Clay Wynn

Design Engineer
Scintillating Barrel Calorimeter

SSC GEM Detector

Central Engineering Services Division
Oak Ridge National Laboratory

MARTIN MARIETTA ENERGY SYSTEMS INC.

SSC GEM DETECTOR
SCINTILLATOR BARREL CALORIMETER

o MAJOR ASSUMPTIONS

- TIMELY M.O.U. WITH COLLABORATORS FOR FABRICATION - BY FALL OF 1993

- SSC STARTUP - 1999

o OTHER ASSUMPTIONS

- MODULE & STRUCTURE FABRICATION ABROAD

- SCINT TILE TRAY ASSEMBLY IN US

- FINAL ASSEMBLY AT SSCL
  * MODULE ASSEMBLY
  * MODULES INTO BARREL
  * BARREL STRUCTURE ASSEMBLY

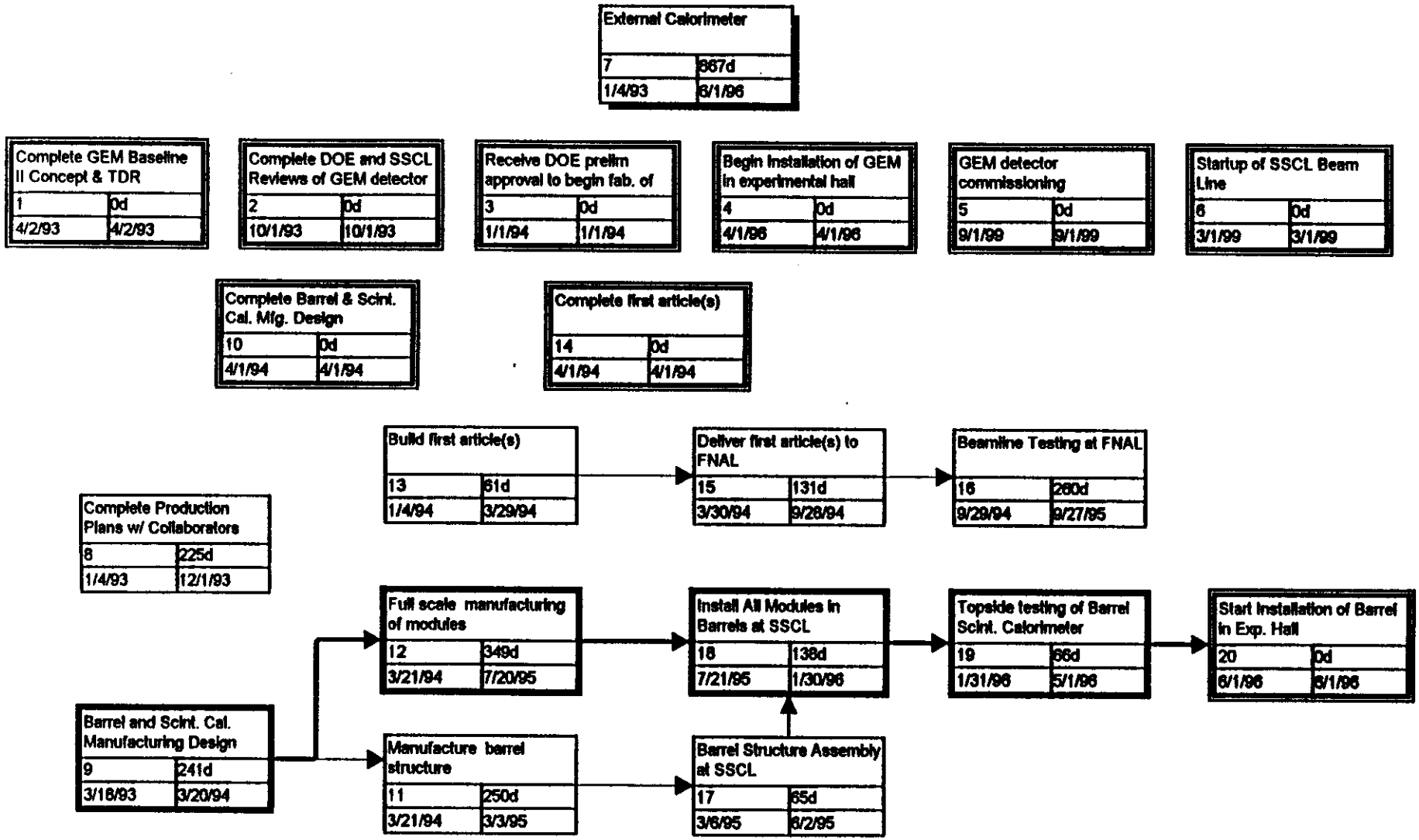
OVERALL GEM SCHEDULE MILESTONES

Complete GEM Baseline II Concept and TDR	-	April 1993
Complete DOE and SSCL Reviews of GEM Detector	-	October 1993
Receive DOE Approval to Begin Fabrication	-	May 1994
Begin Installation of GEM in Experimental Hall	-	April 1996
GEM Detector Commisioning	-	September 1999
SSC Beam Line Commissioning	-	March 1999

Scintillating Barrel Production Milestones:

Discuss Production Plans with Collaborators	- January-June 1993
Complete Final Production Plans with Collaborators	- June-December 199.
Complete Manufacturing Pre-Prod. Module	- March 1994
Install Module Prototype for Fermi test	- September 1994
Complete Manufacturing Design	- March 1994
Begin Full Scale Manufacturing	- March 1994
Begin Barrel Structure Assembly @ SSCL	- March 1995
Complete Scintillating Modules and Barrel Fabrication	- July 1995
Begin Module Installation	- July 1995
Complete Scintillating Barrel Assembly (at SSCL)	- January 1996
Install Barrel in Experimental Hall	- June 1996

GEM External Calorimeter Project Schedule

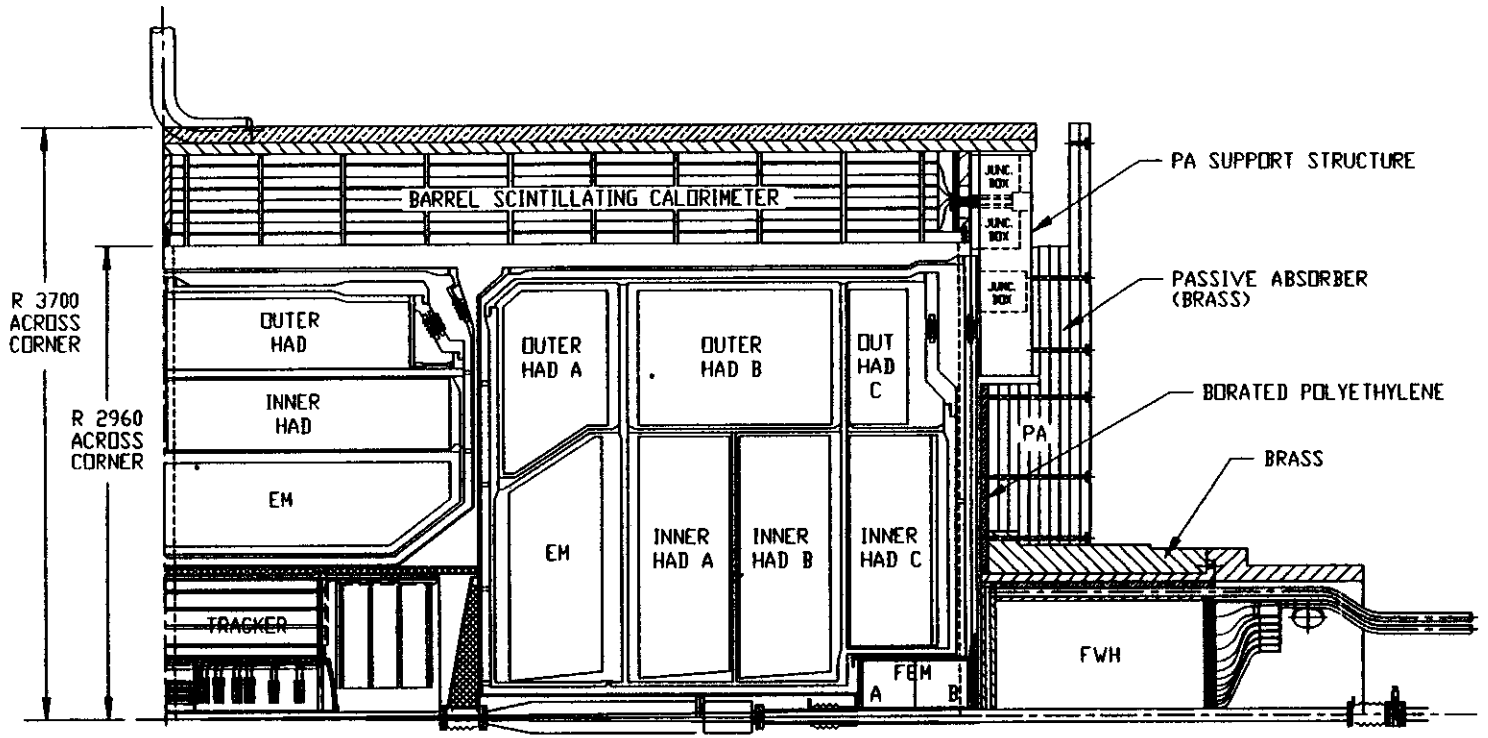


Project: External Calorim
Date: 4/8/93

Name	
ID	Duration
Scheduled Start	Scheduled Finish

Critical | Milestone | Subproject

Noncritical | Summary | Marked



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SBC Design Parameters

Number of modules (total)	44
Number of absorber brass plates per module	8 or more
Number of scintillation layers per module	4
Scintillation material	6 mm Polystyrene
Number of scintillation tiles per module	384
Number of fibers per tile	2
Number of tiles per pseudo-tower	24
Pseudo-tower segmentation	0.16 rad.φ x 0.16 rad.η
Total scintillation layer area	672 square meters
Total wave length shifting fiber length	18816 meters
Total transmission fiber length	65856 meters
Fiber diameter	1 mm
Number of fibers per pseudo-tower	48
Total number of channels (1 per tower)	640
Coverage in eta	0-1.28 rad.
Effective absorbtion length	4.5 λ

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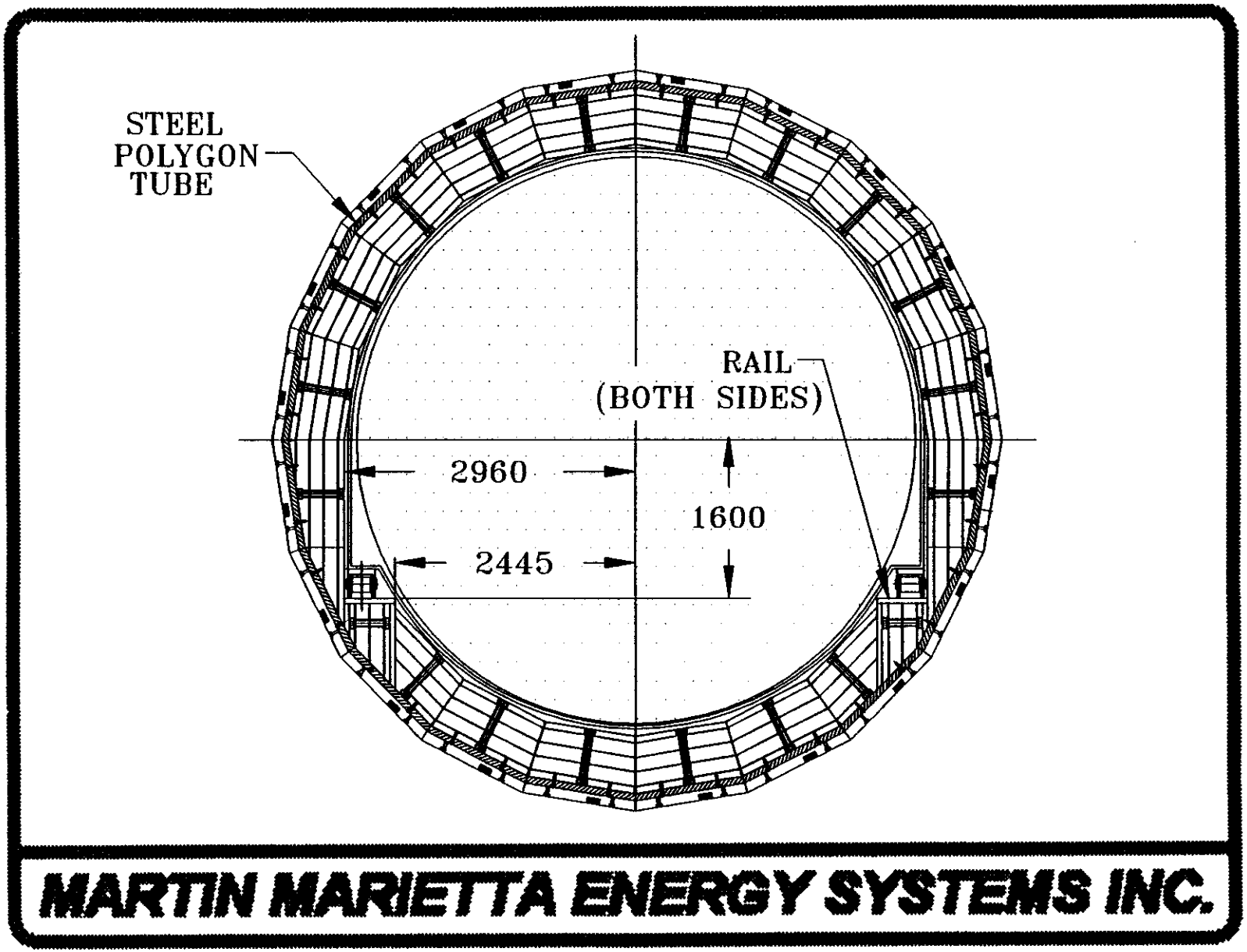

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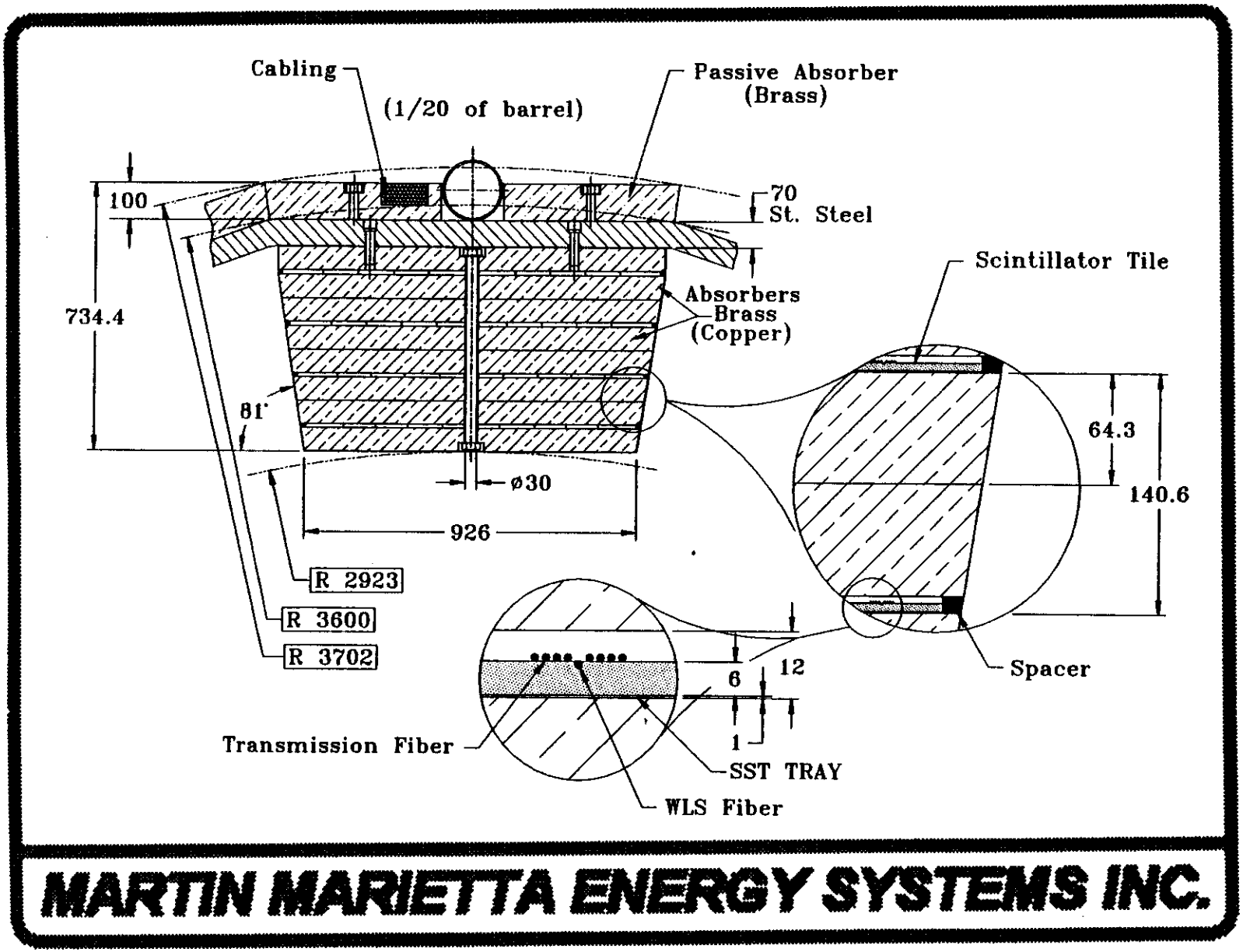

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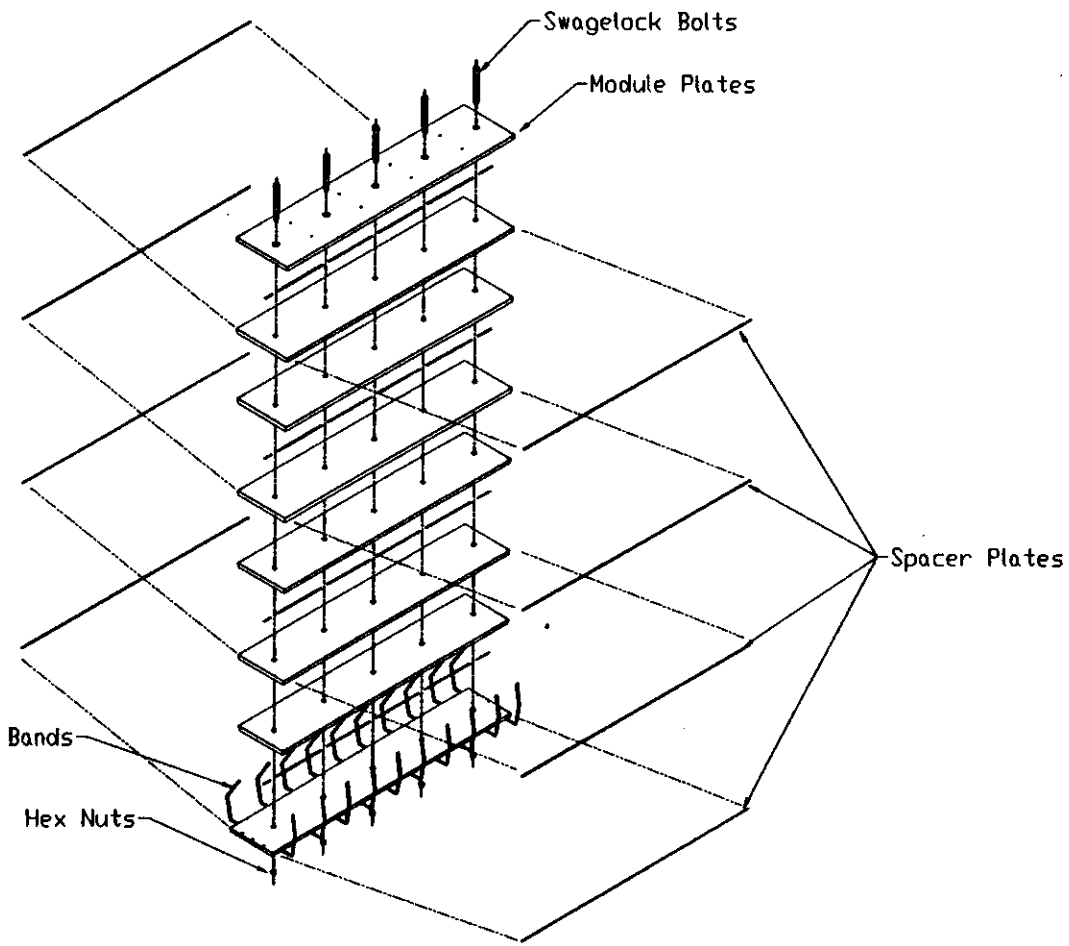
SBC Module Construction (Cont'd)

- Tiles 6mm thick Bicron Corp. Type BC-404 or equivalent.
- Tiles arranged in 8 stainless steel trays per module, 48 tiles per tray.
- Tiles grooved to accept wave length shifting fibers, 1mm diameter.
- Light input quartz fibers added for dynamic calibration .
- WLS fibers glued or mechanically held in tile grooves, tiles wrapped in Tyvex, taped and seated.
- Free ends of WLS fibers thermally bonded to 1mm dia. clear transmission fibers.
- Fibers sheathed, taped, and dressed along length of tray.



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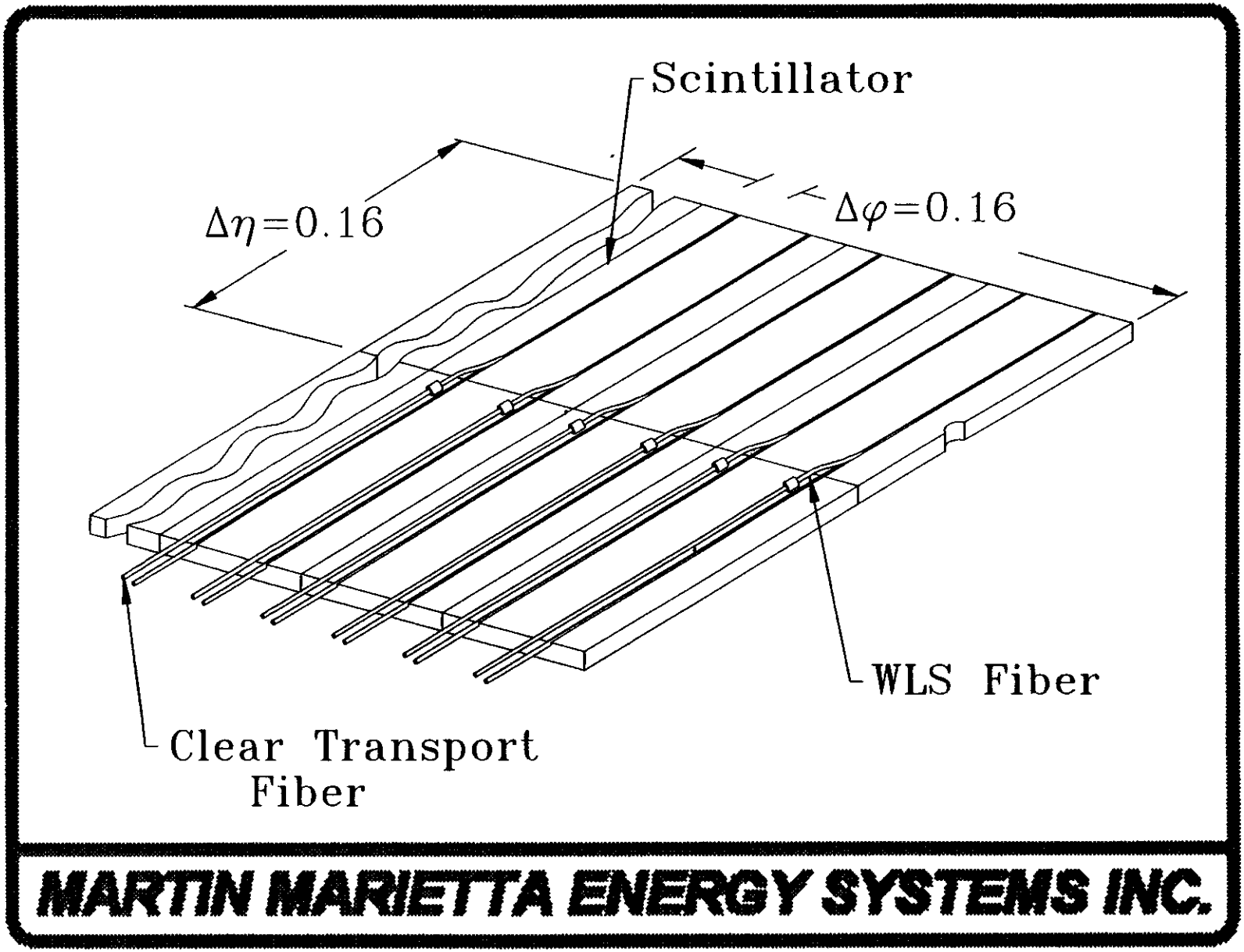
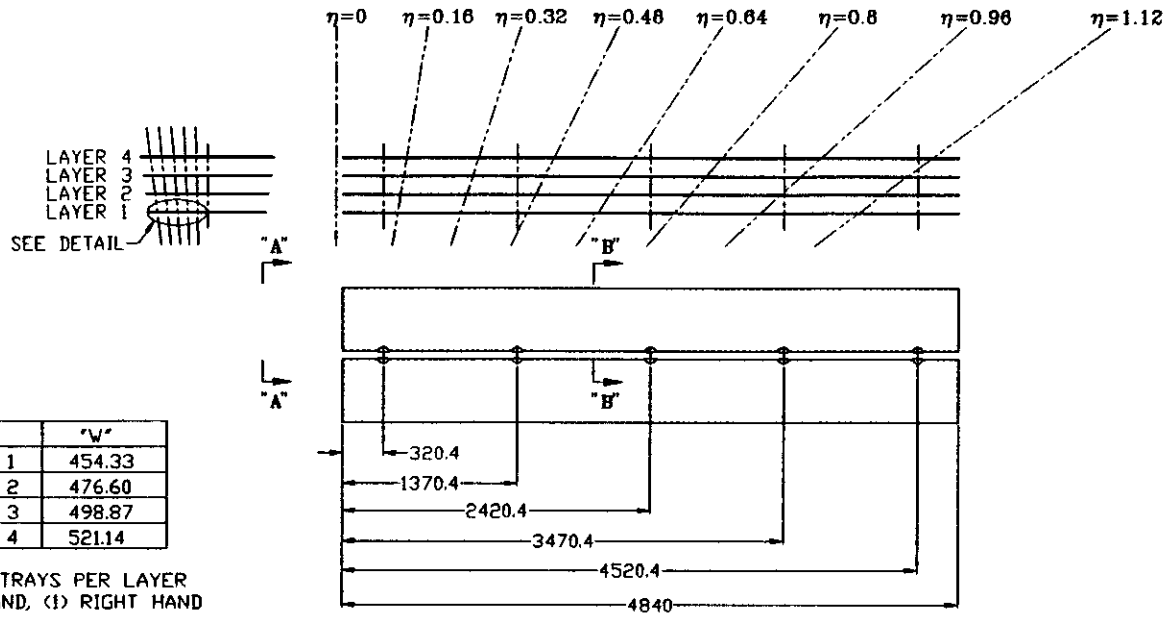
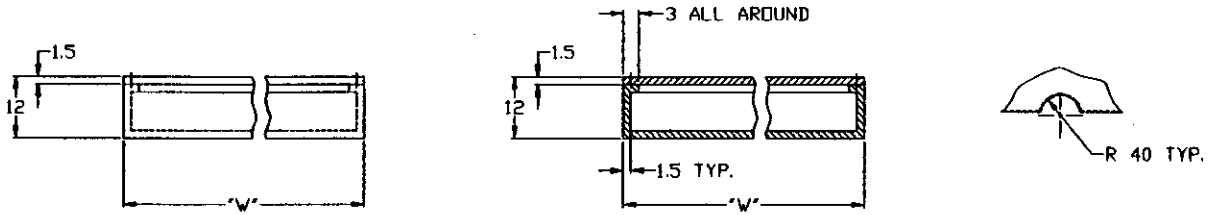

Scintillator
$\Delta\eta$=0.16
$\Delta\varphi$=0.16
WLS Fiber
Clear Transport Fiber
MARTIN MARIETTA ENERGY SYSTEMS INC.



	"W"
LAYER 1	454.33
LAYER 2	476.60
LAYER 3	498.87
LAYER 4	521.14

NOTE: (2) TRAYS PER LAYER
(1) LEFT HAND, (1) RIGHT HAND



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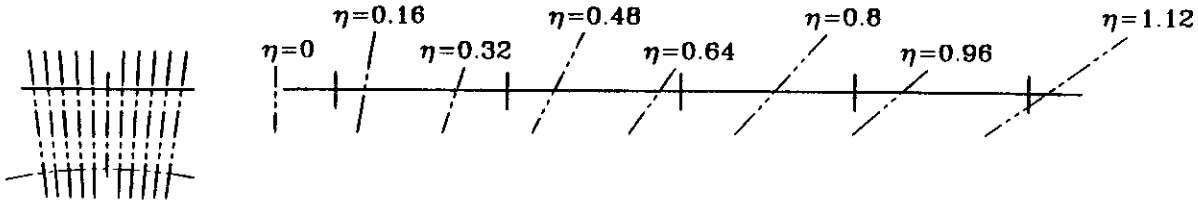
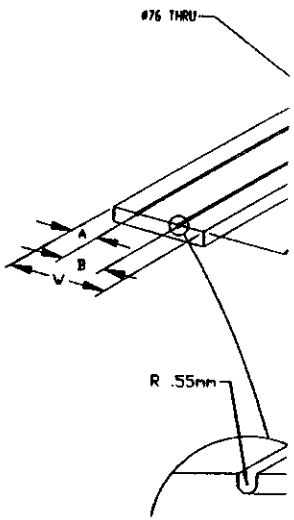


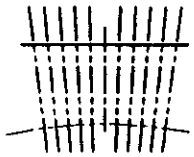
1	7	13	19	25	31	37	43
2	8	14	20	26	32	38	44
3	9	15	21	27	33	39	45
4	10	16	22	28	34	40	46
5	11	17	23	29	35	41	47
6	12	18	24	30	36	42	48

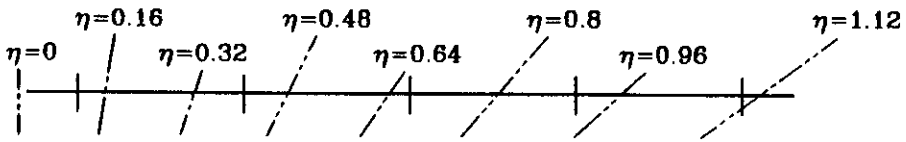
TILE NO.	"L"	"W"	"A"	"B"	"C"
1	496.2	76.1	19	38	X
2	496.2	90.1	22.5	45	X
3	496.2	89.6	22.4	44.8	X
4	496.2	89.2	22.3	44.6	X
5	496.2	88.9	22.2	44.4	X
6	496.2	81.3	20.3	40.6	318.6
7	561.6	76.1	19	38	X
8	561.6	90.1	22.5	45	X
9	561.6	89.6	22.4	44.8	X
10	561.6	89.2	22.3	44.6	X
11	561.6	88.9	22.2	44.4	X
12	561.6	81.3	20.3	40.6	X
13	589.9	76.1	19	38	X
14	589.9	90.1	22.5	45	X
15	589.9	89.6	22.4	44.8	X
16	589.9	89.2	22.3	44.6	X
17	589.9	88.9	22.2	44.4	X
18	589.9	81.3	20.3	40.6	309.8
19	634.4	76.1	19	38	X
20	634.4	90.1	22.5	45	X
21	634.4	89.6	22.4	44.8	X
22	634.4	89.2	22.3	44.6	X
23	634.4	88.9	22.2	44.4	X
24	634.4	81.3	20.3	40.6	X

TILE NO.	"L"	"W"	"A"	"B"	"C"
25	693.5	76.1	19	38	X
26	693.5	90.1	22.5	45	X
27	693.5	89.6	22.4	44.8	X
28	693.5	89.2	22.3	44.6	X
29	693.5	88.9	22.2	44.4	X
30	693.5	81.3	20.3	40.6	134.5
31	771.7	76.1	19	38	X
32	771.7	90.1	22.5	45	X
33	771.7	89.6	22.4	44.8	X
34	771.7	89.2	22.3	44.6	X
35	771.7	88.9	22.2	44.4	X
36	771.7	81.3	20.3	40.6	490.5
37	868.7	76.1	19	38	X
38	868.7	90.1	22.5	45	X
39	868.7	89.6	22.4	44.8	X
40	868.7	89.2	22.3	44.6	X
41	868.7	88.9	22.2	44.4	X
42	868.7	81.3	20.3	40.6	768.4
43	217.1	76.1	19	38	X
44	217.1	90.1	22.5	45	X
45	217.1	89.6	22.4	44.8	X
46	217.1	89.2	22.3	44.6	X
47	217.1	88.9	22.2	44.4	X
48	217.1	81.3	20.3	40.6	X



MARTIN MARIETTA ENERGY SYSTEMS INC.

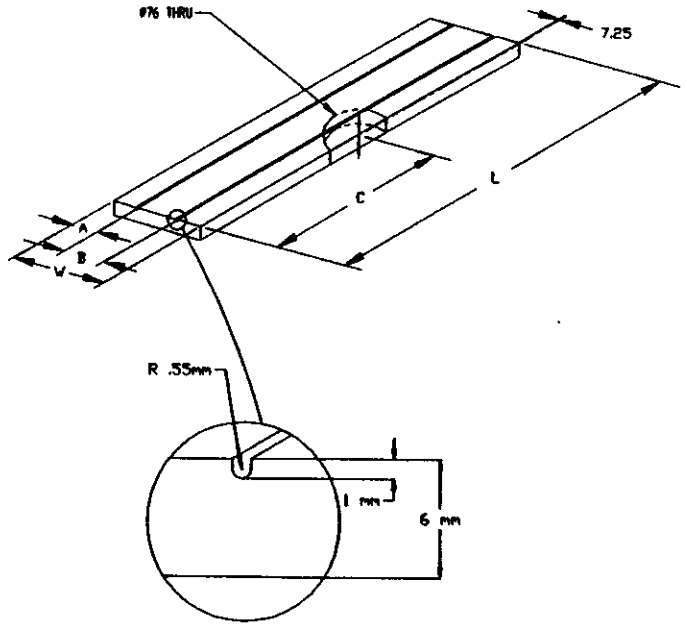




1	7	13	19	25	31	37	43
2	8	14	20	26	32	38	44
3	9	15	21	27	33	39	45
4	10	16	22	28	34	40	46
5	11	17	23	29	35	41	47
6	12	18	24	30	36	42	48

TILE NO.	"L"	"W"	"A"	"B"	"C"
1	496.2	76.1	19	38	X
2	496.2	90.1	22.5	45	X
3	496.2	89.6	22.4	44.8	X
4	496.2	89.2	22.3	44.6	X
5	496.2	88.9	22.2	44.4	X
6	496.2	81.3	20.3	40.6	318.6
7	561.6	76.1	19	38	X
8	561.6	90.1	22.5	45	X
9	561.6	89.6	22.4	44.8	X
10	561.6	89.2	22.3	44.6	X
11	561.6	88.9	22.2	44.4	X
12	561.6	81.3	20.3	40.6	X
13	589.9	76.1	19	38	X
14	589.9	90.1	22.5	45	X
15	589.9	89.6	22.4	44.8	X
16	589.9	89.2	22.3	44.6	X
17	589.9	88.9	22.2	44.4	X
18	589.9	81.3	20.3	40.6	309.8
19	634.4	76.1	19	38	X
20	634.4	90.1	22.5	45	X
21	634.4	89.6	22.4	44.8	X
22	634.4	89.2	22.3	44.6	X
23	634.4	88.9	22.2	44.4	X
24	634.4	81.3	20.3	40.6	X

TILE NO.	"L"	"W"	"A"	"B"	"C"
25	693.5	76.1	19	38	X
26	693.5	90.1	22.5	45	X
27	693.5	89.6	22.4	44.8	X
28	693.5	89.2	22.3	44.6	X
29	693.5	88.9	22.2	44.4	X
30	693.5	81.3	20.3	40.6	134.5
31	771.7	76.1	19	38	X
32	771.7	90.1	22.5	45	X
33	771.7	89.6	22.4	44.8	X
34	771.7	89.2	22.3	44.6	X
35	771.7	88.9	22.2	44.4	X
36	771.7	81.3	20.3	40.6	490.5
37	868.7	76.1	19	38	X
38	868.7	90.1	22.5	45	X
39	868.7	89.6	22.4	44.8	X
40	868.7	89.2	22.3	44.6	X
41	868.7	88.9	22.2	44.4	X
42	868.7	81.3	20.3	40.6	768.4
43	217.1	76.1	19	38	X
44	217.1	90.1	22.5	45	X
45	217.1	89.6	22.4	44.8	X
46	217.1	89.2	22.3	44.6	X
47	217.1	88.9	22.2	44.4	X
48	217.1	81.3	20.3	40.6	X



UNLESS OTHERWISE SPECIFIED	
TOLERANCES (Except As Specified)	
OVER	UNDER
0	2.999
3	9.999
10	99.999
100	999.999
1000	9999.999
10000	99999.999
100000	999999.999
ANGLES	
DO NOT SCALE DRAWING	

DO NOT REVISE MANUALLY

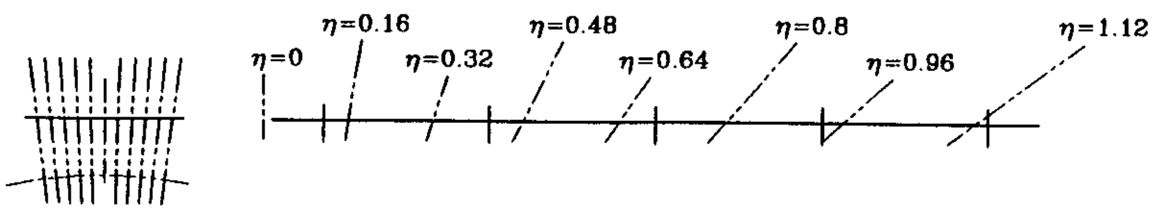
ORIGINAL ISSUE

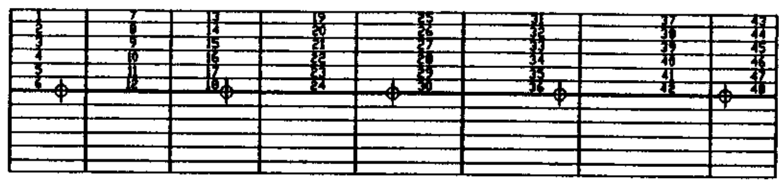
GEM DETECTOR
BARREL SCINTILLATING CALORIMETER
MODULE TILE LAYER 1 DETAIL

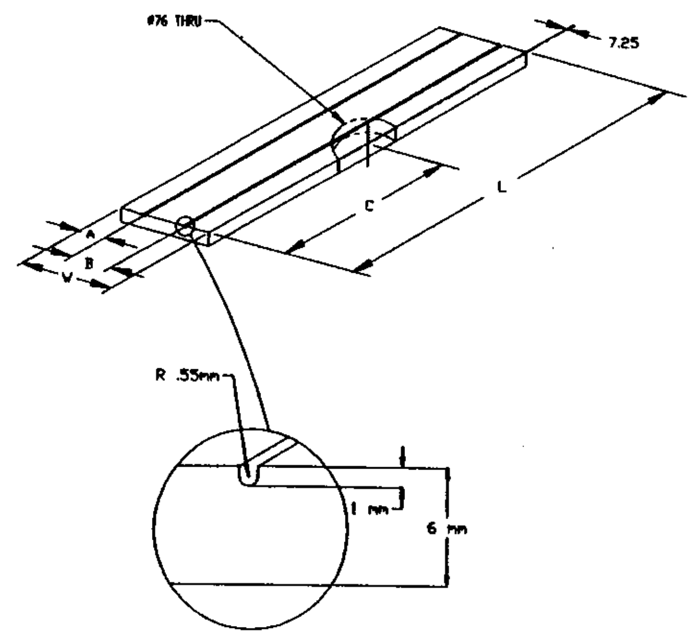
N/A

SCALE 1/4 | SHEET 1 | X3E017848 | A078

PLOT SCALE: XXX







TILE NO.	"L"	"V"	"A"	"B"	"C"
1	473.6	72.3	18.1	36.2	X
2	473.6	86.4	21.6	43.2	X
3	473.6	85.8	21.5	42.9	X
4	473.6	85.5	21.4	42.8	X
5	473.6	85.3	21.3	42.6	X
6	473.6	77.7	19.4	38.8	318.6
7	538.4	72.3	18.1	36.2	X
8	538.4	86.4	21.6	43.2	X
9	538.4	85.8	21.5	42.9	X
10	538.4	85.5	21.4	42.8	X
11	538.4	85.3	21.3	42.6	X
12	538.4	77.7	19.4	38.8	X
13	565.6	72.3	18.1	36.2	X
14	565.6	86.4	21.6	43.2	X
15	565.6	85.8	21.5	42.9	X
16	565.6	85.5	21.4	42.8	X
17	565.6	85.3	21.3	42.6	X
18	565.6	77.7	19.4	38.8	355.6
19	608.2	72.3	18.1	36.2	X
20	608.2	86.4	21.6	43.2	X
21	608.2	85.8	21.5	42.9	X
22	608.2	85.5	21.4	42.8	X
23	608.2	85.3	21.3	42.6	X
24	608.2	77.7	19.4	38.8	X

TILE NO.	"L"	"V"	"A"	"B"	"C"
25	664.8	72.3	18.1	36.2	X
26	664.8	86.4	21.6	43.2	X
27	664.8	85.8	21.5	42.9	X
28	664.8	85.5	21.4	42.8	X
29	664.8	85.3	21.3	42.6	X
30	664.8	77.7	19.4	38.8	230.8
31	739.8	72.3	18.1	36.2	X
32	739.8	86.4	21.6	43.2	X
33	739.8	85.8	21.5	42.9	X
34	739.8	85.5	21.4	42.8	X
35	739.8	85.3	21.3	42.6	X
36	739.8	77.7	19.4	38.8	615.4
37	832.9	72.3	18.1	36.2	X
38	832.9	86.4	21.6	43.2	X
39	832.9	85.8	21.5	42.9	X
40	832.9	85.5	21.4	42.8	X
41	832.9	85.3	21.3	42.6	X
42	832.9	77.7	19.4	38.8	X
43	409.6	72.3	18.1	36.2	X
44	409.6	86.4	21.6	43.2	X
45	409.6	85.8	21.5	42.9	X
46	409.6	85.5	21.4	42.8	X
47	409.6	85.3	21.3	42.6	X
48	409.6	77.7	19.4	38.8	91.7

DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED

TOLERANCES (Except As Specified)

OVER	UNDER	TOLERANCE
0	2.999	[illegible]
3	5.999	[illegible]
6	[illegible]	[illegible]
30	[illegible]	[illegible]
[illegible]	314.999	[illegible]
315	999.999	±2
1000	1999.999	±3
2000	3999.999	±4
4000	7999.999	±5
ANGLES		[illegible]

DO NOT SCALE DRAWING

DO NOT REVISE MANUALLY

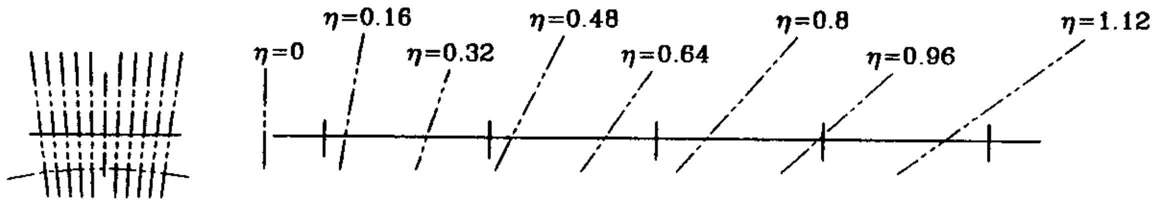
ORIGINAL ISSUE

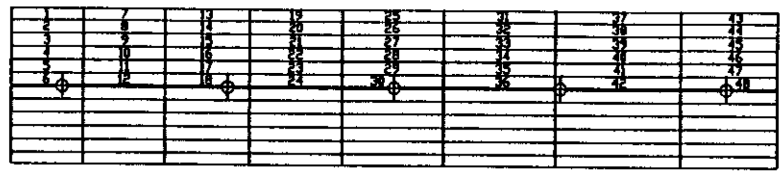
B.H. SINGLETARY 3/93

GEM DETECTOR
BARREL SCINTILLATING CALORIMETER
MODULE TILE LAYER 2 DETAIL

X3E017048 A879

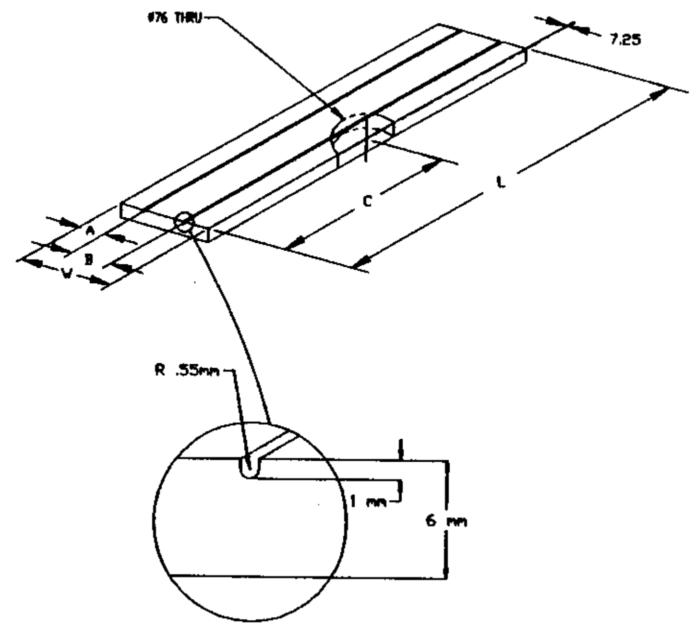
PLOT SCALE: XXX





TILE NO.	"L"	"V"	"A"	"B"	"C"
1	451	68.5	17.1	34.3	X
2	451	82.6	20.7	41.3	X
3	451	82.1	20.5	41	X
4	451	81.8	20.5	40.9	X
5	451	81.6	20.4	40.8	X
6	451	74	18.5	37	318.6
7	515.3	68.5	17.1	34.3	X
8	515.3	82.6	20.7	41.3	X
9	515.3	82.1	20.5	41	X
10	515.3	81.8	20.5	40.9	X
11	515.3	81.6	20.4	40.8	X
12	515.3	74	18.5	37	X
13	541.2	68.5	17.1	34.3	X
14	541.2	82.6	20.7	41.3	X
15	541.2	82.1	20.5	41	X
16	541.2	81.8	20.5	40.9	X
17	541.2	81.6	20.4	40.8	X
18	541.2	74	18.5	37	401.8
19	582.1	68.5	17.1	34.3	X
20	582.1	82.6	20.7	41.3	X
21	582.1	82.1	20.5	41	X
22	582.1	81.8	20.5	40.9	X
23	582.1	81.6	20.4	40.8	X
24	582.1	74	18.5	37	X

TILE NO.	"L"	"V"	"A"	"B"	"C"
25	636.3	68.5	17.1	34.3	X
26	636.3	82.6	20.7	41.3	X
27	636.3	82.1	20.5	41	X
28	636.3	81.8	20.5	40.9	X
29	636.3	81.6	20.4	40.8	X
30	636.3	74	18.5	37	327
31	708	68.5	17.1	34.3	X
32	708	82.6	20.7	41.3	X
33	708	82.1	20.5	41	X
34	708	81.8	20.5	40.9	X
35	708	81.6	20.4	40.8	X
36	708	74	18.5	37	740.3
37	797.1	68.5	17.1	34.3	X
38	797.1	82.6	20.7	41.3	X
39	797.1	82.1	20.5	41	X
40	797.1	81.8	20.5	40.9	X
41	797.1	81.6	20.4	40.8	X
42	797.1	74	18.5	37	31.8
43	602.1	68.5	17.1	34.3	X
44	602.1	82.6	20.7	41.3	X
45	602.1	82.1	20.5	41	X
46	602.1	81.8	20.5	40.9	X
47	602.1	81.6	20.4	40.8	X
48	602.1	74	18.5	37	284.2



DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED

DO NOT SCALE DRAWING

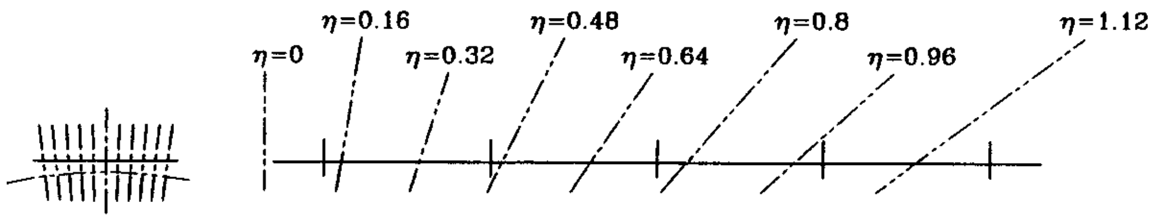
DO NOT REVISE MANUALLY

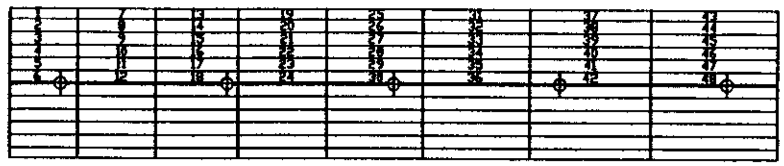
ORIGINAL ISSUE

GEM DETECTOR
BARREL SCINTILLATING CALORIMETER
MODULE TILE LAYER 3 DETAIL

X3E017048

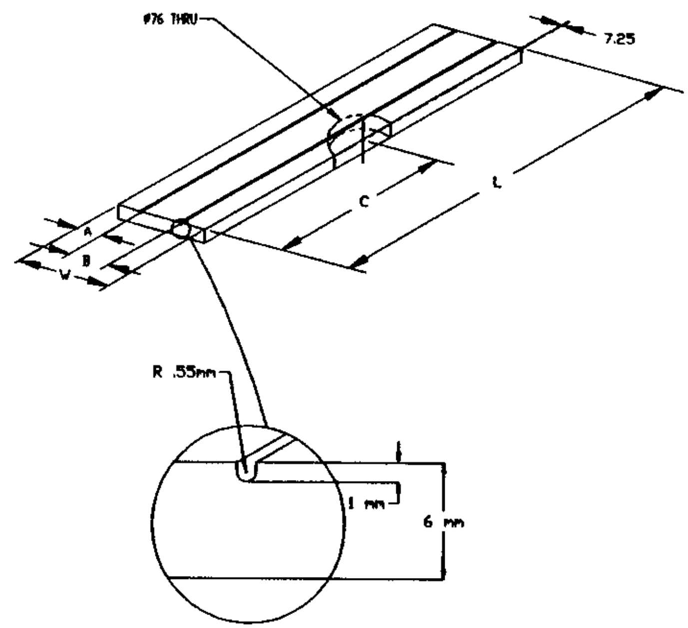
PLOT SCALE: XXX





TILE NO.	"L"	"W"	"A"	"B"	"C"
1	428.4	64.8	16.2	32.4	X
2	428.4	78.9	19.7	39.5	X
3	428.4	78.4	19.6	39.2	X
4	428.4	78.1	19.5	39.1	X
5	428.4	77.9	19.5	39	X
6	428.4	70.3	17.6	35.2	318.6
7	492.1	64.8	16.2	32.4	X
8	492.1	78.9	19.7	39.5	X
9	492.1	78.4	19.6	39.2	X
10	492.1	78.1	19.5	39.1	X
11	492.1	77.9	19.5	39	X
12	492.1	70.3	17.6	35.2	X
13	516.9	64.8	16.2	32.4	X
14	516.9	78.9	19.7	39.5	X
15	516.9	78.4	19.6	39.2	X
16	516.9	78.1	19.5	39.1	X
17	516.9	77.9	19.5	39	X
18	516.9	70.3	17.6	35.2	447.1
19	555.9	64.8	16.2	32.4	X
20	555.9	78.9	19.7	39.5	X
21	555.9	78.4	19.6	39.2	X
22	555.9	78.1	19.5	39.1	X
23	555.9	77.9	19.5	39	X
24	555.9	70.3	17.6	35.2	X

TILE NO.	"L"	"W"	"A"	"B"	"C"
25	607.6	64.8	16.2	32.4	X
26	607.6	78.9	19.7	39.5	X
27	607.6	78.4	19.6	39.2	X
28	607.6	78.1	19.5	39.1	X
29	607.6	77.9	19.5	39	X
30	607.6	78.3	17.6	35.2	423.3
31	676.2	64.8	16.2	32.4	X
32	676.2	78.9	19.7	39.5	X
33	676.2	78.4	19.6	39.2	X
34	676.2	78.1	19.5	39.1	X
35	676.2	77.9	19.5	39	X
36	676.2	78.3	17.6	35.2	X
37	761.2	64.8	16.2	32.4	X
38	761.2	78.9	19.7	39.5	X
39	761.2	78.4	19.6	39.2	X
40	761.2	78.1	19.5	39.1	X
41	761.2	77.9	19.5	39	X
42	761.2	78.3	17.6	35.2	188.5
43	794.7	64.8	16.2	32.4	X
44	794.7	78.9	19.7	39.5	X
45	794.7	78.4	19.6	39.2	X
46	794.7	78.1	19.5	39.1	X
47	794.7	77.9	19.5	39	X
48	794.7	78.3	17.6	35.2	476.8



DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED

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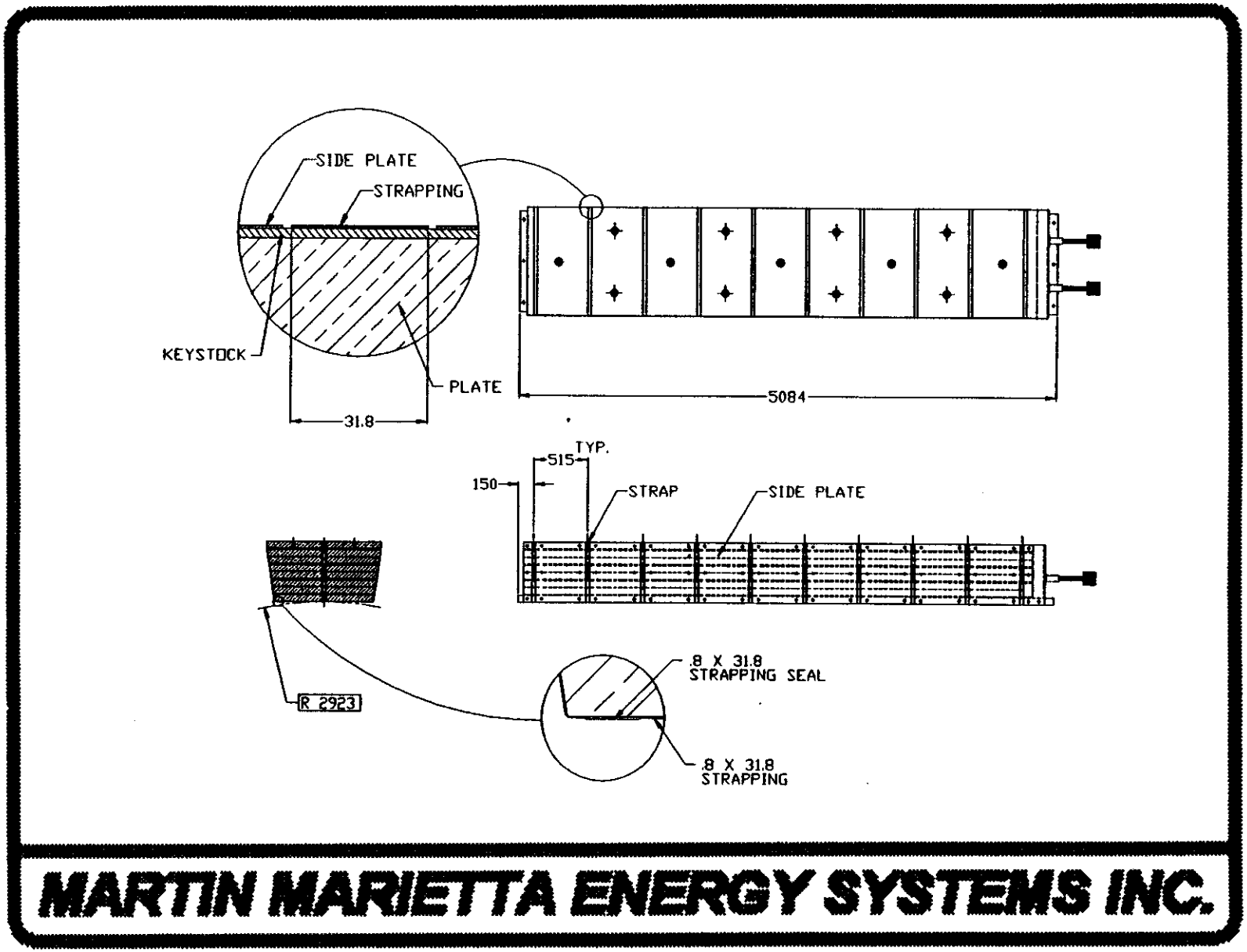
DO NOT REVISE MANUALLY

ORIGINAL ISSUE

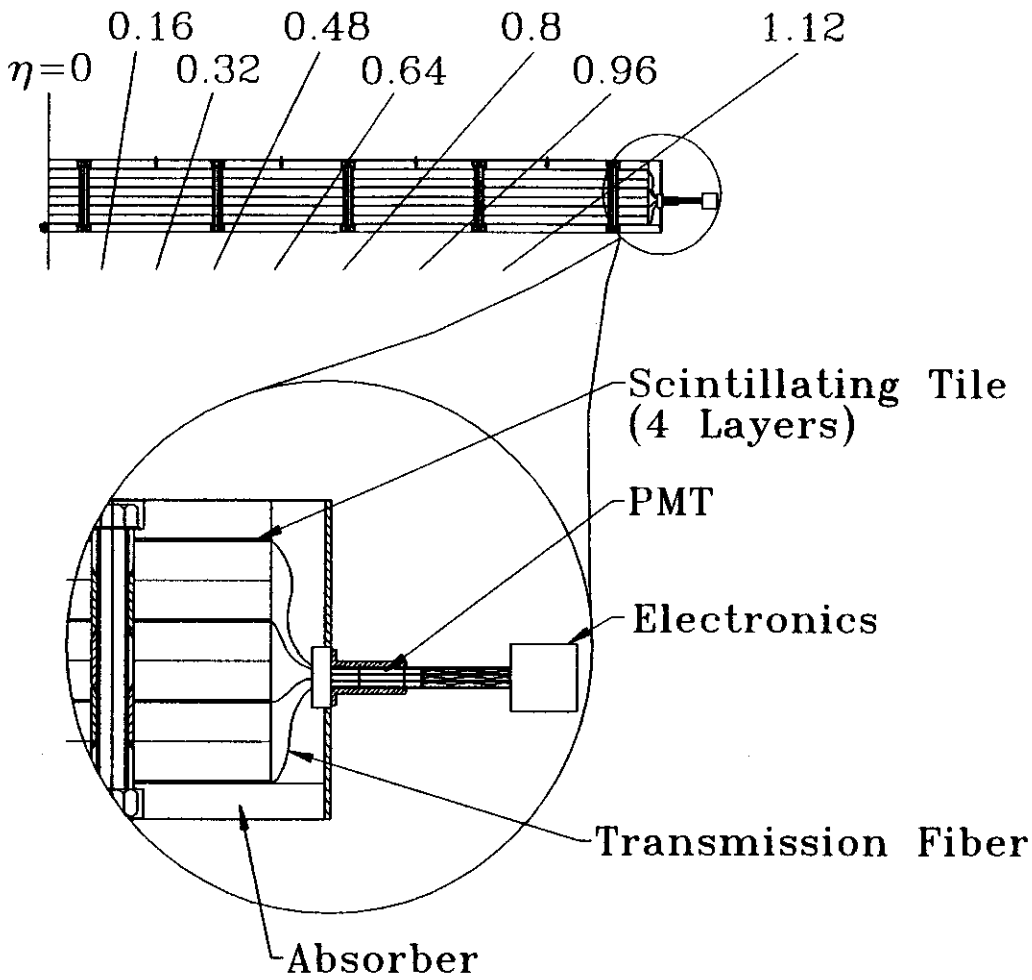
GEM DETECTOR
BARREL SCINTILLATING CALORIMETER
MODULE TILE LAYER 4 DETAIL

X3E017048 A881

PLOT SCALE: XXX



MARTIN MARIETTA ENERGY SYSTEMS INC.



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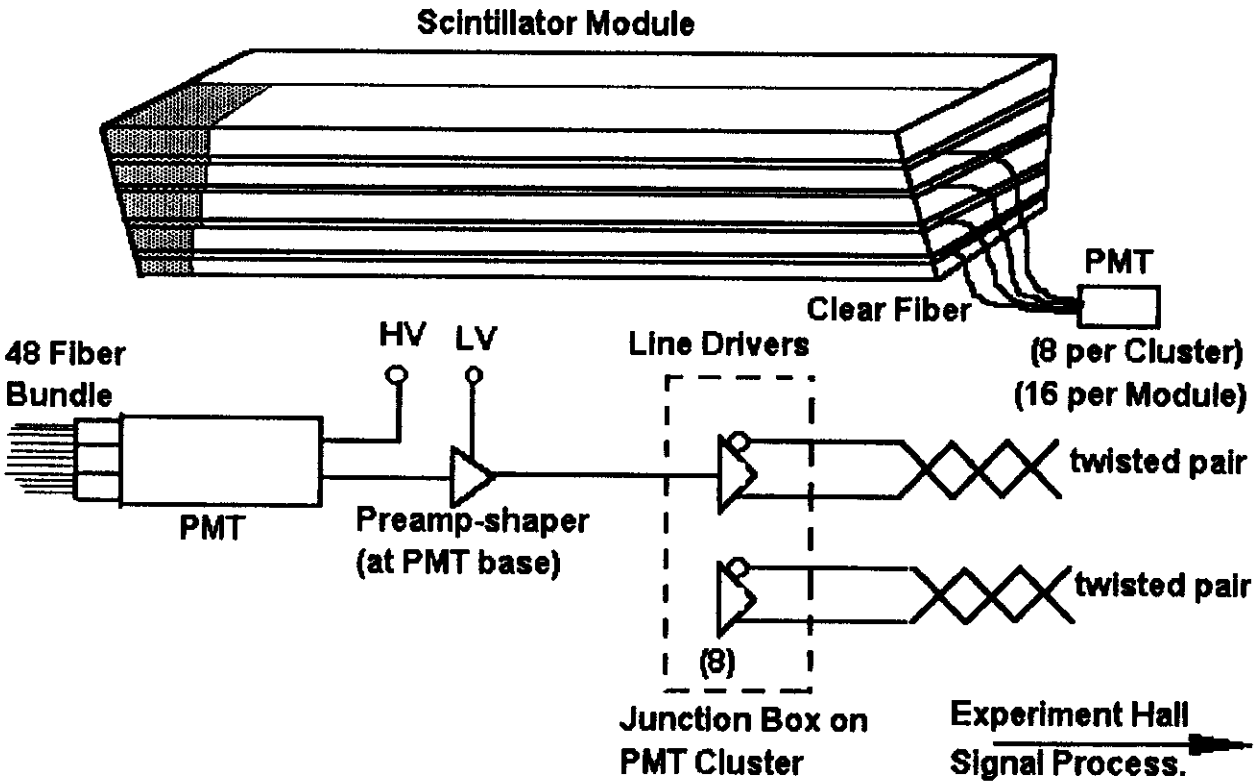
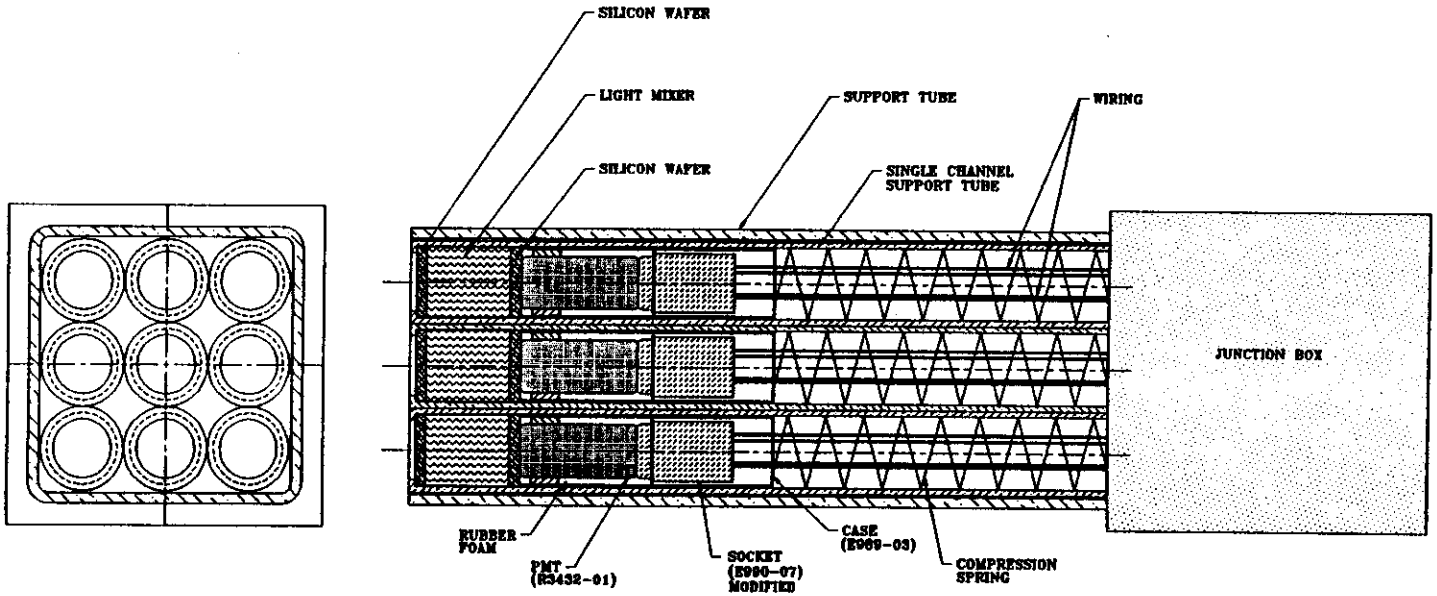
Module Readout Electronics



MARTIN MARIETTA ENERGY SYSTEMS INC.

NOTE:

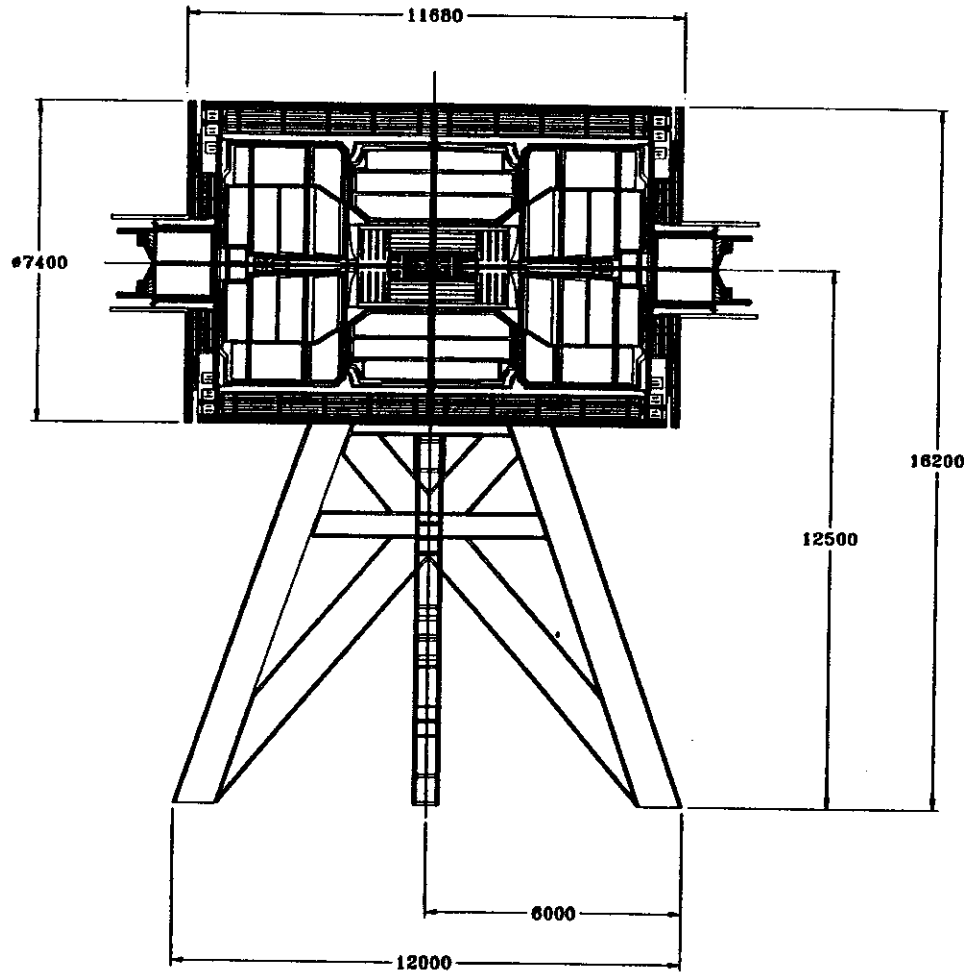
FOAM RUBBER OR A SIMILAR MATERIAL HAVING GOOD INSULATING PROPERTIES AND ELASTICITY CAN BE USED TO SECURELY HOLD THE TUBE IN THE CENTER AND AN APPROPRIATE HOLDER SHOULD BE USED TO MOUNT THE SHIELD CASE TO THE MEASUREMENT SYSTEM. WHEN TIGHTENING THE SHIELD CASE USING BANDS OR SCREWS, SUFFICIENT CARE SHOULD BE TAKEN THAT A FORCE SUFFICIENT TO DEFORM THE SHIELD CASE IS NOT APPLIED.



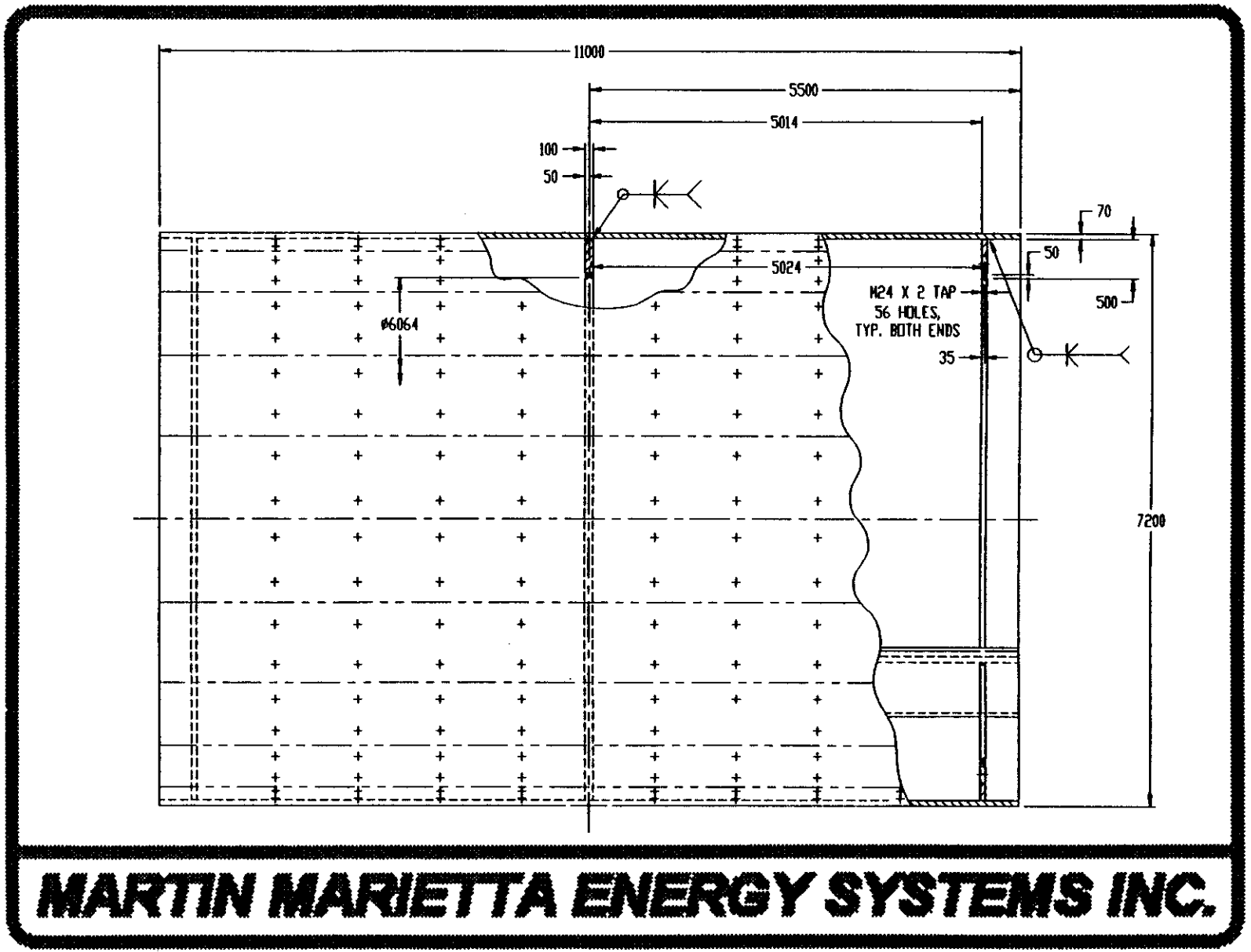
MARTIN MARIETTA ENERGY SYSTEMS INC.

SBC Structural Shell

- Material: 304L Stainless Steel (UNS 30403), ~195 Mg.
- Struc. Shell & Central Detector Support performance interrelated.
- Critical welds shop fabricated using submerged arc.
- Machining, shaping, & tack-up at shop before shipping.
- Final fabrication & erection at IR-5 site.
- Nominal material thickness, 70mm or 2 3/4 inches.
- Scintillator Modules added to shell & tested at ground level.
- Assembly lowered into experiment hall for further assembly.



MARTIN MARIETTA ENERGY SYSTEMS INC.



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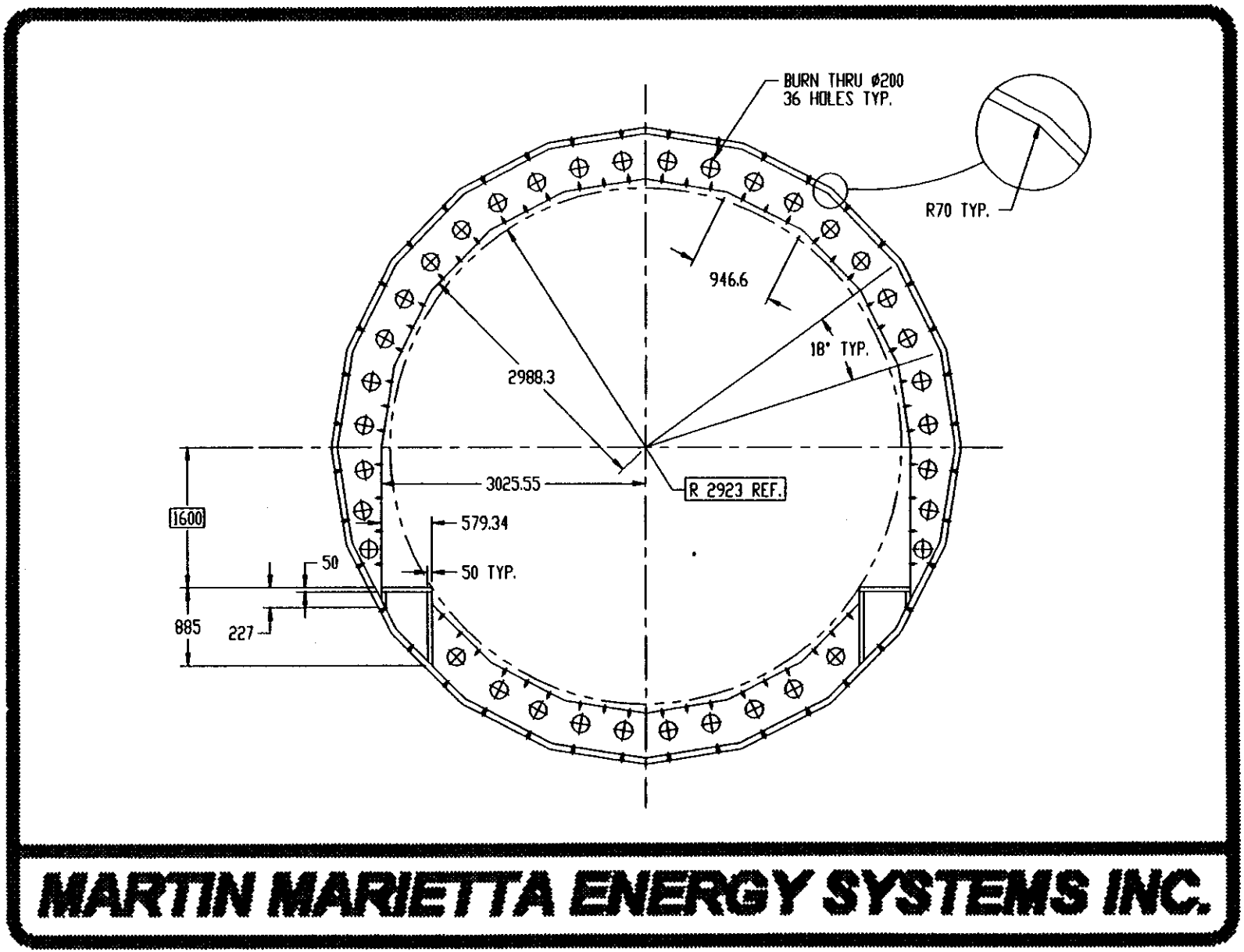

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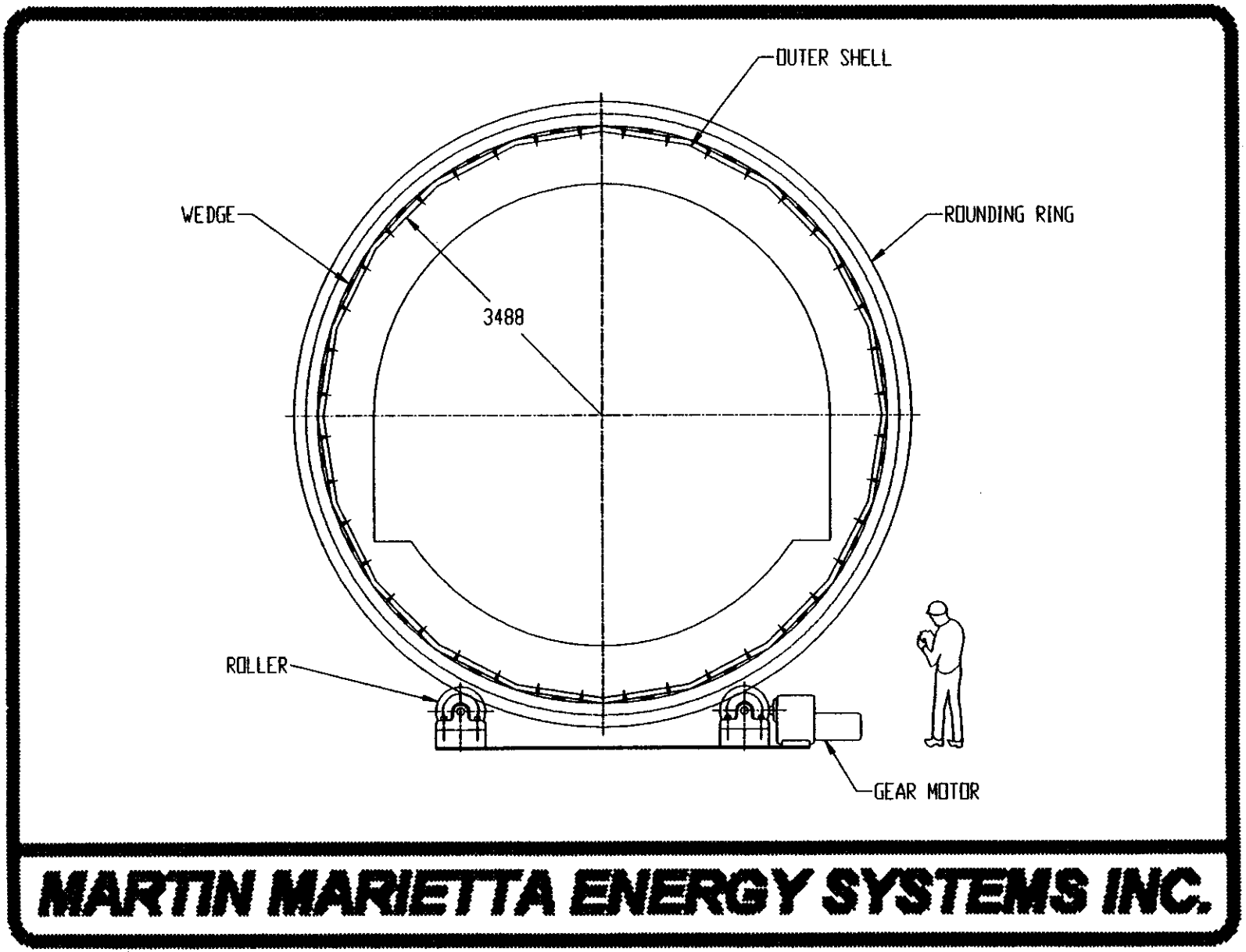

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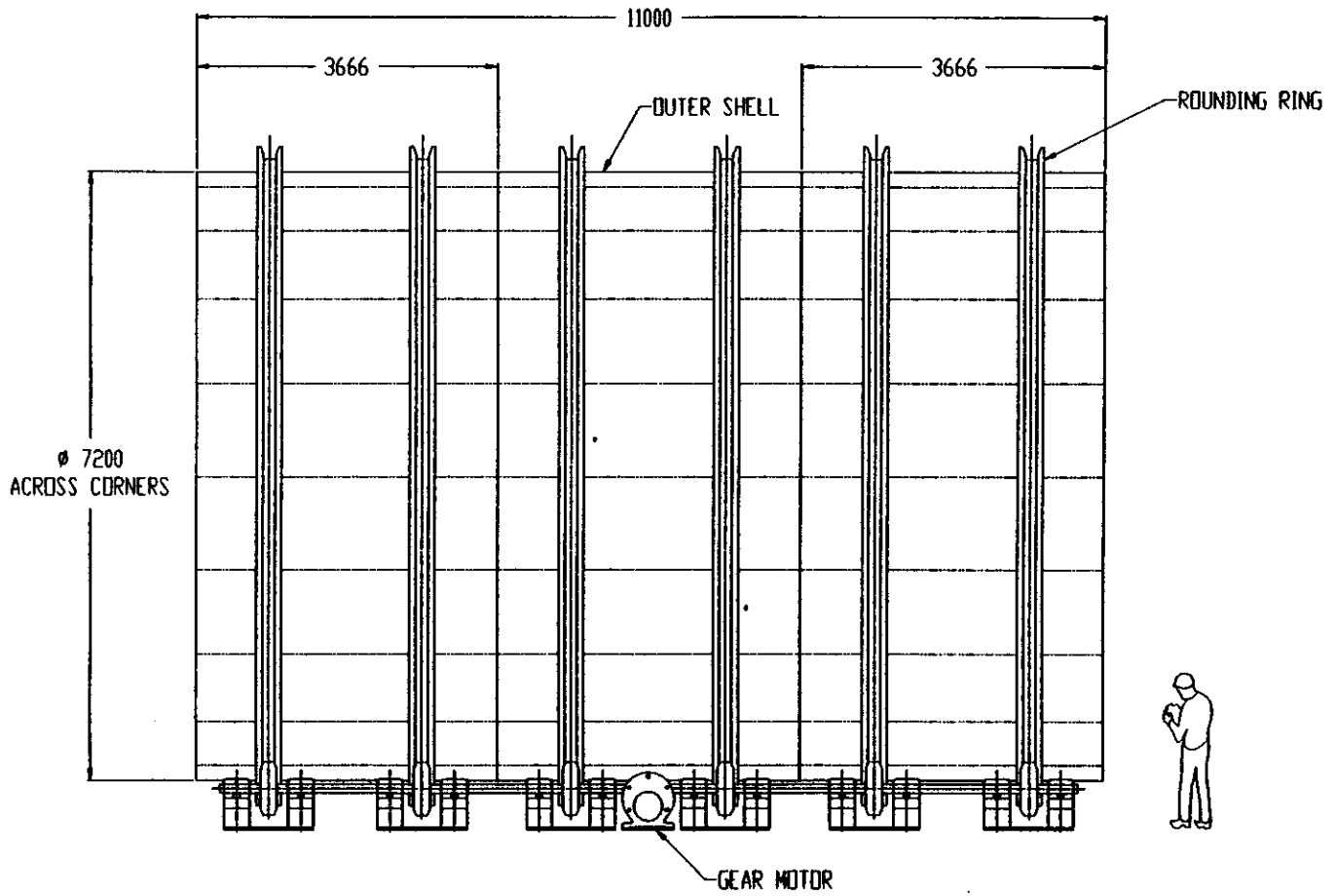

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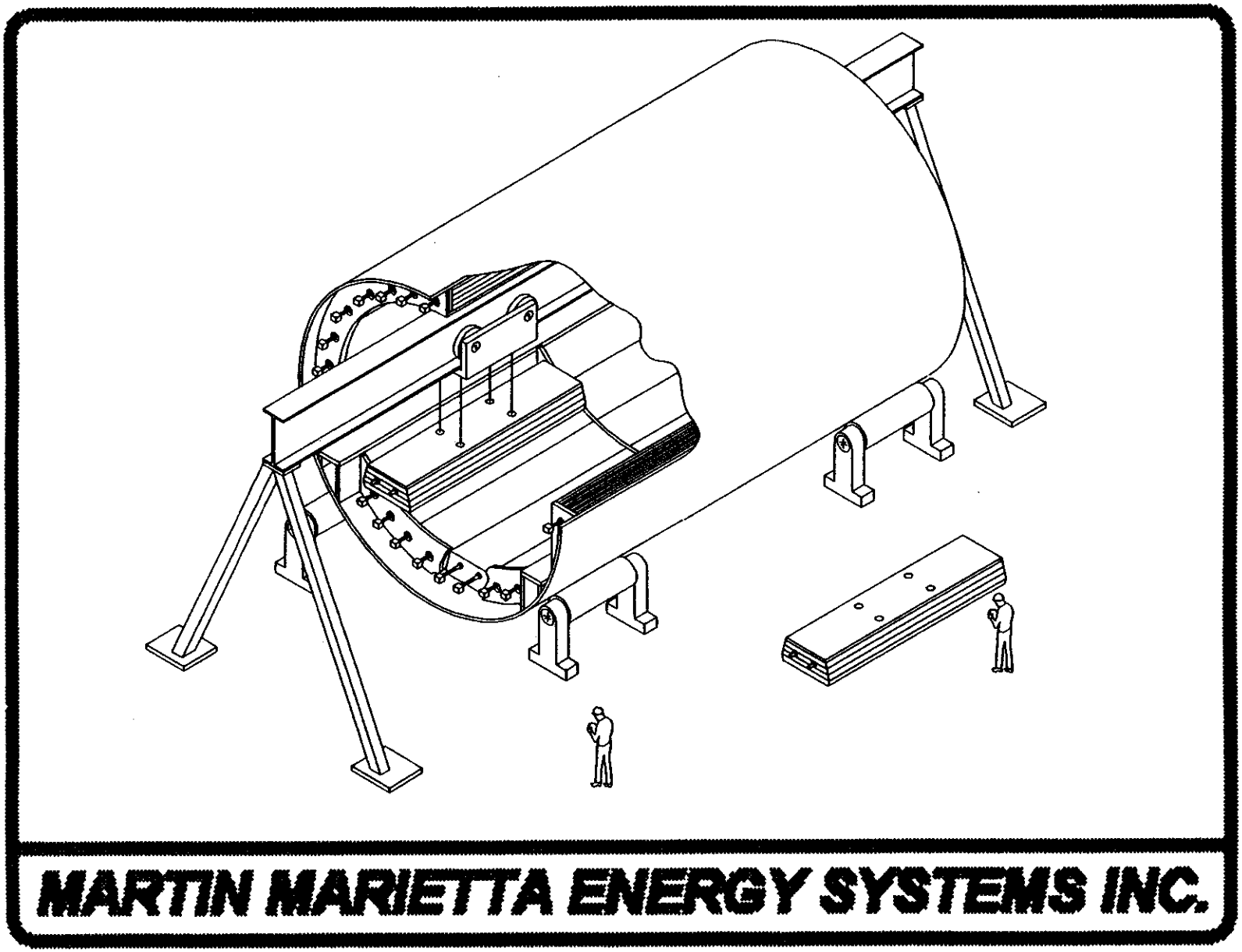

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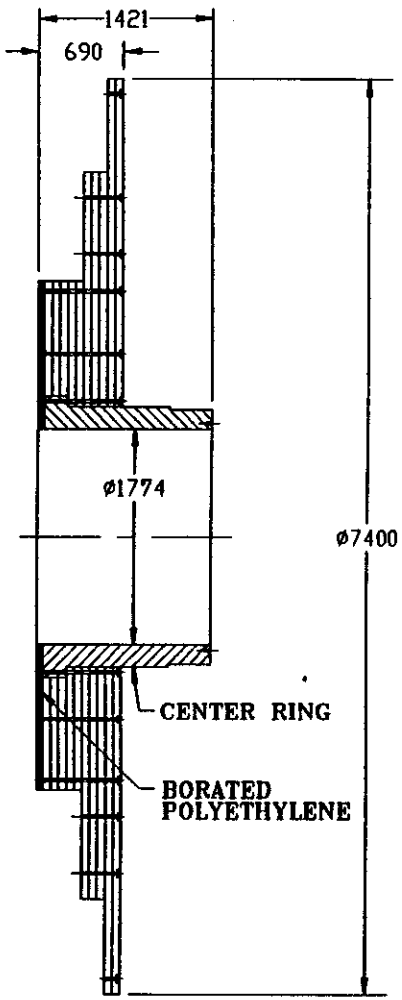

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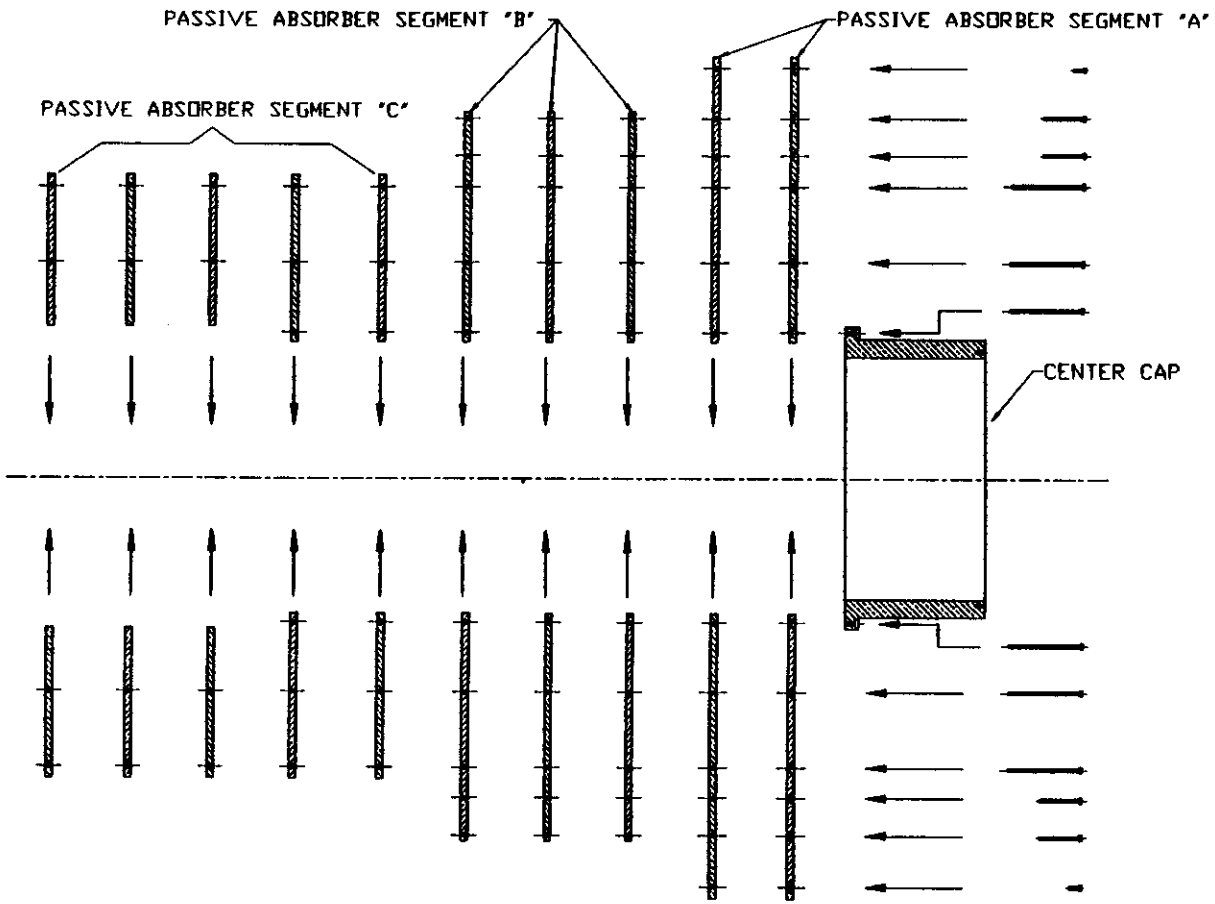

MARTIN MARIETTA ENERGY SYSTEMS INC.

Scintillating Barrel Calorimeter
Forty-four 4.8 Meter Scintillation Modules

Structure Design

Single Wall Shell & Track, Supported on CDS

SST. Weight (Shell & Flanges)	195	Mg

Scintillation Module Design

Weight per Std. Module(5m)			24	Mg	
No. of Std. Modules			25		
No. of Special Modules			19		
Total Scint Cal. Module Weight			934	Mg	
Four Layers in pseudo-towers					
No. of Channels			640	total	Grow to 3840
Tile	Const.	η	0.16	rad.	
Seg.	Const.	φ	0.16	rad.	Grow to 0.03 rad.
Total Tile Area			672	square meters	
Total Scint. Fiber Length			18816	meters	
Total Transmission Fiber Lgth.			65856	meters	
Coverage in		η	0-1.28	rad.	

End Cap PA with J-Box Clearance

Mat'l: Brass

Single End Cap Weight	167	Mg
Total End Cap Weight	334	Mg

Endcap Neutron Absorber

Total Volume of BPE	4.58	cu. meters
Total Weight of BPE	4.26	Mg

Add'l Barrel Passive Absorber

Mat'l: Brass

Brass Thickness	100	mm
Barrel PA Weight	223	Mg