-185 C to +150 C -300 to +302 F

AH

Space Simulation, Ultra High Vacuum, Thermal Vacuum Systems

Environmental Test and Space Simulation Systems

Description:

Cross the threshold of Space while still standing in your laboratory with a Bemco Thermal Vacuum Chamber, Space Simulation System, or Ultra High Vacuum Testing Facility.

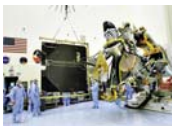
From the very first orbital simulator manufactured in the United States in the 1950's, to state of the art turbo mechanical, cryogenic, and ion pumped systems, we offer all embracing capability and technical expertise in this specialized field.

We design and manufacture our own vacuum vessels, we manufacture our own thermal shrouds from "Bemcoil," an exclusive Bemco product, we manufacture our own base plates and heat exchangers, we manufacture our own fluid and gas circulating systems, and we use only the most reliable, carefully tested components.

Why settle for the appearance of testing when you can have a system that actually works?

Choose Bemco, the true experts in Space Simulation, Ultra High Vacuum, and Thermal Vacuum Systems.





Almost every United States space program has in some part been tested in a Bemco Space Simulator or Thermal Vacuum System. Photographs - NASA.

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Bemco Inc, since 1951

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Space Simulation Systems

Thermal Vacuum Chambers

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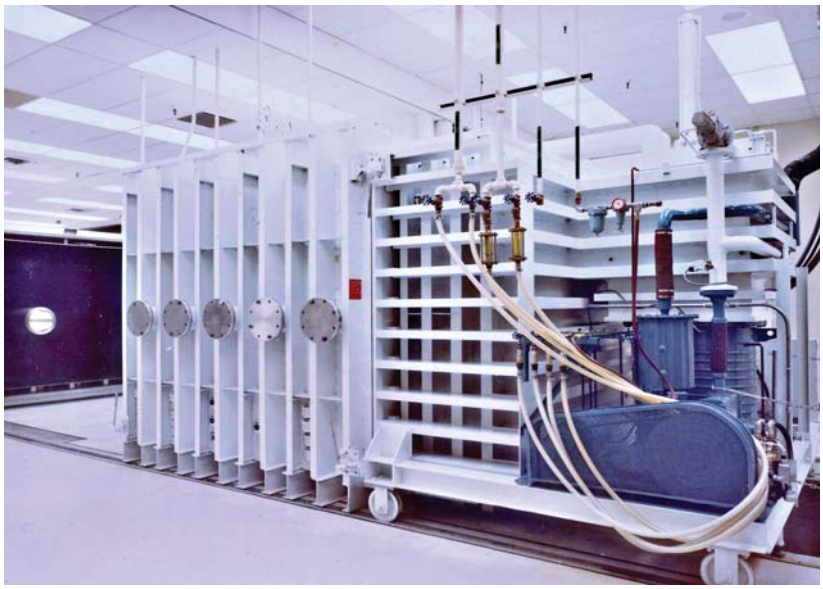
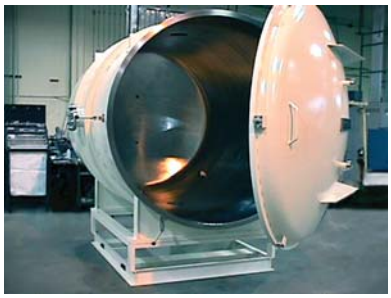


Round or Square

Every Bemco thermal vacuum or high vacuum chamber can be furnished in a round or a square workspace shape. The smallest available systems start at 12 inches inside diameter or 12 x 12 inches wide and high by any length and increase to the largest machines with measurements of 50 feet inside diameter or 50 feet wide and high by any length. The largest systems must be constructed, at least partially, on site due to shipping restrictions.



Construction

Every Bemco chamber and all vacuum accessories, including access ports, are reinforced in accordance with, and designed to meet, Section VIII of the ASME Code (Unfired Pressure Vessels). Chambers are available with inner surfaces made from high strength steel, 304 series stainless steel, and 316 series stainless steel.

For normal high vacuum service, 304 series stainless steel is recommended. Carbon steel is sometimes specified for very large vessels where cost is a primary consideration and 316 series stainless steel is suggested for pharmaceutical applications and clean rooms.

All chambers include a replaceable "O" ring seal. Interior chamber surfaces are ground smooth and polished for low emissivity and to minimize outgassing.

Supporting Structure

Exterior chamber reinforcement, enclosures, and structures, with the exception of the door sealing face which always matches the interior material, are made from high strength steel and carbon steel finished with a preventative primer and a Bemco Blue overcoat. Custom colors are available on request.

Leak Testing

All Bemco high vacuum chambers are tested with a helium mass spectrometer sensitive to 1 x 10^{-9} Torr.

All components used on Bemco Thermal Vacuum and Space Simulation Systems are high vacuum rated.

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Space Simulation Systems

Thermal Vacuum Chambers

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Environmental Test and Space Simulation Systems

Standard Thermal Conditioning Systems Available				
Fluid Circulated in Shroud	Cooling Method	Heating Method	Relative Specimen Live Load Dissipation	Temperature Range Maximum
Liquid Nitrogen	Flooded Liquid Nitrogen	None	Low to Medium	-185 C (-300 F) Only
Liquid Nitrogen	Circulated Liquid Nitrogen	None	Low to High	-185 C (-300 F) Only
Circulated Fluid (1)	Liquid Nitrogen Exchanger	Electric	Medium to High	-85 C to +150 C (1)
Circulated Fluid (1)	Mechanical Cooling	Electric	Medium to High	-65 C to +150 C (1)
Gaseous Nitrogen	Liquid Nitrogen Exchanger	Electric	Low to Medium	-170 C to +150 C
Gaseous Nitrogen	Mechanical Cooling	Electric	Low to Medium	-65 C to +150 C
(1) See the "Circulating Fluid Table" for recommended thermal conditioning fluids and their properties.				

Fluid and Gas Thermal Conditioners

Liquid nitrogen, circulated fluid, and circulated gaseous nitrogen conditioning of shrouds and base plates are offered. Each system has its own advantages. The common fluids used in circulating fluid systems and information on Bemco's technically advanced line of high performance PCL-III Packaged Fluid Chillers is shown on the following pages.

Flooded and circulated liquid nitrogen systems are selected for continuous operation at -185 C (-300 F). Gaseous nitrogen conditioners are chosen for their wide operating temperature range and are also specified when the

unusual possibility of circulating fluid leakage in the workspace outweighs the gaseous system's much higher first cost. Gaseous conditioners require high pressure, larger horsepower blowers, custom heat exchangers, and special low pressure drop gas circuited headers on the associated thermal shrouds and baseplates.

Circulating fluid systems are the most common type selected. They offer the advantages of excellent thermal uniformity under load and relatively lower operating cost.

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Recommended Circulating Fluids for Shrouds and Base Plates

Fluid Manufacturer's Name	Primary Advantages As a Circulated Fluid	Primary Disadvantages As a Circulated Fluid	Temperature Range Maximum
d-Limonene	Citrus based food grade chemical	Combustible, odor, and residue (1)	-85 C to +150 C
FC77 Fluorinert	No residue dielectric fluid	Limited range, environmental (2)	-85 C to +100 C
Galden HT170	No residue dielectric fluid	Very expensive, environmental (2)	-85 C to +150 C
Lexol 408	Common in older systems	Combustible and residue	-55 C to +150 C
Paratherm CR	Synthetic hydrocarbon	Combustible at high temperature	-85 C to +150 C
Coolanol 25	Low volatility dielectric fluid	Residue and high viscosity	-45 C to +125 C (3)
PAO (4)	Low volatility dielectric fluid	Residue and high viscosity	-45 C to +125 C (3)

(1) Applies if spilled or if a leak develops in the shroud or base plate under vacuum.
(2) Has potential environmental problems due to long life of the chemical in the atmosphere.
(3) High viscosity at low temperature makes pumping difficult. Recommended range is 10 C higher than shown.
(4) Bemco is the largest volume maker of PAO Chillers for the Aerospace Industry in the United States.

PCL-III Free Standing Fluid Conditioners

Bemco PCL-III fluid conditioners are furnished as free standing caster mounted systems, ready to provide a reliable and precisely controlled flow of temperature conditioned fluid.

To save floor space, these systems are also packaged with larger space simulators and thermal vacuum systems. Bemco's A6H Standard Space Simulators, described near the end of this bulletin, each include a fully integrated and appropriately sized PCL-III fluid conditioner.

They also make an ideal upgrade to an older vacuum chamber or bell jar without thermal capability or an existing thermal vacuum system or space simulator with obsolete controls, leaking pumps, dangerous circulating fluids, or environmentally unfriendly refrigerants.

Standard PCL-III fluid conditioners use d-Limonene, a product of Florida Chemical Company and a derivative of citrus peel oil. This material has a strong citrus odor, has a GRAS rating (Generally Recognized As Safe) from the US FDA, and is commonly used in modern space simulators and thermal vacuum chambers. Other fluids can be substituted. If another fluid is preferred, consult your Bemco technical representative for a recommendation.

Bemco makes custom fluid chillers over the temperature range of -115 C to +200 C. No single fluid covers the entire range. Special fluids, not shown above, many with unique challenges, are available on request.

Fluid circulating systems are available with magnetically sealed gear pumps up to about 50 gpm at an external loop pressure drop of 50 psid. Above this flow rate, magnetically sealed centrifugal pumps are offered up to 150 gpm at approximately 20 psid external loop pressure drop.

Please note that liquid nitrogen cooling is required below -65 C.

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Environmental Test and Space Simulation Systems

Standard PCL-III Packaged Liquid Chillers								
Model Number	Flow gpm	~ External Load, Watts	~ Loop Rise Full Load, C	Temperature Range, C	Cooling Type	Refrigeration Horsepower	Circulating Fluid	Circulating Pump Type
PCL3L-III	3	1500	5	-55 to +150	LN_2	None	d-Limonene	Mag Gear
PCL3M-III	3	1500	5	-55 to +150	Mechanical	2 x 2	d-Limonene	Mag Gear
PCL8L-III	8	4000	5	-55 to +150	LN_2	None	d-Limonene	Mag Gear
PCL8M-III	8	4000	5	-55 to +150	Mechanical	6.5 x 6.5	d-Limonene	Mag Gear
PCL15L-III	15	8000	5	-55 to +150	LN_2	None	d-Limonene	Mag Gear
PCL15M-III	15	8000	5	-55 to +150	Mechanical	10 x 10	d-Limonene	Mag Gear
PCL20L-III	20	10000	5	-55 to +150	LN_2	None	d-Limonene	Mag Gear
PCL20M-III	20	10000	5	-55 to +150	Mechanical	15 x 15	d-Limonene	Mag Gear

PCL-III's Include:

The third generation PCL-III Packaged Liquid Chiller combines the outstanding features developed in over 55 years of manufacturing these systems with modern controls, safer fluids, advanced heat exchangers, and convenient packaging.

Bemco refrigeration systems are all water cooled. They use environmentally friendly refrigerants, industrial grade semi-hermetic compressors, and include automatic hot gas bypass unloading as well as Bemco's exclusive, high performance coaxial cascade heat exchanger.

Heaters are interlocked with a separate heavy duty power contactor and a factory preset high temperature safety control.

All electrical wiring meets the United States National Electric Code.

Fluid System:

The standard Bemco PCL-III fluid circulating system includes a magnetically sealed, positive displacement gear pump capable of producing rated flow at 50 psi between the supply and return connection.

The fluid system includes: shutoff valves, a bypass modulating valve to allow system preconditioning, discharge and suction pressure gauges, and a relief valve to protect the system from over pressurization.

The system also has a fluid reservoir with a sight glass to monitor fluid level as well as a nitrogen gas pressurization system to prevent boiling, water condensation, and to allow the fluid to expand and contract with temperature. Discharge and suction pressure switches protect the system. The PCL-III is enclosed in a carbon steel case painted Bemco blue.

Instrumentation:

Each PCL-III includes a microprocessor based programmable 1/4-DIN solid state 256-step ramping temperature controller with a 4-line LCD interface display and a large red LED display.

An RS232 and RS485 interface is standard. The protocol is Modbus™. LabVIEW™ drivers are available.

A Factory Mutual Approved high and low temperature safety control with audible and visual alarm is included at no extra cost.

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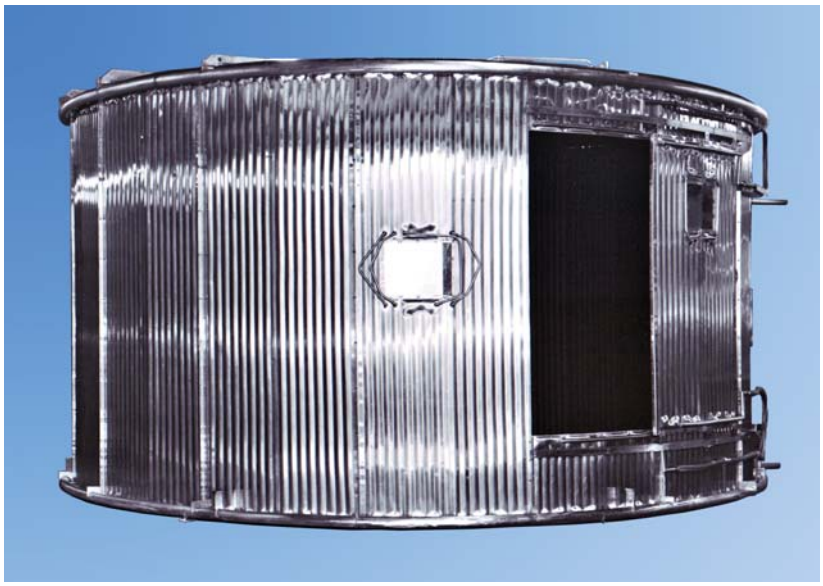

Bemcoil Shrouds and Base Plates

Bemcoil's distinguished history includes almost every major space program in the United States. The liquid nitrogen circuited shroud shown above housed the Apollo Astronauts and the Apollo Capsule running at -185 C. Many Bemcoil shrouds made in the 1960's are still functioning reliably, without leaks, today.

Bemcoil, is a proprietary Bemco stainless steel shroud material proven in high vacuum service for over 50 years. This material is available in both single and double embossed versions. It is made from 18 gauge roll welded stainless steel with welded edges.

Because each panel is made to order, circuiting can be optimized to match both the fluid in the shroud and the shape of the enclosing space. Starting with shrouds as small as 12 inches in diameter, Bemcoil is available for installation in systems as large as 50 feet in diameter.

Imitators sometimes use uncircuited, spot welded, waffle shrouds in an attempt to duplicate the precise flow patterns that are easily achievable with Bemcoil. Waffle shrouds often suffer from random fluid flow tunnelling due to uneven loading or local gas build-up in flooded shrouds.

Why compromise when you can have optimized circuiting as well as the superior pressure and helium mass spectrometer tested long term leak tight integrity of a stainless steel Bemcoil shroud?

Bemcoil is pressure expanded in a controlling die. Unlike many aluminum shrouds that depend on conduction for heat transfer, Bemcoil has over 95% of its surface in contact with the circulating fluid. Even through stainless steel is typically not a good conductor, users report outstanding temperature uniformity due to Bemcoil's high wetted surface-to-fluid ratio.

Stainless steel's great advantage versus aluminum is its resistance to strain cracking and porosity induced by thermal expansion and contraction. Many users prefer Bemcoil to any other type of thermal shroud.

Bemcoil thermal shrouds are usually polished on the outside and painted with high emissivity black epoxy paint on the inside to optimize heat transfer.

Base plates from Bemcoil-FOS (Flat-One-Side) and machined or gun-drilled aluminum toolplate combined with copper or stainless steel tubes are also available. The plates can be mounted on slides and connected with flexible stainless steel bellows tubing if desired.

Base plates are available with pre-drilled stainless steel threaded inserts mounted in regular patterns to allow test item mounting. Base plates are specified when test loads require conductive heating and cooling.

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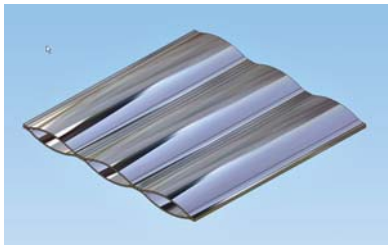


Bemcoil-DE

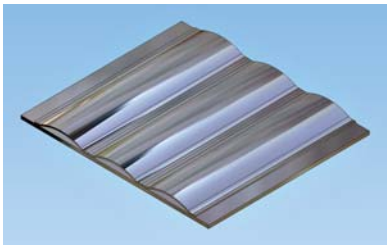
Bemcoil-DE (double embossed) is made from roll and continuous welded 18 gauge 304 stainless steel sheet. Each tube passage is almost equivalent to a 7/8 inch OD tube.

It is available in three finishes:

- A number 2B (semi-reflective) finish on the inside face and a number 4 (polished unidirectional) finish on the outside surface, specified when one side of the shroud is to be painted with black epoxy.
- A number 4 finish on both sides, specified when both sides will remain unfinished.
- Electropolish on one or both sides.

Bemcoil-DE's minimum roll diameter is 18 inches. The maximum diameter is unlimited. Sheets can be as small as 4 inches wide with a maximum width of 44 inches. Length of each sheet is limited only by the available material.

Assembled shrouds can be round or square. They can have any number of penetrations. Circuiting is optimized to the intended use and pressure drop is matched to the conditioning system. Each plate or assembly is tested under pressure at 150 psig and with a helium mass spectrometer.

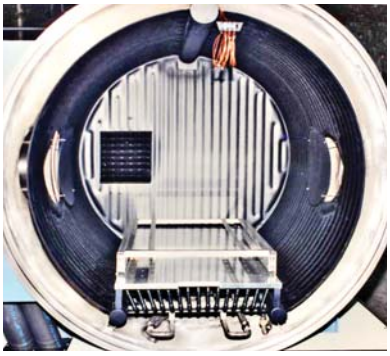


Bemcoil-FOS

Bemcoil-FOS (Flat One Side) is made from 18 gauge, 304 stainless steel sheet combined with 11 gauge (0.120 inch thick), 304 stainless steel plate.

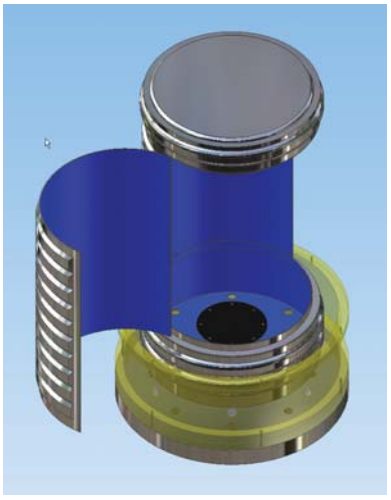
Bemcoil-FOS can be circuited to allow tapped or clearance hole penetrations for mounting.

This material is sometimes specified as a liquid nitrogen cooled water getter plate material in optical testing systems.



Chevron Baffles

Stepped, pump opening spacer plates made from Bemcoil-DE and stainless steel chevron baffles are provided to cover pumping port openings while maintaining test object optical density.



Bell Jar Clam Shell

Shown above is a cutaway drawing of a Bemco BC8-55/150C thermal shroud. The inside is shown in blue for clarity but is actually painted with black epoxy.

When combined with a thermal conditioner such as the Bemco PCL3L or M-III, this shroud converts a 24 inch inside diameter by 30 inch high vacuum only vertical bell jar into a 19 inch inside diameter by 20 inch high thermal vacuum testing system.

With a convenient clam shell door, test objects are easily loaded by simply raising the bell jar above the top of the door opening.

The BC8-55/150C Bell Jar Thermal Shroud is made from a combination of Bemcoil-DE (the walls, ceiling and door) and Bemcoil-FOS (the floor and the pump port spacer plate).

The clam shell door is piped to the main shroud circuiting using flexible stainless steel bellows tubing.

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Recommended High Vacuum Pumping Systems			
Pump Type Description	Primary Advantages As a High Vacuum Pump	Primary Disadvantages As a High Vacuum Pump	Pressure Ultimate Capability
Helium Cryopump	Clean pumping and high speed	Regeneration, Noble Gases (2)	5×10^{-8} Torr (1)
Turbomolecular Pump	Clean pumping, no regeneration	Potential vibration, low speed	5×10^{-8} Torr (1)
Ion Pump	Clean pumping, no regeneration	Low speed, magnetic field	5×10^{-8} Torr (1)
Oil Diffusion Pump	Pumps all gasses, inexpensive	Oil back-streaming in workspace	5×10^{-8} Torr (1)
Ti Sublimation	Pumps all gasses	Sputtering of titanium, service (3)	5×10^{-8} Torr (1)

(1) Refer to the "System Performance Chart" for standard system ultimate and working pressure ranges.
(2) Cryopumps require periodic regeneration and have limited capacity for pumping noble gasses.
(3) Ti Sublimation pumps require periodic replacement of the Titanium source.

Cryopumps

Cryopumps work by cryocondensation and freezing. Cryopumps that Bemco selects are multistage systems that first trap condensable gases such as water on an external shield maintained at approximately -185 C, then condense or freeze gasses that are susceptible at about -263 C and finally trap (cryoadsorb) the remaining gasses like helium, hydrogen, and neon within an expanded matrix maintained at about -265 C.

Because gasses are condensed, frozen, and trapped, the pump requires regeneration when its internal surfaces become saturated.

Cryopumps are the cleanest type of high vacuum pump. They utilize no exposed lubricants or fluids.

Turbopumps

Resembling a jet engine, turbo molecular pumps recommended by Bemco are usually of the modern Turbo-Drag type. These pumps work by progressively mechanically accelerating molecules with multiple angled blades and by momentum transfer. Molecules that enter the throat of the pump are forced downward towards higher pressure.

Bemco selected pumps utilize magnetic levitation and a dedicated motor speed control to eliminate the need for bearing lubrication, maintain alignment, and reduce wear. For proper operation these pumps require a backing pump.

They are generally more expensive than a Cryopump but offer the ability to reliably pump particle laden and corrosive gasses.

High Vacuum Pumps

A large Bemco designed, triode type, integral Ion pump is shown above. Sputter ion pumps operate by ionizing gas within a magnetically confined cold cathode discharge. This type of pump requires a high voltage power supply and is more expensive than a Cryopump. It does a good job of pumping noble gasses.

Oil diffusion pumps are chosen for their ability to reliably pump almost all gasses. They are currently seldom selected due to their potential for hydrocarbon back streaming.

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Recommended Roughing Pump Systems			
Pump Type Description	Primary Advantages As a High Vacuum Pump	Primary Disadvantages As a High Vacuum Pump	Pressure Ultimate Capability
Rotary Piston Pump	Oil sealed pumping, lower cost	Oil back streaming, requires trap	5×10^{-2} Torr
Scroll Pump	Oil free roughing and pumping	Expensive, limited maximum size	5×10^{-2} Torr
Rootes Booster Package	Pumping speed at low pressures	Expensive, use with a large system	5×10^{-4} Torr
Rotary Vane Pump	Oil sealed, lower vibration	Oil back streaming, requires trap	5×10^{-3} Torr

Oil Sealed Pumps

Bemco recommends rotary vane and for much larger systems, rotary piston pumps with gas ballast for roughing standard thermal vacuum and space simulation systems down to the switch over pressure required by the selected high vacuum pump.

All Bemco oil sealed pump systems include a dive valve to immediately reduce pressure in the foreline when power is removed, an isolation valve for leak checking, and a heated molecular sieve trap to limit the potential for oil back streaming in the event of power failure.

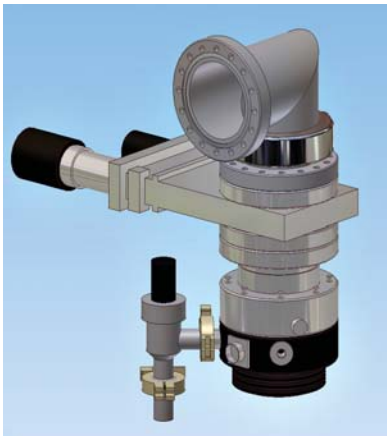
Also furnished is a digital vacuum gauge and control to monitor foreline pressure.

"Clean" Pumps

Scroll pumps and for much larger systems, Rootes booster package pumps, and Screw pump,s are selected for "Oil Free" roughing of thermal vacuum and space simulation systems where the proposed test load is sensitive to even the lowest level of hydrocarbon back streaming.

Scroll pumps are the most common selection. They are completely oil-free and make an ideal complement to a turbomolecular pump or a cryopump in a system intended for optical testing.

They require no filters, no foreline trap, little routine maintenance, and no oil changes.



Drawing of a turbopump with roughing valve, slide valve, right angle elbow, and elbow cold trap. An optional elbow heat exchanger is shown to limit thermal face loading on the pump at high temperature.

Typical Performance with Various Pumping Systems		
Operating Pressure	Recommended Roughing Pump or High Vacuum Pump	Special Accessories Disadvantages or Notes
5×10^{-3} Torr	Rootes Booster Package	High voltage breakdown may occur at these pressures
5×10^{-5} Torr	Cryopump, Turbopump, or Ion Pump	Reliable operating range with high outgassing
5×10^{-6} Torr	Cryopump, Turbopump, or Ion Pump	Normal Bemco operating range without bakeout
5×10^{-7} Torr	Cryopump, Turbopump, or Ion Pump	Normal Bemco ultimate with clean system, no bakeout
5×10^{-8} Torr	Cryopump, Turbopump, or Ion Pump	Requires bakeout, metal or dual seals, and clean system

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Standard A6H Space Simulator Specifications

Model Number	Inside Diameter		Inside Length		Temperature Range, C	Working Pressure	Circulating Fluid	High Vacuum System
	Inches	cm	Inches	cm				
A6H4	18	45.7	24	61.0	-55 to +150	5 x 10^{-6} Torr	d-Limonene	Cryopump
A6H6	24	61.0	24	61.0	-55 to +150	5 x 10^{-6} Torr	d-Limonene	Cryopump
A6H10	24	61.0	36	91.4	-55 to +150	5 x 10^{-6} Torr	d-Limonene	Cryopump
A6H15	30	76.2	36	91.4	-55 to +150	5 x 10^{-6} Torr	d-Limonene	Cryopump
A6H20	30	76.2	48	121.9	-55 to +150	5 x 10^{-6} Torr	d-Limonene	Cryopump
A6H28	36	91.4	48	121.9	-55 to +150	5 x 10^{-6} Torr	d-Limonene	Cryopump
A6H35	36	91.4	60	152.4	-55 to +150	5 x 10^{-6} Torr	d-Limonene	Cryopump
A6H48	42	106.7	60	152.4	-55 to +150	5 x 10^{-6} Torr	d-Limonene	Cryopump
A6H63	48	121.9	60	152.4	-55 to +150	5 x 10^{-6} Torr	d-Limonene	Cryopump
A6H75	48	121.9	72	182.9	-55 to +150	5 x 10^{-6} Torr	d-Limonene	Cryopump

A6H Space Simulators

Bemco offers a line of up-to-date space simulators incorporating all of the preferred features needed for reliable combined temperature and high vacuum testing. The A6H series is designed in accordance with the ASME code.

It includes a fully integrated and appropriately sized PCL-III Packaged Liquid Chiller utilizing liquid nitrogen for cooling. Mechanical cooling is also available as an option. Please refer to the PCL-III section of this Bulletin for additional information.

Each A6H system includes:

- An optically dense, electropolished, right angle elbow to support the pump stack and protect the face shield on the cryopump from excessive thermal load.
- A high conductance pneumatic aluminum slide valve to isolate the cryopump.
- A matching cryopump with a regeneration heater and a digital cryo-array temperature indicator.
- Two, 3 inch ASA style, access ports.
- Pneumatic roughing and cryopump isolation valves.
- A rotary vane pump roughing system with a heated regeneration molecular sieve foreline filter.
- Two Convectron digital display gauge controllers and tubes: one on the roughing foreline and one on the cryopump roughing line.
- A Stabil-Ion gauge controller and tubes.
- Automatic electrical interlocks to assure proper vacuum system operation.
- Six cold plate hard points to support an optional base plate test item frame and four roof mounted hard points.
- A Bemcoil thermal shroud with a stepped plate baffle at the rear of the workspace.

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Bemco Standard Right Angle Poppet Valves								
Model Number	PV6	PV8	PV10	PV18	PV21	PV22	PV32	PV35
Nominal Size, Inches	4″ - ASA	6″ - ASA	10″ - ASA	16″- ASA	20″ - ASA	20″ - ASA	32″ - ASA	35″ ASA
Conductance, L/Sec	1250	2100	5300	14300	21400	25200	50000	60800
Seals in Both Directions	Yes	Yes	Yes	No	No	No	No	No
Flange ID, Inches	5.750″	8.000″	12.000″	18.000″	21.250″	22.750″	32.000″	35.000″
Air Pressure, Psig	80-110	80-110	80-110	80-110	80-110	80-110	80-110	80-110
O-Ring Material	Viton	Viton	Viton	Viton	Viton	Viton	Viton	Viton
Material, Stainless Steel	316	316	316	316	316	316	316	316
Roughing Port (Standard)	KF25	KF25	KF40	KF40	KF50	KF50	KF80	KF80
Position Indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Electropolish Finish	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Poppet Valves and Cold Traps

Both cold traps and right angle poppet valves are all stainless steel except for the pneumatic piston. They are available in both ASA flange and weld mounting. Electropolished poppet valves are optionally available.

Cold traps are electropolished to minimize LN_2 consumption or the required size of a low temperature mechanical refrigeration system. They feature a positive creep barrier, are oversized for maximum conductance, and are optically dense.

Bemco Standard Round Cold Traps								
Model Number	MCT6	MCT8	MCT12	MCT18	MCT21	MCT22	MCT32	MCT35
Nominal Size, Inches	4″ - ASA	6″ - ASA	10″ - ASA	16″- ASA	20″ - ASA	20″ - ASA	32″ - ASA	35″ ASA
Conductance, L/Sec	800	1500	3500	11500	17500	20300	40000	48000
Flange ID, Inches	5.750″	8.000″	12.000″	18.000″	21.250″	22.750″	32.000″	35.000″
Overall Height, Inches	4.500	5.500	8.500	10.500	12.500	12.500	16.500	18.500
Positive Creep Barrier	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Material, Stainless Steel	316	316	316	316	316	316	316	316
Optically Dense	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LN2 Level Controls	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional
Electropolish Finish	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Excellence

Bemco Inc.

Request a free quotation or analysis of your testing needs. Our experienced engineers are ready to help you.

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Bemco chambers really simulate the environments expected. We take your specifications and requirements literally. Our equipment does what we promise and you specify. We are truly focused on Excellence.

Space Simulation Systems

Thermal Vacuum Chambers

AH

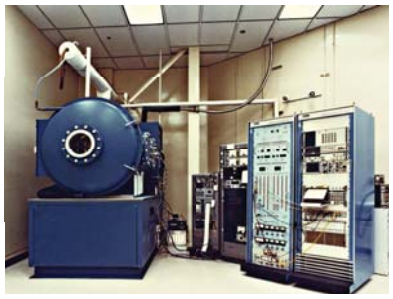
Environmental Test and Space Simulation Systems

Options

- Access ports with ASA pattern flanges in 1, 1.5, 2, 3, 4, 6, 10, 12, and 24 inch sizes.
- Access ports with Conflat flanges in any commercially standard size.
- Matching blank 304 series stainless steel cover plates.
- When a shroud is specified, matching full size or undersize holes in the shroud conductive aluminum cover plates.
- Viewports and shutters.
- Electrical, thermocouple, and mechanical feed throughs.
- Mild bakeout systems.
- Wall cooling systems.
- Radiant heating systems, solar mirrors, and simulators.
- Overhead rails, product fixturing hard points, and supports.
- Manipulators, drives, transfer systems, and mechanisms.
- Cryotraps, coldtraps, and filters.
- Thermally conditioned mounting surfaces.
- Bemcoil or other heat exchanger type getter plates.
- Multiple pumping arrays.
- Chevron baffles.
- Valved secondary compartments.
- Stainless steel and carbon steel tanks fabricated to your specifications.
- Thermal shrouds fabricated to your specifications.
- Stainless steel, aluminum, and copper thermal baseplates fabricated to your specifications.

Optional Instruments

- 24 hour or 7 day, digital indicating, self chart printing, circular recorders for temperature.
- Single pen or multi-pen strip chart recorders.
- Programmable logic control sequencing of test processes. Bemco recommends Allen Bradley (ABB) PLC's and software.
- Touchscreen HMI's (human machine interfaces).
- RS232, RS485 and Ethernet communication interfaces.
- Engraved or silk screened graphic control panels with switches and lights logically placed within a schematic of the system.
- Convectron digital display gauge controllers and tubes. Typical pressure range is atmosphere to 1 x 10^{-4} Torr. Standard Bemco Space Simulators have two: one on the roughing foreline and one on the cryopump roughing line.
- Stabil-Ion gauge controller and tubes. Typical pressure range is 10^{-3} Torr to 10^{-11} Torr. One unit is standard on all Bemco Space Simulators.
- Additional Stabil-Ion gauge tubes to act as a backup, if needed.



Excellence

Bemco Inc.

2255 Union Place, Simi Valley
California 93065, USA
805-583-4970 telephone
805-583-5033 fax
http://www.bemcoinc.com

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