thermionics laboratory, inc.
Vacuum Innovation Since 1958

Vacuum Components & Systems

2021 Catalog

Vacuum Components & Systems

Catalog 2021

Table of Contents

Table of Contents

Table of Contents

Material, Surface & Molecular Beam Science 12

Material, Surface & Molecular Beam Science 12

Table of Contents

Molecular Beam Epitaxy

Reflection High Energy Electron Diffraction (RHEED)

Pulsed Laser Deposition (PLD)

Molecular Beam and Surface Chemistry Products

Ordering Information

About the Company

Since 1958, Thermionics has designed, developed, and manufactured vacuum equipment for scientific and industrial applications. Our products are the result of careful research and development. rigorous testing, and continuing performance evaluation. Our commitment to quality and reliability is one reason researchers and OEM manufacturers specify Thermionics' products

We listen to our customers. They are the best source for information about current and emerging processes and technologies. These discussions stimulate product development and ensure continuous improvement.

For new components and systems, or the modification and repair of existing equipment, Thermionics will deliver the best equipment and value to you.

Minority Statement

When you purchase products from Thermionics Laboratory, Inc., you fulfill the minority vendor requirements for all Government Institutions and Contractors.

Vacuum Training Courses

Three-day basic vacuum technology courses tailored to meet the needs of your personnel, and those individuals wanting to learn more about high and ultra-high vacuum technology.

Course Description

An introduction to basic vacuum technology, theory and fundamentals, including, but not limited to: gas behavior, conductance, viscous flow, molecular flow, vap or pressure, vacuum measurement, mean free path, etc.

Familiarization with the physical construction, operation, and maintenance of mechanical, diffusion, ion, cryo, turbo and sorption pumps, mass spectrometer leak detectors, residual gas analyzers, deposition monitors, e-Guns, sputtering systems, etc.

Introduction to practical vacuum system design concepts using accessory vacuum equipment such as valves, traps, fanges, feedthroughs, viewports, pumps, chambers, etc.

As a rule, all classes are held at the Thermionics facility, located at 3118 Depot Rd, Hayward, CA 94545, but classes can be scheduled at your facility.

Courses can be customized to meet most special requirements. On-site training requires a suitable classroom, audiovisual equipment, and operating equipment.

Please contact us at sales@thermionics.com for further information about schedules and fees.

Ordering Information

Orders are placed directly with the company. Contact the office nearest you. If you cannot find the product you need, or if you have any questions, please do not hesitate to contact us. We will provide all the assistance you may need.

Thermionics Northwest, Inc.

231-B Otto Street, Port Townsend, WA 98368
Phone: (360) 385-7707
Toll Free: (800) 962-2310
Email: sales@thermionics.com
Website: thermionics.com

Thermionics Laboratory, Inc.

3118 Depot Road, Hayward, CA 94545
Phone: (510) 225-6975 ext 100
Toll Free: (800) 962-2310
Email: sales@thermionics.com
Website: thermionics.com

Prices and Specifications

Prices and specifications are subject to change without notice, please contact us for firm price quotations and current specifications.

Terms of Payment

Domestic: Net 30 days upon approval of credit.
Export: Letter of Credit on deposit prior to shipment.

Discounts

OEM, quantity, and domestic educational discounts are available, on request, to qualified customers, when applicable.

Minimum Order

There is a $100.00 minimum order, for non-replacement parts.

Delivery

An inventory level is maintained on all items shown in this catalog. Delivery will be quoted at the time the order is placed.

FOB Point

Shipments are FOB our plant, unless quoted otherwise.

Method of Shipment

Shipments are normally sent on a prepay and add basis. Firm shipment arrangements are quoted at the time of order.

Thermionics' Commitment

Standard products manufactured by Thermionics Vacuum Products and its subsidiaries are guaranteed to be free of material and workmanship defects for a period of one (1) year. Expendable component parts are guaranteed for their expected service life.

If, for any reason, you are not completely satisfied with our products, let us know. We want to address your concerns.

Our relationship with the user does not end with the delivery of the equipment. We have a large stake in your new equipment operating up to your expectations. Our goal is to be part of your success.

Thermionics' One

I. Thermionics Laboratory, Inc. (herein called THERMIONICS) warrants to the original purchaser.

A. Standard catalog products manufactured by THERMIONICS against defects in workmanship for a period of one (1) year from the date goods are received at the customer's facility

B. Special products and electronic components are covered for a period of one (1) year from the date goods are received at the customer's facility

II. Scope

A. Liability under this warranty is expressly limited to repair or replacement of defective part THERMIONICS, at its sole option, may at any time discharge its warranty as to any of its products by refunding the purchase price and taking back the product(s).

B. This warranty applies only to parts manufactured and labor provided by THERMIONICS.

C. Valid warranty claims must be received by THERMIONICS within the warranty period and are subject to the terms and conditions herein.

D. All warranty replacement or repair of parts shall be limited to equipment malfunctions which at the sole discretion of THERMIONICS, are due or traceable to defects in original materials or workmanship.

E. Malfunctions, which in the sole opinion of THERMIONICS, are caused by abnormal wear and tear, lack of maintenance, abuse, operation maintenance or care inconsistent with the product manual, accident, or neglect of equipment are expressly not covered by this warranty. It is the responsibility of the user to operate the equipment in a reasonable and prudent manner, consistent with the stated intended use

F. In-warranty repaired, or replaceable parts are warranted only for the remaining portion of the original warranty period, applicable to the parts which have been repaired or replaced, and the total equipment is warranted for the balance of the one (1) year period. After expiration of the applicable warranty period, the buyer shall be charged at THERMIONICS' current prices for parts and labor, plus freight and per diem, when applicable

G. Expendable component parts, including, but not limited to pump elements, cold cathode gauges, bellows, thermocouple gauges, hot cathode gauges, sublimator filaments, emissive filaments, heaters, elastomers, bearings and gasket, etc. are guaranteed for their expected service life. If the expendab1e component parts a to give reasonable service, as determined solely by THERMIONICS, they will be repaired or replaced at our discretion

Expected Service Life

Pump Elements	
Diode, Differential Diode	40,000 hours at 2 x 10^1 Torr
Hydrogen and Triode	30,000 hours at 2 x 10^1 Torr
Cold Cathode Gauges	40,000 hours at 2 x 10^1 Torr
Bellows	
Valves	10,000 full cycles
Manipulators	
Linear Actuation	10,000 full cycles
Rotary Feedthroughs	700,000 rotations
Thermocouple Gauges	Meet specifications upon
Hot Cathode Gauges	receipt. Life is dependent
Sublimator Filaments	upon operating conditions
Emissive Filaments	
Heater, Elastomers	
Bearings	Life is dependent upon service conditions and maintenance
Gaskets	One time use

Year Warranty

III. Conditions

A. THERMIONICS expressly disclaims responsibility for any loss or damage caused by the use of its products, when not used in accordance with proper operating and safety procedures in accordance with specifications, or if the equipment is used without the proper recommended maintenance. Reasonable care must be taken by the user to avoid hazards.

B. Except as stated herein, THERMIONICS makes no warranty, express or implied, either in fact or by operation of law; and, as stated herein, THERMIONICS shall have no liability under any warranty, express or implied, either in fact or by operation of law.

C. THERMIONICS shall have no liability for special or consequential damages of any kind, or from any cause arising out of the sale, installation, or use of any of its products. Statements made by any person, including representatives of THERMIONICS, which are inconsistent or in conflict with the terms of this warranty shall not be binding upon THERMIONICS unless reduced to writing and approved by an authorized officer of THERMIONICS.

D. This warranty does not cover normal maintenance requirements which are the customer's responsibility.

E. This warranty does not extend to equipment that

a) someone other than Thermionics approved personnel have disassembled or attempted to repair,
b) has been modified or altered, or
c) has been contaminated with hazardous material or induced activation

IV. Procedures

A. If you wish to return equipment for repair, contact the THERMIONICS DIVISION which sold you the product in question. You will be given an RMA Authorization Number and instructions on how and by what means to ship the product to the factory. NO SHIPMENT WILL BE ACCEPTED WITHOUT PRIOR APPROVAL and completed RMA Authorization Form.

B. In the first year, goods must be returned, freight prepaid, to the factory and will be returned, freight prepaid, to the customer. After the first year, all freight costs must be paid by the customer.

Trademarks & Copyrights

The trademarks and registered trademarks listed below are the property of their respective companies.

Alberox	Alberox Corp.
Alcatel	AlcatelVacuumProducts, Inc.
Alumel	Hoskins Mfg. Co.
Amphenol	Allied Corp.
ASA	American Standards Association
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AutoCAD	AutoDesk Corp
BiMetl	Thermionics Laboratory, Inc.
C-100	Felt Products Mfg. Co.
Cajon	Swagelok Marketing Co.
Calrod	Wellman Thermal Systems
Ceramaseal	Ceramx
Chromel	Hoskins Mfg. Co
Clearview	Thermionics Northwest, Inc.
Combo-Vac	Thermionics Laboratory, Inc.
ConFlat	Varian Associates
Constantan	Wilbur B. Driver Co.
CTI-Cryogenics	Helix Technology Corp.
CVC	CVC Products, Inc.
Delrin	E.I. DuPont de Nemours & Co, Inc.
Diversey	Diversey Corp.
Dow Corning	Dow Corning Corp.
DRS-1000	Thermionics Northwest, Inc.
DuoSeal	Welch Vacuum, Thomas Industries. Inc.
Dynamic Electron	
Emitter	Anatech, Ltd
Edwards	Edwards High Vacuum International
e-Gun	Thermionics Laboratory, Inc.
EPI	EPI, Inc.
Fabmate	Poca Graphite, Inc.
Fel-Pro	Felt Products Mfg., Inc.
Ferrofluidics	Ferrofluidics Corp
Fomblin	Ausimont U.S.A
Fredricks	Fredricks Co.
Freon	E.I. DuPont de Nemours & Co, Inc.
Gast	Gast Mfg. Corp.
General Valve	General Valve Corp.
Granville-Philips	Granville-Phillips Co.
Hanks HM²	
e-Gun	Thermionics Laboratory, Inc.
Hastings	Teledyne Hastings-Raydist, Inc.
Haynes Alloy	Haynes International, Inc.
Heli-Coil	Heli-Coil Corp.
HM²	Thermionics Laboratory, Inc.
Hydra	Thermionics Laboratory, Inc.
Hyper-Unimelt, Hyper-Unimelt, Sweep	Thermionics Laboratory, Inc.
IBM	International Business Machines Corp.
IBM PC	International Business Machines Corp.
Inconel	International Nickel Co.
Intevac	Intevac, Inc./EPI, Inc.
ISO	International Standards Organization
Kalrez	DuPont Dow Elastomers L.L.C.
Kel-F	E.I. DuPont de Nemours & Co., Inc.
KF	Leybold Vacuum Products. Inc.
Klinger Stage	Newport/Klinger Corp
Kovar	Westinghouse Electric Corp.
Load-Lok	Thermionics Laboratory, Inc.
Macor	Corning, Inc.
maTCed	Thermionics Laboratory, Inc.
MegaSorb	Varian Associates
Microdot	Microdot Corp.
MKS	MKS Instruments, Inc.
Monel	International Nickel Co.
MS-DOS	Microsoft Corp
NEC	Nippon Electric Corp
Nonex	Corning, Inc.
NRC	Varian Associates
Nupro	Swagelok Marketing Co.
OFE	Copper Development Assn.
OFHC	Phelps-Dodge Specialty Copper Products; American Metals Climax, Inc.
Omicron	Omicron Corp GmbH
Perkin-Elmer	Perkin-Elmer Corp.
PLD-2200	Thermionics Laboratory, Inc.
PyraFlat	Thermionics Laboratory, Inc.
Pyrex	Corning, Inc.
Riber	Instruments S.A.
RNN	Thermionics Laboratory, Inc.
Saes Getters	Saes Getters S.p.A.
Santovac	Monsanto Co.
Sargent-Welch	Welch Vacuum Technology, Inc.
StarCell	Varian Associates
STLC	Thermionics Northwest, Inc.
Styrofoam	E.I. DuPont de Nemours & Co., Inc.
Superior Electric	Superior Electric
Super-Sorb	Thermionics Laboratory, Inc.
Suprasil	Heraeus Amersil, Inc.
Sure-Lok	Thermionics Laboratory, Inc.
Swagelok	Swagelok Marketing Co.
Teflon	E.I. DuPont de Nemours & Co., Inc.
TogleLok	Thermionics Laboratory, Inc.
Triad	Thermionics Laboratory, Inc.
TriBond	Thermionics Laboratory, Inc.
TriMetl	Thermionics Laboratory, Inc.
TTS Table Top	Thermionics Laboratory, Inc.
Ultra-Torr	Swagelok Marketing Co.
Variac	Technipower, Inc.
Varian	Vanan Associates
VCO	Swagelok Marketing Co.
VCR	Swagelok Marketing Co.
Veeco	Veeco Instruments, Inc.
Veeder-Root	Danaher Controls
Vespel	E.I. DuPont de Nemours & Co., Inc.
VG	Vacuum Generators Ltd.
Viton	DuPont Dow Elastomers L.L.C.
Welch	Welch Vacuum, Thomas Industries, Inc.
Wheeler	Varian Associates
Windows	Microsoft Corp.
Windows 95	Microsoft Corp.

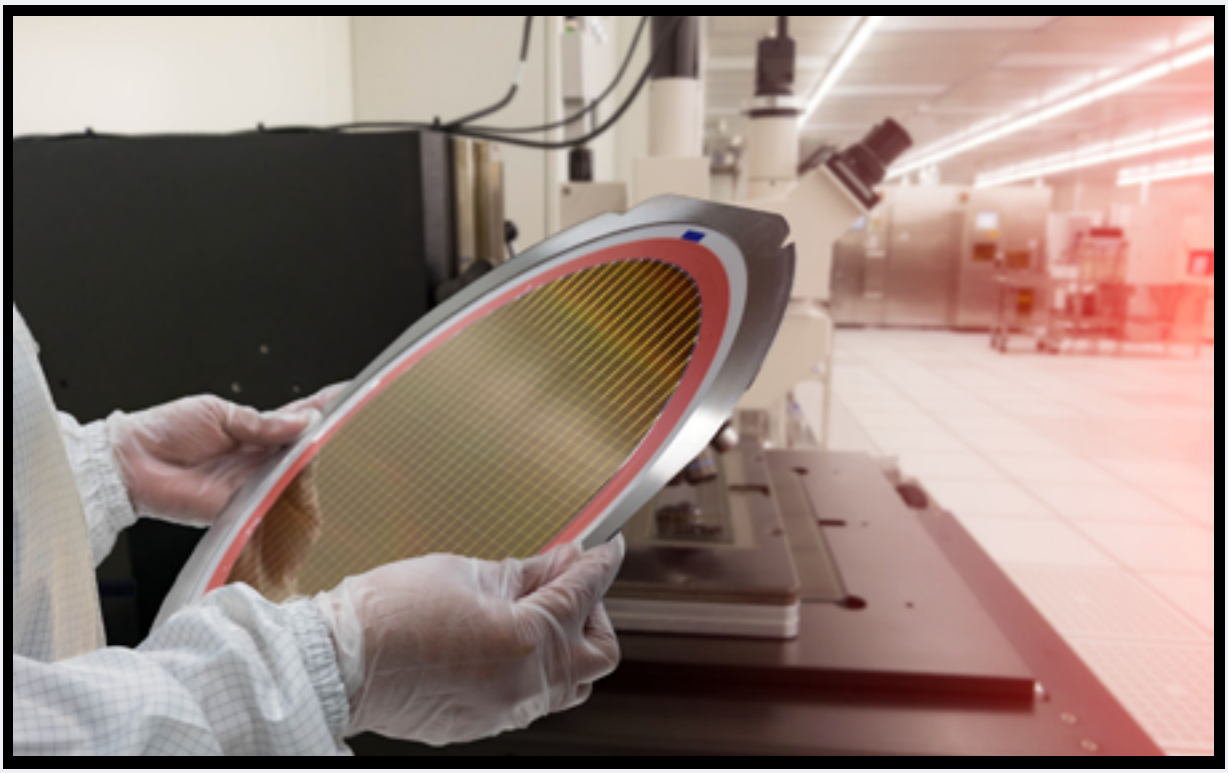
OFHC and OFE Copper

OFHC was a registered trademark of American Metals Climax. Inc. The trademark, proprietary process, product line and production machinery were sold to Phelps Dodge Phelps Dodge retired the product.

ASTM F68 was the specification for proprietary OFHC copper product The Copper Development Association, a trade organization, proposed and adopted specification UNSC-10 100. UNSC-10100 and ASTM F68 are identical specifications.

In the market OFHC copper has been replaced by OFE copper products. Throughout this catalog references to OFHC have been replaced with OFE. OFE is produced as a generic copper product. OFHC and OFE are interchangeable.

TMPI Precision Cleaning



1

TMPI Precision Cleaning

Services

Precision Cleaning

About

Although all manufacturing operations require cleaning as part of their process, it is important to understand the distinct difference between “cleaning” and “precision cleaning.” For some industries, a surface that is visually clean may be sufficient while for others, even the most microscopic contaminants need to be removed to ensure the safety and quality of the equipment. Precision cleaning is the process that is utilized to achieve these critical levels of cleanliness in a wide array of industries, including Space, Aviation, Military & Defense, Medical Device, Semiconductor, Laser and Automotive.

What is Precision Cleaning?

Precision cleaning removes contaminants such as particles, fibers, oils, and greases, resulting in a surface so clean it must be validated on a microscopic level. Ineffective removal of these contaminants can be costly and have a significant impact on a company’s productivity, profitability and reputation. TMPI understands the importance of providing quality cleaning services. We recognize that each industry and every component have its own unique requirements. The proper cleaning solution will be based on a combination of factors including:

- The material composition and configuration of the hardware/components
- The level and composition of the contamination that is present
- The level of cleanliness that is required by the customer

As such, we test and certify all materials prior to the cleaning process. Our cleaning methodologies are comprised of two core elements.

The first element involves cleaning the surface using specific precision cleaning techniques combined with an approved cleaner in a process that has been validated for the stated purpose.

The second element involves testing and verification that the surface is cleaned to the level of precision necessary for it to be safely used in its intended environment. Our degreed scientists test the critical surfaces for residues using a process called Gravimetric Non-Volatile Residue Mass Determination (NVR) Testing. We also quantify and size any remaining particles that are found on the critical surfaces.

Precision Cleaning Techniques

Based on the above factors, one or more of the following techniques may be employed:

Aqueous Cleaning: This method allows parts to have a long dwell time in the cleaning solution. Additives such as detergents and surfactants are added to water that has been treated by deionization or reverse osmosis. This water-based cleaning method is very effective at removing different soils on parts that are compatible with water. The result is in an environmentally friendly method for achieving the desired level of cleanliness.

Solvent Cleaning: Cleaning by immersion in solvents is particularly effective on parts with complex configurations and for certain soil compositions. This method utilizes the chemical properties of the solvent to remove the contaminants from the part. For some applications, solvent cleaning is used in conjunction with ultrasonic cleaning.

Ultrasonic Cleaning: This technique uses cavitation which is induced by high frequency sound waves to agitate the cleaning solution aiding in dislodging particles. It is particularly effective for precision parts cleaning of complex parts with threads, rough surfaces and blind interior spots that are inaccessible by other cleaning methods. Ultrasonic cleaning typically employs aqueous, semi-aqueous and solvent-based cleaning systems and detergents. This combination removes contaminants at nearly a microscopic level, with higher sound frequencies generally able to remove finer particles.

High-Pressure Spray Cleaning: This procedure utilizes the kinetic energy of a water jet to “blast” the particles and soils from a surface. It is most often used in conjunction with detergents or surfactants to chemically loosen or solubilize the soils in order for the water jet to more effectively remove the contaminants from the surface. The ability to vary the water pressure, nozzle size and/or spray pattern allows this method to be easily customizable for different materials of construction and soil compositions.

Wipe Cleaning: This method uses special lint- and particle-free wipes or swabs, often wetted with solvents or deionized water, to hand clean delicate surfaces that cannot withstand more aggressive cleaning methods.

Flush Cleaning: Using a turbulent velocity, cleaning liquids are flooded through the interior of tubes, pipes, and other internal pathways to flush the contaminants out of the hardware or component as it rotates. This method is particularly useful for precision cleaning of components of varying shape and size for which high-pressure sprays are not useful.

Vacuum Bakeout: This methodology uses vacuum baking to volatilize hydrocarbon contaminants and remove hydrocarbons that are entrapped in the pores of sensitive equipment. It also reduces the outgassing rates to acceptable levels for aerospace instrumentation.

1 Passivation

Passivation

About

The passivation of stainless steel is a method carried out to create a passive layer, i.e. making a surface film that allows the surface to lose its chemical reactivity. Steels with more than 11 percent chromium are capable of forming on their surface a transparent, inert or inactive, self-repairing oxide film. However, iron particles, tool steel or abrasive particles may be embedded or deposited on the surfaces of stainless steel components during handling and processing such as rolling, forming, machining, pressing, tumbling, and lapping. If allowed to remain, these particles can cause corrosion of a surface of stainless steel to adversely affect the sanitary condition or mechanical operation of a part, component or system or contaminate a process fluid.

Passivation, consisting of immersion of stainless steel parts in a nitric or citric acid solution without oxidizing salts, dissolves the embedded metal and preserves the initial corrosion-resistant coating by creating a thin, translucent oxide film.

Passivation is also accomplished through electropolishing, an electrochemical process that is a stainless steel “super passivator” resulting in a more passive surface than the other methods mentioned above. A combination of electropolishing and treatment of nitric and/or citric acid is recommended for maximum corrosion resistance.

In house passivation processes:

- QQ-P-35
- ASTM A967/ ASTM A380
- AMS 2700

Nitric vs Citric Passivation Methods

Nitric Acid

When looking at nitric versus citrus passivation, the most well-known strategy utilized all through industry is nitric corrosive passivation. The Nitric corrosive passivation procedures was the first passivation prepared determined in QQ-P-35, the primary military detail covering passivation, amendment A being discharged during the 1960s. Nitric corrosive passivation offers a scope of choices to redo the oxidizing capability of the corrosive to suit a particular evaluation of hardened steel. The different strategies and sorts of nitric corrosive passivation incorporate a few warmed alternatives just as choices that incorporate a sodium dichromate.

The higher nitric corrosive focus and the higher the nitric corrosive temperature, the all the more oxidizing potential the passivation science has. Sodium dichromate can likewise be added to the nitric corrosive to build the oxidizing capacity of the shower improving it for less erosion safe treated steels, for example, precipitation solidified, martensitic and ferritic evaluations of hardened steel. These evaluations of hardened steel have less nickel and chromium in them making them increasingly helpless to drawing. The higher the oxidizing capability of the science, the quicker and progressively successful the detached oxide boundary is shaped superficially, diminishing the potential for carving.

Tainting of passivation science can prompt glimmer assault of the surface, which produce a vigorously carved or darker surface. A typical control that prompts glimmer assault is chlorides which can emerge out of a few sources incorporating hauling in acids or utilizing having chloride in the water. What’s more, natural development in passivation showers, for example, the drag-in of machining oils from parts that are not appropriately cleaned, can prompt glimmer assault or scratching of the hardened steel. All things considered, customary scientific examination and support of passivation sciences is required. Certain passivation techniques are additionally more impervious to glimmer assaults than others. For nitric corrosive passivation the showers with expanded oxidizing potential are additionally increasingly impervious to blaze assaults. Nitric corrosive likewise is increasingly impervious to blaze assault contrasted with citrus extract.

Citric Acid

Citrus acid passivation was created by Adolf Coors brewing company for the passivation of within lager barrels. It offers a compelling option in contrast to nitric passivation with less handling and is consider earth inviting being on the GRAS (Generally Recognized as Safe) list for the FDA making it perfect for nourishment and refreshment applications.

When looking at nitric versus citrus passivation, citrus arrangements can viably passivate a more extensive scope of hardened steel compounds contrasted with any one nitric corrosive passivation arrangement, considering congregations of a few treated steel amalgams to be passivated.

Passivation sciences expel free iron from the surface yet can likewise expel some nickel and chromium from tempered steel. Evacuating nickel and chrome decreases the erosion safe material at the surface leaving a more slender oxide layer. Citrus extract passivation specifically expels iron over nickel and chromium leaving a thicker erosion safe oxide layer than nitric corrosive passivation.

Once of different points of interest of citrus extract is the shower plan can be acclimated to diminish process durations over nitric corrosive, taking into account increment throughput and decreased expenses of passivation stanzas that of nitric corrosive. Process durations as low as 4 minutes are conceivable with certain citrus extract passivation plans.

Benefits of TMPI’s UHV Passivation

TMPI (Thermionics Metal Processing, Inc.) has over 35 years of experience perfecting our proprietary UHV passivation chemistries and processes for SST 300 and 400 series. In addition, TMPI’s modern equipment, highly trained technicians, controlled environments, Class 100/1000 Cleanroom packaging, and in-house testing ensures consistent quality and compliance to industry standards and customers specific standards. We have a state-of-the-art plant that can accommodate parts and chambers of various sizes and complexities.

To accommodate various passivation industry standards, we have in house capability of building special tank chemistries based on the size and complexity of the part.

Our proprietary passivation process is environmentally friendly that bind metal ions preventing redepositing on surfaces. Thus, incapacitating. redepositing on surfaces reducing material out-gassing, handling requirements and optimizing the passive layer on the stainless-steel surface

Helium Leak Testing

About

Helium is an inert, stable, and non-condensable gas that is often used as a tracer gas to identify leaks in parts and systems. The very small atomic size allows the helium to easily pass through leaks, and because it is inert, it will not react with virtually any of the materials within the part or system that is being tested. Since helium is only naturally present in the atmosphere in small amounts (~5 ppm), qualitative helium leak testing can be performed in ambient air to test areas that need rewelding, fittings that need tightening, failed gaskets, and other pressure system leak points. It is also used to determine what the total leak of a system is before it is put into service.

For the aerospace industry, the ability to test for leaks with high-level sensitivity is imperative to ensuring mission success, and at times, safety. Failure to identify and repair even small leaks can have detrimental consequences. During regular operations, all aircraft, satellites and rocket systems are subjected to different temperatures, atmospheric pressures and other stressors that can result in more severe leaks. An airplane leaking fuel may have a fire and not reach its destination safely. Spacecraft missions, with their limited resource supplies, will be compromised if the gas within a tank or primed system leaks out before the mission is complete.

Helium leak detection has been used for many years in the aerospace industry for the following:

- Critical gas lines
- Fuel systems and COPV tanks
- Sealed electronic enclosures
- Missile guidance systems
- Solid rocket booster cone assemblies
- Antennas
- Heat exchangers
- Hydraulic systems
- Valves
- Cockpit instruments

Helium leak detection methods are also used across a variety of other industries including medical, automotive, and oil and gas processing. Helium leak detectors are used in the quality control of production parts such as medical devices, hydraulic lines, condensers, radiators, manifolds, fuel lines, fittings, and COPV tanks. Pressurized systems such as those found in oil and gas processing and vacuum systems, including vacuum furnaces, isolation glove boxes and laser process equipment, also utilize helium leak detectors to ensure the integrity of those systems prior to start-up and as part of their preventative maintenance procedures.

What are the Benefits of Helium Leak Testing?

There are many benefits associated with helium leak testing, which include:

- Leaks can be detected and quantified with a high level of sensitivity
- No adverse impact on the materials being tested due to the inert properties of helium
- The test process is essentially dry and temperature independent
- Microscopic leaks can be fixed before they do significant damage
- Lost production, time and costs can be avoided by repairing leaks before putting the part into service
- Reduced operational and maintenance costs for equipment through preventative maintenance

How Does Helium Leak Testing Work?

Helium leak testing utilizes a Helium Leak Detector, also referred to as a Mass Spectrometer Leak Detector (MSLD), to find a leak inside or outside of a system and then measure the leak rate. The helium leaks in/out of the tested product and is measured by the detector. The detector determines the leak rate based on the helium concentration and flow rate.

A complete Helium Leak Detector system contains the following elements:

- Helium mass spectrometer to detect the mass of the helium
- Vacuum system to maintain sufficiently low pressure for the spectrometer
- Valves which control individual steps of the measuring cycle: evacuation, testing, and venting
- Electronic measuring and control systems
- Power sources for individual components – valves, circuits, etc.
- Fixtures, which connect the tested product to the detector

1 Pickling

Pickling

About

When steel is heated by welding or other means to the extent that a heat tint or oxide scale layer is visible, the layer below that has been depleted of chromium, thereby making the steel less resistant to corrosion. Pickling steel is the process of applying an acid solution to remove heat affected zones along with the underlying chromium reduced layer from the stainless steel. Pickled steel is free from surface carbon steel contamination and embedded iron particles. It typically leaves a dull, matte gray finish. Simply stated, pickling removes the heat affected layer of stainless steel and prepares the surface for passivation.

Oxygen Cleaning

Oxygen Cleaning

About

Oxygen cleaning services can be defined as specialized cleaning for components, equipment, piping, and systems used in the production, storage, distribution and use of gaseous oxygen (GOX) and liquid oxygen (LOX). LOX is the liquid form of elemental oxygen (O2). Examples of industries that use LOX systems include Aerospace, Military and Defense (NASA), and the Compressed Gas industry.

Oxygen cleaning services are necessary for both safety and product purity considerations. Oxygen cleaning reduces contaminants that can lead to a fire or potential explosion. It also reduces the chance of autoignition at a temperature much lower than expected by material selection. Combustion in systems that contain enriched oxygen requires only fuel and an ignition source because the gaseous or liquid oxygen is the oxidizer.

Types of Contaminants Removed in Oxygen Cleaning

The primary goal of Precision Cleaning for oxygen service is the removal of any material, chemical, residue, contaminant, or particulate matter that could promote combustion or impact product purity.

Contaminants can be classified into three categories:

1. **Organic Compounds**
   - Volatile organic compounds (VOC)
   - Grease and oils (Hydrocarbon based)
2. **Inorganic Compounds**
   - Nitrates
   - Phosphates
   - Water-based detergents and cutting oils
   - Mineral acids and solvents
3. **Particulates**
   - Weld slag and metal grindings or filings from fabrication
   - Dust
   - Particles, lint, and fibers

Oxygen equipment and systems, including all components and parts, must be appropriately cleaned to remove harmful contamination prior to the introduction of oxygen. An example of this is hydrocarbon-based residue. These are often made up of small amounts of oils and greases, which are commonly used in manufacturing environments and end up on the surfaces of newly-produced hardware.

When a hydrocarbon-based residue comes into contact with an enriched oxygen atmosphere or a strong oxidizer, the temperature at which it will ignite and burn is lowered – sometimes low enough that it will catch fire at or below room temperature. If a fire ignites, the presence of many oxygen molecules in the immediate area causes it to burn hotter and faster than usual, so much so that it may even cause an explosion.

The other contaminant of concern is particulate matter. These can travel in a stream of moving gas within a pipe or tube. In an oxygen-enriched atmosphere, especially one under high pressure, things that normally are not considered flammable may catch fire and burn. The only requirement is a spark. If particles are travelling with the gas stream and they strike the wall of the pipe or tube with enough velocity, a small hot spot may develop.

Moreover, if the particle is metallic, a spark might even occur. In either case, contaminants in the pipe, or even the wall of the pipe itself, may catch fire. This can result in a pipe rupture, releasing high-pressure gas and thereby endangering everything in the area. High-pressure gas ruptures are essentially explosions and it is not uncommon for shrapnel to be propelled for some distance.
For oxygen-enriched environments constructed using certain alloys (i.e. Stainless Steel) , require not only combustible organic and particulate contamination removal but also an optimal passive surface which provides corrosion resistance. A passive layer surface will inhibit oxidation and corrosive reactions, thus minimizing particulate contamination.

Derouging

About

Whether it is the FDA, NASA or some other external agency – many organizations have mandates to ensure that corrosion (rust or rouge) is not present in their product and distribution systems, tanks, vessels or equipment as if left untreated can cause issues with equipment cleaning and validation. Therefore, stainless steel systems for water, steam or products must be free of corrosion to prevent equipment downtime. Removing corrosion also referred to as 'derouging', is critical for product safety and also extends the life of systems and equipment. Rouge not only can cause surface degradation but also expose contaminants into the final product. In addition, rouge areas may exacerbate bioburden issues within the system itself causing greater contamination.

What is Rouge?

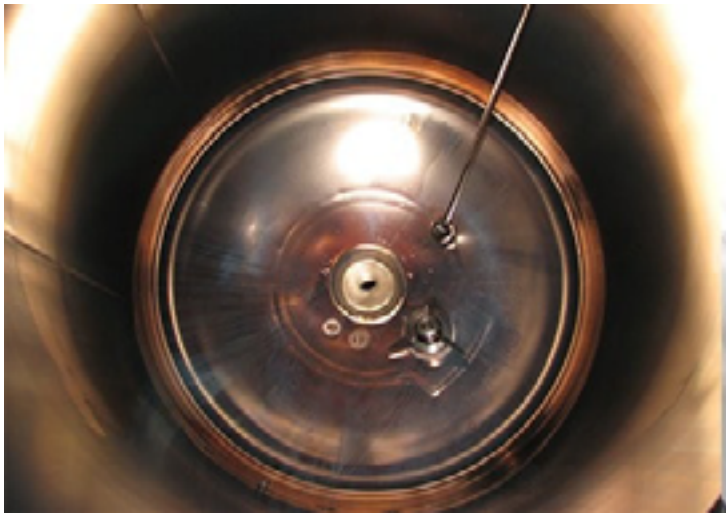
A general term used to describe a variety of discolorations in high purity stainless steel systems. It is composed of metallic (primarily iron) oxides and/or Hydroxides. Three types of Rouge are as follows:

Type 1: Rouge originates from an external source. It usually appears as a lightly-adhered red or orange "dusting" of the surface. Most Type 1 Rouge is metal oxide particles that are broken loose by the erosion of rouge or cavitation at pump impellers or internals. This type of rouge is relatively easy to remove chemically or by electropolishing. Generally, a wipe may or may not remove Rouge Type 1. However, it is best to passivate the surface after Type 1 rouge removal to ensure Rouge removal.

Type 2: Rouge forms at the site where it is seen and where chloride exposure is induced. It typically has a red, reddish-orange, or brownish color. A chemical process removes the rouge or it may need more aggressive derouging formulations or by electropolishing. The surface must be passivated after Type 1 rouge removal.

Type 3: Rouge normally contains a form of iron oxide called magnetite, which is black in color and forms in high-temperature steam systems. It often has relatively high silica content in many cases which can make it resistant to chemical removal, necessitating the use of more aggressive chemicals. On shiny surfaces, it may appear tightly adhered to and shiny, but on rough surfaces, it is less tightly adhered and may have a powdery appearance. Removal of Type 3 Rouge, includes aggressive chemical solution, or mechanical polishing and/or electropolishing.

Each type of rouge has specific chemistry and process for remediation. Post derouging, it is imperative to Passivate in order to provide enhanced corrosion resistance. The passivation process applied will help with the formation of chromium oxide layer, helping in corrosion resistance.



Before Derouging

After Derouging

1 Mechanical Blasting

Mechanical Blasting

About

TMPI provides Air (Pneumatic) Pressure blasting method in which compressed air is used to apply abrasives to the surface. Direct air pressure blasting is applied where pressurized container is used to feed abrasive through a blast hose. Air pressure used to apply media onto the metal surface is also controlled and can be adjusted based on Customer process requirements.

Blasting Applications

- Etching Metal
- Paint Stripping
- Prepping Surfaces for Coatings
- Monument Etching
- Cleaning Discoloration from Welding
- Surface Prep for Metalizing and Welding
- Preparation for Bonding

Most common abrasive medias used at TMPI are Aluminum Oxide, Glass and Silicon Carbide—all used based upon Customer request.

An angular, durable blasting abrasive, aluminum oxide (or aluminum oxide) can be recycled many times. It is the most widely used abrasive grain in sand blast finishing and surface preparation because of its cost, longevity, and hardness. Harder than other commonly used blasting materials, aluminum oxide grit powder penetrates and cuts even the hardest metals and sintered carbide.

Glass Bead Blasting media available in wide selection of grit sizes is not only an economical media to choose from, it is also silica free offering aggressive surface profiling and coatings removal. It can also be used when surface preparation is required to increase the bonding during sputtering processes.

Silicon Carbide is the hardest blasting media currently available that is used due to its angular grain shape as it provides required finish is sorter blast times when compared with other medias.

Choose from wide variety of available grit blast sizes for Aluminum oxide, Glass and Silicon Carbide medias available in house.

Precious Metal Reclamation

Precious Metal Reclamation

The Challenge

Precious metals are often lost as a result of internal manufacturing processes as metals can adhere to chamber shields or become by-products or scrap. The challenge is to recover the greatest amount of precious metal feasible from shields in order to decrease total cost-of-production. This requires a trusted service partner with the technical capabilities to provide high-value metal recovery services while minimizing manufacturing downtime.

The Solution

TMPI employs advanced and cost-effective methods of shield cleaning and precious metal removal. Our industry-leading process includes innovative chemical cleaning, advanced surface treatments, clean room conditions for cleaning, final conditioning and testing, and onsite logistical support. We collect most precious metals without aggressive mechanical procedures to expedites the cleaning process with high metal returns. Full life-cycle precious metals management lowers the total-cost-of ownership.

Reclaimable Metals

TMPI routinely removes and recovers the following metals:

- Gold – Au
- Silver- Ag
- Palladium- Pd
- Platinum- Pt
- Iridium- In
- Rhodium- Rh
- Ruthenium- Ru

Key Industries

Reclamation programs for precious metals and other valuable materials from thin film deposition processes originating in a variety of industries:

- Wireless
- LED
- Photovoltaic
- Semiconductor
- Optics
- Medical

Reclaimed Rates Achieved

Pure Precious Metals Reclaim: **> 90%**
Middle-Grade Precious Metals Reclaim: **> 85%**
Low-Grade Precious Metals Reclaim: **> 70%**

Class 100 and 1000 Cleanroom Packaging

Why is Cleanroom Packaging Important?

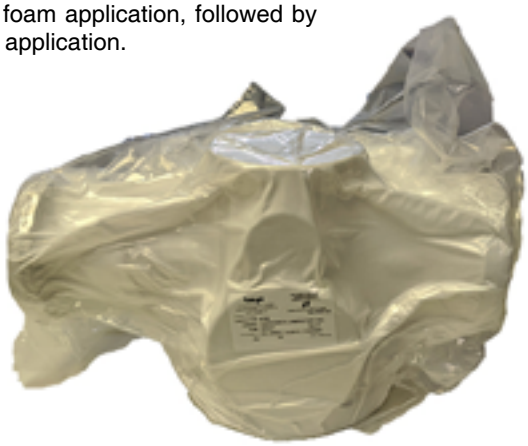
Cleanroom Packaging is the method of using clean, certified packaging materials and sealing techniques to protect the cleanliness of precision cleaned surfaces and components. After hardware and components undergo precision cleaning and cleanliness verification testing, the final step Cleanroom packaging to preserve the cleanliness level provided. Once Cleanroom packaging is applied, precision cleaned parts can then be safely transported and stored outside of cleanroom environments without compromising cleanliness.

The material must also be capable of protecting the part during transportation and handling, which means it must resist punctures and tearing. Additional cushion is also provided for select parts per Customer request using Cleanroom approved Lint free clothes and Cleanroom approved foam. Foam is not directly applied onto the direct cleaned surface hence Aluminum foil or lint free is applied prior to foam application, followed by Cleanroom Bag application.

Additionally, the packaging material itself cannot be the source of contaminants. Particles resulting from friction between the material itself and the part inside or outgassing of plasticizers are commonly found in flexible materials in everyday commercial packaging. TMPI has approved Class 100 and 1000 Cleanrooms certified annualy per FED-STD 209E specialized in precision cleaning packaging options such as polyethylene and nylon film. Polyethylene and nylon films are available in plain or antistatic varieties, which protect sensitive electronic components from damage induced by static electricity.

The plastic films that we employ undergo rigorous testing prior to use. The amount of particulate contamination and residue on the film surface is measured and then certified to a corresponding cleanliness level.

- TMPI packages cleaned product according to best practices or to customer specification after precision cleaning;
- The application of customer specs is subject to explicit ordering;
- State of the art “standard packaging” is supposed to preserve the integrity during transfer back into the control of the customer and to allow a proper transfer into the customer’s clean room (e.g. double bagging);
- State of the art packaging consists of the proper foils and evacuation and back-filling as well as controlled bag-sealing.
- In case of rough surfaces, Al foil and lint free paper can be added inside the bags;
- TMPI does not make any claim to the shelf life of parts inside packages as it is solely dependent upon the bag type and method dictated by the Customer.



1 Residual Gas Analysis (RGA)

Residual Gas Analysis (RGA)

About

TMPI (Thermionics Metal Processing, Inc.) offers precisely measure outgassing rates of a wide range of atomic mass units (AMU's) from 1-300 using a highly precise, state-of-the-art RGA test system.

Benefits:

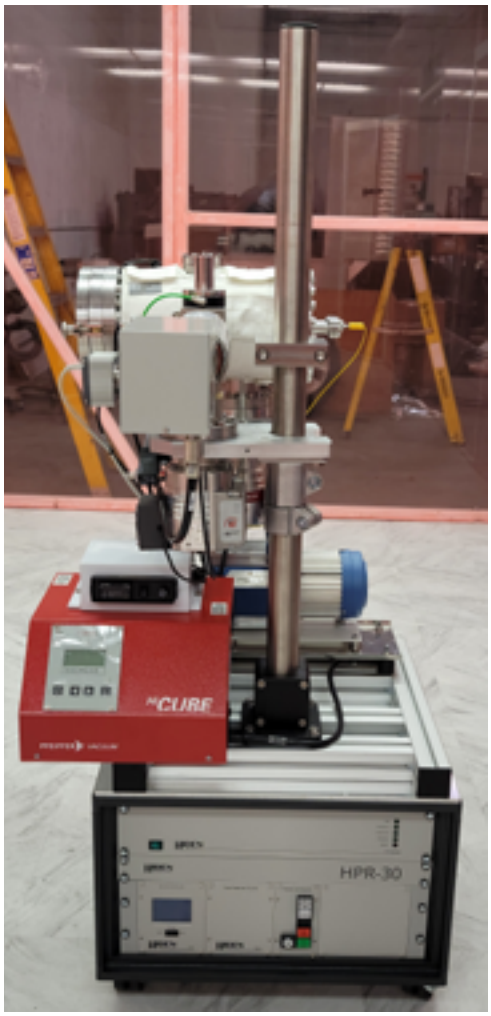
- Certification of the cleanliness of parts cleaned by TMPI to customers' OEM specifications
- Failure analyses of contaminated parts
- Information on processing, storage conditions, hermeticity and material reactions
- Detect various gaseous, e.g., Moisture, Oxygen, Argon, Carbon Dioxide, Helium, Freon, Methane, Pump Oil, Chlorine, Halogen Compounds, Hydrogen and Organic Vapors

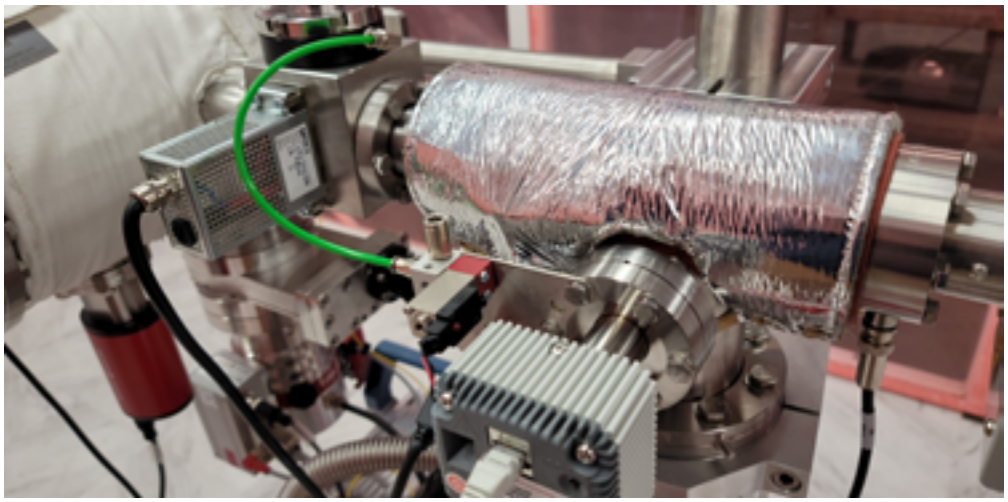
Quality Assurance

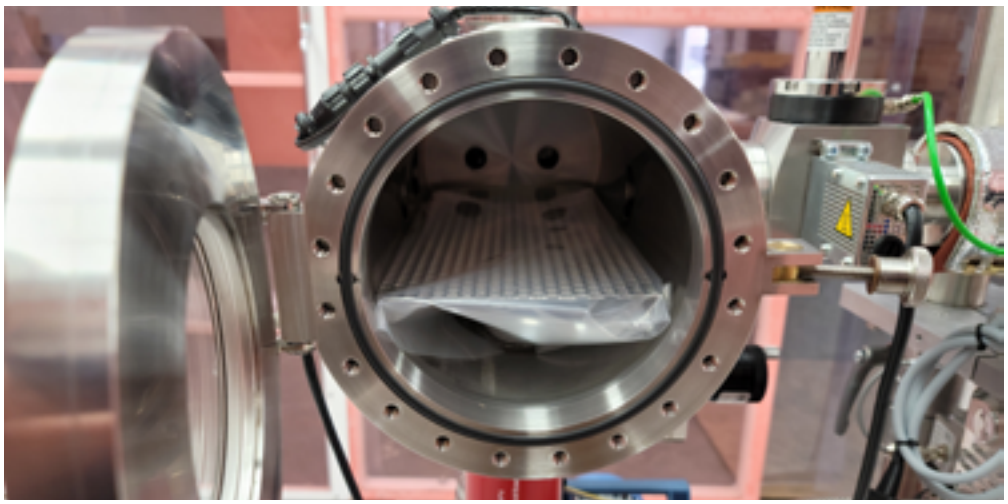
Periodic defect analysis results in process improvements with narrower acceptable limits on subsequent production runs. TMPI's quality system is ISO 9001:2015 certified. Our chamber qualification test benches, that include vacuum pumps, gauges, RGA, heaters, nitrogen back fill and a leak detection. Once water and other background are eliminated by the 150°C bakeout, we can provide customized scans and reports to detect the slightest contamination enabling us to attain the highest possible cleanliness for your application!

Vacuum Process Gas Analyzer
A Differentially Pumped RGA System for Vacuum Process Monitoring

- Analyze processes with high dynamic range operating at pressures >10^{-4} Torr
- Sampling connection to the process chamber is optimized to maintain fast response time and maximum sensitivity
- High conductance path from orifice to RGA
- Capable of monitoring gas composition and contaminants in sputtering, CVD, ALS, MOCVD, PECVD, PVD, evaporation and optical coatings
- Re-entrant orifice provides for fast response, high sensitivity sampling
- Special high conductance sampling path provides for residual gas analysis when the chamber is at less than 10-3 mbar or at base vacuum
- Cart mounted system design has small footprint, adjustable RGA height, and mobile
- Leak valve design extends sampling pressure range
- Mass range: 300 AMU
- Dual Faraday cup and single channel electron multiplier
- 500 measurements per second
- Data examples: vacuum diagnostics, base pressure, residuals, backfill, sputter-on, bake-out, leak checking
- Trend Analysis: water, hydrogen, hydrocarbons CO_2, Ar, N_2 in four titanium nitride deposition cycles
- Temperature controlled Sample Chamber heater jacket, maximum operation temperature 150°C (302°F)



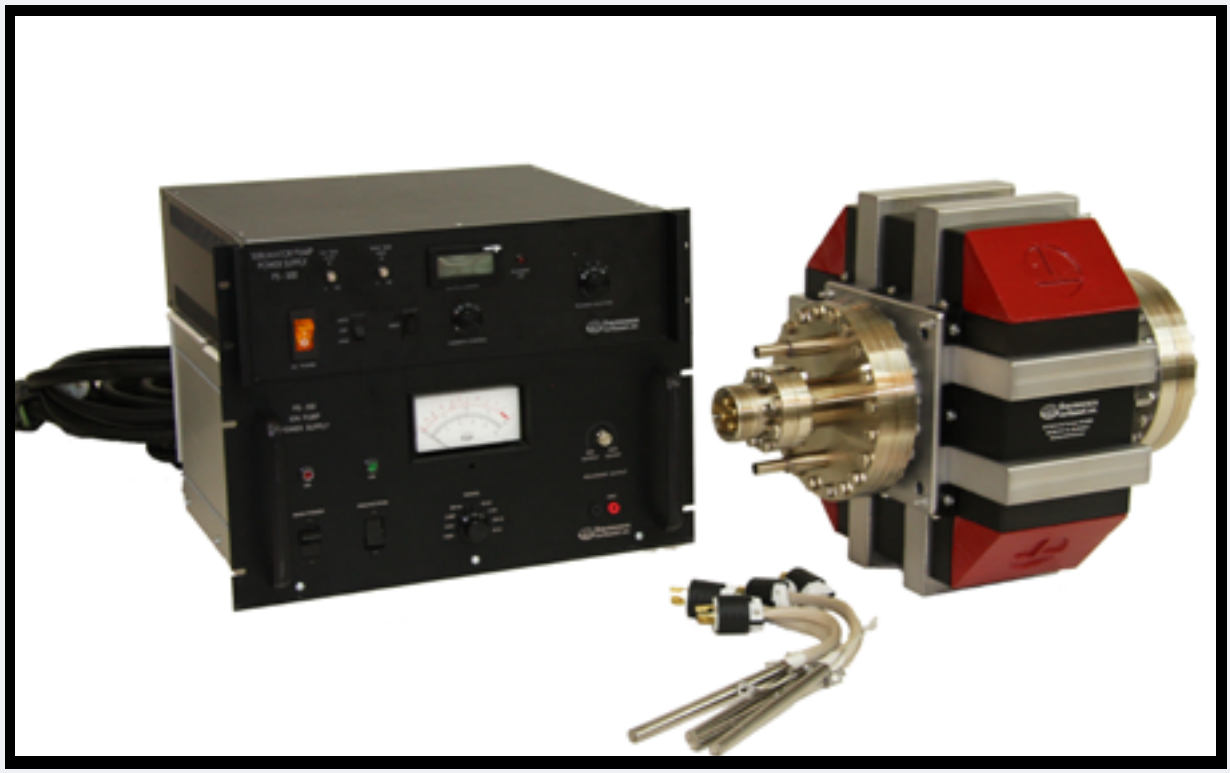




RGA System

(510) 786-0680 thermionics metal processing, inc. A Precision Cleaning Service sales@tmpi.us

Ion Pumps



Ion Pumps

Technical Information

Specifications/Ordering Information

Sputter ion pumps operate by ionizing gas within a magnetically confined cold cathode discharge. The events that combine to enable pumping of gases under vacuum are:

1. Entrapment of electrons in orbit by a magnetic field.
2. Ionization of gas by collision with electrons.
3. Sputtering of titanium by ion bombardment.
4. Titanium gettering of active gases.
5. Pumping of heavy noble gases by ion burial.
6. Diffusion of hydrogen and helium into titanium.
7. Dissociation of complex molecules into simple ones for pumping ease, e.g., CH4 breaks down into C and 2H2. Hydrogen is pumped separately. Carbon is no longer part of the residual gas and resides in solid form.

Burial is the basic means of pumping heavy noble gases. Argon ions neutralized via glancing collisions with a sputter cathode impact the pump wall and are coated with sputtered titanium. Triode pumps are specially designed to maximize the kind of collisions that produce energetic neutrals.

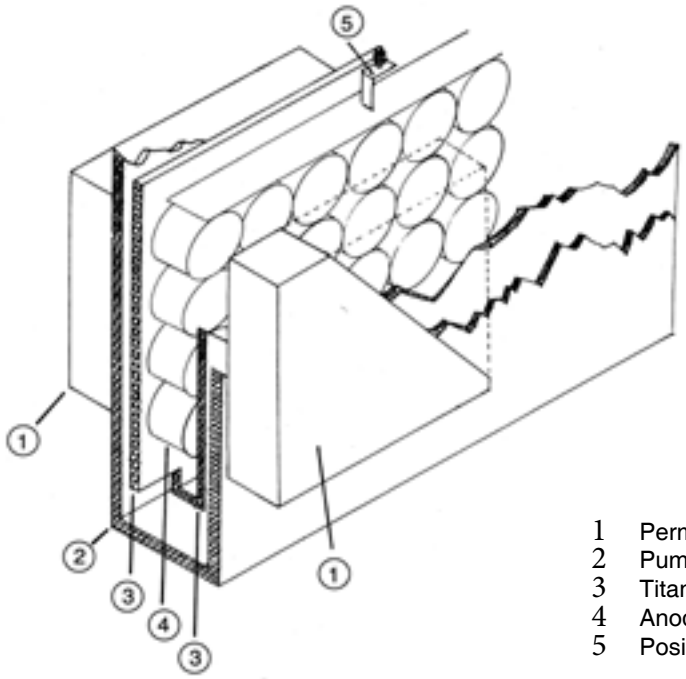
Argon is permanently pumped on the wall behind the cathode in these pumps. The wall area receives titanium for inert gas burial but, because of a retarding electrical field between the cathode and the wall, it is not subjected to ion bombardment and thus gases are not resputtered

Standard Diode Pump

Figure 2-1 model of a diode sputter ion pump. The main elements are a vacuum-tight envelope external magnets and an element consisting of multiple anode cells and two cathodes. The application of a positive high voltage to the anode creates a plasma discharge. Ions are formed (Figure 2-2) from the gas molecules present in the system. These ions are accelerated toward one of the cathodes. When they strike. they can be buried or reflected to be buried elsewhere. In addition. titanium is sputtered from the cathode to be deposited elsewhere in the pump where it acts as a getter for active gases. An ion pump, then, does not remove gas from the vacuum system.

It binds gases down chemically and physically so they can no longer contribute to the pressure in the system. Diode pumps cover a very wide pressure range. The recommended starting pressure is 5 x 10^{-3} Torr or lower. The operation for extended periods of time at high pressure, other than starting, is not recommended because it shortens the pump life.

The ultimate pressure after bakeout is generally in the region of 2 x 10^{-11} Torr. Pumping speeds fall at these pressures because wall effects diminish discharge intensity. Between this extreme and 10-5 Torr, discharge intensity is proportional to pressure and thus the pump can be used as a gauge.



1 Permanent Magnets
2 Pump Envelope
3 Titanium Cathodes
4 Anode Cell Array
5 Positive High Voltage Lead

Fig 2-1. Cutaway view of a typical diode sputter ion pump

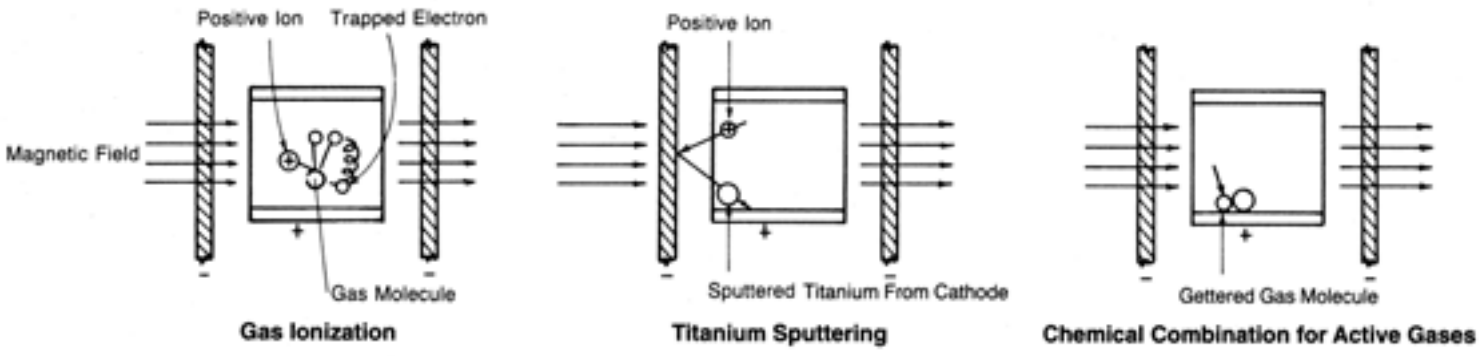


Fig 2-2. Structure of diode ion pump pumping mechanism.

2 Theory of Operation

Triode Pumps

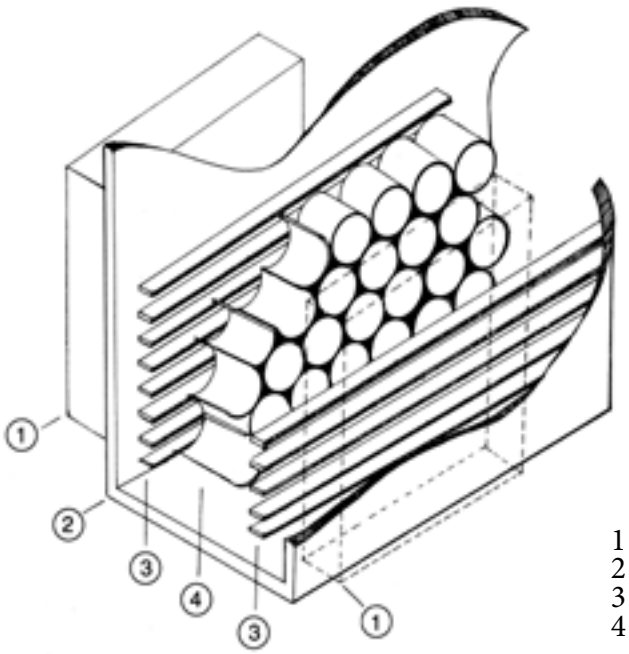
Figure 2-3 is a sketch of a triode sputter ion pump.

Triode sputter ion pumps include:

1. External magnets which intensify the discharge.
2. Stainless steel, internally welded pump envelope.
3. Two-sputter cathodes consisting of multiple strips of titanium held at a negative high voltage.
4. An array of stainless-steel anode cells which are at ground potential.

As in the diode. a plasma discharge is created within the anode cells upon the application of high voltage to the cathode grid. The ions impinge upon the sputter cathode and dislodge titanium atoms as in the diode. At this point, there is a significant difference. Because the cathode grids are open considerable titanium reaches the pump walls where it cannot be further disturbed by ion bombardment. This has at least two favorable results: Undisturbed deposits mean less regurgitation of previously pumped gases; and deposits at the pump wall mean that titanium compounds are kept cooler in the starting mode.

A further benefit of the open cathode grid structure is a higher production rate for energetic neutral atoms. These energetic neutrals are produced by glancing collisions at the cathode and are readily buried at the pump wall This burial without reemission accounts for the triode's high speed for noble gases.



1 Permanent Magnets
2 Pump Envelope
3 Titanium Strip Cathodes
4 Anode Cell Array

Fig 2-3. Cutaway view of a typical triode sputter ion pump.

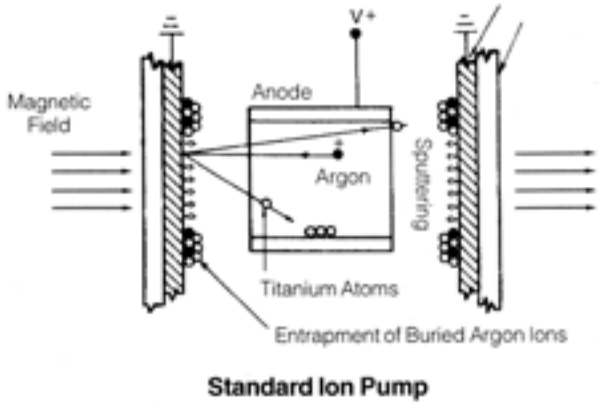
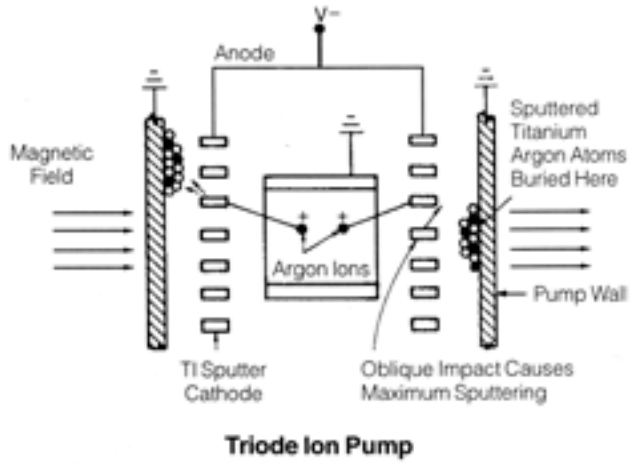


Fig 2-4. Argon (noble) pumping mechanism. Cross section views of single cells.



(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Thermionics manufactures a full line of sputter ion pumps.

These are:

- Standard Diode Pumps (IP Series)
- Noble Diode Pumps (NP Series)
- Hydrogen Diode (HP Series)
- Triode Pumps (TP Series)

Each pump Is

- Designed for a specific application
- Able to provide continuous and contaminant
- free pumping
- Reliable from 1 micron to 2 x 10^{-11} Torr (measured)
- Free from backstreaming
- Bakeable to 300°C assembled
- Bakeable to 450°C magnets removed
- Able to act as its own vacuum gauge

All pumps are manufactured to exacting UHV standards Pump bodies, flanges and element anodes are made of 304 stainless steel, bakeable to 450°C. Double re-entrant electrical insulators are made of high-quality aluminum oxide, bakeable to 450°C, and are equipped with sputter shields. Pump magnets are high-strength ferrites bakeable to 300°C.

Choosing the Right Pump for Your Application

As a full line vacuum manufacturer, TLI can recommend the best pump for your job without reservation or bias We cover the full line of ion pumps. The table below gives a comparison between pumps for different pumping applications.

Pump Characteristics Normalized to the Standard Diode

Pump Type	Air Speed	Argon Speed (% of Air)	Hydrogen Speed	Starting Performance	Life Time at 1 x 10^{-6} Torr
Standard Diode	100%	1%	200-270% Light Duty Only	Average 10 µ	5 x 10^4 hours
Noble Diode	95%	1%	Not Recommended	Below Aver-age 5 µ	5 x 10^4 hours
Hydrogen Diode	100%	1%	200-270%	Average 10 µ	7.5 x 10^4 hours
Triode	85%	21%	200-270% Light Duty Only	Good 50 µ	3.5 x 10^4 hours

Standard Diode Pump use two titanium cathodes in each pumping element. They are the pump of choice for most applications for their long life, reliability, and high speed per unit price. Not recommended when significant amounts of hydrogen or noble gases are to be pumped or where frequent high starting loads are encountered.

Noble Diode Pumps use one titanium and one tantalum cathode to improve pumping speed for noble gases. Increased speed eliminates the pressure and speed instabilities shown by standard diodes when pumping against a prolonged air leak while retaining the long life and reliability of the standard diode. Most stable pump for noble gas loads.

Noble diodes were deve1oped to pump noble gases in every instance but one they are identical to a standard diode. The difference is the use of one tantalum cathode in place of one of the two titanium cathodes in the standard pump. The tantalum. because of its larger atomic number. produces a greater number of energetic neutrals that can now bury themselves in locations that are less subject to resputtering.

Tantalum is somewhat less effective than titanium as a getter. Therefore, the speed of the noble diode is approximately 5% lower than the standard diode. Another fact of note is the lessened solubility of hydrogen in tantalum at elevated temperatures. Since elevated temperatures will be encountered during prolonged starting, it would be wise to avoid applications that require this pump to handle large amounts of hydrogen. Naturally, applications differ. Should you have any questions about the applicability of a pump for your use, please give us a call. We have a wide variety of prior applications to draw upon.

Hydrogen Diode Pumps are also similar to standard diodes. There are two differences in construction. The first is a thicker cathode. Because hydrogen diffuses into titanium like water into a sponge, the more titanium the more capacity for hydrogen the pump has. This absorption of hydrogen can lead to a structural problem, however, Titanium swells and distorts as it absorbs large amounts of hydrogen. Therefore, hydrogen pumps have special structural modifications to prevent distortion from causing electrical shorts.

These extra construction details make the hydrogen diode a good choice for long pump life applications. Examples might be pumps operating in radioactive environments or operating at remote locations Recommended when major gas load is hydrogen or hydrogen-containing gases such as water vapor Also pumps other non-noble gases

Triode Pumps use reverse electrical polarity and a radically different cathode design to achieve two important advantages over the diode pumps: (1) an electrically isolated cathode allows the starting glow discharge to be confined at significantly higher pressures, resulting in shorter starting times; (2) the sputter cathode design allows noble and non-noble gases to be permanently buried without resputtering. Triodes have the highest speeds for noble gases and freedom from argon instability in the event of an air leak Disadvantage: because of the sputter cathode design, the triode pump requires more frequent service.

2 Ion Pump Guide

Starting Performance

For many applications, starting performance is not a criterion when choosing a pump because the system is seldom brought up to ai. In other applications, such as surface analysis equipment or process related equipment, the time lost waiting for pumpdown to operating pressures is a very important consideration. In some cases, the labor costs saved by shorter pumpdowns can earn back the differential in the price of a triode pump in less than a month. The figure below demonstrates the value of the higher triode speed at higher pressures. Two pumps, a 60 l/sec triode and a 440 l/sec diode, were attached to the same large vacuum chamber. The smaller triode pump first pumped the chamber down. It was then released to air and pumped down by the larger diode. The triode, despite a 7-to-1 speed disadvantage. showed a very significant advantage over the diode in reaching the 10^{-5} region. The diode, despite its larger rated speed at lower pressures, took more than three hours to match the pressure achieved by the smaller pump. Naturally, pumpdown performance depends on other variables such as the roughing system, prior chamber exposure. etc . but if pumpdown time is important to your ion pumped system, a triode is the pump of choice.

Summary

Any of the ion pumps will do a good job in a general pumping application. (1) The diode pump is usually the choice when there is no requirement for pumping noble gases and when the initial price is an important criterion. (2) The noble diode is designed for pumping noble gases with longer life, and does so at a lower price (3) The hydrogen diode is used not only where large amounts of hydrogen are expected, such as tube processing, but also in applications where a longer lifetime is needed. (4) The triode is the pump of choice when frequent pumpdowns are expected. It is also excellent for noble gas pumping.

Sizing the Pump to Your Applications

After you have selected the type of pump you need for your application; you must then determine its size. This section gives sample computations for three common pumping applications. They are: (1) pumping with no load other than wall out-gassing: (2) pumping with an additional load, and (3) pumping with an additional pump of another type. If you are accustomed to the large speeds required by diffusion pumped systems, you may be surprised at the capabilities of TLI ion pumps. Ion pumps do not need elaborate baffles to protect the system from contamination, hence effective speeds are not diminished by those conductance considerations.

System Information Needed

1. What species of gases will be found in your system and what is the anticipated outgassing rate? (This, 1n large part, can be determined from your expected bakeout temperature.)
2. What is the surface area of the system?
3. What additional gas loads, if any, will be introduced as a result of the work done in the system?
4. What is the conductance between the pump and the system?
5. What is the desired process pressure and/ or desired ultimate pressure?

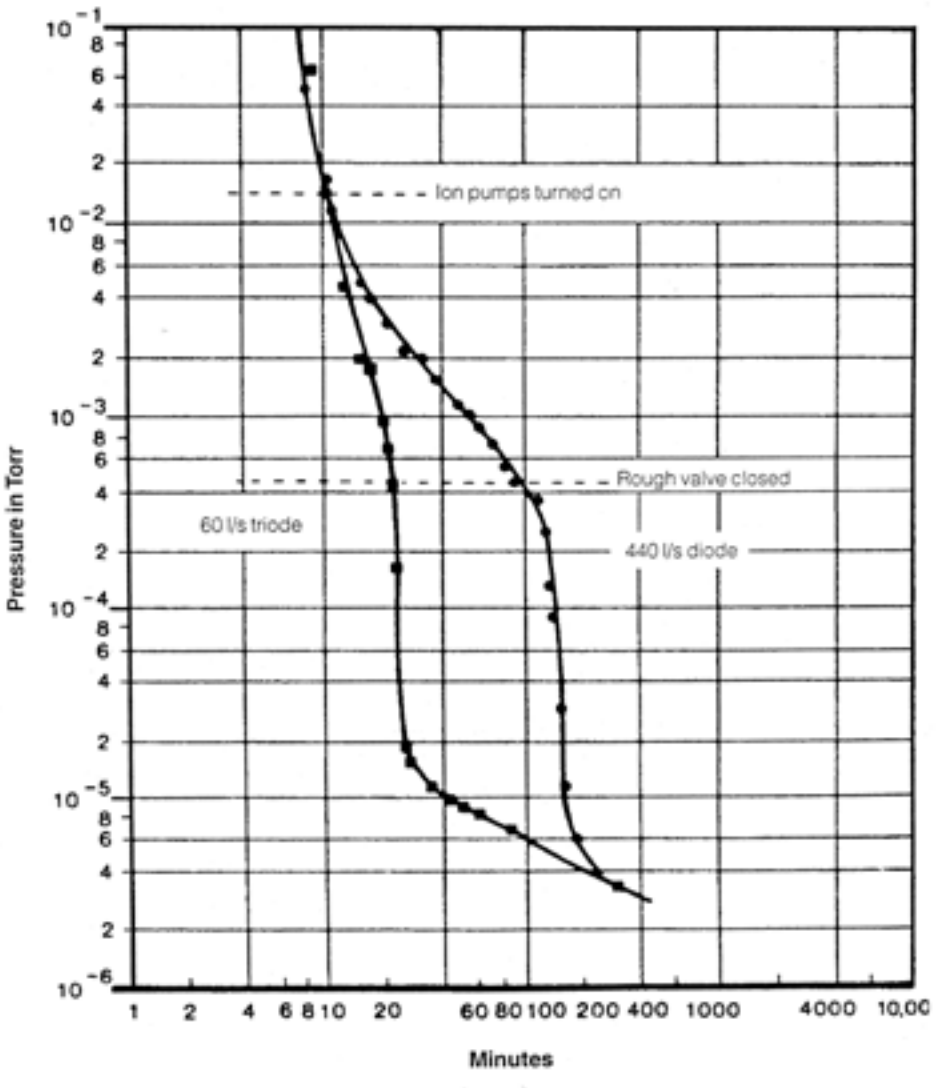


Fig 2-5. Alternate pumpdown times for a diode and triode on large chamber

Example 1
Speed Needed for Wall Outgassing Only

Internal surface area $A = 100{,}000\ cm^2$
Bakeout temperature $T = 200°C$
Outgassing rate of 304 SS* $R = 2 \times 10^{-13}$ Torr l/sec cm^2
Desired base pressure $P = 2 \times 10^{-10}$ Torr
Conductance between pump and chamber $C = 4800$ l/sec**

The speed needed at base pressure is given by: $S = R \times \frac{A \text{ liter}}{P \text{ sec}}$

Inserting values; $S = \frac{(2 \times 10^{-13}) \times (1 \times 10^{5})}{(2 \times 10^{-10})} = 100$ l/sec

This is the speed needed at the chamber. To adjust for conductance losses, use the formula:

$$\frac{1}{S_{Chamber}} = \frac{1}{S_{Pump}} + \frac{1}{C} \qquad S_{Pump} = \frac{(C \times S_c)}{(C - S_c)} = \frac{(4800 \times 100)}{(4800 - 100)} = 102 \text{ l/sec}$$

Looking at Fig. 1-6, pumping speed as a function of pressure, we see that the speed at 2×10^{-10} is 70% of nominal rated speed. Dividing 102 by .7 yields a minimum nominal speed of 146 l/sec to achieve the desired base pressure. A 150 l/sec pump would therefore meet this requirement.

Example 2
Speed Needed for Additional Gas Load

Suppose that the operating pressure is to be 2×10^{-7} Torr with a nitrogen gas load of $Q = 2.8 \times 10^{5}$ Torr liters/sec. The pump must handle the outgassing load as well as the process load.

$$S_C = \frac{(Q + R \times A)}{P} \qquad S_C = \frac{[(2.8 \times 10^{-5}) + (2 \times 10^{-13}) \times (1 \times 10^{5})]}{(2 \times 10^{-7})} \qquad S_C = 140 \text{ l/sec}$$

Adjusting for conductance as above:

$$S_{Pump} = \frac{(C \times S_c)}{(C - S_c)} = \frac{(4800 \times 140)}{(4800 - 140)} = 144 \text{ l/sec}$$

Looking once again at Fig. 1-6, we see that the pump delivers rated speed at 2×10^{-7}. Therefore a 140 to 150 l/sec pump would meet this requirement.

Example 3
Pumping with an Ion Pump and a Titanium Sublimation Pump

Ion pumps are often used in combination with titanium sublimation pumps. Sublimation pumps used with properly designed deposition shrouds can have very high speeds for getterable gases such as H_2, H_2O, CO, CO_2, N, and O_2. They do not pump noble gases or saturated hydrocarbons, such as methane. In fact, sublimation pumps, like ion gauges, can produce methane at their hot surfaces. These non-getterable gases are pumped by ion pumps. For the purposes of speed calculation, it would be tempting to assume that the speeds are additive when applied to the partial pressures of the getterable and nongetterable gases. For several reasons too complex to consider here, this is not the case. As a practical matter, sublimation pumps are a major help in pumpdown at high pressure and will lower the pressure by a factor of ten at low pressures. Thus, as a rule of thumb, you may reduce ion pump size by about half if a sublimation pump is added to a system. This will, in general, lower the initial cost of a system while still assuring the same base pressure. This rule of thumb may seem conservative in view of the high speeds achieved with sublimation pumping, but it can be qualitatively understood if it is realized that the ion pump is pumping a mixture of gases for which it has a lower speed at a lower pressure. For further information, please see the data sheets on our Combo-Vac pumps beginning on page 1-19 in this section

** Outgassing rates for 304 stainless steel:*
2×10^{-13} Torr l/sec cm^2 after an 850°C - 900°C bakeout in a vacuum furnace for 2 hrs Ref: R.L Samuel, Vacuum. Vol 20. 1970, p 295.
3×10^{-12} Torr l/sec cm^2 after a 250°C bakeout for 30 hrs.
Ref: J.R Young, JVST, Vol 6, 1969, p. 398
***This is the approximate conductance of a 6" full opening gate valve. Use of a valve is good practice on ion pumped systems which are often brought up to atmospheric pressure.*

2 Long-Term Pumping Speed

Long-Term Pumping Speed as a Percentage of Rated Ion Pump Speed for Various Gases

Gas	Triode Speed	Diode Speed Standard & Hydrogen	Noble Diodes
Nitrogen	100%	100%	100%
Carbon Monoxide	100%	100%	108%
Water Vapor	100%	100%	100%
Carbon Dioxide	100%	100%	100%
Hydrogen	200 to 250%	200 to 250%	160%
Misc. Hydrocarbons	50 to 150%	50 to 150%	90%
Oxygen[1]	50%	50%	70%
Helium[2]	30%	10%	30%
Argon	21%	1% or less[3]	6 to 20%

1. *Low oxygen speed is thought to be due to formation of a sputter-resistant oxide film on the cathod e. Speed for oxygen when other gases are present is undoubtedly much higher.*
2. *In all ion pumps, the pumping mechanism for helium limits the long-term pumping speed for helium. When helium saturation occurs, which is a function of the load over time, pump ing speeds for helium will be less than the percentages shown.*
3. *Diodes are qwte satisfacto,y for pumpdown of systems backfilled with argon. They do exhibit instabilities when pumping against air or pure argon leaks.*

Air Pumping Speed as a Percentage of Rated Speed vs. Pressure

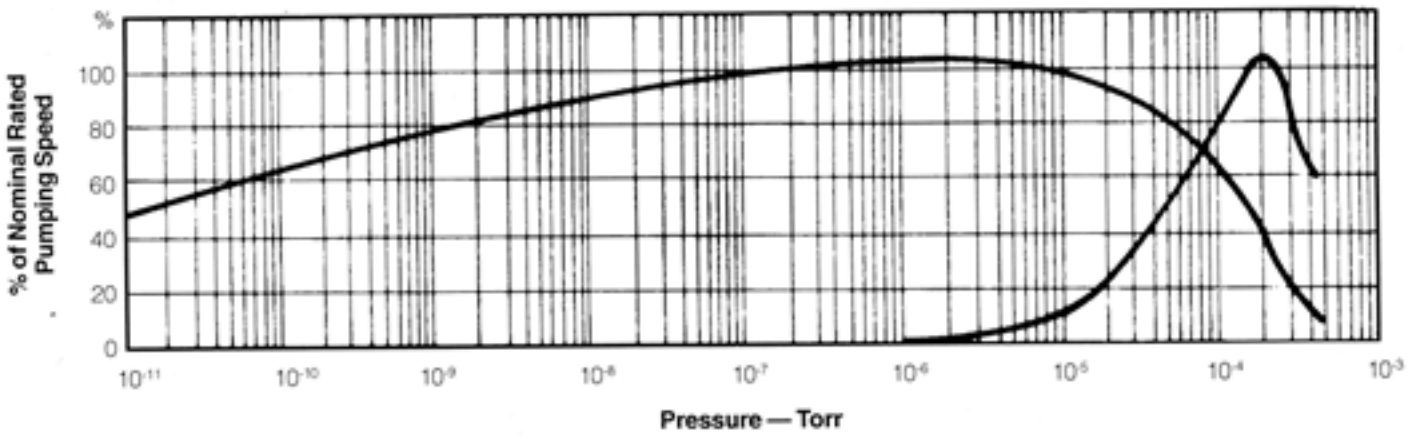


Fig. 2-6. Universal speed and throughput curves for all TLI diode-type ion pumps. To find speed in liters per second at a given pressure, multiply % speed at that pressure times rated speed.

Performance Curves, Triode Pumps

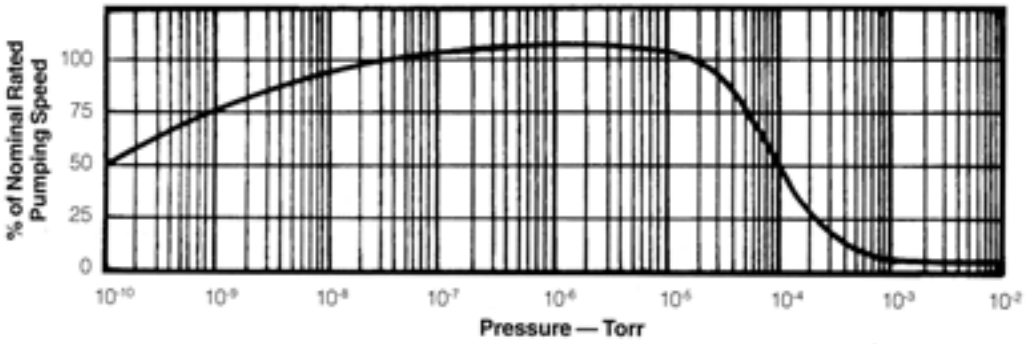


Fig. 2-8. Percentage of nominal rated pumping speed vs pressure

Starting and Throughput

Pumpdown time is determined by net pumping speed in the 10^{-3} to 10^{-4} Torr range. Net pumping speed is rated speed minus outgassing due to power dissipation in the pump. Thus net speed is time dependent. Any factor such as a leak or a dirty system which prolongs the time spent in the high power region can seriously lengthen pumpdown times.

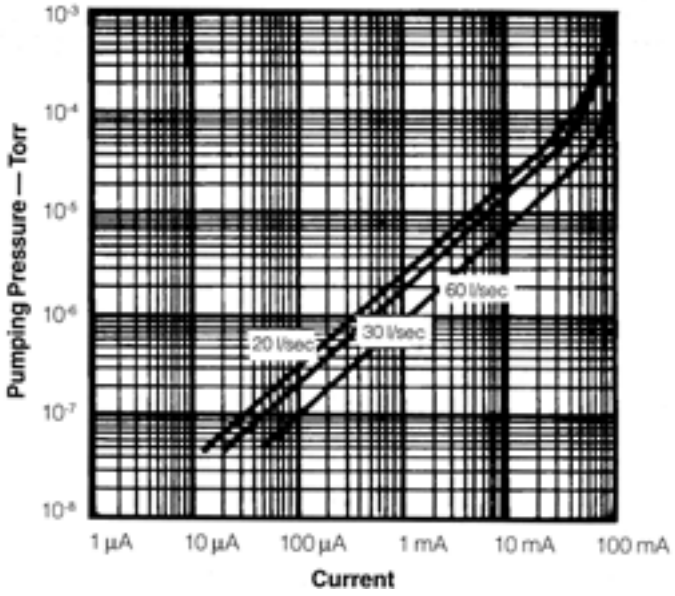


Fig. 2-9. Pressure vs Current

60 Years Experience in Ion Pump Development and Manufacturing - 1000's Sold

- Most complete line of ion pumps, power supplies and accessories
- Fastest, most reliable ion pumps available.
- Thermionics ion pumps are 100% compatible with your existing Varian or Perkin-Elmer power supplies.

Sizes

- 0.2 l/sec to 1,000 l/sec

Models

- Diode configurations
  - Standard (IP Series)
  - Nobile (D-I) (NP Series
  - Hydrogen (HP Series)
- Triode configurations
  - Standard (TP Series)
  - Greater (GT Series)
- Combo-Vac Pumps
  - Combining a Noble (D-I) or Triode pump, Titanium Sublimation Pump (TSP), and Cryo panel

Each Pump is:

- Able to provide continuous and contaminant free pumping
- Reliable from 1 micron to 2 x 10^{-11} Torr
- Free from backstreaming
- Bakeable to 300°C assembled
- Bakeable to 450°C magnets removed
- Able to act as its own vacuum gauge

Construction

- All pumps are manufactured to exacting UHV standards
- Pump bodies, flanges and element anodes are made of 304 stainless steel
- Double re-entrant electrical insulators are made of high-quality aluminum oxide, with sputter shields
- Pump magnets are high-strength ferrites bakeable to 300°C

Choosing the Right Pump for Your Application

- As a full line vacuum manufacturer, TLI can provide the best pump for your job without reservation or bias
- We manufacture a full range of ion pumps
- TLI will custom design pumps for a special application

Service and Parts

We service, repair, and supply replacement parts for all pumps including TLI, Varian, Perkin-Elmer, Ultek, Ion Equipment, Hughes, Ulvac, Anelva, etc.

Rebuilding

We rebuild and repair all sizes and manufacturers of ion pumps, elements, and power supplies. Please refer to page 2-22 for futher information.

Power Supplies, Cables

We offer five power supply models: from a small power supply, which operates with an input voltage of either 110 Vac or 12 Vdc, and is capable of starting and operation small pumps or "holding" larger pumps; to a large, reliable, no frolls, 1.0 A output power supply capable of starting and operating the largest of ion pump. We sell replacement cables for Varian and P-E power supplies

2 Diode Pump Specifications and Order Information

Model Number	Rates Pump Speed l/sec	Flange I.D./O.D.[1,2] Inches	Weight lbs	Dimensions	Bakeout Heater Quantity[3]	Replacement Elements[8]
IP-011	11	1.5/2.75	14	Fig. A (page 2-12)	0	Fact. repl.
IP-020 **IP-020/IH**	20[4]	1.5/2.75	26	Fig. B (page 2-12)	0 1	Fact. repl.
IP-025 **IP-025/IH**	25[4]	2.0/3.375	31	Fig. C (page 2-12)	0 1	Fact. repl.
IP-050 **IP-050/DE**	80/50[5]	4.9/8.0	94	Fig. D (page 2-12)	2	PE-100 2 ea
IP-100 **IP-100/DE**	150/100[5]	6.0/8.0	127 142	Fig. E (page 2-12)	4	PE-100 4 ea
IP-140 **IP-140/DE**	140[5,6]	6.0/8.0	140 150	Fig. L (page 2-13)	0	DE-110 1 ea
IP-150 **IP-150/DE**	220/150[5]	6.0/8.0	145 160	Fig. F (page 2-13)	4	PE-100 6 ea
IP-200 **IP-200/DE**	270/200[5]	6.0/8.0	141 156	Fig. G (page 2-13)	4	PE-100 8 ea
IP-270 **IP-270/DE**	270[5]	6.0/8.0	250 290	Fig. M (page 2-15)	0	DE-110 2 ea
IP-400 **IP-400/DE**	500/400[5]	6.0/8.0	275 290	Fig. H (page 2-13)	8	PE-100 16 ea
IP-500 **IP-500/DE**	500[5,6]	6.0/8.0	400 460	Fig. N (page 2-15)	0	DE-110 4 ea
IP-1000 **IP-1000/DE**	1000[5,7]	10.75/12.75 Wire seal flange	930 990	Fig. O (page 2-15)	Bakeout shroud available	DE-110 8 ea

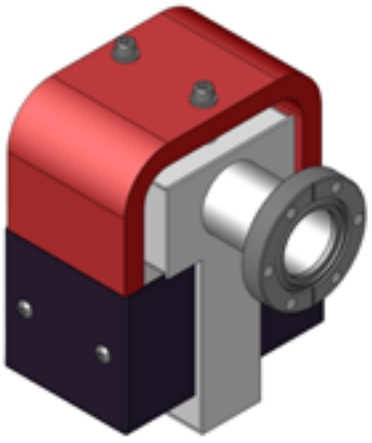
1 See Section 7 for matching gasket and bolt and nut sets.
2 All flanges ConFlat compatible except 1,000 l/sec pumps.
3 Heaters are model IH-100 Calrod heaters which fit into matching interior heater wells in most pumps.
4 IH signifies interior heater well available as option.
5 DE specifies a double-ended option
6 No bakeout heaters available for this pump.
7 Larger pumps available on special order.
8 See Accessories, page 2-11

Ion Pump Power Supplies

Please refer to page 2-16 for power supply applications and specifications

'Pumping Speed Ratings for Ion Pumps

Some pumps in this table have two pumping speeds shown, ie. 150/100. The lower number is observed when the measurement standard established by the American Vacuum Society (AVS) is followed. The higher number is observed when the same pump is measured under optimum pumping speed conditions. Some manufacturers only report the optimum pumping speed number. Both ratings are provided here to allow the customer to make an informed choice.



11 l/sec Pump

Model Number	Rates Pump Speed l/sec	Flange I.D./O.D.[1,2] Inches	Weight lbs	Dimensions	Bakeout Heater Quantity[3]	Replacement Elements[8]
NP-011	11	1.5/2.75	14	Fig. A (page 2-12)	0	Fact. repl.
NP-020 **NP-020/IH**	20[4]	1.5/2.75	26	Fig. B (page 2-12)	0 1	Fact. repl.
NP-025 **NP-025/IH**	25[4]	2.0/3.375	31	Fig. C (page 2-12)	0 1	Fact. repl.
NP-050 **NP-050/DE**	60/50[5]	4.9/8.0	82 94	Fig. D (page 2-12)	2	PE-100N 2 ea
NP-100 **NP-100/DE**	120/100[5]	6.0/8.0	127 142	Fig. E (page 2-12)	4	PE-100N 4 ea
NP-140 **NP-140/DE**	115[5,6]	6.0/8.0	143 154	Fig. L (page 2-14)	0	DE-110N 1 ea
NP-150 **NP-150/DE**	160/150[5]	6.0/8.0	145 160	Fig. F (page 2-13)	4	PE-100N 6 ea
NP-200 **NP-200/DE**	220/200[5]	6.0/8.0	145 160	Fig. G (page 2-13)	4	PE-100N 8 ea
NP-220 **NP-220/DE**	220[5]	6.0/8.0	250 290	Fig. M (page 2-15)	0	DE-110N 2 ea
NP-400 **NP-400/DE**	400[5]	6.0/8.0	276 290	Fig. H (page 2-13)	8	PE-100N 16 ea
NP-500 **NP-500/DE**	400[5]	6.0/8.0	402 460	Fig. N (page 2-15)	0	DE-110N 4 ea
NP-1000 **NP-1000/DE**	800[5,7]	10.75/12.75 Wire seal flange	932 990	Fig. O (page 2-15)	Bakeout shroud available	DE-110N 8 ea

1 See Section 7 for matching gasket and bolt and nut sets.
2 All flanges ConFlat compatible except 1,000 l/sec pumps.
3 Heaters are model IH-100 Calrod heaters which fit into matching interior heater wells in most pumps.
4 IH signifies interior heater well available as option.
5 DE specifies a double-ended option
6 No bakeout heaters available for this pump.
7 Larger pumps available on special order.
8 See Accessories, page 2-11

Ion Pump Power Supplies

Please refer to page 2-16 for power supply applications and specifications

'Pumping Speed Ratings for Ion Pumps

Some pumps in this table have two pumping speeds shown, ie. 150/100. The lower number is observed when the measurement standard established by the American Vacuum Society (AVS) is followed. The higher number is observed when the same pump is measured under optimum pumping speed conditions. Some manufacturers only report the optimum pumping speed number. Both ratings are provided here to allow the customer to make an informed choice.

20 l/sec Pumps

2 Hydrogen Diode Pump Specifications and Order Information

Model Number	Rates Pump Speed l/sec	Flange I.D./O.D.[1,2] Inches	Weight lbs	Dimensions	Bakeout Heater Quantity[3]	Replacement Elements[8]
HP-011	11	1.5/2.75	14	Fig. A (page 2-12)	0	Fact. repl.
HP-020 **HP-020/IH**	20[4]	1.5/2.75	26	Fig. B (page 2-12)	0 1	Fact. repl.
HP-025 **HP-025/IH**	25[4]	2.0/3.375	32	Fig. C (page 2-12)	0 1	Fact. repl.
HP-050 **HP-050/DE**	80/50[5]	4.9/8.0	82 96	Fig. D (page 2-12)	2	PE-100H 2 ea
HP-100 **HP-100/DE**	150/100[5]	6.0/8.0	129 144	Fig. E (page 2-13)	4	PE-100H 4 ea
HP-140 **HP-140/DE**	140[5,6]	6.0/8.0	143 154	Fig. L (page 2-14)	0	DE-110H 1 ea
HP-150 **HP-150/DE**	220/150[5]	6.0/8.0	147 162	Fig. F (page 2-13)	4	PE-100H 6 ea
HP-200 **HP-200/DE**	270/200[5]	6.0/8.0	143 158	Fig. G (page 2-13)	4	PE-100H 8 ea
HP-270 **HP-270/DE**	270[5]	6.0/8.0	252 292	Fig. M (page 2-15)	0	DE-110H 2 ea
HP-400 **HP-400/DE**	500/400[5]	6.0/8.0	278 294	Fig. H (page 2-13)	8	PE-100H 16 ea
HP-500 **HP-500/DE**	500[5]	6.0/8.0	404 464	Fig. N (page 2-15)	0	DE-110H 4 ea
HP-1000 **HP-1000/DE**	1000[5,7]	10.75/12.75 Wire seal flange	936 996	Fig. O (page 2-15)	Bakeout shroud available	DE-110H 8 ea

1 See Section 7 for matching gasket and bolt and nut sets.
2 All flanges ConFlat compatible except 1,000 l/sec pumps.
3 Heaters are model IH-100 Calrod heaters which fit into matching interior heater wells in most pumps.
4 IH signifies interior heater well available as option.
5 DE specifies a double-ended option
6 No bakeout heaters available for this pump.
7 Larger pumps available on special order.
8 See Accessories, page 2-11

Ion Pump Power Supplies

Please refer to page 2-16 for power supply applications and specifications

'Pumping Speed Ratings for Ion Pumps

Some pumps in this table have two pumping speeds shown, ie. 150/100. The lower number is observed when the measurement standard established by the American Vacuum Society (AVS) is followed. The higher number is observed when the same pump is measured under optimum pumping speed conditions. Some manufacturers only report the optimum pumping speed number. Both ratings are provided here to allow the customer to make an informed choice.

COV-1000S: 200 l/sec Triode Pump with Cryoshroud and Ti Sublimation Pump (shown with Power Supply)

Model Number	Rates Pump Speed l/sec	Flange I.D./O.D.[1,2] Inches	Weight lbs	Dimensions	Replacement Elements[8]
TP-020	20	1.5/2.75	27	Fig. I (page 2-14)	Fact. repl.
TP-030	30	2.84/4.50	34	Fig. J (page 2-14)	Fact. repl.
TP-060	60[3]	4.26/6.0	56	Fig. K (page 2-14)	TE-060 2 ea
TP-110	110[3]	6.0/8.0	164	Fig. L (page 2-14)	TE-110 1 ea
TP-220	220[3]	6.0/8.0	249	Fig. M (page 2-15)	TE-110 2 ea
TP-400	400[3]	6.0/8.0	398	Fig. N (page 2-15)	TE-110 4 ea
TP-800	800[3,6]	10.75/12.75 Wire seal flange	927	Fig. O (page 2-15)	TE-110 8 ea

1 See Section 7 for matching gasket and bolt and nut sets.
2 All flanges ConFlat compatible except 1,000 l/sec pumps.
3 Double-ended pumps available on special order.
4 Larger pump sizes available on special order.
5 See Accessories below.

Ion Pump Power Supplies

Please refer to page 2-16 for power supply applications and specifications

New Model: Non-shorting triode pump available In all sizes (shown with optional PyraFlatflange)

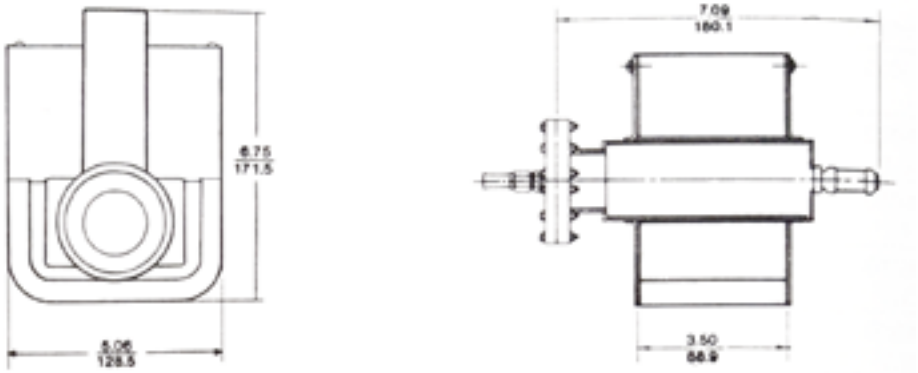
PyraFlat flanges are manufactured and protected under on ore more of the following patents: 5,640,751; 4,685,193

Accessories

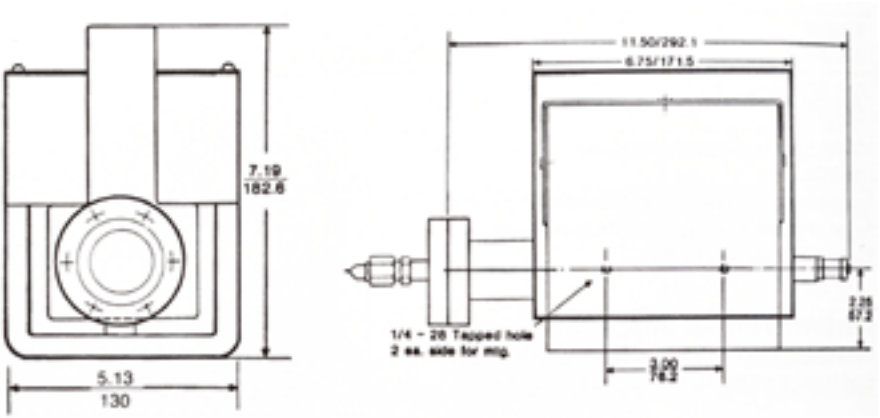
Description	Model Number	Application
Glow Discharge screen used to improve diode pump starting performance	**GS-150**	For 1.5" O.D. tubes; 11 & 20 l/sec pumps
	GS-200	For 2.0" O.D. tubes; 25 l/sec pump
	GS-600	For 6.0" O.D. tubes; 60 to 500 l/sec pumps
Insertion heaters	**IH-100**	125 watt, 120 VAC
High voltage feedthrough	**HV-100**	On 2.125" O.D. flange
Replacement elements	**PE-100**	For most diode pumps and systems
	PE-100H	For most hydrogen diode pumps
	PE-100N	For most noble diode pumps
	DE-110	For 140, 500 & 1,000 l/sec diode pumps
	DE-110H	For 140, 500 & 1,000 l/sec hydrogen pumps
	DE-110N	For 140, 500 & 1,000 l/sec noble pumps
	TE-60	For 60 l/sec triode pumps
	TE-110	For 110, 220, 400 & 800 l/sec straight pump
	PE-75	For special 150 l/sec straight pump
Replacement diode cathodes	**RDC-100**	For PE-100 element, 2 required, priced each
	RDC-110	For DE-110 element, 2 required, priced each
Element insultators	**REI-50**	For all elements, each pack of four
High voltage cable and connector	**HC-100**	10 feet long, not bakeable
	HC-150	15 feet long, not bakeable
	BK-100	10 feet long, bakeable
External bakeout shrouds (aluminum cans)	**BS-20**	For 20 l/sec pump
	BS-30	For 30 l/sec pump
	BS-60	For 60 l/sec pump

2 Physical Dimensions of Diode/Noble/Hydrogen Pumps

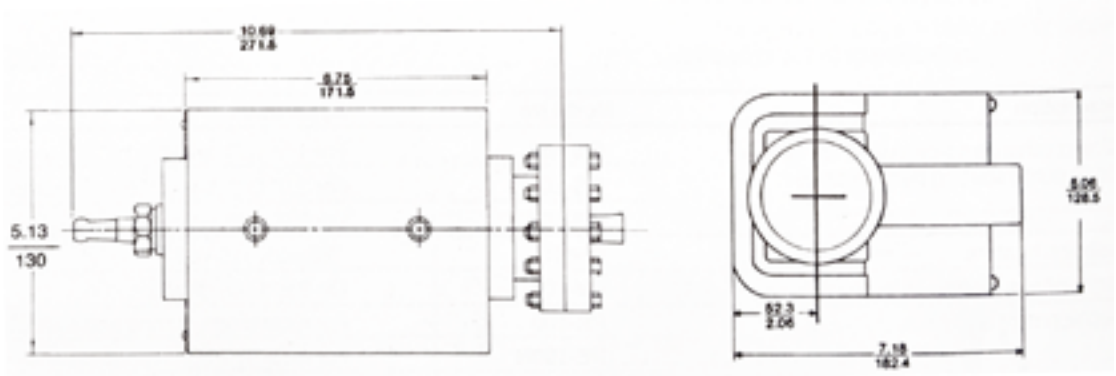
A 11 l/sec Standard Pump



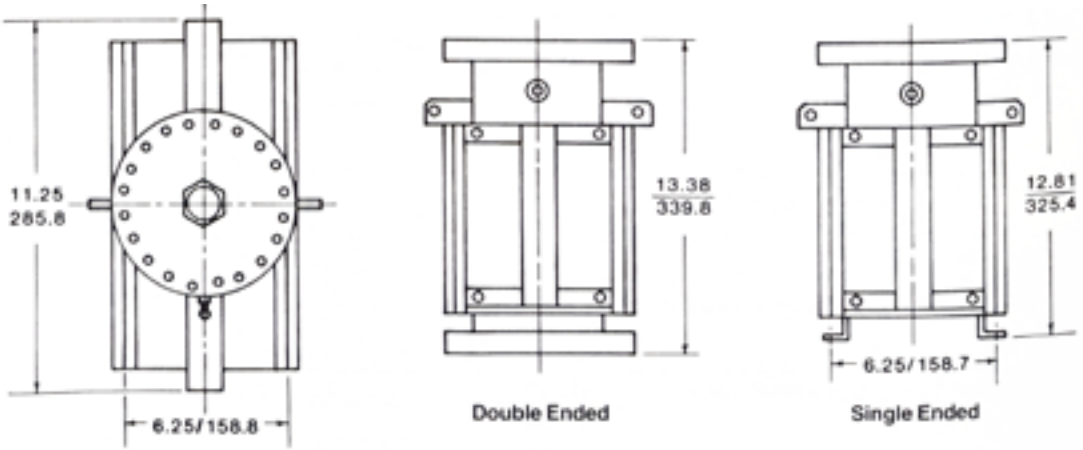
B 20 l/sec Standard Pump



C 25 l/sec Standard Pump



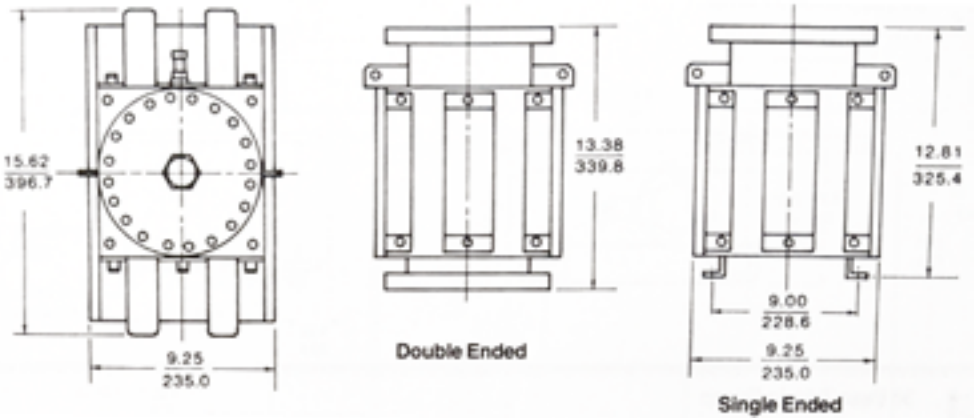
D 60 l/sec Standard Pump
50 l/sec Noble Pump



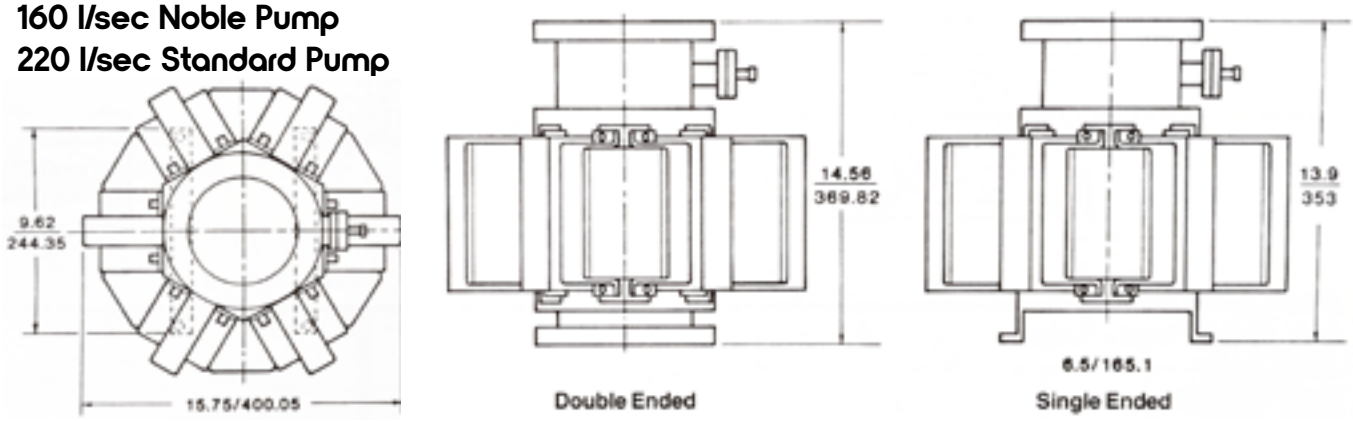
Dimensions in:
inches
mm

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

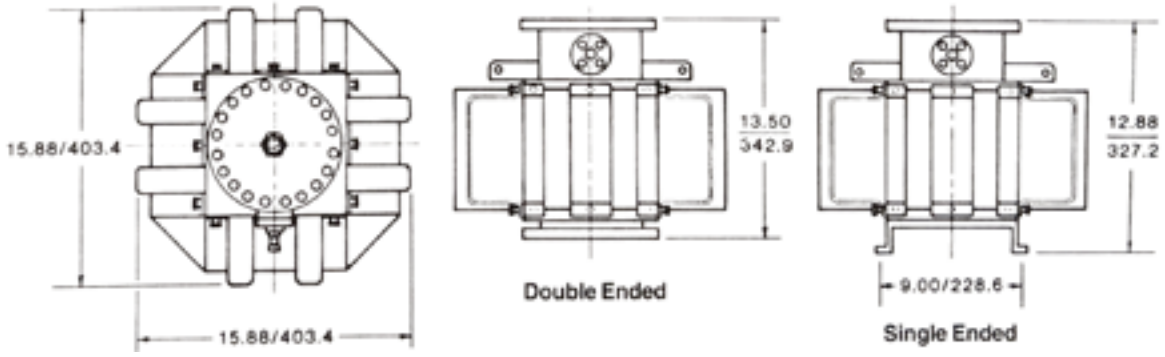
E
120 l/sec Noble Pump
150 l/sec Standard Pump



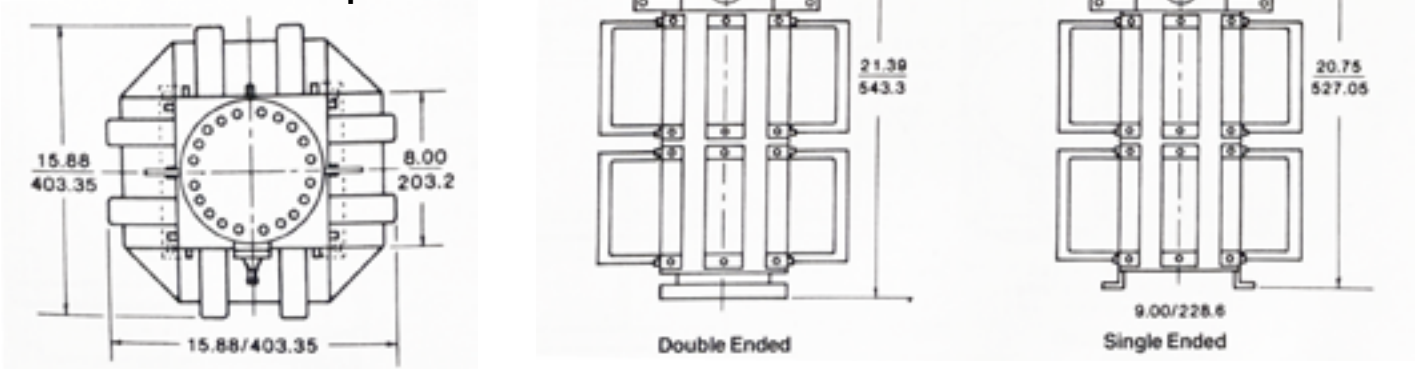
F
160 l/sec Noble Pump
220 l/sec Standard Pump



G
220 l/sec Noble Pump
270 l/sec Standard Pump

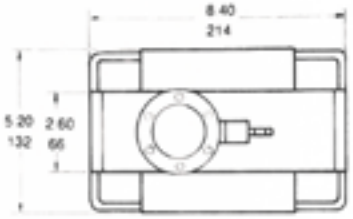


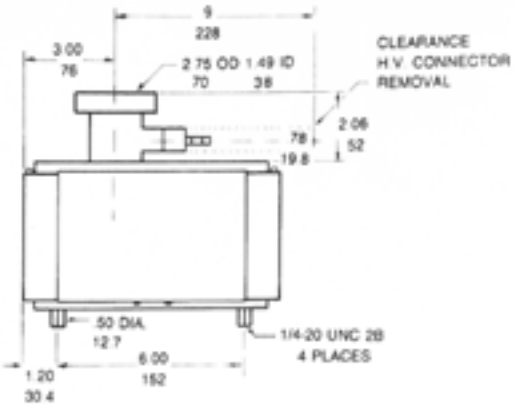
H
400 l/sec Noble Pump
500 l/sec Standard Pump

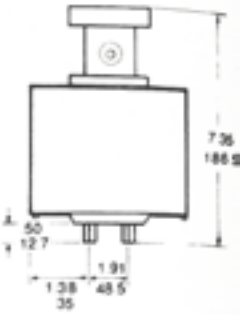


2 Physical Dimensions of Triode/Diode Pumps

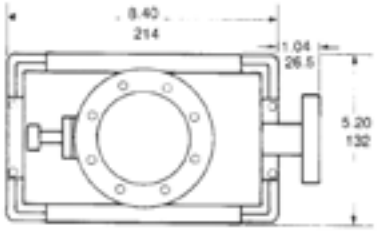
I 20 l/sec Triode Pump

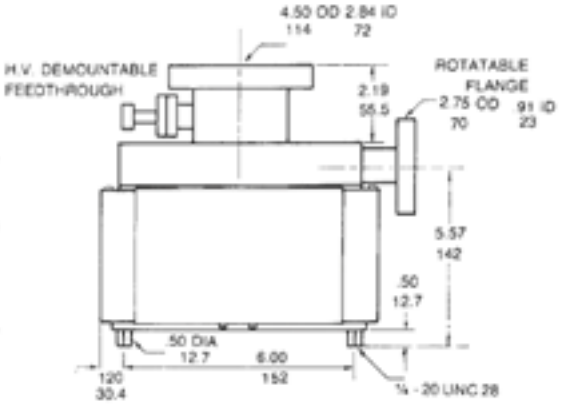


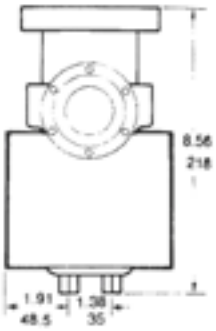




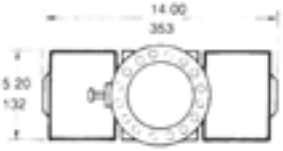
J 30 l/ec Triode Pump

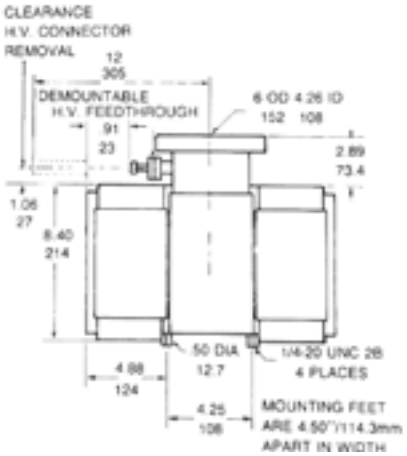


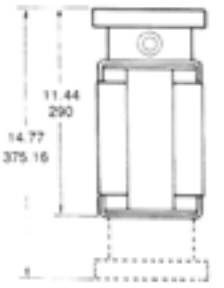




K 60 l/sec Triode Pum

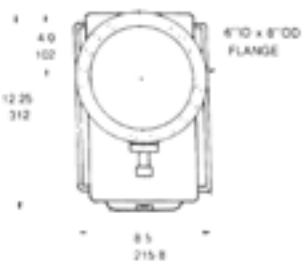


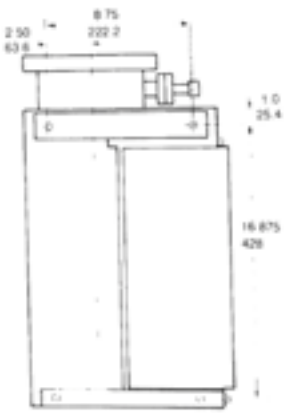


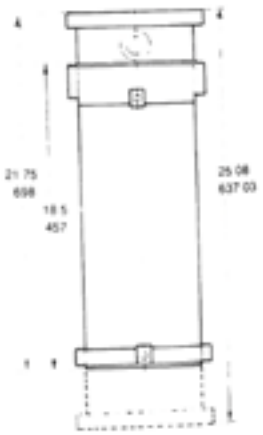


Double Ended

L 110 l/sec Triode Pump
140 l/sec Standard Pump



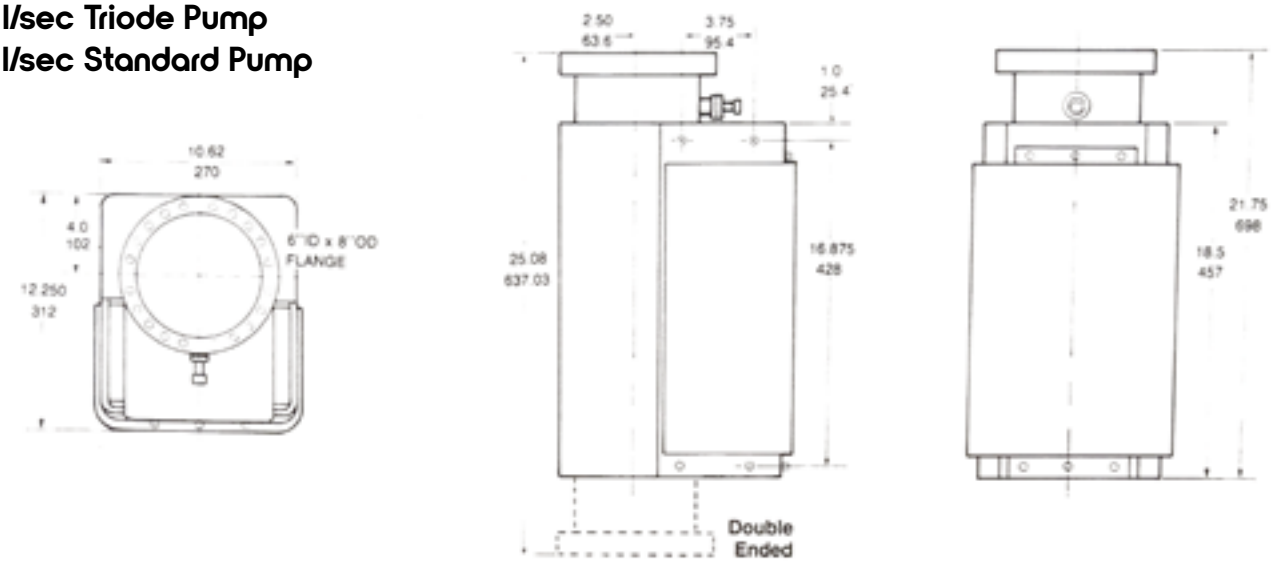




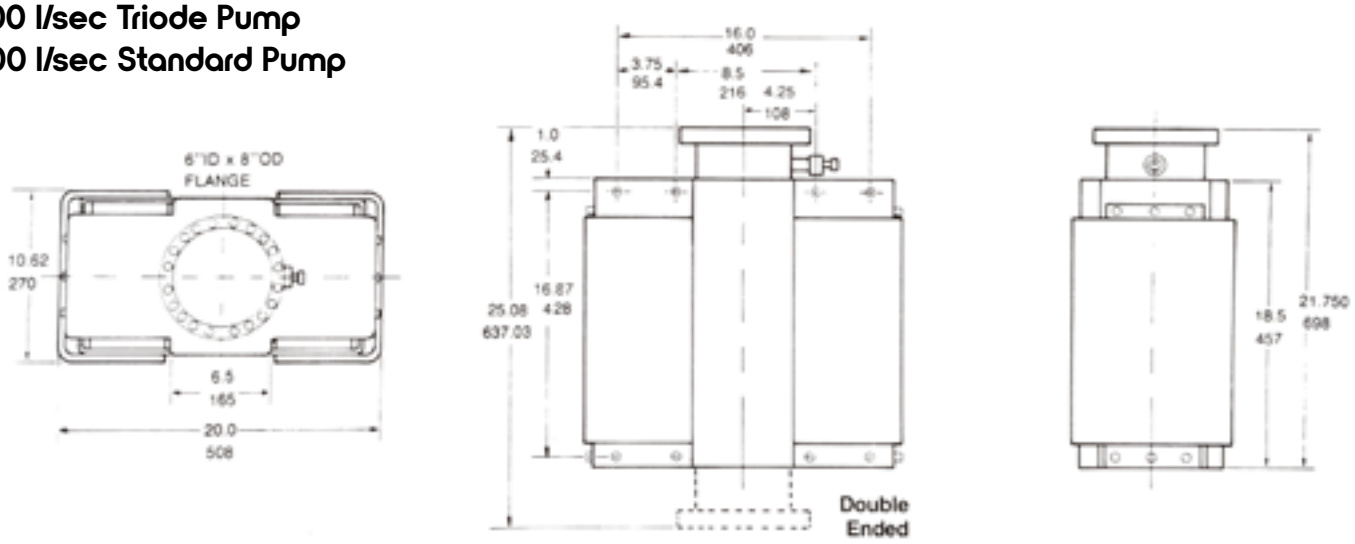
Double Ended

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

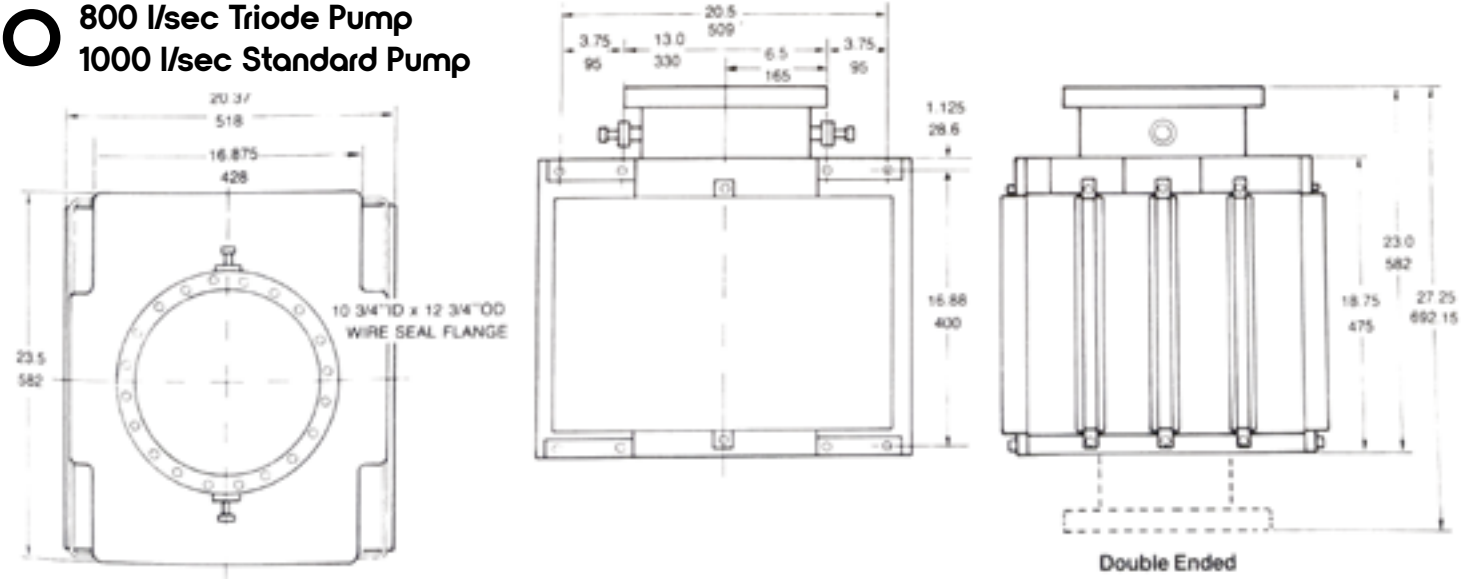
M 220 l/sec Triode Pump
270 l/sec Standard Pump



N 400 l/sec Triode Pump
500 l/sec Standard Pump



O 800 l/sec Triode Pump
1000 l/sec Standard Pump



2 Ion Pump Control Units

Features

- Reliable - proven design
- Includes high voltage cable at no extra cost
- Recorder output

TLI's ion pump control units provide matched power and control for all the pumps listed in the catalog. When ordering, please specify diode or triode operation. Control units for triode pumps have the suffix "N" added to their model number.

Front Panel: PS-20

Front Panel: PS-100 or PS-100N

Front Panel: PS-350 or PS-350N

Front Panel: PS-350 and PS-500 for Combo Pump

Ion Pump Control Unit Specifications

Thermionics offers five different ion pump controllers to suit various pump sizes and operating conditions

Model Number	PPS-5* (Portable)	PS-10	PS-100 (N)**	PS-350 (N)**	PS-1000 (N)**
Physcial					
Rack Mount	No	Yes (requires rack adapter)	Yes (requires rack adapter)	Yes	Yes
H x W x D	9" x 8.1" x 14.125"	5.25" x 5" x 8.75"	5.5" x 8" 14"	8" x 17" 14"	8" x 17" 14"
Ship Weight	30 lbs (24 lbs actual)	6.5 lbs	14 lbs	85 lbs	110 lbs
Electrical Input					
(Single phase)	95-240 VAC, 50/60 Hz or 12 VDC	120 VAC, 60 Hz	120 VAC, 60 Hz	50 / 60 Hz	50 / 60 Hz
Voltage	has internal battery	230 VAC, 50 Hz available	230 VAC, 50 Hz available	120/230 VAC	208/230 VAC
Current	(<50 Watts)	0.5 A	5 A	15/8 A	25/22 A
AC Cord	AC and DC cords included	15' with plug	15' with plug	15' with plug	15' with plug
Electrical Output					
Voltage	4.8 kV DC @ mA	4.2 kV DC @ 1 mA	5 kV DC @ 10 mA	5 kV DC	5 kV DC
Current	5 mA	10 mA	120 mA	350 mA	1,000 mA
Protection circuit	Adjustable	Current limit 12 mA	20-25 mA trip	210-280 mA trip	60-1,000 mA trip
HV coax cable	4' w/ dual safety ground straps & cable halyard	10' w/ connector both ends	10' w/ connector both ends	10' w/ connector both ends	10' w/ connector both ends
Recorder Output	No	Yes	Yes	Yes	Yes
Display	Digital Meter	LED	Digital Meter	Meter	Meter

** Capable of maintaining a pump for > 48 hours (< 1 mA draw) without external power*
***Triode Pump supplies (N) provide (-) voltage, other provide (+) voltage*

Ion Pump Controller	Application (pump size, l/sec) Starting / Sustaining	Output
	2 2 20 200 1000	
PPS-5		5 mA
PS-10		10 mA
PS-100 (N)		120 mA
PS-350 (N)		350 mA
PS-1000 (N)		1,000 mA

The table to the left indicates the range of controller sizes recommended for various pump sizes. For more specific application informtaion, please contact us.

Accessories

Rack Adaptor for the **PS-10** and **PS-100 (N)**
19" rack adapter, space for three PS-10 or two PS-100 (N)
PS-05HRA

Recommended for All Power Supplies
DS-GR Grounding Rod

Additional HV Coax Cable

Additional Bakeable HV Coax Cable

Appendage pumps are available in 0.2 l/sec, 2 l/sec, and 8 l/sec sizes, with the following features:

- Pumps are either vacuum processed and pinched off (after 400˚C+ bake out) or shipped in up-to-air configuration
- Inlet ports are 3/8", ¾" O.D. copper or SS tubes; 1.33" mini or 2.75" O.D. ConFlat type flanges
- High-voltage feedthroughs are TLI, P-E (Alberox type), Varian style or standard BNC type connectors
- All pumps are tested for vacuum integrity and excessive electrical leakage current

AP-2/133

Features

Please refer to page 2-16 for power supply applications and specifications.

Appendage Pumps

Nom. Speed (l/sec)	Pump Inlet	Pump Design	
		TLI Style	Varian Style
		Model Number	Model Number
0.2	90˚, 3/8" SS	**AIP-0.2T**	**
0.2	90˚, 3/8" CU	**AIP-0.2TC**	**
0.2	90˚, mini flange	**AIP-0.2/133**	**
2.0	180˚, 3/4" SS	**AIP-2T**	913-0032
2.0	180˚, mini flange	**AIP-2/133**	913-5000
8.0	180˚, 2.75 flange	**AIP-8/233**	911-5005

***TLI pump performance is fully comparable to a Varian pump*

AIP-2/275

Magnets for TU and Varian Appendage Pumps

Size (l/sec)	Type	Gauss	Model Number	Varian Model Number
0.2	Alnico	800+	**MP-0.2**	914-0042
2.0	Alnico	1200	**MP-2**	913-0011
2.0	Sm-Co —	1200	**MEV-2**	913-00112
8.0	Sm-Co —	1200	**ME-8**	*
8.0	Sm-Co —	1200	**MEV-8**	913-0030

**Long life Samarium-Cobalt magnet mounted in low stray field enclosure*

SP-150

To meet your special application requirements, any of our pumps can be built in a custom configuration. All of the pumps are manufactured in the USA. Prefab pump subassemblies are kept in stock. We can modify them, process, and ship your custom pump in two weeks or less.

In-Line, Tube Type Ion Pump

Straight Through, 150 l/sec, Line of Sight Ion Pump

This unusual ion pump illustrates TLI's ability to meet special needs. In this case, the need was for pumping on either side of the magnetic deflection sector of an ultra-high

Custom Design

vacuum mass spectrometer. Either of the large ports or the small ports can be attached to the system, providing good conductance and a savings in the cost of fittings.

This pump allows line-of-sight conductance for X-ray beams, laser beams, and high-energy particle beams. Because of the small magnetic fringing field, it is not recommended for low-energy particle beams.

Length	32 1/4"
Height	16 3/4"
Large Flange	8" O.D., 4.5" I.D.
Small Flange	6" O.D., 2.5"
Model Number	I.D **SP-150**

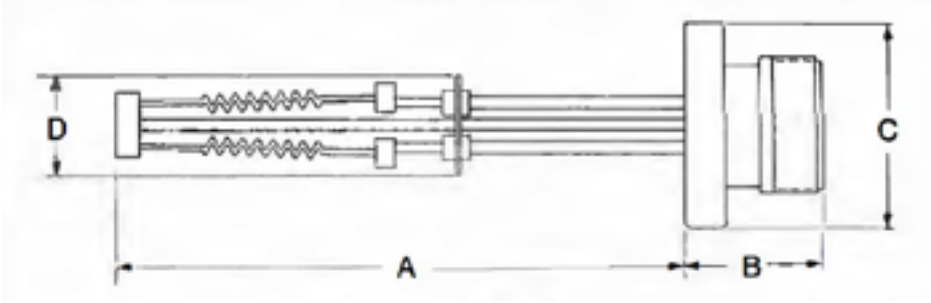
2 Titanium Sublimation Pumps

Titanium Sublimation Pump

Titanium Sublimation Pumps (TSP's) are used to pump chemically reactive, getterable gases. Titanium is effective, is easily sublimed, and is inexpensive.

TSP's have high pumping speeds. At pressures below 10^{-6} Torr, pumping speed is dependent upon available surface area for condensation. Pumping speed is increased by cooling the sub-strate surfaces with water or liquid nitrogen

The filaments of the titanium sublimation pump are 85% titanium and 15% molybdenum, a combination which prevents premature filament "burnout."



Model No.	A*	B	C	D
SB-1000	9.5"	2.26"	3.38"	1.625"
SB-1020	9.5"	3.07"	2.75"	1.312"

**Standard length Special lengths on request.*

SB-1000

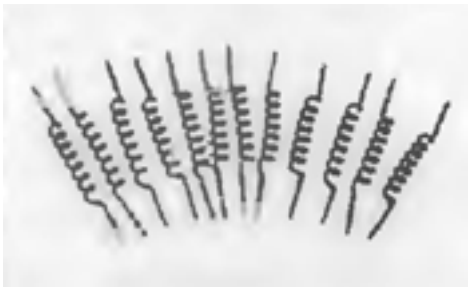
TSP with 3.38" mounting flange.

SB-1020

TSP with 2.75" mounting flange.

SB-1002B

Bakeable adapter with Amphenol female MS connector and bakeable cable



SB-1001

12 spiral filaments

Material	85% Ti, 15% Mo
Length	8 5/8" before cooling; 4 5/8" coiled
Weight	3.6 grams/filament
Usable Ti	1.5 grams/filament

PS-500 Sublimator Power Supply

Specify if used with sublimator with 2.75" or 3.38" flange. Example: PS-500/275 or PS-500/338.

Specifications

Physcial		Electrical Input[1]		Electrical Output[2]		Timer		Display	
Rack Size	19"	Voltage	115 VAC	Voltage	12 VAC	OFF-time (range)	2 to 120 min	Analog meter, current	75A
Chassis Dimensions	8 3/4" x 17" x 12"	Frequency	60HZ	Max current	50 A	ON-time	4 to 120 sec		
Ship Weight	50 lbs			Selector switch for 4 filaments					
AC Cord	15 feet with plug								

1 230/208 VAC and/or 50 Hz available as special order. Please specify on order. *2 WithSB-1001 spiral filaments*

(360) 385-7707
thermionics laboratory, inc. Vacuum Innovation Since 1958
sales@thermionics.com

Liquid Nitrogen Shroud for Use with TSP

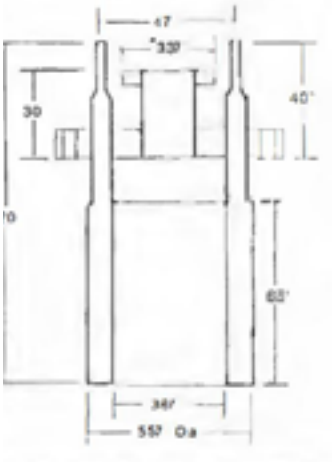
High-speed LN_2 cooled cryoshroud. Full-flood design keeps all surfaces at LN_2 temperature. Readily removeable for maintenance purposes All stainless-steel construction

Model S5400/275

with 8" O.D. main falnge and 2.75" mounting flange

Model SS400/338

with 8" O.D. main falnge and 3.38" mounting flange



LN_2 Controller

For specifications, see Section 6, page 6-12

Model LNC-400

Combo-Vac Pumps: Ion, Cryo and TSP Combined in One Pump

What is a Combo-Vac Pump?

Combo-Vac pumps are a combination of titanium sublimation pumps and noble diode ion pumps in one cryo-cooled package. (Model COV-500 is an exception, as it has an integral wa-ter-cooled jacket rather than a cryoshroud) They are often used in factory processing of high-power vacuum tubes, Xray sources, etc. It is well suited to the gases evolved by such devices in their initial processing. They are tremendously cost effective for certain applications, i.e., where reliable, clean, contaminant-free pumping is a major consideration Their high speed is the result of the ability of a freshly deposited titanium film in vacuum to chemisorb such gases as oxygen, nitrogen, water vapor, carbon monoxide, and carbon dioxide. When the walls on which titanium is deposited are water-cooled, speeds of 40 to 90 l/sec (depending upon gas species) for each square inch of substrate are obtained. Thus total pump speeds can be quite large for large deposition chambers The ion pumps handle gases that are not pumped by the sublima-tion pump-more about this later.

Because you control the rate at which titanium is deposited on the walls, you can adjust pump-ing speeds to suit your needs. For example, if you must pump down to a certain pressure before starting a process, you can reach that pressure more quickly by increasing the sublimation rate. If your process liberates gas, you will be able to speed the process with more speed at your dis-posal. Conversely, when the system is not in active use, the ion pump alone will maintain it at a low pressure indefinitely, thus conserving the titanium supply of the sublimation pump.

At this point, you might have a question about the ion pump: Since its speed is so much lower than that of the sublimation pump, why include it at all? One reason has already been mentioned. It is a reliable way to maintain a holding vacuum when the system is not in active use. The most important reason, however, is the noble ion pump's ability to pump the non-getterable gases such as methane and the noble gases. Since these gases are generally present in small quantities in most systems, a small ion pump is able to handle the load, providing it is specially designed to pump noble gases. Caution: If your process produces large quantities of non-getterable gases, this will determine the size of ion pump needed.

All Combo-Vacs use the SB-1000 sublimator assembly with a PS-500 control unit. (See page 2-18.) The sublimator assembly holds four separate spiral titanium filaments, each with 1.5 grams of usable titanium. In normal operations, power is supplied to the filament for 90 seconds and then removed for an interval. The OFF interval is continuously selectable in the range of 2 to 120 minutes by means of a front panel control knob.

Pumping results are better with cyclic operation than with continuous operation. One reason has to do with the characteristics of heated surfaces in vacuum. The power dissipated has two undesirable effects. One is that it causes outgassing of inferior substrates just as a bakeout does though in lesser degree. The second is the formation of methane at the hot filament. This is thought to be a catalyzed reaction between hydrogen or water vapor and carbon or carbon dioxide at the hot filament. Because methane is not pumped by the sublimator, it must be pumped by the ion pump. Obviously, intermittent operation produces less methane and less work for the sputter ion pump. What is observed during operation of the sublimation pump is a brief pres-sure rise as the filament comes up to sublimation temperature, followed by a gradual decline in pressure as the fresh titanium deposits and cools at the substrate. When the power is removed from the filament, the pressure will generally drop by an order of magnitude. No new titanium will be needed until the pressure begins to rise again This last period of time is dependent on the rate of gas evolution in the system but is usually within the range of the sublimator control unit timer.

2 Combo-Vac Pumps

All Combo-Vacs consist of the ion pump, cryoshroud, and sublimation pump assembly together with the appropriate cooling mechanism, control units, cables, internal heaters, 6 spare Ti sub-limation filaments, and 2 UHV copper gaskets. Bolt the Combo-Vac to your system in any po-sition, rough it down, and it's ready for operation. The table on page 2-21 will help you to select the Combo-Vac you need for your application

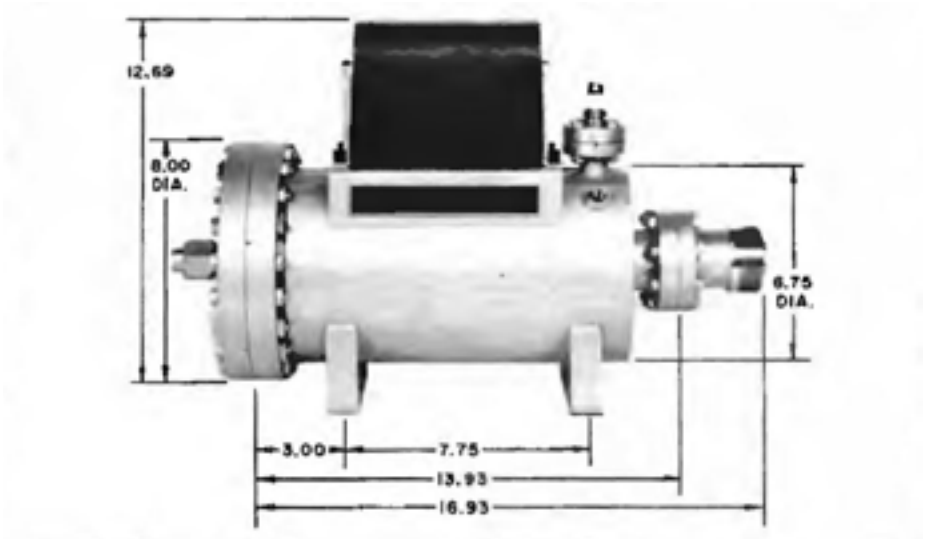
Model S5400/275

- High speed, filament-type titanium sublimator/baffle assembly works at a constant current set-ting for reliable repetitive operation. Four separate, spiral titanium alloy filaments are incorpo-rated in the sublimator assembly to allow continuous pumping over a 120-hour period. Cycling the operation extends sublimator assembly life proportionally. Replaceable noble ion pumps with demountable high-voltage feedthrough.
- Can be supplied with diode, hydrogen diode, or triode elements in a range of sizes. Please con-tact us for custom details.
- Pumping port(s) are fitted with metal gasketed flange and are blanked off for bakeout and shipment.
- Separate power supplied for selective operation of sublimator and noble ion pump(s).
- Stainless steel construction.
- Internal bakeout heaters.
- Mounting brackets are attached to pump body for assembly and support.
- Liquid nitrogen/water shroud standard.
- Ideal for vacuum applications where many different gases must be pumped.
- Combo-Vacs integrate three standard components in one-unit lor selective pumping: a noble ion pump, a cooling unit, and a titanium sublimator.
- Combo-Vacs operate in any position.

COV-500

The model COV-500 is the smallest combination pump offered by Thermionics. It has an 8" O.D., 6" I.D., UHV flanged pumping port. A reducing flange can be used to interface the pump with a manifold or with small individual devices. The pump operates in any position and is eas-ily disassembled for cleaning and/or replacement of elements. This pump uses a water-cooled shroud.

See table on page 2-21 for more details

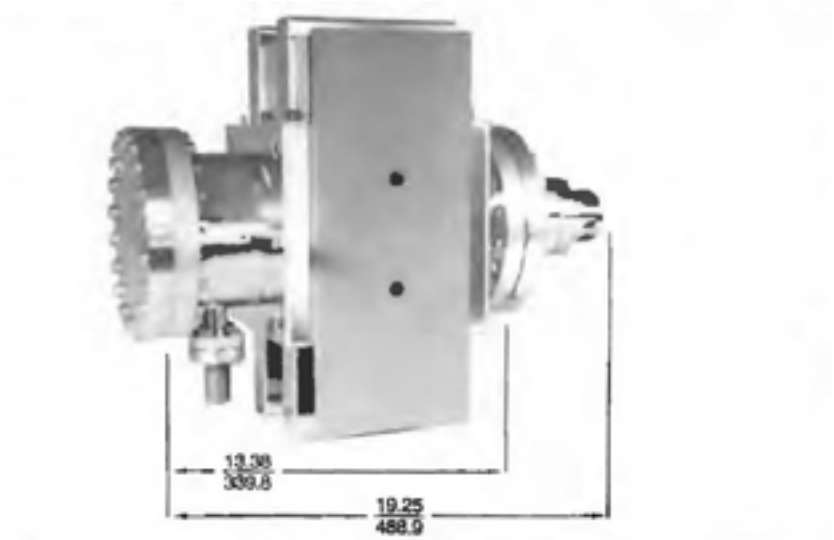


COV-500

COV-750

The model COV-750 offers an increase in speed and throughput for two reasons. First, there are 4 noble pump elements available to handle a larger throughput of non-getterable gases. Second, a liquid nitrogen cryoshroud is added. The lower temperature of the cryoshroud as a deposition surface improves the intrinsic speed of the pump. As is the case for all the Combo-Vacs, it is simple to operate and is field proven. It can be used in tube processing, vacuum deposition systems, ion accelerators, and surface research.

See page 2-21 for more details

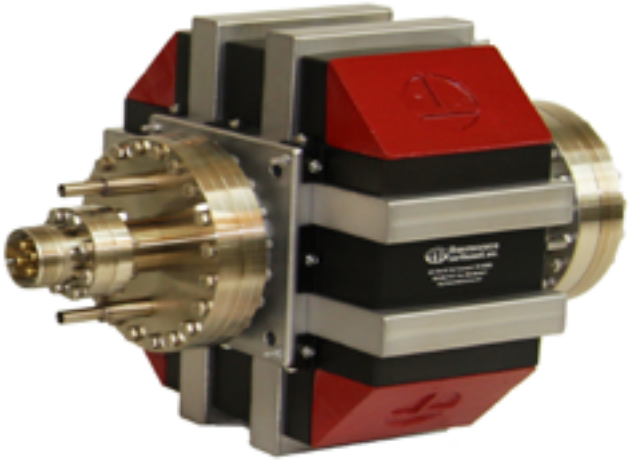


COV-750

COV-1000

The COV- 1000 is the pump of choice when the non-getterable gas load 1s larger than the COV-750 can comfortably handle.

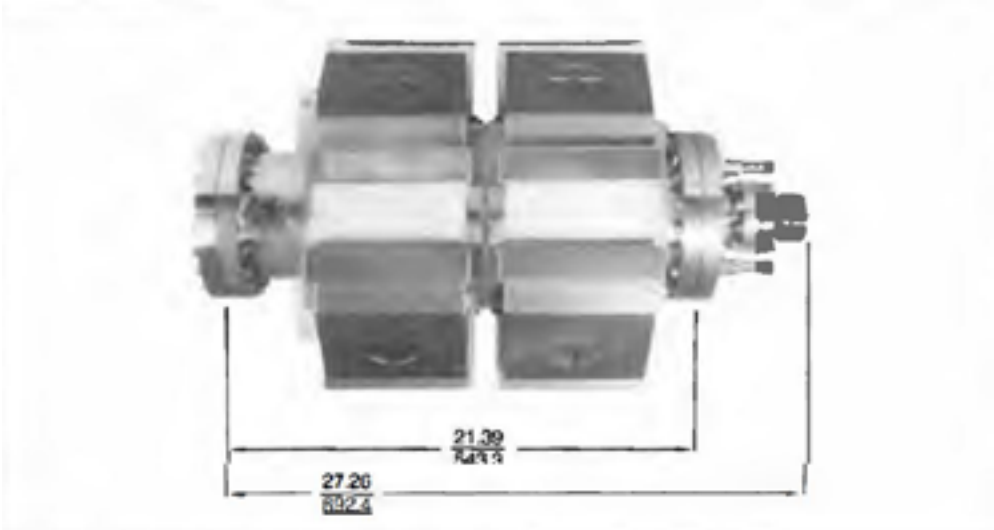
As with the other Combo-Vacs. It is shipped complete with all the components needed to get your system operational. You simply remove the blank-off flange and attach the Combo-Vac to your system. The control units are designed for rack mounting and are supplied with the high voltage and high current cables which attach to the pump. Filaments are already mounted in the sublimator assembly. Rough the system down, add LN2 to the cryoshroud (or use TLI model LNC-400 liquid nitrogen level controller; see Section 6, page 6-12), and turn on the control units. The final adjustment made at operating pressure, is to adjust the sublimator interval so that the sublimator turns on after the ores sure has risen 60 to 100% over its previous low value.



COV-1000

COV-2000

The COV-2000 offers additional throughput because the ion pump's capacity is double that of the COV-1000. That means additional speed for non-getterable gases. The overall system speed is increased by use of larger flange and shorter pump neck.



COV-2000

Combo-Vac Pumping Systems and Controls

	COV-500	COV-750	COV-1000	COV-2000
Nom. nitrogen speed, l/sec (sublimator & ion pump)	500 plus	1000	1000	2000
Nom. air speed, l/sec (ion pump)	30/60	120	220	400
Max. argon speed, l/sec (ion pump)	7	28	56	112
Sublimator control unit (see page 2-18)	PS-500	PS-500	PS-500	PS-500
Ion pump control unit (see page 2-16)	PS-100	PS-350	PS-350	PS-1000
Number of internal heaters	2	4	4	8
UHV flange size (I.D. /O.D. in inches)	6.0/8.0	6.0/8.0	6.0/8.0	6.0/8.0
Substrate coolant	water	LN_2	LN_2	LN_2
Shipping Weight {lbs)	85	130	200	304

2 Combo-Vac Pumps

Accessories

Description	Part Number	Qty./Pkg.
OFE copper gaskets for 2.75" O.D. flanges	GK-275	10/pkg
OFE copper gaskets for 3.38" O.D. flanges	GK-338	10/pkg
OFE copper gaskets for 8" O.D. flanges	GK-800	10/pkg
Titanium filaments	SB-1001	12/pkg
Bakeout heater, 125 watts, 120 VAC	IH-100	1 ea.
Pump replacement elements	See Page 2-11	
Automatic LN_2 level controller (see sec. 6, page 6-12)	LNC-400	1 ea

Ion Pump Rebuilding: All Makes, All Sizes

We offer the following services:

- Rebuild and repair all makes and sizes of ion pumps, elements and power supplies
- Reconditioned ion pumps and power supplies comply with new equipment specifications and carry a 90-day guarantee
- Reconditioned pumps are in stock for exchange or sale, please call for availability
- TLI, Varian and P-E pump elements, parts and accessories available. We rebuild the Varian StarCell pump, please call for details

Price Includes:

- Inspection
- Complete disassembly
- Chemical and mechanical cleaning of the pump body, elements and ceramic components
- Re-assembly
- 400˚C bakeout
- Pinch-off under vacuum
- Exterior refinishing
- 24-hour bench test
- 90-day guarantee

Price Does Not Include:

- New pumping elements
- New high voltage leadthroughs or ceramic insulators
- Replacement of damaged flanges or magnets
- Blank pinch-off flange

These items will be quoted separately after our incoming inspection.

Prior Authorization

Please call to receive authorization from TLI prior to shipment. No shipment will be accepted without prior authorization.

Pumps are to be securely crated with pinch-off flange and sent to Thermionics Laboratory, Inc., freight prepaid, to the attention of Customer Service.

Pump Size (l/sec)	TLI	Varian	Perkin-Elmer
	Model Number	Model Number	Model Number
8, 11	IP-11	911-505	30800/90
20/25	IP-020/025	911-5030/36	32000/90
30	-	911-5032/37	43000/10
60/80	IP-050	911-5034/38	-
100	IP-100	912-7006	70120/
140	IP-140	912-7000	Old 150 l/sec
220	IP-200	912-7014	70230/32
270	IP-270	912-7008	70280/82
400	IP-400	912-7022	70420/22
500	IP-500	912-7016	70500/02/04
HIQ		CONTACT US	

Manipulators and Mechanical Feedthroughs

Thermionics Northwest manufactures the broadest line of UHV positioning equipment current-ly available. Our goal is to provide researchers with the high-quality equipment needed in their endeavors by incorporating the greatest functional value at the lowest cost.

Thermionics Commitment

One Year Guarantee

Standard products manufactured by Thermionics are guaranteed to be free of mate-rial and workmanship defects for a period of one year. Special products and electronic components are guaranteed for a period of one-year. Expendable component parts are guaranteed for their expected service life. See complete text on page viii.

If, for any reason, you are not completely satisfied with our products, let us know. We want to address your concerns.

In this manner, our relationship with the user does not end with the delivery of the equipment. We have a large stake in your new equipment operating up to your expectations. Our goal is to be part of your success.

Design Philosophy

Our equipment is designed with a modular Framework. This permits the user to select the needed functional devices and have them work well together. This way, custom equipment, matching the requirements of the application, can be assembled efficiently. Changes in capabil-ity can also be made during the functional life of the equipment.

Equipment Selection

We routinely manufacture several series of equipment that perform the same basic task. Each series has its own characteristics with different performance levels. This is true for XYZ manipulators, translators, linear-rotary feedthroughs, etc. If in doubt, please contact us to discuss your particular application. Perhaps we can suggest a successful and more cost effective way to obtain the desired result.

In most manipulator applications, the sample size. degrees and range of freedom, and need of accuracy and rigidity determine the exact specifications of the equipment required. Increasing levels of versatility tend to increase the needed bellows size and thus the required superstructure. This can escalate into larger equipment and greater cost. Careful establishment of the needed requirements will minimize the cost of the equipment and assure performance consistent with your expectations.

Thermionics Catalog

Thermionics expands its standard product line continually by developing new and custom products to meet the technical needs of researchers worldwide. Contact Thermionics Northwest for its latest and most complete UHV sample manipulation product line.

Layout Drawings

Layout drawings are available for all our standard products. These provide the dimensions re-quired to ensure the equipment will fit in or on your system. Many of these drawings are shown in this catalog. You can also find more drawings, models, pictures and more on our website at www.thermionics.com

CAD Users

We can supply layout drawings on disk for your application. They are produced using SolidWorks®. Many are in 3D. Many CAD files can be found on our website at www.thermionics.com. If you are unable to find what you're looking for there, please contact us.

3 Ultra-High Vacuum Positioning

Terminology
We have adopted the following functional definitions when used in reference to our equipment.

Manipulator (X, Y, Z)
A manipulator is a 3-axis (X. Y, Z) positioning device. For most applications, the instrument hardware is mounted outside the vacuum chamber, with a welded bellows providing a flexible vacuum curtain. The X axis passes in front of the vertical, mechanical structure, or "back-frame," with the Y axis moving to and away from the backframe. The Z axis is perpendicular to the X and Y axes and moves up and down directly against the vacuum pressure differential. The polar axis is the same as the Z axis. The polar axis is also referred to as theta (θ).

The limit of X and Y travel is normally a circular pattern. The range is indicated as a vector sum. This means a ±1/2" range of X and Y allows the polar axis to be moved anywhere inside a 1" diameter circle. The sum of the X and Y vectors is limited to .5". Square pattern XY stages are available as options on some models.

Translators (Z)
A translator is a single axis positioning device, utilizing a bellows as a vacuum seal. They are also referred to as a "Z only" stage. This axis is normally perpendicular to the chamber. This causes the Z axis to work directly against the force from the pressure differential.

XY Stage
The XY stage provides the X and Y axes only. No Z motion is available.

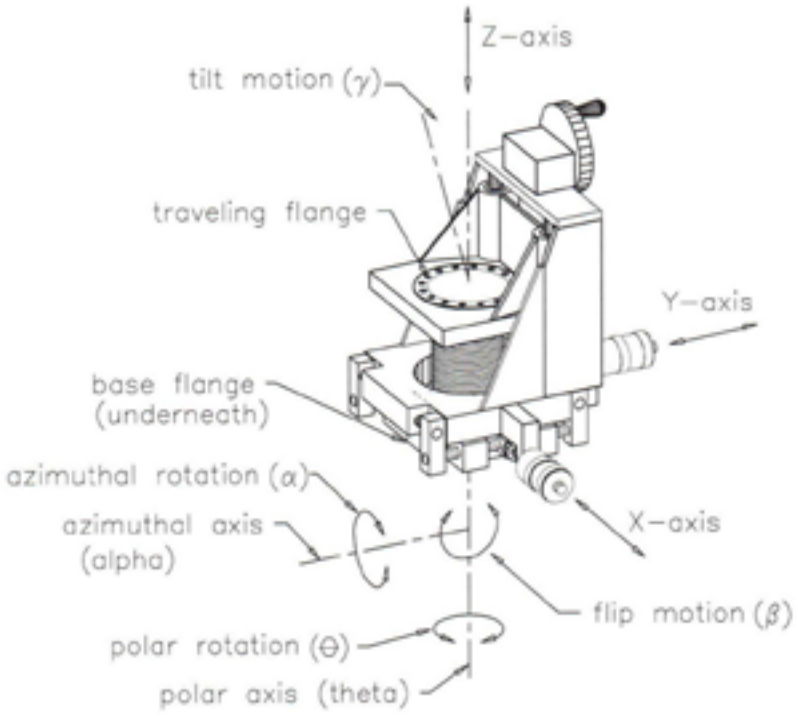
Polar Rotation (θ)
The polar axis is the same as the Z axis, above. Rotation about the polar axis is commonly achieved by mounting a rotary feedthrough at the center of the traveling flange of a manipulator or translator. This degree of freedom can also be achieved with a differentially pumped rotary seal.

Azimuthal Axis (α)
The azimuthal axis (α) is perpendicular to the polar axis (θ). Sample azimuthal rotation refers to rotation of the sample about an axis normal to the sample face and perpendicular to the polar axis.

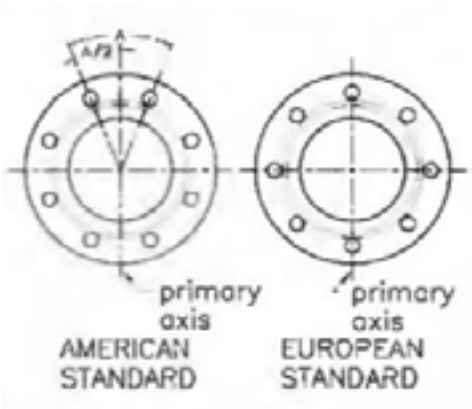
Flip (β)
Flip motion is the changing of an axis normal to the sample face from parallel (or coaxial) to the polar axis to coaxial with the azimuthal axis. The range of this change of axis may be 90°, 180° or full 360°.

Tilt (γ)
Tilt refers to changing the polar axis with respect to the X, Y and Z axes. This is usually done at the traveling flange of a 3-axis manipulator (or other exterior mounting stage). Tilt range is of-ten limited by the bellows I.D. and the O.D. of the probe passing through the bellows. The max-imum angle practical is about ± 7°. When used in this manner, translation in X, Y and (slightly) Z will occur with adjustment of the tilt angle. Tilt stages are available in single or dual axis units.

Bolt Pattern Orientation
Our equipment is manufactured with the primary axis straddling adjacent bolt holes on the mounting flange (American Standard). Most equipment can be supplied with the axis passing through a bolt hole axis (European Standard) on request. Some equipment is field adjustable.

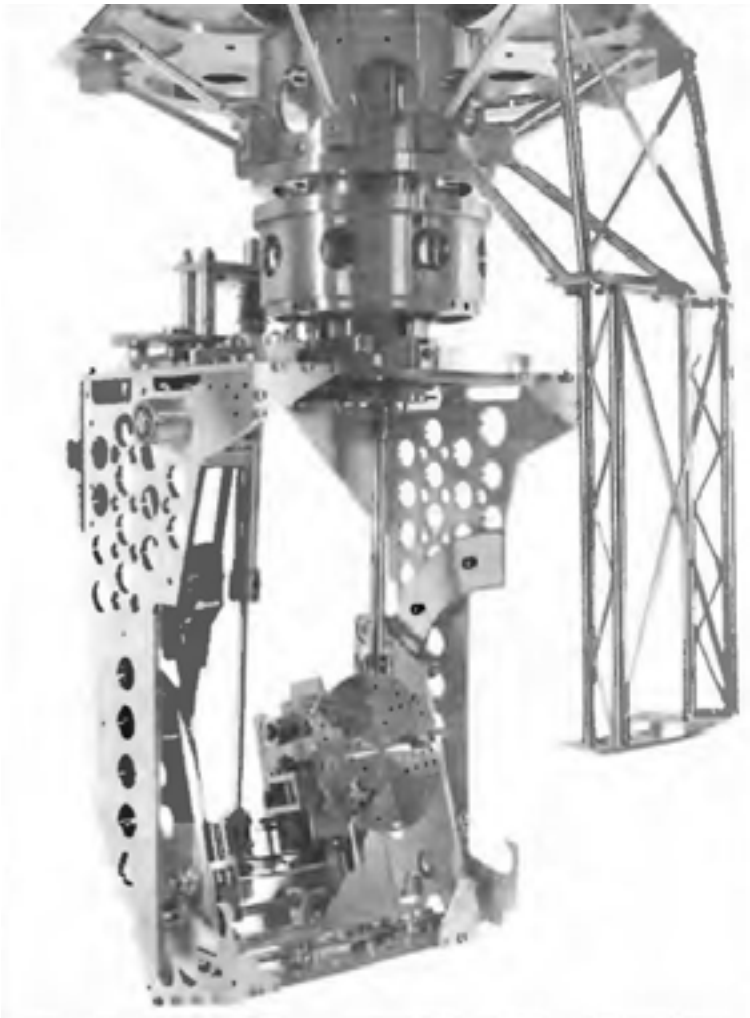


Manipulator Terminology (FB Manuipulator shown)



Bolt Pattern Orientation

Large Optic Soft X-Ray Reflectometer



8-Axis Goniometer (close up view)

Our goal is to provide researchers with the high-quality equipment needed in their endeavor. Our modular design philosophy allows us to tailor standard instruments to a particular applica-tion at a minimum cost. Often, fully meeting a customer's equipment requirements means mak-ing a modification to an existing instrument design. It may mean designing a new unit to the customer specifications. We accept this challenge as being part and parcel of our commitment to assist the researcher. Indeed, many of our new equipment designs are outgrowths of respond-ing to specific customer needs. We have even interfaced our equipment and sample handling with that of many other manufacturers.

We strive to supply this design and manufacturing service as efficiently as possible, both in terms of price and delivery. We encourage you to email us a hand sketch of your equipment needs. We are comfortable bidding to your specifications. Our standard policy is the customer reviews and approves the design drawings before custom equipment is manufactured.

A sampling of custom equipment is shown here. We can supply further information on these and many other existing designs if requested.

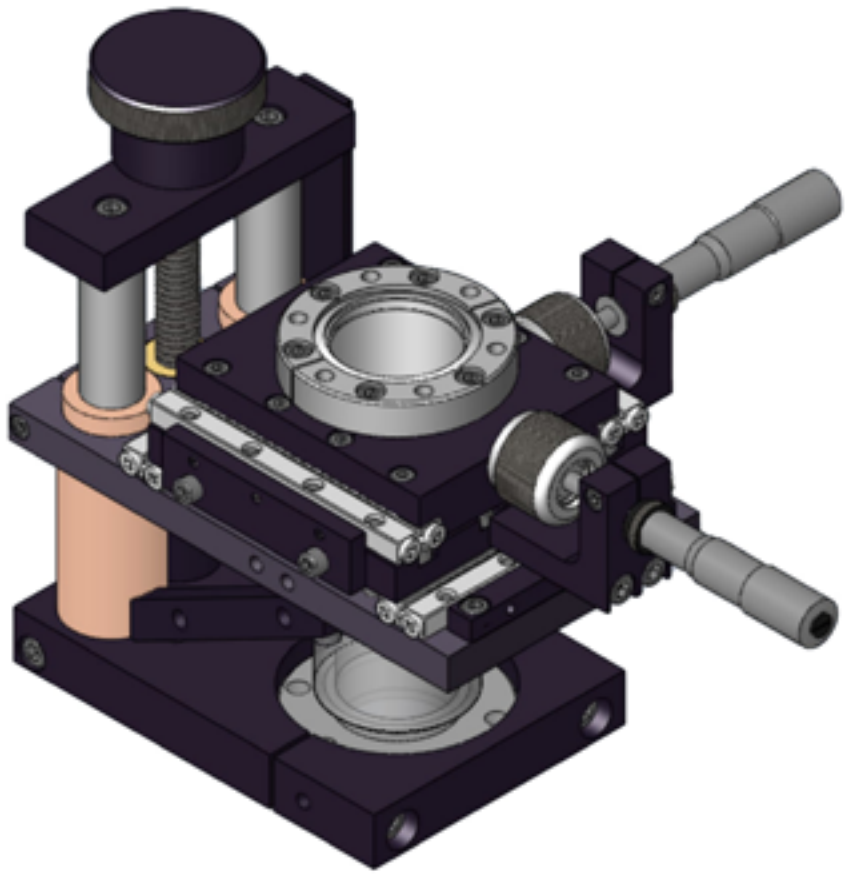
Performace

Polar, flip and detector angle
- resolution < 0.003˚
- repeatability < 0.002˚

U, V and W axis position
- resolution < 0.003˚
- repeatability < 0.003˚

8-Axis Goniometer

3 EC Series Precision Manipulators



EC-1.39-2

The EC series manipulators provide high precision positioning at minimum cost. They feature precision pre-loaded cross-roller stage control with pre-loaded micrometer-to-stage coupling. The XY guide system is made of hardened carbon steel.

EC Series Specifications

Bellows
- 1.39", 2" or 2.5" I.D. bellows

X & Y Axes
- ±0.5" X and Y travel, circular pattern, preloaded micrometer-to-stage coupling, 0.001" (or 0.0001") micrometer divisions
- Micrometers bakeable to 200°C

Z Axis
- 2" micrometer drive Z travel, 0.025"/turn, 0.001" division, 2" diameter drive knob (1.39" I.D only)
- 2", 4" and 6" Acme Z travel, 0.100"/turn knob adjust

Traveling Flange
- 2.75" O.D. traveling flange, tapped

Features
- Bakeable to 200˚C fully assembled; no castings used in construction
- Hardened steel X and Y cross-roller guides
- Dual 0.75" I.D. hardened stainless sleel Z guide rods
- Aluminum stage construction
- All position operation
- Stainless steel only material exposed to vacuum

Ordering Information — 3-Axis Ultra High Vacuum Precision Manipulators

Base Flange O.D.	Bellows I.D.	Z Travel	Model Number
2.75	1.39"	2"	**EC-1.39-2***
	1.39"	4"	**EC-1.39-4**
	1.39"	6"	**EC-1.39-6**
4.5	1.87"	2"	**EC-1.87-2**
	1.87"	4"	**EC-1.87-4**
	1.87"	6"	**EC-1.87-6**
	2.0"	2"	**EC-2.0-2**
	2.0"	4"	**EC-2.0-6**
	2.0"	6"	**EC-2.0-8**
	2.5"	2"	**EC-2.5-2**
	2.5"	4"	**EC-2.5-4**
	2.5"	6"	**EC-2.5-6**

** This model is equipped with micrometer Z drive. All other models are equipped with Acme drive*

Motion Specifications

X axis resolution < 0.001" (0.0025 mm)
repeatability < 0.00015" (0.0038 mm)
backlash < 0.00015" (0.0038 mm)

Y axis resolution < 0.0001" (0.0025 mm)
repeatability < 0.00015" (0.0038 mm)
backlash < 0.00015" (0.0038 mm)

2" Z range micrometer drive
resolution < 0.0001" (0.0025 mm)
repeatability < 0.00015" (0.0038 mm)
backlash < 0.00015" (0.0038 mm)
rigidity (1.39" I.D. bellows only)
< 0.001" change with 20lb load change

2" to 6" Z range Acme drive
resolution < 0.0005" (0.013 mm)
repeatability < 0.0005" (0.013 mm)
backlash < 0.0007" (0.018 mm)
rigidity (1.39" I.D. bellows only)
< 0.001" change with 5lb load change

Options

Base Flange

/B-6 6" O.D. base flange

/B-6M 6" O.D. base flange with 5 miniports

/LM XY Micrometers

- Large micrometers with 0.0001" divisions
- Set of two

/SSB Stainless Steel Bearings

- Replaces carbon steel cross roller bearings

/FCL Traveling Flange Modification

- Supplies traveling flange with clearance holes
- Modifies traveling stage to allow screw heads
- Allows direct mouting of tapped flange to traveling stage (e.g. RNN-150)

Note: Traveling flange bolt pattern changed to "on axis"

/MSA Axial Stepping Motor Drive

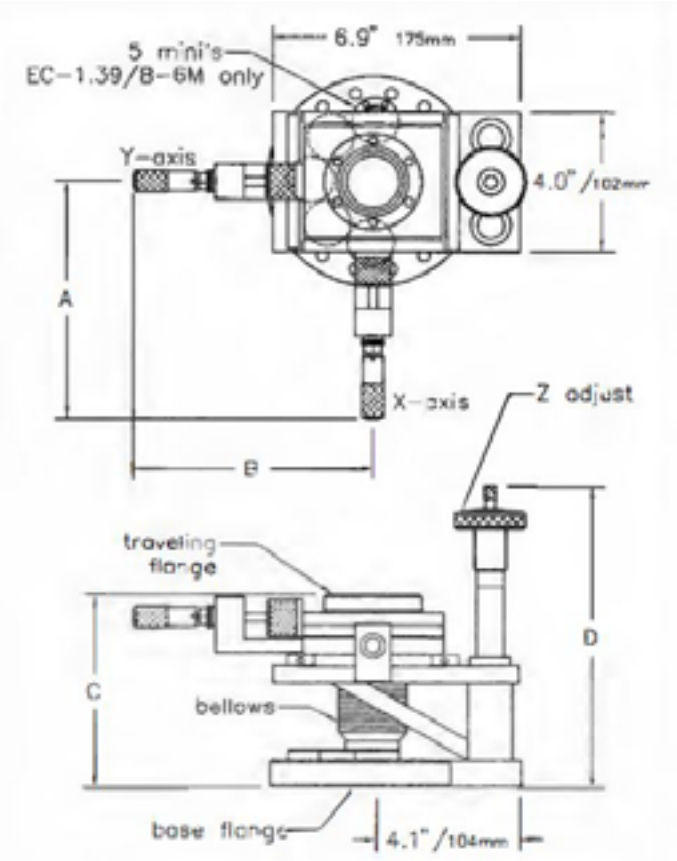
- Low cost drive for X and/or Y axes
- Direct Acme screw drive
- Axial drive stepping motors
- No manual adjust on motors

/SMC Stepping Motor Controllers

See page 3-81

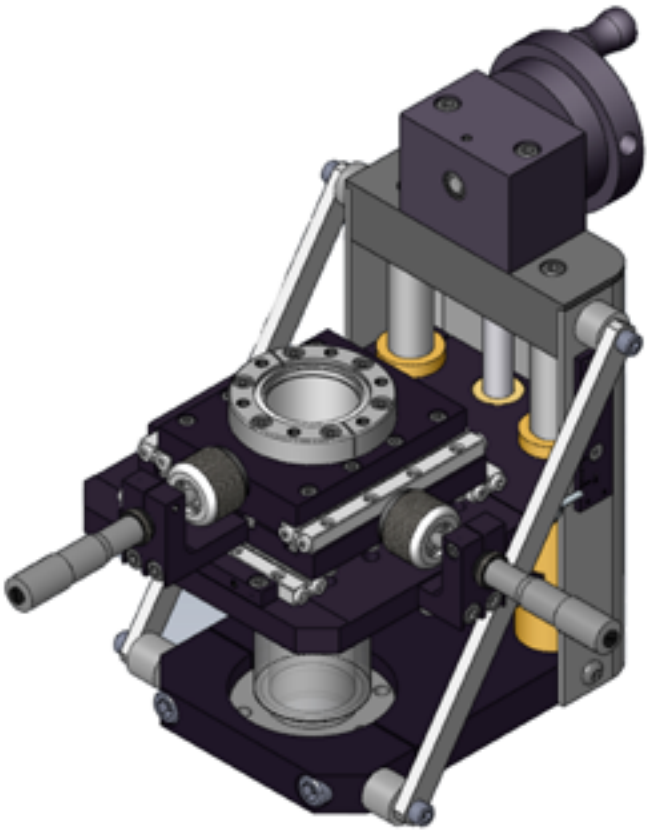
Other Options

EC-1.39-4 (shown with RNN-150/FA)



EC-1.39-2/B-6M

3 EMC-200 Series Precision Manipulators



EMC-201.39-1-1-2

The EMC-200 series is the basic workhorse of our manipulator line. It can be easily and efficiently customized to meet a broad range of applications. The EMC units have ±0.5" of travel in X and Y, with Z travel of 2" standard. The EMC series may be supplied with Z travels of up to 36" or more. They are available with 1.39" I.D. or 1.87"' I.D. bellows. They are supplied with 2.75", 4.5", 6" or 8" O.D. base flanges.

EMC Series Specifications

Bellows
- 1.39" or 1.87" I.D. bellows

X & Y Axes
- ±0.5" X and Y travel, circular pattern, preloaded micrometer-to-stage coupling, 0.0001" micrometer divisions, large drum dial micrometers (metric micrometers optional)

Z Axis
- 2" to 36+" Z travel, gearbox Acme drive, 0.100"/turn, 10 turns/inch, 0 001" divisions, position lock

Base Flange
- 6" O.D. (standard), 2.75", 4.5" and 8" optional
- 5 mini-ports on a 6" or 8" O.D. base flange (6 mini-ports with 1.39" I.D. bellows available on special request)

Traveling Flange
- 2.75" O.D. traveling flange

Features
- 0.375" O.D hardened stainless steel X and Y guide rods
- 0.500" O.D. hardened stainless steel Z guide rods
- All linear bearings hardened stainless stell
- Bakeable to 200˚C fully assembled
- X micrometer can be ordered with either left or right side mount
- Stainless steel only material exposed to vacuum

Ordering Information —
3-Axis Ultra High Vacuum Precision Manipulators - with 2" of Z travel

Bellows I.D.	Dimensions		Model Number
	A	C min*	
1.39"	11.4"	6.3"	EMC-201.39-1-1-2
1.87"	11.8"	6.7"	EMC-201.87-1-1-2

NOTE: This equipment has the shortest possible minimum flange-to-flange "C min" dimensions.* ***This distance can be changed by a large number of possible options. The C min dimension shown is only for the exact model listed. Please consult the factory for further information.*

*** Available in 2 inch increments*

Motion Specifications

X axis resolution	< 0.0001"	(0.0025 mm)
repeatability	< 0.0001"	(0.0025 mm)
backlash	< 0.00015"	(0.0038 mm)
Y axis resolution	< 0.0001"	(0.0025 mm)
repeatability	< 0.0001"	(0.0025 mm)
backlash	< 0.00015"	(0.0038 mm)
Y axis resolution	< 0.0005"	(0.0127 mm)
repeatability	< 0.0005"	(0.0127 mm)
backlash	< 0.0007"	(0.0178 mm)

Options

EMC series manipulators can be customized to meet your exact requirements. The following options can be incorporated at the time of manufacture. Some can be field retrofitted after delivery. Please consult the factory for further information.

Base Flange

Change from 6" O.D. to
/B-2.75 - 2.75" O.D. no mini-flanges
/B-4.5 - 4.5" O.D. no mini-flanges

/B-8 - 8" O.D. 5 mini-flanges

/SQ Square Pattern XY

- Provides 1" square pattern of X and Y motion for a 3/8" O.D. probe
- Requires a 1.87" I.D. bellows

/FCL Traveling Flange Modifications

- Supplies traveling flange with clearance holes
- Extends traveling flange nipple and backframe
- Allows direct mouting of tapped flange to traveling stage (e.g. RNN-150)

/ST-.75 Support Tube

- Support tube, 0.75" O.D., end bearing support
- Requires 1.87" I.D. bellows

MZD Micrometer Z Drive

- Available on 2" travel, 1.39" I.D. bellows only
- 2" diameter dial
- 0.0001" divisions

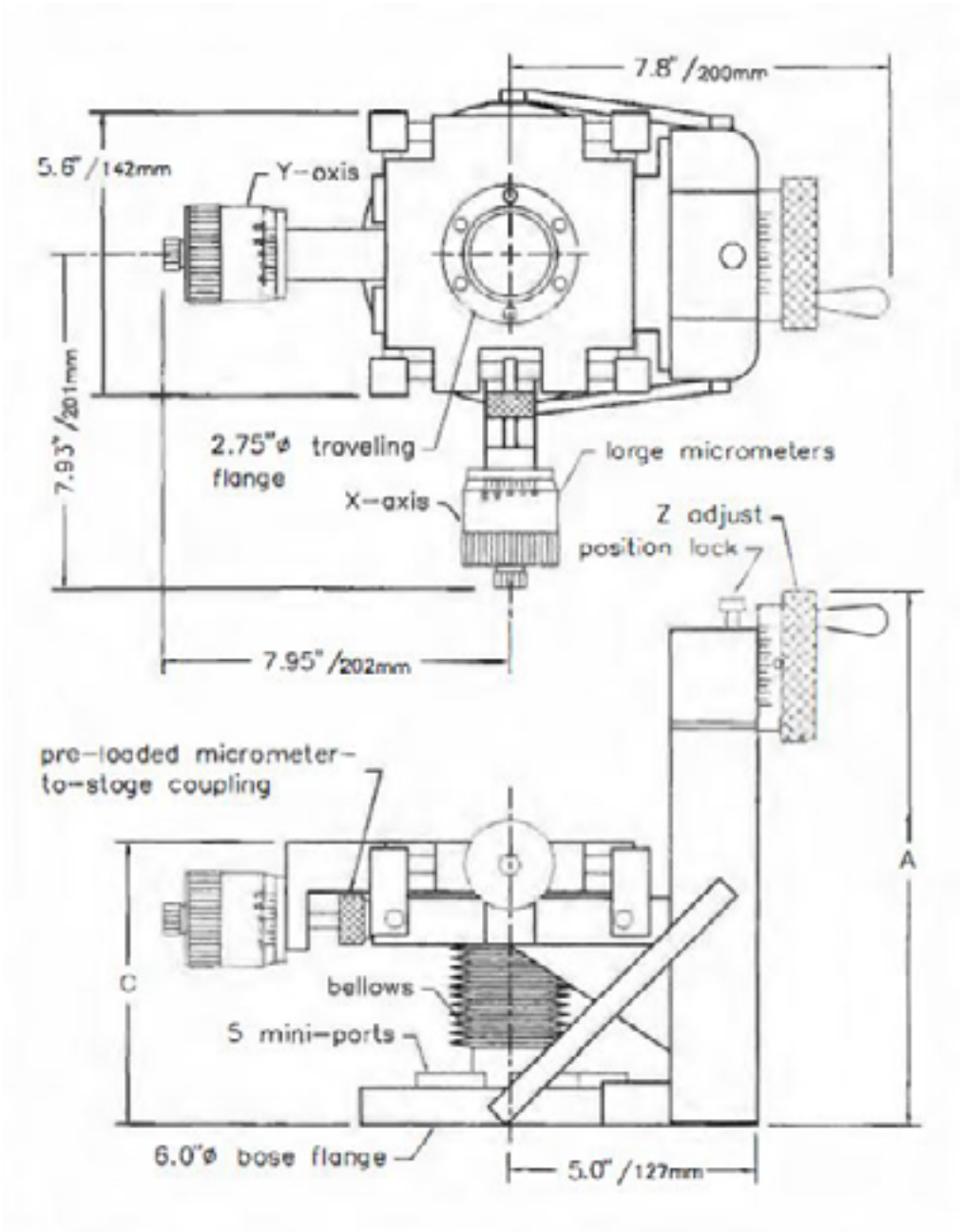
/SM Small Micrometers with 0.001" Divisions

- Set of two
- ±0.5" travel

/SMC Stepping Motor Controllers

See page 3-79

All stainless steel construction available. Please consult the factory



EMC Layout

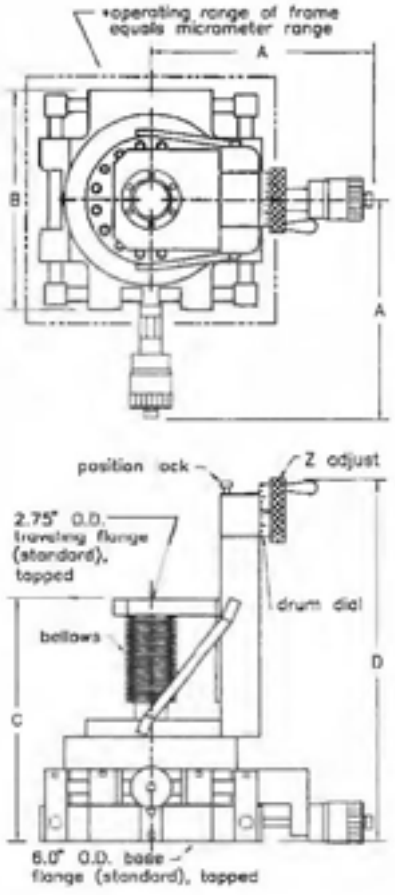
Other Options	Page No.
Polar rotation	
Rotary seals	3-27
Rotary feedthroughs	3-30
Reducer feedthrough hats	3-56
Tilts	3-24
Sample motion	3-58
Mounting	3-49
Heating	3-50
Cooling	3-52

3 FM Series Compound Precision Manipulators

FM Series

The FM series compound precision manipulator combines the XY stage from the FB manipulator series with the Z stage from the ZB precision translators. This combination works well vertically or horizontally. The FM series is available with horizontal mounting packages with custom-rated counterbalance springs to maintain "instrument"' positioning. The Z stage can be separated from the XY stage.

The FM series compound precision manipulators are XYZ units utilizing two bellows. A large I.D. short bellows located at the base of the unit is used to provide the XY operating range. A smaller I.D. bellows supplies the Z axis travel. XY bellows I.D's of 2", 2.5", 3" and 4" are standard, with inside diameters to 6.3" I.D. possible. These units are available with ±0.5" or ±1" of X and Y travel. They can be supplied with Z travel of up to 36" or more, with Z bellows I.D.s of 1.04", 1.39" and 1.87" standard. This approach provides considerable savings over the single large I.D. bellows systems, where a clear bore is not required and significant Z travel is needed.



FM Layout

A non-rotating tubular probe can also be provided with a stabilizing linear bearing at the base of the Z stage. This results in a more stable probe assembly, with a shorter effective "lever arm."

This probe option provides a center less, ground, hollow, stainless steel tube extending through the center of the manipulator bellows. This probe is mounted to the traveling flange with a double-sided flange and can be easily removed for equipment installation. This tube is stabilized by a stainless-steel linear bearing mounted at the base of the Z travel system. This bearing dramatically improves the stability of the probe.

In addition, differentially pumped rotary seals can be fitted to these manipulators. They provide an additional degree of rotary freedom for the customers' equipment. The probe bearing can be modified to allow probe polar rotation as well as polar axis linear travel. This system provides an excellent method of utility delivery.

FM Series Specifications

X & Y Axes

- ±0.5" X and Y travel, circular pattern, preloaded micrometer-to-stage coupling, 0.0001" micrometer divisions, large drum dial micrometers (metric micrometers optional)

Z Axis

- 2" to 36+" Z travel, gearbox Acme drive, 0.001" divisions, pre-loaded lead screw and worm shaft, position lock; comes with extended backgrame

Base Flange

- 4.5", 6" (standard, tapped), 8" or 10" O.D. base flange

Traveling Flange

- 2.75" (standard, tapped), 3.38" and 4.5" O.D traveling flange

Features

- /EB (standard) extended backframe
- Hardened stainless stell bearings and guide rods throughout
- All XY bearings adjustable
- Maximum bakeout temperature: 200°C

Motion Specifications

X axis	resolution	< 0.0001"	(0.0025 mm)
	repeatability	< 0.0001"	(0.0025 mm)
	backlash	< 0.00015"	(0.0038 mm)
Y axis	resolution	< 0.0001"	(0.0025 mm)
	repeatability	< 0.0001"	(0.0025 mm)
	backlash	< 0.00015"	(0.0038 mm)
Y axis	resolution	< 0.0005"	(0.0127 mm)
	repeatability	< 0.0005"	(0.0127 mm)
	backlash	< 0.0007"	(0.0178 mm)

Ordering Information —
3-Axis Ultra High Vacuum Precision Manipulators - with 2" of Z travel

XY I.D.	Z I.D.	X & Y Travel	Dimensions A	B	C min*	D	Model Number
2"	1.04"	±0.5"	11.0"	10.0"	6.50"	15.4"	FM-102-1.04-1-1-2
2.5"	1.04"	±0.5"	11.0"	10.0"	6.58"	15.5"	FM-102.5-1.04-1-1-2
		±1"	13.5"	10.0"	7.29"	16.4"	FM· 102.5-1,04-2·2-2
	1.39"***	±0.5"	11.0"	10.0"	6.58"	15.5"	FM-102.5-1.39-1-1-2
3"	1.04"	±0.5"	11.0"	10.0"	6.79"	15.7"	FM-103-1.04-1-1-2
		±1"	13.5"	10.0"	7.67"	16.6"	FM-103-1.04-2-2-2
	1.39"***	±0.5"	11.0"	10.0"	6.79"	15.7"	FM-103-1.39-1-1-2
		±1"	13.5"	10.0"	7.67"	16.6"	FM-103-1 .39-2-2-2
	1.87"	±0.5"	11.0"	10.0"	6.58"	15.5"	FM-103-1.87-1-1-2
		±1"	13.5"	10.0"	7.29"	16.4"	FM-103-1.87-2-2·2
	2.25"	±0.5"	11.0"	10.0"	6.79"	16.6"	FM-103-2.25-1-1-2
		±1"	13.5"	10.0"	7.29"	17.4"	FM-103-2.25-2-2-2
4"	1.04"	±0.5"	11.0"	10.0"	7.38"	16.3"	FM-104-1.04-1-1-2
		±1"	13.8"	10.3"	8.47"	17.4"	FM-104-1 .04-2-2-2
	1.39"***	±0.5"	11.0"	10.0"	7.38"	16.3"	FM-104-1.39-1-1-2
		±1"	13.8"	10.3"	8.47"	17.4"	FM-104-1.39-2-2·2
	1.87"	±0.5"	11.0"	10.0"	6.79"	15.7"	FM-104-1 .87-1-2
		±1"	13.8"	10.3"	8.47"	17.4"	FM-104-1.87-2-2-2
	2.25"	±0.5"	11.0"	10.0"	6.79"	15. 7"	FM-104-2.25-1-1-2
		±1"	13.8"	10.3"	8.47"	17.4"	FM-104-2.25-2-2-2

Larger diameters upon request.
NOTE: This equipment has the shortest possible minimum flange-to-flange "C min" dimensions.* ***This distance can be changed by a large number of possible options. The C min dimension shown is only for the exact model listed. Please consult the factory for further information.*
***Additional Z travel is available in 2" increments.*
****When Z stroke exceeds 12" this model is changed to a 1.53" bellows I.D. at no additional charge.*

/PL Probe Support Option
Adds linear all stainless steel bearlng at base of Z stage

Tube O.D.	Add to "C" Dimension	Model Number
0.75"	2.50"	/PL-.75
1.00"	2.65"	/PL-1
1.50"	2.25"	/PL-1 .5*
2.00"	2.50"	/PL-2

/PLR or /PTF Probe Support Option
Adds linear-rotary all stainless steel or Teflon bearing
Commonly used with RNN series rotary platform and rotating support tube

Tube O.D.	Add to "C" Dimension	Model Number	Teflon Model Number
0.75"	2.50"	/PLR-.75	/PFT-.75
1.00"	3.30"	/PLR-1	/PFT-1
1.50"	2.63"	/PLR-1 .5*	/PFT-1 .5*
2.00"	2.50"	/PLR-2	/PFT-2

**NOTE: 1.87" bellows recommended for 1.5" probes*

Options

FM series compound precision manipulators can be customized to meet your exact requirements. The following options can be incorporated at the time of manufacture. Some can be field retrofitted after delivery. Please consult the factory for further information.

Base Flange
6" O.D. (standard) base flange, tapped (clearance available, without additional charge.)

/B-8T 8" O.D. base flange, tapped

/B-10T 10" O.D. base flange, tapped

Traveling Flange
/T-3.3T 3.38" O.D. traveling flange, tapped

/T-4.5T 4.5" O.D. traveling Fiange, tapped

/HMP Horizontal Mounting Package
(Suitable for most FM models, up to 6" Z travel)
- Base flanges modified as required
- Oversized guide rods
- Two force spring assemblies, custom force level based on customer payload

/ST-.75 Custom Support Tube, 0.75" to 3"0.D.
- End bearing support for rotary shaft
- Length specified by customer

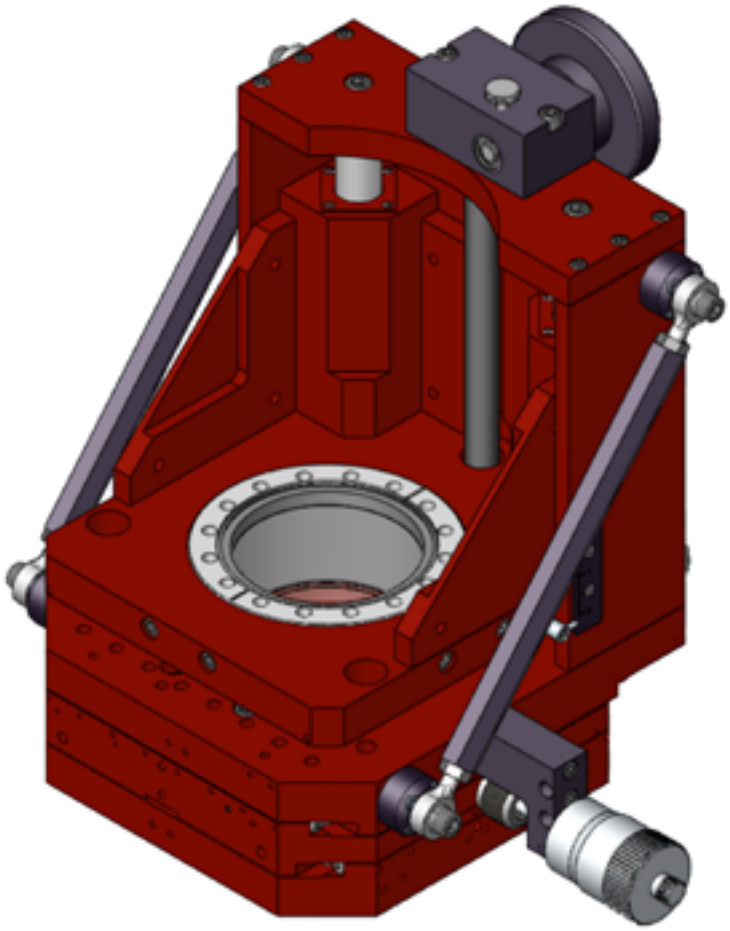
/SM Small Micrometers with 0.001" Divisions
Set of two
- ±0.5" travel
- ±1" travel

/MS Stepping or /MY Synchronous Motor Drive
See page 3-79

/LP Lifting Package
- Stainless steel lifting eyes
- Custom sling assembly
- Suitable for up to 200 lb systems

/LH Lifting Handles
- Stainless steel lifting handles
- Consult factory for application

3 FB Series Precision Manipulators



FB Series

FB series manipulators provide large I.D. bellows and the mechanical strength required for significant payloads. Bellows I.D.s of 2”, 25”, 3” and 4” are standard, with inside diameters to 6.3” I.D. possible. These manipulators are available with ±0 5” or ±1 “X and Y travel. 2” Z travel is standard. Travels of up to 36” or more can be supplied.

The FB series can be ordered in the standard cantilever model or with the 3-lead screw option. The cantilever model has an 80 lb payload rating in the vertical orientation, and the 3-lead screw model has a 200 lb payload rating.

The FB series is available with horizontal mounting packages with custom-rated counterbalance springs to maintain “instrument” positioning.

Differentially pumped rotary seals provide an additional degree of rotary freedom for customers’ equipment at full bellows I .D.

FB Series Specifications

X & Y Axes

- ±0.5” X and Y travel, circular pattern, preloaded micrometer-to-stage coupling, 0.0001” micrometer divisions, large drum dial micrometers (metric micrometers optional)

Z Axis

- 2” to 36+” Z travel, 4.1 worm Acme gearbox drive, 0.050”/turn (20 turns/inch), 0.001” divisions. pre-loaded lead screw and worm shaft, position lock

Base Flange

- 4.5”, 6” (standard), 8” or 10” O.D. base flange

Traveling Flange

- 4.5”, 6” (standard) or 8” O.D. traveling flange

Features

- Super rigid 5-sided box construction
- Hardened stainless steel bearings and guide rods throughout
- All bearings adjustable
- Wide spacing (7” to 9”) on all guide rods
- Wide spacing (6’’) of bearings on rods
- Maximum bakeout temperature: 200°C with micrometers attached

Ordering Information —
3-Axis Ultra High Vacuum Precision Manipulators - with 2” of Z travel

Bellows I.D.	X & Y Travel	Dimensions			Model Number
		A	B	C min*	
2”	±0.5”	11.0”	10.0”	4.66”	FB-102-1-1-2
2.5”	±0.5”	11.0”	10.0”	4.66”	FB-102.5-1-1-2
	±1”	13.5”	10.0”	5.08”	FB-102.5-2-2-2
3”	±0.5”	11.0”	10.0”	4.69”	FB-103-1-1-2
	±1”	13.5”	10.0”	5.57”	FB-103-2-2-2
4”	±0.5”	11.0”	10.0”	5.30”	FB-104-1-1-2
	±1”	13.8”	10.3”	6.39”	FB-104-2-2-2

Larger diameter bellows available upon request

NOTE: This equipment has the shortest possible minimum flange-to-flange “C min” dimensions.* ***This distance can be changed by a large number of possible options. The C min dimension shown is only for the exact model listed. Please consult the factory for further information.*

Motion Specifications

X axis	resolution	< 0.0001”	(0.0025 mm)
	repeatability	< 0.0001”	(0.0025 mm)
	backlash	< 0.00015”	(0.0038 mm)
Y axis	resolution	< 0.0001”	(0.0025 mm)
	repeatability	< 0.0001”	(0.0025 mm)
	backlash	< 0.00015”	(0.0038 mm)
Y axis	resolution	< 0.0002”	(0.0051 mm)
	repeatability	< 0.0003”	(0.0076 mm)
	backlash	< 0.0006”	(0.0152 mm)

Options

Base Flange

- 6” O.D. (standard) base flange, tapped (clearance available, without additional charge)
- **/B-8T** - 8” O.D. base flange, tapped
- **/B-10T** - 10” O.D. base flange, tapped

Traveling Flange

- **/T-4.5T** - 4.5” O.D. traveling flange, tapped
- **/T-8T** - 8” O.D. traveling flange, tapped

/ST-.75 Custom Support Tube, 0.75” to 3” O.D.

- End bearing support for rotary shaft
- Length specified by customer

/3LS 3-Lead Screw

- 3 Acme screw support to traveling flange
- Minimizes traveling flange deflection
- Used for increased payload requirements
- Used for long Z stroke application
- Required when mounting an RNN-400/FA to the traveling flange

Z drive anti-backlash coupling available on all drives

/TLT-4-2-FB Integral Tilt Stage

- Provides ±5˚ tilt in two axes
- Uncalibrated adjusting screws
- Provides full manipulator bellows I.D.

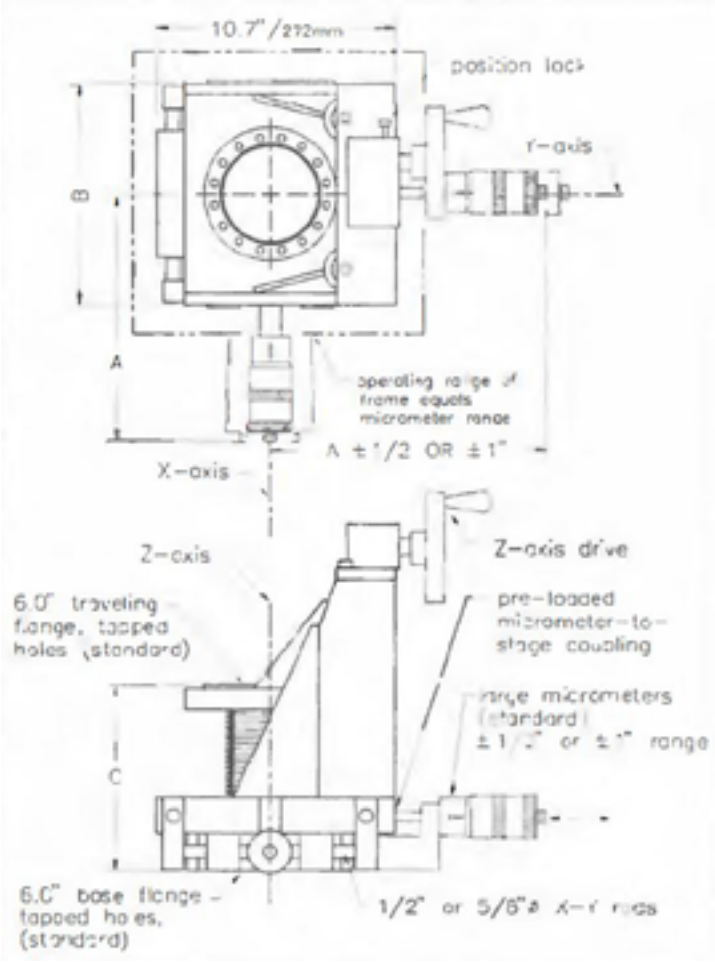
/HMP Horizontal Mounting Package

(Suitable for most FB models, up to 6” Z travel)

- Base flanges modified as required
- Oversized guide rods
- Two force spring assemblies, custom force level based on customer payload

/FB-160 Long Stroke Horizontal Mounting Package

- XY stage is mounted on the traveling flange
- Suitable for horizontal mounting of long stroke, wide bore manipulators
- All items in /HMP package above, except only one spring assembly, as required
- Stationary Z back allowing simple additional support
- Traveling X & Y stages, with a maximum throat diameter of 2.87” I.D.



FB-104

/SM Small Micrometers with 0.001” Divisions

Set of two

- ±0.5”travel
- ± 1”travel

/LP Lifting Package

- Stainless steel lifting eyes
- Custom sling assembly
- Suitable for up to 200 lb systems

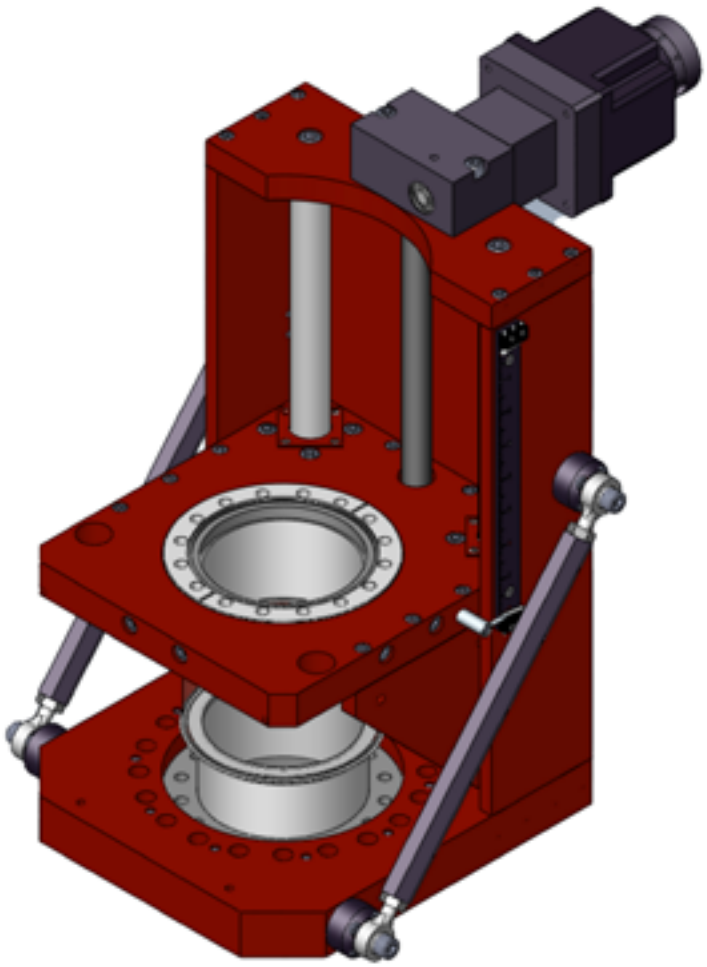
/LH Lifting Handles

- Stainless steel lifting handles

/MS Stepping or /MY Synchronous Motor Drive

See page 3-79

3 FBT Series Precision Translators



FBT series translators provide single-axis (Z only) motion. They are based on the FB-100 series manipulator Z drive. These units offer unparalleled mechanical support for customer payloads. They are available with bellows I.D.s of 2", 2.5'', 3" and 4", with larger I.D.s available. Standard base and traveling flange sizes are 6" O.D., with tapped or clearance holes, as required. Other flange diameters available. Options include 3-lead screw version for extra-heavy payloads (to 200 lbs) and 10" O.D. base flange for horizontal mounting. The Z drive is an Acme screw with a precision 4:1 gearbox. The stage position is indicated to 0.001" divisions.

FB Series Specifications

Z Axis

- 2" to 36+" Z travel, 4.1 worm Acme gearbox drive, 0.050"/turn (20 turns/inch), 0.001" divisions. pre-loaded lead screw and worm shaft, position lock

Base Flange

- 4.5", 6" (standard), 8" or 10" O.D. base flange

Traveling Flange

- 4.5", 6" (standard) or 8" O.D. traveling flange

Features

- Super rigid 5-sided box construction
- Hardened stainless steel bearings and guide rods throughout
- All bearings adjustable
- Wide spacing (7" to 9") on all guide rods
- Wide spacing (6'') of bearings on rods
- Maximum bakeout temperature: 200°C with micrometers attached

Motion Specifications

Z axis	resolution	< 0.0002"	(0.005 mm)
	repeatability	< 0.0005"	(0.013 mm)
	backlash	< 0.0008"	(0.020 mm)

FBT Series

Ordering Information —
3-Axis Ultra High Vacuum Precision Translators -
with 2" of Z travel

Bellows I.D.	Dimensions C min*	Model Number
2"	3.06"	**FB-102-2**
2.5"	3.06"	**FB-102.5-2**
3"	3.06"	**FB-103-2**
4"	3.06"	**FB-104-2**
6"	Consult factory	**FB-106-2****
8"	Consult factory	**FB-108-2****

Larger diameter bellows available upon request

NOTE: This equipment has the shortest possible minimum flange-to-flange "C min" dimensions.* ***This distance can be changed by a large number of possible options. The C min dimension shown is only for the exact model listed. Please consult the factory for further information.*

***NOTE: Requires /3LS option*

Options

/3LS 3-Lead Screw

- 3 Acme screw support to traveling flange
- Used for increased payload requirements
- Used for long Z stroke application

Z drive anti-backlash coupling available on all drives

/LP Lifting Package

- Stainless steel lifting eyes
- Custom sling assembly
- Suitable for up to 200 lb systems

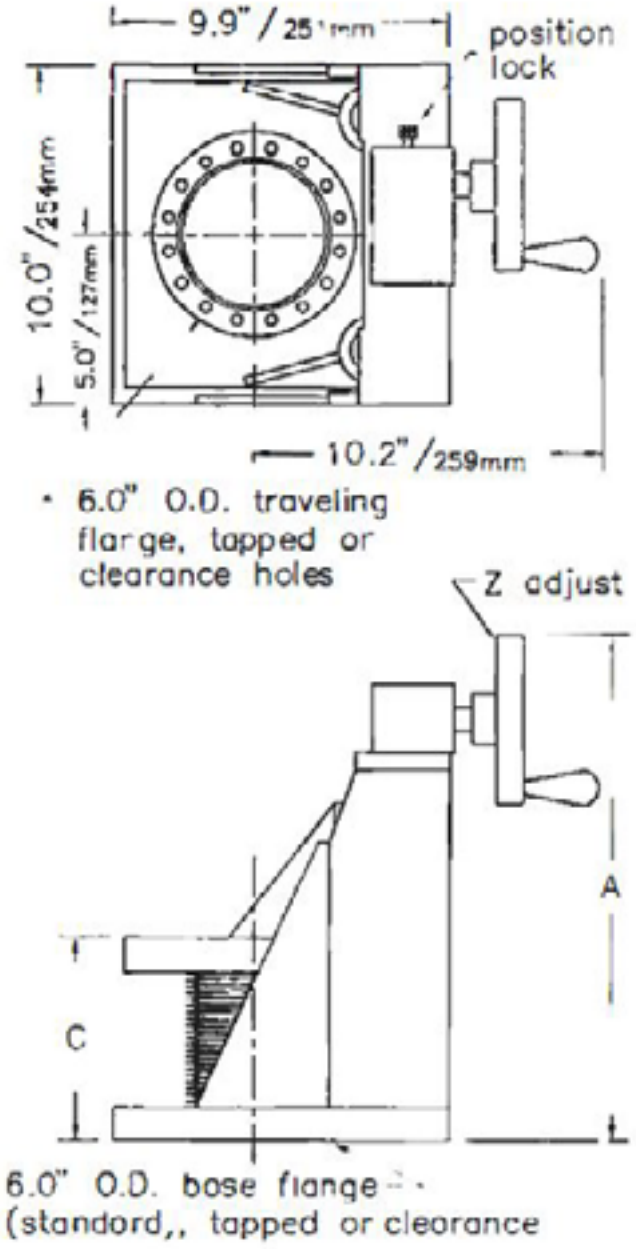
/LH Lifting Handles

- Stainless steel lifting handles

IMS Stepping or /MY Synchronous Motor Drive

See page 3-79

Other Options



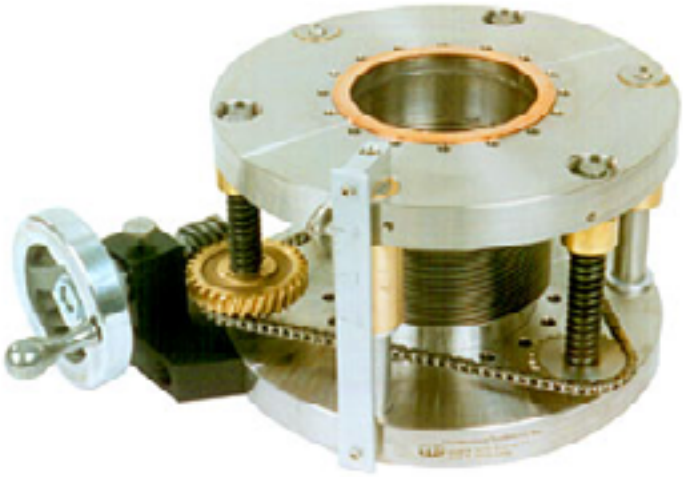
FBT Layout

3 ECT Jacking Stages

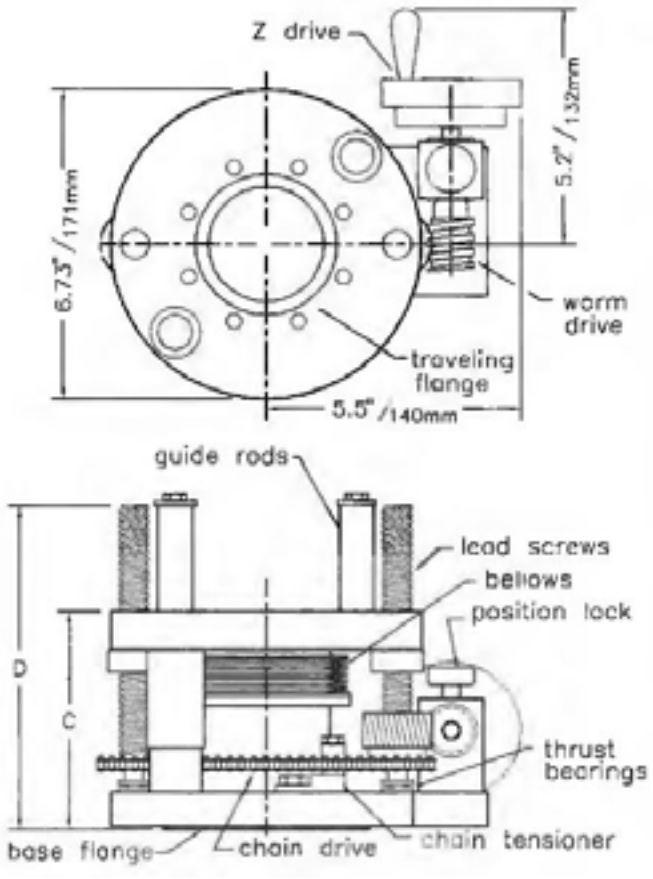
ECT series translators provide single axis (Z only) motion. This series provides short strokes of Z travel with a wide range of bellows I.D. All units employ two or three lead screws and two or three precision-ground stainless steel guide rods. These units offer excellent mechanical support. They are well suited to applications involving equipment insertion and withdrawal from investigative points where space is restricted. These jacking stages are all metal and bakeable. Adjustable preset stops are optional.

The ECT series is designed to handle customer payloads up to 45 lbs standard, in a vertical orientation with the center of gravity on axis. Horizontal mounting and cantilever loads can be handled on many units. Please consult the factory for your particular application.

The stages are available with bellows I.D.s from 1.39" through 6" standard, with larger I.D.s available.



ECT Series



ECT/2LS Layout

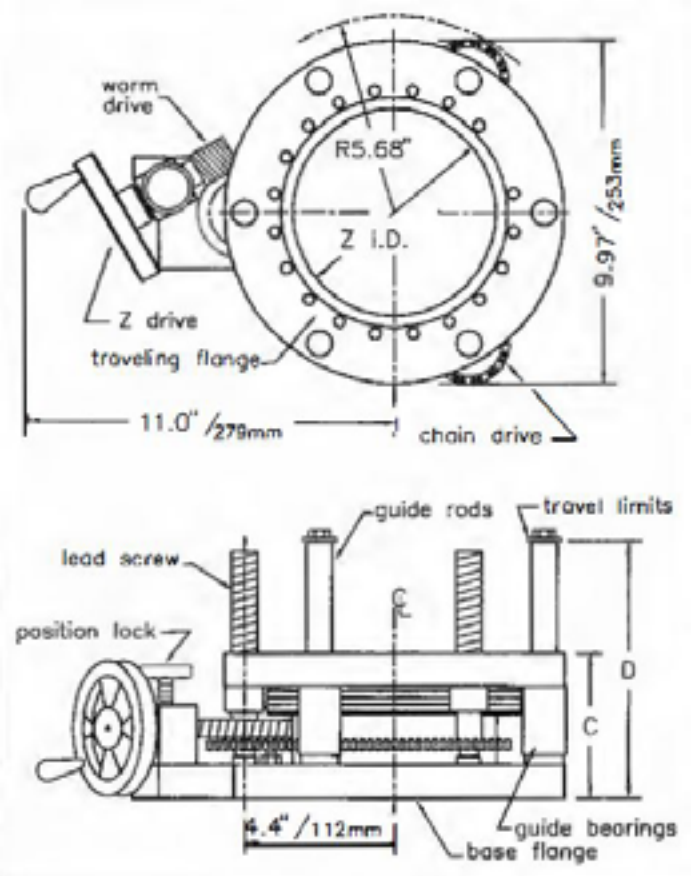
ECT Series Specifications

- 2" to 6" Z travel. worm Acme gearbox drive, pre-loaded lead screw and worm shaft, position lock
- /2LS 2-Lead Screw 2. 75" or 4.5" 0 .0. base flange detail 2.75" or 4.5" O.D. traveling flange detail, tapped
- /3LS 3-Lead Screw 4.5", 6" or ff' 0 .0. base flange detail 4.5", 6" or 8" O.D. traveling flange detail, tapped
- Hardened stainless steel guide rods throughout
- Bronze bushings
- Maximum bakeout temperature: 200°C
- Without position indicator

Motion Specifications

Y axis resolution < 0.001" (0.025 mm)
With /PI option readable to 0.01"

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com



ECT/3LS Layout

ECT-4-2/3LS-6

ECT-3-2/3LS-6 with RNN-250/FA/MFD

Ordering Information — Single-Axis Ultra High Vacuum Precision Translators - with 2" of Z travel

Bellows I.D.	Lead Screws	Flange Detail	Max. Z Travel Available	Model Number
1.39"	/2LS	2.75"	6	ECT-1.39-2/2LS-2.75
1.87"	/2LS	2.75"	6	ECT-1.87-2/2LS-2.75
2.50"	/2LS	4.50"	6	ECT-2.5-2/2LS-4.5
3.00"	/3LS	6.00"	6	ECT-3-2/3LS-6
	/3LS	8.00"	6	ECT-3-2/3LS-8
4.00"	/3LS	6.00"	6	ECT-4-2/3LS-6
	/3LS	8.00"	6	ECT-4-2/JLS-8
5.00"	/3LS	8.00"	6	ECT-5-2/JLS-8
6.00"	/3LS	8.00"	6	ECT-6-2/3LS-8

Options

/STOP Adjustable Preset Stop

- Adjustable Acme screw stop with set

/PI Position Indicator

- Scale and pointer

3 XY Stages With Bellows

XY stages use the standard manipulator XY platforms to provide precise 2-axis positioning. The stages are available in four sizes. All include bellows. Stages are available with I.D.s from 1.39" to 6.3" (see below). Stage construction is of 6061 series aluminum (300 series stainless steel available) All feature pre-loaded micrometer-to-stage coupling and all stainless steel guide rails and bearings (the EC and EB series use hardened carbon steel cross-rollers). Larger units incorporate fully adjustable bearings. Maximum bakeout temperature: 200°C

Motion Specifications

ECXY Series

X & Y Axes

resolution	< 0.0001"	(0.0025 mm)
repeatability	< 0.00015"	(0.0038 mm)
backlash	< 0.00015"	(0.0038 mm)

EMXY Series

X & Y Axes

resolution	< 0.0001"	(0.0025 mm)
repeatability	< 0.0001"	(0.0025 mm)
backlash	< 0.00015"	(0.0038 mm)

FBXY Series

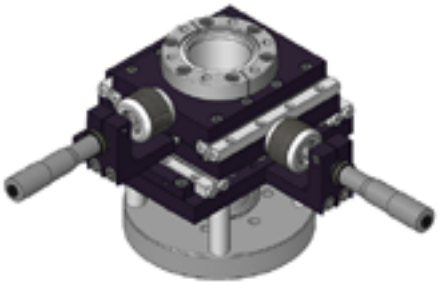
X & Y Axes

resolution	< 0.0001"	(0.0025 mm)
repeatability	< 0.0001"	(0.0025 mm)
backlash	< 0.00015"	(0.0038 mm)

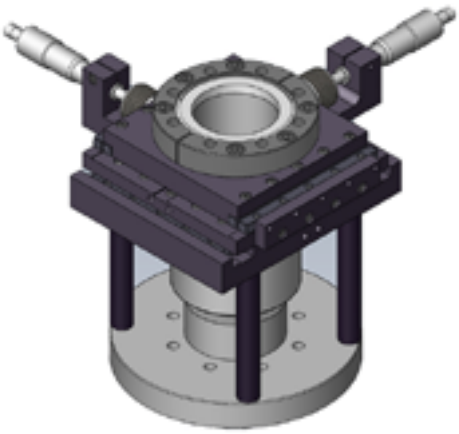
EBXY Series

X & Y Axes

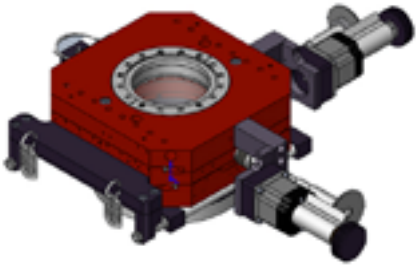
resolution	< 0.0001"	(0.0025 mm)
repeatability	< 0.0001"	(0.0025 mm)
backlash	< 0.00015"	(0.0038 mm)



ECXYB



EMXYB



FBXYB

XY Stage with Bellows

I.D.	X & Y Range	Mat	Dimensions		XY Rods	Model Number
			B	C		
1.39"	±0.5"	Al	-	4.70"	-	ECXYB-1.39-1
1.39"	±0.5"	Al	-	3.18"	3/8"	EMXYB-1.39-A-1
1.39"	±0.5"	SS	-	3.18"	3/8"	EMXYB-1.39-S-1
1.87"	±0.5"	Al	-	4.20"	3/8"	EMXYB-1.87-2A-1
1.87"	±0.5"	SS	-	4.20"	3/8"	EMXYB-1.87-2S-1
2.00"	±0.5"	Al	10"	3.69"	1/2"	FBXYB-2.0-A1
2.50"	±0.5"	Al	10"	4.09"	1/2"	FBXYB-2.5-A1
2.50"	±1"	Al	10"	4.89"	1/2"	FBXYB-2.5-A2
3.00"	±0.5"	Al	10"	4.20"	1/2"	FBXYB-3.0-A1
3.00"	±1"	Al	10"	5.08"	1/2"	FBXYB-3.0-A2
4.00"	±0.5"	Al	10"	4.81"	1/2"	FBXYB-4.0-A1
4.00"	±1"	Al	10.25"	5.78"	5/8"	FBXYB-4.0-A2
5.00"	±1"	Al	-	-	-	EBXYB-5.0-A2
6.30"	±1"	Al	-	-	-	EBXYB-6.3-A2

Base Flange

ECXYB and EMXYB

- 2.75" O.D. base flange, tapped, on 1 39" I.D. bellows unit
- 4.5" O.D. base flange tapped, on 1.87" I.D. bellows unit

FBXYB

- 6" O.D. (Standard) base flange, tapped

Other flange sizes available

EBXYB

- 8" O.D. (Standard) base flange, tapped

Other flange sizes available

Traveling Flange

ECXYB and EMXYB

- 2.75" O.D. traveling flange, tapped

FBXYB

- 6" O.D. (standard) traveling flange, tapped

Other flange sizes available

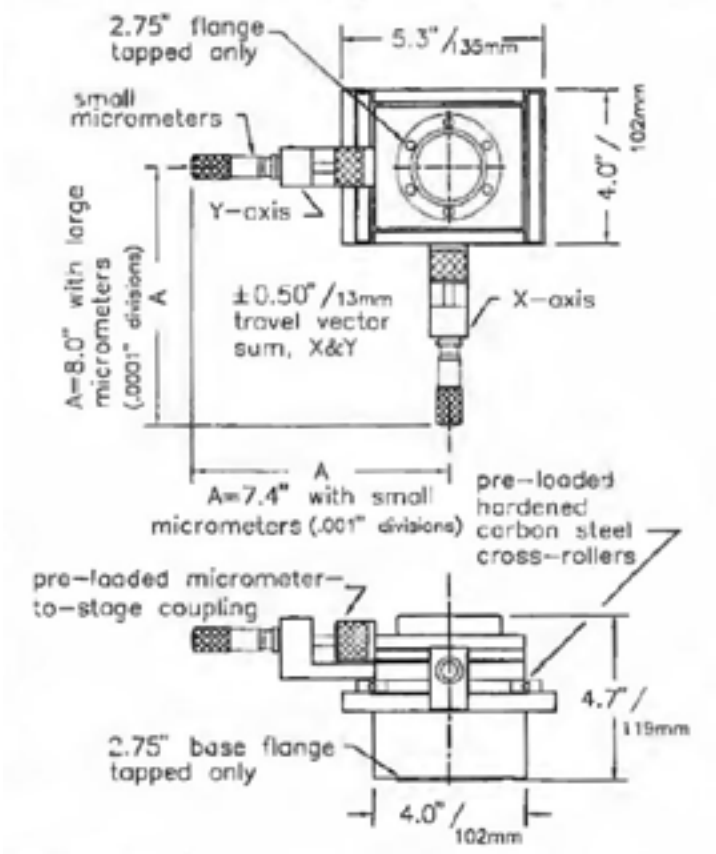
Features

- Removable micrometers for bakeout
- All stainless steel guide rods and bearings
- Pre-loaded micrometer-to-stage coupling
- Large units incorporate fully adjustable bearings
- Maximum bakeout temperature: 200°C

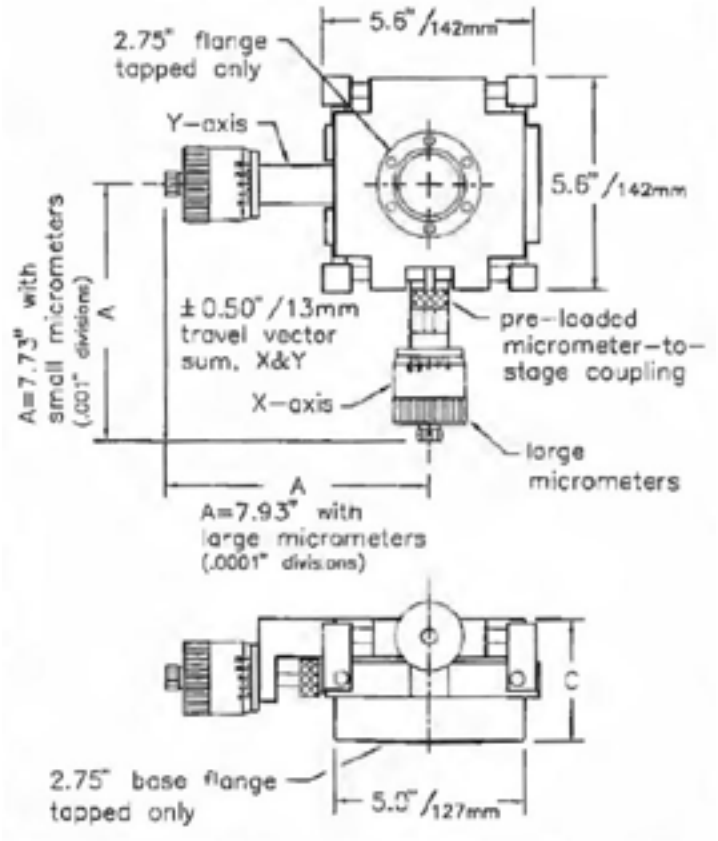
Options

/HMP Horizontal Mounting Package for ECXYB, EMXYB, FBXYB and EBXYB Units

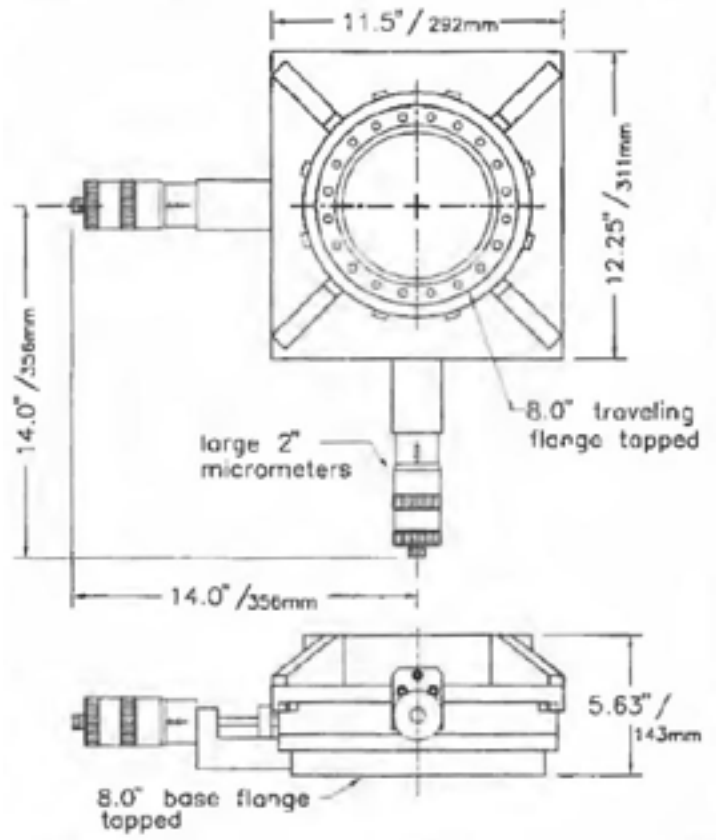
- Larger (up to 10" O.D.) base flange, as required, flange face O.D. as per customer requirements
- Oversized guide rods, as required
- Modified travel limit
- Two force spring assemblies, custom force level based on customer payload



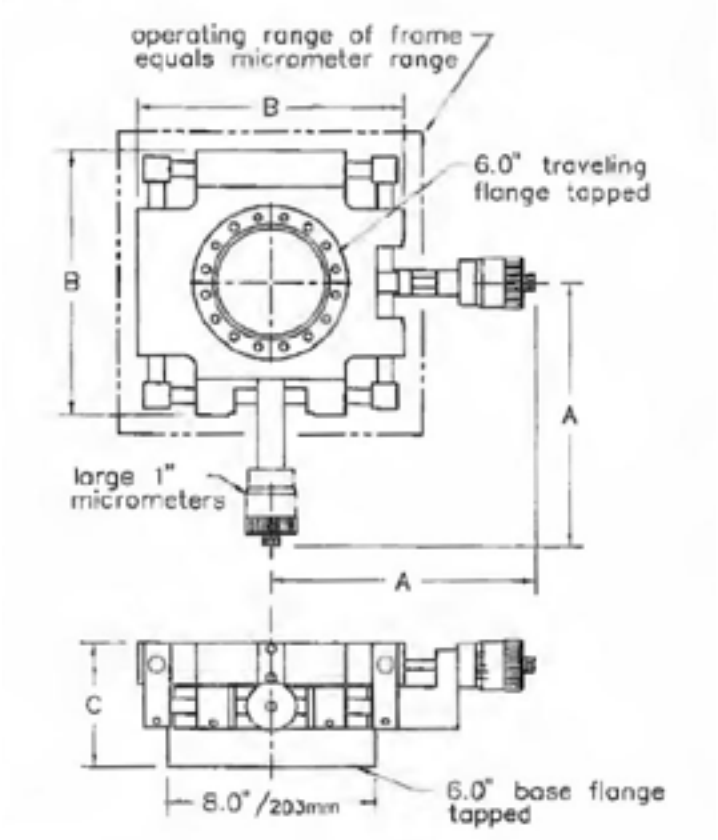
ECXYB Layout



EMXYB Layout



EBXYB Layout



FBXYB Layout

3 Tilt Systems

Tilt stages allow a precise angle alignment to be established (and repeated) between two flanges. When the base flange of a tilt stage is attached to the chamber flange (or traveling stage of a positioning device) and a probe is attached to the tilting flange, probe angle and tip position can be changed.

Tilts can also be used as an inexpensive method to align docking systems and actuate sample transfers. The TLT series was designed for that purpose and is constructed for cantilever (horizontal) loads. TLT tilt stages are available in single and dual axis units

GBLM-1.5 Precision Tilt Stage

- Dual micrometer adjust
- 1.5" I.D.
- 2.75" O.D. base flange, clearance holes
- 2.75" O.D. tilting flange, tapped
- Demountable with independent, formed, stainless steel bellows
- Stainless steel ball bearing pivots
- Bakeable to 200°C fully assembled
- Up to ±7° tilt range *(NOTE: When used with an XYZ manipulator, actual angular range available for the tilt stage is limited by manipulator bellows I.D., axial probe O.D., and the flange-to-flange distance of Z range position)*
- Dual angle lock

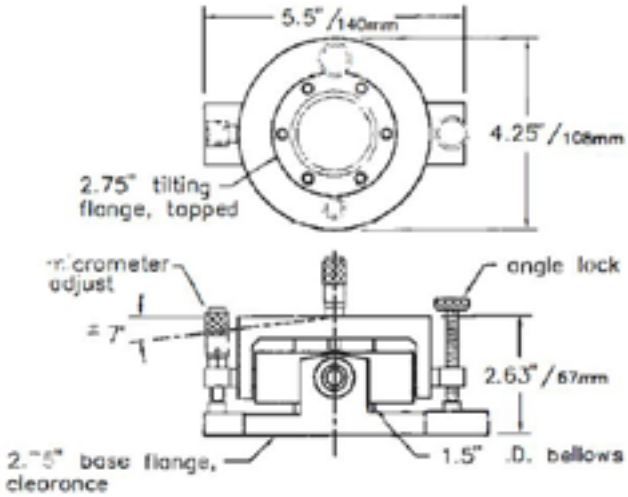
TLT-1.5-1 Single Axis Tilt Stage

- 1.5" I.D. formed bellows
- 2.75" O.D. flanges, tapped
- Knob adjust on one axis
- ±5° tilt range
- Roller bearing pivots suitable for horizontal mounting (cantilever) of payloads
- Maximum bakeout temperature: 200°C

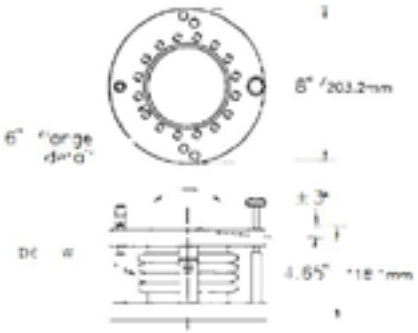
TLT-1.5-2 Dual Axis Tilt Stage

- 1.5" I.D. formed bellows
- 2.75" O.D. flanges, tapped
- Knob adjust or two axes
- ±5° tilt range
- Roller bearing pivots suitable for horizontal mounting (cantilever) of payloads such as FLLRE and RPLR transfer units (consult factory for application)
- Maximum bakeout temperature: 200°C

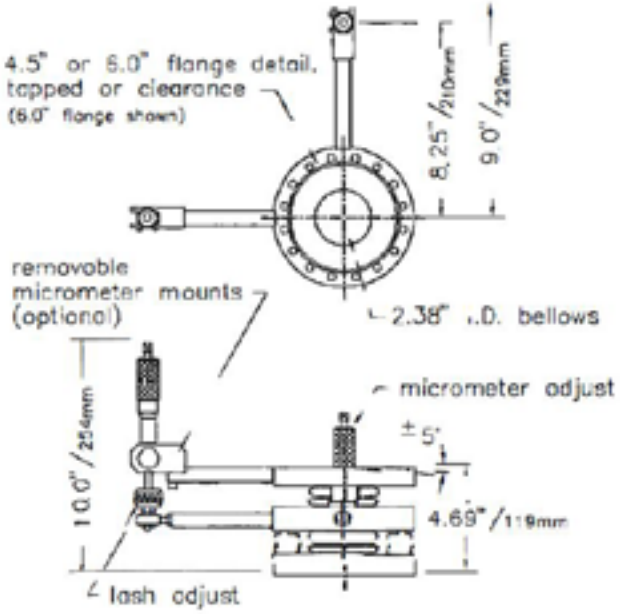
FLLRE linear-rotary feedthroughs are manufactured and protected under one or more following patents 5,514,925



GBLM-1.5



TLTM-4.0-1



TLTM-2.5-2

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

TLTM-4.0-1 Single Axis Tilt Stage

- Micrometer adjust, bakeable
- 4.0" I.D. formed bellows
- 6" O.D. flange faces, tapped, 8" flange
- ±5° tilt range
- Roller bearing pivots
- Maximum bakeout temperature: 200°C

Other bellows I.D. dual axis and angle range available

TLTM-2.5-2 Dual Axis Tilt Stage

- Micrometer adjust
- Heavy built for mounting manipulator on top
- 2.5" I.D. formed bellows
- 6'' base flange with clearance holes
- 6" top flange. tapped
- ±5° tilt range
- Suitable for vertical or horizontal (cantilever) payloads

TLTW-1.5-2 Dual Axis Tilt Stage

- Wrench adjust on two axes (3-point adjustment)
- 1.5" I.D. formed bellows
- 2.75" O.D. falnges, tapped
- ±4° tilt range
- Suitable for horizontal mouonting (cantilever) of payloads.
- Maximum bakeout temperature: 200°C

Options

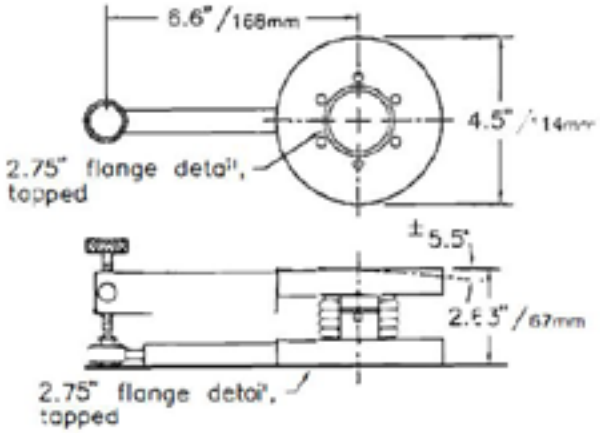
/B-6 Base Flange

- For all TLT series
- Replaces 2.75" O.D. base with 6" O.D.
- Allows throughhole mounting

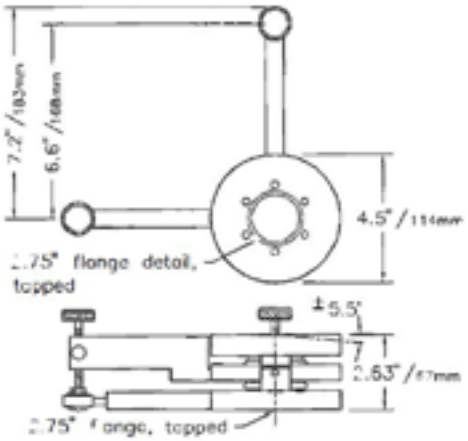
/HMPT Horizontal Mounting Package

- Add counter spring to tilt
- Relieves load on micrometers

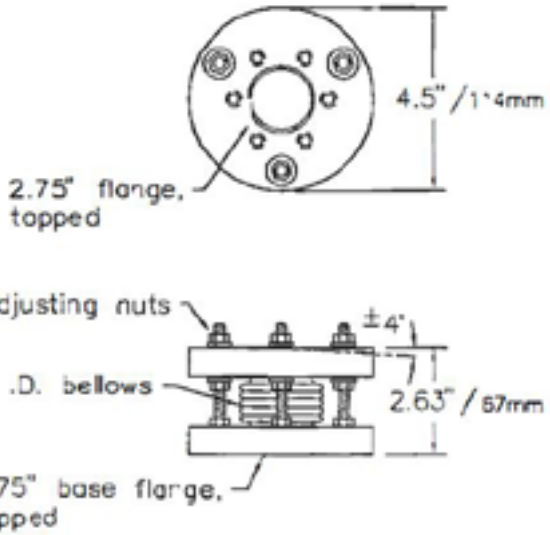
/MA Micrometer Adjust



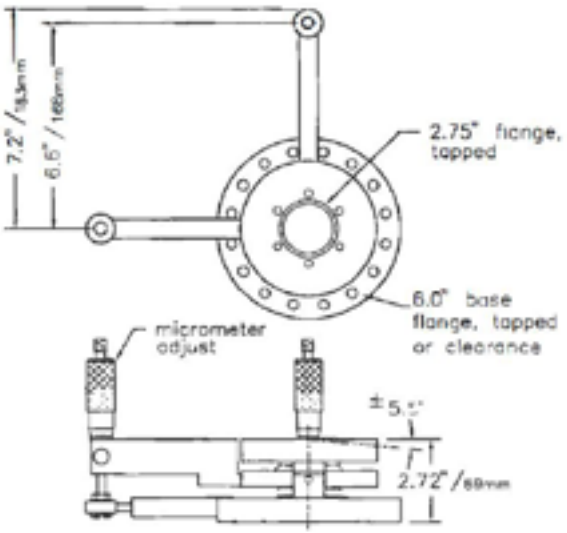
TLT-1.5-1



TLT-1.5-2



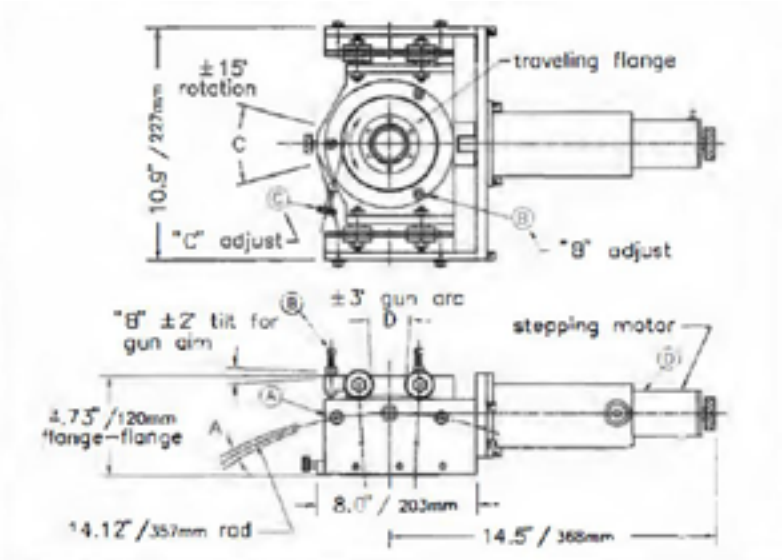
TLTW-1.5-2



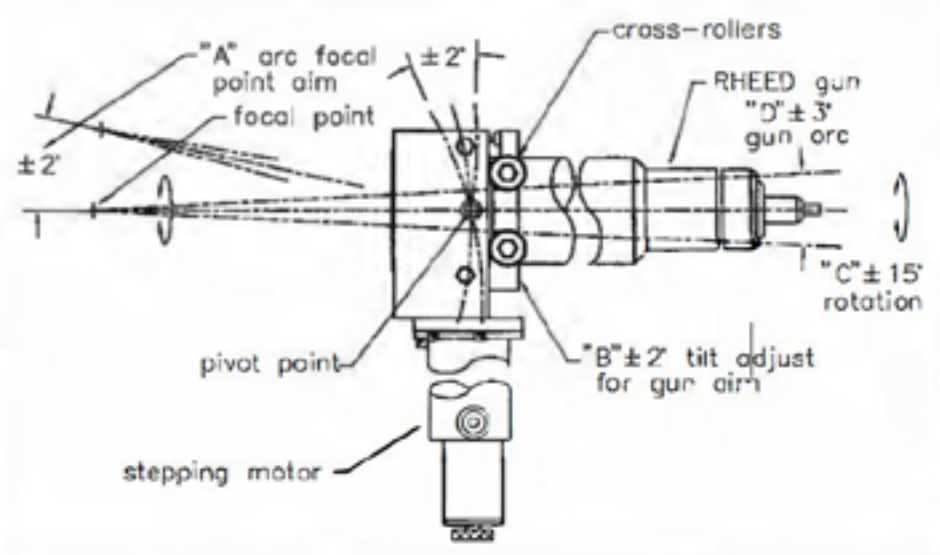
TLT-1.5-2/8-6/MA

3 VXT Series Virtual Axis Tilting/Positioning Assembly

VXT-1.87/MS



VXT-1.87/MS Layout



VXT-1.87/MS (shown with RHEED gun)

The VXT series precision tilt was developed to hold and position larger excitation sources or special detector systems.

Typical applications include positioning of larger electron guns, UV or X-ray sources, as in ESCA-XPS applications or RHEED studies. Extreme flexibility of positioning allows concise targeting.

This device provides five independent degrees of freedom. The critical freedom is the ability to "pivot" the source/detector about the target. with a point on the target surface becoming a focal point or "virtual axis" point of the motion of the VXT.

The arc radius guides are custom-made to suit specific target-to-flange distance requirements.

The stepping motor option can provide automated arc-scan motion.

The VXT is particularly suitable for payloads up to 35 lbs in vertical operation.

When using an X-ray slit source or a polarized excitation source, a differentially pulled rotary seal can be mounted to the VXT and the source on top. This configuration allows the source to be rotated about the polar axis and then scanned.

VXT Specifications

- 4.5" O.D. mounting flange face, tapped
- 2.75" O.D. traveling flange, tapped
- 1.87" I.D. stainless steel welded bellows
- Virtual axis to mounting flange face: Per customer requirements
- Angle ranges:

A	Arc focal point aim	±2°
B	Gun aim (2 axes, 3 pt. adj.)	±2°
C	Arc plane rotation	±15°
D	Gun arc	±3° (based on 12" radius)
	Scale graduations	0.1°
	Resolution	Better than 0.01°
	Adjustment	Knob, approx. 6 turns/degree

Other flanging, bellows available

Options

/MS Custom Stepping Motor

- Superior Electric stepping motor
  - MO62-FC09E motor
  - 200 steps/revolution
  - 100 oz-in holding torque
- Ball screw, drive
- Adjustable backlash
  - 0.001" travel/full step
  - Approx. 0.005 °/step
- Ball bearing motor pivots

(360) 385-7707

thermionics laboratory, inc.
Vacuum Innovation Since 1958

sales@thermionics.com

Differentially pumped rotary seals (RNNs) provide 360° of continuous rotary freedom through the vacuum wall of a UHV system. The RNN has two stages of differential pumping isolated by graphite-impregnated, expanded, Teflon seals on special sealing surfaces. A pre-loaded ball bearing set accurately controls the rotating stage position. This allows the unit to be successfully used with manipulators and other precision positioning devices.

RNNs are available with worm drive fine adjust option. This allows for easier and more accurate angle adjustment. RNNs are also available with anti-backlash stepping or synchronous motor drive.

RNNs with up to 12" I.D. are listed. Larger I.D.s have been built with excellent performance. Please consult factory for special applications.

RNN Series Specifications

- Models with clear inside diameters of 1.53" to 10" standard (see table). Larger sizes on request. All units are bakeable to 150°C
- Stationery and rotation flanges, tapped
- Flange face-to-flange face distance approximately that of two Con Flat-type flanges of the corresponding size
- 2 stage differentially pumped
- Base pressures in 10^{-11} Torr range
- 0-360° scale with Vernier, standard

Typical Performance Specifications

for RNN-400 and larger models

resolution	< 0,004˚
repeatability	< 0.008˚
backlash	< 0.035˚

Options

- Fine adjust worm drive
- Digital read-out on fine adjust
  0.1° read-out, mechanical, nonresetable
- Anti-backlash stepping motor drive
  0.018˚ per full step (0.0225°/full step on RNN-150/MS)
  With manual, knob
- Custom pumpout tube lengths and crank shaft lengths on /FA units available

Readability Specifications

Standard scale	1.0˚
Mechanical counter	0.1˚

Micro stepped motor drive required for maximum resolution

Options

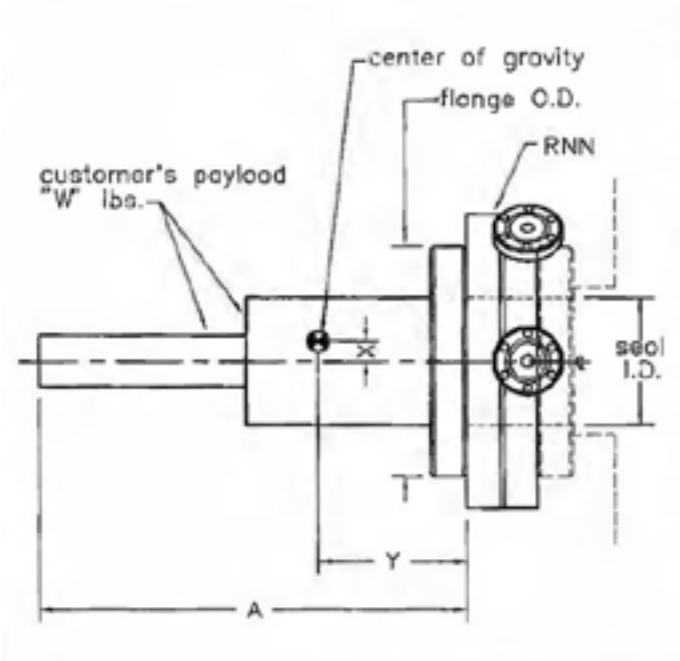
The standard maximum payloads are indicated below. Larger loads may be handled under specific applications. Please consult the factory for custom applications.

- The center of gravity of the payload is within "X" of the polar axis of the unit, where X isequal to 10% of the RNN I.D.
- The center of gravity of the payload is within "Y" distance of the rotating flange on the horizontal mounted units, where Y is the flange I.D
- The overall maximum size "A" of the payload outside vacuum is:

Vertical operation	7 x falnge O.D.
Horizontal operation	5 x flange O.D.
Inverted operation	7 x flange O.D.

Maximum Payload "W"

Model No.	Vertical	Horizontal	Inverted
RNN-150	54 lbs	30 lbs	45 lbs
RNN-250	90 lbs	38 lbs	70 lbs
RNN-400	144 lbs	66 lbs	110 lbs
RNN-600	180 lbs	84 lbs	140 lbs
RNN-800	200 lbs	91 lbs	160 lbs
RNN-1000	370 lbs	160 lbs	280 lbs
RNN-2000	430 lbs	200 lbs	350 lbs



Payload Location

3 RNN Series Differentially Pumped Rotary Seals

Ordering Information —

Differentially Pumped Rotary Seals - (includes a removeable adiustment wrench) Dimensions in Inches

I.D.	Flange O.D	A	B	C	D	E	F	G	H	Model No.
1.53	2.75	4.50	2.99	1.0	3.18	2.75	.49	.13	60˚	**RNN-150**
1.53	2.75/6*	6.00	2.99	1.34	3.33	2.75	.15	.13	45˚	**RNN-150/6**
2.53	4.5	5.75	3.64	1.36	3.58	4.50	.49	.03	45˚	**RNN-250**
2.53	4.5/6*	6.00	3.64	1.52	3.71	4.50	.33	.03	45˚	**RNN-250/6**
4.03	6	7.75	4.57	1.68	4.34	6.02	.37	.06	45˚	**RNN-400**
6.03	8	10.25	6.16	1.74	5.70	8.00	.42	.13	54˚	**RNN-600**
8.00	10	12.05	7.03	1.94	6.70	10.00	.42	.13	45˚	**RNN-800**
10.00	13.25	15.75	8.81	2.37	8.50	13.28	.29	.13	24˚	**RNN-1000**
12.00	14	20.00	-	2.25	-	-	-	-	-	**RNN-1200**

Differentially Pumped Rotary Seals with Fine Adjust**

I.D.	Flange O.D	A	B	C	D	E	F	G	H	I	Drive Ratio	Model No.
1.53	2.75	5.13	3.38	1.00	4.95	2.75	.49	0.37	60˚	3	80:1	**RNN-150/FA**
1.53	2.75/6*	6.00	3.84	1.34	5.32	2.75	.15	0.37	45˚	3	100:1	**RNN-150/6/FA**
2.53	4.5	6.38	4.20	1.36	6.11	4.50	.49	0.41	45˚	3	100:1	**RNN-250/FA**
2.53	4.5/6*	6.38	4.20	1.52	6.11	4.50	.33	0.41	45˚	3	100:1	**RNN-250/6/FA**
4.03	6	8.50	8.25	1.68	9.28	6.02	.37	0.54	45˚	4	100:1	**RNN-400/FA**
6.03	8	10.25	8.50	1.74	9.93	8.00	.42	1.10	54˚	5	100:1	**RNN-600/FA**
8.00	10	12.75	9.56	1.94	11.50	10.00	.42	1.10	45˚	5	100:1	**RNN-800/FA**
10.00	13.25	17.00	11.83	2.37	17.25	13.28	.29	0.91	24˚	7	100:1	**RNN-1000/FA**
12.00	14	Consult Factory										**RNN-1200/FA**

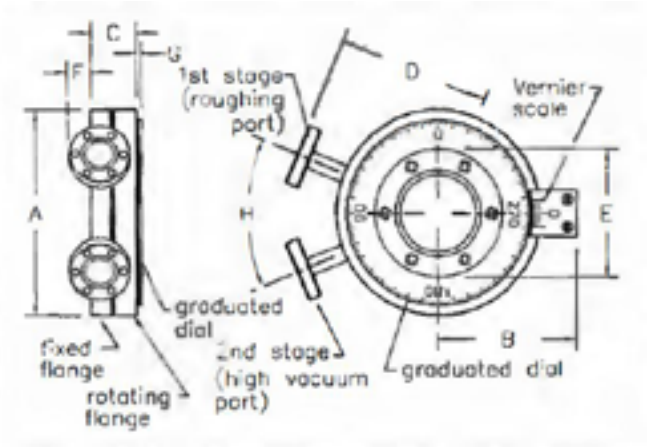
Differentially Pumped Rotary Seals with Anti-Backlash /MS Stepping or /MY Synchronous Motor Drive***

I.D.	Flange O.D	A	B	C	D	E	F	G	H	I	Drive Ratio	Model No.
1.53	2.75	5.13	10.00	1.00	9.97	2.75	.49	0.74	60˚	3.39	80:1	**RNN-150/MS** or **/MY**
1.53	2.75/6*	5.13	10.00	1.34	9.97	2.75	.15	0.74	45˚	3.39	100:1	**RNN-150/6/MS** or **/MY**
2.53	4.5	6.38	10.10	1.36	8.30	4.50	.49	0.41	45˚	3.39	100:1	**RNN-250/MS** or **/MY**
2.53	4.5/6*	6.38	10.10	1.52	8.30	4.50	.33	0.41	45˚	3.39	100:1	**RNN-250/6/MS** or **/MY**
4.03	6	8.50	9.77	1.68	11.69	6.02	.37	0.54	45˚	3.39	100:1	**RNN-400/MS** or **/MY**
6.03	8	10.20	10.13	1.74	11.69	8.00	.42	1.10	54˚	3.39	100:1	**RNN-600/MS** or **/MY**
8.00	10	12.75	11.39	1.94	11.69	10.00	.42	1.10	45˚	3.39	100:1	**RNN-800/MS** or **/MY**
10.00	13.25	Consult Factory										**RNN-1000/MS** or **/MY**
12.00	14	Consult Factory										**RNN-1200/MS** or **/MY**
18.00	24	Consult Factory										**RNN-1800/MS** or **/MY**
24.00	34	Consult Factory										**RNN-2400/MS** or **/MY**

**Signifies rotating/mounting flange sizes respectively*

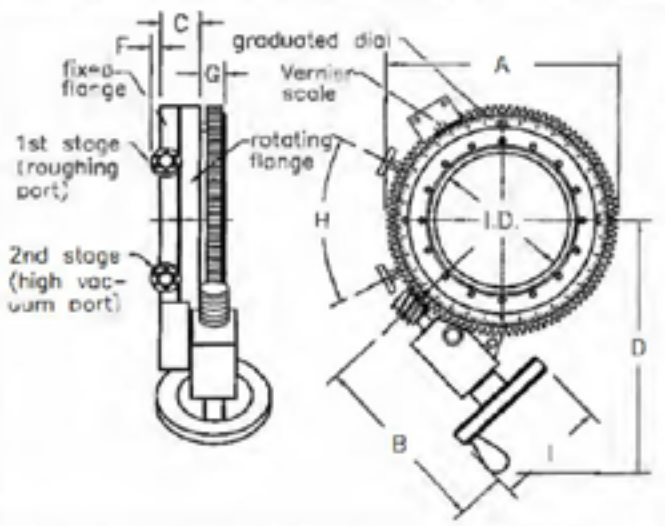
***The fine adjust utilizes worm drive and are dynamic anti-backlash on RNN-400 and larger models They come with large knobs and crank handles.*

****The motor drive units utilize worm drive and are all dynamic anti-backlash with hand knobs at the rear of the motor.*

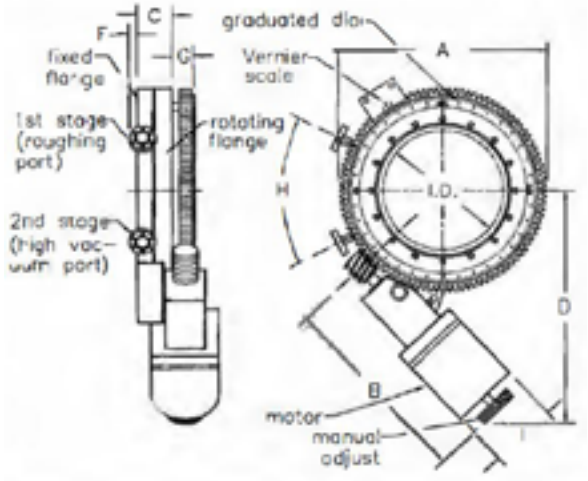


RNN

RNN-800/FA/MFO/MC



RNN-400/FA to RNN-1000/FA



RNN/MS Stepping or /MY Synchronous Motor Drive

Options

/MC Mechanical Counter

- Add digital read-out to fine adjust or motor drive unit
- 0.1° read-out, mechanical, non-resetable
- Viewable from the side
- Solution to difficulty caused by equipment mounted to platform obstructing view of degree scale

When /MC option is selected the Vernier scale is not included

/MFD Valve Manifold System

- Allows first stage pump to evacuate second stage pump
- Includes:
  - Two 1.33" O.D flange nipples, modified
  - 1.33" O.D. hardware
  - BVV-025 bakeable valve
  - Flexible metal plumbing
- Assembled on RNN platform

/TC Thermocouple Access Tubes

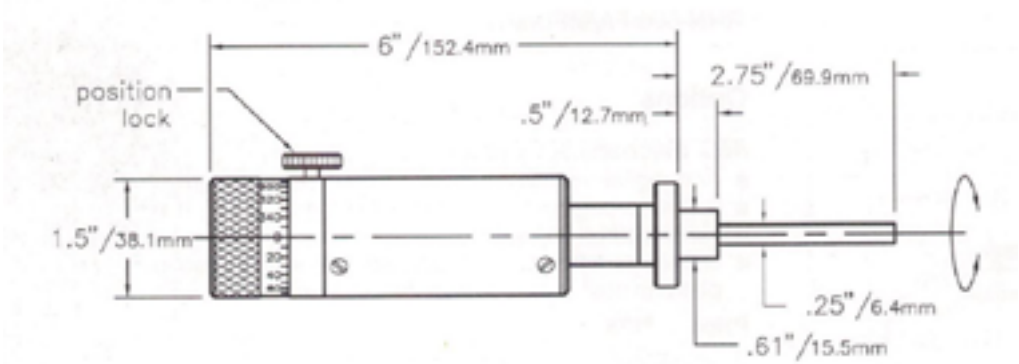
- Allows access to measure vacuum levels at each differentially pumped zone

/EFA High Resolution Fine Adjust

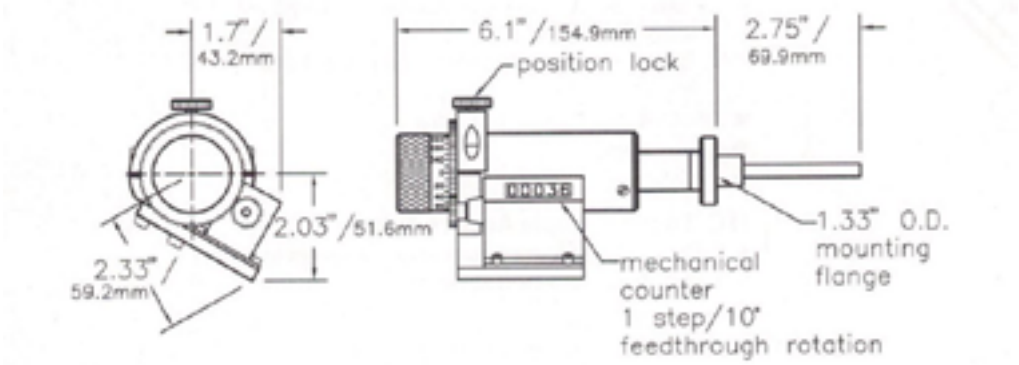
- RNN-150 only (includes digital read-out)
- 0.01° resolution
- <0.1 ° backlash

3 Rotary Motion Feedthroughs

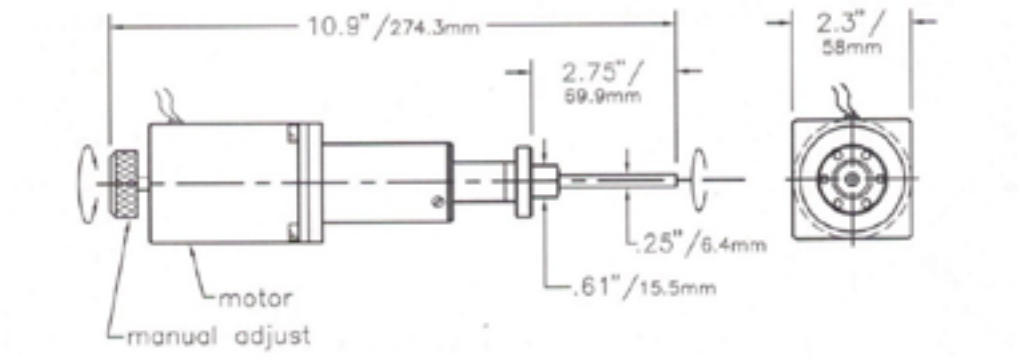
FRM-133-25/MC



FRM-133-25



FRM-133-25/MC



FRM-133-25/MS

Thermionics Northwest manufactures a full line of metal sealed rotary motion feed throughs. These feedthroughs are designed and manufactured to the highest standard of quality and care in the industry. Our design is conservative, utilizing the same principles as those of our precision feedthrough line. We use welded bellows, and all ball bearing construction.

Custom shaft lengths and shaft extensions are available.

1/4" Shaft Rotary Feedthroughs

FRM-133-25 Rotary Feedthrough

- 1/4" O.D. output shaft
- Bellows sealed
- Maximum bakeout temperature: 200°C
- 1.33" O.D. flange with position lock
- Torque limit: 150 oz-in
- Maximum speed: 300 rpm
- Uses 7 ball bearings
- 2° graduations. 0° to 360°

/MC Mechanical Counter Option

for FRM-133-25

- 5-digit Veeder Root mecha111cal counter, metal case
- 3.6:1 spur gear drive
- Adjustable counter orientation
- 36 counts per feedthrough rotation
- Removable for bakeout
- Retrofit kit allows mounting without breaking vacuum

FRMC-133-25 Rotary Shutter Feedthrough

- 1/4" O.D. output shaft
- 1.33" O.D. mounting flange
- Bellows sealed
- Maximum bakeout temperature: 200°C
- Mechanical torque limit. 150 oz-in
- This is a coarse positioning device

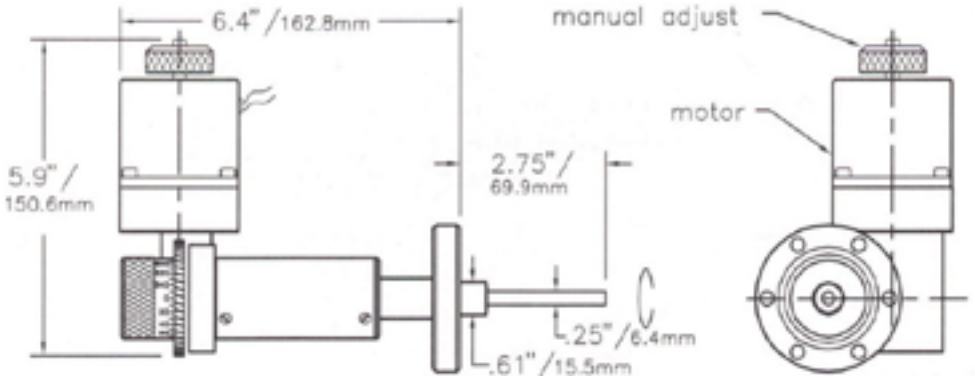
FRM-133-25/MS Stepping or /MY Synchronous Motorized Rotary Feedthrough

- 1/4" O.D. output shaft
- Bellows sealed
- Maximum bakeout temperature: 200˚C
- Mechanical torque unit: 150 oz-in
- Maximum speed: 300 rpm
- With integral motor drive
- 1.33" O.D mounting flange
- /MS stepping or /MY synchronous motor
  50 oz-in holding torque (higher torque motors available)
- Low inertia design
- Manual knob
- Without motor controller

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

FRM-133-25/MS/W or /MY/W Motorized Rotary Feedthrough

- 1/4" O.D. output shaft
- 1.33" O.D. mounting flange
- Bellows sealed
- Manual knob
- Maximum bakeout temperature: 200°C
- Mechanical torque limit: 150 oz-in
- Maximum speed: 300 rpm
- High speed worm drive
  - Self-locking
  - /MS stepping or /MY synchronous motor
  - 50 oz-in holding torque (higher available)
- Without motor controller

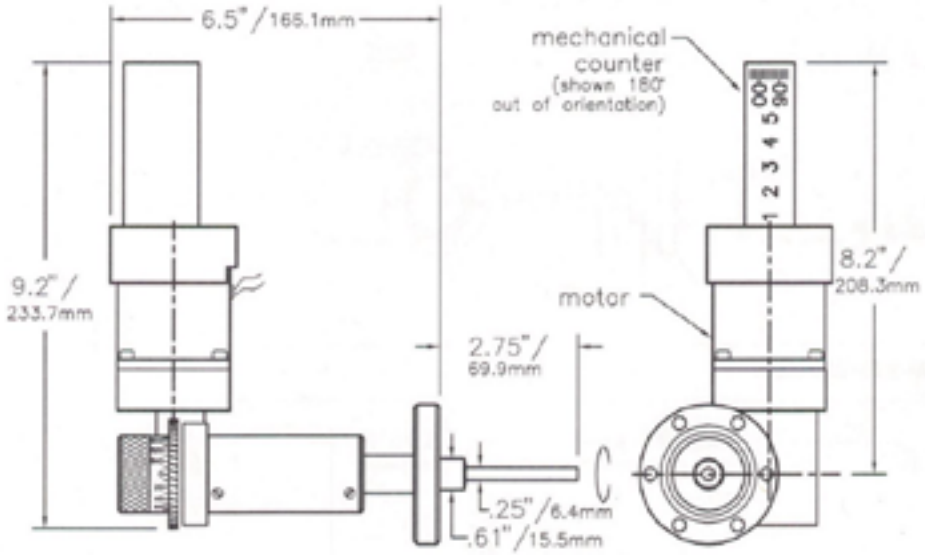


FRM-275-25/MS/W

/MC Mechanical Counter Option

for FRM-133-25/MS or /MY

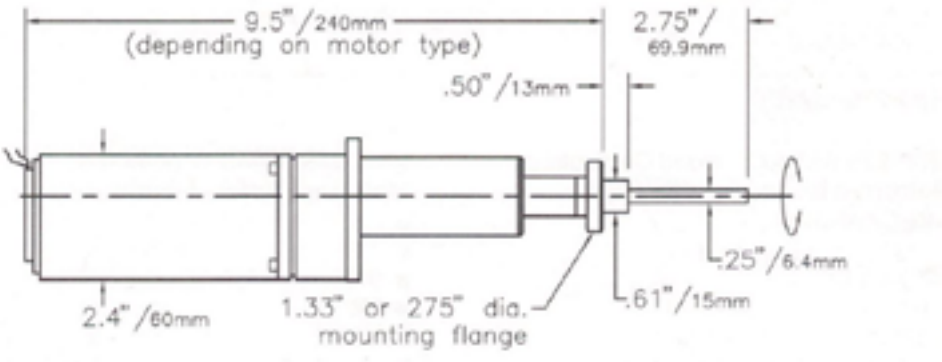
- Mounts to rear of stepping or synchronous drive motors
- Indicates step count. 200 counts/motor revolution
  - 100 counts on last digit wheel (100 divisions)
- Maximum motor speed: 2,500 pps
- 9,999,999 maximum count (50,000 motor revolutions)
- 5-digit Veeder Root mechanical counter, metal case
  - 2:1 ratio gear drive
  - Adjustable counter orientation
  - Removes with motor for bakeout
  - Retrofit kit available



FRM-275-25/MS/W/MC

FRM-133-25/SCC Speed Controlled Motorized Rotary Feedthrough with Controller

- 1/4" O.D. output shaft
- 1.33" O.D. mounting flange
- Bellows sealed
- Low inertia design
- Manual knob
- Maximum bakeout temperature: 200°C
- Mechanical torque limit: 150 oz-in
- Maximum speed: 300 rpm
- Speed control motor, with controller
  - 5-95 RPM with 50 oz-in torque standard
  - Options available:
    - Higher torque motors
    - Different speed ranges
    - Switchable direction



FRM-133-25/SCC

FRM-133-25/PNM Pneumatically Operated Rotary Feedthrough

- 1/4" O.D. output shaft
- 1.33" O.D. flange
- Bellows sealed
- Torque limit: 150 oz-in
- 90° rotation
- 180° or 270° rotations available
- Adjustable stops available

/ACV-24 Air Control Valve Option

for FRM-133-25/PNM

- Mounted to feedthrough
- Valve-to-rotary actuator plumbing installed
- Control voltage 24 VDC standard or per customer requirements
- With flow controls, both directions

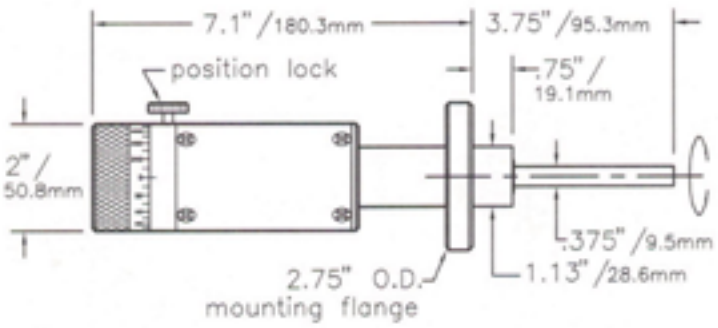
Options

FRM-133(275)-25

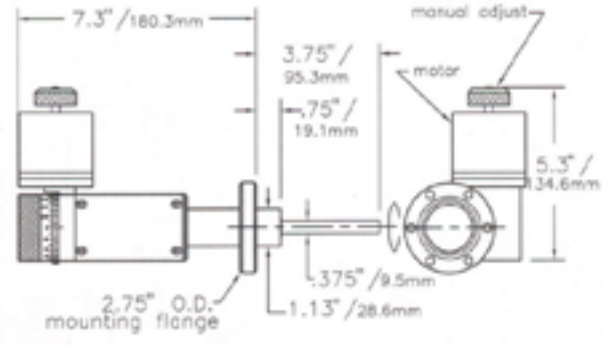
- 2.75" mounting flange replaces 1.33"
- All other dimensions remain the same

/CL Custom Length Shaft

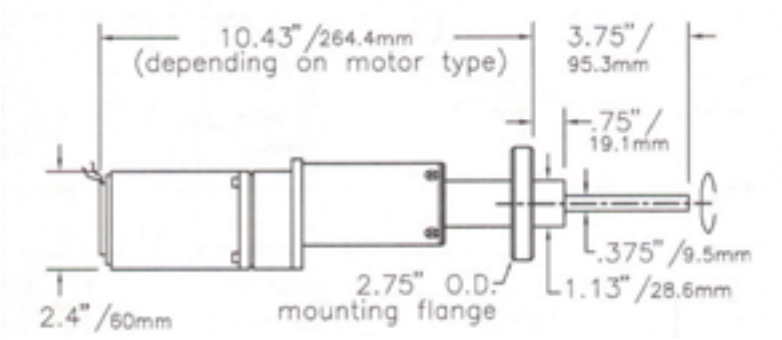
3 Rotary Motion Feedthroughs



FRM-275-38



FRM-275-38/MS/W



FRM-275-38/SCC

3/8" Shaft Rotary Feedthroughs

FRM-275-38 Rotary Feedthrough

- 3/8" O.D. output
- 2.75" O.D. flange
- Bellows sealed
- Position lock
- Angle dial
- Uses 8 ball bearings
- 2° graduations, 0° to 360°
- Maximum bakeout temperature: 200°C
- Torque limit: 1,100 oz-in
- Maximum speed: 300 rpm

/MC Mechanical Counter Option

- 5 digit Veeder Root mechanical counter, metal case
- 3.6:1 spur gear drive
- Adjustable counter orientation
- 36 counts per feedthrough rotation
- Removable for bakeout
- Retrofit kit allows mounting without breaking vacuum

FRM-275-38/MS Stepping or /MY Synchronous Motorized Rotary Feedthrough

- Direct drive
- 3/8" O.D. output shaft
- 2.75" O.D. flange
- Bellows sealed
- Uses 8 ball bearings
- Manual knob
- IN Maximum bakeout temperature: 200°C
- Mechanical torque limit: 1,100 oz-in
- Maximum speed: 300 rpm
- With integral motor drive
  - /MS stepping or /MY synchronous motor
    - 100 oz-in holding torque (higher torque motors available)
  - Without motor controller
  - Low inertia design

FRM-275-38/SCC Speed Controlled Motorized Rotary Feedthrough with Controller

- 3/8" O.D. output shaft
- 2.75" O.D flange
- Bellows sealed
- Employs 8 ball bearings
- Low inertia design
- Maximum bakeout temperature: 200°C
- Mechanical torque limit: 1,100 oz-in
- Maximum speed: 300 rpm
- Speed control motor, with controller
  - 5-95 rpm with 50 oz-in torque standard
  - Options available:
    - Higher torque motors
    - Different speed ranges
    - Switchable direction

FRM-275-38/MS/W or /MY/W Motorized Rotary Feedthrough

- 3/8" 0.0. output shaft
- 2.75" 0.0. mounting flange
- Bellows sealed
- Manual knob
- Maximum bakeout temperature: 200°C
- Mechanical torque limit: 1,100 oz-in
- Maximum speed: 300 rpm
- Worm drive (50,000 motor revolutions)
  - Self locking
  - /MS stepping or /MY synchronous motor
  - 50 oz-in holding torque (higher available)
- Without motor controller

/CL Custom Length Shaft Option

- Up to 24"

/MC Mechanical Counter Option

for FRM-275-38/MS or /MY

- Mounts to rear of stepping or synchronous drive motors
- Read-out of step count, 200 counts/motor revolution
  - 100 counts on last digit wheel (100 divisions)
- Maximum motor speed: 2,500 pps
- 9,999,999 maximum count (50,000 motor revolutions)
- 5 digit Veeder Root mechanical counter, metal case
  - 2:1 ratio gear drive
  - Adjustable counter orientation
  - Removed with motor as an assembly for bakeout
  - Retrofit kit available

The rare earth magnetic series single and dual rotary drives are designed to provide exceptional, long life performance. They are UHV compatible and are an excellent option to conventional bellows sealed and other rotary devices. They can be adapted to PLO target clocking and continuous rotation of targets and substrates, as well as applications which require small profiles and high performance.

There are no sliding seals or magnets in vacuum and stray magnetic fields are virtually nonexistent. The in-vacuum armature is made of paramagnetic materials with stainless steel and silicon nitride bearings and is capable of repeated bake-out to 200°C (with magnets removed). Out-of-vacuum bearings are accessible for lubrication and the magnet drive is easily removable.

FRMRE-275-38 Rare Earth Magnetic Rotary Feedthrough

- 3/8" O.D. rotating shaft
- 2.75" O.D. mounting flange
- Manual drive knob with position lock
- 4,000,000 revolutions before internal bearing service
- 200°C bake-out (magnetic drive removed)
- Mechanical torque limit: 150 oz-in
- Removable neodymium iron boron magnetic drive for bake-out

Options

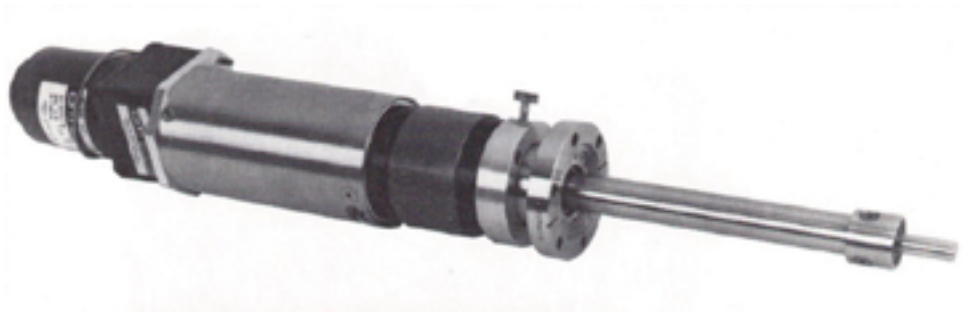
/SCC Speed Controlled Motor Drive with Controller

- Speed control motor, with controller
- 5-95 rpm with 50 oz-in torque standard
  Options available:
  Higher torque motors
  Different speed ranges
  Switchable direction

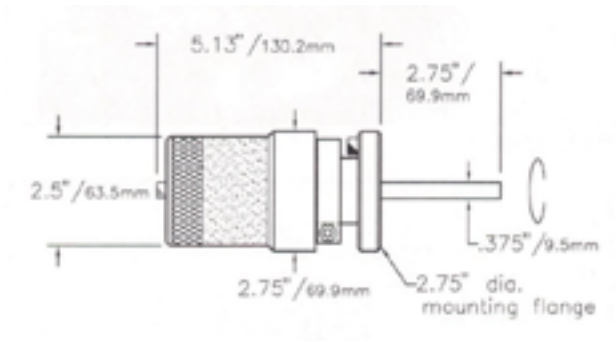
Higher torque drives available. Stepping motor drive option available.

FRRMRE-275-.75/.38/SCC Dual Axis Speed Controlled Motor Drive with Controller

- Manual adjustment of 3/4" diameter shaft
- Ideal for PLO target gearboxes
- Speed control motor, with controller for 3/8" diameter shaft
- 5-95 rpm with 50 oz-in torque standard
  Options available:
  Higher torque motors
  Different speed ranges
  Switchable direction

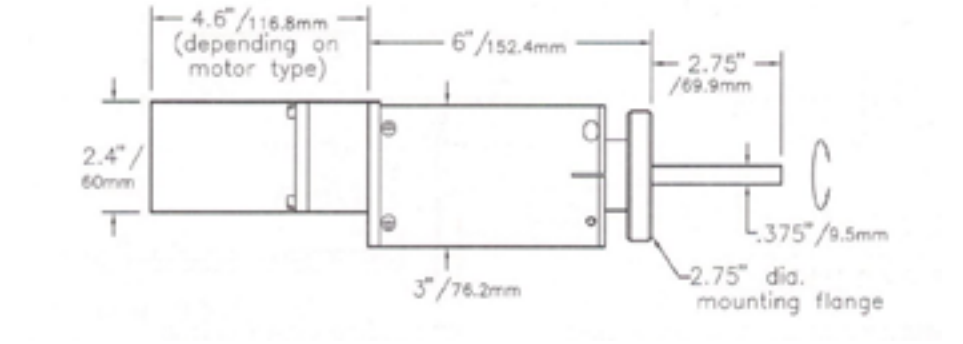


FRRMRE-275-.75/.38/SCC Dual Rotary Magnetic Drive

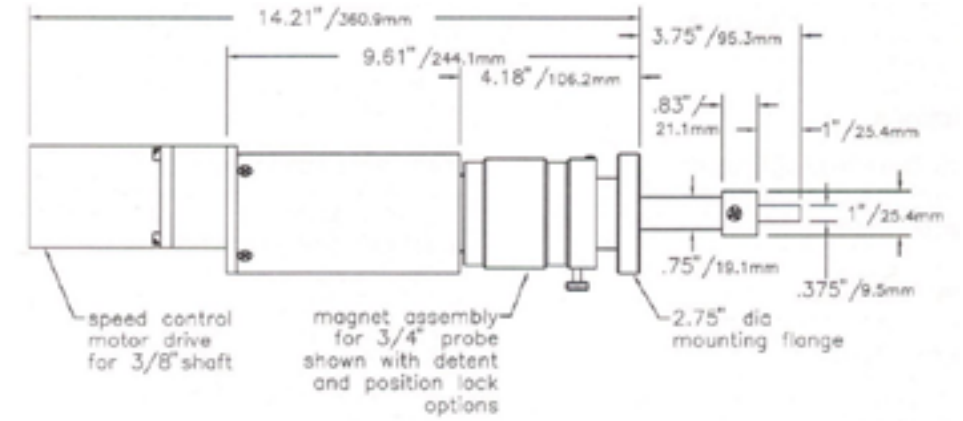


FRMRE-275-38

FRMRE feedthroughs and FRRMRE motor drives are manufactured and protected under one or more of the following patents: 5,514,925



FRMRE-275-38/SCC



FRRMRE-275-.75/.38/SCC

3 Precision Rotary Motion Feedthroughs

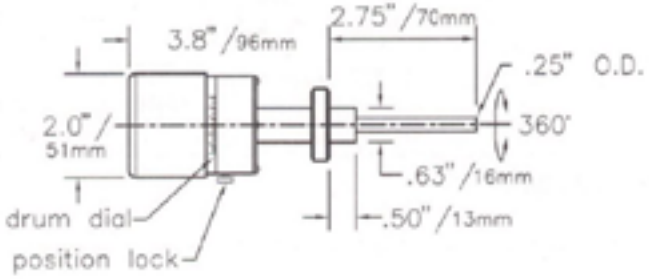
Precision rotary feedthroughs are commonly used to define a polar axis for a sample or probe. They provide 360° continuous rotation and are mounted on top of XYZ manipulators and other stages to provide polar axis freedom. They are also used separately where precision angular orientation is needed.

All our precision rotary feedthroughs are all metal sealed, utilizing welded bellows. All ball bearings are stainless steel.

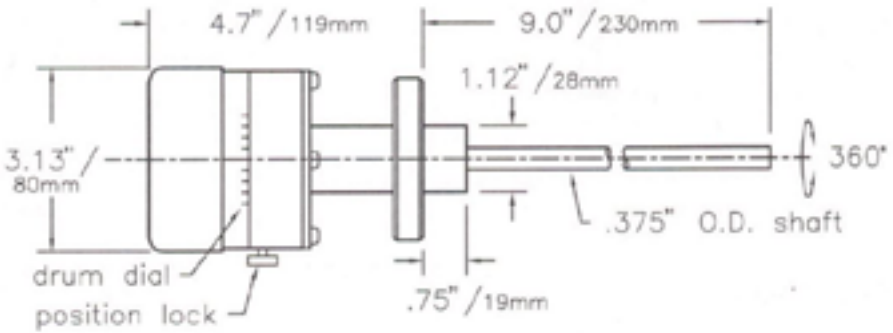
All units have 0.1 ° resolution minimum. Standard feedthroughs have 1° graduated dials. The fine adjust option utilizes a tangential screw and is calibrated to one minute with a Vernier scale. All have position locks. The maximum acceptable output shaft runout is 0.005".

These feedthroughs are available with custom output shaft lengths for your specific application. Field-mountable shaft extensions are also available. All are available with optional anti-backlash stepping motor drive.

FPRM-275-38



FPRM-133-25



FPRM-275-38

Options

/CL Custom Length Shaft Option

- Up to 24", tip-to-flange face

/FA Fine Adjust

- Utilizes a precision Klinger stage for rotary actuation
- Resolution <0.1°
- Three seconds on Klinger stage

/FA/W Fine Adjust Worm Drive

- Adds a precision worm gear to rotary feedthrough
- FPRM-275-38 gear ratio 96:1 (standard), 48:1, 24:1 optional gear ratios
- FPRM-133-25 gear ratio 100:1 (standard), 50:1, 25:1 optional gear ratios

Motion Specifications

Angular resolution	<0.1°
Shaft run-out	0.005"
Three seconds with Klinger stage	

Readability Specifications

Standard scale	1 ° graduations
/FA with Vernier	1 minute

FPRM-133-25 Precision Rotary Feedthrough

- 1/4" O.D. shaft
- 1.33" O.D. mounting flange
- 0.1° resolution, 1° graduations
- Position lock
- Maximum bakeout temperature: 200°C
- For sample rotation

FPRM-275-38 Precision Rotary Feedthrough

- 3/8" O.D. shaft
- 2.75" O.D. mounting flange
- 0.1° resolution, 1° graduations
- Position lock
- Maximum bakeout temperature: 200°C
- For sample rotation

/MS/W Stepping or /MY/WSynchronous Motor Drive with Worm Gear

- Self-locking
- 50 oz-in holding torque
- Manual knob

/MS Stepping or /MY Synchronous Motor Drive

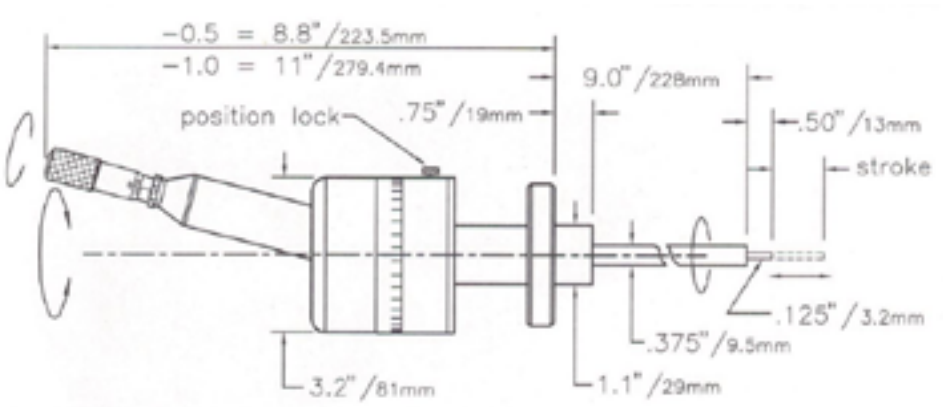
(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

FRLC-275-0.5 or FRLC-275-1 Precision Rotary Feedthrough

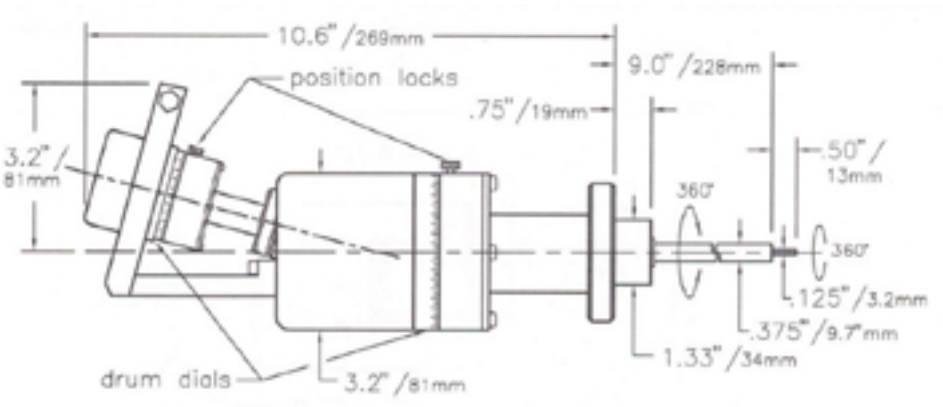
- With coaxial linear-rotary shaft
- 3/8" O.D. outer shaft
- 1/8" O.D. inner shaft, micrometer adjust for 1/2" or 1" linear travel
- 9" shaft length standard
- 0.1° resolution, 1° graduations
- Position lock
- Maximum bakeout temperature: 200°C

FRRC-275 Dual Precision Rotary Feedthrough

- With coaxial rotary-rotary shafts
- 3/8" O.D. outer shaft
- 1/8" O.D. inner rotary coax
- 360° continuous rotation, both shafts, independent
- 0.1° resolution, 1° graduations
- Lockable as dependent or independent rotation
- Maximum bakeout temperature: 200°C
- Combines two FPRMs (see page 3-34)



FRLC-275-0.5 & 1



FRRC-275

Options

/CL Custom Length Shaft Option

- Up to 24", tip-to-flange face

/FA Fine Adjust Option

- Utilizes a precision Klinger stage for rotary actuation
- Resolution of 0.1°
- One minute Vemier reading

/MS Stepping or /MY Synchronous Motor Drive

Retrofit Shaft Extensions

EXTS-FPRM-25 Shaft Extension

- Precision 1/4" O.D. stainless steel shaft
- Split clamp attachment to existing shaft
- Shaft extension length 2" to 24", as per customer requirements
- Simple field installation or removal
- Mounts to 1/4" O.D. shaft FPRM-133, FRM-133-25, FRM-275-25 and others

EXTS-FPRM-38 Shaft Extension

- Same as above with precision 3/8" O.D. stainless steel shaft
- Mounts to 3/8" O.D. shaft FPRM-275, FRM-275-38 and others

EXTS-FRLC-0.5 Shaft Extension

- Precision 3/8" O.D. stainless steel tube
- Includes 1/8" O.D. center push rod extension with return spring
- 1/2" push rod range
- Split clamp attachment to existing shaft
- Shaft extension length 3" to 24", as per customer requirements
- Simple field installation or removal
- Mounts to 3/8" O.D. shaft FRLC-275-0.5 and others

EXTS-FRLC-1 Shaft Extension

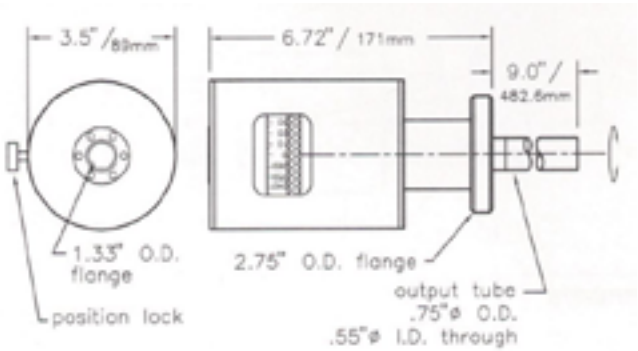
- Same as above except for 1" push rod range

EXTS-FRRC Shaft Extension

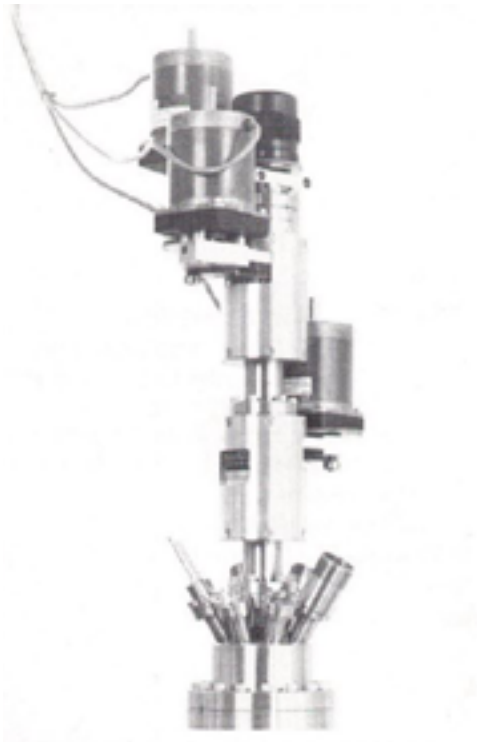
- Precision 3/8" O.D. stainless steel tube
- Includes 1/8" O.D. center rotational shaft with end guide bearing
- Split clamp attachment to existing shaft
- Shaft extension length 3" to 24", as per customer requirements
- Simple field installation or removal
- Mounts to 3/8" O.D. shaft FRRC-275 and others

3 WOA Series Precision Open Axis Rotary Feedthrough

WOA-550/FA



WOA-550



Tri-Axial Mount
(two WOA-550/MS, one FRM-133-25/MS)

Options

/TF-275 Top Flange

- 2.75” O.D. top flange, replacing the 1.33”O.D.

/CL Custom Length Shaft Option

- 3/4” O.D. stainless steel output tube
- To 24”

/FA Fine Adjust

- Utilizes a precision Klinger stage for rotary actuation
- Three seconds on Klinger stage
- One minute Vernier reading

/FA/W Fine Adjust Worm Drive

- Adds a precision worm gear
- 96:1 (standard), 48:1, 24:1 optional gear ratios

/MS Stepping or /MY Synchronous Motor Drive

The WOA rotary feedthrough is an all metal-sealed rotary feedthrough with unique features and exceptional performance.

Open Axis

The top flange does not rotate with the tube. The output tube rotates, but not the top flange.

The feedthrough is hollow through the entire shaft. The output shaft is a 3/4” diameter tube with a 0.55” bore clear diameter. The top of the rotary feedthrough has a 1.33” O.D. flange (2.75” O.D. optional).

This open axis feature allows a multi-axis feedthrough to be constructed by stacking multiple WOA feedthroughs atop each other and using smaller and smaller output tubes (see photo). Unlimited coaxial-linear travel is possible by simply adding the appropriate linear feedthrough to the top of this rotary feedthrough. Continuous coaxial-rotary drives are now simpler and more reliable.

Precision

The WOA feedthrough demonstrates unique rotary precision. Tests confirm resolution of better than 0.003° with a backlash of less than 0.005° for positioning (no torque load) applications.

Readability

Standard scale	1° graduations
/FA with Vernier	1 minute

WOA-550 Clear Axis Rotary Feedthrough

- 3/4” O.D. stainless steel output tube
- 0.55” clear axis up through feedthrough

WOA-550-B Precision Rotary Feedthrough

- 3/4” O.D. stainless steel output tube
- Without clear axis

EXTS-WOA Shaft Extension

- Precision 3/4” O.D. stainless steel tube
- Split clamp attachment to existing shaft
- Shaft extension length 3” to 24”, as per customer requirements
- With end guide bearing, as required
- Simple field installation or removal
- Mounts to 3/4” O.D. shaft WOA and others

Thermionics manufactures a full line of metal-sealed linear motion feedthroughs. They are designed and manufactured to a high level of quality. They are all metal, using welded bellows and stainless-steel linear bearings. All manual units are bakeable to 200°c fully assembled. Higher bakeouts may be used with partial disassembly. These feedthroughs are available with a number of custom options, listed below.

Custom shaft lengths and shaft extensions are available.

FLML-133-25 Series Linear Vacuum Feedthroughs

- 1/4" O.D. shaft
- 1.33" O.D. mounting flange
- 1", 2" or 3" stroke
- Stainless steel bellows sealed
- Coarse linear actuated
- Stainless steel linear shaft bearing

Stroke	A	Model No.
1"	7.25"	FLML-133-25-1
2"	8.75"	FLML-133-25-2
3"	10.85"	FLML-133-25-3
Custom shaft length		

Other strokes available

FLMR-133-25 Series Linear Vacuum Feedthroughs

- 1/4" O.D. shaft
- 1.33" O.D. mounting flange
- 1", 2" or 3" stroke
- Stainless steel bellows sealed
- Rotary actuated, 28 turns/inch, all ball bearing drive
- Stainless steel linear shaft bearing
- Includes position indicator

Stroke	A	Model No.
1"	5.6"	FLMR-133-25-1
2"	7.1"	FLMR-133-25-2
3"	9.2"	FLMR-133-25-3
Custom shaft length		

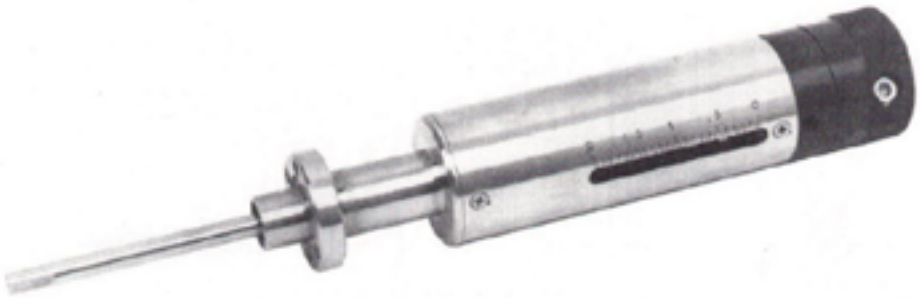
Other strokes available

FLMR-133-25 Series Linear Vacuum Feedthroughs

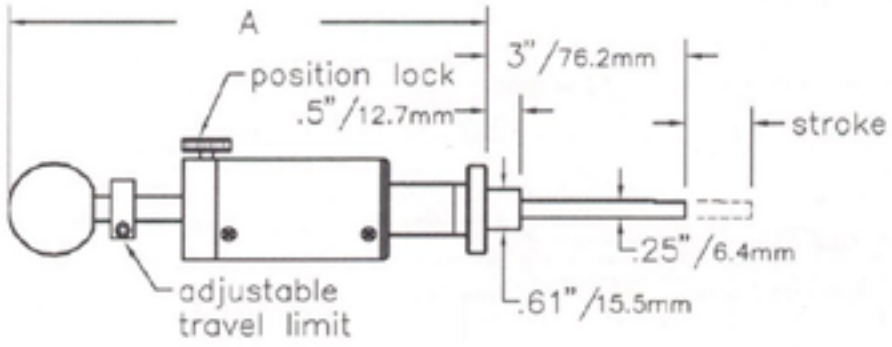
- 1/4" O.D. shaft
- 1.33'' O.D. mounting flange
- 1" or 2" stroke
- Stainless steel bellows sealed
- Micrometer actuated, 40 turns/inch, preloaded coupling
- 3" minimum flange face to probe tip
- Stainless steel linear shaft bearing

Stroke	A	Model No.
1"	5.6"	FLMR-133-25-1
2"	7.1"	FLMR-133-25-2
Custom shaft length		

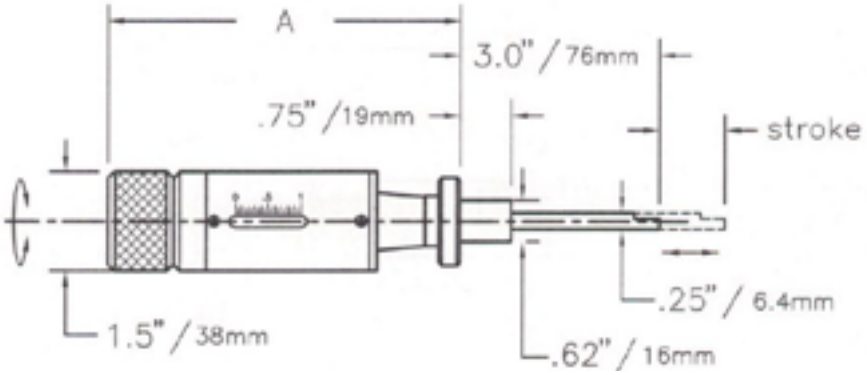
Other strokes available



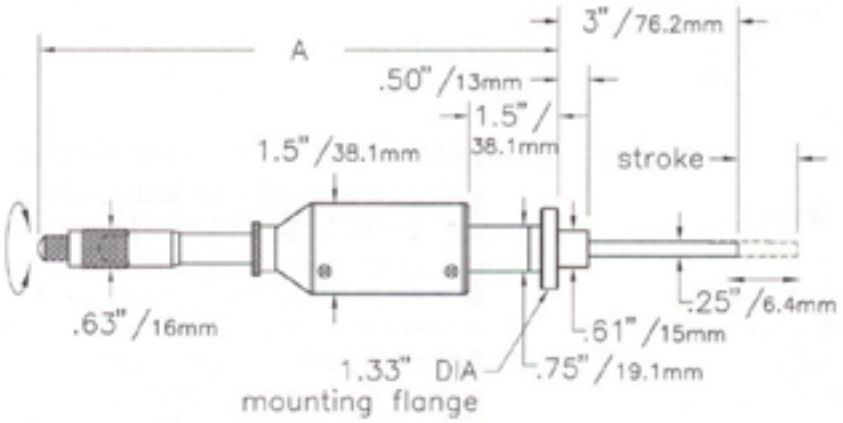
FLMR-133-25-2



FLML-133-25

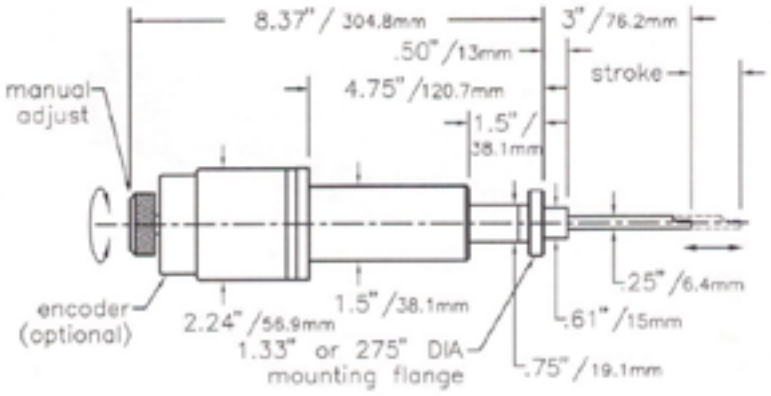


FLMR-133-25

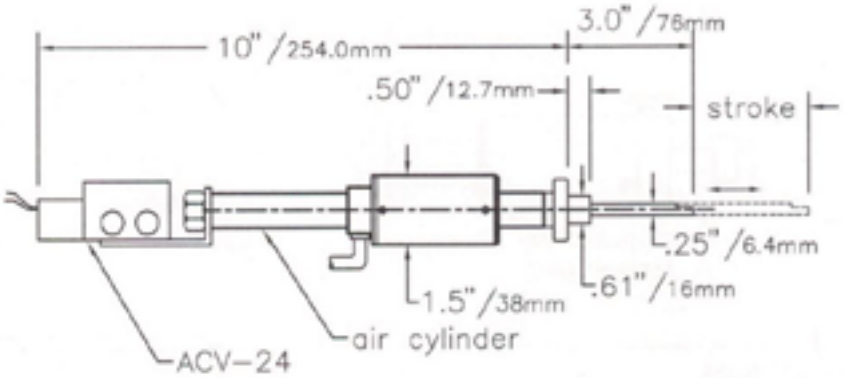


FLMM-133-1 & 2

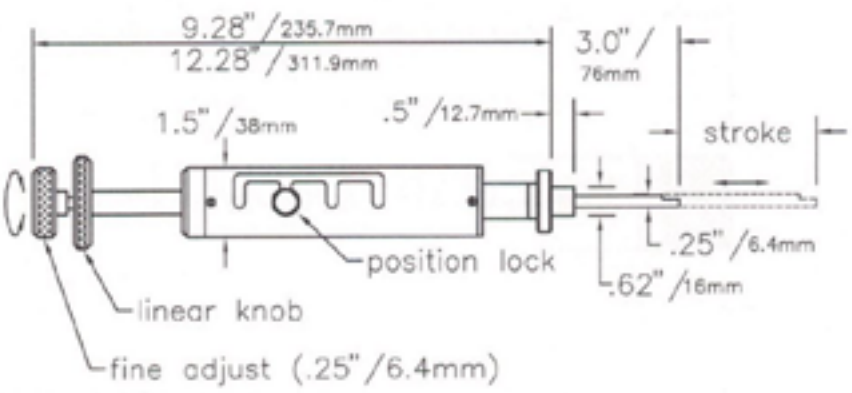
3 Linear Feedthroughs



FLMR-133-1/MS



FLML-133-25-1/PNM (with /ACV-24)



FLMLQA-133-25-3

Options

/CL Custom Length Shaft Option

SMC Stepping or YMC Synchronous Motor Controller

FLMLQA-133-25-3 Fast Acting Linear Vacuum Feedthrough

- 1/4" O.D. shaft
- 1.33" O.D. mounting flange
- 3" stroke, 4 positions, 1" apart
- Excellent for sample positioning or indexing
- Stainless steel bellows sealed
- Stainless steel linear shaft bearing
- Position lock
- With line adjust

FLMR-133/MS Stepping or /MY Synchronous Series Motorized Linear Vacuum Feedthroughs

- 1/4" O.D. shaft
- 1.33" O.D. mounting flange
- 1", 2" or 3" stroke
- Stainless steel bellows sealed
- Stainless steel linear shaft bearing
- Stepping motor actuated, 28 turns/inch
- Integral motor drive
  - /MS stepping or /MY synchronous motor
  - 100 oz-in holding torque (higher torque motors available)
  - Without motor controller
  - Low inertia design
- Manual knob

Stroke	Model No.
1"	FLMR-133-1/MS or /MY
2"	FLMR-133-2/MS or /MY
3"	FLMR-133-3/MS or /MY

Other strokes available

FLML-133-25/PNM Series Pneumatically Actuated Linear Vacuum Feedthroughs

- 1/4" O.D. shaft
- 1.33" O.D. mounting flange
- 1", 2" or 3" stroke
- Stainless steel bellows sealed
- Stainless steel linear shaft bearing
- Pneumatically actuated
  - 3/4" I.D. cylinder
  - 50 to 150 psi air pressure
  - Stainless steel rod and cylinder with bumpers, both ends
- Performance (with optional /ACV-24 valve below): <180 msec from coil energize to finish of 4" travel with 80 psi on an FLM-133-4/PNM with shutter

Stroke	Model No.
1"	FLML-133-25-1/PNM
2"	FLML-133-25-2/PNM
3"	FLML-133-25-3/PNM
As above, but mounted on a 2.75" O.D. flange	

Other strokes available

/A CV-24 Air Control Valve Option

for FLM-133-25/PNM series feedthroughs

- Mounted to feed through
- Valve-to-actuator plumbing installed
- Control voltage 24 VDC standard or per customer requirements
- With flow controls, both directions

FLML-275-50 Series
Linear Vacuum Feedthroughs

- 1/2" O.D. main shaft
- 2.75" O.D. mounting flange
- Up to 15" stroke or more
- Stainless steel bellows sealed
- Push-pull actuated, with adjustable position stop
- Position lock
- Linear bushings

Stroke	A	B	Model No.
1"	6.26	1.40	FLML-275-50-1
2"	7.65	1.79	FLML-275-50-2
10"	20.77	4.91	FLML-275-50-10
Additional stroke, per inch			

NOTE: The probe (1/2" dia.) supports itself beyond the mounting flange. In horizontal operation. depending on stroke, extension and payload, some deflection may occur

/FA Fine Adjust Option

- Knob adjustment
- 10 turns/inch linear travel
- Ball bearing mount

FLMM-275-50 Series
Linear Vacuum Feedthroughs

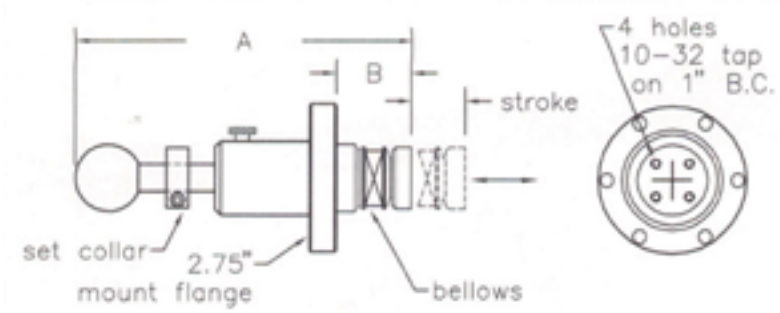
- 1/2" O.D. main shaft
- 2.75" O.D. mounting flange
- 1" or 2" stroke
- Stainless steel bellows sealed
- Micrometer actuated. with pre-loaded micrometer-to-probe coupling
- Linear bushings

Stroke	A	B	C	Model No.
1"	8.20	1.40	4.34	FLMM-275-50-1
2"	10.00	1.79	6.03	FLMM-275-50-2

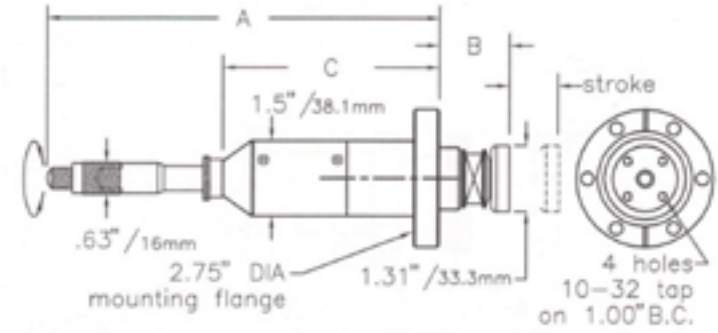
FLMH-275-50 Series
Hollow Linear Feedthroughs

- 1/2" O.D. support tube
  Open through unit 1.33" O.D. flange
- Up to 16" linear travel
- 1" or 2" stroke
- Push-pull linear (12 lb maximum force)
- Position stop (adjustable) and lock

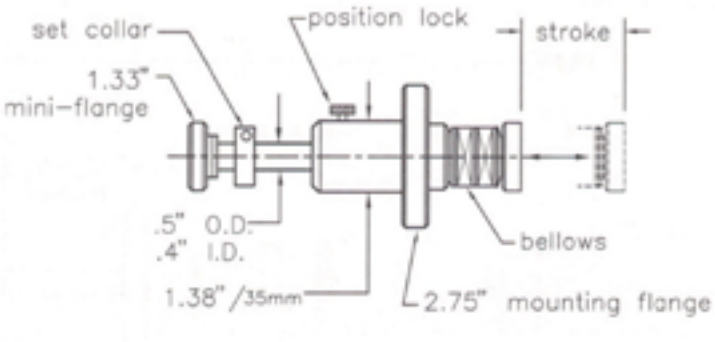
Stroke	Model No.
1"	FLMH-275-50-1
4"	FLMH-275-50-4
6"	FLMH-275-50-6
Additional stroke, per inch	



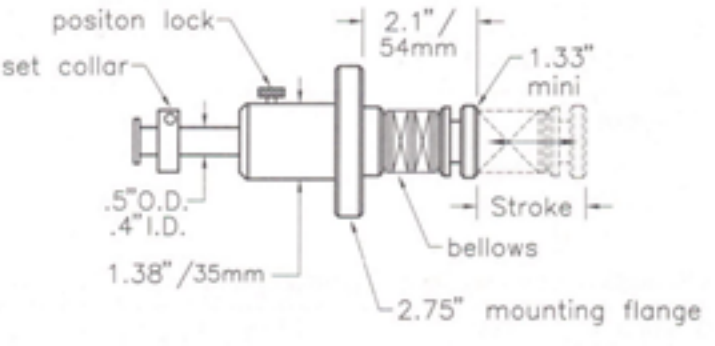
FLML-275-50



FLMM-275-50



FLMH-275-50



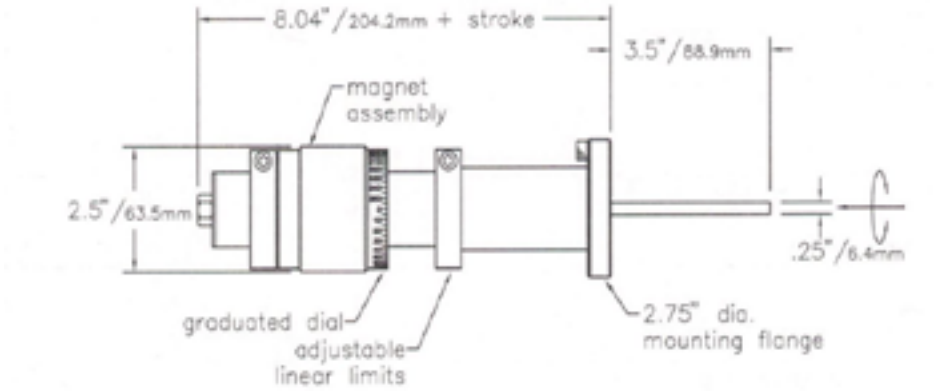
FLMH/R-275-50-2

/R Reversed Flange Option

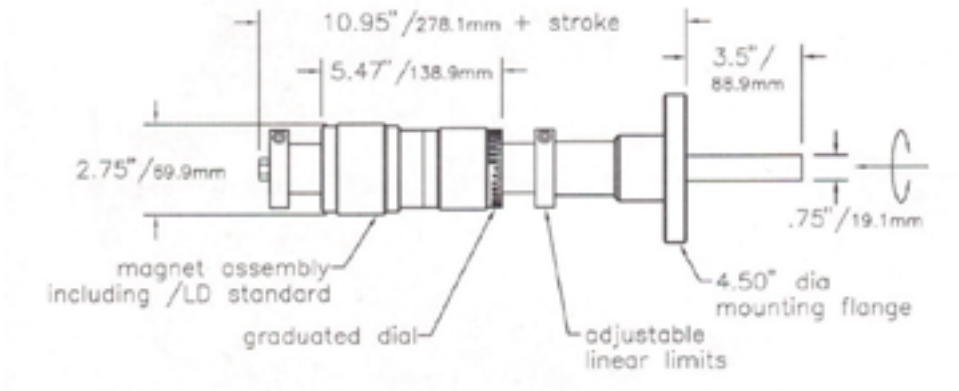
- 1.33" O.D. flange mounted on vacuum side
- Liquid or gas feedthrough to mini-flange in vacuum

3 FLLRE Series Magnetically Coupled Linear-Rotary Feedthroughs

FLLRE-275-38/LD



FLLRE-275/.25 Layout



FLLRE-450/.75 Layout

The FLLRE modular magnetic linear-rotary feedthroughs offer exceptional coupling with a small magnetic driver package. The driver is only 2.75" O.D. and 2" long. It provides more than 150 oz-in of torque and four lbs of linear force. Because of their small size, two drivers can be added together to double coupling strengths. Linear force can also be enhanced with the addition of the linear driver. The linear driver is a separate module that has been developed for its exceptional linear force.

The FLLRE stainless steel probe tube has a polished I.D. The inside traveler has no magnets, but it is made of magnetically-permeable material. The design uses eight all stainless-steel bearings for long life even with repeated bakeout to 200°C (with magnets removed).

Four probe sizes are available — 1/4", 3/8", 1/2" and 3/4" O.D. The selection of the probe diameter will depend on the travel distance, mass of the sample, and physical constraints of the chamber and related equipment. Please call the factory to discuss your specific requirements

FLLRE-275 Series Linear-Rotary Feedthrough

- 1/4", 3/8" and 1/2" O.D. probe sizes
- 2.75" O.D. mounting flange
- Up to 36" stroke (1/2" O.D. probe model)
- Mechanical torque limit: 150 oz-in
- Linear force: 4 lbs
- Eight all stainless-steel bearings
- 200°C bakeout (magnetic drive removed)
- Removeable neodymium iron boron magnetic drive

FLLRE-450 Series Linear-Rotary Feedthrough

- 3/4" O.D. probe size
- 4.50" O.D. mounting flange
- Up to 48" stroke (3/4" O.D. probe model)
- Mechanical torque limit: 150 oz-in
- Linear force: 15 lbs
- Eight all stainless-steel bearings
- 200°C bakeout (magnetic drive removed)
- Removeable neodymium iron boron magnetic drive

FLLRE Series Specifications and Ordering Information

Probe Size	Standard Stroke	Max Stroke	Model No.
1/4"	10"	24"	**FLLRE-275-10/.25**
3/8"	12"	30"	**FLLRE-275-12/.38**
1/2"	18"	36"	**FLLRE-275-18/.50**
3/4"	24"	38"	**FLLRE-450-24/.75**

FLLRE linear-rotary feedthroughs are manufactured and protected under one or more of the following patents: 5,514,925

(360) 385-7707
thermionics laboratory, inc. Vacuum Innovation Since 1958
sales@thermionics.com

FLLRRE Dual Linear-Rotary Feedthrough

- Actuates jaws, pincers or other devices requiring dual rotational motion
- May be used in place of expensive rack and pinion devices

Options

Optional Force Package

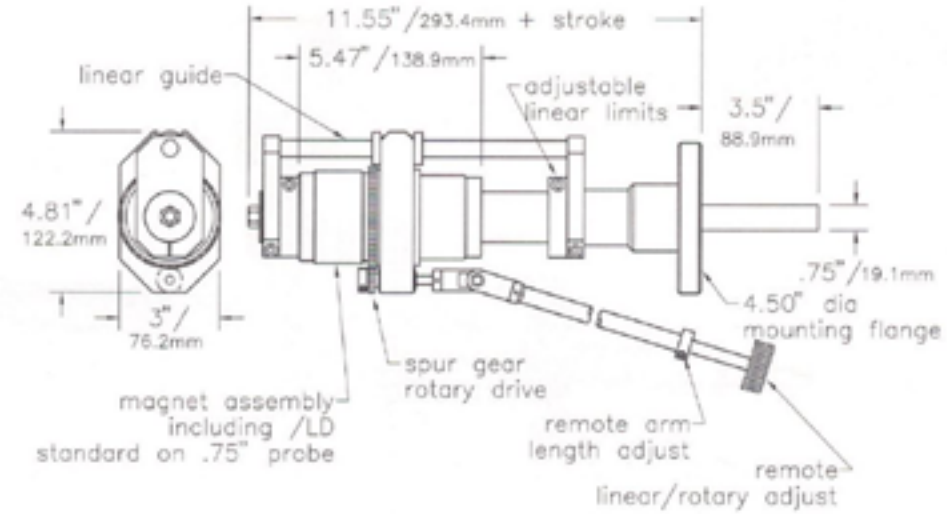
Available on all units and recommended for high mass payloads and longer strokes

/LD Linear Magnet Driver

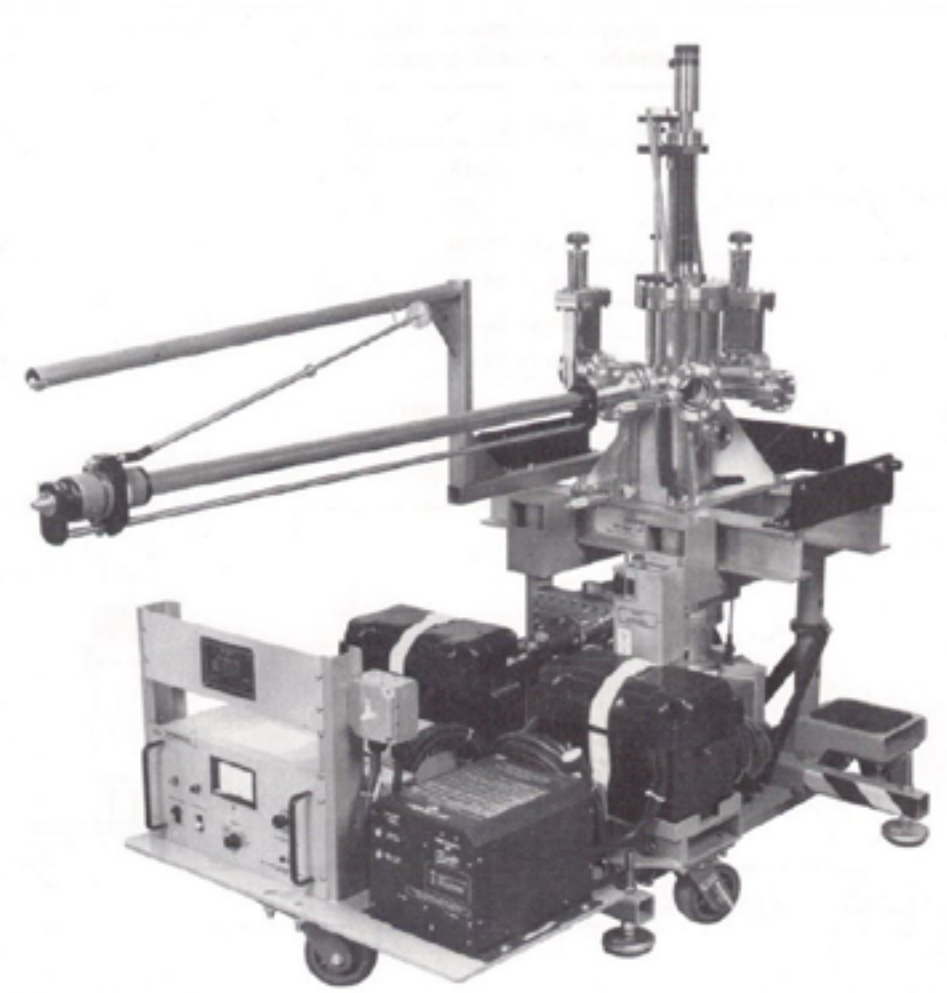
- Adds a linear magnetic external driver
- Adds a linear internal traveler
- Torque: 150oz-in

/REM Remote Rotary Operation

- For use on any FLLRE
- Linear and rotary actuation can be performed from several feet away
- Allows practical single operator sample transfer



FLLRE-275-12/.38/REM



FLLRE-450/LD/REM (shown integrated on custom modular cart system)
For more information about the Thermionics Northwest modular carts see page 11-33.

3 RPLR Series Rack & Pinion Linear-Rotary Feedthroughs

The RPLR series of linear-rotary feedthroughs use a 3/4" diameter probe. The probe is actuated by a rack and pinion positive drive (rotary bellows sealed feedthrough). The independent rotary actuation is achieved by a second rotary feedthrough. Only the 3/8" diameter probe tip rotates, keyed with a ball bearing keyway. This allows mounting of jaw-type devices which are actuated by the rotary action. The standard mounting flange is a 2.75" O.D. rotatable flange. The RPLR is an all-position device with position locks on both rotary feedthroughs. All metal construction for bakeability.

This unit is also available as a linear feedthrough only (RPL series).

RPLR-.75

Ordering Information — Rack and Pinion Actuated Linear-Rotary Feedthroughs

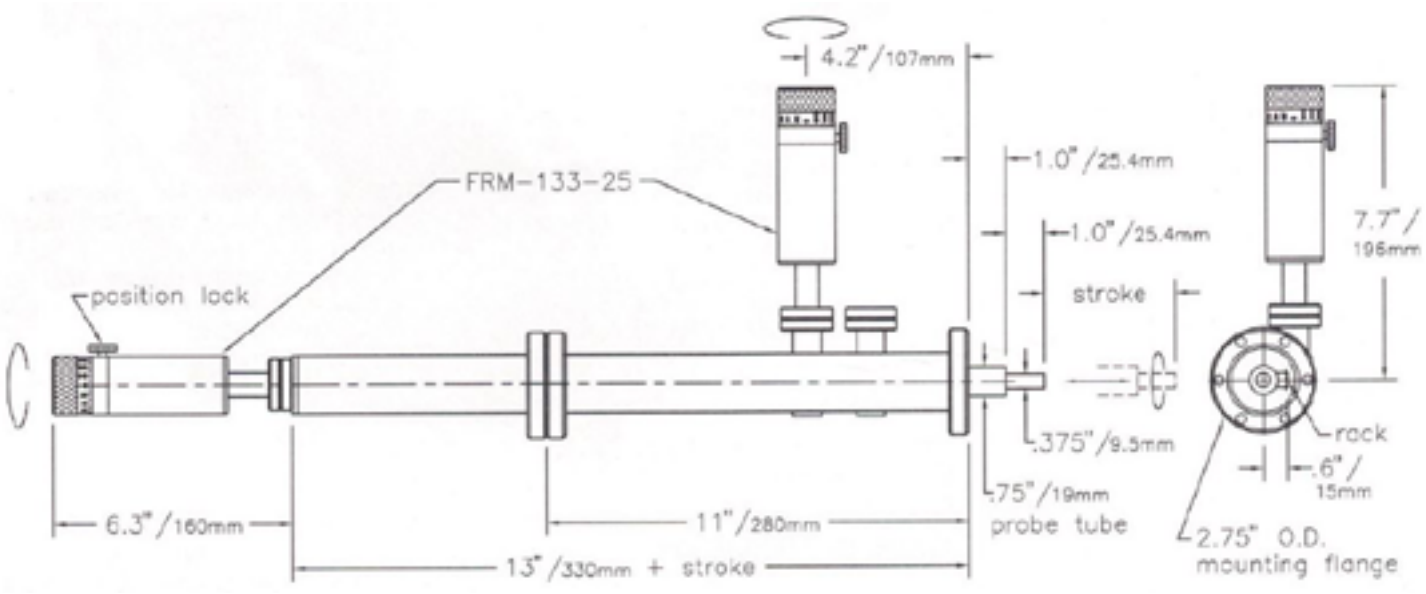
Stroke	Model No.
10"	**RPLR-.75-10**
20"	**RPLR-.75-20**
30"	**RPLR-.75-30**
40"	**RPLR-.75-40**
50"	**RPLR-.75-50**
60"	**RPLR-.75-60**

NOTE: Custom strokes between those listed are available

Rack and Pinion Actuated Linear Feedthroughs Without Rotary Action

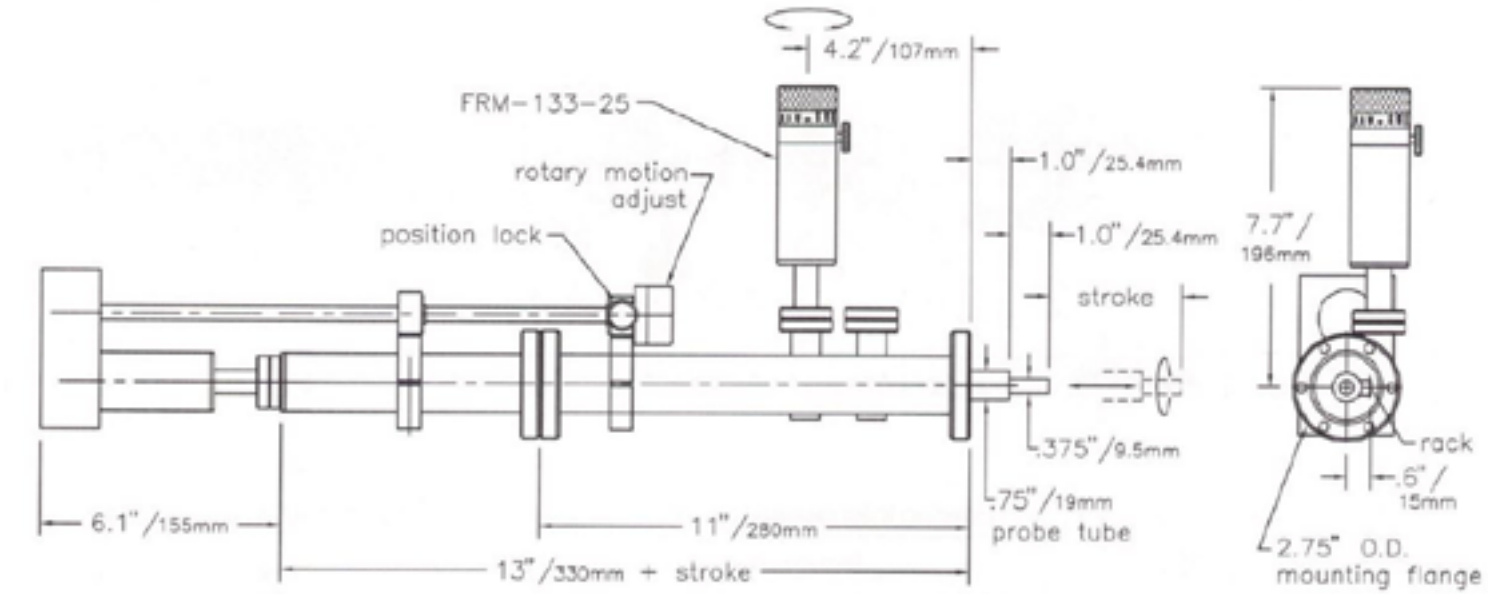
Stroke	Model No.
10"	**RPL-.75-10**
20"	**RPL-.75-20**
30"	**RPL-.75-30**
40"	**RPL-.75-40**
50"	**RPL-.75-50**
60"	**RPL-.75-60**

NOTE: Custom strokes between those listed are available



RPLR-.75

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com



RPLR Layout (shown with remote rotary option)

Options

/MC Mechanical Counter — Manual Operation

- 40 counts per feedthrough rotation (approximately 0.034" linear travel per count on RPLR)
- Removable for bakeout
- Retrofit kit allows mounting without breaking vacuum

/MS Stepping or /MY Synchronous Motorized Rotary Feedthrough

for RPLR rotary drive

- With integral motor drive
- /MS stepping or /MY synchronous motor drive
  - 50 oz-in holding torque (higher torque motors available)
- Low inertia design
- Manual knob

NOTE: The /MS or /MY motor option is suitable for the rotary actuation on an RPLR and the linear actuation when the operation is horizontal. When the linear travel is other than horizontal, the /MS/W option should be used.

We strongly recommend the use of limit switches on this or any other motor drive being used to actuate the linear drive on the RPLR. The limit switch actuator assembly specified below (or one similar) should be used to protect the RPLR from being overdriven. See the RLS-40/MS rotary limit switch option on page 3-80.

/MS/W Stepping or /MY/W Synchronous Motorized Rotating Feedthrough

for RPL or RPLR rotary drive

- High speed worm drive
- Self locking
- /MS stepping or /MY synchronous motor drive
  - Supplied with motor
  - Without controller
- Capable of driving up to 16"/min minimum at 1,000 pps
- May be field-mounted without breaking vacuum, or returned to the factory for installation

NOTE: This motor drive is self-locking. This is necessary to protect the probe and associated equipment from spinning down if the power is removed from the motor. Because of the self-locking design, the drive can generate significant torque at the FRM, and thus do damage if overdriven.

/RLS-40/MS Rotary Limit Switch Actuator Assembly

See page 3-80

SMC Stepping or YMC Synchronous Motor Controller

See page 3-81

/MC Mechanical Counter — Motorized Operation

- Mounts to rear of stepping or synchronous drive motors
- Read-out of step count, 200 counts/motor revolution
  - 100 counts on last digit wheel (100 divisions)
- Maximum motor speed: 2,500 pps
- 9,999,999 maximum count (50,000 motor revolutions)
- 5-digit Veeder Root mechanical counter, metal case
  - 2:1 ratio gear drive
  - Adjustable counter orientation
  - Removes with motor for bakeout
  - Retrofit kit available

/SCC Speed Controlled Motorized Rotary Feedthrough with Controller

- With integral motor drive
- Speed control motor, with controller
  - 5-95 rpm with 50 oz-in torque standard
  - Options available:
    - Higher torque motors
    - Different speed ranges (300 rpm max.)
    - Switchable direction

/RRO Remote Rotary Operation

- For use on long stroke RPLRs
- Locates a rotary actuator knob near the linear actuator feedthrough
- Position lock

3 FLAM Series Push-Pull Linear-Rotary Feedthroughs

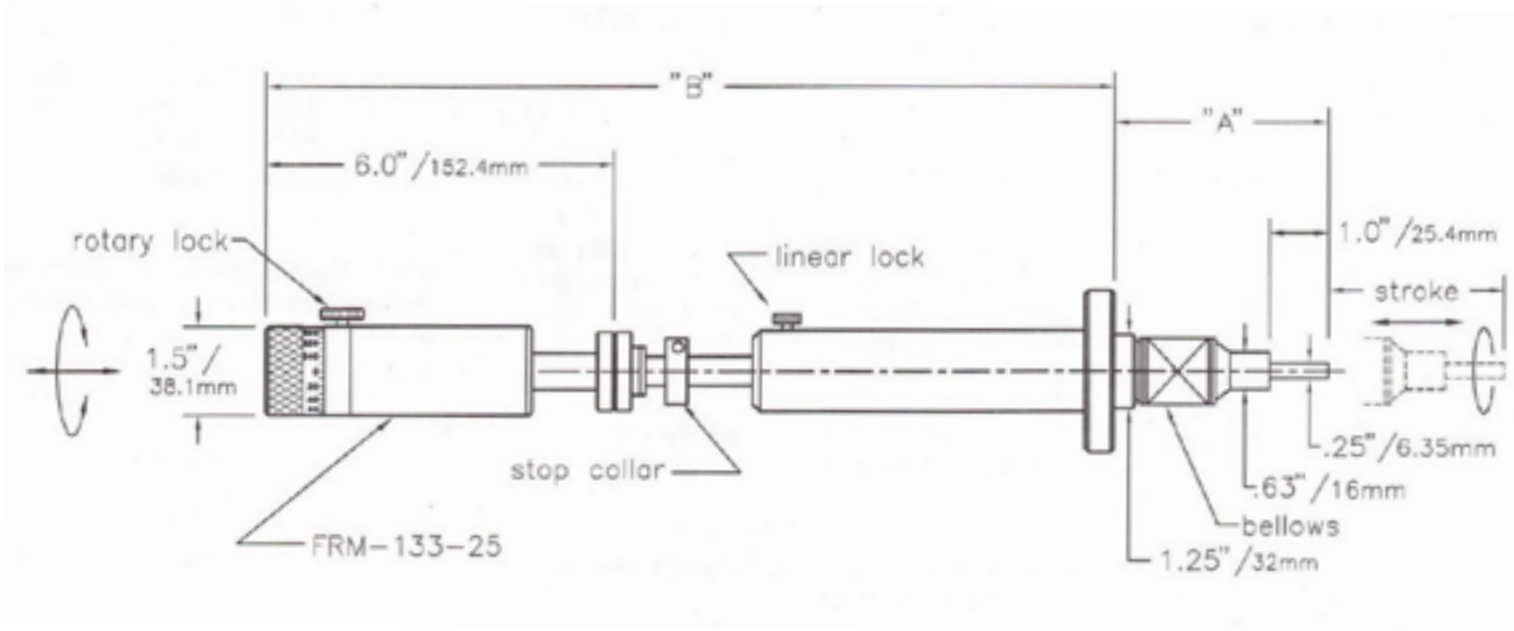
FLRM-275

The FLRM series of linear-rotary feedthroughs are based on the FLM series pushpull linear feedthroughs. The FLRM mounts on a standard 2.75" O.D. flange. Other size flange mounts are available. The body length has been increased to provide greater spacing between the linear bearings, and the 1/2" O.D. rod replaced with a 1/2" O.D. tube. An FRM-133-25 rotary feedthrough is mounted on the axis of the 1/2" tube, providing rotary motion at the probe tip. Linear motion is push-pull against the pressure differential (12 lbs maximum). This unit is an all-position device with position locks on both feedthroughs. Strokes of up to 36" are feasible, dependent upon payload, orientation and acceptable deflection. All metal construction for bakeability.

Ordering Information — Push-Pull Linear-Rotary Feedthroughs

Stroke	A	B	Model No.
2"	3.3"	13.3"	**FLRM-275-2**
4"	4.1"	15.3"	**FLRM-275-4**
6"	4.9"	17.3"	**FLRM-275-6**
8"	5.7"	19.3"	**FLRM-275-8**
10"	6.5"	12.3"	**FLRM-275-10**

NOTE: Custom strokes between those listed are available



FLRM-275-3

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Options

Rotary Options

/MS Stepping or /MY Synchronous Motorized Rotary Feedthrough

- With integral motor drive
- /MS stepping or /MY synchronous motor drive
  - 50 oz-in holding torque (higher torque motors available)
- Low inertia design
- Manual knob

/MC Mechanical Counter Option

for /MS or /MY Motorized Rotary Feedthrough

- Digital read-out of motor drive location
- Mounts to rear of stepping or synchronous drive motors
- Read-out of step count, 200 counts/ motor revolution
  - 100 counts on last digit wheel (100 divisions)
- Maximum motor speed: 2,500 pps
- 999,999 maximum count (5,000 motor revolutions)
- 5-digit Veeder Root mechanical counter, metal case
  - 2:1 ratio gear drive
  - Adjustable counter orientation
  - Removes with motor for bakeout
  - Retrofit kit available

/SCC Speed Controlled Motorized Rotary Feedthrough with Controller

- With integral motor drive
- Speed control motor, with controller
  - 5-95 rpm
  - 50 oz-in torque minimum
  - Options available:
    - Higher torque motors
    - Different speed ranges
    - Switchable direction

/MC Mechanical Counter Option

for /SCC Motorized Rotary Feedthrough

- Digital read-out of motor drive location
- 5-digit Veeder Root mechanical counter, metal case
- 4:1 ratio bevel gear drive
- Adjustable gear lash
- Adjustable counter orientation
- 40 counts per feedthrough rotation
- Removable for bakeout

Linear Options

/LFA Fine Adjust

- 10 threads/inch
- Ball bearing support
- Suitable for use up to 6”
  - Requires longer housing on longer travels

/LFA/MS/W Stepping or /LFA/MY/W Synchronous Motorized Fine Adjust

- /MS stepping or /MY synchronous motor
- Worm drive
- Ball bearing support
- With manual knob
- Suitable for use up to 6”
  - Requires longer housing on longer travels

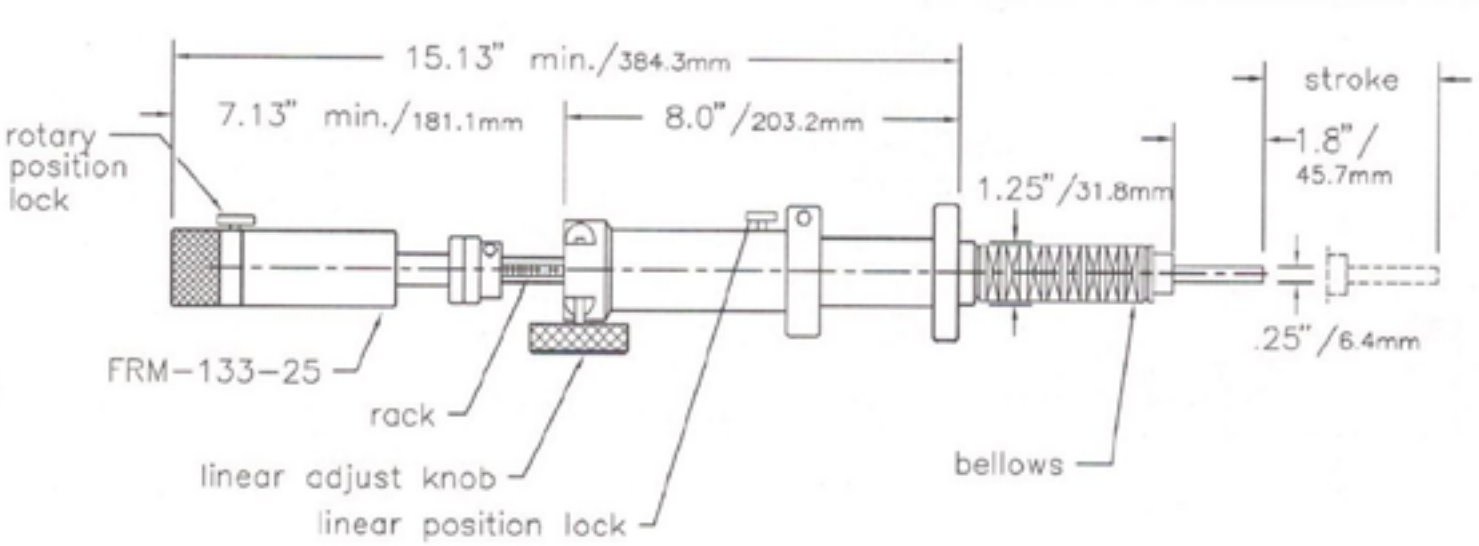
FLLM-275-2F-1 Linear/LinearCoaxial Feedthrough

1ST LINEAR

- 2” linear travel
- Linear travel via thread/collar adjust
- Position lock
- 1/2” O.D. support tube, bearing/bushing mount
- Adjustable travel limit

2ND LINEAR

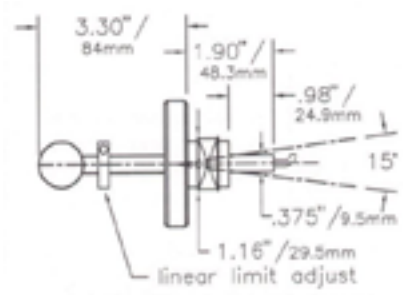
- 1” linear travel
- Rotary adjust
- Linear ball bearing nose support
- Eight lb force maximum
- Uses FRM-133-25 rotary feedthrough
- Position lock
- Custom shaft lengths on both linear probes



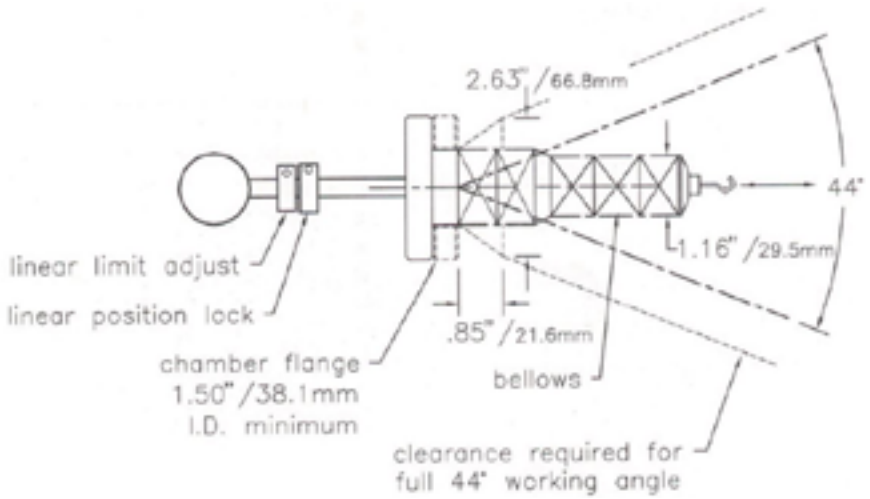
FLRM-275-8/LFA

3 Wobble Sticks

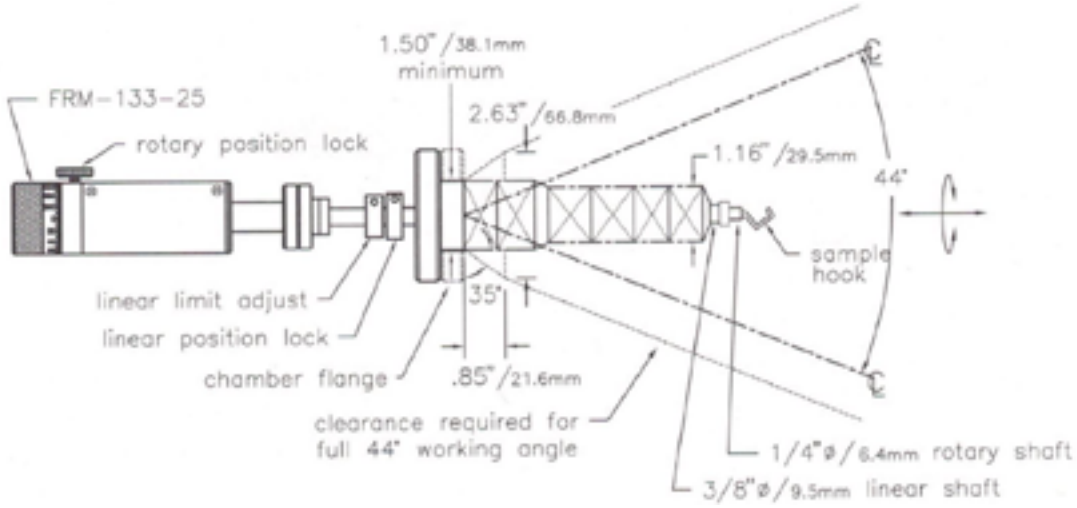
FWS-44R-275-4



FWS-15-275



FWS-44-275-10



FWS-44R-275-4

FWS series wobble stick probes supply a combination of Z axis, polar rotation, and polar axis tilt to allow tip positioning inside the vacuum chamber. They can be fitted with clamp jaws, hooks, or forks to attach and release samples. The user can specify the required Z travel.

FWS-15-275-1 Wobble Stick

- 3/8" O.D. shaft
- 2.75" O.D. mounting flange
- ± 7.5° angular range
- 1" linear travel (on axis)
- Without fork

FWS-44-275-1 Wobble Stick

- ±22 ° angular range
- 1" Z stroke
- Independent bellows for Z and θ
- Special spherical bearing mount
- Z travel position lock
- Includes tip fitted with hook, per customer requirements

FWS-44R-275-2 Wobble Stick

- ± 22° angular range
- 2" Z stroke
- Independent bellows for Z and θ
- Special spherical bearing mount
- Z travel position lock
- 360° probe rotation via FRM-133-25 Removable unit
- Includes tip fitted with hook, per customer requirements

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

FWS-44R-275-2/P Wobble Stick

- ±22 ° angular range
- 2” Z stroke
- Independent bellows for Z and θ
- Special spherical bearing mount
- Z travel position lock
- 360° probe rotation
- Includes push knob with 0.20” of linear actuation
- Order pincer below

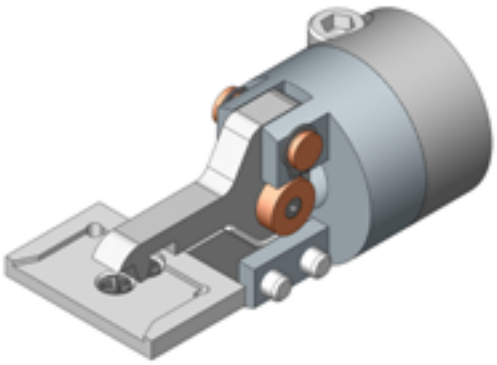
FWS-44R-275-8/PW

Pincer Options

Thermionics Northwest offers a variety of pincers for your application. Custom pincers can be supplied on request.

/PW Standard Single Jaw Pincer

- Single jaw action
- Suitable for thin wafers



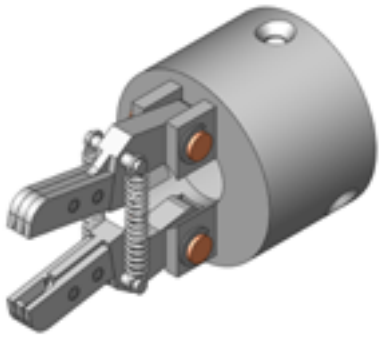
/PDME Single Jaw Pincer

/PDME DME Single Jaw Pincer

- Single jaw action
- Handles DME rectangular platens

/PO Omicron Single Jaw Pincer

- Single jaw action
- Handles Omicron brand platens

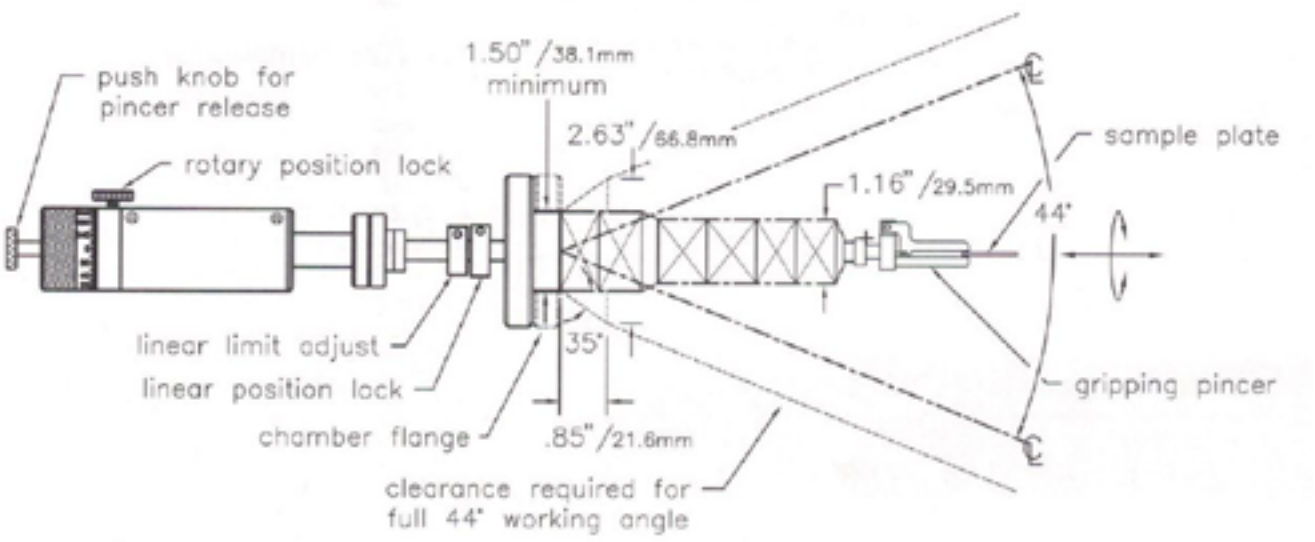


/POE Omicron Double Jaw Pincer

/POE Omicron Double Jaw Pincer

- Handles Omicron brand platens
- Edge grip double jaw action

/PS Special Pincer



FWS-44R-275-4/PW

3 BPLR Baseplate Linear-Rotary Motion Feedthroughs

BPLR Linear-Rotary Baseplate Feedthrough

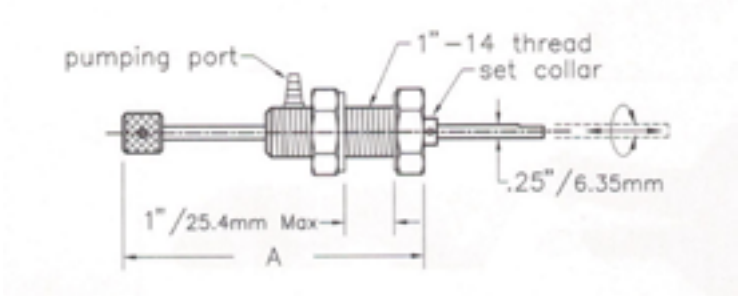
- Differentially pumped Viton O-ring sealed linear-rotary action
- Linear travels to 24”
- 1/4” O.D. shaft
  With clamp type stop collar
  Hand knob
- Baseplate mount
  For 1” I.D. hole
  Maximum baseplate thickness: 1”
- Stainless steel construction
- Teflon body insert
  Insert removable for O-ring service without removal of body

Ordering Information — High Vacuum Push-Pull Linear-Rotary Feedthroughs
Elastomer-sealed

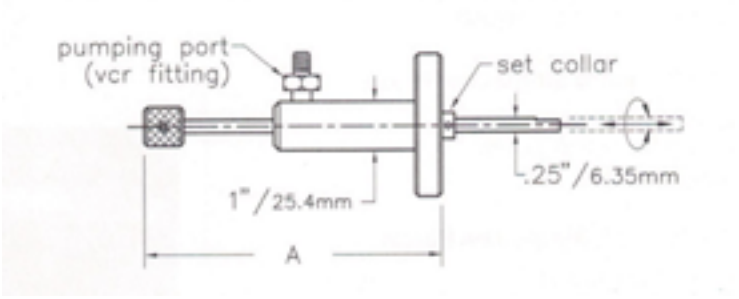
Stroke	A	Model No.
10”	15”	**BPLR-10**
14”	19”	**BPLR-14**
20”	25”	**BPLR-20**
24”	29”	**BPLR-24**

High Vacuum Push-Pull Linear-Rotary Feedthroughs
Elastomer-sealed
2 75” 0.0. mounting flange
with VCR-type differential pumping port

Stroke	A	Model No.
10”	15.2”	**BPLR-275-10**
14”	19.2”	**BPLR-275-14**
20”	25.2”	**BPLR-275-20**
24”	29.2”	**BPLR-275-24**



BPLR-10



BPLR-275-10

SLJ Series Locking Jaw Systems

The SLJ series systems allow for sample handling by simply gripping the sample or sample carrier with a jaw. The jaw has a capacity of over 1/2” thick and has a 1/2” deep throat. The jaw can easily generate over 20 lbs of clamping force. The jaw opens and closes under positive control, maintaining a constant centerline. This allows samples of various sizes and shapes to be handled with one gripper.

Gentle jaw assemblies for specific sample systems also available.

Features

- Handles various sample shapes and sizes
- Easily adapts to magazine multiple loading
- Grips with clamping force

Transfer Requirements for Actuation

Transfer probe requirements are a nonrotating probe with respect to a rotary-coaxial shaft. This action is supplied by:

- RPLR series rack and pinion linear-rotary feedthroughs
- FLRM series push-pull linear-rotary feedthroughs
- EMT series translators with rotary feedthroughs

Transfers of up to 80” can be obtained without intermediate support.

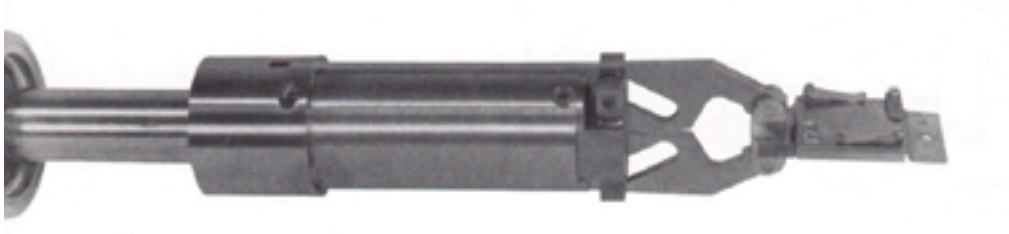
All the above systems can use a quick access door load lock chamber and tilt stages for precise alignment.

SLJ-0.75 Sample Jaw

- Up to 3/4” thick sample
- Jaw depth: 3/ 4”
- Minimum gripping force: 25 lbs
- With swivel jaw pads
- Requires RPLR or similar linear-rotary feedthrough to operate
- Stainless steel construction
- Will pass through a 1.39” I.D. tube

SLJ-0.25 Sample Jaw

- Up to 1/4” thick sample
- Jaw depth: 3/4”
- Minimum gripping force: 4 lbs
- With swivel jaw pads
- Spring grip/cam release
- Requires RPLR or similar linear-rotary feedthrough to operate
- Stainless steel construction
- Will pass through a 1.39” I.D. tube



SLJ-0.75

Thermionics sample mounts provide platen-based support for customer samples. They interface with the supporting structure (rod, gearbox, etc.) and provide mechanical support for the sample. All standard sample mounts provide the following:

- Removable platen
- Clip sample restraint
- Electrically-isolated platen

A wide variety of options or modifications are available for the sample mount to obtain the customers' exact requirements. They include:

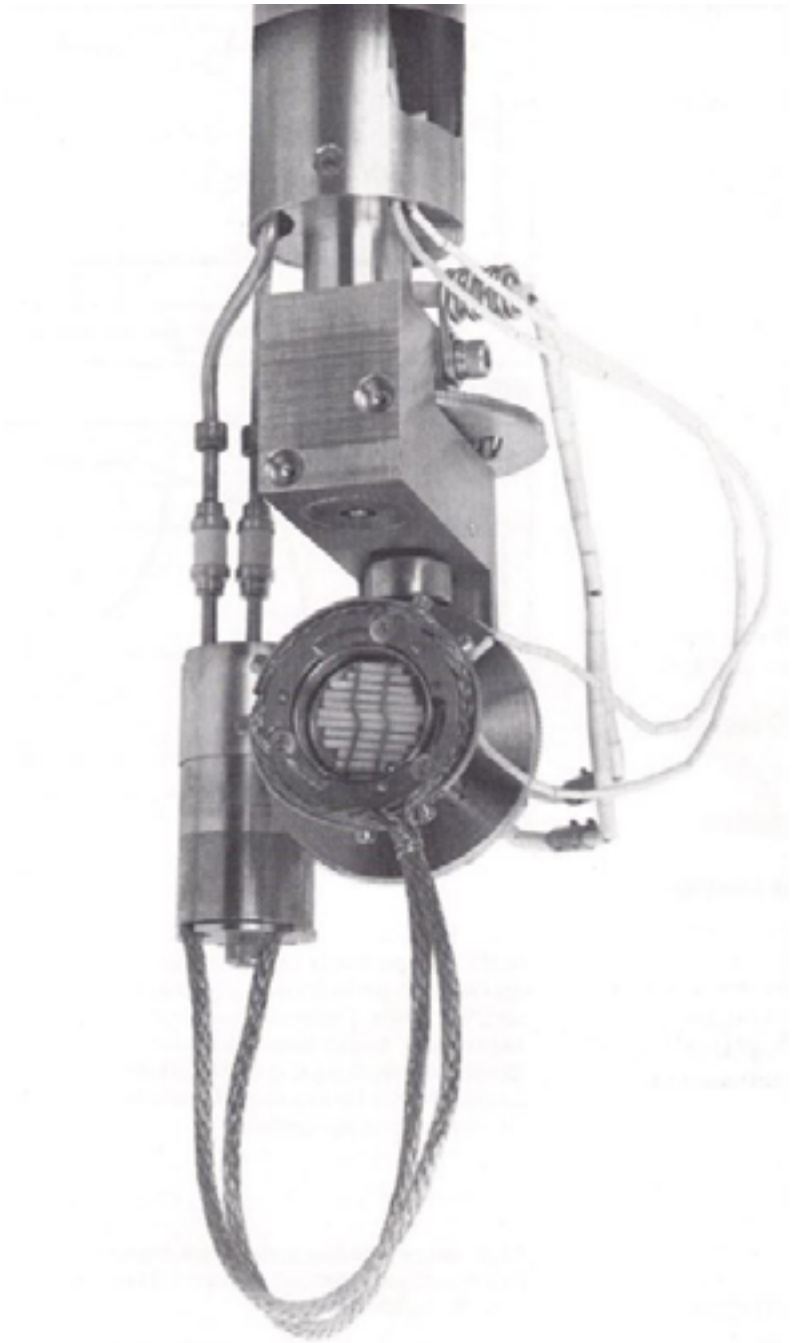
- Sample Heating
  - Resistive
    - Standard
    - Nude filament
    - PBN
    - Quartz lamp
  - e-Beam
- Sample Cooling
  - Direct LN2
  - Indirect LN2
  - Water
- Sample transfer
- Sample bias, RF

These options are described more fully in the following pages.

SMR Series

SMR-1 Sample Mount

- 3/8" shaft or gearbox mounting
- "0" sample face offset to 4" offset. Per customer requirements
- Sample orientation per customer requirements
- 1" diameter sample area, 1.4" diameter sample plate
- Clip sample mount
- Removable sample plate, electrically-isolated



SMR (shown with 1" sample heater, LN_2 cooling, electrical isolation and GB-7 gearbox)

3 UHV Environment Heater Options

The following heating options may be mounted to the SMR sample mounts.

/HR-1 Radiant Resistive Heater

- Maintains electrical isolation
- Moly sample plate with three sample clips
- With all necessary feedthroughs. Atmosphere side connectors, internal wiring, temperature thermocouple, and spare filaments
- Temperatures up to 1,000°C depending upon application

/HRN-1 Nude Filament Radiant Resistive Heater

- Maintains electrical isolation
- Moly sample plate with three sample clips
- With all necessary feedthroughs, atmosphere side connectors, internal wiring, temperature thermocouples, and spare filaments
- Temperatures up to 1,200°C depending upon application

/HRD Intrinsic Resistive Heater

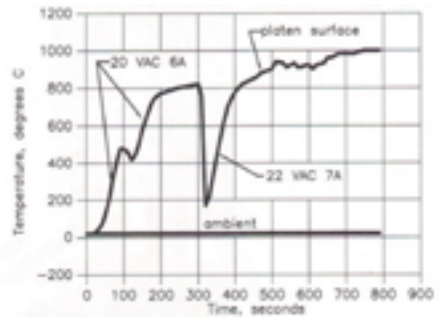
- Modifies STLC platen for direct heating
- Moly sample plate with two power supply clips
- Sapphire sample electrical isolation
- With alt necessary feedthroughs, atmosphere side connectors. internal wiring, and STLC moly platen

/ERH-0-6-1200 Electron Beam Enhanced Resistive Heater

- 0.6" O.D. sample size
- 1,200°C maximum temperature
- Low power filament (approx. 40 watts)
- Suitable for 500 VDC biasing
- With all necessary atmosphere side connectors, internal wiring, temperature thermocouples and spare filaments
- Tungsten, moly, tantalum. alumina and stainless steel construction

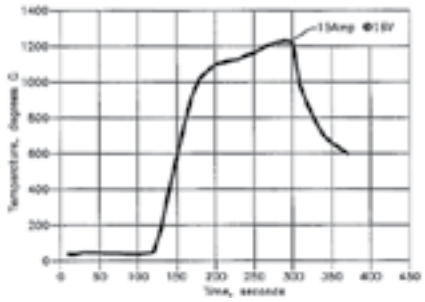
/HEB Electron Beam Heater

- Moly sample plate with three sample clips
- Electrically grounded sample plate
- With all necessary feedthroughs, atmosphere side connectors, internal wiring, temperature thermocouples and spare filaments
- Temperatures up to 2,000°C depending upon application



/HR Graph

/HR-1 Radiant Resistive Heater

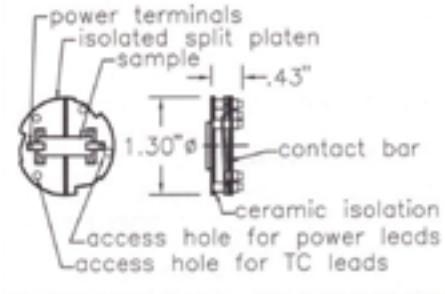


/HRN Graph

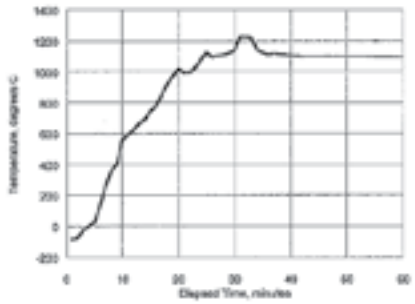
/HRN-2 Nude Filament Heater

NOTE: The performance ratings are for specific applications, generally without sample cooling or sample transfer. Depending on parameters such as sample size, temperature requirements, and motions involved, cooling of the substrate or heater framework may be required. Please consult factory for your specific application

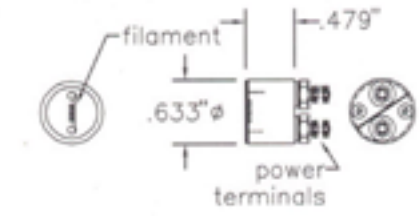
STLC sample transfer systems are manufactured and protected under one or more of the following patents: 5,705,128



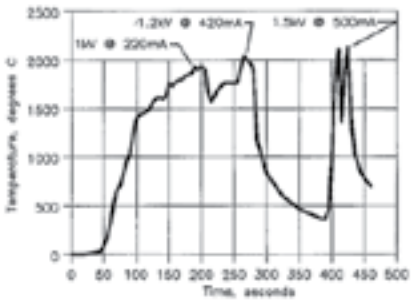
/HRD Intrinsic Resistve Heater



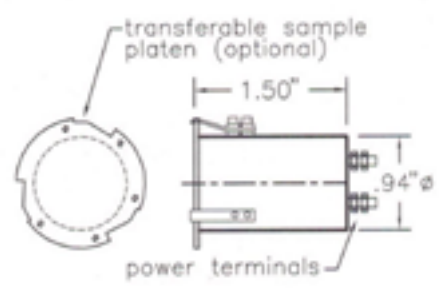
/ERH Graph



/ERH-0.6 Electron Beam Heater



/HEB Graph



/HEB Electron Beam Heater

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Oxygen or Chemical Vapor Environment Heater Options 3

The following heating options may be mounted to the SMR sample mounts.

/SHQ-2 Radiant Quartz Lamp Heater*

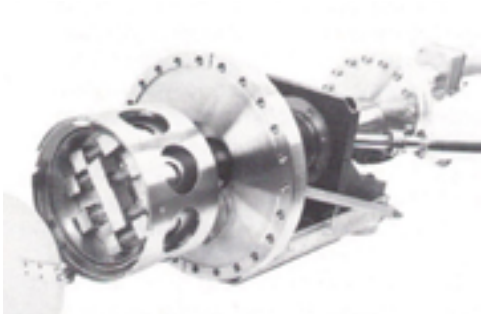
- For 2" O.D. (standard) maximum sample size (optional sizes to 5"O.D.)
- Electrically isolated sample
- Haynes alloy sample plate with three sample clips
- Best temperature uniformity: 1" O.D.
- Maximum temperature:
  700°C continuous
  1,000°C peak
- Utility requirements:
  Thermionics model SPS-232/M or SPS- 232/A (page 3-54)
  0 to 110 VAC, 8A variable power supply
  Requires 0.5 gallons per minute water cooling
- Maintains electrical isolation
- Comes mounted to 2.75" O.D. and support shaft up to 24" long, per customer requirements, dual bakeable electrical feedthroughs, re-entrant metal seal, dual cooling feedthrough and all necessary atmosphere side connectors
- Supplied without thermocouples

/GS Gas Shower Ring Option

- For chemical vapor (CV) applications
- Extends thermal shield above sample plane
- Single gas shower ring, stainless steel construction
- Gas ring clamped to heat shield

/SA Shutter Assembly Option

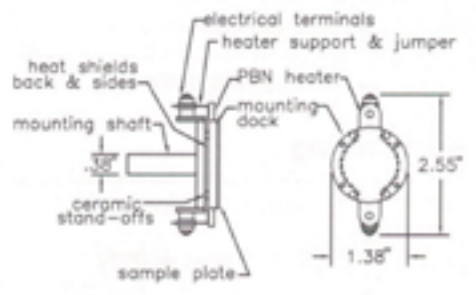
- For evaporation or sputter applications



GB-3O-5/SHQ-5/GS/SA (see page 3-67)

/PBN-1 Radiant Resistive Pyrolytic Boron Nitride Heater*

- Heating to 1,200°C in UHV
- Heating to 800°C in oxygen environment without heater degradation
- Maintains electrical isolation
- Includes all necessary feedthroughs, atmosphere side connectors, and internal wiring
- Heater outgassing above 1,100°C



/PBN-1 Pyrolytic Boron Nitride Heater

***WARNING**

Operations involving enriched oxygen environments can be hazardous including explosive. Many materials commonly considered non-hazardous become dangerous in such environments. Simple mechanical pumps using oil can explode, putting both personnel and equipment at great risk. Many other common materials will react violently to oxygen. The SHQ series heater has not been tested in enriched oxygen environments and is not intended for that use. We recommend systems utilizing enriched environments be undertaken only by those properly skilled to perform such operations in a safe and cautious manner.

Heating and Cooling Accessories

ACS-CR Copper Rope

- Approximately 1/8" O.D.
- OFE copper
- Suitable for UHV cooling transfer
- Available in custom lengths

ACS-TS Tantalum Screws

- Manufactured from tantalum/rhenium
- 0-80 screw size
- 3/16" tip to head base
- Filister head

ACS-Ag Silver Plated Screws

- 300 series stainless steel screws
- Plated with silver
- Resists galling
- Improves heat transfer
- Available in all standard screw sizes and head types
- Vented or unvented

ACS-SVS Slot Vented Screws

- 300 series stainless steel screws
- Vent cut through screw threads and base of head
- Allows pumpout of each thread
- Available in all standard screw sizes arid head types

SMRHR-HS Heater Spares Kit

- Two replacement tungsten filaments
- Replacement ceramic insulators

3 LN_2 Sample Cooling Options

The following cooling options may be added to the SMR sample mounts.

LN_2 Sample Cooling

There are two basic methods of cooling samples using LN_2 for vacuum application, direct cooling and indirect cooling.

In most cases direct contact of the LN_2 Dewar with the sample achieves the highest rate of heat transfer and the most rapid cooling to the lowest temperature. If the sample is mounted to a goniometer head or precision gearbox, the plumbing of the LN2 to the Dewar can restrict the motion. In such cases a clamping Dewar may be considered.

A clamping Dewar can allow certain degrees of freedom, such as continuous rotation, and still achieve maximum cooling. A heated rotating sample can be cooled by stopping the motion and activating a Dewar that clamps to the sample platen.

The indirect cooling method cools the sample by conduction through a flexible copper rope to a remote LN_2 Dewar. The copper rope can be an effective means of cooling. Sample motion and temperature are restricted by the length and number of copper ropes used to achieve the desired level of cooling.

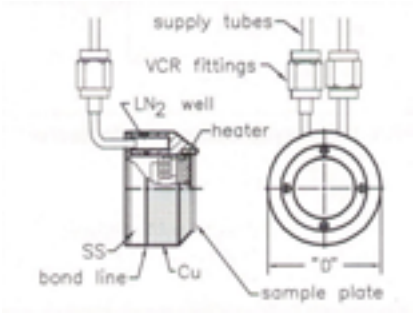
The ability of a cooling system to cool the sample to its lowest temperature is limited by many factors: Direct versus indirect cooling, size of sample, sample heating attachments, limitations required by goniometer, number of copper ropes used. sample transfer requirements, electrical isolation requirements of the sample. and the ability to use a clamping Dewar.

Dewar Materials

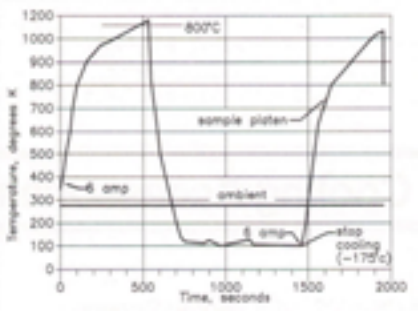
Dewars are fabricated from composite, explosively-bonded OFE copper to stainless steel. This material is formed in an explosive process that creates a high-quality metallurgical bond. A high explosive charge compresses the copper and stainless plate material at supersonic speeds and at extreme pressures forming a plasma at the contact point. The plasma scours the surfaces to molten conditions as the plates collide and instantaneously cool. The resulting knitted mechanical bond of copper-to-stainless has excellent mechanical and thermal properties for UHV LN_2 Dewar applications.

Dewars fabricated of this composite material allow LN_2 to flow in contact with high thermal transfer capacity copper, with stainless steel plumbing (TIG welded) to the stainless steel side of the bonded Dewar. No brazing is required reducing the possibility of contamination and virtual leaks.

Direct Cooling



SMR-1/CLND-1

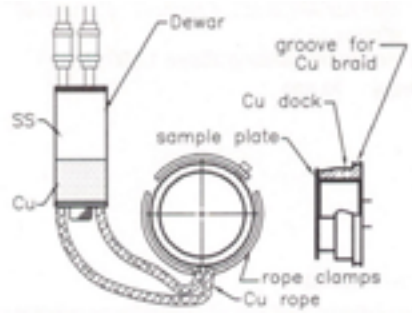


/CLND-1
(temperature graph showing direct cooling of substrate between heating cycles)

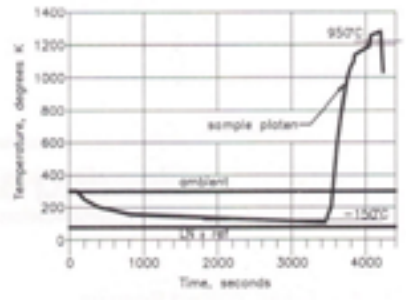
Time-Temperature Test

- SMR-1 sample mount
- Resistive heating
- Direct cooling
- Screw platen attachment

Indirect Cooling



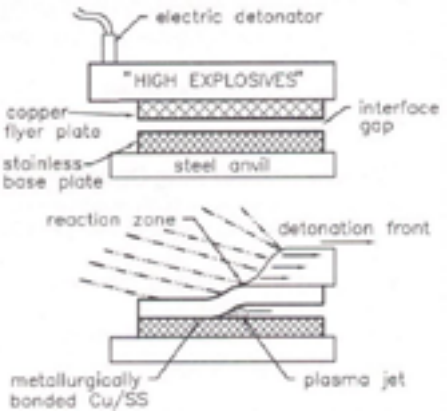
SMR-1/CLNI-1



/CLNI-1
(Cooling using in-vacuum Dewar and copper rope connections to sample plate)

Time-Temperature Test

- STLP-1 sample transfer
- Molybdenum platen
- Indirect cooling
  - 2" x 6" copper rope
  - Copper Dewar
  - 8" x 1/8" feed lines



Explosive Process

Dewar Design

Dewars have an internal phase separator that maximizes thermal transfer. The liquid LN2 contacts the copper and is allowed to boil, releasing nitrogen gas that is separated and allowed to escape. This technique maximizes contact of the copper with the liquid and keeps boiled-off nitrogen gas (a poor thermal transfer medium) away from the copper heat transfer surfaces. This dramatically lowers the temperature of the Dewar and increases its capacity for thermal transfer. True OFE copper rope is clamped to the copper side of the Dewar for indirect cooling to the sample.

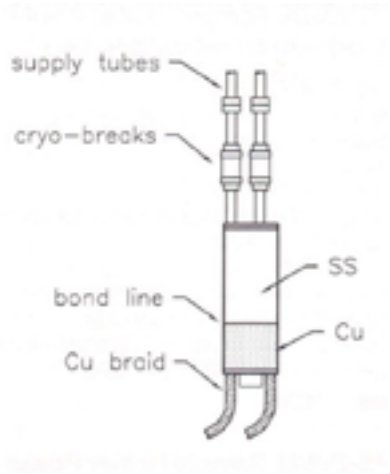
A 1.33" CF re-entrant seal, with plumbing made to length, may be used to connect the Dewar to the atmosphere side of the LN2 source. The welded plumbing connected to the re-entrant seal eliminates the need for in-vacuum fittings and possible leaks. All Dewars are helium leak-tested at LN2 temperatures prior to shipping.

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

The following cooling options may be added to the SM or SMR sample mounts.

/CLNI-1 LN$_2$ Indirect Cooling

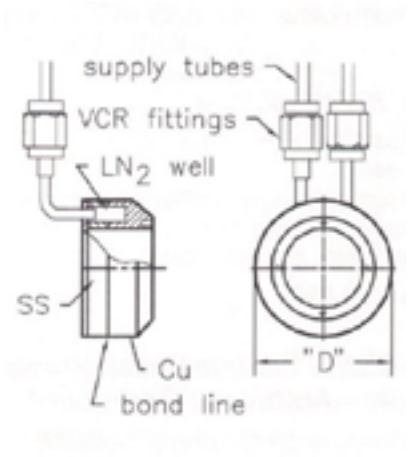
- 1" O.D., 2" long
- Explosively-bonded OFE copper to stainless steel
- Two OFE copper ropes, 12" length
- Internal phase separator
- Electrically grounds sample
- With VCR fittings
- 1/8" O.D. or 0.093" O.D. supply tubes
- Includes FLN-133-2 LN$_2$ feedthrough (see page 5-13)
- Includes custom supply tube lengths, coils, thermally-isolated mounting hardware, as required



/CLNI-1/CEI-I

/CLNI-1 LN$_2$ Direct Cooling

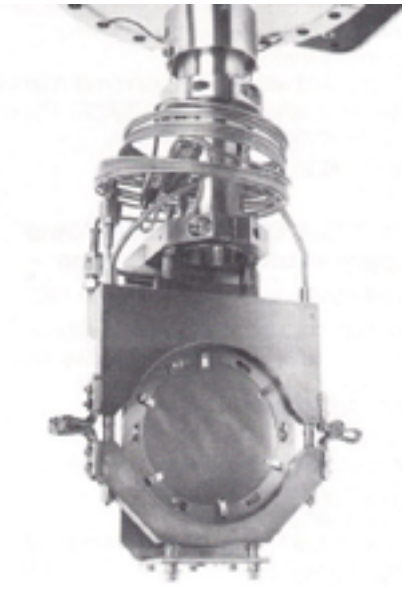
- Annular Dewar mounted around 1" sample plate
- Explosively-bonded OFE copper to stainless steel
- Internal phase separator
- Electrically grounds sample
- With VCR fittings
- 1/8" O.D. or 0.093" O.D. supply tubes
- Includes FLN-133-2 LN$_2$ feedthrough (see page 5-13)
- Includes custom supply tube lengths, coils, thermally-isolated mounting hardware, as required
- Application depends upon gearbox and range of degrees of freedom



Direct Cooling

/CDC LN$_2$ Clamping Direct Cooling

- Actuated clamping annular Dewar
- Explosively-bonded OFE copper to stainless steel
- Internal phase separator
- Electrically grounds sample
- With VCR fittings
- 1/8" O. D. or 0.093" O.D. supply tubes
- Includes FLN-133-2 LN$_2$ feedthrough (see page 5-13)
- Includes custom supply lube lengths, coils, thermally-isolated mounting hardware, as required
- Application depends upon gearbox and range of degrees of freedom



Clamping Dewar (with heater sample transfer and sample rotation)

Options

/CEI-I Ceramic Electrical Isolation

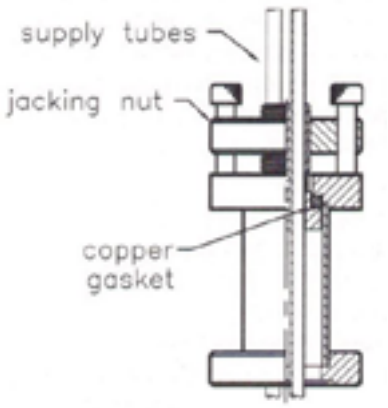
- Provides electrical isolation for indirect cooling

/CEI-D Ceramic Electrical Isolation

- Provides electrical isolation for direct cooling

/RE-ENTRANT Re-entrant Seal

- Allows Dewar to be connected to atmosphere without in-vacuum VCR fittings
- Fits on 1.33" O.D. flange



/RE-ENTRANT Seal

3 SPS Series Sample Heater Power Supplies

SPS-252/A

SPS-202/M Sample Heater Power Supply—Manual Operation

Samples to 1" O.D.
For /HR and /HRN radiant resistive heaters
Maximum output. 10 A at 50 VDC
Input:
120 V 60 Hz AC input
(220 VAC units available)

- Current limit
- Current meter
- Rack-mount chassis

SPS-202/A Sample Heater Power Supply—Automatic Operation

Adds these features to the SPS-202M:

- Automatic PID temperature control
- Automatic system tuning
- Digital temperature read-out
- True phase-fired proportional control, with adjustable bias (minimum output control)
- Adjustable power limit
- To be used with Type "K" Chromel-Alumel thermocouple (-200°C to 1,300°C)

SPS-232/M Sample Heater Power Supply—Manual Operation

Samples to 3" O.D.
For /SHQ radiant quartz lamp heaters and
/HR and /HRN radiant resistive heaters
Maximum output: 10A at 120 VDC
Input: 120 V 60 Hz AC input
(220 VAC units available)

- With isolation transformer
- With current limit
- Current meter

**NOTE: These units do not include external plugs for use with alternating current meters. This provision would access the high voltage circuitry to the outside chassis. We believe this design to be hazardous.*

SPS-232/A Sample Heater Power Supply—Automatic Operation

Adds these features to the SPS-232/M:

- With temperature read-out and PID automatic control
  Accuracy: < 3°C
  Repeatability: < 0.3°C
  Stabilty: 3 µV/°C including compensation
  Set-point resolution: 1°C
- Auto-tuning
- Includes thermocouple cable
- Requires system thermocouple
- To be used with Type "K" Chromel-Alumel thermocouple (-200°C to 1,300°C)

SPS-252/M Sample Heater Power Supply—Manual Operation*

Consult factory for sample size capability
For /HEB electron beam heater
Maximum output: 14 A at 60 VAC filament
0-2,000 VDC bias up to
0.25 A emission
Input: 220 V 50/60 Hz AC

- Adjustable power limits, filament and emission
- Current read-outs, filament and emission
- Voltage read-out, bias
- With safety ground cable

SPS-252/A Sample Heater Power Supply—Automatic Operation*

Adds these features to the SPS-252/M:

- Automatic PID temperature control
- Digital temperature read-out
- True phase-fired proportional control of filament or bias high voltage, switchable with adjustable output bias (minimum output control)
- To be used with Type "K" Chromel-Alumel thermocouple (-200°C to 1,300°C), (Type "C" thermocouple available)

SPS-253/A Sample Heater Power Supply—Automatic Operation

For e-beam heater models ERH-0.6-1200
Maximum output: 8A at 12 VAC filament
0-500 VDC bias up to
0.2A emission
Input: 120V 60 Hz AC input
(220 VAC units available)

- Automatic PIO temperature control
- Automatic system tuning
- Digital temperature read-out
- True phase-fired proportional control of filament with stable bias (minimum output control)
- Adjustable current limit with read-out
- Adjustable bias at 0.25 A with current meter and on/off switch
- Rack mount chassis

SPS-262/M Sample Heater Power Supply—Manual Operation*

Consult factory for sample size capability
For /HEB electron beam heater
Maximum output: 15 A at 20 VAC filament
0-3,000 VDC bias up to
0.5 A emission
Input: 220 V 50/60 Hz AC

- Adjustable power limits, filament and emission
- Current meters, filament and emission
- Voltage meter, bias
- With safety ground cable

SPS-262/A Sample Heater Power Supply—Automatic Operation*

- Consult factory for sample size capability
- For /HEB electron beam heater
- Maximum output: 15 A at 20 VAC filament
- 0-3,000 VDC bias up to
- 0.5 A emission
- Input: 220 V 50/60 Hz AC
- Automatic PID temperature control
- Digital temperature read-out
- True phase-fired proportional control of filament or bias high voltage, switchable with adjustable output bias (minimum output control)
- Adjustable power limits, filament and emission
- Current meters, filament and emission
- Voltage meter, bias
- With safety ground cable
- To be used with Type "K" Chromel-Alumel thermocouple (-200°C to 1,300°C), (Type "C" thermocouple available)

Options

/CI Computer Interface

- Available on all automatic controllers
- RS-232 interface-to-PID control
- Complete set-up and operational commands

/RSC Ramp and Soak Process Controller

- Available on all automatic controllers
- Computer interface capability
- Up to eight adjustable ramp and soak periods

Model DRS-1000
In-situ Temperature Measurement, Temperature Control, Process Monitoring

This Innovative patented optical technology provides accurate, real time temperature measurement and control for semiconductors. Unlike pyrometry, this process is not affected by emissivity or thin coatings. The noncontact, non-invasive system gives precise (± 0.5°C) readings with one second updates.

Diffuse Reflectance Spectroscopy

Diffusely reflected light intensity as a function of wavelength displays a characteristic absorption edge that is related to the bandgap of a semiconductor. This edge shifts with temperature. The technique can be used on bare wafers, patterned wafers and multilayer wafers.

DRS-1000 System

The light output module is a broadband, modulated light source that illuminates the wafer through an optical port. The collection module, located on a second (non-specular) port, focuses the diffusely scattered light onto a fiber optic bundle. The spectrum information is transmitted to the scanning monochromator /detector/lock-in amplifier module. A control computer running the DRS-1000 software measures the absorption edge and generates temperature values based on internal calibration information. The software runs under WINDOWS and is equipped with a user-friendly graphical interface.

Specifcations

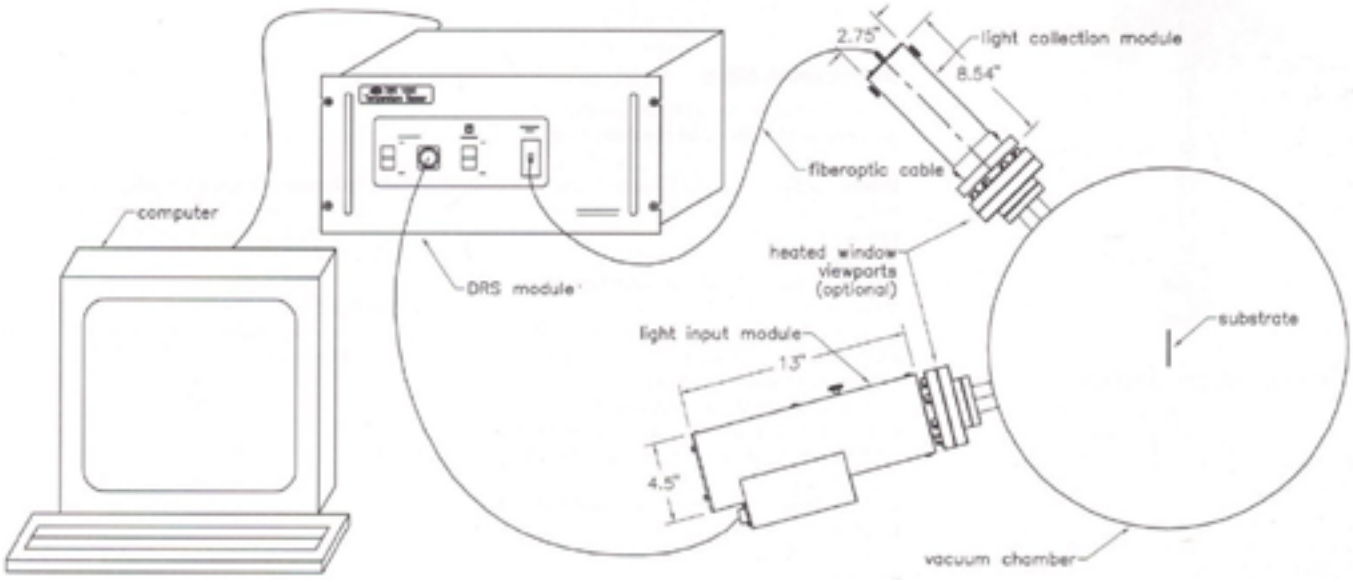
- Calibrations for substrate materials include:
  GaAs 0-800°C
  InP 0-700°C
  Silicon 0-600°C
- ± 0.5°C resolution and repeatability
- One second updates
- Attaches to standard 2. 75" ConFlat flanges
- Temperature control feedback provided with RS-232 communications or analog output voltage

Applications

- Molecular Beam Epitaxy (MBE)
- Chemical Beam Epitaxy (CBE)
- Metal Organic Chemical Vapor Deposition (MOCVD)
- Silicon Wafer Etching

The VHW series heated viewports (page 3-78) allow the DRS-1000 to operate continuously in deposition environments.

DRS-1000 System (shown mounted on Test Chamber)



Schematic of the DRS-1000 System Components

3 RFH Series Feedthrough Hats

Utility Delivery

Goniometers and precision gearboxes with heating and cooling have requirements for many types of utility feedthroughs:

- Rotary and/or linear motion for goniometer actuation
- Electrical power for sample heaters
- Thermocouple for temperature measurement
- Sample biasing for processing
- Water cooling for gearbox cooling
- LN_2 cooling for sample cooling

Polar rotation of the sample is a fundamental requirement of most goniometers and precision gearboxes. When using base flange utility delivery, polar rotation causes utility lines to flex and abrade against one another in vacuum. Flexing can cause line failure and abrasion can cause particle contamination. To avoid these potential risks an axial utility delivery system can be used.

Utility Delivery System
(heating, thermocouple and LN_2 lines delivered through RFH-275-133-3 top hat and EC-1.39-2/B-6M manipulator to GB-7 gearbox)

Axial Utility Delivery

The Axial Utility Delivery method organizes the utilities to eliminate flexing and abrading. The RFH top hat delivers the entire utility package axially through a probe support tube assembly to the sample head.

Polar rotation is achieved by mounting the entire utility package (top hat, probe support tube and sample head) through the center of a differentially pumped rotary seal (see page 3-27). This procedure organizes the entire in-vacuum sample assembly on to the rotating top flange of the platform. The package now rotates as a unit with no in-vacuum utility line flexing or abrading. Flexing of utility lines occurs out of vacuum where you can deal with it.

The RFH series feedthrough hats are available on 2.75", 4.5" and 6" O.D. base flanges. Top flanges are either 2.75" or 1.33" O.D. flanges. The utility delivery ports are "crowned" to improve access, ease installation, and avoid kinking of utility lines.

Re-entrant seals are available for single piece LN_2 systems (see page 3-53).

These assemblies are supplied without blank-off flanges

Ordering Information — Feedthrough Hat Assemblies

Base Flange O.D.	Top Flange O.D	Number of Mini-Ports	Top Flange to Base Flange Dimension	Model Number
2.75"	2.75"	2	5.0"	**RFH-275-275-2**
		3	5.0"	**RFH-275-275-3**
		4	5.0"	**RFH-275-275-4**
		5	5.0"	**RFH-275-275-5**
		6	5.0"	**RFH-275-275-6**
	none	3	0.0"	**RFH-275-0-3**
	1.33"	3	3.75"	**RFH-275-133-3**
		4	5.75"	**RFH-275-133-4**
4.5"	2.75"	2	4.5"	**RFH-450-275-2**
		4	4.5"	**RFH-450-275-4**
		6	4.5"	**RFH-450-275-6**
	1.33"	4	4.5"	**RFH-450-133-4**
6"	2.75"	2	4.5"	**RFH-600-275-2**
		4	4.0"	**RFH-600-275-4**
		6	4.0"	**RFH-600-275-6**
		8	4.0"	**RFH-600-275-8**

Application Note

A standard axial utility delivery assembly consists of the following components:

Utility Porting The RHF series feedthrough hat provides utility porting for utility-intensive probe assemblies.

Sample Head Any goniometer or precision gearbox with related sample heating and cooling or other sample environmental conditioning.

Polar Rotation The RNN series differentially pumped rotary seals (see page 3-27) provide 360° polar rotation.

Probe Support Tube Delivery Channel
Mounted to the top hat and attached to the sample head. Probes are typically a minimum of 0.75" and at least 1.5" O.D. when heating and LN_2 utilities are required.

Large diameter probe support tubes and substantial stability to the sample head. Additional bearing support can be added to the probe at the base flange of linear translators and FM style compound manipulators (see page 3-10).

Options

/ST-0.75 Custom Support Probe Tube

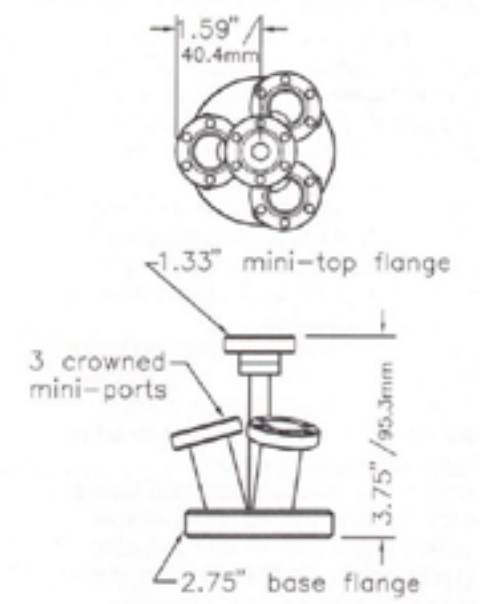
- 0.75" O.D. stainless steel construction
- End bearing support for rotary shaft
- Length specified by customer

/PP Parallel Mini-Port

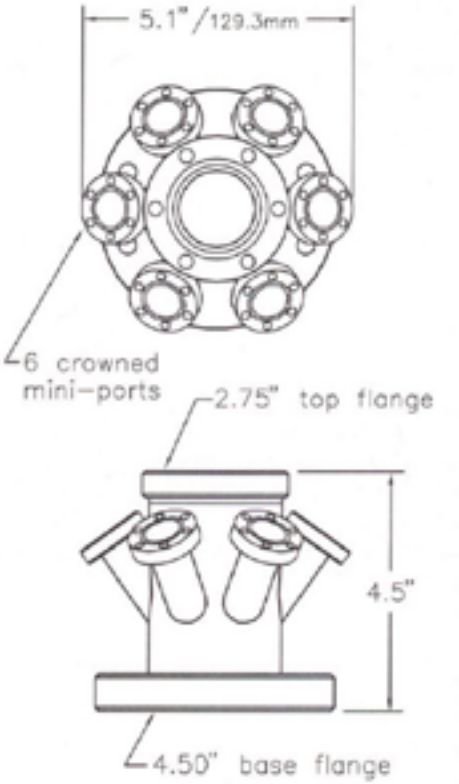
- Allows hat assembly to rotate with minimum effective radius
- Cannot be used with high voltage connectors or WOA feedthroughs
- Extends tubulations and installs elbows under each mini-port flange
- Aligns mini-port polar axis parallel to mounting flange axis

/PPE Extended Parallel Mini-Port

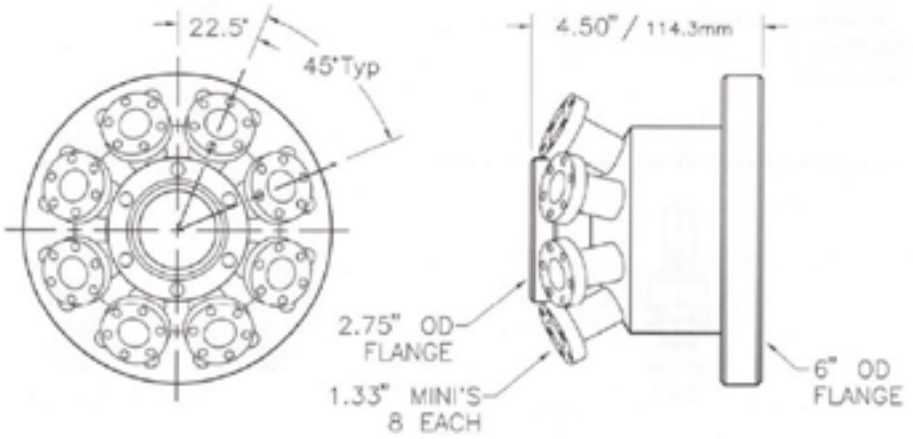
- Sample as /PP above except:
- Allows for high voltage connectors and WOA feedthroughs



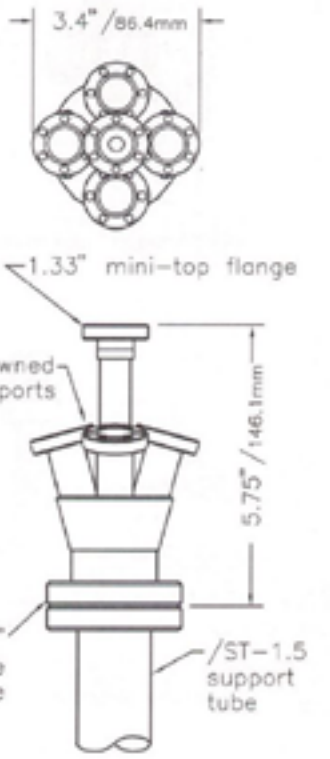
RFH-275-133-3



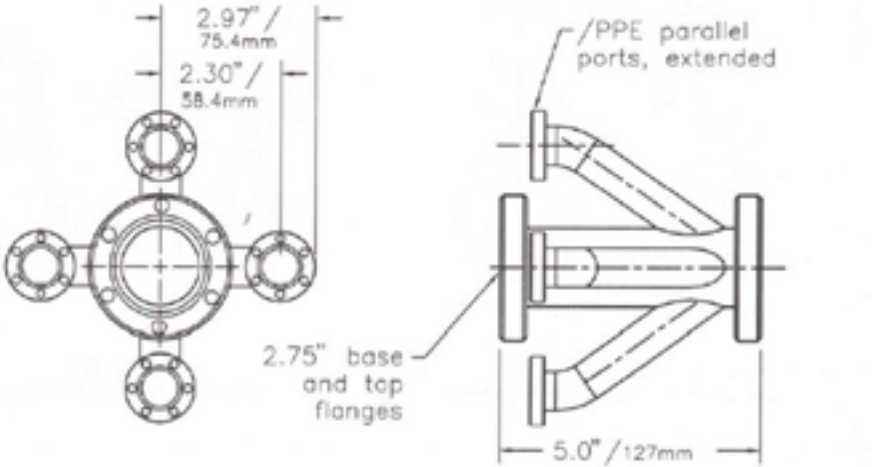
RFH-450-275-6



RFH-600-275-8



RFH-275-133-4/ST-1.5



RFH-275-275-4/PPE

3 Goniometers and Precision Motion Gearboxes

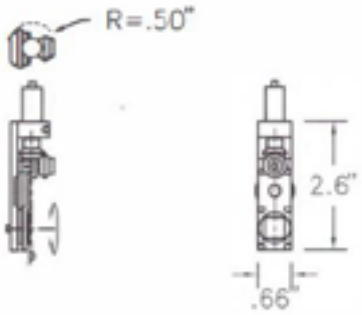
A goniometer head permits precision sample positioning and alignment motion at the sample location. Installation of a goniometer head increases the number of degrees of freedom of the sample. Rotations, translations and flip movements can be supplied with various accuracies.

Sample faces can be held on axis, allowing a single sample site to be investigated during a change of angle. Virtual axis goniometers allow unobstructed surface access for glancing angle studies.

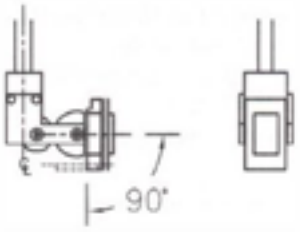
Precision gearboxes are designed to provide motion for sample processing. Precision gearboxes can rotate the sample continuously during deposition, ablation or for other growth processing requirements.

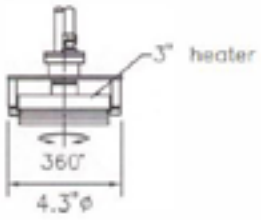
All goniometer and precision gearboxes are suitable fer UHV use. All stainless-steel construction, anti-backlash spring-loaded gearing is standard. Optional heating, cooling and sample transfer are available for most units.

/NM Non-Magnetic Option: Most goniometers and precision gearboxes can be constructed of non-magnetic materials. Beryllium Copper (BeCu) bearings and 300 series stainless steel are used for basic non-magnetic applications and titanium is used for even lower Gauss levels. Please consult the factory for your application cost.

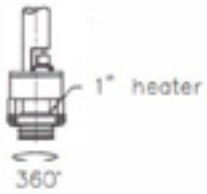


GB-21
360° Continuous
Azimuthal Rotation

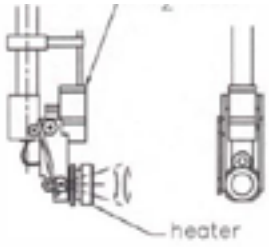




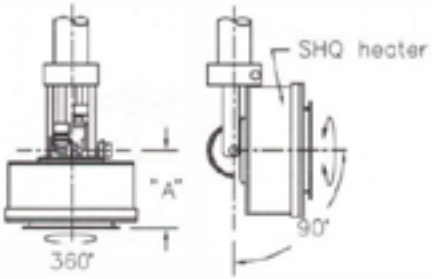
GB-19-3
Continuous Polar Rotation



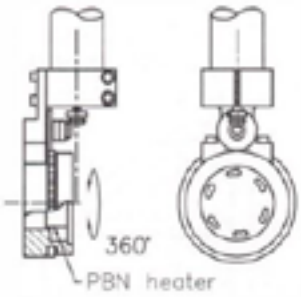
GB-19-1
Continuous Polar Rotation



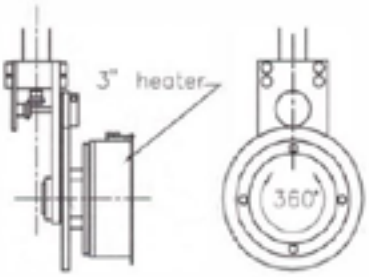
GB-41
Continuous Azimuthal Rotation
Offset Flip



GB-11
Azimuthal Rotation, Offset Flip



GB-14-1
Continuous Azimuthal Rotation



GB-25/OS
Offset Continuous Rotation

The goniometers and precision gearboxes shown above are some of the models also available. Please consult the factory for details.

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

GB-2/OA Open Axis Goniometer Head
Azimuthal and Polar Rotation

- Up to 2" O.D. samples
- Open azimuthal axis required for nonrotating heater
- Requires coaxial rotary-linear drive
- Rack and pinion gear drive, adjustable lash
- All ball bearing drive
- Adjustable sample orientation

GB-2/OA/ HR/CLNI/ STLC (shown with options)

Typical Activation Components

	Azim	Polar 1	Polar 2	Flip
FRLC (page 3-35)	x	x	-	-
FLMM-1 (page 3-37)	x	-	-	-
WOA (page 3-36)	-	x	-	-
FLMM-1 (page 3-37)	x	-	-	-
RNN (page 3-27)	-	x	-	-

Specifications

Polar

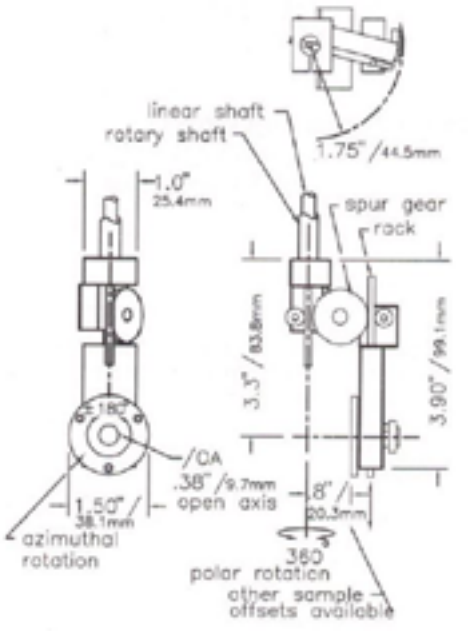
- 360° continuous without utility delivery, or when mounted to support tube for heating and cooling utility delivery and by using an RNN series differentially pumped rotary platform for polar rotation
- ± 180° capability when utilities are delivered from the base flange, using a clear axis rotary feedthrough such as the WOA or using a rotary-linear feedthrough such as the FRLC for polar and azimuthal rotation

Azimuthal

- ±90° using a linear feedthrough such as the FLMM-1 or the dual coaxial FRLC-1 with 1.0" linear stroke
- ±180° with 2.0" linear stroke, limited by the cooling

Sample Offset

- 0.8" standard sample offset



GB-2/0A (shown without options)

Options

Sample Transfer

- STLC Series (turn-to-lock-3—70)
- SPF Series (dual groove—3-72)
- SMR (direct mount, no sample transfer—3-49)

Heating

- /HR (radiant resistive, 1,000°C—3-50)
- /HAN (nude filament, radiant resistive, 1,200° C—3-50)
- /PBN (pyrolytic boron nitride, above 1,200° C—3-51)
- May require gearbox cooling depending upon application

Cooling

- /CLNI (indirect, copper rope—3-53)
- /CWGB (water cooling to gearbox)
- /CEI (ceramic electrical isolation of sample—3-53)

Offset

- /OS (custom offset sample available) Consult factory

Bias

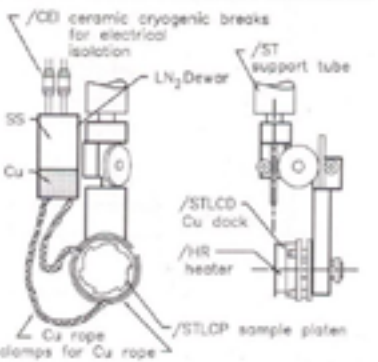
- /EBS (electrical bias of sample)

Multpile Sample

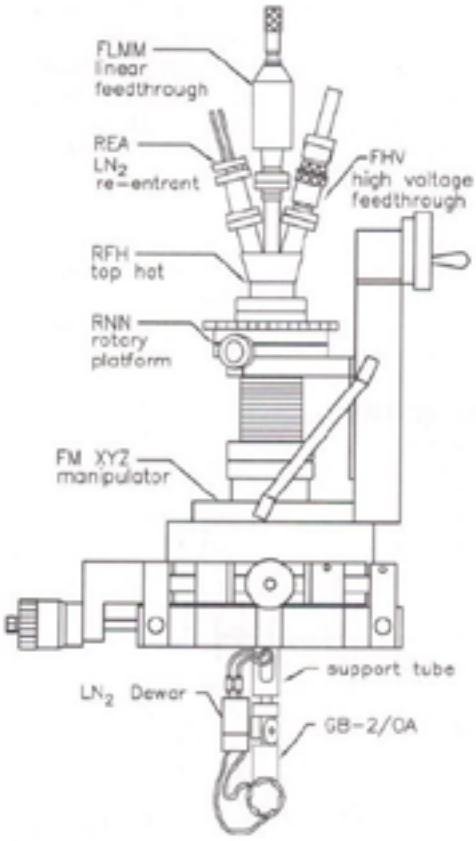
- /FSD (live sample drive)

Non-Magnetic

- /NM (beryllium copper bearings, bronze gears, titanium construction—3-58)



GB-2/OA/HR/CLNI/STLC (shown with options)



GB-2/OA/HR/CLNI/STLC (shown with options mounted to FM XYZ manipulator)

STLC sample transfer systems are manufactured and protected under one or more of the following patents: 5,705,128

GB-4-1 Goniometer Head
Azimuthal, Polar Rotation

- Up to 2" O.D. sample (other sizes available, consult factory)
- 1:1 gear ratio, standard
- Requires coaxial rotary-rotary drive
- All ball bearing drive, adjustable gear lash
- Offset sample

Specifications

Polar

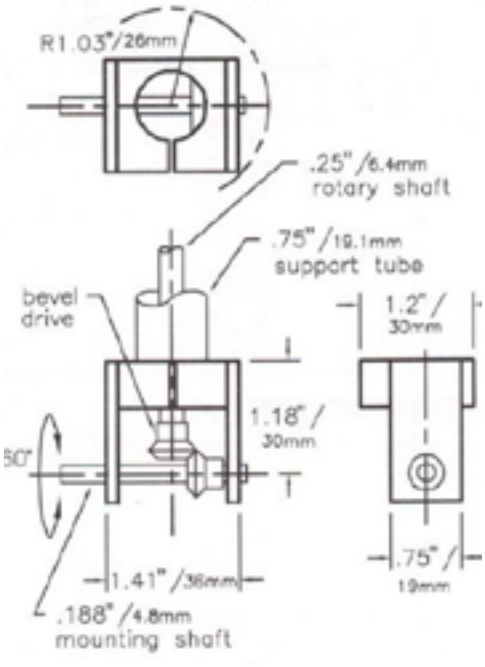
- ± 180° capability when utilities are delivered from the base flange, using clear axis rotary feedthrough such as the WOA or the coaxial rotary feedthrough model FRRC for polar rotation and azimuthal motion
- 360° continuous when mounted to support tube for heating and cooling utility delivery that is mounted to a differentially pumped rotary platform such as the RNN series

Azimuthal

- 360° continuous with rotary such as the FRM or by using the coaxial rotary feedthrough such as the FRRC for the polar axis rotation and the azimuthal rotation, limited by cooling

Sample Offset

Consult factory



GB-4-1 :1 (shown without options)

Options

Sample Transfer

- STLC Series (turn-to-lock—3-70)
- SPF Series (dual groove—3-72)

Open Axis For Heating

- /OA Allows a non-rotating heater with heating utilities delivered along the azimuthal rotation axis. The sample can be heated while rotating continuously

Heating

- /HR (radiant resistive—3-50)
- /HRN (nude filament. radiant resistive—3-50)
- /PBN (pyrolytic boron nitride—3-51)
- /SHO (quartz lamp—3-51)
- May require gearbox cooling depending upon application

Cooling

- /CLNI (indirect, copper rope—3-53)
- /CEI (ceramic electrical isolation—3-53)

Gear Ratio

- /GR-4:1 replaces the 1:1 gear ratio with a 4:1 gear ratio tor higher resolution movement

Offset Flip

- /OF Offset flip available

Offset

- /OS Custom offset sample available

Bias

- /EBS (electrical bias of sample)

Non-Magnetic

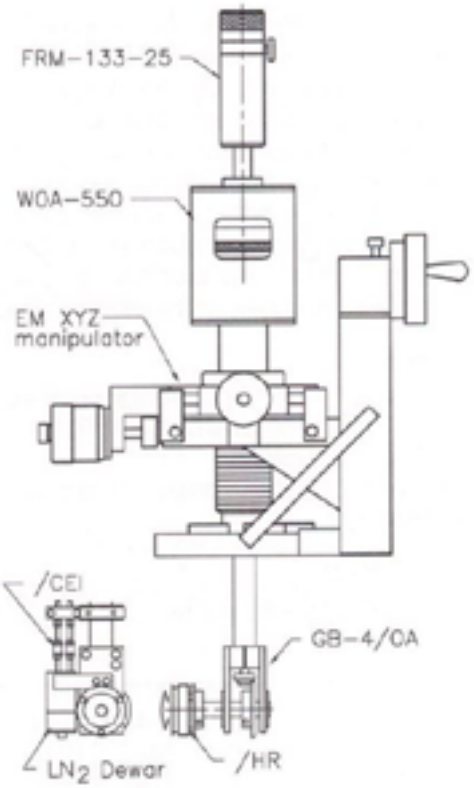
- /NM (beryllium copper bearings, bronze gears, titanium construction—3-58)

GB-4

Typical Activation Components

	Azim	Polar 1	Polar 2	Flip
FRRC (page 3-35)	x	x	-	-
FRM (page 3-30)	x	-	-	-
WOA (page 3-36)	-	x	-	-
FRM (page 3-30)	x	-	-	-
RNN (page 3-27)	-	+	-	-

+ *Required for heating and cooling*



GB-4-1/OA/HR-1/CLNI/CEI-I
(shown mounted to FM XYZ manipulator with utility delivery support tube, top hat rotary drive components)

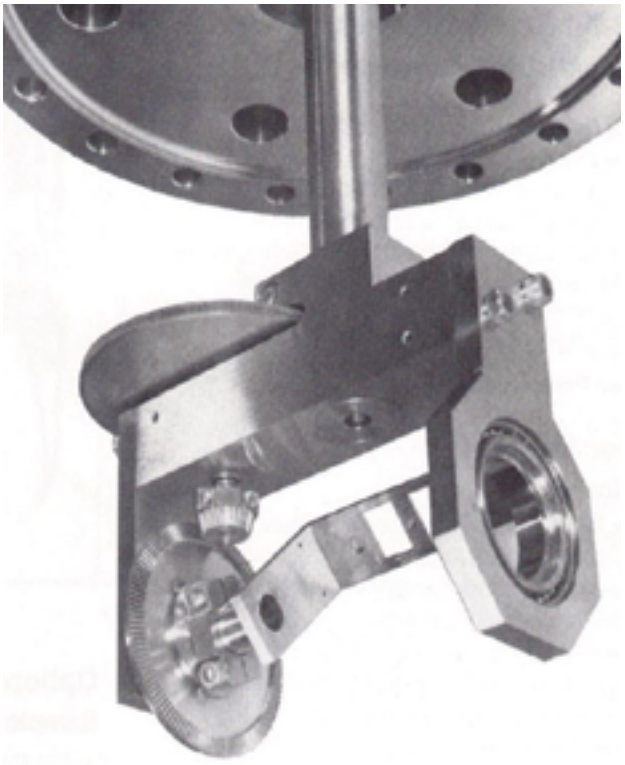
STLC sample transfer systems are manufactured and protected under one or more of the following patents: 5,705,128

GB-5 Gearbox

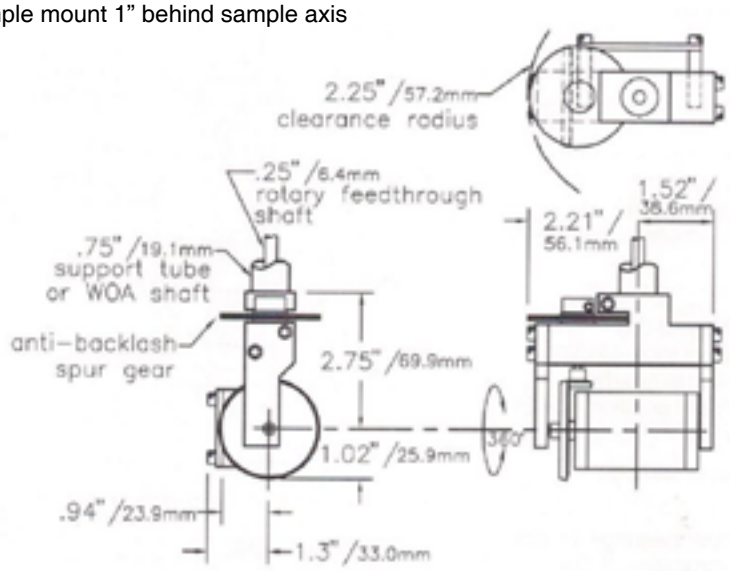
- Provides fine 360” flip
- Requires WOA (or support tube) and FRM
- All ball bearing actuation, anti-backlash gearing
- Sample platform surface 0.94” behind rotational axis

GB-5/HA Gearbox

- 0.312’ hollow access through axis shafts allowing 0° to 2: glancing angle studies
- Provides fine 360” continuous flip rotation
- All ball bearing actuation, adjustable and anti-backlash gearing
- Mounts to a 3/4” O.D. shaft (WOA or support tube)
- Driven by an FRM-133-25 rotary feedthrough
- Sample polar axis and azimuthal axis “0” offset
- Sample mount 1” behind sample axis



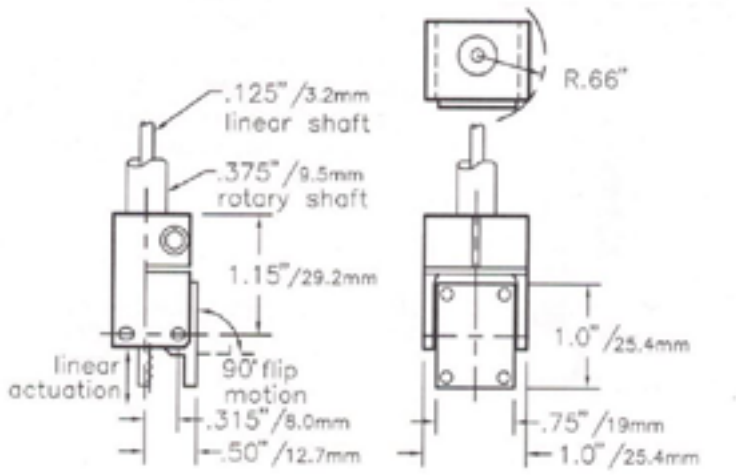
GB-5/HA



GB-5

GB-6 Geared Flip

- Provides over 90˚ of flip from perpendicular to parallel to main shaft axis
- Requires FRLC-275-0.5 for actuation
- Linear response
- Sample flip axis and face not on polar axis



GB-6

GB-7-1 Goniometer Heater
Azimuthal and Polar Rotation

- Up to 1.5" O.D. sample (other sizes
- available, consult factory)
- High resolution azimuthal rotation
- Requires coaxial rotary-rotary drive
- Open azimuthal axis for non-rotating heater
- All ball bearing drive, adjustable anti-backlash gearing
- Adjustable to zero sample offset

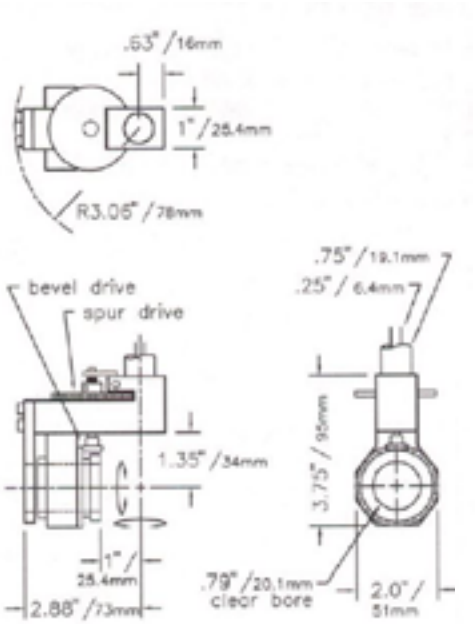
Specifications

Polar

- ± 180° limited when cooling utilities are delivered from the base flange, using a clear axis rotary feedthrough such as the WOA for polar rotation
- 360° continuous when utilities are delivered by support tube and top hat mounted to an RNN series differentially pumped rotary platform for polar rotation

Azimuthal

- 360˚ continuous orthogonal to the polar axis by using a rotary feedthrough such as the FRM
- ± 180˚ limited by sample cooling
- 20:1 gear ratio for precision azimuthal angle positioning



GB-7-1 (shown without options)

GB-7-1/HR-1/CLNI
(shown with options)

Typical Activation Components

	Azim	Polar 1	Polar 2	Flip
FRM (page 3-30)	x	-	-	-
WOA (page 3-36)	-	x	-	-
FRM (page 3-30)	x	-	-	-
RNN (page 3-27)	-	x	-	-
Precision Azimuthal Motion				
FPRM (page 3-34)	x	-	-	-
WOA (page 3-36)	-	x	-	-
FPRM (page 3-34)	x	-	-	-
RNN (page 3-27)	-	x	-	-

Options

Sample Transfer

- STLC Series (turn-to-lock--3-70)
- SPF Series (dual groove--3-72)

Heating

- /HR (radiant resistive--3-50)
- /HRN (nude filament, radiant resistive--3-50)
- /PBN (pyrolytic boron nitride--3-51)
- /SHO (quartz lamp--3-51)
- /HEB (electron beam--3-50)
- May require gearbox cooling depending upon application

Cooling

- /CLND (direct cooling--3-53)
- /CLNI (indirect, copper rope--3-53)
- /CWGB (water cooling to gearbox)
- /CEI (ceramic electrical isolation--3-53)

Bias

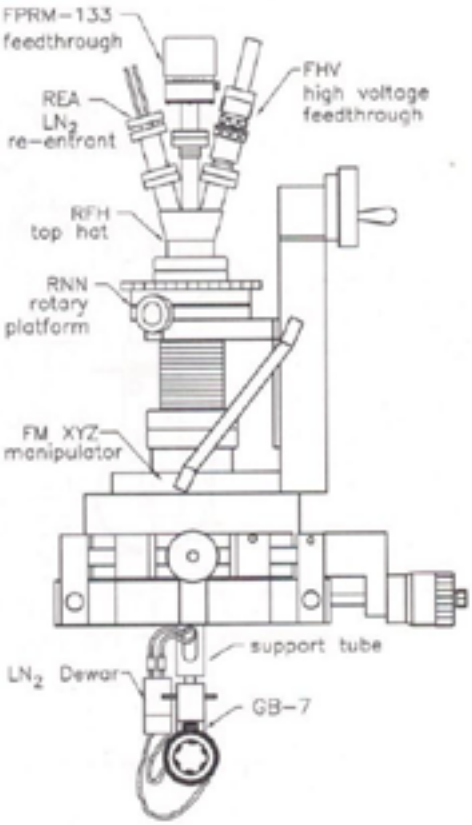
- /EBS (electrical bias of sample)

Non-Magnetic

- /NM (beryllium copper bearings, bronze gears, titanium construction—3-58)

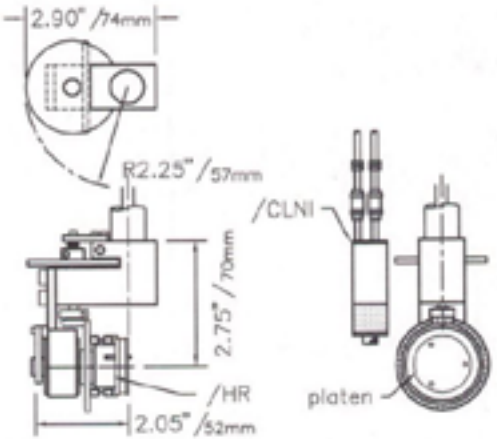
Dual Polar

- /DP (dual polar rotation)



GB-7-1/HR-1/CLNI
(shown with options mounted to FM XYZ manipulator)

STLC sample transfer systems are manufactured and protected under one or more of the following patents: 5,705,128



GB-7-1/HR-1/CLNI
(shown with options)

GB-8-2 Virtual Axis Goniometer Head *with Virtual Axis Flip*

- Up to 2" O.D. sample (other sizes available, consult factor,
- Zero sample off set all axes of movement
- Requires linear drive
- Open axis for non-relation heater
- All ball bearing drive

Specifications

Polar

- ± 180˚ limited by heating and cooling utilities are delivered from the base flange, using clear axis rotary feedthrough such as the WOA for polar rotation
- 360˚ continuous when using support tube and top hat for heating and cooling utility delivery mounted to an RNN series differentially pumped rotary platform for polar rotation

Flip

- +5°/-100˚ with clear surface virtual axis about the intersection of the azimuthal and polar axes actuated by 1" linear drive such as the JS jacking stage (see page 3-82)

Options

Sample Transfer

- STLC Series (turn-to-lock--3-70)
- SPF Series (dual groove--3-72)

Heating

- /HR (radiant resistive--3-50)
- /PBN (pyrolytic boron nitride--3-51)
- May require gearbox cooling depending upon application

Cooling

- /CLNI (indirect, copper rope--3-53)
- /CWGB (water cooling to gearbox)

Miniature

- /MINI For small sample virtual axis movement (see page 11-32)

Non-Magnetic

- /NM (beryllium copper bearings, bronze gears, titanium construction--3-58)

Bias

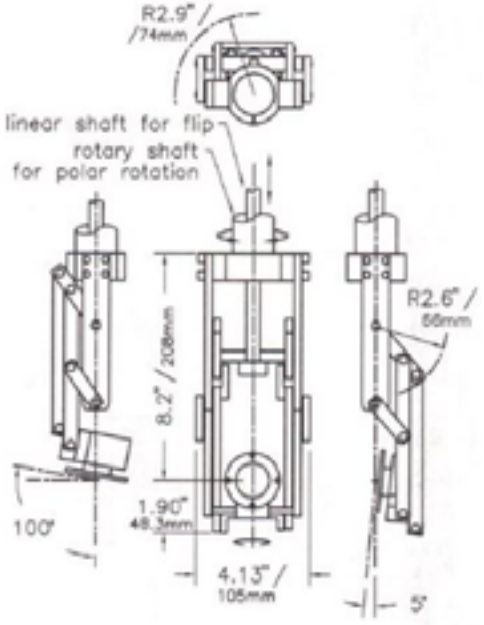
- /EBS (electrical bias of sample)

Azimuthal

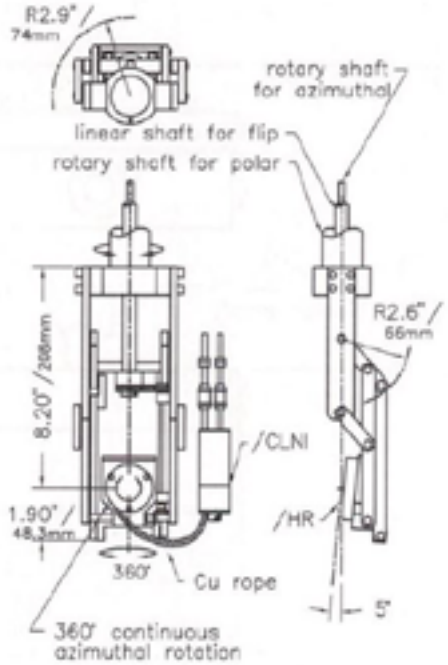
- /AZ (azimuthal rotation)
- 360° continuous with rotary drive such as an FRM
- ±90˚ limited by cooling utility delivery

Typical Activation Components

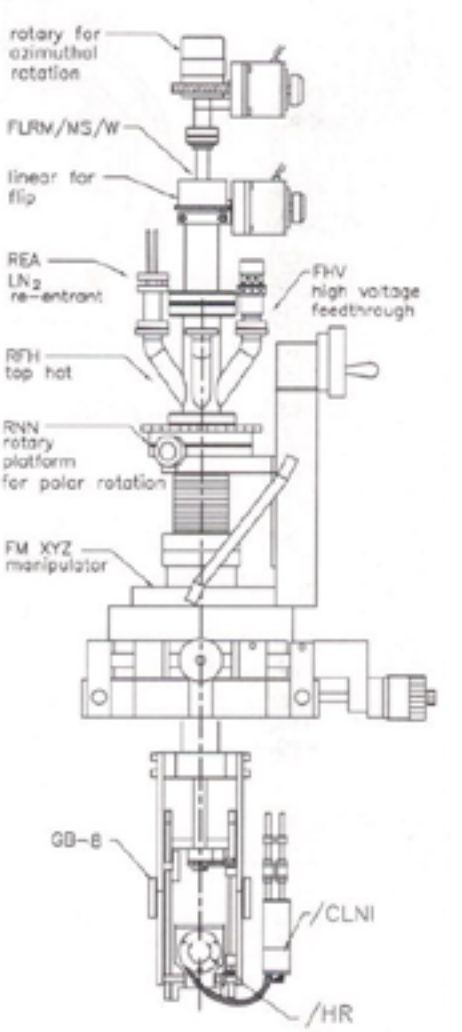
	Azim	Polar 1	Polar 2	Flip
FLRM (page 3-44)	x	-	-	x
RNN (page 3-27)	-	x	-	-
JS (page 3-82)	-	-	-	x
FRM (page 3-30)	x	-	-	-
RNN (page 3-27)	-	x	-	-



GB-8-2 (shown without options)

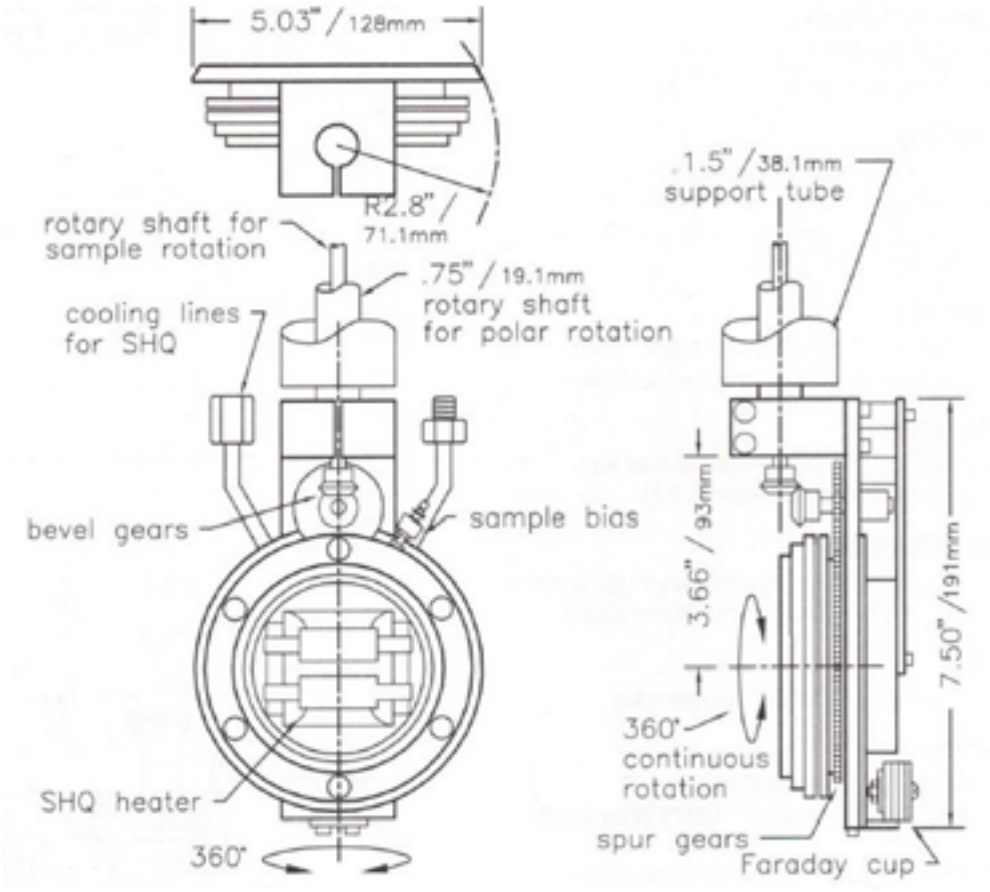


GB-8-1/AZ/HR-1/CLNI-1
(shown with options)



GB-8-1/AZ/HR-1/CLNI-1
(shown with options mounted to FM XYZ manipulator)

STLC sample transfer systems are manufactured and protected under one or more of the following patents: 5,705,128



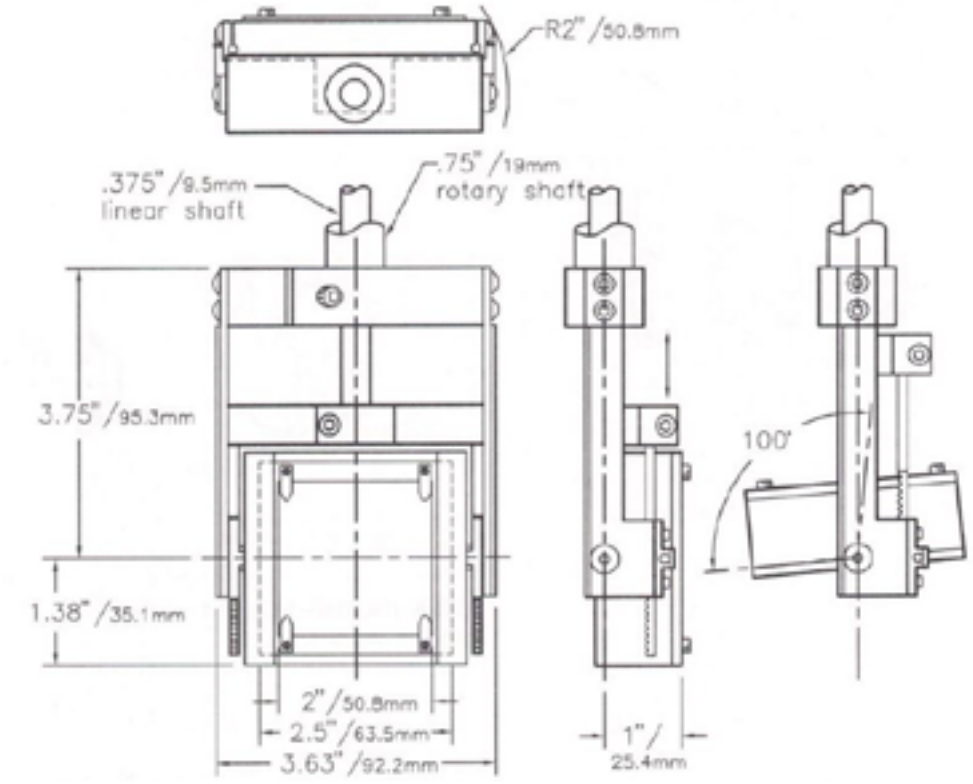
GB-14 (shown with SHQ heater)

GB-14 Gearbox

- Provides 360° continuous azimuthal rotation (perpendicular to polar axis)
- All ball bearing actuation
- Mounts to a 3/4" O.D. shaft (WOA or support tube)
- Driven by an FRM-133-25 feedthrough
  - Allows sample face on polar axis
  - Large hollow bore allowing stationary heater
  - Electrically-isolated sample

GB-15 Large Zero Offset Geared Flip

- Provides 100° of flip from perpendicular to parallel to main shaft axis
- Requires FRLC-275-1 or FLMM-133-1 with rotary coupling for actuation
- Linear response
  - Dual rack and pinion drive, with antibacklash adjustment
- All ball bearing actuation
- Sample face on polar axis and flip axis
  - Allows glancing angle as small as 10°
  - 2" square sample size
  - Accommodates up to 0.5" thick samples, easily positioning sample face on polar and flip axis
  - Removable sample plates
  - Will install through standard 4" O.D. tube



GB-15

GB-16 Virtual Axis Goniometer Head
Polar Rotation, Azimuthal Rotation, Flip

- Virtual axis sample mount
- Up to 0.9" O.D. samples
- All ball bearing drive
- Dynamic anti-backlash bevel and spur gears deliver precision control

Applications

- Non-destructive depth profiling
- Ion scattering
- Angle resolved electron or ion spectroscopy (XPS, Auger)
- Photo electron diffraction

Specifications

Polar

- 360° continuous with clear axis rotary drive such as the WOA or ANN differentially pumped rotary platform
- ± 180° when heating and cooling utilities are delivered from the base flange

Azimuthal

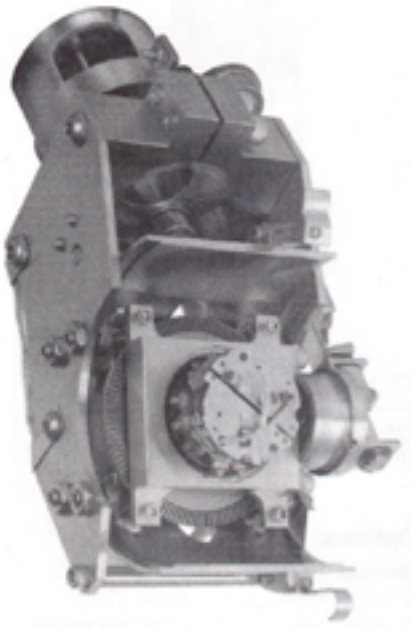
- 180° rotation of sample

Flip

- +95°/-5° from the axis orthogonal to the polar axis
- Actuated with precision micrometer-linear feedthrough such as the FLMM linear feedthrough with 1" linear movement

Virtual Axis Sample Positioning

- The precision polar rotation, azimuthal rotation and flip motions move the sample about the virtual axis of the sample plane without line-of-sight interference. Virtual axis allows glancing angle studies without gearbox shadow.



GB-16 Azimuthal Goniometer
(shown with STLC-TTC transferable thermocouple and intrinsic heating)

System Performance

	Azimuthal Axis	Flip Axis	Polar Axis
Resolution	<0.018°	<0.025°	0.01°
Repeatability	<0.012°	<0.006°	—
Backlash	<0.040°	<0.084°	<0.01°
Range	360+°	±47°	360+°

Options

Sample Transfer

- STLC Series (turn-to-lock—3-70)
- SMR (direct mount, no sample transfer—3-49)

Heating

- /HR (radiant resistive, 1,000°C—3-50)
- /HAN (nude filament. radiant resistive, 1,200°C—3-50)
- /PBN (pyrolytic boron nitride, above 1, 200°C—3-51)
- May require gearbox cooling depending upon application

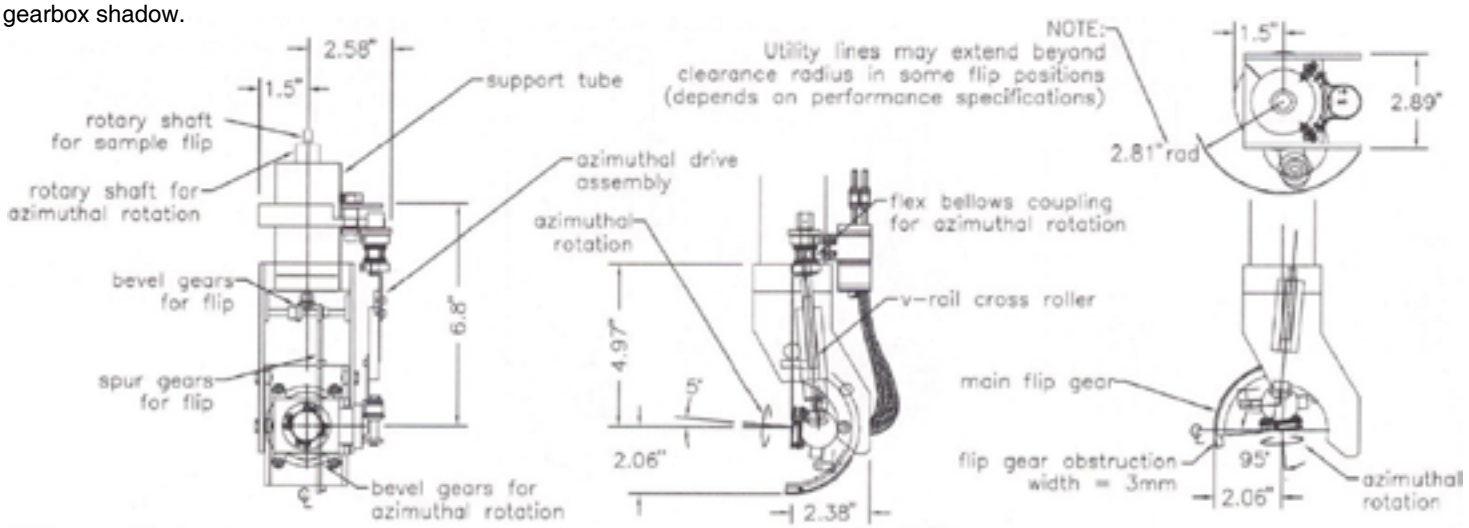
Cooling

- /CLNI (indirect, copper rope—3-53)
- /CEI (ceramic electrical isolation—3-53)

Non-Magnetic

- /NM (beryllium copper bearings, bronze gears, titanium construction—3-58)

STLC sample transfer systems are manufactured and protected under one or more of the following patents: 5,705,128



GB-16/AZ Dimensions

GB-17-.8 Goniometer Head
Azimuthal, Polar Rotation with Flip

- Up to 0.8" O.D. (standard) sample (optional 1.5" O.D. available) (other sizes available, consult factory)
- Requires tri-axial rotary-rotary-rotary drive
- Dynamic anti-backlash spur gears
- All ball bearing drive
- Zero sample offset

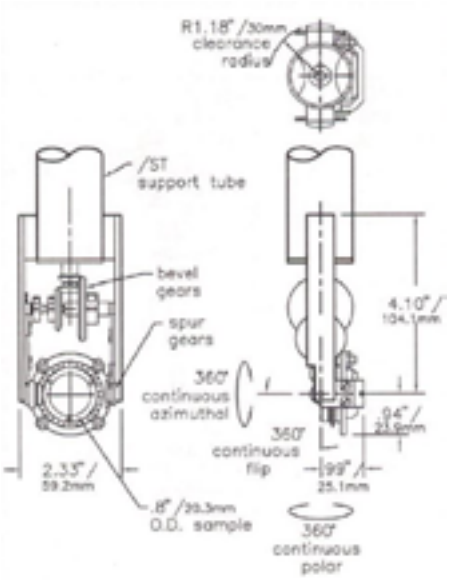
Specifications

Polar
- 360° continuous with clear axis rotary drive such as the RNN series differentially pumped rotary platform
- ± 180° when heating and cooling utilities are delivered from the base flange

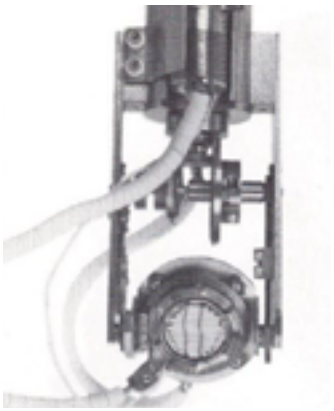
Azimuthal
- 360° continuous with clear axis rotary drive such as the WOA or by using a dual rotary drive such as the FRRC
- ±90° limited with the addition of cooling

Flip
- Flip axis is aligned orthogonal to the polar axis
- 360° capability actuated by rotary feedthrough such as the FRM or using a dual rotary drive such as the FRRC
- ± 130° limited when heating option is added
- ±90° limited when cooling option is added

Sample Offset
- Zero sample offset-samples' polar and azimuthal rotation and flip motion are all on the sample plane



GB-17-.8 (shown without options)



GB-17-.8/HR-1/CLNI
(shown with options)

Options

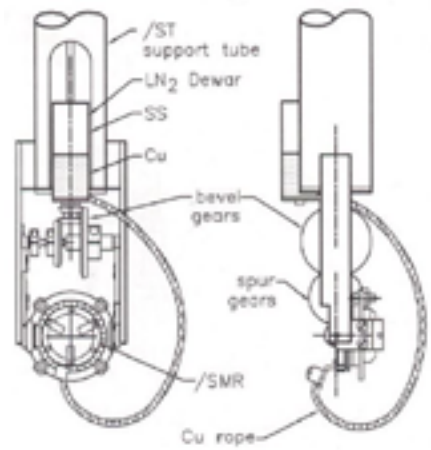
Sample Transfer
- STLC Series (turn-to-lock—3-70)
- SMR (direct mount, no sample transfer—3-49)

Heating
- /HR (radiant resistive, 1,000°C—3-50)
- /HRN (nude filament, radiant resistive, 1,200°C—3-50)
- /PBN (pyrolytic boron nitride, above 1,200°C—3-51)
- May require gearbox cooling depending upon application

Cooling
- /CLNI (indirect, copper rope—3-53)
- /CEI (ceramic electrical isolation—3-53)

Non-Magnetic
- /NM (beryllium copper bearings, bronze gears, titanium construction—3-58)

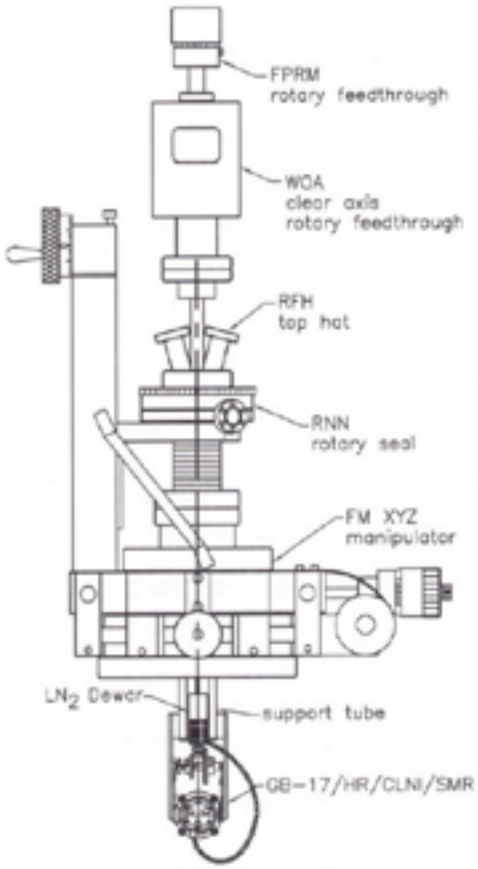
Bias
- /EBS (electrical bias of sample)



GB-17-.8/HR-1/CLNI
(shown with options)

Typical Activation Components

	Azim	Polar 1	Polar 2	Flip
RNN (page 3-27)	—	x	—	—
FRM (page 3-30)	x	—	—	—
WOA (page 3-36)	—	—	—	x
FRRC (page 3-35)	x	—	—	x
RNN (page 3-27)	—	x	—	—



GB-17-1.5/HR-1/CLNI
(shown with options mounted to FM XYZ manipulator with RNN differentially pumped rotary seal, utility delivery top hat and clear axis rotary feedthrough and rotary feedthrough)

STLC sample transfer systems are manufactured and protected under one or more of the following patents: 5,705,128

GB-30-2/SHQ/STLC Precision Gearbox Head with Oxygen Environment Heater and Sample Transfer
Motorized Continuous Polar Rotation

- Provides continuous rotation during deposition
- Complete sample drive-includes all heating, feedthroughs, flanges and connectors
- For 2" O.D. (standard) maximum sample (optional sizes to 5" O.D.)
- Includes motorized rotary feedthrough and controller
- Quartz lamp heater for oxygen or chemical vapor environments
- Utilizes custom top hat motor drive
- Water-cooled gear drive for heater assembly
- All ball bearing drive
- Edge clip turn-to-lock sample transfer dock
- Sample face center on polar axis
- Electrically-isolated sample

Specifications

Polar
- ±360° continuous with heating and gearbox cooling

Sample Rotation Speed
- 4.5-88 rpm using the FRM-SC integral speed-control rotary drive feedthrough with manual knob and motor controller

Heater
- /SHQ quartz lamp heater 1,000 watt (standard), temperature to 700°C continuous, 1,000° C peak
- Requires 110 VAC, 8 A variable power supply with proper isolation and overload protection such as the SPS-232/A sample power supply

Gearbox Cooling
- /CWGB water cooling to back of heater to protect heater and gear chain

Sample Transfer
- STLC Series edge clip sample transfer dock, platens, and fork

Electrical Isolation
- /CEI (ceramic electrical isolation)

GB-30-5/SHQ-5 /STLC/SA
(shown with options)

Typical Activation Components

	Azim	Polar 1	Polar 2	Flip
FRM/SCC	x	x	—	—
Speed controlled motor drive (standard) (Page 3-32)				
FRM/MY	x	x	—	—
Synchronous motor drive (Page 3-31)				
FRM/MS	x	x	—	—
Stepping motor drive (Page 3-31)				
FRM (page 3-30)	x	—	—	—
RNN Non-motorized (page 3-27)	—	x	—	—

Options

Sample Transfer
- SMR (direct mount, no sample transfer included—3-49)

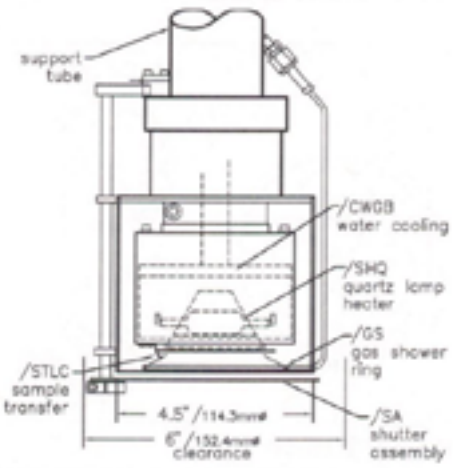
Heating
- /PBN (pyrolytic boron nitride, above 1,200°C—3-51)

Sample Cooling
- Consult factory for options (also see 3-53)

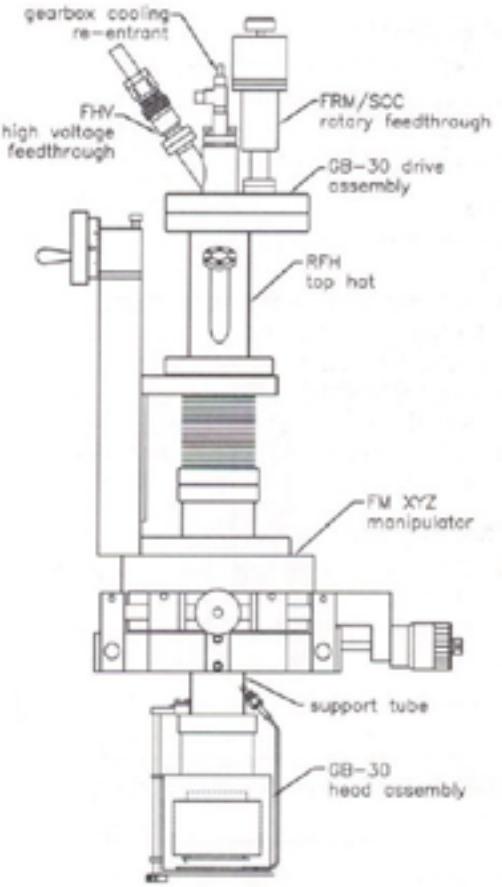
Gas Shower
- /GS (gas shower ring to sample during rotation—3-51)

Shutter
- /SA (shutter assembly moves shutter between sample and deposition source—3-51)

Bias
- /EBS (electrical bias of sample)



GB-30-2/SHQ/STLC/SA/GS
(shown with options)



GB-30-2/SHQ/STLC/SA/GS
(shown with options mounted to FM XYZ manipulator with utility delivery top hat and linear drive for shutter actuation with gas shower ring and feedthrough)

STLC sample transfer systems are manufactured and protected under one or more of the following patents: 5,705,128

3 UHV/Pulsed Laser Deposition Target Stage

TGB-4-1 Target Gearbox for Laser Deposition Azimuthal Target Rotation

The TGB is a target gearbox only. To be a complete target drive system it must be connected to two rotary feedthroughs, one for the target rotation and the second used for clocking the targets into position to face the laser from behind the protective shroud.

- Provides continuous target rotation during ablation
- Holds 4 one-inch O.D. targets
- Includes shroud/probe tube exposing one target at a time (shroud actuation requires RNN or WOA)
- All stainless steel construction

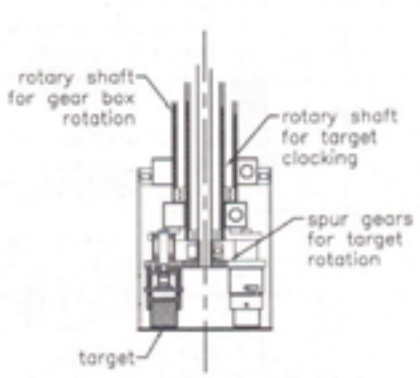
Specifications

Polar

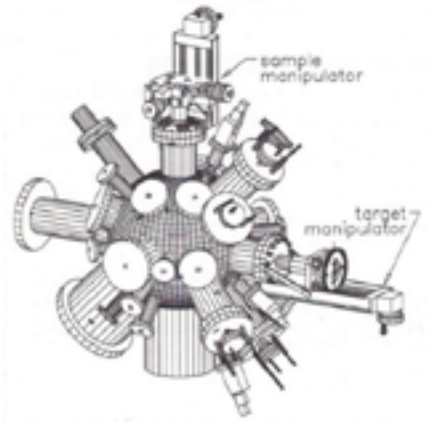
- 360° continuous target rotation

Azimuthal

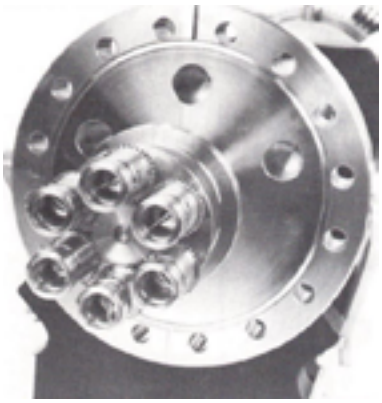
- +/- 0.1 ° about the azimuthal axis of the target. This capability can be used to sweep the ablated plume across the substrate.



TGB-6-.5/TT Layout



Typical Vacuum Chamber
(shown with sample and target manipulator)



TGB-6-.5/TT (shown with options)

Options

Target Size and Number

- TGB-6-0.5 Six 1/2" O.D. targets
- TGB-3-2 Three 2" O.D. targets

Target Transfer (used to transfer the target through a load-lock)

- /TT Bayonet target transfer system

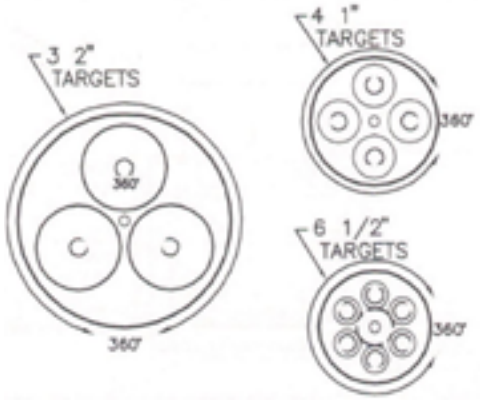
Recommended Rotational Drivers

Target Rotation

- FRMRE-275-25/SCC Magnetic rotary drive designed for continuous operation, 4,000,000 revolutions in vacuum conditions. Comes with speed control motor and hand-held controller.

Target Clocking

- RNN-275/MS Differentially pumped rotary Seal. Used for the entire probe mounting with shroud. Rotate the RNN and a fresh target is clocked from behind the shroud into position for ablation.



TGB-3-2, TGB-4-1, TGB-6-.5

FRMRE magnetic rotary feedthroughs are manufactured and protected under one or more of the following patents 5,514,925

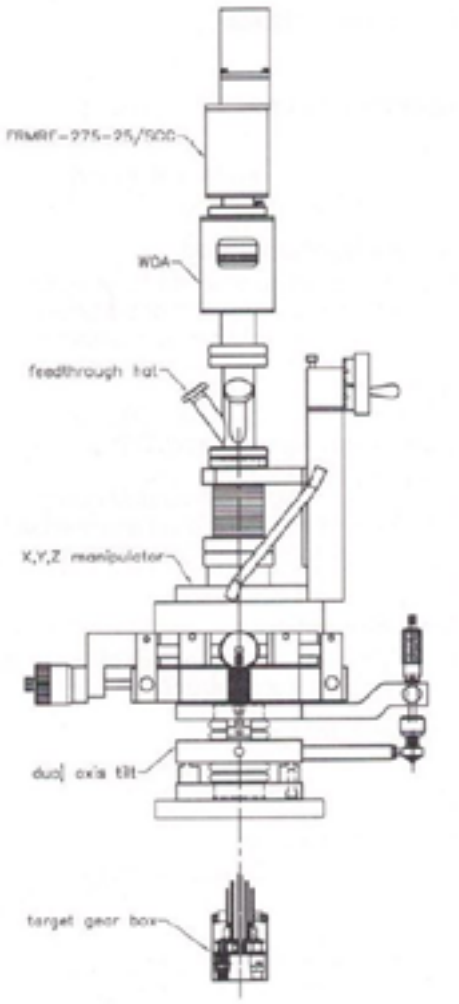
Typical Activation Components

Positioning

	XY	Z
EC Series manipulator	x	x
EMC Series manipulator	x	x

Target Rotation

	Aximuthal	Clocking
FRMRE Rare earth rotary drives	x	—
WOA Hollow axis rotary drives	x	x
RNN Differentially pumped rotary seals	—	x



Complete Target Positioning and Gear Drive Manipulator

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

There are many factors that influence the selection of a sample handling system. Thermionics NW manufactures several standard sample transfer systems, each with its own features and performance characteristics.

Factors that influence the selection of a sample transfer system vary by application.

- Sample motion requirements
- Heating requirements
- Cooling requirements
- Sample size
- Size of chamber tubulations available
- Geometry of the chambers relative to manipulators and type of transfer translator and load-lock
- Motion available for actuation
- Compatibility with existing or planned equipment
- Ease and reliability of operation

When selecting a sample handling system, consideration must be given to its operation with goniometers and precision gearboxes. These devices typically require that the sample be solidly held and moved in a precise way. The sample plate must be docked to a goniometer so as not to limit the degrees of freedom or degrade the goniometer's resolution.

Sample Transfer and Heating

Sample transfer reduces heating performance at the highest temperatures (see page 3-50). The ideal transfer system for heating the sample to the highest temperatures should use thin sample plates made of material to withstand the temperature, that can be placed as close to the heater as possible. Thick, high mass, sample plates reduce thermal response and lower peak heating temperatures.

Sample Transfer and Cooling

Sample transfer reduces cooling performance at low operating temperatures. The ideal transfer system for cooling the sample to the lowest temperatures should use thin, highly conductive, sample plates that contact the Dewar with a large surface area. Thick, high mass, sample plates reduce thermal response and reduce peak cooling performance.

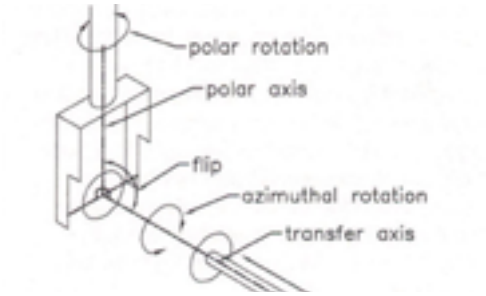
Sample Transfer Terminology

The following functional definitions can be used in reference to sample transfer.

Types of Motion Used For Transfer Actuation

- Linear Motion — linear movement of the sample along any axis
  - FLRM (see page 3-44)
  - FLLRE (see page 3-40)
  - Z motion translators (see pages 3-14, 3-16, 3-18)
- Rotary Motion — rotary motion about any axis
  - FLRM (see page 3-44)
  - RPLR (see page 3-42)
  - FLLRE (see page 3-40)
  - Rotary motion feedthroughs (see pages 3-30, 3-32, 3-34)
- Tilt Motion — angular positioning movement of the horizontal or orthogonal axis. The weight of the sample, plate, fork and translator can cause deflection that misaligns the axis of transfer. A tilt stage (see page 3-24) can be used to re-align the axis to enable a transfer.

FLLRE linear-rotary feedthroughs are manufactured and protected under one or more of the following patents: 5,514,925



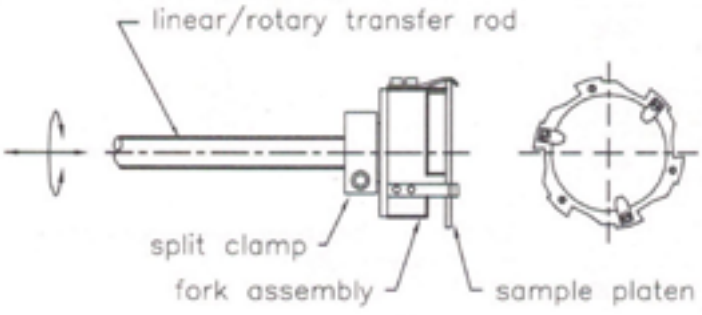
Transfer Axes

Transfer Components

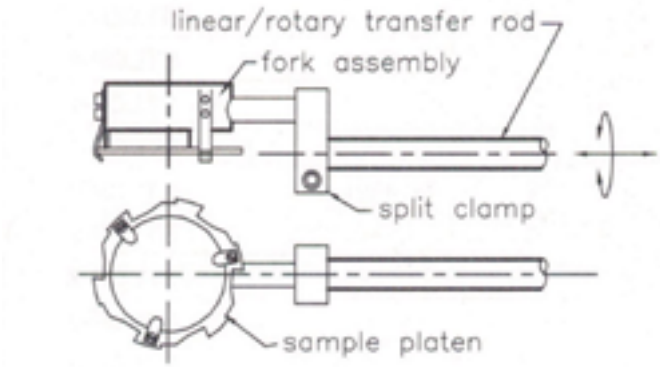
- Sample Platen — the transferable plate that holds the sample
- Sample Fork — attaches to a translator arm from the load-lock and holds the sample platen
- Sample Dock — attaches to a workstation (manipulator) and holds the platen for processing or positioning the sample

Fork and Dock Configurations

- Axial Fork — a sample fork with the plane of the sample platen face orthogonal to the axis of the translator on which the fork is mounted
- Radial Fork — a sample fork with the plane of the sample platen face parallel to the axis of the translator on which the fork is mounted
- Axial Dock — a sample dock with the plane of the sample platen face orthogonal to the axis of the manipulator on which the dock is mounted
- Radial Dock — a sample dock with the plane of the sample platen face parallel to the axis of the manipulator to which the dock is mounted



Axial Fork

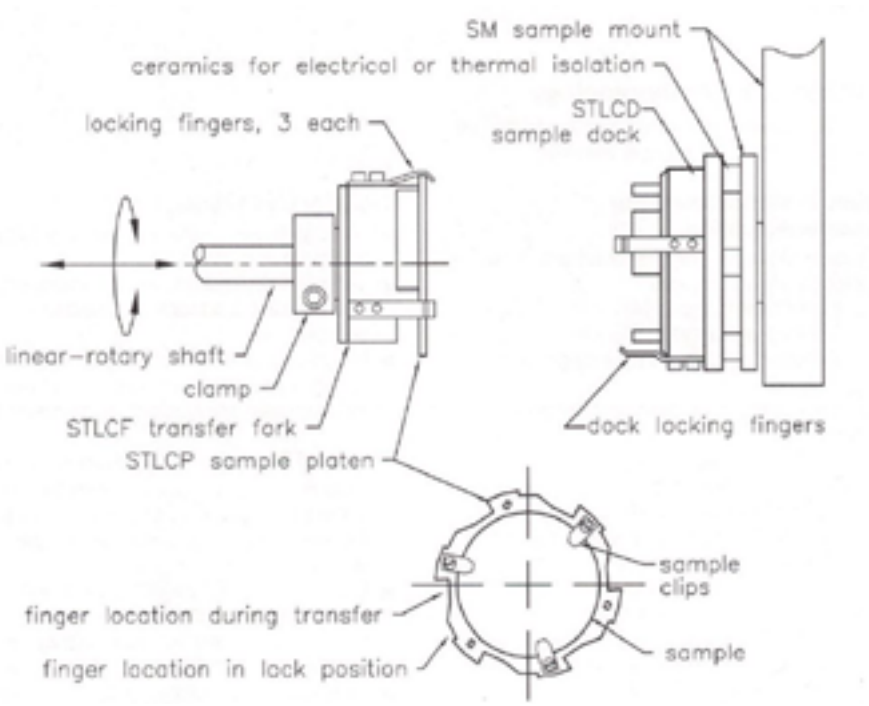


Radial Fork

3 STLC Locking Clip Turn-To-Lock Sample Transfer System

The STLC sample transfer system uses thin (.040") sample plates with six, saw tooth shaped ramps, profiled on the plate's edge. The sample transfer probe is fitted with a fork consisting of three, tab-shaped, spring fingers positioned radially on a barrel. The sample plate locks on to the fork by rotating the fork's fingers over three of the six ramps. When the fork is rotated, the locking fingers slide up the ramps to stops. The plate is gripped by the spring fingers holding it tight to the barrel of the fork.

Transferring the sample from the probe fork to a manipulator sample dock is done with a rotary motion. The dock has the same type of locking fingers as the fork. The plate is mated to the dock by orienting it so that the three unused ramps can receive the dock's fingers. Rotating the fork releases the plate at the same time the fingers on the dock grip and lock the plate to the manipulator. This rotary movement makes a smooth sample transfer from the fork to dock and back again.



STLC Locking Clip System

Ordering Information — Sample Transfer Systems

Sample platen with axial fork, radial dock
Stainless steel construction

Sample O.D.	Description	Model Number
0.5"	Platen	**STLCP-0.5**
	Fork	**STLCF-0.5**
	Dock	**STLCD-0.5**
1"	Platen	**STLCP-1**
	Fork	**STLCF-1**
	Dock	**STLCD-1**
2"	Platen	**STLCP-2**
	Fork	**STLCF-2**
	Dock	**STLCD-2**
3"	Platen	**STLCP-3**
	Fork	**STLCF-3**
	Dock	**STLCD-3**

Note: Consult factory for larger sizes to 12" O.D.

Features

- Available from 1.33" to 6" O.D. sample platens
- Easy, forgiving transfer operation
- Fast thermal response and greater extremes
- Larger samples may be introduced through smaller I.D. plumbing
- Wide range of sample sizes
- Excellent sample plane repeatability
- Adapts to most goniometers and precision gearboxes
- Excellent performance for direct cooling (see page 3-53)
- Transferable thermocouple, optional
- Transferable intrinsic direct heating

STLC System Basic Components

- STLCP- sample platen, a thin sample plate with three sample holding clips screwed to the plate
- STLCD - sample dock, mounts to the manipulator SMR sample mount. The dock comes in many configurations determined by the requirements of the SMR (see page 3-49). Standard configuration is radial
- STLCF - sample fork, mounts to the linear translator
- Standard configuration is axial

Types of Motion Used For Transfer Actuation

- Linear Motion - linear movement of the sample about the horizontal axis
  - FLRM (see page 3-44)
  - FLLRE (see page 3-40)
  - Z motion translators (see pages 3-14, 3-16, 3-18)
- Rotary Motion - rotary motion about any axis
  - FLRM (see page 3-44)
  - RPLR (see page 3-42)
  - FLLRE (see page 3-40)
  - Rotary motion feedthroughs (see pages 3-30, 3-32, 3-34)
- Tilt Motion - angular positioning movement of the horizontal axis. The weight of the sample, plate, fork and translator can cause deflection that mis-aligns the axis of transfer. A tilt stage (see page 3-24) can be use to re-align the axis to enable a transfer. Flip motion at the goniometer head can provide similar alignment of the axis of transfer

FLLRE linear-rotary feedthroughs are manufactured and protected under one or more of the following patents: 5,514,925

STLC sample transfer systems are manufactured and protected under one or more of the following patents: 5,705,128

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Options

STLCF-1/DUAL Radially-Mounted Sample Forks

- Holds two STLCP-1 sample platens
- Two sample forks back-to-back
- Three spring docking fingers
- Sample face parallel to axis of linear translator
- Mounts to linear feedthrough
- Stainless steel construction

STLCF-1/CAROUSEL Four Radially Mounted Forks

- Holds three STLCP-1 sample platens
- Four sample forks radially-mounted together
- Sample face parallel to axis of linear translator
- 3/8" O.D. mounting shaft
- Mounts to rotary feedthrough
- Stainless steel construction

/TTC Transferable Thermocouple

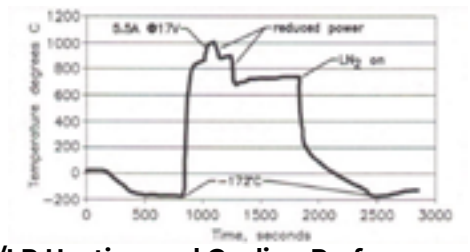
- Modifies STLCP sample platen and STLCD sample dock
- Allows thermocouples to be placed on sample face
- 1.3" O.D. minimum
- Adds a second ramped locking ring with:
  - Electrical contact ramps for thermocouple
  - Electrically-isolated sample ramps
- Stainless steel construction
- Chromel-Alumel materials for Type "K" thermocouples

/HRD Intrinsic Resistive Heater — Transferable

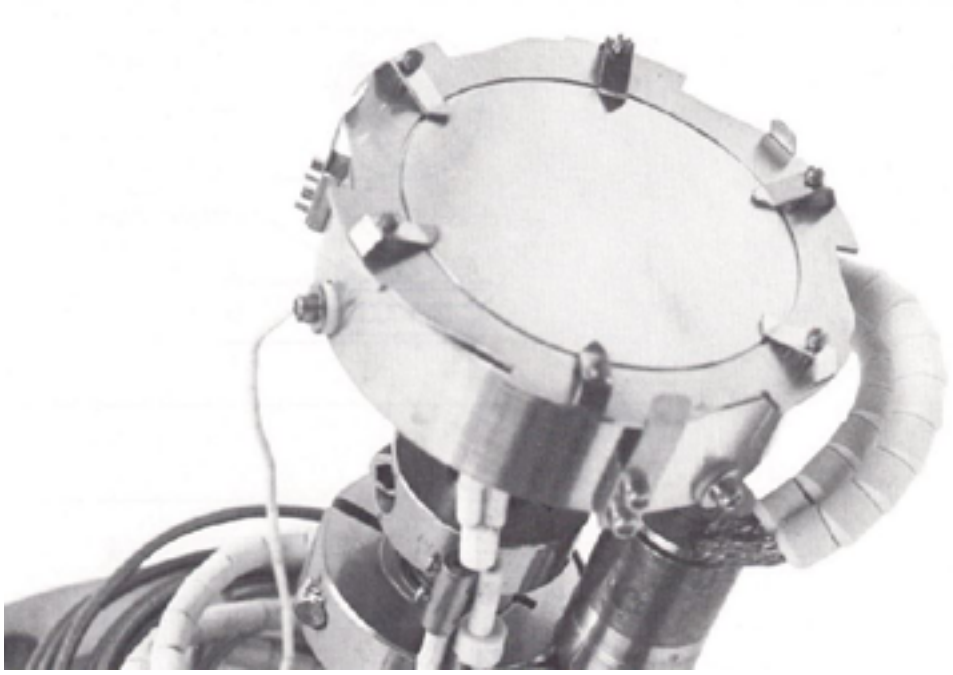
- Modifies STLCP sample platen and STLCD sample dock
- Adds second ramped locking ring with:
  - Electrical power connections
  - Electrical contact ramps for heater connection
  - Electrically-isolated contact ramps
- Electrically-isolated sample
- Molybdenum platen construction

/LR High Thermal Performance Platen

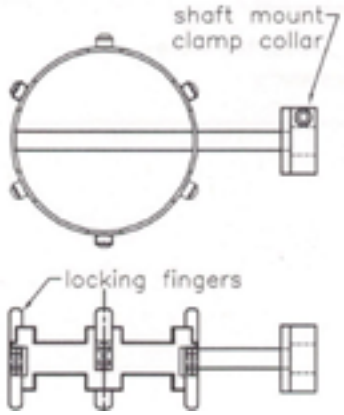
- Rapid heating (18° per second) and cooling to -172° C



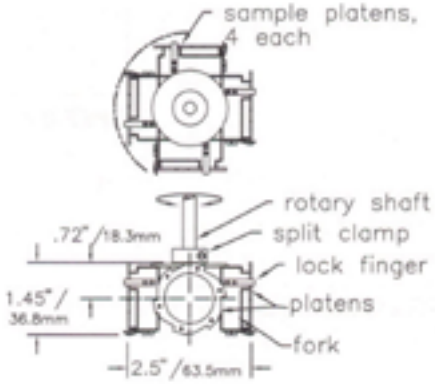
/LR Heating and Cooling Performance



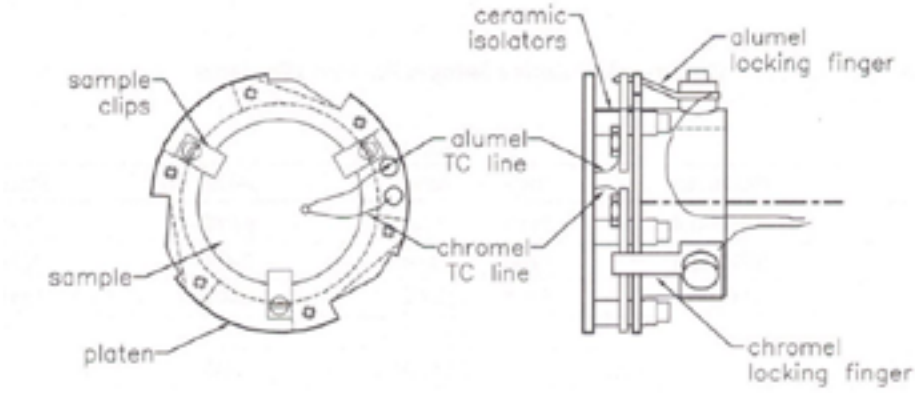
STLCP and STLCD (shown mounted on heater head)



/DUAL (holds two samples)

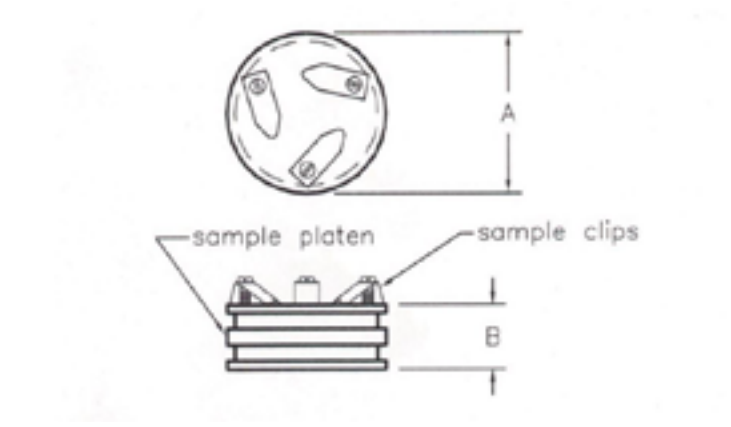


/CAROUSEL (holds foour samples)

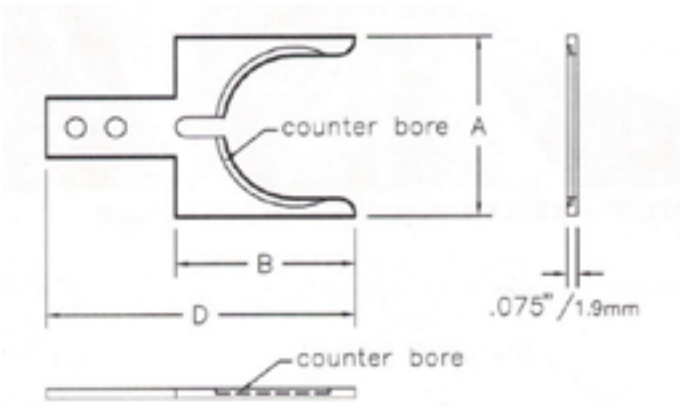


/TTC Layout (transferable thermocouple platen and dock)

3 SPF Series Dual Groove Disc System



SPFP-0.4



SPFF-0.4

The SPFP sample platen has two grooves around its perimeter. The SPFF sample fork has a counter-bored receiver machined into the fork's prongs. The prongs slide into the grooves of the platen and the platen is lowered into the counter-bored receiver. The SPFD has the same configuration as the fork and uses the second groove on the platen for docking. Docks using hold-down rails are also available

Features

- Available from 1" diameter to 6" diameter or larger puck
- Sample lock onto transfer probe via gravity or spring load
  Dual groove, allowing direct transfer of sample from one transfer arm to another, running at a different angle
- Easily adapts to magazine multiple loading
- Requires sample disk thickness of approximately 0.5"
- Usually limited to side loading only

Transfer Requirements for Actuation

Transfer probe requirement is a horizontal probe with SPF fork, capable of linear motion from the side of the sample. Short vertical travel is required to uncouple/recouple the sample. This can be supplied by a tilt stage at the linear probe mounting flange, or by vertical motion of the sample dock (i.e., manipulator). This action can be supplied by:

- APL series rack and pinion linear feedthrough (see page 3-42)
- Z motion translators (see pages 3-14, 3-16, 3-18)
- FLLRE series linear-rotary feedthroughs (see page 3-40)
- APL or RPLR series rack and pinion linear-rotary feedthroughs (see page 3-42)
- FLAM series push-pull linear-rotary feedthroughs (see page 3-44)

Transfers of up to 60" can be easily obtained without intermediate support.

FLLRE linear-rotary feedthroughs are manufactured and protected under one or more of the following patents: 5,514,925

Equipment Selection Guide — SPF Series Sample Handling Systems

All stainless steel construction

Sample size: 0.4"

Type	Model Number
Platen	**SPFP-0.4**
Transfer Grip	**SPFF-0.4**
Dock	**SPFD-0.4**

Sample size: 1.0"

Type	Model Number
Platen	**SPFP-1**
Transfer Grip	**SPFF-1**
Dock	**SPFD-1**

Sample size: 3.0"

Type	Model Number
Platen	**SPFP-3**
Transfer Grip	**SPFF-3**
Dock	**SPFD-3**

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Quick access caps are designed to provide quick and easy covers for open ports. Capable of operating at 10^{-8} Torr, quick caps can serve many applications when time and convenience are critical.

Only stainless steel is exposed to the vacuum, for excellent UHV vacuum compatibility. The seal is a spring-loaded Viton O-ring which seals against the ports' ConFlat knife-edge detail. Sizes are available from 1.33" to 8" O.D.

Applications

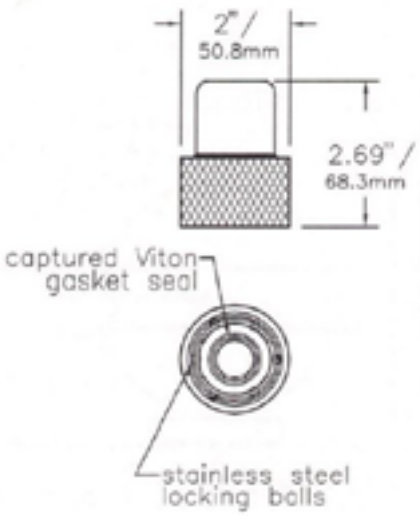
- Synchrotron beam lines, cap-off during experimental change
- Load-lock chambers quick access doors
- Vacuum chamber maintenance, remove equipment, cap and pumpdown
- Adapt as connector for vacuum hose to portable roughing pumps
- Adapt with hollow access for feedthroughs

QAC Series Quick Access Cap

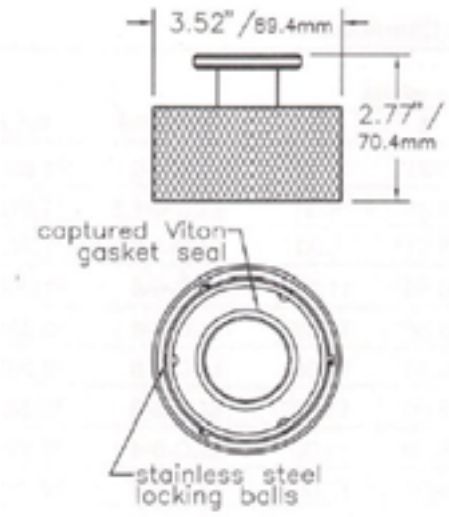
- Removal and replacement in seconds
- Cover ports for pumpdown during maintenance
- Use as low-cost quick access door
- Viton-sealed
- Vacuum to 10^{-8} Torr
- Maximum bakeout temperature: 200°C

Flange Size	Model Number
1.33"	QAC-133
2.75"	QAC-275
3.38"	QAC-338
4.50"	QAC-450
6.00"	QAC-600
8.00"	QAC-800

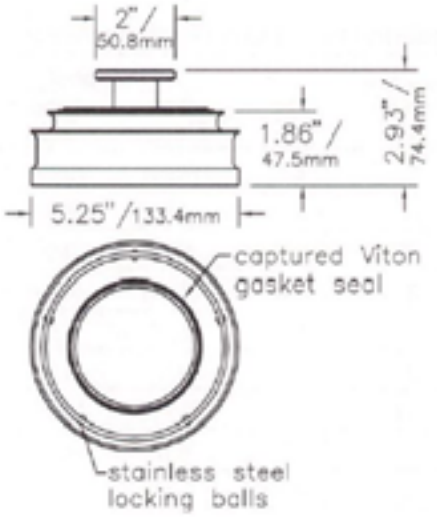
QAC-275



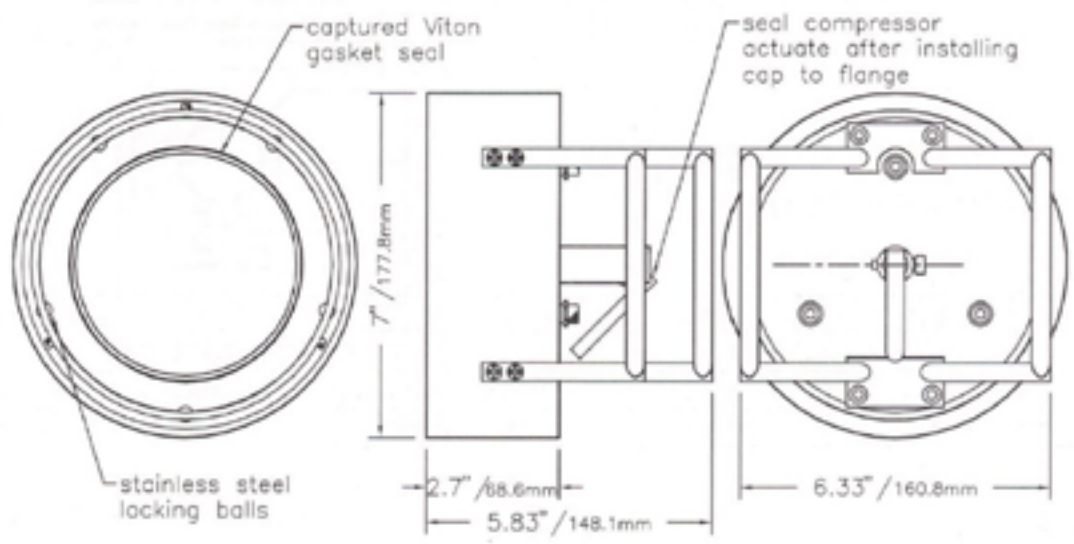
QAC-133



QAC-275



QAC-450



QAC-600

QuickAccess Caps are manufactured and protected under one or more of the following patents: 5,228,587

3 LLC Series Quick Access Load Lock Chambers

LLC

Thermionics manufactures a full line of high vacuum load lock chambers. These include:

- Mitered elbow body
- QAD access doors for ease and speed of access where a Viton gasket seal to atmosphere is acceptable
- One roughing port, 2.75" O.D. flange
- HV pumpout port (optional)
- One linear feedthrough port, 2. 75" O.D. flange
- Chem-cleaned chamber

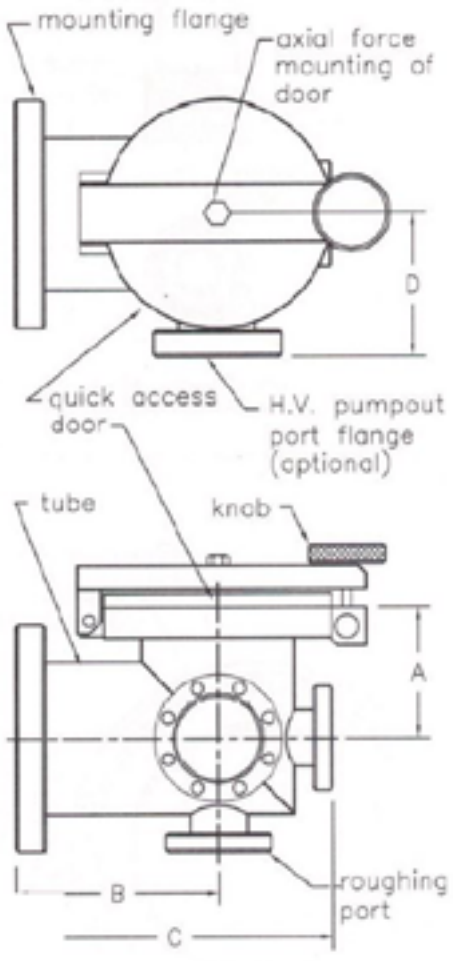
Available in three standard sizes. We will customize these units to meet the customer's specific need for such applications as magazine load, sample preparation, sample storage, dry box transfer, etc.

Gate valves with larger mounting flanges than standard are available. This permits the valve to be no larger than required for the actual transfer diameter.

Ordering Information — Quick Access Load Lock Chambers

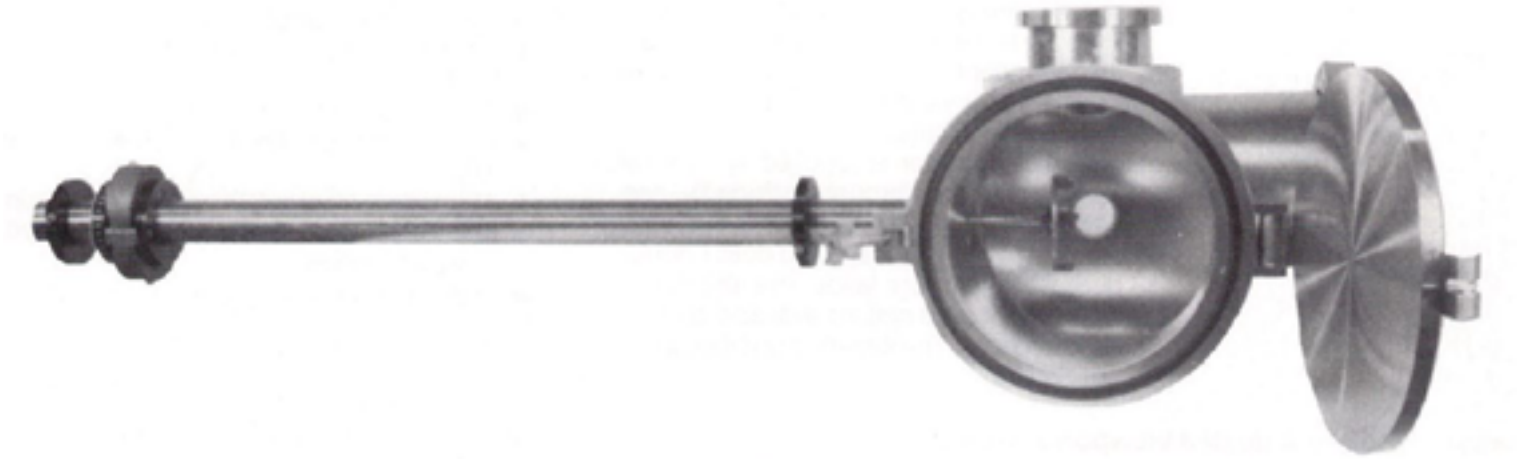
Mounting Flange O.D.	Tube O.D.	HV Pumpout Port Flange	HV Pumpout Tube O.D.	Dimensions A	B	C	Model Number
6"	4"	None	None	3.8"	5.31"	8.31"	**LLC-4-0**
6"	4"	4.5"	1.5"	3.8"	5.31"	8.31"	**LLC-4-1.5**
6"	4"	6.0"	3.0"	3.8"	5.31"	8.31"	**LLC-4-3**
8"	6"	None	None	4.5"	6.56"	11.06"	**LLC-6-0**
8"	6"	6.0"	4.0"	4.5"	6.56"	11.06"	**LLC-6-4**
8"	6"	8.0"	6.0"	4.5"	6.56"	11.06"	**LLC-6-6**
10"	8"	None	None	6.2"	8.00"	13.00"	**LLC-8-0**
10"	8"	6.0"	4.0"	6.2"	8.00"	13.00"	**LLC-8-4**
10"	8"	8.0"	6.0"	6.2"	8.00"	13.00"	**LLC-8-6**

LLC Left Hand Model



LLC-4

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com



QAD-1000-F (shown mounted on LLC with FLLRE feedthrough)

Thermionics manufactures a full line of high vacuum doors. These are designed for use in load lock systems and other applications requiring ease and speed of access where a Viton gasket seal to atmosphere is acceptable. Our design incorporates a number of features which ensure a long, trouble-free life.

FLLRE linear-rotary feedthroughs are manufactured and protected under one or more of the following patents: 5,514,925

Available as a weld-on or bolt-on unit, the user has the option of constructing a permanent or adaptable assembly.

The bolt-on "F" Series design mates to the system via a standard ConFlat-type flange.

The "T" Series can be welded to a standard O.D. tube on a chamber.

QuickAccess Caps are manufactured and protected under one or more of the following patents: 5,228,587

Features

- Captured Viton gasket (with gasket pumpout)
- Swing-away clamp design with handoperated knob for speed and ease of operation. No parts are removed during use
- Axial force is applied to door for uniform sealing pressure
- Extra rugged construction

Options

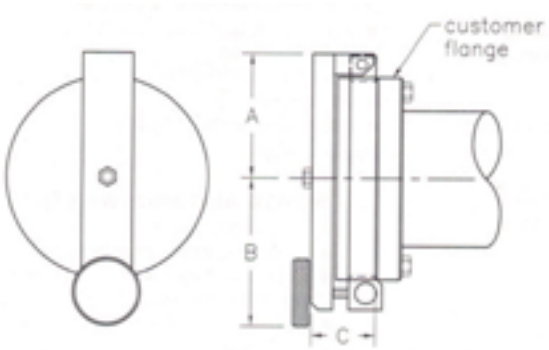
/DW Door Windows

Consult factory

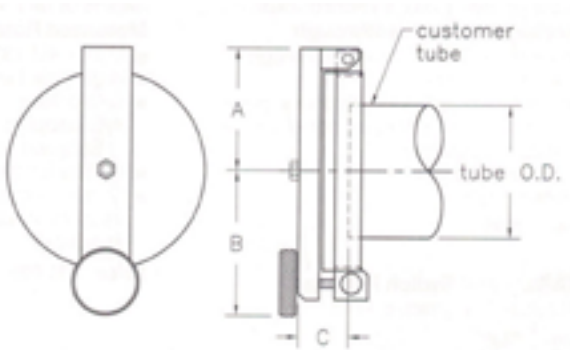
QAD/DW (with window)

Ordering Information — Quick Access Vacuum Doors

Mounting		Dimensions			
Flange O.D.	Tube O.D.	A	B	C	Model Number
2.75"	—	Use Quick Access Camps (See page 3-73)			QAD-275-F
4.5"	—				QAD-450-F
6"	—	3.63"	4.38"	1.88"	QAD-600-F
8"	—	4.68"	5.43"	1.98"	QAD-800-F
10"	—	5.71"	6.40"	2.19"	QAD-1000-F
—	4"	3.69"	4.38"	1.45"	QAD-600-T
—	6"	4.75"	5.43"	1.52"	QAD-800-T
—	8"	5.71"	6.40"	1.73"	QAD-1000-T



QAC-133



QAC-275

3 VRS Series Viewport Shutters

Thermionics manufactures a series of rotary-actuated shutter assemblies. They are of the 90° shutter swing type, suitable for mounting behind "zero height" viewports. VRS Series shutters are built into double-sided flanges.

Rotary actuation is supplied by our FRMC-133-25 rotary feedthrough (included)—see page 3-30. This supplies positive mechanical control of shutter position and does not introduce stray magnetic fields. This also makes a number of drive options available at competitive prices. The standard unit includes a position lock.

Specifications

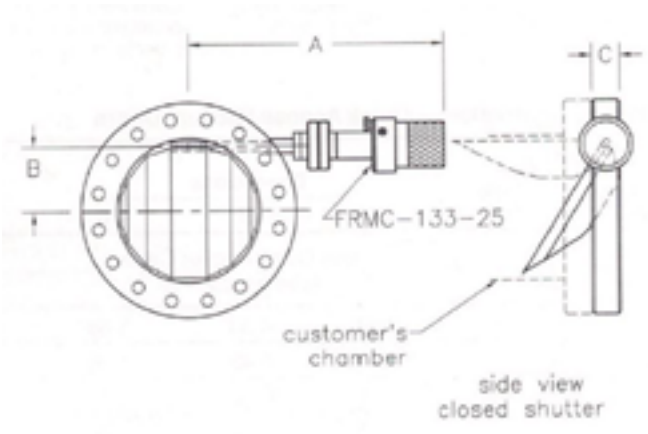
- Double-sided flange mount
- Suitable for mounting behind viewport on tube neck
- All metal sealed
- Actuated with attached FRMC with position lock
- All stainless-steel ball bearing construction
- Attached shutter covers > 80% of standard viewport window
- Protects viewport from depositing materials

Ordering Information — Rotary-Actuated Viewport Shutters

Mounting Flange O.D.	A	B	C	Model Number
2.75"	6.05"	0.53"	.750"	**VRS-275**
4.50"	6.66"	1.16"	.687"	**VRS-450**
4.63"	6.69"	1.22"	.812	**VRS-463**
6.00"	7.10"	1.78"	.781"	**VRS-600**
8.00"	8.31"	2.53"	.875"	**VRS-800**

NOTE: Sliding shutters with and without housings are available. See page 3-77

VRS Series



VRS-600

Options

/MS Stepping or /MY Synchronous Motorized Rotary Feedthrough

- Uses FRM-133-25 rotary feedthrough
- Integral motor drive
- /MS stepping or /MY synchronous motor 50 oz-in holding torque (higher torque motors available)
- Low inertia design
- Manual knob

/LSA-90 Limit Switch Package

- Allows 90° actuation of FRM
- For 110 VAC use - additional cost

/MS/W or /MY/W Motorized Rotary—Self-Locking

- Uses FRM-133-25 rotary feedthrough
- High speed worm drive
- Self-locking
  /MS stepping or /MY synchronous motor
  Supplied with motor without controller
- Can be retrofitted
- May be field mounted without breaking vacuum or returned to the factory for installation

/PNM Pneumatically Operated

- 1/4" O.D. output shaft
- Bellows sealed
- Torque limit: 150 oz-in
- 90° rotation
- Adjustable stops available

/ACV-24 Air Control Valve Option

- Mounted to feedthrough
- Valve to actuator plumbing installed
- Control voltage 24 VDC standard or per customer requirements
- With flow controls. both directions

Thermionics manufactures a series of linear-actuated shutter assemblies. They are of the "gate valve actuation" type. Linear actuation is supplied by our FLM-133- 25 push-pull linear feedthrough (included). This supplies positive mechanical control of shutter position, and does not introduce stray magnetic fields. This also makes a number of drive options available at competitive prices.

Specifications

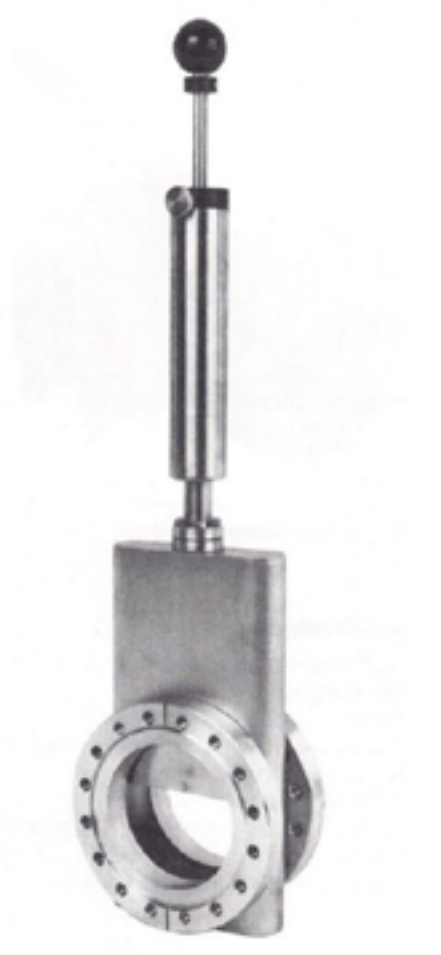
- All metal sealed
- Actuated with attached FLM with position lock
- All stainless steel construction
- Attached shutter covers 100% of standard viewport window
- Protects viewport from depositing materials

Ordering Information — Linear-Actuated Viewport Shutter

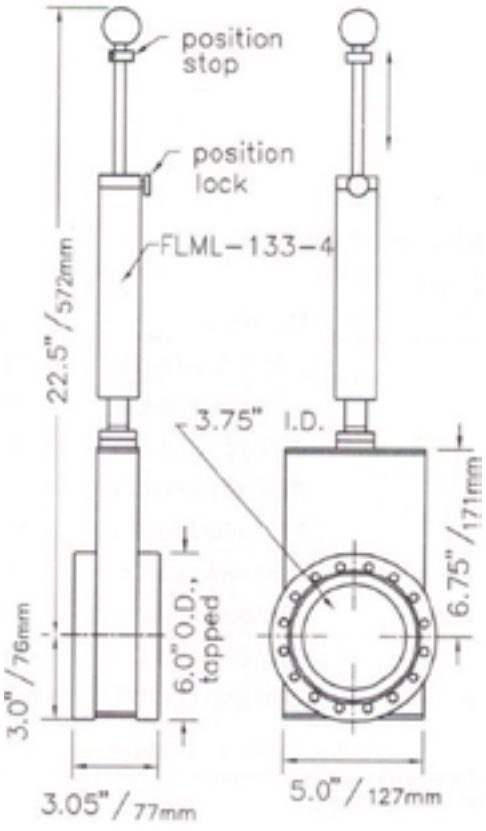
Mounting Flange O.D	I.D.	Model No.
2.75"	1.50"	**VLS-275**
6.00"	3.75"	**VLS-600**

Pneumatic actuation available. Other sizes available

VLS-600/PNM/ ACV-24
(with pneumatic actuation)



VLS-600



VLS-600

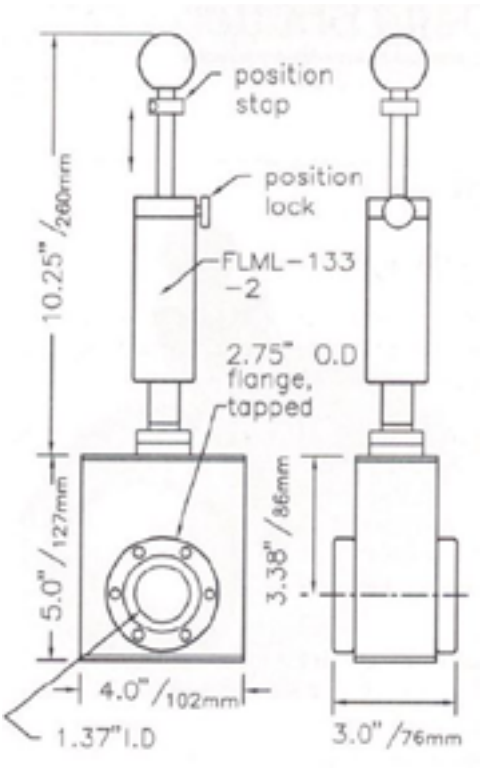
Options

/PNM Pneumatically Operated

- 1/4" O.D. output shaft
- Bellows sealed

/ACV-24 Air Control Valve Option

- Mounted to feedthrough
- Valve to actuator plumbing installed
- Control voltage 24 VDC standard or per customer requirements
- With flow controls, both directions



VLS-275

3 Clearview VHW Series Self-Cleaning Optical Window

The ClearView™ self-cleaning optical viewports are ideal for use in deposition environments. The viewport consists of an in-vacuum heated quartz disk, thermally isolated behind a standard vacuum window. Material that would normally cloud or obscure the view through a vacuum window encounters the protective heated disk instead. The material re-evaporates from the heated disk at a rate dependent upon its vapor pressure/ temperature.

The sturdy filament-style construction of the ClearView viewport will withstand repeated temperature cycling and sustained temperatures up to 550°C (450°C for 4.50" flange mount).

The ClearView viewport is available in 1.5" and 2.5" nominal port diameter configurations. The 150 model includes fan-cooling, whereas the 250 model includes water-cooling. See specifications below and options on back.

Features

- Thin profile provides large viewing area
- Sturdy filament design
- Variable temperature control
- Continuous temperature up to 550°C (450°C for 4.50" viewport)

VHW-150 for 2.75" Port Specifications

- 2.75" mounting flange, 4.5" optional
- 1.37" diameter viewing area
- 7056 glass vacuum viewport, quartz optional
- Fused silica heated element
- Continuous operation up to 550°C
- Forced air cooling of housing
- Includes variable temperature power supply
- Suitable for UHV environment

Model No: VHW-150-275-G

VHW-250 for 4.50" Port Specifications

- 4.50" mounting flange, 6.0" optional
- 2.375" diameter viewing area
- 7056 glass vacuum viewport, quartz optional
- Fused silica heated element
- Continuous operation up to 450°C
- Water-cooling of housing
- Includes variable temperature power supply
- Suitable for UHV environment

Model No: VHW-250-450-G

Options

/B-4.5 Mounting Flange

- For VHW-150-275 only
- Viewport modified for mounting on a 4.50" diameter chamber port

/B-6.0 Mounting Flange

- For VHW-250-450 only
- Viewport modified for mounting on a 6.0" diameter chamber port

/Q Quartz Viewport

- Replaces 7056 glass vacuum viewport

/PID Temperature Control

- Option for VHW Series power supplies
- Closed loop temperature control
- Thermocouple placed at heated element
- Allows variable temperature setting control
- Temperature display

/RMA Rack Mount Adapter

- 19" rack adapter for mounting up to three VHW Series power supplies

/S Custom configurations

- Please consult factory with your specific requirements

VHW Series Heated Window

Delta Shutter

The Delta viewport shutter assembly uses a pendulum-type shutter that is opened and closed by placing the removable magnetic actuator against the curved edge of the shutter body. It provides a completely unobstructed view and there is no stray magnetic field with the actuator removed from the body. There is no position lock provided.

Features

- All metal sealed, UHV compatible
- May be mounted in any axial position on a chamber
- Unobstructed view
- Magnetically actuated with an external, removable magnet assembly
- No stray field with the actuator removed
- Constructed of 304 and 400 stainless steel, and Pyrex
- Pyrex viewport glass is standard - sapphire, quartz, fused silica, etc., are available upon request, at additional cost

Ordering Information

Flange O.D.	Model Number
1.33"	ZPV-133-075-DS
2.12"	ZPV-212-100-DS
2.75"	ZPV-275-150-DS
3.38"	ZPV-338-200-DS
4.50"	ZPV-450-250-DS
4.62"	ZPV-462-300-DS
6.00"	ZPV-600-400-DS
6.75"	ZPV-675-500-DS
8.00"	ZPV-800-600-DS

Thermionics can provide motor drive to almost all motion systems. We commonly mount 200 steps/rev (400 steps/rev in half step) stepping motors or synchronous motors. Micro-step and speed control motors are also available. We use double-ended motors to provide hand knob adjustment and/or encoder read-out.

Manipulator Motor Drive

Motor Drive, each axis

- /MS stepping or /MY synchronous
- X and Y axes motorized micrometer drive
- Z axis
  FB, FM, TPM, EM, FBT. EMT. LMAB
- Without motor controller

Ordering Information - Motor Drive Options

- FB, FM, TPM and EM Series manipulators
- FBT, EMT and LMAB Series translators
- FBXY, EMXY, EBXY and ECXY Series stages

Axis	Motor Type	Drive Systems	Model Number
X	Stepping	Micrometer	**/MS-XM**
X	Synchronous	Micrometer	**/MY-XM**
Y	Stepping	Micrometer	**/MS-YM**
Y	Synchronous	Micrometer	**/MY-YM**
Z	Stepping	Acme	**/MS-Z**
Z	Synchronous	Acme	**/MY-Z**

Worm Gear Rotary Drive Actuation

/MS/W or /MY/W Motor Drive

- Worm gear drive
- With /MS stepping or /MY synchronous motor
- Without motor controller
- Anti-backlash worm drive
- With manual knob

Ordering Information — Motor Drive Options

- FPRM. FRLC, WOA and FRRC Series

Motor Type	Model Number
Stepping	**/MS/W**
Synchronous	**/MY/W**

Linear Drive Actuation

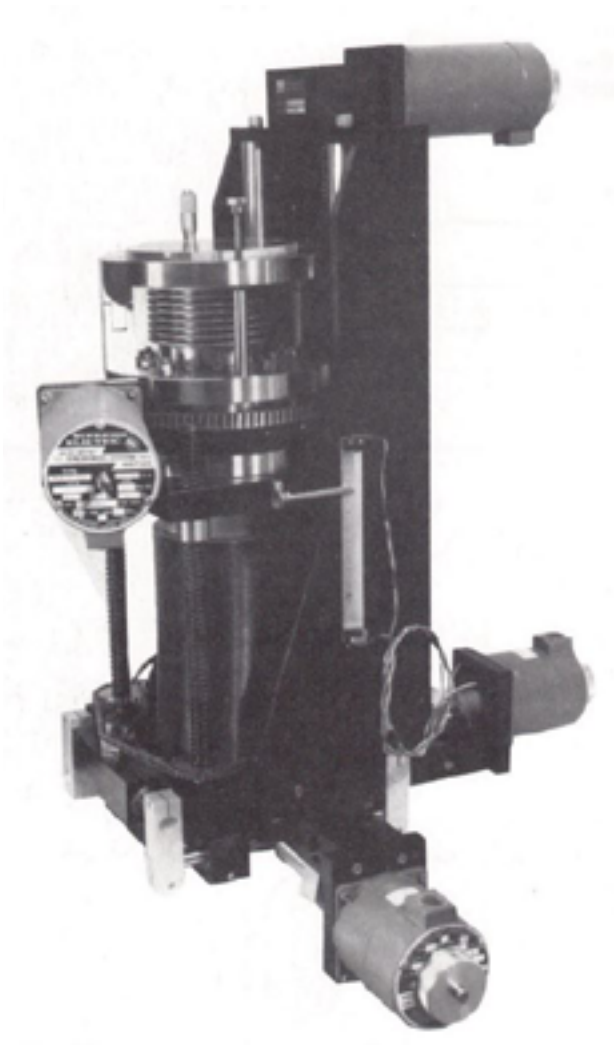
/MS/L or /MY/L Motor Drive

- For FRLC coaxial-linear
- With /MS stepping or /MY synchronous motor
- Without motor controller
- With manual knob
- Requires limit switch package

Ordering Information — Motor Drive Options

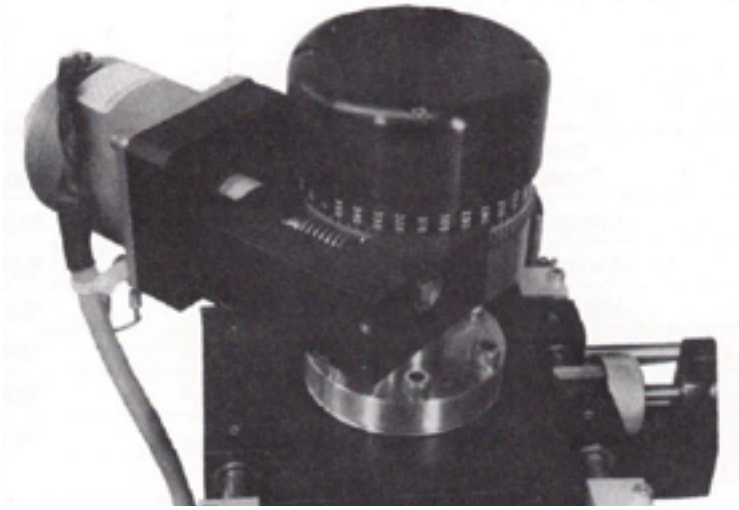
Motor Type	Model Number
Stepping	**/MS/L**
Synchronous	**/MY/L**

SMC Stepping or YMC Synchronous Motor Controllers

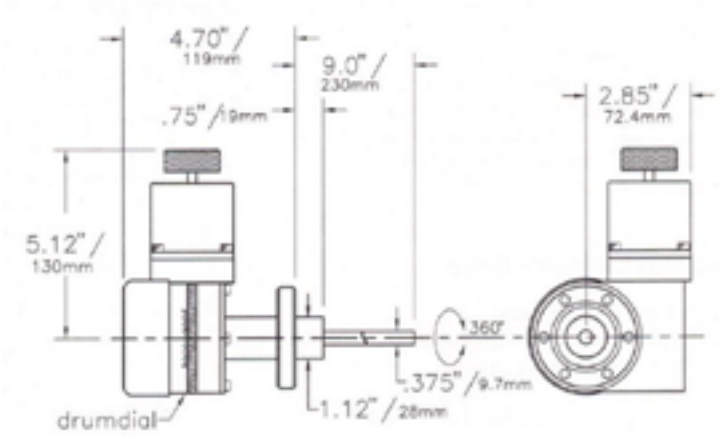


FB-104/MS-XB/MS-VB/MS-Z with RNN/MS

3 Motor Drives & Accessories



FPRM with /MS/W



FPRM-275-38/MS/W

Options

/LS Series Limit Switch Sets

- Mounted on sub-plates for easy dismount for bakeout
- We strongly recommend the use of limit switches on any motor drive. Consult the factory for custom limit switch applications
- Suitable for logic voltage only

Ordering Information — Limit Switch Sets

Axis	Switch Systems	Model No.
X & Y	Dual Axis	/LS-XY
Z	Single Axis	/MY-Z

/EDR-200-0 Shaft Encoders

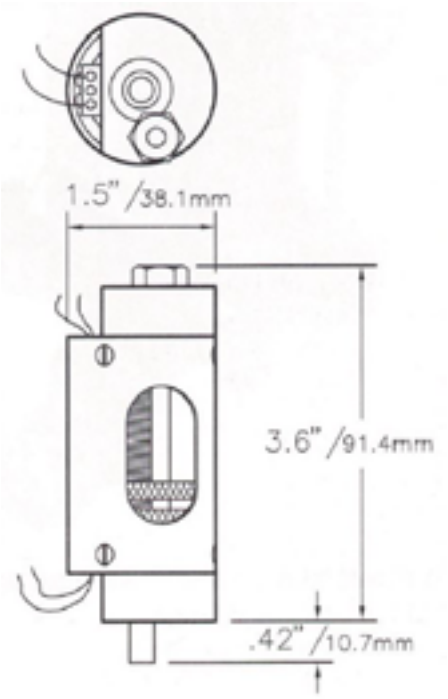
- Mounted to rear of drive motors
- Five VDC pulses bi-directional (sine/cosine)
- 200 pulses per revolution (other counts/rev available)
- With "zero" pulse location
- Other types and mounting available

/ZPI Zero Position Indicator

- Slit/photo-diode principle
- Indicates stage position to within approximately 0.015"
- Couple with "zero" pulse from encoder to establish unique system zero position
- Includes mounting and wire pigtail

/OPS Origin Position Indicator

- Mechanical switch
- Located at mid-travel
- Includes mounting and wire pigtail
- Available for most motor drives



/RLS-40

/RLS Series Adjustable Rotary Limit Switch

- Supplies limit switch protection to multi-turn rotary feedthroughs
- Adjustable, one turn to maximum
- Switch contact ratings: 5A
- Compact unit 1.5" O.D. stainless steel body
  Length determined by maximum number of turns
- 1/4" O.D. input shaft
- All ball bearing operation
- Without mount

Maximum Turns	Model No.
40	/RLS-40
100	/RLS-100
200	/RLS-200
500	/RLS-500

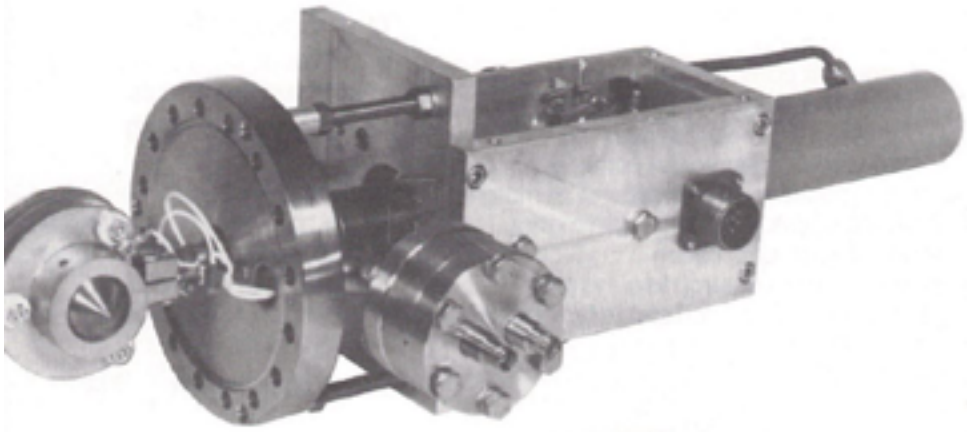
/AD Adaptor Option

- Allows mounting of /RLS Series rotary limit switch to motorized FPRM- 133/MS/W or /MY/W
- Includes drive gear

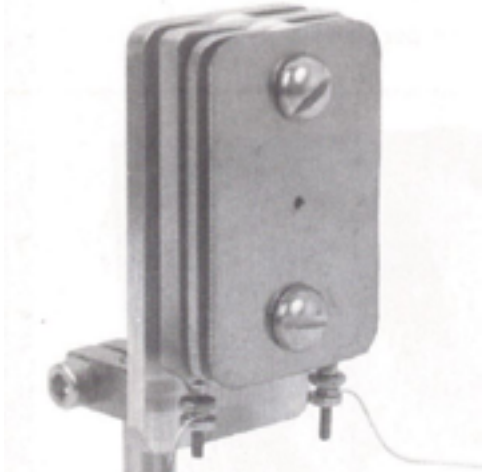
/MO Mount Option

- Allows mounting of /RLS Series rotary limit switch to rear shaft of MO60 Series stepping motor
- Aluminum construction
- Includes shaft coupler

3 Faraday Cup and Linear Actuator Assembly



AC-3/FD-1



FD-0.4

FD-0.4 Faraday Cup Assembly

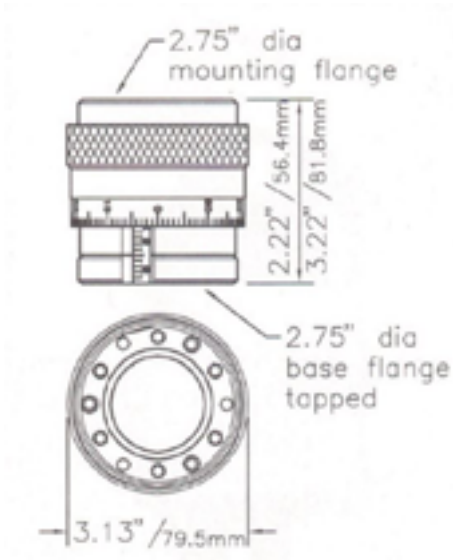
- Maximum active area: 1 cm diameter
- Cup face plate drilled per customer requirements
- Tantalum face and cup lining
- With secondary electron suppression ring
- Stainless steel, tantalum and alumina construction
- 1/4" shaft mount, orientation per customer requirements
- Requires two electrical connections (HV and signal)

AC-3/FD-1 Faraday Cup with Linear Actuator Assembly

Typically used as a remotely removable Faraday Cup in a charged particle accelerator beamline.
Consisting of:

- Actuator AC-3
  - 3" travel, bellows sealed
  - 6" O.D. flange, mounted
  - 1/2" diameter actuator shaft
  - "In" position adjustable ±0.25" in two axes
  - Actuator reproducibility less than 0.010"
  - Air operated. electro-pneumatic valve installed
  - Valve voltage optional
  - 400 W maximum power (with optional ceramic wire insulation, Teflon normally supplied)
  - With secondary electron suppression ring
  - Tantalum cup, face shield and screw cover to minimize induced activation
  - "Signal" and "B-" BNC feedthroughs
- Mounting flange face to cup centerline (in position) distance: 5.31 (standard 4" tee or cross suitable as operating chamber)

JS Series Clear Bore Linear Motion Thimble Jacking Stages



JS-275-1

Thimble jacking stages are precision linear motion devices with a clear bore flange/bellows assembly. A knurled Acme screw threaded collar actuates the linear drive. The top flange slides up and down on three stainless steel guide pins maintaining a ridged mount.

Thimble jacking stages are ideal for precision linear probe positioning of distances less than 2". Rotating the Acme screw threaded collar jacks the top flange with a range of one or two inches. One rotation of the Acme threaded collar moves the top flange 0.1" (0.001" per gradation).

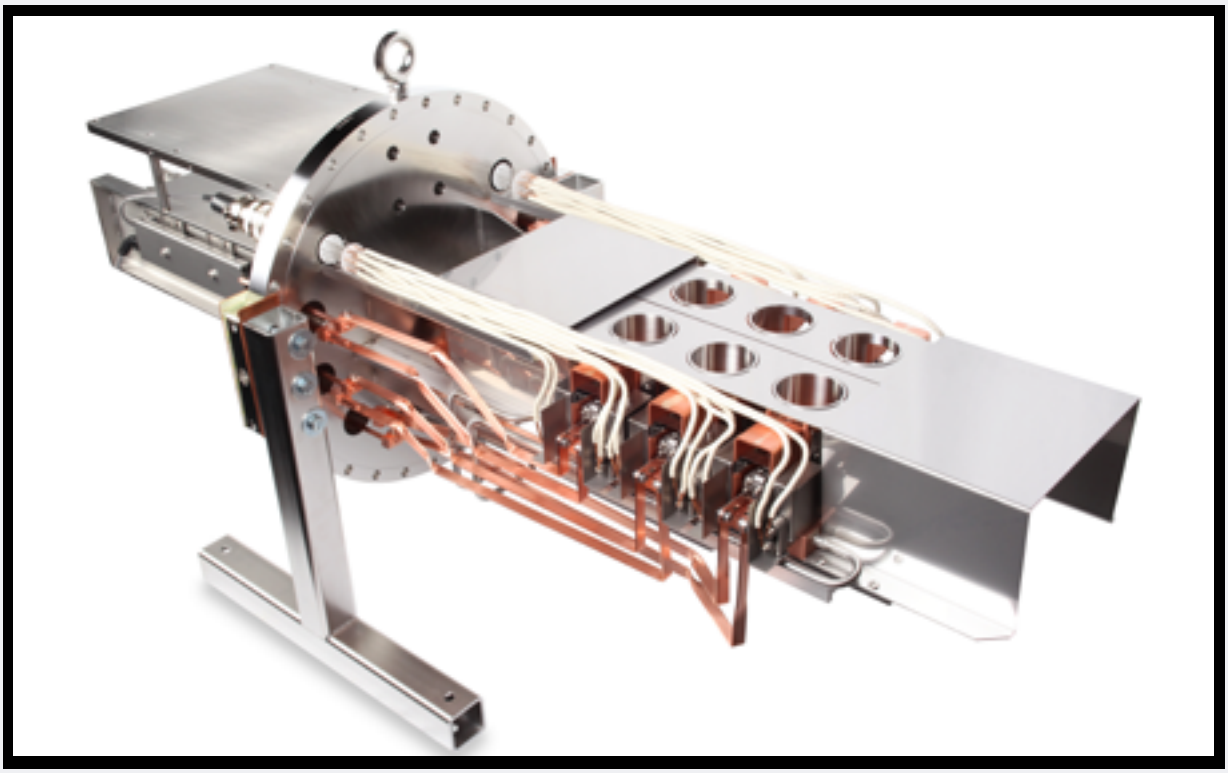
- 2.75" O.D. rotatable top flange
- 2.75" O.D. base flange
- 1.39" I.D. bellows
- Bakeable to 200°C
- 0.001" resolution per gradation
- Available with optional guide bearing

Ordering Information — Thimble Jacking Stages

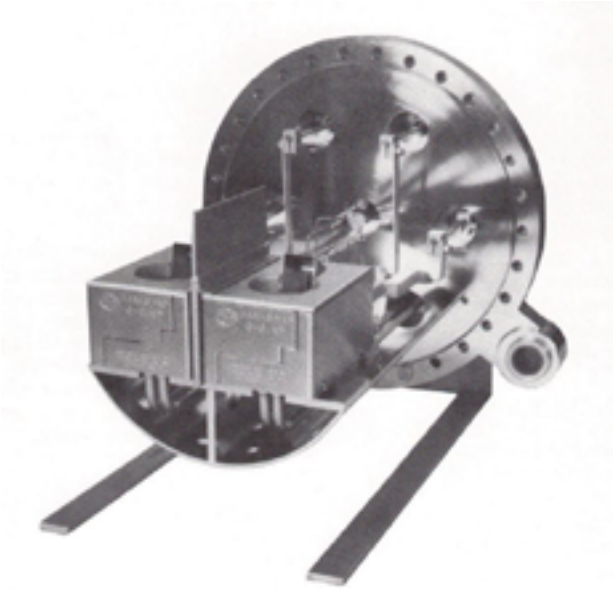
Z Travel	Bore I.D.	Model Number
1"	1.0"	JS-275-1
2"	1.0"	JS-275-2

JS Thimble

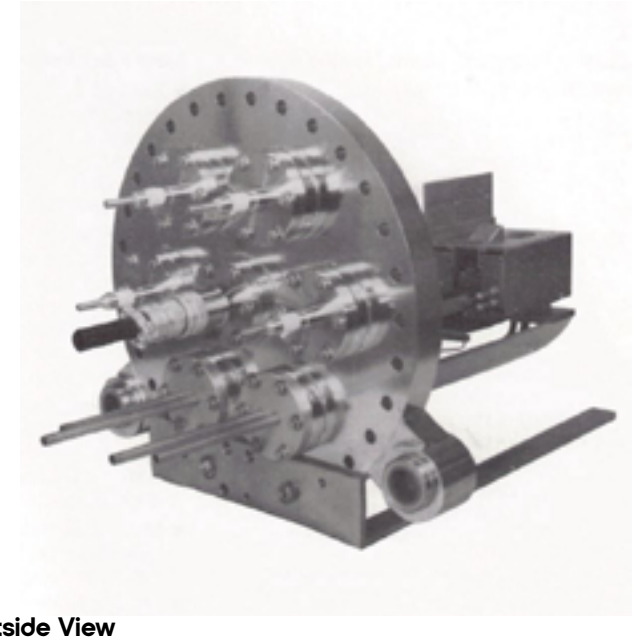
(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com



e-Gun™



Custom Installation: Twin HM² e-Guns Mounted on a Single Flange
(Inside View (note: this e-Gun assembly is shown mounted on a 13.25" flange)



Outside View
Hanks HM² e-Guns are manufactured and protected under one or more of the following patents: 4,835,789; 4,891,821; 4,947,404

Introduction

The Thermionics e-Gun, an electron beam evaporation source, is used to produce uniform high-purity films and optical coatings. The compact design and ease of maintenance make it useful in practically all vacuum systems and for many varied applications. It has been used to evaporate refractory and dielectric materials, as well as the more common conductive and semi-conductor materials. e-Gun evaporation sources are reliable and simple to operate. They are equally suited for research or production applications.

Theory of Operation

Electron beam heating is an efficient way of achieving temperatures in excess of 3500°C (6300°F) for uniform thin film, optical coating and vacuum metallurgic processes. The all-metal sealed models are bakeable to 230°C (446°F). The e-Gun source and companion control power supply have been designed to be part of any high or ultra-high vacuum system.

The e-Gun source is a self-accelerated electron beam device. A beam of electrons, held at a high negative potential, is produced by the hot tungsten filament. The beam of electrons leaving the filament is magnetically focused and then deflected 270° by the integral permanent magnet. The electron beam is accelerated into the evaporant material contained within the water-cooled, grounded crucible. The beam strikes the evaporant material with a spot of approximately 1/8" diameter and an intensity of approximately 25 kW/cm². Sweeping the electron beam across the evaporant material contained in the crucible is performed by an electro-magnetic system, with either manual or automatic controls. Larger Thermionics e-Guns offer the sweep capability as a standard feature, 3 kW model sweep capability is available as an option.
The focused electron beam is capable of producing temperatures over 3500°C in source materials, so virtually any material may be evaporated.

The rate at which source materials may be evaporated is dependent upon power input, charge size, charge shape, and the characteristics of the material to be evaporated. The highest evaporation rates are obtained with materials that have low evaporation temperatures and low thermal conductivity.

The evaporant vapor cannot become contaminated because the focused electron beam strikes only the evaporant source material in the crucible. The beam deflection and effective shielding keeps the filament hidden from the evaporant vapor. The crucible is cooled so efficiently that its surface never gets warm enough to unite with the evaporant material.

The e-Gun source will operate in a system base pressure as low as 5 x 10^{-11} Torr. The magnitude of pressure, which normally increases during evaporation, depends on the pumping capacity of the system and the cleanliness of the evaporant material. This pressure increase is minimized by the high thermal efficiency of the source. There is minimal outgassing of surrounding surfaces because only the evaporant is heated.

Mounting Configurations

Each gun is available in three standard mounting configurations:

1. e-Gun mounted on a PyraFlat or ConFlat metal seal type flange, which uses a standard OFE copper gasket
2. e-Gun with a 1" diameter bolt-type mount, which mounts through a 1" diameter hole, and is sealed by a compression O-ring
3. e-Gun alone with no mounting flange

Ordering Information

Please specify the mounting configuration at the time the order is placed.

Other mounting flanges, configurations and geometries are routinely supplied, please call the factory for further information.

Custom e-Guns

Any e-Gun can be designed and manufactured to fit existing or new systems. Please consult the factory with your special requirements.

PyraFlat flanges are manufactured and protected under one or more of the following patents: 5,640,751; 4,685,193

4 The Revolutionary Hanks HM² e-Gun with Modular Magnet Design and Hyper-Unimelt Sweep

Unique Electron Beam Heated Evaporation Sources

By means of a unique modular magnetic configuration, the Hanks HM² e-Gun offers a more efficient electron beam heated source. It is 2/3 the size of traditional evaporation sources, yet provides the same crucible volume, evaporation rate, and power capability of physically larger guns.

The Hanks HM² e-Gun is approximately 350% more efficient magnetically, which is reflected in its reduced physical size. It is also markedly different from other e-Guns because of the unique method used to generate the magnetic field. e-Gun manufacturers that use a transverse field for beam focusing place the permanent magnet horizontally at the rear of the source and conduct the magnetic field lines through steel pole pieces. The use of this system results in an inherently high magnetic leakage flux and thus, larger magnets must be used.

In the Hanks HM² e-Gun, the magnetic field generator is rotated 90˚ from a horizontal to a vertical position. It is made of two sets of a number of small individual magnets arranged vertically along the two sides of the crucible and the beam path. This allows placement of the top ends of the magnets at a position slightly above the crucible top, which is the optimum position from which to deliver the flux to the desired magnetic field area. This very short length path reduces leakage flux. Leakage flux is further reduced by the use of a steel plate which connects the bottom end of the magnets to form a unitized magnetic structure. The desired changes and shaping of the magnetic gradient along the beam path are accomplished by shaping and positioning the individual magnets along the two sides of the beam path. The magnets can be either permanent magnets, electromagnets, or both, depending upon the application.

Hanks HM² e-Guns are manufactured and protected under one or more of the following patents: 4,835,789; 4,891,821; 4,947,404

New Features and Benefits

- Elimination of beam curl - Electrons impact the melt at a 90˚ angle providing maximum energy transfer with a minimum of energy-wasting secondary electrons. This is the result of a carefully graduated magnetic field which is stronger at the top of the crucible than at the bottom.
- Elimination of pole pieces - Vertically mounted magnets result in less magnetic flux leakage. This improves electron capture, and it improves efficiency. Thus, the more compact a magnetic circuit is, the smaller its source footprint.
- Easy filament alignment-Filaments are quickly, easily, and very accurately aligned by simply removing the emitter assembly from the vacuum system. An alignment tool is included with each gun.
- More efficient electron collimation - Our new design produces a better collimated beam with fewer stray electrons.
- Minimal filament distortion - By clamping the filament adjacent to the spiral, filament movement is held to a minimum.
- Electron tails - Special filament shielding prevents low energy electrons from leaving the filament environment, eliminating electron tails.
- Larger crucible size - 40 cc crucible volume in a footprint 2/3 the size of traditional evaporation sources.

200 Hz Sweep

- The Hyper-Unimelt high frequency sweep system virtually eliminates tunneling and source material eruptions. Operating from 0-200 Hz, it is over twice as fast as any other beam sweep system.

The high Hz sweep capability facilitates uniform heating of dielectric and sublimating materials. Without it, tunnels will develop, producing high evaporation rates, but with restricted distribution. Uniform heating is essential for maintaining a uniform flat evaporant surface. Maintaining the uniformity of the surface of the material being evaporated produces superior results.

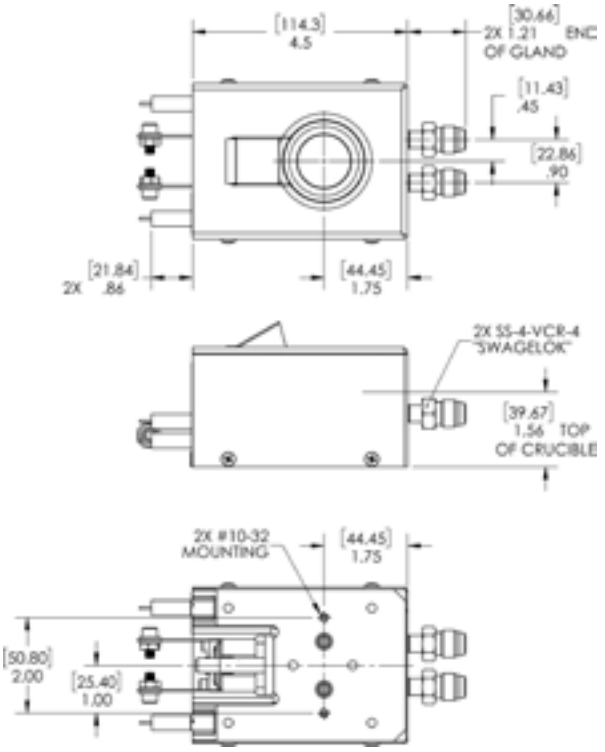
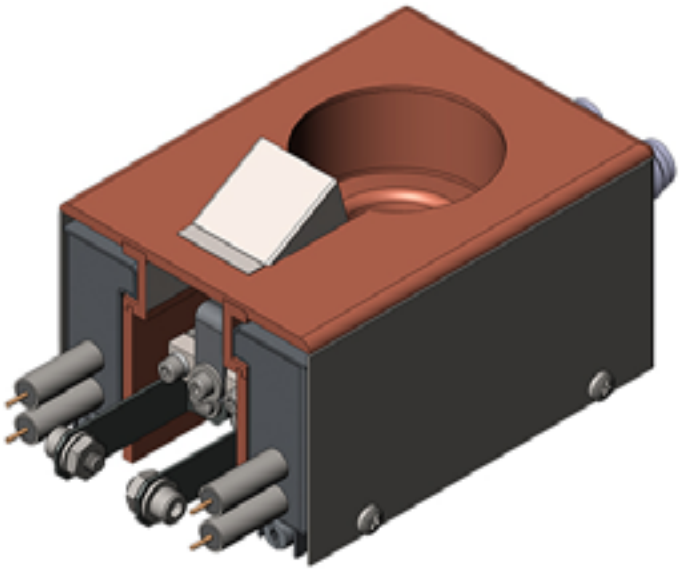


Fig. 4-1. Dimensional diagram of single crucible, 15 cc Hanks HM² e-Gun.

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

The Hanks HM² Single Crucible, Single Emitter e-Gun



Hanks HM² Single Crucible e-Gun

UHV Compatible

Metal-sealed, fully UHV compatible, measured base pressure 2 x 10^{-11} Torr.

The Hanks HM² e-Gun — 6, 10, 15, 20 kW
Crucible Volumes — 7, 10, 15, 40, 75, 100, and 156 cc

Single Crucible Models - Single Emitter

Model No.	Power	Crucible Volume
0607	6 kW	7 cc
0610	6 kW	10 cc
1010	10 kW	10 cc
1015	10 kW	15 cc
1540	15 kW	40 cc
1575	15 kW	75 cc
15100	15 kW	100 cc
15156	15 kW	156 cc
20156	20 kW	156 cc

Twin — Two Single Crucible e-Guns

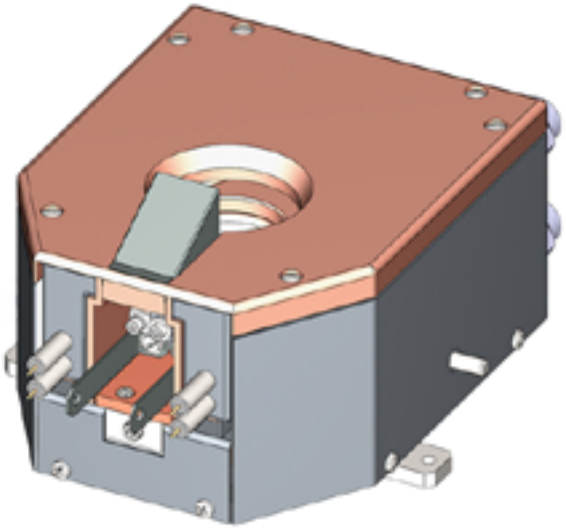
Model No.	Power	Crucible Volume
D1010	10 kW	10 cc
D1015	10 kW	15 cc
D1540	15 kW	40 cc

Specifcations

Power Output	6 kW	10 kW	15 kW	20 kW
	7.5 kV	10 kV	10 kV	10 kV
	0 to 800 mA	0 to 1.0 A	0 to 1.5 A	0 to 2.0 A
Crucible Volume	7/10 cc	10/15/40 cc	40/75/100/156 cc	156 cc
Dimensions	2.50” h	2.50” h	2.50” h	3.00” h
	3.25” w	3.25” w	3.50” w	5.00” w
	4.50” l	4.50” l	5.00” l	6.00” l
Weight	5 lbs	5 lbs	7 lbs	11 lbs
Filament	12 VAC 60 A			
Electron Beam	270˚ deflection			
Evaporation rates (for aluminum)	1 gm /min at 10 kW		1.5 gm /min at 15 kW	
	3.6 microns at 25 cm		50,000 A min	
Beam spot size	.25" circular (approximate)			
	(beam can be adjusted and located electrically with beam sweep controller)			
Crucible	OFE copper			
Bakeout temperature	230°C (446°F)			
Water	3.0 gpm (filtered) at 70 psi			
Minimum water tube size	3/8” dia (6/10/15 kW)			1/2” dia (20 kW)
Pressure differential	50 psi minimum			
X and Y sweep	Hyper-Unimelt sweep (0 to above 200 Hz)			

Hanks HM² e-Guns are manufactured and pro- tected under one or more of the following patents: 4,835.789; 4,891,821; 4,947,404

4 Hanks HM² Rotary Pocket e-Gun



Hanks HM² Rotary Pocket e-Gun

Rotary, Multiple Crucible e-Guns

(Not all models appear in this pricing grid, please consult factory)

Model No.	Power	Crucible No.	Crucible Volume
R0607-4	6 kW	4	7 cc
R0610-4	6 kW	4	10 cc
R0615-4	6 kW	4	15 cc
R1010-4	10 kW	4	10 cc
R1015-4	10 kW	4	15 cc
R1025-4	10 kW	4	25 cc

Modular Magnets

The unique modular magnet concept is incorporated in the rotary pocket Hanks HM² e-Gun design. This concept makes possible a very compact unit (see outline drawing). All of the Hanks HM² unique features are incorporated in this model.

Modular Magnets

(Optimum Control on Low or High Rates)

High frequency sweep (0-200 Hz) provides the user with total flexibility in the operation of the e-Gun. By operating a sweep controller, the beam can be varied in size to suit the material being evaporated. This is very beneficial for optical coatings and other materials, where beam size plays an important role in optimum control from 1-2 A to very high deposition rates.

Hanks HM² e-Guns are manufactured and protected under one or more of the following patents: 4,835.789; 4,891,821; 4,947,404

High Vacuum Compatible

Metal and elastomer seals, measured base pressure: 2 x 10^{-9} Torr.

Specifications

Power Output	6 kW	10kW
	7.5 kV	10 kV
	0 to 800 mA	0 to 1.0A
Crucible Volume	7/10/15 cc	7/10/15/25 cc
Filament	12 VAC 60A	
Electron beam	270˚ deflection	
Evaporation rates (for aluminum)	1 gm/min at 10 kW 3.6 microns at 25 cm	
Beam spot size	.25” circular (approximate) (beam can be adjusted and located electrically with beam sweep controller)	
Crucible	OFE Copper	
Bakeout temperature	120°C (250°F)	
Water	3.0 gpm (filtered) at 70 psi	
Minimum water tube size	3/8” dia (6kW/10 kW)	
Pressure differential	50 psi minimum	
X and Y sweep	Hyper-Unimelt sweep (0 to above 200 Hz)	

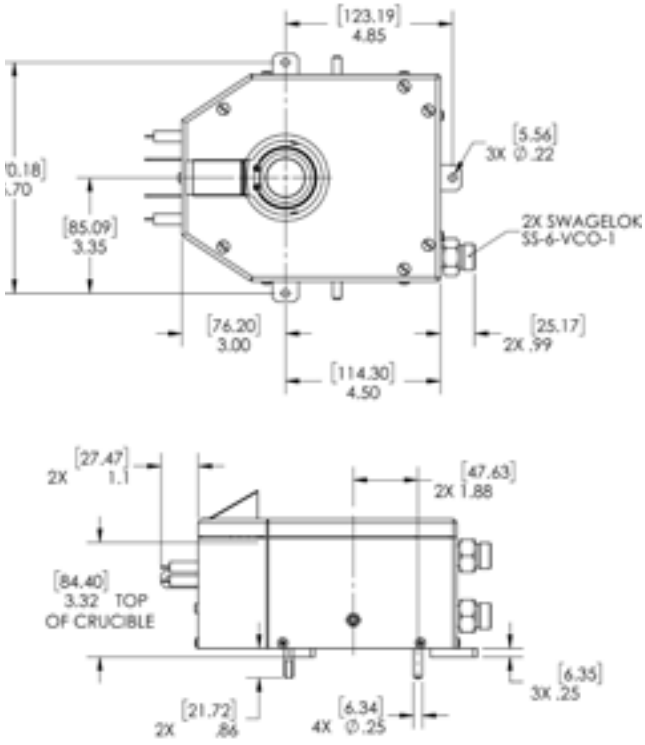
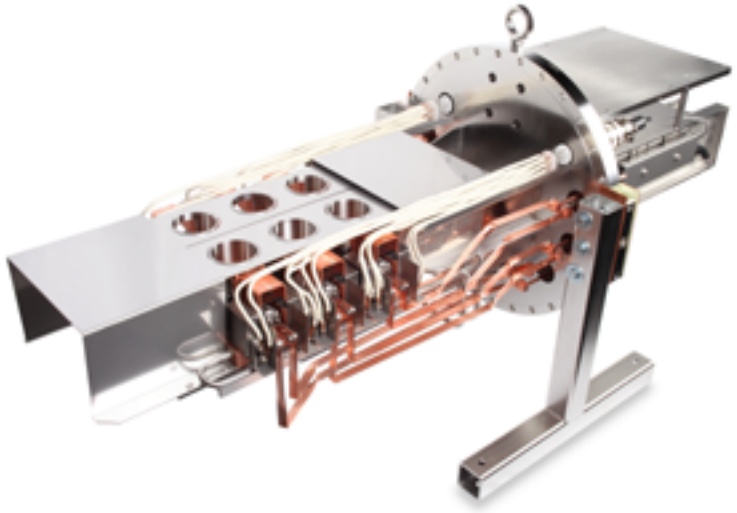


Fig. 4-2 Dimensional drawing of Hanks HM² rotary pocket e-Gun.

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com



Hydra-2 (shown mounted on a PyraFlat flange, with an optional stand)

PyraFlat flanges are manufactured and protected under one or more of the following patents: 5,640,751; 4,685,193

Hanks HM² e-Guns are manufactured and protected under one or more of the following patents: 4,835.789; 4,891,821; 4,947,404

Specifications

Power Output	10 kW	15 kW
	10 kV	10 kV
	0 to 1.0 A	0 to 1.5 A
Crucible Volume	10/15 cc	40 cc
Dimensions (Please refer to diagram on page 4-6 for reference dimensions)	10/15 cc	40 cc
	6.25" h	6.25" h
	11.0" w	11.5" w
	15" l	15" l
Filament	12 VAC 60A	
Electron beam	270° deflection	
Evaporation rates (for aluminum)	1 gm/min at 10 kW 3.6 microns at 25 cm	1.5 gm/min at 15 kW 50,000 Å min
Beam spot size	.25" circular (approximate) (beam can be adjusted and located electrically with beam sweep controller)	
Crucible	OFE Copper	
Bakeout temperature	230°C (446°F)	
Water	30 gpm (filtered) at 70 psi (each crucible has its own water supply, common return)—(3 gpm/crucible)	
Pressure differential	50 psi minimum	
X and Y sweep	Hyper-Unimelt sweep (0 to above 200 Hz)	

A Breakthrough in Co-Evaporation Technology

The Hydra evaporation system is specifically designed to meet the current technological challenges posed by complex co-deposition processes and "leading-edge" materials research. The Hydra design consists of a compact array of crucibles and electron emitters which translate linearly with respect to each other to provide for the co-deposition of up to six different materials simultaneously. By the efficient utilization of space, four different combinations of six crucibles or up to forty-two permutations of two-material combinations are available for co-deposition in a single vacuum pumpdown.

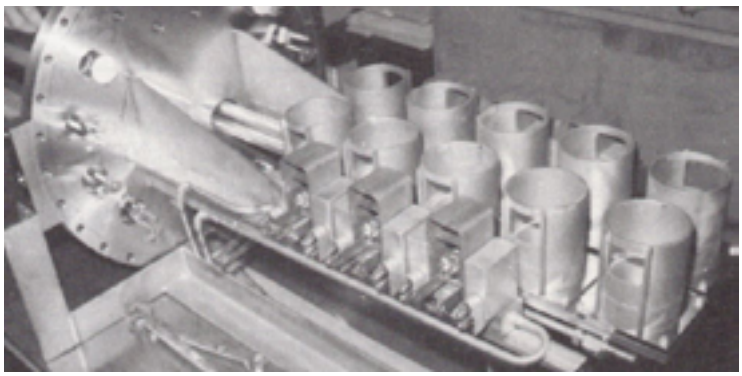
Innovative technology and a creative approach to magnetic field concepts has been fostered by Thermionics to result in several new, unique electron emission configurations. The Hydra configuration eliminates adjacent source interactions without complex beam directions and bulky field shunting components. Thus, the design allows close source proximity for uniform coating and material interaction. Each source crucible is independently water cooled to prevent steam buildup. Each source crucible has separate sweep coils, ensuring the independent operational integrity of each source, and eliminating cross talk interference from any adjacent source.

UHV Compatible

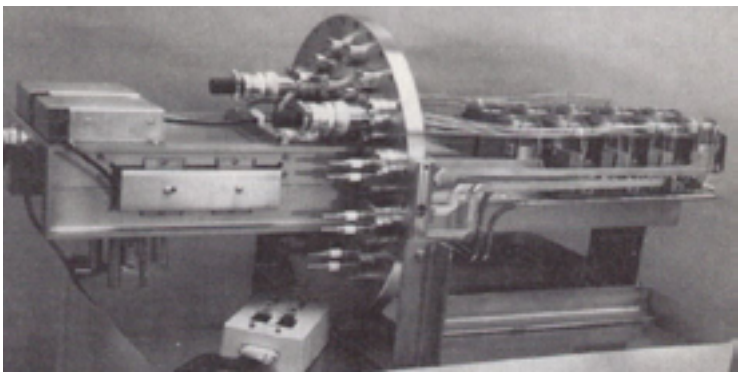
Metal-sealed, fully UHV compatible, measured base pressure: 2 x 10^{-11} Torr.

Prices

Prices are dependent upon many factors, i.e.: system, mounting flange, and e-Gun configurations, geometries, etc. Our engineering group will work closely with you to determine your requirements, then a firm quotation can be given.

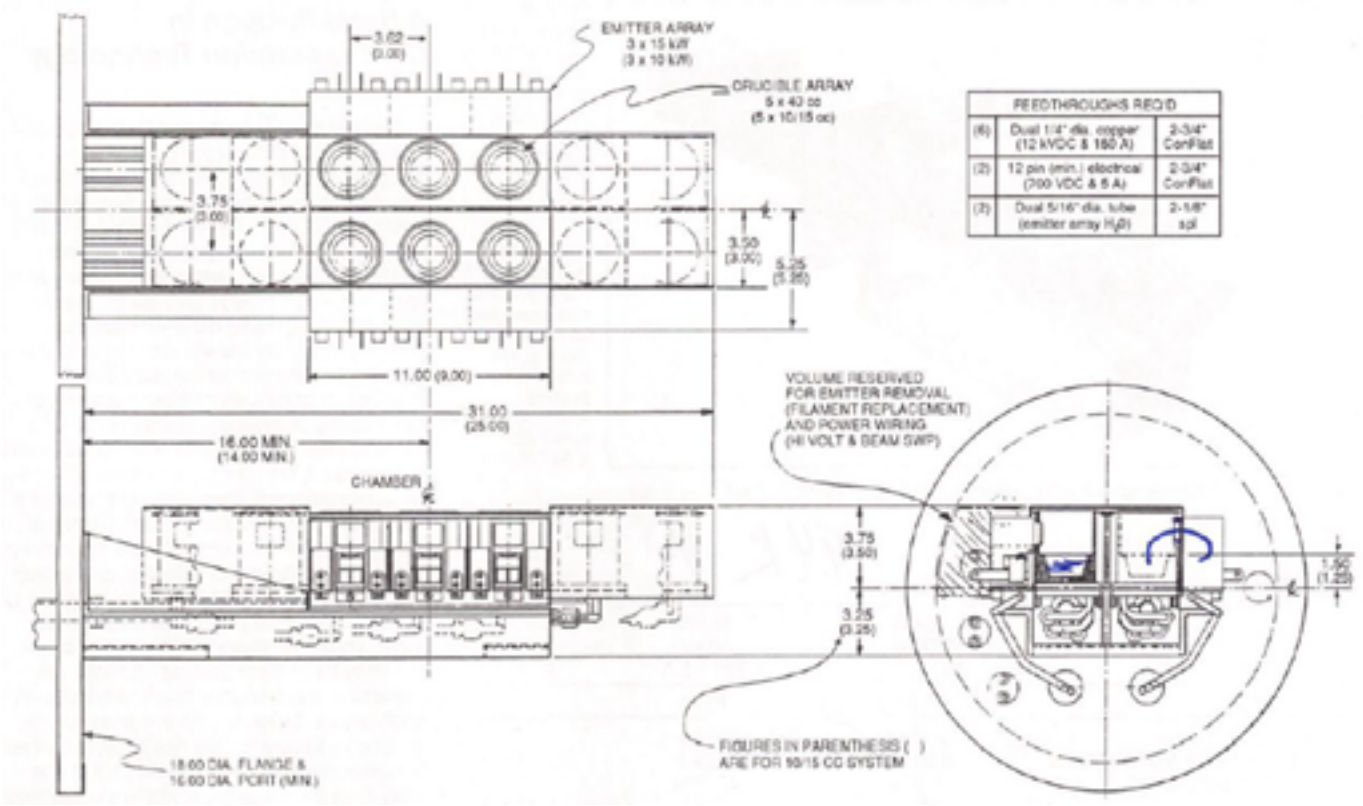


Inside View of Hydra-2 (shields removed for clarity)



Overall View of Hydra-2 (shields removed for clarity)

4 Hanks HM² Hydra-2



40cc Hydra System Dimensions

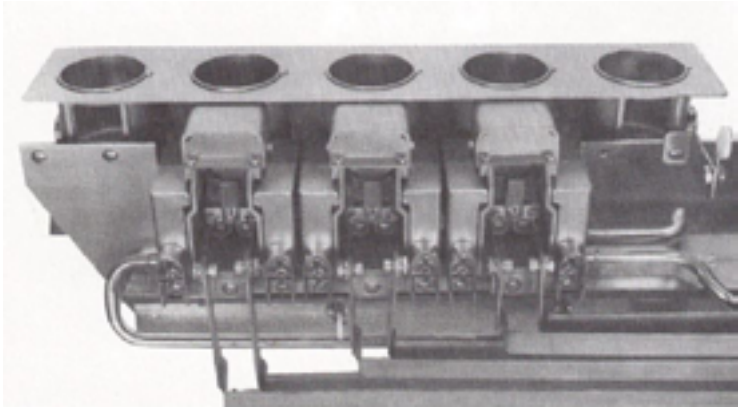
Hanks HM² e-Guns are manufactured and protected under one or more of the following patents: 4,835,789; 4,891,821; 4,947,404

Hanks HM² Hydra-1

Co-Evaporation Technology — Single Array

Available with:
- 5 crucibles, other options available upon request
- 1-3 emitters, other options available upon request

Prices are dependent upon many factors, i.e.: system, mounting flange, and e-Gun configurations, geometries, etc. Our engineering group will work closely with you to determine your requirements, then a firm quotation can be given.



Hydra-1 Single Array Gun

UHV Compatible

Metal-sealed, fully UHV compatible, measured base pressure: 2 x 10^{-11} Torr.

Specifications

Power Output	10 kW	15 kW
	10 kV	10 kV
	0 to 1.0 A	0 to 1.5A
Crucible Volume	10/15 cc	40 cc
Dimensions (Please refer to the diagram above for reference dimensions)	10/15 cc	40 cc
	6.25" h	6.25" h
	5.5" w	5.75" w
	15" l	15" l
Filament	12 VAC 60A	
Electron beam	270° deflection	
Evaporation rates (for aluminum)	1 gm/min at 10 kW 3.6 microns at 25 cm	1.5 gm/min at 15 kW 50,000 Å min
Beam spot size	.25" circular (approximate) (beam can be adjusted and located electrically with beam sweep controller)	
Crucible	OFE copper	
Bakeout temperature	230°C (446°F)	
Water	15 gpm (filtered) at 70 psi (each crucible has its own water supply, common return)—(3 gpm/crucible)	
Pressure differential	50 psi minimum	
X and Y sweep	Hyper-Unimelt sweep (0 to above 200 Hz)	

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

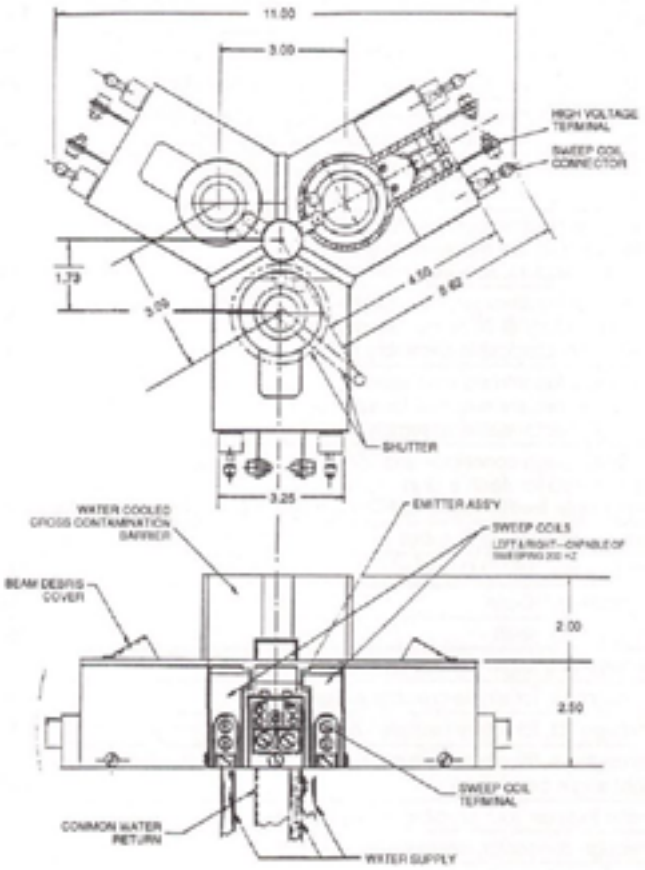
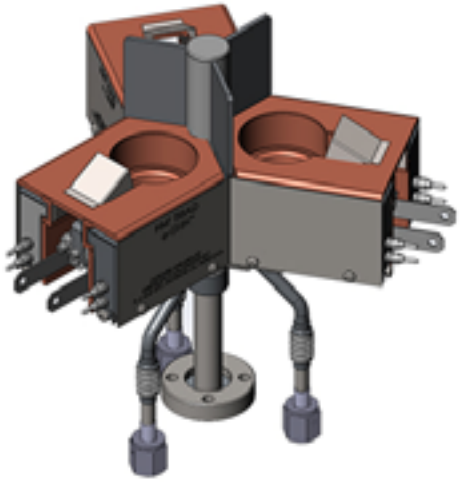


Fig. 4-3. Dimensional diagram of Hanks HM2 Triad e-Gun — (10 kW/15 cc).



Hanks HM2 Triad e-Gun

Hanks HM² e-Guns are manufactured and protected under one or more of the following patents: 4,835.789; 4,891,821; 4,947,404

Triad, Three Single Crucible e-Guns

(Not all models appear in this pricing grid, please consult factory)

Model No.	Power*	Crucible Volume
T0610	6 kW	10 cc
T1010	10 kW	10 cc
T1015	10 kW	15 cc
T1040	10 kW	40 cc

**Please note: This is the power capacity of each crucible, multiply by three to determine the total system power requirement.*

UHV Compatible

Metal-sealed, fully UHV compatible, measured base pressure: 2×10^{-11} Torr.

Specifications

Power Output	6 kW	10kW
	7.5 kV	10 kV
	0 to 800 mA	0 to 1.0A
Crucible Volume	10 cc, 15 cc, or 40 cc	
Filament	12 VAC 60A	
Electron beam	270˚ deflection	
Dimensions	See drawing	
Weight	14 lbs	
Evaporation rates (for aluminum)		1 gm/min at 10 kW 3.6 microns at 25 cm
Beam spot size	.25" circular (approximate) (beam can be adjusted and located electrically with beam sweep controller)	
Crucible	OFE Copper	
Bakeout temperature	230°C (446°F)	
Water	9 gpm (filtered) at 70 psi (each crucible has its own water supply)	
Pressure differential	50 psi minimum	
X and Y sweep	Hyper-Unimelt sweep (0 to above 200 Hz)	

4 Hanks HM² e-Gun Accessories

Replacement Parts

Model No.	Description
A111555	Filament
A111556	Beam deflector
A112019-01	New beam deflector
A111557	Beam former
A111558	Insulator post
A111562-01	Anode
A111906	Main insulator
A111418-03	Ceramic washer
B111336	Beam cover
A526482-04	Emitter assembly
C111540-01	Sweep coil right side
C111540-02	Sweep coil left side
A111366	HM² emitter rebuild kit — includes screws, washers, ceramic insulators and spacers, two filaments and a filament alignment tool

Accessories

Model No.	Description
210-SW	Water interlock switch
SVA-GROUND	Grounding rod

Hanks HM² e-Guns are manufactured and protected under one or more of the following patents: 4,835.789; 4,891,821; 4,947,404

Feedthroughs and Connectors

Model No.	Description
111139-04	4-pin instrument feedthrough mounted on a 1.33” ConFlat flange
111140-04	4-pin instrument feedthrough mounted on a 2.75” ConFlat flange
B111136-12	Two electrical feedthroughs mounted on a 2.75” ConFlat flange, 12 kV @ 70 A (use with connector/cable assembly HVC-D-12)
HVC-D-12	Dual feedthrough connector w/interlock and 10’ dual cable assembly (use with dual feedthrough B111136-12)
EBFT-100	One electrical feedthrough mounted on a 2.75” ConFlat flange, 12 kV @ 70 A, two are required for each e-Gun (use with connector/cable assembly HVC-T-12)
EBFT-100-1B	One electrical feedthrough mounted on a 1” bolt-type baseplate feedthrough, 12 kV @ 70 A, two are required for each e-Gun (use with connector/cable assembly HVC-T-12)
EBFT-133	One electrical feedthrough mounted on a 1.33” ConFlat flange, 12 kV © 70 A, two are required for each e-Gun (use with connector/cable assembly HVC-T-12)
HVC-T-12	Single feedthrough connector and 10’ cable assembly, two are required for each e-Gun (use with single feedthroughs EBFT-100, EBFT-100-1B, and EBFT-133)
EBFT-200	Dual pass water, 1/4” O.D. tubes
EBFT-300	Dual pass water, 3/8” O.D. tubes
EBFT-400	Instrumentation, 10-pin
EBFT-500	Rotary, 1/4” O.D. shaft
EBFT-600	Rotary, with right angle translation, 1/4” O.D. shaft
EBFK-700	Feedthrough Kit, for single crucible e-Gun
EBFK-800	Feedthrough Kit, for rotary multiple crucible e-Gun
EBFK-900	Feedthrough Kit, for rotary multiple crucible e-Gun, with right angle translation
EBCR-4	Automatic Indexer, four crucible, rotary model
111489	Feedthrough connector, internal 1/4” rod to 10-32 screw connector
086190	Feedthrough connector, internal 1/4” rod to 0.090” wire

e-Gun Crucible Liners

- Please consult the factory if there is a special material you need.
- If you are unsure which liner fits your gun, please contact the factory and we will send you a template.

Each feedthrough is available in two mounting configurations:

- A 1” diameter bolt-type mounts through a 1” diameter hole, sealed by a compression O-ring;
- A 2.75” O.D. ConFlat-type flange uses a standard copper gasket. Other mounting flanges are routinely supplied, please call the factory for information and prices.

Ordering information

The model numbers listed are for the 1” diameter bolt-type baseplate feedthrough configuration. To specify the 2.75” flange mounting, please add the suffix /275 to the model number, i.e.: EBFT-200/275.

Starter Charges

Please consult the factory for information concerning starter charges.

Accessories

Material Type	10 cc Model No.	15 cc Model No.	40 cc Model No.	156 cc Model No.
Graphite	111959-G	111962-G	111368-G	111466-G
Glassy carbon	111959-CG	111962-CG	111368-CG	111466-CG
Fabmate	111959-FM	111962-FM	111368-FM	111466-FM
Tantalum	111959-TA	111962-TA	111368-TA	111466-TA
Alumina	111959-AL	111962-AL	111368-AL	111466-AL
Molybdenum	111959-MO	111962-MO	111368-MO	111466-MO
Tungsten	111959-W	111962-W	111368-W	111466-W
Boron nitride	111959-BN	111962-BN	111368-BN	111466-BN
Copper	111959-CU	111962-CU	111368-CU	111466-CU

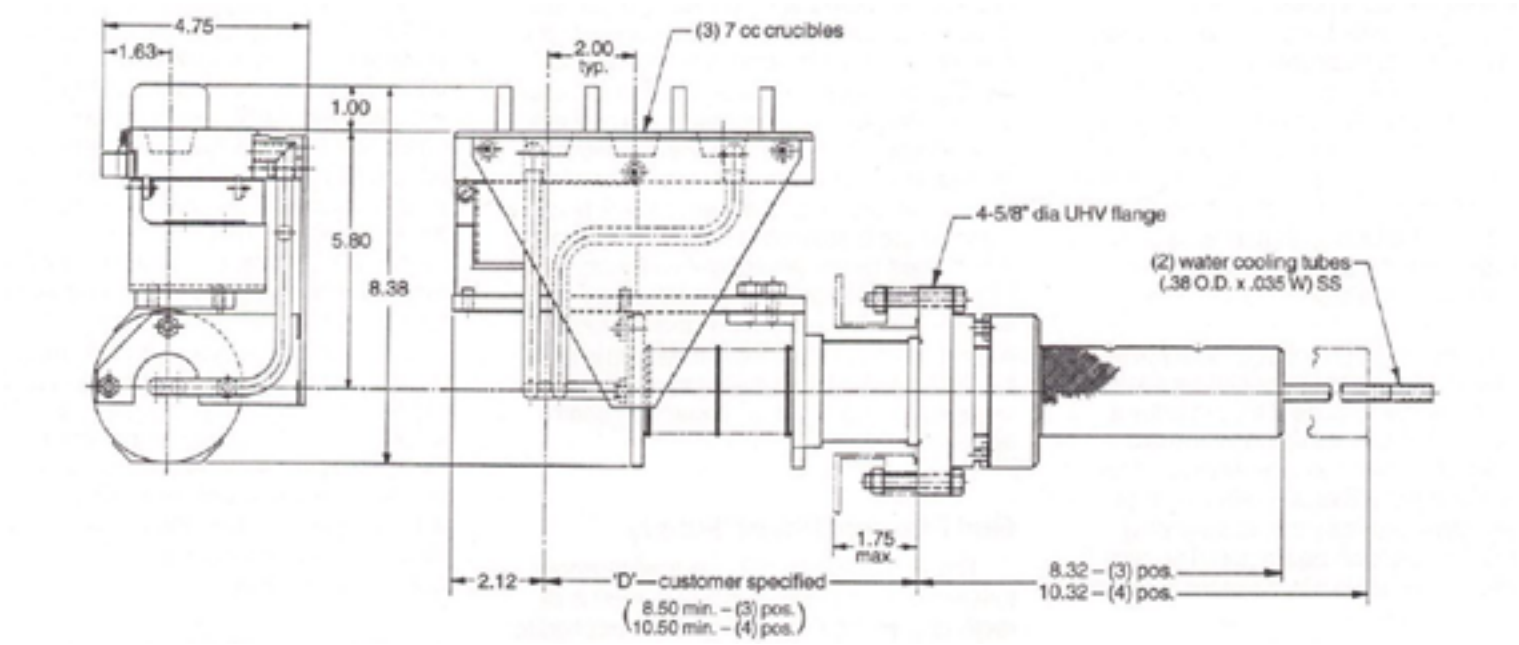


Fig. 4-7. Dimensional drawing of Model 600-0060-33 (e-Gun shown fully retracted).

Specials

All multiple position e-Guns can be mounted on larger diameter ConFlat or rectangular PyraFlat flanges.

PyraFlat flanges are manufactured and protected under one or more of the following patents: 5,640,751; 4,685,193

UHV Compatible

Metal-sealed, fully UHV compatible, measured base pressure: 2 x 10^{-11} Torr.

See pages 4-10 and 4-11 for power supply information.

Specifications

Operating pressure	Below 5 x 10^{-5} Torr is desirable for best operation
Beam voltage	6,000 V
Beam current	0 -1 A continuously variable
Maximum power	6,000W
Cooling water	2 gpm, minimum
Cooling water connection	Two 3/8" stainless steel tubing
Maximum bakeout temperature	230°C (446°F)
Electrical feedthrough	Two 7 kV 50 A
Filament current	0-40 A
Filament voltage	0-10 VAC (filament is also at high DC voltage)
Beam deflection	220°
Crucible volume	7 cc

Standard Models

Model No.	Description
600-0060-30	3 crucible model, no sweep
600-0060-33	3 crucible model with X-Y sweep coils
600-0060-40	4 crucible model, no sweep
600-0060-44	4 crucible model with X -Y sweep coils

6 kW e-Gun Replacement Parts

Model No.	Description
610-40	6 kW filament assembly
610-15	6 kW filaments, each
610-25	Anode shield, each
Special	Repair 6 kW beam intensifier

6 kW e-Gun Accessories

Model No.	Description
DSC-1.5A	Digital Sweep Controller (See page 4-12 for specifications)
PSC-1.5A	Programmable Sweep Controller (See page 4-13 for specifications)
680-1040	High current feedthrough (2 required)
210-S/W	Water interlock switch
PS-GR	Grounding rod
111139-04	4-pin instrument feedthrough on 1.33" ConFlat
111140-04	4-pin instrument feedthrough on 2.75" ConFlat

4 Electron Beam Power Supplies

Thermionics e-Gun source (ebeam gun) solid state power supplies offer our users state-of-the-art technology in switching mode power supplies. Extensive arc management provides fast recovery, arc counting and duration sensing technology. Ranging from 4 kW to 12kW these supplies are available in single or multi-source output configuration. Current regulation is <0.5%. Adjustable output current and ultra-low ripple are a great advantage to our users. When combined with the Digital Sweep, these e-Gun power supplies afford extremely stable beam position and repeatable results. The use of separate controllers offers fast support and minimal downtime in the event of failures. Thermionics solid state power supplies are rack mountable and air cooled for easy installation.
Handheld remote control units with voltage and current displays are available.

- Maximum power 4/6/8/10/12kW
- Simultaneous operation of up to 2 e-Gun sources
- All Solid-State switch mode design
- Rugged well overrated IGBT inverter for superior reliability
- Extensive arc management for outstanding performance, fastest arc recovery, arc counter and arc duration sensor
- Adjustable voltage 0 to -10kV (0 to -8kV for SVA-4) with precise regulation (<+/- 0.25%) for stable beam position, ultra-low ripple for minimum beam size
- Constant emission current regulation <+/- 0.5%
- Full remote operation from PLC or optional Handheld for both High Voltage and Source
- 19 inch rack mountable, ultra-compact, ST chassis: 8.75˚ (5U), Controller: 1.75˚ (1U), Digital Sweep: 3.50˚ (2U), Programmable Sweep Optional: 3.50˚ (2U)
- Air cooled

2-Channel Power Supply Shown:
SVA Remote (2 top devices)
SVA Controller (2 middle devices)
SVA-12 Power Supply (Bottom device)

Specifications

High Voltage Power Supply

Input voltage	208/400 VAC, 3-phase, 50/60 Hz				
Output current	4 kW 500 mA	6 kW 600 mA	8 kW 800 mA	10 kW 1.0 A	12 kW 1.2 A
Precise regulation	(<+/- 0.25%)				
HV Adjustment **Output Voltage Variable**	SVA-4 -0 to -8 kV	SVA-6 -0 to -10 kV	SVA-8 -0 to -10 kV	SVA-10 -0 to -10 kV	SVA-12 -0 to -10 kV
Response time	for all units < 50 microseconds				

Filament Controller

Input voltage	208/400 VAC
Primary control	SCR, phase control
Output current	5 A max
Current regulation	Less than 2%

Control Panel

The remote control panel contains all the necessary controls and indicators for operation of the power supply, filament controllers and sweep generators.

Handheld Remote Control

A handheld remote control chassis may be provided as an option. It provides control of the emission current, emission on-off, lateral sweep amplitude, lateral sweep position, longitudinal amplitude and longitudinal position.

Physical Dimensions

Control panel **Weight**	19.0” wide x 1.7” high x 8.2” deep Approximately 4 lbs
Power supply **Weight**	19” wide x 8.7” high x 21.1” deep Approximately 56 lbs

Features

- Proven high reliability
- Adjustable high voltage
- Output ripple same at any voltage setting
- Air-cooled
- Rapid arc quenching
- Tight emission regulation
- Built-in multi-gun operation

e-Gun (e-Beam) Power Supplies

Includes power supply, rack mountable control panel, closed loop filament controller, enclosed filament transformer, and all connecting cables.

Model No.	Power
SVA-4	4 kW
SVA-6	6 kW
SVA-8	8 kW
SVA-10	10 kW
SVA-12	12 kW

Hand Held Remote Control

Provides remote control of emission, high voltage off.

Model No.
HHRC

SVA Power Supply Controller

SVA Power Supply Filament Transformer

High Voltage Dual Connector

4 Sweep Controllers

Digital Sweep Controller

The Thermionics Sweep is a five-function sweeper. It is intended for use with e-Gun sources such as the Thermionics line of e-Gun sources and with other compatible EB (electron beam) sources that use electromagnetic deflection or combinations of electromagnetic deflection and permanent magnet focusing. The Sweep outputs user adjustable patterns to e-Gun sources. A Sweep is needed for positioning and moving the EB around the source's crucible pocket in a defined pattern. The beam movement helps heat (and evaporate) the crucible pocket's material more evenly. Sweeping is accomplished by running current through magnetic coils next to the crucible pocket. One output runs to each of two coils (latitude and longitudinal), which are placed perpendicularly to each other. Their magnetic fields affect the position/motion of the electron beam. A simple front panel touch screen color LCD (liquid crystal display) and handheld joystick interface is used to configure and run EB sweep patterns. The LCD display allows for easy visualization of each pattern. The LCD panel prompts the user through the various steps of a normal operation.

Specifications

- Frequency range: 0.1 to 100 Hz
- Coil current, dual channel +/1.5A max
- Rotational resolution, 360 steps (1˚ angular resolution)
- Patterns, 8
- Reprogrammed shapes, 4
- Remote included
- Pocket setup, 9 point
- LCD touch screen, resolution 320 x 240
- Input voltage 90-264 VAC, 47-63 Hz
- Remote inputs, passive or active: individual, binary
- Remote outputs, Dry Contact closures (N.O.) individual, binary

Accessories

See page 4-8 for information.

Digital Sweep Controller

Mechanical Specifications

Dimensions	19.0" wide x 3.5" high x 9.4" deep
Weight	10.6 lbs

Model No.
DSC-1.5A

Digital Sweep Controller Remote

Programmable Sweep Controller

The Thermionics Sweep is a five-function sweeper. It is intended for use with e-Gun sources such as the Thermionics line of e-Gun sources and with other compatible EB (electron beam) sources that use electromagnetic deflection or combinations of electromagnetic deflection and permanent magnet focusing. The Sweep outputs user adjustable patterns to e-Gun sources. A Sweep is needed for positioning and moving the EB around the source's crucible pocket in a defined pattern. The beam movement helps heat (and evaporate) the crucible pocket's material more evenly. Sweeping is accomplished by running current through magnetic coils next to the crucible pocket. One output runs to each of two coils (latitude and longitudinal), which are placed perpendicularly to each other. Their magnetic fields affect the position/motion of the electron beam. A simple front panel touch screen color LCD (liquid crystal display) and handheld joystick interface is used to configure and run EB sweep patterns. The LCD display allows for easy visualization of each pattern. The LCD panel prompts the user through the various steps of a normal operation.

Specifications

- Frequency range: 0.1 to 100 Hz
- Coil current, dual channel +/1.5A max or optional +/-3.0A max
- Rotational resolution, 360 steps (1˚ angular resolution)
- Patterns, 32
- Reprogrammed shapes, 7
- Programmable user shapes, 32
- Avatar joystick, included
- Pocket setup, 9 point
- Profile
- Magnetic distortion adjust
- LCD touch screen, resolution 480 x 272
- Input voltage 90-264 VAC, 47-63 Hz
- Remote inputs, passive or active: individual, binary
- Remote outputs, Dry Contact closures (N.O.) individual, binary

Accessories

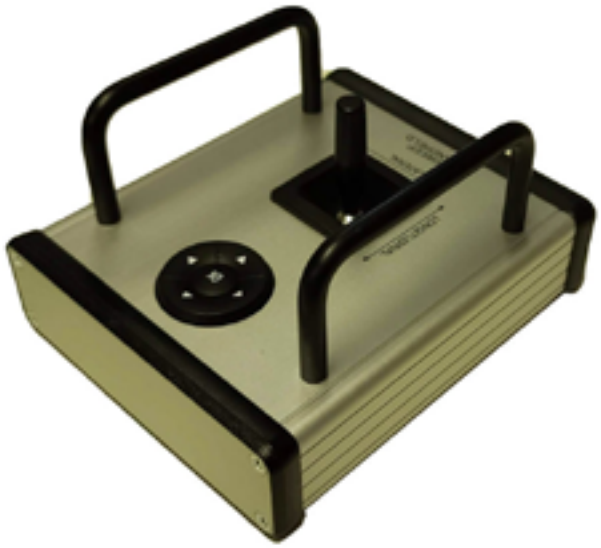
See page 4-8 for information.

Programmable Sweep Controller

Mechanical Specifications

Dimensions	19.0" wide x 3.5" high x 9.4" deep
Weight	10.6 lbs

Model No.
PSC-1.5A



Programmable Sweep Controller Remote

4 3 kW Single Position e-Gun

Single Models — standard

Model No. 100-0010 (shown)

Special Models

- 2 singles mounted on ConFlat flange
- 3 singles mounted on 8” dia ConFlat flange

UHV Compatible

Metal-sealed, fully UHV compatible, measured base pressure: 2 x 10^{-11} Torr.

Specifications

Operating pressure	Below 5 x 10^{-5} Torr is desirable for best operation
Beam voltage	4000 V
Beam current	0 - 750 mA continuously variable
Maximum power	3,000W
Cooling water	1/2 gpm
Maximum bakeout temperature	230°C (446°F)
Feedthrough requirements	Two 7 kV 50 A
Crucible volume	2.24 cc
e-Gun size	2.50”h x 1.94”w x 1.69”d

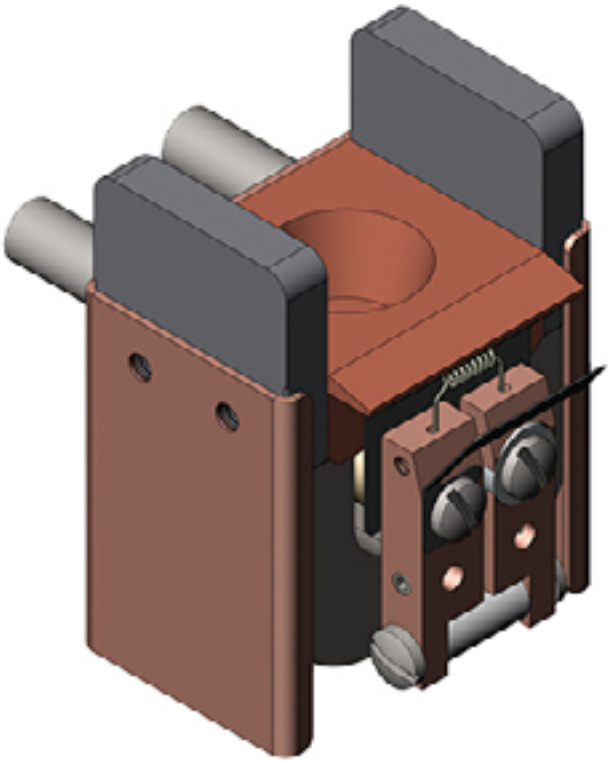
3 kW Evaporation Characteristics

Material	Power	Rate - Å min
Aluminum	100%	1260
Copper	100%	1220
Gold	100%	1550
Tantalum	100%	435
Molybdenum	100%	2290
Nickel	100%	2250
Tungsten	100%	590
Palladium	100%	750
Silver	100%	3000

All measurements were taken with the substrate 10” (25.4 cm) directly above the crucible.

100% power means 100% of the power required to bring the material to a molten state—not 3 kW of power

Thermionics developed and was the private-label manufacturer of many of Varian Associates’ single and multiple position 2- and 3-kW e-Guns and e-Gun power supplies. We maintain a stock of replacement parts of these Varian e-Guns and power supplies. If you need parts, service, or assistance, please call us. We will be glad to help you.



Model 100-0010

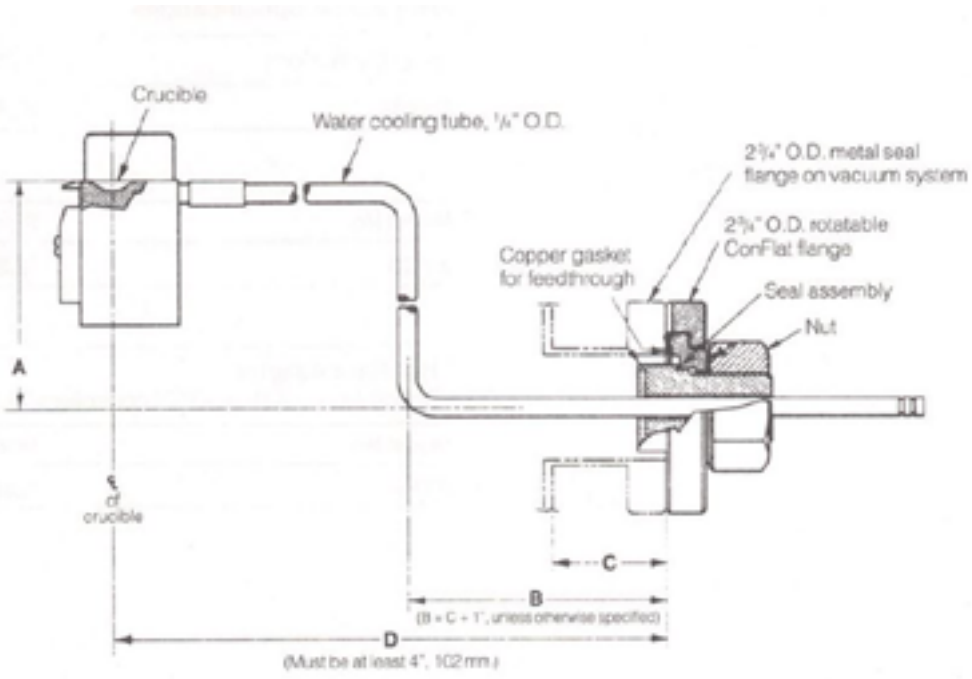
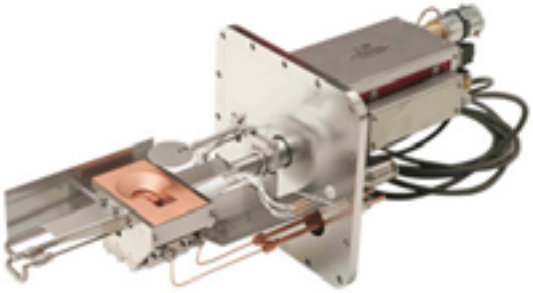
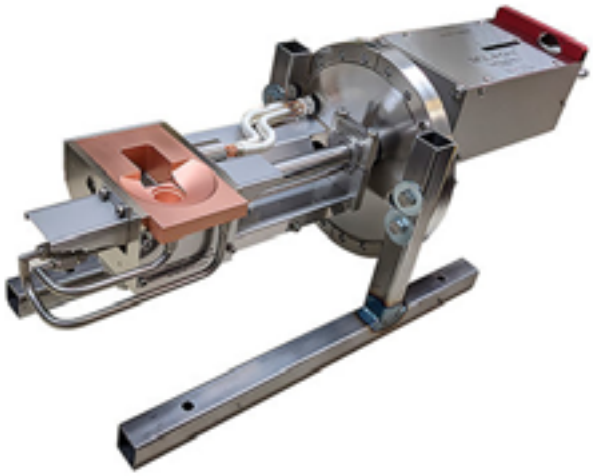


Fig. 4-4. Single crucible 3 kW e-Gun source, Model 100-0010.

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com





Model 100-0030

Standard Models

Model No.	Crucibles
100-0030	3
100-0040	4
100-0050	5

Specials

All multiple position e-Guns can be mounted on larger diameter ConFlat or rectangular PyraFlat flanges, single or back-to-back.

PyraFlat flanges are manufactured and protected under one or more of the following patents: 5,640,751; 4,685,193

Operation

The operating principle of the multiple crucible e-Gun is identical to the single crucible source with the following advantages:

- Large supply of evaporant — When every crucible is filled with the same source material, an increased volume of evaporant can be evaporated in a single vacuum cycle.
- Deposition of up to five different materials in one vacuum cycle — A different material can be put in each crucible and deposited in any sequence during a single vacuum cycle. The deposition rates are the same as those of the single crucible model. Only one crucible is heated at a time. The single filament remains stationary and the crucible head is indexed into position by the drive handle. Therefore, the evaporation always originates from exactly the same position in the vacuum chamber. The inactive crucibles are shielded from the heated crucibles by the magnetic pole pieces, thereby eliminating contamination between crucibles.

UHV Compatible

Metal-sealed, fully UHV compatible, measured base pressure: 2 x 10^{-11} Torr.

Specifications

Operating pressure	Below 5 x 10^{-5} Torr is desirable for best operation
Beam voltage	4000 V
Beam current	0 - 750 mA continuously variable
Maximum power	3,000W
Cooling water	1/2 gpm
Maximum bakeout temperature	230°C (446°F)
Feedthrough requirements	Two 7 kV 50 A
Crucible volume	2.24 cc

4 3 kW Multiple Position Linear e-Gun

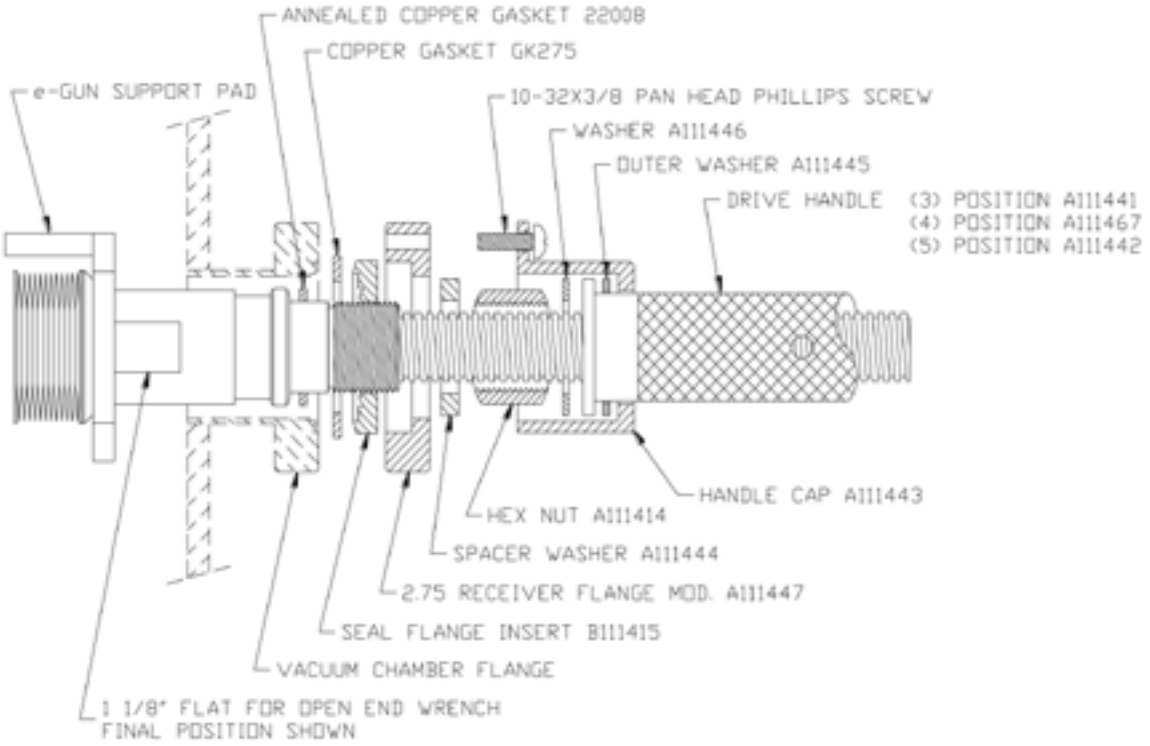


Fig. 4-5. 3 kW e-Gun source, model 100-0030.

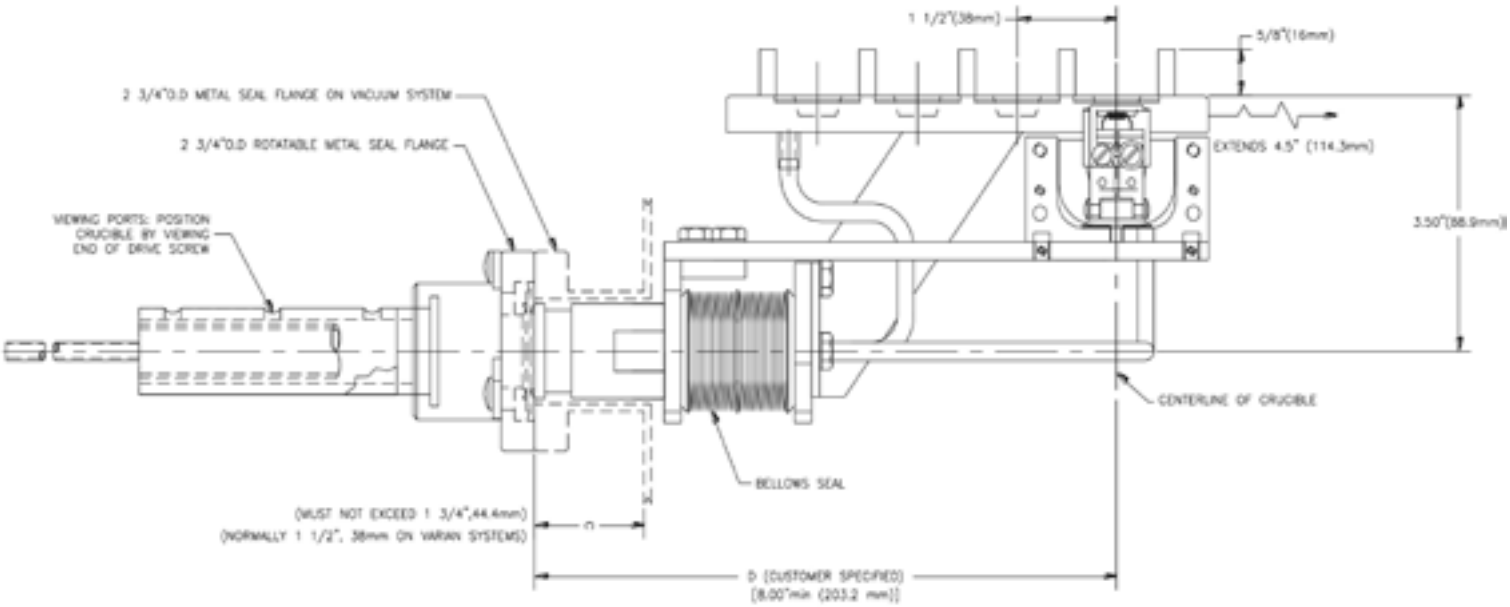


Fig. 4-6. 3 kW e-Gun source, Model 100-0050.

Introduction

The operation of the 3 kW rod-fed e-Gun is unique. The evaporant source material, in the form of a rod up to a 1/4" in diameter, is fed continuously into the crucible using an external linear feedthrough. Film thickness may be controlled using a rate monitor.

The e-Guns are available mounted on various flanges.

Mounting and Configurations

- The 3 kW rod-fed e-Gun may be mounted and operated in any orientation, including upside down (which is material dependent)
- The rod-fed e-Gun shown in the photo on the right can fit through a 2.5" I.D. tube
- An optional cryoshroud to surround the e-Gun is available
- Multiple rod-fed e-Guns can be mounted side- by-side
- Custom designs are available, please consult the factory

Knudsen Cell Replacement

e-Guns can evaporate difficult materials, i.e.: carbon, niobium, and silicon.

A rod-fed e-Gun, complete with all the necessary utility and mechanical feedthroughs, installed on a 4.5" O.D. ConFlat mounting flange, is available as a direct replacement for existing Knudsen Cell furnaces on Varian/Intevac, Perkin-Elmer, Riber, EPI, and VG systems.

Please call to discuss your specific application requirements.

UHV Compatible

Metal-sealed, fully UHV compatible, measured base pressure: 2 x 10^{-11} Torr.

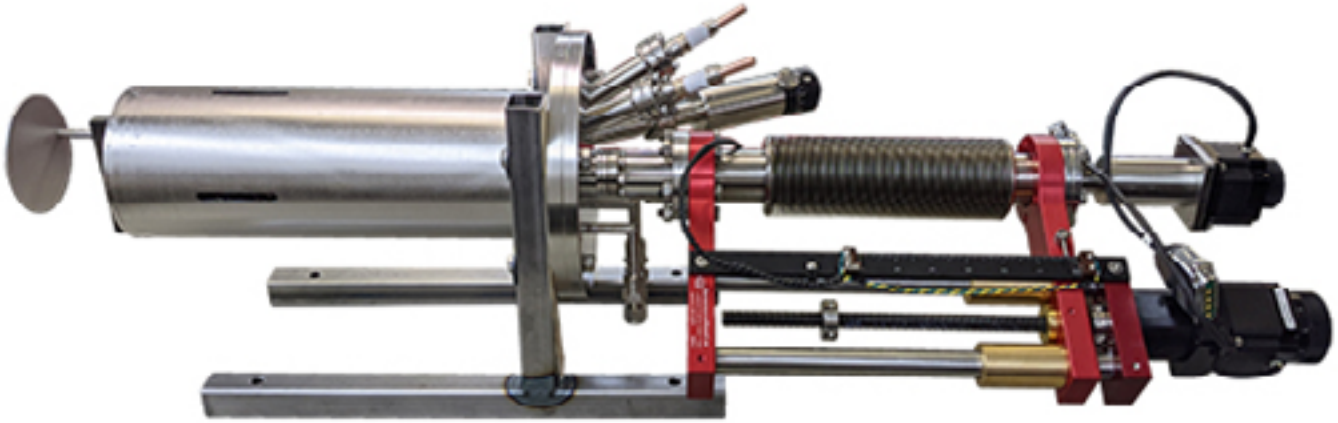
Model No.	Description
100-0010R	Rod-fed e-Gun only
100-0010R/SK	Rod-fed e-Gun with all utility, electrical and mechanical feedthroughs

Specifications

Operating pressure	Below 5 x 10^{-5} Torr is desirable for best operation
Beam voltage	4000 V
Beam current	0 - 750 mA continuously variable
Maximum power	3 kW @ 4 kV
Cooling water	1/2 gpm
Maximum bakeout temperature	230°C (446°F)
Feedthrough requirements	Two 7 kV 50 A
Crucible volume	1/4" dia rod
e-Gun size	2.50"h x 1.94"w x 1.69"d

3 kW Rod-Fed e-Gun

Rod-Fed e-Gun with motorized material feed and azimuthal material rotation.



Custom Special Rod-Fed e-Gun

4 3 kW Accessories

Replacement Parts

Model No.	Description
22001-1	Ceramic insulator (6-32 x 3/8" dia x 3/4" length)
22001-2	Ceramic insulator (6-32x 1/4" dia x 1/2" length)
22009	Ceramic washer
21040	3 kW emitter assembly (includes filament assembly two filaments, legs, hardware set, magnet, cathode shield, overspray shield, and two flange gaskets)
21015	Filament (.015 dia tungsten)
21007-1	Filament leg—neutral
21007-2	Filament leg—insulated
22013	Hardware set (includes all screws, ceramics and shims)
21005	Magnet
21011	Cathode shield
21013	Overspray shield
22008	Copper flat gasket (vacuum annealed), each
22015	Remote potentiometer with amphenol connector
310-6A18-1P	Shorted plug
310-990009	Diode pack

Sweep

Model No.	Description
XYS	X-Y beam sweep controller (see page 4-12 for specifications)
XYCS	Circular beam sweep controller (see page 4-12 for specifications)
180-1030	Beam adjust (requires 150-0030 or 150-0040)
180-8384	Set of two coils for multi-position guns
180-8385	Set of two coils for single-position guns

Accessories

Model No.	Description
210-SW	Water interlock switch for all e-Guns
PS-GA	Grounding rod

Feedthroughs and Connectors

Model No.	Description
B111136-07	Two electrical feedthroughs mounted on a 2.75" ConFlat flange, 7 kV @70 A (use with connector/cable assembly HVC-D-12) Note: Please consult the factory for power supply installation information.
HVC-D-12	Dual feedthrough connector with interlock and 10' dual cable assembly (use with dual feedthrough B111136-07)
8111137	One electrical feedthrough mounted on a 2.75" ConFlat flange, 7 kV@ 70 A, two are required for each e-Gun (use with connector/cable assemblies HVC-T-12 and HVC-V-12)
8111138	One electrical feedthrough mounted on a 1.33" ConFlat flange, 7 kV@ 70 A, two are required for each e-Gun (use with connector/cable assemblies HVC-T-12 and HVC-V-12)
HVC-T-12	Single feedthrough connector and 10' cable assembly, two are required for each e-Gun (use with single feedthroughs B111137 and B111138)
HVC-V-12	Single feedthrough connector and 10' cable assembly, two are required for each e-Gun (use with single feedthroughs B 111137 and B 111138), for Varian power supplies
A111489	Feedthrough connector, internal 1/4" rod to 10-32 screw connector
A086190	Feedthrough connector, internal 1/4" rod to 0.090" wire

See page 4-8 for instrumentation and other feedthroughs

e-Gun Crucible Liners

(1) Please consult the factory if there is a special material that you need or
(2) if you are unsure which liner fits your gun, we will send you a template.

Single Crucible, Single Position
(60° wall angle)

Material	Model No.
Graphite	111455-G
Glassy Carbon	111455-CG
Fabmate	111455-FM
Tantalum	111455-TA
Alumina	111455-AL
Molybdenum	111455-MO
Tungsten	111455-W
Boron Nitride	111455-BN

Multiple Crucible, 3 and 5 Position
(60° wall angle, old style)

Material	Model No.
Graphite	111449-G
Glassy Carbon	111449-CG
Fabmate	111449-FM
Alumina	111449-AL
Molybdenum	111449-MO
Tungsten	111449-TA
Boron Nitride	111449-BN

Multiple Crucible, 3 and 5 Position
(New style 15° wall angle)

Material	Model No.
Graphite	111460-G
Glassy Carbon	111460-CG
Fabmate	111460-FM
Alumina	111460-TA
Molybdenum	111460-AL
Tungsten	111460-MO
Boron Nitride	111460-W

4 kW High Voltage Power Supplies

Power Supply Remote Control

Features

- All solid-state switch mode design
- Rugged well overrated IGBT inverter for superior reliability
- Extensive ARC management for outstanding performance: fastest ARC recovery, ARC counter and ARC duration sensor
- Constant emissions regulation
- Full remote operation from PLC or optional handheld for both high voltage and source
- 19-inch rack mountable, ultra-compact chassis
- Air cooled

Power Supply Specifications

Input power	208 or 400 VAC
Output, high voltage	-0kV to -8 kV
Output, current	500 mA
Response Time	<50 microseconds
Source Filament	50 A max @ 8 VAC
Process Control Votage	+10 VDC
e-Gun filament leads	10 ft
Remote control cable	15 ft
Panel space	19"w x 8.7"h x 21.9"d
Weight	100 lbs

4 kW Power Supply and Sweep Controllers

Model No.	Description
SVA-4	4 kW power supply
DSC-1.5A	Digital Sweep Controller (see page 4-12 for specifications)
PSC-1.5A	Programmable Sweep Controller (see page 4-13 for specifications)

4 kW Power Supply

4 6 kW High Voltage Power Supplies

Power Supply Remote Control

Features

- All solid-state switch mode design
- Rugged well overrated IGBT inverter for superior reliability
- Extensive ARC management for outstanding performance: fastest ARC recovery, ARC counter and ARC duration sensor
- Constant emissions regulation
- Full remote operation from PLC or optional handheld for both high voltage and source
- 19-inch rack mountable, ultra-compact chassis
- Air cooled

Power Supply Specifications

Input power	208 or 400 VAC
Output, high voltage	-0kV to -10 kV
Output, current	600 mA
Response Time	<50 microseconds
Source Filament	50 A max @ 8 VAC
Process Control Votage	+10 VDC
e-Gun filament leads	10 ft
Remote control cable	15 ft
Panel space	19"w x 8.7"h x 21.9"d
Weight	100 lbs

6 kW Power Supply and Sweep Controllers

Model No.	Description
SVA-6	6 kW power supply
DSC-1.5A	Digital Sweep Controller (see page 4-12 for specifications)
PSC-1.5A	Programmable Sweep Controller (see page 4-13 for specifications)

6 kW Power Supply

Power Supply Remote Control

Features

- All solid-state switch mode design
- Rugged well overrated IGBT inverter for superior reliability
- Extensive ARC management for outstanding performance: fastest ARC recovery, ARC counter and ARC duration sensor
- Constant emissions regulation
- Full remote operation from PLC or optional handheld for both high voltage and source
- 19-inch rack mountable, ultra-compact chassis
- Air cooled

Power Supply Specifications

Input power	208 or 400 VAC
Output, high voltage	-0kV to -10 kV
Output, current	800 mA
Response Time	<50 microseconds
Source Filament	50 A max @ 8 VAC
Process Control Votage	+10 VDC
e-Gun filament leads	10 ft
Remote control cable	15 ft
Panel space	19"w x 8.7"h x 21.9"d
Weight	100 lbs

8 kW Power Supply and Sweep Controllers

Model No.	Description
SVA-8	8 kW power supply
DSC-1.5A	Digital Sweep Controller (see page 4-12 for specifications)
PSC-1.5A	Programmable Sweep Controller (see page 4-13 for specifications)

8 kW Power Supply

4 10 kW High Voltage Power Supplies

Power Supply Remote Control

Features

- All solid-state switch mode design
- Rugged well overrated IGBT inverter for superior reliability
- Extensive ARC management for outstanding performance: fastest ARC recovery, ARC counter and ARC duration sensor
- Constant emissions regulation
- Full remote operation from PLC or optional handheld for both high voltage and source
- 19-inch rack mountable, ultra-compact chassis
- Air cooled
- Control up to two (2) e-Gun sources

Power Supply Specifications

Input power	208 or 400 VAC
Output, high voltage	-0kV to -10 kV
Output, current	1000 mA (1 A)
Response Time	<50 microseconds
Source Filament	50 A max @ 8 VAC
Process Control Votage	+10 VDC
e-Gun filament leads	10 ft
Remote control cable	15 ft
Panel space	19"w x 8.7"h x 25.7"d
Weight	100 lbs

10 kW Power Supply and Sweep Controllers

Model No.	Description
SVA-10	10 kW power supply
DSC-1.5A	Digital Sweep Controller (see page 4-12 for specifications)
PSC-1.5A	Programmable Sweep Controller (see page 4-13 for specifications)

10 kW Power Supply

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Power Supply Remote Control

Features

- All solid-state switch mode design
- Rugged well overrated IGBT inverter for superior reliability
- Extensive ARC management for outstanding performance: fastest ARC recovery, ARC counter and ARC duration sensor
- Constant emissions regulation
- Full remote operation from PLC or optional handheld for both high voltage and source
- 19-inch rack mountable, ultra-compact chassis
- Air cooled
- Control up to two (2) e-Gun sources

Power Supply Specifications

Input power	208 or 400 VAC
Output, high voltage	-0kV to -10 kV
Output, current	1200 mA (1.2 A)
Response Time	<50 microseconds
Source Filament	50 A max @ 8 VAC
Process Control Votage	+10 VDC
e-Gun filament leads	10 ft
Remote control cable	15 ft
Panel space	19"w x 8.7"h x 25.2"d
Weight	100 lbs

12 kW Power Supply and Sweep Controllers

Model No.	Description
SVA-12	12 kW power supply
DSC-1.5A	Digital Sweep Controller (see page 4-12 for specifications)
PSC-1.5A	Programmable Sweep Controller (see page 4-13 for specifications)

12 kW Power Supply

4 Training Classes

General Outline of One-Day Practical and Theoretical Training for e-Gun Technology

I. Physical Components

1. Crucible
   A. Water Passage
   B. Turbulence Sheet Flow
   C. Water Pressure
2. Emitter Theory
   A. Filament
   B. Anode
   C. Beam Former
   D. Space Charge Effects

II. Magnetic Field and Field Effects

1. Permanent Magnet
   A. Bar Magnet
   B. Modular Magnet
   C. Various Other Types of Magnets
2. Pole Piece
   A. Materials
   B. Hysteresis and Saturation
3. Beam Trajectory
   A. Flat or High
   B. Curvature of Radius of Electron
   C. How the Magnetic Field Effects the Electrons
4. X-Y Sweep
   A. High Frequency

III. Rate Power Definition

1. Rate Power Curve Phenomena
2. Tight Beam
3. Diffused Beam

IV. Al-Cu Deposition Problems

1. Erosion
2. Thermal Shorts

V. Summary

VI. Questions and Answers

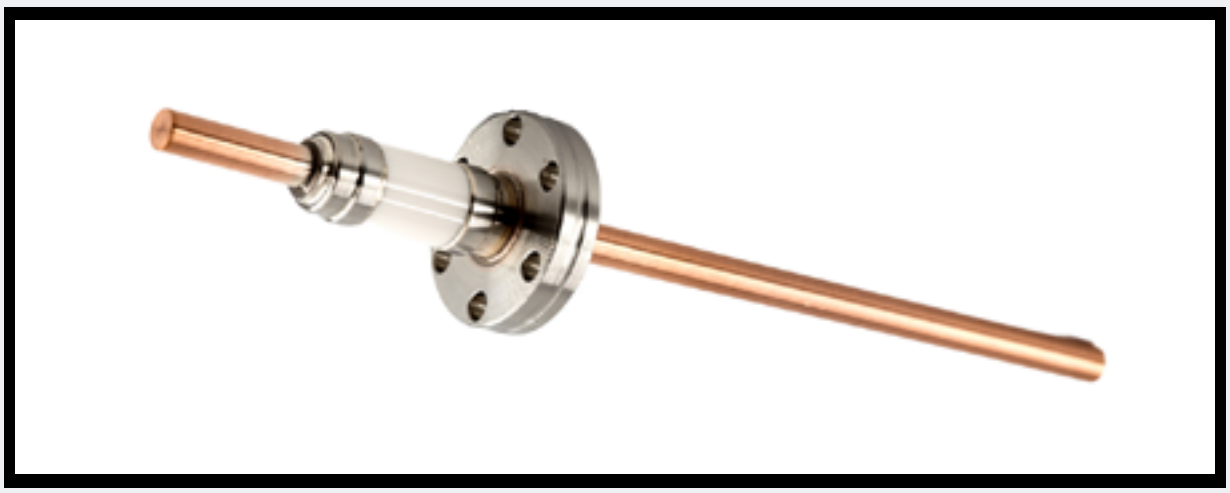
Scheduled Classes:

Call factory for class schedules

Special classes at your plant on request

The information in the tables has been compiled from a number of sources, some of which may be out of date. Should you find an error or be able to add new information, please contact us. **A MORE COMPLETE LIST CONSISTING OF OVER 167 MATERIALS IS AVAILABLE UPON REQUEST.**

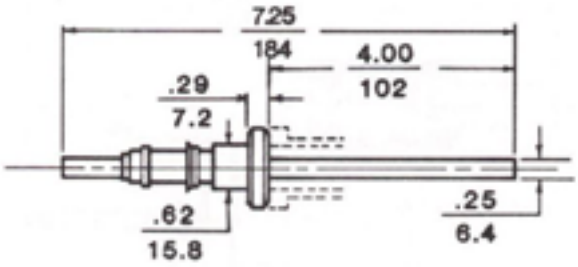
				Temperature (°C) at Vap. Press.			Evaporation Techniques					
Name	Symbol	Melting Point °C	Density gm/cm³	10^{-8} Torr	10^{-6} Torr	10^{-4} Torr	Electron Beam	Crucible	Coil	Boat	Basket	Remarks
Aluminum	Al	660	2.7	677	812	1010	Xlnt.	ZrB_2BN Vit. Carbon	W	TiB_2BN Al_2O_3	W	Alloys and wets, Tungsten-stranded
Aluminum Carbide	Al_4C_3	1400	2.4			~800	Fair					
Aluminum Fluoride	AlF AlF_3	Subl.	2.9	410 Sublimes	490 Sublimes	700 Sublimes	Poor		W Ta			Loses Fluorine. Disproportionates.
Aluminum Nitride	AlN	Subl.	3.3			~1750	Fair					Decomposes.
Alumina (a)	Al_2O_3	2020	4.0	1045	1210	1325	Xlnt.	W	W	W	W	Sapphire Xlnt. in EB, Chemically deposit, Index may change.
Antimony	Sb	630	6.7	279	345	425	Poor	Al_2O_3	Mo Ta	Mo, Ta Al_2O_3 Coated	Mo Ta	
Antimony Trioxide	Sb_2O_3	656	5.2			~300	Good	Al_2O_3		Pt Al_2O_3 Coated	Pt	Toxic.
Antimony Trisulphide	Sb_2S_3	550	4.6			~200				Mo Ta	Mo Ta	
Arsenic	As	814	5.7	107 Sublimes	150 Sublimes	210 Sublimes	Poor	Al_2O_3 BeO Vit Carbon		C		Sublimes rapidly at low temperature, toxic.
Arsenic Selenide	As_2Se_3	360	4.5					Quartz				
Barium	Ba	725	3.5	545	627	735	Fair		W	W Ta Mo	W	Wet without alloying. Reacts with ceramics.
Barium Fluoride	BaF_2	1280	4.9			~700						
Barium Oxide	BaO	1923	5.7			~1200	Poor			Pt	Pt	
Barium Titanate	$BaTiO_3$	Dec.	6.0		Decomposes							Decomposes. Yields free Ba from Titanate single source-evaporate from two sources, flash from superheated W.
Beryllium	Be	1278	1.9	710	878	1000	Xlnt.	BeO C Vit Carbon	W	W Ta Mo	W	Wets W/Mo/Ta, Oxides are toxic.
Beryllium Fluoride	BeF_2	Subl.	2.0			~200	Good					Toxic.
Beryllium Oxide	BeO	2530	3.0			~1900	Good				W	Powders toxic.
Bismuth	Bi	271	9.8	330	410	520	Good	Al_2O_3 Vit Carbon	W	W, Mo Al_2O_3 Ta	W	Vapors are Toxic. High resistivity. No shorting of baskets
Bismuth Fluoride	BiF_3	727	5.3									
Bismuth Oxide	Bi_2O_3	820	8.9			~1400	Poor				Pt	Vapors are toxic.
Bismuth Selenide	Bi_2Se_3	710	6.8				Good	Quartz				
Bismuth Telluride	Bi_2Te_3	585	7.9					Quartz		W Mo		
Bismuth Titanate	$BiTi_2O_7$				Decomposes							Decomposes, evaporate from two sources.
Bismuth Trisulphide	Bi_2S_3	685	7.5									



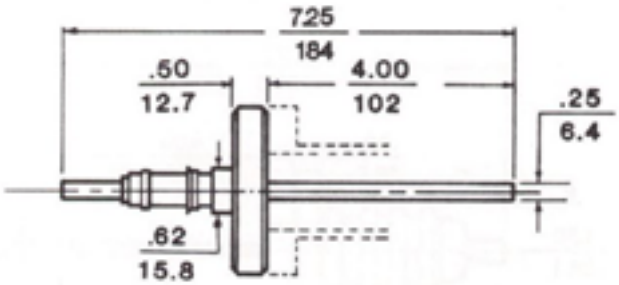
Electrical and Fluid Feedthroughs

Electrical Feedthroughs

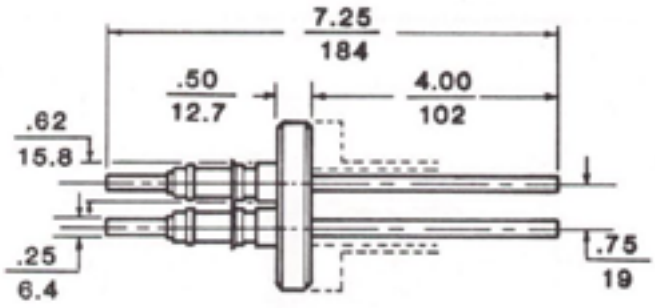
Fluid Feedthroughs



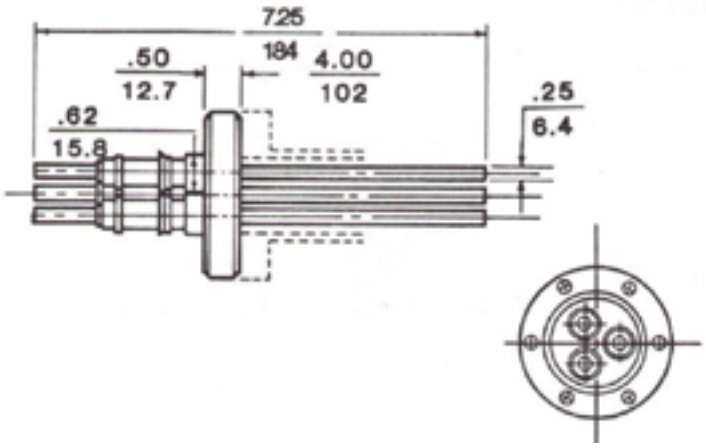
FMC-133-1



FMC-275-1



FMC-275-2



FMC-275-3

These feedthroughs are used in a variety of applications where a significant amount of power is to be transferred into a vacuum system. The feedthrough conductors are available in two styles, solid and hollow tube. The tube option (Model No. suffix "T") allows for water cooling or special coaxial construction.

General Specifications

	FMC
Max. current	150 A solid 1/4" rod 10 A 1/4" tube (0.032 wall)
Max. voltage	7,000 V
Conductor	Copper
Temperature range	-200°C to 450°C
Max. rate of change	25°C/min

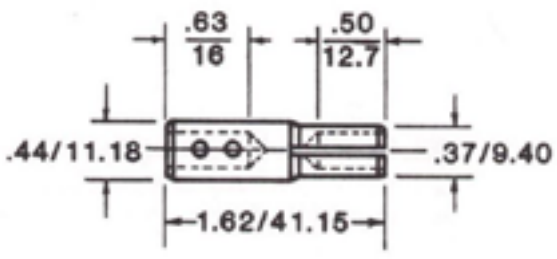
Ordering Information — Medium Current Ultra High Vacuum Electrical Feedthroughs

Flange Size	Conductor	No. of Conductors	Model No.
1.33" O.D	Rod	1	FMC-133-1
2.75" O.D.	Rod	1	FMC-275-1
2.75" O.D.	Rod	2	FMC-275-2
2.75" O.D.	Rod	3	FMC-275-3
2.75" O.D.	Rod	4	FMC-275-4
1.33" O.D	Tube	1	FMC-133-1T
2.75" O.D.	Tube	1	FMC-275-1T
2.75" O.D.	Tube	2	FMC-275-2T
2.75" O.D.	Tube	3	FMC-275-3T
2.75" O.D.	Tube	4	FMC-275-4T

Connectors

PMC-150 Internal Connector

- OFE copper, nickel plated
- 150 A
- 450°C max. temperature
- For 1/4" O.D. conductor
- Push-on connector



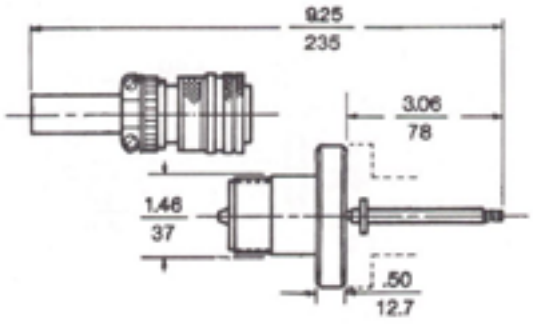
PMC-150

5 FHV Series High Voltage Electrical Feedthroughs

The FHV series feedthroughs provides HV access to the vacuum chamber. They include single or dual conductor models with mating exterior connector.

FHV12-275-1 High Voltage Feedthrough

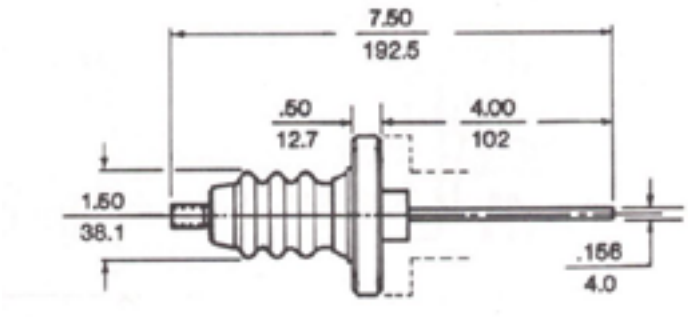
- 10 A
- 12,000 V (below 10^{-4} Torr)
- Temperature range: -200°C to 450°C, 25°C/min max. rate of change
- SS conductor
- 2.75" O.D. flange
- Internal attachment: 8-32 nut
- External connector supplied



FHV12-275-1

FHV28-275-1 High Voltage Feedthrough

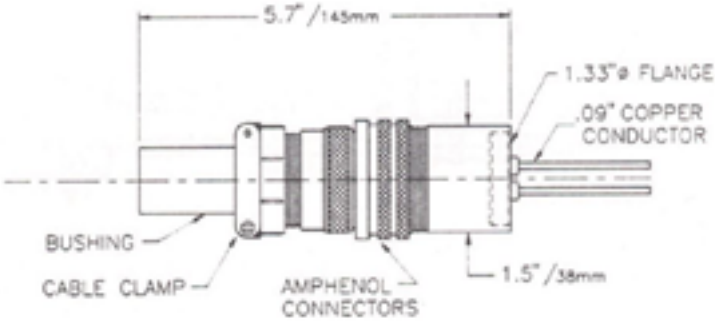
- 15 A
- 28,000 V (below 10^{-4} Torr)
- Temperature range: -200°C to 450°C, 25°C/min max. rate of change
- OFE copper conductor
- 2.75" O.D. flange
- Internal attachment: 4-40 nut
- External attachment: 1/4-28 nut



FHV28-275-1

FHV3-133-2 High Voltage Feedthrough

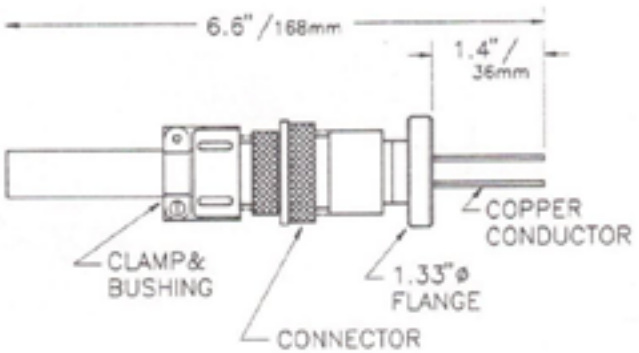
- 1.33" O.D. flange
  1.5" O.D. body cylinder
- 2 conductors (plus safety ground contact)
- Electrical ratings (with exterior connector):
  Max. current: 15 A
  Max. voltage: 3,000 VDC
- Environmental ratings (with connector detached):
  Temperature range: -200°C to 450°C
  Max. rate of change: 25°C/min
- Supplied with connector



FHV3-133-2

FHV.5-133-2 High Voltage Feedthrough

- 1.33" O.D. flange
- 2 conductors
- Electrical ratings (with exterior connector):
  Max. current: 10 A
  Max. voltage: 500 V
- Environmental ratings (with connector detached):
  Temperature range: -200°C to 450°C
  Max. rate of change: 25°C/min
- Supplied with connector



FHV.5-133-2

/EL45 Elbow Mount Option

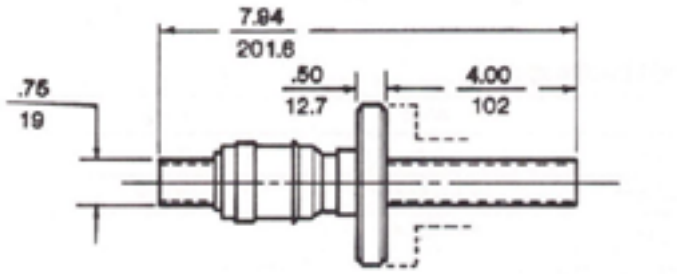
- For 1.33" O.D. mounted feedthroughs
- Angles connector or leads at 45° to flange polar axis
- Elbow installed between 1.33" O.D. flange and electrical feedthrough core

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

These feedthroughs provide high current path to the vacuum chamber. They include water cooled and solid conductor models.

FHC-275-1 High Current Feedthrough

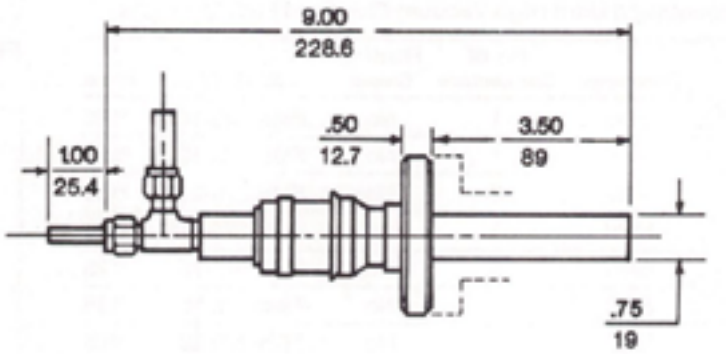
- 600 A
- 3,000 V (below 10^{-4} Torr)
- Temperature range: -200°C to 450°C, 25°C/min max. rate of change
- 3/4" O.D. OFE copper conductor
- 2.75" O.D. flange
- Internal and external attachment: use CMC-150



FHC-275-1

FHC-275-1T

- Same as FHC-275-1 except 3/4" O.D. copper tube conductor
- 100 A max.



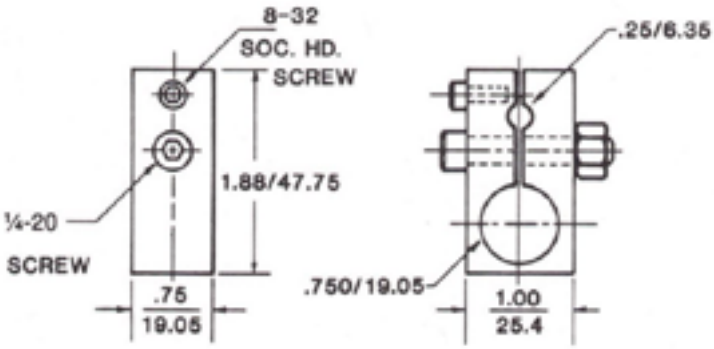
FHC-275-1WC

FHC-275-1WC
High Current Electrical Feedthrough

- Water cooled
- Conductor: 0.75" O.D. OFE copper with water channel
- Max. current: 1,600 A
- Max. voltage: 3.000 V below 1 x 10-4 Torr
- 2.75" O.D. flange
- Temperature range: -200°C to 450°C, 25°C/min max. rate of change

Connectors
CMC-150 Internal/External Connector

- OFE copper
- 450 A
- 450°C max. temperature
- For 3/4" O.D. to 1/4" O.D. conductor
- Clamp-on connector



CMC-150

5 FMH & FBN Instrumentation Series Electrical Feedthroughs

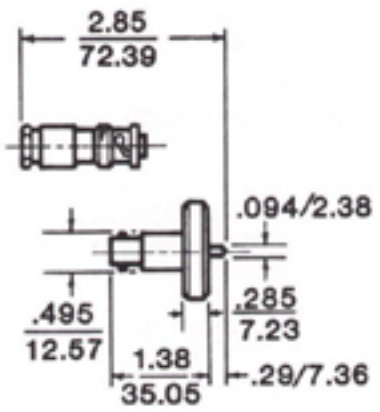
FMH and FBN series feedthroughs provide UHV feedthrough access for MHV and BNC cables.

General Specifications

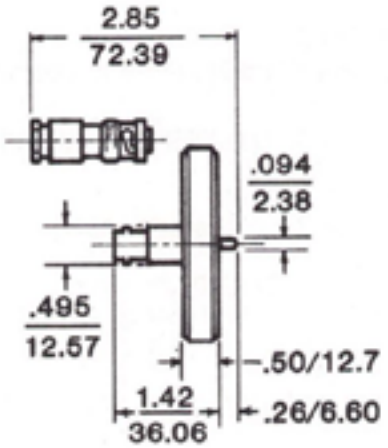
	MHV	BNC
Max. current	3 A	3 A
Max. voltage	5,000 V	500 V
Conductor	304 SS	304 SS
Temperature range	-200°C to 450°C	
Max. rate of change	25°C/min	
External connector	74868-932/U	74868UG-88/U

Ordering Information — Instrumentation Ultra High Vacuum Electrical Feedthroughs

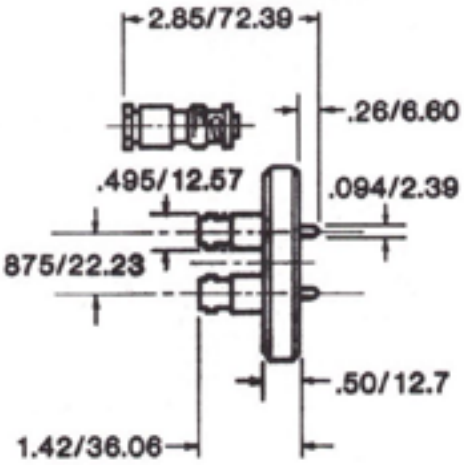
Flange Size	Conductor	No. of Conductors	Floating Shield	Model No.
1.33” O.D	MHV	1	No	**FMH-133-1C**
2.75” O.D.	MHV	1	No	**FMH-275-1C**
2.75” O.D.	MHV	2	No	**FMH-275-2C**
2.75” O.D.	MHV	1	Yes	**FMH-275-1CF**
1.33” O.D	BNC	1	No	**FBN-133-1C**
2.75” O.D.	BNC	1	No	**FBN-275-1C**
2.75” O.D.	BNC	2	No	**FBN-275-2C**
2.75” O.D.	BNC	1	Yes	**FBN-275-1CF**



FMH-133-1C

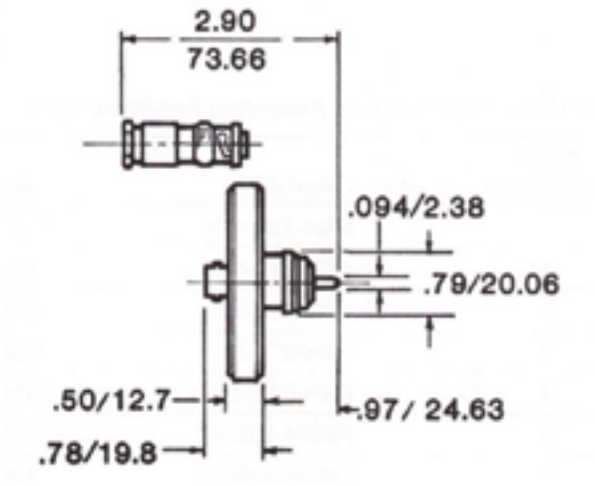


FMH-275-1C

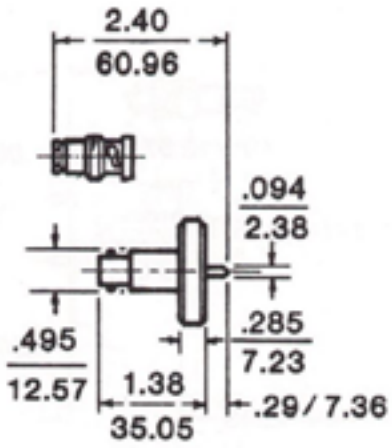


FMH-275-2C

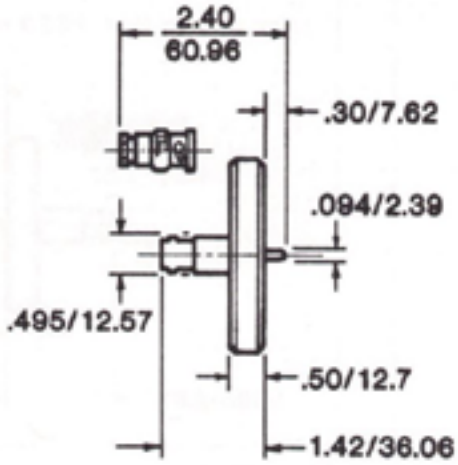
(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com



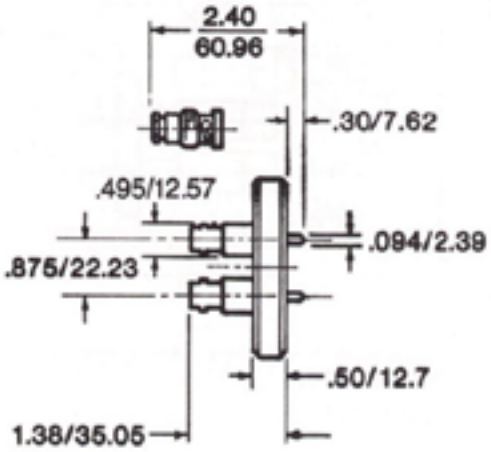
FMH-275-1CF



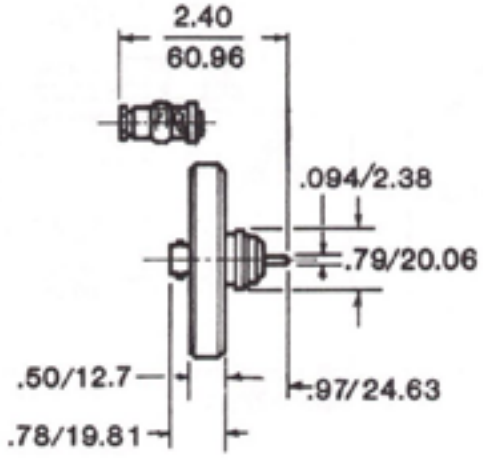
FBN-133-1C



FBN-275-1C



FBN-275-2C



FBN-275-1CF

5 FSH & FBSH Instrumentation Series Electrical Feedthroughs

FSH and FBSH series feedthroughs provide UHV feedthrough access for SHV and FBSH cables.

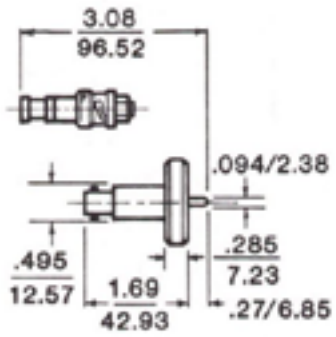
General Specifications

	MHV	BNC
Max. current	3 A	3 A
Max. voltage	5,000 V	7500 V
Conductor	304 SS	304 SS
Temperature range	-200°C to 450°C	
Max. rate of change	25°C/min	
External connector	Kings 1705-1	
Supplied with mating external connector		

Ordering Information — Instrumentation Ultra High Vacuum Electrical Feedthroughs

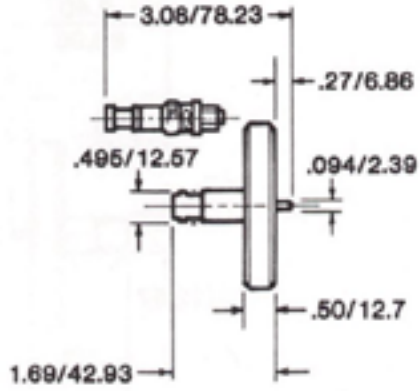
Flange Size	Conductor	No. of Conductors	Model No.
1.33" O.D	SHV	1	**FSH-133-1C**
2.75" O.D.	SHV	1	**FSH-275-1C**
2.75" O.D.	SHV	2	**FSH-275-2C**
2.75" O.D	SHV	3	**FSH-275-3C**
2.75" O.D.	SHV	4	**FSH-275-4C**
1.33" O.D	FBSH	1	**FBSH-133-1C**
2.75" O.D.	FBSH	1	**FBSH-275-1C**
2.75" O.D.	FBSH	2	**FBSH-275-2C**

SHV Mini Single Coax



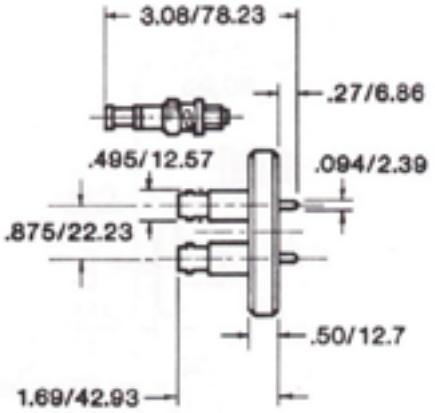
FSH-133-1C

SHV Single Coax



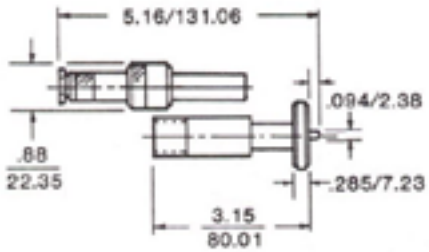
FSH-275-1C

SHV Dual Coax



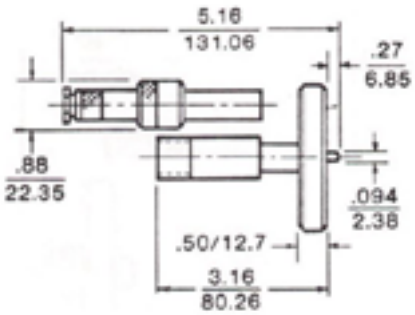
FSH-275-2C

FBSH Mini Single Bakeable Connector Coax



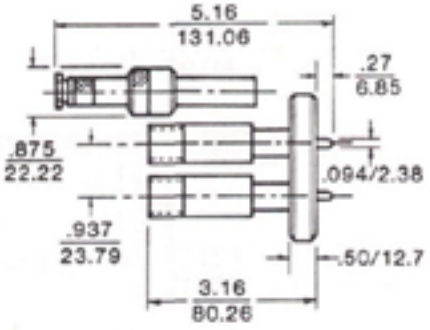
FBSH-133-1C

FBSH Single Bakeable Connector Coax



FBSH-275-1C

FBSH Dual Bakeable Connector Coax



FBSH-275-2C

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

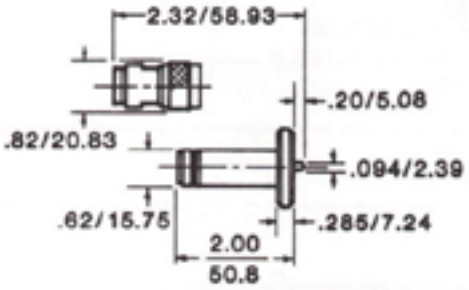
FIM series feedthroughs provide UHV feedthrough access for type N cables.

General Specifications

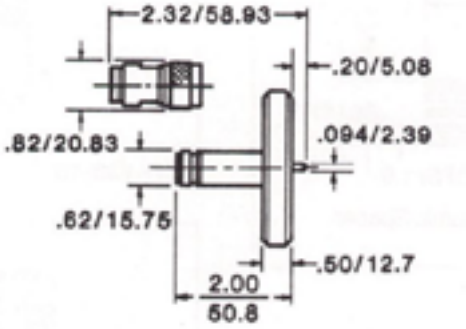
	FIM
Max. current	3 A
Max. voltage	5,000 V
Conductor	304 SS
Temperature range	-200°C to 450°C
Max. rate of change	25°C/min
External connector	74868-UG 21D/U
Supplied with mating external connector	

Ordering Information — Instrumentation Ultra High Vacuum Electrical Feedthroughs

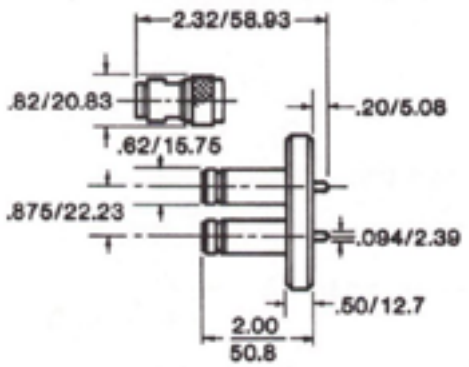
Flange Size	Conductor	No. of Conductors	Model No.
1.33" O.D	FIM	1	**FIM-133-1C**
1.33" O.D	FIM	1	**FIM-275-1C**
2.75" O.D.	FIM	2	**FIM-275-2C**



FIM-133-1C



FIM-275-1C



FIM-275-2C

5 Multi-Conductor Instrumentation Feedthroughs

FEP series feedthroughs provide UHV feedthrough access for multi-conductor instrumentation. All units are supplied with external connector and ceramic interior spacer (except 8 tube).

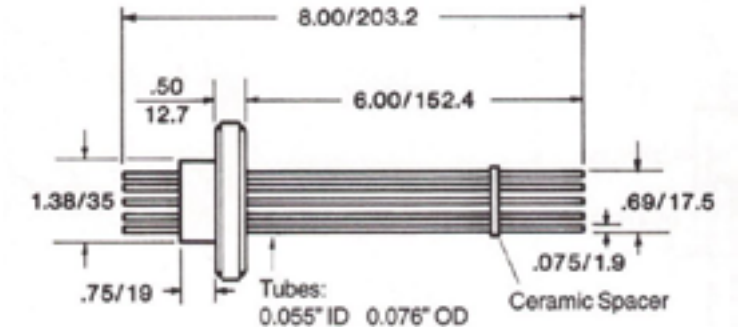
General Specifications

	FEP
Max. current	7 A per solid pin 2 A per tubular pin
Max. voltage	500 VAC, 700 VDC
Temperature range	-200°C to 450°C
Max. rate of change	25°C/min
External connector (10 pin)	MS 3106A-18-1S

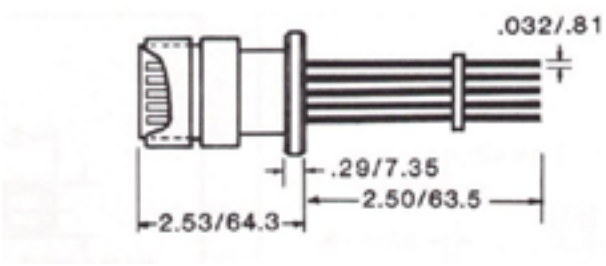
Ordering Information — Multi-Conductor Instrumentation Feedthroughs

Flange Size	Conductor	No. of Conductors	External Connector	Flange Model No.
2.75" O.D.	Tubular	8	No	**FEP-275-8T**
1.33" O.D.	Solid	10	Yes	**FEP-133-10**
2.75" O.D.	Solid	10	Yes	**FEP-275-10**
2.75" O.D.	Solid	20	Yes	**FEP-275-20**

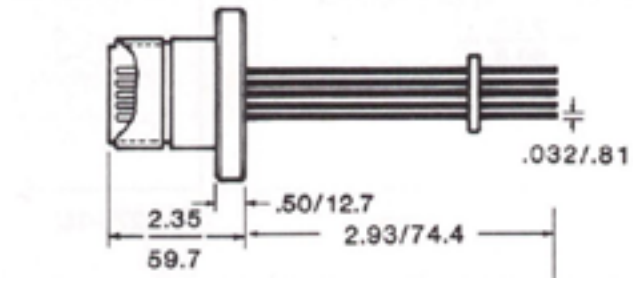
Supplied with external connector and internal ceramic spacer (except for the 8 pin tubular which is supplied without connector).



FEP-275-8T



FEP-133-10



FEP-275-20

Accessories

FEP-10C Connector

- External connector
- 10 pin, with cable grip
- Replacement for connectors supplied with FEP-275-10 feedthroughs above

FEP-20C Connector

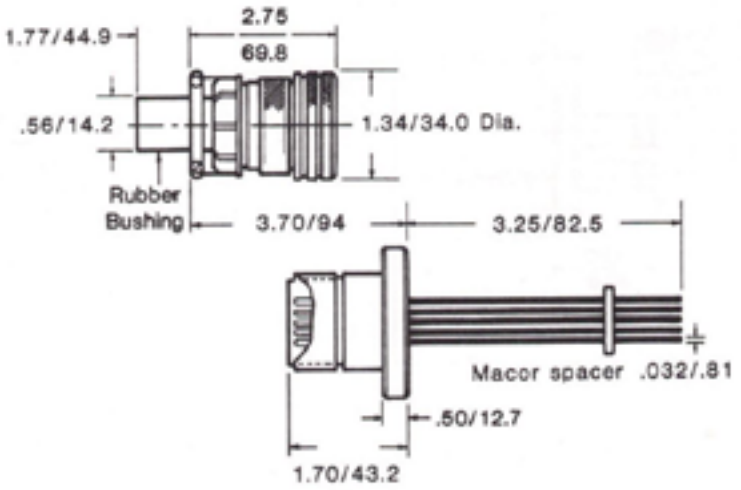
- External connector
- 20 pin with cable grip
- Replacement for connectors supplied with FEP-275-20 feedthroughs above

PLC-100 Internal Push-on Connectors

- For pins 0.032" dia, or less
- 200°C maximum temperature in vacuum
- 10 amps maximum current

PLC-150 Internal Push-on Connectors

- For pins 0.062" dia. or less
- 200°C maximum temperature in vacuum
- 15 amps maximum current



FEP-275-10

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

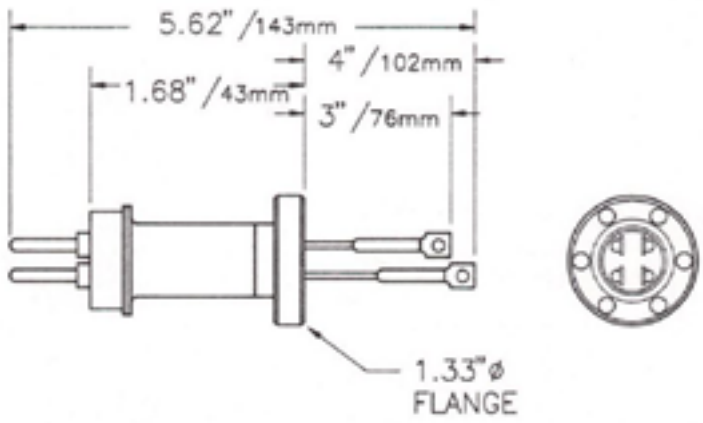
FETC series feedthroughs provide UHV feedthrough access for thermocouple instrumentation. All units are supplied with external connectors.

General Specifications

	FETC
Temperature range	-200°C to 450°C
Max. rate of change	25°C/min
External connector	Supplied
Type K	Chromel/alumel
Type C	Tungsten 5% Rhenium/tungsten 26% rhenium

Ordering Information — Thermocouple Instrumentation Feedthrough

Flange Size	Thermocouple Type	Number of Pairs	Model No.
1.33" O.D	K	1	**FETC-133-K**
1.33" O.D	K	2	**FETC-133-2K**
1.33" O.D	C	1	**FETC-133-C**
1.33" O.D	C	2	**FETC-133-2C**



FETC-133-2C

5 Film Thickness Monitor Feedthroughs

The FWCX series feedthroughs provide for electrical and cooling water transfer required for film thickness monitors.

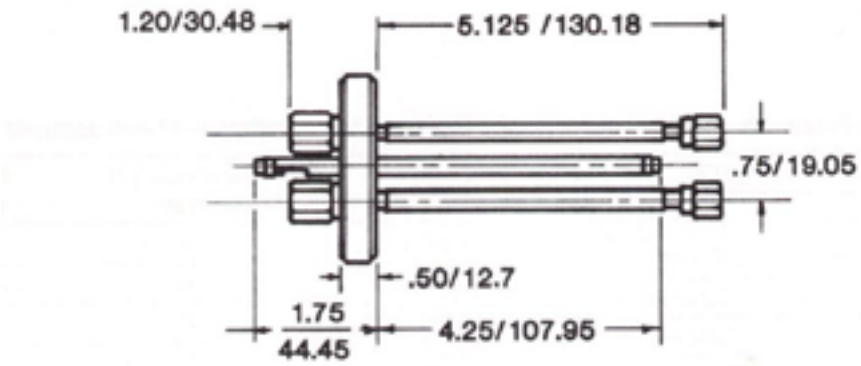
FWCX-275

Film Thickness Monitor Feedthrough

- 2.75” O.D. feedthrough
- Two water cooling lines, 1/4” O.D.
  External water connectors 1/4” female Swagelok
  Internal water connection 1/4” female Cajon 2VCR with mating connectors
- One electrical feedthrough
  Microdot 051-0049-0001 interior connector
  BNC exterior connector
- Max. temperature 125°C

FWCX-275/W

- Same as FWCX-275, but without water cooling connectors



FWCX-275

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

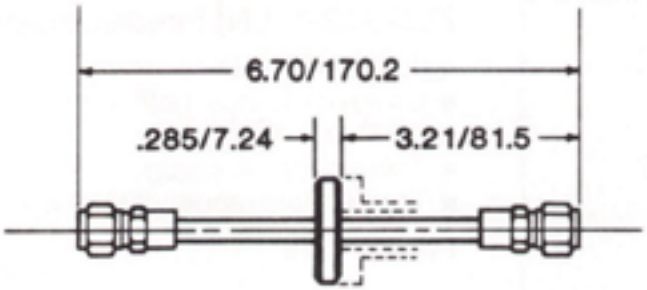
The FCW series feedthroughs provide for liquid transfer into UHV systems. Although they are capable of operation at cryogenic temperatures, they are designed for liquid and gas use at or above room temperature.

Temperature range for metal sealed units: -200°C to 450°C

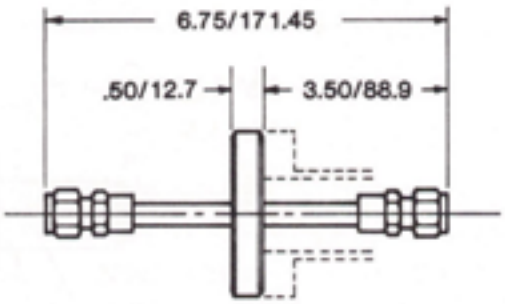
Ordering Information — Thermocouple Instrumentation Feedthrough

All metal sealed

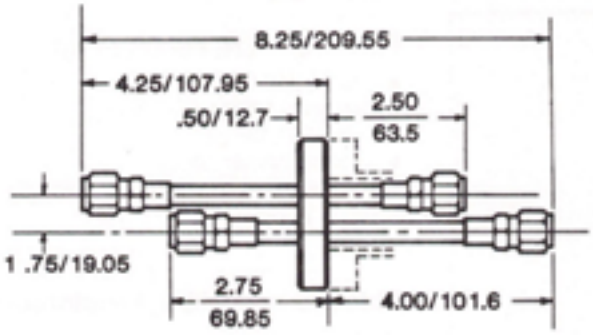
Flange Size	Tube O.D.	No. of Tubes	Tube Fittings	Model No.
1.33" O.D	1/4"	1	Swagelok	**FCW-133-1-25**
1.33" O.D	3/8"	1	Swagelok	**FCW-133-1-38**
2.75" O.D	1/4"	2	Swagelok	**FCW-275-2-25**
2.75" O.D	3/8"	1	Swagelok	**FCW-275-1-38**
2.75" O.D	3/8"	2	Swagelok	**FCW-275-2-38**



FCW-133-1-38



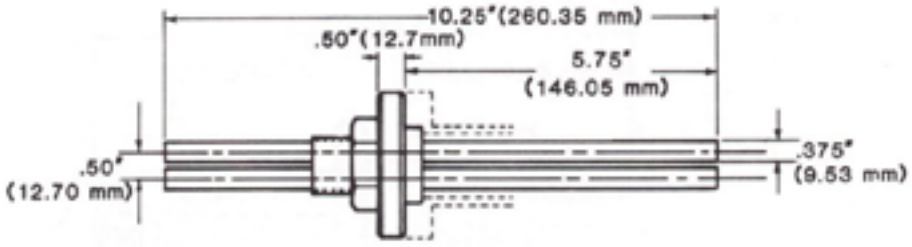
FCW-275-1-38



FCW-275-2-38

De-mountable Fluid Feedthroughs

- De-mountable from vacuum side
- Metal sealed mounting flange
- Viton elastomer de-mountable seal

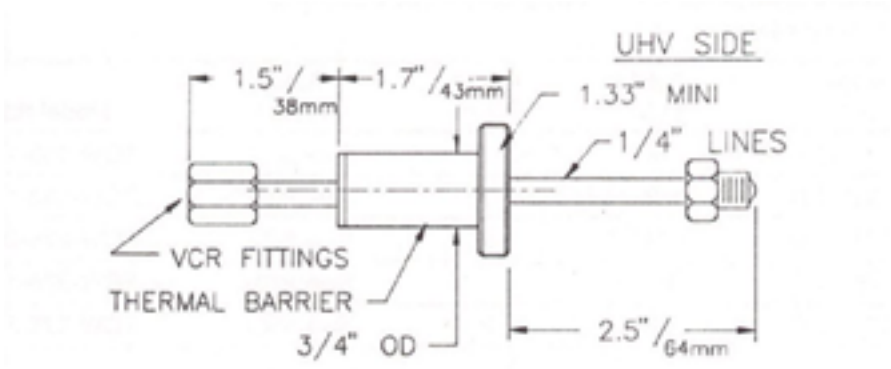


FCW-275-2D0/.38

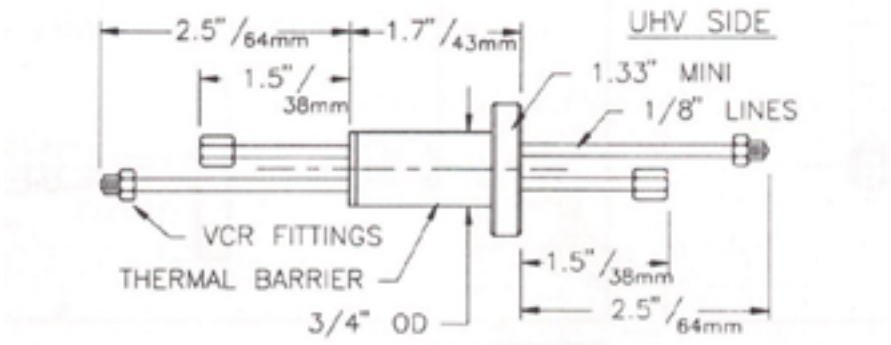
Ordering Information

Flange Size	Tube O.D.	No. of Tubes	Tube Fittings	Model No.
2.75" O.D	1/4"	2	None	**FCW-275-2DO/.25**
2.75" O.D	3/8"	2	None	**FCW-275-2DO/.38**

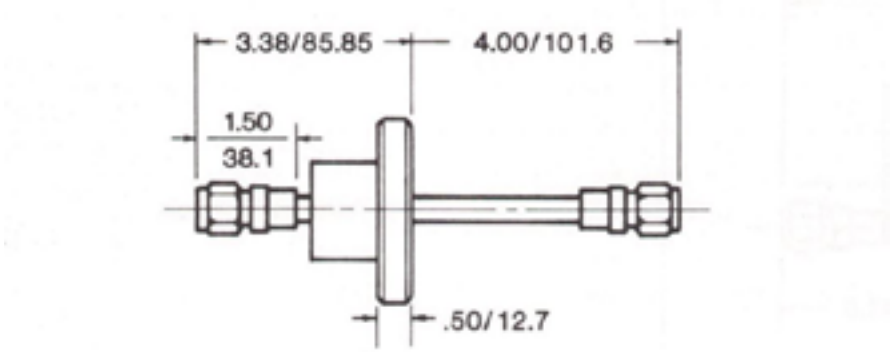
5 FLN Fluid UHV Feedthroughs



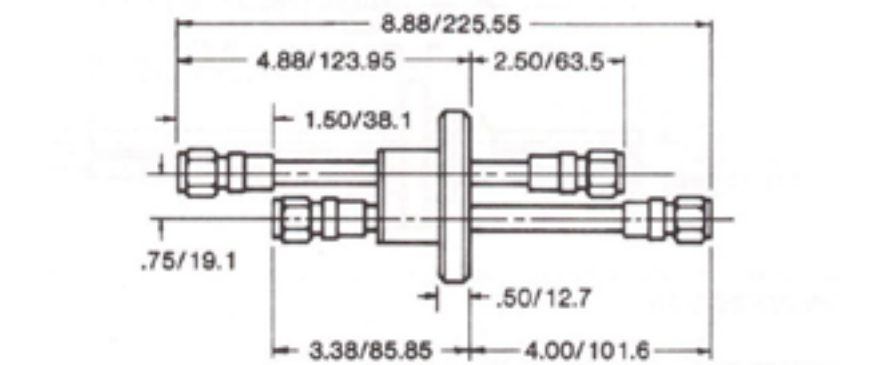
FLN-133-1



FLN-133-2



FLN-275-1



FLN-275-2

The FLN series feedthroughs provide for cryogenic and heated liquid transfer into UHV systems. All incorporate a thermal barrier design.

General Specifications

Temperature range	-200°C to 450°C
Thermal barrier design	
All metal sealed	

FLN-133-1 LN_2 Feedthrough

- 1 tube, 1/4" O.D.
- Swagelok fittings, both ends
- .33" O.D. flange
- Thermal barrier design
- Temperature range: -200°C to 450°C

FLN-133-2 LN_2 Feedthrough

- 2 tubes, 1/8" O.D.
- VCR fittings, both ends
- 1.33" O.D. flange
- Thermal barrier design
- Temperature range: -200°C to 450°C

FLN-275-1 LN_2 Feedthrough

- 1 tube, 3/8" O.D.
- Swagelok fittings, both ends
- 2.75" O.D. flange
- Thermal barrier design
- Temperature range: -200°C to 450°C

FLN-275-2 Dual LN_2 Feedthrough

- 2 tubes, 3/8" O.D.
- Swagelok fittings, both ends, both tubes
- 2.75" O.D. flange
- Thermal barrier design
- Temperature range: -100°C to 450°C

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

FLN-133-2D LN_2 Feedthrough

- 2 tubes, 1/8" O.D.
- VCR fittings, both ends
- 2.75" O.D. mounting flange
- 1.33" O.D. flange seal
  - Reverse (de-mountable) sealing
    - With jacking nut
    - Requires special mating flange
    - Allows removal of LN_2 tubing from inside the chamber
- Thermal barrier design
- Temperature range: -200°C to 450°C

FLN-275-2DM/.25 Dual Liquid Feedthrough, De-mountable

- 2 tubes, 1/4" O.D.
- 2.75" O.D. flange
- De-mountable
  - Metal sealed de-mountable
  - GK-212 copper gasket, supplied
- Temperature range: -100°C to 450°C
- Thermal barrier design

FLN-275-2DM/.375 Dual Liquid Feedthrough, De-mountable

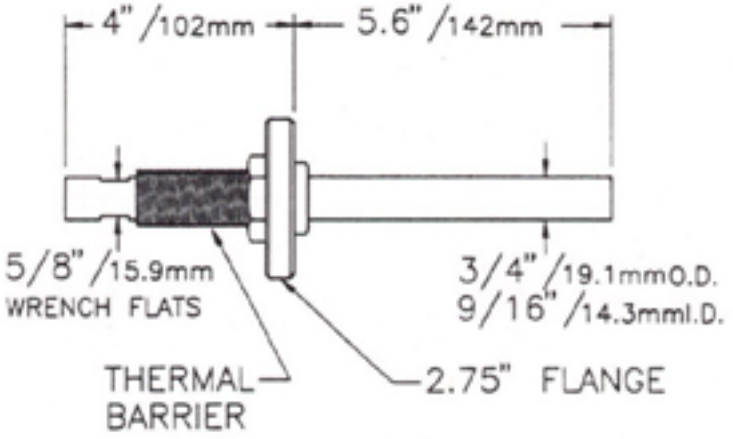
- 2 tubes, 3/8" O.D.
- 2.75" O.D. flange
- De-mountable
  - Metal sealed de-mountable
  - GK-212 copper gasket, supplied
- Temperature range: -100°C to 450°C
- Thermal barrier design

FLN-275-1DM/.75 Single Liquid Feedthrough, De-mountable

- 1 tubes, 3/4" O.D.
- 2.75" O.D. flange
- De-mountable
  - Metal sealed de-mountable
  - GK-212 copper gasket, supplied
- Temperature range: -200°C to 450°C
- Thermal barrier design

Re-entrant Seal

- Allows Dewar to be connected to atmosphere without in-vacuum VCR fittings
- Fits on 1.33" O.D. flange



FLN-275-1DM/.75

Ordering Information — Fluid UHV Feedthroughs

Flange Size	Tube O.D.	No. of Tubes	Tube Fittings	Model No.
1.33" O.D	1/8"	2	VCR	**FLN-133-2**
1.33" O.D	1/4"	1	Swagelok	**FLN-133-1**
2.75" O.D	3/8"	1	Swagelok	**FLN-275-1**
2.75" O.D	3/8"	2	Swagelok	**FLN-275-2**

De-mountable Fluid Feedthroughs

De-mountable from vacuum side

Flange Size	Tube O.D.	No. of Tubes	Tube Fittings	Model No.
1.33" O.D	1/8"	2	VCR	**FLN-133-2DM***
2.75" O.D	1/4"	2	Swagelok	**FLN-275-2DM-25**
2.75" O.D	3/8"	2	Swagelok	**FLN-275-2DM-38**
2.75" O.D	3/4"	1	None	**FLN-275-1DM/.75**

** Includes special mounting flange that must be welded into chamber wall.*

Instrumentation

Thermocouple Vacuum Gauges

(A gauge cross-reference guide, and specifications appear on page 6-2)
Nickel-plated steel construction and 1/8" NPT vacuum connection are standard

Model Number	Description/Application
TG-500M	Direct replacement for the Varian 531. Noble metal alloy thermocouple, excellent sensitivity and reproducibility. "Workhorse" for general use and easily calibrated for different gases.
TG-6343M	Fast response, long-term stability, low filament contamination under normal use. Very low supply current requirements. Applications include battery operation, implantation and plasma systems
TG-6343/004M	Same as TG-6343 except manufactured with tighter tolerances to achieve a high degree of repeatability from tube to tube
TG-7822M	Very stable response, MilSpec vibration resistance, low filament contamination rate
TG-600M	Direct replacement for Hastings DV-6M. Low heater current for low power controllers
TG-100	Extended range, low internal resistance, extended response time, ruggedized for harsh environments
TG-300M	Extended range, low internal resistance, extended response time, high tolerance version of TG-100
TG-400M	Extended range, good reproducibility at higher pressures. Applications: gas exposure systems, vacuum interlocks

Options

/xx	User-specified vacuum fitting connection (ConFlat flange, VCR gas fitting, ISO/KF fittings, quick-disconnect, etc.)
/KF-16	Gauge tube with ISO/KF-16 flange
/KF-25	Gauge tube with ISO/KF-25 flange
/SS	All stainless-steel construction — the thermocouple gauges above are available in stainless steel. To order, use the standard tube model number and add the suffix /SS, i.e.: TG-500M/SS. The complete price for each stainless-steel tube is

Thermocouple Tube

MATCHED™ TC Gauges

Every Thermionics thermocouple vacuum gauge tube is individually calibrated. Each tube is matched to perform as each and every other tube of the same model so tubes can be replaced without the need to recalibrate the gauge controller. Tubes from some manufacturers are not matched—every tube from Thermionics is **MATCHED™.**

Thermocouple Vacuum Gauges

- Each tube is individually calibrated
- Each tube is individually **MATCHED™.**
- MilSpec models
- Fast response time 1 second
- Operating range: 1 mTorr-atm
  Measuring range: 1 mTorr - 2,000 mTorr
- Reliable, rugged, and low cost
- O.E.M and quantity discounts
- Private labeling
- Strict quality control standards
- Interchangeable with other manufacturers tubes (see the table on the next page)
- Controllers for multiple gauges

Thermocouple vacuum gauges offer an economical method of vacuum pressure measurement with accuracy suitable for many monitoring and control applications as well as general laboratory use. Simplicity of operation, low cost and the inherent ruggedness of these gauges has led to their widespread general use for "time proven" dependability and zero maintenance.

Thermionics offers a wide range of thermocouple gauges to suit demanding scientific, industrial and process control applications. Three basic units offer a choice in cost, materials, and power supply requirements. Additional models are available to satisfy specialized ranges and operating conditions as well as provide interchangeability with other manufacturers' products.

All materials used in the tubes are vacuum compatible and satisfy moderate temperature and environmental requirements. Optional materials of construction are available to provide higher temperature excursions and greater resistance to environmental conditions.

We offer technical information and welcome consultation on the application of these gauges. Quantity discounts and private label packaging are available to OEM customers.

6 Thermocouple Gauges & Controllers

Cross Reference Guide Equivalency Table

(Consult the factory for cross reference for tubes not listed here)

Model Number	Ion Equip. Hughes	Hastings	Veeco	Varian/NRC	CVC	MKS	Granville-Phillips
TG-100			DV-1M				
TG-300M		DV-3M					
TG-400M		DV-4D	DV-4M				
TG-500M				531		TCIA	
TG-600M		DV-6M					270006
TG-6343M	TG-6343						
TG-6343/004M	TG-6343/004				GTC-004		
TG-7822M	TG-7822M						

M signifies that heater current, tube to tube is matched within 1% of scale. Shipping weight for all of the above tubes is 3/4 lb.

Thermocouple Gauge Operating Characteristics

Thermionics Model Number	Range, mTorr	Heater Current, mA	Nom. Cold Heater Resistance	Approx. mV Output at Atm.*	Heater Pins	TC Pins (Pos. 1st)
TG-100	0.1-100	130-150		1.50	3,5	1,7
TG-300M	0.1-100	130-150		1.50	3,5	1,7
TG-400M	0.1-20,000	40.0		1.40	3,5	1,7
TG-500M	0.1-2,000	165.0		2.10	1,7	3,5
TG-600M	0.1-1,000	20.0	1.5	1.85	1,7	5,3
TG-6343M	0.1-1,000	16.6	8.5	1.20	1,7	5,3
TG-6343/004M	0.1-1,000	16.4	8.5	1.00	1,7	5,3
TG-7822M	0.1-1,000	74.5	2.5	1.20	1,5	7,3

**Into a 55 ohm load. Output for all gauges at 0.1 mTorr is 10 mV. Gauge tubes fit Amphenol 78-PF8-11 or equal basing.*

NOTES
1. Gauge tubes are individually calibrated and marked with the heater current required to provide 10 mV output. This is done across 55 ohms when the gauge is under vacuum and pressure is lower than 1 x 10^{-4} Torr.
2. For the TG-6343/004M high tolerance tube the calibration settings are 9.6 mV at 16.4 mA.

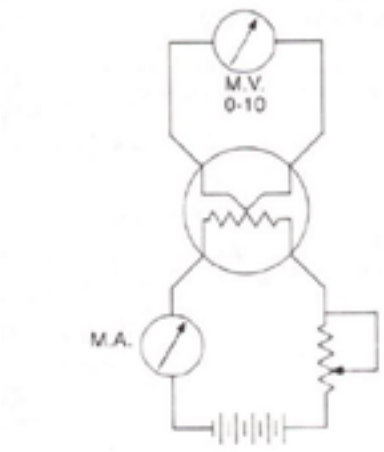


Fig. 6-2. Typical circuit.

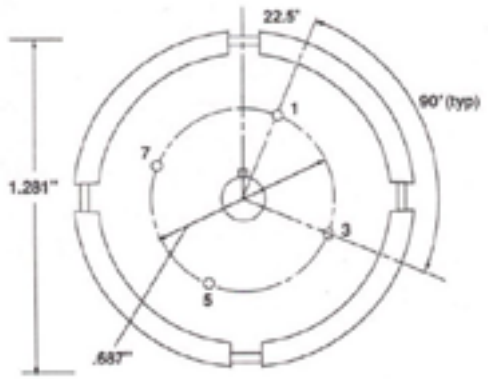
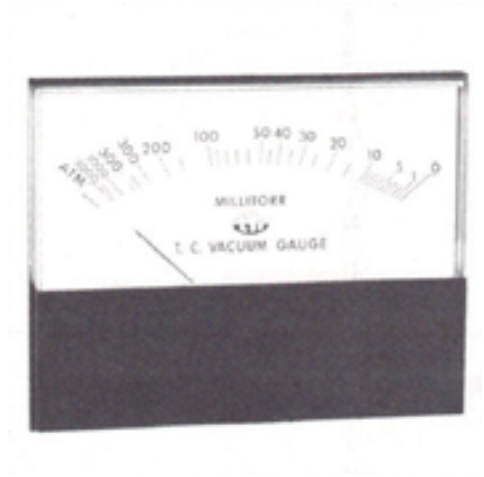


Fig. 6-3. Physical outline.

Reference Tubes

References tubes are used for the calibration of thermocouple vacuum gauge controllers or other measuring electronics. They provide an output which mimics the normal tube performance at a given pressure and therefore are a fast, accurate means of calibrating electronics or troubleshooting system functions. Standard models come factory set to 10 mV output with the appropriate tube current input.

Model Number	Description
TGR-500	For TG-500M calibration
TGR-6343	For TG-6343 calibration
TG R-6343/004	For TG-6343/004 calibration
TGR-7822	For TG-7822M calibration



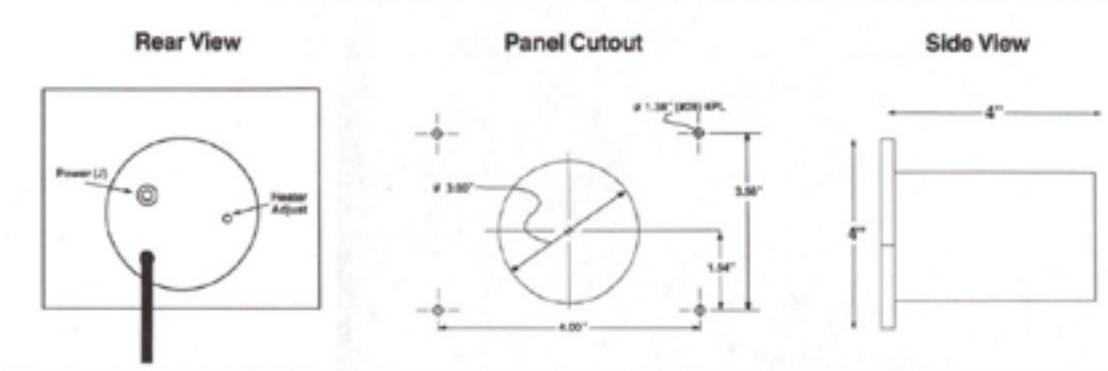
TGC-100

The TGC-100 is a panel mounted thermocouple gauge controller that is intended to operate any one of four standard thermocouple tubes offered by Thermionics: model TG-6343, TG-6343/004, TG-7822M, or TG-500. The suffix added to the model number of the unit designates the tube type that must be used with a respective meter (Example: TGC-100-6343 will operate a TG-6343 tube). Depending on the tube type, the circuitry is factory adjusted to provide the correct heater current, and the meter face is calibrated to reflect the pressure in milliTorr.

TGC-100A

The TGC-100A is a thermocouple gauge controller that is intended to operate one of four standard thermocouple tubes offered by Thermionics: model TG-6343, TG-6343/004, TG-7822M, or TG-500. This unit retains the same physical mounting as the TGC-100 but has additional control features not normally found on panel mount controllers. The TGC-100A provides a degree of system control by the inclusion of relay contacts that close at a pre-set setpoint. Besides the relay closure, the setpoint condition is also indicated on the front panel face by a visible light-emitting diode (LED). The setpoint is adjustable through the rear of the panel and can be easily changed without any disassembly. Additionally, an amplified thermocouple output is available for strip recorder or computer input.

The suffix added to the model number of the unit designates the tube type that must be used with a respective meter (Example: TGC-100A-6343 will operate a TG-6343 tube). Depending on the tube type, the circuitry is factory adjusted to provide the correct heater current, and the meter face is calibrated to reflect the pressure in milliTorr.



Specifications

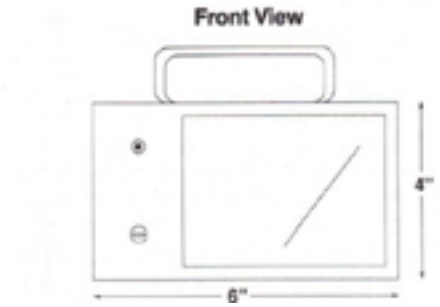
Power	115/220 VAC, 50/60 Hz, 0.5 A
Range	1 mTorr to 1 Torr
Sensitivity	10 mV full scale
Operating temperature range	10°C to 40°C
Heater supply	Constant current DC source
Gauge cable	10' long
Power cable	6' long
Weight	3.0 lbs

Model Number	Description
TGC-100	Panel mounted thermocouple gauge controller for the operation of one tube.
TGC-100A	Panel mounted thermocouple gauge controller with analog output signal, adjustable setpoint control and 1 A relay contacts, LED indication of setpoint condition.

6 Thermocouple Gauges & Controllers

TGC-100B

The TGC-100B is a battery powered thermocouple gauge controller that is intended to operate the TG-6343 or TG-6343/004 thermocouple tube offered by Thermionics. The unit comes in a compact chassis for easy portability and remote use. It employs inexpensive, easily replaced "C" cell batteries, and no complicated re-zeroing adjustment is required over the useful life of the batteries. The circuitry is factory adjusted to provide the correct heater current, and the meter face is calibrated to reflect the pressure in milliTorr. Battery lifetime is somewhat variable due to battery manufacturers' specifications. However, factory tested units have lasted over 700 hrs (-30 days) with continuous operation. Periodic shutdown when not in use will significantly prolong useful operation with one battery set. Battery lifetime is easily monitored with a battery check on the front panel.



Specifications

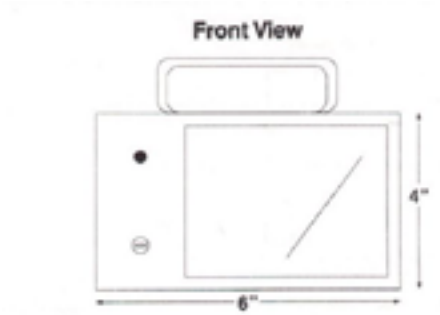
Power	6 VDC (4 "C" cell batteries)
Range	1 mTorr to 1 Torr
Sensitivity	10 mV full scale
Operating temperature range	10°C to 40°C
Heater supply	Constant current DC source
Gauge cable	10' long
Power cable	6' long
Weight	3.0 lbs

Model Number	Description
TGC-100B	Cabinet mounted, battery operated thermocouple gauge controller for the operation of 1 TG-6343 or TG-6343/004 thermocouple gauge tube. Operates on four "C" cells.

TGC-100C

The TGC-100A is a thermocouple gauge controller that is intended to operate one of four standard thermocouple tubes offered by Thermionics: model TG-6343, TG-6343/004, TG-7822M, or TG-500. This unit retains the same physical mounting as the TGC-100 but has additional control features not normally found on panel mount controllers. The TGC-100A provides a degree of system control by the inclusion of relay contacts that close at a pre-set setpoint. Besides the relay closure, the setpoint condition is also indicated on the front panel face by a visible light-emitting diode (LED). The setpoint is adjustable through the rear of the panel and can be easily changed without any disassembly. Additionally, an amplified thermocouple output is available for strip recorder or computer input.

The suffix added to the model number of the unit designates the tube type that must be used with a respective meter (Example: TGC-100A-6343 will operate a TG-6343 tube). Depending on the tube type, the circuitry is factory adjusted to provide the correct heater current, and the meter face is calibrated to reflect the pressure in milliTorr.



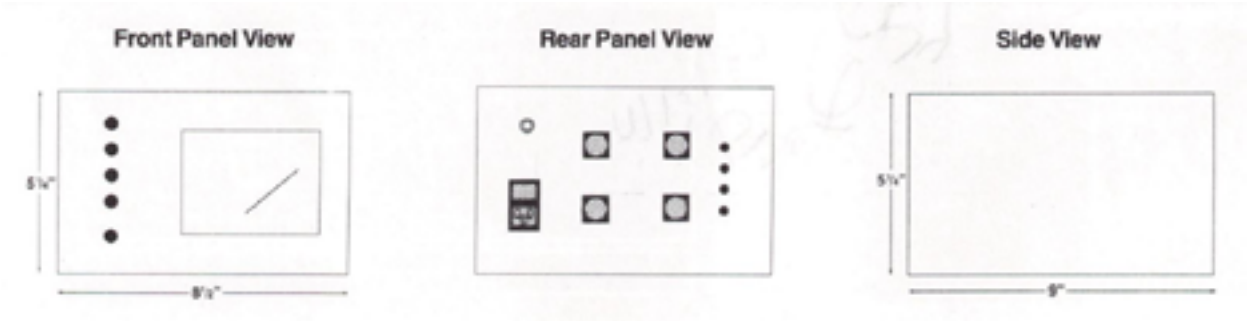
Specifications

Power	115/220 VAC, 50/60 Hz, 0.5 A
Range	1 mTorr to 1 Torr
Sensitivity	10 mV full scale
Operating temperature range	10°C to 40°C
Heater supply	Constant current DC source
Gauge cable	10' long
Power cable	6' long
Weight	3.0 lbs

Model Number	Description
TGC-100B	Same features as TGC-100A except in cabinet.

TGC-400

The TGC-400 is a 4-channel thermocouple gauge controller that is intended to operate one of four standard types of thermocouple tubes offered by Thermionics: model TG-6343, TG-6343/004, TG-7822M, or TG-500. The suffix added to the model number of the unit designates the tube type that must be used with a respective controller (Example: TGC-400-6343 will operate four TG-6343 tubes). Depending on the tube type, the circuitry is factory adjusted to provide the correct heater current, and the meter face is calibrated to reflect the pressure in milliTorr. Additionally, the thermocouple signal is amplified and brought to the rear panel for strip chart or computer input.



Model Number	Description
TGC-400	Cabinet mounted thermocouple gauge control for the operation of four tubes.

Specifications

Power	115/220 VAC, 50/60 Hz, 0.5 A
Range	1 mTorr to 1 Torr
Sensitivity	10 mV full scale
Operating temperature range	10°C to 40°C
Heater supply	4 independent constant current DC sources
Gauge cable	10’ long
Power cable	6’ long
Weight	3.0 lbs

6 Thermocouple Gauges & Controllers

The digital gauges to the right run TC-500M tubes, or the Varian model 531. Each is supplied with one TC-500M tube, a 10 ft tc gauge connecting cable, a 6 ft power cable, and an instruction manual. Range is 0-1999 milliTorr.

Model Number	Description
DTC-500	A portable, compact, rugged, low-cost, benchtop gauge with a large LCD display. Includes a 115 VAC, 50/60 Hz wall adapter.
DTC-505	A DTC-500 in a 1/8 DIN enclosure, will mount in your existing panel, 115/230 VAC, 50/60 Hz.
DTC-510	A DTC-500 in a 1/8 DIN enclosure, will mount in your existing panel, with one process control output to drive an optional, external solid-state relay, 115/230 VAC, 50/60 Hz.
DTC-801	A digital replacement for the most common analog tc gauge—the Varian 801. Featuring a large, bright, easy-to-read, red LED display, it mounts directly in an existing 801 mounting hole geometry, 115 VAC, 50/60 Hz. Options: a) 2 process outputs to drive external solid state relays, or b) a case.

DTC-500

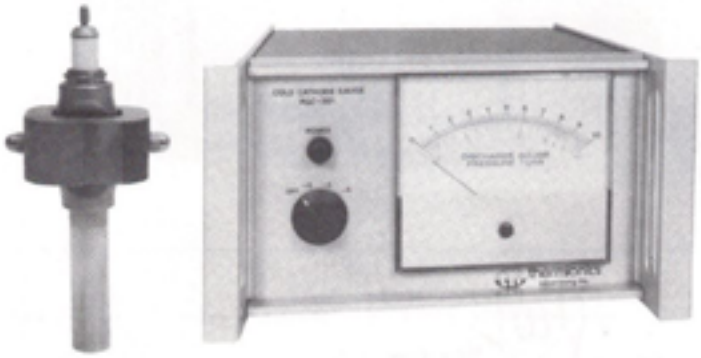
DTC-505

DTC-801

DTC-801

Features

- 2 gauge models and compatible control model
- Self cleaning, minimum maintenance
- Rugged, all welded construction
- With or without O-rings or gaskets on standard models
- Viton O-ring on removable anode model
- Long, uninterrupted service life
- Small size
- Connectable to glass or metal systems



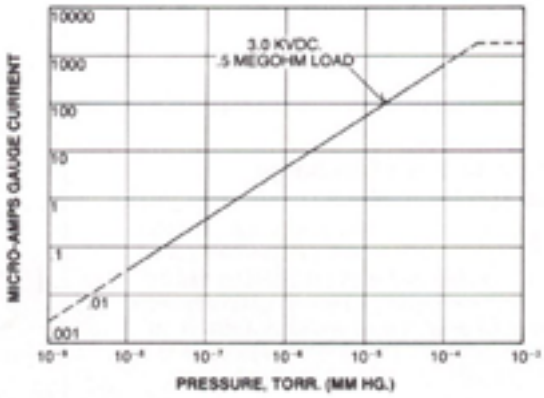
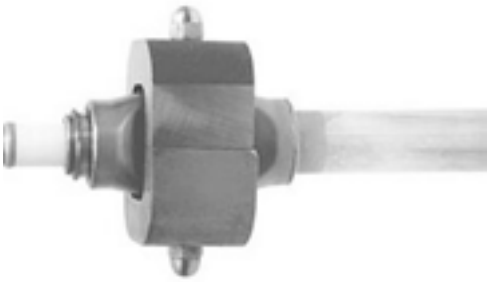


Fig. 6-4. Pressure vs. current curve.

Cold Cathode Ionization Gauge Tubes

Cold cathode discharge gauges are an economical and durable alternative to hot filament ionization gauges in the high vacuum pressure regime. With no active components such as hot filaments, the discharge gauge is not destroyed in sudden or prolonged high pressure gas exposures. This feature and the relative simplicity of the gauge promotes its use in evaporation systems, heat treatment applications and plasma processing environments.

Thermionics offers two types of discharge tubes and a wide variety of connections to new and existing vacuum systems. The choice between the two gauges is based on the anticipated frequency of high pressure exposures and the nature of the residual gases in the vacuum. While these exposures will not often ruin the gauge, some deposition of foreign material may occur on the internal electrodes. To prevent a cumulative degradation in tube performance, the electrodes may be removed and cleaned. This significantly prolongs the lifetime of the gauge operation, but is usually not a problem under typical vacuum environments. Thermionics offers a standard unit (DG-7) for typical operation and an additional unit with an easily removable anode assembly (DG-8) for the more austere applications.



Model DG-8

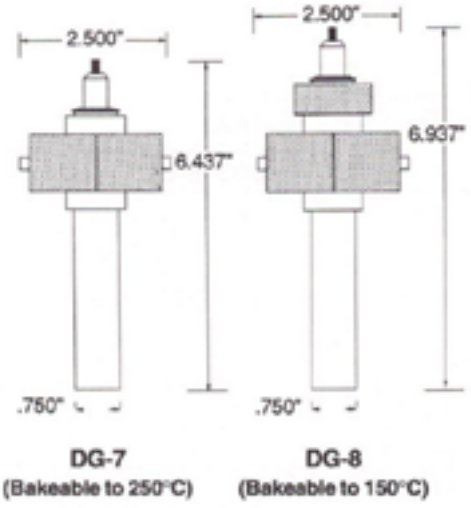


Fig. 6-5. Gauge outlines

Model Number	Description
DG-7	Standard tube with stainless steel (SS304) envelope, all welded construction and terminated with 3/4" tubulation. Bakeable to 250°C.
G-8	Same anode configuration as DG-7 except 0-ring assembly ring allows for removal of the anode for inspection and cleaning. Bakeable to 150°C (Viton limit).

Additional Terminations

Suffix	Description
-1/2SS	1/2" stainless steel tubulation
-CF	3/4" tubulation with 2 3/4" ConFlat flange connection
-OD	1/2" tubulation to quick disconnect fitting
-KF	3/4" tubulation to KF-40 fitting
-1/2G	1/2" glass tubulation

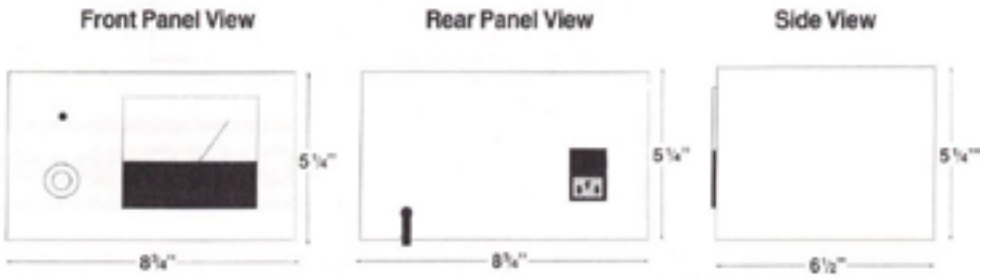
6 TLI Cold Cathode Gauge Controllers

Features

- Designed to operate DG-7 and DG-8 series gauge tubes
- Calibrated range: 1 x 10^{-7} to 1 x 10^{-4}Torr
- Operate from 115 VAC
- Easy-to-read meter
- Lightweight: approx. 7 lbs
- Cabinet/half rack mounted

Cold Cathode Discharge Gauge Controllers

Thermionics provides a gauge controller that operates with all of our standard tubes. The almost indestructability of tube and the lack of hot filaments make it suitable for many applications. This controller includes large analog meters with voltage meter scale for system check.



Cold Cathode Gauge Control Specifications

	DGC-202
Range	1 x 10^{-7} to 1 x 10^{-4}
Power	115 VAC, 60 Hz, 1 A
Output	4,400 VDC (maximum) 5 mA (maximum)
Dimensions	8" W x 5" H x 10" D
Weight	5 lbs
Response	0.1 sec
Power Cord	8'
Gauge Cord	10'

Ordering Information

Model Number	Description
DGC-202	Cabinet mounted discharge gauge control (pressure is displayed on logarithmic scale)

Options

Suffix	Description
-RM	Rack mount option to allow mounting in standard 19" electronic "racks"
-XX	Additional cable length to be specified up to 50'

To Order: For example, to order a rack mounted DGC-202 with 30 ft cable length, one would write: **DGC-202-RM-30.**

Shown with Standard Threaded Connector

Shown with Optional ISO25 Flange

Pirani Gauges

Operating on the same principles as the thermocouple gauge, the Pirani gauge provides additional range with better resolution. It is a rugged, dependable gauge which is not readily destroyed by high pressure exposures and can readily serve as the control transducer in protection circuits for diffusion and turbomolecular pumps.

Thermionics offers a Pirani gauge with a variety of fittings to allow ready connection to most vacuum systems. An analog controller with a wide view meter is available with setpoint and relay contacts for system control.

Specifications

Power	115 VAC (60 Hz)/220 VAC (50 Hz)
Pressure	0.1-1,000 mTorr (meter will indicate 1 atm at reduced accuracy)
Size	6" x 3 1/2" front panel and approximately 8" deep with cable connections
Heater	Independent constant current DC sources

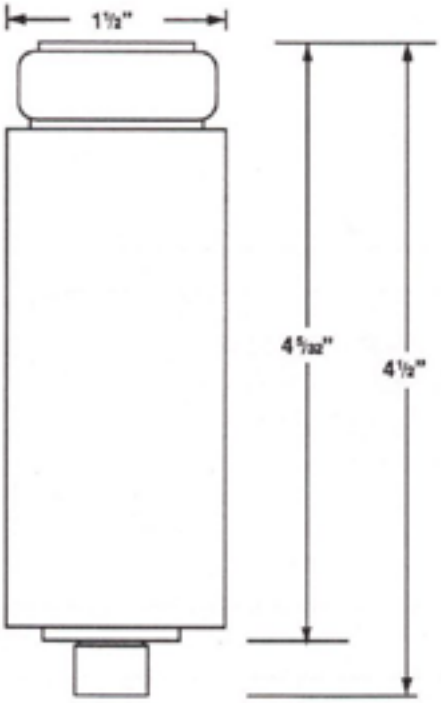


Fig. 6-6. Gauge outline.

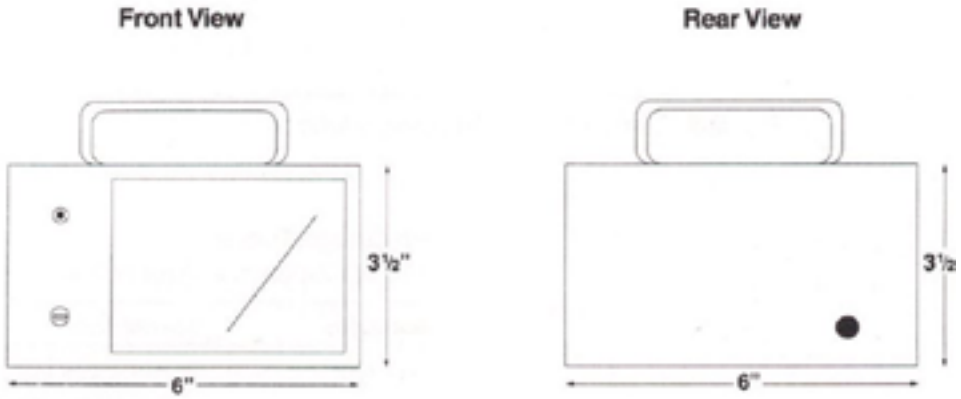


Fig. 6-7 Controller mechanical.

PG-100 Pirani Gauges and PGC-100 Controllers

Controllers are shipped with a 10' cable(s) and instruction manual. Longer cables can be supplied at a charge. Tubes are not included in controller prices and must be ordered separately.

Pirani Gauge Tube and Controller

Model Number	Description
PG-100	Pirani gauge
IPGC-100	Controller Controllers are shipped with 10' cable(s) and instruction manual. Longer cables can be supplied at a charge. Tubes are not included in controller price and must be ordered separately.

6 Glass Ionization Gauge Tubes

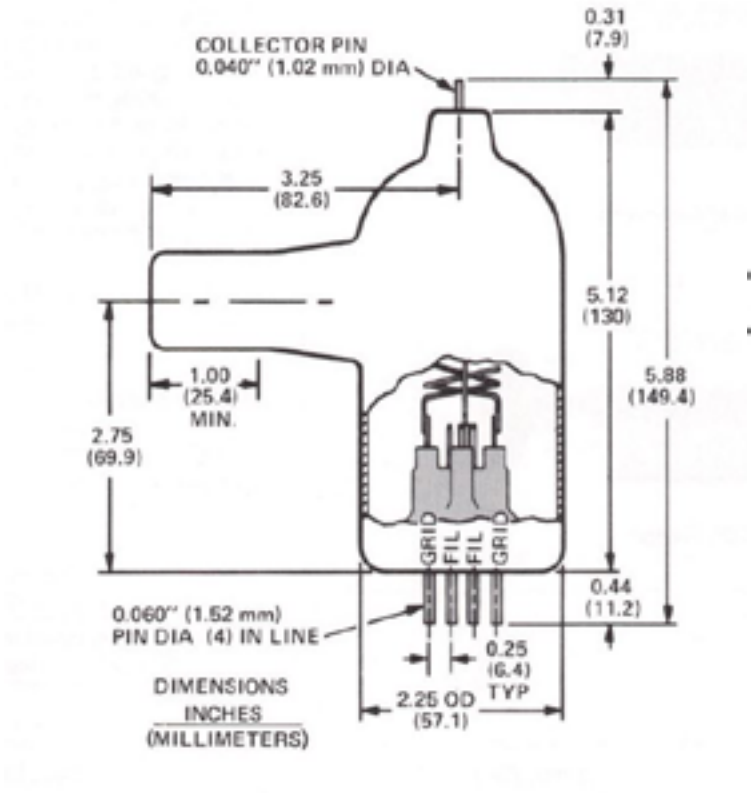


Fig. 6-8. Standard ionization gauge tube.

Ionization Gauge Tube

Features

- Bayard-Alpert design
- Easily outgassed grid
- Ease of connection
- Nonex, Pyrex, or Kovar tubulation
- Thoria-coated iridium filament (burnout resistant) or dual tungsten filaments
- Range: 10^{-3} to 10^{-10} Torr
- High conductance 1.0" tubulation available

Bayard-Alpert Ionization Gauge Tube Specifications

Vacuum range	9.9 x 10^{-3} to 3 x 10^{-10} Torr
Filament voltage	3-5 V
Filament bias	30 VDC
Filament current	4-6 A
Grid outgass	6.3-7.5 V at approx. 10 A
Collector voltage	0 VDC
Linearity	10^{-4} to 10^{-10} Torr at 10 mA emission 10^{-3} to 10 Torr at 1 mA emission

Ion Gauge Tubes

-x refers to option suffixes below

Model Number	Description
IG-1-N-x	Nonex glass encapsulated tube terminated with 1" tubulation.* Dual filament assembly and choice of filament material.
IG-1-P-x	Pyrex glass encapsulated tube terminated with 1" tubulation.* Dual filament assembly and choice of filament material.

Options

Suffix	Description
-W	Tungsten filaments
-I	Thoria-coated iridium filaments
-K	Kovar weldable transition termination
-CF	2.75" ConFlat flange termination

To Order: For example, to order a Pyrex encapsulated tube with thoria-iridium filaments and terminated with a ConFlat flange, one would write: **IG-1-P-I-CF.**

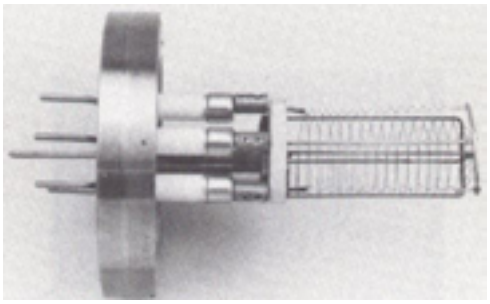
Pirani Gauges

TLI nude gauges are used when direct access to a vacuum chamber is needed. Nude gauges prevent errors which have been ascribed to glass envelopes and associated tubulations. They have a closed grid structure which minimizes gas reactions and improves sensitivity by a factor of 2 1/2. The improved sensitivity and a .005" collector results in a low x-ray limiting current corresponding to a pressure of about 2 x 10^{-11}Torr.

The gauge is available mounted on a 2 3/4" O.D. UHV flange, greatly simplifying filament replacement. Standard filaments are made of tungsten. For long life in higher pressure and/or active gas environments, we recommend use of the thoria-coated iridium filament.

Medium to UHV Vacuum Pressure Measurement

- Range: 10^{-3} to 10^{-11} Torr
- Linear response in 10^{-4} and 10^{-5} Torr ranges with reduced emission
- Nude configuration
- Bayard-Alpert type



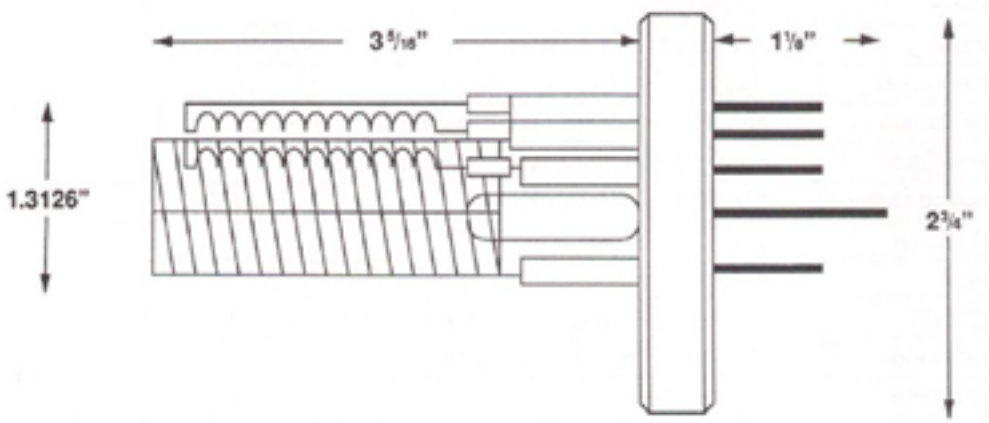


Fig. 6-9. Nude bakeable gauge tube.

Nude Bakeable Bayard-Alpert GaugeTube Specifications

Vacuum range	1 x 10^{-3} to 2 x 10^{-11} Torr
Filament voltage	3-4.5V
Filament bias	30 VDC
Filament current	2.5-3.5 A with emission current of 4 mA
Grid voltage	180 VDC
Collector voltage	0 VDC
Sensitivity	0.1 A/Torr @ 4 mA grid current (N_2 equivalent)
Degas method	Electron bombardment (30-40 W@ approx. 500V)
Flange	2.75" (70 mm) O.D. CF flange
Length	4.12" overall, 3" insertion length
Filament	Two tungsten filaments, two thoria-coated iridium filaments or two tungsten rhenium filaments on replaceable filament assembly
Grid	Tantalum grid on platinum-clad molybdenum supports with top and bottom caps

Ion Gauge Tubes

-x refers to option suffixes below

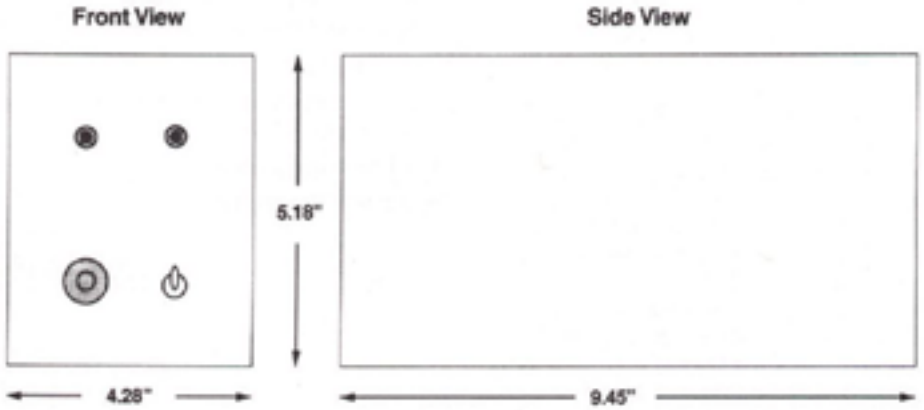
Model Number	Description
IG-2-x	Nude ionization gauge tube mounted on 2 3/4" ConFlat flange.
IG-2F-x	Replacement filaments for nude ion gauge tube.

Options

Suffix	Description
-W	Tungsten filaments
-I	Thoria-coated iridium filaments

To Order: For example, to order a Pyrex encapsulated tube with thoria-iridium filaments and terminated with a ConFlat flange, one would write: **IG-1-P-I-CF.**

6 LN_2 Controller



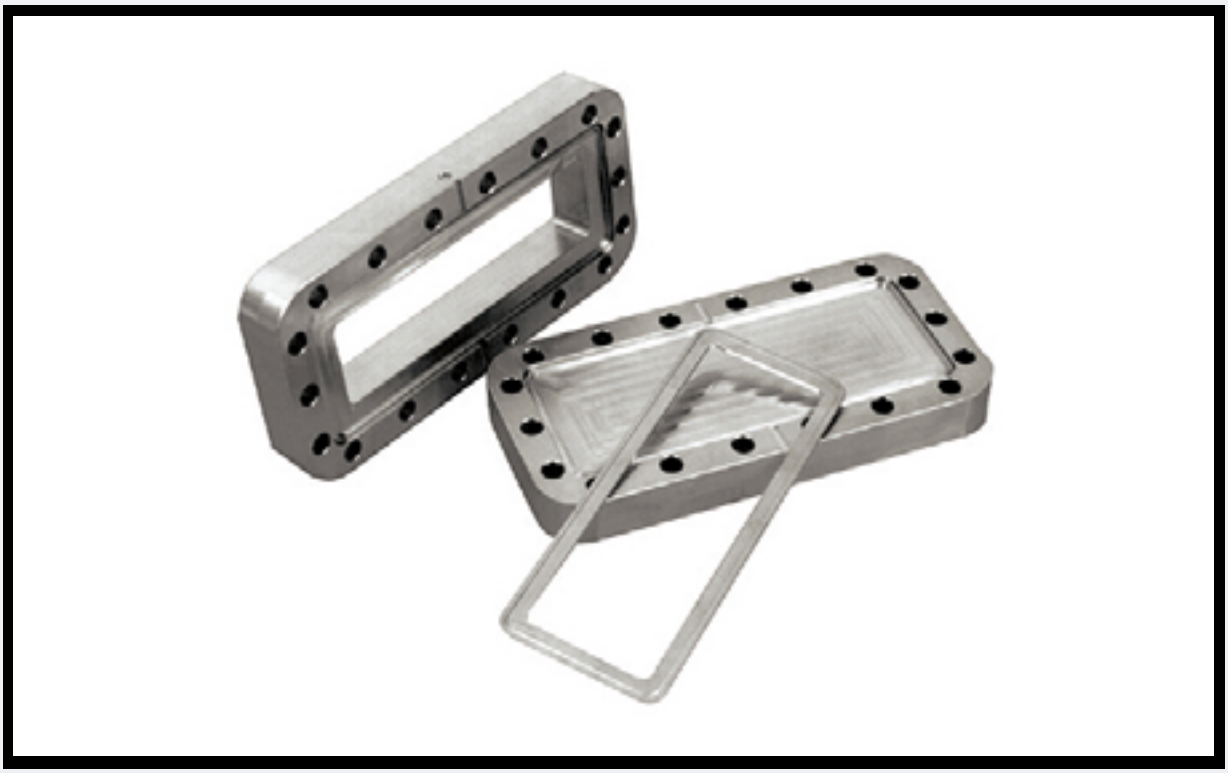
The LNC-400 provides monitoring and control of liquid nitrogen levels in cryogenic containers. The level sensing device is a special ruggedized solid-state transducer designed for LN_2 immersion

Model LNC-400 Specifications

Cabinet	Height 5.5", Width 4.25", Depth 9.5"
Sensor	Solid state encapsulated; 7/16" O.D. x 5/8" long (one each)
Sensor Lead	8' long, RG-188 coax (Teflon)
Line Voltage	105-125 or 210-265 VAC, 50 or 60 Hz
Power Cord	6' long, 3 wire detachable, polarized plug
Solenoid Outlet	115 VAC, 3 wire receptacle
Safety Fuse	3 A
Switch	3 position, manual/off/automatic
Lights (2)	One on when filling; other on when power is on
Level Range	Determined by sensor placement
Cycle Time	Adjustable from 0.1 to 6 min
Balance	No calibration or balancing necessary
Warranty	Fully guaranteed for one year; parts and labor
Weight	3 lbs

Liquid Nitrogen Transfer Line

Model LNT-500 liquid nitrogen transfer line assembly includes fittings, tubing, insulation, connectors and solenoid valve, for use with the LNC-400 controller.



Flanges

A Word About Bolt and Nut Sets
If an ultra-high vacuum seal is to maintain its integrity, it must not be affected by the thermal stresses inherent in the bakeout process. Therefore, the bolt and nuts sets described on the following pages are made of series 300 stainless steel to match the thermal expansion co-efficient of the flanges. They are made from high strength steel to insure against failures due to plastic flow. Do not substitute ordinary bolts and nuts of these sets.

OFHC and OFE Copper
OFHC was a registered trademark of American Metals Climax, Inc. The trademark, propriety process, product line and production machinery were sold to Phelps Dodge retired the product, and discontinued manufacturing OFHC copper products.

ASTM F68 was the specification for proprietary OFHC copper product. The Copper Development Association, an industry trade organization, proposed and adopted specifications UNSC-10100. UNSC-10100 and ASTM F68 are identical specifications. OFHC copper is no longer being produced and has been replaced in the market with OFE copper products. OFE is produced as a generic copper product. OFHC and OFE are interchangeable.

General Information

Description

The reliable sealing performance of PyraFlat and ConFlat flanges is due to the geometry which “captures” the gasket material. When the sealing edge of the flange is pressed into the OFE copper gasket, a lateral cold flow of the gasket material upon the slope occurs. This cold flow is limited by the vertical flange wall. Further material flow away from the seal area is severely limited and high interface pressures are developed. These pressures cause gasket material to fill surface imperfections and produce a highly reliable seal. At high temperatures, the “capturing” geometry maintains high pressures despite softening of the gasket.

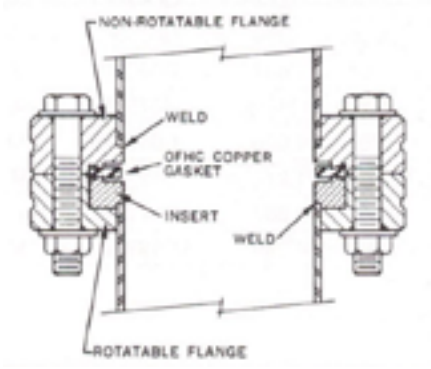
Flanges, flange components, accessories, and basic tube fittings are detailed here in Section 7. Other vacuum system components mounted

Features

- Large selection of standard sizes
- Identical mating flanges—no male and female
- Mate with all other PyraFlat and ConFlat type flanges of same dimension
- Easy repeated sealing
- Leak-tight even with minor gasket nicks and scratches
- Offered in both rotatable and nonrotatable versions
- Components can be welded or brazed to flanges

Specifications

- Vacuum range: to below 10^{-13} Torr
- Temperature operating range:
  -196°C to +500°C
- Material:
  Mini and 2 3/4” O.D.
  Vacuum melt type 304 SS
  3 3/8” O.D. and larger and PyraFlat
  Type 304 SS plate
- Maximum torque required to seal flanges:
  Mini and 2 3/4”: 16 ft-lbs
  3 3/8” and larger: 26 ft-lbs



Round, Rectangular & Odd Shapes*

- Featuring the TLI PyraFlat flange
- Certified leak-free to 10^{-13} Torr
- Ideal for metal sealed valve bonnets!

The PyraFlat is the ideal metal seal for any rectangular vacuum connection. It is based on the same knife edge and captured flat copper gasket sealing principle used by the ConFlat flange and is equally reliable. Assembly, even with flange face vertical, is easy and fast. Your service people and technicians will welcome its use.

PyraFlats can be used for valve flange seals, too. A 2” by 10” rectangular gate valve is 8” more compact than the equivalent 10” circular gate valve.

Guaranteed leak-free from atmosphere to 1 x 10^{-13} Torr from -196° to 500°C.

The PyraFlat is the ideal metal seal for any rectangular vacuum connection. It is based on the same knife edge and captured flat copper gasket sealing principle used by the ConFlat flange and is equally reliable. Assembly, even with flange face vertical, is easy and fast. Your service people and technicians will welcome its use.

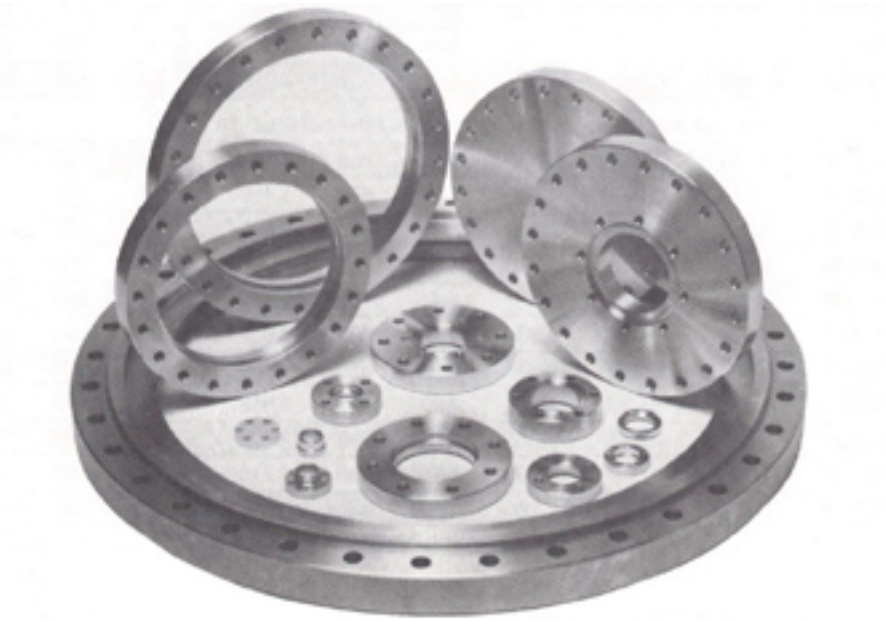
PyraFlats can be used for valve flange seals, too. A 2” by 10” rectangular gate valve is 8”

Standard ConFlat-Type

Features

- Flange and seal geometry totally compatible with Varian ConFlat
- Leak-free construction
- Wide selection
- Immediate shipment
- All flanges made of 304 stainless steel
- Certified leak-free to 10-13 Torr**

*** Based upon the 10^{-11} Torr ion gauge x-ray limit and 5 x 10^{-13} Torr l/sec/cm2 outgassing rate of 304 SST*



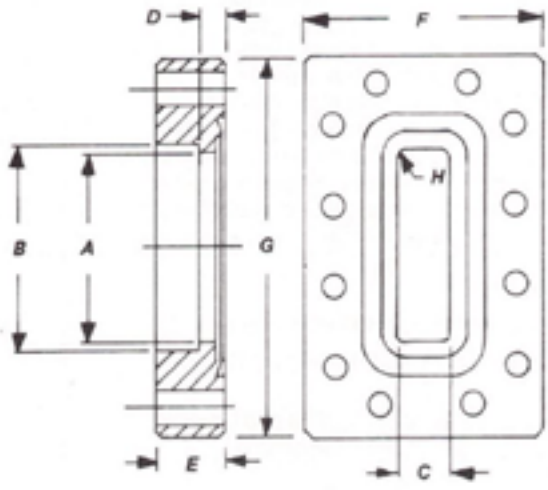
7 PyraFlat Flanges

PyraFlat seals use the ConFlat sealing principle in a rectangular flange. Result: The ease, convenience, and reliability of circular seals are now available for rectangular vacuum seals.

Standard and custom PyraFlat versions have been designed for and used in many applications including high power microwave components and plasma-fusion. Please call our engineering group with your requirements.

Applications

- Gate valve metal bonnet seals (replaces wire-sealed flanges)
- Close packed geometries
- Fusion reactors
- Cassette seals
- Wave guides
- Drift tubes
- Ion pumps



Integral Flanges (bolt hole and sealing portion in one unit)

Applications

PyraFlat flanges are manufactured and protected under one or more of the following patents: 5,640,751; 4,685,193

Standard Sizes

Dimensions in inches

Model No.*	A	B	C	D	E**	F	G	H	Holes (Qty./Dia)	Gaskets (5/pkg.)
026046	3.125	3.375	1.125	.274	.571	2.605	4.605	.125	12/.265	**G026046**
026056	4.125	4.375	1.125	.274	.571	2 605	5.605	.125	14/.265	**G026056**
035073	5.250	5.510	1.500	.524	.821	3.560	7.310	.125	18/.332	**G035073**
035098	7.750	8.010	1.500	.524	.821	3.560	9.810	.125	22/.332	**G035098**
043124	10.125	10.380	2.000	.524	.821	4.324	12.450	.125	24/.332	**G043124**
The following flanges are designed to accept standard sizes of square tubing:										
029029	1.370	1.510	1.370	.194	.485	2.956	2.956	.093	8/.270	**G029029**
034034	1.870	2.010	1.870	.210	.605	3.456	3.456	.093	8/.270	**G034034**
044044	2.370	2.510	2.370	.360	,665	4.450	4.450	.093	12/.332	**G044044**
049049	2.870	3.010	2.870	.422	.735	4.950	4.950	.093	12/.332	**G049049**
059059	3.834	4.010	3.834	.422	.765	5.952	5.952	.093	16/.332	**G059059**
069069	4.834	5.010	4.834	.465	.825	6.952	6.952	.093	20/.332	**G069069**
079079	5.834	6.010	5.834	.485	.855	7.952	7.952	.093	24/.332	**G079079**
099099	7.834	8.010	7.834	.485	.985	9 952	9.952	.093	28/.332	**G099099**
127127	9.760	10.010	9.760	.585	1.235	12.714	12.714	.093	36/.390	**G127127**
147147	11.760	12 010	11.760	.587	1.235	14.714	14.714	.093	40/.390	**G147147**
167167	3.375	14.010	13.760	.860	1.485	16.714	16.714	.093	48/.390	**G167167**

**Add suffixes as follows: T = Tapped Flange, B = Blank Flange (no extra charge), BT = Blank Tapped Flange*
***± .015" to dividing line of two flanges*

Larger or other sizes and shapes available on request

Bolt Sets for PyraFlat Flanges

Dimensions in inches

Model No.*	For Flange Model No.	Size	Qty.
PBN-25-150N	029029 034034	1/4-28 x 1 1/ 2	Pack of 25
PBN-25-175N	026046 026056	1/4-28 x 1 3/4	Pack of 25
PBN-31-200N	044044 049044 049049	5/16-24 x 2.0	Pack of 25
PBN-31-225N	035073 035098 043124 067069 079079	5/16-24 x 2 1/4	Pack of 25
PBN-31-250N	099099	5/16-24 x 2 1/2	Pack of 50
PBN-38-300N	127127 147147	3/8-24 x 3.0	Pack of 50
PBN-38-350N	167167	3/8-24 x 3 1/ 2	Pack of 50

NOTE: Consult factory for tapped flange bolt set information.

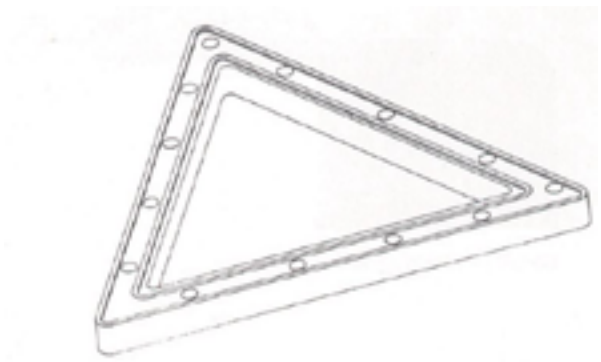
PyraFlat flanges are manufactured and protected under one or more of the following patents: 5,640,751; 4,685,193

Examples of Possible PyraFlat Flange Geometries & Applications

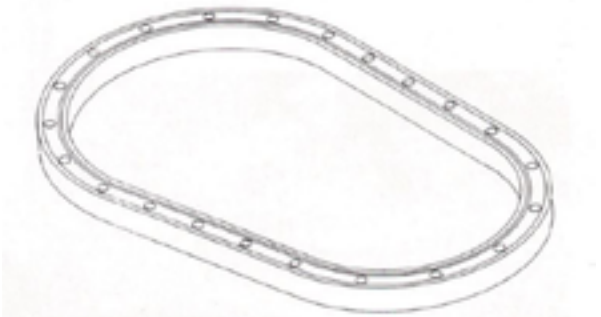
ConFlat-Type Captured Gasket
All Metal Seal Flange

ConFlat-Type Captured Gasket All Metal Seal Flange

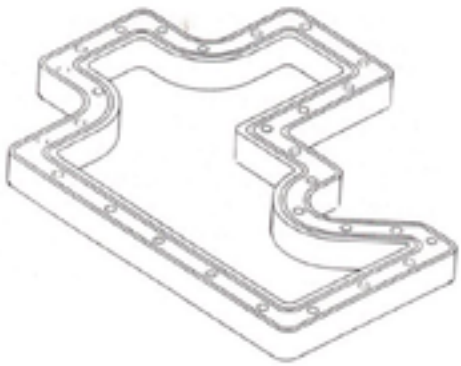
Triangular flanges can yield maximum packing density when a large number of flanges must be placed on a single surface.



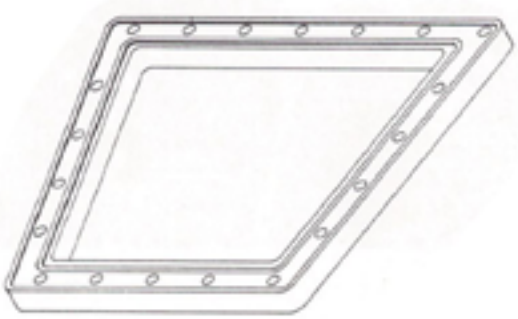
Elliptical flanges are used when you wish to join two circular tubes at a flange angle of other than 90°. If the join angle is 45°, a 180° rotation produces a right-angle bend.



Odd-shaped flanges can be the best solution to a unique research problem.



Trapezoidal flanges can be made in almost any ratio of height to base.



7 Some Applications for PyraFlat Flanges

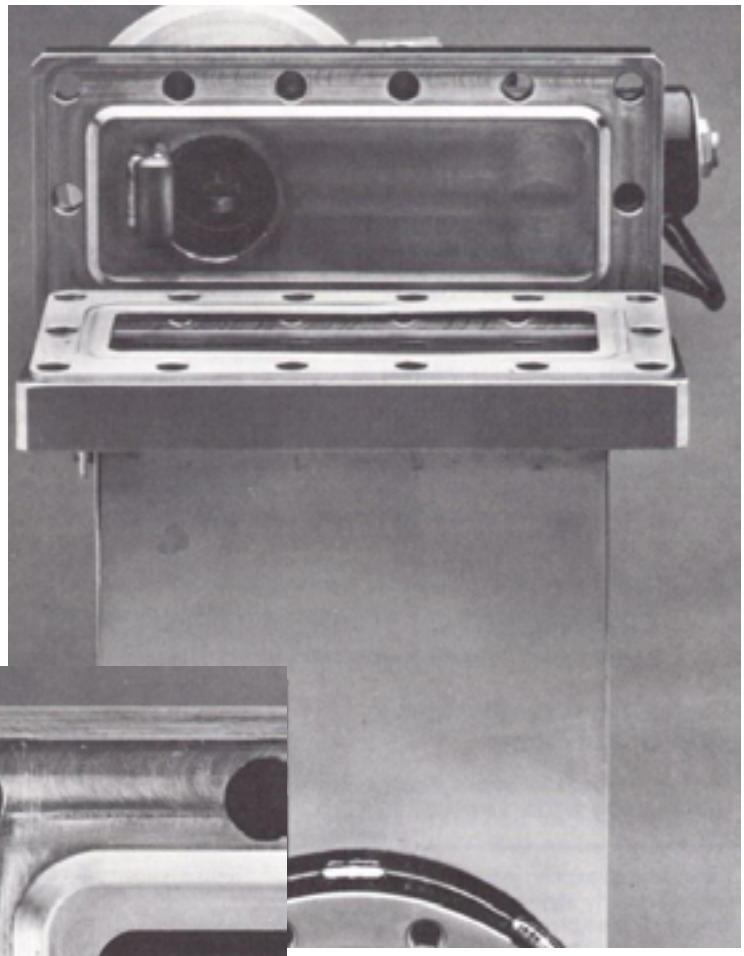
PyreFlats and Valve Bonnets

The PyraFlat is an ideal metal seal for valve bonnets. This remarkable UHV flange makes any other rectangular metal valve bonnet seal obsolete. Its reliability and ease of assembly have been repeatedly proven, and its range of shapes and sizes will satisfy any non-circular UHV flange requirements.

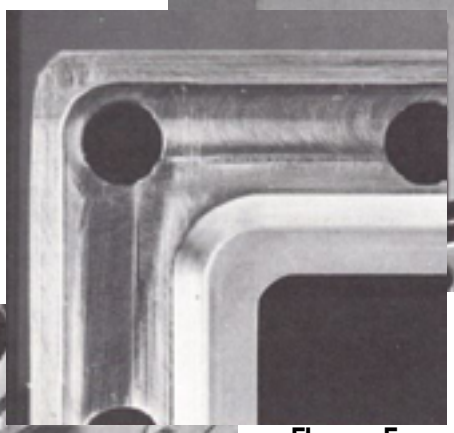
Prior metal-sealed valve bonnets used wire gaskets. However, unconstrained gaskets are far less reliable than the knife edge/ captured flat copper gasket sealing principle. Wire gaskets are also difficult to install and almost impossible when sealing surfaces are vertical. Not so with PyraFlat. Assembly requires only minutes, not hours, regardless of the angle of installation. This is important when valve bodies must be left inline when systems are being serviced.

Recently, a National Laboratory conducted independent testing on valves. Thermionics' gate valve with the PyraFlat bonnet seal won the competition. Like the ConFlat, its Varian ancestor, the PyraFlat will soon become a new standard in the industry.

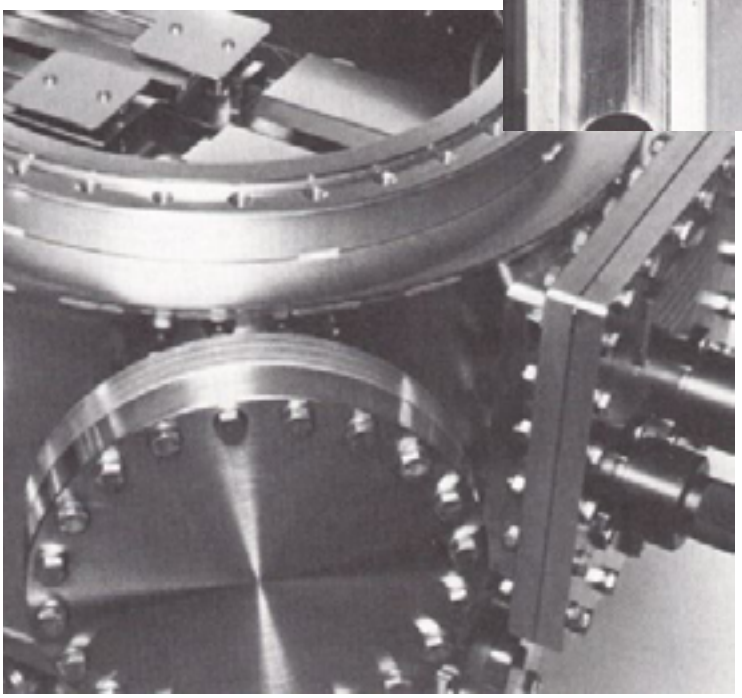
PyraFlat flanges are manufactured and protected under one or more of the following patents: 5,640,751; 4,685,193



Valve Bonnet Assembly



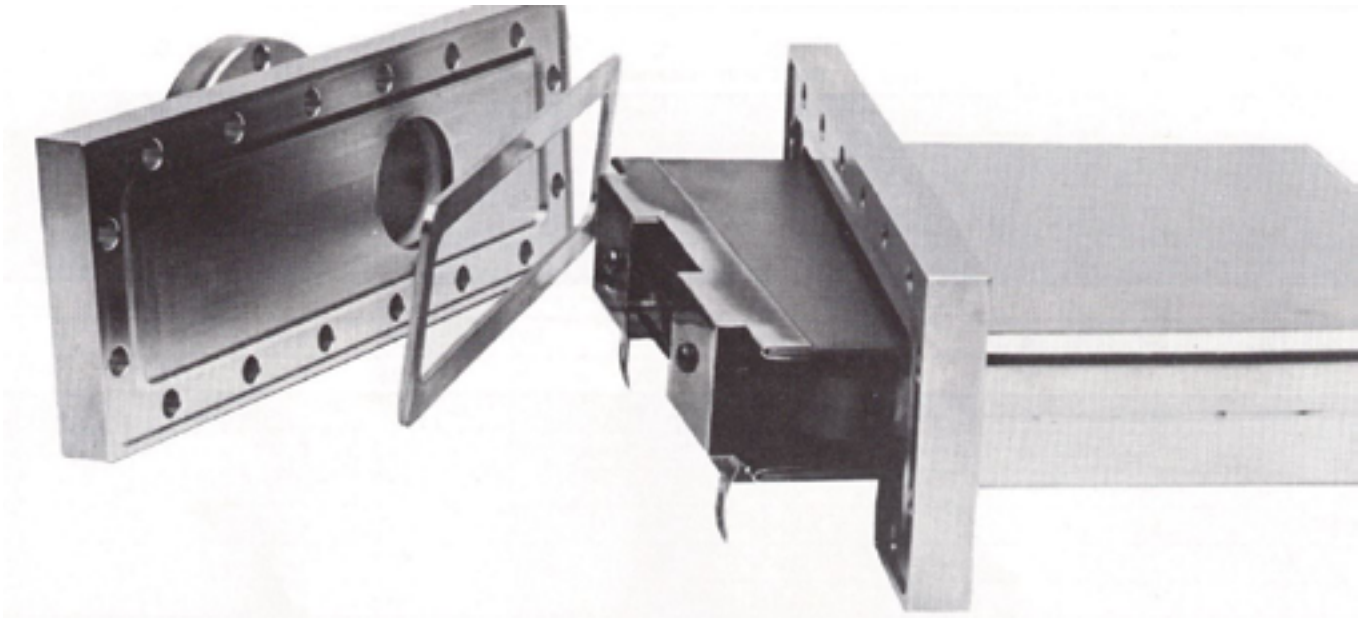
Flange Face



Multiple e-Gun Assembly

PyreFlats in Custom Applications

Recently, we were asked to install two 5-crucible e-Guns in a 17" chamber. We wanted to provide our customer with optimal access for servicing—without disrupting the entire assembly. The PyraFlat was our solution. Its rectangular shape provided a 21% larger access opening than the equivalent circular flange could offer. Our customer was delighted.



See Section 1 for futher information.

PyraFlats and Ion Pumps

What Do You Do When Your Small Ion Pump Fails or Dies?

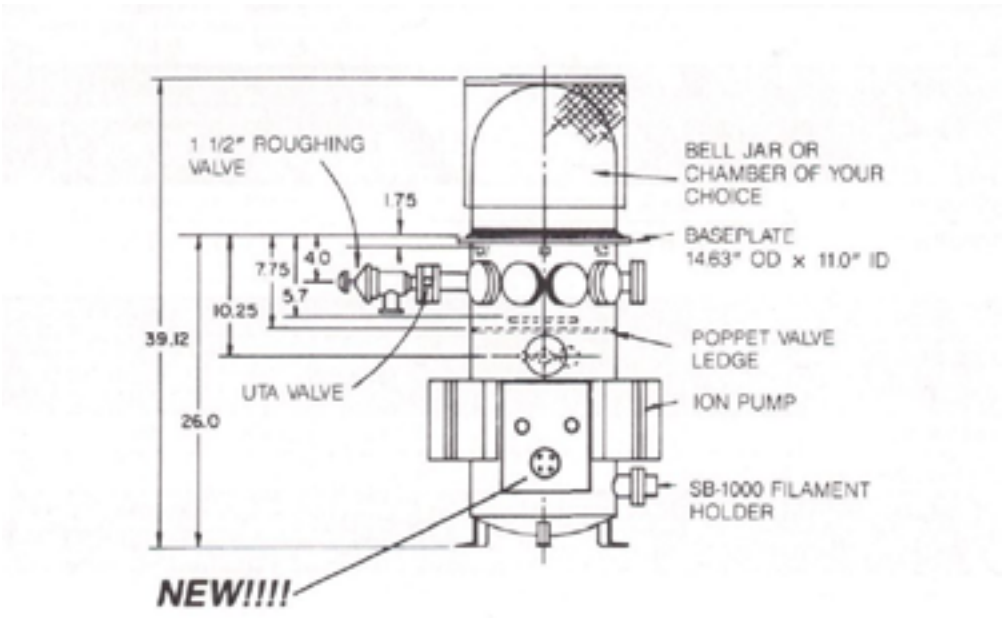
For decades, there have been only two choices. You could buy a new pump or pay to have your old pump rebuilt. Either way, your system was out of service until the new or rebuilt pump could be delivered and installed. The PyraFlat now provides an alternative.

By using the PyraFlat in the construction of our ion pump bodies, we can offer users of small- to medium-sized ion pumps the same advantage enjoyed by users of larger ion pumps: immediate and total access for servicing your own pump elements, plates and insulators. This translates into a substantial savings in money and time, since ion pump elements can often be restored to satisfactory service by proper vacuum cleaning procedures.

PyraFlats for Ion Pumped Table Top Systems

In the system shown, the modular, removable sublimator and cryoshroud assembly is mounted on a PyraFlat flange. This also provides access to the inside of the pumping stack for hassle-free cleaning, repair or maintenance.

PyraFlat flanges are manufactured and protected under one or more of the following patents: 5,640,751; 4,685,193



PyraFlat Access Port (see Section 9 for details)

7 Rotatable UHV Flanges

Dimensions in inches

Model No.*	Nom. O.D.	Nom. I.D.	Dwg.*	A O.D.	B Bolt Circle	C Thickness	D Setback	E I.D.	F I.D.	G
133000R	1 1/3	Blank	a	1.33	1.062	0.285	—	0.750	—	—
133025R	1 1/3	1/4	b	1.33	1.062	0.285	—	0.750	0.260	—
133038R	1 1/3	3/8	b	1.33	1.062	0.285	—	0.750	0.380	—
133050R	1 1/3	1/2	b	1.33	1.062	0.285	—	0.750	0.510	—
133075R	1 1/3	3/4	c	1.33	1.062	0.285	—	0.750	0.630	—
212000R	2 1/8	Blank	d	2.12	1.625	0.470	—	1.075	—	—
212075R	2 1/8	3/4	e	2.12	1.625	0.470	.170	1.075	0.625	0.760
212100R	2 1/8	1	e	2.12	1.625	0.470	.170	1.075	0.875	1.010
275000R	2 3/4	Blank	d	2.73	2.312	0.500	—	1.560	—	—
275025R	2 3/4	1/4	e	2.73	2.312	0.500	.209	1.560	0.125	0.255
275050R	2 3/4	1/2	e	2.73	2.312	0.500	.209	1.560	0.375	0.505
275075R	2 3/4	3/4	e	2.73	2.312	0.500	.209	1.560	0.625	0.755
275100R	2 3/4	1	e	2.73	2.312	0.500	.209	1.560	0.875	1.010
275125R	2 3/4	1 1/4	e	2.73	2.312	0.500	.209	1.560	1.125	1.255
275150R	2 3/4	1 1/2	e	2.73	2.312	0.500	.209	1.560	1.375	1.510
338000R	3 3/8	Blank	d	3.37	2.850	0.680	—	2.030	—	—
338150R	3 3/8	1 1/2	e	3.37	2.850	0.680	.225	2.030	1.375	1.510
338200R	3 3/8	2	e	3.37	2.850	0.680	.225	2.030	1.875	2.010
450000R	4 1/2	Blank	d	4.47	3.628	0.750	—	2.625	—	—
450150R	4 1/2	1 1/2	e	4.47	3.628	0.750	.375	2.625	1.375	1.510
450200R	4 1/2	2	e	4.47	3.628	0.750	.375	2.625	1.875	2.010
450250R	4 1/2	2 1/2	e	4.47	3.628	0.750	.375	2.625	2.375	2.510
462000R	4 5/8	Blank	d	4.62	4.030	0.810	—	3.100	—	—
462250R	4 5/8	2 1/2	e	4.62	4.030	0.810	.375	3.100	2.375	2.510
462300R	4 5/8	3	e	4.62	4.030	0.810	.375	3.100	2.875	3.010
600000R	6	Blank	d	5.97	5.128	0.840	—	4.125	—	—
600400R	6	4	e	5.97	5.128	0.840	.437	4.125	3.810	4.010
675000R	6 3/4	5	d	6.75	5.969	0.840	—	5.125	—	—
675400R	6 3/4	Blank	e	6.75	5.969	0.840	.460	5.125	3.870	4.010
675500R	6 3/4	6	e	6.75	5.969	0.840	.460	5.125	4.870	5.010
800000R	8	Blank	d	7.97	7.128	0.940	—	6.125	—	—
800600R	8	6	e	7.97	7.128	0.940	.500	6.125	5.810	6.020
1000000R	10	Blank	d	9.97	9.128	0.970	—	8.125	—	—
1000800R	10	8	e	9.97	9.128	0.970	.500	8.125	7.810	8.020
1325000R	13 1/4	Blank	d	13.25	12.060	1.120	—	10.875	—	—
13251000R	13 1/4	10	e	13.25	12.060	1.120	.500	10.875	9.860	10.020
13251075R	13 1/4	10 3/4	e	13.25	12.060	1.120	.500	10.875	10.630	10.765
1400000R	14	Blank	d	14.00	12.810	1.120	—	12.250	—	—
14001200R	14	12	e	14.00	12.810	1.120	.500	12.250	11.750	12.020
1650000R	16 1/2	Blank	d	16.50	15.310	1.120	—	14.290	—	—
16501400R	16 1/2	14	e	16.50	15.310	1.120	.500	14.290	13.750	14.020

*See drawings on page 7-14

H Rec. Depth	Bolt Holes No.	Bolt Holes Dia	Ship Wt. lbs
—	6	.172	.50
—	6	.172	.50
—	6	.172	.50
—	6	.172	.50
—	6	.172	.50
.236	4	.265	.75
.236	4	.265	.50
.236	4	.265	.50
.300	6	.265	1.00
.300	6	.265	.75
.300	6	.265	.75
.300	6	.265	.75
.300	6	.265	.75
.300	6	.265	.75
.300	6	.265	.75
.381	8	.332	2.00
.381	8	.332	1.75
.381	8	.332	1.75
.500	8	.332	2.50
.500	8	.332	2.00
.500	8	.332	2.00
.500	8	.332	2.00
.505	10	.332	3.00
.505	10	.332	2.50
.505	10	.332	2.50
.563	16	.332	6.50
.563	16	.332	4.50
.563	18	.332	7.00
.563	18	.332	5.00
.563	18	.332	5.00
.624	20	.332	10.00
.624	20	.332	7.00
.675	24	.332	15.00
.675	24	.332	12.00
.775	30	.390	50.00
.775	30	.390	20.00
.775	30	.390	20.00
.775	30	.390	45.00
.775	30	.390	13.00
.775	30	.390	62.00
.775	30	.390	18.00

Assembly Hardware		
Model No.	Description	Qty. per pkg.
GK-133	OFE copper gaskets	10
VG-133	Viton gaskets	5
B-8-75N	Bolt & nut set 8-32 x .75”	25
GK-212	OFE copper gaskets	10
VG-212	Viton gaskets	5
B-25-125N	Bolt & nut set 1/4-28 x 1 25”	25
GK-275	OFE copper gaskets	10
VG-275	Viton gaskets	5
B-25-150N	Bolt & nut set 1/4-28x 1.50”	25
GK-338	OFE copper gaskets	10
VG-338	Viton gaskets	1
B-31-175N	Bolt & nut set 5/16-24x 1.75”	25
GK-450	OFE copper gaskets	10
VG-450	Viton gaskets	1
B-31-200N	Bolt & nut set 5/16-24 x 2.0”	25
GK-462	OFE copper gaskets	10
VG-462	Viton gaskets	1
B-31-225N	Bolt & nut set 5/16-24 x 2.25”	25
GK-600	OFE copper gaskets	10
VG-600	Viton gaskets	1
B-31-225N	Bolt & nut set 5/16-24 x 2.25”	25
GK-675	OFE copper gaskets	10
VG-675	Viton gaskets	1
B-31-225N	Bolt & nut set 5/16-24 x 2.25”	25
GK-800	OFE copper gaskets	10
VG-800	Viton gaskets	1
B-31-225N	Bolt & nut set 5/16-24 x 2.25”	25
GK-1000	OFE copper gaskets	10
VG-1000	Viton gaskets	1
B-31-250N	Bolt & nut set 5/16-24 x 2.25”	25
GK-1325	OFE copper gaskets	1
VG-1325	Viton gaskets	1
B-38-300N	Bolt & nut set 3/8-24 x 3.0”	30

Contact factory for further information.
Wire seal flanges recommended for these sizes.
See pages 7-20 through 7-23.

7 Tapped Rotatable UHV Flanges

Dimensions in inches

Model No.*	Nom. O.D.	Nom. I.D.	Dwg.*	A O.D.	B Bolt Circle	C Thickness	D Setback	E I.D.	F I.D.	G
133000RT	1 1/3	Blank	a	1.33	1.062	0.285	—	0.750	—	—
133025RT	1 1/3	1/4	b	1.33	1.062	0.285	—	0.750	0.260	—
133038RT	1 1/3	3/8	b	1.33	1.062	0.285	—	0.750	0.380	—
133050RT	1 1/3	1/2	b	1.33	1.062	0.285	—	0.750	0.510	—
133075RT	1 1/3	3/4	c	1.33	1.062	0.285	—	0.750	0.630	—
212000RT	2 1/8	Blank	d	2.12	1.625	0.470	—	1.075	—	—
212075RT	2 1/8	3/4	e	2.12	1.625	0.470	.170	1.075	0.625	0.760
212100RT	2 1/8	1	e	2.12	1.625	0.470	.170	1.075	0.875	1.010
275000RT	2 3/4	Blank	d	2.73	2.312	0.500	—	1.560	—	—
275025RT	2 3/4	1/4	e	2.73	2.312	0.500	.209	1.560	0.125	0.255
275050RT	2 3/4	1/2	e	2.73	2.312	0.500	.209	1.560	0.375	0.505
275075RT	2 3/4	3/4	e	2.73	2.312	0.500	.209	1.560	0.625	0.755
275100RT	2 3/4	1	e	2.73	2.312	0.500	.209	1.560	0.875	1.010
275125RT	2 3/4	1 1/4	e	2.73	2.312	0.500	.209	1.560	1.125	1.255
275150RT	2 3/4	1 1/2	e	2.73	2.312	0.500	.209	1.560	1.375	1.510
338000RT	3 3/8	Blank	d	3.37	2.850	0.680	—	2.030	—	—
338150RT	3 3/8	1 1/2	e	3.37	2.850	0.680	.225	2.030	1.375	1.510
338200RT	3 3/8	2	e	3.37	2.850	0.680	.225	2.030	1.875	2.010
450000RT	4 1/2	Blank	d	4.47	3.628	0.750	—	2.625	—	—
450150RT	4 1/2	1 1/2	e	4.47	3.628	0.750	.375	2.625	1.375	1.510
450200RT	4 1/2	2	e	4.47	3.628	0.750	.375	2.625	1.875	2.010
450250RT	4 1/2	2 1/2	e	4.47	3.628	0.750	.375	2.625	2.375	2.510
462000RT	4 5/8	Blank	d	4.62	4.030	0.810	—	3.100	—	—
462250RT	4 5/8	2 1/2	e	4.62	4.030	0.810	.375	3.100	2.375	2.510
462300RT	4 5/8	3	e	4.62	4.030	0.810	.375	3.100	2.875	3.010
600000RT	6	Blank	d	5.97	5.128	0.840	—	4.125	—	—
600400RT	6	4	e	5.97	5.128	0.840	.437	4.125	3.810	4.010
675000RT	6 3/4	5	d	6.75	5.969	0.840	—	5.125	—	—
675400RT	6 3/4	Blank	e	6.75	5.969	0.840	.460	5.125	3.870	4.010
675500RT	6 3/4	6	e	6.75	5.969	0.840	.460	5.125	4.870	5.010
800000RT	8	Blank	d	7.97	7.128	0.940	—	6.125	—	—
800600RT	8	6	e	7.97	7.128	0.940	.500	6.125	5.810	6.020
1000000RT	10	Blank	d	9.97	9.128	0.970	—	8.125	—	—
1000800RT	10	8	e	9.97	9.128	0.970	.500	8.125	7.810	8.020
1325000RT	13 1/4	Blank	d	13.25	12.060	1.120	—	10.875	—	—
13251000RT	13 1/4	10	e	13.25	12.060	1.120	.500	10.875	9.860	10.020
13251075RT	13 1/4	10 3/4	e	13.25	12.060	1.120	.500	10.875	10.630	10.765
1400000RT	14	Blank	d	14.00	12.810	1.120	—	12.250	—	—
14001200RT	14	12	e	14.00	12.810	1.120	.500	12.250	11.750	12.020
1650000RT	16 1/2	Blank	d	16.50	15.310	1.120	—	14.290	—	—
16501400RT	16 1/2	14	e	16.50	15.310	1.120	.500	14.290	13.750	14.020

*See drawings on page 7-14

We reserve the right to substitute threaded inserts.

H Rec. Depth	Bolt Holes		Ship Wt. lbs
	No.	TPI	
—	6	8-32	.50
—	6	8-32	.50
—	6	8-32	.50
—	6	8-32	.50
—	6	8-32	.50
.236	4	1/4-28	.75
.236	4	1/4-28	.50
.236	4	1/4-28	.50
.300	6	1/4-28	1.00
.300	6	1/4-28	.75
.300	6	1/4-28	.75
.300	6	1/4-28	.75
.300	6	1/4-28	.75
.300	6	1/4-28	.75
.300	6	1/4-28	.75
.381	8	5/16-24	2.00
.381	8	5/16-24	1.75
.381	8	5/16-24	1.75
.500	8	5/16-24	2.50
.500	8	5/16-24	2.00
.500	8	5/16-24	2.00
.500	8	5/16-24	2.00
.505	10	5/16-24	3.00
.505	10	5/16-24	2.50
.505	10	5/16-24	2.50
.563	16	5/16-24	6.50
.563	16	5/16-24	4.50
.563	18	5/16-24	7.00
.563	18	5/16-24	5.00
.563	18	5/16-24	5.00
.624	20	5/16-24	10.00
.624	20	5/16-24	7.00
.675	24	5/16-24	15.00
.675	24	5/16-24	12.00
.775	30	3/8-24	50.00
.775	30	3/8-24	20.00
.775	30	3/8-24	20.00
.775	30	3/8-24	55.00
.775	30	3/8-24	20.00
.775	36	3/8-24	62.00
.775	36	3/8-24	22.00

Assembly Hardware		
Model No.	Description	Qty. per pkg.
GK-133	OFE copper gaskets	10
VG-133	Viton gaskets	5
B-8-50	Bolt & nut set 8-32 x 0.5”	25
GK-212	OFE copper gaskets	10
VG-212	Viton gaskets	5
B-25-87	Bolt & nut set 1/4-28 x .875”	25
GK-275	OFE copper gaskets	10
VG-275	Viton gaskets	5
B-25-87	Bolt & nut set 1/4-28x .875”	25
GK-338	OFE copper gaskets	10
VG-338	Viton gaskets	1
B-31-125	Bolt & nut set 5/16-24x 1.25”	25
GK-450	OFE copper gaskets	10
VG-450	Viton gaskets	1
B-31-125	Bolt & nut set 5/16-24 x 1.25”	25
GK-462	OFE copper gaskets	10
VG-462	Viton gaskets	1
B-31-125	Bolt & nut set 5/16-24 x 1.25”	25
GK-600	OFE copper gaskets	10
VG-600	Viton gaskets	1
B-31-125	Bolt & nut set 5/16-24 x 1.25”	25
GK-675	OFE copper gaskets	10
VG-675	Viton gaskets	1
B-31-125	Bolt & nut set 5/16-24 x 1.25”	25
GK-800	OFE copper gaskets	10
VG-800	Viton gaskets	1
B-31-175	Bolt & nut set 5/16-24 x 1.75”	25
GK-1000	OFE copper gaskets	10
VG-1000	Viton gaskets	1
B-31-175	Bolt & nut set 5/16-24 x 2.25”	25
GK-1325	OFE copper gaskets	1
VG-1325	Viton gaskets	1
B-38-200	Bolt & nut set 3/8-24 x 2.0”	30

Contact factory for further information.
Wire seal flanges recommended for these sizes.
See pages 7-20 through 7-23.

7 Non-Rotatable UHV Flanges

Dimensions in inches

Model No.*	Nom. O.D.	Nom. I.D.	Dwg.*	A O.D.	B Bolt Circle	C Thickness	D Setback	E I.D.	F I.D.
133000	1 1/3	Blank	f	1.33	1.062	0.285	—	—	—
133025	1 1/3	1/4	g	1.33	1.062	0.285	—	—	0.260
133038	1 1/3	3/8	g	1.33	1.062	0.285	—	—	0.380
133050	1 1/3	1/2	g	1.33	1.062	0.285	—	—	0.510
133075	1 1/3	3/4	h	1.33	1.062	0.285	—	0.750	0.630
212000	2 1/8	Blank	i	2.12	1.625	0.470	—	—	—
212075	2 1/8	3/4	j	2.12	1.625	0.470	.170	0.760	0.625
212100	2 1/8	1	j	2.12	1.625	0.470	.170	1.010	0.875
275000	2 3/4	Blank	j	2.73	2.312	0.500	—	—	—
275025	2 3/4	1/4	i	2.73	2.312	0.500	.209	0.255	0.125
275050	2 3/4	1/2	j	2.73	2.312	0.500	.209	0.505	0.375
275075	2 3/4	3/4	j	2.73	2.312	0.500	.209	0.755	0.625
275100	2 3/4	1	j	2.73	2.312	0.500	.209	1.010	0.875
275125	2 3/4	1 1/4	j	2.73	2.312	0.500	.209	1.255	1.125
275150	2 3/4	1 1/2	j	2.73	2.312	0.500	.209	1.510	1.375
338000	3 3/8	Blank	i	3.37	2.850	0.680	—	—	—
338150	3 3/8	1 1/2	j	3.37	2.850	0.680	.225	1.510	1.375
338200	3 3/8	2	j	3.37	2.850	0.680	.225	2.010	1.875
450000	4 1/2	Blank	i	4.47	3.628	0.750	—	—	—
450150	4 1/2	1 1/2	j	4.47	3.628	0.750	.375	1.510	1.375
450200	4 1/2	2	j	4.47	3.628	0.750	.375	2.010	1.875
450250	4 1/2	2 1/2	j	4.47	3.628	0.750	.375	2.510	2.375
462000	4 5/8	Blank	i	4.62	4.030	0.810	—	—	—
462250	4 5/8	2 1/2	j	4.62	4.030	0.810	.375	2.510	2.375
462300	4 5/8	3	j	4.62	4.030	0.810	.375	3.010	2.875
600000	6	Blank	i	5.97	5.128	0.840	—	—	—
600400	6	4	j	5.97	5.128	0.840	.437	4.010	3.810
675000	6 3/4	5	i	6.75	5.969	0.840	—	—	—
675400	6 3/4	Blank	j	6.75	5.969	0.840	.460	4.010	3.870
675500	6 3/4	6	j	6.75	5.969	0.840	.460	5.010	4.870
800000	8	Blank	i	7.97	7.128	0.940	—	—	—
800600	8	6	j	7.97	7.128	0.940	.500	6.020	5.810
1000000	10	Blank	i	9.97	9.128	0.970	—	—	—
1000800	10	8	j	9.97	9.128	0.970	.500	8.020	7.810
1325000	13 1/4	Blank	i	13.25	12.060	1.120	—	—	—
13251000	13 1/4	10	j	13.25	12.060	1.120	.500	10.020	9.860
13251075	13 1/4	10 3/4	j	13.25	12.060	1.120	.500	10.765	10.630
1400000	14	Blank	i	14.00	12.810	1.120	—	—	—
14001200	14	12	j	14.00	12.810	1.120	.500	12.020	11.750
1650000	16 1/2	Blank	i	16.50	15.310	1.120	—	—	—
16501400	16 1/2	14	j	16.50	15.310	1.120	.500	14.020	13.750

*See drawings on page 7-15

Bolt Holes		Ship Wt. lbs	Assembly Hardware		
No.	Dia.		Model No.	Description	Qty. per pkg.
6	.172	.50	GK-133	OFE copper gaskets	10
6	.172	.50	VG-133	Viton gaskets	5
6	.172	.50	B-8-75N	Bolt & nut set 8-32 x .75”	25
6	.172	.50			
6	.172	.50			
4	.265	.75	GK-212	OFE copper gaskets	10
4	.265	.50	VG-212	Viton gaskets	5
4	.265	.50	B-25-125N	Bolt & nut set 1/4-28 x 1 25”	25
6	.265	1.00	GK-275	OFE copper gaskets	10
6	.265	.75	VG-275	Viton gaskets	5
6	.265	.75	B-25-150N	Bolt & nut set 1/4-28x 1.50”	25
6	.265	.75			
6	.265	.75			
6	.265	.75			
6	.265	.75			
8	.332	2.00	GK-338	OFE copper gaskets	10
8	.332	1.75	VG-338	Viton gaskets	1
8	.332	1.75	B-31-175N	Bolt & nut set 5/16-24x 1.75”	25
8	.332	2.50	GK-450	OFE copper gaskets	10
8	.332	2.00	VG-450	Viton gaskets	1
8	.332	2.00	B-31-200N	Bolt & nut set 5/16-24 x 2.0”	25
8	.332	2.00			
10	.332	3.00	GK-462	OFE copper gaskets	10
10	.332	2.50	VG-462	Viton gaskets	1
10	.332	2.50	B-31-225N	Bolt & nut set 5/16-24 x 2.25”	25
16	.332	6.50	GK-600	OFE copper gaskets	10
16	.332	4.50	VG-600	Viton gaskets	1
			B-31-225N	Bolt & nut set 5/16-24 x 2.25”	25
18	.332	7.00	GK-675	OFE copper gaskets	10
18	.332	5.00	VG-675	Viton gaskets	1
18	.332	5.00	B-31-225N	Bolt & nut set 5/16-24 x 2.25”	25
20	.332	10.00	GK-800	OFE copper gaskets	10
20	.332	7.00	VG-800	Viton gaskets	1
			B-31-225N	Bolt & nut set 5/16-24 x 2.25”	25
24	.332	15.00	GK-1000	OFE copper gaskets	10
24	.332	12.00	VG-1000	Viton gaskets	1
			B-31-250N	Bolt & nut set 5/16-24 x 2.25”	25
30	.390	50.00	GK-1325	OFE copper gaskets	1
30	.390	40.00	VG-1325	Viton gaskets	1
30	.390	40.00	B-38-300N	Bolt & nut set 3/8-24 x 3.0”	30
30	.390	50.00			
30	.390	16.00			
36	.390	65.00			
36	.390	22.00			

Contact factory for further information.
Wire seal flanges recommended for these sizes.
See pages 7-20 through 7-23.

7 Tapped Non-Rotatable UHV Flanges

Dimensions in inches

Model No.*	Nom. O.D.	Nom. I.D.	Dwg.*	A O.D.	B Bolt Circle	C Thickness	D Setback	E I.D.	F I.D.
133000T	1 1/3	Blank	f	1.33	1.062	0.285	—	—	—
133025T	1 1/3	1/4	g	1.33	1.062	0.285	—	—	0.260
133038T	1 1/3	3/8	g	1.33	1.062	0.285	—	—	0.380
133050T	1 1/3	1/2	g	1.33	1.062	0.285	—	—	0.510
133075T	1 1/3	3/4	h	1.33	1.062	0.285	—	0.750	0.630
212000T	2 1/8	Blank	i	2.12	1.625	0.470	—	—	—
212075T	2 1/8	3/4	j	2.12	1.625	0.470	.170	0.760	0.625
212100T	2 1/8	1	j	2.12	1.625	0.470	.170	1.010	0.875
275000T	2 3/4	Blank	j	2.73	2.312	0.500	—	—	—
275025T	2 3/4	1/4	i	2.73	2.312	0.500	.209	0.255	0.125
275050T	2 3/4	1/2	j	2.73	2.312	0.500	.209	0.505	0.375
275075T	2 3/4	3/4	j	2.73	2.312	0.500	.209	0.755	0.625
275100T	2 3/4	1	j	2.73	2.312	0.500	.209	1.010	0.875
275125T	2 3/4	1 1/4	j	2.73	2.312	0.500	.209	1.255	1.125
275150T	2 3/4	1 1/2	j	2.73	2.312	0.500	.209	1.510	1.375
338000T	3 3/8	Blank	i	3.37	2.850	0.680	—	—	—
338150T	3 3/8	1 1/2	j	3.37	2.850	0.680	.225	1.510	1.375
338200T	3 3/8	2	j	3.37	2.850	0.680	.225	2.010	1.875
450000T	4 1/2	Blank	i	4.47	3.628	0.750	—	—	—
450150T	4 1/2	1 1/2	j	4.47	3.628	0.750	.375	1.510	1.375
450200T	4 1/2	2	j	4.47	3.628	0.750	.375	2.010	1.875
450250T	4 1/2	2 1/2	j	4.47	3.628	0.750	.375	2.510	2.375
462000T	4 5/8	Blank	i	4.62	4.030	0.810	—	—	—
462250T	4 5/8	2 1/2	j	4.62	4.030	0.810	.375	2.510	2.375
462300T	4 5/8	3	j	4.62	4.030	0.810	.375	3.010	2.875
600000T	6	Blank	i	5.97	5.128	0.840	—	—	—
600400T	6	4	j	5.97	5.128	0.840	.437	4.010	3.810
675000T	6 3/4	5	i	6.75	5.969	0.840	—	—	—
675400T	6 3/4	Blank	j	6.75	5.969	0.840	.460	4.010	3.870
675500T	6 3/4	6	j	6.75	5.969	0.840	.460	5.010	4.870
800000T	8	Blank	i	7.97	7.128	0.940	—	—	—
800600T	8	6	j	7.97	7.128	0.940	.500	6.020	5.810
1000000T	10	Blank	i	9.97	9.128	0.970	—	—	—
1000800T	10	8	j	9.97	9.128	0.970	.500	8.020	7.810
1325000T	13 1/4	Blank	i	13.25	12.060	1.120	—	—	—
13251000T	13 1/4	10	j	13.25	12.060	1.120	.500	10.020	9.860
13251075T	13 1/4	10 3/4	j	13.25	12.060	1.120	.500	10.765	10.630
1400000T	14	Blank	i	14.00	12.810	1.120	—	—	—
14001200T	14	12	j	14.00	12.810	1.120	.500	12.020	11.750
1650000T	16 1/2	Blank	i	16.50	15.310	1.120	—	—	—
16501400T	16 1/2	14	j	16.50	15.310	1.120	.500	14.020	13.750

*See drawings on page 7-15.

We reserve the right to substitute threaded inserts.

(360) 385-7707

thermionics laboratory, inc.
Vacuum Innovation Since 1958

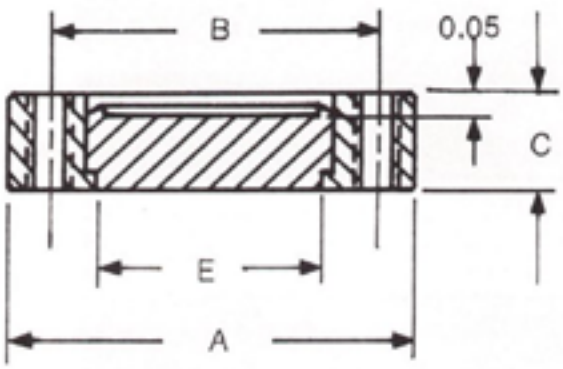
sales@thermionics.com

Bolt Holes		Ship Wt.	Assembly Hardware		
No.	Dia.	lbs	Model No.	Description	Qty. per pkg.
6	.172	.50	GK-133	OFE copper gaskets	10
6	.172	.50	VG-133	Viton gaskets	5
6	.172	.50	B-8-50	Bolt & nut set 8-32 x 0.5”	25
6	.172	.50			
6	.172	.50			
4	.265	.75	GK-212	OFE copper gaskets	10
4	.265	.50	VG-212	Viton gaskets	5
4	.265	.50	B-25-87	Bolt & nut set 1/4-28 x .875”	25
6	.265	1.00	GK-275	OFE copper gaskets	10
6	.265	.75	VG-275	Viton gaskets	5
6	.265	.75	B-25-87	Bolt & nut set 1/4-28x .875”	25
6	.265	.75			
6	.265	.75			
6	.265	.75			
6	.265	.75			
8	.332	2.00	GK-338	OFE copper gaskets	10
8	.332	1.75	VG-338	Viton gaskets	1
8	.332	1.75	B-31-125	Bolt & nut set 5/16-24x 1.25”	25
8	.332	2.50	GK-450	OFE copper gaskets	10
8	.332	2.00	VG-450	Viton gaskets	1
8	.332	2.00	B-31-125	Bolt & nut set 5/16-24 x 1.25”	25
8	.332	2.00			
10	.332	3.00	GK-462	OFE copper gaskets	10
10	.332	2.50	VG-462	Viton gaskets	1
10	.332	2.50	B-31-125	Bolt & nut set 5/16-24 x 1.25”	25
16	.332	6.50	GK-600	OFE copper gaskets	10
16	.332	4.50	VG-600	Viton gaskets	1
			B-31-125	Bolt & nut set 5/16-24 x 1.25”	25
18	.332	7.00	GK-675	OFE copper gaskets	10
18	.332	5.00	VG-675	Viton gaskets	1
18	.332	5.00	B-31-125	Bolt & nut set 5/16-24 x 1.25”	25
20	.332	10.00	GK-800	OFE copper gaskets	10
20	.332	7.00	VG-800	Viton gaskets	1
			B-31-175	Bolt & nut set 5/16-24 x 1.75”	25
24	.332	15.00	GK-1000	OFE copper gaskets	10
24	.332	12.00	VG-1000	Viton gaskets	1
			B-31-175	Bolt & nut set 5/16-24 x 2.25”	25
30	.390	50.00	GK-1325	OFE copper gaskets	1
30	.390	40.00	VG-1325	Viton gaskets	1
30	.390	40.00	B-38-200	Bolt & nut set 3/8-24 x 2.0”	30
30	.390	50.00			
30	.390	16.00			
36	.390	65.00			
36	.390	20.00			

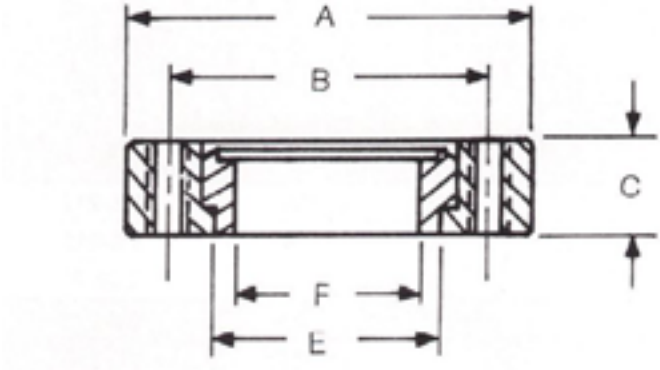
Contact factory for further information.
Wire seal flanges recommended for these sizes.
See pages 7-20 through 7-23.

7 Physical Dimensions

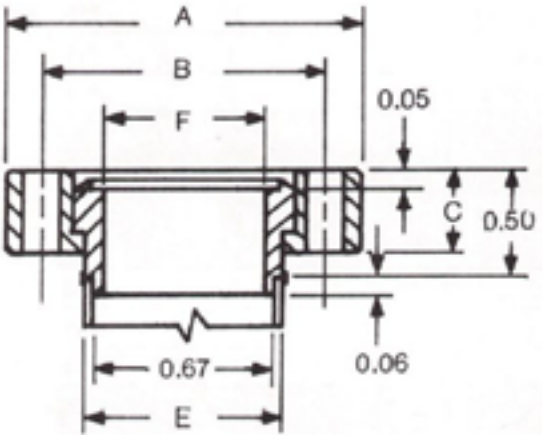
Mini Flanges—Rotatable and Tapped Rotatable Page 7-6 to 7-9



Drawing A



Drawing B

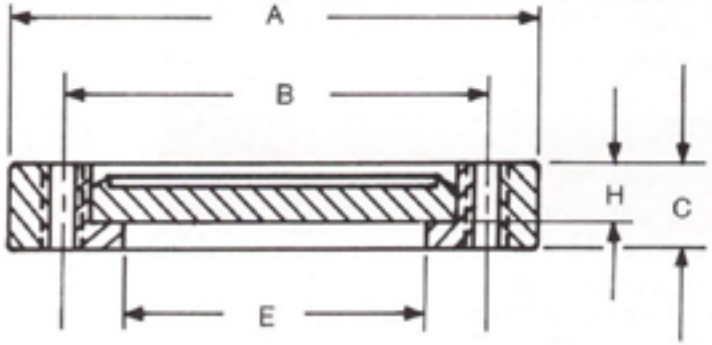


Drawing C (shown welded to tubing)

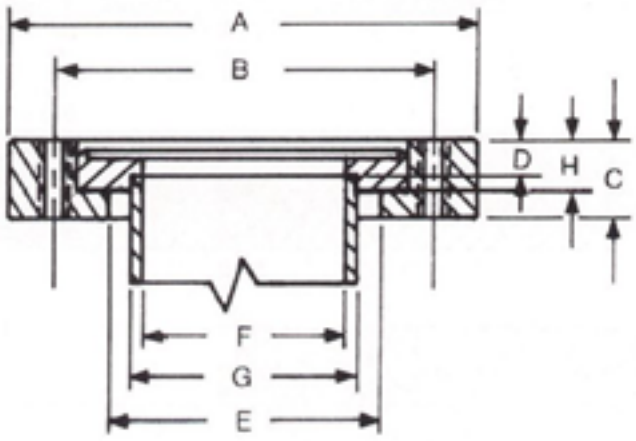
Assembly Technique

1. Check cleanliness of gasket and seal area. If necessary, clean using UHV technique. Note: Gaskets are cleaned before packaging and are ready to use as received.
2. Inspect knife edges on both flanges for damage. Small nicks will not affect sealing, but large nicks can cause leaks.
3. Assemble joint with bolts finger tight.
4. Visually check that gasket is centered.
5. Tighten bolts evenly until flanges touch. Do not overtighten
   Maximum torque required to seal flanges:
   Mini and 2 3/4": 16 ft-lbs
   3 3/8" and larger: 26 ft-lbs
6. After the initial bakeout, it is good practice to check the tightness of the bolts. It is not necessary on subsequent bakeouts.

Standard Flanges—Rotatable and Tapped Rotatable Page 7-6 to 7-9



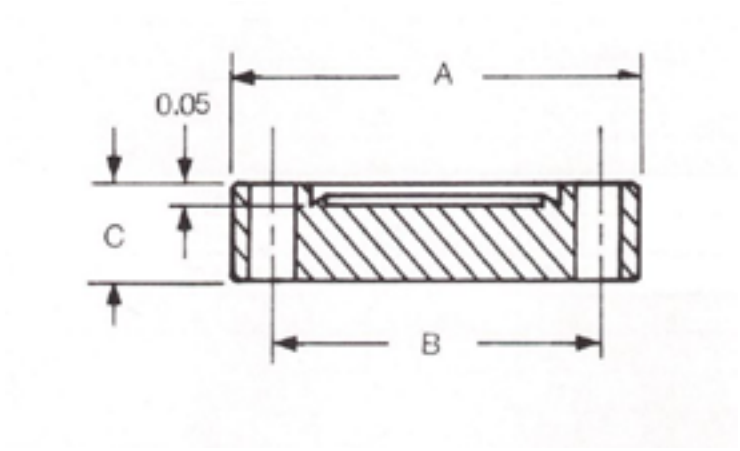
Drawing D



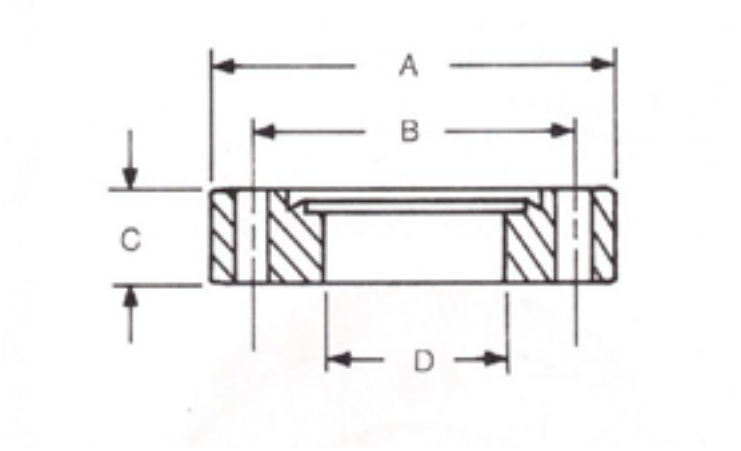
Drawing E

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

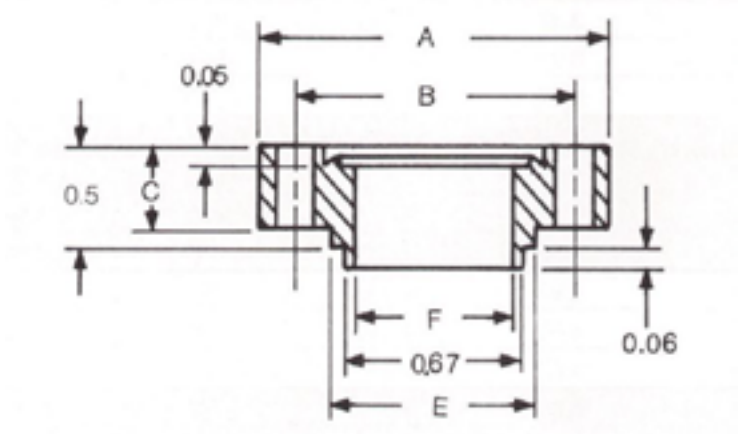
Mini Flanges—Integral and Tapped Integral Page 7-10 to 7-13



Drawing F

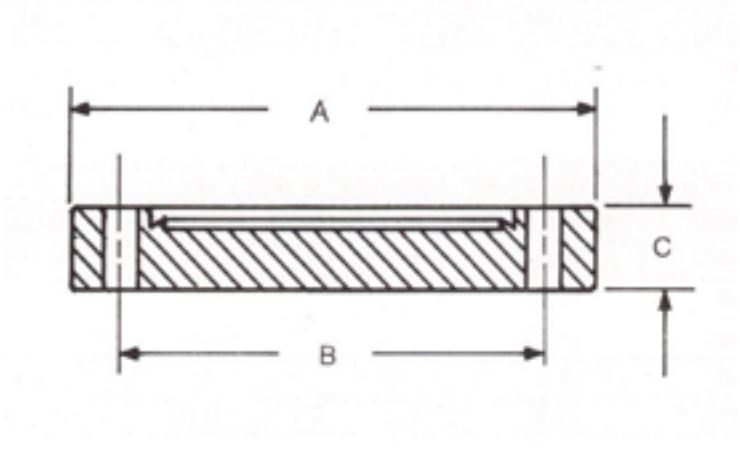


Drawing G

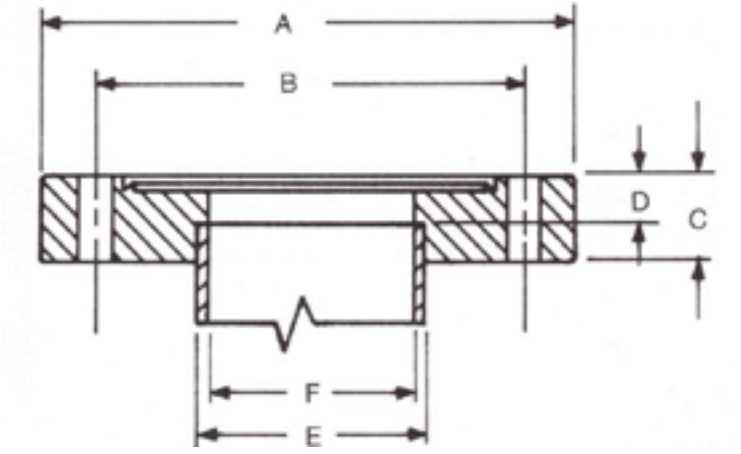


Drawing H

Standard Flanges—Integral and Tapped Integral Page 7-10 to 7-13



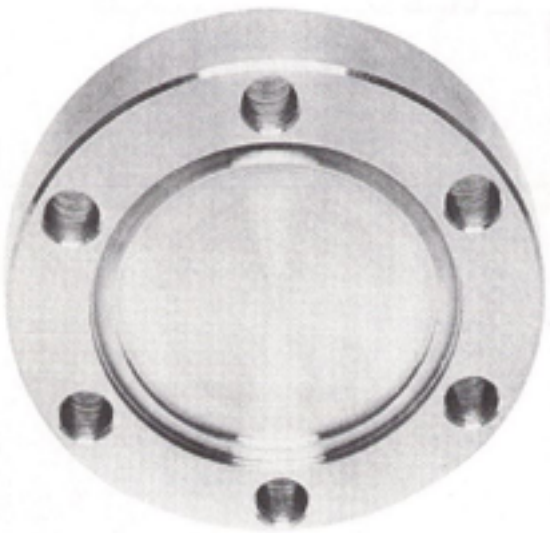
Drawing I

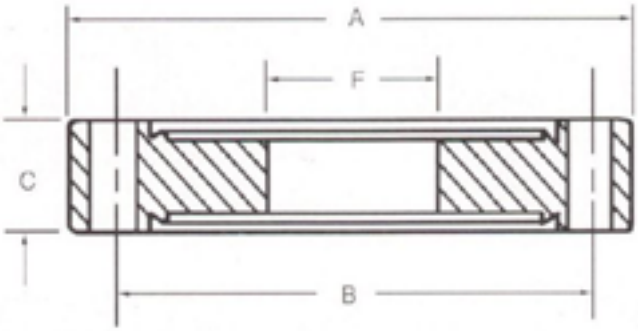


Drawing J

7 Double-Sided Flanges

Double-sided flanges are designed to be inserted between two flanges of the same size, providing a simple method for adding both thermocouple gauge tubes and up-to-air valves to a system with virtually no change in conductance or pumping speed. Refer to Section 8, page 8-24 for special purpose flanges supplied with valves and tubes installed.





Dimensions in inches

Model No.*	A O.D.	B Bolt Circle	C Thickness	F I.D.
D-133000	1.33	1.062	0.285	blank
D-133025	1.33	1.062	0.285	0.250
D-133037	1.33	1.062	0.285	0.380
D-133050	1.33	1.062	0.285	0.500
D-212000	2.12	1.625	0.470	blank
D-212075	2.12	1.625	0.470	0.750
D-212100	2.12	1.625	0.470	1.000
D-275000	2.75	2.312	0.750	blank
D-275025	2.75	2.312	0.750	0.250
D-275050	2.75	2.312	0.750	0.500
D-275075	2.75	2.312	0.750	0.750
D-275100	2.75	2.312	0.750	1.000
D-275125	2.75	2.312	0.750	1.250
D-275150	2.75	2.312	1.000	1.500
D-275150-1	2.75	2.312	1.000	1.500
D-338000	3.37	2.850	0.620	blank
D-338150	3.37	2.850	0.620	1.500
D-338200	3.37	2.850	0.620	2.000
D-450000	4.50	3.628	0.680	blank
D-450150	4.50	3.628	0.680	1.500
D-450200	4.50	3.628	0.680	2.000
D-450250	4.50	3.628	0.680	2.500
D-462000	4.62	4.030	0.750	blank
D-462250	4.62	4.030	0.750	2.500
D-462300	4.62	4.030	0.750	3.000
D-600000	6.00	5.128	0.780	blank
D-600400	6.00	5.128	0.780	4.000
D-675000	6.75	5.969	0.840	blank
D-675400	6.75	5.969	0.840	4.000
D-675500	6.75	5.969	0.840	5.000
D-800000	8.00	7.128	0.870	blank
D-800600	8.00	7.128	0.870	6.000
D-1000000	10.00	9.128	0.970	blank
D-1000800	10.00	9.128	0.970	8.000
D-1325000	13.25	12.060	1.120	blank
D-13251000	13.25	12.060	1.120	10.00
D-13251075	13.25	12.060	1.120	10.750
D-1400000	14.00	12.810	1.120	blank
D-14001200	14.00	12.810	1.120	12.000
D-1650000	16.50	15.310	1.120	blank
D-16501400	16.50	15.310	1.120	14.000

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Bolt Holes		Nom. Size	Ship Wt. lbs
No.	Dia.		
6	.172	1 1/3	.50
6	.172	1 1/3	.50
6	.172	1 1/3	.50
6	.172	1 1/3	.50
4	.265	2 1/8	.75
4	.265	2 1/8	.50
4	.265	2 3/4	.50
6	.265	2 3/4	.75
6	.265	2 3/4	.75
6	.265	2 3/4	.75
6	.265	2 3/4	.75
6	.265	2 3/4	.50
6	.265	2 3/4	.50
6	.265	2 3/4	.50
6	.265	2 3/4	.75
8	.332	3 /3/8	2.00
8	.332	3 /3/8	1.50
8	.332	3 /3/8	1.50
8	.332	4 1/2	3.00
8	.332	4 1/2	2.50
8	.332	4 1/2	2.50
8	.332	4 1/2	2.00
10	.332	4 5/8	3.00
10	.332	4 5/8	2.00
10	.332	4 5/8	2.00
16	.332	6	6.00
16	.332	6	4.00
18	.332	6 3/4	7.00
18	.332	6 3/4	6.50
18	.332	6 3/4	6.50
20	.332	8	9.00
20	.332	8	6.00
24	.332	10	15.00
24	.332	10	12.00
30	.390	13 1/4	50.00
30	.390	13 1/4	40.00
30	.390	13 1/4	40.00
30	.390	14	—
30	.390	14	—
36	.390	16 1/2	—
36	.390	16 1/2	—

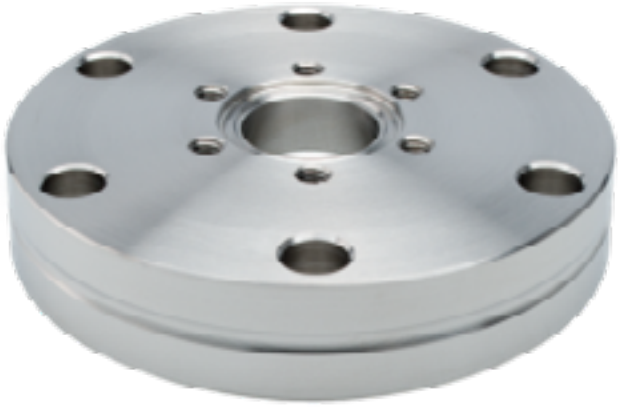
Assembly Hardware		
Model No.	Description	Qty. per pkg.
GK-133	OFE copper gaskets	10
VG-133	Viton gaskets	5
B-8-125D	Bolt & nut set 8-32 x 1.25”	6
GK-212	OFE copper gaskets	10
VG-212	Viton gaskets	5
B-25-200D	Bolt & nut set 1/4-28 x 2.0”	4
GK-275	OFE copper gaskets	10
VG-275	Viton gaskets	5
B-25-225D	Bolt & nut set 1/4-28 x 2 25”	6
B-25-250D	Bolt & nut set (for 1” thick flange) 1/4-28 x 2 5”	6
GK-338	OFE copper gaskets	10
VG-338	Viton gaskets	1
B-31-225D	Bolt & nut set 5/16-24 x 2.25”	8
GK-450	OFE copper gaskets	10
VG-450	Viton gaskets	1
B-31-250D	Bolt & nut set 5/16-24 x 2.5”	8
GK-462	OFE copper gaskets	10
VG-462	Viton gaskets	1
B-31-275D	Bolt & nut set 5/16-24 x 2.75”	10
GK-600	OFE copper gaskets	10
VG-600	Viton gaskets	1
B-31-275D	Bolt & nut set 5/16-24 x 2.75”	16
GK-675	OFE copper gaskets	10
VG-675	Viton gaskets	1
B-31-300D	Bolt & nut set 5/16-24 x 3.0”	18
GK-800	OFE copper gaskets	10
VG-800	Viton gaskets	1
B-31-325D	Bolt & nut set 5/16-24 x 3.25”	20
GK-1000	OFE copper gaskets	10
VG-1000	Viton gaskets	1
B-31-350D	Bolt & nut set 5/16-24 x 3.5”	24
GK-1325	OFE copper gaskets	1
VG-1325	Viton gaskets	1
B-38-400D	Bolt & nut set 3/8-24 x 4.0”	30

Contact factory for further information.
Wire seal flanges recommended for these sizes.
See pages 7-20 through 7-23.

7 Reducing Flanges

Reducing flanges, also known as adapter flanges, offer the simplest and least expensive method of mating two different sized flanges. Details of various size combinations are machined on opposite sides of reducing flanges. To connect two sizes, the appropriate reducing flange is inserted between the two and bolted into place. Conductance and pumping speed remain virtually unchanged.

Custom sizes and geometries are available.



Dimensions in inches

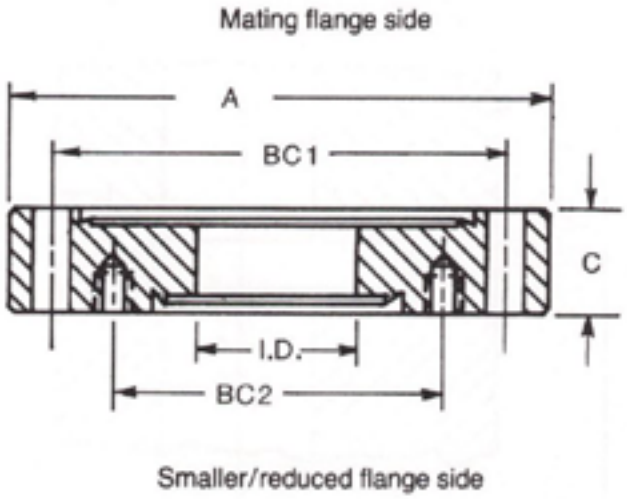
	Mating Flange Side			Smaller Flange Side					Ordering Information
Model No.*	Nom. Size	A O.D.	BC1	Nom. Size	I.D.	BC2	Thread BC2	C	Ship Wt. lbs
212 x 133T*	2.12	2.12	1.625	1.33	0.62	1.060	8-32	.470	.5
275 x 133	2.75	2.73	2.312	1.33	0.62	1.060	8-32	.500	.5
275 x 212T*	2.75	2.73	2.312	2.12	1.00	1.625	.25-28	.500	.5
338 x 133	3.37	3.37	2.850	1.33	0.62	1.060	8-32	.620	2.0
338 x 212	3.37	3.37	2.850	2.12	1.00	1.625	.25-28	.620	2.0
338 x 275T*	3.37	3.37	2.850	2.75	1.50	2.312	.25-28	.620	1.5
450 x 133	4.50	4.47	3.628	1.33	0.62	1.060	8-32	.680	3.5
450 x 212	4.50	4.47	3.628	2.12	1.00	1.625	.25-28	.680	3.5
450 x 275	4.50	4.47	3.628	2.75	1.50	2.312	.25-28	.680	3.0
450 x 338T*	4.50	4.47	3.628	3.37	2.00	2.850	.31-24	.680	3.0
462 x 133	4.62	4.62	4.030	1.33	0.62	1.060	8-32	.750	4.0
462 x 212	4.62	4.62	4.030	2.12	1.00	1.625	.25-28	.750	4.0
462 x 275	4.62	4.62	4.030	2.75	1.50	2.312	.25-28	.750	4.0
462 x 338	4.62	4.62	4.030	3.37	2.00	2.850	.31-24	.750	3.5
600 x 133	6.00	5.97	5.128	1.33	0.62	1.060	8-32	.780	6.5
600 x 212	6.00	5.97	5.128	2.12	1.00	1.625	.25-28	.780	6.5
600 x 275	6.00	5.97	5.128	2.75	1.50	2.312	.25-28	.780	6.5
600 x 338	6.00	5.97	5.128	3.37	2.00	2.850	.31-24	.780	6.0
600 x 450	6.00	5.97	5.128	4.50	2.50	3.628	.31-24	.780	6.0
600 x 462	6.00	5.97	5.128	4.62	3.00	4.030	.31-24	.780	5.5
675 x 133	6.75	6.75	5.969	1.33	0.62	1.060	8-32	.840	7.0
675 x 212	6.75	6.75	5.969	2.12	1.00	1.625	.25-28	.840	7.0
675 x 275	6.75	6.75	5.969	2.75	1.50	2.312	.25-28	.840	7.0
675 x 338	6.75	6.75	5.969	3.37	2.00	2.850	.31-24	.840	6.5
675 x 450	6.75	6.75	5.969	4.50	2.50	3.628	.31-24	.840	6.5
675 x 462	6.75	6.75	5.969	4.62	3.00	4.030	.31-24	.840	6.0
675 x 600T*	6.75	6.75	5.969	6.00	4.00	5.128	.31-24	.840	5.5

**T indicates that both sets of bolt holes are threaded.*

(360) 385-7707

thermionics laboratory, inc.
Vacuum Innovation Since 1958

sales@thermionics.com



Dimensions in inches

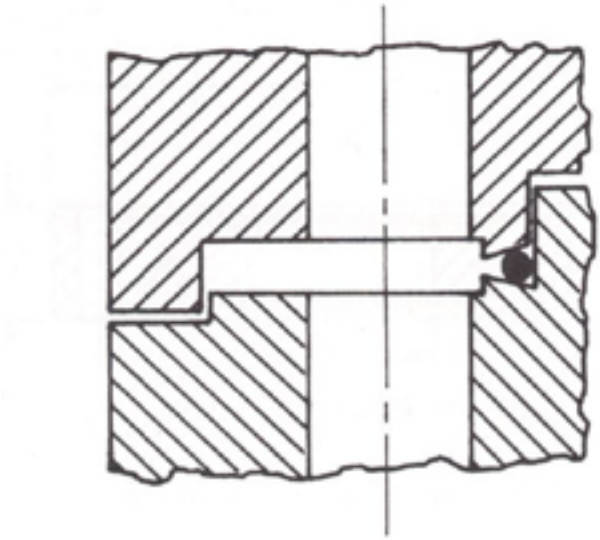
	Mating Flange Side			Smaller Flange Side					Ordering Information
Model No.*	Nom. Size	A O.D.	BC1	Nom. Size	I.D.	BC2	Thread BC2	C	Ship Wt. lbs
800 x 133	8.00	7.97	7.128	1.33	0.62	1.060	8-32	0.880	12.0
800 x 212	8.00	7.97	7.128	2.12	1.00	1.625	.25-28	0.880	12.0
800 x 275	8.00	7.97	7.128	2.75	1.50	2.312	.25-28	0.880	11.5
800 x 338	8.00	7.97	7.128	3.37	2.00	2.850	.31-24	0.880	11.5
800 x 450	8.00	7.97	7.128	4.50	2.50	3.628	.31-24	0.880	11.0
800 x 462	8.00	7.97	7.128	4.62	3.00	4.030	.31-24	0.880	11.0
800 x 600	8.00	7.97	7.128	6.00	4.00	5.128	.31-24	0.880	10.5
800 x 675T*	8.00	7.97	7.128	6.75	5.00	5.969	.31-24	0.880	10.5
1000 x 133	10.00	9.97	9.128	1.33	0.62	1.060	8-32	0.970	22.0
1000 x 212	10.00	9.97	9.128	2.12	1.00	1.625	.25-28	0.970	22.0
1000 x 275	10.00	9.97	9.128	2.75	1.50	2.312	.25-28	0.970	22.0
1000 x 338	10.00	9.97	9.128	3.37	2.00	2.850	.31-24	0.970	21.0
1000 x 450	10.00	9.97	9.128	4.50	2.50	3.628	.31-24	0.970	20.0
1000 x 462	10.00	9.97	9.128	4.62	3.00	4.030	.31-24	0.970	20.0
1000 x 600	10.00	9.97	9.128	6.00	4.00	5.128	.31-24	0.970	19.0
1000 x 675	10.00	9.97	9.128	6.75	5.00	5.969	.31-24	0.970	18.0
1000 x 800	10.00	9.97	9.128	8.00	6.00	7.128	.31-24	0.970	18.0
1325 x 133	13.25	13.25	12.060	1.33	0.62	1.060	8-32	1.120	41.0
1325 x 212	13.25	13.25	12.060	2.12	1.00	1.625	.25-28	1.120	41.0
1325 x 275	13.25	13.25	12.060	2.75	1.50	2.312	.25-28	1.120	41.0
1325 x 338	13.25	13.25	12.060	3.37	2.00	2.850	.31-24	1.120	40.0
1325 x 450	13.25	13.25	12.060	4.50	2.50	3.628	.31-24	1.120	39.0
1325 x 462	13.25	13.25	12.060	4.62	3.00	4.030	.31-24	1.120	39.0
1325 x 600	13.25	13.25	12.060	6.00	4.00	5.128	.31-24	1.120	37.0
1325 x 675	13.25	13.25	12.060	6.75	5.00	5.969	.31-24	1.120	37.0
1325 x 800	13.25	13.25	12.060	8.00	6.00	7.128	.31-24	1.120	34.0
1325 x 1000	13.25	13.25	12.060	10.00	8.00	9.128	.31-24	1.120	30.0

**T indicates that both sets of bolt holes are threaded.*

7 Bolt-Type Wire Seal Flanges

Reducing flanges, also known as adapter flanges, offer the simplest and least expensive method of mating two different sized flanges. Details of various size combinations are machined on opposite sides of reducing flanges. To connect two sizes, the appropriate reducing flange is inserted between the two and bolted into place. Conductance and pumping speed remain virtually unchanged.

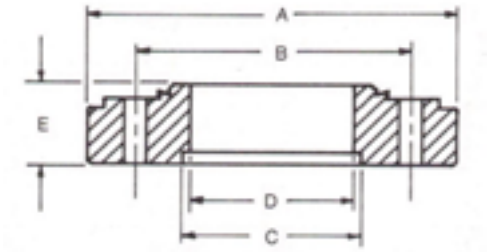
Custom sizes and geometries are available.



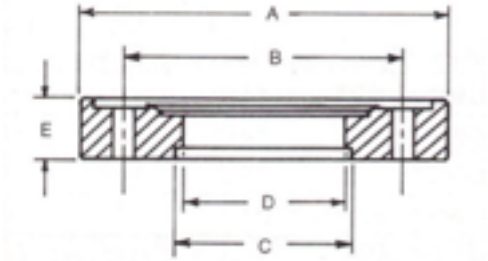
Cross section drawing of wire seal gasket before compression.

Dimensions in inches

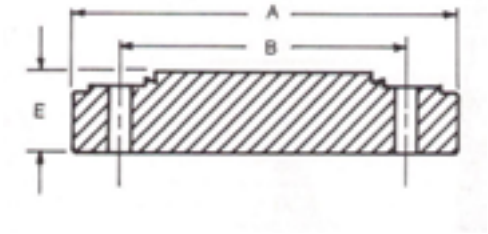
Model No.	A Flange O.D.	B Bolt Circle	No. of Bolt Holes	C Tube O.D.	D Flange I.D.	E Thickness
BWS12-00M	12.375	11.343	24	10”	blank	1.125
BWS12-10F	12.375	11.343	24	10”	9.750	1.125
BWS12-10M	12.375	11.343	24	10”	9.750	1.125
BWS12-00F	12.375	11.343	24	10”	blank	1.125
BWS14-00M	14.625	13.593	32	12”	blank	1.125
BWS14-12F	14.625	13.593	32	12”	11.750	1.125
BWS14-12M	14.625	13.593	32	12”	11.750	1.125
BWS14-00F	14.625	13.593	32	12”	blank	1.125
BWS17-00M	17.250	15.718	36	14”	blank	1.125
BWS17-14F	17.250	15.718	36	14”	13.750	1.125
BWS17-14M	17.250	15.718	36	14”	13.750	1.125
BWS17-00F	17.250	15.718	36	14”	blank	1.125
BWS19-00M	19.562	17.875	36	16”	blank	1.312
BWS19-16F	19.562	17.875	36	16”	15.750	1.312
BWS19-16M	19.562	17.875	36	16”	15.750	1.312
BWS19-00F	19.562	17.875	36	16”	blank	1.312
BWS22-00M	22.125	20.187	36	18”	blank	1.500
BWS22-18F	22.125	20.187	36	18”	17.750	1.500
BWS22-18M	22.125	20.187	36	18”	17.750	1.500
BWS22-00F	22.125	20.187	36	18”	blank	1.500
BWS27-00M	27.125	25.843	40	24”	blank	1.750
BWS27-24F	27.125	25.843	40	24”	23.750	1.750
BWS27-24M	27.125	25.843	40	24”	23.750	1.750
BWS27-00F	27.125	25.843	40	24”	blank	1.750



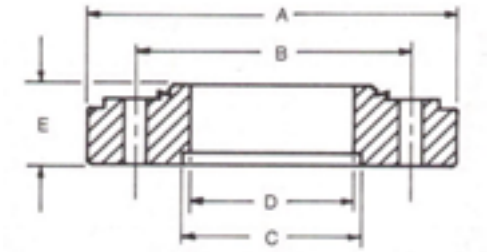
Bored male wire seal flange



Bored female wire seal flange



Blank male wire seal flange



Blank female wire seal flange

Dimensions in inches

Flange			Gaskets		Bolt Sets	
Model No.	Nom. Flange Size	Type	Model No.	Qty. per pkg.	Model No.	Qty. per pkg.
BWS12-00M	12.37	male	GW-120	1	GW-120	24
BWS12-10F	12.37	female				
BWS12-10M	12.37	male				
BWS12-00F	12.37	female				
BWS14-00M	14.52	male	GW-140	1	BW-140	32
BWS14-12F	14.52	female				
BWS14-12M	14.52	male				
BWS14-00F	14.52	female				
BWS17-00M	17.25	male	GW-170	1	BW-170	36
BWS17-14F	17.25	female				
BWS17-14M	17.25	male				
BWS17-00F	17.25	female				
BWS19-00M	19.56	male	GW-190	1	BW-190	36
BWS19-16F	19.56	female				
BWS19-16M	19.56	male				
BWS19-00F	19.56	female				
BWS22-00M	22.12	male	GW-220	1	BW-220	36
BWS22-18F	22.12	female				
BWS22-18M	22.12	male				
BWS22-00F	22.12	female				
BWS27-00M	27.12	male	GW-270	1	BW-270	40
BWS27-24F	27.12	female				
BWS27-24M	27.12	male				
BWS27-00F	27.12	female				

7 Clamp-Type Wire Seal Flanges

TLI has flanges for the entire range of UHV applications. Clamp -type wire seal flanges are used where an existing flange must be matched or space requirements preclude the use of bolt-type flanges. Standard sizes vary from 12” tube to 36” pipe diameters. Custom flanges can be supplied.

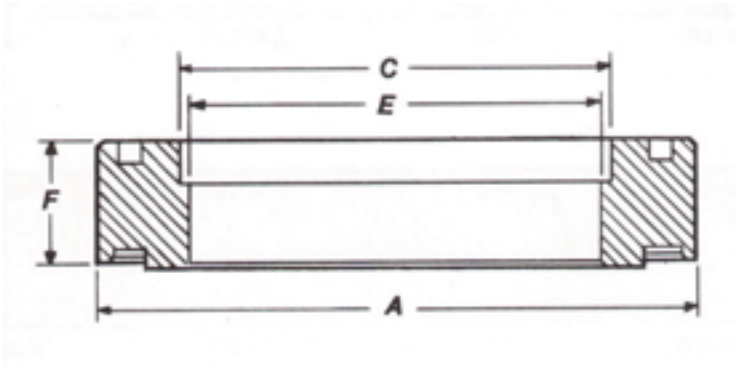
As is the case with all TLI UHV flanges, the clamp-type wire seal flange is made of type 304 stainless steel . It is usually used with a .090” diameter OFF copper gasket for bakeout temperatures of up to 450°C. For leak checking or use at temperatures below 120°C, a reuseable Viton gasket may be used. Note that these gaskets are not interchangeable with bolt-type wire seal flange gaskets.

To ensure long-term seal reliability under repeated bakeout at elevated temperatures, super-high tensile strength clamping hardware is supplied, thus matching the thermal expansion coefficient of the flanges.

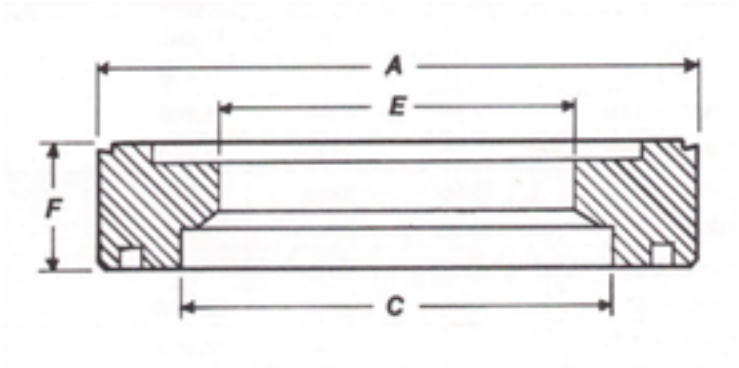
NOTE: Wire seal blank flanges with a domed head insert available at reduced prices. Consult factory for information.

Dimensions in inches

Model No.	A Flange O.D.	C Tube O.D.	E Flange I.D	Tube I.D.	F Thickness	Flange Type
CWS-14-00M	14.0	—	blank	—	1.56	Male
CWS-14-12F	14.0	12.0	11.75	11.75	1.56	Female
CWS-14-12M	14.0	12.0	11.75	11.75	1.56	Male
CWS-14-00F	14.0	—	blank	—	1.56	Female
CWS-17-00M	16.0	—	blank	—	1.56	Male
CWS-17-14F	16.0	14.0	13.75	13.75	1.56	Female
CWS-17-14M	16.0	14.0	13.75	13.75	1.56	Male
CWS-17-00F	16.0	—	blank	—	1.56	Female
CWS-19-00M	18.0	—	blank	—	1.56	Male
CWS-19-16F	18.0	16.0	15.75	15.75	1.56	Female
CWS-19-16M	18.0	16.0	15.75	15.75	1.56	Male
CWS-19-00F	18.0	—	blank	—	1.56	Female
CWS-22-00M	20.0	—	blank	—	1.56	Male
CWS-22-18F	20.0	18.0	17.75	17.75	1.56	Female
CWS-22-18M	20.0	18.0	17.75	17.75	1.56	Male
CWS-22-00F	20.0	—	blank	—	1.56	Female
CWS-27-00M	26.0	—	blank	—	1.56	Male
CWS-27-24F	26.0	24.0	23.75	23.75	1.56	Female
CWS-27-24M	26.0	24.0	23.75	23.75	1.56	Male
CWS-27-00F	26.0	—	blank	—	1.56	Female
CWS-41-00M	41.0	—	blank	—	2.00	Male
CWS-41-36F	41.0	36.0	35.75	35.75	2.00	Female
CWS-41-36M	41.0	36.0	35.75	35.75	2.00	Male
CWS-41-00F	41.0	—	blank	—	2.00	Female



Clamp-Type Wire Seal Flange-Female



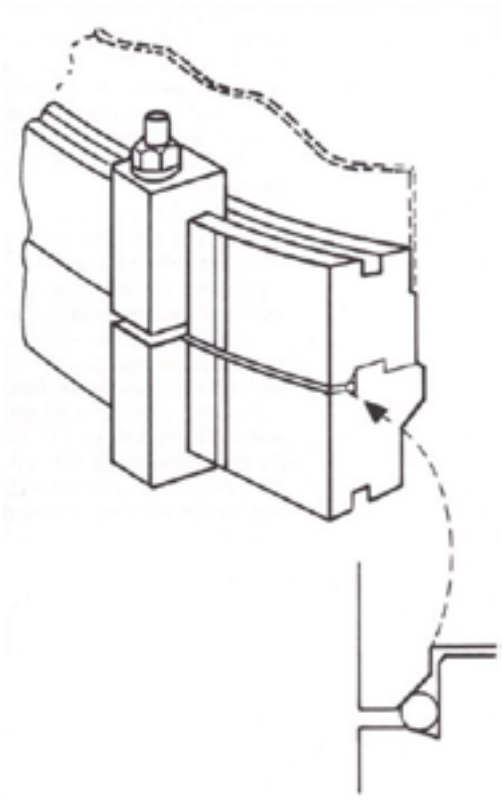
Clamp-Type Wire Seal Flange-Male

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

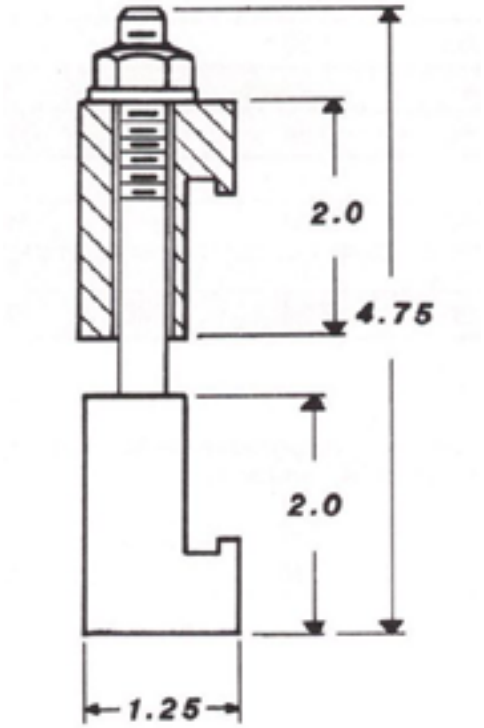
Dimensions in inches

Clamp-Type Hardware	
Model No.	**Description**
GWC-140	OFE copper gasket
GWV-140	Viton gasket
GWS-100	Clamp (each) -18 clamps required
GWC-170	OFE copper gasket
GWV-170	Viton gasket
GWS-100	Clamp (each) - 20 clamps required
GWC-190	OFE copper gasket
GWV-190	Viton gasket
GWS-100	Clamp (each) - 22 clamps required
GWC-220	OFE copper gasket
GWV-220	Viton gasket
GWS-100	Clamp (each) - 24 clamps required
GWC-270	OFE copper gasket
GWV-270	Viton gasket
GWS-100	Clamp (each) - 32 clamps required
GWC-410	OFE copper gasket
GWV-410	Viton gasket
GWS-100	Clamp (each) - 42 clamps required

NOTE: Clamp-type wire seal gaskets are made of .090" diameter OFE copper



NOTE: Factory installation of a 6" skirt recommended. (Skirt shown with dotted lines.)



Clamp

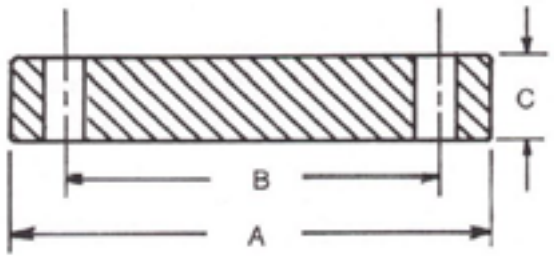
7 ASA Flanges

ASA-style smooth face flanges mate with standard ASA 150-lb 0-ring flanges for use to 10-8 Torr. These ASA flanges are fabricated from type 304 stainless steel with a surface finish of 32 micro-inches on both sides. All corners are chamfered 45°. Four flange sizes are offered, blank or bored, to fit four standard tube sizes.

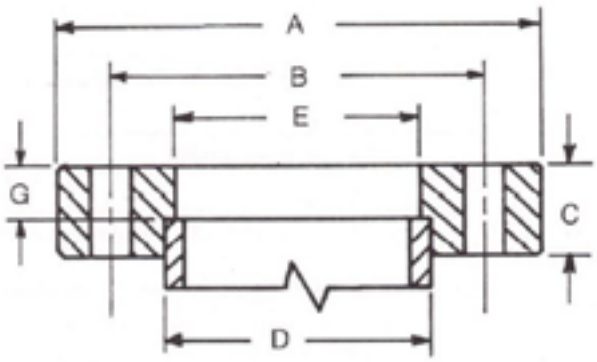
Applications include use with various types of vacuum chambers, manifolds, furnaces, diffusion pump stations, valves, test equipment, pumps, special viewports, and a variety of experimental devices.

NOTE: Model No. ASA-5B matches the foreline connector for a 6" diffusion pump. ASA-6B matches the top flange of a 2" diffusion pump, while ASA-9B and ASA-11B match the top flange of 4" and 6" diffusion pumps, respectively. Flanges may be welded or brazed to the connecting tubulation.

Contact Thermionics for custom ASA assemblies.



Blank Flange



Bored Flange (shown with tubing in place)

Dimensions in inches

Model No.	Type	A O.D.	B Bolt Circle	Bolt Holes		C Thickness	D Bore	E I.D.	G Step
				No.	Dia.				
ASA-5	blank	5.00	3.88	4	.625	.50	—	—	—
ASA-5B	bored	5.00	3.88	4	.625	.50	1.63	1.50	.340
ASA-6	blank	6.00	4.75	4	.750	.50	—	—	—
ASA-6B	bored	6.00	4.75	4	.750	.50	3.50	3.34	.340
ASA-9	blank	9.00	7.50	8	.687	.50	—	—	—
ASA-9B	bored	9.00	7.50	8	.687	.50	5.50	5.34	.340
ASA-11	blank	11.00	9.50	8	.812	.75	—	—	—
ASA-11B	bored	11.00	9.50	8	.812	.75	7.50	7.34	.340

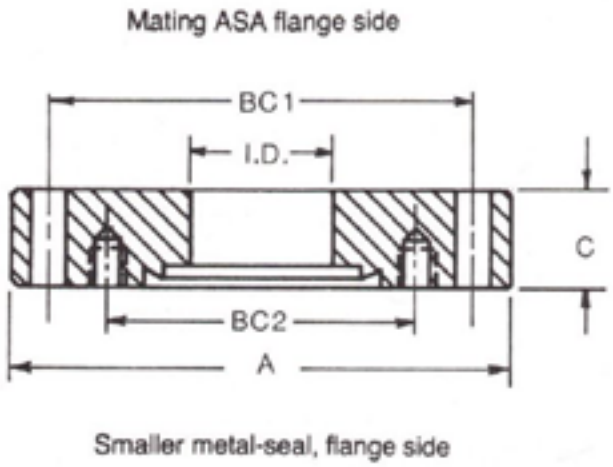
For optional O-ring grooves in ASA flanges, use suffix "/OR," and add:

ASA 5" O.D.	ASA 9" O.D.
ASA 6" O.D	ASA 11" O.D

(360) 385-7707

thermionics laboratory, inc.
Vacuum Innovation Since 1958

sales@thermionics.com



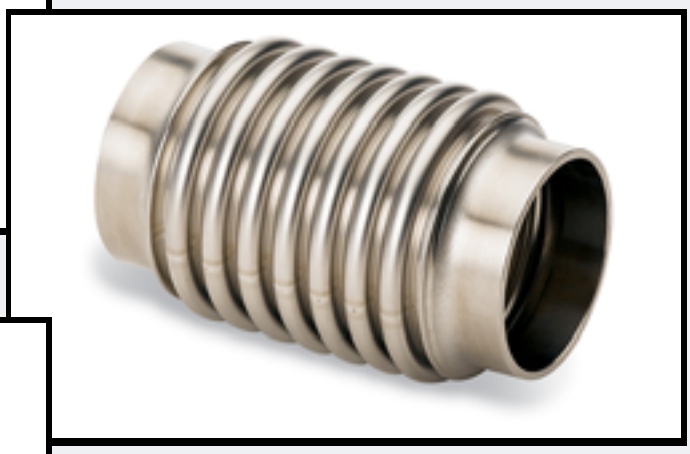
Dimensions in inches

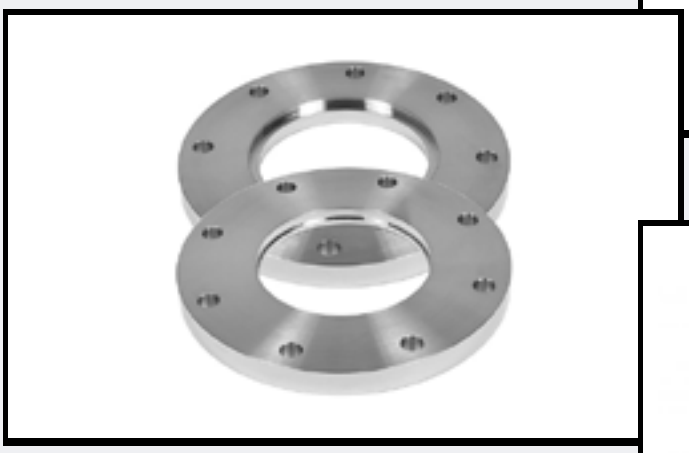
Model No.	ASA Flange Side		Metal Seal Flange Side				C Thickness	Ship. Wt. lbs
	A O.D.	BC1	Nom. Size	I.D.	BC2	BC2 Tap Size		
ASA5-133	5	3.880	1.33	0.625	1.062	8-32	.500	3.5
ASA5-212	5	3.880	2.12	1.000	1.625	.25-28	.500	3.5
ASA5-275	5	3.880	2.75	1.500	2.312	.25-28	.500	3.0
ASA6-133	6	4.750	1.33	0.625	1.062	8-32	.500	4.0
ASA6-212	6	4.750	2.23	1.000	1.625	.25-28	.500	4.0
ASA6-275	6	4.750	2.75	1.500	2.312	.25-28	.500	3.5
ASA6-338	6	4.750	3.37	2.000	2.850	5/16-24	.500	3.5
ASA9-133	9	7.500	1.33	0.625	1.062	8-32	.500	7.5
ASA9-212	9	7.500	2.12	1.000	1.625	.25-28	.500	7.0
ASA9-275	9	7.500	2.75	1.500	2.312	.25-28	.500	7.0
ASA9-338	9	7.500	3.37	2.000	2.850	5/16-24	.500	6.5
ASA9-450	9	7.500	4.50	2.500	3.628	5/16-24	.500	6.5
ASA9-462	9	7.500	4.62	3.000	4.030	5/16-24	.500	6.0
ASA9-600	9	7.500	6.00	4.000	5.128	5/16-24	.500	6.0
ASA11-133	11	9.500	1.33	0.625	1.062	8-32	.750	21.0
ASA11-212	11	9.500	2.12	1.000	1.625	.25-28	.750	21.0
ASA11-275	11	9.500	2.75	1.500	2.312	.25-28	.750	20.5
ASA11-338	11	9.500	3.37	2.000	2.850	5/16-24	.750	20.0
ASA11-450	11	9.500	4.50	2.500	3.628	5/16-24	.750	19.0
ASA11-462	11	9.500	4.62	3.000	4.030	5/16-24	.750	19.0
ASA11-600	11	9.500	6.00	4.000	5.128	5/16-24	.750	17.0
ASA11-675	11	9.500	6.75	5.000	5.968	5/16-24	.750	17.0
ASA11-800	11	9.500	8.00	6.000	7.128	5/16-24	.750	15.0

For optional O-ring grooves in ASA flanges, use suffix "/OR," and add:

ASA 5" O.D.	ASA 9" O.D.
ASA 6" O.D	ASA 11" O.D

Fittings, Accessories and Hardware





Fittings, Accessories and Hardware

Fittings

Accessories

Hardware

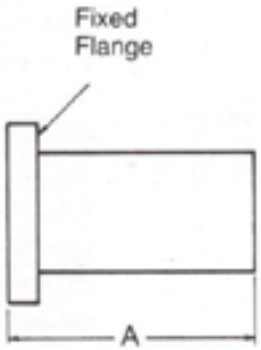
Note: Bolt Sets for Standard Flanges are listed with the Flanges in Section 7

Traps

TLI UHV flanges and fittings are 100% compatible with ConFlat flanges.

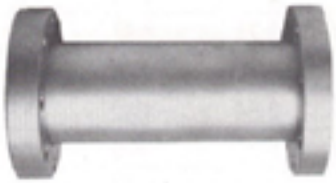
Dimensions in inches

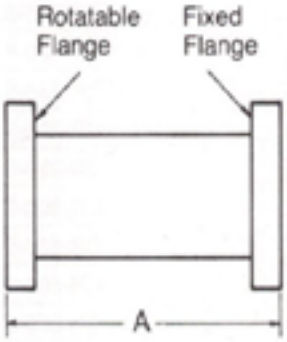
Half-Nipples



Model No.	Tube O.D.	A	Flange O.D.	Ship Wt. lbs
HN-075	0.75	1.50	1.33	0.75
HN-100	1.00	2.09	2.12	1.0
HN-150	1.50	2.46	2.75	1.5
HN-200	2.00	3.21	3.37	2.0
HN-250	2.50	4.12	4.50	6.0
HN-300	3.00	3.53	4.62	8.0
HN-400	4.00	5.31	6.00	11.0
HN-500	5.00	4.93	6.75	12.0
HN-600	6.00	6.56	8.00	19.0
HN-800	8.00	8.00	10.00	25.0
HN-1000	10.00	10.00	13.25	45.0

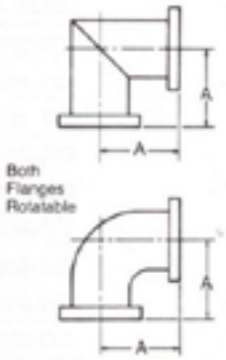
Nipples





Model No.	Tube O.D.	A	Flange O.D.	Ship Wt. lbs
NN-075	0.75	3.00	1.33	1.5
NN-100	1.00	4.18	2.12	2.0
NN-150	1.50	4.93	2.75	2.0
NN-200	2.00	6.43	3.37	3.0
NN-250	2.50	8.25	4.50	8.0
NN-300	3.00	7.06	4.62	10.0
NN-400	4.00	10.62	6.00	15.0
NN-500	5.00	9.87	6.75	19.0
NN-600	6.00	13.12	8.00	24.0
NN-800	8.00	16.00	10.00	34.0
NN-1000	10.00	20.00	13.25	75.0

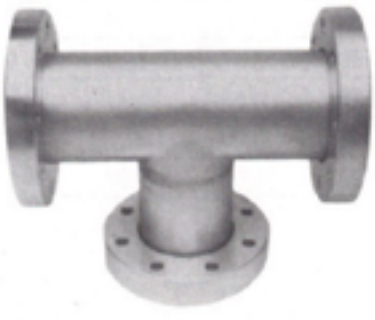
Elbows

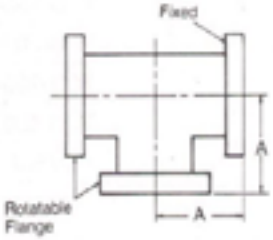


Model No.	Tube O.D.	A	Flange O.D.	Ship Wt. lbs
EL-075*	0.75	1.50	1.33	1.5
EL-100	1.00	2.04	2.12	2.0
EL-150*	1.50	2.46	2.75	2.0
EL-200*	2.00	3.21	3.37	5.0
EL-250*	2.50	4.12	4.50	8.0
EL-300	3.00	3.34	4.62	13.0
EL-400	4.00	5.31	6.00	15.0
EL-500	5.00	4.93	6.75	20.0
EL-600	6.00	6.56	8.00	24.0
EL-800	8.00	8.00	10.00	34.0
EL-1000	10.00	10.00	13.25	75.0

*Radius elbows. Other sizes are mitred.

Tees

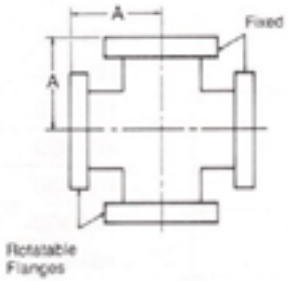




Model No.	Tube O.D.	A	Flange O.D.	Ship Wt. lbs
TE-075	0.75	1.50	1.33	2.0
TE-100	1.00	2.04	2.12	2.5
TE-150	1.50	2.46	2.75	4.0
TE-200	2.00	3.21	3.37	6.0
TE-250	2.50	4.12	4.50	11.0
TE-300	3.00	3.34	4.62	17.0
TE-400	4.00	5.31	6.00	21.0
TE-500	5.00	4.93	6.75	30.0
TE-600	6.00	6.56	8.00	34.0
TE-800	8.00	8.00	10.00	40.0
TE-1000	10.00	10.00	13.25	100.0

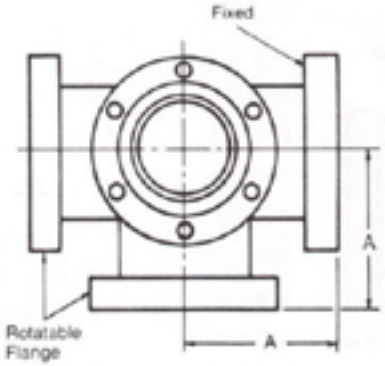
8 CF Fittings

4-Way Crosses



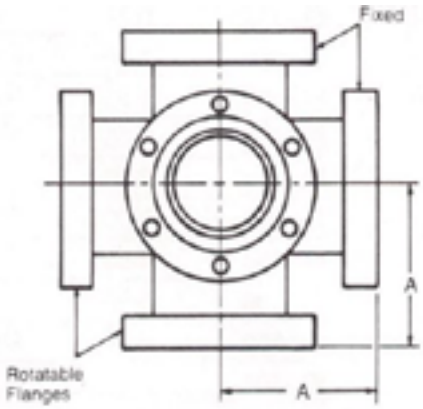
Model No.	Tube O.D.	A	Flange O.D.	Ship Wt. lbs
CR-075-4	0.75	1.50	1.33	2.5
CR-100-4	1.00	2.04	2.12	3.5
CR-150-4	1.50	2.46	2.75	5.0
CR-200-4	2.00	3.21	3.37	7.0
CR-250-4	2.50	4.12	4.50	14.0
CR-300-4	3.00	3.34	4.62	17.0
CR-400-4	4.00	5.31	6.00	26.0
CR-500-4	5.00	4.93	6.75	31.0
CR-600-4	6.00	6.56	8.00	44.0
CR-800-4	8.00	8.00	10.00	45.0
CR-1000-4	10.00	10.00	13.25	130.0

5-Way Crosses



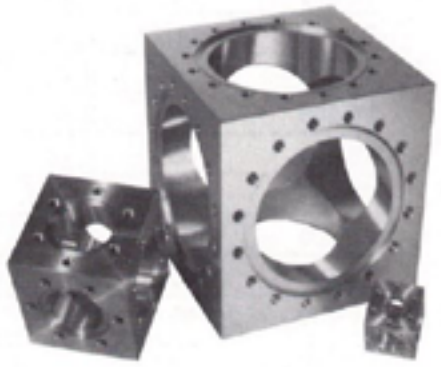
Model No.	Tube O.D.	A	Flange O.D.	Ship Wt. lbs
CR-075-5	0.75	1.50	1.33	4.0
CR-100-5	1.00	2.04	2.12	5.0
CR-150-5	1.50	2.46	2.75	6.5
CR-200-5	2.00	3.21	3.37	17.0
CR-250-5	2.50	4.12	4.50	20.0
CR-300-5	3.00	3.34	4.62	34.0
CR-400-5	4.00	5.31	6.00	37.0
CR-500-5	5.00	4.93	6.75	57.0
CR-600-5	6.00	6.56	8.00	63.0
CR-800-5	8.00	8.00	10.00	70.0
CR-1000-5	10.00	10.00	13.25	170.0

6-Way Crosses



Model No.	Tube O.D.	A	Flange O.D.	Ship Wt. lbs
CR-075-6	0.75	1.50	1.33	5.5
CR-100-6	1.00	2.04	2.12	6.5
CR-150-6	1.50	2.46	2.75	8.0
CR-200-6	2.00	3.21	3.37	22.0
CR-250-6	2.50	4.12	4.50	26.0
CR-300-6	3.00	3.34	4.62	43.0
CR-400-6	4.00	5.31	6.00	48.0
CR-500-6	5.00	4.93	6.75	75.0
CR-600-6	6.00	6.56	8.00	82.0
CR-800-6	8.00	8.00	10.00	95.0
CR-1000-6	10.00	10.00	13.25	200.0

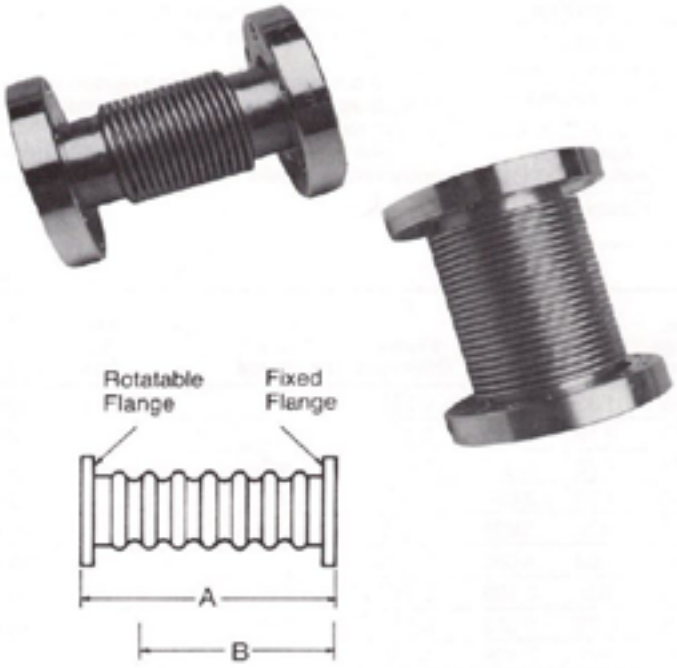
6-Way Cubes (Fabricated from solid blocks of forged steel)



Model No.	A	Flange Size	Cube Height	Ship Wt. lbs
TCU-075-6	0.67	1.33	1.33	1.0
TCU-150-6	1.38	2.75	3.00	3.0
TCU-200-6	1.68	3.37	3.37	5.0
TCU-250-6	2.23	4.50	4.47	8.0
TCU-400-6	2.98	6.00	5.97	16.0
TCU-600-6	3.98	8.00	7.97	30.0

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

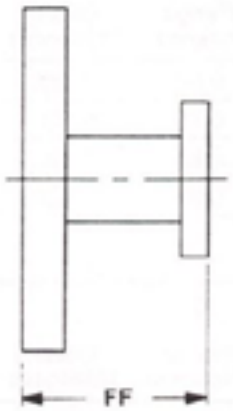
Flexible Couplings



Model No.	Bellows I.D.	A (free)	B (Compressed)	Nom. Flange Size	Ship Wt. lbs
FX-075	0.62	3.00	2.62	1.33	1.5
FX-075-10	0.62	10.00	9.00	1.33	1.5
FX-100	0.75	3.34	2.93	2.12	2.0
FX-150	1.25	3.34	2.93	2.75	2.0
FX-200	1.62	4.00	3.50	3.37	4.5
FX-250	2.00	6.25	5.46	4.50	7.0
FX-300	2.50	7.25	6.50	4.62	7.5
FX-400	3.50	7.62	6.62	6.00	13.0
FX-500	4.00	8.00	7.00	6.75	15.0
FX-600	5.50	9.00	8.00	8.00	18.0
FX-800	7.50	10.00	9.00	10.00	28.0
FX-1000	10.00	11.00	10.00	13.25	80.0

Custom lengths available

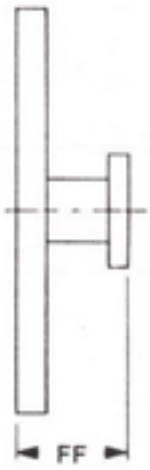
Reducing Nipples



Model No.	Tube	F-F
RN-275x133	0.75	2.50
RN-450x133	0.75	2.50
RN-450x275	1.50	2.75
RN-450x338	2.00	3.00
RN-600x133	0.75	3.00
RN-600x275	1.50	3.25
RN-600x338	2.00	3.50
RN-600x450	2.50	3.50
RN-800x133	0.75	3.75
RN-800x275	1.50	3.75

Model No.	Tube	F-F
RN-800x338	2.00	4.00
RN-800x450	2.50	4.00
RN-800x600	4.00	4.25
RN-1000x133	0.75	4.25
RN-1000x275	1.50	4.25
RN-1000x338	2.00	4.50
RN-1000x450	2.50	4.50
RN-1000x600	4.00	4.50
RN-1000x800	6.00	4.50

ASA to UHV Reducing Nipples



Model No.	Tube	F-F
RN-ASA5x133	0.75	2.50
RN-ASA5x275	1.50	2.75
RN-ASA5x338	1.50	3.50
RN-ASA5x450	1.50	3.75
RN-ASA6x133	0.75	2.50
RN-ASA6x275	1.50	2.75
RN-ASA6x338	2.00	3.50
RN-ASA6x450	2.50	3.75
RN-ASA9x133	0.75	2.50
RN-ASA9x275	1.50	2.75
RN-ASA9x338	2.00	3.50
RN-ASA9x450	2.50	3.75
RN-ASA9x600	4.00	4.25

Model No.	Tube	F-F
RN-ASA9x800	5.00	4.25
RN-ASA11x133	0.75	3.00
RN-ASA11x275	1.50	3.25
RN-ASA11x338	2.00	3.75
RN-ASA11x450	2.50	4.25
RN-ASA11x600	4.00	4.50
RN-ASA11x800	6.00	4.50
RN-ASA11x1000	6.00	5.00

For optional O-ring grooves in ASA flanges, use suffix "/OR," and add:

ASA 5" O.D.	ASA 9" O.D.
ASA 6" O.D	ASA 11" O.D

8 Viewports

Viewport Specifications

	Useful Transmission Range in Microns-80% Minimum	Bakeout Temperature	Window-to-Sleeve Transition
Zero profile wide angle glass	0.32 to 2.7	400°C	Matched-expansion seal
Nonmagnetic glass	0.32 to 2.7	400°C	Housekeeper seal
Quartz	0.29 to 2.0	200°C max.	Lead alloy (melts at 300°C)
Sapphire	0.25 to 5.5	450°C	Brazed joint

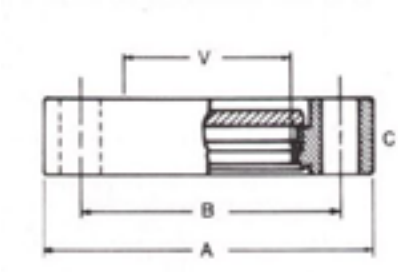
Thermionics viewports are mounted in UHV stainless steel flanges in the sizes noted below. Useable to below 1 x 10^{-11} Torr. Polished window surfaces offer a minimum of distortion and provide maximum light transmission.

The custom viewports are available for special applications, i.e., special materials and/or optical properties.

Refer to the flange section (Section 7) for assembly hardware information.

Zero Profile, Wide-Angle Viewports

7056 glass with Kovar sleeves and stainless steel flanges

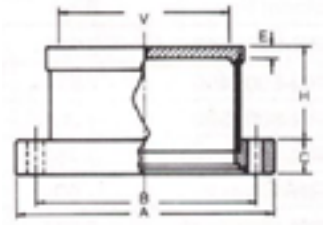


Dimensions in inches

Model No.	V Viewing Dia.	Nom. Flange Size	A Flange O.D.	B Bolt Circle	C Flange Thickness	E Glass Thickness	Ship Wt. lbs
ZPV-075	0.625	1.33	1.33	1.062	0.285	0.062	1.0
ZPV-100	0.625	2.12	2.12	1.625	0.470	0.062	1.0
ZPV-150	1.40	2.75	2.75	2.312	0.625	0.105	1.0
ZPV-200	1.40	3.37	3.37	2.850	0.625	0.105	2.0
ZPV-250	2.69	4.50	4.50	3.628	0.680	0.175	4.0
ZPV-300	2.69	4.62	4.62	4.030	0.750	0.175	5.0
ZPV-400	3.88	6.00	6.00	5.128	0.780	0.200	6.0
ZPV-500	3.88	6.75	6.75	5.969	0.840	0.200	7.0
ZPV-600	5.38	8.00	8.00	7.128	0.880	0.375	9.0
ZPV-800	5.38	8.00	10.0	9.128	0.970	0.375	10.0

Non-magnetic Viewports

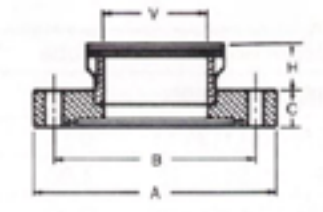
7056 glass with stainless steel sleeves and flanges



Model No.	V Viewing Dia.	Nom. Flange Size	A Flange O.D.	B Bolt Circle	C Flange Thickness	E Glass Thickness	H Window Sleeve Extension	Ship Wt. lbs
NMV-150	1.37	2.75	2.75	2.312	0.50	0.120	1.75	1.0
NMV-250	2.50	4.50	4.5	3.628	0.75	0.120	1.75	4.5
NMV-400	3.50	6.00	6.0	5.128	0.84	0.220	1.75	6.0
NMV-600	5.38	8.00	8.0	7.128	0.94	0.220	2.00	10.0

Quartz Viewports

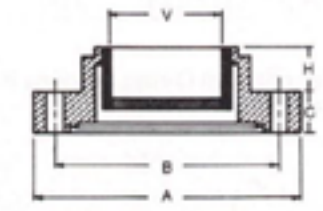
With stainless steel sleeves and flanges



Model No.	V Viewing Dia.	Nom. Flange Size	A Flange O.D.	B Bolt Circle	C Flange Thickness	E Glass Thickness	H Window Sleeve Extension	Ship Wt. lbs
QVP-150	1.37	2.75	2.75	2.312	0.50	0.125	0.56	3.0
QVP-250	2.37	4.50	4.5	3.628	0.75	0.250	0.78	6.0
QVP-400	3.84	6.00	6.0	5.128	0.84	0.250	1.00	9.0
QVP-600	5.78	8.00	8.0	7.128	0.94	0.375	1.31	13.0
QVP-800	7.78	10.00	10.0	9.128	0.97	0.375	1.49	17.0

Sapphire Viewports

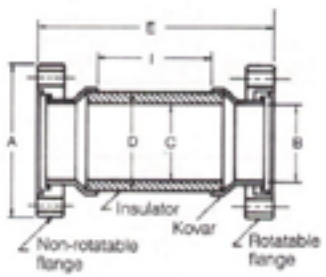
With Kovar sleeves and stainless steel flanges



Model No.	V Viewing Dia.	Nom. Flange Size	A Flange O.D.	B Bolt Circle	C Flange Thickness	E Glass Thickness	H Window Sleeve Extension	Ship Wt. lbs
SVP-075	0.625	1.33	1.33	1.060	0.28		0.062	0.5
SVP-100	1.000	2.75	2.75	2.312	0.50		0.062	2.0
SVP-200	2.000	4.50	4.5	3.628	0.75		0.125	4.0

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

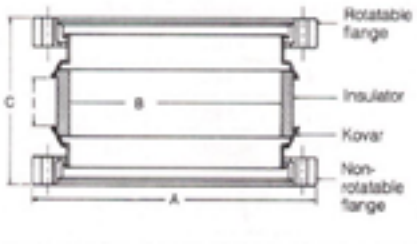
Ceramic-to-Metal Adapters 8



TLI ceramic-to-metal adapters for high and ultra-high vacuum system applications requiring high voltage insulation. Supplied with one rotatable and one non-rotatable metal seal flange for easy installation. Bakeable to 450°C. Feature high reliability, leak tight at 1 x 10^{-10} atm cc/sec helium. Maximum voltage ratings as noted in the tables below.

Dimensions in inches

Model No.	Voltage Rating	Nom. Flange	A	B	C	D	E	I
TCB-075	10 kV RMS	1 1/3	1.33	0.63	0.75	1.00	3.63	1.00
TCB-125	15 kV RMS	2 3/4	2.75	1.21	1.25	1.63	4.20	2.00

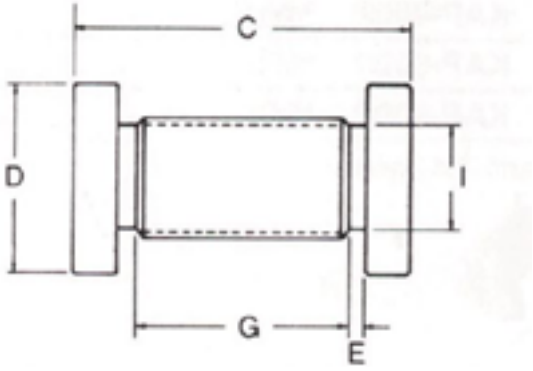


Model No.	Voltage Rating	Nom. Flange	A	B	C	I Min
TCE-250	7.5 kV RMS	4 1/2	1.5	2.50	4.50	0.75
TCE-350	7.5 kV RMS	6	6.0	3.50	4.62	0.75
TCE-600	15 kV RMS	8	8.0	6.00	5.50	1.50
TCE-775	15 kV RMS	10	10.0	7.75	5.75	1.50

Glass-to-Metal Adapters

Double-Ended Glass Adapters

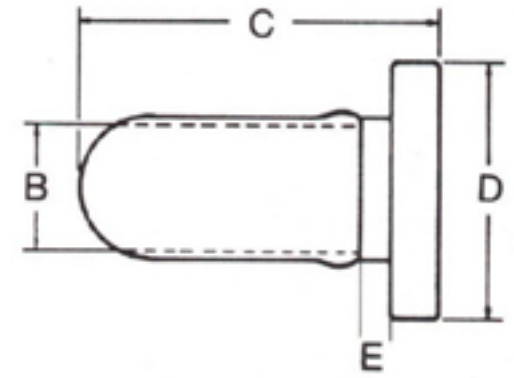
7052 glass to Kovar. Bakeable to 400°C. Pyrex or stainless steel available on request. Other lengths designed to customer's specifications also available on request. Both flanges are non-rotatable unless otherwise specified.



Dimensions in inches

Model No.	C	I Nom I.D	G Nom. Glass Length	D Nom Flange Size	I
TDEG-075	3.00	0.50	1.4	1.33	.500
TDEG-100	3.00	0.75	1.0	2.12	.500
TDEG-150	3.00	1.25	1.0	2.75	.500
TDEG-200	4.50	1.62	1.0	3.37	.500
TDEG-250	4.50	2.12	1.5	4.50	.750
TDEG-300	4.50	2.50	1.5	4.62	.750
TDEG-400	4.50	3.50	1.3	6.00	.750
TDEG-500	4.50	4.37	1.3	6.75	.750
TDEG-600	4.50	5.37	1.1	8.00	.750

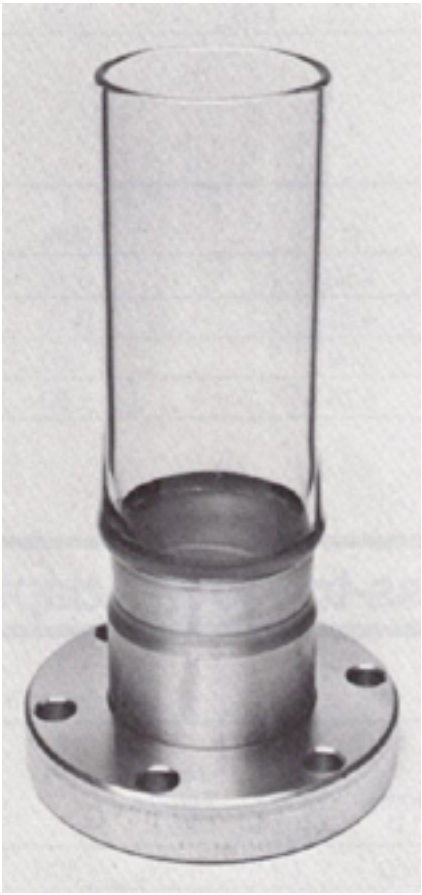
Sealed-Off Glass Adapters

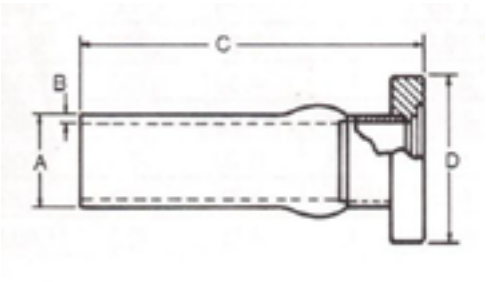


Model No.	C	I Nom I.D	G Nom. Glass Length	D Nom Flange Size	I
TDEG-075	3.00	0.50	1.4	1.33	.500
TDEG-100	3.00	0.75	1.0	2.12	.500
TDEG-150	3.00	1.25	1.0	2.75	.500
TDEG-200	4.50	1.62	1.0	3.37	.500
TDEG-250	4.50	2.12	1.5	4.50	.750
TDEG-300	4.50	2.50	1.5	4.62	.750
TDEG-400	4.50	3.50	1.3	6.00	.750
TDEG-500	4.50	4.37	1.3	6.75	.750
TDEG-600	4.50	5.37	1.1	8.00	.750

8 Glass-to-Metal Adapters

Glass-to-metal adapters for attachment of glass accessories to metal high vacuum systems and for mounting UHV flange devices to glass systems. Standard adapters offer a choice of 7052 glass/Kovar sleeve or 7740 Pyrex/type 304 stainless steel sleeve non-magnetic combination. Both types are bakeable to 400°C and are useable to below 10^{-10} Torr.





Dimensions in inches

304 S.S. to 7740 Pyrex Model No.	Kovar to 7740 Pyrex Model No.	A Nom. Glass O.D.	B Glass Thickness	C 304 S.S. to 7740 Pyrex	C Kovar to 7740 Pyrex	D Flange O.D.
GAP-012P-S	KAP-012P	1/8	.060	4.750	5.250	1.33
GAP-018P-S	KAP-018P	3/16	.060	4.750	5.250	1.33
GAP-025P-S	KAP-025P	1/4	.060	4.750	5.250	1.33
GAP-031P-S	KAP-031P	5/16	.060	4.750	5.250	1.33
GAP-037P-S	KAP-037P	3/8	.080	4.750	5.250	1.33
GAP-050P-S	KAP-050P	1/2	.080	4.750	5.250	1.33
GAP-062 P-S	KAP-062P	5/8	.080	4.750	5.250	1.33
GAP-075P-S	KAP-075P	3/4	.080	5.250	5.750	1.33
GAP-087P-S	KAP-087P	7/8	.080	4.920	5.420	2.12
GAP-100P-S	KAP-100P	1	.080	4.920	5.420	2.12
GAP-112P-S	KAP-112P	1 1/8	.080	4.960	5.460	2.75
GAP-125P-S	KAP-125P	1 1/4	.080	4.960	5.460	2.75
GAP-137P-S	KAP-137P	1 3/8	.080	4.960	5.460	2.75
GAP-150P-S	KAP-150P	1 1/2	.083	4.960	5.460	2.75
GAP-162P-S	KAP-162P	1 5/8	.083	4.975	5.475	3.37
GAP-175P-S	KAP-175P	1 3/4	.083	4.975	5.475	3.37
GAP-200P-S	KAP-200P	2	.083	4.975	5.475	3.37
GAP-225P-S	KAP-225P	2 1/4	.083	5.625	6.125	4.50
GAP-250P-S	KAP-250P	2 1/2	.115	5.625	7.750	4.50
GAP-275P-S	KAP-275P	2 3/4	.115	5.625	7.750	4.62
GAP-300 P-S	KAP-300P	3	.115	5.625	7.750	4.62
GAP-325P-S	KAP-325P	3 1/4	.115	5.690	8.062	6.00
GAP-350P-S	KAP-350P	3 1/2	.115	5.690	8.062	6.00
GAP-375P-S	KAP-375P	3 3/4	.115	5.690	8.062	6.00
GAP-400P-S	KAP-400P	4	.115	5.690	8.062	6.00
GAP-500P-S	KAP-500P	5	.200	5.710	10.460	6.75
GAP-600P-S	KAP-600P	6	.200	5.750	11.250	8.00

Note: All sizes are available with 7052 glass.

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Assembly

Each assembly consists of two symmetrical flanges, a centering ring, an O-ring and a clamp. The connection is made without tools and is completed by simply tightening the wing nut on the clamp.

Step 1

Step 2

Step 3

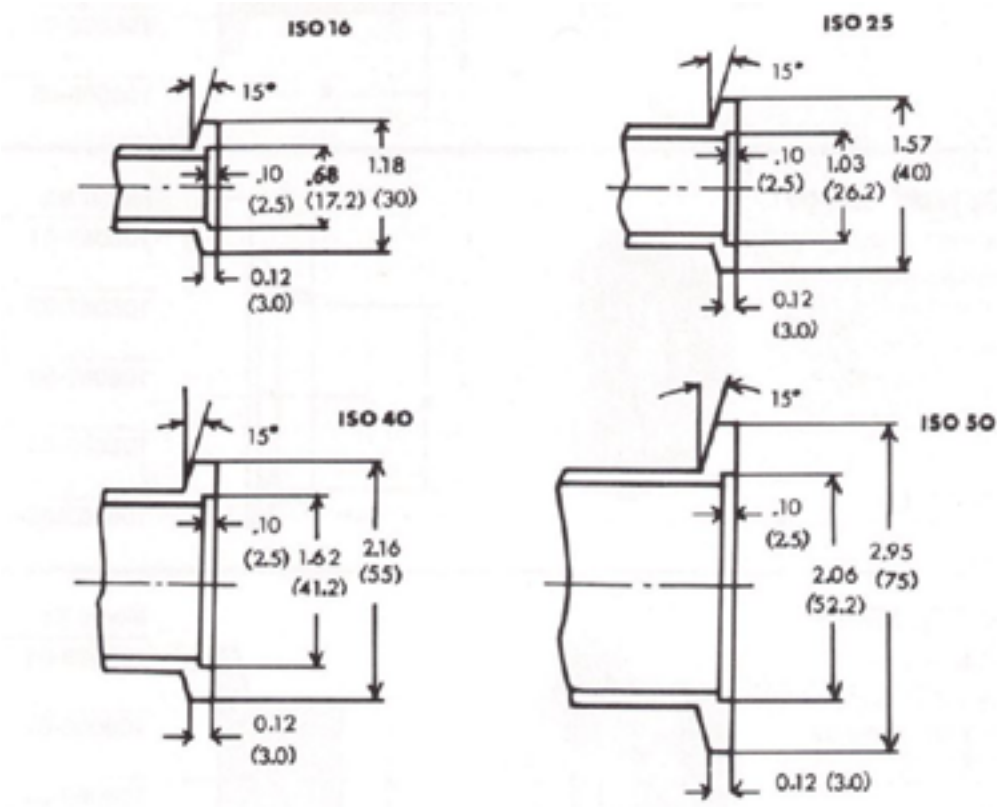
Clean and Leak Tested

All components sold by Thermionics are clean and ready for immediate use. During assembly, all components are helium mass spectrometer leak-checked prior to shipment. The sealing surfaces are specially machined to ensure perfect repeat sealing. This surface quality enables the slightest damage to be detected by visual inspection. To ensure the cleanliness and quality of the components until they are put into use, TLI employs vacuum shrink wrapping of each component. This technique prevents damage in shipping and storage.

The flange dimensions shown here are the International Standard Flange dimensions. Rather than repeating them throughout the catalog, they will be referred to only by their ISO number (16, 25, 40, or 50).

Note

All TLI/ISO fittings are manufactured to the ISO standards, and therefore, are compatible with other vacuum components designed to the same standards. Thermionics offers as a convenience other TLI fittings, feedthroughs, vacuum components, and accessories with these fittings.



Dimensions

Large ISO Flanges

Flanges for tube sizes greater than 2" (50mm) diameter are available. Please consult factory.

To Order

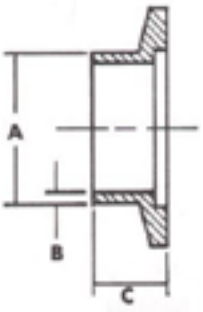
To order ISO fittings on any component in this catalog, add ISO + flange size. For example, if you are ordering an inline valve (L-1500-P) you would then add (IS0-40) to the end to get (L-1500-P-IS0-40).

8 ISO Flanges

Dimensions in inches (millimeters)

Short Weld Stub

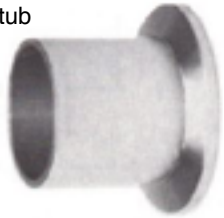
- Stainless steel
- Butt weld
- Standard inch stub diameters

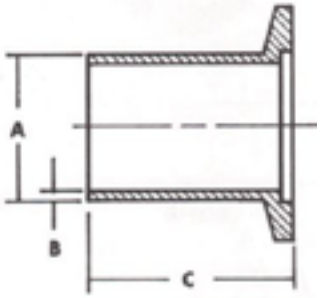


Model No.	Flange Size	Tube Size	A	B	C
108064-01	16	1/2”	.50 (12.7)	.065 (1.7)	.50 (12.7)
108064-02	16	3/4”	.75 (19.1)	.065 (1.7)	.50 (12.7)
108064-03	25	1”	1.00 (25.4)	.065 (1.7)	.50 (12.7)
108064-04	40	1 1/2”	1.50 (38.1)	.065 (1.7)	.75 (19.1)
108064-05	50	2”	2.00 (50.8)	.065 (1.7)	.75 (19.1)

Long Weld Stub

- Stainless steel
- Butt weld
- Standard inch stub diameters

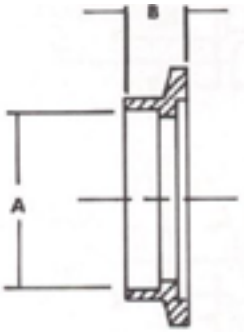




Model No.	Flange Size	Tube Size	A	B	C
108065-01	16	1/2”	.50 (12.7)	.065 (1.7)	1.575 (40)
108065-02	16	3/4”	.75 (19.1)	.065 (1.7)	1.575 (40)
108065-03	25	1”	1.00 (25.4)	.065 (1.7)	1.575 (40)
108065-04	40	1 1/2”	1.50 (38.1)	.065 (1.7)	1.575 (40)
108065-05	50	2”	2.00 (50.8)	.065 (1.7)	1.575 (40)

Inside Weld Flange

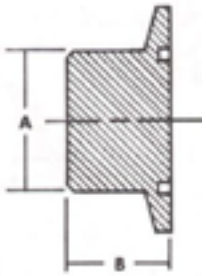
- Stainless steel
- Standard inch counter bore
- Internal weld



Model No.	Flange Size	Tube Size	A	B
108087-01	16	1/2”	.51 (12.9)	.56 (14.2)
108087-02	16	3/4”	.76 (19.3)	.56 (14.2)
108087-03	25	1”	1.01 (25.7)	.47 (11.9)
108087-04	40	1 1/2”	1.51 (38.4)	.50 (12.7)
108087-05	50	2”	1.62 (41.1)	.62 (15.7)

Blank Weld Stub

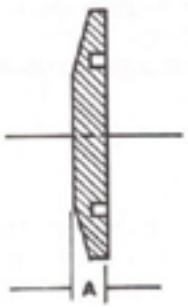
- Stainless steel
- Bore to desired diameter or use as a blank-off



Model No.	Flange Size	A	B
108069-01	16	.50 (12.7)	.75 (19.1)
108069-02	16	.75 (19.1)	.75 (19.1)
108069-03	25	1.00 (25.4)	.75 (19.1)
108069-04	40	1.50 (38.1)	1.00 (25.4)
108069-05	50	2.00 (50.8)	1.00 (25.4)

Blank-Off

- Stainless steel
- Use for closing off unused ports
- Not recommended for welding



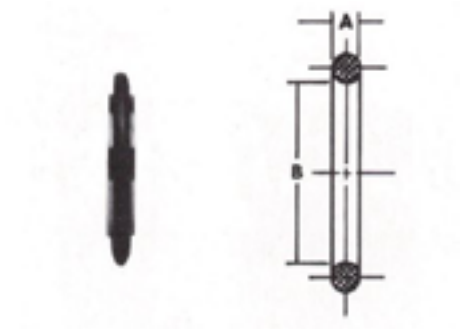
Model No.	Flange Size	A
108063-02	16	.19 (4.8)
108063-04	25	.19 (4.8)
108063-06	40	.19 (4.8)
108063-07	50	.19 (4.8)

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Dimensions in inches (millimeters)

O-Ring

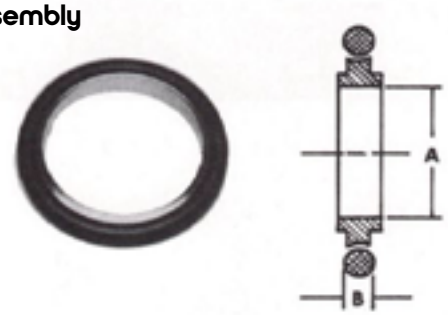
- Replaceable seal for centering ring
- Standard O-ring sizes
- Supplied in Viton (Buna and silicone available)



Model No.	Flange Size	Tube Size	A	B
108092-01	16	2.314	.210 (5.3)	.725 (18.4)
108092-02	25	2.320	.210 (5.3)	1.10 (27.9)
108092-03	40	2.326	.210 (5.3)	1.60 (40.6)
108092-04	50	2.330	.210 (5.3)	2.10 (53.3)

Centering Ring Assembly

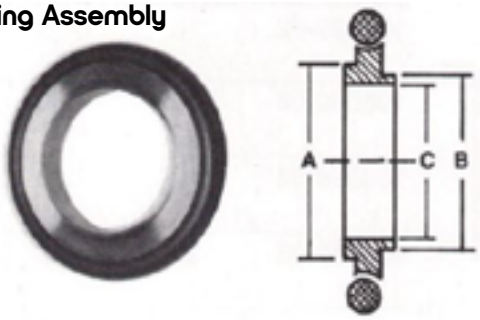
- Stainless steel
- Supplied in Viton (Buna and silicone available)
- 200°C max. baking temperature, 150°C continuous



Model No.	Flange Size	A	B
108061-02	16	.63 (16.0)	.210 (5.3)
108061-04	25	.98 (25.0)	.210 (5.3)
108061-06	40	1.58 (40.1)	.210 (5.3)
108061-07	50	1.97 (50.1)	.210 (5.3)

Adaptive Centering Ring Assembly

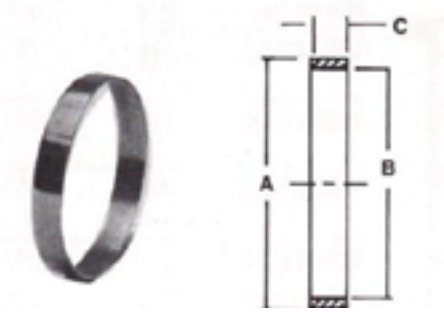
- Stainless steel
- Viton O-ring
- To connect obsolete bore sizes with current ISO sizes



Model No.	Flange Size	A	B	C
108062-01	16/10	.67 (17.0)	.47 (11.9)	.39 (9.9)
108062-02	25/20	1.02 (25.9)	.87 (22.1)	.83 (21.1)
108062-03	40/32	1.61 (40.9)	1.34 (34.0)	1.26 (32.0)

Overpressure Ring

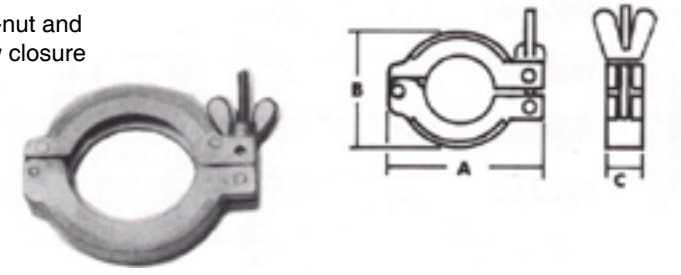
- Stainless steel
- Fits over O.D. of O-ring



Model No.	Flange Size	A	B	C
108070-01	16	2.24 (57)	1.69 (43)	.63 (16)
108070-02	25	2.76 (70)	2.17 (55)	.63 (16)
108070-03	40	3.39 (86)	2.76 (70)	.63 (16)
108070-04	50	4.33 (110)	3.70 (94)	.79 (20)

Clamp

- Wing-nut and screw closure

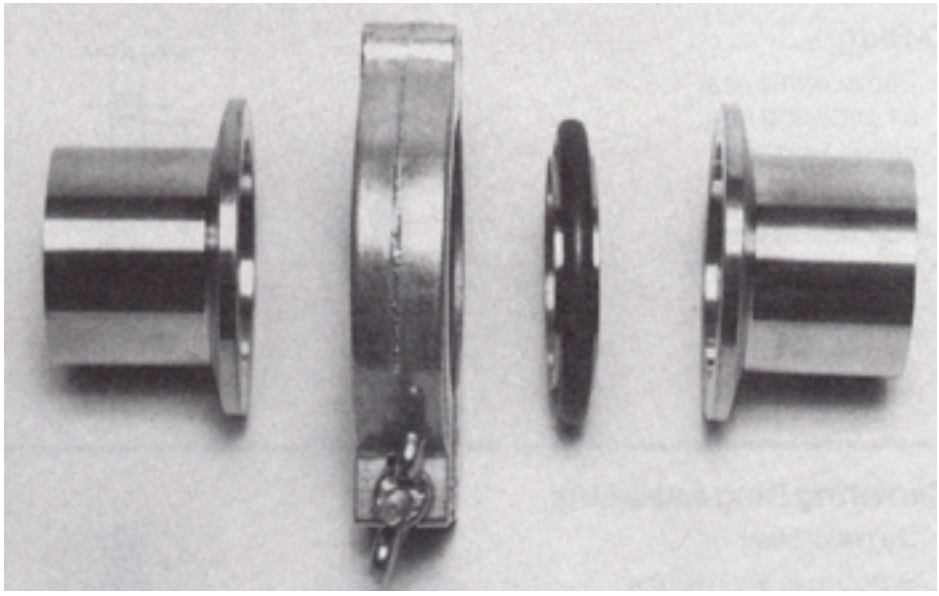


Model No.	Flange Size	A	B	C
108093-01	16	2.24 (57)	1.69 (43)	.63 (16)
108093-02	25	2.76 (70)	2.17 (55)	.63 (16)
108093-03	40	3.39 (86)	2.76 (70)	.63 (16)
108093-04	50	4.33 (110)	3.70 (94)	.79 (20)

8 ISO Quick Clamp System

Each Thermionics quick clamp system includes 2 flanges, a centering ring, an O-ring, and a clamp. Systems are available in sizes 3/4" to 2".

Model No.	Tube Size	Ref. ISO
ISO-16	3/4"	16
ISO-25	1"	25
ISO-40	1 1/2"	40
ISO-50	2"	50



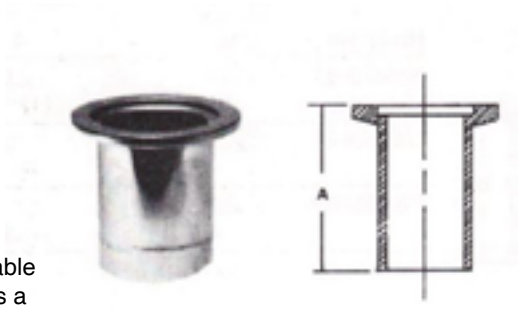
ISO Fittings

Fittings with ISO/pneurop flanges

Dimensions in inches (millimeters)

Half-Nipples

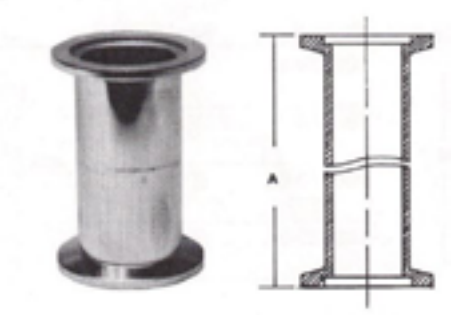
- All stainless steel
- All welds are either inside or 100% penetration
- All dimensions are standard fitting measurements
- All fittings are available in special lengths as a special order



Model No.	Flange Size	Tube Size	A
108089-02	16	0.75"	2.37 (60)
108089-03	25	1.00"	2.37 (60)
108089-04	40	1.50"	3.75 (95)
108089-05	50	2.00"	3.75 (95)

Nipples

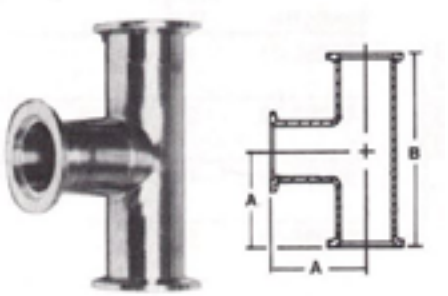
- All stainless steel
- All welds are either inside or 100% penetration
- All dimensions are standard fitting measurements
- All fittings are available in special lengths as a special order



Model No.	Flange Size	Tube Size	A
108077-02	16	0.75"	3.15 (80)
108077-03	25	1.00"	3.94 (100)
108077-05	40	1.50"	5.12 (130)
108077-07	50	2.00"	5.51 (140)

Tees

- All stainless steel
- All welds are either inside or 100% penetration
- All dimensions are standard fitting measurements
- All fittings are available in special lengths as a special order



Model No.	Flange Size	Tube Size	A	B
108080-01	16	0.75"	1.57 (40)	3.15 (80)
108080-02	25	1.00"	1.97 (50)	3.94 (100)
108080-03	40	1.50"	2.56 (65)	5.12 (130)
108080-04	50	2.00"	2.76 (70)	5.51 (140)

(360) 385-7707

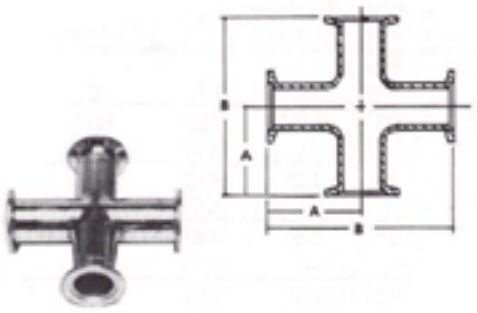
thermionics laboratory, inc.
Vacuum Innovation Since 1958

sales@thermionics.com

Dimensions in inches (millimeters)

4-Way Crosses

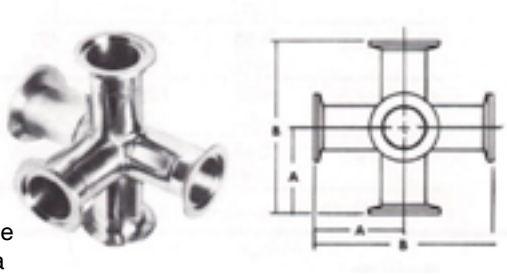
- All stainless steel
- All welds are either inside or 100% penetration
- All dimensions are standard fitting measurements
- All fittings are available in special lengths as a special order



Model No.	Flange Size	Tube Size	A	B
108081-01	16	0.75”	1.57 (40)	3.15 (80)
108081-02	25	1.00”	1.97 (50)	3.94 (100)
108081-03	40	1.50”	2.56 (65)	5.12 (130)
108081-04	50	2.00”	2.76 (70)	5.51 (140)

5-Way Crosses

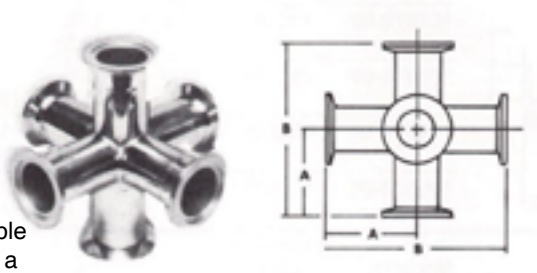
- All stainless steel
- All welds are either inside or 100% penetration
- All dimensions are standard fitting measurements
- All fittings are available in special lengths as a special order



Model No.	Flange Size	Tube Size	A	B
108090-01	16	0.75”	1.57 (40)	3.15 (80)
108090-02	25	1.00”	1.97 (50)	3.94 (100)
108090-03	40	1.50”	2.56 (65)	5.12 (130)
108090-04	50	2.00”	2.76 (70)	5.51 (140)

6-Way Crosses

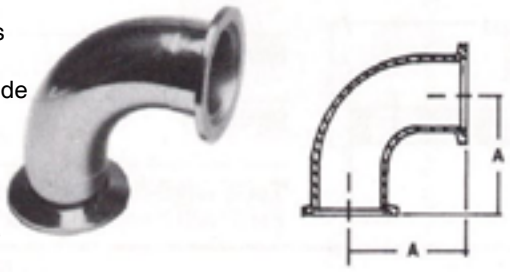
- All stainless steel
- All welds are either inside or 100% penetration
- All dimensions are standard fitting measurements
- All fittings are available in special lengths as a special order



Model No.	Flange Size	Tube Size	A	B
108091-01	16	0.75”	1.57 (40)	3.15 (80)
108091-02	25	1.00”	1.97 (50)	3.94 (100)
108091-03	40	1.50”	2.56 (65)	5.12 (130)
108091-04	50	2.00”	2.76 (70)	5.51 (140)

Elbow

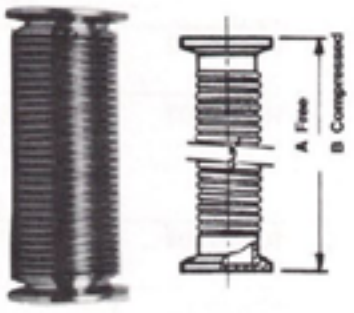
- Fittings are all stainless steel
- All welds are either inside or 100% penetration
- All dimensions are standard fitting measurements
- All fittings are available in special lengths as a special order



Model No.	Flange Size	Tube Size	A
108072-01	16	0.75”	1.57 (40)
108072-02	25	1.00”	1.97 (50)
108072-03	40	1.50”	2.56 (65)
108072-04	50	2.00”	2.76 (70)

ISO/Pneurop Flexible Couplings

- For flexible connections
- Formed bellows
- All stainless steel
- Quick and easy alignment



Model No.	Flange Size	Tube Size	A	B
108094-01	16	0.75”	3.00 (76)	2.67 (68)
108094-02	25	1.00”	3.40 (86)	2.93 (74)
108094-03	40	1.50”	3.40 (86)	2.93 (74)
108094-04	50	2.00”	4.00 (102)	3.49 (89)

8 ISO Fittings

Dimensions in inches (millimeters)

Hoses

Flexible

- For roughing connections
- As flexible tubing
- Supplied in lengths as shown
- Special lengths on request
- Supplied with or without braid
- All stainless-steel construction

Base Model No.: 108075. Add suffix shown under price to denote length and flange size. -01 through -20 (Fig. 1), no braid. -21 through -40 (Fig. 2), braided.

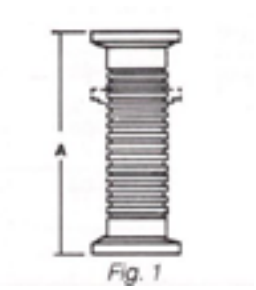


Fig. 1

Flange Size	A*	18"	24"	36"	48"	72"
16	0.75"	(-01)	(-02)	(-03)	(-04)	(-05)
25	1.00"	(-06)	(-07)	(-08)	(-09)	(-10)
40	1.50"	(-11)	(-12)	(-13)	(-14)	(-15)
50	2.00"	(-16)	(-17)	(-18)	(-19)	(-20)

Braided

- Same

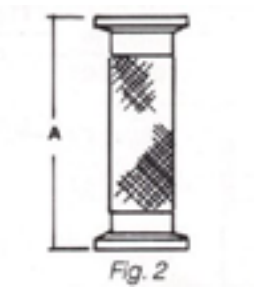


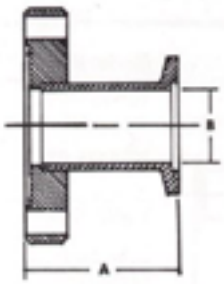
Fig. 2

Flange Size	A*	18"	24"	36"	48"	72"
16	0.75"	(-01)	(-02)	(-03)	(-04)	(-05)
25	1.00"	(-06)	(-07)	(-08)	(-09)	(-10)
40	1.50"	(-11)	(-12)	(-13)	(-14)	(-15)
50	2.00"	(-16)	(-17)	(-18)	(-19)	(-20)

**Also available in other sizes and configurations.*

ConFlat Flange

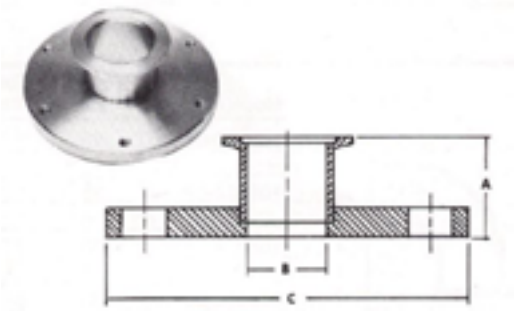
- ISO to ConFlat flange
- Stainless steel



Model No.	Flange Size	Tube Size	A	B
108078-01	16/133	0.50"	2.08 (52.7)	0.62 (15.8)
108078-02	16/275	0.75"	1.78 (45.3)	0.62 (15.8)
108078-03	25/275	1.00"	1.78 (45.3)	0.78 (22.1)
108078-04	40/275	1.50"	1.78 (45.3)	1.37 (34.8)
108078-05	50/450	2.00"	1.95 (49.5)	1.87 (47.5)

ASA Flange

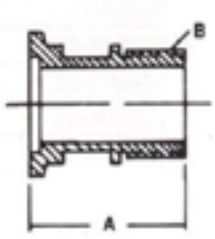
- ISO to ASA
- Standard without O-ring groove
- O-ring groove on request*
- Stainless steel



Model No.	Flange Size	A	B	C
108079-01	40/2"	1.825 (46.4	1.38 (35.1)	6.00 (152)
108079-02	40/3"	1.825 (46.4)	1.38 (35.1)	7.50 (190)
108679-03	50/2"	1.825 (46.4	1.88 (47.8)	6.00 (152)
108079-04	50/3"	1.825 (46.4)	1.88 (47.8)	7.50 (190)

Sargent-Welch Mechanical Pump

- Replaces inlet hose connector
- Stainless steel



Model No.	Flange Size	Corresp. Welch-Pump Model Nos.	A	B
108088-01	16	1339, 1400, 1406, 1410	2.50 (63.5)	3/8-18
108088-02	16	1405	2.00 (50.8)	3/4-20
108088-03	25	1380, 1402, 1403,8806, 8811,8816, 8821	2.12 (53.8)	1-20
108088-04	40	1373, 1376, 8831	2.12 (53.8)	1.5-12
108088-05	40	1397, 1374, 8851	2.50 (63.5)	1.75-20

(360) 385-7707

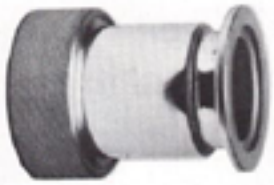
thermionics laboratory, inc.
Vacuum Innovation Since 1958

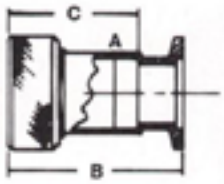
sales@thermionics.com

Dimensions in inches (millimeters)

Compression Fitting

- Compression type
- Quick-connect for insertion tube
- Viton O-ring
- Compression fitting tightened by hand
- Use with tubulated gauges
- Stainless steel





Model No.	Flange Size	Tube Size	A	B	C
108076-01	16	0.25”	0.265	1.3	thru
108076-02	16	0.50”	0.515	2.0	1.3
108076-03	16	0.75”	0.765	2.2	1.6
108076-04	25	0.50”	0.515	2.0	1.3
108076-05	25	0.75”	0.765	2.3	1.6
108076-06	25	1.00”	1.015	2.4	1.8
108076-07	40	0.50”	0.515	2.3	1.3
108076-08	40	0.75”	0.765	2.5	1.6
108076-09	40	1.00”	1.015	2.8	1.8
108076-10	40	1.50”	1.510	3.3	2.5
108076-11	50	1.50”	1.510	3.4	2.5
108076-12	50	2.00”	2.010	3.4	2.6

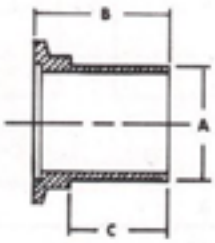
NPT Pipe Adapter

- Stub tapped 1/8” NPT female
- Compatible with most thermocouple gauges
- Use with Teflon tape
- Stainless steel

Model No.	Flange Size	A	B
108073-01	16	0.62 (15.7)	0.75 (19.1)
108073-02	25	0.88 (22.4)	0.75 (19.1)
108073-03	40	1.25 (31.8)	1.00 (25.4)
108073-04	50	1.75 (44.5)	1.00 (25.4)

Roughing Hose Adapter

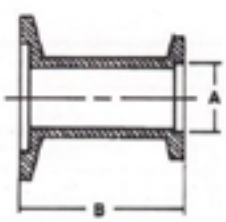
- ISO to rubber roughing hose
- Stainless steel



Model No.	Flange Size	Tube Size	A	B	C
108074-01	16	0.50”	0.50 (12.7)	1.25 (31.8)	0.80 (20.3)
108074-02	16	0.75”	0.75 (19.1)	1.25 (31.8)	0.80 (20.3)
108074-03	25	1.00”	1.00 (25.4)	1.50 (38.1)	1.00 (25.4)
108074-04	40	1.50”	1.50 (38.1)	2.00 (50.8)	1.50 (38.1)
108074-05	50	2.00”	2.00 (50.8)	2.18 (55.4)	2.00 (50.8)

Reducer

- Mates differing ISO sizes
- Stainless steel



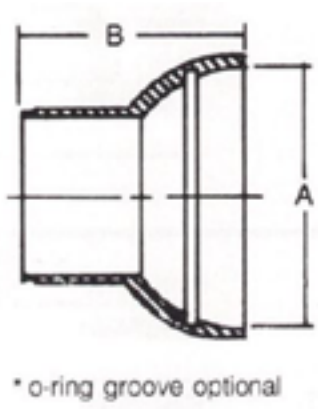
Model No.	Flange Size	A	B
108071-01	16/25	0.62 (15.8)	1.575 (40)
108071-02	16/40	0.62 (15.8)	1.575 (40)
108071-03	16/50	0.62 (15.8)	1.575 (40)
108071-04	25/40	0.87 (22.1)	1.575 (40)
108071-05	25/50	0.87 (22.1)	1.575 (40)
108071-06	40/50	1.34 (33.9)	1.575 (40)

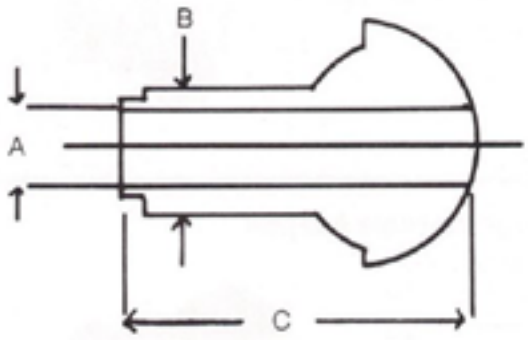
8 Metal Spherical Joints

Thermionics has supplied stainless steel ball and socket joints to the semiconductor industry since 1978. Connections are made with a ball and socket, an O-ring, and a clamp. These items can be brazed or welded to components or manifolding for difficult curves or adjustable angular connections.

The socket joints are manufactured from type 304 stainless steel to ASTM standards for ground glass joints. They will mate with standard quartz or Pyrex ball couplings and have a vacuum integrity to 5 x 10^{-9} Torr.

They feature the same ease of assembly as the ISO series, and the same elastomer seals are available on these fittings. There are no metal seals available, however.





Pinch Clamp

Model No.
PC-50
PC-65
PC-75
PC-102

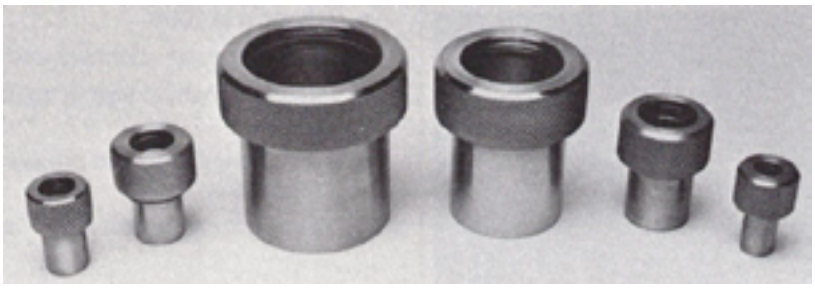
Ball

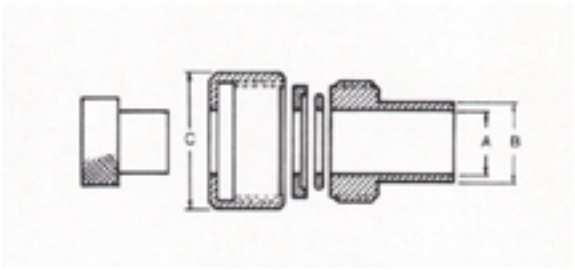
Dimensions in inches

Model No.	Size	A	B	C
B-106140	50/30	1.00	1.25	2.92
B-106141	65/40	1.25	1.50	3.32
8-106142	75/50	1.75	2.00	4.00
B-106143	102/75	2.75	3.00	4.00

Socket

Model No.	Size	A	B
S-106136	50/30	2.00	2.58
S-106137	65/40	2.50	2.80
S-106138	75/50	3.00	2.86
S-106139	102/75	4.00	3.36





Stainless Steel Quick-Disconnects

Dimensions in inches

Model No.	Tube Size (O.D.)	A Bore I.D.	B Body O.D.	C Knurled Nut O.D	Assembled Length
SQD-06	0.06	0.072	0.375	0.50	1.31
SQD-12	0.12	0.135	0.375	0.50	1.31
SQD-18	0.18	0.197	0.375	0.62	1.31
SOD-25	0.25	0.260	0.375	0.62	1.31
SQD-31	0.31	0.322	0.500	0.81	1.31
SQD-38	0.37	0.385	0.500	0.81	1.31
SQD-50	0.50	0.510	0.625	0.94	1.37
SOD-62	0.62	0.635	0.750	1.19	1.50
SQD-75	0.75	0.760	0.875	1.38	1.62
SQD-87	0.87	0.885	1.000	1.44	1.75
SQD-100	1.00	1.010	1.125	1.62	1.87
SOD-112	1.12	1.130	1.250	1.88	2.00
SOD-125	1.25	1.260	1.500	1.88	2.25
SOD-138	1.37	1.380	1.625	2.12	2.37
SOD-150	1.50	1.510	1.750	2.25	2.50
SOD-162	1.62	1.630	1.875	2.38	2.56
SOD-200	2.00	2.010	2.250	2.75	2.62

Blank-Offs

Model No.
SQD-06
SQD-12
SQD-18
SQD-25
SQD-31
SQD-38
SQD-50
SQD-62
SQD-75
SQD-87
SQD-100
SQD-112
SQD-125
SQD-138
SQD-150
SQD-162
SQD-200

Brass Quick-Disconnects

Dimensions in inches

Model No.	Tube Size (O.D.)	A Bore I.D.	B Body O.D.	C Knurled Nut O.D	Assembled Length
BQD-06	0.06	0.072	0.375	0.50	1.31
BQD-12	0.12	0.135	0.375	0.50	1.31
BQD-18	0.18	0.197	0.375	0.62	1.31
BQD-25	0.25	0.260	0.375	0.62	1.31
BQD-31	0.31	0.322	0.500	0.81	1.31
BQD-38	0.37	0.385	0.500	0.81	1.31
BQD-50	0.50	0.510	0.625	0.94	1.37
BQD-62	0.62	0.635	0.750	1.19	1.50
BQD-75	0.75	0.760	0.875	1.38	1.62
BQD-87	0.87	0.885	1.000	1.44	1.75
BQD-100	1.00	1.010	1.125	1.62	1.87
BQD-112	1.12	1.130	1.250	1.88	2.00
BQD-125	1.25	1.260	1.500	1.88	2.25
BQD-137	1.37	1.380	1.625	2.12	2.37
BQD-150	1.50	1.510	1.750	2.25	2.50
BQD-162	1.62	1.630	1.875	2.38	2.56
BQD-200	2.00	2.010	2.250	2.75	2.62

Blank-Offs

Model No.
QBB-06
QBB-12
QBB-18
QBB-25
QBB-31
QBB-38
QBB-50
QBB-62
QBB-75
QBB-87
QBB-100
QBB-112
QBB-125
QBB-138
QBB-150
QBB-162
QBB-200

TLI quick-disconnects provide a fast and convenient method for coupling and uncoupling metal and glass tubing. They can be welded, brazed or soldered to flanges, manifolds, chambers or other vacuum equipment. Quick-disconnects are ideal for mounting ion gauges, thermocouple gauges, special test ports and feedthroughs. These fittings are also supplied mounted on UHV flanges for use on flanged ports. See FQD series below.

Standard quick-disconnects are available in a choice of stainless steel or brass in seventeen standard sizes from 1/16" through 2". Custom quick-disconnects are available in a variety of other sizes, metals, wall thicknesses, and configurations.

FQD Stainless Steel Quick-Disconnects Mounted on 2.75" UHV Flanges.

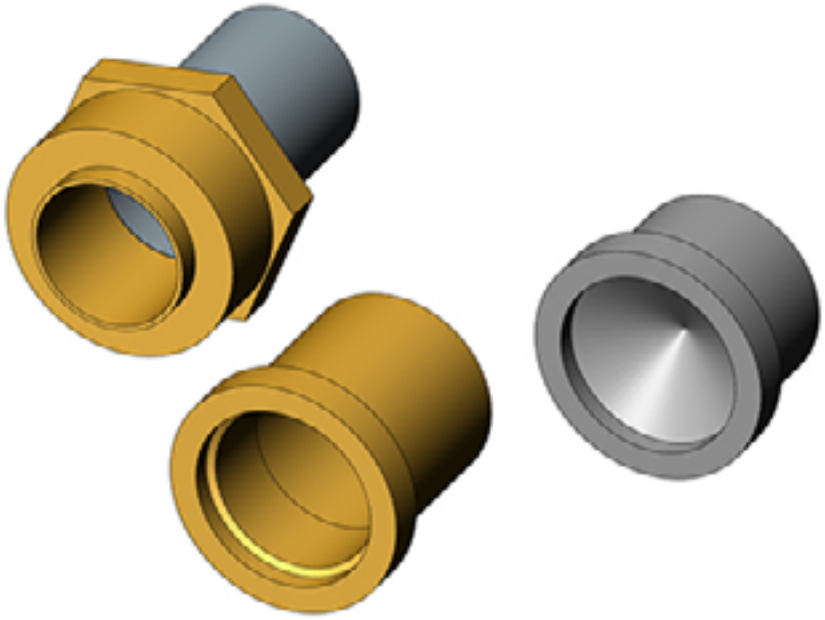
Model No.	Tube Size (O.D.)
FQD-50	1/2
FQD-75	3/4
FQD-100	1
FQD-150	1 1/2

Other FQD sizes are available. Consult factory.

Swagelok Tube Fitting Mounted on UHV Flanges

Model No.	Tube Size (O.D.)	Nom. Flange (O.D.)
STF25-133	1/4	1 1/3
STF25-275	1/4	2 3/4
STF50-133	1/2	1 1/3
STF50-275	1/2	2 3/4
STF75-275	3/4	2 3/4
STF100-275	1	2 3/4

8 RL Fittings



- Bakeable to 200°C
- Quick and easy—connect and disconnect
- Versatile—many possible combinations and uses
- Both high-vacuum and pressure applications
- Hand-tight usable to 1 x 10^{-7} Torr

History

Since 1965, Thermionics Laboratory has manufactured RL vacuum and pressure fittings. The fittings were originally developed in the 1940's by the Lawrence Radiation Laboratory. Initially they were used as connectors between leak detectors, mechanical pumps, and water lines through vacuum systems. However, in recent years, they have been found to be very versatile, with many uses in pressure environments. The fact that they are economical, dependable, and easy to install has been a major reason for their popularity in the vacuum industry.

Materials

RL fittings are available in a choice of brass or stainless steel. (Please specify your choice when ordering.) They are machined from solid bar stock. They may also be specially ordered in Teflon, nylon or any machinable plastic. Brass fittings have been most popular, and a large inventory is maintained at the factory to ensure prompt shipment. All RL fittings are bakeable to 200°C (392°F). Bakeout is usually required to achieve pressures of 1 x 10^{-7} Torr. Assembly of RL fittings is quick and easy.

Assembly is accomplished by simply handtightening each fitting as it is added to the system. Some fittings may need to be brazed or soldered onto pipes or tubing to fit the demands of your system; however, no special tools are required with normal installation.

RL fittings are supplied in a large selection of sizes. The normal sizes used are: 1/8", 3/16", 1/4", 3/8", 1/2", 5/8", 3/4,7/8", 1", 1 1/8"; special sizes may be requested.

We are evaluating the types of RL fittings we manufacture. Some RL models and sizes may be discontinued, and may be available only as a special order

Guarantee

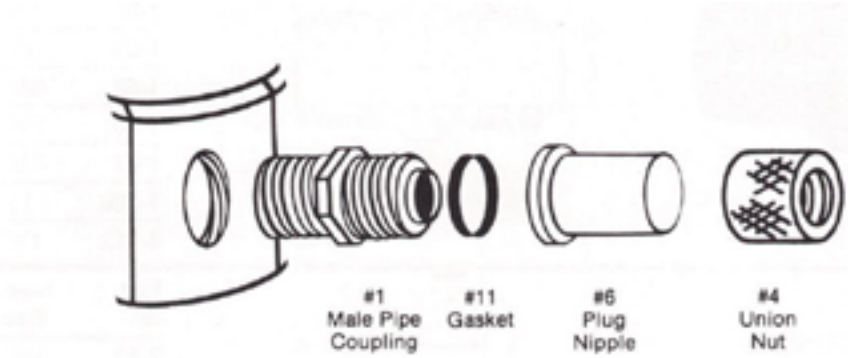
All vacuum components manufactured by Thermionics come with a guarantee of excellence, reliability and longevity. RL fittings are manufactured from the highest quality materials available and meet the highest standards of workmanship. All fittings are individually inspected and packaged clean and ready for immediate use.

There are several combinations in which RL fittings can be used—a few are described below. RL fittings have an added advantage over most other quick couplings. The nut is an integral part of the fitting and is therefore much less subject to failure under stress.

We are evaluating the types of RL fittings we manufacture. Some RL models and sizes may be discontinued, and may be available only as a special order

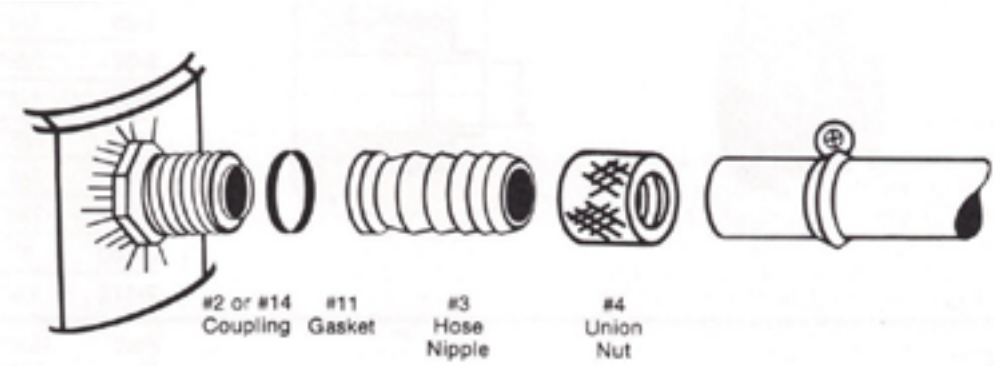
A Vent or Plug

Loosen the #4 Union Nut and the fitting becomes a vent-valve. Tighten it down and it becomes a vacuum or pressure tight plug.



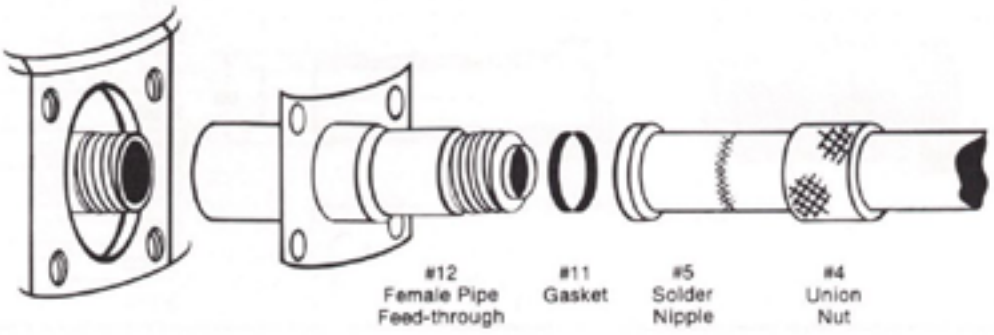
B Low Pressure Gas or Liquid

Interchangeable high pressure fittings are also available to connect to the permanently installed Half Union.

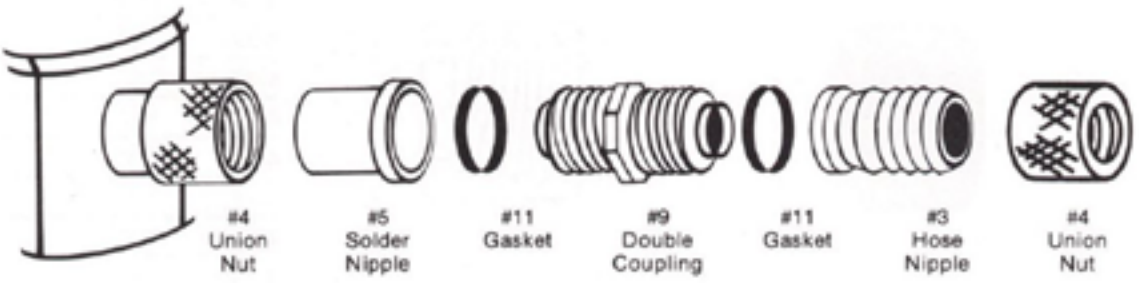


C High Pressure Gas or Liquid

The #12 Female Pipe Feedthrough is welded to a flange plate. It may be replaced with a blank flange when the fitting is not in use.



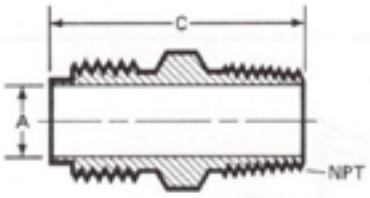
D Metal Tube to Non-Metal Tube



8 RL High-Vacuum & Pressure Fittings

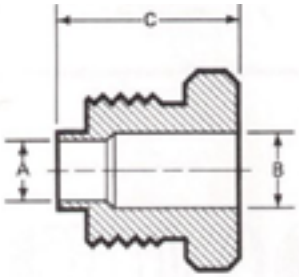
Please specify on order whether parts are of brass or stainless steel. *Dimensions in inches*

1 Male Pipe Coupling



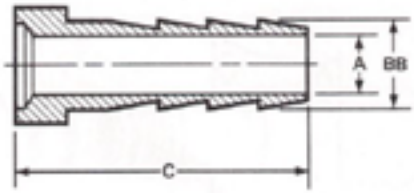
Model No.	Nom. Size	A	NPT	C
1-12	1/8”	0.06	1/8	1.38
1-18	3/16”	0.13	1/8	1.38
1-25	1/4”	0.19	1/8	1.38
1-37	3/8”	0.31	1/4	1.41
1-50	1/2”	0.44	3/8	1.53
1-62	5/8”	0.56	1/2	1.66
1-75	3/4”	0.69	3/4	1.66
1-87	7/8”	0.81	3/4	1.84
1-100	1”	0.94	1	1.91
1-112	1 1/8”	1.06	1	1.91

2 Solder Coupling



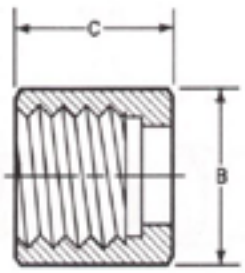
Model No.	Nom. Size	A	B	C
2-12	1/8”	0.06	0.13	0.88
2-18	3/16”	0.13	0.19	0.88
2-25	1/4”	0.19	0.25	0.88
2-37	3/8”	0.31	0.38	0.90
2-50	1/2”	0.44	0.50	0.90
2-62	5/8”	0.56	0.63	0.90
2-75	3/4”	0.69	0.75	0.90
2-87	7/8”	0.81	0.88	0.97
2-100	1”	0.94	1.00	1.03
2-112	1 1/8”	1.06	1.13	1.03

3 Hose Nipple



Model No.	Nom. Size	A	BB	C
3-12	1/8”	0.06	3/16	1.50
3-18	3/16”	0.13	1/4	1.50
3-25	1/4”	0.19	5/16	1.50
3-37	3/8”	0.31	7/16	1.50
3-50	1/2”	0.44	9/16	1.50
3-62	5/8”	0.56	11/16	1.50
3-75	3/4”	0.69	13/16	1.50
3-87	7/8”	0.81	15/16	1.50
3-100	1”	0.94	1 1/16	2.25
3-112	1 1/8”	1.06	1 3/16	2.25

4 Union Knurled Nut

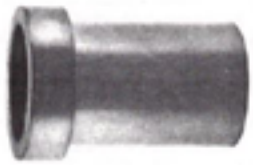


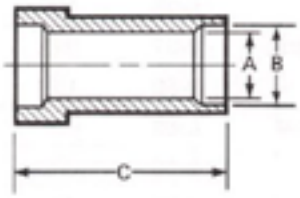
Model No.	Nom. Size	B	C
4-12	1/8”	0.56	0.75
4-18	3/16”	0.56	0.75
4-25	1/4”	0.63	0.75
4-37	3/8”	0.81	0.75
4-50	1/2”	1.00	0.75
4-62	5/8”	1.13	0.75
4-75	3/4”	1.25	0.75
4-87	7/8”	1.50	0.75
4-100	1”	1.75	0.75
4-112	1 1/8”	1.88	0.75

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Please specify on order whether parts are of brass or stainless steel. *Dimensions in inches*

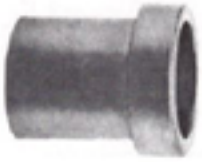
5 Solder Nipple

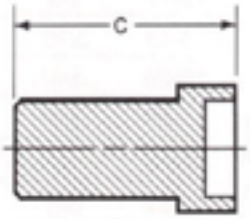




Model No.	Nom. Size	A	B	C
5-12	1/8”	0.06	0.13	0.75
5-18	3/16”	0.13	0.19	0.75
5-25	1/4”	0.19	0.25	1.00
5-37	3/8”	0.31	0.38	1.00
5-50	1/2”	0.44	0.50	1.00
5-62	5/8”	0.56	0.63	1.25
5-75	3/4”	0.69	0.75	1.25
5-87	7/8”	0.81	0.88	1.25
5-100	1”	0.94	1.00	1.50
5-112	1 1/8”	1.06	1.13	1.44

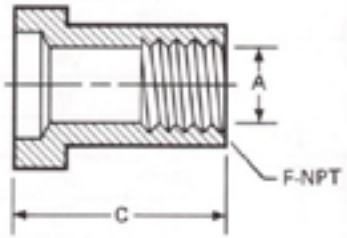
6 Plug Nipple





Model No.	Nom. Size	C
6-12	1/8”	1.00
6-18	3/16”	1.00
6-25	1/4”	1.00
6-37	3/8”	1.00
6-50	1/2”	1.00
6-62	5/8”	1.00
6-75	3/4”	1.00
6-87	7/8”	1.00
6-100	1”	1.00
6-112	1 1/8”	1.00

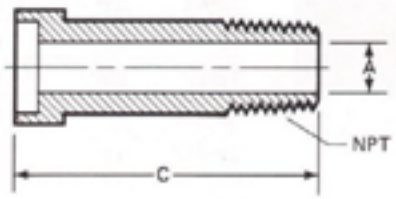
7 Female Pipe Nipple



Model No.	Nom. Size	A	F-NPT	C
7-50	1/2”	0.34	1/8	1.00
7-62	5/8”	0.44	1/4	1.25
7-75	3/4”	0.58	3/8	1.50
7-87	7/8”	0.72	1/2	1.50
7-100	1”	0.72	1/2	1.50
7-112	1 1/8”	0.91	3/4	1.50

8 Male Pipe Nipple

Dims according to print. I.D. must be smaller due to minor dia. of NPT.

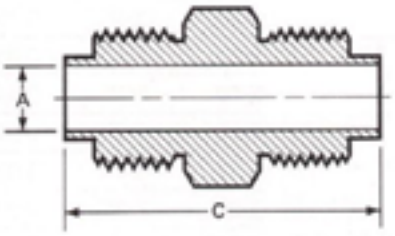


Model No.	Nom. Size	A	NPT	C
8-37	3/8”	0.25	1/8	1.50
8-50	1/2”	0.38	1/4	1.50
8-62	5/8”	0.50	3/8	1.50
8-75	3/4”	0.62	1/2	1.75
8-87	7/8”	0.62	1/2	1.75
8-100	1”	0.88	3/4	2.00
8-112	1 1/8”	0.88	3/4	2.00

8 RL High-Vacuum & Pressure Fittings

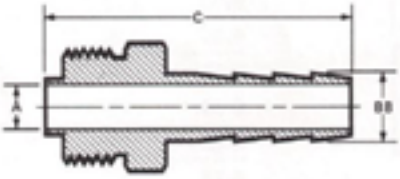
Please specify on order whether parts are of brass or stainless steel. *Dimensions in inches*

9 Double Coupling



Model No.	Nom. Size	A	C
9-12	1/8”	0.06	1.50
9-18	3/16”	0.13	1.50
9-25	1/4”	0.19	1.50
9-37	3/8”	0.31	1.56
9-50	1/2”	0.44	1.56
9-62	5/8”	0.56	1.56
9-75	3/4”	0.69	1.56
9-87	7/8”	0.81	1.63
9-100	1”	0.94	1.69
9-112	1 1/8”	1.06	1.69

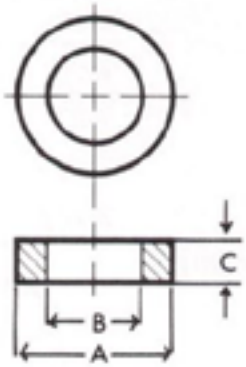
10 Hose Coupling



Model No.	Nom. Size	A	BB	C
10-12	1/8”	0.06	3/16	2.13
10-18	3/16”	0.13	1/4	2.13
10-25	1/4”	0.19	5/16	2.13
10-37	3/8”	0.31	7/16	2.16
10-50	1/2”	0.44	9/16	2.16
10-62	5/8”	0.56	11/16	2.16
10-75	3/4”	0.69	13/16	2.16
10-87	7/8”	0.81	15/16	2.22
10-100	1”	0.94	1 1/16	3.03
10-112	1 1/8”	1.06	1 3/16	3.03

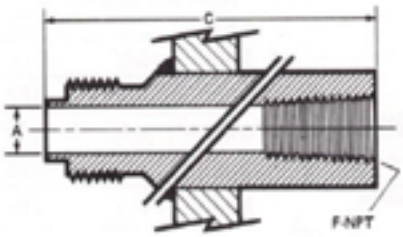
11 Gasket

Gaskets supplied are fabricated from Viton.



Model No.	Nom. Size	A	B	C
11-12	1/8”	0.29	0.10	0.09
11-18	3/16”	0.34	0.16	0.09
11-25	1/4”	0.39	0.22	0.12
11-37	3/8”	0.56	0.34	0.12
11-50	1/2”	0.72	0.47	0.12
11-62	5/8”	0.89	0.62	0.12
11-75	3/4”	1.00	0.72	0.12
11-87	7/8”	1.15	0.83	0.12
11-100	1”	1.38	0.97	0.12
11-112	1 1/8”	1.53	1.11	0.12

12 Female Pipe Feedthrough

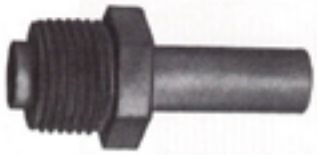


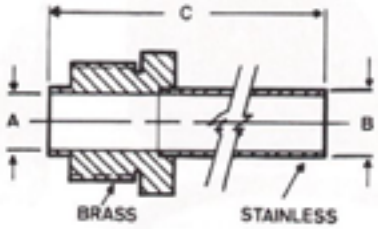
Model No.	Nom. Size	A	F-NPT	C
12-25	1/4”	0.19	1/8	3.16
12-37	3/8”	0.31	1/4	3.16
12-50	1/2”	0.44	3/8	3.16
12-62	5/8”	0.56	1/2	3.16
12-75	3/4”	0.69	1/2	3.16
12-87	7/8”	0.81	3/4	3.16
12-100	1”	0.94	1	3.16
12-112	1 1/8”	1.06	1	3.16

Please specify on order whether parts are of brass or stainless steel. *Dimensions in inches*

13 Weld Neck Feedthrough

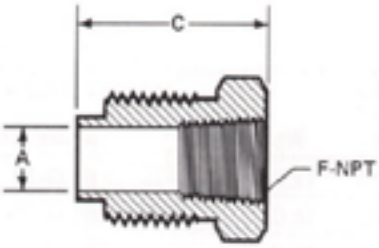
Weld neck feedthrough is normally machined as a brass neck with a stainless steel tube brazed onto it. Other materials may be specially ordered.





Model No.	Nom. Size	A	B	C
13-12	1/8”	0.06	0.13	2.22
13-18	3/16”	0.13	0.19	2.22
13-25	1/4”	0.19	0.25	2.22
13-37	3/8”	0.31	0.38	2.22
13-50	1/2”	0.44	0.50	2.22
13-62	5/8”	0.56	0.63	2.22
13-75	3/4”	0.69	0.75	2.22
13-87	7/8”	0.81	0.88	2.22
13-100	1”	0.94	1.00	2.22
13-112	1 1/8”	1.06	1.13	2.22

14 Female Pipe Coupling



Model No.	Nom. Size	A	F-NPT	C
14-25	1/4”	0.19	1/8	0.87
14-37	3/8”	0.31	1/4	0.91
14-50	1/2”	0.44	3/8	0.91
14-62	5/8”	0.56	1/2	0.91
14-75	3/4”	0.69	1/2	0.91
14-87	7/8”	0.81	3/4	0.97
14-100	1”	0.94	1	1.03
14-112	1 1/8”	1.06	1	1.03

8 Glass Bell Jars

Pyrex glass bell jars are designed to be used with flat base plates. The rimless bottom edge of the jar is ground flat to accept a Viton L-shaped gasket and provide a positive seal of the jar to the base plate.

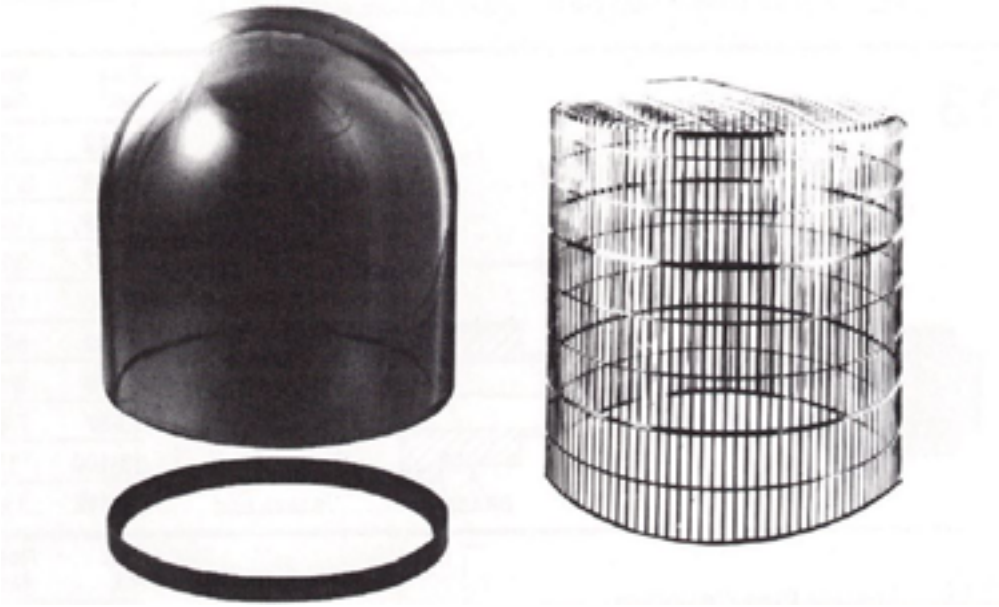
Pyrex glass has a strain point of 520°C and a coefficient of linear expansion of 32.5 x 10^{-7}, in/°C. Bakeout temperatures above 150°C are not recommended. Infra-red heat lamps are recommended for bakeout. They distribute heat evenly and minimize uneven stress in the glass. Bell jar guards are made from an expanded lightweight metal which is reinforced at top and bottom. Use of a guard protects the jar from breakage and provides implosion protection for personnel and equipment.

Option: Bell Jar Strap

Whenever bell jars and metal guards are assembled, we recommend a gasket or "strap" of Buna rubber be installed on the outside of the bell jar, between the bell jar and the metal guard. The strap is a cushion between the bell jar and the metal guard.

The strap is 1/8" thick x 1" wide, installed midway between the bottom and the top of the bell jar, and a clamping ring (which is supplied with the bell jar guard) is installed on the outside diameter of the guard, creating a clamp ring/guard/strap/bell jar "sandwich".

Model No.	Bell Jar Dia.
BR-10	10"
BR-12	12"
BR-18	18"



Dimensions in inches

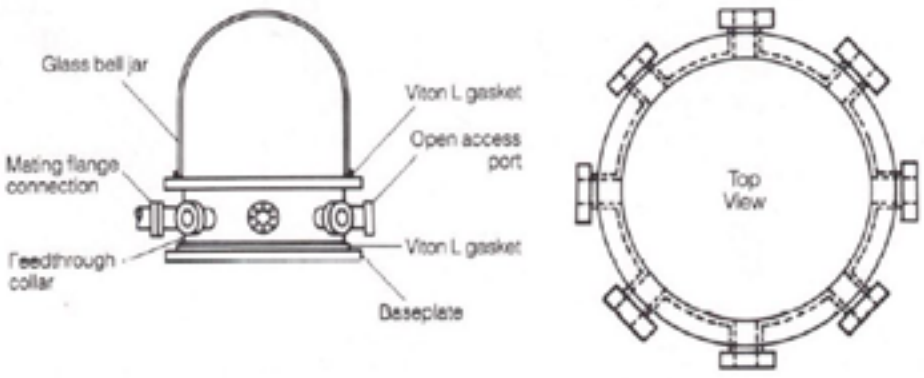
Model No.	Bell Jar Nom Size	Wt.
PBJ-1012	10 x 12	12.0
PBJ-1212	12 x 12	15.0
PBJ-1218	12 x 18	25.0
PBJ-1818	18 x 18	40.0
PBJ-1830	18 x 30	50.0

Viton L Gasket	
Model No.	Wt.
BLG-10	1.0
BLG-12	1.0
BLG-12	1.0
BLG-18	1.5
BLG-18	1.5

Metal Guard	
Model No.	Wt.
BLG-1012	4.0
BLG-1212	5.0
BLG-1218	7.0
BLG-1818	8.0
BLG-1830	10.0

Bell Jar Feedthrough Collars

Our feedthrough collars are designed for inclusion between the bell jar and the baseplate of the vacuum system. Feedthrough collar ports accept equipment that is mounted on a mounting flange, i.e., electron beam guns, residual gas analyzers, gauges, valves, feedthroughs, etc. Ports not in use are blanked off with blank flanges.



(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Lightweight Stainless Steel Collars

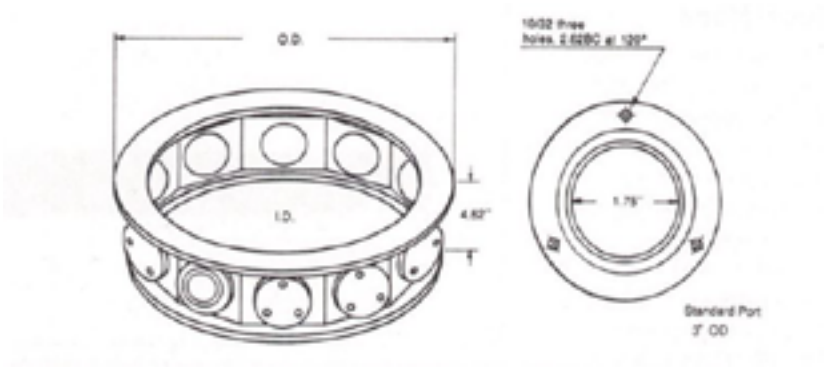
(Lighter than many aluminum collars)

Options Available

Custom feedthrough collars are available in the standard collar sizes to fit customer specifications. Choices of special specifications include varying the port tubulation length or having a specially machined O-ring gasket groove. An option of ConFlat flange sealing of ports is available upon request.

Specifications

- 10^{-9} to 10^{-11} Torr
- Bakeable to 200°C
- O-ring grooved
- Special sizes available

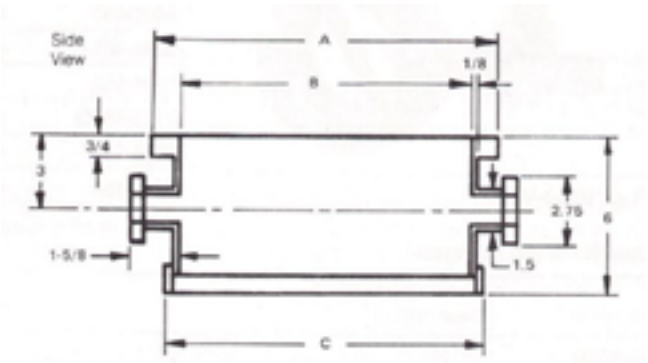


Dimensions in inches

Model No.	Bell Jar Dia.	Collar O.D.	Collar I.D.	O-Ring Centerline	No. Ports	Wt lbs
C-1200	12”	13	10.5	11.94	10	24
C-1400	14”	15	12.5	13.81	12	28
C-1800	18”	19	16.5	17.81	12	32
C-2400	24”	25	22.0	23.62	16	36

Collar Dimensions

	Model Number	
Specifications	FC-1200	Collar
Nom. diameter	12”/305 mm	18”/457 mm
Dimension A	14”/356 mm	20”/508 mm
Dimension B	11.75”/298 mm	17.25”/438 mm
Dimension C	12.5”/318 mm	18.5”/470 mm
Material	Stainless steel, type 304	
Feedthrough ports	8 ports with 2 3/4” 0.D. x 1 1/2” I.D. ConFlat flanges	
Top seal	Flat flange mates with standard glass bell jar seal	
Bottom seal	Standard L-shaped bell jar gasket	
Test specification	No detectable leaks with mass spectrometer leak detector sensitivity of 1 x 10^{-10} std. cc/sec	
Shipping wt.	85 lbs/39 kg	125 lbs/57 kg



Pinch-Off Tubes

Pinch-off tubes may be used whenever an item must be sealed and removed, under vacuum, from a pumping station.

- Pinch-off tubes have annealed OFE copper tubes and gaskets
- The gasket/tube assembly is brazed for easy and reliable sealing
- Designed for and used with standard flanges

Ordering information

Model No.	Bell Jar Dia.
CA-133/37	For 1.33” O.D. flange
CA-133/50	For 1.33” O.D. flange
CA-275/38	For 2.75” O.D. flange
CA-275/50	For 2.75” O.D. flange
CA-275/75	For 2.75” O.D. flange

Dimensions

A	B	C
0.83”	6.0”	.375”
0.83”	6.0”	.500”
1.89”	6.0”	.38”
1.89”	6.0”	.50”
1.89”	6.0”	.75”

8 Roughing Accessories

Flexible Stainless Steel Hose

Covering type 304 stainless steel thin wall bellows with a tough flexible metal braid of the same material provides great flexibility with maximum strength and durability. Use of flexible hose makes many system connections easier by eliminating some of the alignment problems involved with rigid tubing. Their high capacity for vibration damping makes them especially useful for connecting roughing pumps to UHV vacuum systems.

Hoses are bakeable to 450°C and can be used at temperatures as low as -196°C. They feature low outgassing, high conductance and are leak-tight to 10-11 Torr. A selection of standard lengths and flange combinations are listed here. Other sizes and flange configurations are available on special order. Can be supplied without braid upon request.

NOTE: Hoses are available with ISO flanges (refer to page 8-12) and in 2", 3", and 4" diameters.

FL-275150-TC

FL-275150-V

Flexible Stainless Hoses

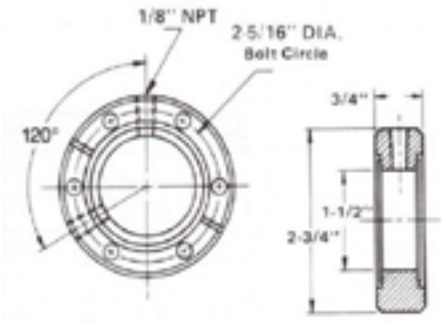
Model No.	Length*	Description
SSH-180	18"	1.50" O.D. nipples both ends
SSH-181	18"	2.75" O.D. flange one end only
SSH-182	18"	2.75" O.D. flange both ends
SSH-182Q	18"	1.50" I. D. Viton sealed quick-disconnects both ends
SSH-183	18"	2.75" O.D. flange and Welch 17.7 CFM adapter
SSH-184	18"	2.75" O.D. flange and Welch 5 CFM adapter
SSH-240	24"	1.50" O.D. nipples both ends
SSH-241	24"	2.75" O.D. flange one end only
SSH-242	24"	2.75" O.D. flange both ends
SSH-242Q	24"	1.50" I. D. Viton sealed quick-disconnects both ends
SSH-243	24"	2.75" O.D. flange and Welch 17.7 CFM adapter
SSH-244	24"	2.75" O.D. flange and Welch 5 CFM adapter
SSH-360	36"	1.50" O.D. nipples both ends
SSH-361	36"	2.75" O.D. flange one end only
SSH-362	36"	2.75" O.D. flange both ends
SSH-362Q	36"	1.50" I. D. Viton sealed quick-disconnects both ends
SSH-363	36"	2.75" O.D. flange and Welch 17.7 CFM adapter
SSH-364	36"	2.75" O.D. flange and Welch 5 CFM adapter
SSH-480	48"	1.50" O.D. nipples both ends
SSH-481	48"	2.75" O.D. flange one end only
SSH-482	48"	2.75" O.D. flange both ends
SSH-482Q	48"	1.50" I. D. Viton sealed quick-disconnects both ends
SSH-483	48"	2.75" O.D. flange and Welch 17.7 CFM adapter
SSH-484	48"	2.75" O.D. flange and Welch 5 CFM adapter

Double-Sided Flanges

Model No.	Description	Wt. lbs
FL-1000	Double-sided 1.33" 0.0. flange 5/8" thick, no accessory holes	0.5
FL-1000T	Double-sided 1.33" 0.0. flange 5/8" thick, one 1/16"-NPT tapped hole	0.5
FL-275150	Double-sided 2 3/4 " 0.0. flange 3/4" thick, no accessory holes	0.7
FL-275150-1H	Double-sided 2 3/4" 0.0. flange with one 1/8"-27NPT tapped hole	0.7
FL-275150-2H	Double-sided 2 3/4 " 0.0. flange with two 1/8"-27NPT tapped holes, 120° apart	0.7
FL-275150-TC	Double-sided 2 3/4" 0.0. flange with 7822M thermocouple gauge tube"	1.0
FL-275150-V	Double-sided 2 3/4 " 0.0. flange with Model BVV-025 bakeable valve for up-to-air use	1.5
FL-275150-VTC	Double-sided 2 3/4" 0.0. flange with TC tube and valve.	1.5
FL-275000-V	Blank 2 3/4 " O.D. flange with BVV-025 bakeable up-to-air valve	1.5

Flanges

Double-sided and blank flanges are supplied with thermocouple gauge tubes, up-to-air valves or combinations of the two for use as roughing accessories. Other configurations are readily available on special order.



(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

12-Point Head Bolt Sets For High Vacuum Flanges

Thermionics Vacuum Products 12-point head bolts have increased surface area for greater contact with ordinary socket wrenches. Bolt head stripping due to higher torque is minimized. Made of high tensile strength, non-magnetic 300 series stainless steel. Bolt sets are supplied complete with flat washers and hex nuts. 25 sets per package.

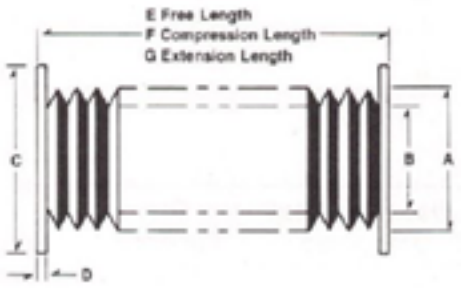
Dimensions in inches

Model No.	Flange Size O.D..	Flange Type	Bolt Description	Pkg. Wt. lbs
DB-25-125N	2.75	Through	1/4-28x1.25	1.5
DB-25-87N	2.75	Tapped	1/4-28x.87	1.0
DB-25-200N	2.75	Thru/Dbi	1/4-28x2	2.0
DB-31-175N	3.37	Through	5/16-24x1.75	1.5
DB-31-125N	3.37	Tapped	5/16-24x1.25	1.5
DB-31-200N	4.50	Through	5/16-24x2	2.0
DB-31-125N	4.50	Tapped	5/16-24x1.25	1.5
DB-31-225N	6 or 6.75	Thru/Dbi	5/16-24x2.25	2.0
DB-31-200N	6 or 6.75	Thru/Non	5/16-24x2	2.0
DB-31-125N	6 or 6.75	Tapped	5/16-24x1.25	1.5
DB-31-225N	8	Through	5/16-24x2.25	2
DB-31-175N	8	Tap	5/16-24x1.75	2
DB-31-250N	10	Through	5/16-24x2.50	2.5
DB-31-175N	10	Tapped	5/16-24x1.75	1.5

Stud and Nut Sets

Are available in various sizes. Consult factory.

Welded Bellows



Off-the-Shelf Stainless Steel Welded Metal Bellows

- Normally 350 but also available in AM-347, 304L, 321 or 316L stainless steel.

Applications

High vacuum seals, leak-free motion feedthroughs, flexible joints, compensators, reservoirs, actuators, UHV valves, manipulators, etc.

Corrosion Resistance-High Temperature

Metallurgically stabilized stainless steel provides corrosion resistance and low or high temperature capability from cryogenic to 450°C and above. This means excellent corrosion resistance, weldability and engineering properties appropriate for high vacuum applications.

Leak Tightness

Helium mass spectrometer leak-tight to 10^{-10} std. cc/sec.

Long Stroke-Minimum Package Length

Welded nested construction gives excellent flexibility and long stroke, compact envelope, and nested compressed length.

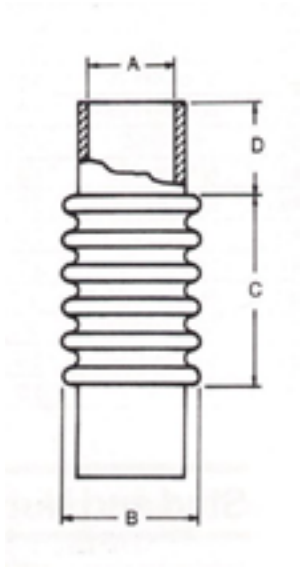
Model No.	A Bellows O.D.	B Bellows I.D.	C Flange O.D.	D Flange Thickeness	E Free Length	F Compressed Length	G Extended Length	Stroke
WB-01	0.746	0.26	0.775	0.012	0.78	0.21	1.10	0.47
WB-03	1.030	0.52	1.150	0.015	1.00	0.32	1.38	1.06
WB-05	1.430	0.81	1.500	0.015	1.50	0.32	2.25	1.94
WB-06	1.620	0.79	1.075	0.020	2.25	0.47	3.25	2.78
WB-10	0.595	0.26	0.687	0.015	0.56	0.21	0.75	0.53
WB-11	1.170	0.75	1.250	0.015	1.50	0.44	2.31	1.87
WB-12	1.620	0.88	1.675	0.015	1.70	0.38	2.62	2.25
WB-13	1.890	1.39	2.025	0.012	3.00	1.09	4.13	3.04

Other sizes available. Six different end flange styles are available. Please consult factory for further information.

8 Formed Bellows

Dimensions in inches

Type 321 stainless steel



Model No.	A	B	C	D	Deflection (+ or -)
MFB-6502	0.250	0.37	1.00	0.50	0.25
MFB-6503	0.312	0.45	1.00	0.50	0.25
MFB-6504	0.375	0.54	1.50	0.50	0.38
MFB-6506	0.500	0.73	1.50	0.50	0.38
MFB-6508	0.625	0.87	1.50	0.50	0.38
MFB-6510	0.750	1.05	1.50	0.50	0.50
MFB-6512	0.875	1.23	2.00	0.50	0.50
MFB-6513	1.000	1.38	2.00	0.75	0.50
MFB-6516	1.125	1.55	2.00	0.75	0.50
MFB-6518	1.250	1.60	2.00	0.75	0.50
MFB-6520	1.375	1.90	2.00	0.75	0.50
MFB-6522	1.500	1.95	2.00	0.75	0.50
MFB-6523	1.625	2.12	2.00	0.75	0.50
MFB-6525	1.750	2.30	2.00	0.75	0.50
MFB-6528	2.000	2.60	2.50	0.75	0.75
MFB-6530	2.250	3.06	2.50	0.75	0.75
MFB-6532	2.500	3.13	2.50	0.75	0.75
MFB-6536	3.000	3.75	3.00	1.00	0.75
MFB-6540	3.500	4.35	3.50	1.00	0.75
MFB-6544	4.000	5.20	4.00	1.00	1.25
MFB-6548	4.500	5.30	4.00	1.00	1.25
MFB-6552	5.000	6.00	5.00	1.00	1.50
MFB-6557	6.000	7.20	5.00	1.25	1.50
MFB-6564	8.000	9.25	6.00	1.25	1.50
MFB-6571	10.000	11.25	6.00	1.25	2.00
MFB-6577	12.000	13.25	6.00	0.75	2.00

Vacuum Tubing

Type 304 stainless steel

Model No.	Tube O.D.	Tube I.D.	Wall Thickness	Recommended Flange No.	Wt. Per Foot
SST-025	0.250	0.180	0.035	133025	0.125
SST-037	0.375	0.305	0.035	133037	0.127
SST-050	0.500	0.430	0.035	133050	0.173
SST-075	0.750	0.680	0.035	133075	0.267
SST-100	1.000	0.870	0.065	275100	0.649
SST-125	1.250	1.120	0.065	275125	0.822
SST-150	1.500	1.370	0.065	275150	0.966
SST-200	2.000	1.870	0.065	388200	1.343
SST-250	2.500	2.370	0.065	450250	1.690
SST-300	3.000	2.870	0.065	458300	2.037
SST-400	4.000	3.834	0.083	600400	3.472
SST-500	5.000	4.834	0.083	675500	4.359
SST-600	6.000	5.834	0.083	800600	5.245
SST-800	8.000	7.834	0.083	100800	10.500
SST-1000	10.000	9.760	0.120	13251000	12.500
SST-1075	10.750	10.482	0.134	13251075	15.190

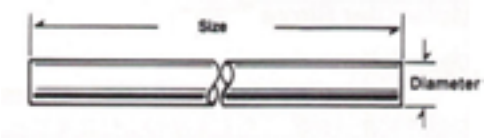
(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Type 304 Stainless Steel Precision Ground Shafting 8

Type 304 Stainless Steel Precision Ground Shaft*

Model No.	Dia.
PGS-125	0.1247”
PGS-188	0.1872”
PGS-250	0.2497”
PGS-312	0.3122”
PGS-375	0.3747”
PGS-437	0.4372”
PGS-500	0.4997”
PGS-625	0.6247”
PGS-750	0.7497”
PGS-875	0.8747”
PGS-1000	0.9997”

“All sizes within +.0000/-.0002



Tube, 304 Stainless Steel Precision Bored Shafts

For prices and sizes consult factory.

Fel-Pro C-100 Lubricant

A high-temperature lubricant which contains a molydisulfide base to prevent seizing and galling in a temperature range of -200° F to +2,400° F. For use outside the vacuum with stainless steel, aluminum, titanium, brass and copper.

Model No.	Description
PGS-125	1-oz tube lubricant
PGS-188	4-oz tube lubricant

Super Seal: Epoxy Sealing

Permanent or temporary repair of leaks in ultra-high vacuum chambers, feedthroughs, tubing, valves, fittings, etc.

- Very low vapor pressure, outgassing rate lower than 1 x 10^{-8} Torr liters/sec/cm^2
- +150°C to -60°C range. Cures overnight at room temp. or in two hours at 100°C
- A superior adhesive for metal, glass, ceramic or plastics
- Economical 7-gram packages

Model No.
SS100

Foreline Traps

Optically-Dense Traps

- Economical—Lowest price of any foreline trap.
- No maintenance—Eliminates bakeout, LN cooling and attention.

Operating Principles

The TLI optically-dense foreline trap is economical, and relies for its trapping effect on a large area of metallic adsorption characteristics.

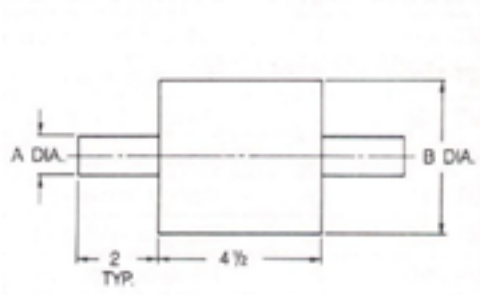
A molecule can only pass through the optically-dense foreline trap by contacting the adsorbent material a great number of times, thereby greatly increasing the probability that it will be trapped.

Materials

The optically-dense traps are made of type 304 stainless, TIG welded. They are supplied in three different configurations — 1) hose connections only (unflanged), 2) hose connection one end, other end flanged, and 3) flanged at both ends. Flanges are coppergasketed compatible type, which mate with all other standard copper-gasketed flanges. Special flanges, such as ASA, can be supplied on request.

Trap Dimensions

Type	A	B
075	3/4”	4”
100	1”	4”
150	1 1/2”	4”
200	2”	4”
250	2 1/2”	6”
300	3”	6”
400	4”	6”



Ordering Information

Description	3/4” Size	1” Size	1 1/2” Size	2” Size	2 1/2” Size	3” Size	4” Size
Hose connection both ends	CT-075	CT-100	CT-150	CT-200	CT-250	CT-300	CT-400
Flange one end Hose other end	CT-076	CT-101	CT-151	CT-201	CT-251	CT-301	CT-401
Flange connection both ends	CT-077	CT-102	CT-152	CT-202	CT-252	CT-302	CT-402
Hose connection both ends with quick-disconnect head for easy bronze wool removal	CT-075/CD	CT-100/CD	CT-150/CD	CT-200/CD	CT-250/CD	CT-300/CD	CT-400/CD

8 Foreline Traps

Molecular Sieve Traps

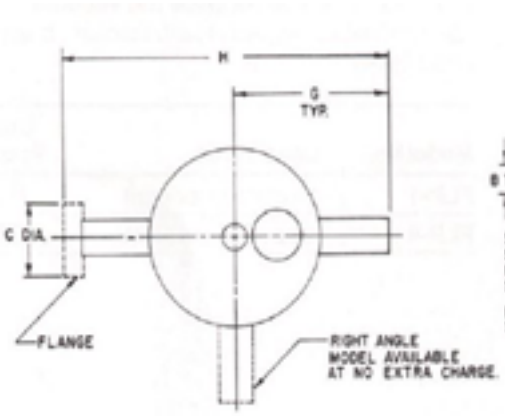
Description

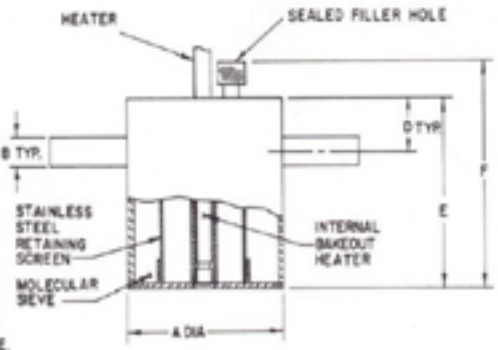
TLI's molecular sieve traps utilize synthetic zeolite with a high surface area per unit volume. Its design ensures effective trapping of hydrocarbons and water vapor, as well as preventing backsteaming of mechanical roughing pump oil. The molecular sieve trap operates at room temperature, thereby eliminating the necessity of any refrigerants. A built-in heater reprocesses the sieve material when necessary at a bakeout temperature of 375°C.

Specifications

TLI molecular sieve traps are fabricated of type 304 stainless steel. An internal screen assembly serves to contain the sieve material, preventing it from entering other areas of the vacuum system. Baffles are arranged around the sieve container to insure the passage of all molecules into the sieve material area.

Inlet and outlet ports are available either 180° apart inline (or 90° apart right angles) with or without flanges.





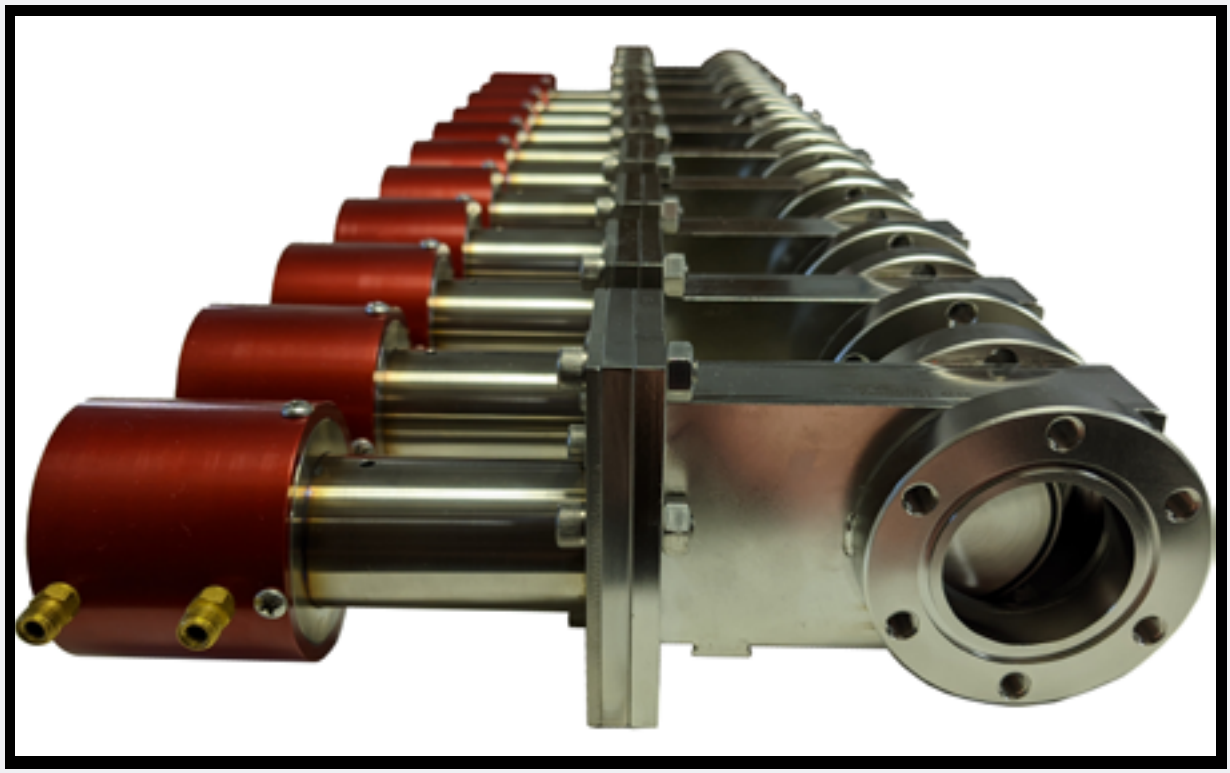
Mech. Pump Size	Recommended Trap Size	Gas Handling Load (50% Relative Humidity)	Capacity	115V Heater Power
To 8 cfm	1"	60 cu. ft.	270 gms	75 W
8-17 cfm	1 1/2"	125 cu. ft.	400 gms	125 W
17-30 cfm	2"	125 cu. ft.	400 gms	125 W
Over 30 cfm	3"	150 cu. ft.	500 gms	375 W

Dimensions in inches

Model No.	Size	Description	A	B	C	D	E	F	G	H
MT-100	1	Hose connection both ends	4 1/2	1	2 1/8	1 11/16	5 1/4	6 3/8	4 1/2	9
MT-101	1	Flange one end	4 1/2	1	2 1/8	1 11/16	5 1/4	6 3/8	4 1/2	9
MT-102	1	Flanges both ends	4 1/2	1	2 1/8	1 11/16	5 1/4	6 3/8	4 1/2	9
MT-150	1 1/2	Hose connection both ends	4 1/2	1 1/2	2 3/4	2	7 7/8	9	4 1/2	9
MT-151	1 1/2	Flange one end	4 1/2	1 1/2	2 3/4	2	7 7/8	9	4 1/2	9
MT-152	1 1/2	Flanges both ends	4 1/2	1 1/2	2 3/4	2	7 7/8	9	4 1/2	9
MT-200	2	Hose connection both ends	4 1/2	2	3 3/8	2	7 7/8	9	4 1/2	9
MT-201	2	Flange one end	4 1/2	2	3 3/8	2	7 7/8	9	4 1/2	9
MT-202	2	Flanges both ends	4 1/2	2	3 3/8	2	7 7/8	9	4 1/2	9
MT-300	3	Hose connection both ends	6	3	4 5/8	3	10	11 1/8	5 1/2	11
MT-301	3	Flange one end	6	3	4 5/8	3	10	11 1/8	5 1/2	11
MT-302	3	Flanges both ends	6	3	4 5/8	3	10	11 1/8	5 1/2	11
MS-100	1	Replacement molecular sieve charge								
HS-100	1	Replacement heater assembly								

Complete heater assembly and molecular sieve charge are provided with each trap.
One molecular sieve charge is required for 1",1 1/2" and 2" traps and three charges for the 3" traps.
One heater assembly is required for 1",1 1/2" and 2" traps and two heater assemblies for the 3" traps.

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com



Valves

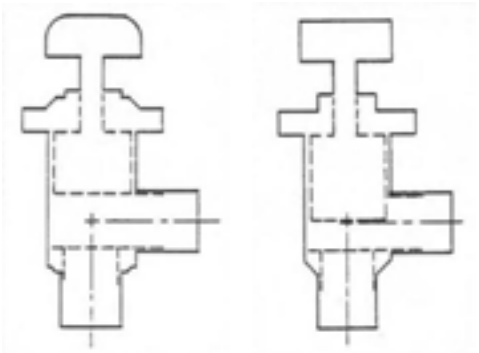
Since 1958, Thermionics has manufactured over 65,000 qualified valves. Thermionics manufactures the broadest line of vacuum valves. They have been tested and judged the highest quality valves manufactured in the United States (details on page 9-5).

Full Conductance

The figure of merit of a vacuum valve is its conductance, i.e., the amount of gas that passes from the plane of the inlet valve port to the plane of the outlet port of the valve in 1 sec per unit of pressure differential.

The inside diameter, the length of the tube, and any constrictions or obstructions can adversely affect conductance. Be certain that the gate or poppet of your valve opens fully and does not interfere with gas flow. The inside diameter of the port is almost meaningless as a specification unless full conductance is offered.

Valves that provide full conductance are qualified valves; those that do not might be referred to as unqualified or counterfeit valves. All Thermionics valves open fully and provide full conductance under all conditions.



TLI valves open fully

Competitors valves may not

We have included some computed conductances with some of our valve specifications. Because the short tube approximation to the conductance equation was used, ignoring the larger diameter in the valve body area, computed conductances are slightly understated.

Valve Choice Criteria

1. When deciding to specify either manual or electro-pneumatic actuation for the valve, consider frequency of use, available utilities, and operator attention required when the valve is actuated.
2. Select a valve capable of withstanding the bakeout temperature required to reach the base pressure desired in the time required.
3. All Thermionics valves are designed and manufactured to reach and maintain very low vacuum pressures easily. To do this, valves are free of virtual leaks, they have the lowest particulate levels, greatly reduced surface areas, less parts exposed to vacuum, have a smaller number of bearings exposed to vacuum, are smaller in size, weigh less, and are fully welded. Thermionics valves are welded internally or with full penetration, eliminating the problems inherent with brazed assemblies, and further reducing the internal surface area and profile.
4. The outgassing rate of the materials from which the valve is manufactured must be considered. Materials affect the gas load, and thereby the pump size required. If a valve is to be used in a corrosive environment, the appropriate material must be specified when the order is placed.
5. The smaller the seat or gate conductance leakage, the smaller the pump required. High leak rates make additional pump speed necessary to compensate for leakage through the seal. A valve is often sealed against atmosphere when equipment is shut down for the night or weekends; the leak rate must be small to prevent wasting pumping capacity.
6. Consider the number of cycles for which the valve is guaranteed and if the number is independently verifiable. Is the valve stem seal O-ring or bellows sealed? If bellows sealed. is a welded or formed bellows used? Viton-sealed gate and poppet valves are very forgiving, whereas metal-sealed bakeable valves must be manufactured with greater precision and they are more sensitive to contamination.
7. Determine whether the chamber pressure requirements for your particular needs are met by your proposed system by comparing the gas load at designed base pressure with pumping speed as reduced by any conductance restrictions between pump and chamber. First, the outgassing load Q is simply the product of the outgassing rate(s) of the material or materials used in the system and the respective area or areas. Then, calculate the chamber pumping speed required to maintain the pressure necessary for your vacuum process,

$$S = Q/P$$

where S = Pumping speed in the chamber (l/sec)
Q = Chamber outgassing as calculated above (Torr l/sec)
P = Pressure in the chamber (Torr)

A. If S appears excessively high, consider:
   1) Changing the chamber size or configuration to decrease surface area.
   2) Changing to a construction material with a lower outgassing rate.
   3) Reducing the outgassing rate by baking the chamber or by special passivation, such as the TLI passivation process.

B. The delivered pumping speed, Sd (pump speed at the chamber port), is limited by component conductance between the pump and the port. Conductance, in turn, is a function of tube size, length and amount the poppet or gate opens. The higher the chamber speed needed, the larger the valve size needed, and the greater the need for full conductance. Usually the conductance of high vacuum valves should be greater than the rated pump speed.

C. Finalize the chamber design and determine how you will connect the valve and other component parts to the chamber system, keeping in mind how each component will affect conductance and associated gas flow pattern.

D. After selecting your chamber, pump, valves, and plumbing, calculate the pumping speed delivered to the chamber as follows:

$$1/S_d = 1/S + 1/C_1 + 1/C_2 + 1/C_3 + \ldots + 1/C_n + 1/C_v$$

where $1/S_d$ = Pumping speed delivered to the chamber
$1/S$ = Pump speed
C_1 to C_n = Conductance of the components 1 to n between the pump and the chamber
C_v = Valve conductange

E. Compare the delivered chamber speed (Sd) to the required chamber speed S as calculated in step 7.

F. If the delivered speed is less than your required chamber speed, then consider:
   1) The alternatives in 7 A above;
   2) Shortening the distance between pump and chamber;
   3) Increasing the pipe and valve size between pump and chamber;
   4) Increasing the pump speed.

9 Selecting A Valve

Valve Terminology

Actuator The external valve component which transfers motion to the valve stem in angle and in line valves or to the slide assembly in gate valves. Manual actuators are knobs, cranks, or levers. Pneumatic actuators use compressed air controlled by a separate solenoid valve, while motor actuators use an electric gear motor.

Adsorption Adherence of atoms or molecules of a gas or liquid to the surface of another substance.

Angle Valve Any valve with the inlet port at a right angle to the outlet port.

Bellows A flexible metal connector, usually made of stainless steel, to accommodate: the expansion of stem seal vacuum valve bellows; to seal feedthrough shafts; isolate vacuum envelopes; isolate vibration; or to protect sensitive components from mechanical stress. Bellows are made by rollforming, hydroforming, metal depositing, or welding of individual convolutions. The choice of bellows depends on applications:
A) Welded bellows are made of two thin-contoured metal diaphragms welded on their inside diameter to form a section. The sections are then stacked and welded on their outside diameter to form a complete convolution. Welded bellows provide maximum flexibility and stroke with minimum size.
B) Formed bellows are an alternative to welded bellows. They are good for applications requiring moderate flexibility and/or high-pressure resistance. They are made by corrugating walls of thin-walled tubing.
(C) Deposited bellows are miniature, precise and thin-walled.

Bellows Assembly The valve mechanism which transfers motion from external drive components to vacuum side components through a metal bellows seal.

Bi-Pass A solenoid-controlled option feature which equalizes pressure on both sides of the valve seat before the valve is opened. The bi-pass mechanism protects delicate samples from damage caused by sudden pressure changes. It also permits gas to be bled into the system.

Bonnet The area where the actuator is joined with the case. This area provides access for valve maintenance. It consists of two flanges, a mechanism mounted on the top flange (such as a bellows assembly), and a gasket.

Buna Elastomer, nitrile rubber. A synthetic rubber made by random polymerization. Used for gaskets and O-rings. Maximum service temperature is 121°C/250°F.

Closure Seal Where prevention of gas passage between the outlet and inlet ports is achieved by means of a poppet or gate incorporating a gasket (the closure seal). Many types of gaskets are used, each with different capabilities. Fundamental to any closure is the application of force from the actuator through the bellows assembly to the seal assembly. At the end of the seal assembly is a gate or plug with a gasket which is deformed against the valve seat for sealing purposes.

Conductance The figure of merit of a valve can be expressed as the maximum number of Torr l/sec of gas which can pass from the plane of the inlet port to the plane of the outlet port. To help you make comparisons, we have included some computed conductances with our valve specifications. Because the short tube approximation to the conductance equation was used which ignores the larger diameter in the valve body area, computed conductances are slightly less than actual conductances.

Counterfeit Valves Vacuum valves that do not offer full conductance because of obstructions in the gas flow path such as gates or poppets that do no open fully. Unqualified valves are sometimes referred to as “counterfeit” valves.

Desorption Release or outgassing of gases or vapors adsorbed by the interior walls of the vacuum envelope. Low desorption rates are made possible by selecting correct materials, cleaning processes, optimum surface finish and proper engineering techniques.

Dielectric A substance with very low electrical conductivity, i.e., an insulator.

Elastomers A general term for high polymers having the property of extensibility and elastic recovery, i.e., the ability to be stretched and to retract rapidly to approximately the original size. (See “polymer.”)

Electro-pneumatic A method of valve actuation utilizing a pneumatic cylinder and a solenoid valve to direct the air pressure to one end, or alternately to both ends of the pneumatic cylinder, thus opening or closing the gate or poppet.

Gasket The replaceable, deformable metal or elastomeric component which, when compressed, prevents the passage of gas from one side of the seal to the other. Gaskets are used in the bonnet seal, the closure seal and the flange seals (when flanges are used). Metal gaskets provide the best seal by virtue of their low permeability, low outgassing rate and higher bakeout temperature. Elastomeric gaskets, chiefly Viton, are used when vacuum requirements are less stringent. They are economical and within limitations are reuseable. Metal closure seals are reusable, but must be replaced more often than elastomeric closure seals.

Gate/Poppet The gasket carrier which moves the closure gasket into position with the valve seat and transfers the sealing force to the gasket. The gate/poppet in all TLI valves is fully retractable from the space between ports, ensuring full conductance.

Gate Valve (See “gate/poppet” above.) This type of valve has three advantages: It offers a full line of sight transmission from port to port; it has the best conductance available; and it can be made in large sizes at a reasonable price.

Indium A metal, element No. 49 in the Periodic Table. It is ductile and softer than lead with a very low vapor pressure. It is used for radiation resistant seals.

Inlet Port A tubular opening, usually flanged, through a chamber wall, permitting access or installation of a device into the chamber.

Inline Valve A valve with the outlet port parallel to, but not necessarily axial with, the inlet port.

Kalrez A carbon-black filled compound with good mechanical properties and excellent chemical resistance, manufactured by DuPont. A maximum intermittent operating temperature of 366°C is recommended. It is used as a gasket material in high temperature applications.

KEL-F A polymer with high thermal stability, resistance to chemical corrosion, high dielectric strength, and high impact and tensile strengths. It is used for gaskets and seals.

Leak Detection The establishment by various detection methods that a leak is present and significant to system performance. Mass spectrometer helium leak detectors, offering sensitivity to about 5 x 10^{-10} Torr l/sec or better, are excellent for this purpose. NOTE: Teflon is permeable to helium, so care must be exercised to avoid saturating the Teflon tape used with thermocouple tubes. This permeation can sharply curtail the usefulness of a helium mass spectrometer.

Macor A machineable glass-ceramic manufactured by Corning, which retains the usual hardness and strength of ordinary ceramics without needing to be fired after machining.

Nitrile Rubber A synthetic rubber formed by random polymerization of acrylonitrile with butadiene used for gaskets and O-rings.

Outlet Port A tubular opening through a chamber wall, usually flanged, permitting access for pumping or the extraction of components from the chamber.

Over Center Locking A gate valve mechanical feature which ensures that the valve will remain closed in the event of loss of either air pressure or electrical power.

Permeability In high vacuum devices, the degree of vacuum that can be maintained depends, in part, upon the quantity of gas passing through (permeating) the wall or gasket from outside the chamber. Materials used for gaskets and chamber walls should be of low permeability.

Pneumatic A pneumatic valve is supplied with the pneumatic actuator alone, without a solenoid valve. (See “electro-pneumatic.”)

Polymer A chemical compound or mixture consisting essentially of repeating structural units. Polymers with special elastic properties are called elastomers.

Polyimide A high molecular weight polymer with high temperature stability (up to 375°C) and low outgassing at high temperatures. It is used for gate, bonnet, poppet and other seals. It absorbs large amounts of water when exposed to air. Thus it should be avoided in systems which are frequently cycled using room air.

Poppet A gasket or O-ring carrier which moves the closure gasket or O-ring into position with the valve seat and transfers sealing force to the gasket or O-ring to effect a leak tight seal.

Qualified Valve A valve that provides full conductance (see page 9-2). All Thermionics valves are qualified valves.

Seat The portion of the body which is polished and aligned to provide the docking/ receiving surface against or into which the gate or poppet seals.

Stem The axial shaft in angle and inline valves connecting actuator and bellows assembly. Many valve stems rise as the valve is opened, while other valves may have a non-rising feature.

Straight Through Valve This valve offers a line of sight valve opening (generally somewhat smaller than port I.D.) from inlet port to outlet port. It is a design particularly suited for metal closure seals.

Tee Valve A valve with an extra port on the system side. It is useful for roughing manifolds.

Teflon A trademarked (DuPont) elastomer (tetrafluoroethylene) with good chemical resistance. It is used for seals, gaskets, O-rings, and recommended for temperatures up to 300°C. It is permeable to helium. It has no melting point, but turns into an amorphous jelly above 327°C. Above 400°C, it decomposes, releasing poisonous fluorine volatiles .

Venting of Valve Plate/Poppet Provision for venting of any gas which might be trapped in the seal groove by means of a pumpout opening.

Viton A trademarked fluoroelastomer used for bonnet, gate, poppet, and other seals. It can be used for 250°C continuous service, and is useful for ultra-high vacuum systems.

Conversion Table for Various P ressure Units Used in High Vacuum Practice

	Torr	microns	Pascal	dyne/cm^2	atm	mbar
Torr (mm Hg)	1	1,000	133	1,330	1.32 x 10^{-3}	1.32
microns (milliTorr)	0.001	1	0.133	1.33	1.32	1.32 x 10^{-3}
Pascal Newton/m^2	7.5 x 10^{-3}	7.5	1	10	9.87 x 10^{-6}	9.87 x 10^{-3}
dyne/cm^2	7.5 x 10^{-4}	0.75	0.1	1	9.87 x 10^{-7}	9.87 x 10^{-4}
atm std atmosphere	760	7.6 x 10^5	1.01 x 10^5	1.01 x 10^6	1	1,010
mbar	0.75	750	100	1,000	9.87 x 10^{-4}	1

Additional Conversions

1 Bar (Bureau) = 750.0 mm Hg = 29.53” Hg

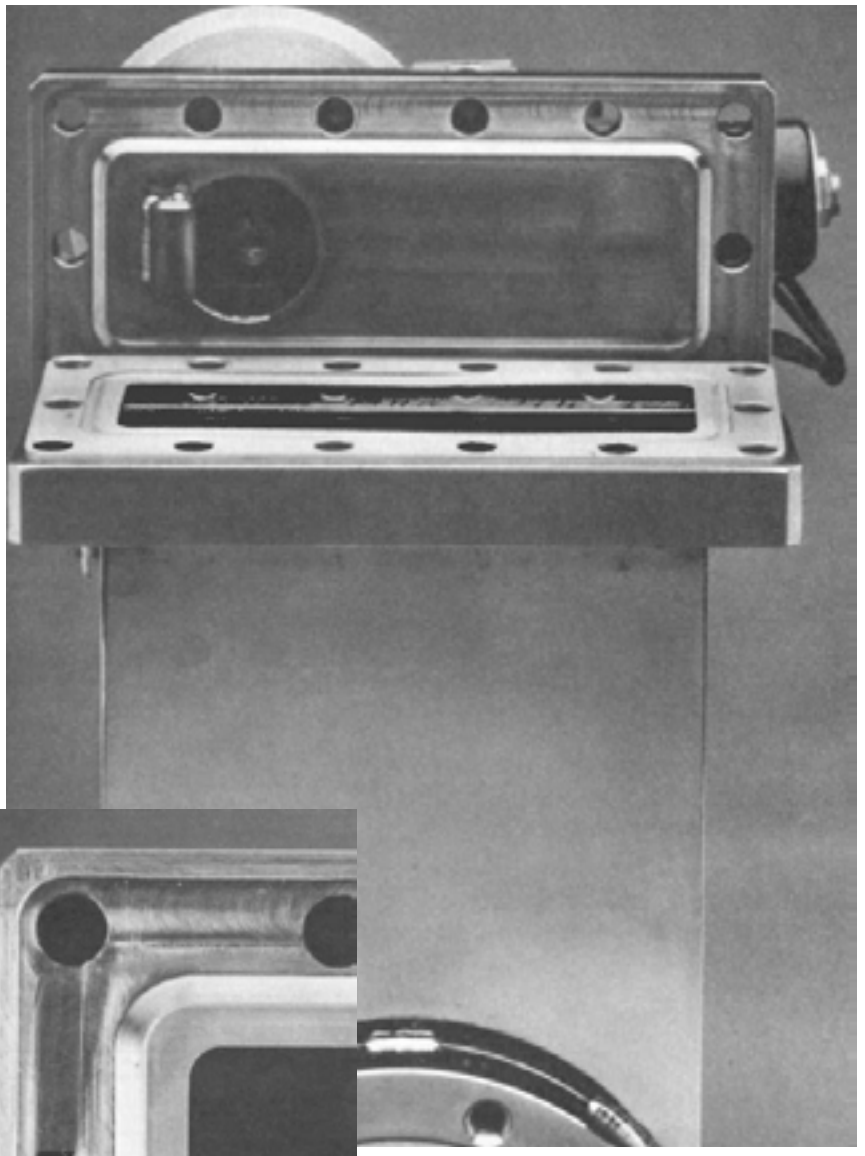
9 Gate Valves—TLG Series

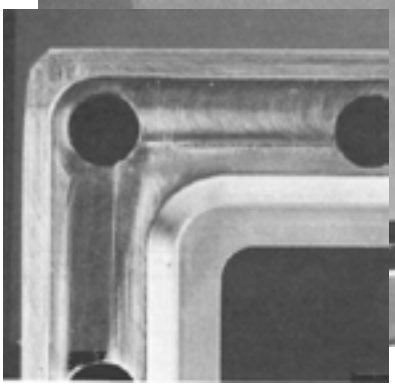
Metal & Valve Bonnets

Our rectangular metal flanges are an ideal metal seal for valve bonnets. This remarkable UHV flange makes any other rectangular metal valve bonnet seal obsolete. Its reliability and ease of assembly have been repeatedly proven, and its range of shapes and sizes will satisfy any non-circular UHV flange requirements. Refer to Section 7 for further flange information.

Other types of metal-sealed valve bonnets may use unconstrained wire or flat gaskets or may imitate our retangular seals. However, unconstrained gaskets are much less reliable than the knife edge/captured copper gasket sealing principle. Wire gaskets are also difficult to install, and almost impossible when sealing surfaces are vertical. Not so with our flanges. Assembly requires only minutes, not hours, regardless of the angle of installation. This is important when valve bodies must be left inline when systems are being serviced.

Recently, a National Laboratory conducted independent testing on valves. Thermionics' gate valve with our rectangular flange bonnet seal won the competition. Like the ConFlat, its Varian ancestor, our flanges will soon become a new standard in the industry.





Specifications

All gate, roughing, and bakeable valves have the following standard specifications. Customers may request other materials on special order.

"Roughing valves" refers to all inline and angle valves, although they are designed and built for UHV applications they can be used in roughing applications.

Design

No trapped volumes or virtual leaks.

Materials of Construction

VALVE BODY
Fabricated from type 304 stainless steel with all internal or back filled full penetration welds using GTAW (known also as TIG) gas welding process.

INTERNAL MECHANISMS
Fabricated from type 304 stainless steel, fully welded GTAW process.

BELLOWS SHAFT SEALS
Fabricated from special application 300 series stainless steels. Roughing and bakeable valves use fully nested welded bellows assemblies, gate valves may use nested welded or hydrofornied bellows with UHV furnace brazed transition pieces. All bellows have additional convolutions for longer operating life.

BODY SEAL
Viton O-ring or OFE copper captured gasket, depending on model.

GATE/POPPET SEAL
Viton O-ring for gate and roughing valves, bakeable valves use OFE copper gaskets.

BEARINGS
Needle and ball bearings, dry film lubricated.

CLEANING
Valves are chemically cleaned for vacuum service.

PNEUMATIC ACTUATORS
Virgin aluminum cast or drawn.

Bakeability

Bakeout temperatures are limited by seal material selection. Please consult the factory for specific temperature requirements. Following are temperature limits recommended by seal manufacturers

Buna:	121°C/250°F maximum
Viton:	250°C/482°F valve open/unloaded
	204°C/400°F valve closed/loaded
Kalrez:	366°C/680°F valve open/unloaded
	316°C/600°F valve closed/loaded
All metal:	450°C/842°F valve open or closed
Solenoids:	65°C/149°F maximum

Orientation·

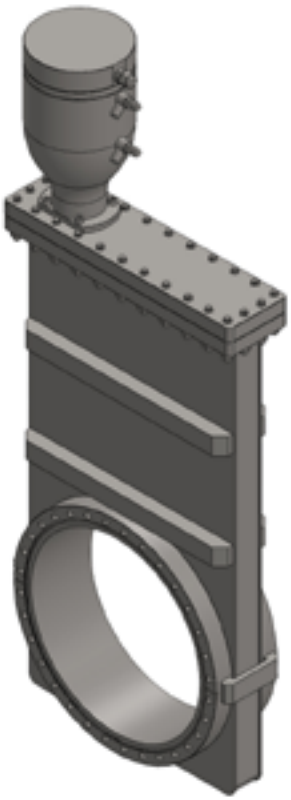
No detectable leak when tested in the vacuum adverse condition using a helium MSLD with a sensitivity of 2 x 10^{-10} std cc/sec.

Leak Free

May be mounted in any position.

Heater Jackets

Heater jackets are available for CVO and metal etch applications. Consult the factory for information.



Since 1958, TLI has manufactured qualified gate valves.

- All stainless steel construction
- Tested against the best gate valves in the world by a national laboratory
- Judged the only U.S. manufactured valve qualified to meet exacting requirements

Now the Improved TLG Series

They offer these additional design features:

- New design and manufacturing process
- Smaller number of bearings exposed to vacuum
- New longer life bearing interface materials
- Longer cycle life
- Lowest particulate levels
- Lower base pressure
- No virtual leaks
- Greatly reduced surface areas
- Less parts exposed to vacuum
- Smaller internal mechanism
- Weighs less
- Seals and opens against atmosphere
- Seals are easily replaced, lower maintenance costs

Theory of Operation—TLG Series

TLG Series valves are toggle action, linear travel gate valves. The gate carriage moves in the valve body on a set of wheels, moved back and forth by a manual or pneumatically-actuated valve stem which passes through a metal bellows.

To close the valve, the carriage moves forward on wheels until it reaches the end of the valve case. When the carriage stops, the toggle linkage continues to travel and extend. The gate does not move forward, only upward toward the port seal surface. There is no abrasion or damage to the Oring. The gate moves up to the port into its sealing position. The O-ring is compressed, making a leak-tight seal. The toggle linkage continues to move forward until the toggle knee passes center and locks, providing positive closure protection in the event control power, or air pressure, is lost.

Valve Specifications for National Laboratory Testing

1. Stainless steel fabrication consistent with good vacuum practice.
2. All metal sealed with the exception of dry Viton gate seal.
3. Helium leak rates at 1 aim differential:
   Across valve $< 1 \times 10^{-9}$ std cc/sec
   To outside environment $< 1 \times 10^{-10}$ std cc/sec
4. Must seal with differential in either direction.
5. Hydrocarbon-free interior.
6. All-metal ConFlat-type port flanges.
7. Electro-pneumatic operation with 110 VAC solenoid, uses less than 25 W of electrical power at 80 psi air pressure.
8. Closed valves must remain sealed if air pressure is lost.
9. Valve closes with loss of electrical power.
10. Positive valve position indication available via electrical contacts.
11. Closing and opening time of less than 3.5 sec.
12. Capable of operating 10,000 cycles without maintenance.
13. Valve actuation mechanism removeable with valve body in beamline.
14. Metal bonnet seal must be positively held in position during assembly.
15. Valve cannot emit peak sound levels greater than 85 dB at 2 ft during operation at 80 psi.
16. Valve cannot generate peak vibration levels greater than 15,000 in/sec^2 below 2,000 Hz during operation at 80 psi.
17. Valve weight cannot exceed 45 lbs in the 6" I.D. size.

The specifications above established minimum requirements for high vacuum gate valves for a major national research laboratory. Valves from all foreign and domestic manufacturers were tested for conformance.

Thermionics' gate valves were the only domestic valves tested which satisfied these stringent specifications. Thermionics was the only domestic valve manufacturer qualified and certified as an acceptable source for valves. A copy of the report is available upon request.

Test Procedures

The valves were installed into a section of 6" beamline. The valves were cycled 10,000 times, stopping each 1,000 cycles for leak checking in both directions at 1 aim differential. Difficulties in mounting, operation, etc. were looked for. After the cycle test, each unit was dismantled for inspection.

9 Gate Valves—TLG Series Ordering Information

I. Introduction

On the following 3 pages TLG gate valves have been listed according to basic body style and port 1.0.

On the next page, to facilitate ordering and pricing and to serve to remind you what features are available, we have listed nine features, together with feature options; for example, Group B covers solenoids. Within this group there are 4 standard group options. Option No. 2, for example, is a 120/60 solenoid, Group Option No. 3 is a 220/60 solenoid, Group Option No. 4 is a 12 VDC solenoid, and so forth.

II. Ordering Procedure

A review of the nine feature groups and the feature group options on the opposite page shows that standard features are always denoted by the number 1, while nonstandard features are always denoted by a number other than 1. Note also that in some instances there is no standard feature, and this has been so indicated.

III. Help

This numbering system was developed to insure the valve supplied is exactly what you need. It addresses questions concerning available features and options for the valve, and incorporates that information in the valve number.

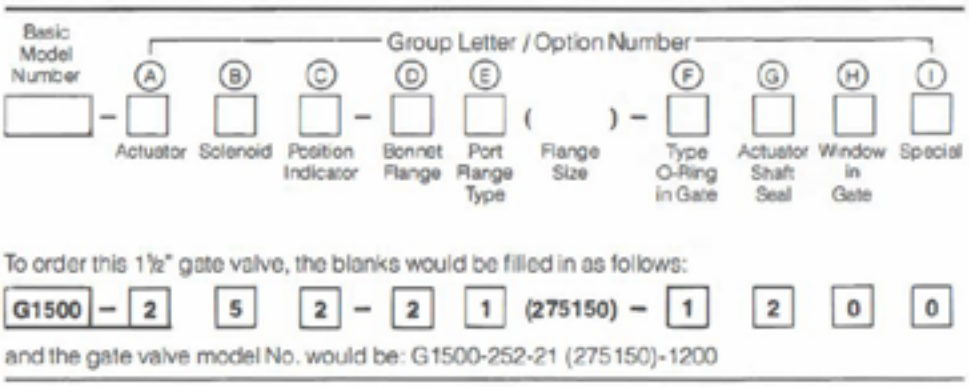
If the numbering system seems complex, or intimidating, please don't give up, call us (510-538-3304). Tell us what size you want and we will do the rest.

A **Below is an example of the ordering procedure and model no. for a 1 1/2" gate valve with the following features:**

Group Description	Group Letter	Group Option No.
Pneumatically operated actuator	A	#2
24 VDC solenoid	B	#5
Reed position indicators	C	#2
Metal bonnet	D	#2
ConFlat type port flanges (include flange size)	E	#1
Viton O-ring in gate	F	#1
Welded bellows actuator shaft seal	G	#2
No window in gate	H	#0
No special features or instructions	I	#0

B If you were to fill in the following blank blocks shown below with the feature group options of your choice, from those listed on the opposite page, the resulting model number would serve as a check list to insure your gate valve incorporates all of the options you need and that nothing has been overlooked or left to chance.

C For each valve size which appears on the following pages, we have listed not only the basic model number, but a number of non-basic model numbers as well.



Gate Valve Options

As you look at the feature groups on the next page, references are given for information concerning various options which are offered. If the option you require is not listed, if you have any questions or would like assistance, please call us. In addition:

1. Flange Options: Port flanges are available in a variety of configurations and geometries. The more common flange types are listed here. Others are routinely supplied, please call the factory for information.

2. Solenoid Control Valves: TLI valves with pneumatic actuators are supplied with a 120 VAC, 60 Hz solenoid control valve. We do not charge extra for solenoids like other manufacturers. Other solenoids are available, see page 9-7 for a partial list. There is an additional charge for most special solenoid valves. Please consult the factory for current price information.

3. Fittings Option: Fittings, such as VCR or NPT fittings, may be installed on valves. The fittings are used to add items, i.e.: gas lines, T.C. tubes, leak valves or up-to-air valves, to a system via the valve. Consult the factory for prices and configurations.

4. Tool Kits: Are available at an additional charge. Please consult the factory for details.

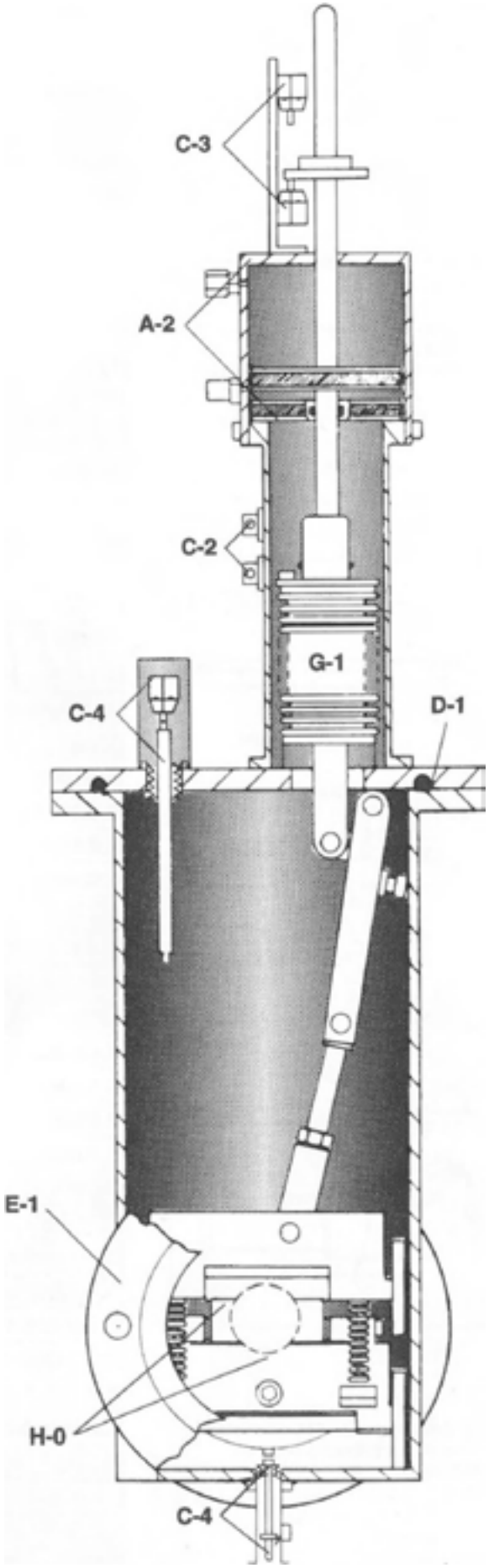
5. Heater Jackets: Are available for CVD and metal etch applications. Consult the factory for information.

6. Roughing Ports: Are available for valves. the most commonly supplied are: Valves with ConFlat port flanges are usually supplied with a ConFlat flange roughing port(s). Valves with ISO port flanges are usually supplied with an ISO flange roughing port(s). You may choose and specify otherwise. Roughing ports with flanges other than those listed above, i.e.: ASA, VCR fittings or tubes without flanges. are also available, please consult the factory for prices. When ordering roughing ports, please consider:
1. the roughing port I.D., and
2. the roughing port flange O.D.

Tube Size O.D.	x	Flange Type/O.D.
0.75"	x	ConFlat 1.33"/ISO 25
1.5"	x	ConFlat 2.75"/ISO 40
2.0"	x	ConFlat 3.38"/ISO 50
2.5"	x	ConFlat 4.5"/ISO 63

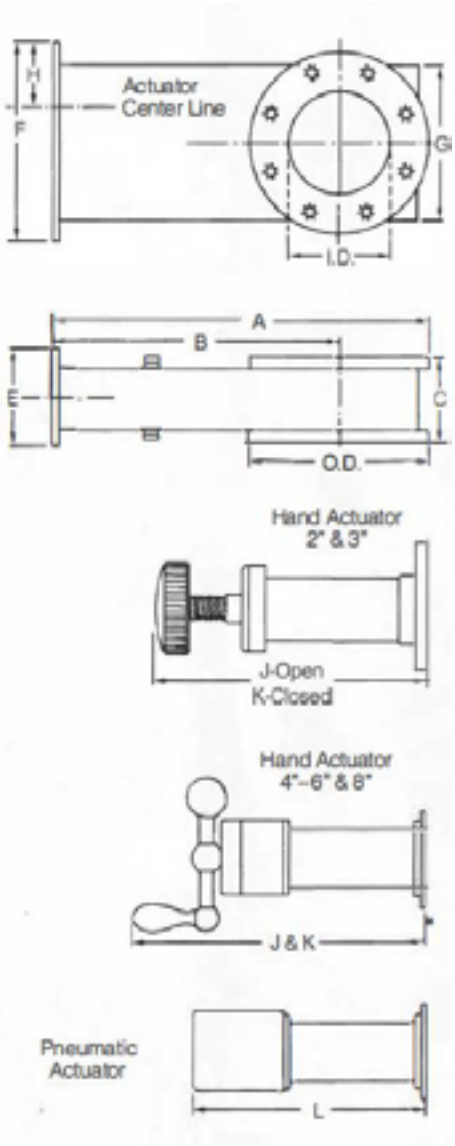
Group Letter	Group Option No.	Group Description
Actuator (see pages 9-2 and 9-8 for details)		
A	0	None
	1*	Standard Manual
	2	Pneumatic
	3	Motorized
	9	Special/Describe
Solenoid		
B	0	None
	1*	Does not apply
	2	120 VAC/60 Hz
	3	220VAC/60Hz
	4	12VDC
	5	24VDC
	9	Special/Describe
Position Indicators (see page 9-11 for details)		
C	0	None
	1*	Does not apply
	2	Reed
	3	Microswitch Type A
	4	Microswitch Type B
	9	Special/Describe
Bonnet Flanges (see pages 9-2 and 9-4 for details)		
D	0	None
	1*	Standard—Viton seal
	2	Metal Flange—flat copper gasket seal
	3	Wire seal
	9	Special/Describe
Port Flanges (see page 9-8 for details)		
E	0	None
	1*	Standard—ConFlat type
	2	Metal Flange—flat copper gasket seal
	3	ASA
	4	ISO
	9	Special/Describe
Type O-Ring in Gate		
F	0	None
	1*	Standard—Viton
	2	Kalrez
	3	Buna
	4	Polyimide
	9	Special/Describe
Actuator Shaft Seal		
G	0	None
	1*	Standard-formed bellows
	2	Welded bellows
	3	O-ring seal
	9	Special/Describe
Window in Gate (see page 9-10 for details)		
H	0	None
	1*	Does not apply
	2	Pyrex
	3	Quartz
	4	Sapphire
	9	Special/Describe
Special		
I	0	None
	1*	133-075 ConFlat roughing port
	2	275-150 ConFlat roughing port
	3	338-200 ConFlat roughing port
	4	450-250 ConFlat roughing port
	5	ISO 25-0.75 ISO roughing port
	6	ISO 40-1.5 ISO roughing port
	7	ISO 50-2.0 ISO roughing port
	8	ISO 63-2.5 ISO roughing port
	9	Special/Describe

*Denotes the standard feature in each group.



9 Gate Valves—TLG Series Ordering Information

Please note:
PORT FLANGES: Gate valves listed here, except for the G5000, are shown with ConFlat port flanges. ISO port flanges are available at no additional cost. The ISO flange face-to-face dimension may be different than the ConFlat dimension shown. Please consult factory for details.
Please consult the factory for prices and dimensions for other port flange options listed on page 9-7.



Basic Model No.	Standard Options	Port Size	Bonnet Viton/ Metal	Manually Operated	Pneumatic Operated	Gasket Set Part No.
G0058-	100-11(133058)-1200	5/8"	Viton	x		GH-G62
G0058-	100-21(133058)-1200	5/8"	Metal	x		GH-G62P
G0058-	220-11(133058)-1200	5/8"	Viton		x	GP-G62
G0058-	220-21(133058)-1200	5/8"	Metal		x	GP-G62P
G1500-	100-11(275150)-1100	1 1/2"	Viton	x		GH-G15
G1500-	100-21(275150)-1100	1 1/2"	Metal	x		GH-G15P
G1500-	220-11(275150)-1100	1 1/2"	Viton		x	GP-G15
G1500-	220-21(275150)-1100	1 1/2"	Metal		x	GP-G15P
G2000-	100-11(338200)-1100	2"	Viton	x		GH-G2
G2000-	100-21(338200)-1100	2"	Metal	x		GH-G2P
G2000-	220-11(338200)-1100	2"	Viton		x	GP-G2
G2000-	220-21(338200)-1100	2"	Metal		x	GP-G2P
G2500-	100-11(450250)-1100	2.5"	Viton	x		GH-G25
G2500-	100-21(450250)-1100	2.5"	Metal	x		GH-G25P
G2500-	220-11(450250)-1100	2.5"	Viton		x	GP-G25
G2500-	220-21 (450250)-1100	2.5"	Metal		x	GP-G25P
G3000-	100-11(462300)-1100	3"	Viton	x		GH-G3
G3000-	100-21(462300)-1100	3"	Metal	x		GH-G3P
G3000-	220-11(462300)-1100	3"	Viton		x	GP-G3
G3000-	220-21(462300)-1100	3"	Metal		x	GP-G3P
TLG4000-	100-11(600400)-1100	4"	Viton	x		GH-G4
TLG4000-	100-21(600400)-1100	4"	Metal	x		GH-G4P
TLG4000-	220-11(600400)-1100	4"	Viton		x	GP-G4
TLG4000-	220-21(600400)-1100	4"	Metal		x	GP-G4P
G5000-	100-13(900525)-1100	5"	Viton	x		GH-G5
G5000-	100-23(900525)-1100	5"	Metal	x		GH-G5P
G5000-	220-13(900525)-1100	5"	Viton		x	GP-G5
G5000-	220-23(900525)-1100	5"	Metal		x	GP-G5P
TLG6000-	100-11(800600)-1200	6"	Viton	x		GH-G6
TLG6000-	100-21(800600)-1200	6"	Metal	x		GH-G6P
TLG6000-	220-11(800600)-1200	6"	Viton		x	GP-G6
TLG6000-	220-21(800600)-1200	6"	Metal		x	GP-G6P
TLG8000-	100-11(10 x 8)-1200	8"	Viton	x		GH-G8
TLG8000-	100-21(10 x 8)-1200	8"	Metal	x		GH-G8P
TLG8000-	220-11(10 x 8)-1200	8"	Viton		x	GP-GS
TLG8000-	220-21(10 x 8)-1200	8"	Metal		x	GP-G8P
TLG10000-	100-11(1325*x10)-1200	10"	Viton	x		GH-G10
TLG10000-	100-21(1325*x10)-1200	10"	Metal	x		GH-G10P
TLG10000-	220-11(1325*x10)-1200	10"	Viton		x	GP-G10
TLG10000-	220-21(1325*x10)-1200	10"	Metal		x	GP-G10P
G12000-	100-11(14 X 12)-1200	12"	Viton	x		GH-G12
G12000-	100-21(14 X 12)-1200	12"	Metal	x		GH-G12P
G12000-	220-11(14 X 12)-1200	12"	Viton		x	GP-G12
G12000-	220-21(14 X 12)-1200	12"	Metal		x	GP-G12P

* Also available with 12" O.D. flange
Larger sizes on request

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Valve Dimensions										Flange Type	Flange Dimensions					
A	B	C	E	F	G	H	J Closed	K Open	L		O.D.	I.D.	Thick-ness	B.C.	No. of Holes	Thread
1.5	1.9	1.5	1.6	1.9	1.3	1	1.9	1.9	NA	MS	1.33	0.6	0.28	1.06	6	8/32
1.5	1.9	1.5	1.6	1.9	1.3	1	1.9	1.9	NA	MS	1.33	0.6	0.28	1.06	6	8/32
1.5	1.9	1.5	1.6	1.9	1.3	1	NA	NA	2.9	MS	1.33	0.6	0.28	1.06	6	8/32
1.5	1.9	1.5	1.6	1.9	1.3	1	NA	NA	2.9	MS	1.33	0.6	0.28	1.06	6	8/32
4.6	3.3	2	2	3.3	2.3	1.3	4.8	4.8	NA	MS	2.75	1.5	0.5	2.31	6	1/4-28
4.6	3.3	2	2	3.3	2.3	1.3	4.8	4.8	NA	MS	2.75	1.5	0.5	2.31	6	1/4-28
4.6	3.3	2	2	3.3	2.3	1.3	NA	NA	4.8	MS	2.75	1.5	0.5	2.31	6	1/4-28
4.6	3.3	2	2	3.3	2.3	1.3	NA	NA	4.8	MS	2.75	1.5	0.5	2.31	6	1/4-28
8.3	6	2.8	2.4	4.4	3.4	1.5	6	6.6	NA	MS	3.38	2	0.69	2.85	8	5/16-24
8.3	6	2.8	2.7	4.6	3.4	1.6	6	6.6	NA	MS	3.38	2	0.69	2.85	8	5/16-24
8.3	6	2.8	2.4	4.4	3.4	1.5	NA	NA	5.8	MS	3.38	2	0.69	2.85	8	5/16-24
8.3	6	2.8	2.7	4.6	3.4	1.6	NA	NA	5.8	MS	3.38	2	0.69	2.85	8	5/16-24
9	6.8	2.7	2.4	5.4	4.4	1.5	6	6.6	NA	MS	4.5	2.5	0.69	3.63	8	5/16-24
9	6.8	2.7	2.6	5.6	4.4	1.6	6	6.6	NA	MS	4.5	2.5	0.69	3.63	8	5/16-24
9	6.8	2.7	2.4	5.4	4.4	1.5	NA	NA	5.8	MS	4.5	2.5	0.69	3.63	8	5/16-24
9	6.8	2.7	2.6	5.6	4.4	1.6	NA	NA	5.8	MS	4.5	2.5	0.69	3.63	8	5/16-24
9.1	6.8	2.9	2.4	5.4	4.4	1.5	6	6.6	NA	MS	4.62	3	0.75	5.03	10	5/16-24
9.1	6.8	2.9	2.6	5.6	4.4	1.6	6	6.6	NA	MS	4.62	3	0.75	5.03	10	5/16-24
9.1	6.8	2.9	2.4	5.4	4.4	1.5	NA	NA	5.8	MS	4.62	3	0.75	5.03	10	5/8-24
9.1	6.8	2.9	2.6	5.6	4.4	1.6	NA	NA	5.8	MS	4.62	3	0.75	5.03	10	5/8-24
11.1	8.1	3.5	3.3	7	5.5	2.2	10.3	10.3	NA	MS	6	3.84	0.78	5.13	16	5/16-24
11.1	8.1	3.5	3.6	7.3	5.5	2.3	10.3	10.3	NA	MS	6	3.84	0.78	5.13	16	5/16-24
11.1	8.1	3.5	3.3	7	5.5	2.2	NA	NA	7.2	MS	6	3.84	0.78	5.13	16	5/16-24
11.1	8.1	3.5	3.6	7.3	5.5	2.3	NA	NA	7.2	MS	6	3.84	0.78	5.13	16	5/16-24
15 3/8	10 7/8	2 3/4	3 1/4	8 3/8	6 7/8	2.4	12.7	12.7	NA	ASA	9	5.25	0.5	7.5	8	5/8-11
15 3/8	10 7/8	2 3/4	3 1/4	8 3/8	6 7/8	2.4	12.7	12.7	NA	ASA	9	5.25	0.5	7.5	8	5/8-11
15 3/8	10 7/8	2 3/4	3 1/4	8 3/8	6 7/8	2.4	NA	NA	10.5	ASA	9	5.25	0.5	7.5	8	5/8-11
15 3/8	10 7/8	2 3/4	3 1/4	8 3/8	6 7/8	2.40	NA	NA	10.5	ASA	9	5.25	0.5	7.5	8	5/8-11
16.3	12.3	3.5	3.3	9.5	12.4	2.4	10.9	10.9	NA	MS	8	5.84	0.87	7.13	20	5/16-24
16.3	12.3	3.5	3.6	9.8	12.4	2.6	10.9	10.9	NA	MS	8	5.84	0.87	7.13	20	5/16-24
16.3	12.3	3.5	3.3	9.5	12.4	2.4	NA	NA	8.4	MS	8	5.84	0.87	7.13	20	5/16-24
16.3	12.3	3.5	3.6	9.8	12.4	2.6	NA	NA	8.4	MS	8	5.84	0.87	7.13	20	5/16-24
20.9	16.2	4.2	3.8	11.9	10.4	2.5	14.8	14.8	NA	MS	10	7.76	0.97	9.13	24	5/16-24
21	16.3	4.2	4.3	12.5	10.4	2.8	14.9	14.9	NA	MS	10	7.76	0.97	9.13	24	5/16-24
20.9	16.2	4.2	3.8	11.9	10.4	2.5	NA	NA	10.5	MS	10	7.76	0.97	9.13	24	5/16-24
21	16.3	4.2	4.3	12.5	10.4	2.8	NA	NA	10.5	MS	10	7.76	0.97	9.13	24	5/16-24
24	17.5	4.5	3.7	14.1	12.6	3.5	14.1	14.1	NA	MS	13.25	9.76	1.12	12.1	30	3/8-24
23.9	17.4	4.5	4.2	14.5	12.6	3.6	14.1	14.1	NA	MS	13.25	9.76	1.12	12.1	30	3/8-24
24	17.5	4.5	3.7	14.1	12.6	3.5	NA	NA	11.8	MS	13.25	9.76	1.12	12.1	30	3/8-24
23.9	17.4	4.5	4.2	14.5	12.6	3.6	NA	NA	11.9	MS	13.25	9.76	1.12	12.1	30	3/8-24
29	21.9	4	4	16	13.5	6	13.25	13.25	NA	MS	14	12	1.12	12.8	30	3/8-24
29	21.9	4	4	16	13.5	6	13.25	13.25	NA	MS	14	12	1.12	12.8	30	3/8-24
29	21.9	4	4	16	13.5	6	NA	NA	10	MS	14	12	1.12	12.8	30	3/8-24
29	21.9	4	4	16	13.5	6	NA	NA	13.5	MS	14	12	1.12	12.8	30	3/8-24

These dimensions are nominal, and are provided for reference. They may have been rounded to the nearest 0.10" or 0.010".
Dimensions and specifications may change without notice, please consult the factory for more exact information.

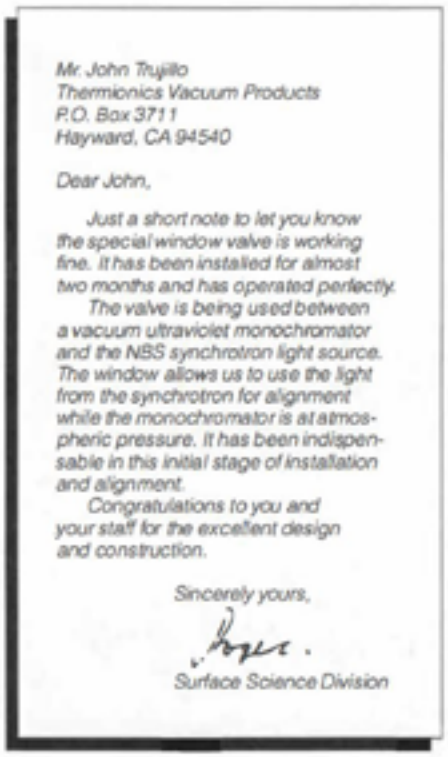
9 Gate Valve Options

Gate Valves with Gate Windows

A window in your gate valve can save you many hours of pumpdown time by allowing alignment of beam transport with the system under vacuum, and because it may be the best spot to introduce a laser beam into an airlock or target handling system.

Whatever your reason, this is a good example of TLI's innovative and flexible approach to valve design. Pictured and described on this page is a sample of the many valves with windows in the gate which we manufacture.

These valves are available on special order with Pyrex, sapphire, or quartz windows.



Mr. John Trujillo
Thermionics Vacuum Products
P.O. Box 3711
Hayward, CA 94540

Dear John,

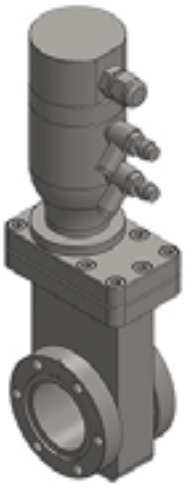
Just a short note to let you know the special window valve is working fine. It has been installed for almost two months and has operated perfectly.

The valve is being used between a vacuum ultraviolet monochromator and the NBS synchrotron light source. The window allows us to use the light from the synchrotron for alignment while the monochromator is at atmospheric pressure. It has been indispensable in this initial stage of installation and alignment.

Congratulations to you and your staff for the excellent design and construction.

Sincerely yours,

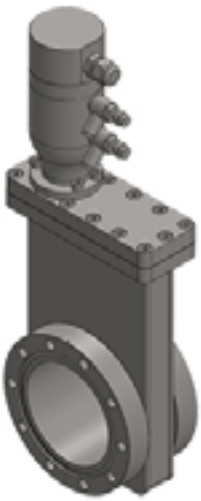
Surface Science Division



1 1/2" Gate Valve

with 3/4" sapphire window, air operated, with metal bonnet seal.

Model No. G1500-220-21(275150)-1149



2 1/2" Gate Valve

with 1 1/2" sapphire window, air operated, with metal bonnet seal.

Model No. G2500-220-21(600250)-1149

1 1/2" Gate Valve

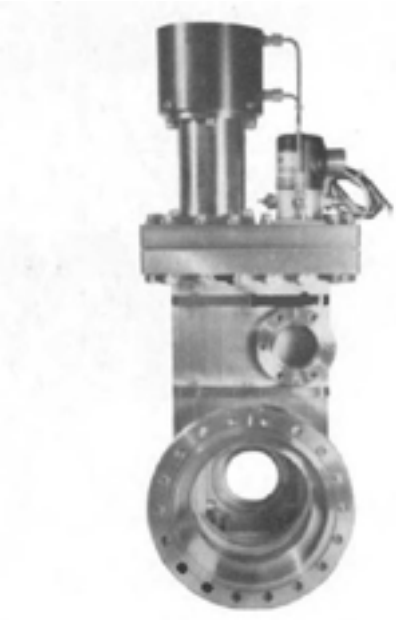
with 3/4" Pyrex window, manual actuator, and Viton bonnet seal.

Model No. G1500-100-11(275150)-1129

2 1/2" Gate Valve

with 11/2" Pyrex window, manual actuator, and metal bonnet seal.

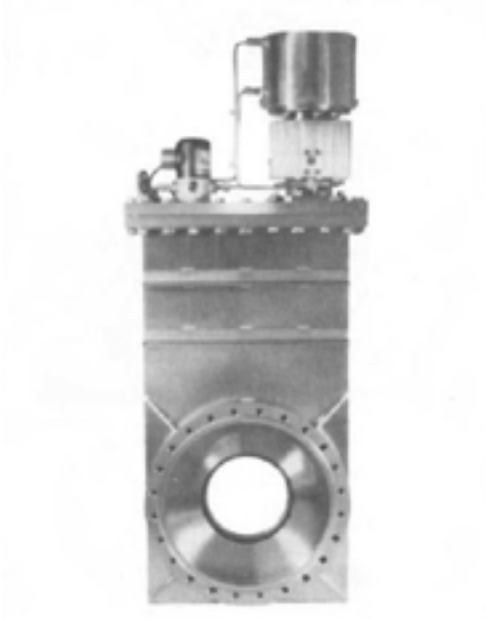
Model No. G2500-100-21(450250)-1129



4" Gate Valve

(shown with roughing port) with 2" sapphire window, air operated, with metal bonnet seal.

Model No. TLG4000-220-21(600400)-1149



8" Gate Valve

shown with 4" Pyrex window

Model No. TLGS000-220-21(1000800)-1129

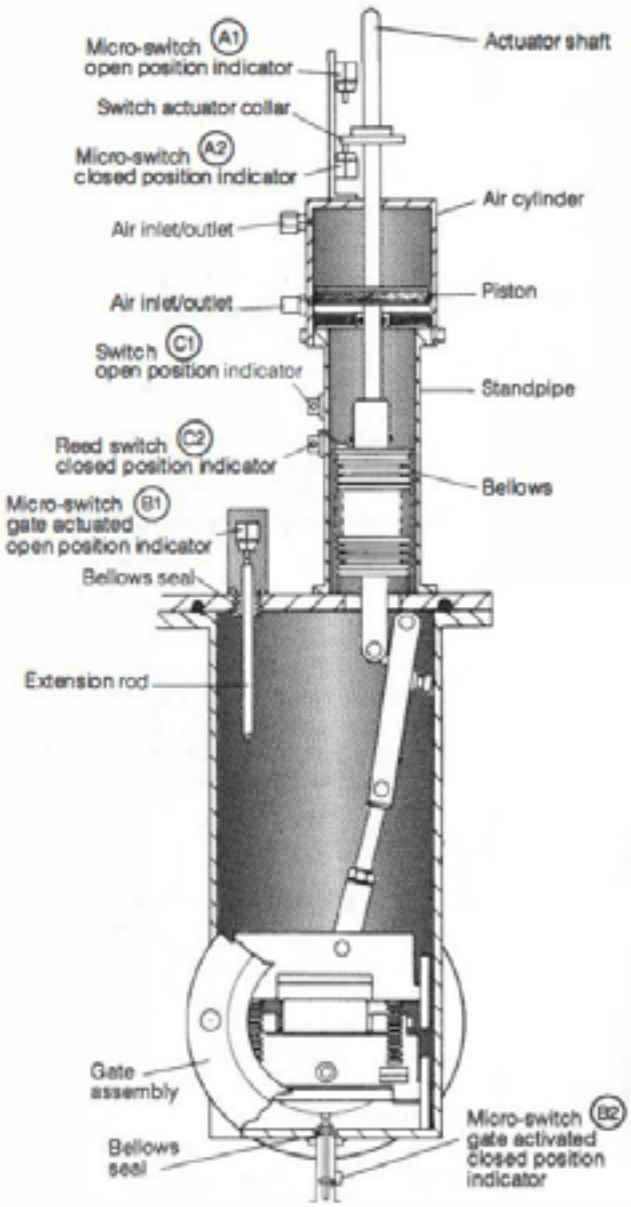
Position Indicators

See page 3-7 for ordering information (under Group “C”)

- For stainless steel high vacuum gate valves

A selection of three position indicators are offered by TLI to fill a range of mechanical, electronic and economic requirements. Signals from the switches can be employed to activate a variety of external devices such as indicator lights, alarms or other instruments. A valve can be wired so that its accidental opening would affect the shutdown of an entire system for its protection. These position indicators are very useful in auto. matic process control applications. Signals from the opening or closing of a valve can be employed to trigger complex procedures

External Microswitch Position Indicator (Option A)



A External Microswitch Position Indicator

This option employs two microswitches, A1 and A2, which are positioned in-line with a vertical stem extension of the pneumatic actuator piston. These positions correspond to the closed and open positions of the valve gate. A switch actuator collar on the moving stem mechanically triggers the appropriate switch when the valve is opened or closed.

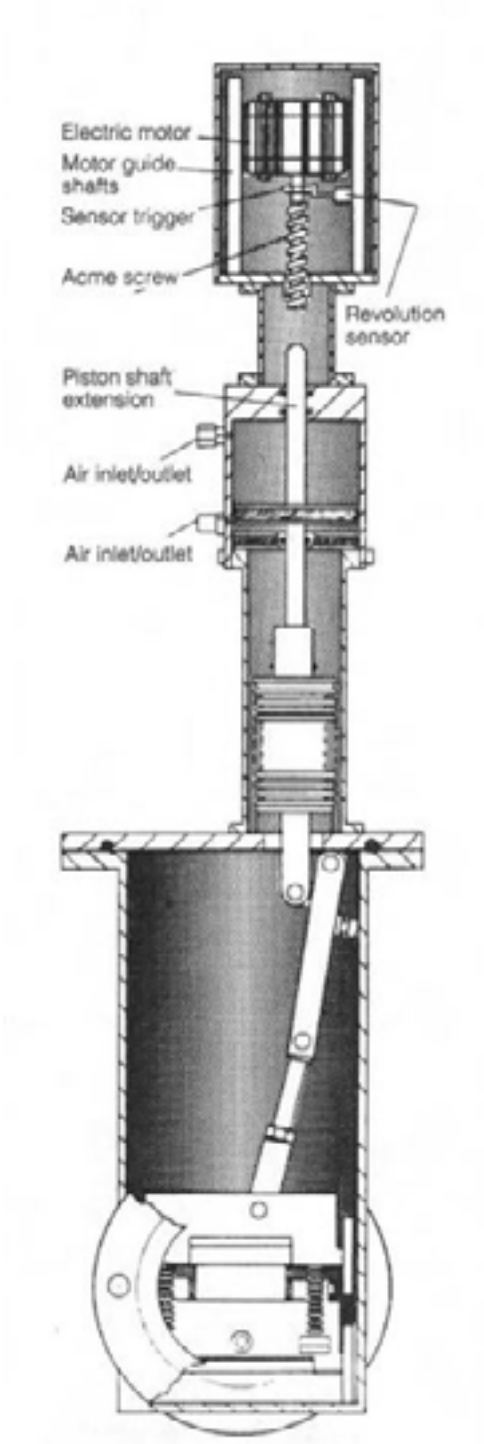
B Bellows-Sealed Position Indicator

The two microswitches, B1 and B2, are connected to bellows sealed rods which extend into the vacuum where they can be in actual contact with the valve gate. B1 is activated by contact with the extension rod when the gate is in the open position, and B2 is triggered in the closed position. The bellows sealed position indicator is the preferred choice in applications where it is essential to know at all times the status of the valve gate with the greatest possible certainty.

C Proximity Reed Switch Position Indicator

This option employs two reed switches: C1 and C2. They are placed on the side of the valve standpipe in the two positions corresponding to a fully open and fully closed valve. A magnet is attached to the top of the movable bellows inside the valves standpipe. When the gate is closed, the magnet is lowered to a position adjacent to the lower reed switch and its proximity causes the switch to close, providing one signal. When the valve is opened, the magnet is raised to a position adjacent to the upper switch and a second signal is generated. Proximity reed switch position indicators are also available for use on our stainless steel angle and in line vacuum valves, 1 1/2’’ and larger.

9 Throttle Devices for High Vacuum Gate Valves



Motorized, Set Microswitch

Throttle devices are used in applications which require that the flow of gas-to or from the vacuum chamber-be impeded. The gate valve is partially reopened after pump down and purge. This allows the gas to escape from the chamber at a controlled rate to maintain atmospheric equilibrium within the chamber. These seven options, employed individually or in combination, fulfill most requirements. Others are available on special order.

Throttle devices control the pneumatic actuators of vacuum gate valves to limit the extent of the valve opening and/or the timing of the valve opening. The piston within the pneumatic actuator is mechanically linked to the gate valve. Controlling the movement of the piston controls the position of the gate. Air is admitted to the inlet of the actuator in the usual manner, causing the piston to move. In options A through D, this motion is limited by a vertical shaft extending down from the top of the actuator housing. In E, F, and G, the motion is controlled by a vent valve which inhibits the expulsion of the compressed air above the piston.

Throttle Device Options

A Manual Set, Continuous

An impeding shaft, not illustrated but in the same position as the Acme screw shown, is manually screwed down to stop the piston at any point along its vertical traverse. This corresponds to the same position of the valve gate between fully opened and fully closed.

B Manual Set, Fixed 3-Position

A sliding knife latch, not illustrated, attached to the top of the standpipe assembly can be manually set to engage in any one of three fixed, discrete grooves on a vertical impeding shaft. Normally, these positions correspond to 1/4, 1/2, and 3/4 open positions of the valve.

C Motorized, Set Microswitches

The assembly is enclosed in a cylinder connected to the top of the pneumatic actuator as illustrated. An electric motor rises and falls vertically as it turns an Acme screw. This screw protrudes down to inhibit the pneumatic actuator piston. The motor is mounted on a round mounting plate which is prevented from rotating by two guide shafts. A collar on the Acme screw actuates one microswitch in a pre-set, partially opened position and the other switch in the fully opened position. The collar and micro switches are not illustrated.

D Motorized, Continuous with Revolution Counter

Same motor assembly and Acme screw impeder as in Option C but without microswitches. Operator manually controls the motor. Position of the impeder screw is indicated on a panel-mounted revolution counter. The counter penta nut trips the revolution counter five times per revolution. Percentage of gate opening being allowed is proportional to the total number of counts.

E Time Delayed or Slow Opening

A vent valve (not illustrated) controls the movement of the piston by restricting the expulsion of the compressed air above the piston. The relay controlling this vent may be either fixed time-delayed opening or slow opening, depending on your requirement.

F Momentary Open or Close

The delay or slow opening relay control of the vent valve in Option Eis replaced with an instantaneous contact switch which is manually controlled by the operator. Markers on a piston shaft extension allow him to visually observe the status of the valve. He can open or close it as much as the situation requires.

G Continuous Position Indicator and Control

Same as Option F but with a proportional voltage signal for remote valve position indication. For configurations where the piston markers are not visible to the operator. A potentiometer is attached to the shaft with a rack and pinion arrangement. A signal is generated which is proportional to the degree of valve opening over a 100% range. The indicating meter is an additional option.

Pictured and described below is a sample of the many custom valves we have manufactured. Please consult the factory with your requirements.

Custom 4 atm Valve

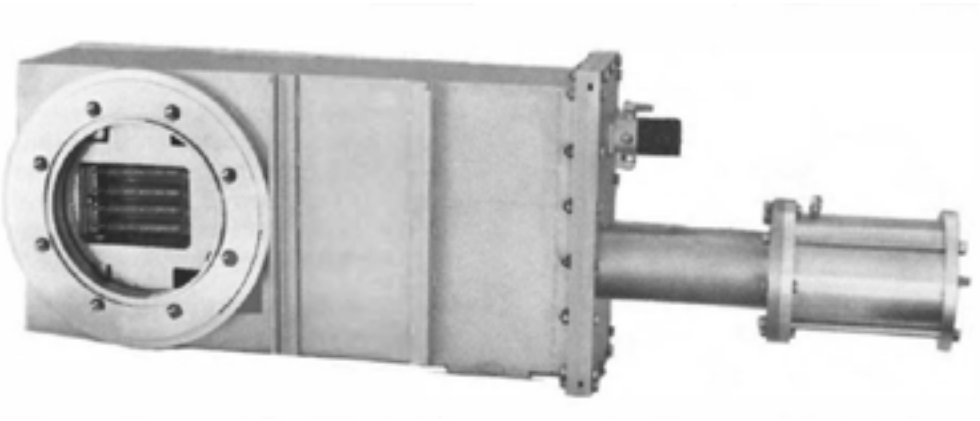
- Seals against 4 atm

This custom 8" gate valve was especially designed to be leak tight with a pressure differential across the gate of up to 4 atm (60 psig). The pressure is applied at the gate side of the valve. The leak rate is less than 1 x 10^{-10} std cc/sec, the same as our standard valves.

The valve case is deeper than a standard valve, and the gate transport mechanism has been strengthened. The photo above shows the larger release springs on the rear of the gate assembly.

Comparable modifications are available on all TLG Series gate valves. Contact the factory for specific information on these custom valves.

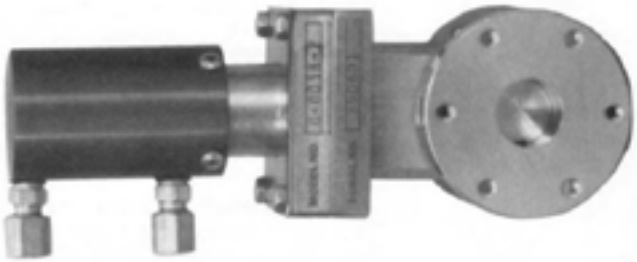
Model No.	Valve
TLG6000-220-13(8 x 6)-1109	6"
TLGS000-220-13(11 x 8)-1109	8"



Custom 4 atm Valve

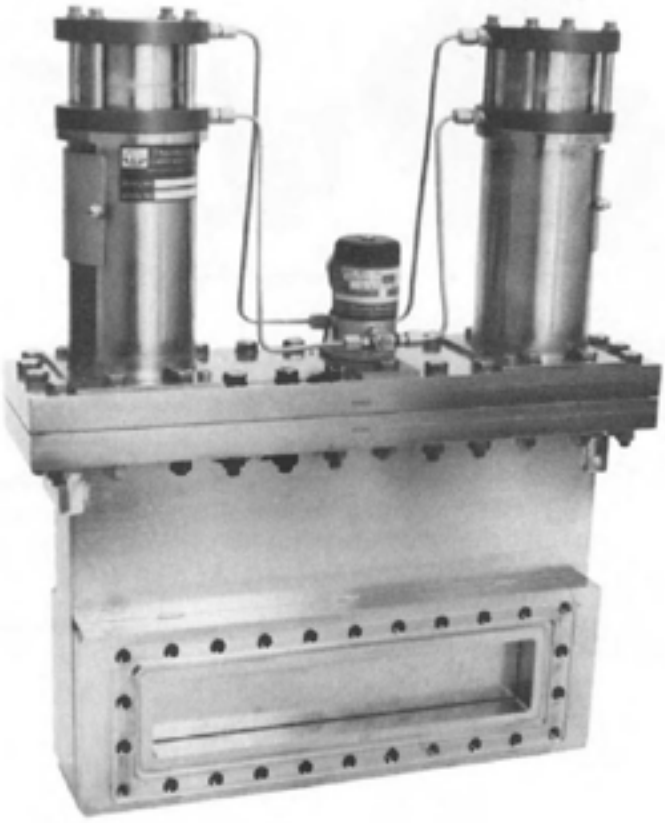
M.E.S.C./M.E.S.A. Gate Valves

Thermionics manufactures rectangular gate valves with Viton seals in manual and pneumatic versions, meeting M.E.S.C./ M.E.S.A. standards. Consult the factory for further information.



Custom G0058-P Valve with ASA Flange

Custom Gate Valve



Custom Rectangular Gate Valve with PyraFlat Flanges

9 Qualified Angle Valves

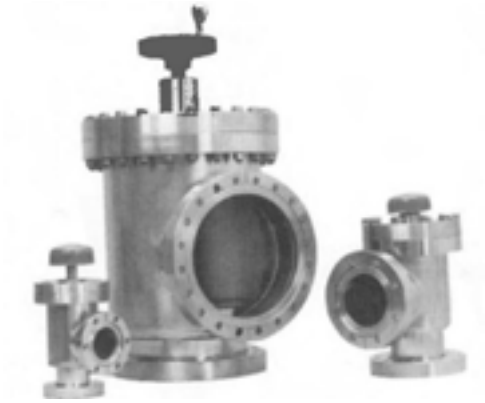
Features

- Bellows stem seal
- Opens and seals against atmosphere
- Less than 2 x 10^{-10} std cc/sec leak rate
- Mount in any position
- GTAW welded construction
- Stainless steel exposed to vacuum

Angle valves are available in a wide range of sizes, and with four choices for actuation: manual, pneumatic, air-to-open/ spring-to-close, or motorized. Actuation mechanisms are interchangeable, a feature that allows the user to upgrade valves as requirements change. Constructed of type 304 stainless steel, these valves are equipped with either Viton or metal poppet seals, as well as a choice of either Viton or metal bonnet seals. Viton bonnet sealed valves are bakeable to 200°C; metal bonnet sealed to 250°C. All angle valves are available with a variety of flanges.

Manually-actuated angle valves have an Acme screw on the valve stem for rapid opening.

The unique motor-actuated valve allows remote control of the system without need for a source of compressed air. The standard motor operates on a 115 VAC 60 Hz power supply with power consumption of 15 W.



Specifications

All gate, roughing, and bakeable valves have the following standard specifications. Customers may request other materials on special order.

"Roughing valves" refers to all inline and angle valves, although they are designed and built for UHV applications they can be used in roughing applications.

Service Life

- Up to 100,000 closures with standard bellows seal, dependent on bellows type, poppet seal type, and application
- Special long life bellows available
- Up to 500,000 closures with O-ring shaft seal

Design

No trapped volumes or virtual leaks.

Valve Construction

Thermionics valve bodies are made of 304 stainless steel. All vacuum-exposed surfaces are 300 series stainless steel. They are engineered, manufactured, and internally or 100% full penetration GTAW (known also as TIG) welded, to insure the elimination of virtual leaks. Before assembly the valve parts are chemically cleaned and polished.

Materials of Construction

VALVE BODY-Fabricated from type 304 stainless steel with all internal or backfilled full penetration welds using GTAW gas welding process.
INTERNAL MECHANISMS-Fabricated from type 304 stainless steel, fully welded GTAW process.
BELLOWS SHAFT SEALS-Fabricated from special application 300 series stainless steels. Roughing and bakeable valves use fully nested welded bellows assemblies, gate valves may use nested welded or hydroformed bellows, with UHV furnace brazed transition pieces. All bellows have additional convolutions for longer operating life.
BODY SEAL-Viton O-ring or OFE copper captured gasket, depending on model.
GATE/POPPET SEAL-Viton O-ring for gate and roughing valves, bakeable valves use an OFE copper gasket.
BEARINGS-Needle and ball bearings, dry film lubricated.
CLEANING-Valves are chemically cleaned for vacuum service.
PNEUMATIC ACTUATORS-Virgin aluminum cast or drawn.

Bakeability

Bakeout temperatures are limited by seal material selection. Please consult the factory for specific temperature requirements. Following are temperature limits recommended by seal manufacturers

Buna:	121°C/250°F maximum
Viton:	250°C/482°F valve open/unloaded
	204°C/400°F valve closed/loaded
Kalrez:	366°C/680°F valve open/unloaded
	316°C/600°F valve closed/loaded
All metal:	450°C/842°F valve open or closed
Solenoids:	65°C/149°F maximum

Leak Free

No detectable leak when tested in the vacuum adverse condition using a helium MSLD with a sensitivity of 2 x 10^{-10} std cc/sec.

Orientation

May be mounted in any position.

1. Actuators

A. Manual Actuation: Rotation of the hand knob which is connected to a coarse threaded Acme screw for fast full opening and closing of valve's poppet seal.
B. Pneumatic Actuation: A pneumatic actuator assembly is joined to the valve body flange. The air cylinder piston shaft is coupled through a bellows shaft seal to the poppet seal. When air is introduced below the air cylinder piston, the valve opens. When air is introduced above the air cylinder piston the valve closes.
Repair and Replacement: Not only can you remove, repair, and replace the pneumatic actuator without removing the valve from the system, but more importantly, you can do all of this while maintaining vacuum. Consult the factory for further details.
C. Electro-Pneumatic Actuation: Pneumatic valves utilizing a solenoid valve to open or close the valve's seal poppet. The solenoid automatically closes the valve in the event of a power failure, or if the user prefers, it can be engineered to open the valve in the event of a power failure.
Solenoid Control Valves: TU valves with pneumatic actuators are supplied with a 120 VAC, 60 Hz solenoid control valve. We do not charge extra for these solenoids like other manufacturers. Because of their limited temperature range, solenoids are not supplied on metal bonnet valves or on springactuated valves. They may be ordered separately.
Other solenoids are available, including: 12 and 24 VDC, and 24, 100 and 210-240 VAC, 50-60 Hz. There is an additional charge of $35 for most special solenoid valves. Please consult the factory for current price information and other options.
D. Spring Loaded Actuation: A spring may be added to the pneumatic actuator to either close or open the valve when there is a power failure. The spring will insure that the valve remains in that position as long as the power is off.
REMEMBER: A spring loaded valve can and should be designed to provide full conductance; see page 3-2, "qualified valves." Also it must keep the valve open or closed and sealed until you decide to change its position.
Air-to-Open/Spring-to-Close Valves: TU air-to-open/spring-to-close valves offer two unique features other manufacturers valves do not:
1. TLI valves close, using only the spring, even against atmosphere, and are guaranteed to be leak-free.
Each valve is leak-checked with a MSLD, and is certified to be leak-free when checked to a sensitivity of 2 x 10-10 standard cc/sec. Each valve is checked in the vacuum adverse condition, using only the spring for closing power, with vacuum pulled on the back side of the sealing poppet and atmosphere trying to force the poppet open.
The result? The valve will seal even when both the electrical power and air supply fail. It is slightly more expensive, but it is a superior product offering greater performance.
2. These valves open fully, no portion of the bellows or poppet obstruct the valve port, allowing full conductance.
E. Motorized Actuation: Operated solely by an electric motor.

2. Position Indicators/Limit Switches

Most commonly used with pneumatic valves. Designed to show if the seal poppet is in a closed or open position. Thermionics offers both magnetically actuated reed switches and positively actuated micro switches. Both can be provided with lights located either at the valve or at a remote location.

3. Flanges

All valves are available with flanges of your choice, be they ConFlat type, ISO, ASA, custom, etc.

4. Retention of Gasket in Sealing Poppet

An elastomer gasket seal is held in a double dove-tailed groove to insure retention of the gasket when the vacuum seal is broken. This is particularly important after a bake, when pulling away the seal poppet, or gate, from the sealing surface (seat), or when there is a pressure differential across the seal.

5. Choice of Sealing Gasket

Your choice of all metal, Viton, Kalrez, polyimide, and Teflon sealed valves.

Viton is the most common sealing gasket material used with the seal poppet or gate. Thermionics offers a wide range of alternative sealing gaskets to users with special bakeout and/or chemical resistance requirements, e.g., copper, Kalrez, polyimide, Teflon, Buna, aluminum, gold, etc.

Valve Options

1. Flange Options: Port flanges are available in a variety of configurations and geometries. The more common flange types are listed here. Others are routinely supplied, please call the factory for information.

2. Fittings Option: Fittings, such as VCR or NPT fittings, may be installed on valves. The fittings are used to add items, i.e.: gas lines, T.C. tubes, leak valves or up-to-air valves, to a system via the valve. Consult the factory for prices and configurations.

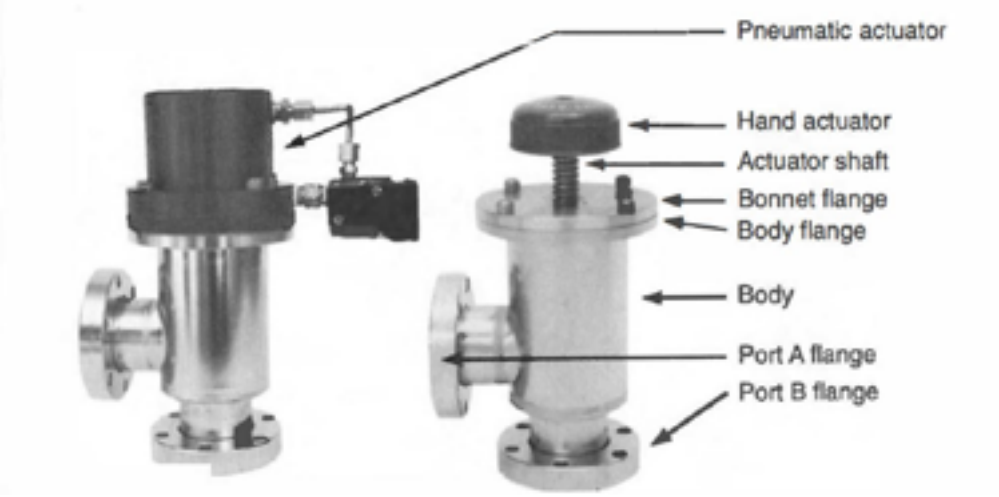
3. Roughing Ports: Are available for valves, please refer to page 9-6 for details on gate valve roughing ports, those options also apply to angle/inline valves.

4. Position Indicators: Please see page 9-11 for details on gate valve position indicators, those options also apply to angle/inline valves.

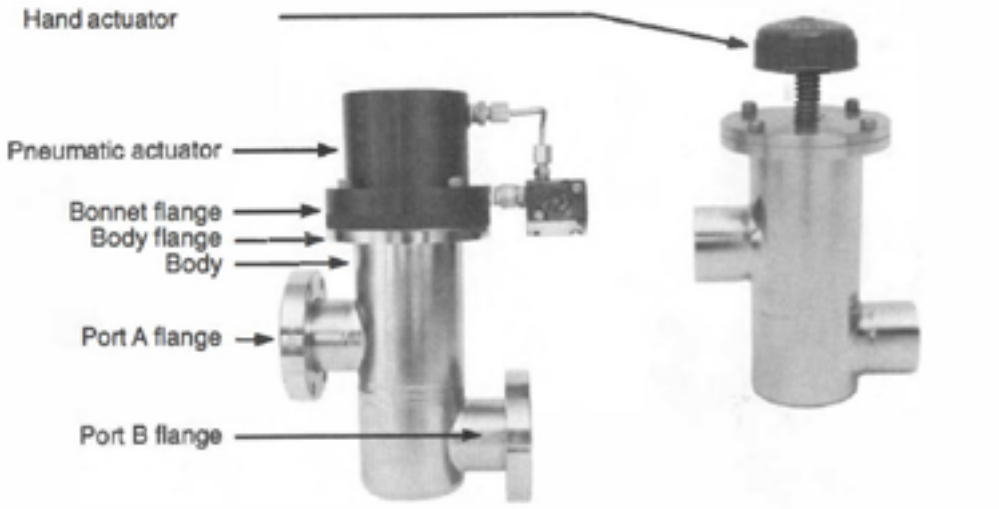
5. Tool Kits: Are available at an additional charge. Consult the factory for details.

6. Heater Jackets: Are available for CVD and metal etch applications. Consult the factory for information.

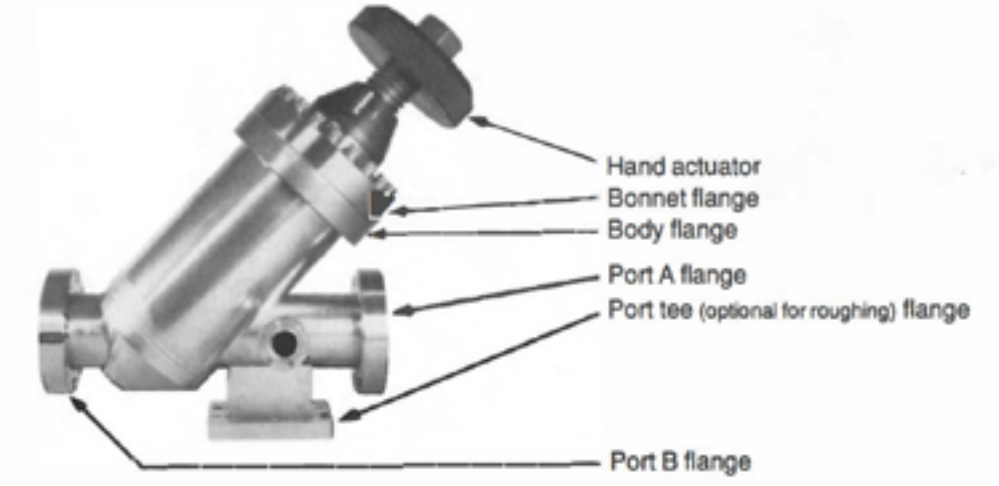
Valve Terminology



"Qualified" Angle Valves



"Qualified" Inline Valves



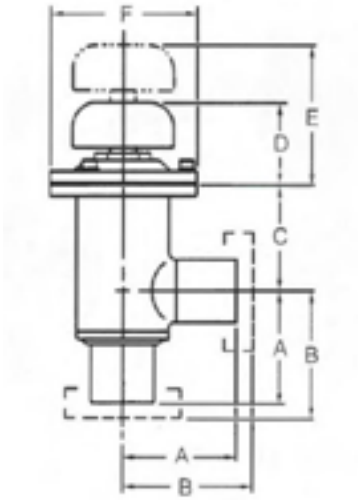
"Qualified" Straight Through Valves

9 Qualified Angle Valves

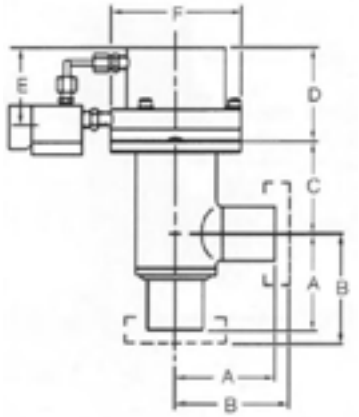
Valve Construction

See page 9-14 for specifications.

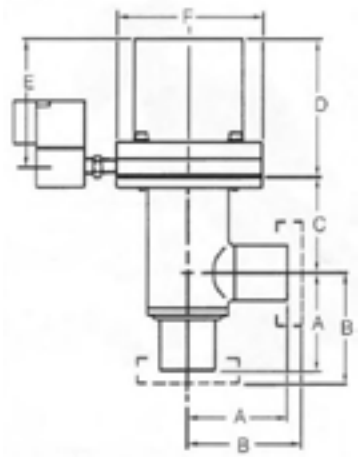
Manual



Electro-Pneumatic



Air-to-Open/Spring-to-Close



These dimensions are nominal, and are provided for reference. They may have been rounded to the nearest 0.10" or 0.010".

Dimensions and specifications may change without notice, please consult the factory for more exact information.

Dimensions are given in inches

Port Size O.D.	A	B	C	D Closed	E Open	Bonnet F Viton	Bonnet F Metal
1/2	2.25	2.42	2.09	1.65	2.77	3.0	3.37
5/8	2.25	2.42	2.09	1.65	2.77	3.0	3.37
3/4	2.25	2.42	2.09	1.65	2.77	3.0	3.37
1	2.25	2.4	2.09	1.65	2.77	3.0	3.37
1.25	2.25	2.46	2.09	1.65	2.77	3.0	3.37
1.5	2.25	2.47	2.25	2.00	3.5	3.38	3.37
2	3.00	3.23	2.34	1.82	3.57	4.0	4.62
2.5	3.37	3.75	2.75	2.28	4.48	4.62	4.62
3	3.71	4.0	4.11	5.83	8.64	6.0	6.0
4	3.81	4.25	4.95	6.51	10.51	6.43	6.75
6	5.5	6.0	5.86	6.90	12.9	10.0	10.00
8	6.44	6.94	7.46	8.68	16.44	12.24	13.25
10	Consult Factory						
12	Consult Factory						

Port Size O.D.	A	B	C	D Closed	E Open	Bonnet F Viton	Bonnet F Metal
1/2	2.25	2.42	2.09	2.12	1.62	3.0	3.37
5/8	2.25	2.42	2.09	2.12	1.62	3.0	3.37
3/4	2.25	2.42	2.09	2.12	1.62	3.0	3.37
1	2.25	2.4	2.09	2.12	1.62	3.0	3.37
1.25	2.25	2.46	2.09	2.12	1.62	3.0	3.37
1.5	2.25	2.46	2.54	2.83	2.05	3.35	3.37
2	3.00	3.23	3.36	3.46	2.18	4.0	4.62
2.5	3.37	3.75	2.75	3.75	2.17	4.62	4.62
3	3.71	4.0	4.11	5.17	4.55	6.0	6.0
4	3.81	4.25	4.95	11.15	8.06	6.43	6.75
6	5.56	6	5.86	9.75	7.2	10.0	10.0
8	Consult Factory						
10	Consult Factory						
12	Consult Factory						

Port Size O.D.	A	B	C	D Closed	E Open	Bonnet F Viton	Bonnet F Metal
1/2	2.25	2.42	2.09	3.15	2.87	3.35	3.37
5/8	2.25	2.42	2.09	3.15	2.87	3.35	3.37
3/4	2.25	2.42	2.09	3.15	2.87	3.35	3.37
1	2.25	2.4	2.09	3.15	2.87	3.35	3.37
1.25	2.25	2.46	2.09	3.15	2.87	3.35	3.37
1.5	2.25	2.47	2.25	3.15	2.87	3.38	3.37
2	3.00	3.23	3.36	3.46	Con Fac	4.0	4.0
2.5	3.37	3.75	2.75	3.75	Con Fac	4.62	4.62
3	3.71	4.0	4.11	5.17	Con Fac	6.0	6.0
4	Consult Factory						
6	Consult Factory						
8	Consult Factory						
10	Consult Factory						
12	Consult Factory						

To Order Valves

Please add the flange type at the end of the valve model number, i.e.: A-1500-H/275 or A-1500-H/ISO40.

Options

Other options should be described, such as "with reed switch position indicators." See page 9-15 for options.

Viton Bonnet					Metal Bonnet		
Port Size O.D.	Model No.	ConFlat Size	ISO/KF Size	Gasket Set Model No.	Model No.	ConFlat Size	Gasket Set Model No.
1/2	A-500-H	1.33	16	GH-11	MA-500-H	1.33	GH-11-M
5/8	A-625-H	1.33	16	GH-11	MA-625-H	1.33	GH-11-M
3/4	A-750-H	1.33	16	GH-11	MA-750-H	1.33	GH-11-M
1	A-1000-H	2.12	25	GH-11	MA-1000-H	2.12	GH-11-M
1.25	A-1250-H	2.75	40	GH-11	MA-1250-H	2.75	GH-11-M
1.5	A-1500-H	2.75	40	GH-12	MA-1500-H	2.75	GH-12-M
2	A-2000-H	3.38	50	GH-13	MA-2000-H	3.38	GH-13-M
2.5	A-2500-H	4.50	63	GH-25	MA-2500-H	4.50	GH-25-M
3	A-3000-H	4.62	80	GH-14	MA-3000-H	4.62	GH-14-M
4	A-4000-H	6.00	100	GH-15	MA-4000-H	6.00	GH-15-M
6	A-6000-H	8.00	160	GH-60	MA-6000-H	8.00	GH-60-M
8	A-8000-H	10.00	200	GH-80	MA-8000-H	10.00	GH-80-M
10	A-10000-H	13.25	250	GH-100	MA-10000-H	13.25	GH-100-M
12	A-12000-H	14.00	320	GH-120	MA-12000-H	14.00	GH-120-M

Viton Bonnet					Metal Bonnet		
Port Size O.D.	Model No.	ConFlat Size	ISO/KF Size	Gasket Set Model No.	Model No.	ConFlat Size	Gasket Set Model No.
1/2	A-500-P	1.33	16	GP-11	MA-500-P	1.33	GP-11-M
5/8	A-625-P	1.33	16	GP-11	MA-625-P	1.33	GP-11-M
3/4	A-750-P	1.33	16	GP-11	MA-750-P	1.33	GP-11-M
1	A-1000-P	2.12	25	GP-11	MA-1000-P	2.12	GP-11-M
1.25	A-1250-P	2.75	40	GP-11	MA-1250-P	2.75	GP-11-M
1.5	A-1500-P	2.75	40	GP-12	MA-1500-P	2.75	GP-12-M
2	A-2000-P	3.38	50	GP-13	MA-2000-P	3.38	GP-13-M
2.5	A-2500-P	4.50	63	GP-25	MA-2500-P	4.50	GP-25-M
3	A-3000-P	4.62	80	GP-14	MA-3000-P	4.62	GP-14-M
4	A-4000-P	6.00	100	GP-15	MA-4000-P	6.00	GP-15-M
6	A-6000-P	8.00	160	GP-60	MA-6000-P	8.00	GP-60-M
8	A-8000-P	10.00	200	GP-80	MA-8000-P	10.00	GP-80-M
10	A-10000-P	13.25	250	GP-100	MA-10000-P	13.25	GP-100-M
12	A-12000-P	14.00	320	GP-120	MA-12000-P	14.00	GP-120-M

Viton Bonnet					Metal Bonnet		
Port Size O.D.	Model No.	ConFlat Size	ISO/KF Size	Gasket Set Model No.	Model No.	ConFlat Size	Gasket Set Model No.
1/2	A-500-AS	1.33	16	GAS-11	MA-500-AS	1.33	GAS-11-M
5/8	A-625-AS	1.33	16	GAS-11	MA-625-AS	1.33	GAS-11-M
3/4	A-750-AS	1.33	16	GAS-11	MA-750-AS	1.33	GAS-11-M
1	A-1000-AS	2.12	25	GAS-11	MA-1000-AS	2.12	GAS-11-M
1.25	A-1250-AS	2.75	40	GAS-11	MA-1250-AS	2.75	GAS-11-M
1.5	A-1500-AS	2.75	40	GAS-12	MA-1500-AS	2.75	GAS-12-M
2	A-2000-AS	3.38	50	GAS-13	MA-2000-AS	3.38	GAS-13-M
2.5	A-2500-AS	4.50	63	GAS-25	MA-2500-AS	4.50	GAS-25-M
3	A-3000-AS	4.62	80	GAS-14	MA-3000-AS	4.62	GAS-14-M
4	A-4000-AS	6.00	100	GAS-15	MA-4000-AS	6.00	GAS-15-M
6	Consult Factory				Consult Factory		
8	Consult Factory				Consult Factory		
10	Consult Factory				Consult Factory		
12	Consult Factory				Consult Factory		

9 Qualified Inline Valves

Features

- Bellows stem seal
- Opens and seals against atmosphere
- Less than 2 x 10^{-10} std cc/sec leak rate
- Mount in any position
- GTAW welded construction
- Stainless steel exposed to vacuum

Inline valves, like the angle valves, are available in a wide range of sizes, and with four choices for actuation: manual, pneumatic, air-to-open/spring-to-close, or motorized. Actuation mechanisms are interchangeable, a feature that allows the user to upgrade valves as requirements change. Constructed of type 304 stainless steel, these valves are equipped with Viton poppet seals and offer a choice of either Viton or metal bonnet seals. Viton bonnet sealed valves are bakeable to 200°C; metal bonnet sealed to 250°C. All inline valves are available with a variety of flanges.

Manually-actuated inline valves have an Acme screw on the valve stem for rapid opening.

The unique motor-actuated valve allows remote control of the system without need for an air inlet connection. The standard motor operates on a 115 VAC 60 Hz power supply with a 15 W power consumption.

Comparable modifications are available on all TLG Series gate valves. Contact the factory for specific information on these custom valves.

3" Inline Valve shown with Optional Spring-to-Close

Specifications

All gate, roughing, and bakeable valves have the following standard specifications. Customers may request other materials on special order.

"Roughing valves" refers to all inline and angle valves, although they are designed and built for UHV applications they can be used in roughing applications.

Specifications

- Up to 100,000 closures with standard bellows seal, dependent on bellows type, poppet seal type, and application
- Special long life bellows available
- Up to 500,000 closures with O-ring shaft seal

Design

No trapped volumes or virtual leaks.

Valve Construction

Thermionics valve bodies are made of 304 stainless steel. All vacuum-exposed surfaces are 300 series stainless steel. They are engineered, manufactured, and internally or 100% full penetration GTAW (known also as TIG) welded, to insure the elimination of virtual leaks. Before assembly the valve parts are chemically cleaned and polished.

Materials of Construction

VALVE BODY
Fabricated from type 304 stainless steel with all internal or back-filled full penetration welds using GTAW gas welding process.
INTERNAL MECHANISMS
Fabricated from type 304 stainless steel, fully welded GTAW process.
BELLOWS SHAFT SEALS
Fabricated from special application 300 series stainless steels. Roughing and bakeable valves use fully nested welded bellows assemblies, gate valves may use nested welded or hydroformed bellows, with UHV furnace brazed transition pieces. All bellows have additional convolutions for longer operating life.
BODY SEAL
Viton O-ring or OFE copper captured gasket, depending on model.
GATE/POPPET SEAL
Viton O-ring for gate and roughing valves, bakeable valves use an OFE copper gasket.
BEARINGS
Needle and ball bearings, dry film lubricated.
CLEANING
Valves are chemically cleaned for vacuum service.
PNEUMATIC ACTUATORS
Virgin aluminum cast or drawn.

Bakeability

Bakeout temperatures are limited by seal material selection. Please consult the factory for specific temperature requirements. Following are temperature limits recommended by seal manufacturers

Buna:	121°C/250°F maximum
Viton:	250°C/482°F valve open/unloaded
	204°C/400°F valve closed/loaded
Kalrez:	366°C/680°F valve open/unloaded
	316°C/600°F valve closed/loaded
All metal:	450°C/842°F valve open or closed
Solenoids:	65°C/149°F maximum

Leak Free

No detectable leak when tested in the vacuum adverse condition using a helium MSLD with a sensitivity of 2 x 10^{-10} std cc/sec.

Orientation

May be mounted in any position.

1. Actuators

A. Manual Actuation: Rotation of the hand knob which is connected to a coarse threaded Acme screw for fast full opening and closing of valve's poppet seal.

B. Pneumatic Actuation: A pneumatic actuator assembly is joined to the valve body flange. The air cylinder piston shaft is coupled through a bellows shaft seal to the poppet seal. When air is introduced below the air cylinder piston, the valve opens. When air is introduced above the air cylinder piston the valve closes.

Repair and Replacement: Not only can you remove, repair, and replace the pneumatic actuator without removing the valve from the system, but more importantly, you can do all of this while maintaining vacuum. Consult the factory for further details.

C. Electro-Pneumatic Actuation: Pneumatic valves utilizing a solenoid valve to open or close the valve's seal poppet. The solenoid automatically closes the valve in the event of a power failure, or if the user prefers, it can be engineered to open the valve in the event of a power failure.

Solenoid Control Valves: TU valves with pneumatic actuators are supplied with a 120 VAC, 60 Hz solenoid control valve. We do not charge extra for these solenoids like other manufacturers. Because of their limited temperature range, solenoids are not supplied on metal bonnet valves or on springactuated valves. They may be ordered separately.

Other solenoids are available, including: 12 and 24 VDC, and 24, 100 and 210-240 VAC, 50-60 Hz. There is an additional charge for most special solenoid valves. Please consult the factory for current price information and other options.

D. Spring Loaded Actuation: A spring may be added to the pneumatic actuator to either close or open the valve when there is a power failure. The spring will insure that the valve remains in that position as long as the power is off.

REMEMBER: A spring loaded valve can and should be designed to provide full conductance; see page 3-2, "qualified valves." Also it must keep the valve open or closed and sealed until you decide to change its position.

Air-to-Open/Spring-to-Close Valves: TU air-to-open/spring-to-close valves offer two unique features other manufacturers valves do not:

1. TLI valves close, using only the spring, even against atmosphere, and are guaranteed to be leak-free.

Each valve is leak-checked with a MSLD, and is certified to be leak-free when checked to a sensitivity of 2 x 10-10 standard cc/sec. Each valve is checked in the vacuum adverse condition, using only the spring for closing power, with vacuum pulled on the back side of the sealing poppet and atmosphere trying to force the poppet open.

The result? The valve will seal even when both the electrical power and air supply fail. It is slightly more expensive, but it is a superior product offering greater performance.

2. These valves open fully, no portion of the bellows or poppet obstruct the valve port, allowing full conductance.

E. Motorized Actuation: Operated solely by an electric motor.

2. Position Indicators/Limit Switches

Most commonly used with pneumatic valves. Designed to show if the seal poppet is in a closed or open position. Thermionics offers both magnetically actuated reed switches and positively actuated micro switches. Both can be provided with lights located either at the valve or at a remote location.

3. Flanges

All valves are available with flanges of your choice, be they ConFlat type, ISO, ASA, custom, etc.

4. Retention of Gasket in Sealing Poppet

An elastomer gasket seal is held in a double dove-tailed groove to insure retention of the gasket when the vacuum seal is broken. This is particularly important after a bake, when pulling away the seal poppet, or gate, from the sealing surface (seat), or when there is a pressure differential across the seal.

5. Choice of Sealing Gasket

Your choice of all metal, Viton, Kalrez, polyimide, and Teflon sealed valves.

Viton is the most common sealing gasket material used with the seal poppet or gate. Thermionics offers a wide range of alternative sealing gaskets to users with special bakeout and/or chemical resistance requirements, e.g., copper, Kalrez, polyimide, Teflon, Buna, aluminum, gold, etc.

Valve Options

1. Flange Options: Port flanges are available in a variety of configurations and geometries. The more common flange types are listed here. Others are routinely supplied, please call the factory for information.

2. Fittings Option: Fittings, such as VCR or NPT fittings, may be installed on valves. The fittings are used to add items, i.e.: gas lines, T.C. tubes, leak valves or up-to-air valves, to a system via the valve. Consult the factory for prices and configurations.

3. Roughing Ports: Are available for valves, please refer to page 9-6 for details on gate valve roughing ports, those options also apply to angle/inline valves.

4. Position Indicators: Please see page 9-11 for details on gate valve position indicators, those options also apply to angle/inline valves.

5. Tool Kits: Are available at an additional charge. Consult the factory for details.

6. Heater Jackets: Are available for CVD and metal etch applications. Consult the factory for information.

9 Qualified Inline Valves Model A

These dimensions are nominal, and are provided for reference. They may have been rounded to the nearest 0.10" or 0.010".

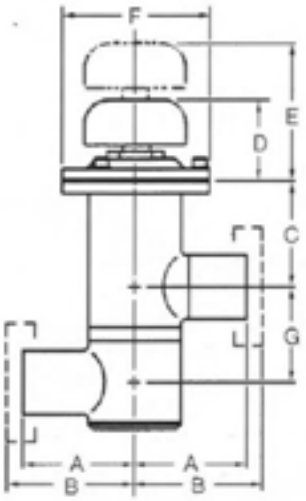
Dimensions and specifications may change without notice, please consult the factory for more exact information.

Dimensions are given in inches

Valve Construction

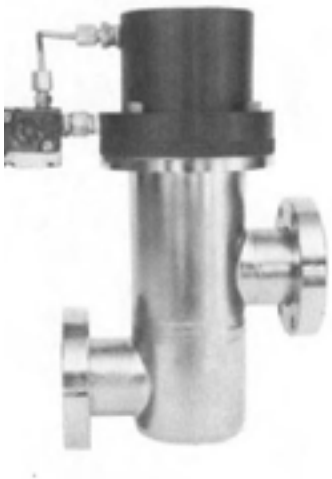
See page 9-18 for specifications.

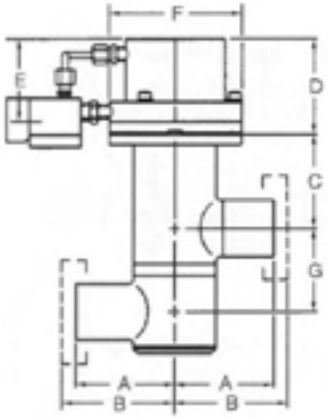
Manual



Port Size O.D.	A	B	C	D Closed	E Open	Bonnet F Viton	Bonnet F Metal	G
1/2	2.25	2.42	2.09	1.65	2.77	3.0	3.37	1.87
5/8	2.25	2.42	2.09	1.65	2.77	3.0	3.37	1.87
3/4	2.25	2.42	2.09	1.65	2.77	3.0	3.37	1.87
1	2.25	2.4	2.09	1.65	2.77	3.0	3.37	1.87
1.25	2.25	2.46	2.09	1.65	2.77	3.0	3.37	1.87
1.5	2.25	2.47	2.25	2.00	3.5	3.38	3.37	2.12
2	3.00	3.23	2.34	1.82	3.57	4.0	4.62	2.77
2.5	3.37	3.75	2.75	2.28	4.48	4.62	4.62	3.13
3	3.71	4.0	4.11	5.83	8.64	6.0	6.0	3.81
4	Consult Factory							
6	Consult Factory							
8	Consult Factory							
10	Consult Factory							
12	Consult Factory							

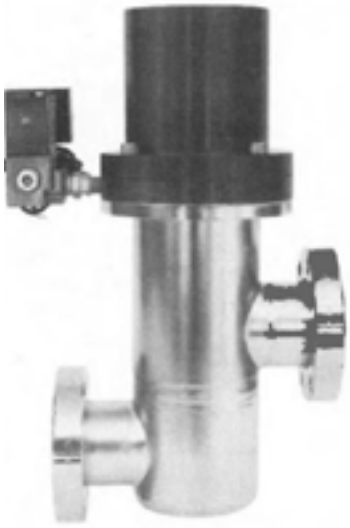
Electro-Pneumatic

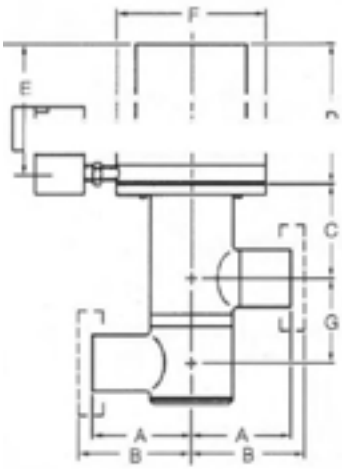




Port Size O.D.	A	B	C	D Closed	E Open	Bonnet F Viton	Bonnet F Metal	G
1/2	2.25	2.42	2.09	2.12	1.62	3.0	3.37	1.87
5/8	2.25	2.42	2.09	2.12	1.62	3.0	3.37	1.87
3/4	2.25	2.42	2.09	2.12	1.62	3.0	3.37	1.87
1	2.25	2.4	2.09	2.12	1.62	3.0	3.37	1.87
1.25	2.25	2.46	2.09	2.12	1.62	3.0	3.37	1.87
1.5	2.25	2.46	2.54	2.83	2.05	3.35	3.37	2.12
2	3.00	3.23	3.36	3.46	2.18	4.0	4.62	2.77
2.5	3.37	3.75	2.75	3.75	2.17	4.62	4.62	3.13
3	3.71	4.0	4.11	5.17	4.55	6.0	6.0	3.81
4	Consult Factory							
6	Consult Factory							
8	Consult Factory							
10	Consult Factory							
12	Consult Factory							

Air-to-Open/Spring-to-Close





Port Size O.D.	A	B	C	D Closed	E Open	Bonnet F Viton	Bonnet F Metal	G
1/2	2.25	2.42	2.09	3.15	2.87	3.35	3.37	1.87
5/8	2.25	2.42	2.09	3.15	2.87	3.35	3.37	1.87
3/4	2.25	2.42	2.09	3.15	2.87	3.35	3.37	1.87
1	2.25	2.4	2.09	3.15	2.87	3.35	3.37	1.87
1.25	2.25	2.46	2.09	3.15	2.87	3.35	3.37	1.87
1.5	2.25	2.47	2.25	3.15	2.87	3.38	3.37	2.12
2	3.00	3.23	3.36	3.46	Con Fac	4.0	4.0	2.77
2.5	3.37	3.75	2.75	3.75	Con Fac	4.62	4.62	3.13
3	3.71	4.0	4.11	5.17	Con Fac	6.0	6.0	3.81
4	Consult Factory							
6	Consult Factory							
8	Consult Factory							
10	Consult Factory							
12	Consult Factory							

(360) 385-7707

thermionics laboratory, inc.
Vacuum Innovation Since 1958

sales@thermionics.com

To Order Valves

Please add the flange type at the end of the valve model number, i.e.: L-1500-H/275 or L-1500-H/ISO40.

Options

Other options should be described, such as "with reed switch position indicators." See page 9-19 for options.

Viton Bonnet					Metal Bonnet		
Port Size O.D.	Model No.	ConFlat Size	ISO/KF Size	Gasket Set Model No.	Model No.	ConFlat Size	Gasket Set Model No.
1/2	**L-500-H**	1.33	16	**GH-11**	**ML-500-H**	1.33	**GH-11-M**
5/8	**L-625-H**	1.33	16	**GH-11**	**ML-625-H**	1.33	**GH-11-M**
3/4	**L-750-H**	1.33	16	**GH-11**	**ML-750-H**	1.33	**GH-11-M**
1	**L-1000-H**	2.12	25	**GH-11**	**ML-1000-H**	2.12	**GH-11-M**
1.25	**L-1250-H**	2.75	40	**GH-11**	**ML-1250-H**	2.75	**GH-11-M**
1.5	**L-1500-H**	2.75	40	**GH-12**	**ML-1500-H**	2.75	**GH-12-M**
2	**L-2000-H**	3.38	50	**GH-13**	**ML-2000-H**	3.38	**GH-13-M**
2.5	**L-2500-H**	4.50	63	**GH-25**	**ML-2500-H**	4.50	**GH-25-M**
3	**L-3000-H**	4.62	80	**GH-14**	**ML-3000-H**	4.62	**GH-14-M**
4	Consult Factory				Consult Factory		
6	Consult Factory				Consult Factory		
8	Consult Factory				Consult Factory		
10	Consult Factory				Consult Factory		
12	Consult Factory				Consult Factory		

Viton Bonnet					Metal Bonnet		
Port Size O.D.	Model No.	ConFlat Size	ISO/KF Size	Gasket Set Model No.	Model No.	ConFlat Size	Gasket Set Model No.
1/2	**L-500-P**	1.33	16	**GP-11**	**ML-500-P**	1.33	**GP-11-M**
5/8	**L-625-P**	1.33	16	**GP-11**	**ML-625-P**	1.33	**GP-11-M**
3/4	**L-750-P**	1.33	16	**GP-11**	**ML-750-P**	1.33	**GP-11-M**
1	**L-1000-P**	2.12	25	**GP-11**	**ML-1000-P**	2.12	**GP-11-M**
1.25	**L-1250-P**	2.75	40	**GP-11**	**ML-1250-P**	2.75	**GP-11-M**
1.5	**L-1500-P**	2.75	40	**GP-12**	**ML-1500-P**	2.75	**GP-12-M**
2	**L-2000-P**	3.38	50	**GP-13**	**ML-2000-P**	3.38	**GP-13-M**
2.5	**L-2500-P**	4.50	63	**GP-25**	**ML-2500-P**	4.50	**GP-25-M**
3	**L-3000-P**	4.62	80	**GP-14**	**ML-3000-P**	4.62	**GP-14-M**
4	**L-4000-P**	6.00	100	**GP-15**	**ML-4000-P**	6.00	**GP-15-M**
6	**L-6000-P**	8.00	160	**GP-60**	**ML-6000-P**	8.00	**GP-60-M**
8	Consult Factory				Consult Factory		
10	Consult Factory				Consult Factory		
12	Consult Factory				Consult Factory		

Viton Bonnet					Metal Bonnet		
Port Size O.D.	Model No.	ConFlat Size	ISO/KF Size	Gasket Set Model No.	Model No.	ConFlat Size	Gasket Set Model No.
1/2	**L-500-AS**	1.33	16	**GAS-11**	**ML-500-AS**	1.33	**GAS-11-M**
5/8	**L-625-AS**	1.33	16	**GAS-11**	**ML-625-AS**	1.33	**GAS-11-M**
3/4	**L-750-AS**	1.33	16	**GAS-11**	**ML-750-AS**	1.33	**GAS-11-M**
1	**L-1000-AS**	2.12	25	**GAS-11**	**ML-1000-AS**	2.12	**GAS-11-M**
1.25	**L-1250-AS**	2.75	40	**GAS-11**	**ML-1250-AS**	2.75	**GAS-11-M**
1.5	**L-1500-AS**	2.75	40	**GAS-12**	**ML-1500-AS**	2.75	**GAS-12-M**
2	**L-2000-AS**	3.38	50	**GAS-13**	**ML-2000-AS**	3.38	**GAS-13-M**
2.5	**L-2500-AS**	4.50	63	**GAS-25**	**ML-2500-AS**	4.50	**GAS-25-M**
3	**L-3000-AS**	4.62	80	**GAS-14**	**ML-3000-AS**	4.62	**GAS-14-M**
4	Consult Factory				Consult Factory		
6	Consult Factory				Consult Factory		
8	Consult Factory				Consult Factory		
10	Consult Factory				Consult Factory		
12	Consult Factory				Consult Factory		

9 Motor Operated Angle & Inline Valves

Thermionics Laboratory's unique motor driven valve allows for a remote controlled system without the necessity for compressed air. The motor driven valve has an added advantage over an air operated valve in that its operation is not "quick actuating" and the opening may be controlled. The motor operates on a 115 VAC 60 Hz power supply with a power consumption of 15 W.

Features

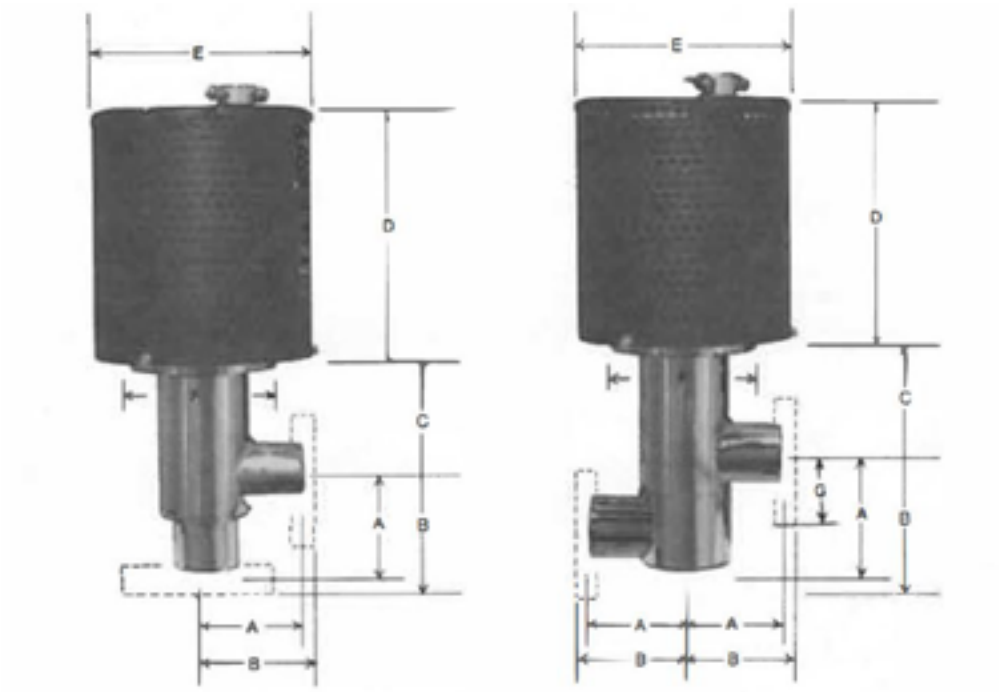
Please refer to pages 9-14, 9-15 and 9-18, 9-19 for a listing of features and options. The options listed also apply to these valves. Please call if you need additional information.

To Order Valves

Please add the flange type at the end of the valve model number, i.e.: A-1500-M/275 or A-1500-M/ISO40.

Options

Other options should be described, such as "with reed switch position indicators."

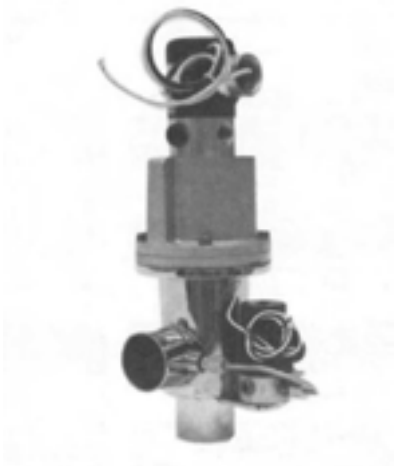


Model No.	Port Size O.D.	A	B	C	D	E	F	G
A-500-M L-500-M	1/2	2 1/4	2 15/16	2 3/4	5 1/32	4 1/4	3	63/64
A-625-M L-625-M	5/8	2 1/4	2 15/16	2 11/16	5 1/32	4 1/4	3	1 3/64
A-750-M L-750-M	3/4	2 1/4	2 15/16	2 5/8	5 1/32	4 1/4	3	1 7/64
A-1000-M L-1000-M	1	2 1/4	2 15/32	2 1/2	5 1/32	4 1/4	3	1 15/64
A-1250-M L-1250-M	1 1/4	2 1/4	2 15/32	2 3/8	5 1/32	4 1/4	3	1 31/64

Other valve sizes available on request.

Standard - Position indicators: microswitch type
Standard - Viton bonnet seal
Additional cost - Metal bonnet seal
Additional cost - Kalrez poppet O-ring for high temperature applications

Bi-Pass Valve



The Thermionics bi-pass valve is solenoid controlled. The bi-pass allows pressure equalization on both sides of the valve seat, before opening the main valve. Available on all TLI angle and inline valves. Consult factory for price and further information.

Applications

- Prevents damage to very delicate samples from sudden pressure changes
- Can be used as gas bleed into system
- Sputtering applications

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Features

- Prevents damage to very delicate samples from sudden pressure changes
- Can be used as gas bleed into system
- Sputtering applications

Please refer to pages 9-14, 9-15, 9-18, 9-19 for a listing of features and options. The options listed also apply to these valves. Please call if you need additional information or further explanation.

To Order Valves

Please add the flange type at the end of the valve model number, i.e.: TL-1500-H/275 or TL-1500-H/ISO40.

Options

Other options should be described, such as "with reed switch position indicators."

Manual

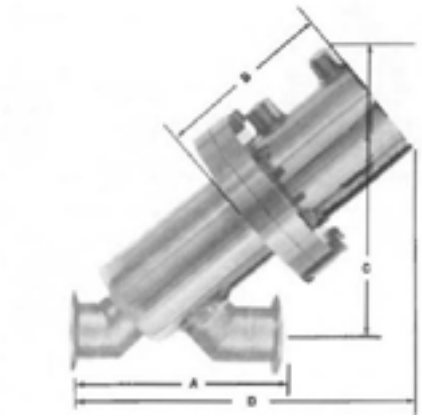
Port Size O.D.	A	B Open	C	D
3/4	2.9	3.0	7.5	9.5
1	4.0	3.2	8.4	10.4
1.5	4.9	3.2	8.6	11.1
2	6.4	4.0	11.5	14.3
2.5	6.8	4.0	11.5	14.8
3	7.0	4.0	11.5	16.2

Viton Bonnet

Port Size O.D.	Model No.	ConFlat Size	ISO/KF Size	Gasket Set Model No.
3/4	**TL-750-H**	1.33	16	**GH-11**
1	**TL-1000-H**	2.12	25	**GH-11**
1.25	**TL-1250-H**	2.75	40	**GH-11**
1.5	**TL-1500-H**	2.75	40	**GH-12**
2	**TL-2000-H**	3.38	50	**GH-13**
2.5	**TL-2500-H**	4.50	63	**GH-25**
3	**TL-3000-H**	4.62	80	**GH-14**

Metal Bonnet

Model No.	ConFlat Size	Gasket Set Model No.
MTL-750-H	1.33	**GH-11-M**
MTL-1000-H	2.12	**GH-11-M**
MTL-1250-H	2.75	**GH-11-M**
MTL-1500-H	2.75	**GH-12-M**
MTL-2000-H	3.38	**GH-13-M**
MTL-2500-H	4.50	**GH-25-M**
MTL-3000-H	4.62	**GH-14-M**



Electro-Pneumatic

Port Size O.D.	A	B	C	D
3/4	2.9	3.5	7.8	9.5
1	4.0	3.5	8.7	10.6
1.5	4.9	3.5	8.9	11.7
2	6.4	4.62	12.0	14.6
2.5	6.8	4.62	12.08	15.0
3	7.0	10.0	16.0	19.0

Viton Bonnet

Port Size O.D.	Model No.	ConFlat Size	ISO/KF Size	Gasket Set Model No.
3/4	**TL-750-P**	1.33	16	**GH-11**
1	**TL-1000-P**	2.12	25	**GH-11**
1.25	**TL-1250-P**	2.75	40	**GH-11**
1.5	**TL-1500-P**	2.75	40	**GH-12**
2	**TL-2000-P**	3.38	50	**GH-13**
2.5	**TL-2500-P**	4.50	63	**GH-25**
3	**TL-3000-P**	4.62	80	**GH-14**

Metal Bonnet

Model No.	ConFlat Size	Gasket Set Model No.
MTL-750-P	1.33	**GP-11-M**
MTL-1000-P	2.12	**GP-11-M**
MTL-1250-P	2.75	**GP-11-M**
MTL-1500-P	2.75	**GP-12-M**
MTL-2000-P	3.38	**GP-13-M**
MTL-2500-P	4.50	**GP-25-M**
MTL-3000-P	4.62	**GP-14-M**

9 Qualified Straight Through Valves

- All stainless steel construction

Specifications

Model No.	Clear Aperture I.D.	Tube O.D.	Flange O.D.	A	B	C	D
SVV-075	0.63	0.75”	1.33	4.50	1.50	3.75	.50
SVV-150	1.25	1.50”	2.75	7.70	2.47	5.00	.21
SVV-200	1.75	2.00”	3.38	8.75	3.50	7.00	.23
SVV-250	2.25	2.50”	4.50	10.00	3.50	8.50	.38
SVV-400	3.75	4.00”	6.00	16.48	5.00	11.24	.43

Qualified SVV Viton Sealed Straight Through Valves Viton bonnet and Viton poppet seal

Features

Please refer to pages 9-14, 9-15 and 9-18, 9-19 for a listing of features and options. The options listed also apply to these valves. Please call if you need additional information or further explanation.

To Order Valves

Please add the actuator, bonnet seal, and flange type as a suffix to the valve model number, ie.: SVV-150-22-PVB-ISO 40 or SVV-150-33-HMB-275.

Options

Other options should be described, such as “with reed switch position indicators .”

Valve Model No.	Description	Manual Operator Viton Bonnet	Pneumatic Operator Viton Bonnet	Manual Operator Metal Bonnet	Pneumatic Operator Metal Bonnet
SVV-075-20	No flanges	HVB	PVB	HMB	PMB
SVV-075-22	Flanges on all ports	“	“	“	“
SVV-075-30	No flanges with roughing port	“	“	“	“
SVV-075-33	Flanges with roughing port	“	“	“	“
SVV-150-20	No flanges	“	“	“	“
SVV-150-22	Flanges on all ports	“	“	“	“
SVV-150-30	No flanges with roughing port	“	“	“	“
SVV-150-33	Flanges with roughing port	“	“	“	“
SVV-200-20	No flanges	“	“	“	“
SVV-200-22	Flanges on all ports	“	“	“	“
SVV-200-30	No flanges with roughing port	“	“	“	“
SVV-200-33	Flanges with roughing port	“	“	“	“
SVV-250-20	No flanges	“	“	“	“
SVV-250-22	Flanges on all ports	“	“	“	“
SVV-250-30	No flanges with roughing port	“	“	“	“
SVV-250-33	Flanges with roughing port	“	“	“	“
SVV-400-20	No flanges	“	“	“	“
SVV-400-22	Flanges on all ports	“	“	“	“
SVV-400-30	No flanges with roughing port	“	“	“	“
SVV-400-33	Flanges with roughing port	“	“	“	“

- All stainless steel construction

Specifications

High Temperature

The entire valve can be repeatedly baked to 450°C, in either the open or closed position.

Mounting Requirements

The valve may be mounted and operated in any position. TLI bakeable valves with flanges are supplied with rotatable flanges to simplify mounting.

Operating Pressures

TLI bakeable valves used in typical all metal or glass/metal UHV systems are reliable to pressures of 10^{-12} Torr.

Vacuum Materials

The valve is made of 300 series stainless steel. The seat gasket is a special copper alloy. Only 300 series stainless steel and OFE copper are exposed to the vacuum system.

Bellows Sealed Drive

The entire valve drive mechanism is isolated from the vacuum system by a welded nesting stainless steel bellows. No sliding vacuum seals are used.

Gasket Life

The life of the sealing gasket is dependent on the temperature history and the cleanliness of the sealing surface. The sealing gasket should remain reliable through forty 450°C cycles. If the system is not repeatedly baked or only baked mildly, many hundreds of cycles can be expected.

Bakeable Valve Mounting Bracket

Use of a mounting bracket is recommended in installations where the connecting tubulation will not support the sealing torque load. The bracket can be bolted to any flange of the valve. It can be used as a wrench fixture or can, in turn, be bolted to a rigid member for support. Each of these stainless steel brackets is shipped with the required number of special length bolts for the flange to bracket connection (shown below).

High Conductance

The TLI design allows the full retraction of the sealing gasket and the bellows assembly. Seat constriction is held to a minimum, giving maximum conductance.

Calculated flange to flange conductance for air at 25°C is:

Series	Size	Conductance
BVV-150	1 1/2”	38 l/sec
BVV-250	2 1/2”	118 l/sec

Gasket Replacement

Gasket replacement is simple. No special tools are required. On some systems a tee style valve is used with one port blanked off. This port is used to change the seat without removing the valve from the system.

Drive Lubrication

After high temperature bakeout, the threads of the drive mechanism must be lubricated to prevent galling and insure proper torque on the seat. The TLI valve drive is sealed from the vacuum system by the stainless steel bellows, and the valve does not have to be removed from the system to be lubricated.

Connections

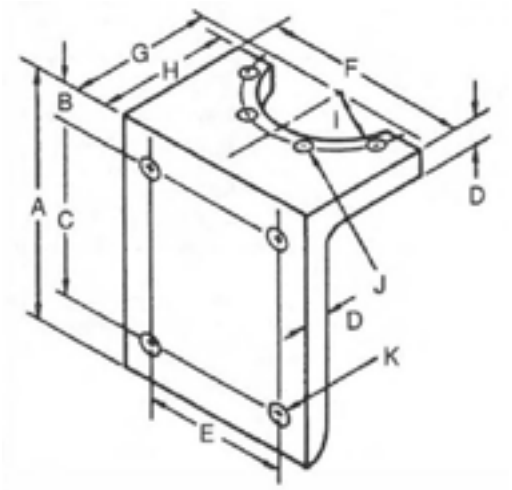
All TLI bakeable valves are available with flanges of your choice.

Leak Tightness

Before shipment, each valve is tested on a helium leak checker to insure leak tightness to 2×10^{-10} std cc/sec.

Bakeable Valve Mounting Bracket Specifications

For Use With:	A	B	C	D	E	F	G	H	I	J	K
1 1/2” valve	3	7/8	1 3/4	1/4	2 1/4	2 3/4	2 1/8	1 3/4	7/8	3 holes 281 dia	4 holes 281 dia
2 1/2” valve	4	1 1/8	2 1/4	3/8	3 7/8	4 1/2	3 1/4	3	1 3/8	4 holes 332 dia	4 holes 343 dia



9 Qualified UHV Bakeable Valves

Features

- All stainless steel construction
- Entire valve bakeable to 450°C
- Bakeable in open or closed positions
- High conductance
- Replaceable metal alloy gasket
- Leak tight to less than 2 x 10^{-11} Torr
- Right angle or tee styles

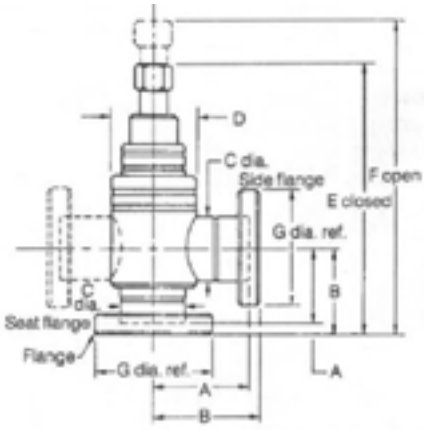
Applications

TLI 's bakeable valves are for use in ultrahigh vacuum systems that are baked up to 450°C. The straightforward design gives maximum reliability and vacuum sealing to pressures below 10^{-11} Torr.

Since these valves can be baked in either the open or closed position, they can be used for any high temperature vacuum application.

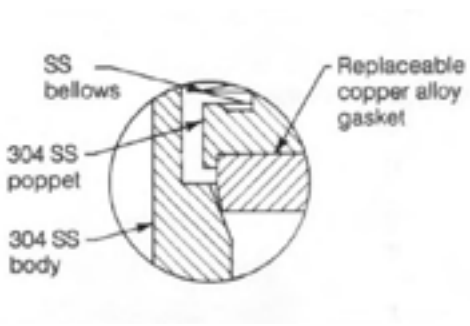
Operation

In the TLI bakeable valve, the seal is formed by impressing a replaceable copper alloy gasket on a stainless steel seat. Repeatable, reliable seals are easily accomplished under the most adverse vacuum conditions.



NOTE: All valve models are provided with ROTATABLE flanges.

BVV Series



Dimensions

Model No.	A	B	C	D	E	F	G
BVV-150 Series	2 1/4	2 1/2	1 1/2	2	6 1/4	7 3/8	2 3/4
BVV-250	3 3/4	4 1/8	2 1/2	3 1/4	10 5/8	11 7/8	4 1/2

Note: All valve models are provided with ROTATABLE flanges.

Ordering Information

Description	1 1/2" Valves		2 1/2" Valves	
	Model	Weight	Model	Weight
Right angle without flanges	**BVV-150**	6	**BVV-250**	14
Right angle with flanges	**BVV-152**	7	**BVV-252**	17
Tee configuration without flanges	**BVV-150T**	7	**BVV-250-T**	17
Tee configuration with flanges	**BVV-153T**	8	**BVV-253-T**	20
Replacement seat gaskets	**BVV-150S**	1/2	**BVV-250-S**	1
Drive lubricant	**DL-100**	1/2	**DL-100**	1/2
Mounting bracket	**MB-150**	2	**MB-250**	4
Flange gaskets (10/pkg)	**GK-275**	1/2	**GK-450**	1 1/2
Bolt-nut sets for flanges (25/pkg)	**B-25-100**	1 1/2	**B-31-125**	2
Torque wrench	**TW-100**	4	**TW-100**	4

New Sizes	Model	Weight
5/8" straight through	BVS-0625-22/133	8
3/4" right angle	BVV-075-22/133	3

(360) 385-7707

thermionics laboratory, inc.
Vacuum Innovation Since 1958

sales@thermionics.com

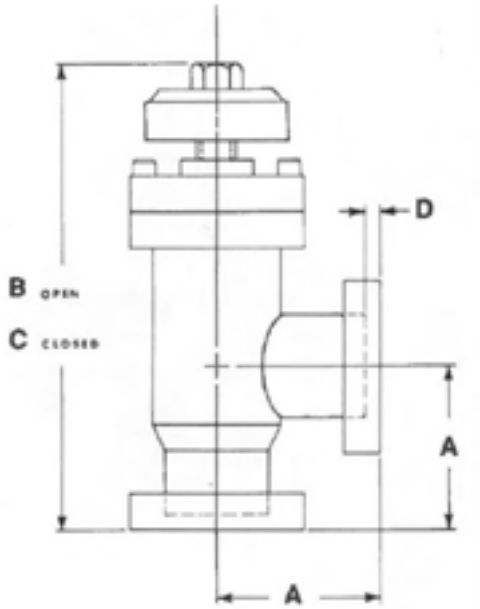
Bakeable Right-Angle Valves—Dimensions

Model No.	Part O.D.	Flange O.D	A	B	C	D
AMV-075 Series	0.75	1.33	2.00	7.00	5.87	.50
AMV-150 Series	1.50	2.75	2.45	8.87	7.25	.21
AMV-200 Series	2.00	3.38	3.16	10.62	8.50	.23
AMV-250 Series	2.50	4.50	4.13	11.12	9.62	.38

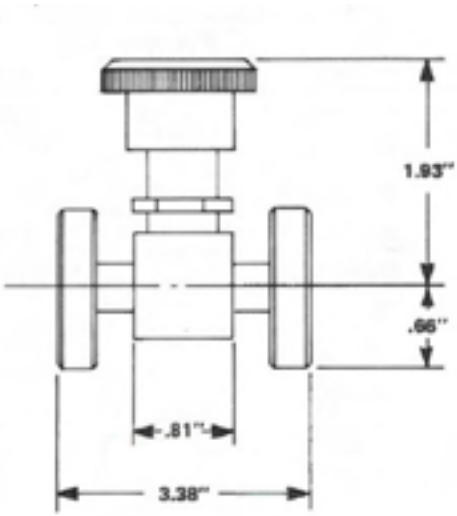
- All stainless steel construction

TLI all metal valves feature OFE copper bonnet and seat seals that are easily replaceable. No need to use liquid nitrogen or risk damaging valve during maintenance. The initial low torque required will provide long seal life.

Bakeable Right-Angle Valve		Gasket Set
Model No.	Gasket Description	Model No.
AMV-075-20	No flanges	AMV-075-G
AMV-075-22	Flanges on both ports	
AMV-150-20	No flanges	AMV-150-G
AMV-150-22	Flanges on both ports	
AMV-200-20	No flanges	AMV-200-G
AMV-200-22	Flanges on both ports	
AMV-250-20	No flanges	AMV-200-G
AMV-250-22	Flanges on both ports	



AMV Dimensions



BVV-025

Model BVV-025

1/4" bakeable valve

- 315°C bakeout
- Bellows sealed
- All stainless steel
- 0.25" O.D. x0.156" I.D . port dimensions
- Can be used in toxic or corrosive applications

Port Options

- Non-rotatable 1.33" mini-flanges
- 1/4" O.D. weld stubs
- VCR fittings

AMV-150-22

9 Qualified UHV Bakeable Straight Through Valves

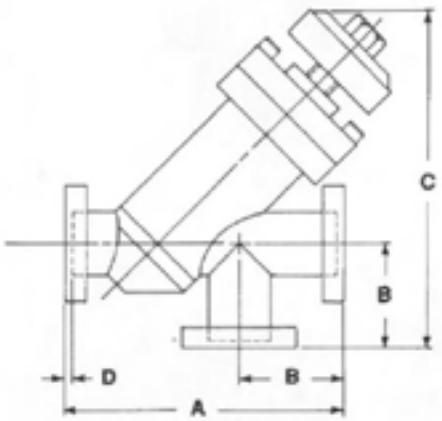
- All stainless steel construction

Thermionics metal sealed bakeable straight through valves are available in the following sizes:

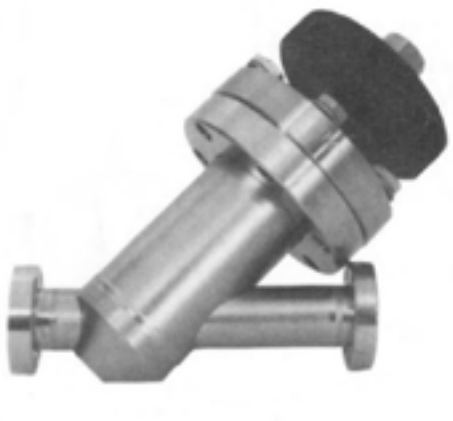
0.75” SMV-075
1.50” SMV-150
2 00” SMV-200
2.50” SMV-250

TLI all metal valves feature OFE copper bonnet and seat seals that are easily replaceable. No need to use liquid nitrogen or risk damaging valve during maintenance.

The initial low torque required will provide long seal life.



SMV Dimensions



SMV-075-22 Valve

SMV Valve Dimensions

Model No.	Clear Aperture I.D.	Flange O.D	A	B	C	D
SMV-075	0.63	1.33	4.50	1.50	5.25	.50
SMV-150	1.25	2.75	6.65	2.47	7.47	.21
SMV-200	1.75	3.38	8.75	3.50	8.50	.23
SMV-250	2.25	4.50	10.00	3.50	12.00	.38

Butterfly Valve

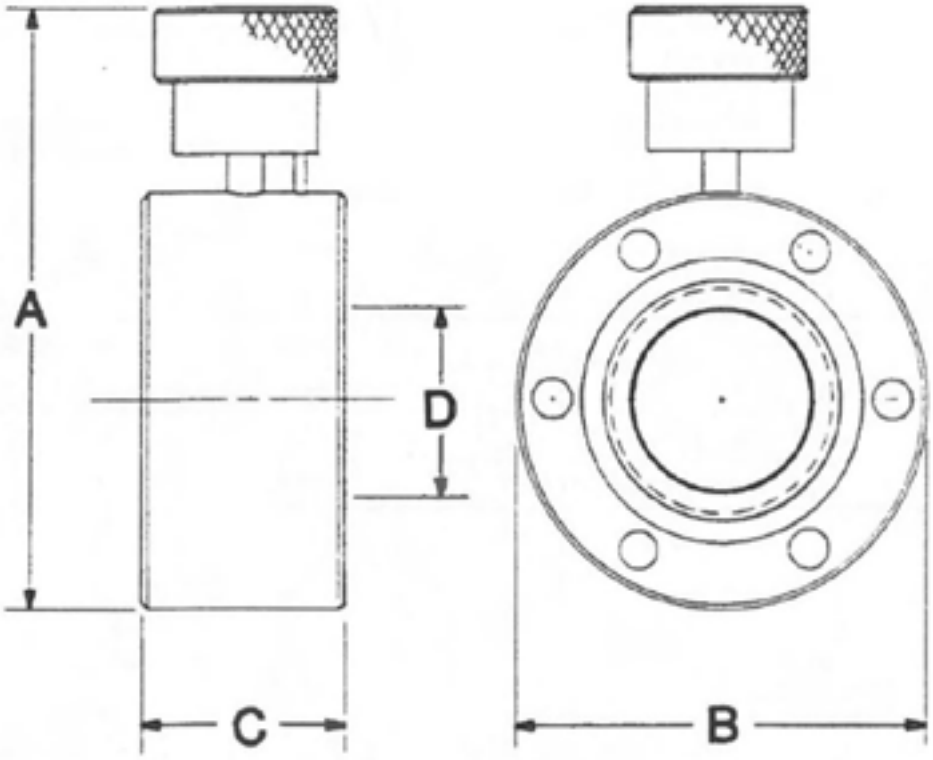
Features

- 1/4 turn fully open/fully closed
- Viton O-ring main seal
- Leak free to 2 x 10^{-10} std cc/sec , vacuum adverse
- 304 stainless steel, vacuum melt bar stock main body
- Most advanced, patented design

Options

- Available with alternate elastomer seals
- Available with O-ring or bellows shaft seals
- Available with motorized and pneumatic actuators

Nom. O.D.	Nom. I.D.	Flange Type	A	B	C	D	Model No.
1.33	0.75	ConFlat		Consult Factory			**BFV-133**
2.75	1.50	ConFlat	4.00	2.73	1.38	1.25	**BFV-275**
3.38	2.00	ConFlat		Consult Factory			**BFV-338**
ISO 16	0.75	ISO/KF		Consult Factory			**BFV-16K**
ISO 25	1.00	ISO/KF		Consult Factory			**BFV-25K**
ISO 40	1.50	ISO/KF		Consult Factory			**BFV-40K**
ISO 50	2.00	ISO/KF		Consult Factory			**BFV-50K**




thermionics
VE-340-PVD

Systems

Note: The LN_2 Controller has been moved to section 6

UHV Systems

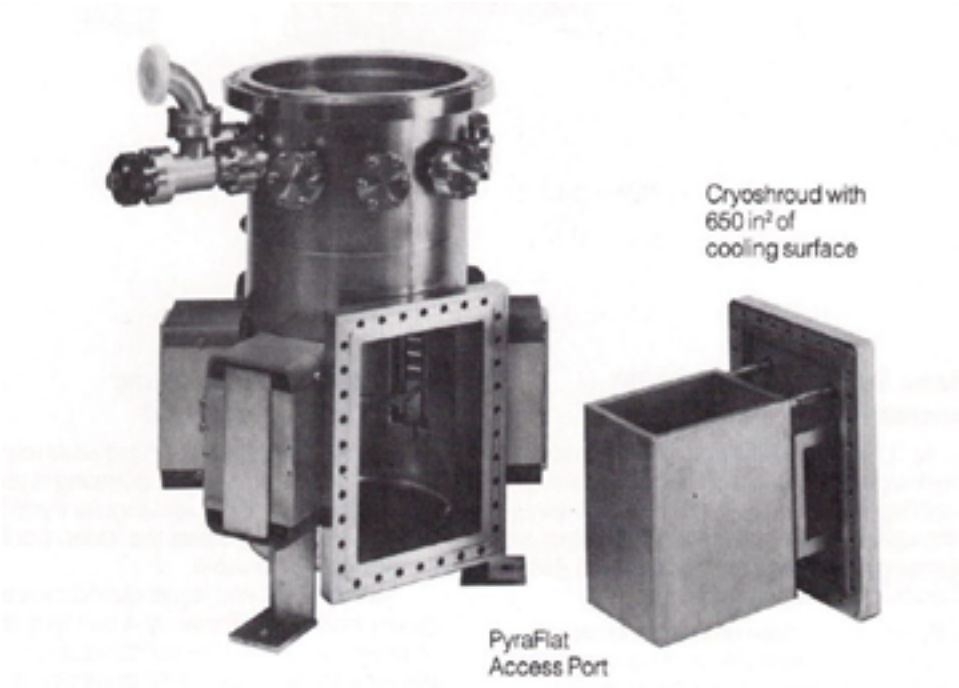
- Standard diode ion pumped
- Noble/differential diode ion pumped
- Triode ion pumped
- Turbo pumped
- Cryo pumped
- Diffusion pumped

Roughing Systems

- Oil free
- Manual
- Automatic

TTS-SWC Series Ion Pumping Systems

Model SP-70 Super-Sorb
TLI 's challenge to the Varian Megasorb



TTS-200T-PF Series Pumping Stacks

At last, a table top system designed to give you ready access to the inside of your pumping stack by means of a 10 1/2" x 7 1/2" rectangular PyraFlat flange. The PyraFlat incorporates the Varian ConFlat flange sealing principle of a knife edge and a trapped copper gasket. See Section 7, pages 7-1 to 7-5.

Any pumping stack without a PyraFlat access port is obsolete.

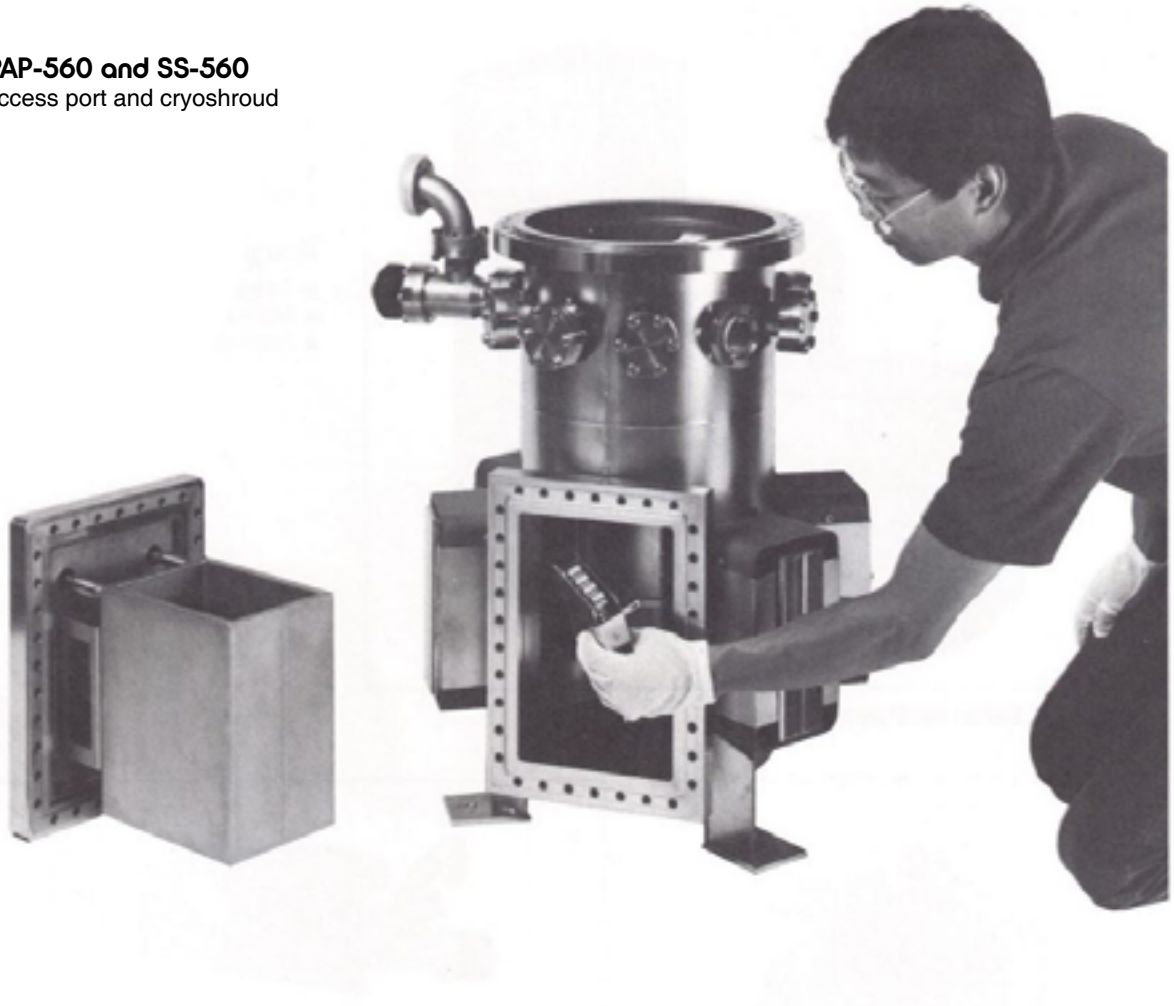
PyraFlat flanges are manufactured and protected under one or more of the following patents: 5,640,751; 4,685,193

10 TTS Series Ion Pumped Table Top Systems

A pumping stack without a PyraFlat access port is an obsolete pumping stack.

PyraFlat flanges are manufactured and protected under one or more of the following patents: 5,640,751; 4,685,193

Models PAP-560 and SS-560
PyraFlat access port and cryoshroud



Basic Systems and Pyraflat Access Ports

At TLI we have over 50 years of experience in the design and fabrication of vacuum and gas-handling systems. We can draw upon our extensive knowledge of vacuum requirements, pumping characteristics, and specific gas-surface interactions to offer you:

- Systems which are properly and promptly engineered, designed and delivered and which will meet or exceed your performance requirements.
- Systems which are manufactured from your drawings, from your sketches, or from a description of your operating requirements. (Final TLI drawings will be submitted for customer approval upon request.)
- Assistance in the selection of components, valves, pumps, gauges, and control circuitry best suited for your exact application.

PyraFlat Access Port and Model 560 Cryoshroud

The PyraFlat access port provides ready access to the inside of your pumping stack by means of a 10 1/2" x 7 1/4" rectangular PyraFlat flange which incorporates the Varian ConFlat flange sealing principle.

Maintenance and repair downtime are greatly minimized. Presently, it can take days or weeks to service your pumping stack, because the only access for purposes of maintenance or servicing is through the poppet. If you haven't gone through the process of removing the bell jar, associated plumbing, and instruments, just check with someone who has. As one user said, "We all know that accidents happen. Somebody drops a sample down the valve or a pump shorts. What we cannot afford is a week's shutdown for a complete disassembly." The PyraFlat access port offers the perfect solution.

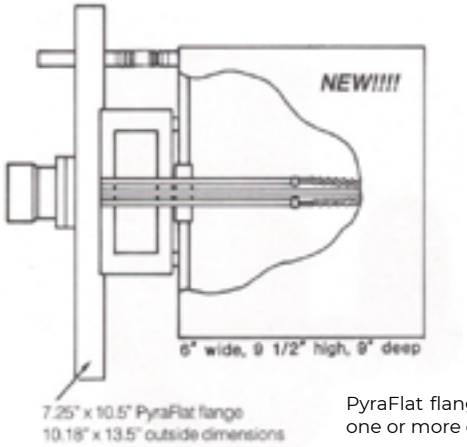
The PyraFlat Advantage

First You have sufficient access to the inside of the pumping stack to allow easy servicing of the pump and poppet areas. You can remove and service the poppet and the pump elements without disturbing the bell jar, associated plumbing, instruments or your work.

Second The larger opening lets us put a larger cryopanel in the system. Our Model 560 has 560 sq in of cooled surface as compared to 500 in^2 for competitor A, and approximately 200 in^2 for competitor B.

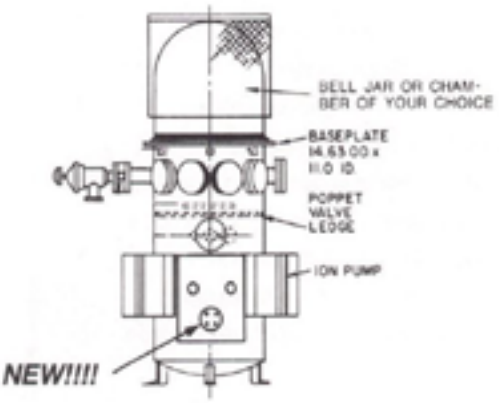
Model SS-560 PyraFlat Cryoshroud

with 560 in² of cooling surface



Model No. SS-560—

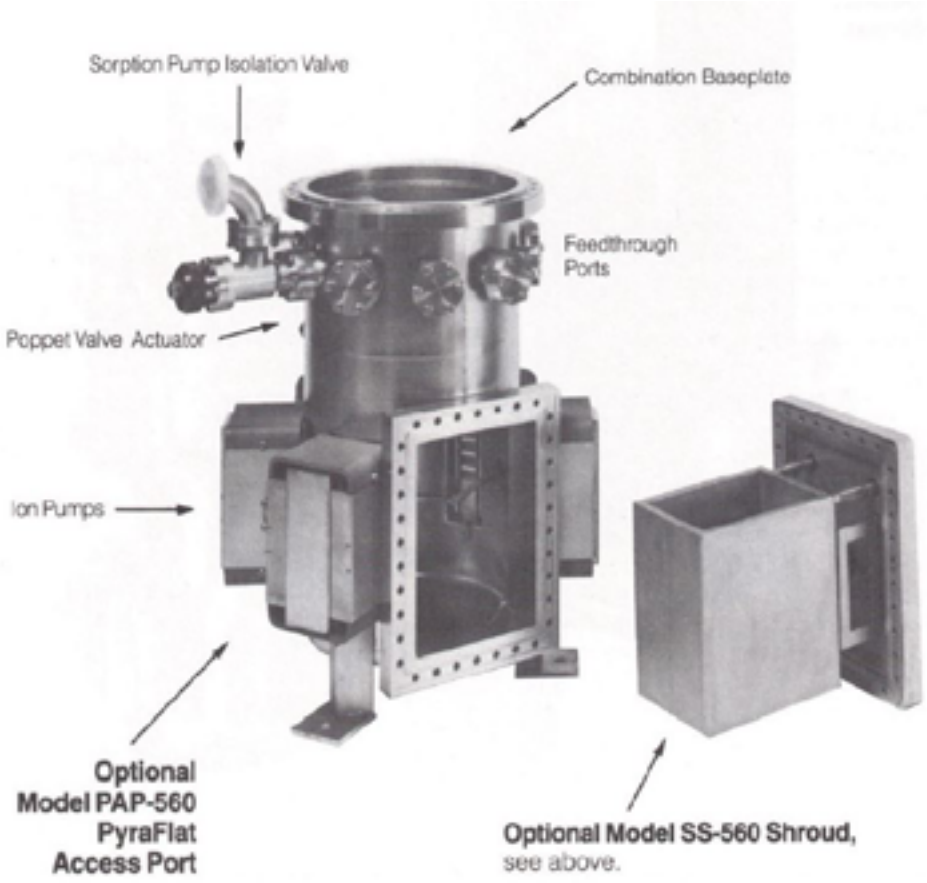
Modular and removable sublimator and cryoshroud assembly mounted on TLI PyraFlat access port also provides access to inside of pumping stack for cleaning, repair and maintenance.



PyraFlat flanges are manufactured and protected under one or more of the following patents: 5,640,751; 4,685,193

12", 14" and 18" Table Top High Vacuum Systems

- TTS pumping stack—the heart of the TTSSWC and US-SLC pumping systems. See pages 10-6 to 10-8 for sizes
- Integral ion pumps—diode or triode with speeds in excess of 1500 l/sec



12", 14" and 18" Table Top High Vacuum Systems

- Surface research (Auger, ESCA, SAM, SIMS, ISS, HEED, RHEED, LEED, etc.)
- Material studies
- High energy studies
- Thin film sputtering and evaporation
- Vacuum deposition
- Residual gas analysis
- Sputtering
- Beam lead/lines studies
- Space simulation
- Environmental testing
- Furnaces
- Tube processing
- Friction studies
- Shadow casting

Features

PUMPING
- Roughing—dual sorption
- Ion pumps—choice of diode, noble diode (differential pumping), hydrogen diode, triode
- Sublimation-4 spiral filaments
- Cryoshroud—Model 300 or Model 560

BASE PLATE
- Combination wire seal and Viton L gasket; size dependent on stack diameter

FEEDTHROUGH PORTS
- 9 each 2 3/4" x 1 1/2" ConFlat type located below poppet valve

POPPET VALVE
- Hand operated, Viton sealed. Isolates pumping stack from chamber

BAKEOUT
- 250°C (limited by elastomer). Consult factory

10 TTS Pump Stack/Options/TTS Systems

TTS Pumping Stack + Following Options = Table Top Ion Pump Systems Complete and Ready to Run

- 1 each standard cabinet enclosure with or without bakeout oven as option
- 1 each electronics cabinet enclosure is 1 each nude ion gauge
- 1 each ionization gauge control
- 1 each thermocouple gauge is 1 each bakeout option on ion pump control
- 1 each bakeout option distribution box
- 1 each bakeout blanket option
- 1 each bakeout oven shroud option
- 1 each metal seal isolation valve option

The series TTS-SWC and TTS-SLC ion pump systems incorporate the TTS ion pump stack together with components guaranteed to provide quick pumpdown of the system from atmosphere to less than 2 x 10^{-11} Torr. Optional vacuum chamber or bell jar is designed and manufactured to meet your specific applications

Pumping Stack Sizes Available

12", 14", and 16" standard. (Other sizes available as custom options.)

Pumping Speeds Available

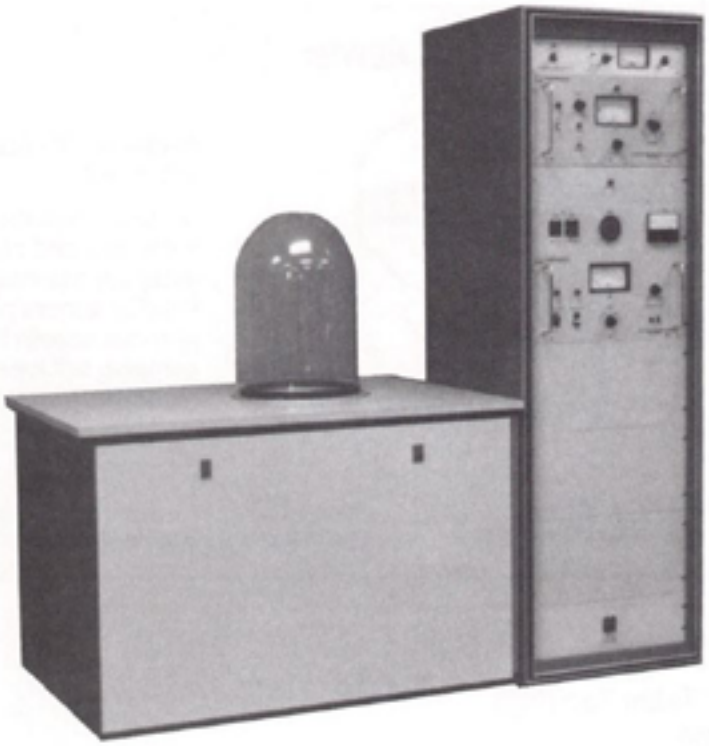
60 l/sec to over 1,500 l/sec

Types of Integral Ion Pumps Available

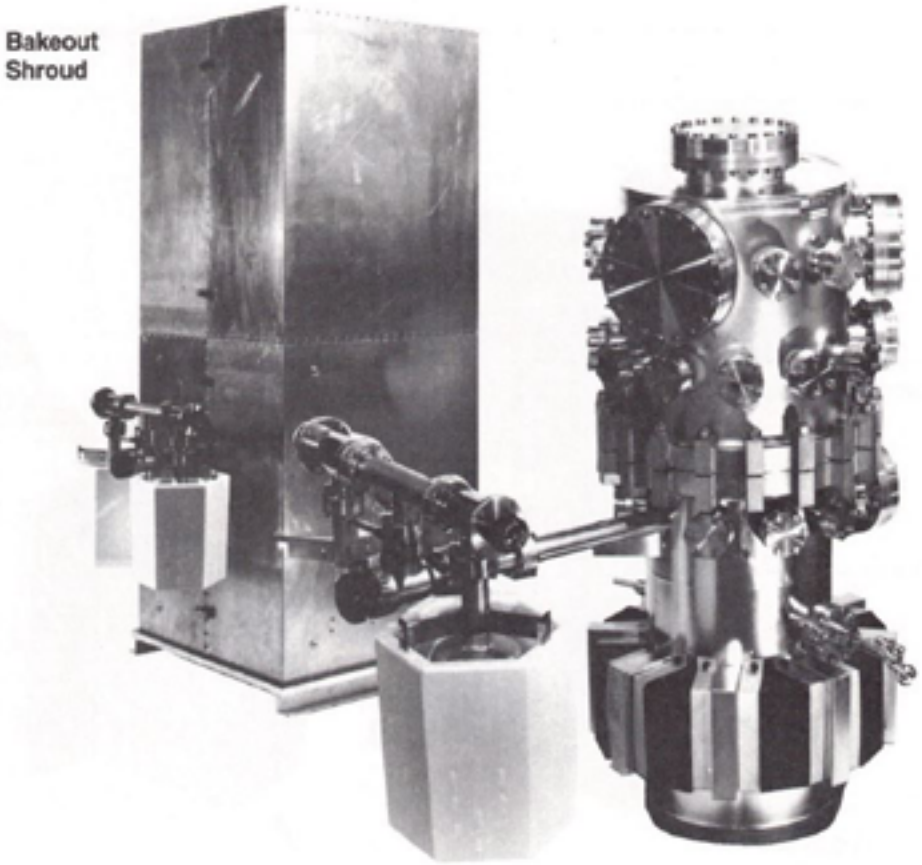
Diode, noble gas diode, hydrogen diode and triode.

Options

TTS vacuum systems can, at customer request, be baked and pumped down to 2 x 10^{-11} or better, backfilled with nitrogen, pinched off, and shipped under vacuum.



Model TTS-SWC Pumping System with Cabinet



Model TTS-SLC Pumping System without Cabinet

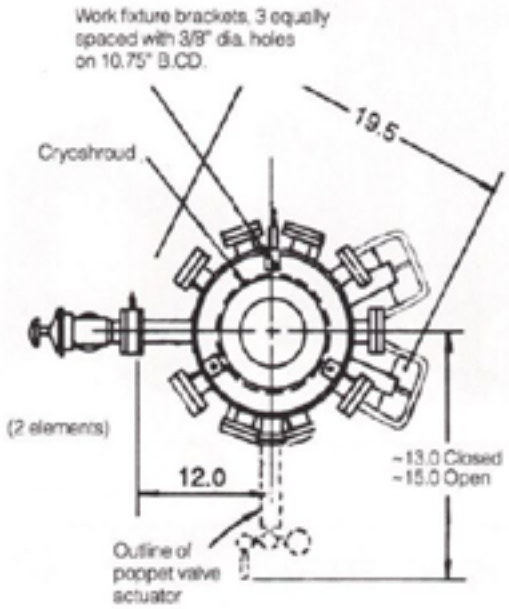


Fig. 10-1. TTS-60N & TTS-80T

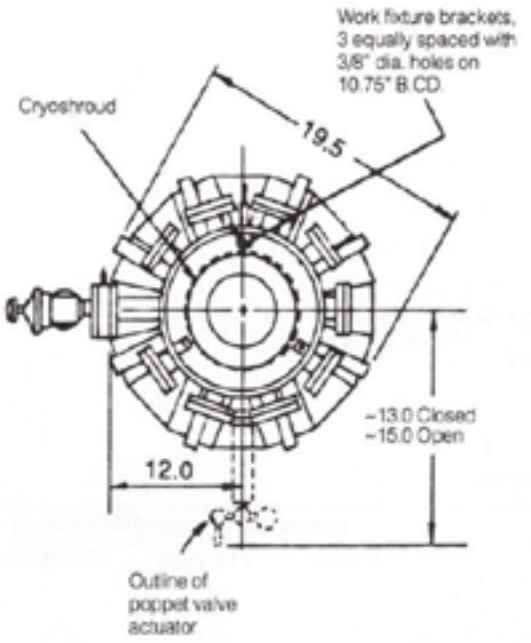


Fig. 10-2. TTS-240N and TTS-200T

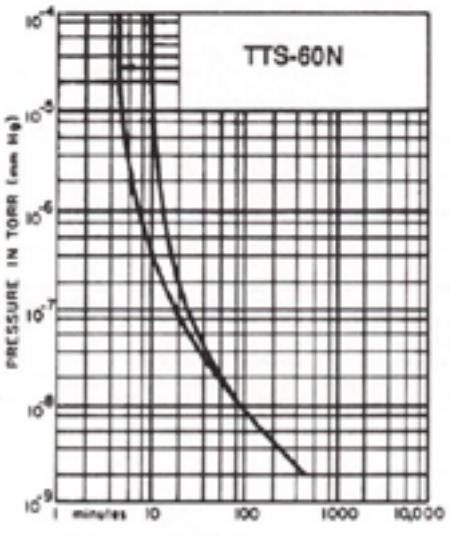


Fig. 10-3. TTC-60

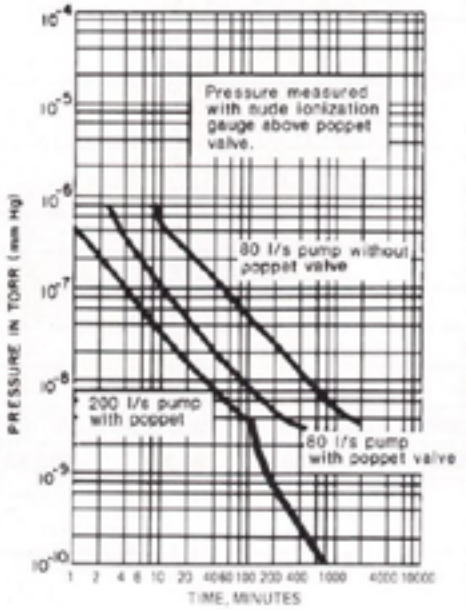


Fig. 10-4. TTS-80T & TTS-200T

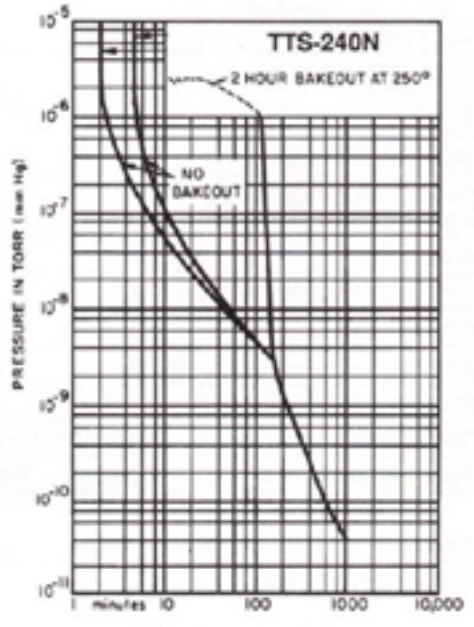


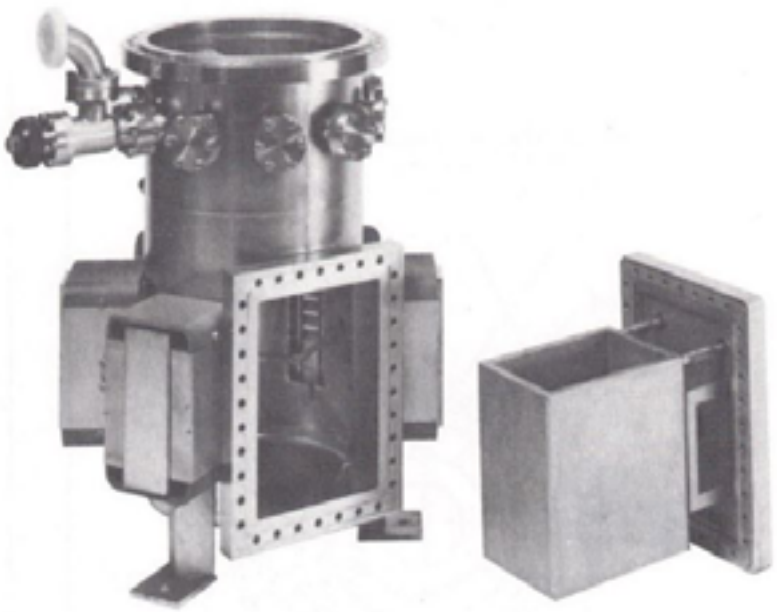
Fig. 10-5. TTS-240N

10 TTS Basic Pumping Stacks

TTS Basic Pumping Stack

Shown with optional PAP-560 PyreFlat access port and optional SS-560 cryoshroud (see pages 10-2 and 10-3).

PyraFlat flanges are manufactured and protected under one or more of the following patents: 5,640,751; 4,685,193



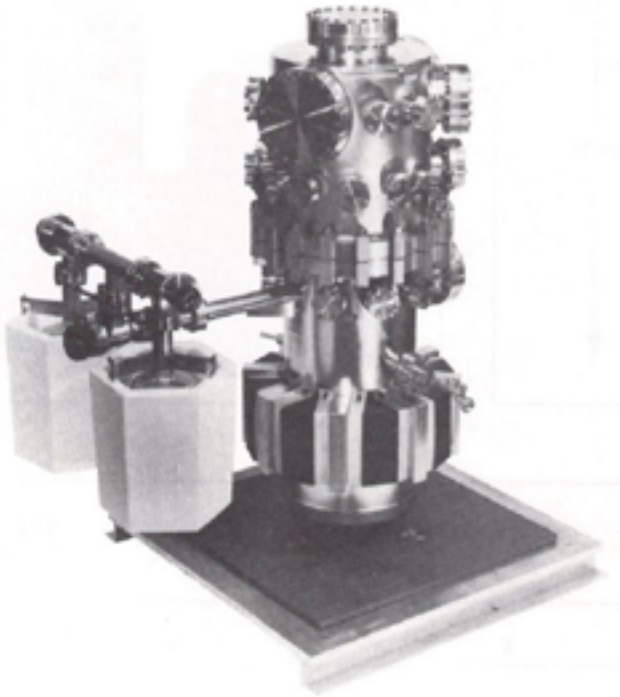
TTS Pumping Stacks

Dimensions in inches

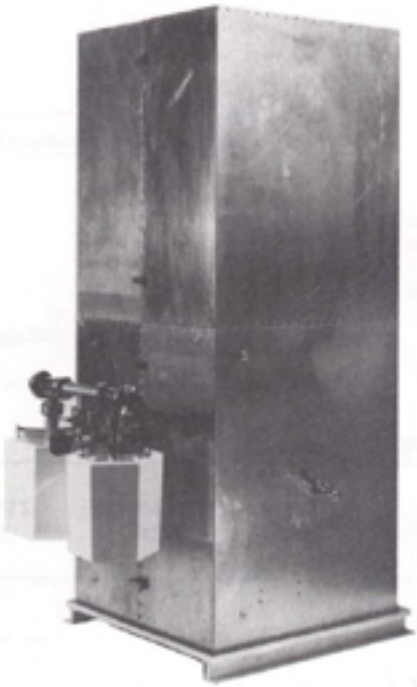
With	Differentially Pumped Noble Diode Ion Pumps				Triode Pumps			
Model No.	**TTS-60N**	**TTS-240N**	**TTS-300N**	**TTS-400N**	**TTS-80T**	**TTS-200T**	**TTS-300T**	**TTS-400T**
Includes:								
Integral ion pump pumping speed (l/sec)	60	240	300	400	80	200	300	400
Ion pump power supply	**PS 350**	**PS 1000**	**PS 1000**	**PS 1000**	**PS 350**	**PS 1000**	**PS 1000**	**PS 1000**
Basewell (inches)	12 x 26	12 x 26	12 x 26	18 x 36	12 x 26	12 x 26	12 x 26	18 x 36
Combination male wire seal and Viton gasket baseplate 14.63" x 11.0"	X	X	X	X (18 x 22)	X	X	X	X (18 x 22)
Viton gasket & wire seal	X	X	X	X	X	X	X	X
Integral 3-tab ledge & port for poppet actuator	X	X	X	X	X	X	X	X
9 each 2.75" x 1.50" blanked off ports	X	X	X	(15 ea)	X	X	X	(15 ea)
One bakeable roughing valve on 2.75"x 1.50" port	X	X	X	X	X	X	X	X
Double-sided flange with air relief valve & TC gauge tube	X	X	X	X	X	X	X	X
Cryoshroud	X	X	X	X	X	X	X	X
Sublimator (4 fils.) SB-1000	X	X	X	X	X	X	X	X
Sublimator control PS-500	X	X	X	X	X	X	X	X
2 each operating manuals	X	X	X	X	X	X	X	X
8" poppet valve	X	X	X	X (12")	X	X	X	X (12")
Spare Parts	10 each GK-275 gaskets; 1 each B-25-137N bolt set; 4 each TSP filaments							

Options
Recommended option: PyraFlat access port (see pp 10-2, 10-3)
Dual sorption pump roughing system (refer to page 10-18 for Sorption 2A)
Top blank-off plate
Top blank-off dished head

Table Top Ion Pump Systems



Bakeout Shroud



TTS-SLC Table Top Systems (Bakeable)

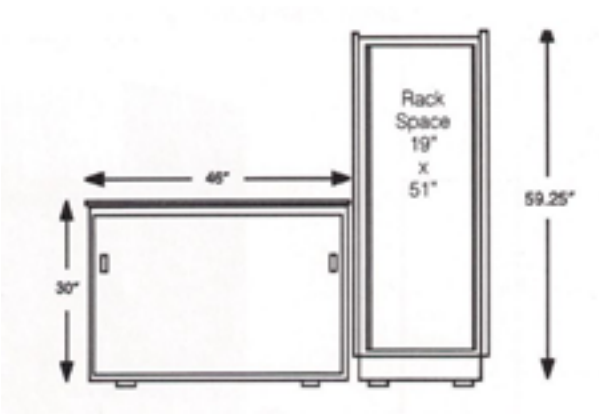
Includes TTS pumping stack items from page 10-6 plus	TTS-60WSLC	TTS-240N/SLC	TTS-300WSLC	TTS-400N/SLC	TTS-80T/SLC	TTS-200T/SLC	TTS-300T/SLC	TTS-400T/SLC
Enclosed electronics rack	X	X	X	X	X	X	X	X
Nude ion gauge	X	X	X	X	X	X	X	X
Ion gauge control	X	X	X	X	X	X	X	X

Options

Console bakeout shroud
Bakeout blanket
Internal bakeout
Recommended option: PyraFlat access port (see pp 10-2, 10-3)
Dual sorption Pump roughing system (refer to page 10-18 for Sorption 2A)
Top blank-off plate
Top blank-off dished head

10 Model TTS-SWC Table Top Systems With Cabinets

PyraFlat flanges are manufactured and protected under one or more of the following patents: 5,640,751; 4,685,193



TTS-SWC Table Top Systems (Bakeable)

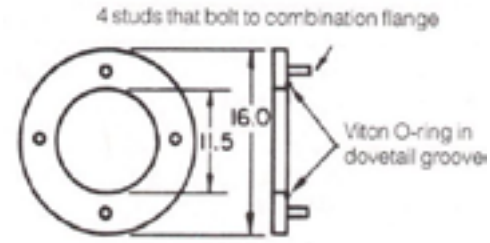
Includes TTS pumping stack items from page 10-6 plus	TTS-60N/ SWC	TTS-240N/ SWC	TTS-300N/ SWC	TTS-400N/ SWC	TTS-80T/ SWC	TTS-200T/ SWC	TTS-300T/ SWC	TTS-400T/ SWC
Enclosed electronics rack	X	X	X	X	X	X	X	X
Nude ion gauge	X	X	X	X	X	X	X	X
Ion gauge control	X	X	X	X	X	X	X	X

TTS-SWC/B Table Top Systems (Bakeable)

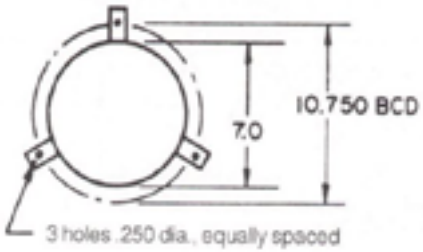
TTS pumping stack	TTC-60N/ SWC/B	TTS-24N/ SWC/B	TTS-300N/ SWC/B	TTS-400N/ SWC/B	TTS/80T/ SWC/B	TTS-200T/ SWC/B	TTS-300T/ SWC/B	TTS-400T/ SWC/B
Table top enclosed cabinet	X	X	X	X	X	X	X	X
Enclosed electronics rack	X	X	X	X	X	X	X	X
Nude ion gauge	X	X	X	X	X	X	X	X
Ion gauge control	X	X	X	X	X	X	X	X
Ion pump bakeout module	X	X	X	X	X	X	X	X
Bakeout power distribution box	X	X	X	X	X	X	X	X
Console bakeout oven	X	X	X	X	X	X	X	X
Bakeout blanket	X	X	X	X	X	X	X	X

Options for TTS-SWC and TTS-SWC/B Table Top Systems

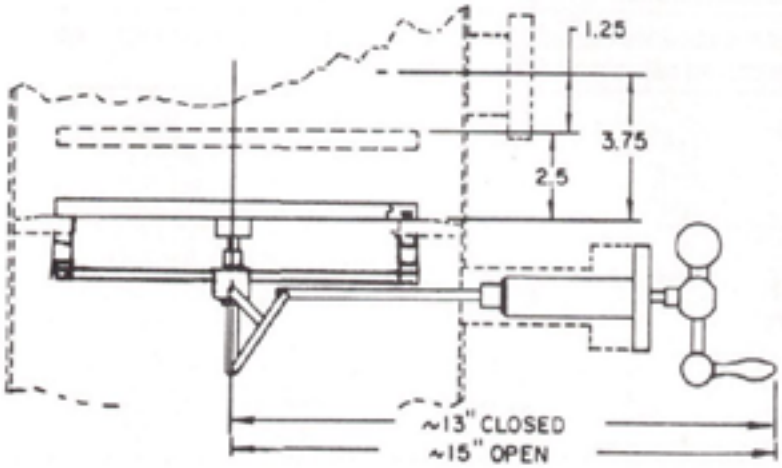
Recommended option: PyraFlat access port (see pp 10-2, 10-3)
Dual sorption Pump roughing system (refer to page 10-18 for Sorption 2A)
Top blank-off plate
Top blank-off dished head



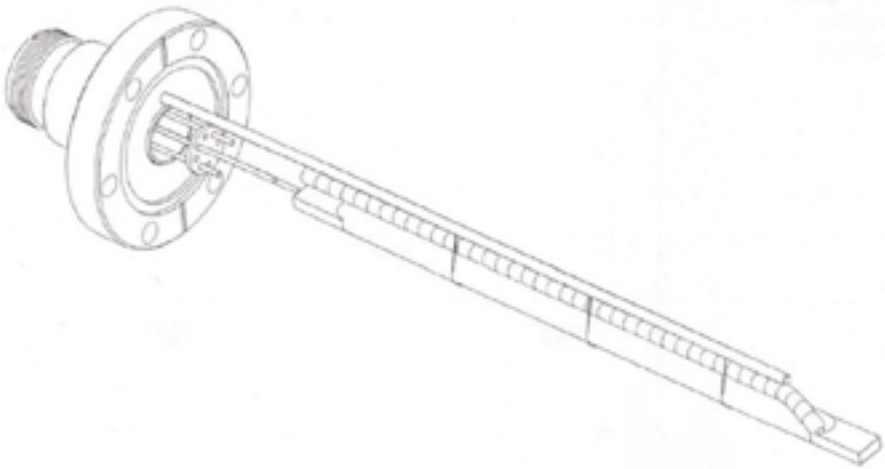
Adapter Plate



Work Support Platform



Poppet Valvet



Integral Bakeout Source Model 275-8QH

Pyrex Bell Jars & Implosion Guard

See Section 8 for more information.

Stainless Steel Custom Chambers

Designed and fabricated to meet your particular needs.

See section 11 for more information

Sorption Roughing

See page 10-17

Mobile Cabinet—on Casters

Available with electronics incorporated or with separate electronics rack. See page 10-8, TTS-SWC.

Adapter Plate

16" O.D. stainless steel adapter plate to allow Viton-sealed bell jars up to 14" diameter to be used with the TTS-240N or TTS-200T systems.

Work Support Platform

Provides support for electron beam guns and other fixtures. Attaches to support tabs in basewell.

Poppet Valve

High conductance poppet valve provides rapid cycling and fast pumpdowns. The poppet valve isolates the entire selective pumping area from the bell jar. This allows the pumping system to maintain a vacuum level of 10^{-8} Torr or lower while the work area is at atmospheric pressure. In the open position, the poppet valve has a conductance equivalent to an 8" orifice. For maintenance purposes, or for high temperature application, the poppet sealing plate is easily removed through the basewell. The stem from the poppet valve is bellows sealed, and the actuator mechanism attaches to the 2" metal seal flange port located immediately below the poppet valve sealing ledge.

Bakeout Systems

(a) Clam Shell Bakeout Shroud designed to fit your particular stainless steel chamber. Thermostatically controlled to achieve temperature uniformity at 200°C throughout chamber. Includes power bus.

(b) Fitted Bakeout Blanket Custom made.

(c) Integral Bakeout Source (with Variac)

Efficient in situ quartz infrared heater assembly on a 2 3/4 " ConFlat-type flange is used— to bakeout vacuum chambers and systems. Consists of a 1200 W, 120 VAC, 10A quartz infrared lamp, coupled to a 2 3/4 " flange, on which is mounted a medium current feedthrough. Easy installation on any standard 2 3/4 " ConFlat-type flange port. Can be kept on during chamber openings to reduce H_2O adsorption on walls. Uses a powerstat power supply to allow bakeout at an upper temperature limit of 400°C. It is UHV compatible at a 2 x 10^{-11} Torr base pressure. Replacement lamps are available. Bulb life expectancy is 500 hours or longer.

Venturi Pump

Contact us for more information

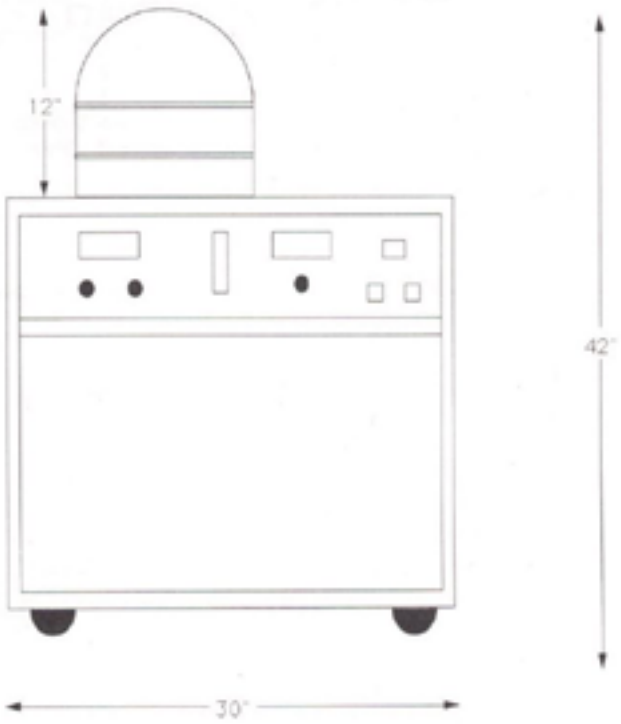
10 Vacuum Evaporators

Vacuum Evaporation Equipment

Model No.	Description
VE-80	Basic vacuum evaporator. Diffusion pumped system with manually operated valves. 12”x 12” bell jar with 1 kVA resistive power supply, baseplate feedthroughs and low and high vacuum instrumentation.
VE-90	Vacuum evaporator. Turbomolecular pumped system with automatic operation. 12” x 12” bell jar with 1 kVA resistive power supply, baseplate feedthroughs and digital low vacuum instrumentation.
VE-100	Vacuum evaporator. Turbomolecular pumped system with automatic operation. 12” x 12” bell jar mounted on 12” collar feedthrough with an electron beam gun evaporation source. All pressure and gun instrumentation mounted in cabinet.
EPS-50	Resistive evaporation power supply. 500 VA supply with metering in a cabinet. 10‘ electrode cables included.
EPS-100	Resistive evaporation power supply. 1 kVA supply with 2 voltage taps and metering instrumentation. 10’ electrode cables included.
EPS-200	Resistive evaporation power supply. 2 kVA supply with 3 voltage taps and multi-range metering. Transformer mounted inside control cabinet and cables provided.

Model VE-80

The model VE-80 vacuum evaporator is a small, dedicated unit for vacuum evaporation or coating. It is simple, manually operated controls are uncomplicated and it offers a basic, low priced alternative to higher priced coaters. Coating chores are accomplished in a diffusion-pumped high vacuum environment that is available in 20 minutes from atmosphere. No compromise in instrumentation is made and vacuum interlocks are provided to warn personnel of improper operating procedure. Additional options are available to give the user some flexibility in customizing the system to a particular application. Consult the factory for available options.



Specifications

1. Vacuum System

A. Bell Jar	Pyrex, Viton sealed, 12” dia. x 12” high (other size bell jars and hoist are optional)
B. High Vacuum Pump	300 l/sec diffusion pump (LN_2 trap optional)
C. Roughing Pump	3.2 cfm 2-stage, direct drive rotary
D. Control	System interlocks to protect source and instrumentation
E. Cycle Time	Typically 15 min to pump-down
F Pressure Gauges	Digital discharge gauge for high vacuum, thermocouple gauge with bar graph display for roughing and interlock control
G. Venting	Venting of system with interlocks to protect gauging and evaporation coils

2. Evaporation System

A. Source (electrong beam sources optional)	Resistive, two positions standard with electrical feedthroughs
B. Readout	Digital
C. Power	2 kVA

3. Utilities

A. Electrical	115/220 VAC at 20 A
B. Water	Yes
C. Air	Yes

4. Hardware

A. Cabinet	Tubular steel frame with casters, side panels, and Formica top
B. Dimensions	24” L x 20” W x 36 1/2” H
C. Weight	250 lbs

(360) 385-7707

thermionics laboratory, inc.
Vacuum Innovation Since 1958

sales@thermionics.com

Model VE-90

The model VE-90 vacuum evaporator is the perfect answer to a requirement for vacuum evaporation or coating. Its simple controls and rapid cycle time facilitate uncomplicated productivity. Reliable coating chores are accomplished in an oil-free, high vacuum environment that is available in 10 minutes from atmosphere with the touch of a button. Greater control and more predictable film parameters are available, almost as fast as the material can be loaded. Additional options are available to give the user some flexibility in customizing the system to a particular application. Consult factory for available options.

Specifications

1. Vacuum System

A. Bell Jar	Pyrex, Viton sealed, 12' dia (optional height)
B. High Vacuum Pump	260 l/sec turbomolecular pump
C. Roughing Pump	3.2 cfm 2-stage, direct drive rotary
D. Control	Automatic pumpdown, interlocks to protect source and instrumentation
E. Cycle Time	Typically 10 min to pump-down

2. Pressure Instrumentation

A. High Vacuum	Digital ionization gauge
B. Low Vacuum	Digital convection gauge

3. Evaporation System

A. Source	Resistive
B. Power	1 kVA, nominal 75 A (optional 2 kVA, 200 A)
C. Positions	2 switch selectable pairs of baseplate feedthroughs (filament holders and carbon evaporation kit are optional)
D. Metering	Digital ammeter (100 A FS)

4. Utilities

A. Electrical	115/220 VAC at 20 A
B. Water	None
C. Air	None

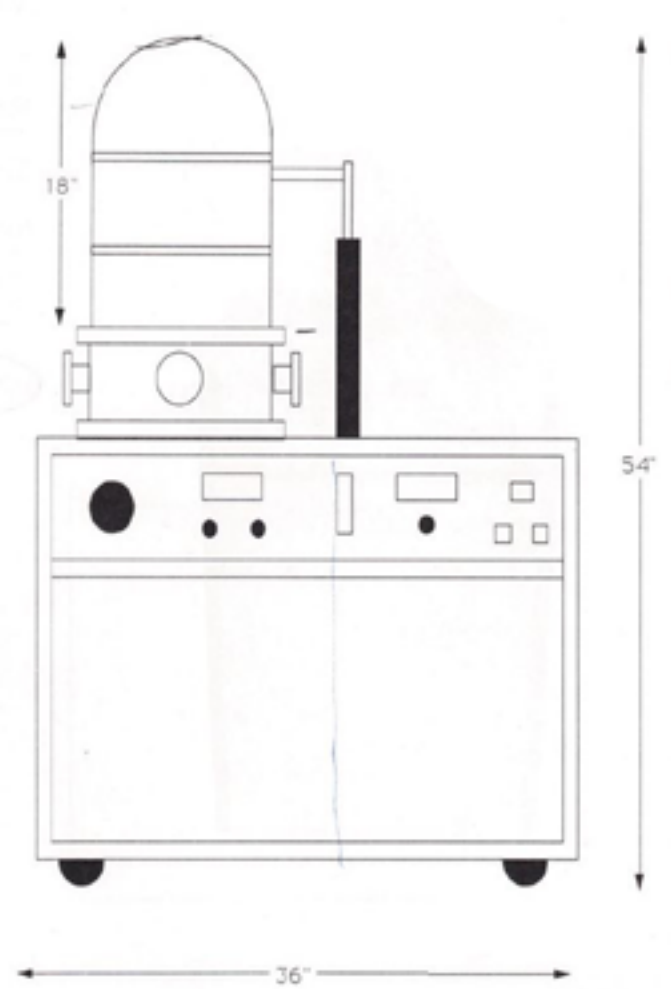
5. Hardware

A. Cabinet	Tubular steel frame with casters, side panels, and Formica top
B. Dimensions	30" L x 20" W x 42" H
C. Weight	Approx. 250 lbs
D. Hoist	Optional

10 Vacuum Evaporators

Model VE-100

The model VE-100 extends the technology of the VE-90 by the addition of a 3 kW e-Gun evaporation source while retaining a philosophy of simple, uncomplicated operation. Unlike larger systems, the VE-100's purpose is not overstated: It simply provides thin film coating—of virtually any material—quickly, cleanly and efficiently in a compact, dedicated system. With the additional technology of the source, a slightly larger bell jar and a collar, the optional flexibility of this system is almost boundless. To list just a few examples, many users add additional crucibles to assist in uninterrupted multi-coating operations, and the addition of a bell jar collar allows the user to introduce manipulators, additional electrical or water feedthroughs, and thin film instrumentation. Consult factory for available options.



Specifications

1. Vacuum System

A. Bell Jar	Pyrex, Viton sealed, 12" x 18" (optional stainless steel)
B. High Vacuum Pump	520 l/sec turbomolecular pump
C. Roughing Pump	3.2 cfm 2-stage, direct drive rotary
D. Control	Automatic pumpdown, interlocks to protect source and instrumentation
E. Cycle Time	Typically 10 min to pump-down

2. Pressure Instrumentation

A. High Vacuum	Ionization gauge with digital controller
B. Low Vacuum	Digital convection gauge

3. Evaporation System

A. Source	Electron beam gun
B. Power	3 kW
C. Positions	1 pocket (multiple pocket guns optional)
D. Metering	Analog metering on handheld power controller

4. Utilities

A. Electrical	208/220 VAC at 20 A
B. Water	.5 cfm
C. Air	None

5. Hardware

A. Cabinet	Tubular steel frame with casters, side panels, and Formica top
B. Dimensions	36" L x 20" W x 54" H
C. Weight	Approx. 350 lbs
D. Hoist	Standard

(360) 385-7707

thermionics laboratory, inc.
Vacuum Innovation Since 1958

sales@thermionics.com

- Fits existing vacuum systems with 12” or larger bell jars
- Full opening hinged lid opens without disconnecting water lines
- Simple to install; requires only water and filament power feedthroughs

The TLI compact cold wall vacuum furnace was designed for use with existing vacuum systems. The 6” CWVF, with an effective heat zone of 6” diameter x 6” high, will work with 12” or larger bell jar systems. The 8” CWVF, with an 8” diameter x 8” high heat zone, can be used in any 14” or larger system. The 14” CWVF can be used in an 18” or larger system.

An important design feature of the CWVF is the full opening lid. The lid can be easily opened and closed without disconnecting the water cooling lines.

The CWVF is easy to install. It requires only one dual water and two single filament power feedthroughs. A thermocouple feedthrough is optional.

Furnaces are constructed of OFE copper. Stainless steel heat shield liners are standard. Molybdenum shields are offered as an option at extra cost. Operation at 1200°C requires a 4.5 kW low voltage supply for the 6” CWVF and 6 kW for the 8” model. The tungsten hairpin filaments can be replaced in minutes without dismantling the furnace. A type K Chromel/Alumel thermocouple is furnished with each furnace for temperature measurement. A thermocouple feedthrough is ordered separately, if needed.

Applications of the CWVF include the brazing of copper, nickel, gold, silver and other alloys. It is also used for annealing, bakeout and numerous other uses.

Furnaces*

	Eft. Heat Zone
6” CWVF	6” dia x 6” high
8” CWVF	8” dia x 8” high
10” CWVF	10” dia x 10” high
12” CWVF	12” dia x 12” high
14” CWVF	14” dia x 14” high

**Including one thermocouple (does not include power supply feedthroughs or vacuum system)*

Power Supplies

Model No.	Power level
VFPS-5kVA	20 V at 250 A
VFPS-10kVA	20 V at 500 A
VFPS-14kVA	40 V at 350 A

Replacement Parts

Part Options
6” SS* heat shield liner
8” SS* heat shield liner
6” filament electrodes, set of three
8” filament electrodes, set of four
Bellows, 6” or 8”, 2 req. per furnace, each
Thermocouple, type K

**Stainless is standard, molybdenum price available on request*

Feedthroughs

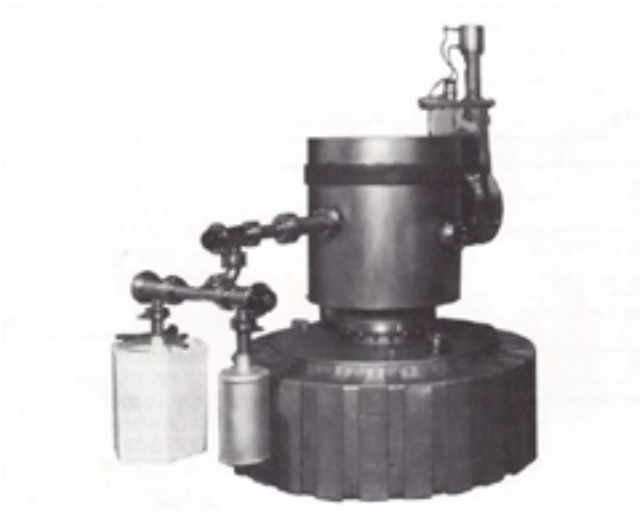
	Description & Model No.
Power	Single conductor electrical feedthrough mounted on 2.75” knife-edge flange. 600 A capacity. Two required. **FHC-275-1**
Water	Dual water feedthrough mounted on 2.75” knife-edge flange. One required. **FCW-275-2-38** **FCW-275-2D0/38** (de-mountable)
Thermocouple	Instrumentation feedthrough mounted on 2.75” knife-edge flange. **FEP-275-8T** Instrumentation feedthrough mounted on 1.33” CF flange. **FETC-133-2K**

6” Water-Cooled Cold Wall Furnace with Copper Tubing

10 Custom Ion Pumped Systems

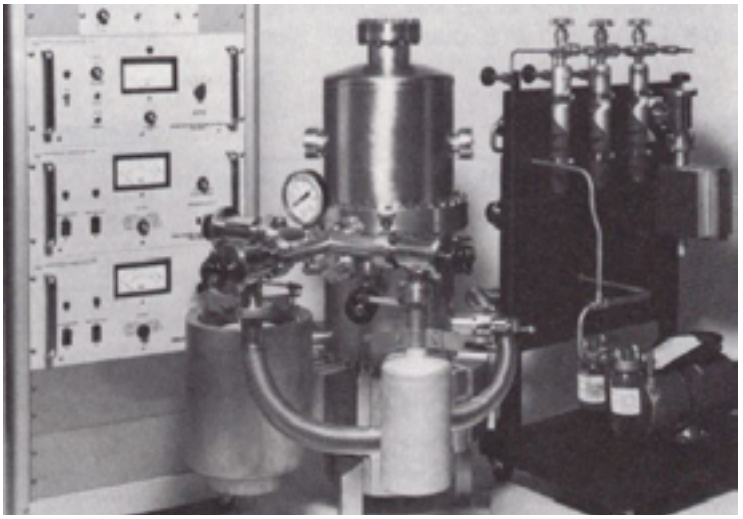
2,000 l/sec Noble Ion Pump System

- Dual sorption pump
- Ionization gauge and control
- Sublimation pump and control
- Rack mounted controls



2,000 l/sec Noble Ion Pump System
with Electronics Rack

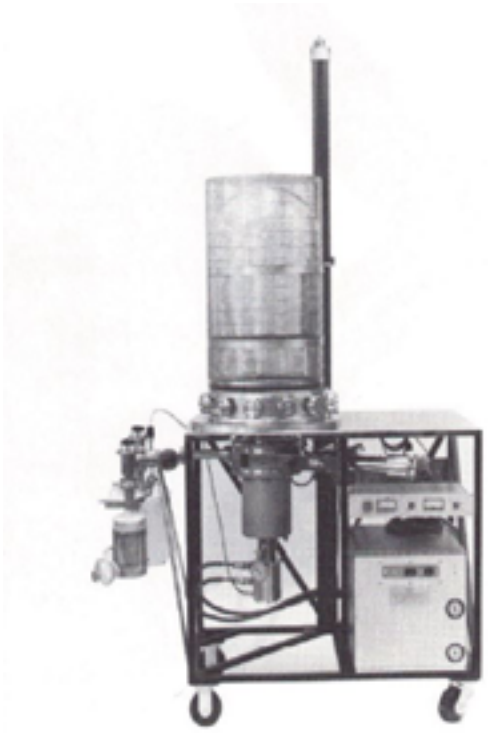
A custom UHV chamber with 240 l/sec ion pump stack and optional bakeable sorption pump Dewars. Includes a carbon vane pump, 20 l/sec appendage pump, Bourdon gauge and sequentially operated, heated lecture bottles for precise gas mixing. Also includes rack mounted control units.



Custom Vacuum Systems

Cryo Pump Cart Mounted System

- Manual Valving
- Ionization gauge and control
- Isolation gate valve
- Dual sorption pump roughing assembly
- Cryo pump high vacuum pumping
- Special collar
- 18” x 30” Pyrex bell jar & guard, with hoist
- 1 x 10^{-7} Torr in 30 min from atmosphere
- Cabinet mounted controllers and power supplies



Cryo Pumped System with Counterbalanced Hoist

(360) 385-7707

thermionics laboratory, inc.
Vacuum Innovation Since 1958

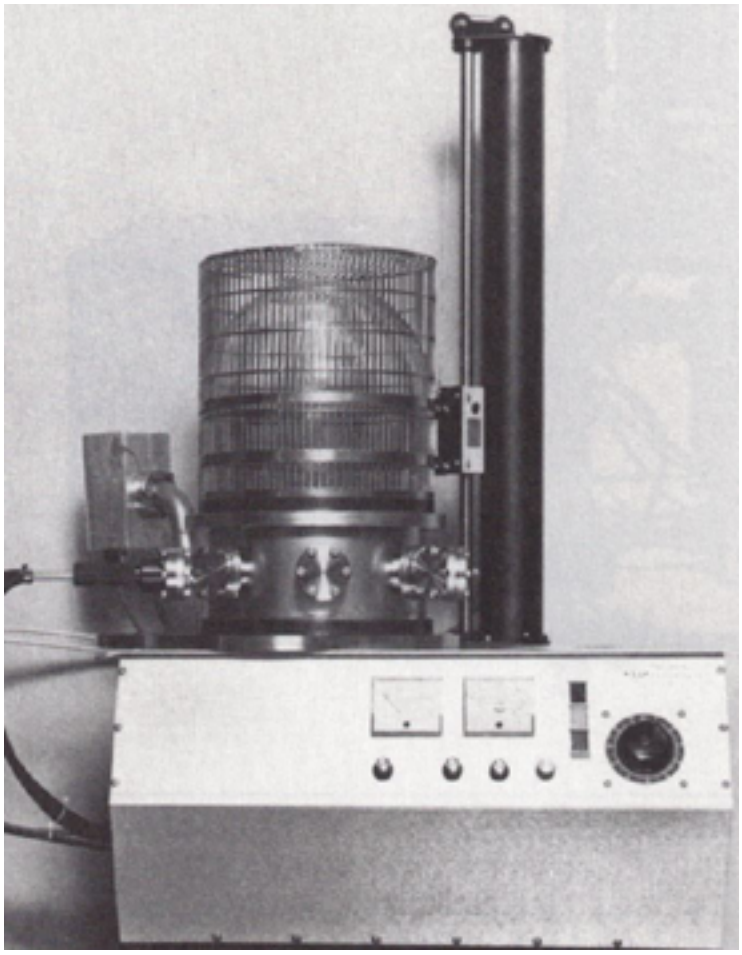
sales@thermionics.com

Turbo Pump Cart Mounted System

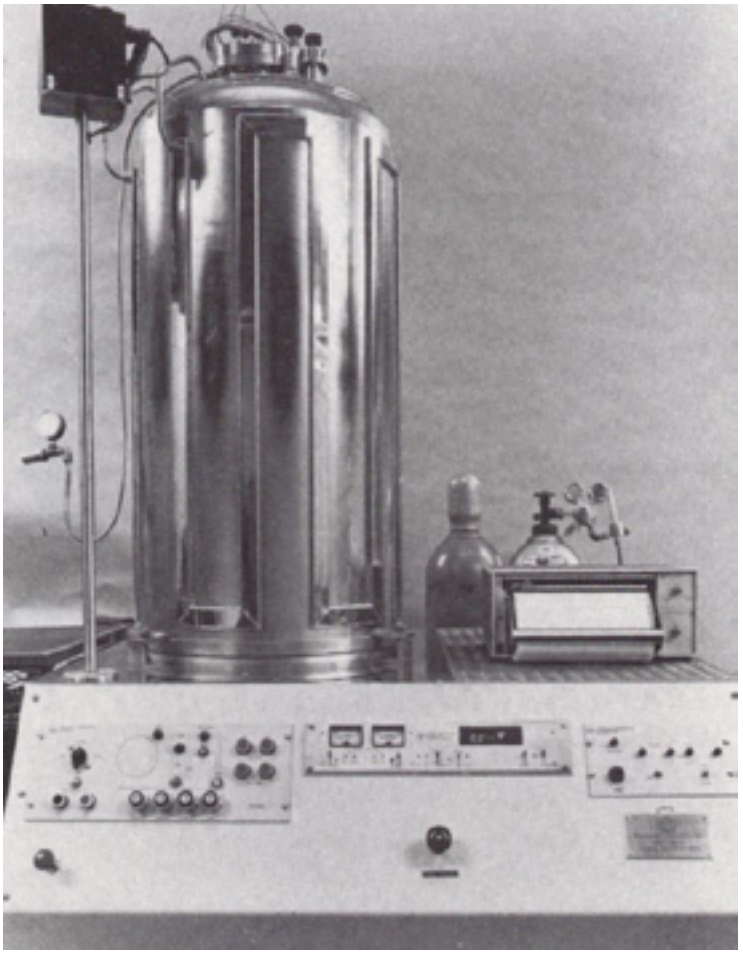
- Evaporation system with special collar for mounting of 3-position e-Gun
- Turbomolecular high vacuum pump
- Rack mounted controls
- Ionization gauge and control
- 12” x 24” Pyrex bell jar, guard and hoist

Diffusion Pump Cart Mounted System

- 6” D.P. for corrosive gas handling
- 1 x 10^{-8} Torr from atmosphere in 10 min
- Water cooled bell jar
- Semi-automatic valving, sequencing and monitoring
- Hydraulic hoist
- Isolation valve
- Ionization gauge and control



Electric Hoist

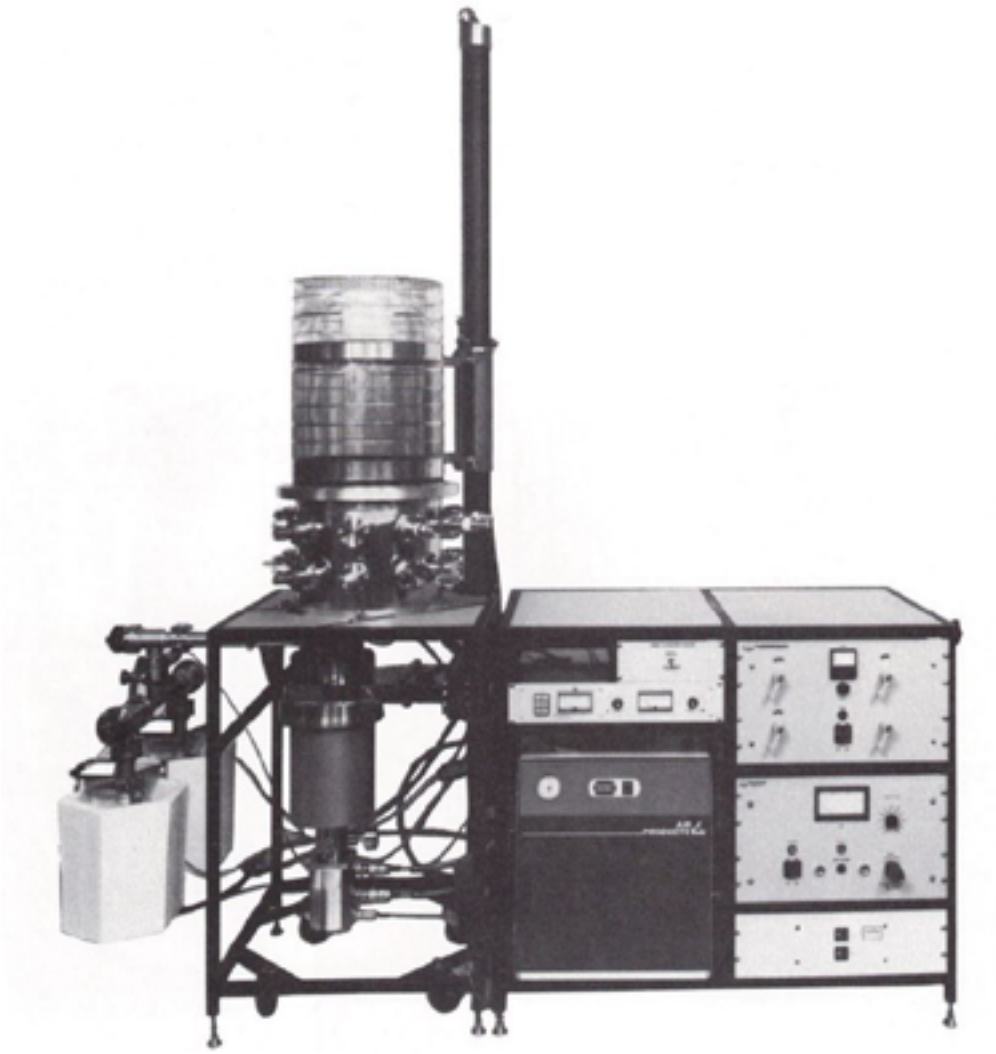


Hydraulic Hoist

10 Custom Vacuum Systems

Custom System with Cryo Pump

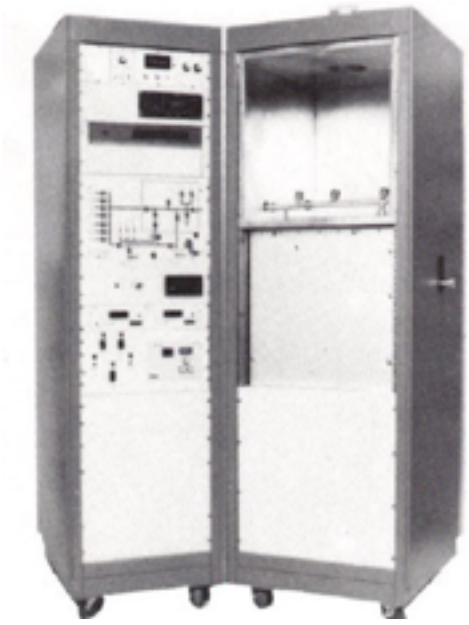
Dual 3 kW e-Gun with cross contamination shutters, dual sorption pump roughing, cyro high vacuum pump, automatic valving, ionization gauge and control, isolation gate valve, dual sorption pump assembly, special electron beam collar, 18" x 30" bell jar and guard with hoist, rack mounted controllers and power supplies. System achieves 1 x 10^{-7} Torr in 30 min from atmosphere.



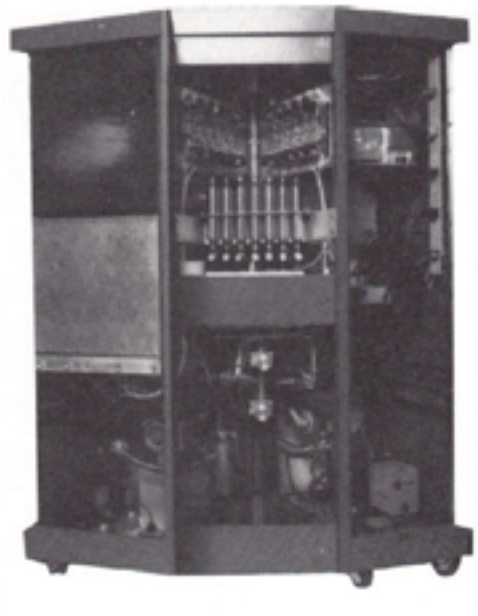
Gas Inlet System

A 20 valve microprocessor (or manually) operated inlet system for introduction of precise amounts of pure gases and gas mixtures into a mass spectrometer for quantitative analysis.

Includes front panel display, macro and micromanometer readout, temperature control readout, thermocouple readout, capacitance manometer readout, turbomolecular pump readout and control, and valve actuator display.



Front View

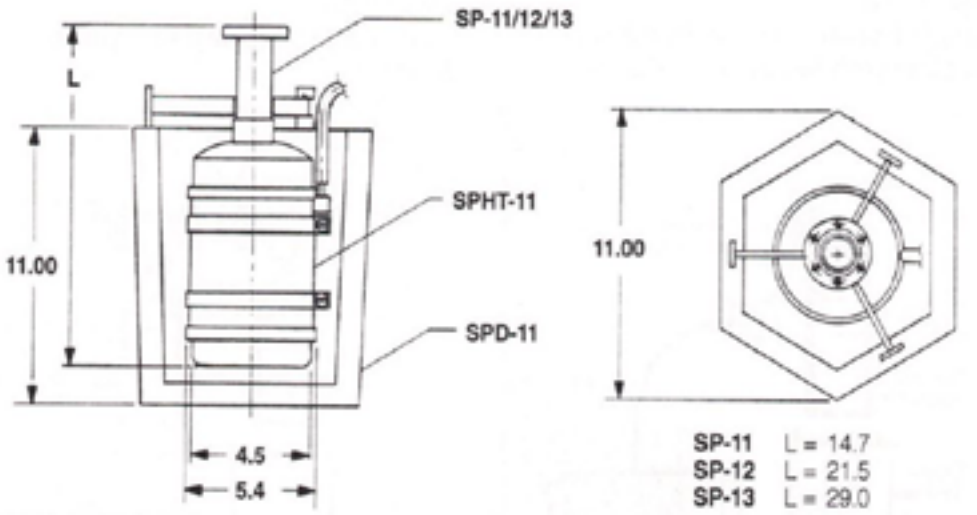


Back View

(360) 385-7707

thermionics laboratory, inc.
Vacuum Innovation Since 1958

sales@thermionics.com



Sorption Pump Diagram (dimensions in inches)

Specifications

Materials	
Body and internal cooling fins	Aluminum
Pump neck and connecting flange	Type 304 stainless steel
Dewar flask	Standard: styrofoam Option: stainless, type 304
Base pressure	1 x 10^{-3} Torr, with normal use
Recommended maximum pumping capacity	SP-11 standard pump = 40 liters
Sieve requirements (Linde 5A) (SP-11)	3 lbs
Liquid nitrogen required (approximate amount in liters/pumpdown from atmosphere) (SP-11)	5 liters
Heater power requirements	115 V, 50/60 Hz, 400 W
Number of heaters required per pump	1 heater
Bakeout temperature	250°C

Ordering Information

Model No.	Description	Wt. lbs
Sorption pumps— All pumps include: one OFE copper gasket, Dewar mounting bracket kit, top screen, RV-11 relief valve, six each nuts, bolts and washers, one charge of molecular sieve, and instructions		
SP-11	Single sorption pump	14.00
SP-12	Double sorption pump	28.00
SP-13	Triple sorption pump	42.00
SPD-11	Dewar, styrofoam	5.00
SPD-11S	Dewar, stainless steel	15.00
SPD-12S	Dewar, stainless steel	30.00
SPD-13S	Dewar, stainless steel	45.00
SPHT-11	Heater, wraparound bakeout, 115 VAC	4.00
MS-200	Sieve	5.00
275150	Mating flange	.50
GK-275	Gaskets (10/pkg.)	.50
B-25-137N	Bolt set	.75
RV-11	Viton relief valve	.50
TS-11	Top screen (old Model No. 4084)	.50

Application

TLI SP series sorption pumps are recommended for all applications needing highspeed, contaminant-free pumping. They have no moving parts or oils. The advanced design insures high speed pumping with maximum conductance and heat transfer. SP pumps have high capacity, are economical to operate, and are easily regenerated.

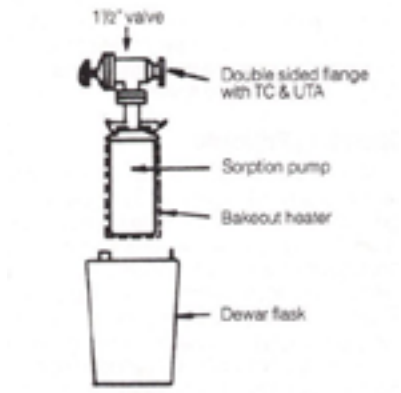
Operating Principle

Molecular sieve sorption pumps evacuate gas molecules from a volume by cryosorption, adsorbing them on a chilled surface. Because the adsorption process essentially takes place on a surface, a large surface area is required to adsorb appreciable quantities of gas. To satisfy this area requirement, a highly porous synthetic zeolite molecular sieve is commonly used as the sorbant material. The molecular sieve has an extremely high surface area to volume ratio (an SP-11 pump contains approximately 1.2 km^2 of sorbant surface area), which allows large quantities of gas to be pumped by relatively small sorption pumps. (An SP-11 sorption pump has a theoretical capacity of approximately 100,000 Torr-liters of gas.)

To obtain maximum speed and capacity from a sorption pump, there are three important design characteristics that are taken into consideration: 1) efficient heat transfer to the cryogenic fluid; 2) maximum conductance to the molecular sieve; and 3) quantity of molecular sieve in contact with a chilled surface (cryogenic surface area to volume ratio). The SP series sorption pumps are designed for optimization of these characteristics.

10 Sorption Roughing Systems

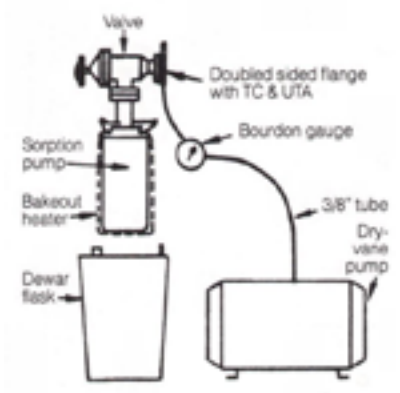
Option 1A Single Sorption Pump Roughing System



Option 1A—Single sorption pump roughing system includes:

1 ea	**A-1500-H**	1 1/2" manual angle valve, Viton sealed, with 2 3/4" ConFlat flanges on both ports
1 ea	**SP-11**	Pump assembly
1 ea	**SPD-11**	Styrofoam Dewar
1 ea	**SPHT-11**	Bakeout heater
1 ea	**FL275150-VTC**	Double-sided flange with TC tube and one up-to-air valve
1 ea		Set of necessary nuts and bolts
1 ea	**FLP-1**	Anti-seize lubricant
Partial assembly		

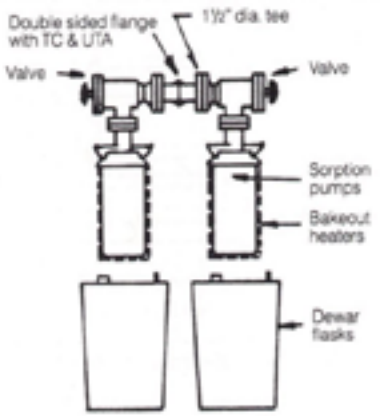
Option 1B Single Sorption Pump Roughing System with Mechanical Pump



Option 1B—Single sorption pump roughing system with mechanical pump includes:

1 ea	**A-1500-H**	1 1/2" manual angle valve, Viton sealed, with 2 3/4" ConFlat flanges on both ports
1 ea	**SP-11**	Pump assembly
1 ea	**SPD-11**	Styrofoam Dewar
1 ea	**SPHT-11**	Bakeout heater
1 ea	**FL275150-VTC/S**	Double-sided flange with TC tube and one isolation valve for dry-vane pump
1 ea		Bourdon gauge
1 ea		Dry-vane mechanical pump
1 ea		10' of 3/.8" copper tubing with fittings
1 ea		Set of necessary nuts and bolts
1 ea	**FLP-1**	Anti-seize lubricant
Partial assembly		

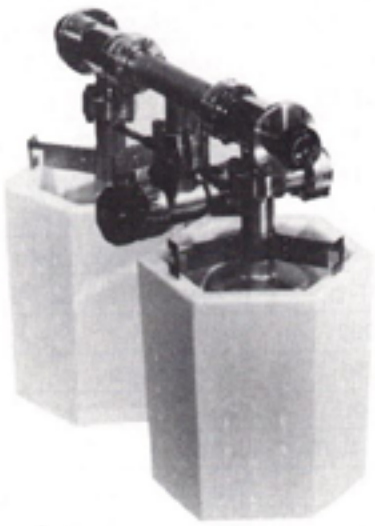
Option 2A Dual Sorption Pump Roughing System



Option 2A—Dual sorption pump roughing system includes:

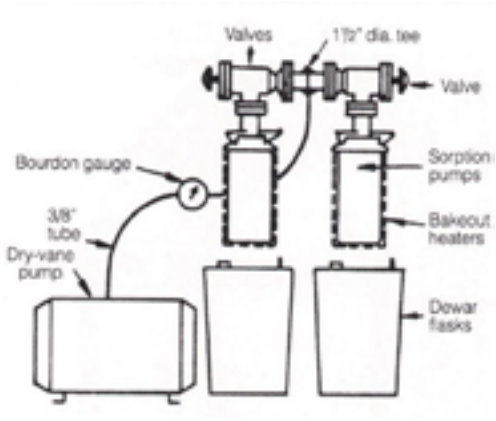
3 ea	**A-1500-H**	1 1/2" manual angle valve, Viton sealed, with 2 3/4" ConFlat flanges on both ports
2 ea	**SP-11**	Pump assembly
2 ea	**SPD-11**	Styrofoam Dewar
2 ea	**SPHT-11**	Bakeout heater
1 ea	**FL275150-VTC**	Double-sided flange with TC tube and one up-to-air valve
1 ea	**TE-150/S**	Fitting
1 ea		Set of necessary nuts and bolts
1 ea	**FLP-1**	Anti-seize lubricant
Partial assembly		

Option LN_2 Control



(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

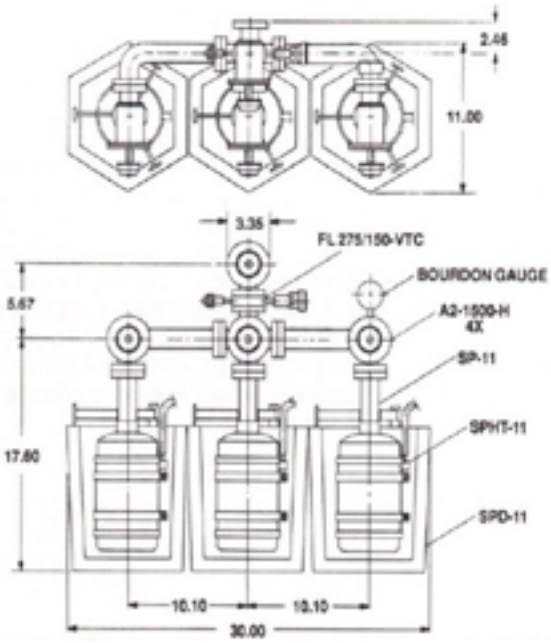
Option 2B Dual Sorption Pump Roughing System with Mechanical Pump



Option 28—Dual sorption pump roughing system with mechanical pump includes:

3 ea	**A-1500-H**	1 1/2" manual angle valve, Viton sealed, with 2 3/4" ConFlat flanges on both ports
2 ea	**SP-11**	Pump
2 ea	**SPD-11**	Styrofoam Dewar
2 ea	**SPHT-11**	Bakeout heater
1 ea	**FL275150-VTC/S**	Double-sided flange with TC tube, one up-to-air valve, and one isolation valve for dry-vane pump
1 ea	**TE-150/S**	Fitting
1 ea		Bourdon gauge
1 ea		Dry-vane mechanical pump
1 ea		10' of 3/.8" copper tubing with fittings
1 ea		Set of necessary nuts and bolts
1 ea	**FLP-1**	Anti-seize lubricant
Partial assembly		

Option 3A Triple Sorption Pump Roughing System



Option 3A —Triple Sorption Pump Roughing System includes:

4 ea	**A-1500-H**	1 1/2" manual angle valve, Viton sealed, with 2 3/4" ConFlat flanges on both ports
3 ea	**SP-11**	Pump assembly
3 ea	**SPD-11**	Styrofoam Dewar
3 ea	**SPHT-11**	Bakeout heater
1 ea	**FL275150-VTC**	Double-sided flange with TC tube and one up-to-air valve
1 ea		Set of necessary nuts and bolts
1 ea	**FLP-1**	Anti-seize lubricant
Partial assembly		

Roughing System Options

Replace Styrofoam Dewars with stainless steel Dewars
Replace one **A-1500-H** Viton-sealed valve with
One **AMV-150-22** all metal right angle valve
One **SMV-150-22** all metal straight through valve
Replace the dry vane pump, copper tubing and fittings with:
One 3 cfm mechanical pump One MT-152 molecular sieve trap One 24" metal hose, unbraided One set hardware

10 Oil-Free Sorption Pump Roughing Carts

Super-Sorb—
Oil-Free Sorption Pump
Roughing Cart—Model SP-70

- Pumps down a 100 ft^3 vessel from atmosphere to less than 10 microns in less than 25 min
- 1.7 million Torr-liters of ultra-clean pumping

Thermionics' portable sorption pump roughing carts are designed to meet the heavy gas loads associated with hydrocarbon- free high production applications. Three pumping stages, with a total of 43 lbs of molecular sieve, have the capacity to deliver multiple pumpdowns for multiple chambers prior to an automatic bakeout during nonworking hours. Caster-mounted cart complete with vacuum gauging and stainless-steel valves.

SP-70

Comparisons of the Thermionics Super-Sorb to the Varian MegaSorb

		Super-Sorb	MegaSorb
Time to evacuate 150 liter chamber from atmosphere to <10 microns		<120 sec	
Time to evacuate 100 ft3 (2,800 liter) chamber from atmosphere to <10 microns		<25 min	
Capable of manual operation		All models	
Automatic temp. controlled bakeout		Yes	
System isolation valve		Yes	
Up-to-air valve		Yes	
Vacuum read-out range		continuous, atm to 1 micron	
Required utilities	Power	20 A 220 VAC or other as desired	15 A 220 VAC
	Air	Control air only	9 scfm at 60 psi**

**The Varian data is fora crossover pressure of 200 Torr between stages 1 & 2. Thermionics data is for 75 Torr crossover on the Super-Sorb, increasing the life of the molecular sieve by over a factor of 2 before requiring bakeout*
***9 scfm at 60 psi requires approximately a 3 hp compressor.*

Oil-Free Sorption Pump Roughing Cart—Model SP-70

- Pumps down a 100 ft^3 vessel from atmosphere to less than 10 microns in less than 25 min

General Description

A large portable sorption roughing system, mounted on a cart with casters, for use on large, hydrocarbon-free chambers. Effective from atmosphere to less than 10 microns (1 x 10^{-2} Torr) pressure with fast pumping speed and large total capacity.

Pumping System

The pumping system consists of three stages.

Stage #1—Capable of evacuating 100 ft^3 from atmosphere to 27" Hg in less than 15 min. Consists of a displacement type oil-free mechanical pump. Its free air capacity is 20 scfm at 25" of Hg. The pump is protected from overload.

Stage #2—pumps from 27" Hg to 90 microns. Consists of four large sorption pumps (24" high x 5" diameter) containing a total of 34 lbs of type 5A molecular sieve cooled in a bath of liquid nitrogen. Includes automatic pressure relief to release trapped gases during bakeout or warm-up. Screens minimize accidental migration of the sieve material.

Stage #3—pumps from 90 microns to less than 10 microns. Consists of one large sorption pump identical to those in the second stage. Contains 8.5 lbs of sieve.

Cryostat

Vacuum insulated stainless steel construction. This allows for sieve bakeout without removal from the cryostat. An insulated lid minimizes boil-off during operation.

Valving

All valves are manually-actuated stainless steel with Viton seals and bellows-sealed actuators. Port size is 1.5" with the exception of the vent valve.

Bakeout System

Is fully automatic with time and temperature control.

Instrumentation/Control

A vacuum gauge indicates pressure continuously between atmosphere and 1 micron. Bakeout time and temperature and stage crossover are adjustable. Presence of AC power and bakeout heater operation are also indicated. The main power switch is of the circuit breaker type.

Size

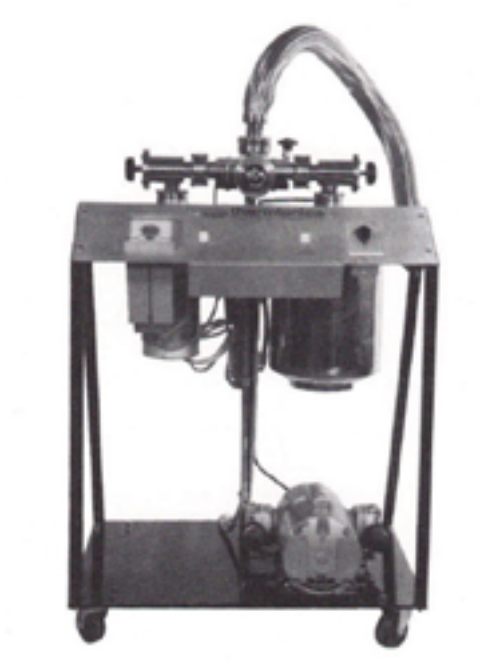
The cart is 24" wide x 36" deep by 40" high and weighs 325 lbs. The cart comes complete with a 48" stainless steel flex hose.

Utilities

208 V, 3 phase "Y," 20 A max—standard. Available with other configurations at customer request. Control air pressure should be between 80 and 100 psi.

Model No.	
SP-70	Manual valving

Oil-Free Sorption Pump Roughing Cart—Model SP-52



SP-52M

- Pumps down a 100 ft^3 vessel from atmosphere to less than 10 microns in less than 25 min

General Description

Portable, cart-mounted sorption roughing pump system for use on small and moderately sized hydrocarbon-free chambers.

Pumping

The SP-52 cart consists of three pumping stages.

Stage #1—Mechanical displacement oil-free pump capable of 27.5" Hg with a speed of 4.2 cfm.

Stages #2 and #3— Two sorption pumps, one for each stage, containing 3 lbs of 5A sieve material each. These pumps are complete with stainless steel Dewars, sieve containment screens and pressure relief devices for gas release during bakeout or warmup.

Valving

Three manually-actuated bellows sealed 1.5" valves control pump isolation and input to the pumping manifold. Stage #1 pumping is controlled through a 1/4" port stainless valve. The same size valve is used to vent the manifold.

Bakeout

An adjustable timer allows unattended bakeout via electrical heaters installed on each sorption pump. These heaters are suitable for submergence in liquid nitrogen in everyday use.

Instrumentation/Control

A vacuum gauge indicates pressure continuously from atmosphere to 1 micron. Indicators on the control panel show the presence of AC power and operation of the bakeout heaters.

Size

The cart is mounted on 2" casters and is 24" wide x 28" deep x 30" high. The cart comes complete with a 48" stainless steel flex hose. Weight is 95 lbs.

Utilities

115 VAC at 15 A max is required. The cart is supplied with a 30 ft power cord.

Model No.	
SP-52	Manual valving

Custom Chambers

Custom Vacuum Chambers

- Experienced engineering and up-to-date design
- Fast delivery. Order to shipment times as low as 4 weeks
- Optional qualifying pumpdown, bake and gas analysis

Custom Vacuum Chambers Guaranteed to Meet Your Special Requirements

We can assist you with chamber concept, application, engineering, and design. We work from your rough sketches, and prepare complete production drawings on our CAD system using the latest version of SolidWorks. The following pages contain photographs and production drawings of chambers we have fabricated.

The cheapest chamber may not be the least expensive. To insure you receive exactly what you need, we provide you with complete production drawings for your review and written approval, before fabrication begins.

Whichever vendor you choose, we strongly recommend production prints be sent to you for final approval prior to manufacturing. Approved prints minimize the possibility of design and/or manufacturing errors.

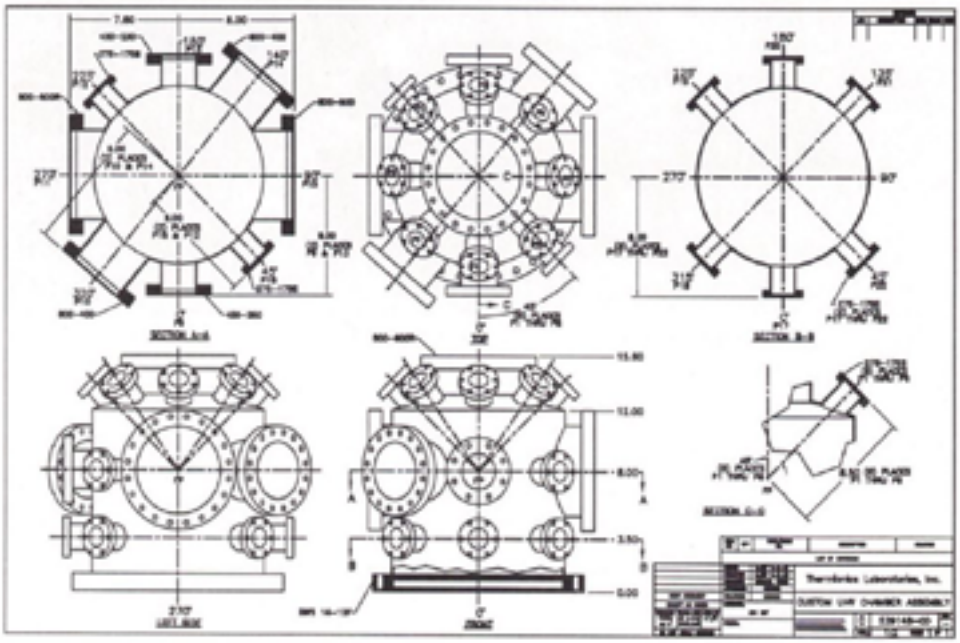
Our many years of experience permit us to offer you the following advantages:

Complete Production Drawings Prepared and Submitted for Customer Approval Before Fabrication Starts

Performance Options

At your option and request, we can perform, certify, and document:

- Qualification of ultimate base pressures measured to 2 x 10^{-11} Torr, achieved with the system in our facility. Certification of bakeout and pumping techniques employed to achieve specified pressure
- RGA partial pressure analysis to 2 x 10^{-13} Torr from 0 to 200 AMU
- Choice of the conditions under which the system is shipped, e.g., blanked off, under vacuum, bagged with dry nitrogen or other gas of your choice, or a combination of the preceding
- Choice of materials used in fabrication
- Chemical and mechanical processes used to prepare systems and surfaces, such as passivation, electro-polishing, mechanical polishing (up to a #2-lap finish), or chemical removal of carbon and/or hydrogen from the surface



Surface Analysis Chamber

11 Custom UHV Chambers

Design Options

- Chambers with multiple ports and multiple focal points in one or more planes
- Port alignment as accurate as ±0.2°
- Water-cooled chambers with double-walled channel or tubing
- Differentially pumped rotary seals
- Magnetic shielding
- Analysis of pumping characteristics and specified gas-surface interactions
- Tube processing chambers with sequential valving
- Heated manifold with automatic sequencing of lecture bottles for precise gas mixing
- Auxiliary hoists: hydraulic, electric, manual, counter-balanced, etc.
- Chambers on rails for horizontal opening and closing with precise, leak-tight sealing
- Chambers and systems on carts for mobility
- Internal or external bakeout capability
- Chambers with internal or external furnaces
- Chambers with pumping stacks: ion, cryo, turbo, or diffusion pumped
- Chemical polishing to reduce surface area by a factor of 10

A Sample of UHV Chambers

Cleaning Processes

Cleaning procedures are tailored to your requirements. Processes available include:

1. Alkaline and/or other degreasing methods
2. Aluminum oxide and/or glass shot bead blasting
3. Micro and precision bead blasting
4. High pressure hydro-wash
5. Chemical cleaning (stainless steel, aluminum, copper, Kovar, titanium, molybdenum, tantalum, nickel, Monel, and ceramics)
6. Chemical cleaning with bead blasting
7. Copper cleaning
8. Chemical cleaning per your specifications with:
   - Potassium permanganate/caustic etch
   - Alkaline prep or vapor degreasing
   - Hydrochloric acid
   - Nitric acid
   - Caustic etch
   - Copper cleaning
   - Cold de-ionized water rinse
   - Hot de-ionized water rinse is Baking
   - Acetone and/or isopropyl and/or methanol alcohol wipe
   - N2 dry and/or N2 bag-6 mil polyethylene bags

Guarantee

Every chamber we manufacture is covered by our unique guarantee; refer to pages vi and vii for specific details.

Cleaning Services

We also offer the following cleaning services at Thermionics Metal Processing, Inc. (TMPI)

- Chemical cleaning at your doorstep — Process success depends upon equipment cleanliness. We clean new and used equipment. We clean for vacuum service, from roughing to UHV, to ultra-high vacuum (10^{-11} Torr) standards.
- Services — Cleaning of system, components, fixtures, shields etc. for evaporator, sputtering systems and process equipment. Stainless steel passivation. Dry honing.
- Emergency and quick turnaround — 8-hour turnaround, 24-hour contact. 7 day a week service available. Local pick-up and delivery.

Chamber Delivery

Normally, depending on the complexity, delivery is 6 to 8 weeks after return of approval drawings. If you are in a bind, call us and we will do what we can to help. For example, the chamber on the bottom of page 10-6 was designed, built, tested and delivered in only 40 days after receipt of order.

Surface Analysis

We can design or can assist you in the design of surface analysis chambers. We are experienced in the design of UHV pumping systems, chambers, differentially pumped rotatable vacuum seals, load-locked sample introduction systems, precision manipulators (manual or computer controlled), electron beam guns, power and motion feedthroughs, and ion pumps, all of which are used to make your UHV chamber a valuable research or production tool.

Performance

Chamber and system performance are dependent upon:

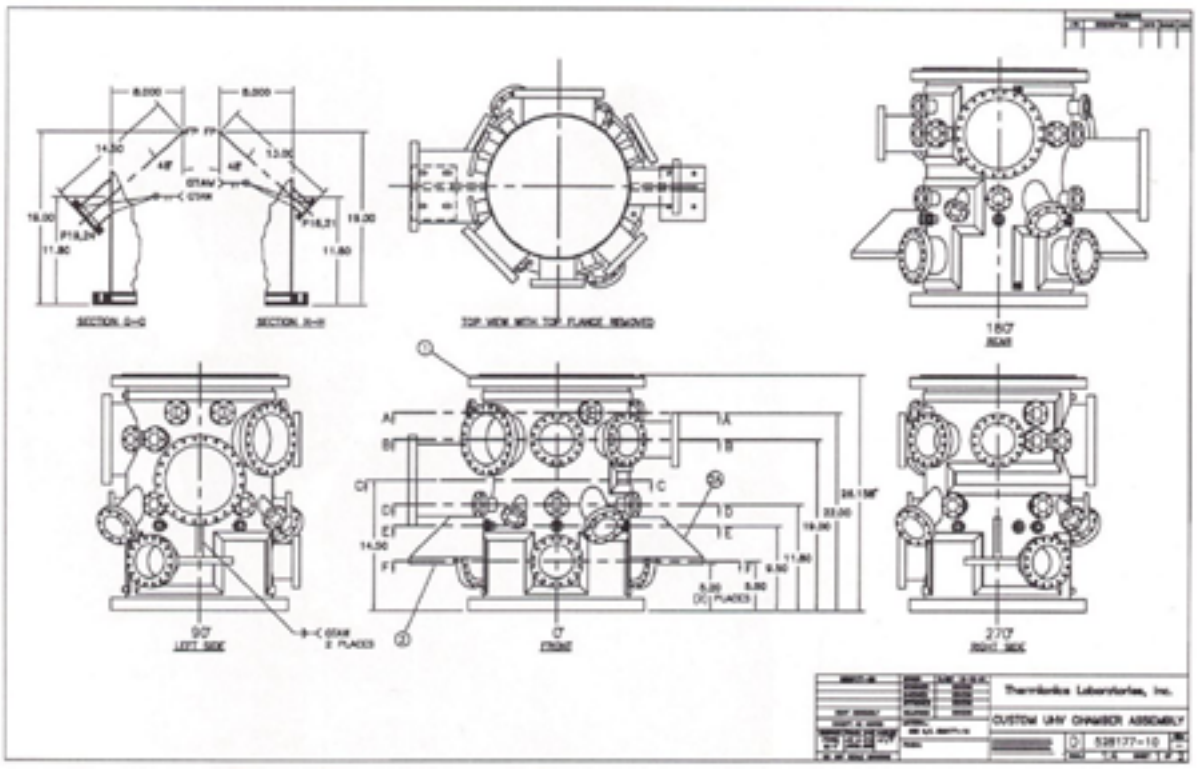
- Volume
- Materials of construction (outgassing and permeability)
- Fabrication techniques
- Surface area
- Surface preparation
- Interior cleanliness
- Material conditioning
- Conductance
- Pump speed and capacity

We deliver a chamber suited to your specific application. Our engineering, design, fabrication techniques, and in-house chemical cleaning facility guarantee it. The result is faster pumpdown and lower ultimate pressures at a reasonable price.

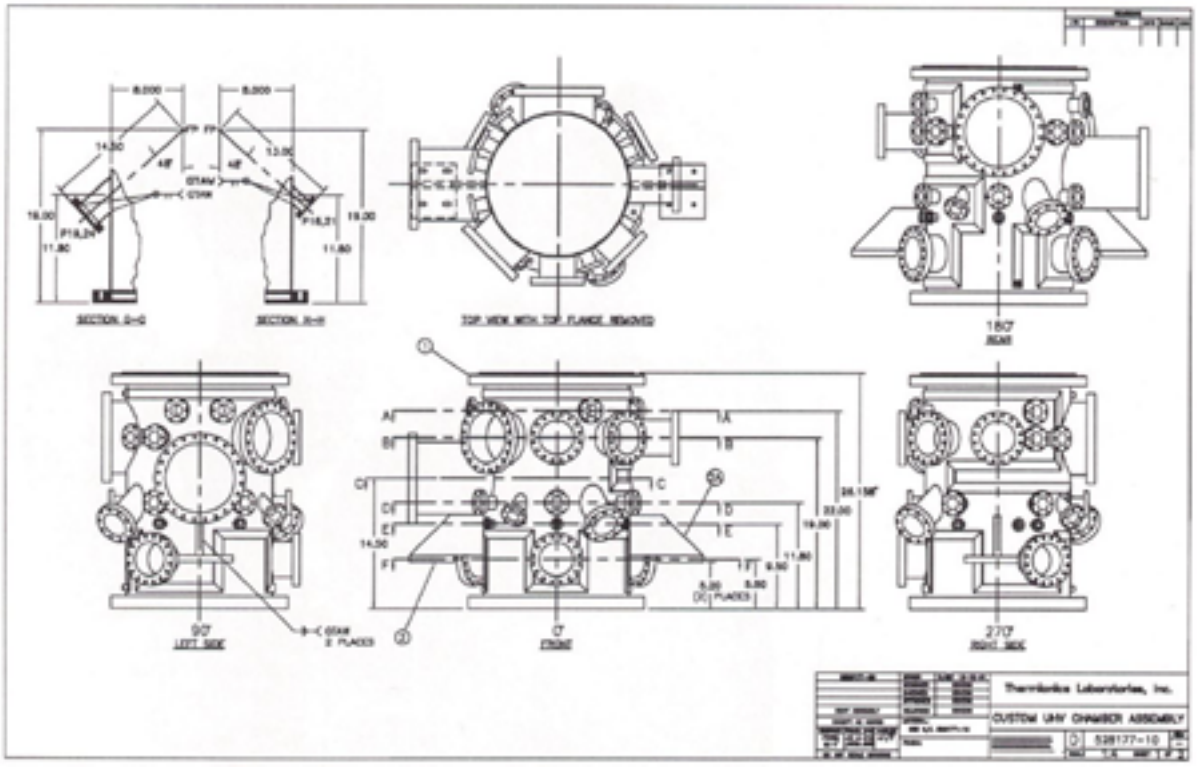
(360) 385-7707

thermionics laboratory, inc.
Vacuum Innovation Since 1958

sales@thermionics.com



Deposition Chamber

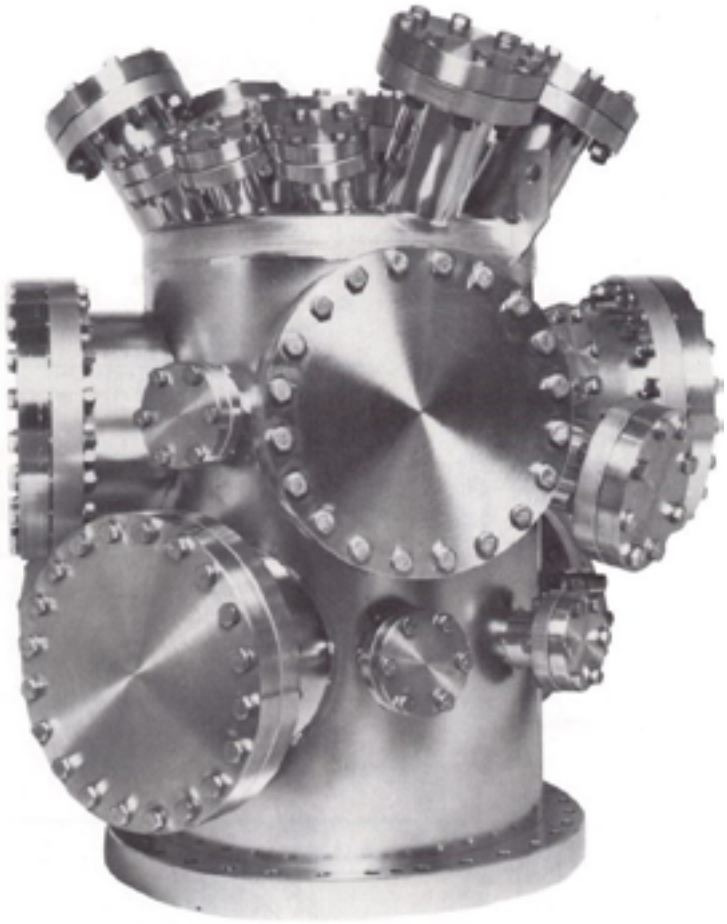


Laser Deposition Chamber

11 Custom UHV Chambers

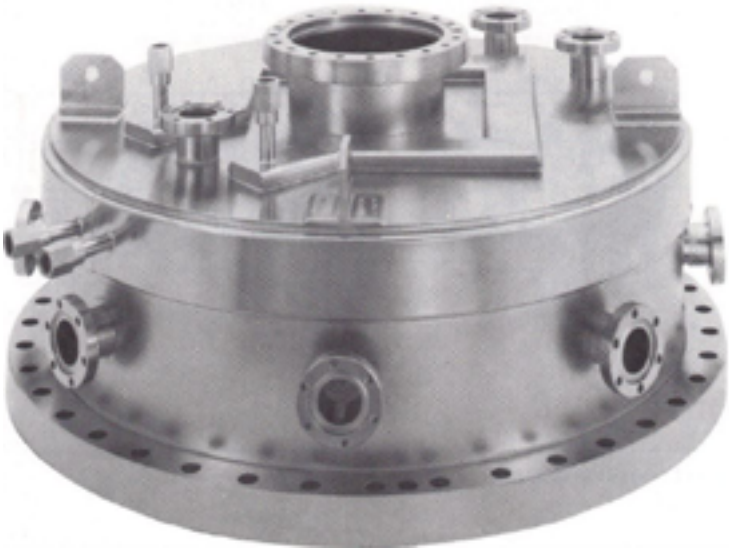
UHV Chamber for LEED-Auger and ESCA Surface Analysis

- 2 x 10^{-11} Torr chamber
- 12” diameter x 12” high
- 9 focal points on two planes



Water Cooled Chambers

24” O.D. water-cooled UHV chamber with water channel, 27 1/8” O.D. wire seal flange



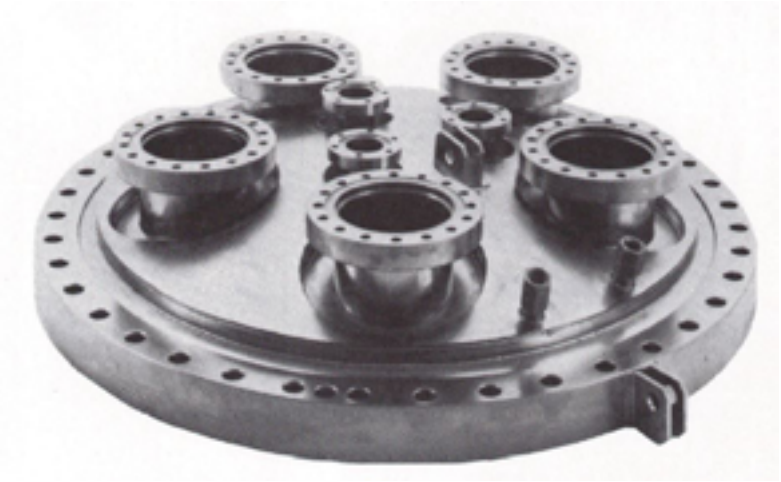
(360) 385-7707

thermionics laboratory, inc.
Vacuum Innovation Since 1958

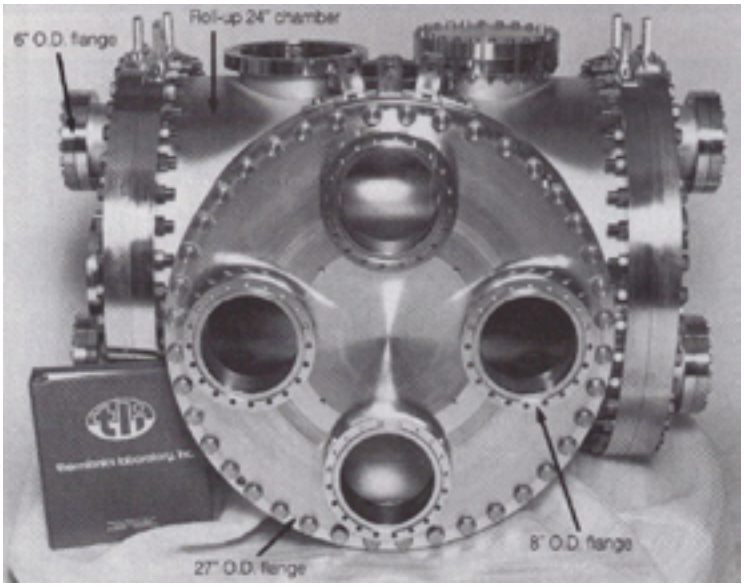
sales@thermionics.com

Water Cooled Chambers

36” O.D. diameter double wall, water-cooled chamber with 41” O.D. wire seal base flange



24” diameter double wall, water-cooled UHV chamber cover with 27 1/8” O.D. wire seal flange

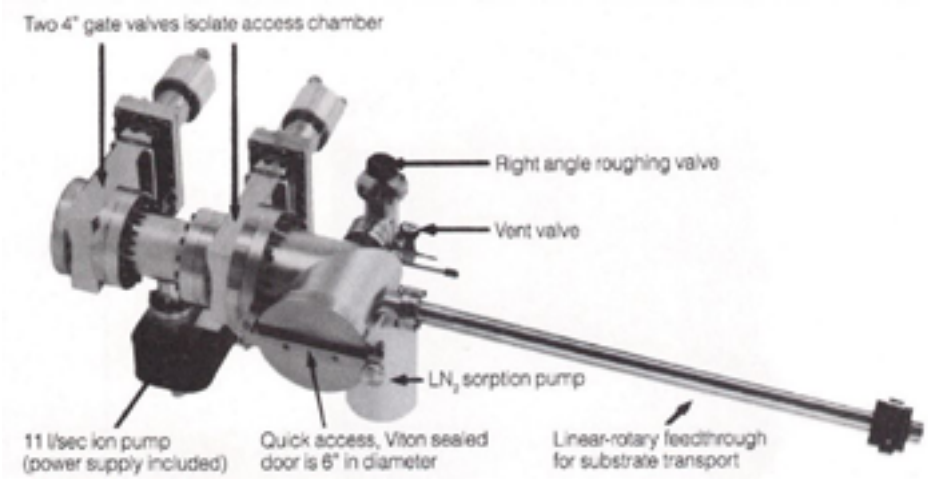


304 stainless steel chamber, 24” O.D. by 46” long. 1/4” wall, full internal welds, chempolished and supplied with convenient lifting lugs

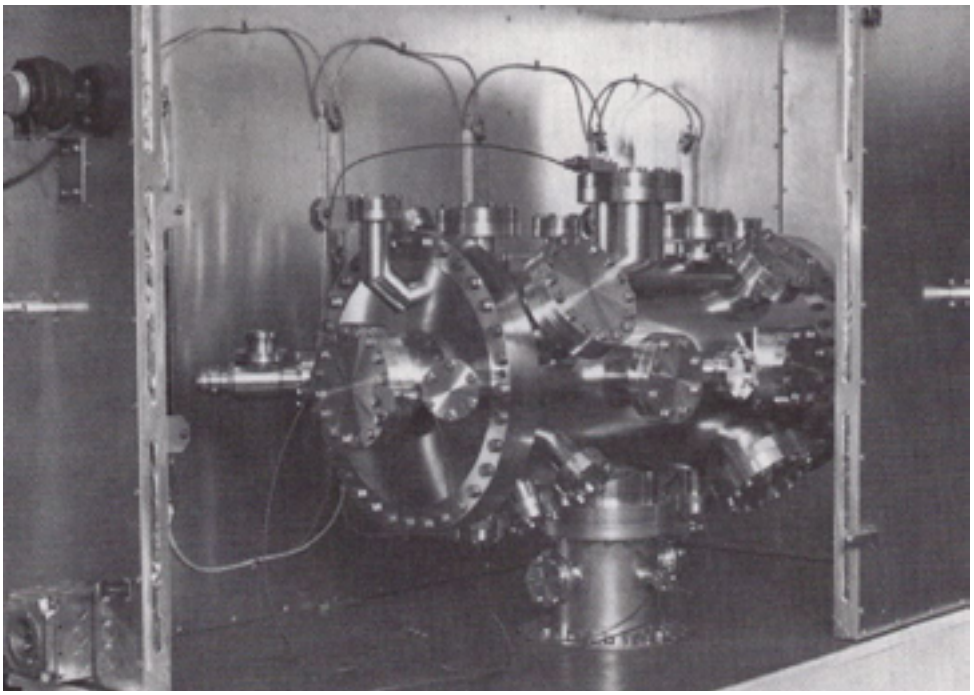
11 Custom UHV Chambers

Sample Introduction System

The Thermionics load lock provides quick access to ultra-high vacuum chambers; no need to bring chamber up to atmosphere when loading sample! (Custom made to your specifications.) Refer to Section 3 for access doors, 2-access chambers and feedthrough details.

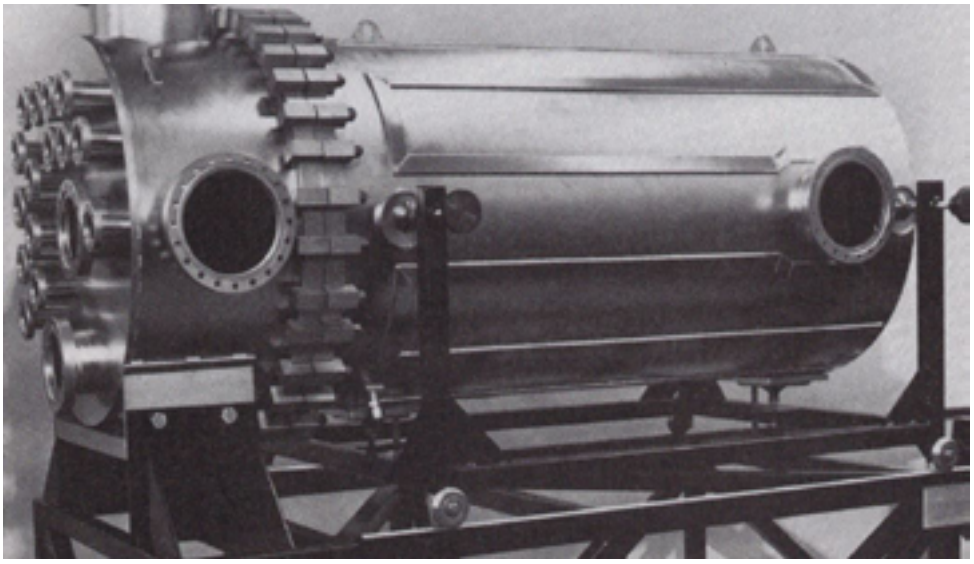


12" diameter x 27" long UHV chamber with 240 l/s noble ion pump and bakeout shroud qualified to 2 x 10^{-11} Torr from atmosphere. Flanges accurate to ±1/2° ±0.005".



2 x 10^{-10} Torr water-cooled custom chamber with rail support

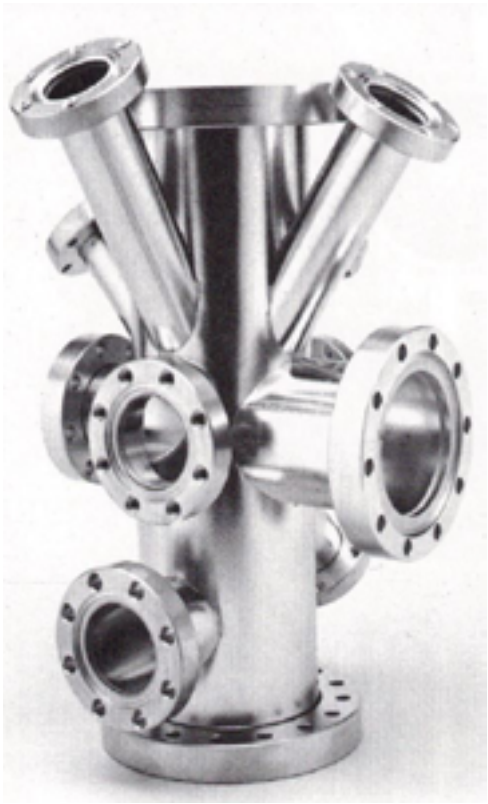
- Engineered and manufactured in 40 days
- 24" diameter x 60" long
- X, Y, Z adjustment for flange mating and alignment



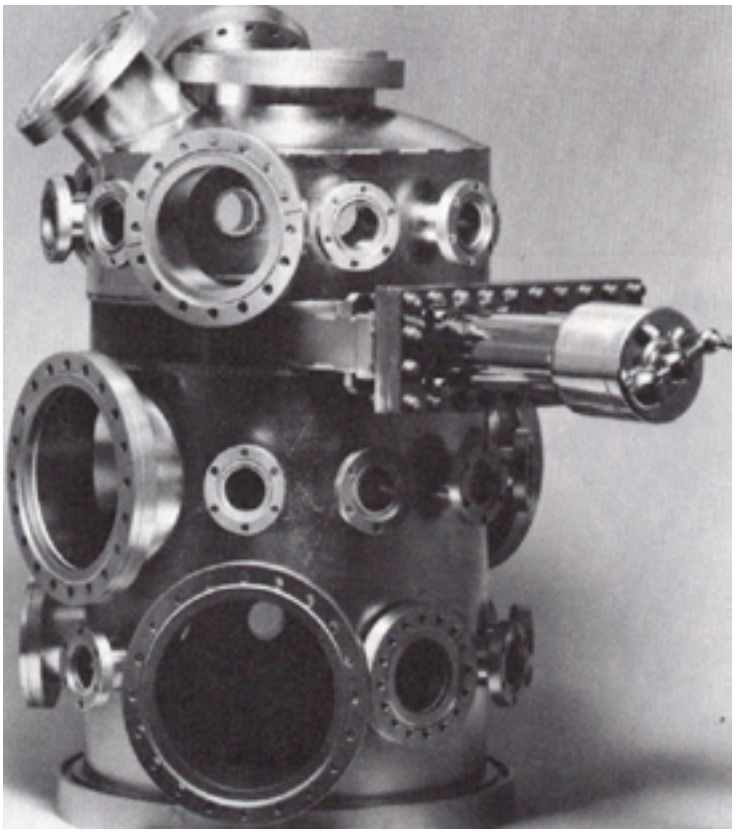
(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Ultra-High Vacuum Chambers

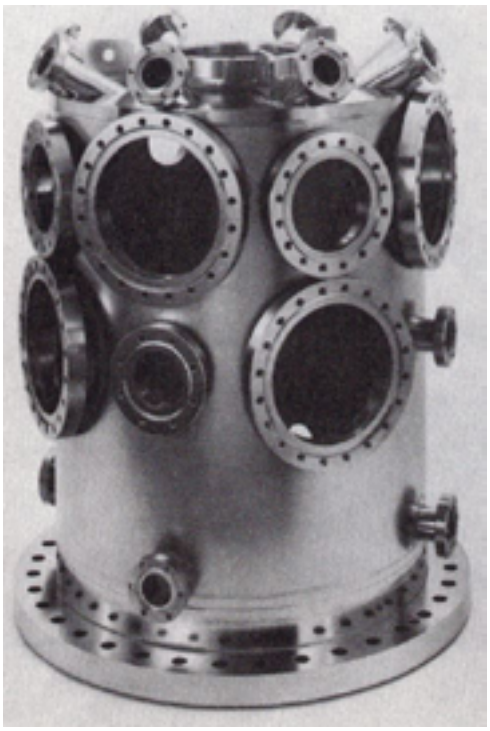
6.00” O.D. tube with 2.75” x 1.50” ports; 4.50” x 2.50” ports; multi-focal points on 2 planes



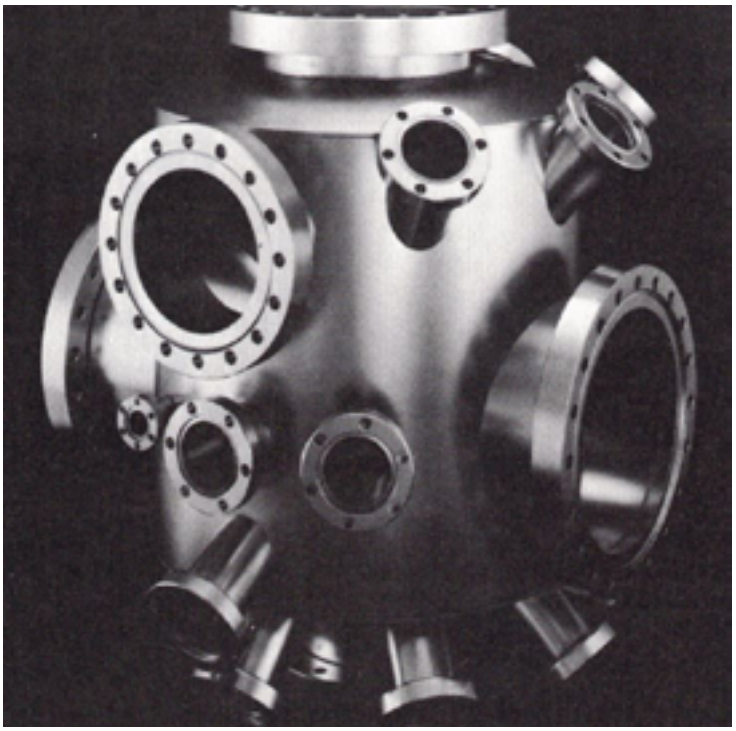
12” chamber with wire seal base flange; gate valve as poppet; multi-port and multifocal points



Angle-resolved ultra-violet photo emission spectrometer chamber



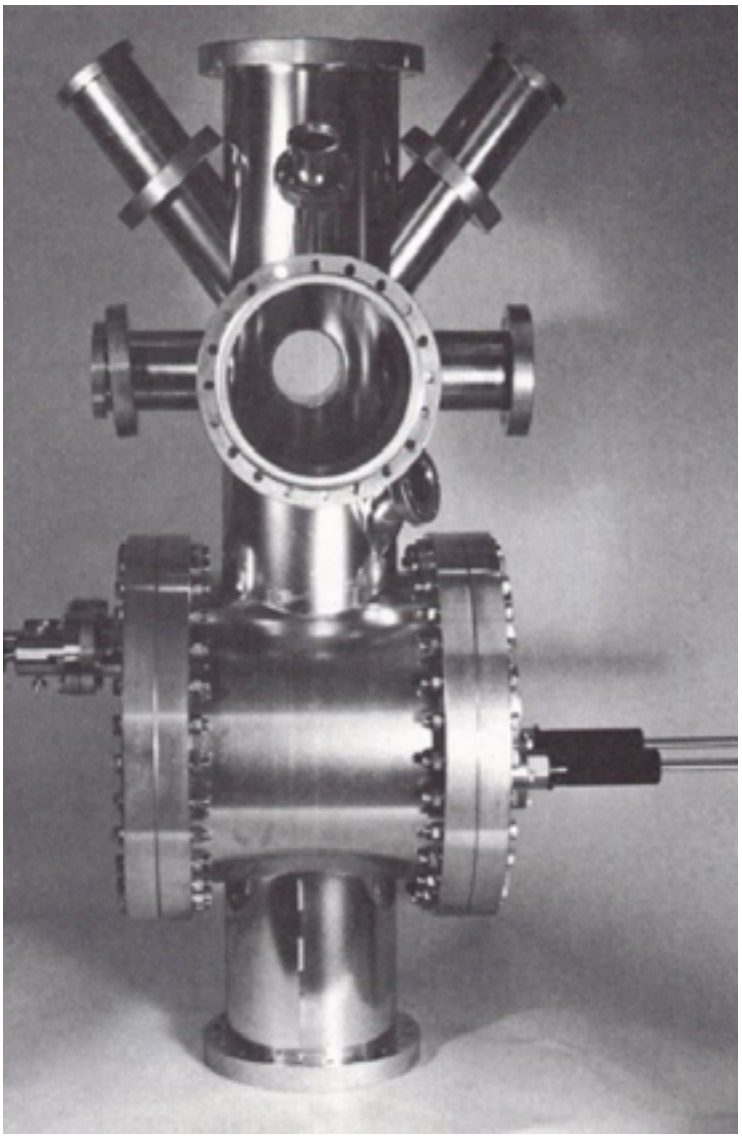
294 mm diameter LEED-Auger surface physics chamber with 64 mm offset focal point



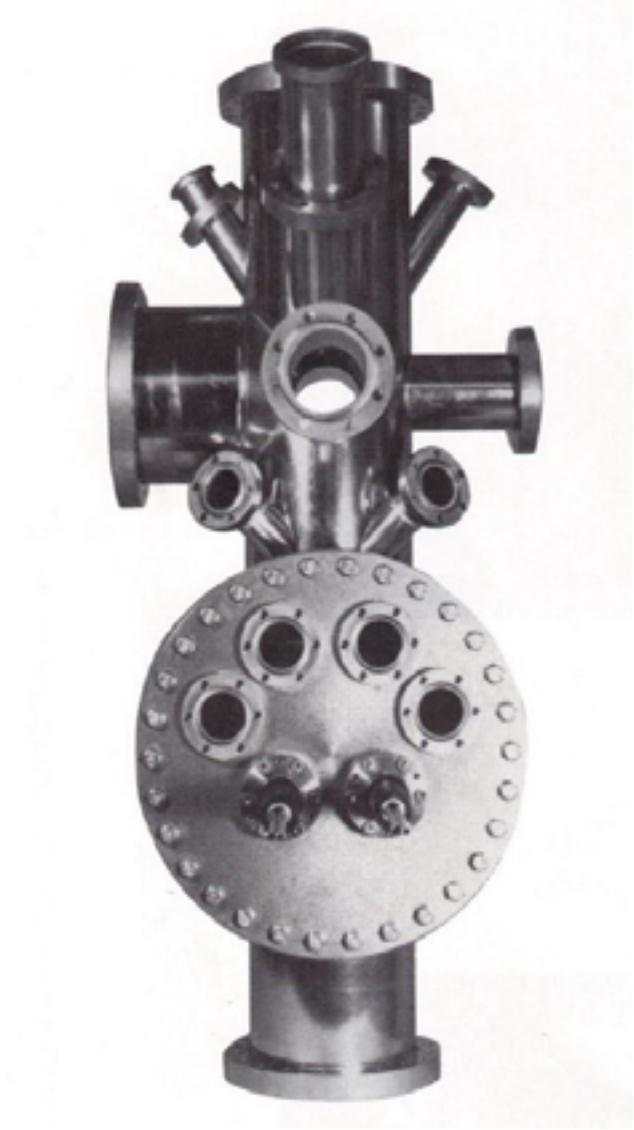
11 Custom UHV Chambers

All Metal Evaporation Chamber

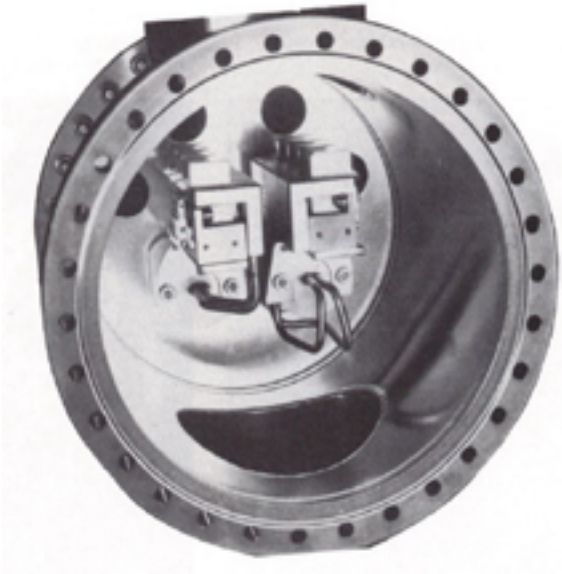
All metal evaporation chamber with two (2) each three position 3 kW e-Guns with shutter. Refer to Section 4 for e-Gun information.



Front View



Side View

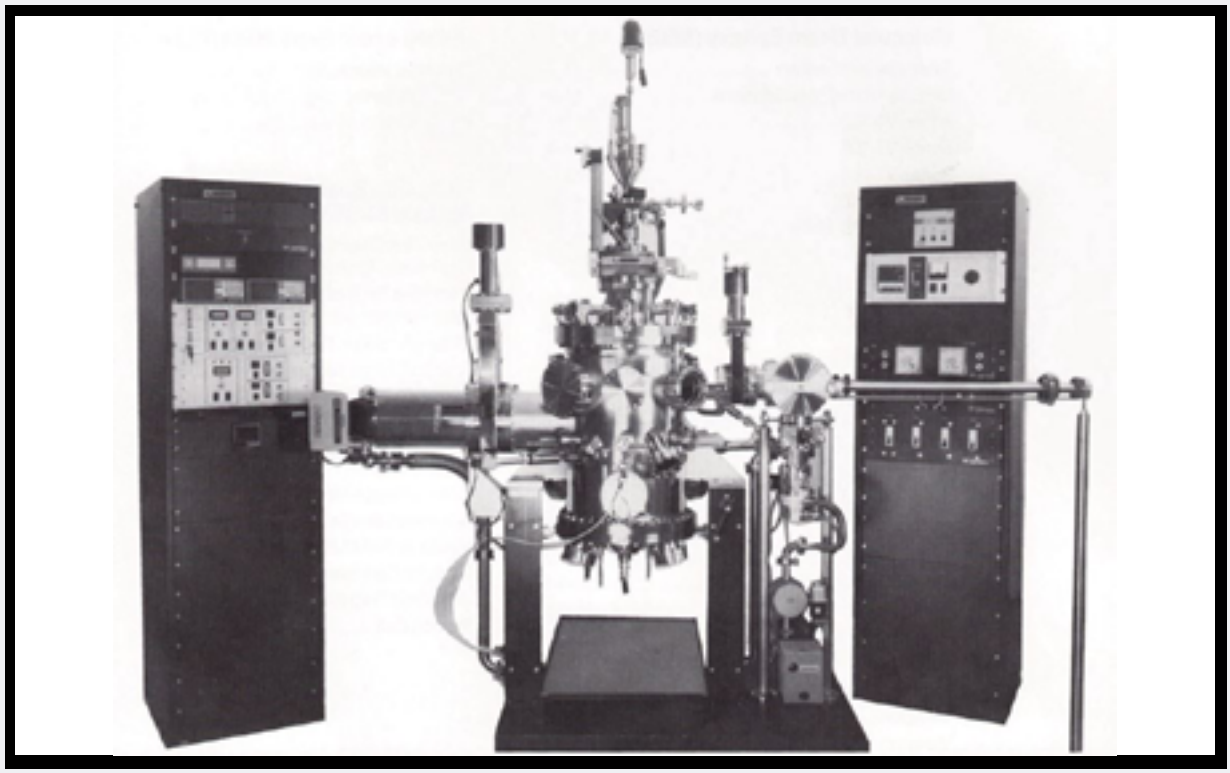


Side View Showing e-Guns

(360) 385-7707

thermionics laboratory, inc.
Vacuum Innovation Since 1958

sales@thermionics.com



Material, Surface and Molecular Beam Sciences

Molecular Beam Epitaxy (MBE)

Reflection High Energy Electron Diffraction (RHEED)

Pulsed Laser Deposition (PLD)

Molecular Beam and Surface Chemistry Products

Introduction

Thermionics, in collaboration with Vieetech, Japan, has developed a modular approach to building custom MBE systems which incorporates a unique “de-mountable growth flange” (DGF), on which are mounted the effusion sources, e-Guns, cryopanel, beam collimators, and other key components.

It is possible, in a very few hours, for one person to easily remove and reinstall the DGF after exchanging any or all of the components or exchanging the entire DGF. This allows maximum utilization of the MBE system with efficient reconfiguring of the DGF to meet different requirements.

Several options for mounting of the DGF are available. Our unique “U-Frame” mount (Fig. 12-1 below) allows the flange to be easily removed downward, away from the main chamber, using a simple reduction gear mechanism. Other mounts which do not include a “U-Frame” also allow for easy removal and reinstallation of the DGF to meet special needs or to adapt to existing equipment.

Principle

Molecular beam epitaxy (MBE) is a technique for growing epitaxial films by directing beams of atoms or molecules produced by thermal evaporation onto a clean, heated substrate. The technique was first developed to meet special material requirements for semiconductor technology, for ultra-thin planar structures with precisely controlled doping profiles. Using MBE, film layers as thin as 5 A can be reproducibly grown, and the interface between layers can be precisely controlled.

Technique

MBE is, essentially, an ultra-high vacuum evaporation process. In practice, molecular or atomic beams for the constituent film elements (or their compounds) are generated by thermally evaporating quantities of the constituents from heated crucibles. The vapors pass through beam-defining apertures in cooled plates and impinge on a heated substrate, where they react on the hot surface to form the semiconductor film.

Technique

The four systems shown on the following pages are pictures of MBE systems which we have manufactured. They were designed for specific materials and processes. They are available as shown and specified, or modified to suit your needs.

In our experience, there is no “standard” MBE system. Systems are modified for different materials and processes, controls, system size, geometry, hardware, pump types and general features.

Modifications will alter the system’s specifications, thereby effecting the system’s performance and price. Modifications which seem minor can have a major impact on design, performance and price.

Our engineering group will work closely with you to determine your requirements and a firm quotation, which delineates specifications and performance and establishes price and delivery, can then be supplied.

MBE Systems Questionnaire

We can provide an estimate for the cost of custom MBE, either complete or partial systems or individual components.
We need to know basic specifications as follows:

1. Materials of interest
2. Size of samples to be used
3. Do you already have a specific design for the growth chamber and cryoshroud? Would you like to have it reviewed?
4. Preferred design configuration, i.e., two or three chambers, etc.
5. Sample transfer and load lock hardware requirements.
6. What type of effusion sources will be used?
7. Manipulator(s) (specifications), e.g.: Number of axes XYZ maximum travel? Tilt range Number of rotation axes Is motor-driven continuous sample rotation required? Sample heating/cooling temperature range Sample holder format
8. Do you wish to incorporate any of your own existing equipment into the new MBE system, e.g., pumping equipment, analytical instrumentation, etc.

Please do not hesitate to contact us to discuss your requirements or proposals.

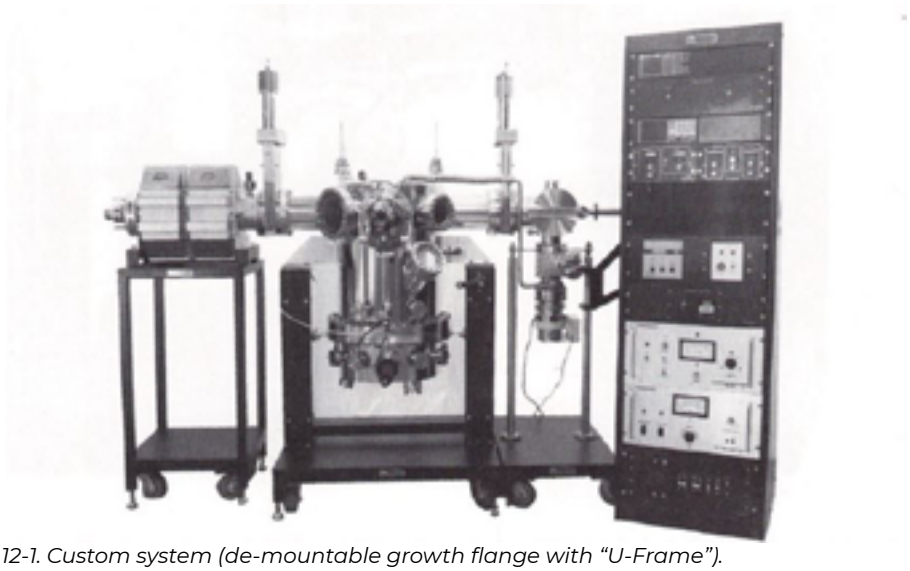


Fig. 12-1. Custom system (de-mountable growth flange with “U-Frame”).

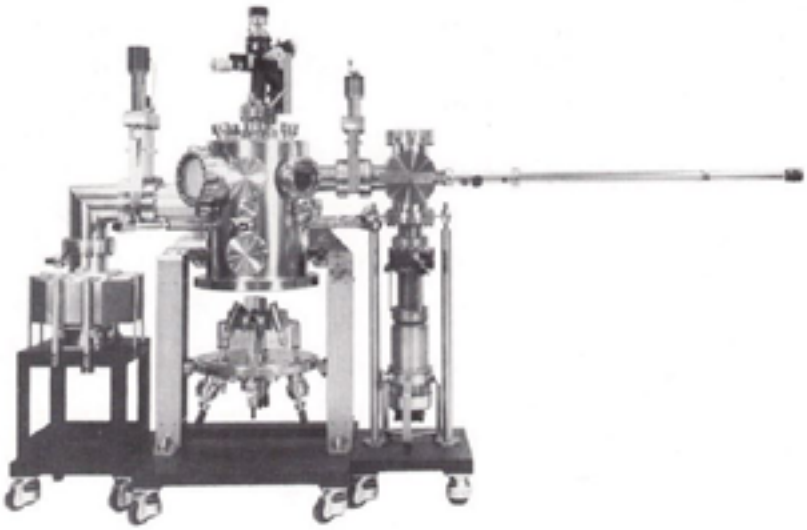
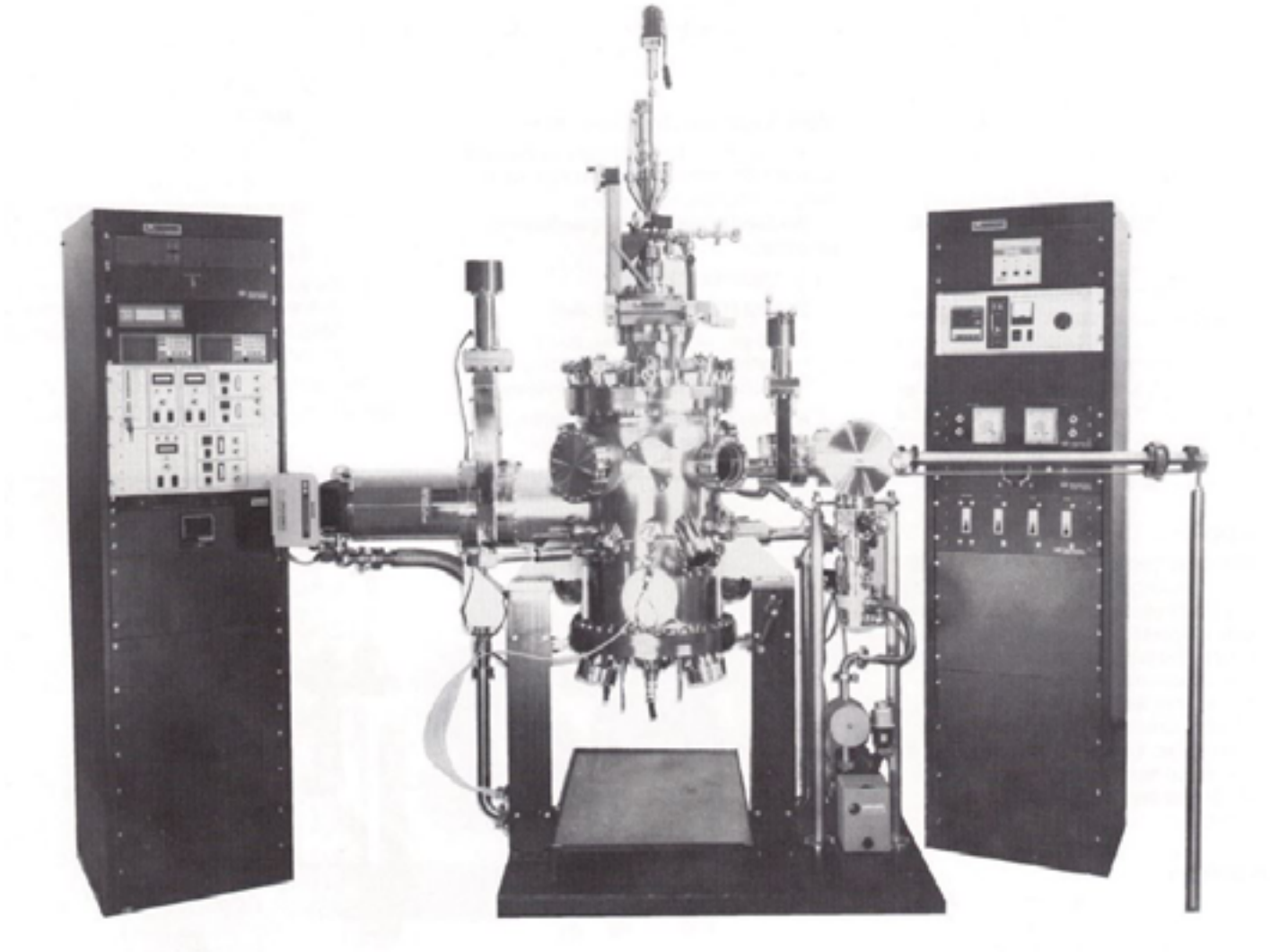


Fig. 12-2. VT-100 (cryopanel removed for clarity).

12 MBE Systems



Custom VT-100 System (shown with sample manipulator and transfer for deposition of 2” wafers)

Introduction

The VT-100 MBE system is a small research MBE system that can be configured to handle wafers up to 3" in diameter. With the Triad e-Gun source and optional effusion cells (up to three) the system may be used with the following materials:

1. Si semiconductor (Si, Ga, Al, Sb)
2. High TC superconductor (Yt, Ba, Cu, St)
3. Metal MBE (Au, Al, Ni, W)
4. GaAs semiconductor (Ga, As, Al)

Specifications

I. Growth System

A. GROWTH CHAMBER

A 16" diameter by 22" high bell jar constructed of 304 stainless steel with all metal seals. The surface has been electro-polished for a smooth UHV surface. Standard configuration includes:

1. Six 1.38" dia. source viewports, one 3.88" dia. sample viewport, and one 5.38" dia. RHEED screen viewport — all with shutters.
2. One manually actuated sample shutter.
3. Six electro-pneumatically actuated source shutters.
4. Three 6" flanged e-Gun emitter access ports.
5. Six 2.75" flanged ports for optional quartz crystal monitors.
6. Three extra 2.75" flanged ports and two extra 6.00" flanged ports (on line with sample).

Other configurations available on request.

B. PUMPING SYSTEM

Thermionics COV-1000 ion pump (200 l/sec ion pump with LN_2 cryoshroud and titanium sublimation pump) is isolated from the main chamber via a manually actuated gate valve with a metal sealed bonnet.

Rough pumping via dual sorption pumps isolated from main system by an all-metal sealed poppet valve. Ultimate vacuum after bakeout in the 1040 Torr range (pressure during evaporation in the 10^{-8} Torr range). Other pumps (cryo, turbomolecular, etc.) available on request.

C. SOURCE FLANGE

Thermionics Triad e-Gun source mounted on a 19" O.D. bolt type wire sealed flange with an LN_2 cryoshroud with debris/collimation shield surrounding the source(s). The Triad consists of three (3) 10 kW, 10 cc single crucible sources with beam sweep control. A tetrode power supply with gun controllers is included. There are also three 3.38" flanged (2" dia. tube) ports for use with effusion cells (cells and power supply are optional).

D. SAMPLE HANDLING

The standard manipulator supplied is a Thermionics FM series manipulator with the following specifications:

1. 4" Z travel, 1.88" I.D. bellows
2. ±0.5" X and Y travel
3. RNN differentially pumped rotary seal
4. Custom gearbox and drive, sample holder with 1" square sample holder with radiant heater capable of 1,000°C operation
5. PID auto tuning sample heater controller, SPS-202/A

Motorized continuous sample rotation, larger sample sizes, oxygen environment heaters, sample cooling, RS-232 interface to PID controllers, and other manipulators available on request.

E. RHEED SYSTEM

A Vieetech VE-052NP-052 30 keV RHEED gun and power supply with a 5.68" dia. phosphor screen and screen shutter is standard.

F. OPTIONS

1. Thin film thickness monitoring/controlling may be accomplished via crystal sensors or flux monitors depending upon customer's preference.
2. Bakeout capability is not included with standard system but may be configured into system per customer's specifications.
3. Quadrupole mass analyzer may be provided per customer's specification.
4. Process or gas flow control.
5. System may be expanded to include an analysis chamber for HREELS, LEED/AES, etc.

II. Load Lock System

A. CHAMBER

Constructed of 304 stainless steel with all metal seals except for Viton sealed quick access door for sample loading. Chamber is electro-polished for a smooth UHV surface. Chamber is isolated from the main chamber by a manually actuated gate valve with metal bonnet seal.

B. PUMPING SYSTEM

200 l/sec magnetic turbomolecular pump with a two-stage mechanical rotary pump and molecular sieve foreline trap is standard. Oil-free pumps are optional. Pressure in the 10^{-7} Torr range without baking after 15 min of pumping from atmosphere.

C. SAMPLE HANDLING

A rack and pinion linear feedthrough, RPL, is standard with sample transfer fork for 1" square sample. Other feedthroughs and sample sizes available upon request. Cassette loading and sample heating also available.

D. OPTION

Chamber bakeout is optional.

III. Electronics

The following electronics are housed in a standard 19" wide enclosure with 70" of rack space:

1. Ion pump and sublimator power supplies, PS-1000 and PS-500.
2. Turbo pump controller.
3. RHEED power supply, VP-052.
4. Ionization gauge controller with dual ionization gauge (one for main chamber and one for load lock) and convection gauge (main system roughing and foreline of turbomolecular pump) capabilities. Also included is EB de-gas and UHV electrometer.
5. Sample heater power supply, SPS-202/A.
6. Shutter controller, VE-050-FB.
7. Optional equipment as needed.

Delivery: 16 weeks ARO

12 MBE Systems

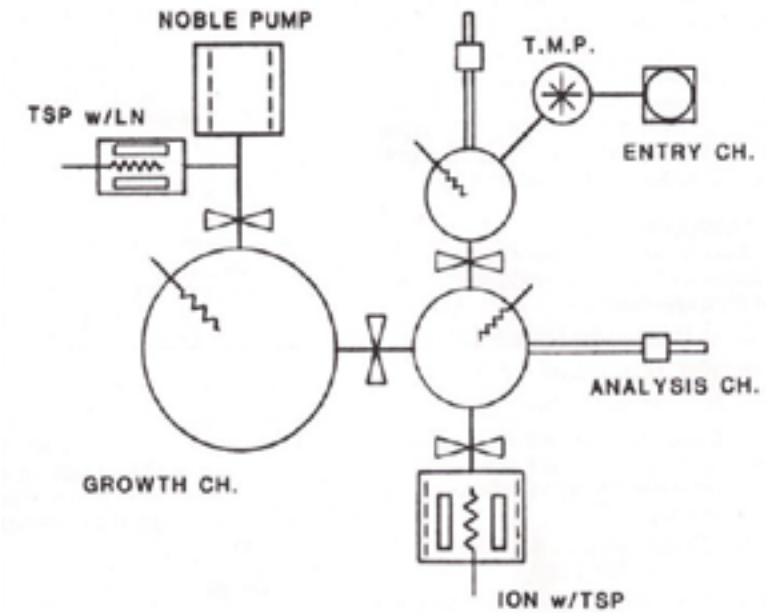


Fig. 12-3. VT-105 pumping system schematic.

VT-105 MBE System

Standard specifications are listed on these two pages.

If you have a special requirement or a custom design for any part of a system, we would be pleased to discuss this with you.

3 Chamber Design

Separate growth, analytical and entry chambers ensure the best possible physical configuration for film growth combined with optimum component layout for film characterization.

Minimum Contamination

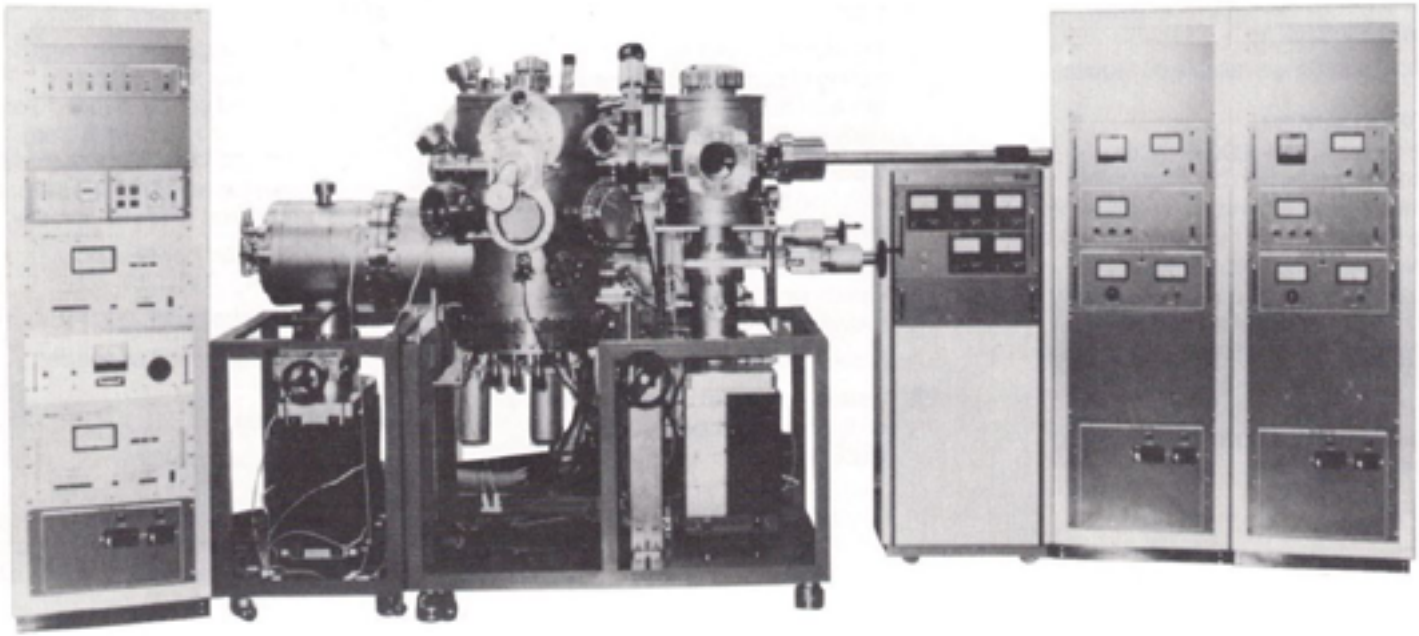
Our custom design cryogenic shrouds in the growth chamber and around each evaporation source minimize film impurity levels.

Rapid Substrate Handling

A custom designed load-lock system to facilitate rapid substrate introduction and replacement while maintaining optimum vacuum conditions in the growth chamber.

In Situ Film Characterization

A crystal thickness monitor and RHEED system mounted in the growth chamber are used to monitor thickness and surface crystal structure during film growth.



VT-105

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Growth Chamber

Film growth in the VT-105 is accomplished in a separate chamber which contains only an evaporation source flange, RHEED gun and screen, and thickness monitor. By minimizing the amount of equipment placed in the growth chamber, the substrate can be almost completely surrounded by a cryogenic shroud to ensure the cleanest possible environment for film growth. The RHEED and thickness monitor capabilities enable pertinent information about film growth, including surface structure and film thickness, to be collected during growth.

Growth Chamber Specifications

Manipulator	6-axis high precision rotating sample type (X, Y, Z, tilt, 1st rotary, 2nd rotary coaxial)
Heated substrate	2” dia. Temp. range: room temp. to 1,000°C
Evaporation source	Four K-cells Three 1-position 3 kW e-Guns
Chamber size	16” dia., 20” height
Pumping system	400 l/sec noble triode sputter-ion pump Ti sublimation pump with LN_2 shroud
Isolation valves	4” manual gate valve (separates the growth and analysis chambers) 6” pneumatic gate valve (for ion pump)
Film characterization	VE-052 30 keV RHEED system 4 channel crystal thickness and rate monitor
Vacuum gauge	Nude ion gauge

Analysis Chamber

Surface analysis of substrate and films is an important adjunct to MBE, whether for basic research involving ultra-clean, ordered surfaces or for quality control during device production. In the VT-105, surface analysis is accomplished in a separate analytical chamber. Facilities for ESCA, including Auger, UVPS, EELS, etc , may be specified as options. Since these analyses are performed in a separate chamber, the problems of contamination or erosion of surface analytical equipment by source beams are eliminated. Furthermore, impurities from filament outgassing from the analytical equipment will not deposit on the growing film.

Analysis Chamber Specifications

Manipulator	6-axis high precision type (X, Y, Z, tilt, 1st rotary, 2nd linear coaxial)
Heated substrate	2” dia. Temp. range: room temp. to 1,000°C
Chamber size	12” dia., 15” height
Pumping system	Combo-Vac model COV-1000, 1,000 l/sec combination pump
Isolation valves	4” manual gate valve (separates the analysis and entry lock chambers) 6” pneumatic gate valve (for combination pump)
Vacuum gauge	Nude ion gauge

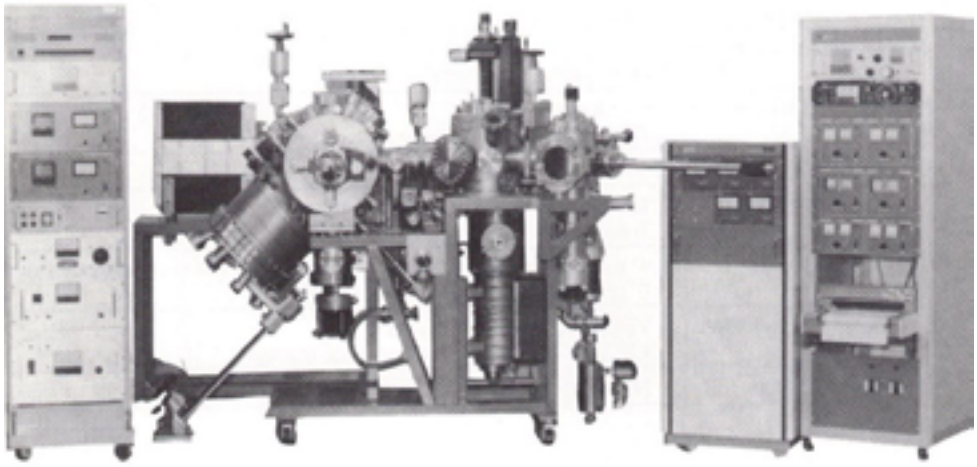
Entry Lock Chamber

Excessive pumping delays after sample introduction have proven to be a problem in many MBE systems. In the VT-105 an all-new substrate introduction system allows the rapid introduction (<30 min cycle time) of single substrates, while the pressure in the growth chamber is maintained in the 10^{-10} Torr range. The introduction system contains two separately pumped entry lock chambers that can also be used for processing substrates or completed film structures.

Entry Lock Chamber Specifications

Manipulator	2-axis (Z, R)
Substrate	2 - 2” dia.
Exchange port	6” I.D. load lock with Viton-sealed door
Transfer mechanism	Magnetically coupled linear feedthrough
Chamber size	8” dia., 10” height
Pumping system	150 l/sec turbomolecular pump 270 l/min oil rotary pump with foreline trap
Isolation valves	4” pneumatic gate valve (for TMP)
Vacuum gauge	Nude ion gauge

12 MBE Systems

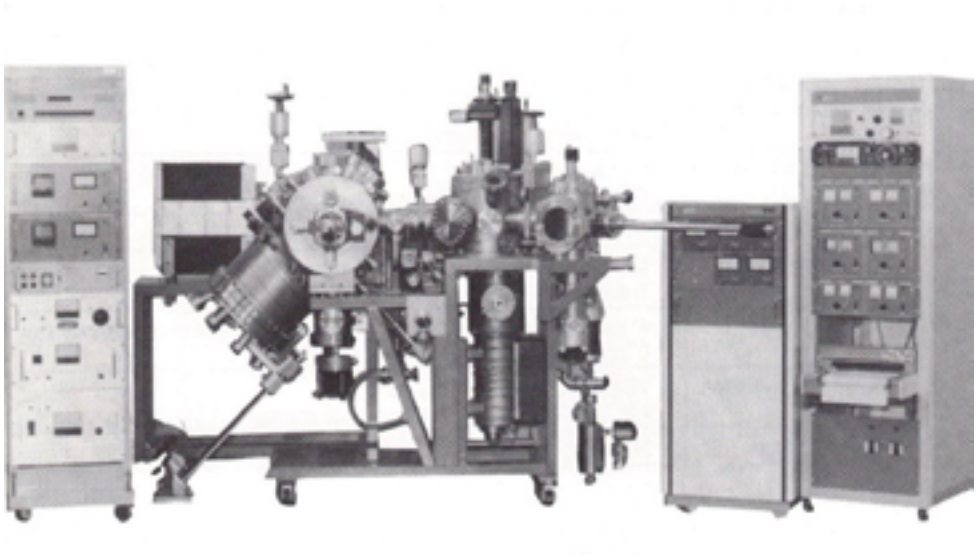


VT-110

VT-110

Features

- Separate growth, analysis and entry chambers
- Elaborate LN_2 growth chamber cryoshrouds ensure ultra-high purity
- Simple K-cell and shutter programming (automatic or manual)
- High precision manipulator/ sample handling system
- Independent sample heaters on each manipulator
- Routine 5 x 10^{-10} Torr growing pressure
- A unique combination “multipumping” system allows rapid sample changing and maximum utilization of all facilities
- System may be easily reconfigured at any time to suit changing applications



VT-108

VT-108

Main Features

- Two chamber configuration
- 3 kW, 3-crucible electron-beam effusion source
- High speed turbo pumping of load lock chamber permits maximum system utilization and high sample yield
- Ultra smooth substrate transfer system uses unique linear motion feedthrough
- Five axis manipulator with heating (1,100°C std.)
- Many options available for analysis and growth monitoring instrumentation
- “T-type” chamber and cryoshroud design (350 mm x 200 mm with 6” isolation valve)

VV-301

Explanation

MBE combined with UHV analysis techniques permits detailed investigation of the initial growth structure of ultra-thin films. These techniques are essential to understanding the growth mechanism and the interface formation between layers of different materials.

Until now, UHV MBE techniques have not been established for organic molecular systems. Such techniques are a prerequisite for realizing current molecular device designs in addition to fundamental interests.

This organic molecular beam epitaxy (OMBE) system has been designed and constructed with in-situ reflective high-energy electron diffraction (RHEED) specifically for the deposition of organic molecular layers under ultra-high vacuum (UHV).

Capability

Heteroepitaxial growth of organic ultra-thin layers on inorganic substrates has been accomplished in this UHV OMBE system with base pressures of about 2 x 10^{-10} Torr.

Special Knudsen Cell

Difficulties in developing UHV MBE methods for organic molecular systems include inherent high vapor pressures which organic materials possess, as well as the combination of thermal instability and the impurities of any trace organic substances. A low-temperature Knudsen cell was specially designed for organic samples in this OMBE system. The temperature of the Knudsen cells can be controlled by electrical heating and by circulating liquid nitrogen.

Modular Design

The schematic shows that the OMBE system consists of three independent chambers connected through gate valves: a growth chamber, an entry chamber and a portable chamber. The portable UHV chamber allows easy transfer of the OMBE film samples to a separate UHV scanning tunneling microscopy (STM) system.

The combination of diffraction methods with real space imaging of STM allows direct studies of epitaxial layers at the atomic scale.

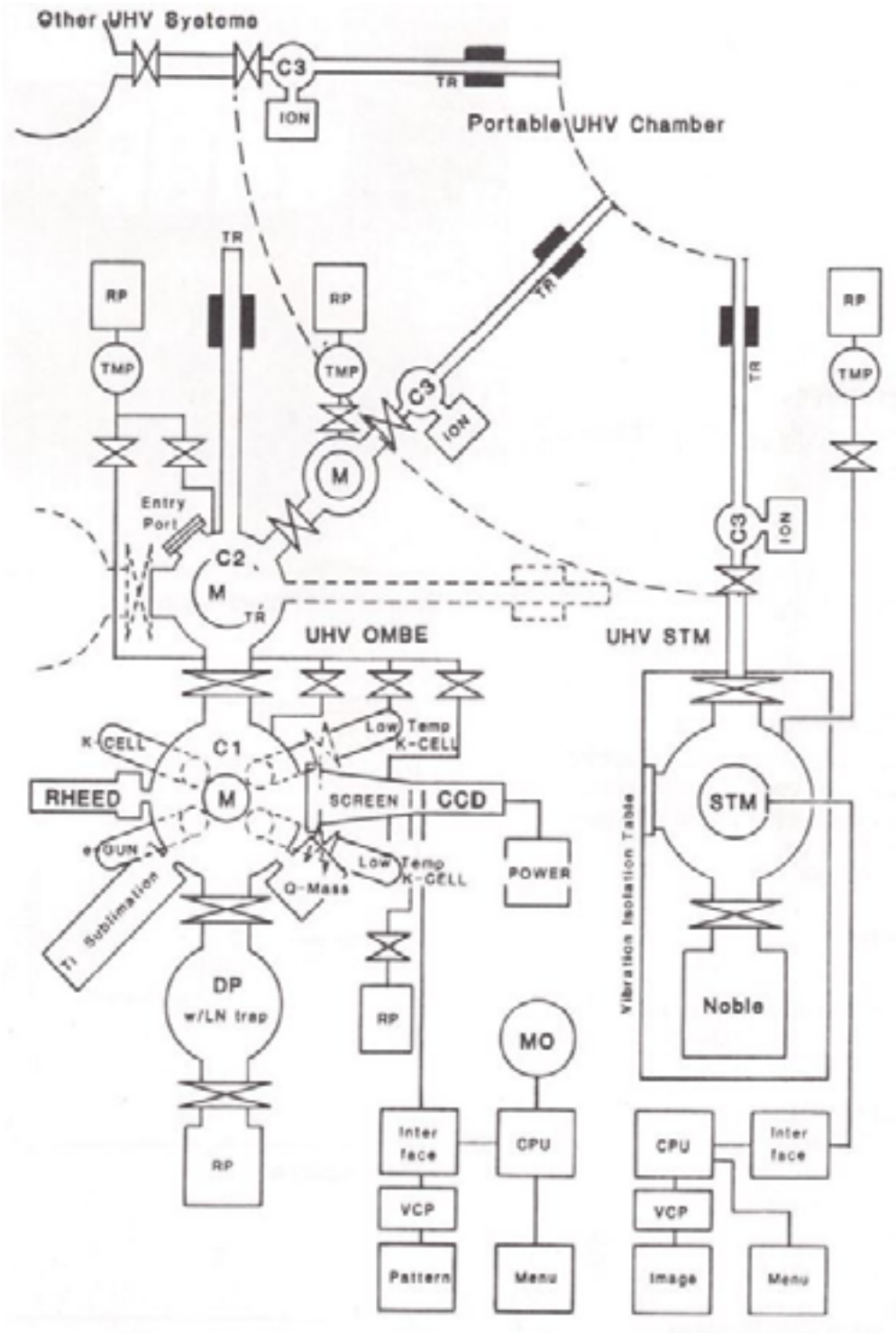
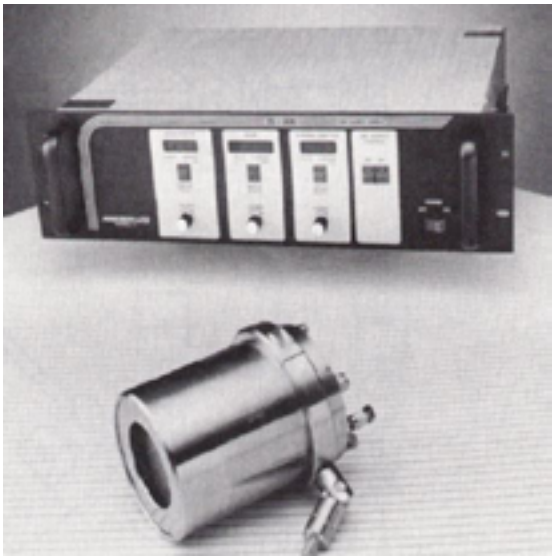


Fig. 12-4. Schematic diagram of the combined UHV OMBE system.

Cl Growth chamber
C2 Entry chamber
03 Portable chamber
TR Sample transfer rod
M Manipulator
VCP Color video copy processor

12 Filamentless Ion Beam Sources



5 cm Source and Power Supply

Applications

- Surface modification
- Thin film stress relief
- Oxiding
- Nitriding
- Ion assisted deposition
- Ion beam insitu pre-cleaning
- Chemically assisted ion beam etching
- Reactive ion beam etching
- Inert ion beam milling
- Ion beam deposition

3 cm Ion Beam System

Includes: 3 cm ion source, graphite or molybdenum ion optics, one inch baseplate feedthroughs with flexible internal utilities, and power supply

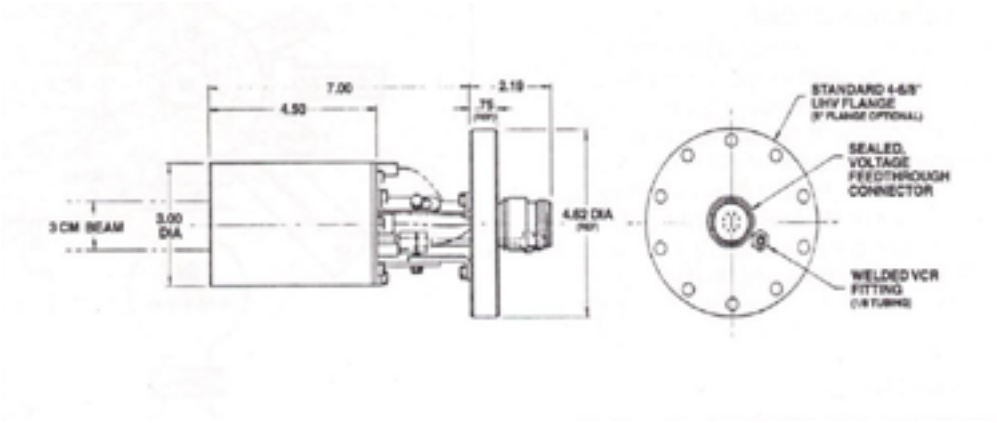
Options

Optics

Convergent, divergent or collimated molybdenum (recommended) or graphite

Flange Mount

Option available



3 cm Source

5 cm Ion Beam System

Includes: 5 cm ion source, graphite or molybdenum on optics, one inch baseplate feedthroughs with flexible internal utilities, and power supply

Options

Optics

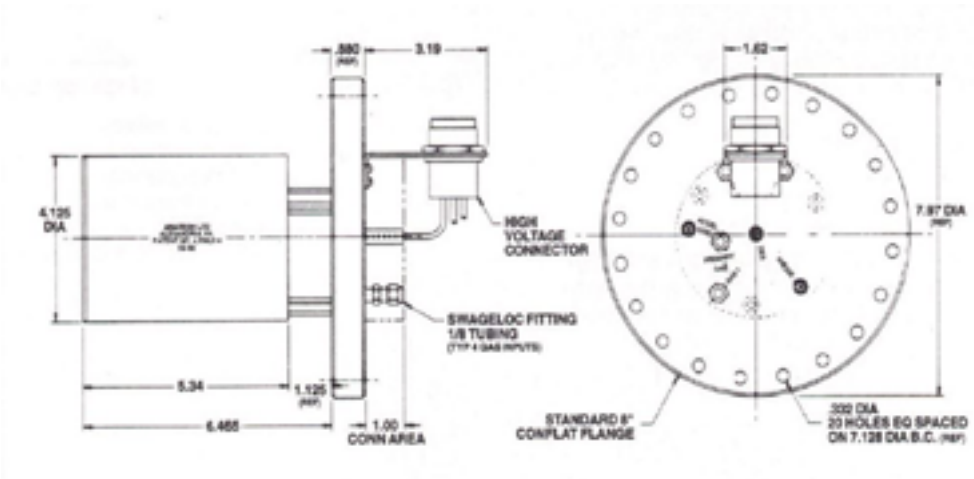
Convergent, divergent or collimated molybdenum (recommended) or graphite

Flange Mount

Option available

Four Gas Feedthrough & Connections

Option available



5 cm Source

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Specifications

Ion Source

Beam diameter	5 cm at grid face
Ion optics	a) Material — graphite or molybdenum b) Formation — collimated, defocused, focused
Output current	Adjustable between .2 mA/cm^2 and greater than 2 mA/cm^2 at 6" from source optics set
Ion energy	Adjustable between 35 eV and 130 eV 6" from source optics set
Cathode	Patented filamentless Dynamic Electron Emitter™ Patent No. 4,739,214
Neutralizer	Automatic filamentless neutralization under optimal conditions
Gas inlet	Four gas capability; required gas (inert or reactive) into cathode electron emitter, auxiliary gas ports into anode discharge area, either reactive or inert species
Gas requirements	3-5 sccm inert or reactive species
Mounting installation	a) Ion source mounting bracket included b) Feedthroughs dual 1" baseplate or single 2-3/4" flange feedthrough with 18" internal flexible connections. Optional rigid mount to flange or O-ring seal flange
Temperature compatibility	Bakeable to 300°C, operation to 80°C
Connections	All connections from rear or ion source to feedthrough are singular keyed plug/socket mil spec type connectors
Magnets	Alnico 5 permanent magnets
Construction	Stainless steel and high temperature ceramics (exclusive of ion optics set)
Dimensions	5.5" long, 4.5" diameter, less than 8 pounds total weight
Pumping requirements	1,800 liters per second nominal

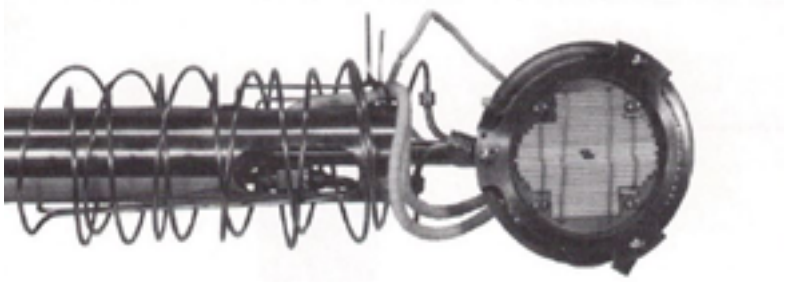
Power Supply

Type	Switching with keyed plug/socket power boards
Dimensions	19" wide, 5-1/4" high, 18" deep
Mounting	Standard rack mounting, integral chassis slide system included
Read-outs	Digital, light-emitting diode displays for each source function
Regulation	1. Constant voltage supply 2. Constant current supplies
Connections	Single keyed plug/socket connectors with safety mil spec type screw collar
Cables	10 foot length standard, gun to power supply, other lengths available
Control	Manual individual potentiometer controls
Power requirements	120 volt single phase, 6 amp
Output energy	2,000 volts at 75 mA

Unique Features

- No heated filaments or tips
- Continuous process life with 100% reactive or inert species
- Monoenergetic beam current densities
- Stable beam currents from 2 mA to 50 mA between 50 eV to 1,300 eV
- Up to four gas or gas mixture capability

Thermionics manufactures a wide variety of manipulators, feedthroughs, transfer devices, sample handling, heating, cooling, power supplies, and special components to be used with MBE systems. This page and the next show examples of the types of equipment we offer. Please consult the referenced sections for complete information about models and sizes currently available.



STLD with heating and cooling

Sample Mounting, Heating, Cooling

See Section 3 for further information about models available.

SPS-102/A

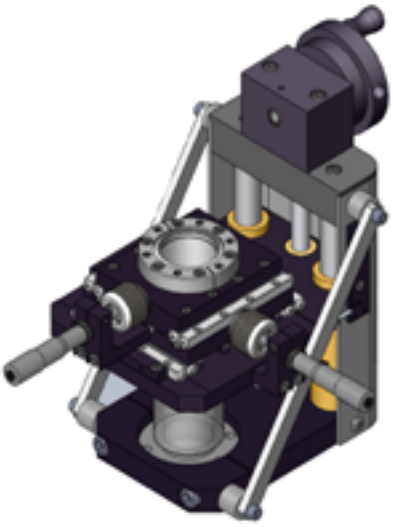
Heater and Bias Power Supplies

See Section 3 for further information about models available.

12 MBE Components & Acessories

Manipulators

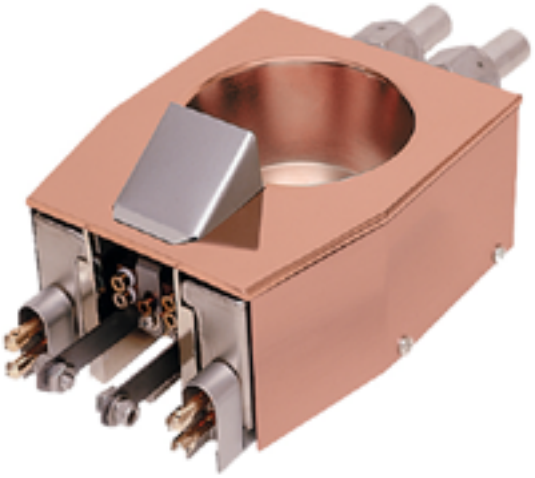
See Section 3 for further information about models available.



EM Series

3, 6, 10, 15, and 20 kW All Metal Sealed e-Guns

See Section 4 for further information about models available.



Hanks HM² e-Gun

Differentially Pumped Rotary Seals

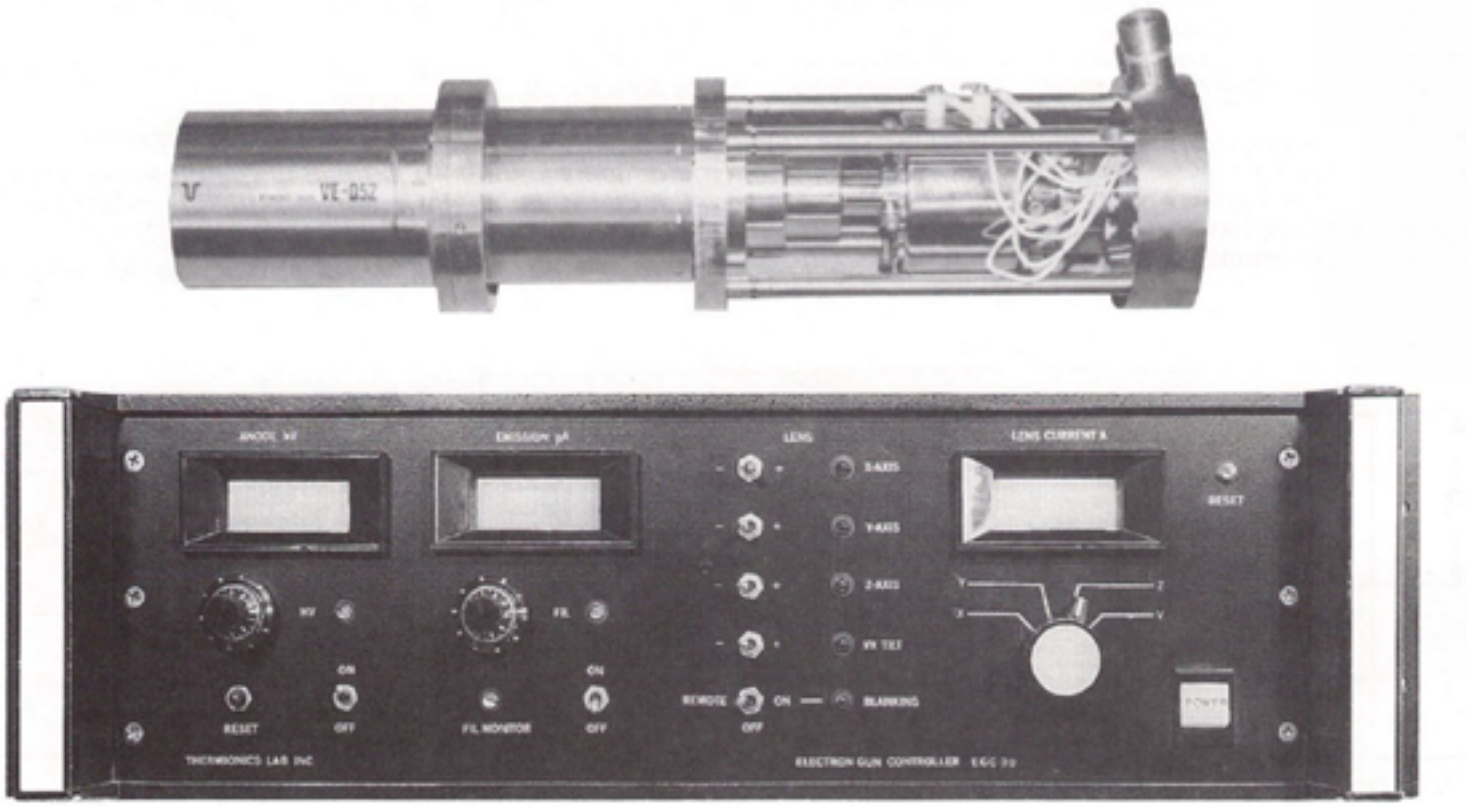
See Section 3 for further information about models available.

RNN Series

Positioning Devices

See Section 3 for further information about models available.

RPLR-.75



RHEED gun and power supply, 15 keV, 30 keV, and 50 keV models available

Introduction

The use of RHEED techniques for surface studies has become widespread with recent advances in materials synthesis, including, but not limited to, molecular beam epitaxy (MBE), high temperature super conductors, and CVD.

Since 1986, Thermionics has supplied our VE series of high energy RHEED sources and associated monitoring systems. Originally developed in Japan for MBE applications, this equipment offers unrivaled performance in the production of bright, high-definition and stable RHEED displays.

The Thermionics/Vieetech VE 50 series of electron guns represents the latest technology available commercially for RHEED applications. The VE series system utilizes an external electron gun source (i.e., it does not project into the vacuum chamber), and the magnetic electron optics make the gun less vulnerable to unpredictable electrostatic interference which may produce display instability in other types of RHEED guns.

For studies involving RHEED intensity oscillation monitoring, a comprehensive range of accessories is available, which includes a sensitive opto-electronic converter and signal analyzer. This device may be used together with our shutter controller and a desktop computer, e.g., IBM PC, to control modes and growth rates in MBE experiments.

For applications requiring multi-angular manipulation of the RHEED source, a precision (motorized) virtual-axis tilt stage is available for various flange sizes.

If you have any specific questions about applications, do not hesitate to call us. We at Thermionics welcome your comments and suggestions.

12 RHEED Guns 15 keV, 30 keV or 50 keV

New High Energy Electron Guns for RHEED Applications

Designed specifically for molecular beam epitaxy applications, the VE series electron beam sources offer many advantages over other guns because of their compact design and ease of use.

Three models are available. The VE-026 covers the energy range from 1 to 15 keV, the VE-052 covers the energy range of 3 to 30 key, and the VE-056 covers the range 5 to 50 key. A remote control module simplifies

Fig. 11-5. Dimensional drawing of RHEED gun. screen observation during initial set-up adjustments. The versatile magnetic lens system provides precision focus and spot adjustment, ensuring well-defined diffraction patterns at high screen intensity. Models are fully bakeable and mounted on standard ConFlat flanges. A complete system includes the RHEED gun, power supply/control unit and remote control module. The guns are bakeable to 230°C (no elastomers).

Features

- Small spot size gives sharp, high brilliance diffraction patterns
- Unique remote control module simplifies set-up
- Automatic overload protection
- Compact size allows easy retrofit to upgrade existing MBE systems from other manufacturers
- External mounting—no projections into chamber

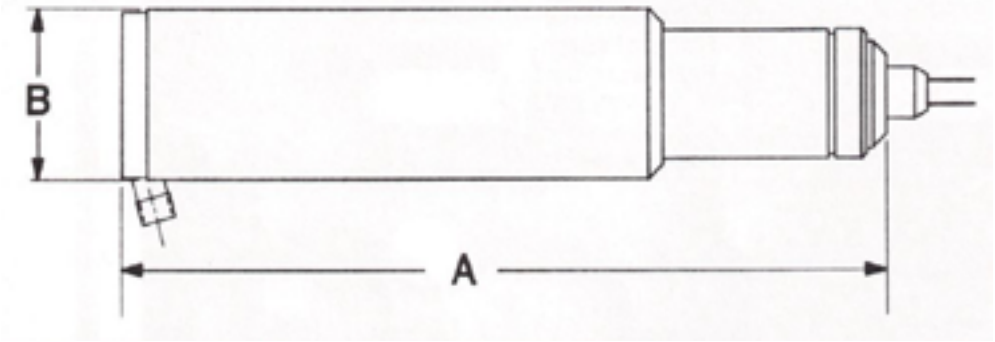


Fig. 12-5. Dimensional drawing of RHEED gun.

RHEED Gun Dimensions

	VE-026	VE-052	VE-056
A	14.6” (370 mm)	19.3” (490 mm)	19.3” (490 mm)
B	3.9” (100 mm)	3.9” (100 mm)	6” (152 mm)
Mounting Flange	2.75”	2.75”	4.5”
Weight (approx.)	13.2 lbs (6 kg)	15.4 lbs (7 kg)	15.4 lbs (7 kg)

RHEED Gun Dimensions

	VE-026	VE-052	VE-056
Beam spot size	110 µm	< 110 µm	< 110 µm
Acceleration voltage	15 keV	30 keV max.	50 keV max.
Filament (tungsten)	0.1 mm wire	0.1 mm wire	0.1 mm wire
Beam focus method	Magnetic lens	Magnetic lens	Magnetic lens
X-Y deflection system	Magnetic	Magnetic	Magnetic
Normal working pressure range	<2 x 10^{-6} Torr	<2 x 10^{-6} Torr	<2 x 10^{-6} Torr
Baking temperature (HV cable removed)	230°C	230°C	230°C
Dimensions	14.6” x 3.9”	19.3” x 3.9”	19.3” x 6”
Weight	13.2 lbs	15.4 lbs	15.4 lbs
Flange size (standard)	2.75”	2.75”	4.5”

VE-052

Cables and Accessories Included:

- Spare filaments (pack of 10)
- Mounting gaskets (pack of 5)
- Viewing screen not included (see page 12-15)

/D Differential Pumping Port option

This is a factory option and must be specified when placing original order. For example, for the 30 keV system, order
Model No. VE-052/D.

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

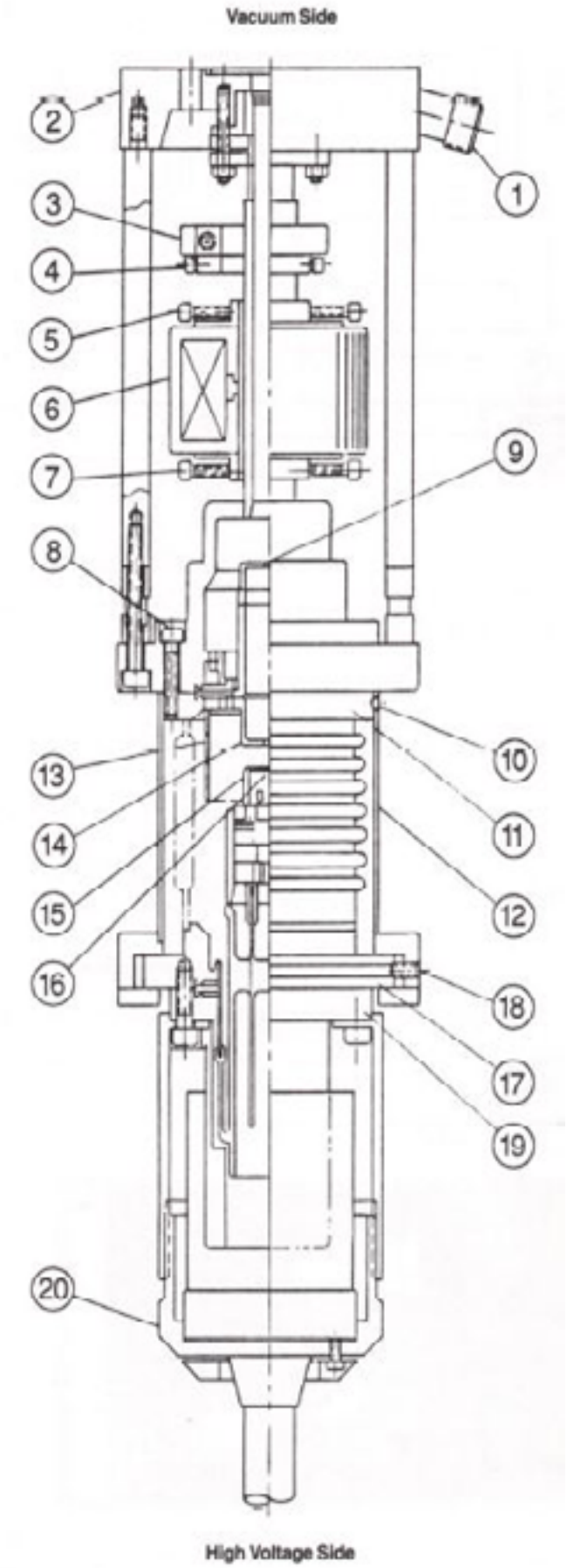
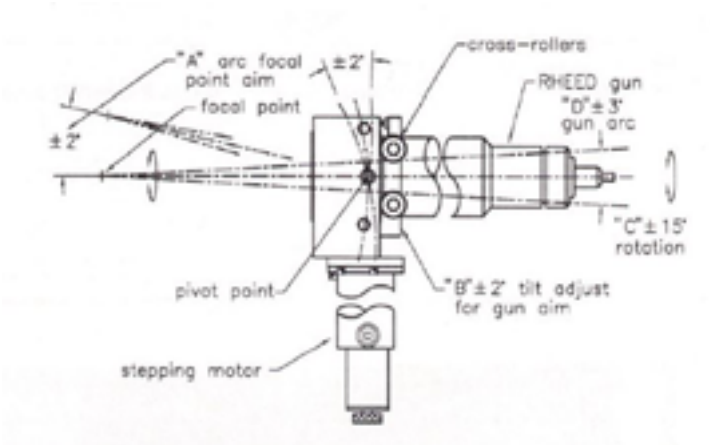


Fig. 12-9. RHEED gun layout.

1. Lens coil connector
2. Chamber mounting flange
3. Deflection coil lens (X, Y)
4. Deflection alignment screws
5. Focus lens alignment screws (A)
6. Focus coil lens (Z)
7. Focus lens alignment screws (B)
8. Bellows flange screws
9. Beam aperture
10. Bellows cover screws
11. Bellows flange
12. Bellows cover
13. Magnetic shield
14. Anode tube
15. Wehnelt cylinder
16. Filament location
17. Beam alignment flange
18. Beam alignment screws
19. Gun mounting flange
20. HV connector

Precise RHEED Targeting— VXT Virtual Axis Tilt

A VXT series precision tilt mounted to an RHEED gun, provides precise targeting with five independent degrees of freedom. The VXT pivots the source about the target, with a location on the target surface becoming the focal or “virtual axis” point. For more information, please refer to page 3-26.



VXT-1.8/MS, shown with RHEED gun

12 RHEED Gun Power Supplies

Power Supply Dimensions

	VE-026	VE-052	VE-056
A	19” (480 mm)	19” (480 mm)	19” (480 mm)
B	7.9” (200 mm)	7.9” (200 mm)	7.9” (200 mm)
C	21.7” (550 mm)	21.7” (550 mm)	24” (610 mm)
Weight (approx.)	42 lbs (19 kg)	45 lbs (20.5 kg)	48.5 lbs (22 kg)

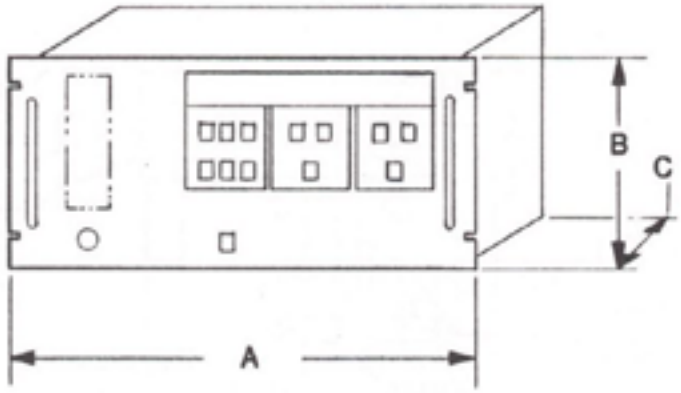


Fig. 12-10. Dimensional drawing of RHEED power supply

Power Supply Specifications

	VP-026	VP-052	VP-056
Power requirements	100-240 VAC, 60 Hz, 300 VA	100-240 VAC, 60 Hz, 300 VA	100-240 VAC, 60 Hz, 300 VA
Acceleration voltage	1-15 keVDC	3-30 keVDC	5-50 keVDC
Output current	110 µA max.	110 µA max.	110 µA max.
Stability	0.005% (AC line ±5%)	0.005% (AC line ±5%)	0.005% (AC line ±5%)
Metering	Voltage and current	Voltage and current	Voltage and current
Filament supply	0-5 VDC at 3 A	0-5 VDC at 3 A	0-5 VDC at 3 A
Stability	0.01% (AC line ±5%)	0.01% (AC line ±5%)	0.01% (AC line ±5%)
Lens supply	0-7 VDC at 3 A	0-7 VDC at 3 A	0-7 VDC at 3 A
Stability	0.01% (AC line ±5%)	0.01% (AC line ±5%)	0.01% (AC line ±5%)
Metering	Current	Current	Current
Shipping weight	64 lbs	64 lbs	67 lbs
Size	See Fig. 12-10 above	See Fig. 12-10 above	See Fig. 12-10 above

NOTE: Power supplies may be rack mounted.
Focus and X-Y controls duplicated on main power supply and remote control unit.

Cables and Accessories Included:

- AC cord (10’)
- Electron gun connector harness (including high voltage connector—10’)
- Remote control cable (10’)

VP-052

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

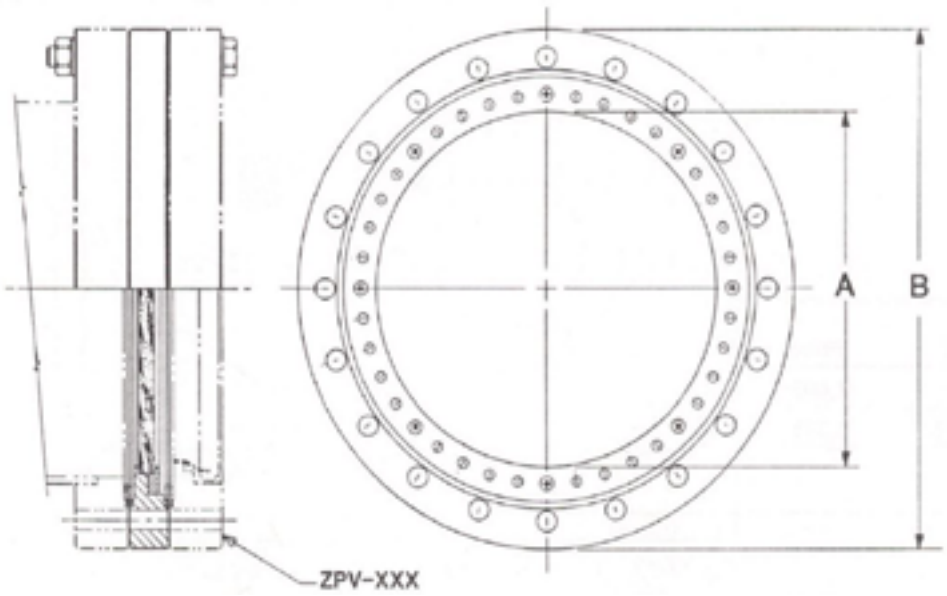


Fig. 12-10. Dimensional drawing of phosphor screen shown with viewport in place.

Model No.	Description
VE-050-SC4	4” phosphor screen with frame for mounting to 6” ConFlat-type flange
VE-050-SC6	6” phosphor screen with frame for mounting to 8” ConFlat-type flange
VE-050-GL	Phosphor coated glass only, either size
Recoating	Recoating of screen with phosphor, either size
Back Coat	Aluminum back coat available, please consult the factory

Phosphor Screens

Our standard phosphor viewing screens utilize a short persistence (P31) zinc sulfide (Cu activated) phosphor which is deposited on low expansion lead safety glass. Screens are metallized prior to coating to minimize image distortion caused by electrostatic charging.

Model No.	A	B
VE-050-SC4	3.8”	6”
VE-050-SC6	5.5”	8”

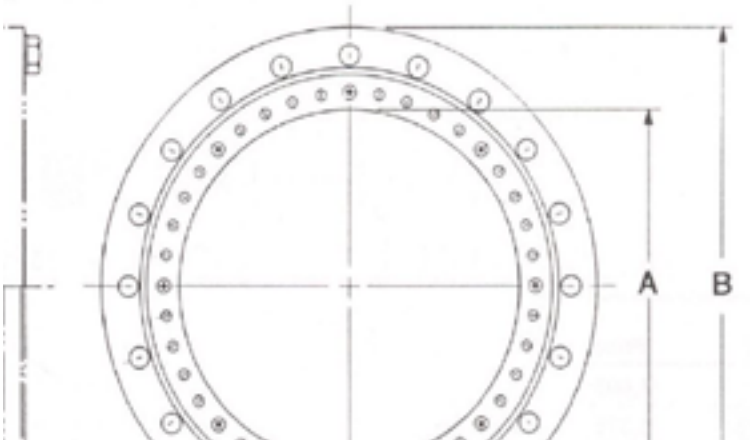


Fig. 12-12. Dimensional drawing of zero-profile, wide-angle viewport.

Viewports

A viewport must be used in conjunction with the standard phosphor viewing screens. The Pyrex viewport permits unobstructed observation of the phosphor screen, offers limited physical protection, and provides the ultimate vacuum seal for the screen to atmosphere. For complete specifications, and for information on materials other than Pyrex, please refer to page 8-4.

Zero Profile, Wide-Angle Viewports

7056 glass with Kovar sleeves and stainless steel flanges

Dimensions in inches

Model No.	V Viewing Dia.	Nom. Flange Size	A Flange O.D.	B Bolt Circle Dia.	C Flange Thickness	Glass Thickness	Ship Wt. lbs
ZPV-400	3.88	6.00	5.97	5.128	0.780	0.210	6.0
ZPV-600	5.38	8.00	7.97	7.128	0.880	0.365	9.0

12 RHEED Accessories

Viewports

Thermionics manufactures a series of rotary-actuated shutter assemblies. They are of the 90˚ shutter swing type, suitable for mounting behind “zero height” viewports. VRS series shutters are built into double-sided flanges. Refer to Section 3, page 3-76 for more information and additional viewport shutter models.

Model No.	Flange O.D.	A	B	C
VRS-600	6.00”	7.10”	1.78”	.781”
VRS-800	8.00”	8.31”	2.53”	.875”

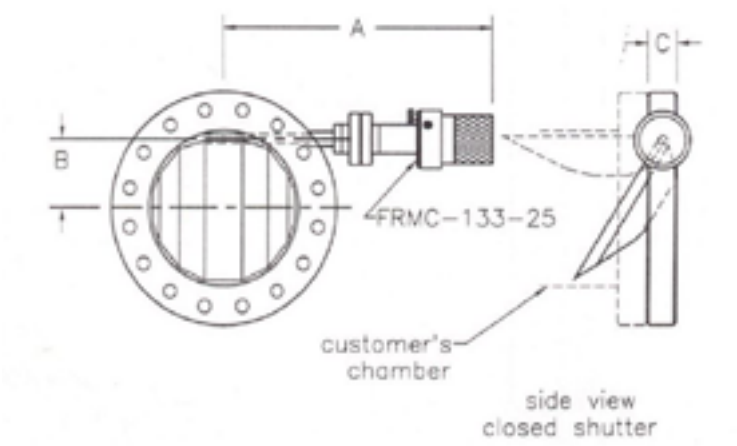


Fig. 12-13. Dimensional drawing of VRS viewport shutter

Camera Mount and Camera

Fits 6” or 8” O.D. flange sizes

Model No. VE-050-CMP

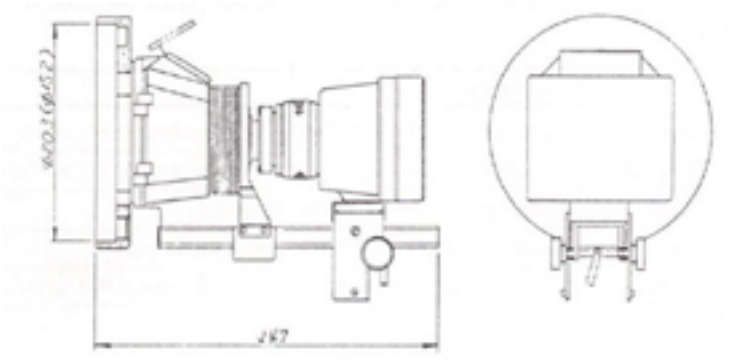
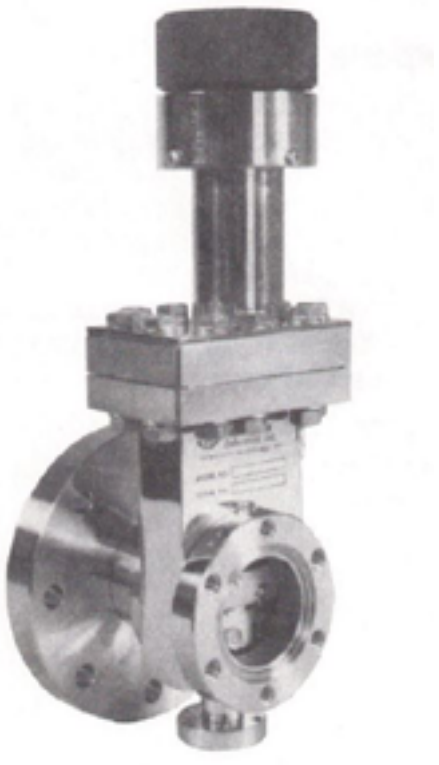


Fig. 12-14. Dimensional drawing of VE-050-CMP.



Isolation Gate Valve

This gate valve is designed to isolate the RHEED gun from the chamber. The gate valve eliminates the requirement of venting the system, therefore simplifying filament replacement, and it allows the gun mounting to a tilt or goniometer stage.

For more information regarding valve specifications, please refer to Section 9, pages 9-1 through 9-12.

Model No.	Description
PFB-G-1500-H/R	Gate valve, 1 1/2” I.D. PyraFlat bonnet, hand actuated, with mini roughing port, and special port flanges
PFB-G-1500-P/R	Same, pneumatic actuation
PFB-G-1500-H/R/G-11	Same with 4 1/2” x 1 1/2” flange on one side (Gen II)
PFB-G-1500-P/R/G-II	Same, pneumatic actuation

Isolation Gate Valve

Roughing Valves

See Section 9, pages 9-27, 9-28 for details

Model No.
BVV-075-22/133
AMV-075-22

Tilt Stages

See Section 3, pages 3-24 for details

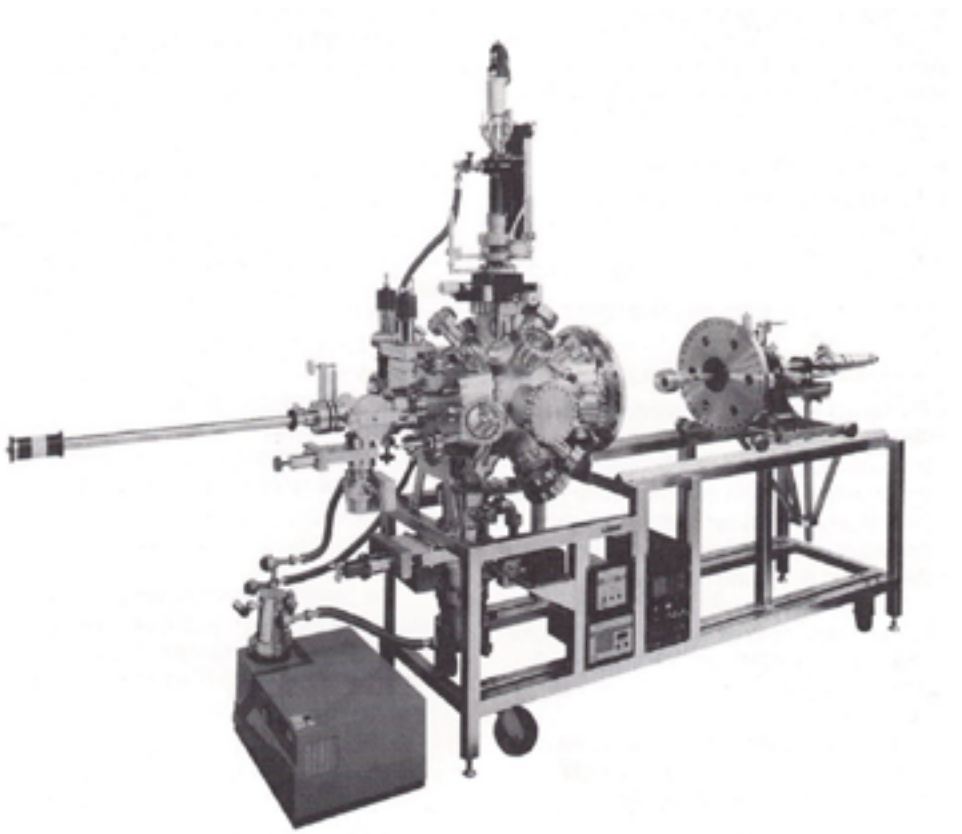
Model No.	
TLT-1.5-2	
TLT-1.5-2/B-6	6” hole through base flange

Introduction

The PLD-2200 is a platform for Pulsed Laser Deposition (PLD) systems. Since it is a platform, it can be built to meet current process requirements or budget constraints. Additional equipment and features may be added at a later time, to reflect changing requirements.

Some of our customers know exactly what they want the system to be, and we work with their specifications. Other customers know their process, but do not know what equipment is required. We work with them to develop a system that will meet their needs.

The system shown and described here is an example of a system designed, configured, modified, and built to accommodate specific customer requirements. This system has been combined with Physical Vapor Deposition (PVD) capabilities. It has two laser ports, one e-Gun source, and access ports for up to four additional evaporation sources. The integration of various tools and techniques allows flexibility, and it may be used with a variety of materials.



PLD-2200 Pulsed Laser Deposition System

Specifications

I. Growth System

A. GROWTH CHAMBER

The growth chamber is manufactured from 304 stainless steel. It measures 16" in diameter and 36" long. Fabrication methods meet or surpass UHV manufacturing standards. The chamber is electro-polished for a smooth UHV surface. Base pressures of 5 x 10^{-10} Torr are achieved.

The chamber pictured here has five port array levels, with a total of forty-three (43) ports. There are two laser ports mounted 45° to the target location. The e-Gun evaporation source flange is located on the side of the chamber.

The target manipulator flange, and four additional evaporation source flanges, are mounted to a large wire seal flange. A trolley system provides transport to remove, install, and align the demountable growth flange, target manipulator, and the LN_2 cryoshroud from the main chamber.

B. PUMPING SYSTEM

The system uses a dry roughing and backing pump, isolated and controlled with a series of high vacuum angle valves. The high vacuum pump is a 520 l/s corrosive environment turbomolecular pump, mounted to the main chamber and isolated with a manually actuated UHV gate valve with a PyraFlat metal-sealed bonnet. Base pressures of 5 x 10^{-10} Torr are achieved. Pressure during evaporation is material dependent, but typically it has been measured in the 10^{-8} Torr range. Other roughing and high vacuum pumps including standard turbomolecular, cryo, sputter ion, etc., are available to meet the customer's requirements.

C. SOURCE FLANGE

Two 45° laser ports are located on the main chamber. Four evaporation source mounting flanges and the target manipulator flange are mounted on a larger wire seal source flange. A trolley system provides transport to install, align, and remove the demountable source flange, target manipulator, and the LN_2 cryoshroud from the main chamber.

A patented Hanks HM^2 e-Gun electron beam evaporation source is supplied. This compact 6 kW source has a 7 cc crucible, and is mounted on an 8" O.D. ConFlat flange. A LN_2 cryoshroud with a debris/collimation shield surrounds the source. A 6 kW tetrode power supply, gun control, triangular beam sweep controller, cables and accessories are included.

Additional sources, monitors, laser, and diagnostic equipment are available as options.

PyraFlat flanges are manufactured and protected under one or more of the following patents: 5,640,751; 4,685,193

D. SAMPLE HANDLING

1. Substrate Manipulator/Heater

The substrate manipulator mounting port is on top of the chamber, perpendicular to the horizontal axis of the load-lock and the ablation target mounting ports.

The sample manipulator is a Thermionics FM Series manipulator with the following specifications:

- 6" Z travel, 1.88" I.D. bellows
- ±0.5" X and Y travel
- Precision ±5° tilt, model TLTM-2.5-2
- FRMRE magnetically coupled rotary feedthrough
- Samples up to 1.5" O.D. can be heated with a water-cooled quartz lamp heater assembly capable of continuous operation at 700°C, and up to 1,000°C peak in O_2
- Motorized continuous sample rotation of 360° about the polar axis and continuous azimuthal rotation
- The substrate heater comes with an SPS-232A power supply with PID auto tuning control and RS-232 computer interface
- Utility delivery ports

Options

- Larger sample sizes
- Choice of heaters
- Sample cooling
- Other manipulators

12 PLD-2200 Pulsed Laser Deposition System

2. Ablation Target Manipulator
The standard manipulator supplied is a Thermionics FM Series manipulator, mounted horizontally, with the following specifications:

- 6" Z travel, 1.88" I.D. bellows
- Horizontal mounting package
- ±0.5" X and Y travel
- Precision ±50 two axis tilt, model TLTM-2.5-2
- FRMRE magnetically coupled rotary feedthrough
- WOA coaxial rotary feedthrough
- The target holder accommodates four 1" targets. The targets clock and rotate continuously during ablation using a long-life motorized rare earth magnetic rotary drive. The targets are hidden behind a watercooled shroud with one target exposed to the laser at any given time. A target can be located and locked into position with the precision stepping motor rotary drive. Targets can be transferred without breaking vacuum through the load-lock. The manipulator comes complete with stepping motor controller and all utility delivery ports and accessories.

E. RHEED SYSTEM
A Model VE-052NP-052 30 keV RHEED source and power supply with a 5.68" diameter phosphor screen and screen shutter is supplied.

F. CLEARVIEW HEATED VIEWPORTS AND LASER WINDOW EXCHANGE
A ClearView heated viewport is provided for viewing. ClearView heated viewports eliminate problems associated with condensate clouding.

As an option, a gate valve isolated laser window can be provided. The gate valve has a roughing port built-in on the gate-seal side of the valve. A stainless steel tee connects to a roughing valve and a vent valve, to allow the removal of occluded laser ports for cleaning.

G. FRAME
The chamber, source flange, load-lock, support equipment, pumping components, and controls are mounted on a stainless steel support frame. The frame has casters and leveling pads.

H. OPTIONS
- Thin film thickness monitors and controllers using crystal sensors or flux monitors
- Bakeout capability per customer's specifications
- Quadrupole mass spectrometer analyzer may be provided per customer's specification
- Process of gas flow control
- The system may be expanded to include an analysis chamber for HREELS, LEED/AES, etc.
- Ellipsometer
- Larger substrates

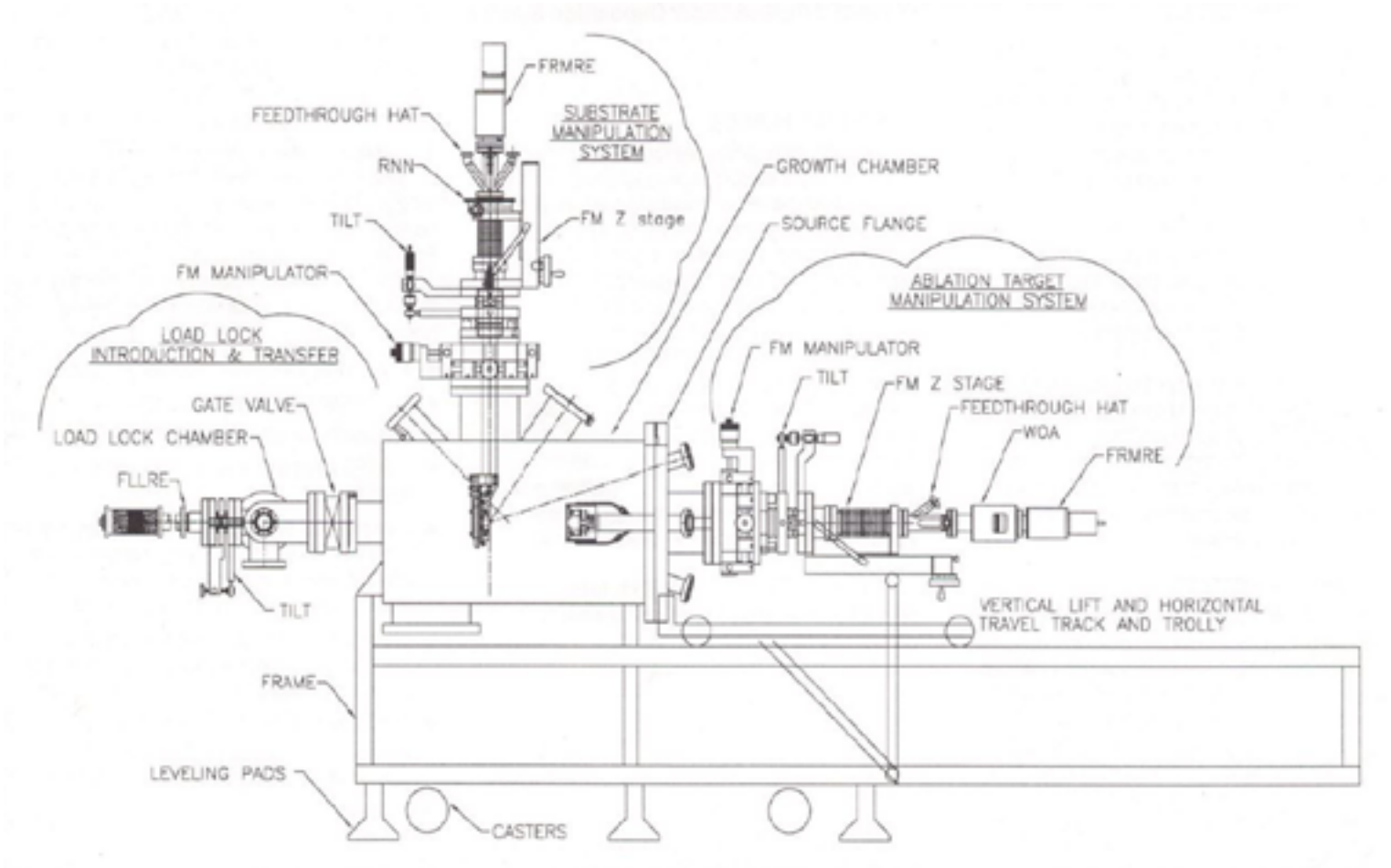


Fig. 12-15. Diagram of PLD-2200 system; pumps not shown

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

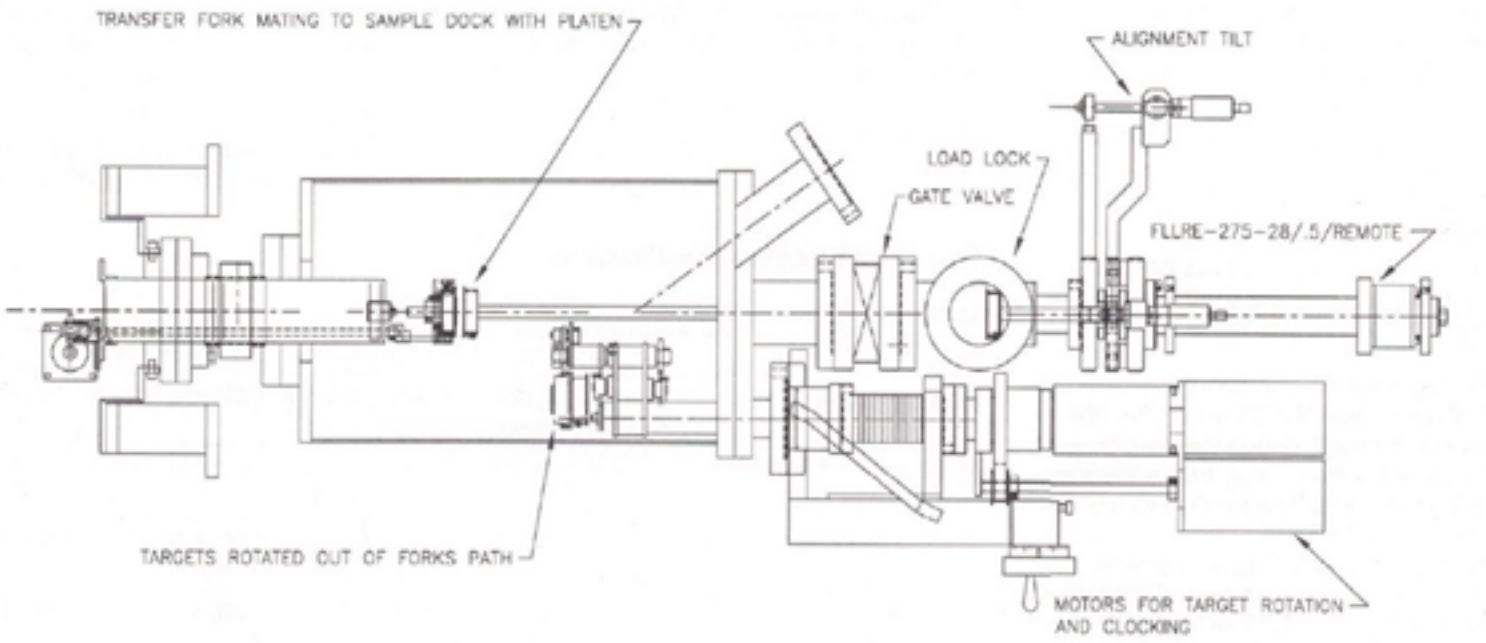


Fig. 12-15a. Diagram of PLD-2200 introduction and transfer detail.

II. Load-Lock Substrate and Target System

Samples are introduced and removed from the main chamber through the loadlock system. The load-lock provides access, rapid pump-down and introduction to the main chamber from the transfer introduction system. The sample load-lock introduction port is opposite the ablation target manipulator port—both are on the horizontal plane.

A. CHAMBER
The load-lock chamber is constructed of 304 stainless steel with metal seals. One exception—an elastomer-sealed quick access door for sample loading. The chamber is electro-polished for a smooth UHV surface. The chamber is isolated from the main chamber by a manually-actuated UHV gate valve with a metal-sealed bonnet utilizing a PyraFlat flange.

B. PUMPING SYSTEM
Using an integral valve and ballast system, the load-lock utilizes the same dry roughing pump as the growth chamber. The load-lock assembly has a dedicated turbo-molecular high vacuum pump and a manually-actuated UHV gate valve with a metal-sealed PyraFlat bonnet flange. The load-lock typically reaches a base pressure in the mid 10^{-7} Torr range from atmosphere, without baking, in fifteen (15) minutes. Other pumps may be specified and supplied.

C. SAMPLE HANDLING
A 24" linear travel long stroke FLLRE rare earth linear-rotary feedthrough is supplied. Targets and samples are introduced, docked, transferred, and removed from the target manipulator or the substrate heating stage in the growth chamber using this feedthrough.

The feedthrough is mounted to a dual axis ±5° precision tilt with motion for alignment of the transfer fork to the substrate manipulator or the target manipulator. Other feedthroughs and sample sizes may be substituted. Cassette loading and sample heating are also available.

D. OPTION
Chamber bakeout is optional.

III. Electronics

The electronics for the system are mounted and integrated into the system frame. Included are:

- Turbomolecular pump controller
- Roughing control system
- e-Gun power supplies and controls
- Gauge controls
- RHEED power supply
- Sample heater power supply
- Stepping motor controller
- Shutter controls

A separate electronics rack is available as an option.

IV. System Testing and Installation

The system includes all necessary valves, blank-off flanges, viewports with shutters, and hardware. The system is assembled prior to shipment. Each component, sub-system, and the complete system, including the sample and target transfer, are fully tested along with all motion, electrical and water utilities, and control interlocks.

The system is pumped down and leakchecked at a minimum sensitivity of 2×10^{-10} std cc/sec with a helium MSLD. The system is not baked. The system is operated under UHV conditions. It is back-filled with dry nitrogen prior to shipment. The system is then disassembled and prepared for shipment.

Operator training is available.

V. Pricing & Availability

Delivery—16 weeks ARO

Our engineering group will work closely with you to determine your requirements and then a firm quotation can be given.

PyraFlat flanges are manufactured and protected under one or more of the following patents: 5,640,751; 4,685,193

12 Laser Test Chamber

General

The LTC-9100 is a laser test chamber for performing multi-photon ionization (MPI) measurements in ultra-high vacuum (UHV). This chamber has a vibration-free pumping system and can be mounted directly on a laser table.

Design

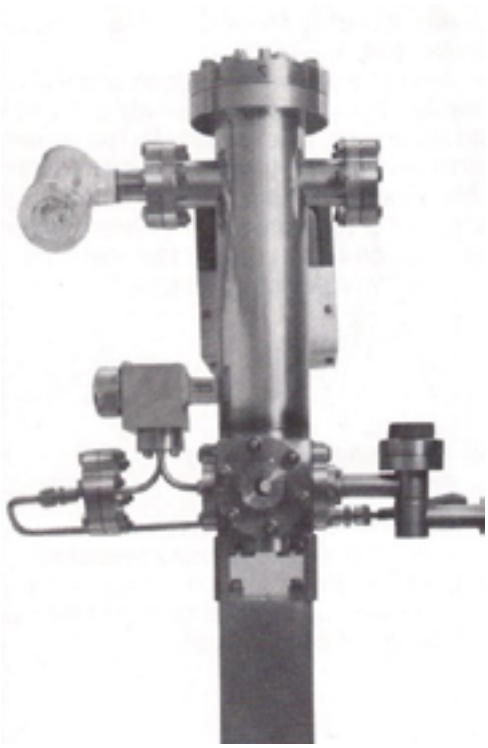
A UHV 6-way cube serves as the ionization chamber. It can be fitted with either 2 or 4 windows, thus allowing single or two-color laser experiments.

The ions are extracted from the cube into a 7.5" long time-of-flight (TOF) tube. The TOF tube contains an independent extraction grid/lens and four steering plates, thus eliminating the need to precisely position the focus of the laser beam.

The detector is a 1.0" active diameter Chevron electron multiplier array (CEMA) with a 50 ohm collector. The CEMA is directly attached to a 50 ohm BNC vacuum feedthrough.

Pumping System

The pumping system (optional) consists of a sorption pump with a shut-off valve for rough pumping the chamber. Ultra-high vacuum is achieved with a 20 l/sec ion pump. The gas can be leaked into the system using a precision leak valve.



Laser Test Chamber with TOF Mass Spectrometer

Mounting

The chamber with the attached pumps and leak valve mounts on a 2" x 2", 1/4"-20 hole pattern. The height of the laser windows is 3.5" (minimum). Other heights are available upon request.

Applications

1. MPI of atoms and molecules under high vacuum (no pressure broadening).
2. Photodissociation of molecules followed by MPI of the photo-products.
3. Testing of laser systems for spectral intensity and band width using MPI as a probe.

Laser Test Chamber Specifications

Laser Spectroscopy Chamber

Ionization chamber	2.75" cube with five ports for 2.75" ConFlat flanges
Laser windows	Quartz, sapphire, MgF, or LiF available (customer supplied or purchased from TLI)
Number of laser windows	2 windows for single color experiments and 4 windows for 2-color cross laser experiments
Window to focus distance	2" minimum; larger distances can be achieved with the employment of 2.75" nipple as laser baffle arms
Gas inlet	A ConFlat-mounted pulsed valve or leak valve is available for attachment to any of the 5 flanges
Legs	A set of legs is available for mounting the test chamber to a standard laser table with a 1" x 1" hole pattern

Time-of-Flight Chamber

TOF chamber	3" or 4" O.D. tube with three 2.75" O.D. ports and TCU-150-5
Rough pump	Sorption pump with valve (customer supplied) (See Section 10)
High vacuum pump	20 l/sec ion pump (customer supplied) (See Section 2)
Pressure gauge	Nude ionization gauge (customer supplied) (See Section 6)

Time-of-Flight Mass Spectrometer

Mounting flange	4.62" 0.0. or 6.0" O.D. ConFlat flange
Extractor lens	1.0" I.D. with nickel mesh and independent voltage control
Steering plates	Four plates; two of the plates at right angles have independent voltage; the other two plates are wired to the extractor
Drift tube	6" long with nickel mesh on the top and bottom and independent voltage control
Detector	Chevron CEMA with 50 ohm collector mounted on a 50 ohm impedance BNC vacuum feedthrough
High voltage feedthroughs	Six MHV vacuum feedthroughs
Model No.	**LTC-9100** Laser test chamber
Model No.	**TOF-9020** TOF mass spectrometer with CEMA plate

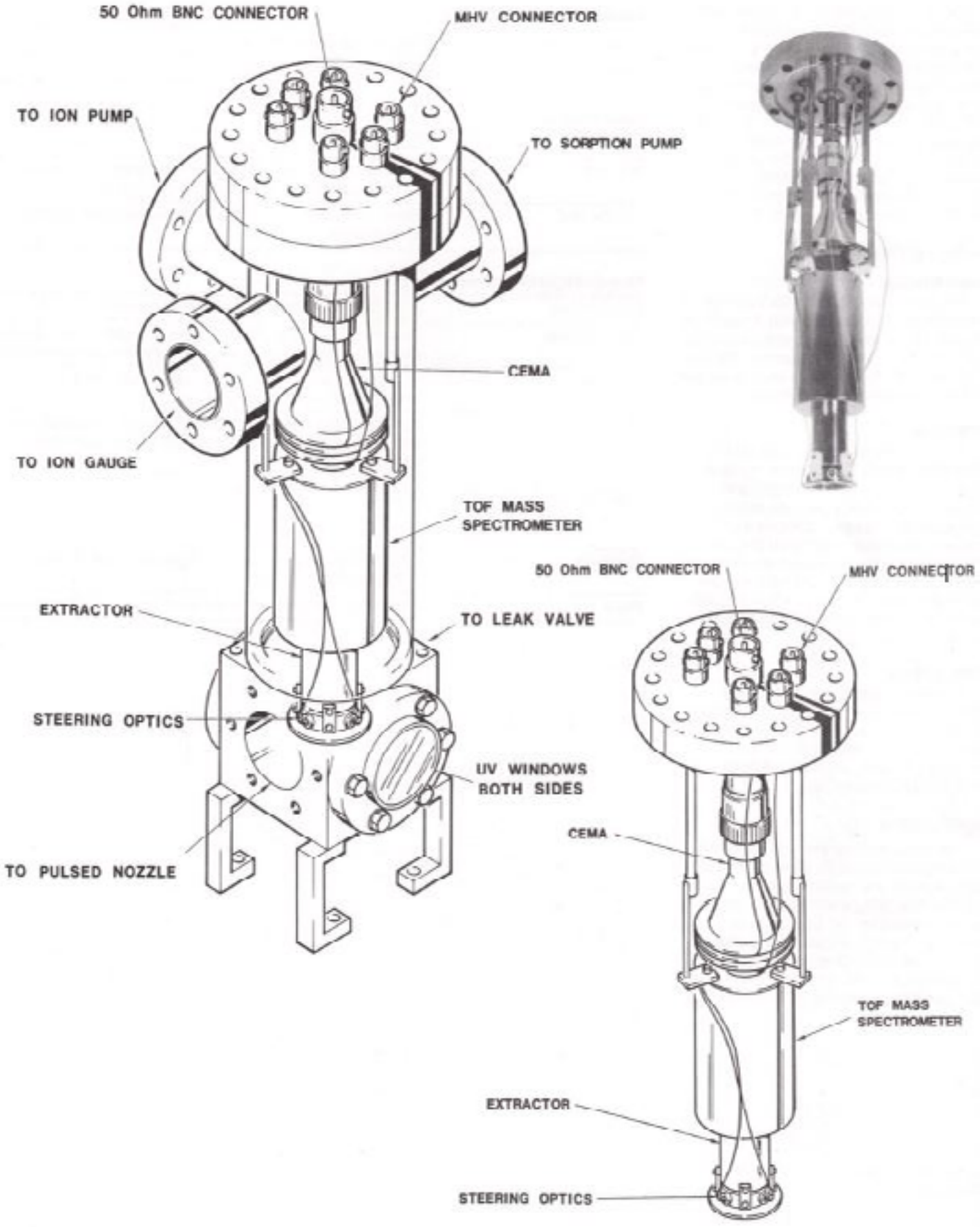


Fig. 12-16. Diagram and photo of laser test chamber with time-of-flight mass spectrometer

12 Rotatable Time-of-Flight Mass Spectrometer with Laser Window

Description

The RTMS-9500 is an ultra-high vacuum-compatible time-of-flight mass spectrometer with a charged particle detector mounted on a UHV rotary stage along with a stress-free laser window. This permits the ionization of molecules and atoms using laser beams (MPI) and subsequent detection of the mass-selected ions with a Chevron electron multiplier array (CEMA). This device can be used for angle and mass-resolved detection of surface reaction/desorption products or gas-phase cross-beam experiments.

Technical Description

Laser Window

The laser window is 1/4" thick Suprasil quartz (standard; other materials available on request).The window is in a weldable adapter and is welded to the main assembly. The laser beam exits the chamber via a second window on the opposite side of the chamber.

TOF Tube

The time-of-flight tube consists of (1) an extractor grid/lens; (2) four steering plates; (3) a TOF tube (6" standard length) and a 1.0" active diameter CEMA plate with a 50 ohm collector. The signal is fed via a UHV shielded BNC cable to a 50 ohm BNC feedthrough. The high voltage lines are connected to MHV feedthroughs. All the feedthroughs are on the same rotary stage which supports the ion optics and CEMA detector, thus allowing 360° rotation.

Rotary Stage

The rotary stage is an 8" O.D., 6" I.D. platform which supports (1) the laser window, (2) the ion optics and detector, and (3) the electrical feedthroughs. It is attached to a worm gear to allow precise, repeatable positioning of the detector.

Applications

The detector allows low-cost angle and mass resolved detection. When combined with a suitable laser system, quantum state specific detection, as well as angle and mass resolved detection, can be performed. This detection should be of utility in (1) surface reaction/desorption chemistry, (2) two-color photodissociation experiments, and (3) cross-beam experiments

Rotatable Time-of-Flight Mass Spectrometer with Laser Window Specifications

Rotation Mechanism

Thermionics differentially pumped rotary seal, Model RNN-600/FA	
Flange	Mates with 8" O.D. ConFlat

Laser Window

Materials	Quartz, sapphire, MgF, LiF
Mounting	The large windows are mounted on the center, while smaller windows can be mounted off center or on center
Window seal	Braze, weld, O-ring, or ConFlat mounted windows depending upon material

Time-of-Flight Mass Spectrometer

Extractor lens	1.0" I.D. with nickel mesh and independent voltage control
Steering plates	Four plates; two of the plates are at right angles and have independent voltage; the other two plates are wired to the extractor
Drift tube	4" long with nickel mesh on the top and bottom and independent voltage control
Detector	Chevron CEMA with 50 ohm collector connected to a 50 ohm impedance BNC vacuum feedthrough via a 50 ohm UHV coax cable
High voltage feedthroughs	Six MHV vacuum feedthroughs
Model No.	**RTMS-9500** Rotatable time-of-flight mass spectrometer with quartz laser window

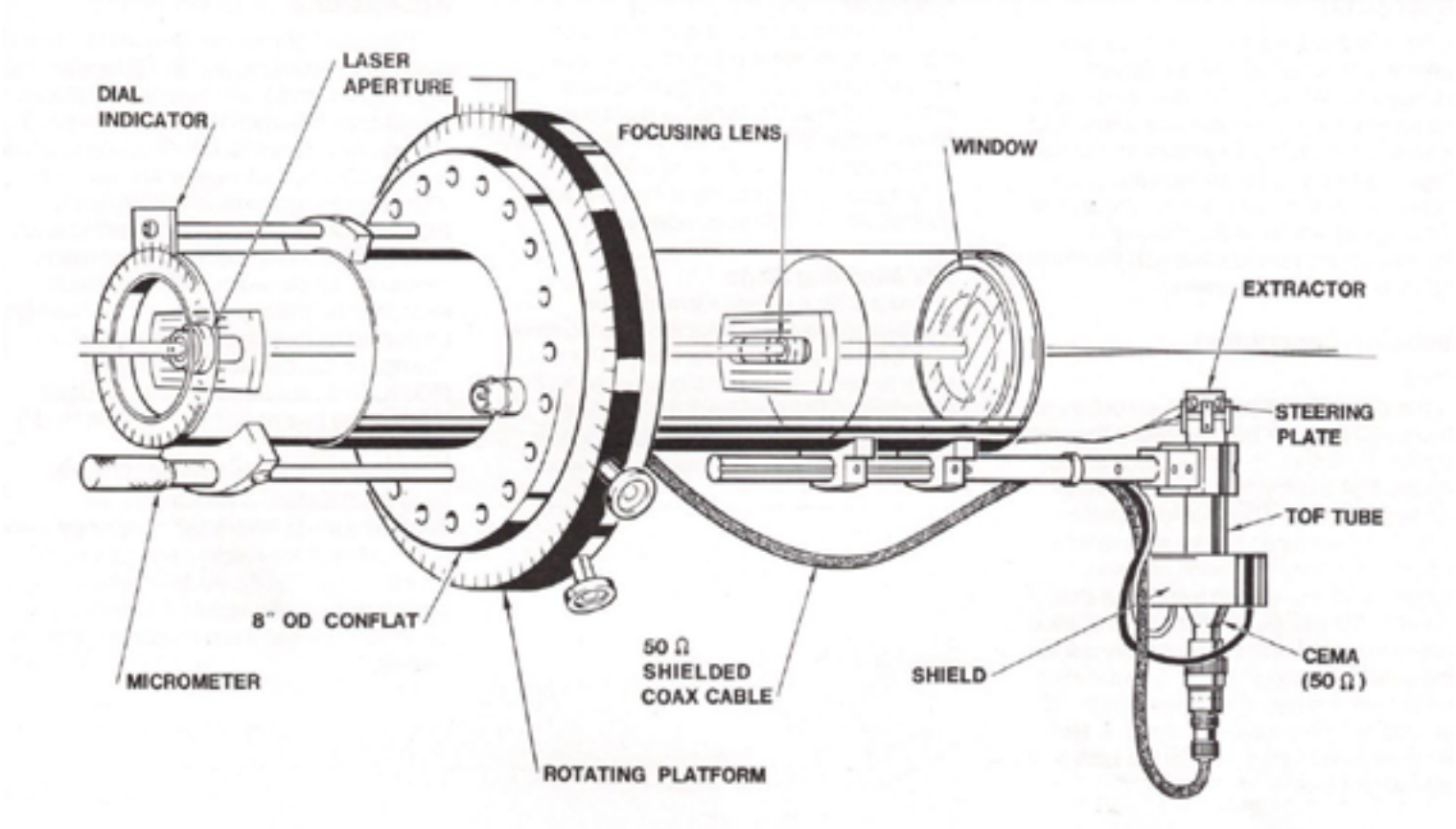
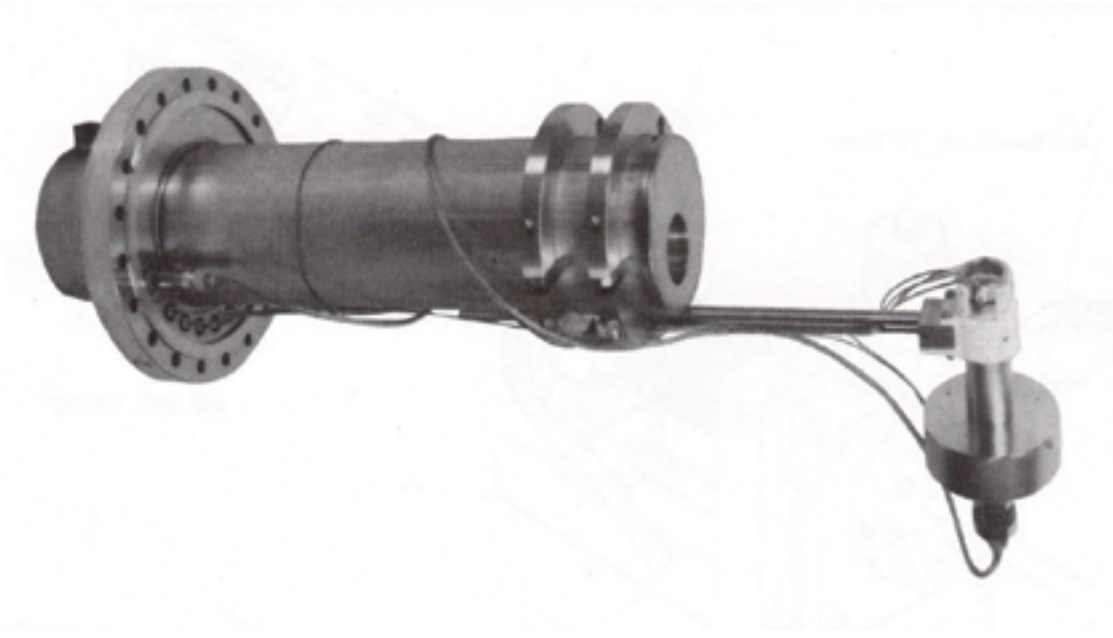


Fig. 12-17. Diagram of RTMS-9500 rotatable time-of-flight mass spectrometer with laser window



RTM S-9500

12 Molecular Beam Pulsed Nozzle Valve

Description

The MB-9600 is a precision molecular beam source which utilizes a solenoid-activated pulsed valve (General Valve type) with an electronic controller, and is mounted on an XYZ stage. The Thermionics controller offers a significant cost savings and greater sophistication than other controllers, and the XYZ stage allows quick mounting and alignment of the pulsed valve with skimmers and other vacuum equipment.

Technical Description

Valve

The pulsed valve can produce pulses as short as 300 µsec or be operated in the open position. Pulses as short as 3 µsec can be achieved by employing a chopper wheel, also available from Thermionics. Aperture sizes of 100 microns to 2 mm are available. The valve consists of a Teflon or Delrin plunger which mates with a stainless steel aperture. The plunger is attached to a Teflon-coated magnet which is actuated by a solenoid outside the valve. The only materials in contact with the gas are stainless steel, Teflon, and the Teflon-coated magnet. A 1/4" or 1/8" Swagelok fitting connects the valve to an external gas supply.

Controller

The pulsed valve controller is impedance matched to the valve solenoid to produce smooth opening and closing of the valve without "bounce," "ringing," or extra pulses. The controller allows the user to vary the open time. In addition, a delay is included for synchronizing the opening of the valve with another device such as a chopper.

XYZ Mounting Stage

Frequently, a pulsed valve must be precisely aligned with an aperture, a skimmer, laser beams, or a molecular beam. This is easily accomplished with the supplied XYZ manipulator. The position of the nozzle is accurately varied using micrometers which can be locked once alignment is achieved.

Technical Description

The pulsed source can be used for (1) time-resolved experiments and for (2) formation of high intensity molecular beams. The pulsed valve allows operation with a very low Knudsen number (compared to continuous sources) and hence produces beams with very low rotational temperatures which are nearly monoenergetic. This is most advantageous for (3) Doppler-free spectroscopy experiments and for (4) beam-surface reaction experiments. The high cooling rates can also be utilized for formation of cluster beams. The nozzle can be fitted with a heater (500°K). The heated source can produce high energy beams (0.75 eV for N_2 in H_2; 3.5 eV for Xe in H_2).

Researchers in the fields of (1) cluster beams, (2) surface chemistry, (3) time-resolved surface infrared spectroscopy (FTIR), (4) surface electron energy loss spectroscopy (EELS), (5) molecular beam epitaxy, and (6) ultraviolet third harmonic generation will find this pulsed valve to be of interest.

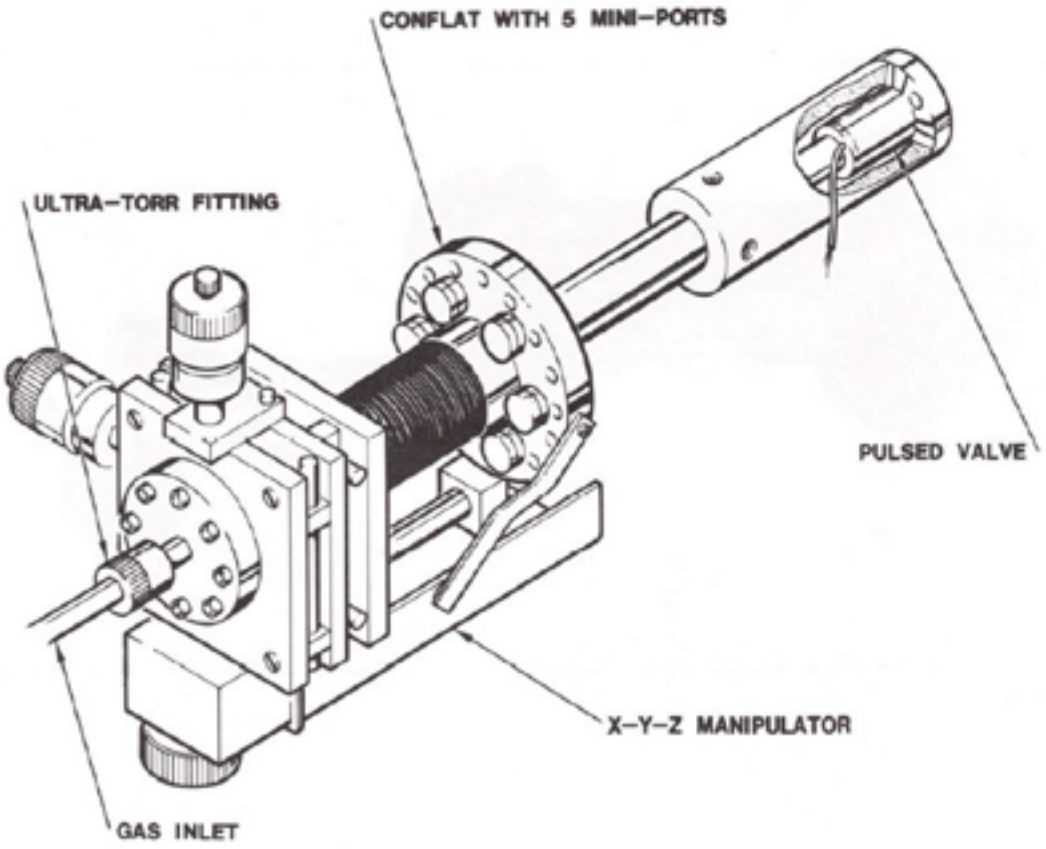


Fig. 12-18. Schematic of molecular beam pulsed nozzle valve.

Pulsed Nozzle Valve Specifications

Nozzle Specifications

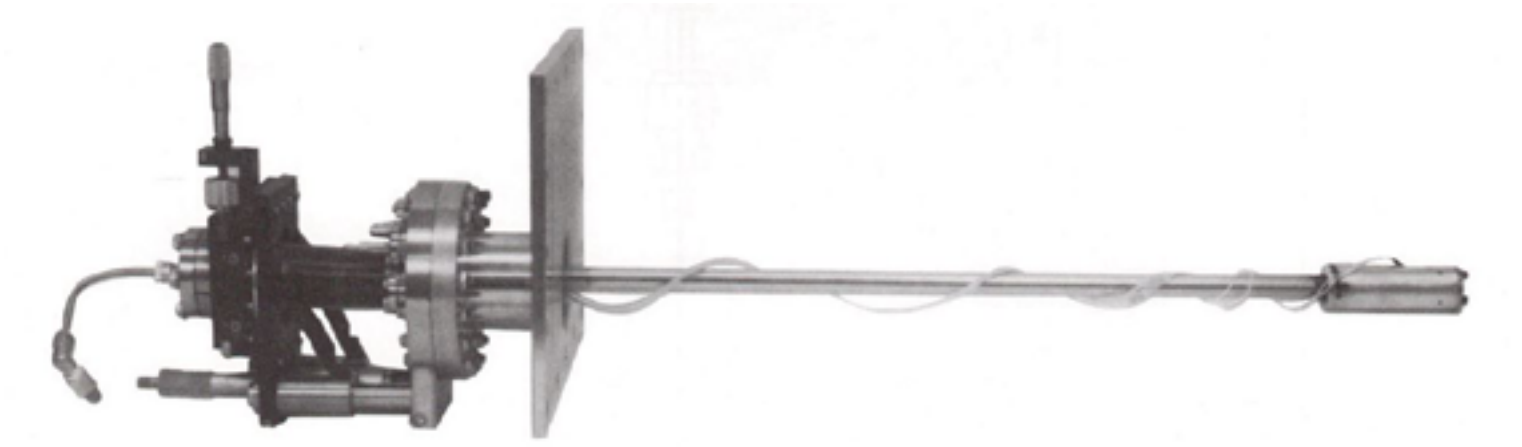
Manufacturer	General Valve
Valve type	Solenoid activated
Aperture size	100 microns to 2 mm
Materials	All stainless steel except plunger (Teflon or Delrin) and the magnet (Teflon-coated iron)
Gas fitting	1/8” or 1/4” Swagelok

Electronics

Opening time	30 µsec minimum to continous open
Variation of opening time	Open time is varied via a front panel knob
Synchronization	Three modes: (a) manual, (b) external, (c) delay
Manual mode	The valve opens in response to a button on the control panel
External mode	The valve opens in response to an external TTL pulse
Delay mode	The valve opens after a finite delay after receiving an external TTL pulse. The delays are user adjustable from the front panel

Mounting Stage — EC 1600

Purpose	To align the pulsed valve with a skimmer or laser beam
X-Y motion	±1/2” in each direction
Z motion	±1” external to vacuum. Additional Z motion is achieved by repositioning the pulsed valve on the manipulator shaft
Position indicators	Micrometers with locking screws
Model No.	**MB-9600** Molecular beam pulsed valve
Model No.	**PS-9600** Controller



MB-9600

12 Heated/Chilled Molecular Beam Nozzle

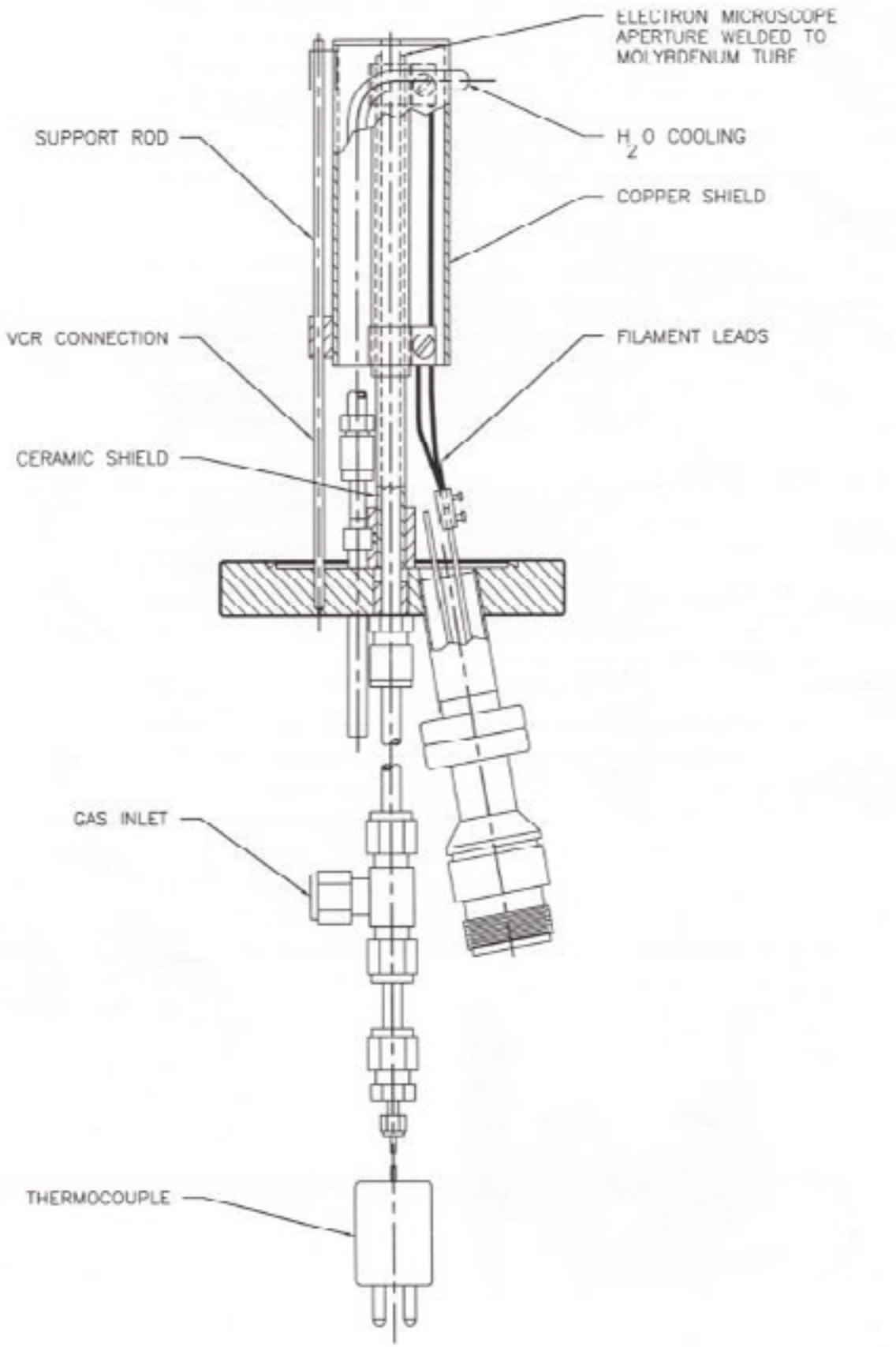


Fig. 12-19. Diagram of heated/chilled molecular beam nozzle.

Description

The MBN-9700 is a heated/chilled molecular beam source which can produce continuous monoenergetic molecular beams (free-jets) with a stagnation temperature of +100°K to +1,600°K. This source can generate beams with very high transitional energies (3 eV for N_2 seeded in H_2, 14 eV for Xe seeded in H_2) or rotationally cooled but vibrationally hot beams. By operating the nozzle at low pressure and high temperature, atomic beams can be formed from molecular gases. The nozzle can also be operated at low temperature with liquid nitrogen cooling, thus allowing the formation of cluster beams or very low energy molecular beams.

Short pulses (3 µsec) can be produced by employing a chopper in conjunction with the heated nozzle. A chopper with associated electronics is available from Thermionics.

Nozzles

Metallic nozzles are formed from molybdenum tubes with molybdenum electron microscope apertures welded onto one end. Aperture sizes as small as 25 microns are available. The gas connection to the tube is a VCR fitting.

Alumina tubes with apertures as small as 200 microns can also be provided. These tubes are cemented to a gas fitting. Ceramic nozzles are most advantageous when using halogens or oxygen.

Heating

The nozzle tubes are enclosed in a ceramic shield and are resistively heated. The gas temperature can be directly measured with a shielded thermocouple inserted inside the nozzle tubes (3/16" ID.). The heating can be regulated manually using a Variac or with a feedback circuit which employs the thermocouple.

Cooling

For high temperature work, the entire nozzle assembly is enclosed in a water cooled copper shield. For low temperature, the shield is chilled by liquid nitrogen, and temperature regulation is achieved by mildly heating the nozzle.

XYZ Mounting Stage

Frequently, a heated nozzle jet must be precisely aligned with an aperture, skimmer, laser beams, or molecular beam. A low-cost bellows sealed XYZ stage is available with mounting hardware for the heated nozzle. The position of the nozzle is accurately varied using micrometers.

Applications

(1) Generation of energetic beams for chemical studies.
(2) Formation of atomic beams (chlorine or fluorine) for etching of semiconductors.
(3) Formation of vibrationally excited rotational cold species for spectroscopic studies.
(4) Formation of cluster beams.
(5) Generation of very low energy beam for diffraction and epitaxy studies.

Heat/Chilled Molecular Beam Source specifications

For Metal Tubes

Material	Molybdenum
Tube size	1/4" O.D.; 35/1000" wall
Aperture diameter	20 microns-400 microns
Aperture thickness	10 microns
Maximum temperature	1,200°C
Gas connection	1/4" VCR brazed onto the tube

For Ceramic Tubes

Material	Alumina 99.8%
Tube size	1/4" O.D.; 3/16" I.D.
Aperture diameter	200 microns (min.)
Aperture thickness	200 microns
Maximum temperature	1,400°C
Gas connection	1/4" VCR cemented onto the tube

Thermocouples

Type	Customer supplied or specified
Protection tubes	Alumina available
Location of thermocouple junction	In the nozzle gas about 1 cm behind the nozzle

Heater

Type	Silicon carbide
Power requirement	110 VAC at 15 A
Model No.	**MBN-9700** Heated/chilled molecular beam nozzle

12 Differentially Pumped Molecular Beam Source Chamber

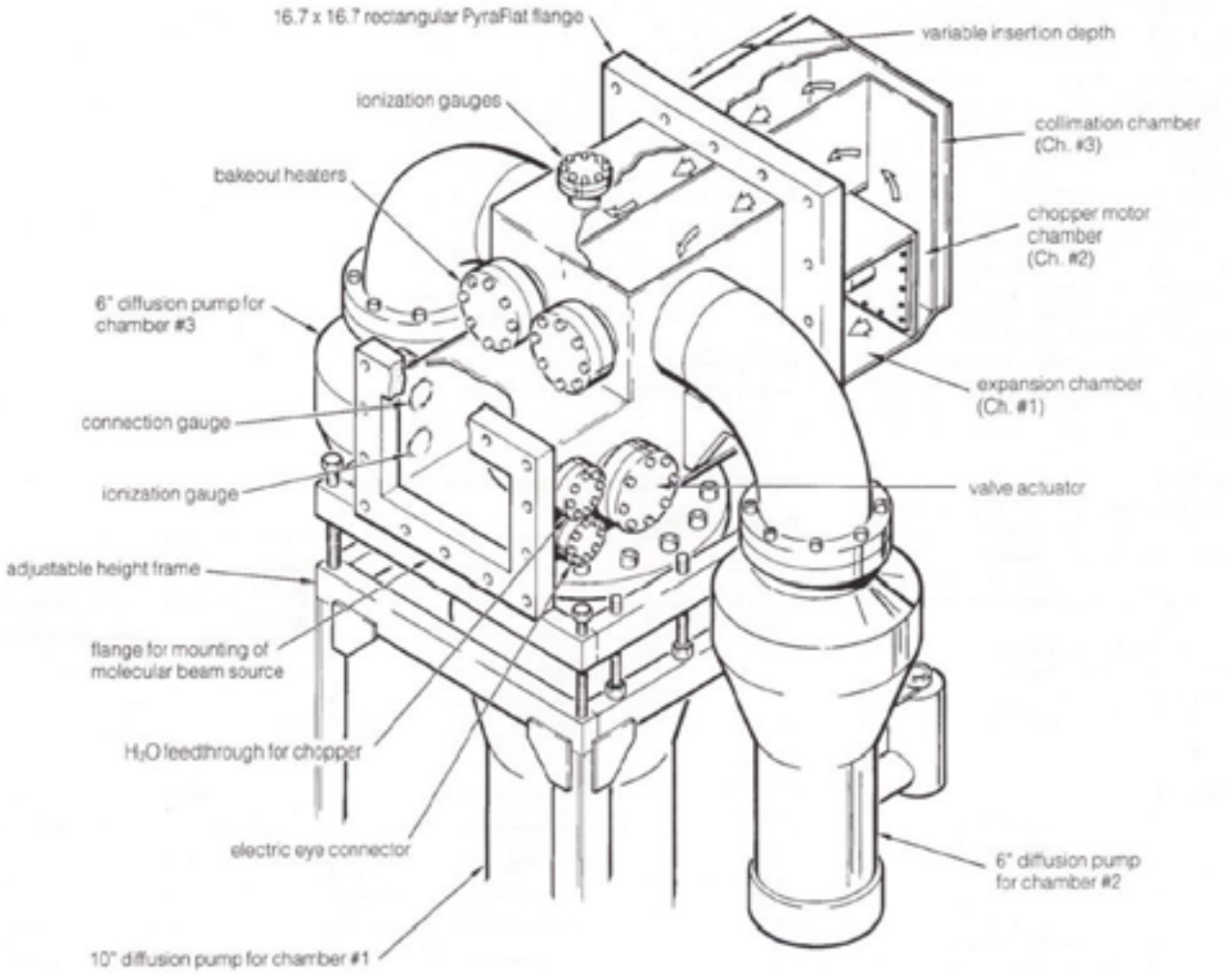


Fig. 12-20. Diagram of differentially pumped molecular beam source chamber with chopper wheel.

Model No.	**MSC-9800** Molecular beam source chamber

Includes:

Chopper motor, chopper wheel, chopper motor drive, electric eye with electronics skimmer and collimator with ionization gauges

Not Included:

Pumps, nozzle, pumped valve source, or ionization gauge controllers

Description

The MSC-9800 is a differentially pumped molecular beam source. It consists of three chambers which are designed to minimize the distance between the nozzle and the final collimator (3.5").

The first (expansion) chamber (1 x 10^{-7} Torr) is a high conductance chamber which directly pumps on the molecular beam source. The molecular beam leaves the expansion chamber via a skimmer and enters the second (chopper motor) chamber.

This second chamber (2 x 10^{-9} Torr) contains a water-cooled 400 Hz chopper which enables the beam to be chopped into microsecond- long pulses. The second chamber also contains a miniature gate valve which allows the first and second chambers to be independently brought up to atmospheric pressure. The molecular beam leaves the second chamber via a collimator inside the gate valve and enters the third (collimator) chamber.

The third chamber is typically maintained under very high vacuum (2 x 10^{-9} Torr); it serves as both a final collimation stage and to differentially pump the miniature gate valve. The beam leaves the collimation chamber via a removable collimator (1-10 mm dia.) and enters the UHV chamber.

Pumps and Flange Sizes

A large rectangular source has been constructed which bolts onto a Thermionics 16.7" x 16.7" PyraFlat. This source has high conductance and thus permits the formation of intense molecular beams. The first chamber is pumped by a 10" pump via a 16" ASA flange, while the second and third chambers are pumped by 6" pumps via 8" O.D. ConFlats.

Applications

The chamber is compatible with the pulsed sources, heated nozzle, and chopper drive manufactured by TLI. Thus, this chamber is most useful for beam-surface experiments, as well as time-resolved experiments under UHV conditions.

Model No.	**CW-9810** Chopper wheel as separate item

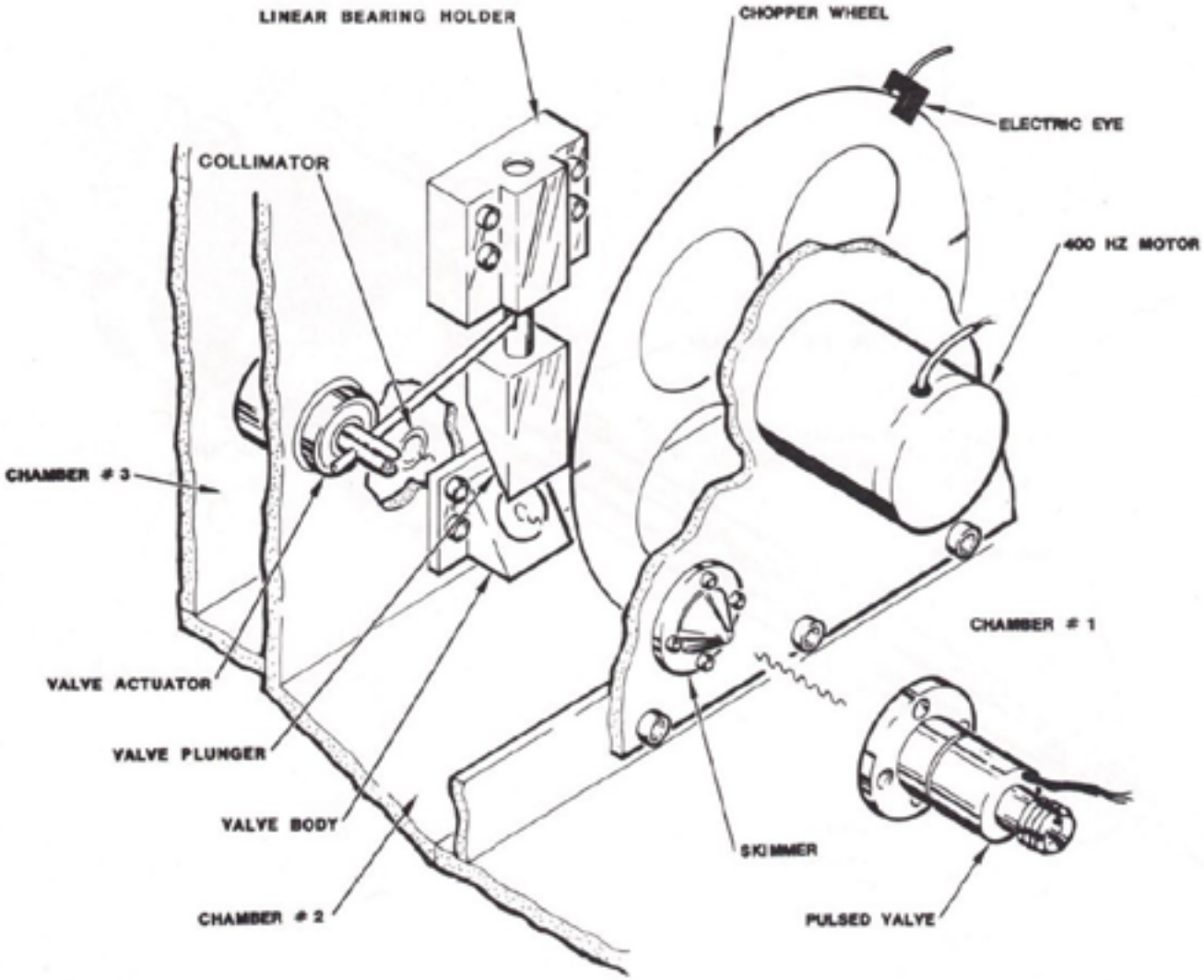


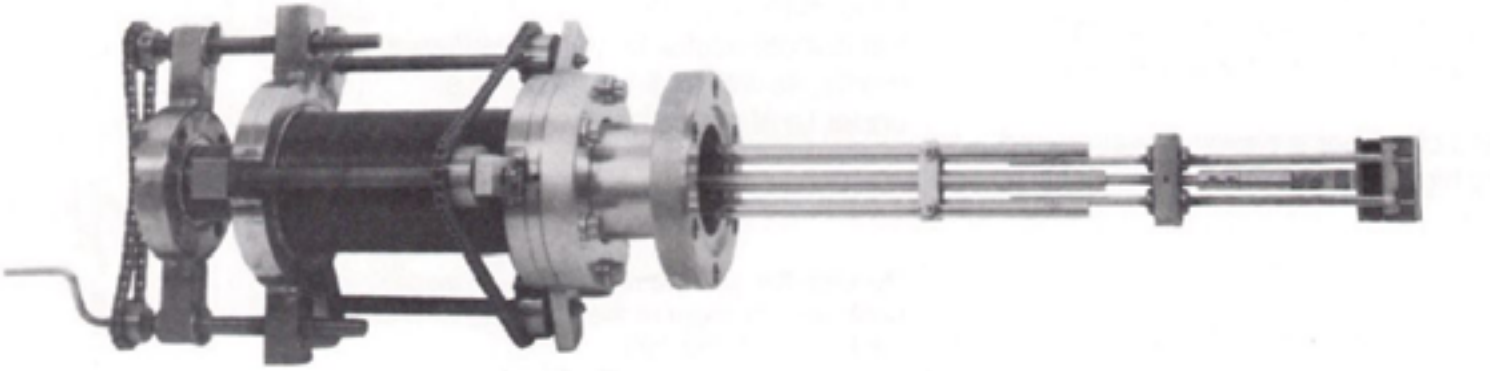
Fig. 12-21. Diagram of chopper wheel.

12 Crystal Cleaver

The 0-9900 is a UHV cleaver which can cleanly cleave 3/8" wide samples. The cleaver has a specially designed backstop to prevent samples from being dislodged from their holder. The entire cleaver can be retracted by 2", allowing it to be employed in close quarters. The cleaver blade is a standard razor blade and is easy to replace. Samples cleaved with this device have been "found flat" using atomically resolved scanning tunneling microscopy.

Heater

Blade travel	≈1"
Blade and backstop retraction	≈2"
Blade metal	Stainless
Linear bearings	Stainless
Mounting	2 3/4" ConFlat
Flange to sample	9" standard
Smoothly cleaved area	90% with good sample-to-blade alignment
Model No.	**C-9900** Crystalcleaver



C-9900

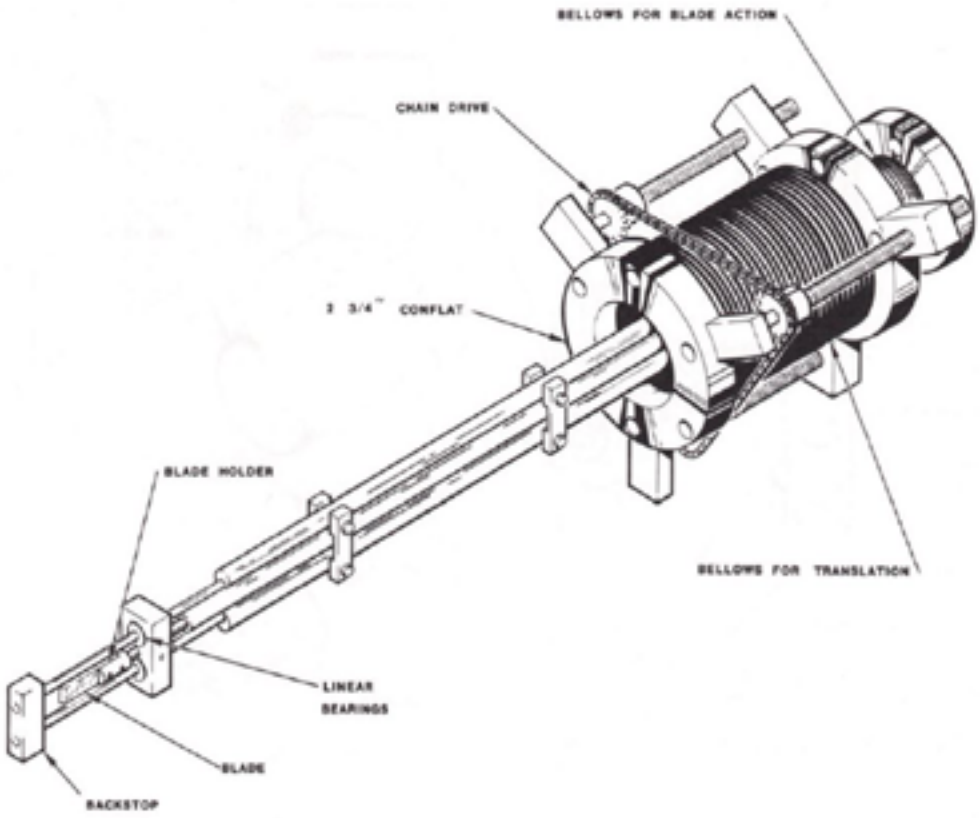


Fig. 12-22. Diagram of crystal cleaver

(360) 385-7707
thermionics laboratory, inc.
Vacuum Innovation Since 1958
sales@thermionics.com

Description

The quick change manipulator gearbox allows rapid sample exchange with a sample carousel or surface science spectrometer (STM, EELS, FTIR) without the use of transfer arms. In addition, the manipulator allows 1200 of flip rotation. The sample can be heated and cooled between 100°K and 1,300°K with precise temperature measurement.

Design

Rotations

360˚ rotation about the vertical axis by use of a rotary platform with 120˚ flip motion by means of worm gear drive.

Translations

Narrow neck allows use of 1.5" I.D. bellows for Z translation, thus making a long Z stroke manipulator quite affordable.

Cooling

A liquid nitrogen reservoir is coupled to the sample by a large OFE copper ribbon.

Heating

Sample is conductively heated by a tantalum filament. The sample is electrically isolated from the heater as well as the manipulator. This allows for measurement of electron beam or ion beam current during Auger, LEED, etc.

Sample Exchange

The sample exchange is accomplished using the X-Y-Z motion of the manipulator.

Sample Size

3/8" standard, but a larger manipulator head can be made to accommodate larger sample.

Applications

Manipulation of sample where heating, cooling, temperature measurement, and flip rotation, as well as sample exchange, are required.

Model No.	**GB-11** Quick change manipulator gearbox

Includes:

Gearbox, cryostat and feedthroughs

Not Included:

RNN differentially pumped rotary seal, XYZ manipulator and rotary feedthroughs. Customer must supply; for complete information and assistance, contact the factory.

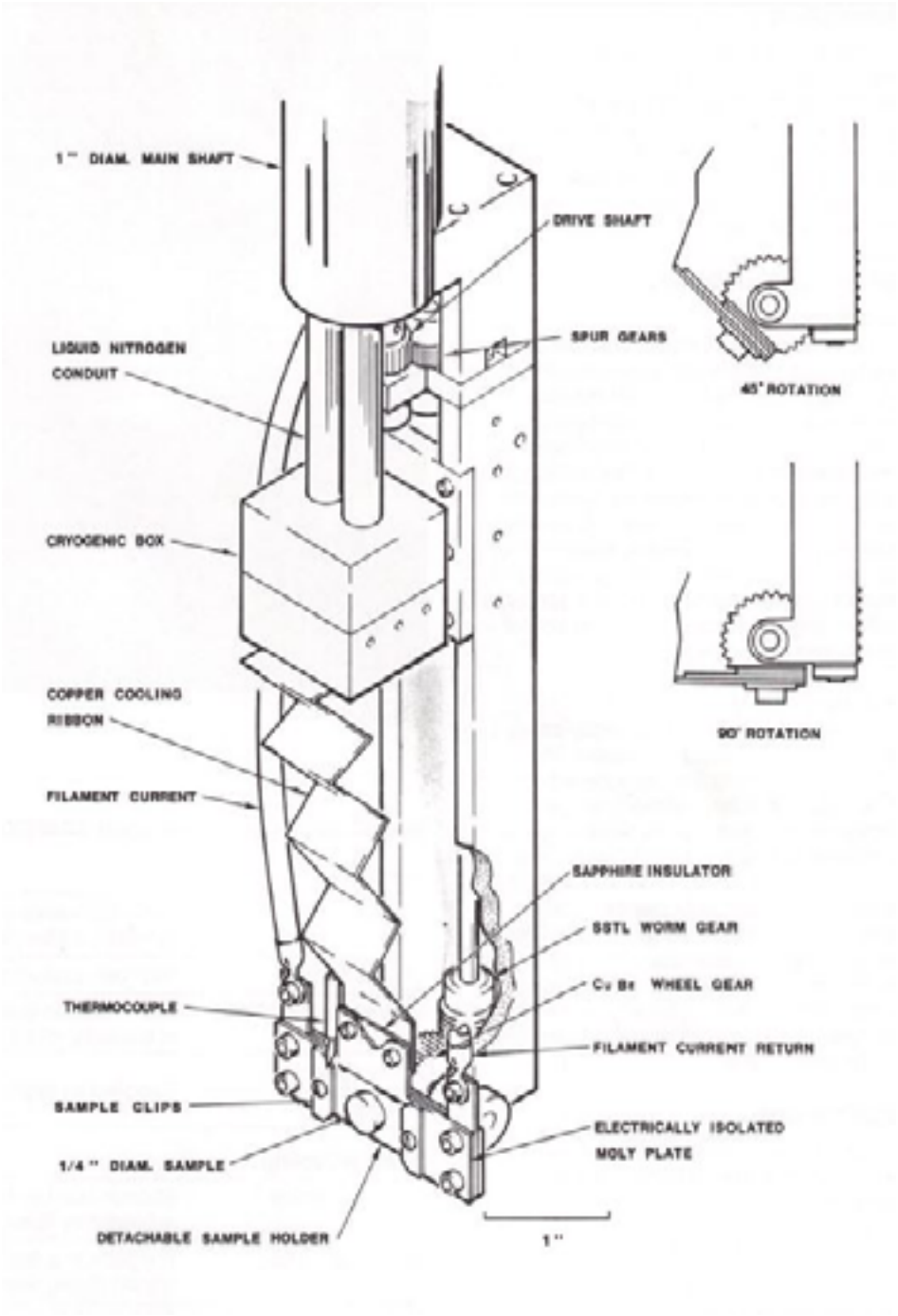


Fig. 12-23. Diagram of quick change manipulator gearbox/sample holder

12 Miniature SAM (Six Axis) Manipulator Gearbox

Description

The “SAM” miniature manipulator allows small samples (2-3 cm dia.) to be rotated over three orthogonal axes and translated in the XY- Z directions. The sample can be heated or cooled between +100°K and +2,100°K. The manipulator is only 2” wide, yet has six axes of motion plus heating and cooling. For more information, see Section 3.

Technical Description

Rotations

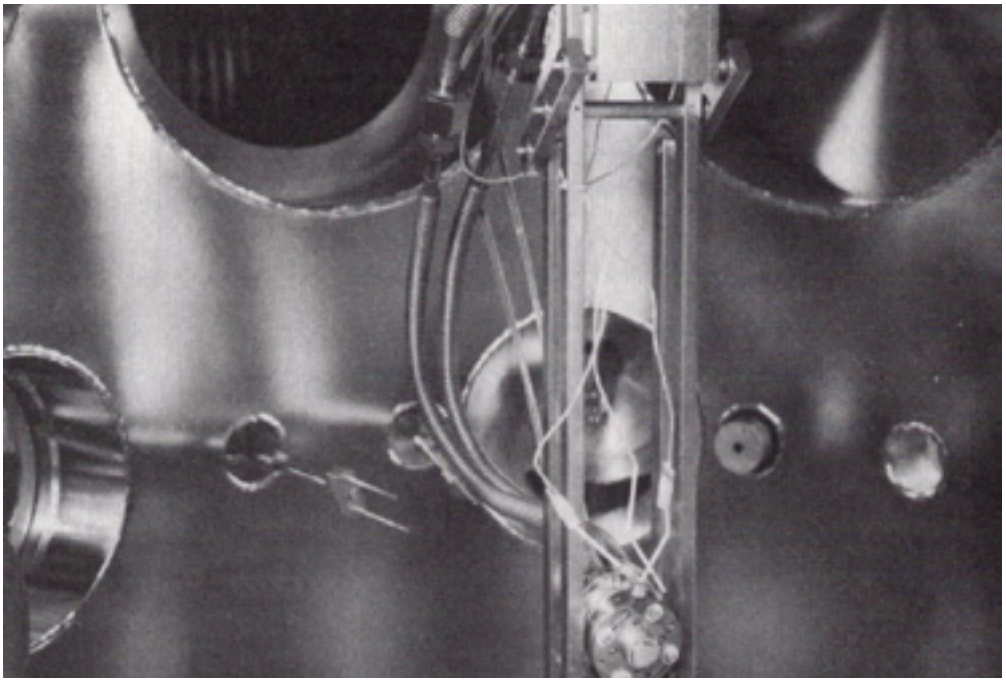
(1) Rotation about the vertical direction (manipulator shaft) is achieved using a UHV rotary stage (see Section 3). (2) Rotation about the horizontal axis is via the pantograph. This pantograph is directly rotated by a rotary motion feedthrough. The pantograph design removes the mechanical parts from the vicinity of the sample face, thus allowing the sample to be accessed by electron, molecular, or laser beams. (3) The azimuthal rotation about the sample normal is achieved by mounting the manipulator on the front of a customized rotary feedthrough.

Heating/Cooling

The sample holder is electrically isolated by means of a thin sapphire washer. The sapphire washer sits directly upon a miniature (1.38” dia) molybdenum liquid nitrogen cooled cryostat. A miniature electron gun is positioned behind the sample holder, thus allowing electron bombardment heating of the sample. A thermocouple is attached either to the sample or sample holder. The temperature regulation is achieved by controlling either the bias of the electron gun or the filament current. This allows for stable temperature regulation both at high and low sample temperature.

Technical Description

Sample manipulation over six axes of motion where pressure bursts cannot be tolerated.



GB-8/OA

Specifications for the Miniature SAM (Six Axis) Manipulator

Rotations

Flip/tilt	105°-150° range depending upon application. Motion is controlled by a rotary feedthrough and a pantograph
On axis rotation	360° with a rotary seal (RNN)
Polar aximuthal rotation	±30°. Rotation is achieved by mounting the manipulator on the front of a special rotary feedthrough
X-Y motion	Supplied by manipulator
Z motion	

Heating/Cooling

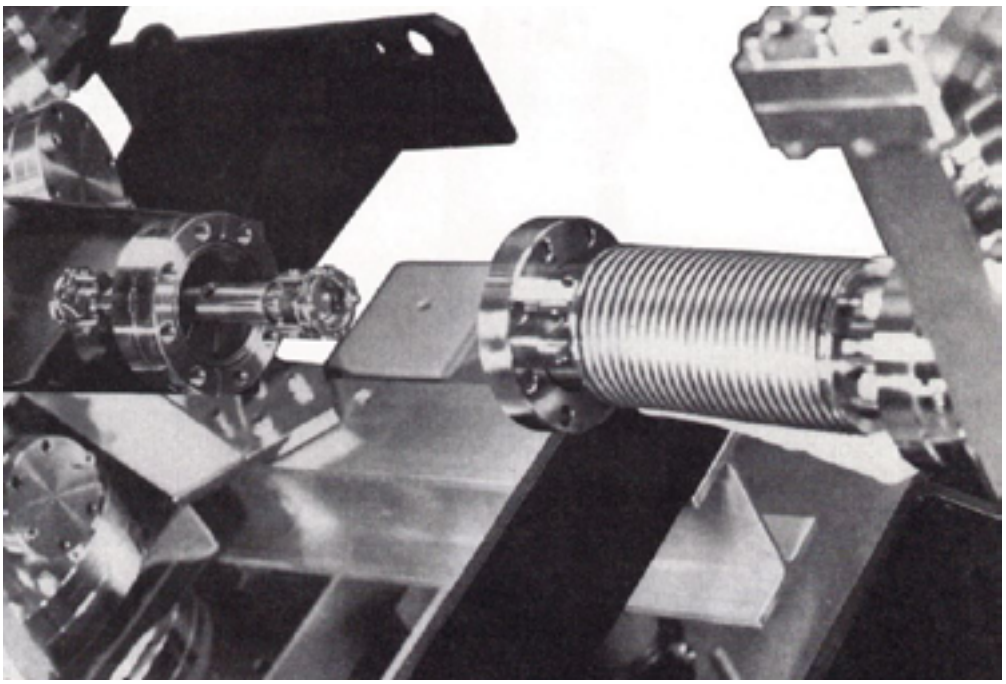
Heating element	Electron bombardment heating on the back face of the crystal is achieved by heating tungsten filaments and biasing the power supply
Surface potential	The sample is electrically isolated and can be grounded or negatively biased during heating
Cooling	The sample sits directly on a liquid nitrogen cooled cryostat (NO COPPER BRAID IS EMPLOYED)
Thermocouple	A W-Re thermocouple is spot welded to the sample or sample holder

Sample Holders

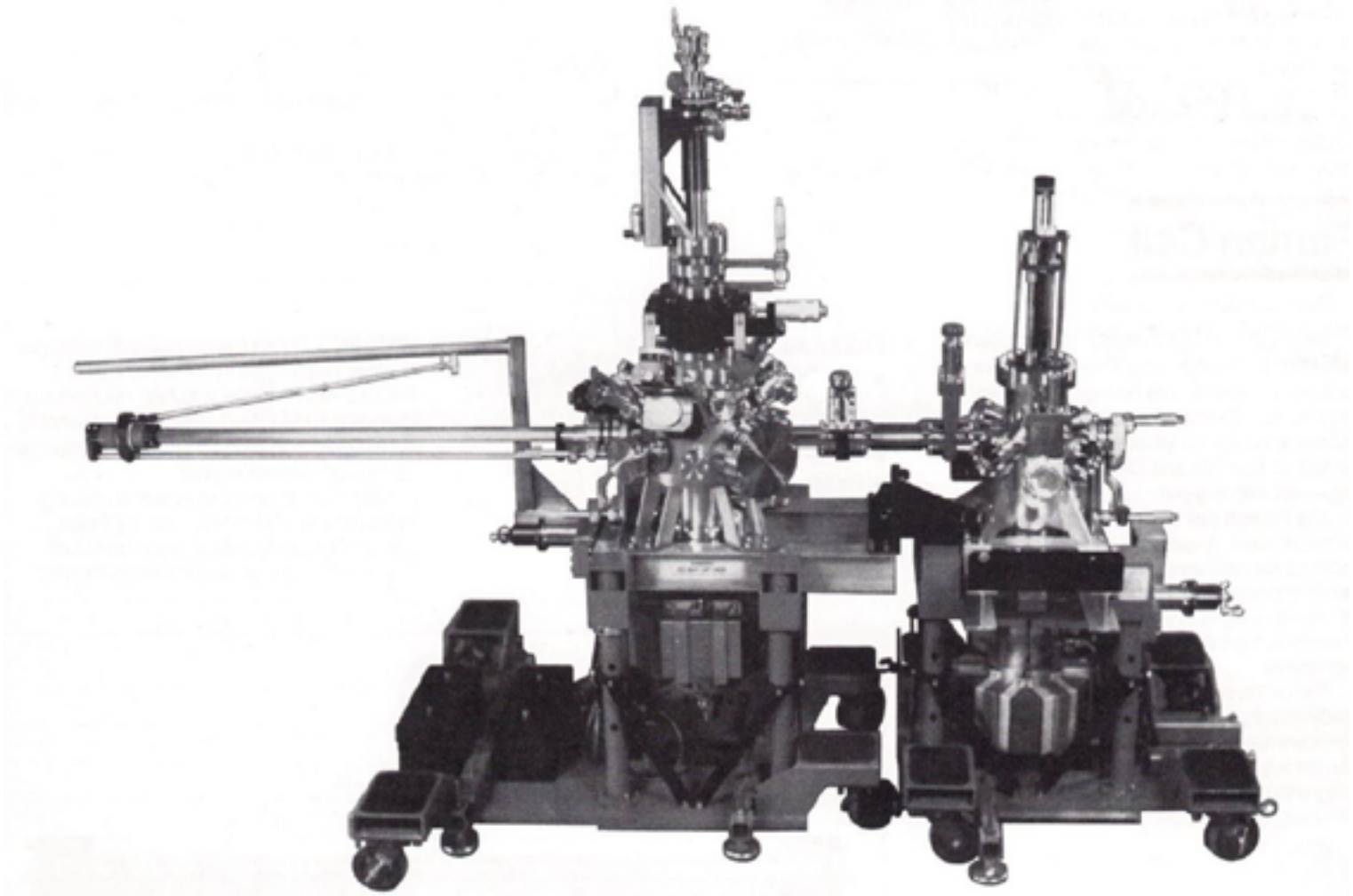
Type	The sample holders are thin pressed disks with a platform for the sample. The electron gun sits inside the platform, thus shielding the sample from the electron gun.
Material	Molybdenum is standard
Model No.	**GB-8/0A** Miniature SAM manipulator gearbox

Description

Portable equipment carts permit modular assembly of complex UHV systems. They allow vacuum systems to be transported, raised and lowered for joining to existing systems and nested together when required. The carts are readily customized including such standard features as a heavy steel base plate, outrigger casters with wheel brakes, and counterbalancing. The base carries four support jack assemblies which are motor driven and lift equipment payloads up to 1,000 lbs. evenly.



Sample transfer from chamber 1 to chamber 2



Two modular carts in tandom (they are easily joined with the aid of guide pins—a bellows assembly completes the UHV channel)

12 UHV Cold Trap Assembly

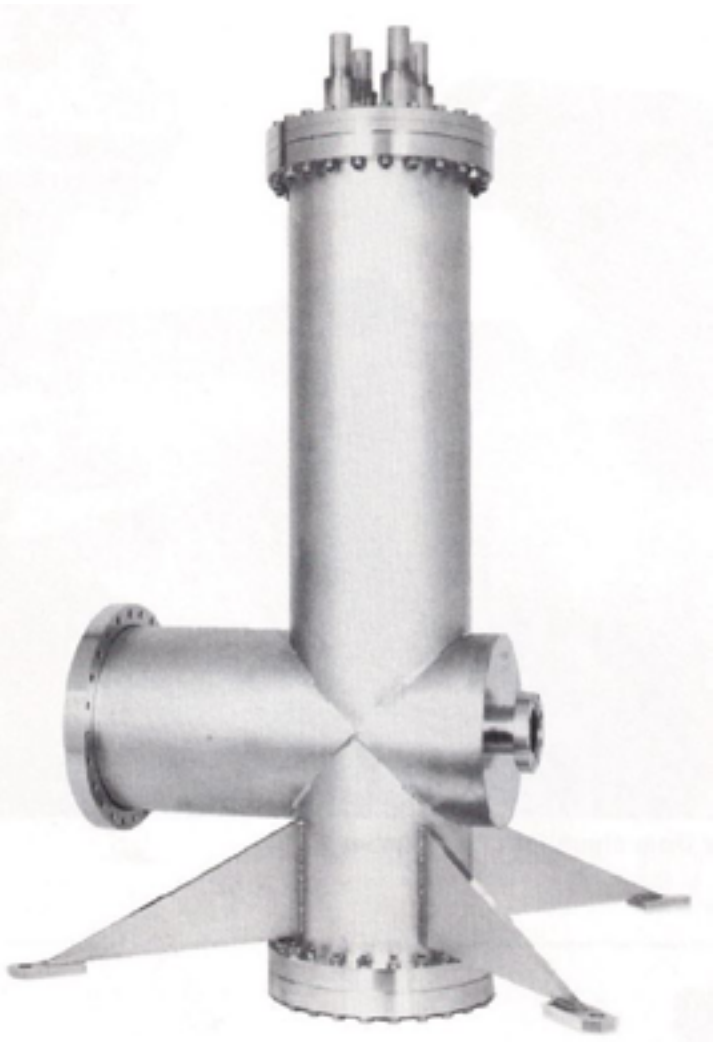


Fig. 12-25. LNT-701.

The LNT-700 is a cold trap which allows a diffusion pump to bring a well-baked chamber to the 10^{-11} Torr pressure range. This trap is designed to work with Edwards and Alcatel diffusion stacks which have built-in water baffles and ConFlat mating flanges. The TLI UHV trap is designed to eliminate the problem of evaporation off the LN_2 reservoir as the liquid nitrogen level falls. A diffusion pump with a TLI UHV trap combines the advantages of (1) vibration-free pumping, (2) pumping of noble gasses, (3) low ultimate pressures, and (4) all ConFlat flange construction (no indium or Viton seals).

Specifications

Baffle flange	13 1/4" ConFlat
Mating flange to pumping	13 1/4", 10", 8", or 6" ConFlat
Mating flange to chamber	10" ConFlat
Reservoir LN_2 life	9 hr standard (other sizes on request)
Conductance	900 l/sec
Baffle material	OFE copper
Model No.	**LNT-700** UHV liquid nitrogen trap
Model No.	**LNT-701** Same as LNT-700, with additional port for TSP (see page 2-18 for TSP)

Options

- Liquid nitrogen level controller—allows LN2 level to be maintained (see page 6-12)
- Integral bakeout lamp (see Section 10)
- Steel stand for trap and pump

Raman Cell

The model RC-9300 Raman cell is used to generate tunable UV and IR radiation from tunable dye lasers.

The Raman cell allows wave length shifting of laser radiation to both the red and blue on infinite laser beams. Orders as high 5th anti-Stokes have been achieved with this cell. The Raman cell is fabricated from stainless steel. A special chemical polishing process allows the cell to be pumped down to very low pressures prior to backfill, and minimizes outgassing from the cell after filling. Therefore, the contained is maintained at very high purity.

The cell is supplied with stress-free, laser feedthrough windows. Suprasil quartz windows are supplied standard, but the cell can be supplied with quartz, sapphire, magnesium fluoride, or lithium fluoride windows, at extra cost.

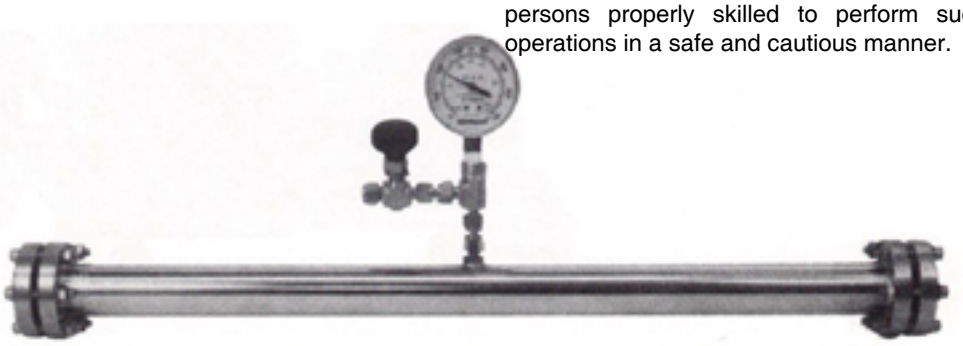
Features

- 1.5" O.D. tube, 24" long, with 2.75" end flanges
- All metal, backfill valve
- Two Suprasil quartz windows
- Pressure gauge

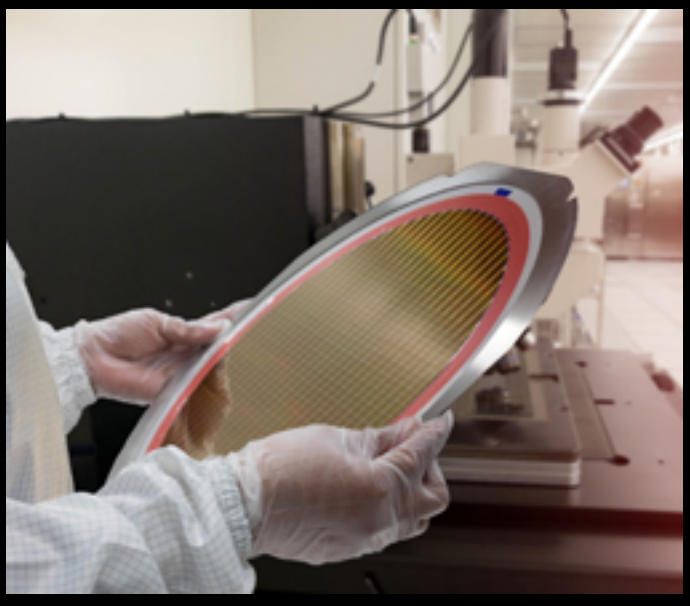
Model RC-9300

WARNING: Using this device with hydrogen or other volatile gases: OPERATIONS INVOLVING HYDROGEN ARE HAZARDOUS, including EXPLOSIVE. Materials commonly considered non-hazardous become dangerous in such environments.

We recommend that systems utilizing hydrogen be undertaken only by those persons properly skilled to perform such operations in a safe and cautious manner.



Vacuum Components & Systems



thermionics laboratory, inc.
Vacuum Innovation Since 1958

Thermionics Laboratory, Inc.

3118 Depot Road,
Hayward, CA 94545
Phone: (510) 225-6975 ext 100
Toll Free: (800) 962-2310
Email: sales@thermionics.com
Website: thermionics.com

Thermionics Northwest, Inc.

231-B Otto Street, Port
Townsend, WA 98368
Phone: (360) 385-7707
Toll Free: (800) 962-2310
Email: sales@thermionics.com
Website: thermionics.com