

For over 50 years Vacuum Barrier has provided innovative solutions to the problems associated with handling liquid nitrogen. When industry required liquid nitrogen in large volume for various modern production processes, it was our products and engineering that helped firms meet their requirements practically and efficiently. A continuing commitment to research and development in cryogenic and vacuum technology has made us a pioneering force in the field and given our customers a competitive edge.

Vacuum Barrier's first automated liquid nitrogen piping system employed vacuum jacketed rigid piping. The limitation of rigid pipe and the increasingly sophisticated demands of industry led to the development of both dynamic and sealed bendable pipe available in OHFC Copper and Stainless Steel. SEMIFLEX® systems boast the lowest cool down and steady state heat loss of any liquid nitrogen piping system available. The Triax Liquid/Vapor Separator and Vapor Vent enhancements deliver liquid nitrogen at low pressure and in pure liquid condition.



### SEMIFLEX® system configurations

In order to meet the pressure and quality requirements of various industrial applications for liquid nitrogen, Vacuum Barrier offers SEMIFLEX® liquid nitrogen in three major system configurations.

#### SEMIFLEX®

Both dynamic and sealed SEMIFLEX® systems deliver liquid nitrogen at bulk tank pressure (normally 25 to 125 psig) in two-phase condition. Basic SEMIFLEX® systems are commonly used in applications that simply require transfer of liquid or refrigeration.

#### SEMIFLEX®/Vapor vent

SEMIFLEX®/Vapor Vent systems employ a mechanical float operated device which minimizes two phase flow – maintaining liquid nitrogen in SEMIFLEX® at storage pressure.



SEMIFLEX®/Vapor vent

#### SEMIFLEX®/Triax/Liquid vapor phase separator

SEMIFLEX®/Triax systems deliver liquid nitrogen in pure liquid form at pressures of 1 to 10 psig. The addition of Triax pipe and Liquid /Vapor Separators completely eliminates two phase flow to use points. In this special system, all of the losses of the total system are vented to the atmosphere separately. Pure low pressure liquid nitrogen is delivered by gravity to each use point on demand. By separating gas losses and venting them prior to liquid delivery no gaseous nitrogen passes through your equipment. SEMIFLEX®/Triax systems are commonly used in applications where pure liquid is critical to the production processes.



SEMIFLEX®/Triax/Liquid vapor phase separator

## Major Component Descriptions

SEMIFLEX® is available in both sealed and dynamic vacuum. The sealed vacuum pipe is constructed of Stainless Steel and the dynamic vacuum pipe is constructed by either OHFC copper or Stainless Steel. Dynamic SEMIFLEX® is continuously evacuated by a pump to provide a dynamic vacuum. Both sealed and dynamic systems consist of SEMIFLEX® pipe with the addition of elbows, crosses, tees and end fittings for connection to the source of supply and the points of outlet. These systems

can be simple point-to-point hook up, or for a multi-branch network supplying an entire plant from a single storage tank.

Triax pipe is similar to SEMIFLEX® pipe, but consists of three concentric tubes. Vacuum is maintained in the outer annular space. Triax systems consist of SEMIFLEX® line and fittings from the supply source to a Liquid/Vapor Phase Separator. The separator continuously removes any gas generated by heat loss and

pressure drop, venting it to the outside and maintaining internal pressures in the system at approximately one atmosphere. Liquid is supplied to the use points via Triax pipe from the separator. Gaseous nitrogen returns continuously to the separator in the annular space between the inside and middle tubing. Triax systems are used where the rapid discharge of liquid nitrogen caused by high tank pressures is undesirable.

## SEMIFLEX® Engineering Data

Size	A-5	S-5	FS-5	A-10	S-10	FS-10	A-15	A-20
<b>Material</b>	OFHC Copper	St Stl	St Stl	OFHC Copper	St Stl	St Stl	OFHC Copper	OFHC Copper
<b>Inside Diameter</b>								
Inches	0.62	0.66	0.62	1.25	1.40	1.00	1.73	2.21
Millimeters	16	17	16	32	36	25	44	56
<b>Outside Diameter</b>								
Inches	1.58	2.0	1.90	2.39	3.0	2.79	2.99	3.54
Millimeters	40	51	48	61	76	71	76	90
<b>End connections – Male NPT</b>								
Inches	½	½	½	1	1	1	1 ½	2
<b>Steady State Heat Loss</b>								
BTU per foot	0.9	0.9	0.9	1.8	1.8	2.8	2	2.4
Watts per meter	0.9	0.9	0.9	1.7	1.7	2.7	1.9	2.3
<b>Cool Down Heat Loss</b>								
BTU per foot	8	4	6	15	9	16.5	21	28
Watts hours per meter	8	4	6	14	9	16	20	27
<b>Bayonet Heat Loss</b>								
BTU per hours	5	5	5	6	6	6	10	17
Watts	1.5	1.5	1.5	1.8	1.8	1.8	2.9	5
<b>Design Pressure</b>								
PSI	175	175	175	175	175	175	125	85
Bars	12	12	12	12	12	12	8.6	5.9
<b>Weight</b>								
Lbs. per foot	1.2	1.2	0.9	1.5	1.7	2.0	1.9	2.4
Kg per meter	1.8	1.8	1.3	2.2	2.5	3.0	2.8	3.6
<b>Minimum Bend Radius</b>								
Inches	20	9.25	5.5	32	12	10	40	48
Cm	51	23	14	81	30	25	102	122
<b>Maximum Length</b>								
Footage	consult factory							
Meters	consult factory							
<b>Flow Rate</b>	consult factory							

## MICROtorr II Vacuum Pump

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The MICROtorr II Dynamic vacuum pump evacuates and holds the insulation vacuum for SEMIFLEX® systems at levels of  $1 \times 10^{-6}$  torr or better, a range in which liquid nitrogen can be piped with minimum loss and least cost. It is a clean, quiet and vibration free pump station and an air-cooled oil diffusion pump with cooling fan designed for reliable and continuous 24 hours a day operation. Maintenance is extremely simple, requiring only routine oil level checks. The pump station includes an integral valve which closes in the event of power interruption and keeps your SEMIFLEX® system operable.

### MICROtorr II Engineering Data

Part number	40110	40220
Ultimate vacuum	$10^{-6}$ torr range	$10^{-6}$ torr range
Diffusion pump speed	11 liters/sec	11 liters/sec
Mechanical pump speed	3.4 CFM	4M <sup>3</sup> /hr
Electrical	115 VAC, 60 Hz 8.2 amps	220VAC, 50 Hz 4.3 amps
<b>Dimensions</b>		
Length	16.5 in	419 mm
Width	8 in	213 mm
Height	22.75 in	577 mm
Weight	65 lbs	29.5 kg

## Installation and service

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Installation is quick, easy and less costly than other liquid nitrogen piping systems. A prefabricated SEMIFLEX® system arrives at your facility in numbered sections with illustrated installation manuals. The bendable nature of the pipe reduces the number of joints and

plant modifications necessary for hanging. Bayonet connections help simplify installation. Our engineers inspect each new system after installation and conduct a series of tests to confirm vacuum integrity and proper operation. In addition, our service technicians can

be called upon anytime to modify your existing system or accommodate an expansion. Vacuum Barrier's service and support helps you reach your maximum savings from SEMIFLEX® year after year.

## Quality Control

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You can count on SEMIFLEX® systems to provide reliable, trouble free performance over a long product life. The entire manufacturing process for all system components is conducted in house under strict quality control programs. SEMIFLEX® systems are tested

before, during and after assembly. Quality control includes a series of helium mass spectrometer vacuum integrity tests to  $1 \times 10^{-9}$  std. cc per second. During assembly the test is repeated – again at the ambient temperature and pressure. When the assem-

bled pipe has passed these tests it is cooled down to  $-320^{\circ}$  F with pressure applied. This vacuum integrity test, with the inner line under pressure and at cold temperatures, simulates field conditions and assures reliable performance.

## Warranty

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Both Sealed and Dynamic SEMIFLEX® systems are backed by the industry longest warranties to protect against loss of vacuum integrity and defects in materials and factory workmanship. Inspection services for warranty claims are provided at no charge.

**VACUUM  
BARRIER VBC**  
CORPORATION

4 Barten Lane, Woburn, MA 01801  
Tel 1-781-933-3570  
Fax 1-781-932-9428  
email: [sales@vacuumbarrier.com](mailto:sales@vacuumbarrier.com)  
[www.vacuumbarrier.com](http://www.vacuumbarrier.com)



**VacuumBarrierSystems**

Rue de l'Atelier, 4  
B-1480 Tubize - Belgium  
Tel +32 2 354 71 77  
Fax +32 2 354 72 22  
email: [sales@vbseurope.com](mailto:sales@vbseurope.com)  
[www.vbseurope.com](http://www.vbseurope.com)