



**Particle Physics Division
Mechanical Department Engineering Note**

Number: MD-ENG- 301

Date: 20 December 2010

Project Internal Reference: 485-1.02.04.01

Project: Microboone

Title: Microboone Molecular Sieve Vessel Assembly Pricing

Author(s): Mike Zuckerbrot

Reviewer(s):

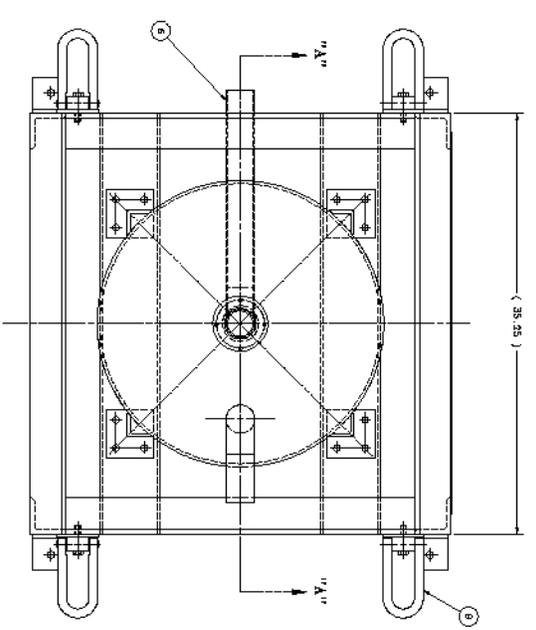
Key Words: Microboone, Molecular sieve

Applicable Codes:

Abstract Summary: This note reviews part and labor costs for assembling the Microboone molecular sieve vessel in house at Fermilab opposed to having it outsourced. Does not include any contingency.

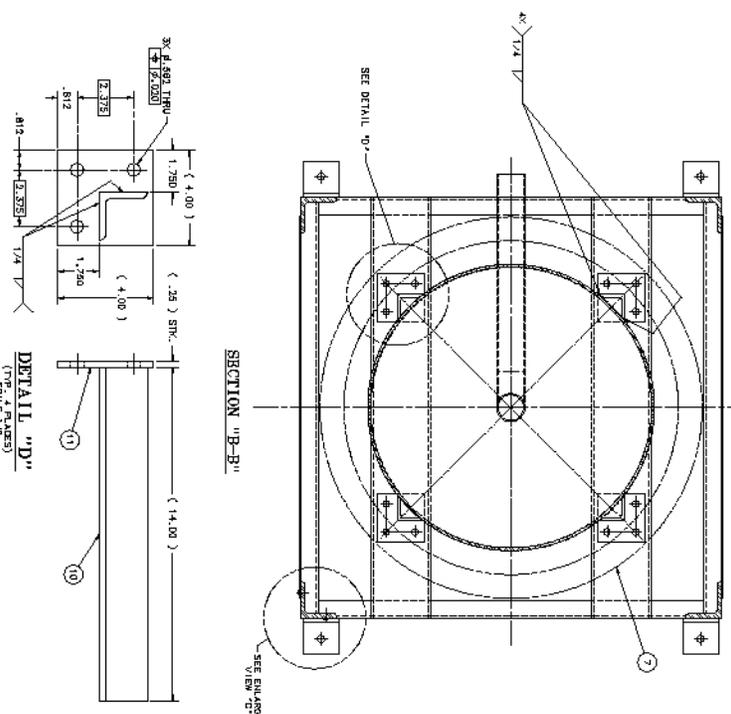
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TOP VIEW

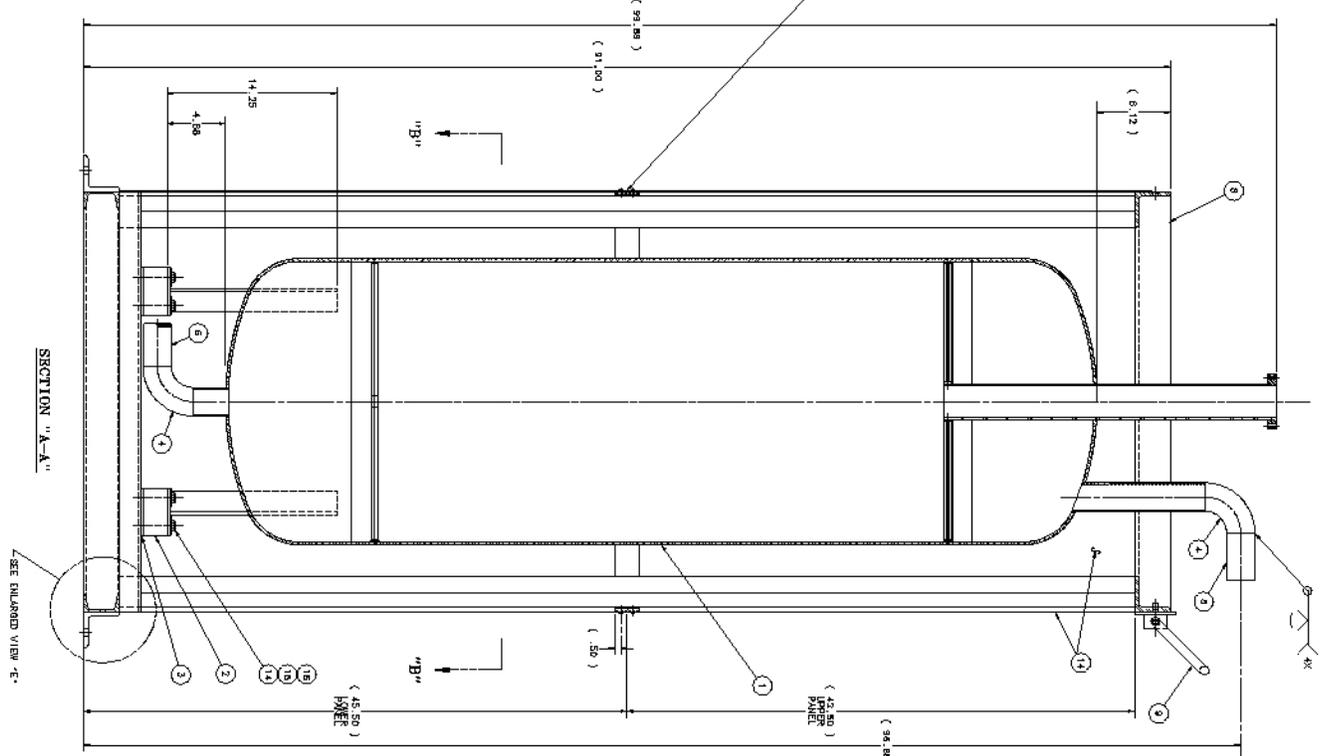
INSTALL LOWER PANELS FIRST.
BUT UPPER PANELS TO LOWER.
SEE NOTE #1, DRAWING.



SECTION "B-B"

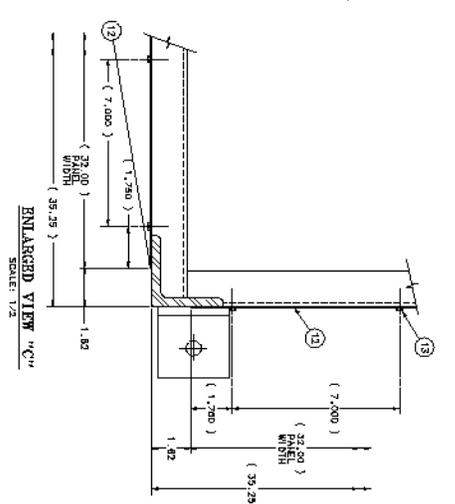
DETAIL "D"

(TYPE 4 PLATES)



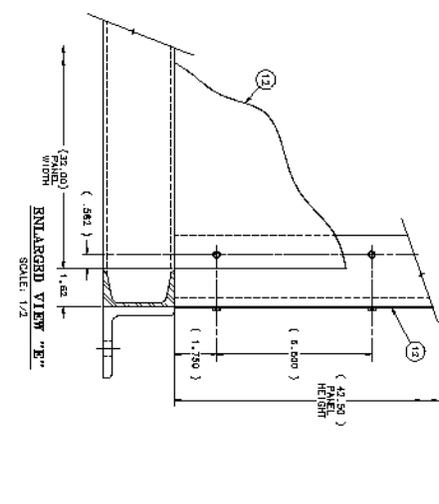
SECTION "A-A"

SEE ENLARGED VIEW "C"



ENLARGED VIEW "C"

SCALE: 1/2"



ENLARGED VIEW "B"

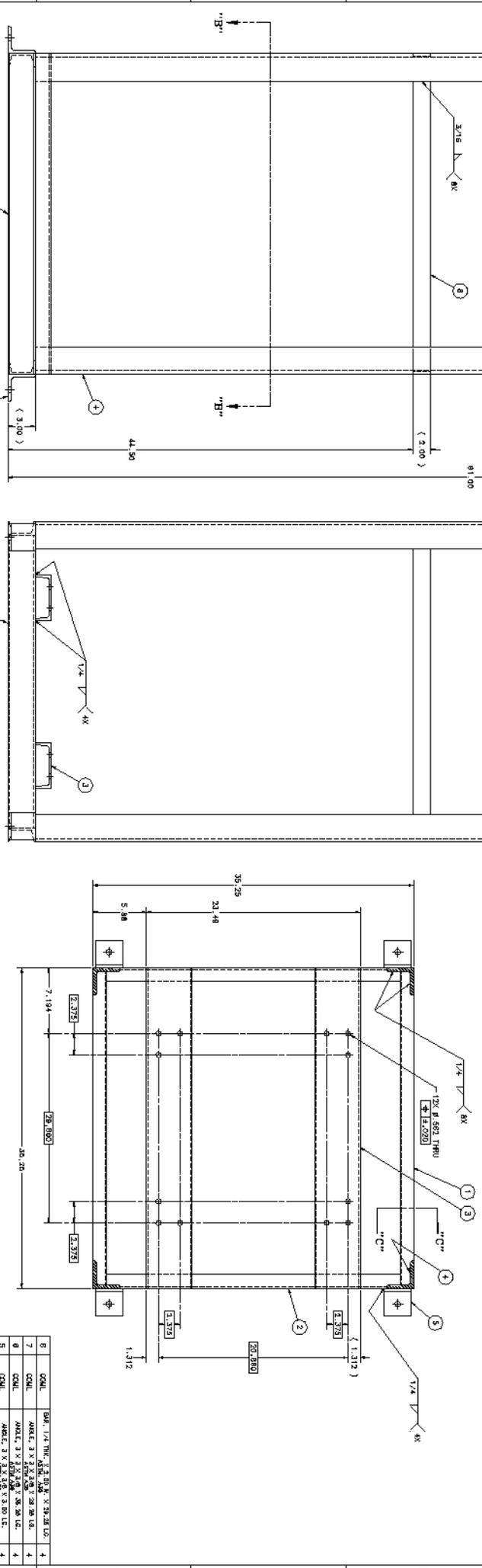
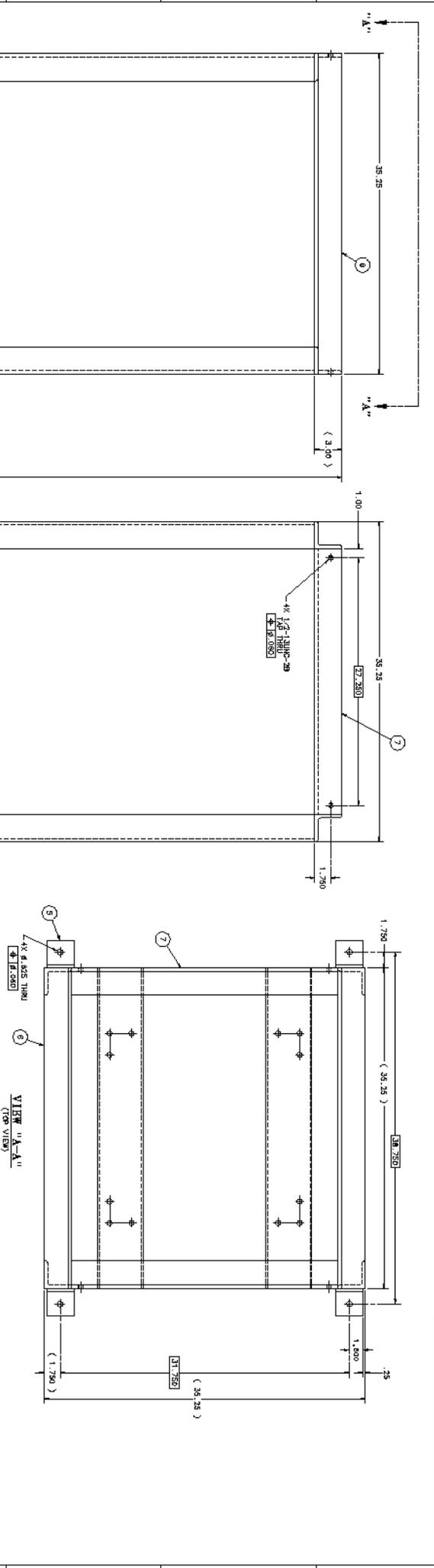
SCALE: 1/2"

ITEM	QTY	DESCRIPTION OR SIZE	UNIT
1	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1
2	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1
3	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1
4	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1
5	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1
6	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1
7	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1
8	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1
9	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1
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11	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1
12	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1
13	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1
14	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1
15	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1
16	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1
17	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1
18	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1
19	1	MC-488037 MICROPHONE MOLE SIEVE CASKET	1

NOTES:

- POSITION PANELS FROM 2" AND SQUARE HOLES OVER THE FRAME (FROM 4" TO 12" WIDTH OF THE FRAME) AND ATTACH TO THE CENTER LINE OF THE FRAME USING THE HOLES ACROSS THE 2" OF WIDTH OF THE PANEL TO THE CENTER LINE OF THE FRAME.

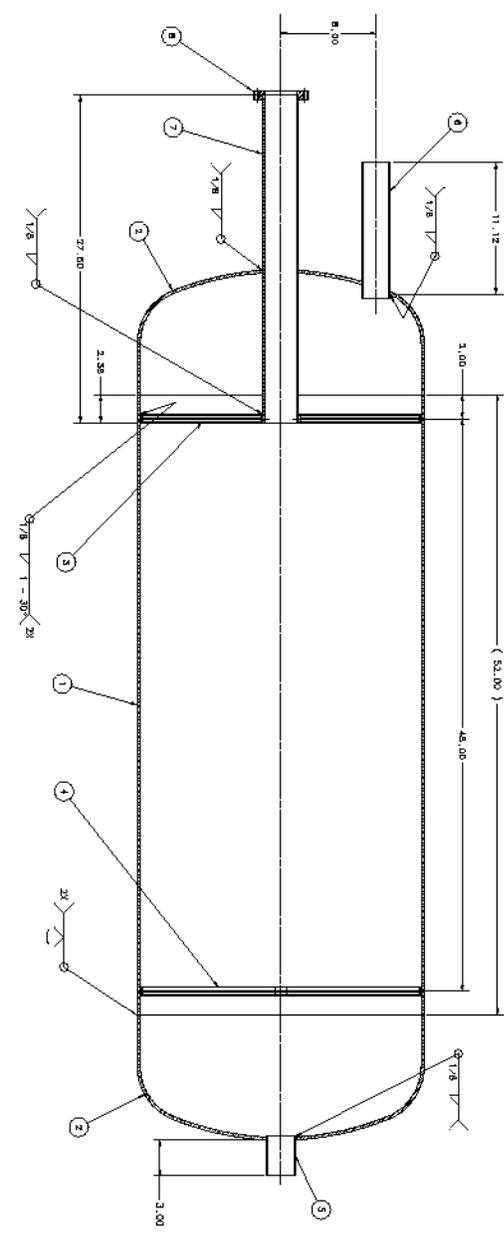
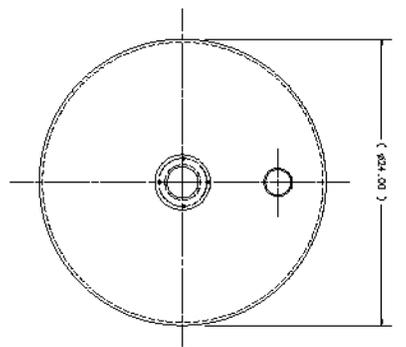
FEDERAL NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY
E974-MICROBOONE - CRYOGENICS
SUPPORT EQUIPMENT
MICROBOONE MOLE SIEVE SKID
SCALE: 1/2"
3874.220-ME-486047



ITEM	QTY	PART NO.	DESCRIPTION	UNIT
1	1	201-201-01-00000	CHANNEL, 3 X 1 X 1/4	PC
2	1	201-201-01-00000	CHANNEL, 3 X 1 X 1/4	PC
3	1	201-201-01-00000	CHANNEL, 3 X 1 X 1/4	PC
4	1	201-201-01-00000	CHANNEL, 3 X 1 X 1/4	PC
5	1	201-201-01-00000	CHANNEL, 3 X 1 X 1/4	PC
6	1	201-201-01-00000	CHANNEL, 3 X 1 X 1/4	PC
7	1	201-201-01-00000	CHANNEL, 3 X 1 X 1/4	PC
8	1	201-201-01-00000	CHANNEL, 3 X 1 X 1/4	PC
9	1	201-201-01-00000	CHANNEL, 3 X 1 X 1/4	PC

SECTION 'A-A'
 SCALE: 1/2" = 1'-0"
 SECTION 'B-B'
 SCALE: 1/2" = 1'-0"
 SECTION 'C-C'
 SCALE: 1/2" = 1'-0"

FEDERAL NATIONAL ACCELERATOR LABORATORY
 UNITED STATES DEPARTMENT OF ENERGY
 E974-MICROPHONE - CRYOGENICS
 SUPPORT EQUIPMENT
 MICROPHONE MOLE SIEVE FRAME
 SCALE: DRAWING NUMBER: 3974.220-WE-486049
 SHEET: 1 OF 1
 DATE: 11/19/60
 DRAWN BY: J. W. BROWN
 CHECKED BY: J. W. BROWN
 APPROVED BY: J. W. BROWN
 WORKING DRAWING



- NOTES:
1. GENERAL DESIGN REQUIREMENTS:
 EXCEPTING FLUID - ARGON GAS;
 MAXIMUM OPERATING PRESSURE - 315 PSIG;
 MAXIMUM TEMPERATURE - 250 F;
 WELD METAL BEHAVIOR - AS PER U.S. NATIONAL BOND REGISTRATION AS REQUIRED;
 WELD METAL BEHAVIOR - 304 STAINLESS STEEL GROUP AS INDICATED.

2. CLEANING OF INTERNAL VESSEL AND PIPING COMPONENTS:
 EACH INTERNAL COMPONENT SHALL BE THOROUGHLY CLEANED AT EVERY STAGE OF FABRICATION. THE INTERIOR SURFACES SHALL BE CLEANED WITH A SUITABLE MILD ABRASIVE SUCH AS SILICOFLUX. THE INTERIOR OF CONSTRUCTION SHALL BE CLEANED AND FINISHED TO THE FREE OF GREASE, FILLS, AND OTHER CONTAMINANTS. THE INTERIOR SURFACES SHALL BE INSPECTED FOR CLEANLINESS. THE INTERIOR SURFACES WILL BE CLEANED WITH A SUITABLE MILD ABRASIVE APPROVED BY THE PURCHASER. WELD BEVELS SHALL BE CLEANED WITH A SUITABLE MILD ABRASIVE APPROVED BY THE PURCHASER. THE INTERIOR SURFACES SHALL BE CLEANED WITH A SUITABLE MILD ABRASIVE APPROVED BY THE PURCHASER. THE INTERIOR SURFACES SHALL BE CLEANED WITH A SUITABLE MILD ABRASIVE APPROVED BY THE PURCHASER. THE INTERIOR SURFACES SHALL BE CLEANED WITH A SUITABLE MILD ABRASIVE APPROVED BY THE PURCHASER.

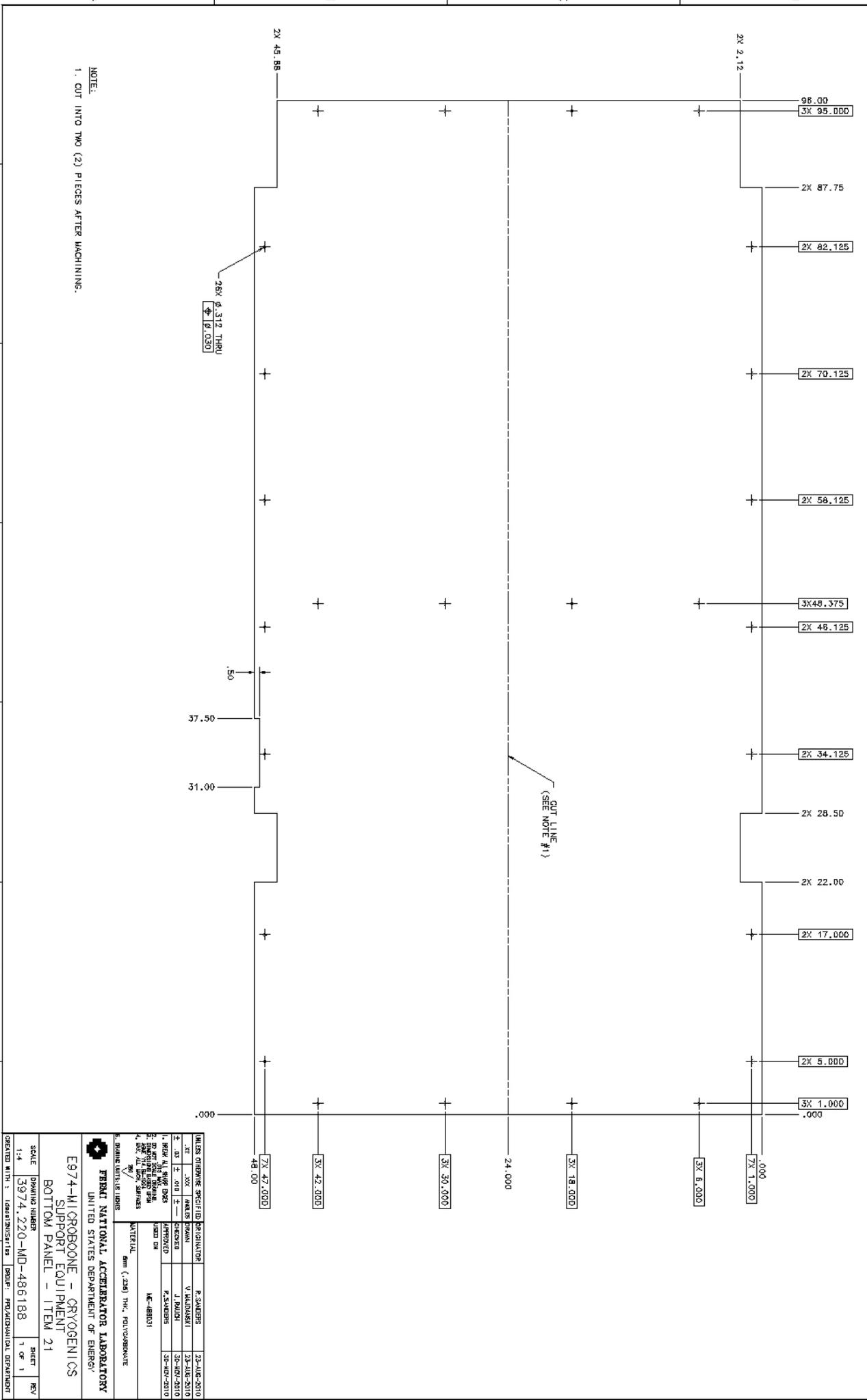
3. THE VESSEL SHALL BE CLEANED AFTER FABRICATION AND PRESUMABLY TESTED IN ACCORDANCE WITH THE DESIGN SECTION VIII, DIVISION 1 REQUIREMENTS. FLUID USED FOR PRESSURE TESTING SHALL BE NITROGEN GAS AT 100% SATURATION.
4. LEAK TESTING:
 NO LEAK SHALL BE DETECTED ON THE MOST SENSITIVE SCALE OF A HELIUM LEAK DETECTOR WITH A MINIMUM SENSITIVITY OF 10⁻⁷ STANDARD CC/S.
5. NO OTC POWERWAVE TESTING ALLOWED.

REV	DESCRIPTION	DATE	APPROVED	DATE
1	ISSUED FOR FABRICATION	11/15/2011		

ITEM NO.	DESCRIPTION	QTY	UNIT
1	VESSEL	1	EA
2	NECK	1	EA
3	HEAD	1	EA
4	FLANGE	1	EA
5	WELD METAL	1	EA
6	WELD METAL	1	EA
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100	WELD METAL	1	EA

FRENCH NATIONAL ACCELERATOR LABORATORY
 UNITED STATES DEPARTMENT OF ENERGY
 E974-MICROBONE - CRYOGENICS
 SUPPORT EQUIPMENT
 MICROBONE MOLE SIEVE VESSEL
 SCALE: DRAWING NUMBER: 3874.220-WE-486037 SHEET 1 OF 1
 DATE: 11/15/2011

REV	DESCRIPTION	DATE
1	DRAWN	
1	APPROVED	
	DATE	



UNLESS OTHERWISE SPECIFIED BY INDICATOR		R. SANDERS	23-AUG-2010
1	3X	ANALYSIS PERFORM	V. J. MADONSKI
2	1	CHECKED	J. BULLOCK
3	1	APPROVED	R. SANDERS
4	1	DESIGN	MC-486031
5	1	REVISION	
6	1	REVISION	
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100	1	REVISION	

FRMFI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

E974-M1 CRYOBOONE - CRYOGENICS
SUPPORT EQUIPMENT
BOTTOM PANEL - ITEM 21

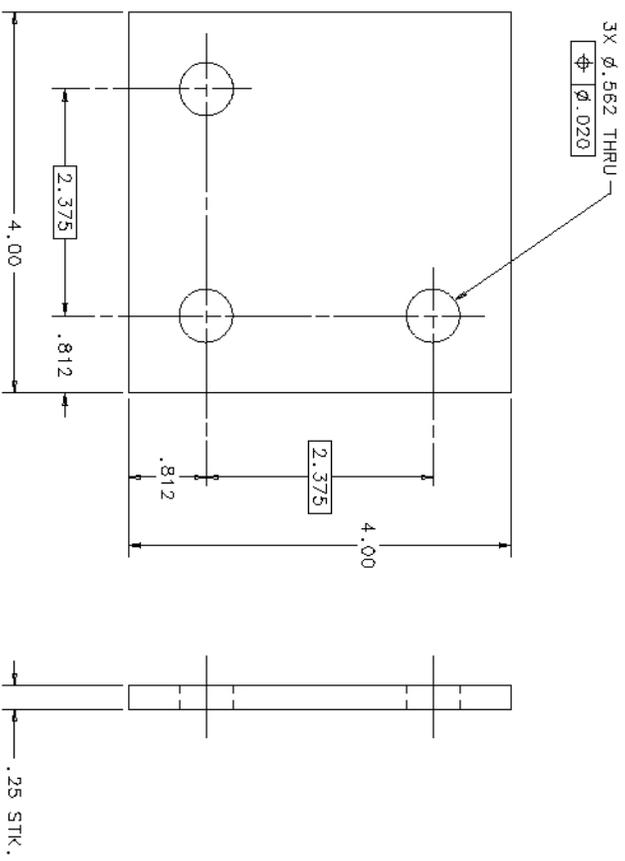
SCALE: DRAWING NUMBER: 3974.220-MD-486188

1 OF 1

REV: 1

CREATED WITH: ISDRA/INVENTOR: SQUAT: PRODUCTIONAL DEPARTMENT

REV	DESCRIPTION	DRAWN	DATE
		APPROVED	DATE



UNLESS OTHERWISE SPECIFIED		ORIGINATOR	
.XX	.XXX	ANGLES	R. SANDERS
± .06	± .010	DRAWN	J. MATYSKI
	± 1°	CHECKED	W. CYKO
1. BREAK ALL SHARP CORNERS		APPROVED	R. SANDERS
2. DO NOT SCALE DRAWING.		USED ON	3974.220-ME-486047
3. DIMENSIONS BASED UPON			
4. MAX. ALLOWABLE SURFACES		MATERIAL	ASTM-A36 STEEL
5. DIMENING UNITS: U.S. INCH			

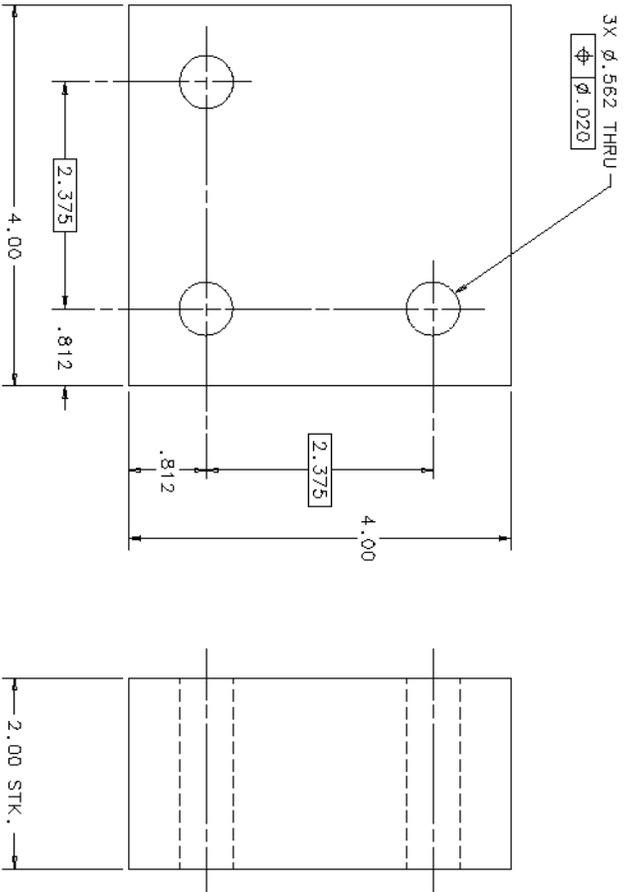

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

E974-MICROBONE - CRYOGENICS
SUPPORT EQUIPMENT
MOLE SIEVE SKID - METAL SPACER

SCALE	DRAWING NUMBER	SHEET	REV
1:1	3974.220-MC-486051	1 OF 1	

CREATED WITH : Idec12NXP.r1es GROUP: PPD/MECHANICAL DEPARTMENT

REV	DESCRIPTION	DRAWN	DATE
		APPROVED	DATE



UNLESS OTHERWISE SPECIFIED		ORIGINATOR	DRAWN	DATE
.XX	.XXX	ANGLES	J. MATESKI	08-JUL-2010
± .06	± .010	± 1°	W. CYKO	25-JUL-2010
1. BREAK ALL SHARP EDGES		APPROVED	R. SANDERS	26-JUL-2010
2. DO NOT SCALE DRAWING.		USED ON	3974.220-ME-486047	
3. DIMENSIONS BASED UPON		MATERIAL: ALUMINA SILICATE CERAMICS		
4. MAX. ALLOW. SURFACES		MANUFACTURER: P/N 8479K97 OR EQUIV.		
5. DRAWING UNITS: U.S. INCH		290		


FERMI NATIONAL ACCELERATOR LABORATORY
 UNITED STATES DEPARTMENT OF ENERGY

E974-MICROBONE - CRYOGENICS
 SUPPORT EQUIPMENT
 MOLE SIEVE SKID - CERAMIC SPACER

SCALE	DRAWING NUMBER	SHEET	REV
1:1	3974.220-MC-486050	1 OF 1	

CREATED WITH : Ideas12NXSeries GROUP : PPD/MECHANICAL DEPARTMENT

II. Mole Sieve Vessel Pricing

The mole sieve pressure vessel can be seen in engineering drawing 486037. It was quoted by Meyer Tool and Mfg, Inc. along with the rest of the assembly. Item 001 listed on the quote is solely for the ASME stamped pressure vessel.



Meyer Tool & Mfg., Inc.
 4601 W. Southwest Highway
 Oak Lawn, IL 60453
 708/425-9080 Fax 708/425-2612

Our Quotation # 003277-00

08/18/2010

To :

**Fermi National Accelerator Lab
 Technical Division
 Material Control Department
 PO Box 500
 Batavia IL 60510
 USA**

Quotation Valid Thru : 09/18/2010

Terms : NET 30

Attention : Ron Evans

Your Request : 80410RE Rev #1

Item	Facility / Part / Rev / Description / Details	Quantity Quoted	Unit Price	Extended Price
001	<p>Default</p> <p>FNAL-ME486037 Rev "None" Rev NS U/M EA</p> <p>Mole Sieve Vessel</p> <p>1. FOB FNAL</p> <p>2. Exceptions Taken</p> <p>A.) Since Dye, Pen. Testing is not allowed, the vessel is to be hydrostatically tested. Per UW-50 Pneumatic testing requires that all nozzle welds be Dye Pen. Tested prior to pneumatic testing.</p> <p>B.) On Dwg 3974.220-ME-486064 and 3974.220-ME-486065 Item 1 is being quoted as 304SS .125"thk x .750wide flat bar since .065"thk is not available</p> <p>C.) On Dwg 3974.220-ME-486064 and 3974.220-ME-486065 Item 2 is being quoted as 304SS .125" x .125" Sq bar since .125" x .25" flat bar is not available</p> <p>D.) On Dwg 3974.220-ME-486064 and 3974.220-ME-486065 Item 4 is being quoted as 304SS .125" x .5" flat bar since .065" x .5" flat bar is not available</p> <p>Delivery: 5-6wks ARO</p>	1.00	16,700.000	\$ 16,700.00

Mole sieve pressure vessel cost: \$16,700.00



to install the upper and lower sieves. The method of installation will be determined by AET and subject to approval by Fermilab prior to the commencement of fabrication.

- Document package will include required test reports eg.
 - Leak Test
 - Material Certs
 - U-1 Data report from AI inspection

We hope that our response meets with your approval, and we thank you for this opportunity to be of service to Fermilab. If you have any questions please contact me at your earliest convenience.

**-Ability Engineering Technology is the cheaper quoted option for the inner vessel at: \$6560
+ \$500 (estimated cost of installing upper and lower sieve) = \$7,060.00**

III. Mole Sieve Skid Frame Parts Pricing

Item #-Description	Source	Part Number	Quantity	Price (each)
#1-Carbon steel channel, C3 x 5 x 35.25 long	Metals Depot	C2350	2 (covered by item #2)	(Covered by item #2)
#2-Carbon steel channel, C3 x 5 x 32.25 long	Metals Depot	C2350	2 (1- 20 foot section)	\$80.00
#3-Carbon steel channel, C5 x 6.7 x 32.25 long	Metals Depot	C2567	2 (1- 6 foot section)	\$48.24
#4-Carbon steel angle, 3 x 3 x 3/8, 85 long	Metals Depot	A23338	4 (3-20 foot sections)	\$114.40
#5- Carbon steel angle, 3 x 3 x 3/8, 3 long	Metals Depot	A23338	4 (covered by item #4)	(Covered by item #4)
#6- Carbon steel angle, 3 x 3 x 3/8, 35.25 long	Metals Depot	A23338	4 (covered by item #4)	(Covered by item #4)
#7- Carbon steel angle, 3 x 3 x 3/8, 29.25 long	Metals Depot	A23338	4 (covered by item #4)	(Covered by item #4)
#8-Carbon steel bar, 1/4 thick x 2 wide x 29.25 long	Metals Depot	F2142	4 (1- 1/4 x 2 x 10 foot length)	\$17.50

Mole sieve skid frame parts pricing: = 80.00 + 48.24 + 114.40(3) + 17.50 = \$488.94

IV. Mole Sieve Parts Pricing

Item #- Description	Source	Part Number	Quantity	Price (each)
#1-Mole sieve vessel	Ability Engineering and Technology	N/A (see section II)	1	\$7,060.00
#2-Ceramic spacer, McM # 8479K97 or equiv.	McMaster	8479K97	4	\$39.62
#3-Carbon steel spacer, 2 x 2 x ¼	Metals Depot	P114	4 (1- ¼ thick, 1 square foot)	\$12.86
#4-Elbow, 2 IPS, 90 degree, long radius type 304 SS	McMaster	45735K216	2	\$8.66
#5-Pipe, 2 IPS type 304 SS, sch. 10, 4 long	McMaster	4347K362	1 (1- 3 foot section)	\$61.72
#6-Pipe, 2 IPS type 304 SS, sch. 10, 16.63 long	McMaster	4347K362	1 (1- 3 foot section)	(covered by item #5)
#7-Insulation, high temp., 2 thick, McM # 9356K13 or equiv., [about 224 x 80 req.]	McMaster	9356K13	As required (about 8 rolls of 24 x 96)	\$27.76
#8-Mole sieve skid frame	Metals Depot (see section III)	N/A	1	\$488.94
#9-Hoist ring, 2500#, McM # 3070T51 or equiv.	McMaster	3070T51	4	\$115.42
#10-Angle, 2 x 2 x ¼ x 14 long	Metals Depot	A12214	4 (1- 6 foot section)	\$20.04

#11-Plate, 2 x 2 x ¼ thick	Metals Depot	P114	4 (1 – ¼ thick, 1 square foot)	\$12.86
#12-Panel (see dwg 486118), 18 gauge galvanized sheet, ASTM A653	Metals Depot	S218	8 (3 full sheets)	\$89.60
	Metal by the inch	N/A		\$72.99
#13-Screw, sheet metal, tap #6 x 3/8 long, McM # 91675A311 or equiv.	McMaster	91675A311	152 (2- packs of 100)	\$7.46
#14-Screw, hex cap, ½-13unc x 3.5 long	McMaster	92240A726	12 (4- packs of 5)	\$9.60
#15-Washer, flat, 1/2	McMaster	98125A443	24 (3- packs of 10)	\$6.90
#16-Washer, lock, 1/2	McMaster	92146A033	12 (1- pack of 50)	\$8.66

Mole sieve skid parts pricing total: 7,060.00 + 39.62(4) + 12.86 + 8.66(2) + 61.72 + 27.76(8) + 488.94 + 115.42(4) + 20.04 + 12.86 + 218.97 + 7.46(2) + 9.60(4) + 6.90(3) + 8.66 = **\$8,738.39**

V. In House Labor Cost

Description	Time (hours)	Base wage	Total
Technician	88	\$51.00 / hour	\$4,488
Machinist	0	\$51.00 / hour	\$0
Welder	16	\$51.00 / hour	\$816
Total / [Total +15%]	104 / [120]		\$5,304 / \$6,120

Total in house labor cost: \$5,304

Total in house labor cost +15%: \$6,120

- **\$6,120 will be used as the total in house labor cost.**

VI. Total in house part and assembly costs

Description	Cost x quantity(if applicable)	Total Cost
Mole sieve frame	\$488.94 x 1	\$488.94
Mole sieve vessel	\$7,060.00 x 1	\$7,060.00
Mole sieve total parts (*includes two above items)	-	*\$8,738.39
In house labor cost	-	\$6,120
Total		\$14,858.39

Total in house assembly and parts: \$14,858.39

VII. Outside quotes



Meyer Tool & Mfg., Inc.
 4601 W. Southwest Highway
 Oak Lawn, IL 60453
 708/425-9080 Fax 708/425-2612

Our Quotation # 003277-00

08/18/2010

To :

**Fermi National Accelerator Lab
 Technical Division
 Material Control Department
 PO Box 500
 Batavia IL 60510
 USA**

Quotation Valid Thru : 09/18/2010

Terms : NET 30

Attention : Ron Evans

Your Request : 80410RE Rev #1

Item	Facility / Part / Rev / Description / Details	Quantity Quoted	Unit Price	Extended Price
001	Default FNAL-ME486037 Rev "None" Rev NS U/M EA Mole Sieve Vessel 1. FOB FNAL 2. Exceptions Taken A.) Since Dye. Pen. Testing is not allowed, the vessel is to be hydrostatically tested. Per UW-50 Pneumatic testing requires that all nozzle welds be Dye Pen. Tested prior to pneumatic testing. B.) On Dwg 3974.220-ME-486064 and 3974.220-ME-486065 Item 1 is being quoted as 304SS .125"thk x .750wide flat bar since .065"thk is not available C.) On Dwg 3974.220-ME-486064 and 3974.220-ME-486065 Item 2 is being quoted as 304SS .125"x .125" Sq bar since .125" x .25" flat bar is not available D.) On Dwg 3974.220-ME-486064 and 3974.220-ME-486065 Item 4 is being quoted as 304SS .125" x .5" flat bar since .065" x .5" flat bar is not available Delivery: 5-6wks ARO	1.00	16,700.000	\$ 16,700.00
002	Default FNAL-ME486047 Rev "None" Rev NS U/M EA Mole Sieve Skid 1. FOB FNAL Delivery: 5-6wks ARO	1.00	7,000.000	\$ 7,000.00
Total Items Price				\$ 23,700.00
<p>We are pleased to quote your requirements. Our company has a reputation for delivering quality products on time and we look forward to the opportunity of serving you. If you have any questions or additional requirements, please feel free to contact us at any time.</p> <p>Thank you for your interest in our company as one of your suppliers.</p> <p>Sincerely yours,</p> <p>Edward C. Bonnema Vice President of Operations</p>				

Customer

 Authorized Signature

IX. Conclusions

Source	Delivery Included	Lead time	Total
Fermi assembled	N	Delivery + 120 labor hours (about 3 weeks after materials are received)	\$14,858.39
Meyer Tool & Mfg	N	5-6 weeks	\$23,700

Having the Microboone molecular sieve fabricated in-house seems to be the cheaper option. In this scenario, the pressure vessel would be fabricated off-site and delivered, with the frame and remaining components being assembled in-house. No contingency has been added, however 15% has been added to the total labor cost per John Voirin's recommendation.