

NCSX Work Approval Form (WAF)

WBS Number: 62

WBS Title: Cryogenic Systems

Job Number: 6201

Job Title: Cryogenic Systems

Job Manager: Geoff Gettlefinger

Description:

This WBS element consists of the three subsystems: (1) the LN2-LHe Supply System (WBS 621) which will be used to receive, store, and deliver cryogenics to the LN2 Coil Cooling System (WBS 622) and to the GN2 Cryostat Cooling System (WBS 623); (2) the LN2 Coil Cooling (WBS 622) which provides a closed loop LN2 system for the cooling of the modular coils (WBS 14), and conventional coils (WBS 13); and (3) the GN2 Cryostat Cooling System (WBS 623) which will be used to circulate nitrogen gas of a controlled temperature through the NCSX cryostat and, consequently, around the exposed surfaces of the structures within the cryostat during cooldown from room temperature and also during operation.

Schedule:

Job 6201:

Approvals:

_____	_____
Job Manager	Date
_____	_____
Responsible Line Manager	Date
_____	_____
Project Manager	Date
_____	_____
Engineering Department Head	Date

NCSX June 2007 ETC
TABLE I - Design Labor

WBS Number: 62
WBS Title: Cryogenic Systems
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	Labor Hours					Assumptions	Basis of Estimate
	EMEM	EAEI	EEEM	EADB	Design		
WBS 62 Engineering Design and Oversight							
<u>WBS-621 LN2-LHe Supply &</u>							
<u>WBS-622 LN2 Coil Cooling Supply System</u>							
Document Requirements 621/622	16					Engineering judgement on NSTX and experience on Jobs 1409 & 1414	
CDR 621/622	8					Engineering judgement on NSTX and experience on Jobs 1409 & 1414	
Resolve CDR Chits 621/622	16					Engineering judgement on NSTX and experience on Jobs 1409 & 1414	
Prelim Dwgs 621/622				50		Engineering judgement on NSTX and experience on Jobs 1409 & 1414	
Flow Calcs 621/622	16					Engineering judgement on NSTX and experience on Jobs 1409 & 1414	
PDR 621/622	8					Engineering judgement on NSTX and experience on Jobs 1409 & 1414	
Resolve PDR Chits 621/622	16					Engineering judgement on NSTX and experience on Jobs 1409 & 1414	
Finalize Dwgs/Calcs 621/622				50		Engineering judgement on NSTX and experience on Jobs 1409 & 1414	
FDR 621/622	8					Engineering judgement on NSTX and experience on Jobs 1409 & 1414	
Resolve FDR Chits 621/622	16					Engineering judgement on NSTX and experience on Jobs 1409 & 1414	
<u>WBS-623 GN2 Cryostat Cooling System</u>							
Document Requirements 623	16					Engineering judgement on NSTX and experience on Job 1701 , previous	
CDR 623	8					Engineering judgement on NSTX and experience on Job 1701 , previous	
Resolve CDR Chits 623	16					Engineering judgement on NSTX and experience on Job 1701 , previous	
Prelim Models 623	80			80	40	Engineering judgement on NSTX and experience on Job 1701 , previous	
Fan Mechanical Design	160					Estimate based on opinions from Engineering Dept managers	
Fan Magnetics Design			160			Estimate based on opinions from Engineering Dept managers	
Stell Core Thermal Analysis 623		160				Estimate based on opinions from Engineering Dept managers	
PDR 623	8					Engineering judgement on NSTX and experience on Job 1701 , previous	
Resolve PDR Chits 623	16					Engineering judgement on NSTX and experience on Job 1701 , previous	
Finalize Dwgs/Calcs 623	16			70	40	Engineering judgement on NSTX and experience on Job 1701 , previous	
FDR 623	8					Engineering judgement on NSTX and experience on Job 1701 , previous	
Resolve FDR Chits 623	16					Engineering judgement on NSTX and experience on Job 1701 , previous	
<u>Title III Support 62X</u>	240					Engineering judgement on NSTX and experience on Jobs 1409 & 1414	
Totals	688	160	160	250	80		

NCSX June 2007 ETC
TABLE I - Materials and Subcontracts

WBS Number: 62
WBS Title: Cryogenic Systems
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Description:

[See Table III](#)

NCSX June 2007 ETC
TABLE III - Fabrication and Assembly

WBS Number: 62															
WBS Title: Cryogenic Systems															
Job Number: 6201															
Job Title: Cryogenic Systems															
Job Manager: Geoff Gettlefinger															
Fabrication and Assembly															
		M&S		Labor											
		# units	\$/ M&S unit	M&S (\$)	EMTB	Assumptions	Basis of Estimate								
<u>WBS-621 LN2-LHe Supply</u>															
O2 controller	8	\$1,500	\$12,000				See Table V								
O2 conduit M&S	1	\$1,000	\$1,000				Based on Job 1409 experience								
O2 install					80		Based on Job 1409 experience								
1 5/8, 50' roll copper	4	\$412	\$1,648		160	estimate, 200 ft 1 5/8 annealed with 2" urethane foam insul.	See Table V - Labor based on Job 1409 experience.								
2" , 3' insul	70	\$21	\$1,456				See Table V								
Misc Hdwe	1	\$5,000	\$5,000				Based on Job 1409 experience.								
pneu vac jacket LN2 valve	1	\$4,191	\$4,191				See Table V								
man vac jacket LN2 valve	1	\$2,838	\$2,838				See Table V								
Install LN2 Line					160										
<u>WBS-622 LN2 Coil Cooling Supply System</u>															
relief valves	50	\$38	\$1,918				See Table V, valve and adapter.								
2 each 460vac lo-amp branch circuits	1	\$1,000	\$1,000				Based on Job 1409 experience.								
2" , 3' insul	70	\$21	\$1,456			estimate, 200 ft 1 5/8 annealed with 2" urethane foam insul.	See Table V								
pipng	4	\$412	\$1,648				See Table V								
isolation valves	20	\$242	\$4,831				See Table V								
Misc Hdwe	1	\$5,000	\$5,000				Based on Job 1409 experience.								
Relocate pump skid to NCSX machine area					240		Labor based on Job 1409 experience.								

NCSX June 2007 ETC
TABLE III - Fabrication and Assembly

WBS-623 GN2 Cryostat Cooling System																				
duct board	150	\$19	\$2,850		480SF/10 linear foot X 100 foot	\$19 per sheet, Local Pricing														
cryo/pneumatic valves	40	\$933	\$37,320			Swagelok Valves & Std Bellows, Table V, 183+300+350=933														
distribution tubing	500	\$1	\$540			See Table V														
Circulating Fans	20	\$600	\$12,000	160		Based on conceptual concept only.														
Evaporator Trays	18	\$300	\$5,400			Needs Design, Based on conceptual design only.														
Evaporator Drops	18	\$500	\$9,000			Needs Design, Based on conceptual design only.														
Thermax Vaporizer	1	\$16,420	\$16,420			See Table V - Based on Job 1409 experience.														
Thermax starter/controls	1	\$591	\$591	80		See Table V - Based on Job 1409 experience.														
duct heater	2	\$1,551	\$3,102	80		See Table V - Based on Job 1409 experience.														
duct heater starter/controls	2	\$591	\$1,182	80		See Table V - Based on Job 1409 experience.														
controllers/TCs	20	\$169	\$3,380			See Table V														
Misc Hdwe	1	\$10,000	\$10,000			Based on Job 1409 experience.														
GN2, Duct, & Insul Labor				1680		Based on Job 1409 experience.														
Engineering Analysis						Based on Job 1409 experience.														
Totals			\$145,770	2720																

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TABLE IV - Uncertainty of Estimate and Residual Risk Assessment

WBS Number: 62
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Uncertainty of the Estimate

	<u>Uncertainty Range</u>			<u>Comments/Other Considerations</u>
	<u>High</u>	<u>Medium</u>	<u>Low</u> (%)	
Design Maturity			X	Only at a conceptual design phase - design still evolving as requirements are better defined.
Design Complexity		X		-20%/+40% More complex work requirements may have the potential to increase costs of this job

Note: High/Medium/Low uncertainty assessment from Job Manager. Uncertainty range based on ACEI recommended practice 18R-97 as amended for NCSX.

Residual Impacts

<u>Job</u>	<u>Risk Description</u>	<u>Likelihood of Occurring</u>	<u>Mitigation Plan</u>	<u>Basis of estimate</u>	<u>Cost Impact</u>		<u>Schedule Impact</u>	
					<u>Low</u>	<u>High</u>	<u>Low</u>	<u>High</u>
NONE								

Notes:

- [1] Low cost and schedule impacts are considered the minimum (0-percentile) impacts should the event occur.
High cost and schedule impacts are considered the maximum (100-percentile) impacts should the event occur
- [2] Cost impacts should be entered as man-hours (by demographic) and M&S direct cost under basis of estimate.
Cost impacts should NOT include standing army costs which are separately calculated from the schedule impact
Project control is responsible for quantifying the low and high cost impacts based on the labor hours and M&S identified
- [3] The schedule impacts should be entered as the min and max impacts on the critical path.
If there is no critical path impact then the schedule entries should be zero.
- [4] Likelihood of occurrence should be entered consistent with our risk classification methodology, i.e.
VL= Very Likely (P>80%), L=Likely (80%>P>40%), U=Unlikely (40%>P>10%), VU=Very Unlikely (P<10%), NC=Non-credible (P<1%)

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Copper Tubing

Part Number: 895529 \$412.00 Each

Type: General Purpose Copper Tubing (Alloy 122)
Material: Single Line
Shape: 1"
Outside Dia. Tolerance: ±.001"
Inside Dia.: .997"
Wall Thickness: .065"
Maximum Pressure: 600 psi @ 70°F
Operating Temperature Range: -425° to +400° F
Metal Bendability: Bendable By Hand
Temper: Soft (Annealed)
Yensile Strength: Low
Metal Construction: Seamless
Cleaning and Coating: Not Cleaned and Coated
Metal Flareability: Flareable
Sterilize With: Steam (Autoclave)
Shipped As: Coil
Specification: American Society for Testing and Materials (ASTM) ASTM B75
Compatible Fittings: Compression and Wirt Copper W/

ZoneGuard Fixed Point Gas Detection Systems

ZoneGuard System Configuration Matrix

Part Number	ZoneGuard Sensor	Add To Part #	Integrally mounted sensor	Price
54-16-00	O ₂ Oxygen			\$ 1,318.00
54-16-01	LEL Combustible			\$ 1,539.00
54-16-02	CO Carbon monoxide			\$ 1,649.00
54-16-03	H ₂ Hydrogen sulfide			\$ 1,649.00
54-16-04	SO ₂ Sulfur dioxide			\$ 1,759.00
54-16-05	Cl ₂ Chlorine			\$ 1,859.00
54-16-06	CH ₄ Methane			\$ 1,859.00
54-16-07	PH ₃ Phosphine			\$ 2,059.00
54-16-08	NO ₂ Nitrogen dioxide			\$ 2,059.00

Oxygen Sensor

Part #	Description	Price
54-17-A0101	Single integrally mounted external strobe for ZoneGuard (red)	\$ 194.00
54-17-A0102	Single integrally mounted external strobe for ZoneGuard (amber)	\$ 194.00
54-17-A0103	Dual integrally mounted external strobes for ZoneGuard (red and amber)	\$ 359.00
54-17-A0201	Remote programmable volume adjustable audible alarm	\$ 135.00
54-17-A0202	Remote high intensity audible alarm	\$ 249.00
54-17-A0301	Top-hat guard for sensors installed in explosion proof remote housings	\$ 61.00
54-17-A0302	Spash guard for sensors installed in standard housings	\$ 61.00
54-17-A0401	Wire, 22 gauge, 6 conductor, twisted pair, shielded with drain, used to connect Oxygen remote detectors with ZoneGuard controller, 50 feet	\$ 61.00
54-17-A0402	Wire, 22 gauge, 4 conductor, twisted pair, shielded with drain, used to connect toxic remote detectors with ZoneGuard controller, 50 feet	\$ 61.00

ZoneGuard Accessories

Part No.	Description	Price
54-17-A0101	Single integrally mounted external strobe for ZoneGuard (red)	\$ 194.00
54-17-A0102	Single integrally mounted external strobe for ZoneGuard (amber)	\$ 194.00
54-17-A0103	Dual integrally mounted external strobes for ZoneGuard (red and amber)	\$ 359.00
54-17-A0201	Remote programmable volume adjustable audible alarm	\$ 135.00
54-17-A0202	Remote high intensity audible alarm	\$ 249.00
54-17-A0301	Top-hat guard for sensors installed in explosion proof remote housings	\$ 61.00
54-17-A0302	Spash guard for sensors installed in standard housings	\$ 61.00
54-17-A0401	Wire, 22 gauge, 6 conductor, twisted pair, shielded with drain, used to connect Oxygen remote detectors with ZoneGuard controller, 50 feet	\$ 61.00
54-17-A0402	Wire, 22 gauge, 4 conductor, twisted pair, shielded with drain, used to connect toxic remote detectors with ZoneGuard controller, 50 feet	\$ 61.00

Brass Cryogenic Relief Valves

Relief Valves

Pipe Size	In.	Relief Valves Each	Pipe Adapters Each
1/4"	2 5/8"	491971 \$31.00	491904 \$7.30
3/8"	2 5/8"	491972 \$35.40	491904 \$7.30
1/2"	2 11/8"	491973 \$37.00	491906 \$7.90

Rigid Polyurethane Foam Insulation for Pipe, Tube, and Fittings

- Temperature Range: -297° to +300° F
- Heat Flow Rate (K-Factor): 0.19 Btu/hr. x in./sq. ft. @ 75° F
- Density: 2.05 lbs./cu. ft.
- Color: Pipe and Tube, Blue with white facing; Fittings, blue

Whether your piping is hot, cold, or somewhere in between, this foam insulation can handle wide temperature ranges. It's made of closed-cell foam with a slit for easy installation. For indoor use; can be used outdoors with additional jacketing. Cut with a knife or saw.

1" thick foam insulation meets ASTM E84 25/50 for flame and smoke and 2" thick foam insulation meets ASTM E84 25/450 for flame and smoke. Insulation for pipe and tube has a kraft paper and aluminum foil jacket that allows moisture to evaporate and results mild and moldew. Jacket has a self-sealing adhesive strip. Insulation for 90° elbows and tees fits over threaded connections.

Rigid Polystyrene Foam Insulation

Lightweight and moisture-resistant, this closed-cell foam insulation is often used for packaging applications and is also ideal for cold room storage applications due to its low-temperature resistance. Cut with a utility knife or saw.

Insulation ID	FOR PIPE AND TUBE				FOR 90° ELBOWS				FOR TEES			
	1" Thick	2" Thick	1" Thick	2" Thick	1" Thick	2" Thick	1" Thick	2" Thick	1" Thick	2" Thick	1" Thick	2" Thick
7/8"	3 R	5431K14 90.10	5431K34 917.71	9097T11 35.03	9097T31 910.29	9097T51 35.03	9097T71 910.29					
1"	3 R	5431K15 8.57	5431K35 18.79	9097T12 5.41	9097T32 10.84	9097T52 5.41	9097T72 10.84					
1 3/8"	3 R	5431K16 9.36	5431K36 19.22	9097T13 5.94	9097T33 11.86	9097T53 5.94	9097T73 11.86					
1 5/8"	3 R	5431K17 10.50	5431K37 20.80	9097T14 6.78	9097T34 12.86	9097T54 6.78	9097T74 12.86					
2"	3 R	5431K18 11.21	5431K38 21.89	9097T15 7.20	9097T35 13.95	9097T55 7.20	9097T75 13.95					
2 3/8"	3 R	5431K21 12.84	5431K41 24.14	9097T16 8.53	9097T36 15.31	9097T56 8.53	9097T76 15.31					
2 7/8"	3 R	5431K23 15.40	5431K43 28.32	9097T17 11.88	9097T37 19.79	9097T57 11.88	9097T77 19.79					
3 1/2"	3 R	5431K25 18.07	5431K45 30.71	9097T18 11.68	9097T38 20.70	9097T58 11.68	9097T78 20.70					
4"	3 R	5431K26 6.40	5431K46 31.84	9097T19 13.41	9097T39 13.41	9097T59 13.41	9097T79 22.90					
4 1/2"	3 R	5431K28 18.20	5431K47 33.89	9097T21 14.50	9097T41 24.38	9097T61 14.50	9097T81 24.38					

Motor Starters with Overload Relay

Starter for Vaporizer

Open-frame starters can be used with an overload relay. Enclosed starters are used with an overload relay. Enclosed starters are used with an overload relay.

Admissible Overload Amp Range	MAXIMUM MOTOR HORSEPOWER RATING, hp			Open-Frame Starters Each	Enclosed Starters Each
	115 VAC	230 VAC	480 VAC		
Standard—For Single- and Three-Phase Motors					
1 1/2-2	1/2	1/2	1/2	7803K56	134.04
2-3	3/4	3/4	3/4	7803K57	176.34
3-5	1	1	1	7803K58	134.04
5-7.5	1 1/2	1 1/2	1 1/2	7803K59	134.04
7.5-10	2	2	2	7803K60	176.34
10-15	3	3	3	7803K61	134.04
15-20	4	4	4	7803K62	176.34
20-30	5	5	5	7803K63	204.04
30-40	7 1/2	7 1/2	7 1/2	7803K64	264.04
40-50	10	10	10	7803K65	352.04
50-60	15	15	15	7803K66	352.04
60-75	20	20	20	7803K67	528.04
75-100	25	25	25	7803K68	528.04

NCSX June 2007 ETC
TABLE V - Basis of Estimate

WBS Number: 62
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Aluminum
This product matches all of your selections.

Part Number: 88685K29 \$345.13 Each

Easy-to-Form Electrical Grade Aluminum (Alloy 1350)
Unfinished (MS)
Sheets, Bars, Strips, and Cubes

Material: Unfinished (MS)
Finish: Plain
Thickness: 0.004"
Length: 8.25"
Width: 48"
Standard
Without Material Certification

Temperature to Maintain Strength:
Specifications Post
ASTM Specifications

Aluminum for Evaporators

omega.com Your One-Stop Source for Process Measurement and Control (888) 70-OMEGA (USA/Canada) | (202) 358-1880 (International)

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search by: Part Number All Omega Search

1/32 DIN Autotune Temperature/Process Dual Setpoint Controllers
CN132 Series

\$169.00 CN132

Temperature Controller

- 1/32 DIN Cutout
- User Selectable Input
- Autotune PID
- Configurable Dual Output
- Second Setpoint and Output
- NEMA-4X Front Panel
- Full Cost Strategy
- Auto-Manual Operation
- Optional 12 Vac/dc or 24 Vac/dc Models
- UL Recognized (US)

View related products - Temperature and Process Controllers and Power Switching Devices

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Item Details **Duct Heater**

HWACR • Heating Equipment • Finned and Strip Heaters

Heater, Finned Duct
Finned Duct Heater, Power Rating 16000 Watts, Voltage Rating 480 Volts, Minimum Air Flow 600 CFM, Minimum Duct Depth 12 Inches, Element Width 24 Inches, 3 Phase

Grainier Item # 3H1797
Price (ea.) **\$1,551.00**
Brand VULCAN
Mfr. Model # VFT1212-16C
Ship Qty. 1
Sell City (Will-Call) 1
Ship Weight (lbs.) 30.65
Usually Ships™ 1-3 Days
Catalog Page No. 3160



Catalog page 414

Globe Valves
For information about globe valves see page 413. For information about pipe size, see page 2-3.

Pipe OD to Pipe Size Conversions

Pipe OD	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
Pipe Size	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"

Low-Temp Long-Stem Bronze Globe Valves

- Maximum Pressure: C, W, P (cold water pressure): 1/2", 1", and 2" sizes: 600 psi @ 300° F, 1 1/2" size: 400 psi @ 100° F (Steam: Not rated)
- Temperature Range: -320° to +300° F
- Rising stem

Extended stem keeps the packing from freezing even at cryogenic temperatures and the CTRF disc provides a tighter-than-normal seal. Casted and packed for nitrogen service. Body and screw-in bonnet are bronze. Stem is 300 series stainless steel, packing is PTFE, and bonnet is machinable iron. Bonnet bearing and seal are glass-filled PTFE. Meet MSS-SP-80 Class 300.

Pipe Size	End-to-End Lg.	Height	Part #	Each
1/2"	2 3/4"	9 3/4"	68419C12	\$103.31
3/4"	3 3/4"	10 1/2"	68419C15	241.54
1"	4 3/4"	14 3/4"	68419C18	399.92
1 1/2"	5 3/4"	15 3/4"	68419C38	508.08

Lever Arm Brass Globe Valves

- For compressed air and fluids only
- Maximum Pressure: See table
- Temperature Range: 50° to 200° F
- Rising stem

Often called whistle valves, these general service valves open quickly and are self-lubricating. Body and stem are brass. Gaskets and packing are Buna-N; spring is Type 302 stainless steel. Offered with two lever styles. Gaskets and stem are for hand operation and have an iron handle. Pull levers have a brass handle with a hole for cord or chain operation.

Pipe Size	End-to-End Lg.	Height	150 psi @ 50° F	400 psi @ 50° F
1/2"	2 5/8"	11 1/4"	40259B1	\$20.77
3/4"	2 5/8"	11 1/4"	40259B2	\$24.70
1"	2 5/8"	11 1/4"	40259B3	\$27.52
1 1/2"	2 5/8"	11 1/4"	40259B4	\$32.04

Isolation Valves

ACME CRYOGENICS 800-422-2770 ext. 601 • www.acmecryo.com
Fax 610-791-2402 • spetra@acmecryo.com

Quotation

To: Geoffrey Gettlefinger From: Brian Robinson
Company: PPPL (Princeton Plasma Physics Laboratory) Fax:
Phone: 609-242-2776 Date: May 30, 2007
Re: Request for Quotation
Quotation# EP6897 Pages: 2

Thank you for your interest in Acme Cryogenics. We appreciate the following quotation:

Vac Jacketed Valves

Line Item 1
CVI G12A Vent Valve, Standard Non-Jacketed
Part Number: 70-2542-00415
Quantity: 1 unit \$2,838.61 each
Delivery: Available to ship 2 weeks ARO

Line Item 2
CVI Model V-1060-100-S-J-5 1" Cryogenic Manual Globe Valve, Vacuum Jacketed, Schedule 5 Pipe Stub End Connections
Part Number: 81-2542-02634
Quantity: 1 unit \$2,838.18 each
Delivery: Available to ship 2 to 3 weeks ARO

Line Item 3
CVI Model V-1070-100-S-J-5 1" Cryogenic Remote Cylinder Operated (CRO) Globe Valve, Vacuum Jacketed, Schedule 5 Pipe Stub End Connections, with CVI Model C-125 A-Size Pneumatic Cylinder Actuator, 12.5 Square Inch, Fail Closed (Air to Open)
Part Number: 82-2542-02914
Quantity: 1 unit \$4,191.73 each
Delivery: Available to ship 2 to 3 weeks ARO

NCSX June 2007 ETC
TABLE V - Basis of Estimate

WBS Number: 62
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STANDARD BELLOW COMPANY
152 EAST GARDNER STREET
WINDSOR LOCKS, CT 06096
Telephone: (860) 232-3201
Fax: (860) 232-3201
http://www.stbco.com

Cryo/Pneumatic Valve Element

Number: 0-21742
Date: March 6, 2007
Windsor Locks, CT
F.O.B.: Please see below
Delivery: Net 30 Days
Terms: Net 30 Days

Attention: Lloyd Cochran
Lloyd.Cochran@stbco.com
152 East Gardner Street
Windsor Locks, CT 06096

Quantity	Description	Unit Price
1	Bellow Assembly P/N 200-125-4-BB	\$ 400.00 Each
60	Bellow Assembly P/N 200-125-4-BB	\$ 165.00 Each
1	Bellow Assembly P/N 200-125-5-BB	\$ 458.00 Each
60	Bellow Assembly P/N 200-125-5-BB	\$ 204.00 Each
1	Bellow Assembly P/N 325-225-4-BB	\$ 541.00 Each
60	Bellow Assembly P/N 325-225-4-BB	\$ 259.00 Each
1	Bellow Assembly P/N 325-225-5-BB	\$ 599.00 Each
60	Bellow Assembly P/N 325-225-5-BB	\$ 328.00 Each

Qty: 1 = 4.5 Weeks ARO
Qty: 60 = 6.7 Weeks ARO

Standard Bellow Company
152 East Gardner Street
Windsor Locks, CT 06096
Telephone: (860) 232-3201
Fax: (860) 232-3201
http://www.stbco.com

Thank you for your inquiry!
David D. Eckert
David.D.Eckert@stbco.com
Sales Engineer

SEC Accepts Visa & MasterCard

Swagelok

R.S. CRUM & COMPANY
1181 GLOBE AVENUE
MOUNTAINSIDE, NJ 07092-2999
Phone: NJ (908) 232-4444
Fax: (908) 232-6291
Phone: NY (212) 662-2266

QUOTE
97364575

Cust Order No: 45523
Bid Number: 45523
Ship To: 45523
** SEE IN **
PRINCETON FORRESTAL CAMPUS

C/O PRINCETON UNIV/ACCOUNTING
P.O. BOX 451 PLASMA PHYS. LAB
PRINCETON NJ 08543

RECEIVING #3
PLASMA PHYSICS LAB
PRINCETON NJ 08543

We Accept:

Quote Date	FOB Description	Expiration Date	Terms	Quote Number
01/18/07	Shipping Point	03/19/07	****NET 30 DAYS*****	97364575

Item	Description	Quantity	Unit Price	Disc	Amount
1	B-8BG-CU + 6-7 WEEK DELIVERY	60	183.84	0	11,030.40

Cryo/Pneumatic Valve Element

Print | How can we improve?

Plastic > PTFE Material > Outside Dia. > Inside Dia. > Compare Items

Tubing

This product matches all of your selections.

Part Number: 52315K184
1-04 Ft. \$1.37 per Ft.
25 or more \$1.08 per Ft.

Distribution Tubing

Type: Extreme-Temperature PTFE Choose-A-Color Tubing
Material: PTFE (Polytetrafluoroethylene)
Shape: Single Line
Outside Dia.: 1/4" (.25")
Inside Dia.: 3/16" (.1875")
Wall Thickness: 1/32" (.0312")
Reinforcement: Unreinforced
Color: Orange Red
Maximum Pressure: 150 psi @ 70°F
Operating Temperature Range: -450°F to +500°F
Performance Characteristics: Vacuum Rated
Vacuum Rating: 29" Hg at 72°F
Bend Radius: 1"
Diameter: 9/64-450 (Hard)
Tensile Strength: 2,500-4,000 psi
Sterilize With: Gamma
Specifications Met: CFR21 177.1550
FDA Specification: Compression
Compatible Fittings: 5, 10, 25
Chemical Compatibility Link: 52315KAC

Thermax Inc.
888 Barnwood St. Dartmouth, MA 01948 USA
Telephone: (508) 248-2800
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QUOTATION

May 30, 2007

Princeton University
Princeton Plasma Physics Laboratory
P.O. Box 451
Princeton, NJ 08543

Attention: Geoffrey A. Gettlefing
geoffg@pppl.gov

Reference: Thermax T007-21688

Application:
Fluid: Nitrogen
Flow Rate: 5000 SCFH, max
Outlet Temp: -200 to 50°F
MW: 350-500
Pressure Drop: 20 psi
Site Electric: 480V/3PH/3W
Special Considerations: Cryogenic block, DCR control, NEMA 4 box

Based on the above conditions, Thermax is pleased to provide you with the following quotation:

Item	Qty (1)	Description
1	1	Thermaxcal Electric Vaporizer, Model HSA-C Stainless steel tube cast in aluminum block Regionally fabricated steel cartridge heater Control cabinet w/SCS controls including high temp block limit Vaporizer Connections: 1/2" NPT inlet, 1/2" NPT outlet 20 W/Power (60Hz) Approx dimensions: 24 in x 14 in x 35 in Price each: \$16,420.00

Please allow 12 weeks to ship.

Vaporizer

Activity ID	MILE-stones (level 2 & 3)	Activity Description	Duration (work days)	Baseline Start	Baseline Finish	Shifts	Total Float	% cmplt	Proposed Budgeted							
										FY07	FY08	FY09	FY10	FY11	FY12	
62 - Cryogenic Systems																
Job: 6201 - Cryogenic Syst-GETTELFINGER																
621 - LN2-LHe Supply System																
621-101		LN2 - LHe Supply-Preliminary Design	20	01OCT08*	28OCT08		221		9,256.72	EM//EM =44hr ; EA//SB =16hr ;						
621-121		LN2 - LHe Supply-Final Design	20	29OCT08	25NOV08		222		10,244.08	EM//EM =44hr ; EA//SB =24hr ;						
621-131		LN2 - LHe Supply-Procure Hardware & Materials	65	01OCT09*	13JAN10		124		40,282.16	41=28.13\$k ;						
621-141		LN2 - LHe Supply-Fabricate & Assembly	35	14JAN10	03MAR10		124		20,272.00	EM//TB =160hr ; ee//tb=80						
621-151		LN2 - LHe Supply-Title III	100	01OCT09	03MAR10		124	LOE	7,529.72	EM//EM =44hr ;						
622 - LN2 Coil Cooling Supply																
622-101		LN2 Coil Cooling Supply-Prelim Design	20	01OCT08*	28OCT08		221		10,984.60	EM//EM =44hr ; EA//SB =30hr ;						
622-121		LN2 Coil Cooling Supply-Final Design	20	29OCT08	25NOV08		222		10,984.60	EM//EM =44hr ; EA//SB =30hr ;						
622-131		LN2 Coil Cooling Supply-Procure Hardware	65	12AUG09*	11NOV09		144		22,398.49	41=15.85\$k ;						
622-141		LN2 Coil Cooling Supply-Assemble Skid	25	12NOV09	18DEC09		144		18,158.80	EM//TB =180hr ; em//sm=20						
622-151		LN2 Coil Cooling Supply-Relocate skid to NCSX TC	25	21DEC09	03FEB10		144		18,158.80	EM//TB =180hr ; em//sm=20						
622-161		LN2 Coil Cooling Supply-Title III	115	12AUG09	03FEB10		144	LOE	7,454.33	EM//EM =44hr ;						
623 - GN2 Cryostat Cooling System																
623-100		GN2 Cryostat Cooling Sys Development	30	05JAN09*	13FEB09		122		87,993.60	em//em=160;ea//sb=160;em//tb=160;ee//em=160						
623-101		GN2 Cryostat Cooling Sys-Preliminary Design	30	16FEB09*	27MAR09		122		18,176.80	EM//EM =80hr ; EA//SB =40hr ;						
623-121		GN2 Cryostat Cooling Sys-Analysis	30	19MAR09*	29APR09		99		30,593.60	EA//EM =160hr ;						
623-141		GN2 Cryostat Cooling Sys-WBS 62/171 PDR	1	30APR09	30APR09		99		1,324.00	EM//EM =08hr ;						
623-161		GN2 Cryostat Cooling Sys-Final Design	20	01MAY09	29MAY09		99		16,942.60	EM//EM =80hr ; EA//SB =30hr ;						
623-181		GN2 Cryostat Cooling Sys-WBS 62/171 FDR	1	11AUG09	11AUG09		49		1,324.00	EM//EM =08hr ;						
623-201		GN2 Cryostat Cooling Sys-Procure Hardware	88	12AUG09	16DEC09		49		144,346.32	41=101.785\$k ;						
623-221		GN2 Cryostat Cooling Sys-Assemble & Install	122	17DEC09	17JUN10		49		156,307.20	EM//TB =1,600hr ; ee//tb=240						
623-261	2	WBS 62/171 Cryo systems PTP	10	18JUN10	01JUL10		49		13,666.00	EM//EM =40hr ; EM//TB =80hr ;						
623-262		GN2 Cryostat Cooling Supply-Title III	258	12AUG09	25AUG10		527	LOE	8,177.58	EM//EM =48hr ;						
Subtotal			472	01OCT08	25AUG10		527		654,576.00							