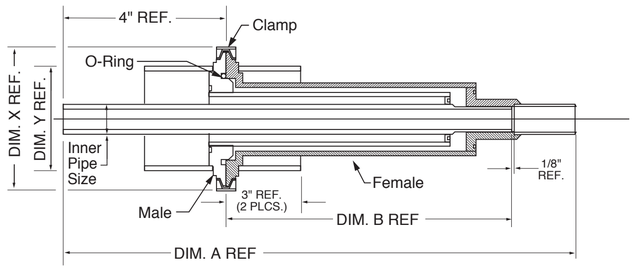
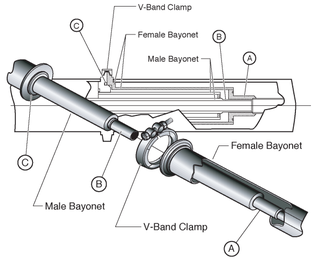
VACUUM INSULATED PIPE

MVE SHRINK-FIT BAYONET™ TECHNOLOGY



Inner Pipe	PART NUMBERS				DIMENSIONS				Outer Pipe
Size	O-Ring	Male	Female	Clamp	Dim. A	Dim. B	Dim. X	Dim. Y	Size
1/2" PS	2322231	21016797	3513241	3514751	16-5/8"	11"	3-1/8"	1-1/2" PS 1.90"	2" PS
1" PS	2322291	21019174	3513261	3514771	17-1/4"	11-5/8"	4-1/4"	2-1/2" PS 2.875"	3" PS
1-1/2" PS	2322341	20627711	10473961	3514781	20-3/4"	15-1/8"	4-3/4"	3" PS 3.50"	3-1/2" PS
2" PS	2300321	20627713	3516151	3514761	23"	17-5/16"	5-1/4"	4" PS 4.50"	3-1/2" PS



TECHNICAL DATA			
Line Size	Max Design Pressure	Weight	
		Male	Female
1/2" x 2"	366 psig	2.03 lbs	1.36 lbs
1" x 3"	206 psig	3.23 lbs	2.49 lbs
1-1/2" x 3-1/2"	150 psig	6.48 lbs	4.49 lbs
2" x 3-1/2"	150 psig	8.29 lbs	4.81 lbs

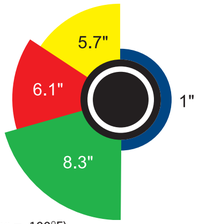
Chart's dissimilar metal bayonet design uses the thermal contraction/expansion that low cryogenic temperature gives to metals. It provides a mechanical connection for sections of vacuum jacketed pipe that have a leak tight shrink fit seal.

When cryogenic liquid passes through the bayonet, the stainless steel nose of the female bayonet (Item A) contracts and forms a tight seal on the nose of the male bayonet (Item B). The nose piece of the male bayonet is precision machined out of Invar® 36. Invar 36 was developed, with the help of NASA, to produce a material that does not shrink when exposed to cryogenic temperatures. A secondary o-ring seal (Item C) is used at the flange. To disassemble the system, simply drain the line of liquid and warm it to ambient temperature.

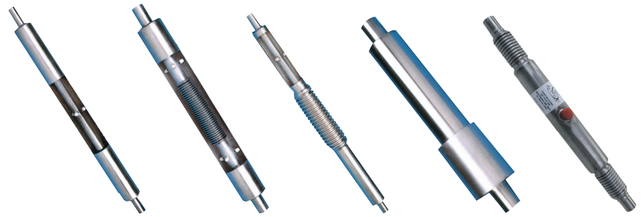
A COMPARISON

Typical System Thermal Efficiency Comparison

	THICKNESS	R-VALUE
Polyurethane Foam	5.7"	R30
Extruded Polystyrene	6.1"	R30
Cellular Glass	8.3"	R30
Chart VIP	1"	R180



Insulation thickness and associated R-value (ambient air = 80°F & pipe = -100°F)



	Invar®	Internal Bellows	External Bellows	Helium Lines	Custom Python®
FEATURES					
Heat Leak	★★★½	★★★½	★★★½	★★★★	★★★
Pressure Drop	★★★★	★★★	★★★★	★★★★	★★★★
External Durability	★★★★	★★★★	★★★	★★★★	★★★
Ease of Installation	★★★★	★★★★	★★★	★★	★★½
Section Connections	Bayonets or Field Joints (w/ vacuum)				Field Welds
MATERIALS					
Inner Pipe	Invar36	T304 Stainless Steel			
Outer Jacket	T304 Stainless Steel				
DESIGN CODE	Built in accordance with ASME, Section B31.3 (1)				
MAWP (2)	150 psig				400 psig
NOMINAL PIPE SIZES (OUTER JACKET)					
½" Inner	2" Nominal Pipe Size				Consult factory
1" Inner	3" Nominal Pipe Size				2" Nominal Pipe Size
1½" Inner	3½" Nominal Pipe Size				Consult factory
2" Inner	3½" Nominal Pipe Size				3" Nominal Pipe Size
3" Inner	N/A	5" Nominal Pipe Size			
4" Inner	N/A	6" Nominal Pipe Size			Consult factory
Larger	N/A	Larger sizes available – consult factory for details			

(1) Code required X-ray or pneumatic pressure tests are optional
(2) MAWP = Maximum Allowable Working Pressure

★ Poor ★★ Good ★★★ Better ★★★★ Best

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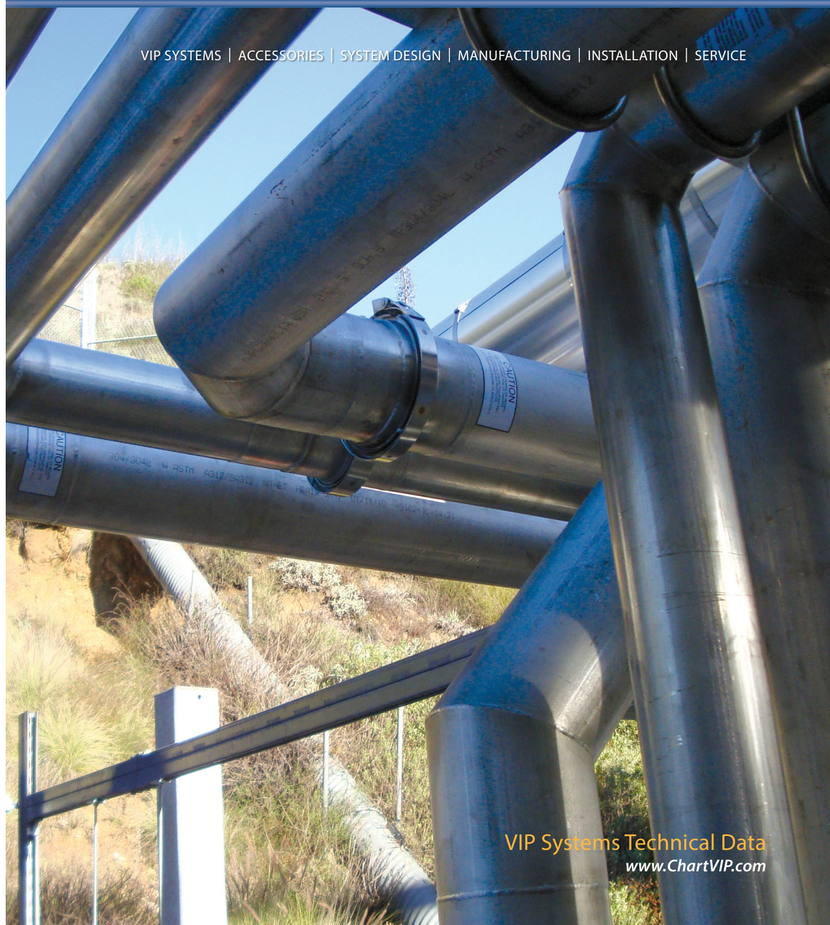


VIP Systems Technical Data
www.ChartVIP.com

THE ANATOMY OF VACUUM INSULATED PIPE

Vacuum 10 Years Warranty CHART

INNER PIPE

Schedule 5, T304 stainless steel or Invar® pipe designed per ASME B31.3

OUTER PIPE

Schedule 5, T304 stainless steel pipe, available with high-shine exterior polish

GAS TRAP

Installed for only vertical drops to prevent ice build-up on uninsulated components like isolation valves

INNER EXPANSION BELLOWS

Required to expand as inner pipe cryogenically shrinks 1/32" per foot *

* Inner Expansion Bellows not required with Invar® inner pipe

MALE BAYONET

T304 stainless steel with Invar® tip for minimum cryogenic shrinkage to allow female bayonet to create a shrink-fit cryogenic seal

FEMALE BAYONET

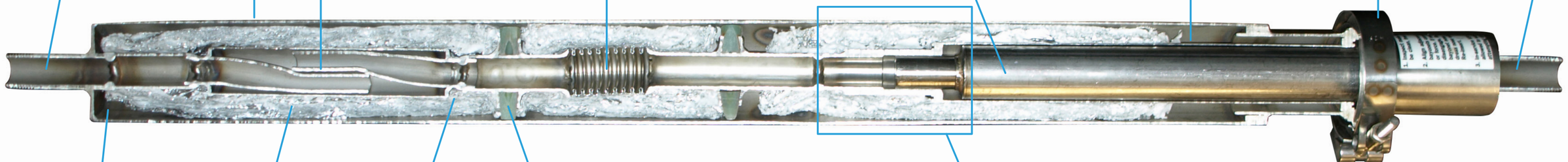
T304 stainless steel, interfaces with male bayonet and cryogenically shrinks around male bayonet Invar® tip for a leak-free seal

V-BAND CLAMP

Secures bayonets together with O-ring for secondary gas seal

INNER PIPE

Schedule 5, T304 stainless steel or Invar® pipe designed per ASME B31.3



ANNULAR SPACE

The voided space between the inner and the outer under high-vacuum (10 microns) to eliminate convective heat transfer by removing all air molecules during manufacturing – 10 year vacuum warranty

MULTI-LAYER INSULATION

Alternating layers of paper and aluminum foil to reduce radiation heat transfer from the outer to the inner pipe

CHEMICAL GETTERS

Installed to maintain vacuum level to a 'fresh' state over time – 20-year design life

SUPPORT ASSEMBLY

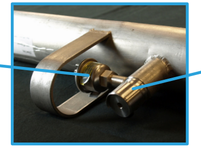
Fiberglass construction engineered for movement when inner cryogenically shrinks and to reduce conductive heat transfer from the outer to the inner

EXCLUSIVE MVE SHRINK-FIT BAYONET™ TECHNOLOGY

- Dissimilar metals - Invar® / SS
- LN_2 shrinks stainless steel around Invar® for a leak-tight seal
- Flexible orientation
- Industry standard for 40 years

HASTINGS DV-6R VACUUM GAUGE TUBE

A rugged thermocouple for testing the vacuum level with a matching meter



PUMP OUT PORT

Allows final evacuation of the VIP component in production and for field service