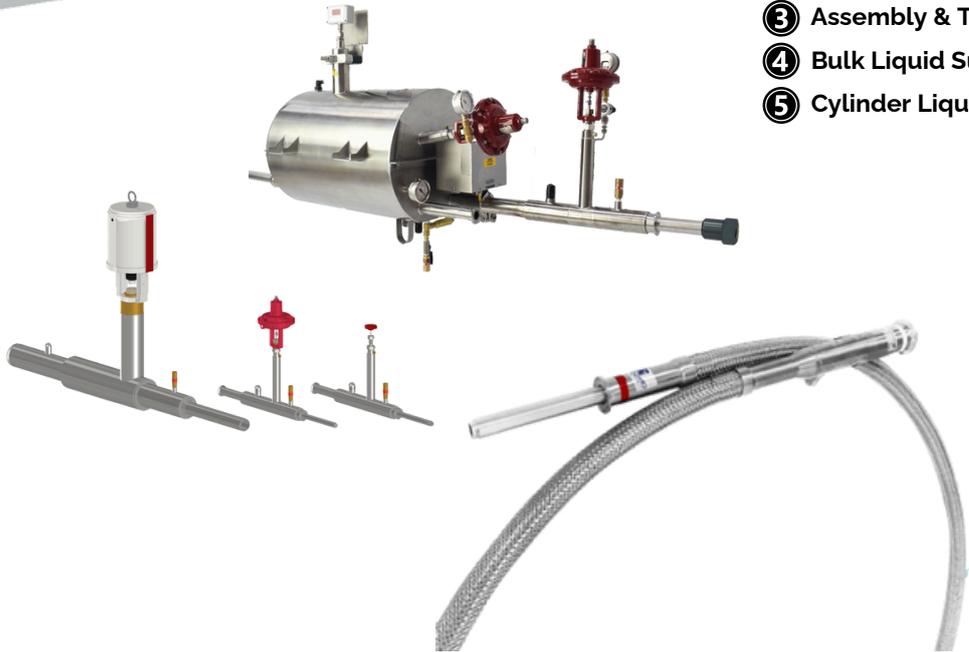
# Semiconductor Industry



# Industry



- ① MBE
- ② Wafer Fab
- ③ Assembly & Test
- ④ Bulk Liquid Supply
- ⑤ Cylinder Liquid Supply



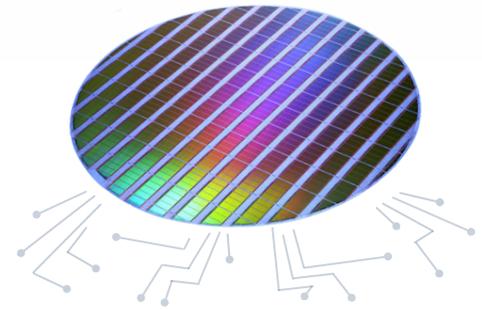
## Molecular Beam Epitaxy (MBE)

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:

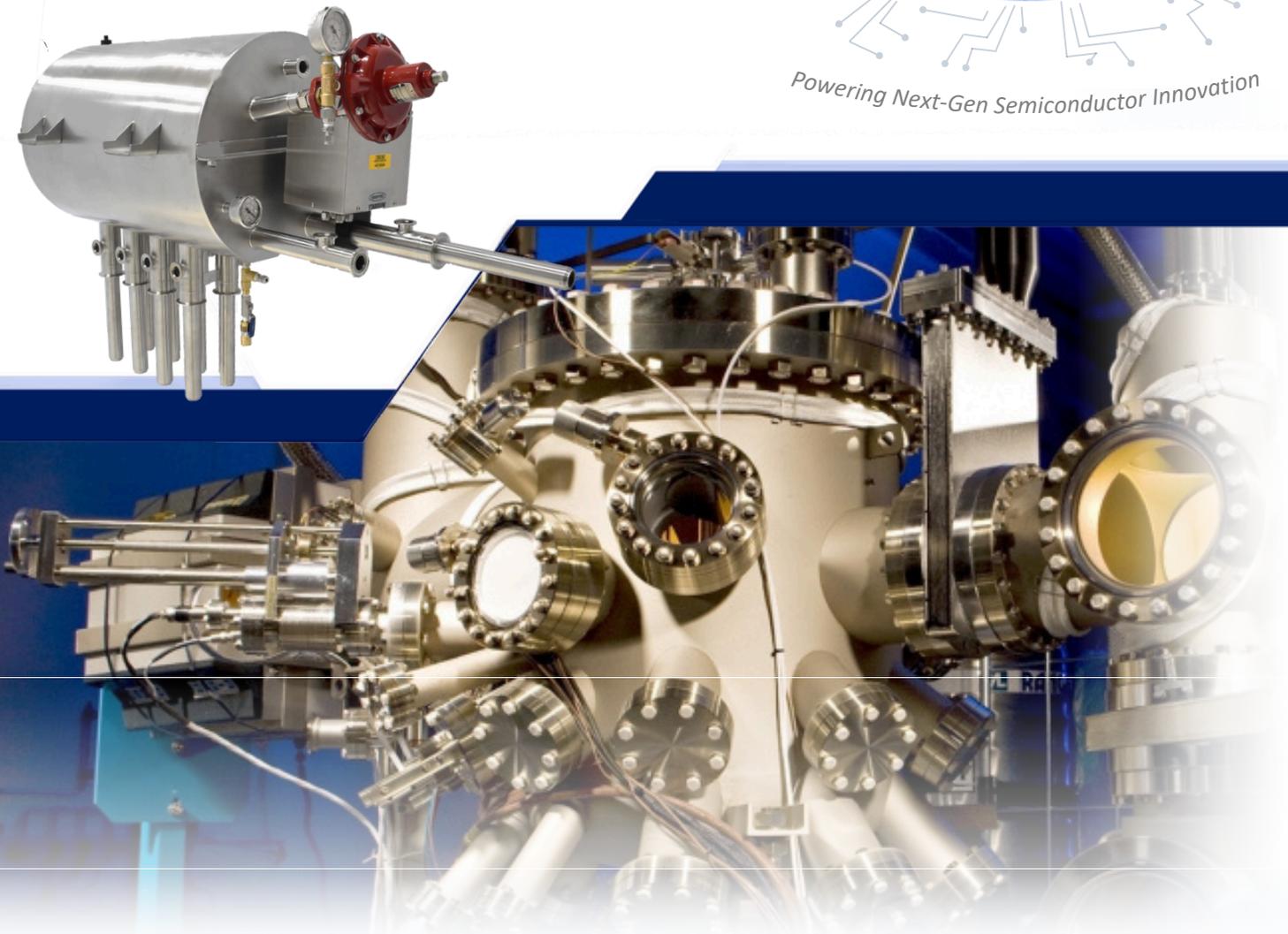
- ✔ Self-regulating, vapor-free LN<sub>2</sub> flow - maintains consistent -196°C cryopanel temperatures
- ✔ 30% LN<sub>2</sub> savings vs. conventional systems
- ✔ Eliminates dewar handling - completely closed-loop operation
- ✔ Enhanced safety - no pressurized dewars or manual transfers
- ✔ 20% lower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



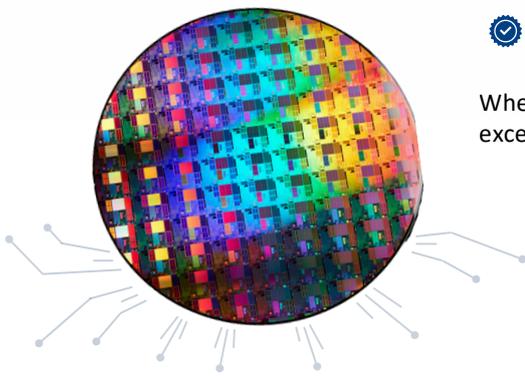
## Wafer Fabrication

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



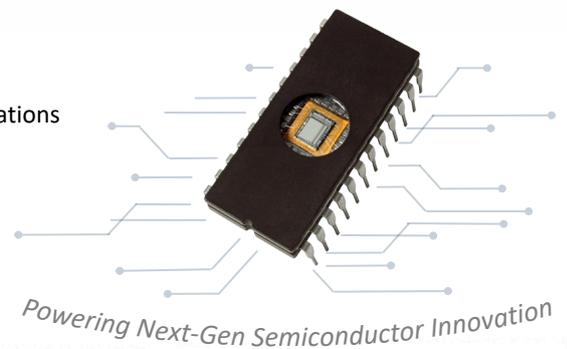
## Backend Chips Testing

In semiconductor backend product testing, thermal precision is paramount. CSM liquid nitrogen delivery system maintain ultra-stable low-temperature conditions at  $\pm 1^\circ\text{C}$  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 LN<sub>2</sub> 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% LN<sub>2</sub> savings – Optimized flow reduces operating costs vs other's LN<sub>2</sub> delivery
- ✓ Enhanced safety – Eliminates risks of two-phase flow and pressure fluctuations



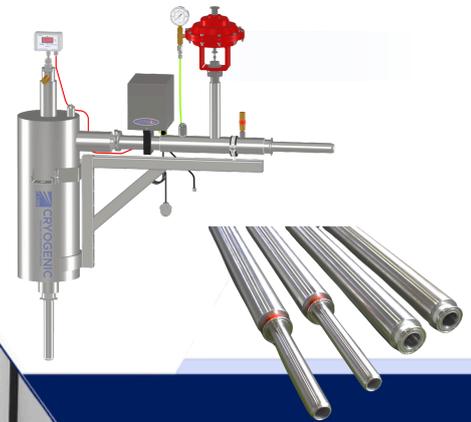
# HALT/HASS Testing

Liquid nitrogen (LN<sub>2</sub>) with boiling point -196°C / -320°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.

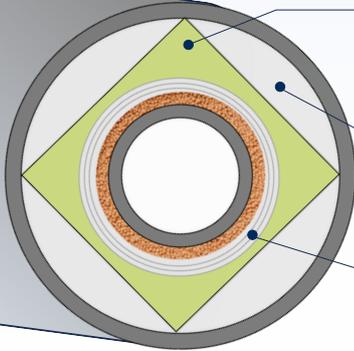
CSM's vacuum-insulated SIVL piping system sets the new standard for next-gen test chambers, delivering:

- ✔ 2X faster cooling – delivering ultra-cold single-phase LN<sub>2</sub> 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.



# Super Insulation Technology



• **Conduction**

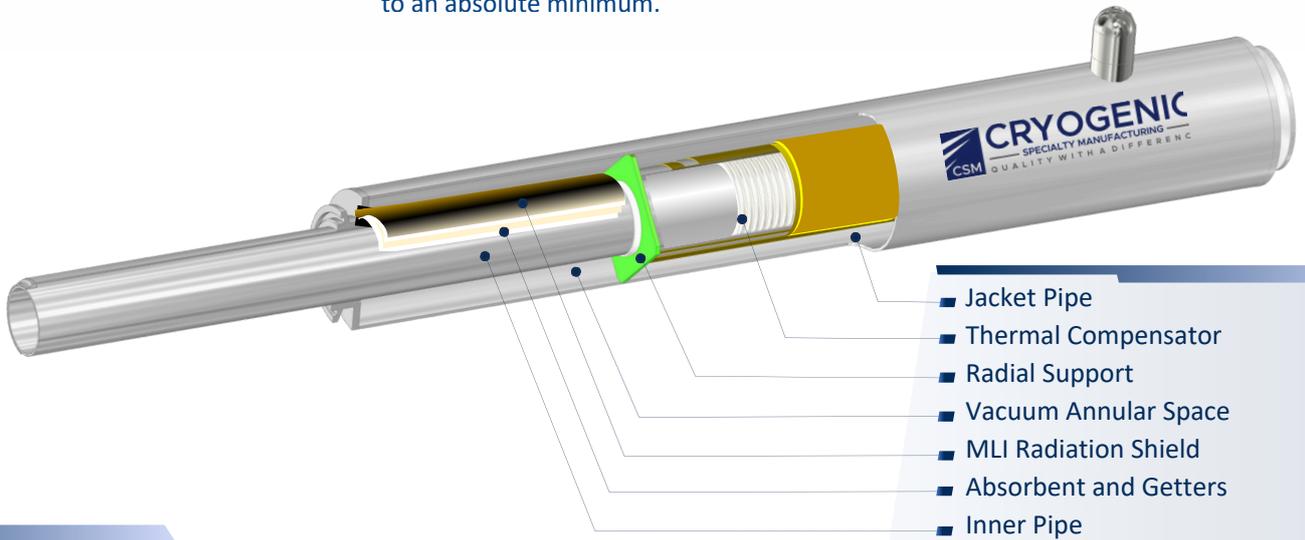
A proprietary radial support design and the use of low-conductivity materials minimize heat leaks through conduction.

• **Convection**

A proprietary degassing and vacuum evacuation process eliminates convection and molecular conduction heat transfer.

• **Radiation**

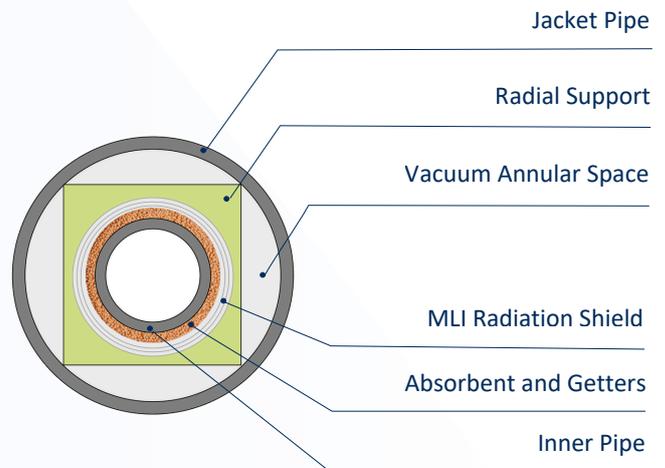
A proprietary assembly process, utilizing a specialized radiation barrier with low emissivity, reduces radiation heat leaks to an absolute minimum.



- Jacket Pipe
- Thermal Compensator
- Radial Support
- Vacuum Annular Space
- MLI Radiation Shield
- Absorbent and Getters
- Inner Pipe

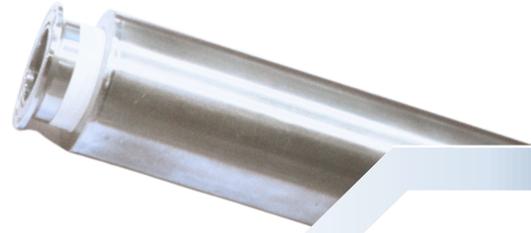
## Superior Quality

- ◆ 10 Years vacuum warranty
- ◆ <10 Micron warm vacuum
- ◆ Helium leak tested < 1.0 x10<sup>-9</sup> 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

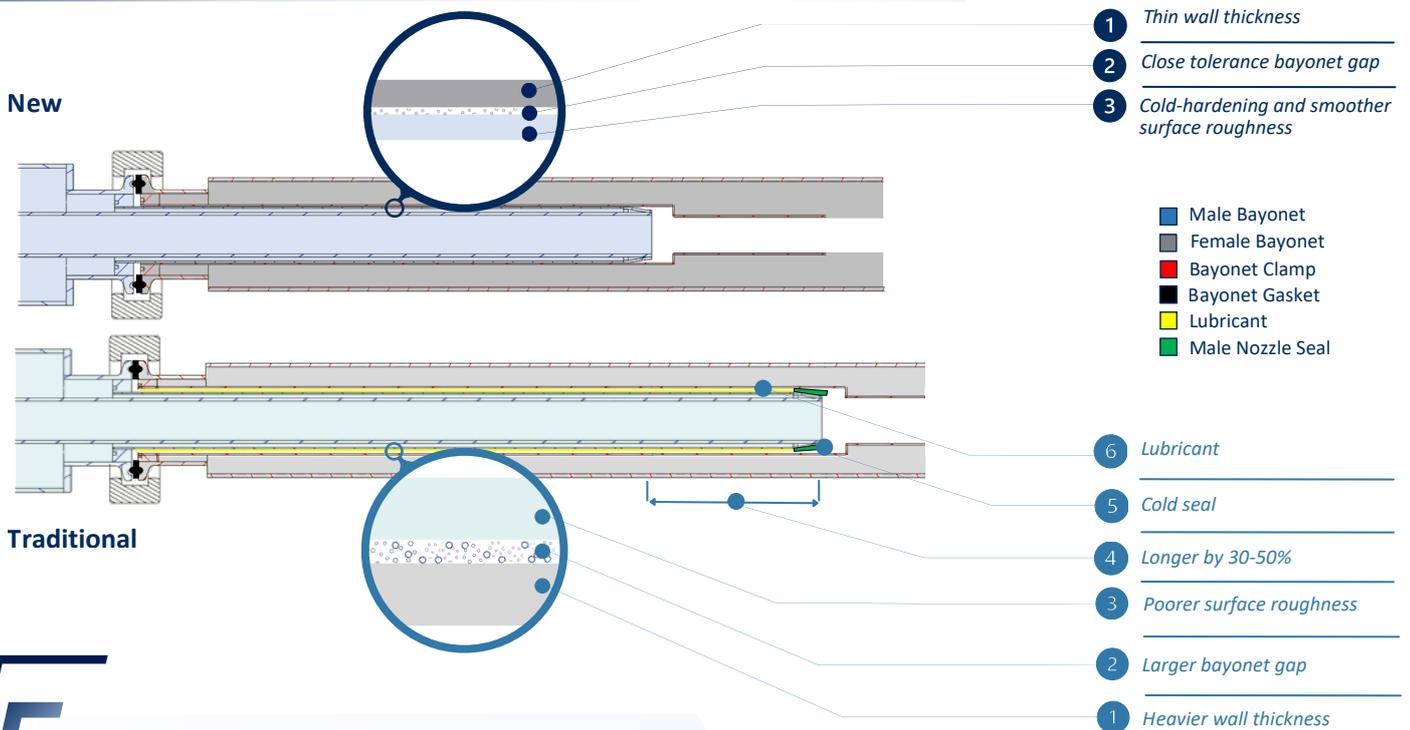




# Bayonet Connection Technology



## Comparison



## CSM Superior Performance

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



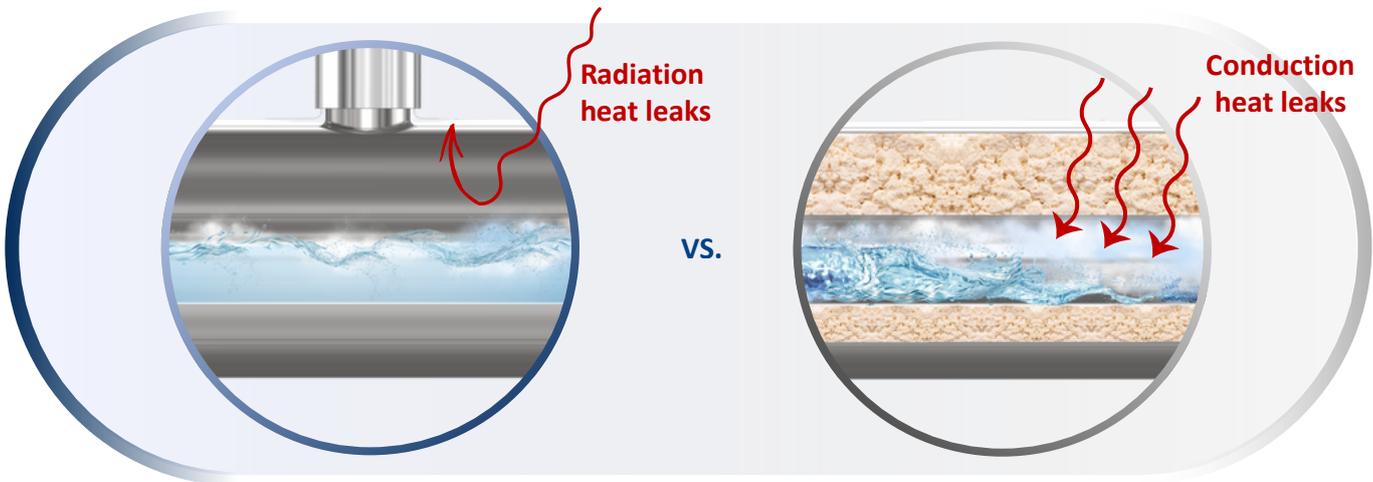
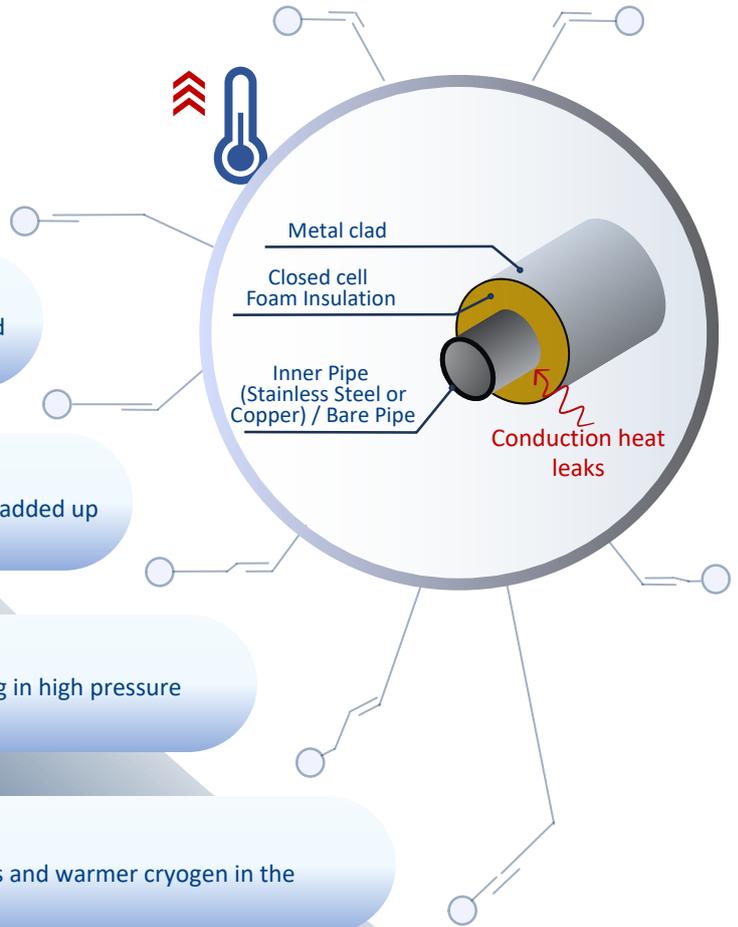
### Increase in Pressure Drop

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.



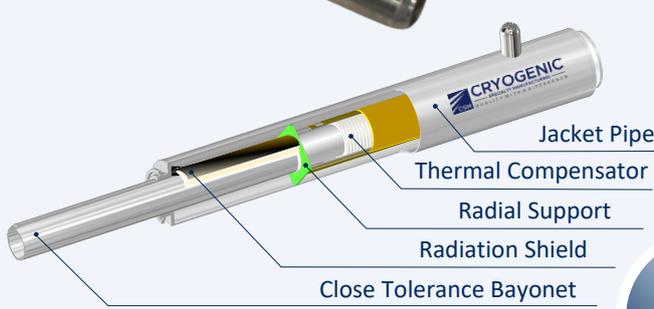
### CSM Super Insulation

Pure and cold liquid.  
Smoother liquid flow.

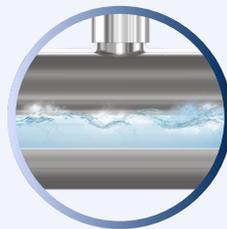
### Foam Insulation

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

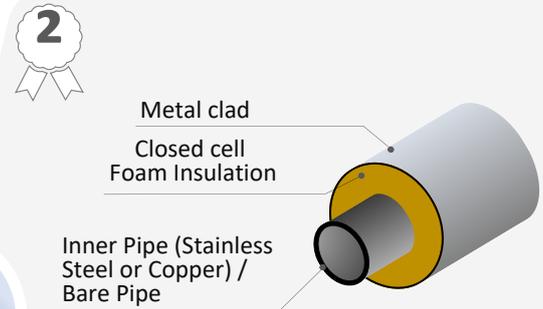
# Value vs. Cost of Heat Leak



Pure and cold liquid.  
Smoother liquid flow.



VS



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

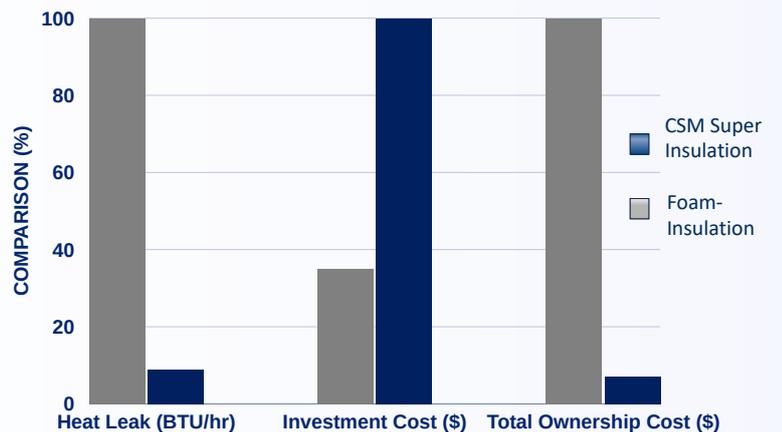


## Heat Leak Performance Comparison Chart

Line Size	Super Insulated Pipe BTU/hr.ft (W/m)	Foam-Insulated Pipe BTU/hr.ft (W/m)		Bare Pipe 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

The Cryotron Series is purpose-built for the semiconductor industry, combining **safety**, **efficiency**, and **automation** in cryogen management. It delivers a stable supply of subcooled cryogens while precisely regulating flow, pressure, and temperature.

Integrated sensors monitor oxygen, liquid nitrogen, vacuum, and condensation, enabling reliable control of critical parameters. This ensures safe operation, optimized efficiency, and simplified automated processes.



## *Phase Separator, P*

Automated LN<sub>2</sub> level & pressure control – ensures consistent pressure and liquid phase

## *CryoVent, V*

Electronic-controlled vapor removal prevents pipeline vapor lock - eliminating flow stagnation risks in intermittent LN<sub>2</sub> applications

## *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

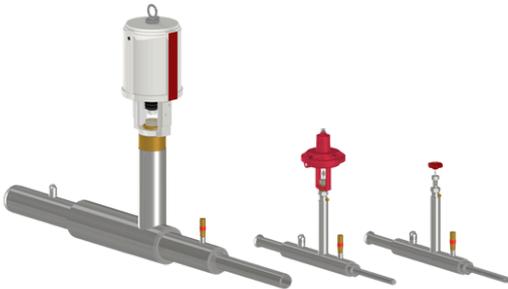


## *Elbow and Tee*

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

Available sizes : 1/2" to 2"

Length : Standard

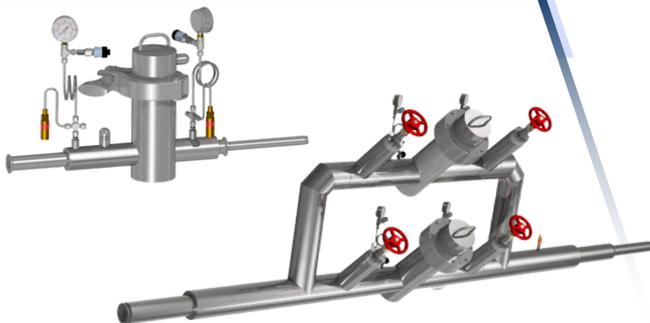


## *Valve*

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



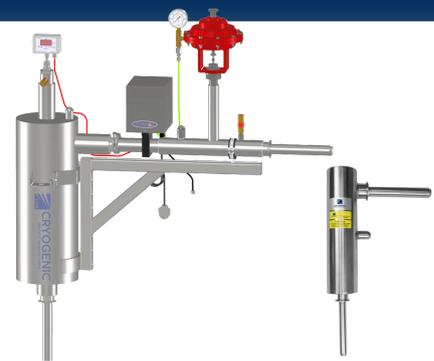
## CryoVent

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:

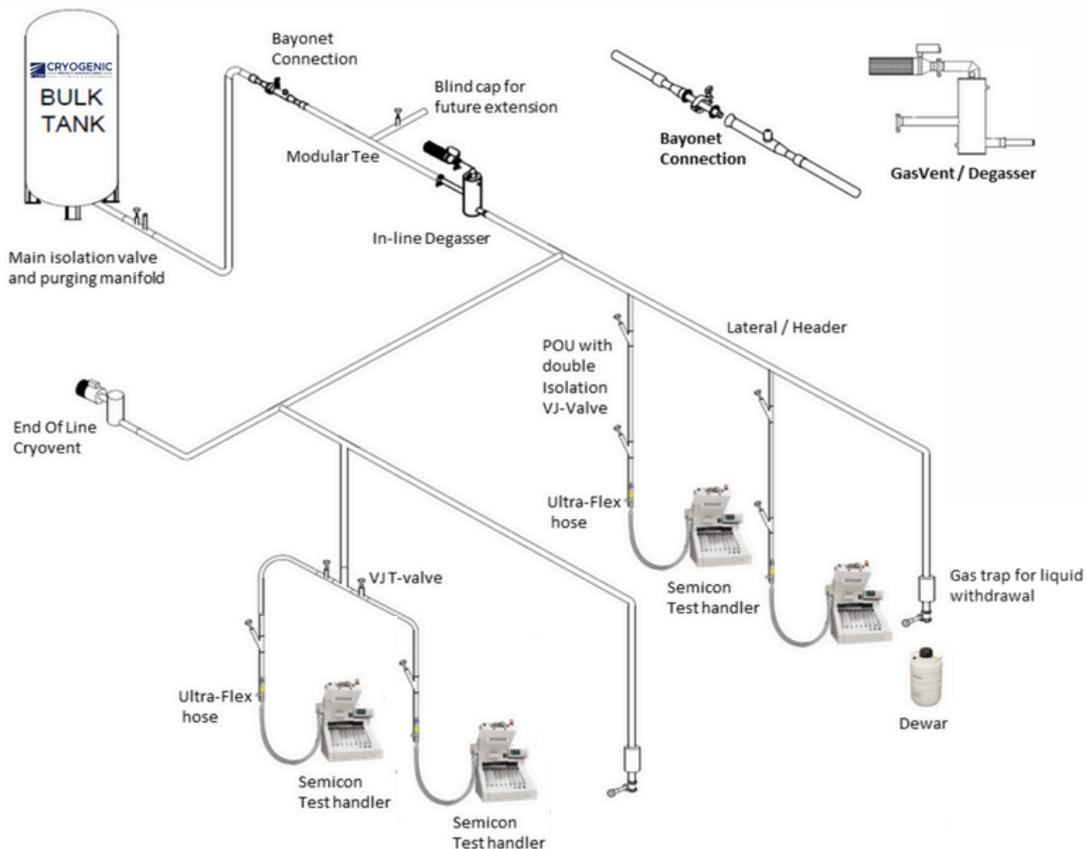
- ☑ Built-in safety monitoring (O<sub>2</sub> detection, emergency shutdown)
- ☑ Real-time performance tracking (temperature/pressure/flow)
- ☑ Seamless FMCS integration via MODBUS TCP/IP

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: Mark@criogenico.com.au

● 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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ACAT-SEMI-R26.1, 10 Feb.