

APPENDIX A
THERMAL EXPOSURE SAMPLE VESSEL DRAWINGS

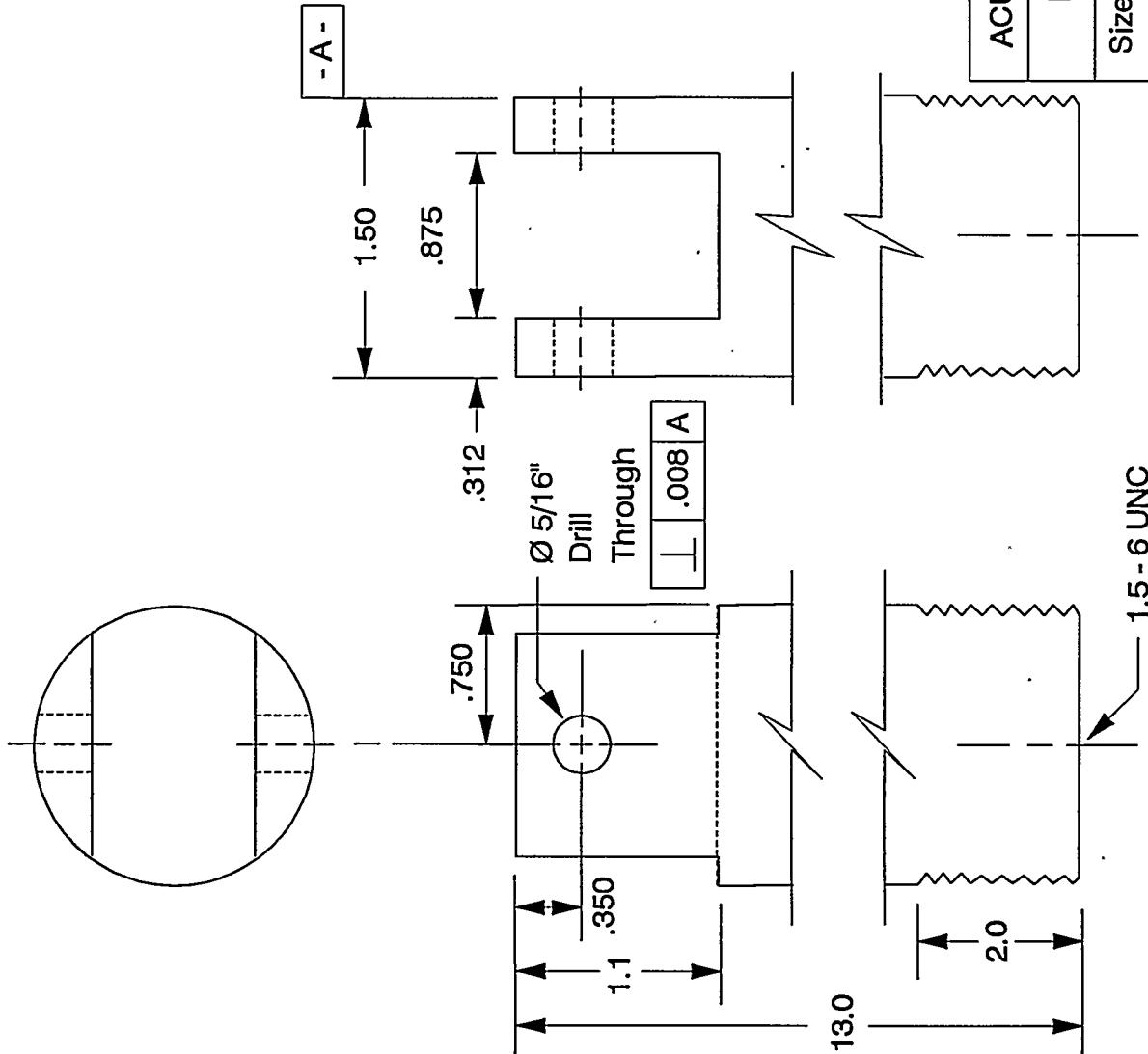
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APPENDIX B
DRAWINGS OF C-RING TESTING FIXTURES

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All tolerances unless
otherwise specified:

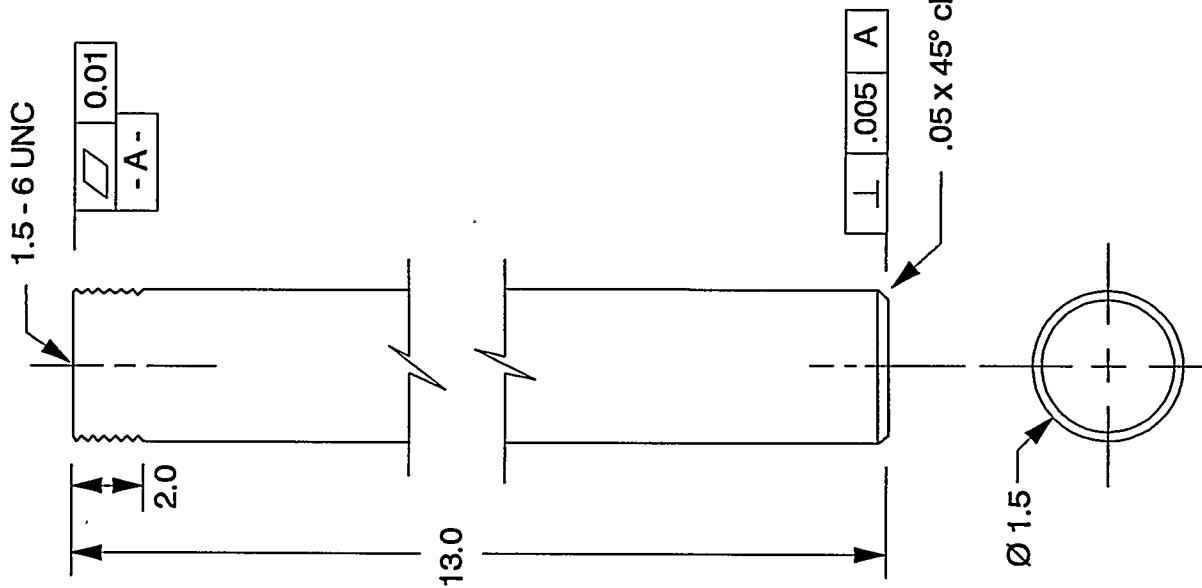
.XXX $\pm$.005
.XX $\pm$.010
.X $\pm$.10



Notes:

1. Material is Haynes Alloy 230
2. All dimensions in inches

ACUREX ENVIRONMENTAL SYSTEMS (ESD)	
LOWER RAM	
Size A	Project Number: 8146
SHEET OF	DWN:



All tolerances unless
otherwise specified:
.XXX ± .005
.XX ± .010
.X ± .10

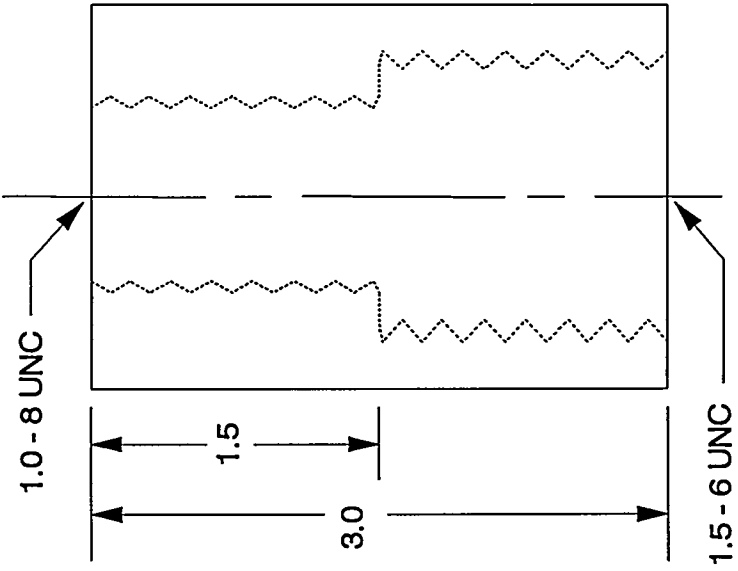
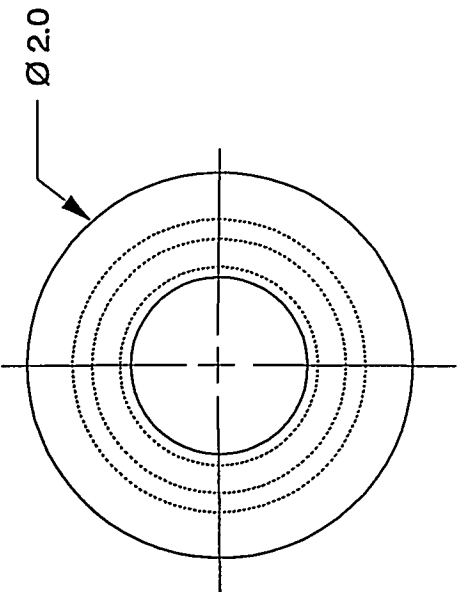
Notes:

1. Material is Haynes Alloy 230
2. All dimensions in inches

ACUREX ENVIRONMENTAL SYSTEMS (ESD)	
UPPER RAM FOR COMPRESSION TEST	
Size A	Project Number: 8146
SHEET OF	DWN:

All tolerances unless
otherwise specified:

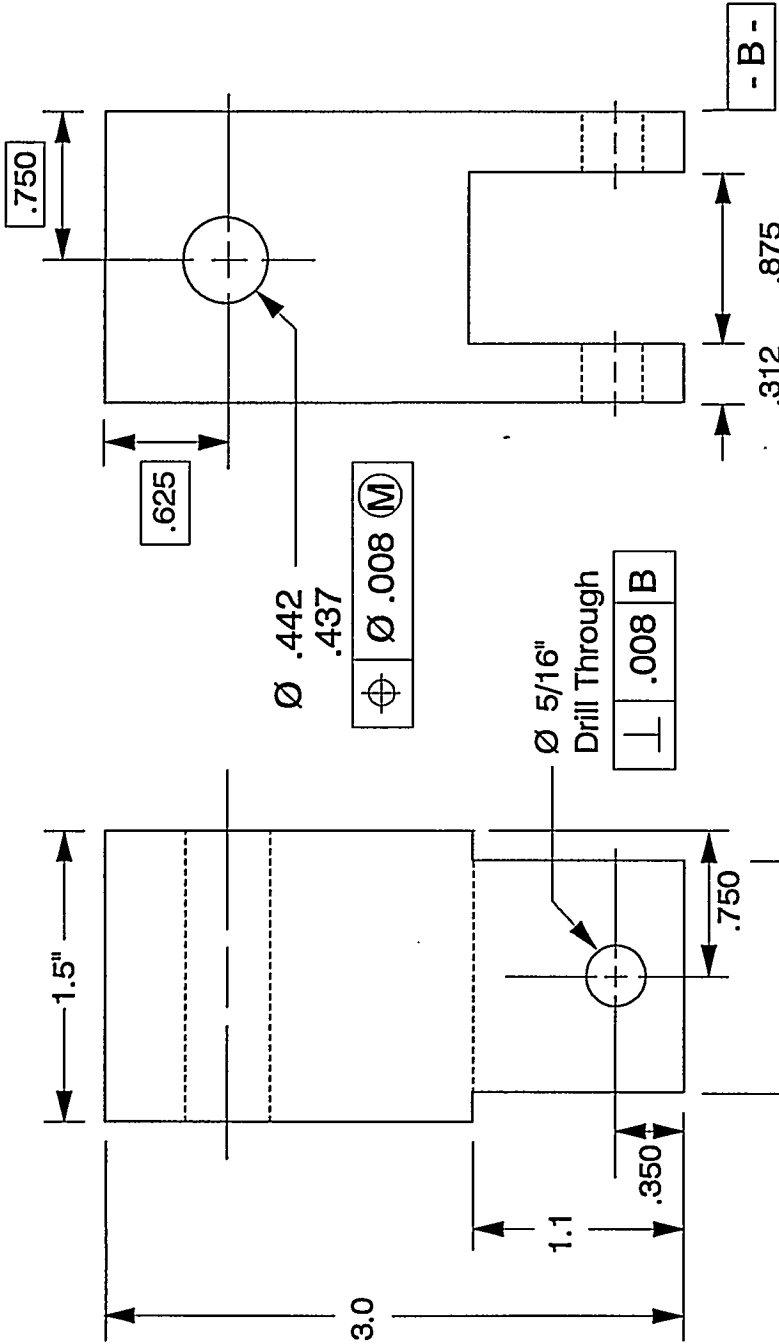
- .XXX ± .005
- .XX ± .010
- X ± .10



Notes:

- 1. Material is
- 2. All dimensions in inches
- 3. Quantity required is 2

ACUREX ENVIRONMENTAL SYSTEMS (ESD)	
ADAPTER COUPLE FOR UPPER RAM (COMPR.)	
Size A	Project Number: 8146
SHEET OF	DWN:



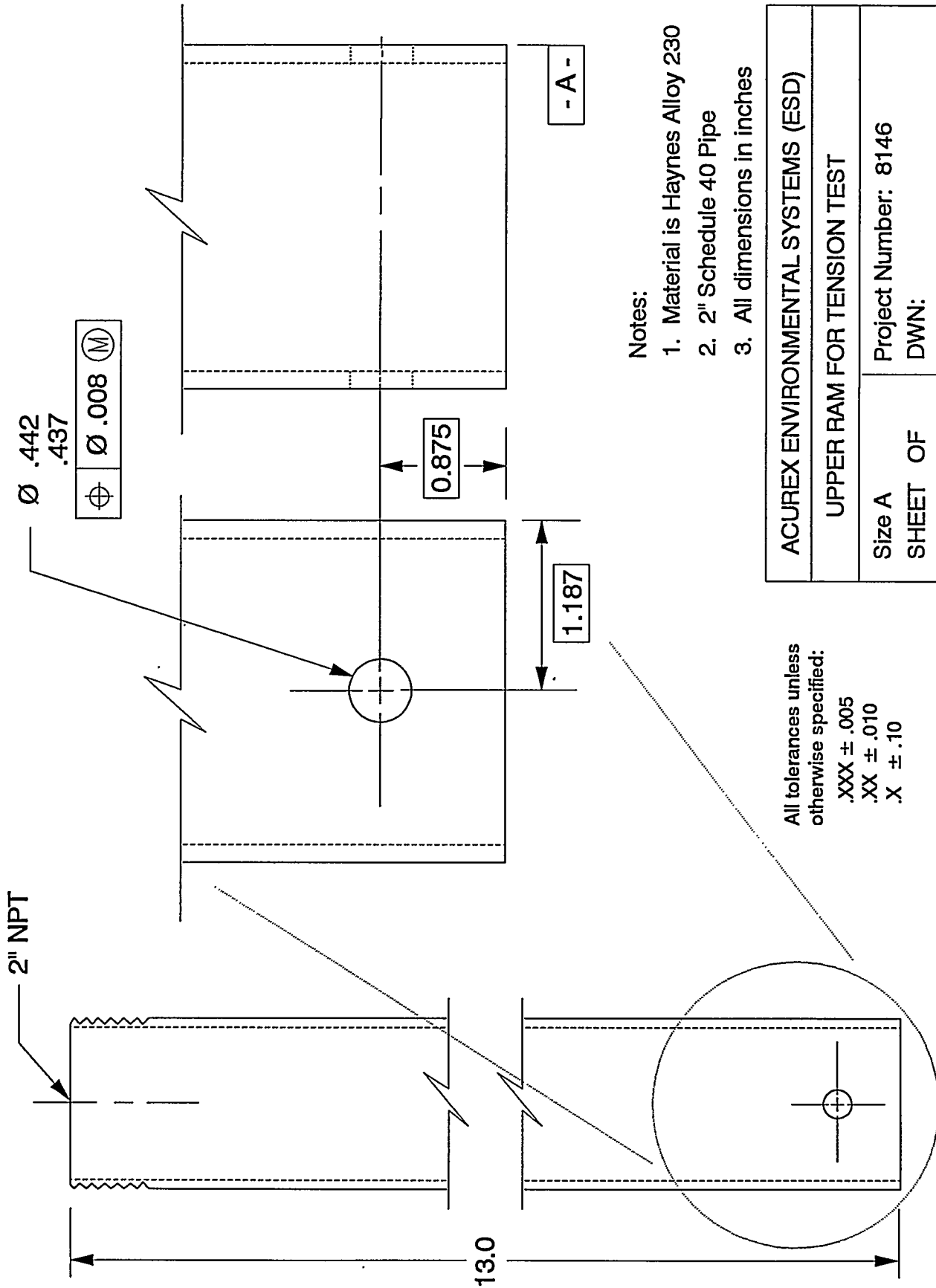
Notes:

1. Material is Haynes Alloy 230
2. All dimensions in inches

All tolerances unless
otherwise specified:

.XXX $\pm .005$
.XX $\pm .010$
.X $\pm .10$

ACUREX ENVIRONMENTAL SYSTEMS (ESD)	
UPPER FIXTURE FOR TENSION TEST	
Size A	Project Number: 8146
SHEET OF	DWN:

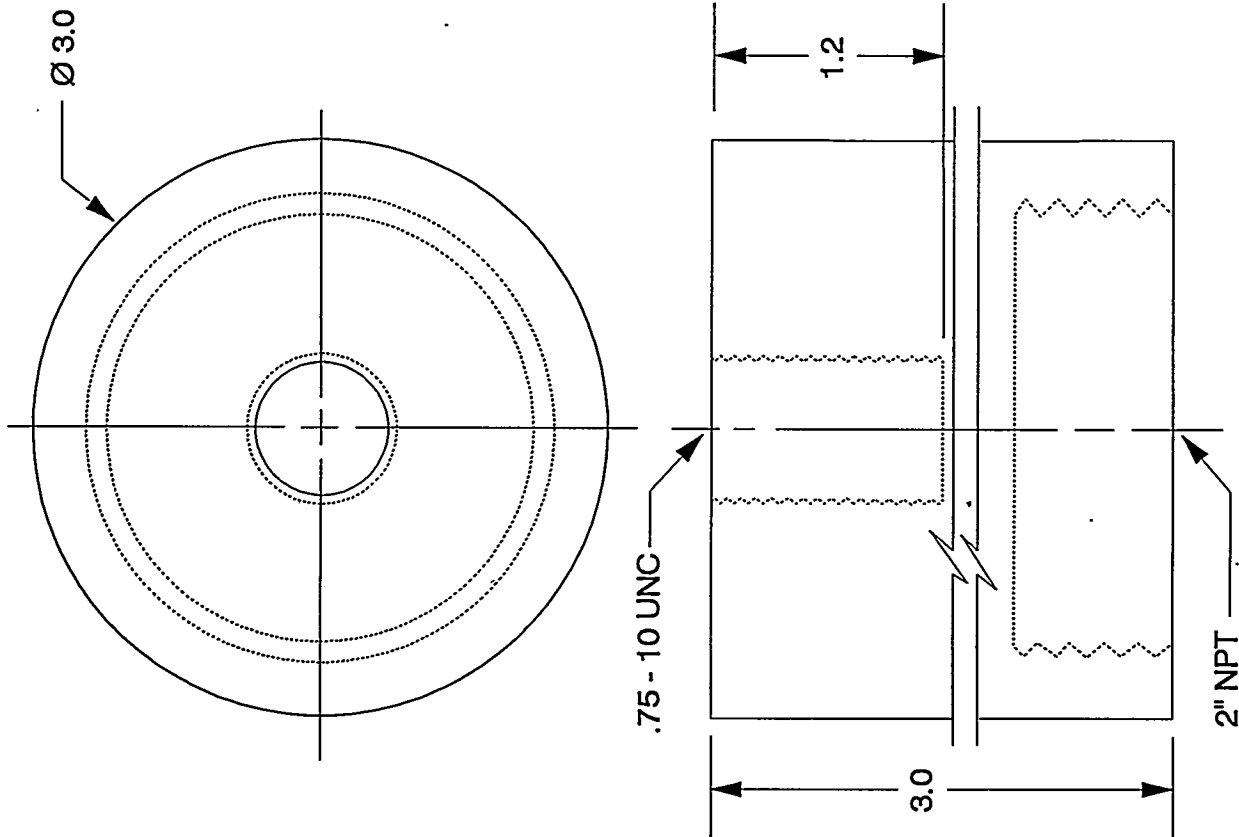


All tolerances unless
otherwise specified:

.XXX $\pm$.005

.XX $\pm$.010

.X $\pm$.10



Notes:

1. Material is
2. Female 2" NPT for a 2" Schedule 40 Pipe
3. All dimensions in inches

ACUREX ENVIRONMENTAL SYSTEMS (ESD)	
ADAPTER COUPLE FOR UPPER RAM (TENSION)	
Size A	Project Number: 8146
SHEET OF	DWN:

MATERIAL:
HAYNES ALLOY 230

				DWN		BOYD	10/3/91	ACUREX Environmental Systems Division	
				CHK				PROJECT C - RING TESTING	
				ENG		CHAN	10/3/91		
				APPD					
				PROJECT NO.		8146			
				SCALE		FULL			
A RELEASED FOR FABRICATION				ADB	10/4/91				
LTR	DESCRIPTION	APPD	DATE	NUMBER	TITLE				
REVISIONS						REFERENCE DRAWINGS			
10/46 - 8146-251 REV A						SIZE DWG NO B 8146-251			
						SHEET 1 OF 1			
						REV A			



**NOTE: SEE LM/8146 - 100 FOR
THE LIST OF MATERIALS
SHOWN ON THIS DRAWING.**

SECTION A - A

[illegible]

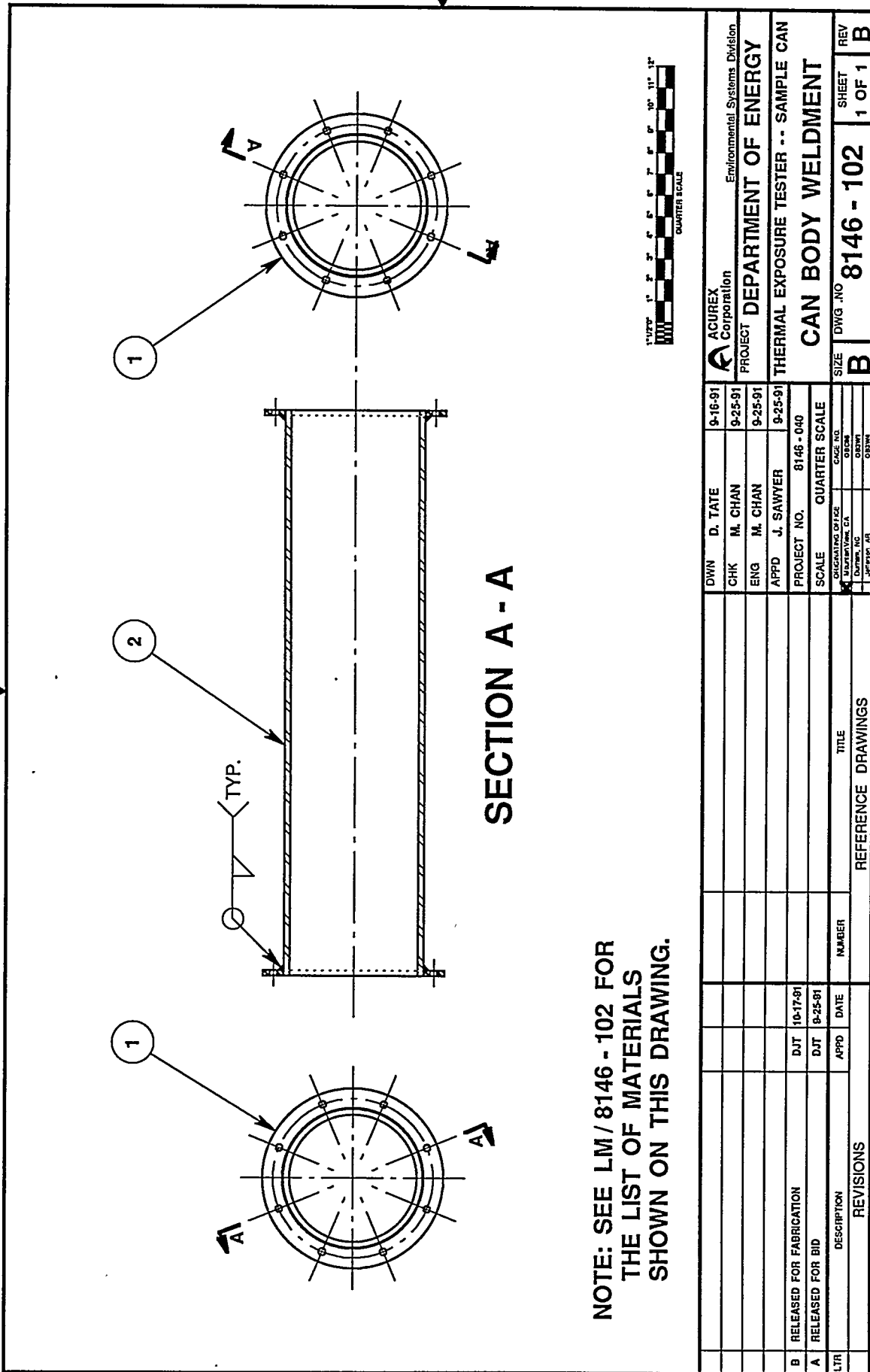


**NOTE: SEE LM / 8146 - 101 FOR
THE LIST OF MATERIALS
SHOWN ON THIS DRAWING.**



SECTION A - A

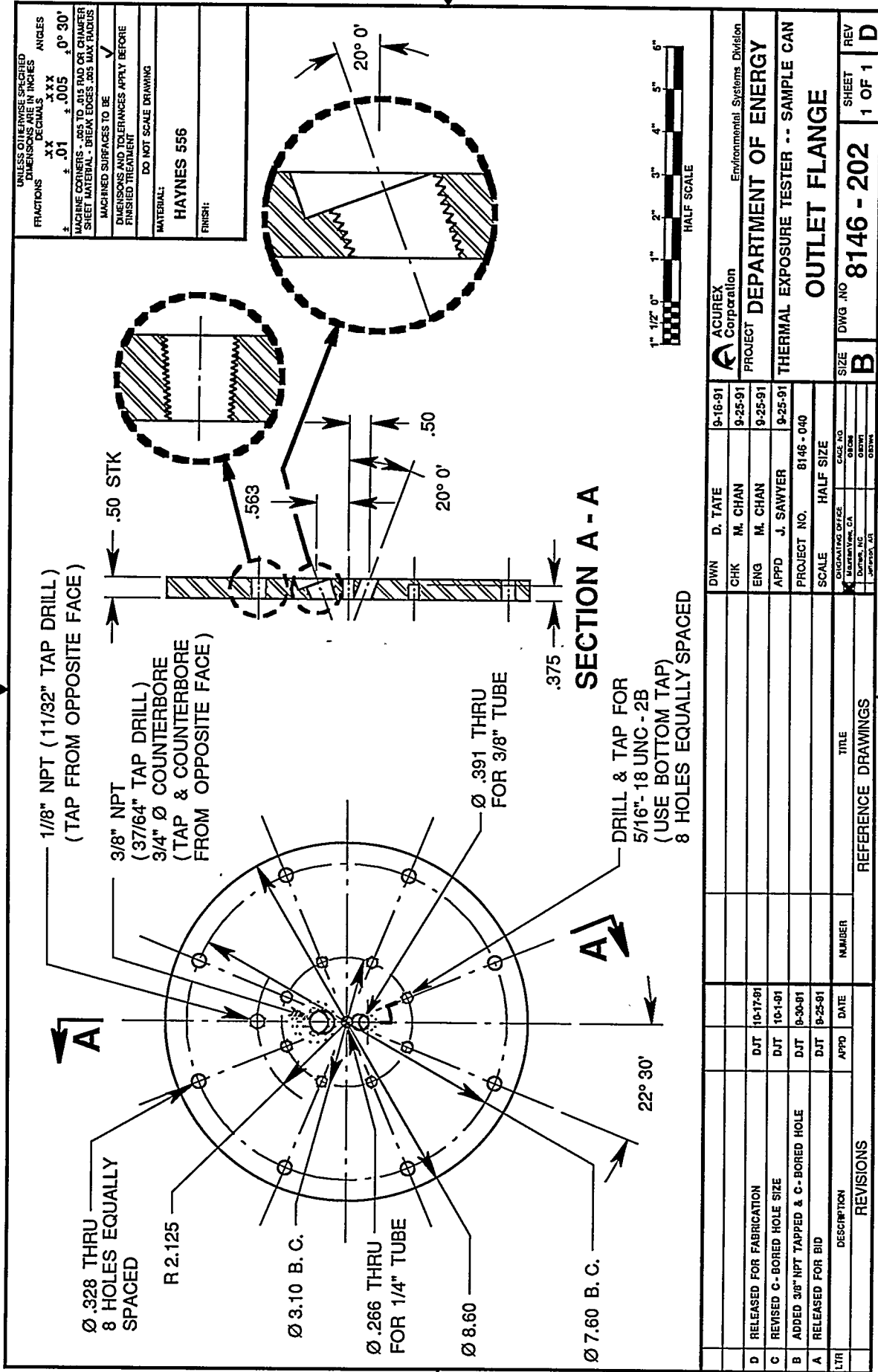
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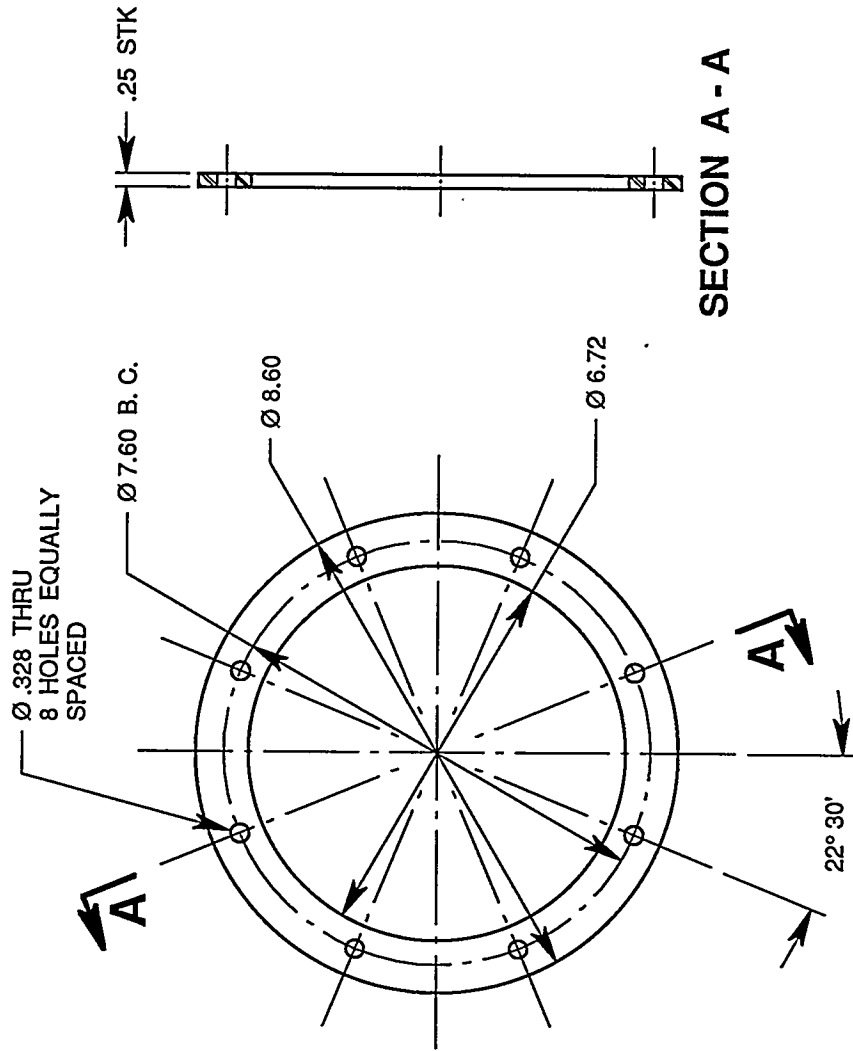
NOTE: SEE LM/8146-102 FOR
THE LIST OF MATERIALS
SHOWN ON THIS DRAWING.

ACUREX Corporation		Environmental Systems Division	
PROJECT		DEPARTMENT OF ENERGY	
THERMAL EXPOSURE TESTER -- SAMPLE CAN		CAN BODY WELDMENT	
SIZE	DWG. NO.	8146 - 102	REV
B	1 OF 1	1	B
DWN		D. TATE	9-16-91
CHK		M. CHAN	9-25-91
ENG		M. CHAN	9-25-91
APPD		J. SAWYER	9-25-91
PROJECT NO.		8146 - 040	
SCALE		QUARTER SCALE	
ORIGINATING OFFICE		CAZL NO.	
LAURELVIEW, CA		ORIG	
DUTY, NC		ORIG	
JUPITER, AR		ORIG	
REFERENCE DRAWINGS		TITLE	
NUMBER		DATE	
DESCRIPTION		DATE	
REVISIONS		DATE	
LTH		DATE	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES			
FRACTIONS	DECIMALS	ANGLES	
$\frac{1}{8}$	.125	30°	
$\frac{1}{16}$	.0625	15°	
$\frac{3}{16}$	.1875	7 1/2°	
$\frac{1}{4}$	.2500	0° 30'	
$\frac{5}{16}$	.3125		
$\frac{3}{8}$	.3750		
$\frac{7}{16}$	.4375		
$\frac{1}{2}$	.5000		
$\frac{9}{16}$	.5625		
$\frac{5}{8}$	.6250		
$\frac{11}{16}$	.6875		
$\frac{3}{4}$	.7500		
$\frac{13}{16}$	.8125		
$\frac{7}{8}$	.8750		
$\frac{15}{16}$	.9375		
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$1 \frac{1}{8}$	1.1250		
$1 \frac{1}{4}$	1.2500		
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$1 \frac{1}{2}$	1.5000		
$1 \frac{5}{8}$	1.6250		
$1 \frac{3}{4}$	1.7500		
$1 \frac{7}{8}$	1.8750		
2	2.0000		
$2 \frac{1}{16}$	2.0625		
$2 \frac{1}{8}$	2.1250		
$2 \frac{1}{4}$	2.2500		
$2 \frac{3}{8}$	2.3750		
$2 \frac{1}{2}$	2.5000		
$2 \frac{5}{8}$	2.6250		
$2 \frac{3}{4}$	2.7500		
$2 \frac{7}{8}$	2.8750		
3	3.0000		
$3 \frac{1}{16}$	3.0625		
$3 \frac{1}{8}$	3.1250		
$3 \frac{1}{4}$	3.2500		
$3 \frac{3}{8}$	3.3750		
$3 \frac{1}{2}$	3.5000		
$3 \frac{5}{8}$	3.6250		
$3 \frac{3}{4}$	3.7500		
$3 \frac{7}{8}$	3.8750		
4	4.0000		
$4 \frac{1}{16}$	4.0625		
$4 \frac{1}{8}$	4.1250		
$4 \frac{1}{4}$	4.2500		
$4 \frac{3}{8}$	4.3750		
$4 \frac{1}{2}$	4.5000		
$4 \frac{5}{8}$	4.6250		
$4 \frac{3}{4}$	4.7500		
$4 \frac{7}{8}$	4.8750		
5	5.0000		
$5 \frac{1}{16}$	5.0625		
$5 \frac{1}{8}$	5.1250		
$5 \frac{1}{4}$	5.2500		
$5 \frac{3}{8}$	5.3750		
$5 \frac{1}{2}$	5.5000		
$5 \frac{5}{8}$	5.6250		
$5 \frac{3}{4}$	5.7500		
$5 \frac{7}{8}$	5.8750		
6	6.0000		
$6 \frac{1}{16}$	6.0625		
$6 \frac{1}{8}$	6.1250		
$6 \frac{1}{4}$	6.2500		
$6 \frac{3}{8}$	6.3750		
$6 \frac{1}{2}$	6.5000		
$6 \frac{5}{8}$	6.6250		
$6 \frac{3}{4}$	6.7500		
$6 \frac{7}{8}$	6.8750		
7	7.0000		
$7 \frac{1}{16}$	7.0625		
$7 \frac{1}{8}$	7.1250		
$7 \frac{1}{4}$	7.2500		
$7 \frac{3}{8}$	7.3750		
$7 \frac{1}{2}$	7.5000		
$7 \frac{5}{8}$	7.6250		
$7 \frac{3}{4}$	7.7500		
$7 \frac{7}{8}$	7.8750		
8	8.0000		
$8 \frac{1}{16}$	8.0625		
$8 \frac{1}{8}$	8.1250		
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$8 \frac{5}{8}$	8.6250		
$8 \frac{3}{4}$	8.7500		
$8 \frac{7}{8}$	8.8750		
9	9.0000		
$9 \frac{1}{16}$	9.0625		
$9 \frac{1}{8}$	9.1250		
$9 \frac{1}{4}$	9.2500		
$9 \frac{3}{8}$	9.3750		
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$9 \frac{3}{4}$	9.7500		
$9 \frac{7}{8}$	9.8750		
10	10.0000		
$10 \frac{1}{16}$	10.0625		
$10 \frac{1}{8}$	10.1250		
$10 \frac{1}{4}$	10.2500		
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$10 \frac{5}{8}$	10.6250		
$10 \frac{3}{4}$	10.7500		
$10 \frac{7}{8}$	10.8750		
11	11.0000		
$11 \frac{1}{16}$	11.0625		
$11 \frac{1}{8}$	11.1250		
$11 \frac{1}{4}$	11.2500		
$11 \frac{3}{8}$	11.3750		
$11 \frac{1}{2}$	11.5000		
$11 \frac{5}{8}$	11.6250		
$11 \frac{3}{4}$	11.7500		
$11 \frac{7}{8}$	11.8750		
12	12.0000		
$12 \frac{1}{16}$	12.0625		
$12 \frac{1}{8}$	12.1250		
$12 \frac{1}{4}$	12.2500		
$12 \frac{3}{8}$	12.3750		
$12 \frac{1}{2}$	12.5000		
$12 \frac{5}{8}$	12.6250		
$12 \frac{3}{4}$	12.7500		
$12 \frac{7}{8}$	12.8750		
13	13.0000		
$13 \frac{1}{16}$	13.0625		
$13 \frac{1}{8}$	13.1250		
$13 \frac{1}{4}$	13.2500		
$13 \frac{3}{8}$	13.3750		
$13 \frac{1}{2}$	13.5000		
$13 \frac{5}{8}$	13.6250		
$13 \frac{3}{4}$	13.7500		
$13 \frac{7}{8}$	13.8750		
14	14.0000		
$14 \frac{1}{16}$	14.0625		
$14 \frac{1}{8}$	14.1250		
$14 \frac{1}{4}$	14.2500		
$14 \frac{3}{8}$	14.3750		
$14 \frac{1}{2}$	14.5000		
$14 \frac{5}{8}$	14.6250		
$14 \frac{3}{4}$	14.7500		
$14 \frac{7}{8}$	14.8750		
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$15 \frac{1}{16}$	15.0625		
$15 \frac{1}{8}$	15.1250		
$15 \frac{1}{4}$	15.2500		
$15 \frac{3}{8}$	15.3750		
$15 \frac{1}{2}$	15.5000		
$15 \frac{5}{8}$	15.6250		
$15 \frac{3}{4}$	15.7500		
$15 \frac{7}{8}$	15.8750		
16	16.0000		
$16 \frac{1}{16}$	16.0625		
$16 \frac{1}{8}$	16.1250		
$16 \frac{1}{4}$	16.2500		
$16 \frac{3}{8}$	16.3750		
$16 \frac{1}{2}$	16.5000		
$16 \frac{5}{8}$	16.6250		
$16 \frac{3}{4}$	16.7500		
$16 \frac{7}{8}$	16.8750		
17	17.0000		
$17 \frac{1}{16}$	17.0625		
$17 \frac{1}{8}$	17.1250		
$17 \frac{1}{4}$	17.2500		
$17 \frac{3}{8}$	17.3750		
$17 \frac{1}{2}$	17.5000		
$17 \frac{5}{8}$	17.6250		
$17 \frac{3}{4}$	17.7500		
$17 \frac{7}{8}$	17.8750		
18	18.0000		
$18 \frac{1}{16}$	18.0625		
$18 \frac{1}{8}$	18.1250		
$18 \frac{1}{4}$	18.2500		
$18 \frac{3}{8}$	18.3750		
$18 \frac{1}{2}$	18.5000		
$18 \frac{5}{8}$	18.6250		
$18 \frac{3}{4}$	18.7500		
$18 \frac{7}{8}$	18.8750		
19	19.0000		
$19 \frac{1}{16}$	19.0625		
$19 \frac{1}{8}$	19.1250		
$19 \frac{1}{4}$	19.2500		
$19 \frac{3}{8}$	19.3750		
$19 \frac{1}{2}$	19.5000		
$19 \frac{5}{8}$	19.6250		
$19 \frac{3}{4}$	19.7500		
$19 \frac{7}{8}$	19.8750		
20	20.0000		
$20 \frac{1}{16}$	20.0625		
$20 \frac{1}{8}$	20.1250		
$20 \frac{1}{4}$	20.2500		
$20 \frac{3}{8}$	20.3750		
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21	21.0000		
$21 \frac{1}{16}$	21.0625		
$21 \frac{1}{8}$	21.1250		
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$21 \frac{7}{8}$	21.8750		
22	22.0000		
$22 \frac{1}{16}$	22.0625		
$22 \frac{1}{8}$	22.1250		
$22 \frac{1}{4}$	22.2500		
$22 \frac{3}{8}$	22.3750		
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$22 \frac{3}{4}$	22.7500		
$22 \frac{7}{8}$	22.8750		
23	23.0000		
$23 \frac{1}{16}$	23.0625		
$23 \frac{1}{8}$	23.1250		
$23 \frac{1}{4}$	23.2500		
$23 \frac{3}{8}$	23.3750		
$23 \frac{1}{2}$	23.5000		
$23 \frac{5}{8}$	23.6250		
$23 \frac{3}{4}$	23.7500		
$23 \frac{7}{8}$	23.8750		
24	24.0000		
$24 \frac{1}{16}$	24.0625		
$24 \frac{1}{8}$	24.1250		
$24 \frac{1}{4}$	24.2500		
$24 \frac{3}{8}$	24.3750		
$24 \frac{1}{2}$	24.5000		
$24 \frac{5}{8}$	24.6250		
$24 \frac{3}{4}$	24.7500		
$24 \frac{7}{8}$	24.8750		
25	25.0000		
$25 \frac{1}{16}$	25.0625		
$25 \frac{1}{8}$	25.1250		
$25 \frac{1}{4}$	25.2500		
$25 \frac{3}{8}$	25.3750		
$25 \frac{1}{2}$	25.5000		
$25 \frac{5}{8}$	25.6250		
$25 \frac{3}{4}$	25.7500		
$25 \frac{7}{8}$	25.8750		
26	26.0000		
$26 \frac{1}{16}$	26.0625		
$26 \frac{1}{8}$	26.1250		
$26 \frac{1}{4}$	26.2500		
$26 \frac{3}{8}$	26.3750		
$26 \frac{1}{2}$	26.5000		
$26 \frac{5}{8}$	26.6250		
$26 \frac{3}{4}$	26.7500		
$26 \frac{7}{8}$	26.8750		
27	27.0000		
$27 \frac{1}{16}$	27.0625		
$27 \frac{1}{8}$	27.1250		
$27 \frac{1}{4}$	27.2500		
$27 \frac{3}{8}$	27.3750		
$27 \frac{1}{2}$	27.5000		
$27 \frac{5}{8}$	27.6250		
$27 \frac{3}{4}$	27.7500		
$27 \frac{7}{8}$	27.8750		
28	28.0000		
$28 \frac{1}{16}$	28.0625		
$28 \frac{1}{8}$	28.1250		
$28 \frac{1}{4}$	28.2500		
$28 \frac{3}{8}$	28.3750		
$28 \frac{1}{2}$	28.5000		
$28 \frac{5}{8}$	28.6250		
$28 \frac{3}{4}$	28.7500		
$28 \frac{7}{8}$	28.8750		
29	29.0000		
$29 \frac{1}{16}$	29.0625		
$29 \frac{1}{8}$	29.1250		
$29 \frac{1}{4}$	29.2500		
$29 \frac{3}{8}$	29.3750		
$29 \frac{1}{2}$	29.5000		
$29 \frac{5}{8}$	29.6250		
$29 \frac{3}{4}$	29.7500		
$29 \frac{7}{8}$	29.8750		
30	30.0000		
$30 \frac{1}{16}$	30.0625		
$30 \frac{1}{8}$	30.1250		
$30 \frac{1}{4}$	30.2500		
$30 \frac{3}{8}$	30.3750		
$30 \frac{1}{2}$	30.5000		
$30 \frac{5}{8}$	30.6250		
$30 \frac{3}{4}$	30.7500		
$30 \frac{7}{8}$	30.8750		
31	31.0000		
$31 \frac{1}{16}$	31.0625		
$31 \frac{1}{8}$	31.1250		
$31 \frac{1}{4}$	31.2500		
$31 \frac{3}{8}$	31.3750		
$31 \frac{1}{2}$	31.5000		
$31 \frac{5}{8}$	31.6250		
$31 \frac{3}{4}$	31.7500		



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		
FRACTIONS	XX	DECIMALS
ANGLES	XXX	0° 30'
±	.01	±.005
MACHINE CORNERS - .005 TO .015 RAD OR CHAMFER SHEET MATERIAL - BREAK EDGES .005 MAX RADIUS		
MACHINED SURFACES TO BE		
DIMENSIONS AND TOLERANCES APPLY BEFORE FINISHED TREATMENT		
DO NOT SCALE DRAWING		
MATERIAL:		
HAYNES 556		
FINISH:		

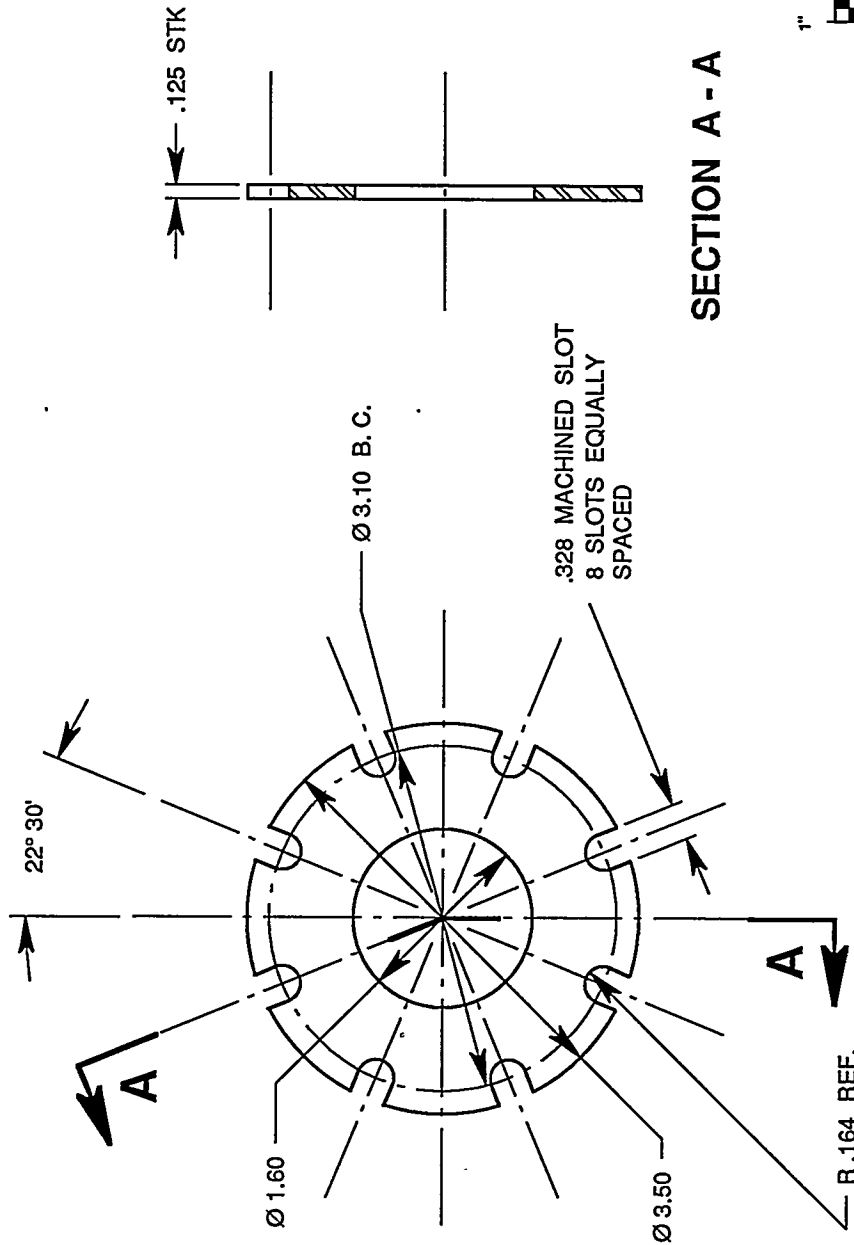


ACUREX Corporation		Environmental Systems Division	
PROJECT		DEPARTMENT OF ENERGY	
THERMAL EXPOSURE TESTER -- SAMPLE CAN		SLIP - ON FLANGE	
PROJECT NO. 8146 - 040		SCALE HALF SIZE	
DWN D. TATE		9-16-91	
CHK M. CHAN		9-25-91	
ENG M. CHAN		9-25-91	
APPD J. SAWYER		9-25-91	
PROJECT NO. 8146 - 040		SCALE HALF SIZE	
ORIGINATING OFFICE		CASE NO.	
Durham, NC		ORIG	
Jefferson, NC		DEWT	
OROW		OROW	
TITLE		REFERENCE DRAWINGS	
NUMBER		DATE	
APPD		10-17-91	
DJT		9-25-91	
DESCRIPTION		REVISIONS	
B		RELEASED FOR FABRICATION	
A		RELEASED FOR BID	
LTR		REV	
DWG NO. 8146 - 203		SHEET 1 OF 1	
REV		B	

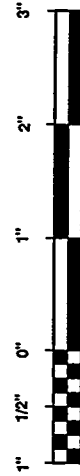


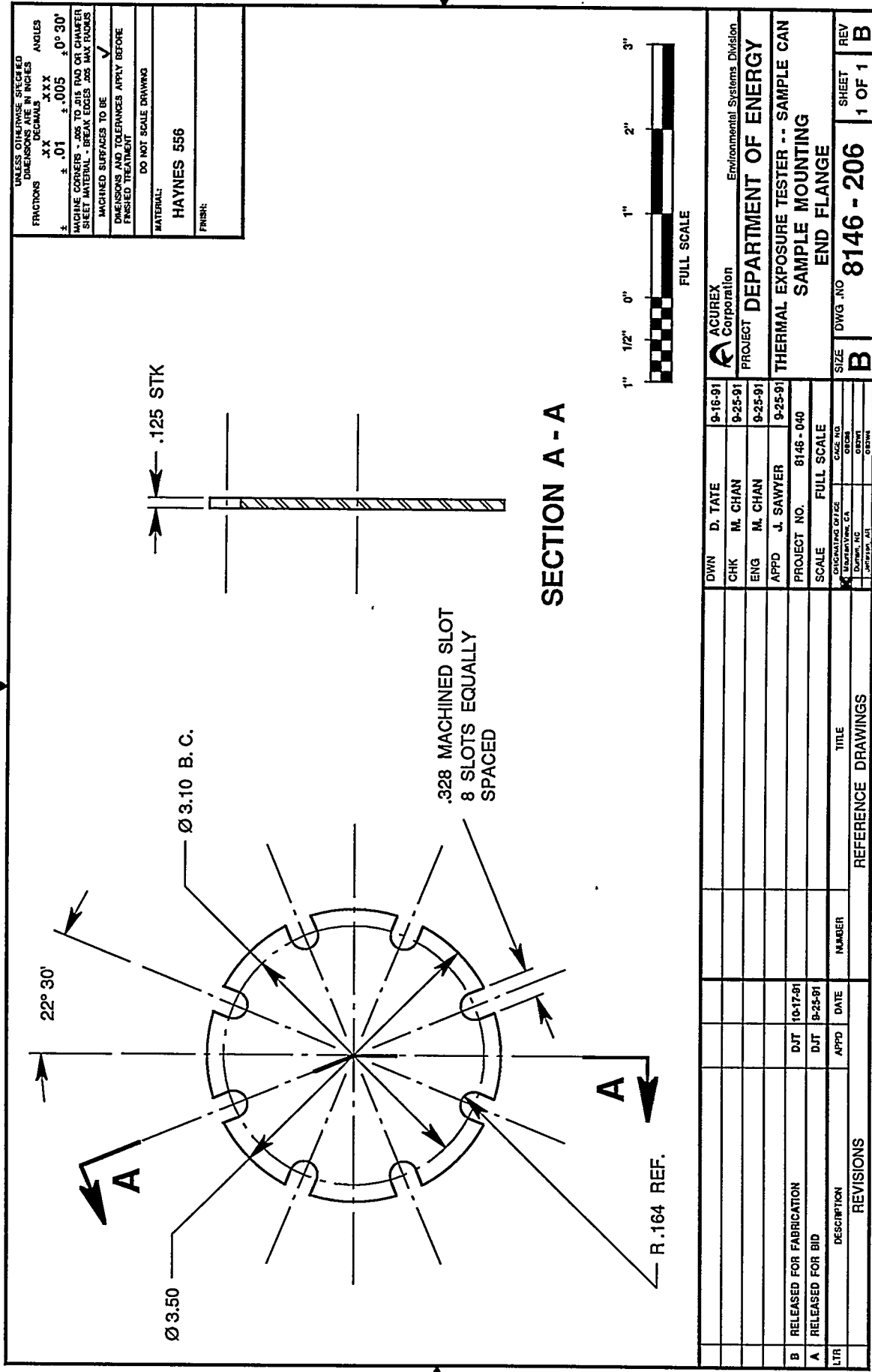
FINISH:

REFERENCE DRAWINGS

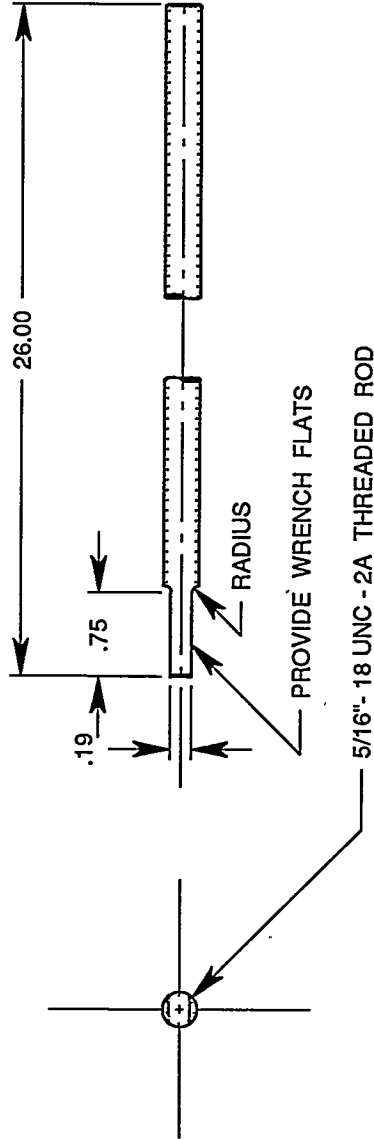


SECTION A - A

[illegible]



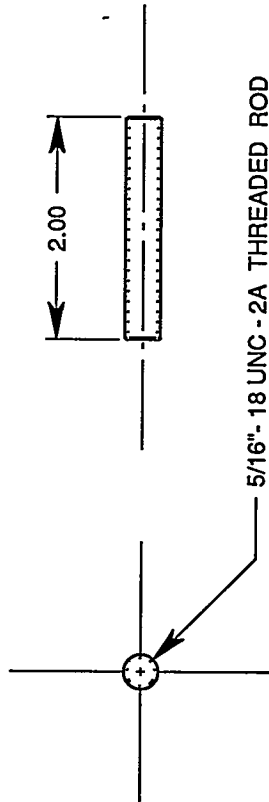
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	
FRACTIONS	DECIMALS
XXX	.XXX
XX	.XX
X	.X
0	0.000
1	1.000
2	2.000
3	3.000
4	4.000
5	5.000
6	6.000
7	7.000
8	8.000
9	9.000
10	10.000
11	11.000
12	12.000
13	13.000
14	14.000
15	15.000
16	16.000
17	17.000
18	18.000
19	19.000
20	20.000
21	21.000
22	22.000
23	23.000
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25	25.000
26	26.000
27	27.000
28	28.000
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31	31.000
32	32.000
33	33.000
34	34.000
35	35.000
36	36.000
37	37.000
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41	41.000
42	42.000
43	43.000
44	44.000
45	45.000
46	46.000
47	47.000
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87	87.000
88	88.000
89	89.000
90	90.000
91	91.000
92	92.000
93	93.000
94	94.000
95	95.000
96	96.000
97	97.000
98	98.000
99	99.000
100	100.000



FULL SCALE

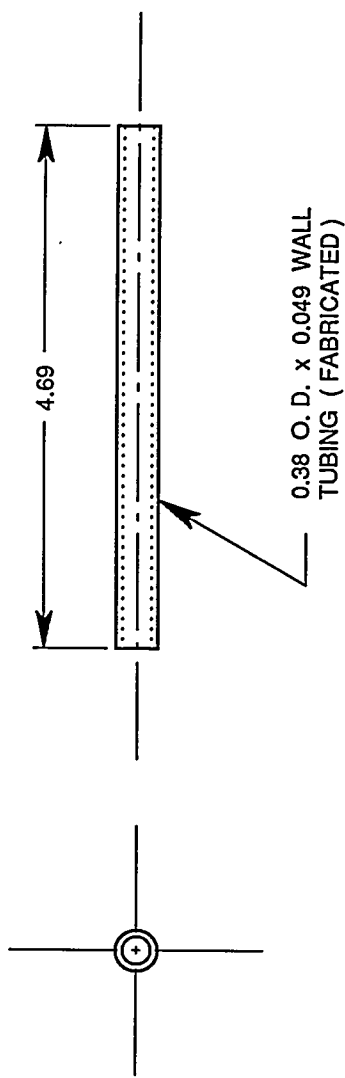
ACUREX Corporation		Environmental Systems Division	
PROJECT		DEPARTMENT OF ENERGY	
THERMAL EXPOSURE TESTER -- SAMPLE CAN		SAMPLE MOUNTING ROD	
SIZE		DWG. NO. 8146 - 207	
REV		SHEET 1 OF 1	
B		B	
DWN		D. TATE	
CHK		M. CHAN	
ENG		M. CHAN	
APPD		J. SAWYER	
PROJECT NO.		8146 - 040	
SCALE		FULL SCALE	
ORIGINATING OFFICE		CASE NO.	
Durham, NC		032791	
APPROVAL		032794	
NUMBER		TITLE	
DATE		REFERENCE DRAWINGS	
APPD		REVISIONS	
DESCRIPTION			
B		RELEASED FOR FABRICATION	
A		RELEASED FOR BID	
LTH			

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	
FRACTIONS	XX
DECIMALS	.XXX
ANGLES	± .01 ± .005 ± 0° 30'
MACHINE CORNERS - .005 TO .015 RAO OR CHAMFER	
SHEET MATERIAL - BREAK EDGES .005 MAX RADII	
MACHINED SURFACES TO BE	
DIMENSIONS AND TOLERANCES APPLY BEFORE	
FINISHED TREATMENT	
DO NOT SCALE DRAWING	
MATERIAL:	
R A - 330	
FINISH:	



FULL SCALE

ACUREX Corporation		Environmental Systems Division	
PROJECT		DEPARTMENT OF ENERGY	
THERMAL EXPOSURE TESTER -- SAMPLE CAN		FLANGE STUD	
SIZE	DWG. NO.	SHEET	REV
B	8146 - 208	1 OF 1	B
DWN	D. TATE	9-16-91	
CHK	M. CHAN	9-25-91	
ENG	M. CHAN	9-25-91	
APPD	J. SAWYER	9-25-91	
PROJECT NO.	8146 - 040		
SCALE	FULL SCALE		
ORIGINATING OFFICE	GAZ. NO.		
Durham, NC	ORDY		
JANUARY, 1991	ORDY		
REFERENCE DRAWINGS			
REVISIONS		NUMBER	TITLE
B	RELEASED FOR FABRICATION	10-17-91	
A	RELEASED FOR BID	9-25-91	
LTR		APPD	

[illegible]

APPENDIX C

**REPORT: "THERMAL SHOCK-INDUCED STRENGTH
DEGRADATION OF POROUS SiC CANDLE FILTERS"**

Removed for separate cycling. al

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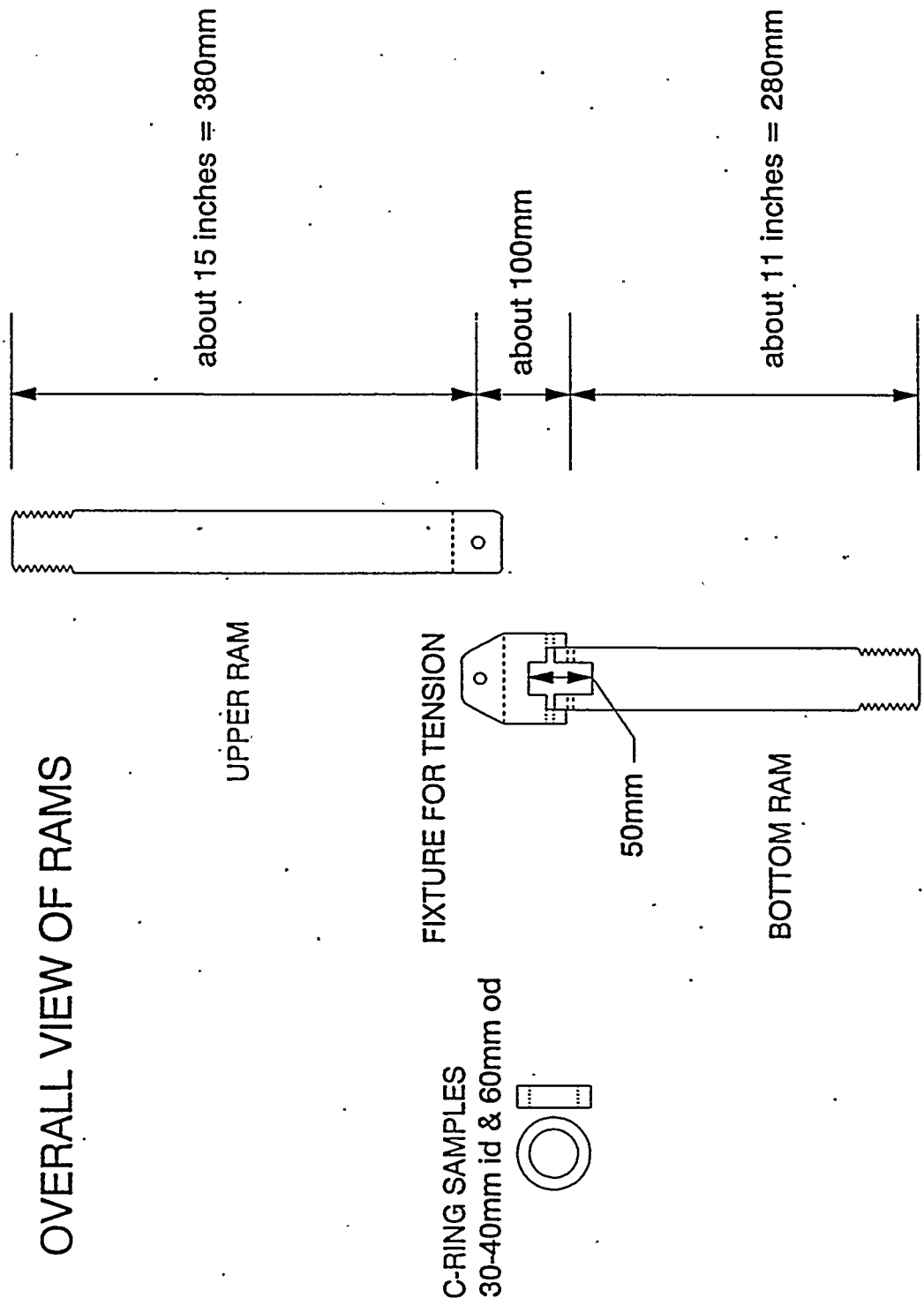
APPENDIX B: SKETCHES OF CERAMIC C-RING TESTING FIXTURES

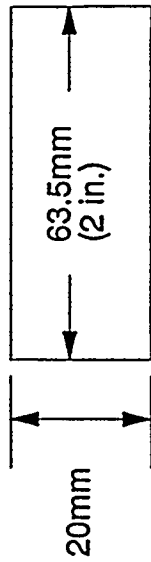
The cost of the raw materials to make one set of fixtures out of Hexoloy SA SiC (from Carborundum^a) was quoted to be about \$10,300. The cost of having the fixtures milled was not attempted because of the expensive cost of the raw materials. Ceramics are brittle materials. If a slight crack is inadvertently introduced into the fixture during manufacturing, it could cause the fixture to break. Since there would be no additional funds (nor time) to finish the Senior Project on schedule, this design route was aborted.

The following pages are preliminary sketches/designs for c-ring testing fixtures to be made out of a ceramic material for elevated temperature testing. They would exceed the testing capabilities of a super alloy ($\approx >1200^{\circ}\text{C}$, low thermal expansions, and high modulus).

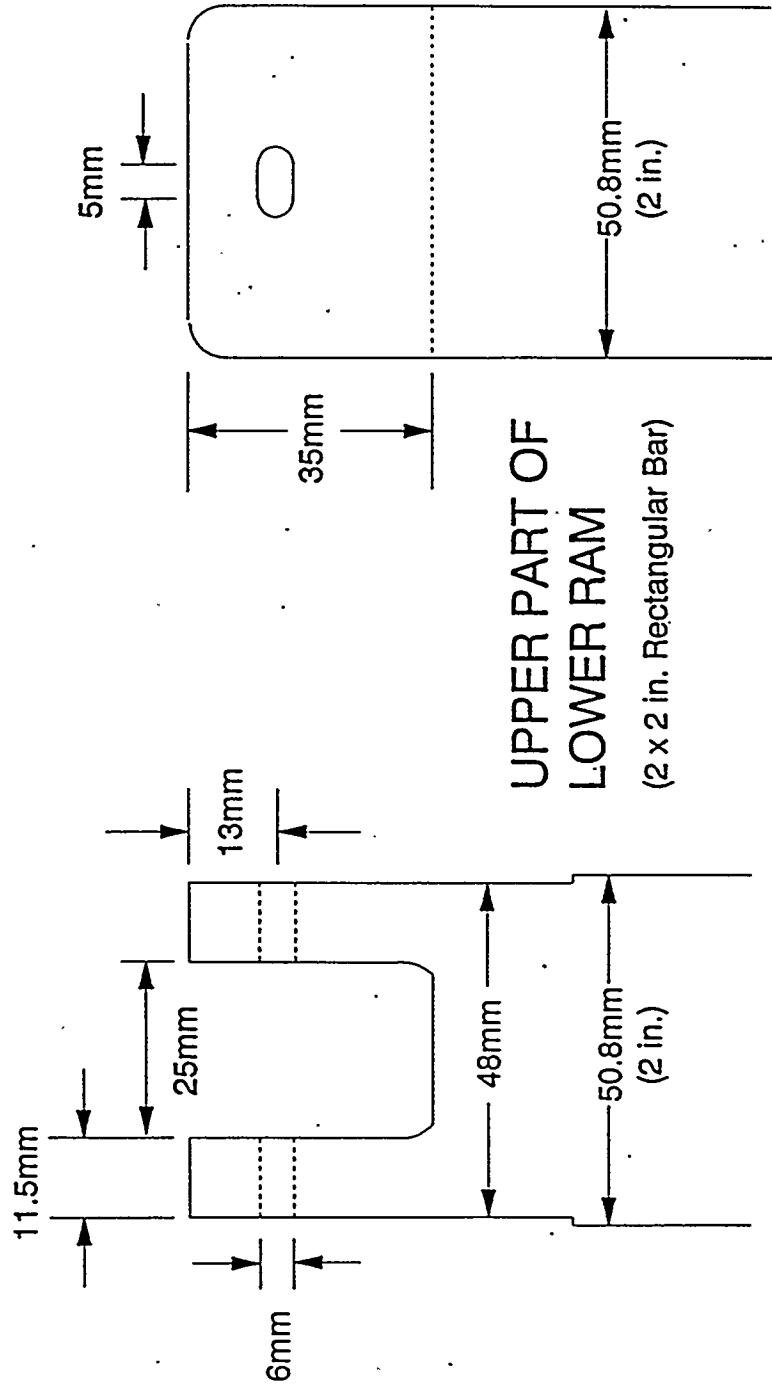
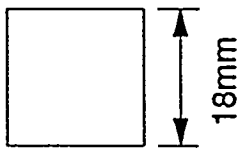
^a Carborundum Company of Niagara Falls, New York

OVERALL VIEW OF RAMS

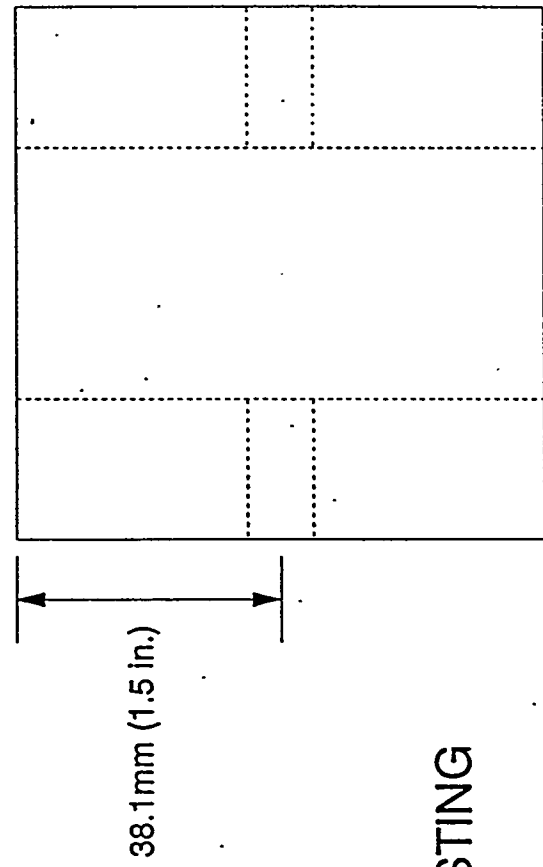
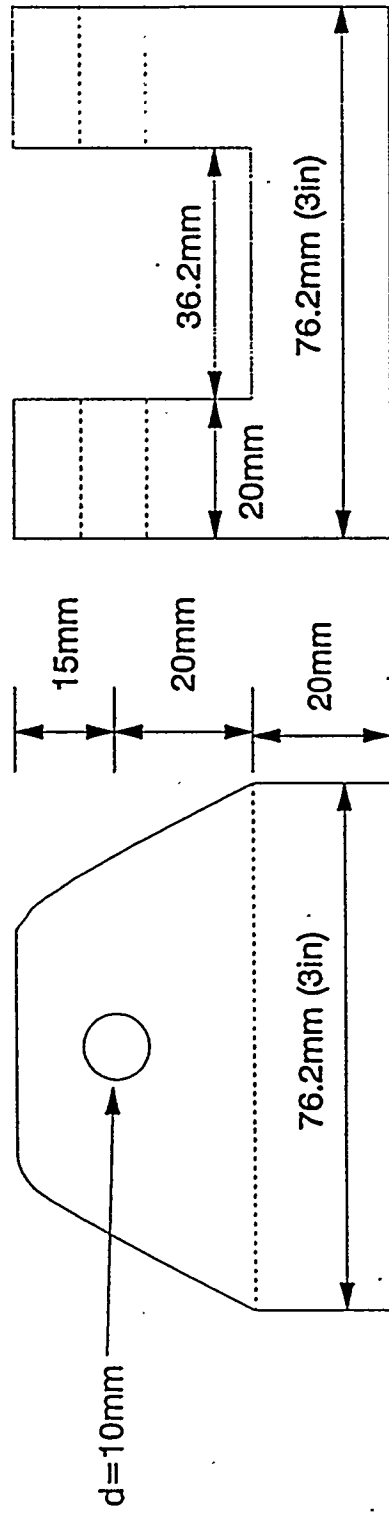




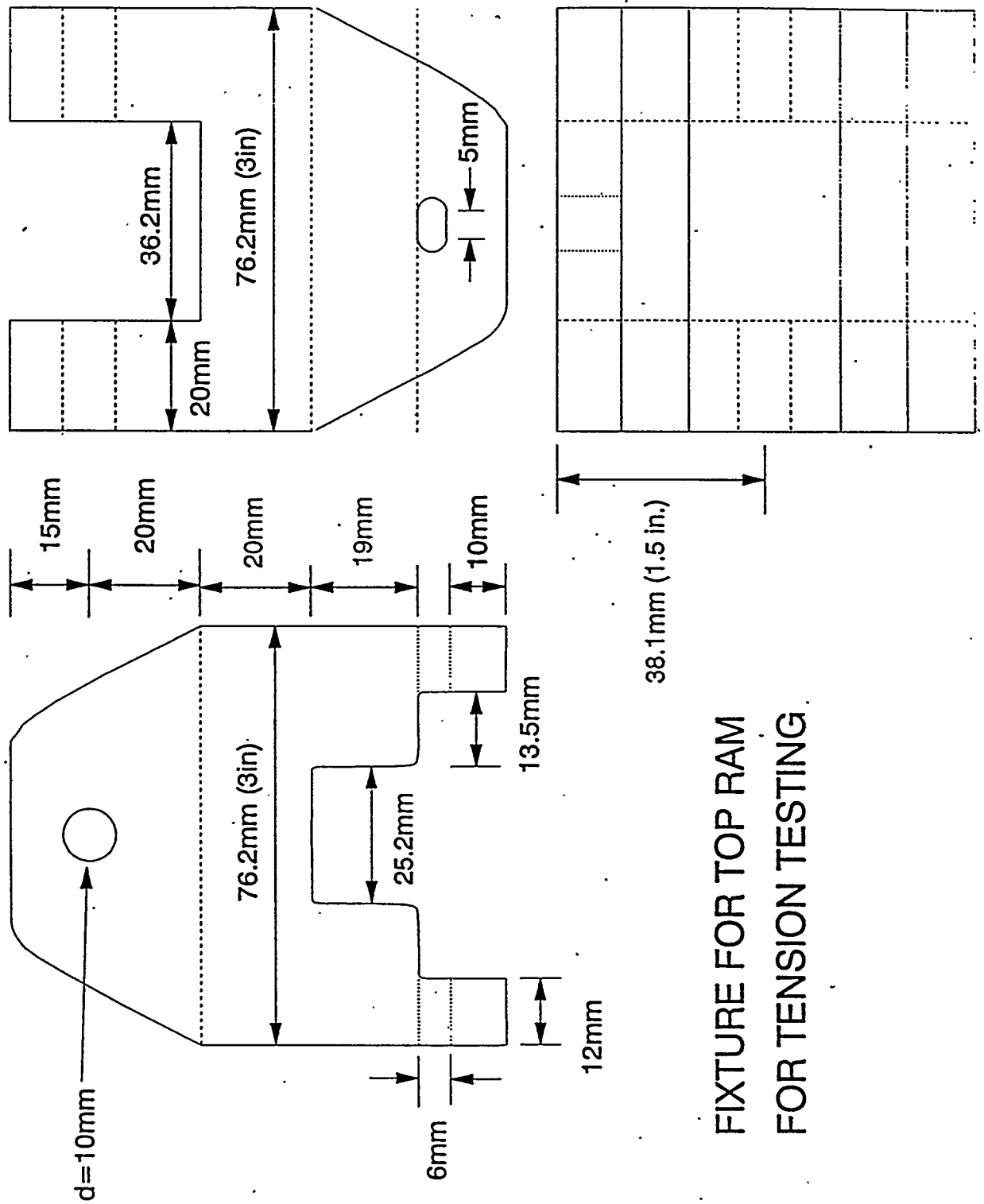
Bar used for
Compression



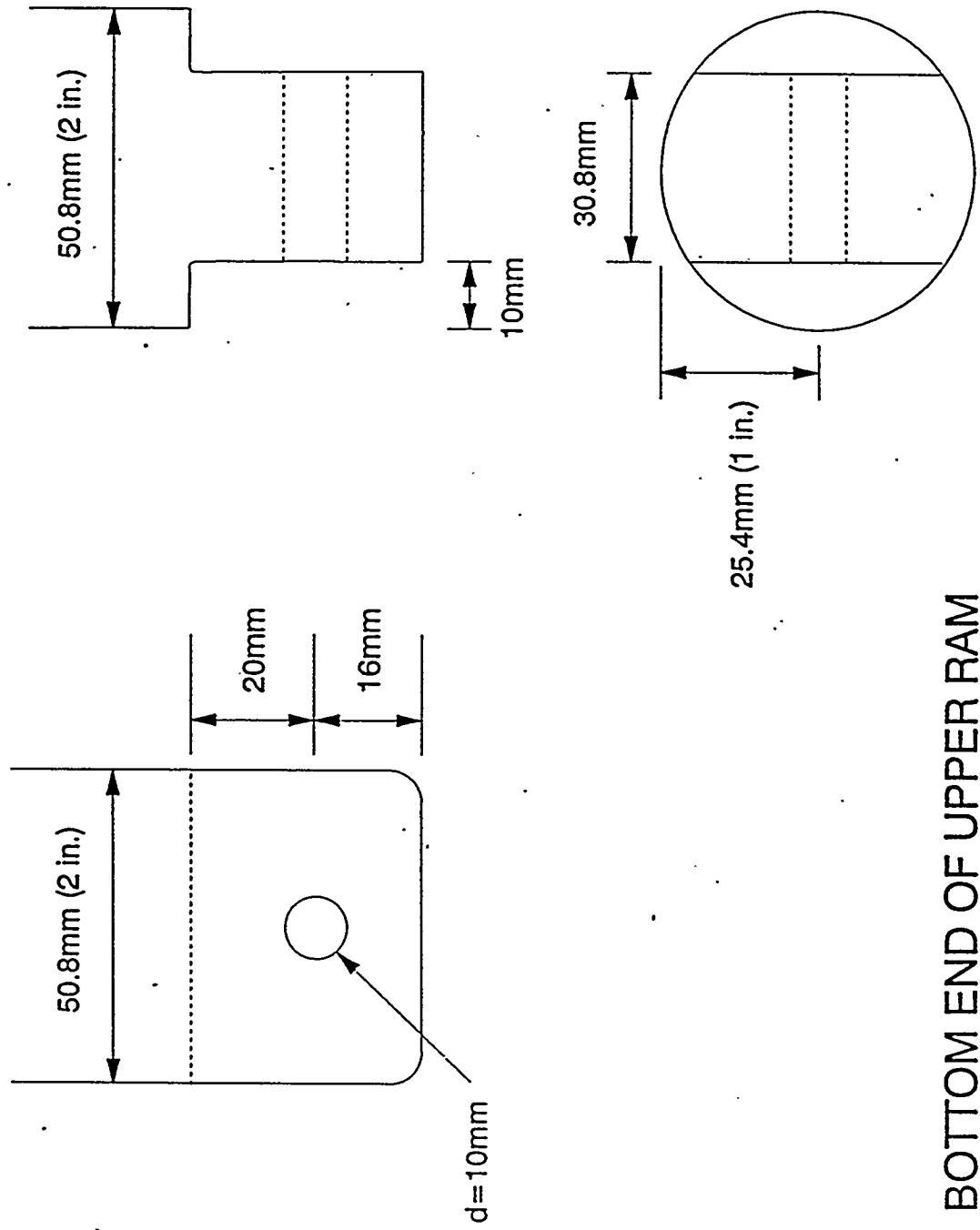
UPPER PART OF
LOWER RAM
(2 x 2 in. Rectangular Bar)



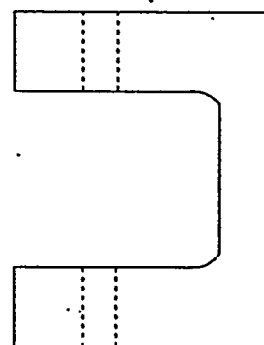
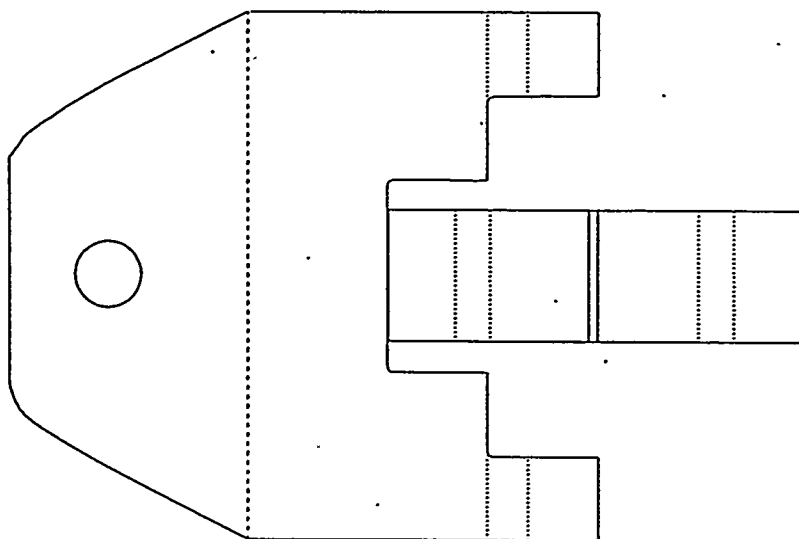
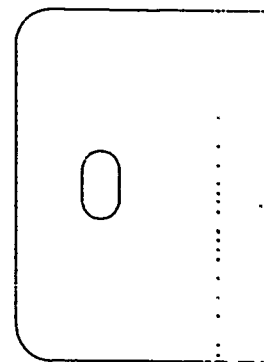
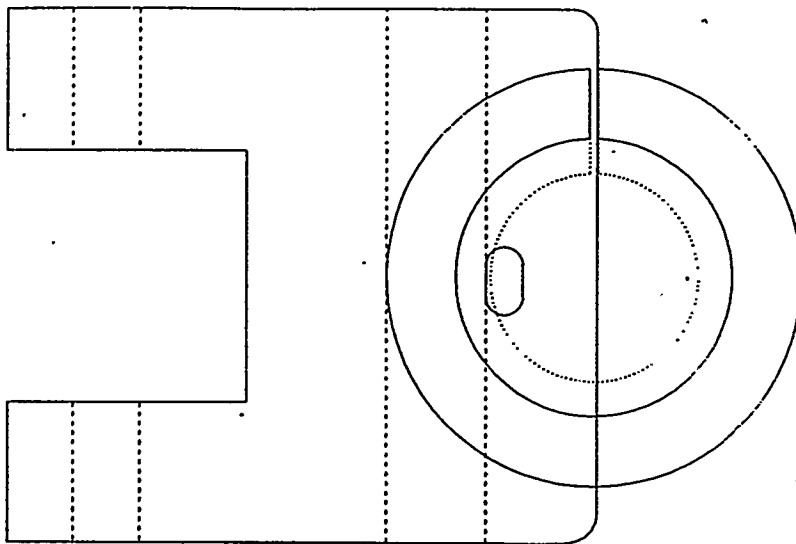
FIXTURE FOR TOP RAM
FOR COMPRESSION TESTING

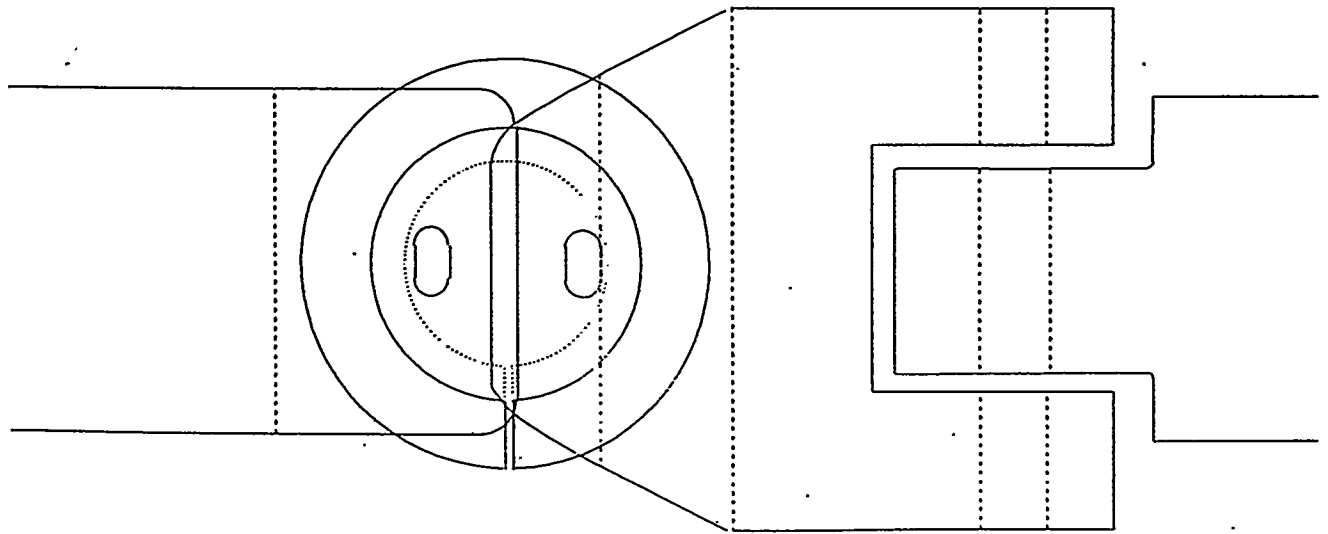
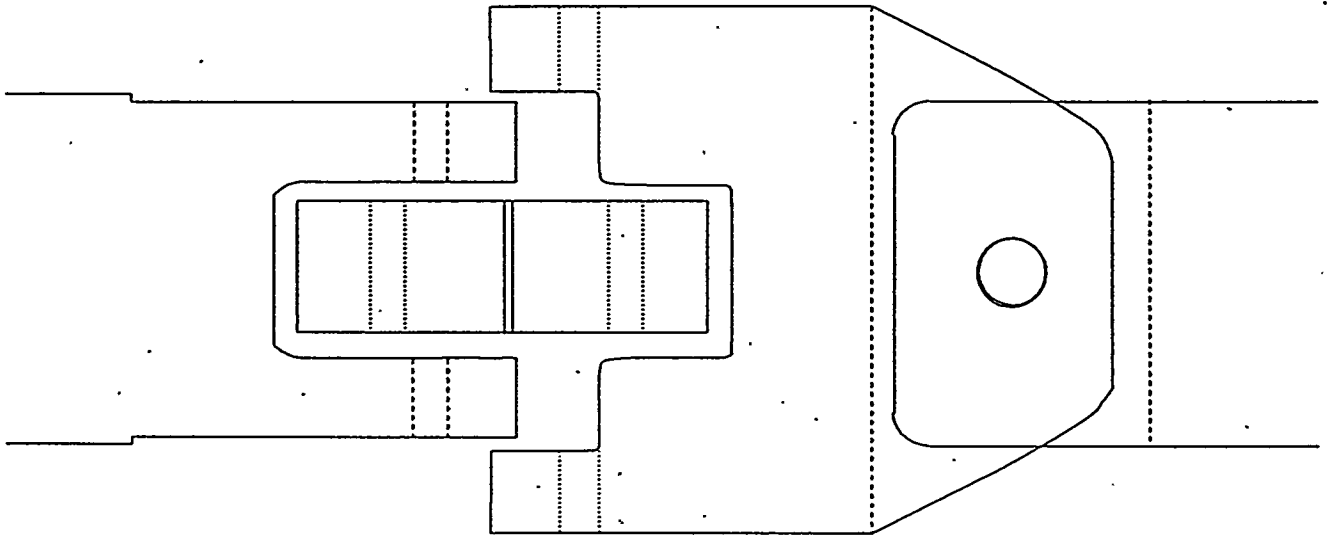


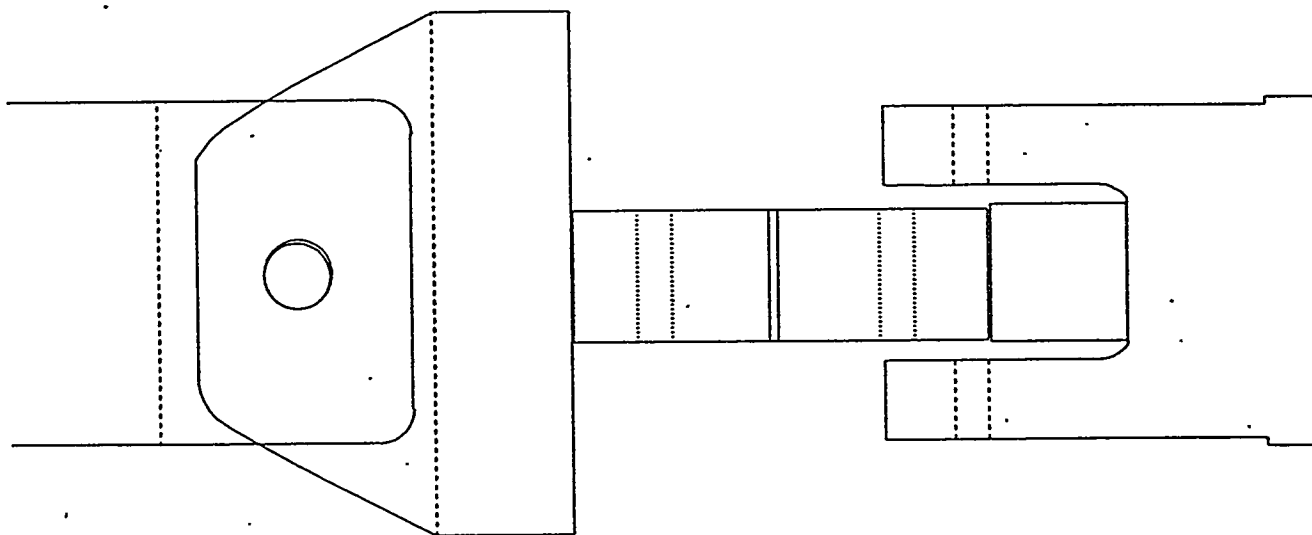
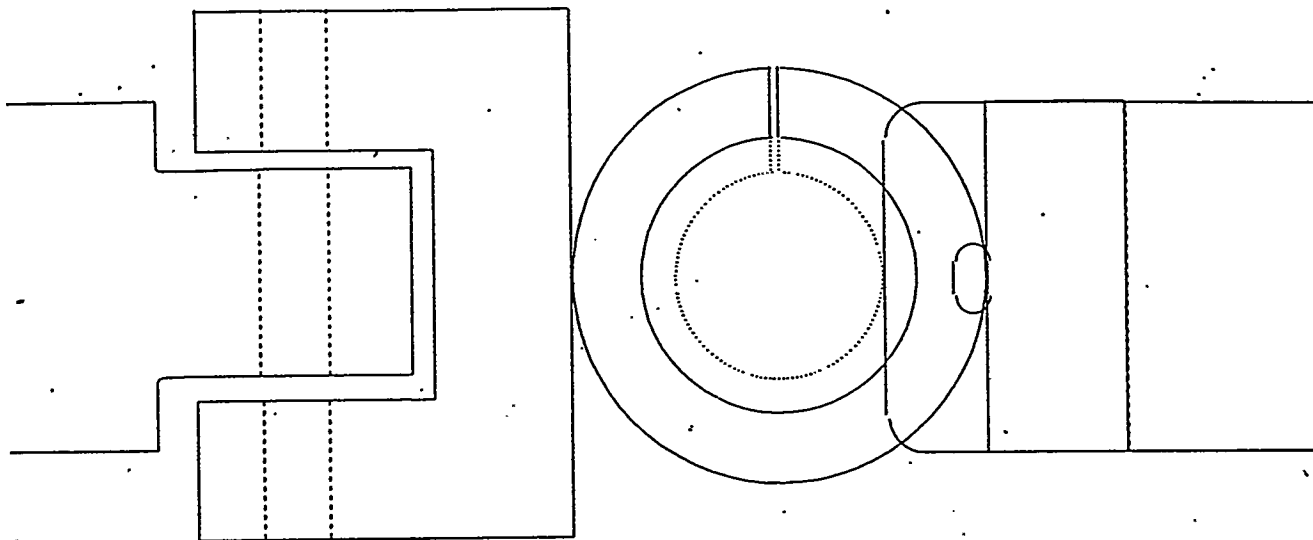
FIXTURE FOR TOP RAM
FOR TENSION TESTING.



BOTTOM END OF UPPER RAM





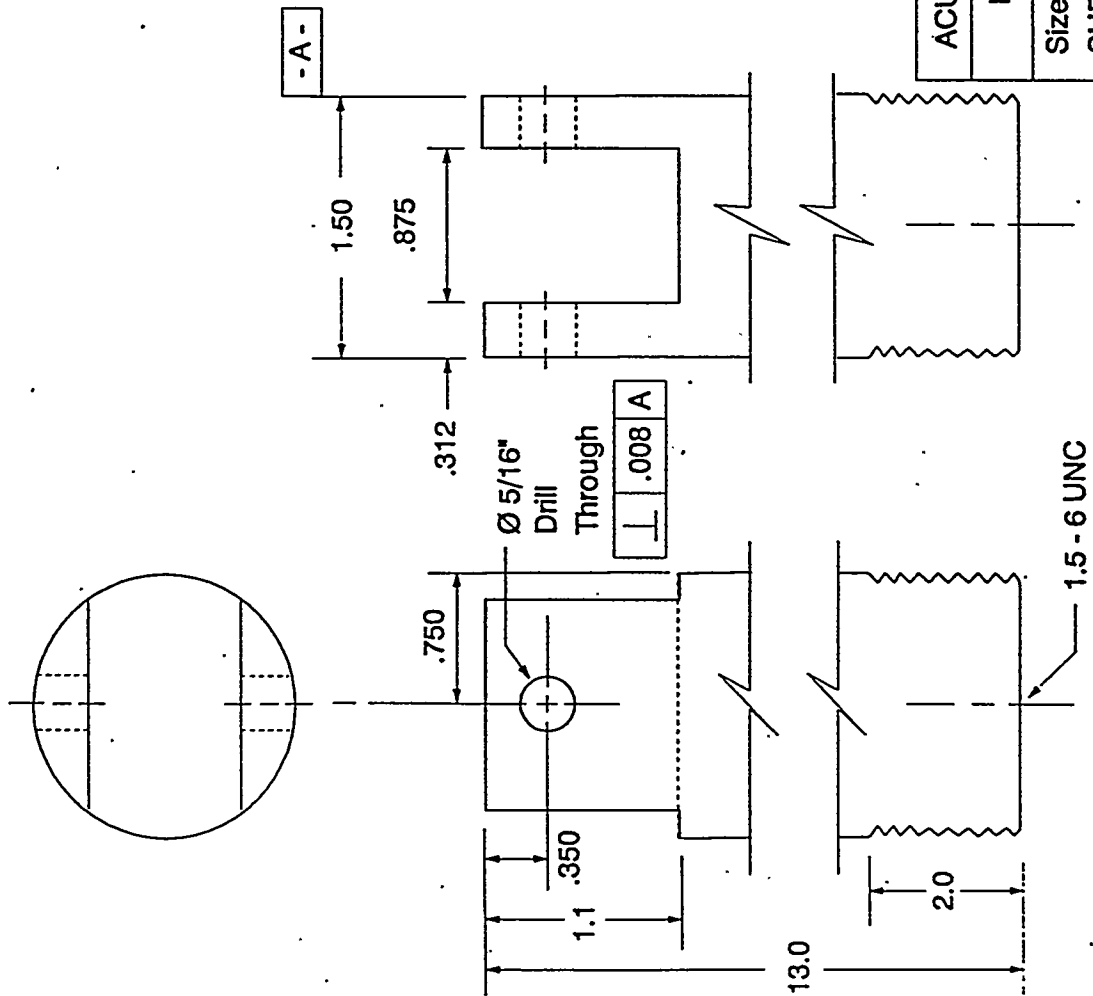


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APPENDIX C: DESIGNS OF THE SUPERALLOY C-RING TESTING FIXTURES

The following designs were drawn by the author and submitted to Modern Machine (in San Jose) to be fabricated from Haynes® Alloy 230 (a nickel-chromium-tungsten-molybdenum alloy). The adapter/cooling couples were made of standard stainless steel that Modern Machine supplied.

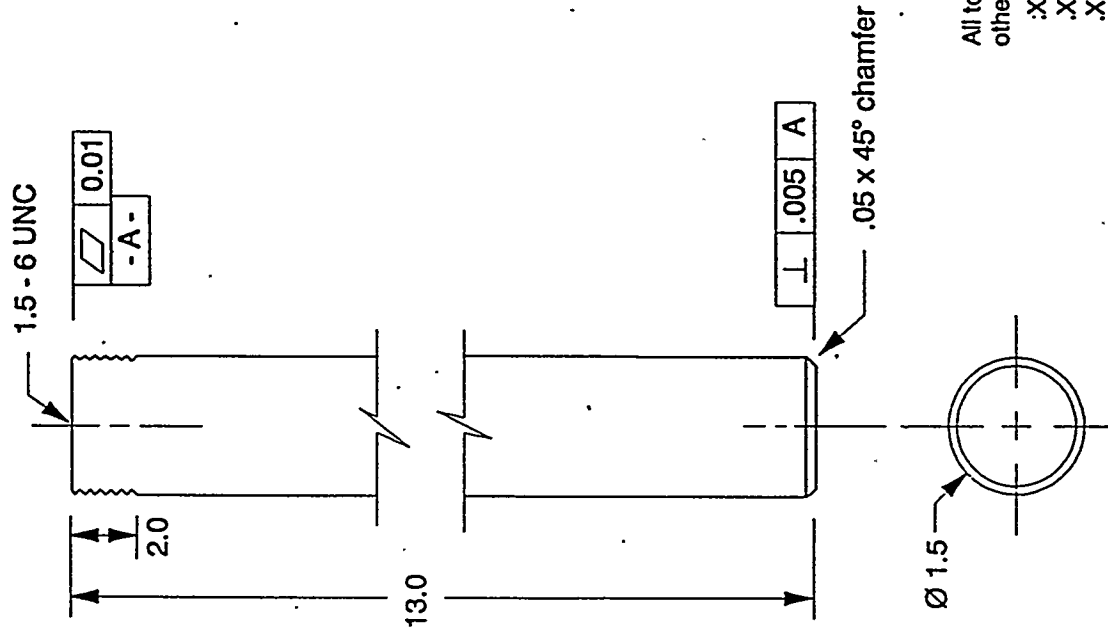
All tolerances unless
otherwise specified:
.XXX $\pm$.005
.XX $\pm$.010
.X $\pm$.10



Notes:

1. Material is Haynes Alloy 230
2. All dimensions in inches

ACUREX ENVIRONMENTAL SYSTEMS (ESD)	
LOWER RAM	
Size A	Project Number: 8146
SHEET 1 OF 6	DWN: <i>[Signature]</i>



All tolerances unless
otherwise specified:
.XXX ± .005
.XX ± .010
.X ± .10

Notes:

1. Material is Haynes Alloy 230
2. All dimensions in inches

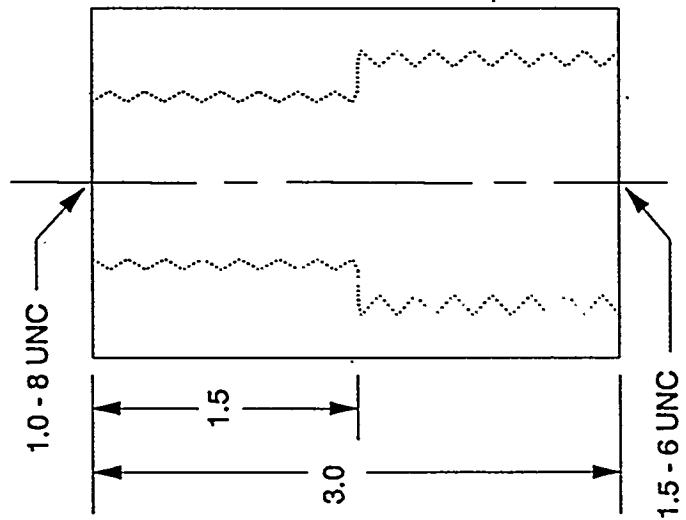
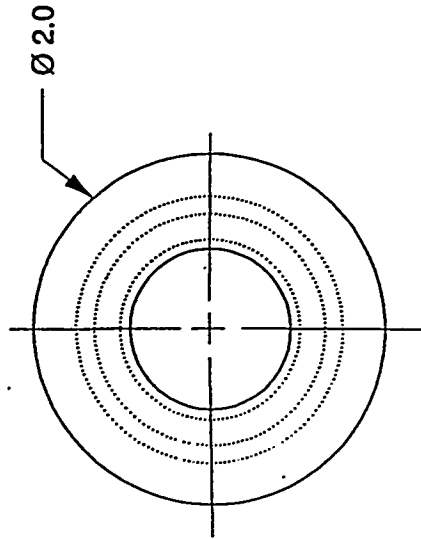
ACUREX ENVIRONMENTAL SYSTEMS (ESD)	
UPPER RAM FOR COMPRESSION TEST	
Size A SHEET 2 OF 6	Project Number: 8146 DWN: <i>Hebert Cho</i>

All tolerances unless
otherwise specified:

.XXX $\pm$.005

.XX $\pm$.010

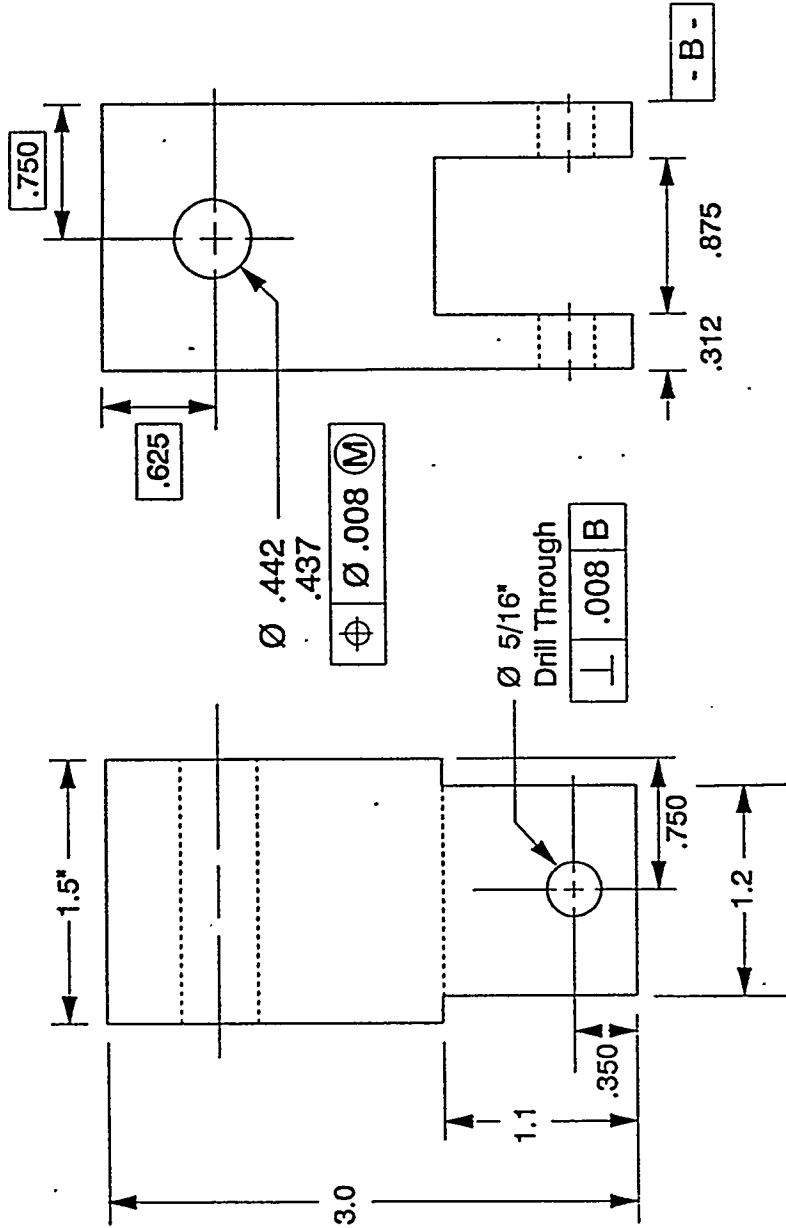
X $\pm$.10



Notes:

1. Material is
2. All dimensions in inches
3. Quantity required is 2

ACUREX ENVIRONMENTAL SYSTEMS (ESD)	
ADAPTER COUPLE FOR UPPER RAM (COMPR.)	
Size A	Project Number: 8146
SHEET 3 OF 6	DWN: <i>Michael Chen</i>



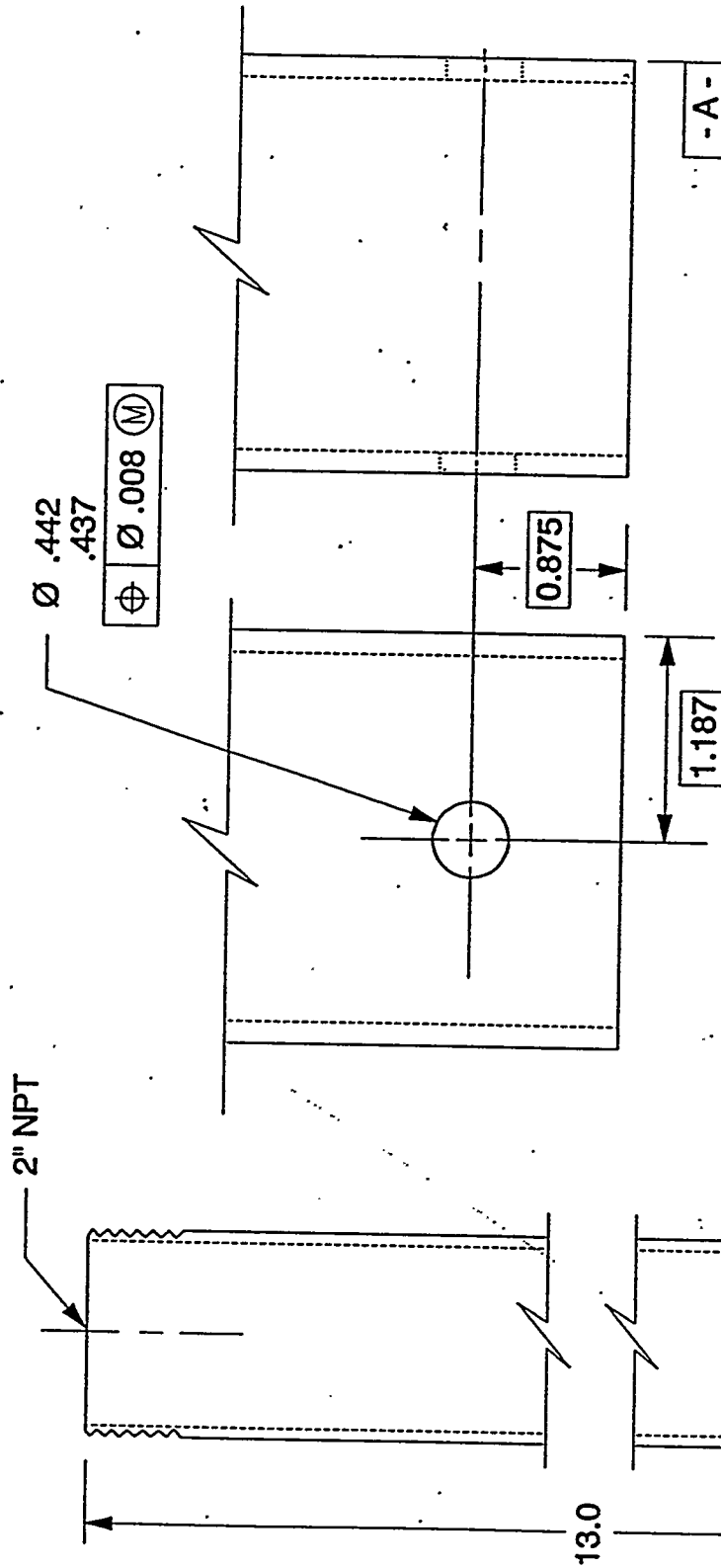
Notes:

1. Material is Haynes Alloy 230
2. All dimensions in inches

All tolerances unless
otherwise specified:

.XXX $\pm .005$
.XX $\pm .010$
.X $\pm .10$

ACUREX ENVIRONMENTAL SYSTEMS (ESD)	
UPPER FIXTURE FOR TENSION TEST	
Size A	Project Number: 8146
SHEET 4 OF 6	DWN: <i>Michael Chan</i>



Notes:

1. Material is Haynes Alloy 230
2. 2" Schedule 40 Pipe
3. All dimensions in inches

All tolerances unless
otherwise specified:

XXX $\pm .005$
XX $\pm .010$
X $\pm .10$

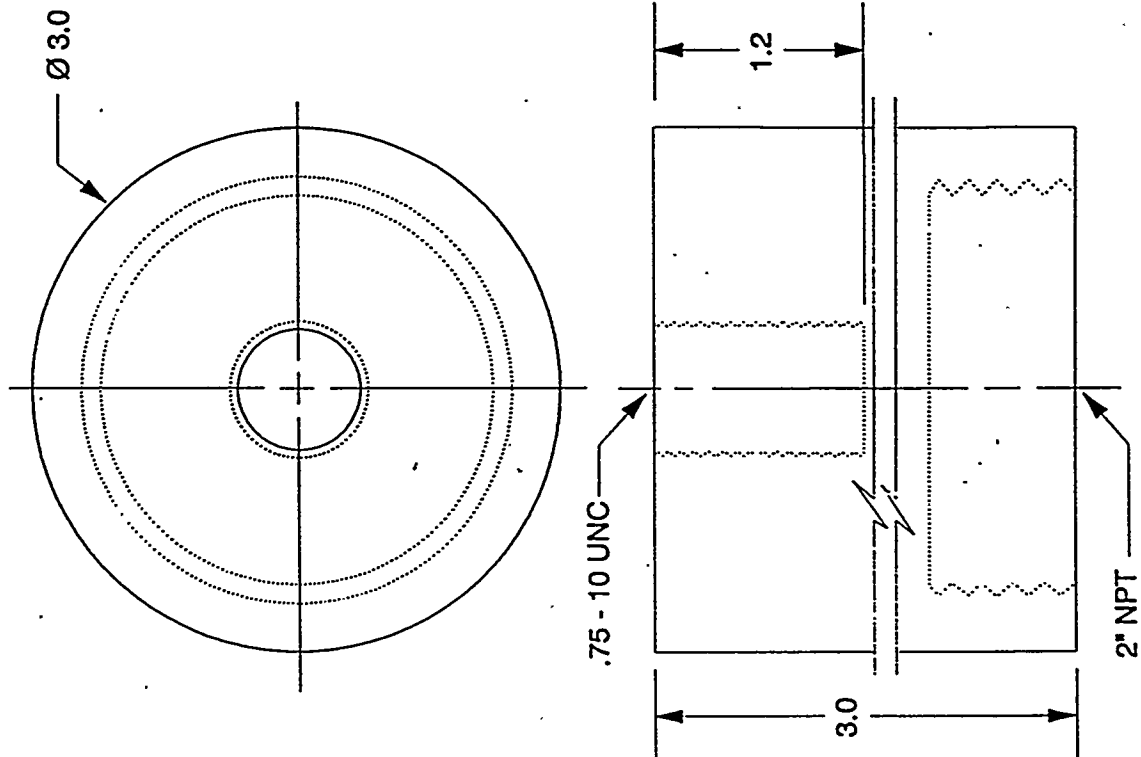
ACUREX ENVIRONMENTAL SYSTEMS (ESD)	
UPPER RAM FOR TENSION TEST	
Size A:	Project Number: 8146
SHEET 5 OF 6	DWN: Michael Chan

All tolerances unless
otherwise specified:

.XXX $\pm$.005

.XX $\pm$.010

X $\pm$.10



Notes:

1. Material is
2. Female 2" NPT for a 2" Schedule 40 Pipe
3. All dimensions in inches

ACUREX ENVIRONMENTAL SYSTEMS (ESD)	
ADAPTER COUPLE FOR UPPER RAM (TENSION)	
Size A SHEET 6 OF 6	Project Number: 8146 DWN: <i>Michael Chan</i>

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APPENDIX D: RAW DATA AND MAXIMUM STRESS CALCULATIONS

The equation used for calculating the maximum stresses for c-ring compression and tension testing is:^a

$$\sigma_{\theta} = \frac{P}{w(r_o - r_i)} \left[\frac{\frac{r_o - r_i}{\ln\left(\frac{r_o}{r_i}\right)} \left(r - \frac{r_o + r_i}{2} \right)}{r \left[\frac{r_o - r_i}{\ln\left(\frac{r_o}{r_i}\right)} - \frac{r_o + r_i}{2} \right]} \right] \cos\theta$$

Note: $\cos \theta = 1$ for $\theta = 0^\circ$

P = breaking load (negative for compressive loading)

w = c-ring thickness

r = radial distance of interest

r_i = inner radius

r_o = outer radius

The following pages are the raw data and stress calculation spreadsheets in Lotus 1-2-3. Two inner diameter (I.D.) (as well as two outer diameter) measurements were made and averaged. The averaged value was then corrected because the calipers the author used was not calibrated.

^a Ferber, M. K., V. J. Tennery, S. B. Waters, and J. Ogle, "Fracture Strength Characterization of Tubular Ceramic Materials Using a Simple C-ring Geometry", Journal of Materials Science, V. 21, 1986, pp. 2628-2632

05/20/91

SPECIMEN	SPECIMEN NUMBER	CORRECTED			CORRECTED			WIDTH	TEST	LOAD (lbs)
		I.D. 1 (in.)	I.D. 2 (in.)	O.D. 1 (in.)	O.D. 2 (in.)	AVE. I.D. (in.)	I.D. (in.)	AVE. O.D. (in.)	O.D. (in.)	
SCHUMACHER	T2	1.220	1.231	2.390	2.380	1.226	1.246	2.385	2.425	0.775 RTT 22.75
SOLAR (UNUSED)	T13	1.190	1.202	2.386	2.376	1.196	1.216	2.381	2.421	0.770 RTT 28.25
	T17	1.185	1.190	2.378	2.364	1.188	1.208	2.371	2.411	0.755 RTT 26.25
	B3	1.155	1.142	2.361	2.345	1.149	1.168	2.353	2.393	0.740 RTT 31.75
	B7	1.160	1.148	2.356	2.338	1.154	1.174	2.347	2.387	0.745 RTT 27.00
SCHUMACHER	2	1.218	1.217	2.370	2.382	1.218	1.238	2.376	2.416	0.732 RTT 17.25
SOLAR (USED)	6	1.205	1.210	2.393	2.375	1.208	1.228	2.384	2.424	0.807 RTT 14.00
	10	1.183	1.187	2.389	2.372	1.185	1.205	2.381	2.421	0.796 RTT 25.50
	14	1.180	1.174	2.376	2.358	1.177	1.197	2.367	2.407	0.798 RTT 23.50
	18	1.179	1.170	2.386	2.395	1.175	1.194	2.391	2.431	0.798 RTT 25.25
SCHUMACHER (UNUSED)	1	1.210	1.200	2.392	2.388	1.205	1.225	2.390	2.431	0.741 RTT 40.50
	3	1.198	1.194	2.380	2.375	1.196	1.216	2.378	2.418	0.742 RTT 37.75
	5	1.199	1.203	2.386	2.386	1.201	1.221	2.386	2.426	0.766 RTT 47.25
	7	1.191	1.178	2.376	2.384	1.185	1.205	2.380	2.420	0.752 RTT 44.25
	9	1.158	1.170	2.340	2.345	1.164	1.184	2.343	2.382	0.730 RTT 43.25
SCHUMACHER	1	1.100	1.100	2.339	2.352	1.100	1.119	2.346	2.385	0.743 RTT 33.00
5000 PULSES	3	1.098	1.098	2.334	2.354	1.098	1.117	2.344	2.384	0.740 RTT 32.00
@ 0.5 sec	5	1.101	1.105	2.339	2.339	1.103	1.122	2.339	2.379	0.729 RTT 35.00
	9	1.091	1.105	2.368	2.362	1.098	1.117	2.365	2.405	0.746 RTT 35.75
	7	1.097	1.088	2.369	2.358	1.093	1.111	2.364	2.404	0.742 RTT 34.00
SCHUMACHER	1	1.155	1.167	2.349	2.346	1.161	1.181	2.348	2.387	0.709 RTT 119.00
KRW 7068	5	1.146	1.140	2.350	2.349	1.143	1.162	2.350	2.389	0.768 RTT 134.25
(UNUSED)	9	1.126	1.134	2.350	2.352	1.130	1.149	2.351	2.391	0.772 RTT 131.00
	12	1.128	1.109	2.360	2.358	1.119	1.137	2.359	2.399	0.751 RTT 140.75
	15	1.114	1.112	2.357	2.365	1.113	1.132	2.361	2.401	0.785 RTT 154.50
DIDIER	3	1.598	1.590	2.361	2.360	1.594	1.621	2.361	2.401	0.754 RTT 88.00
(UNUSED)	5	1.511	1.492	2.361	2.355	1.502	1.527	2.358	2.398	0.752 RTT 101.75
	6	1.500	1.495	2.365	2.347	1.498	1.523	2.356	2.396	0.748 RTT 85.25
	8	1.489	1.493	2.350	2.358	1.491	1.516	2.354	2.394	0.775 RTT 77.25
	9	1.481	1.478	2.348	2.352	1.480	1.505	2.350	2.390	0.786 RTT 95.75
DIDIER	2	1.490	1.477	2.331	2.336	1.484	1.509	2.334	2.373	0.764 RTT 103.25
5000 PULSES	3	1.510	1.519	2.358	2.368	1.515	1.540	2.363	2.403	0.742 RTT 65.75
@ 0.05 sec	4	1.510	1.500	2.362	2.351	1.505	1.531	2.357	2.396	0.770 RTT 83.00
	5	1.508	1.504	2.355	2.352	1.506	1.532	2.354	2.393	0.773 RTT 78.75
	6	1.500	1.494	2.350	2.345	1.497	1.522	2.348	2.387	0.773 RTT 78.50
IFP LAYCER	2	1.575	1.574	2.321	2.321	1.575	1.601	2.321	2.360	0.761 RTT 36.75
(UNUSED)	4	1.572	1.565	2.320	2.318	1.569	1.595	2.319	2.358	0.756 RTT 41.50
	6	1.578	1.573	2.328	2.328	1.576	1.602	2.328	2.367	0.751 RTT 42.00
	8	1.561	1.554	2.320	2.312	1.558	1.584	2.316	2.355	0.744 RTT 43.25
	10	1.542	1.542	2.310	2.313	1.542	1.568	2.312	2.351	0.752 RTT 40.25
IFP LAYCER	2	1.520	1.512	2.282	2.264	1.516	1.542	2.273	2.312	0.731 RTT 45.25
5000 PULSES	3	1.532	1.515	2.286	2.266	1.524	1.549	2.276	2.315	0.778 RTT 50.25
@ 0.05 sec	4	1.537	1.517	2.295	2.278	1.527	1.553	2.287	2.325	0.767 RTT 50.00
	6	1.521	1.532	2.312	2.322	1.527	1.552	2.317	2.356	0.741 RTT 41.75
	5	1.512	1.530	2.293	2.320	1.521	1.547	2.307	2.346	0.750 RTT 54.25
IFP LAYCER	3	1.556	1.562	2.309	2.322	1.559	1.585	2.316	2.355	0.756 RTT 29.50
5000 PULSES	5	1.555	1.560	2.324	2.328	1.558	1.584	2.326	2.365	0.759 RTT 31.00
@ 0.5 sec	7	1.548	1.554	2.312	2.324	1.551	1.577	2.318	2.357	0.745 RTT 29.00
	9	1.560	1.553	2.331	2.316	1.557	1.583	2.324	2.363	0.775 RTT 31.75

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SPECIMEN	SPECIMEN TEST NUMBER		Ri (in.)	Ro (in.)	w (in)	R=Ri(T) R=Ro(C)	STRESS (psi)	STRESS (MPa)		STRESS (psi)	STRESS (MPa)
SCHUMACHER	T2	RTT	0.62	1.21	0.78	0.62	642	4.43	MAX=	864	5.96
SOLAR (UNUSED)	T13	RTT	0.61	1.21	0.77	0.61	770	5.31	MIN=	642	4.43
	T17	RTT	0.60	1.21	0.76	0.60	728	5.02	AVE=	749	5.17
	B3	RTT	0.58	1.20	0.74	0.58	864	5.96	STD=	72	0.49
	B7	RTT	0.59	1.19	0.75	0.59	741	5.11			
SCHUMACHER	2	RTT	0.62	1.21	0.73	0.62	515	3.55	MAX=	661	4.56
SOLAR (USED)	6	RTT	0.61	1.21	0.81	0.61	369	2.55	MIN=	369	2.55
	10	RTT	0.60	1.21	0.80	0.60	661	4.56	AVE=	558	3.85
	14	RTT	0.60	1.20	0.80	0.60	610	4.20	STD=	106	0.73
	18	RTT	0.60	1.22	0.80	0.60	635	4.38			
SCHUMACHER	1	RTT	0.61	1.22	0.74	0.61	1150	7.93	MAX=	1296	8.94
(UNUSED)	3	RTT	0.61	1.21	0.74	0.61	1072	7.39	MIN=	1072	7.39
	5	RTT	0.61	1.21	0.77	0.61	1296	8.94	AVE=	1194	8.23
	7	RTT	0.60	1.21	0.75	0.60	1214	8.37	STD=	77	0.53
	9	RTT	0.59	1.19	0.73	0.59	1238	8.54			
SCHUMACHER	1	RTT	0.56	1.19	0.74	0.56	839	5.78	MAX=	918	6.33
5000 PULSES	3	RTT	0.56	1.19	0.74	0.56	816	5.62	MIN=	816	5.62
@ 0.5 sec	5	RTT	0.56	1.19	0.73	0.56	918	6.33	AVE=	859	5.92
	9	RTT	0.56	1.20	0.75	0.56	883	6.09	STD=	37	0.25
	7	RTT	0.56	1.20	0.74	0.56	839	5.79			
SCHUMACHER	1	RTT	0.59	1.19	0.71	0.59	3470	23.92	MAX=	3724	25.68
KRW 7068	5	RTT	0.58	1.19	0.77	0.58	3506	24.17	MIN=	3331	22.97
(UNUSED)	9	RTT	0.57	1.20	0.77	0.57	3331	22.97	AVE=	3523	24.29
	12	RTT	0.57	1.20	0.75	0.57	3583	24.71	STD=	130	0.89
	15	RTT	0.57	1.20	0.79	0.57	3724	25.68			
DIDIER	3	RTT	0.81	1.20	0.75	0.81	5619	38.74	MAX=	5619	38.74
(UNUSED)	5	RTT	0.76	1.20	0.75	0.76	5237	36.11	MIN=	3796	26.17
	6	RTT	0.76	1.20	0.75	0.76	4388	30.25	AVE=	4719	32.54
	8	RTT	0.76	1.20	0.78	0.76	3796	26.17	STD=	643	4.43
	9	RTT	0.75	1.19	0.79	0.75	4554	31.40			
DIDIER	2	RTT	0.75	1.19	0.76	0.75	5257	36.25	MAX=	5257	36.25
5000 PULSES	3	RTT	0.77	1.20	0.74	0.77	3500	24.13	MIN=	3500	24.13
@ 0.05 sec	4	RTT	0.77	1.20	0.77	0.77	4218	29.08	AVE=	4192	28.91
	5	RTT	0.77	1.20	0.77	0.77	4018	27.70	STD=	582	4.01
	6	RTT	0.76	1.19	0.77	0.76	3968	27.36			
IFP LAYCER	2	RTT	0.80	1.18	0.76	0.80	2409	16.61	MAX=	2805	19.34
(UNUSED)	4	RTT	0.80	1.18	0.76	0.80	2708	18.67	MIN=	2409	16.61
	6	RTT	0.80	1.18	0.75	0.80	2755	18.99	AVE=	2637	18.18
	8	RTT	0.79	1.18	0.74	0.79	2805	19.34	STD=	152	1.05
	10	RTT	0.78	1.18	0.75	0.78	2506	17.28			
IFP LAYCER	2	RTT	0.77	1.16	0.73	0.77	2945	20.31	MAX=	3246	22.38
5000 PULSES	3	RTT	0.77	1.16	0.78	0.77	3113	21.46	MIN=	2508	17.29
@ 0.05 sec	4	RTT	0.78	1.16	0.77	0.78	3099	21.37	AVE=	2982	20.56
	6	RTT	0.78	1.18	0.74	0.78	2508	17.29	STD=	256	1.76
	5	RTT	0.77	1.17	0.75	0.77	3246	22.38			
IFP LAYCER	3	RTT	0.79	1.18	0.76	0.79	1892	13.05	MAX=	1988	13.70
5000 PULSES	5	RTT	0.79	1.18	0.76	0.79	1929	13.30	MIN=	1839	12.68
@ 0.5 sec	7	RTT	0.79	1.18	0.75	0.79	1839	12.68	AVE=	1918	13.22
	9	RTT	0.79	1.18	0.78	0.79	1940	13.38	STD=	50	0.34

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SPECIMEN	SPECIMEN NUMBER					CORRECTED		CORRECTED		WIDTH (in.)	TEST	LOAD (lbs)
		I.D. 1 (in.)	I.D. 2 (in.)	O.D. 1 (in.)	O.D. 2 (in.)	AVE. I.D. (in.)	I.D. (in.)	AVE. O.D. (in.)	O.D. (in.)			
IFP LAYCER 1000 PULSES @ 0.05 sec	11	1.553	1.548	2.325	2.330	1.551	1.577	2.328	2.367	0.762	RTT	32.75
	2	1.515	1.531	2.330	2.335	1.523	1.549	2.333	2.372	0.755	RTT	49.50
	3	1.545	1.526	2.350	2.330	1.536	1.562	2.340	2.380	0.772	RTT	43.75
	4	1.532	1.519	2.345	2.359	1.526	1.551	2.352	2.392	0.758	RTT	46.75
	5	1.532	1.547	2.345	2.354	1.540	1.566	2.350	2.389	0.760	RTT	49.25
	6	1.535	1.528	2.356	2.341	1.532	1.557	2.349	2.388	0.758	RTT	52.50
IFP LAYCER-DOE (USED)	3	1.526	1.512	2.304	2.301	1.519	1.545	2.303	2.342	0.778	RTT	32.25
	7	1.521	1.520	2.310	2.300	1.521	1.546	2.305	2.344	0.751	RTT	26.00
	11	1.500	1.506	2.298	2.304	1.503	1.528	2.301	2.340	0.758	RTT	22.25
	15	1.494	1.498	2.301	2.309	1.496	1.521	2.305	2.344	0.776	RTT	26.50
	21	1.436	1.442	2.295	2.299	1.439	1.463	2.297	2.336	0.745	RTT	49.25
SCHUMACHER KRW 7067 (USED)	1	1.163	1.160	2.347	2.330	1.162	1.181	2.339	2.378	0.761	RTT	96.75
	5	1.164	1.163	2.333	2.349	1.164	1.183	2.341	2.381	0.764	RTT	94.25
	9	1.132	1.131	2.343	2.339	1.132	1.151	2.341	2.381	0.760	RTT	97.25
	13	1.128	1.129	2.348	2.341	1.129	1.148	2.345	2.384	0.752	RTT	107.50
	17	1.110	1.110	2.353	2.349	1.110	1.129	2.351	2.391	0.750	RTT	99.25
SCHUMACHER KRW 7052 (USED)	1	1.165	1.163	2.347	2.342	1.164	1.184	2.345	2.384	0.753	RTT	94.25
	5	1.159	1.162	2.342	2.341	1.161	1.180	2.342	2.381	0.759	RTT	96.75
	9	1.139	1.144	2.346	2.349	1.142	1.161	2.348	2.387	0.756	RTT	110.75
	13	1.122	1.124	2.349	2.352	1.123	1.142	2.351	2.390	0.752	RTT	101.75
	17	1.112	1.110	2.348	2.348	1.111	1.130	2.348	2.388	0.759	RTT	94.25
SCHUMACHER SOLAR (UNUSED) 980 C	T3	1.167	1.177	2.325	2.317	1.172	1.192	2.321	2.360	0.744	HTT	20.50
	T14	1.161	1.172	2.352	2.354	1.167	1.186	2.353	2.393	0.750	HTT	24.00
	T18	1.139	1.142	2.330	2.315	1.141	1.160	2.323	2.362	0.771	HTT	24.75
	B4	1.129	1.116	2.341	2.315	1.123	1.142	2.328	2.367	0.752	HTT	25.50
	B8	1.127	1.122	2.330	2.312	1.125	1.144	2.321	2.360	0.743	HTT	22.50
SCHUMACHER SOLAR (USED) 980 C	3	1.188	1.193	2.368	2.355	1.191	1.211	2.362	2.402	0.796	HTT	20.75
	7	1.181	1.180	2.362	2.345	1.181	1.201	2.354	2.393	0.786	HTT	15.50
	11	1.157	1.159	2.360	2.349	1.158	1.178	2.355	2.394	0.795	HTT	25.00
	15	1.155	1.154	2.361	2.345	1.155	1.174	2.353	2.393	0.798	HTT	22.00
	19	1.111	1.111	2.344	2.369	1.111	1.130	2.357	2.396	0.797	HTT	14.75
SCHUMACHER (UNUSED) 870C	2	1.179	1.185	2.365	2.369	1.182	1.202	2.367	2.407	0.748	HTT	45.50
	4	1.184	1.179	2.362	2.364	1.182	1.202	2.363	2.403	0.761	HTT	42.25
	6	1.164	1.177	2.360	2.355	1.171	1.190	2.358	2.397	0.763	HTT	45.25
	8	1.160	1.155	2.362	2.359	1.158	1.177	2.361	2.401	0.760	HTT	44.50
	10	1.142	1.145	2.342	2.342	1.144	1.163	2.342	2.382	0.720	HTT	49.50
SCHUMACHER 5000 PULSES @ 0.5 sec 870 C	2	1.100	1.100	2.330	2.356	1.100	1.119	2.343	2.383	0.755	HTT	43.25
	4	1.097	1.080	2.332	2.349	1.089	1.107	2.341	2.380	0.723	HTT	41.25
IFP LAYCER-DOE (USED) 870 C	4	1.530	1.522	2.302	2.293	1.526	1.552	2.298	2.336	0.750	HTT	26.75
	8	1.520	1.511	2.310	2.303	1.516	1.541	2.307	2.346	0.760	HTT	21.50
	12	1.499	1.507	2.296	2.304	1.503	1.528	2.300	2.339	0.760	HTT	24.50
	16	1.488	1.500	2.300	2.314	1.494	1.519	2.307	2.346	0.772	HTT	31.50
	22	1.435	1.440	2.291	2.298	1.438	1.462	2.295	2.333	0.752	HTT	45.25
IFP LAYCER (UNUSED) 870 C	3	1.566	1.569	2.321	2.321	1.568	1.594	2.321	2.360	0.755	HTT	30.00
	5	1.543	1.563	2.316	2.314	1.553	1.579	2.315	2.354	0.745	HTT	31.00
	7	1.563	1.559	2.320	2.316	1.561	1.587	2.318	2.357	0.759	HTT	38.25

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SPECIMEN	SPECIMEN TEST NUMBER		Ri (in.)	Ro (in.)	w (in)	R=Ri(T) R=Ro(C)	STRESS (psi)	STRESS (MPa)		STRESS (psi)	STRESS (MPa)
	11	RTT	0.79	1.18	0.76	0.79	1988	13.70			
IFP LAYCER	2	RTT	0.77	1.19	0.76	0.77	2804	19.33	MAX=	2928	20.19
1000 PULSES	3	RTT	0.78	1.19	0.77	0.78	2461	16.97	MIN=	2461	16.97
@0.05 sec	4	RTT	0.78	1.20	0.76	0.78	2553	17.60	AVE=	2707	18.66
	5	RTT	0.78	1.19	0.76	0.78	2788	19.22	STD=	173	1.19
	6	RTT	0.78	1.19	0.76	0.78	2928	20.19			
IFP LAYCER-DOE (USED)	3	RTT	0.77	1.17	0.78	0.77	1867	12.87	MAX=	2488	17.15
	7	RTT	0.77	1.17	0.75	0.77	1557	10.73	MIN=	1274	8.79
	11	RTT	0.76	1.17	0.76	0.76	1274	8.79	AVE=	1726	11.90
	15	RTT	0.76	1.17	0.78	0.76	1446	9.97	STD=	427	2.94
	21	RTT	0.73	1.17	0.75	0.73	2488	17.15			
	1	RTT	0.59	1.19	0.76	0.59	2659	18.33	MAX=	2821	19.45
SCHUMACHER	5	RTT	0.59	1.19	0.76	0.59	2580	17.79	MIN=	2521	17.38
KRW 7067	9	RTT	0.58	1.19	0.76	0.58	2547	17.56	AVE=	2626	18.10
(USED)	13	RTT	0.57	1.19	0.75	0.57	2821	19.45	STD=	108	0.74
	17	RTT	0.56	1.20	0.75	0.56	2521	17.38			
SCHUMACHER	1	RTT	0.59	1.19	0.75	0.59	2609	17.99	MAX=	2938	20.26
KRW 7052	5	RTT	0.59	1.19	0.76	0.59	2652	18.29	MIN=	2377	16.39
(USED)	9	RTT	0.58	1.19	0.76	0.58	2938	20.26	AVE=	2641	18.21
	13	RTT	0.57	1.20	0.75	0.57	2630	18.13	STD=	178	1.23
	17	RTT	0.56	1.19	0.76	0.56	2377	16.39			
SCHUMACHER	T3	HTT	0.60	1.18	0.74	0.60	599	4.13	MAX=	676	4.66
SOLAR (UNUSED)	T14	HTT	0.59	1.20	0.75	0.59	663	4.57	MIN=	599	4.13
980 C	T18	HTT	0.58	1.18	0.77	0.58	662	4.57	AVE=	642	4.43
	B4	HTT	0.57	1.18	0.75	0.57	676	4.66	STD=	31	0.21
	B8	HTT	0.57	1.18	0.74	0.57	610	4.21			
SCHUMACHER	3	HTT	0.61	1.20	0.80	0.61	555	3.83	MAX=	642	4.42
SOLAR (USED)	7	HTT	0.60	1.20	0.79	0.60	417	2.88	MIN=	351	2.42
980 C	11	HTT	0.59	1.20	0.80	0.59	642	4.42	AVE=	505	3.48
	15	HTT	0.59	1.20	0.80	0.59	560	3.86	STD=	106	0.73
	19	HTT	0.56	1.20	0.80	0.56	351	2.42			
SCHUMACHER	2	HTT	0.60	1.20	0.75	0.60	1269	8.75	MAX=	1392	9.60
(UNUSED)	4	HTT	0.60	1.20	0.76	0.60	1163	8.02	MIN=	1163	8.02
870C	6	HTT	0.60	1.20	0.76	0.60	1229	8.48	AVE=	1248	8.60
	8	HTT	0.59	1.20	0.76	0.59	1185	8.17	STD=	81	0.56
	10	HTT	0.58	1.19	0.72	0.58	1392	9.60			
SCHUMACHER	2	HTT	0.56	1.19	0.76	0.56	1085	7.48	AVE=	1075	7.41
5000 PULSES	4	HTT	0.55	1.19	0.72	0.55	1066	7.35	STD=	10	0.07
@ 0.5 sec											
870 C											
IFP LAYCER-DOE (USED)	4	HTT	0.78	1.17	0.75	0.78	1652	11.39	MAX=	2267	15.63
870 C	8	HTT	0.77	1.17	0.76	0.77	1252	8.64	MIN=	1252	8.64
	12	HTT	0.76	1.17	0.76	0.76	1402	9.67	AVE=	1657	11.43
	16	HTT	0.76	1.17	0.77	0.76	1712	11.81	STD=	348	2.40
	22	HTT	0.73	1.17	0.75	0.73	2267	15.63			
IFP LAYCER (UNUSED)	3	HTT	0.80	1.18	0.76	0.80	1946	13.42	MAX=	2631	18.14
870 C	5	HTT	0.79	1.18	0.75	0.79	1989	13.71	MIN=	1946	13.42
	7	HTT	0.79	1.18	0.76	0.79	2443	16.85	AVE=	2318	15.98

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SPECIMEN	SPECIMEN NUMBER	CORRECTED		CORRECTED		AVE. I.D. (in.)	I.D. (in.)	AVE. O.D. (in.)	O.D. (in.)	WIDTH (in.)	TEST	LOAD (lbs)
		I.D. 1 (in.)	I.D. 2 (in.)	O.D. 1 (in.)	O.D. 2 (in.)							
IFP LAYCER 5000 PULSES @0.5 sec 870 C	9	1.558	1.550	2.313	2.307	1.554	1.580	2.310	2.349	0.751	HTT	40.00
	11	1.545	1.544	2.304	2.300	1.545	1.571	2.302	2.341	0.754	HTT	41.25
	2	1.554	1.556	2.306	2.318	1.555	1.581	2.312	2.351	0.750	HTT	38.00
	4	1.542	1.561	2.309	2.317	1.552	1.578	2.313	2.352	0.739	HTT	37.50
	6	1.562	1.547	2.325	2.327	1.555	1.581	2.326	2.365	0.765	HTT	47.25
	8	1.553	1.560	2.322	2.330	1.557	1.583	2.326	2.365	0.759	HTT	39.25
	10	1.550	1.544	2.326	2.315	1.547	1.573	2.321	2.360	0.743	HTT	45.00
	2	1.165	1.158	2.350	2.350	1.162	1.181	2.350	2.390	0.773	HTT	131.75
SCHUMACHER KRW 7068	6	1.144	1.148	2.346	2.348	1.146	1.165	2.347	2.387	0.755	HTT	132.00
(UNUSED) 650 C	10	1.122	1.132	2.358	2.357	1.127	1.146	2.358	2.397	0.773	HTT	141.50
	13	1.120	1.112	2.361	2.359	1.116	1.135	2.360	2.400	0.768	HTT	144.75
	16	1.111	1.112	2.356	2.363	1.112	1.130	2.360	2.399	0.770	HTT	161.25
SCHUMACHER	2	1.163	1.155	2.345	2.341	1.159	1.179	2.343	2.383	0.760	HTT	102.00
KRW 7052	6	1.150	1.149	2.347	2.340	1.150	1.169	2.344	2.383	0.758	HTT	113.75
(USED) 650 C	10	1.128	1.137	2.348	2.344	1.133	1.152	2.346	2.386	0.758	HTT	105.25
	14	1.118	1.114	2.354	2.348	1.116	1.135	2.351	2.391	0.763	HTT	115.50
	18	1.110	1.113	2.349	2.348	1.112	1.130	2.349	2.388	0.768	HTT	108.75
SCHUMACHER	2	1.158	1.167	2.340	2.326	1.163	1.182	2.333	2.373	0.753	HTT	110.50
KRW 7067	6	1.148	1.145	2.341	2.330	1.147	1.166	2.336	2.375	0.760	HTT	112.25
(USED) 650 C	10	1.128	1.128	2.347	2.334	1.128	1.147	2.341	2.380	0.758	HTT	119.50
	14	1.108	1.116	2.349	2.341	1.112	1.131	2.345	2.385	0.764	HTT	119.25
	18	1.111	1.113	2.348	2.352	1.112	1.131	2.350	2.390	0.757	HTT	125.75
SCHUMACHER	T4	1.190	1.203	2.365	2.349	1.197	1.217	2.357	2.397	0.753	RTC	-48.00
SOLAR (UNUSED)	T15	1.165	1.173	2.353	2.343	1.169	1.189	2.348	2.388	0.780	RTC	-48.25
	T19	1.155	1.163	2.358	2.345	1.159	1.179	2.352	2.391	0.764	RTC	-53.50
	B5	1.143	1.132	2.354	2.337	1.138	1.157	2.346	2.385	0.754	RTC	-52.75
	B9	1.125	1.141	2.313	2.339	1.133	1.152	2.326	2.365	0.742	RTC	-45.00
SCHUMACHER	4	1.187	1.191	2.366	2.352	1.189	1.209	2.359	2.399	0.804	RTC	-22.75
SOLAR (USED)	8	1.170	1.176	2.366	2.352	1.173	1.193	2.359	2.399	0.785	RTC	-15.00
	12	1.150	1.159	2.366	2.355	1.155	1.174	2.361	2.401	0.795	RTC	-49.00
	16	1.150	1.155	2.364	2.354	1.153	1.172	2.359	2.399	0.793	RTC	-48.50
	20	1.110	1.105	2.345	2.332	1.108	1.126	2.339	2.378	0.790	RTC	-45.50
IFP LAYCER-DOE	9	1.516	1.512	2.305	2.306	1.514	1.540	2.306	2.345	0.759	RTC	-80.75
(USED)	13	1.500	1.503	2.302	2.308	1.502	1.527	2.305	2.344	0.752	RTC	-89.25
	17	1.493	1.493	2.303	2.303	1.493	1.518	2.303	2.342	0.782	RTC	-79.00
	23	1.434	1.441	2.292	2.299	1.438	1.462	2.296	2.334	0.760	RTC	-108.25
	27	1.422	1.420	2.292	2.291	1.421	1.445	2.292	2.330	0.732	RTC	-99.00
SCHUMACHER	3	1.158	1.163	2.342	2.347	1.161	1.180	2.345	2.384	0.761	RTC	-227.50
KRW 7068	7	1.138	1.146	2.347	2.350	1.142	1.161	2.349	2.388	0.780	RTC	-236.75
(UNUSED)	11	1.113	1.120	2.349	2.351	1.117	1.135	2.350	2.390	0.773	RTC	-252.50
	14	1.116	1.111	2.363	2.362	1.114	1.132	2.363	2.403	0.772	RTC	-262.00
	17	1.110	1.111	2.357	2.361	1.111	1.129	2.359	2.399	0.760	RTC	-282.50
SCHUMACHER	3	1.162	1.163	2.347	2.342	1.163	1.182	2.345	2.384	0.762	RTC	-169.00
KRW 7052	7	1.139	1.148	2.346	2.342	1.144	1.163	2.344	2.384	0.757	RTC	-194.25
(USED)	11	1.113	1.130	2.350	2.347	1.122	1.141	2.349	2.388	0.761	RTC	-191.75
	15	1.107	1.107	2.348	2.348	1.107	1.126	2.348	2.388	0.766	RTC	-214.25
	19	1.113	1.111	2.354	2.354	1.112	1.131	2.354	2.394	0.760	RTC	-260.50
SCHUMACHER	3	1.161	1.160	2.337	2.325	1.161	1.180	2.331	2.371	0.754	RTC	-225.25
KRW 7067	7	1.150	1.155	2.343	2.336	1.153	1.172	2.340	2.379	0.759	RTC	-225.75

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SPECIMEN	SPECIMEN TEST NUMBER	TEST	Ri (in.)	Ro (in.)	w (in)	R=Ri(T) R=Ro(C)	STRESS (psi)	STRESS (MPa)	STRESS (psi)	STRESS (MPa)
	9	HTT	0.79	1.17	0.75	0.79	-2580	17.79	STD=	293 2.02
	11	HTT	0.79	1.17	0.75	0.79	2631	18.14		
IFP LAYCER	2	HTT	0.79	1.18	0.75	0.79	2450	16.89	MAX=	2895 19.96
5000 PULSES	4	HTT	0.79	1.18	0.74	0.79	2427	16.73	MIN=	2427 16.73
@0.5 sec	6	HTT	0.79	1.18	0.77	0.79	2895	19.96	AVE=	2605 17.96
870 C	8	HTT	0.79	1.18	0.76	0.79	2436	16.80	STD=	207 1.42
	10	HTT	0.79	1.18	0.74	0.79	2818	19.43		
SCHUMACHER	2	HTT	0.59	1.19	0.77	0.59	3516	24.24	MAX=	3961 27.31
KRW 7068	6	HTT	0.58	1.19	0.76	0.58	3533	24.36	MIN=	3516 24.24
(UNUSED) 650 C	10	HTT	0.57	1.20	0.77	0.57	3550	24.48	AVE=	3629 25.02
	13	HTT	0.57	1.20	0.77	0.57	3586	24.73	STD=	167 1.15
	16	HTT	0.57	1.20	0.77	0.57	3961	27.31		
SCHUMACHER	2	HTT	0.59	1.19	0.76	0.59	2781	19.17	MAX=	3062 21.11
KRW 7052	6	HTT	0.58	1.19	0.76	0.58	3062	21.11	MIN=	2711 18.69
(USED) 650 C	10	HTT	0.58	1.19	0.76	0.58	2752	18.97	AVE=	2843 19.60
	14	HTT	0.57	1.20	0.76	0.57	2910	20.06	STD=	128 0.88
	18	HTT	0.57	1.19	0.77	0.57	2711	18.69		
SCHUMACHER	2	HTT	0.59	1.19	0.75	0.59	3095	21.34	MAX=	3178 21.91
KRW 7067	6	HTT	0.58	1.19	0.76	0.58	3028	20.88	MIN=	3003 20.70
(USED) 650 C	10	HTT	0.57	1.19	0.76	0.57	3123	21.53	AVE=	3085 21.27
	14	HTT	0.57	1.19	0.76	0.57	3003	20.70	STD=	63 0.44
	18	HTT	0.57	1.19	0.76	0.57	3178	21.91		
SCHUMACHER	T4	RTC	0.61	1.20	0.75	1.20	700	4.82	MAX=	708 4.88
SOLAR (UNUSED)	T15	RTC	0.59	1.19	0.78	1.19	644	4.44	MIN=	600 4.14
	T19	RTC	0.59	1.20	0.76	1.20	708	4.88	AVE=	666 4.59
	B5	RTC	0.58	1.19	0.75	1.19	678	4.67	STD=	40 0.27
	B9	RTC	0.58	1.18	0.74	1.18	600	4.14		
SCHUMACHER	4	RTC	0.60	1.20	0.80	1.20	304	2.10	MAX=	607 4.19
SOLAR (USED)	8	RTC	0.60	1.20	0.79	1.20	197	1.36	MIN=	197 1.36
	12	RTC	0.59	1.20	0.80	1.20	607	4.19	AVE=	447 3.08
	16	RTC	0.59	1.20	0.79	1.20	601	4.15	STD=	166 1.15
	20	RTC	0.56	1.19	0.79	1.19	525	3.62		
IFP LAYCER-DOE	9	RTC	0.77	1.17	0.76	1.17	3088	21.29	MAX=	3354 23.13
(USED)	13	RTC	0.76	1.17	0.75	1.17	3317	22.87	MIN=	2764 19.06
	17	RTC	0.76	1.17	0.78	1.17	2764	19.06	AVE=	3117 21.49
	23	RTC	0.73	1.17	0.76	1.17	3354	23.13	STD=	212 1.46
	27	RTC	0.72	1.17	0.73	1.17	3062	21.11		
SCHUMACHER	3	RTC	0.59	1.19	0.76	1.19	3068	21.15	MAX=	3306 22.80
KRW 7068	7	RTC	0.58	1.19	0.78	1.19	2959	20.40	MIN=	2959 20.40
(UNUSED)	11	RTC	0.57	1.19	0.77	1.19	2989	20.61	AVE=	3069 21.16
	14	RTC	0.57	1.20	0.77	1.20	3024	20.85	STD=	124 0.86
	17	RTC	0.56	1.20	0.76	1.20	3306	22.80		
SCHUMACHER	3	RTC	0.59	1.19	0.76	1.19	2287	15.77	MAX=	3083 21.26
KRW 7052	7	RTC	0.58	1.19	0.76	1.19	2529	17.44	MIN=	2287 15.77
(USED)	11	RTC	0.57	1.19	0.76	1.19	2339	16.12	AVE=	2549 17.58
	15	RTC	0.56	1.19	0.77	1.19	2510	17.30	STD=	283 1.95
	19	RTC	0.57	1.20	0.76	1.20	3083	21.26		
SCHUMACHER	3	RTC	0.59	1.19	0.75	1.19	3134	21.61	MAX=	3206 22.11
KRW 7067	7	RTC	0.59	1.19	0.76	1.19	3018	20.81	MIN=	2830 19.51

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SPECIMEN	SPECIMEN NUMBER	I.D. 1 (in.)	I.D. 2 (in.)	O.D. 1 (in.)	O.D. 2 (in.)	CORRECTED		CORRECTED		WIDTH (in.)	TEST	LOAD (lbs)
						AVE. I.D. (in.)	I.D. (in.)	AVE. O.D. (in.)	O.D. (in.)			
(USED)	11	1.125	1.125	2.346	2.340	1.125	1.144	2.343	2.383	0.767	RTC	-260.50
	15	1.108	1.104	2.345	2.341	1.106	1.125	2.343	2.383	0.761	RTC	-238.75
	19	1.102	1.110	2.362	2.355	1.106	1.125	2.359	2.398	0.760	RTC	-250.25
SCHUMACHER	T5	1.191	1.197	2.369	2.355	1.194	1.214	2.362	2.402	0.748	HTC	-39.00
SOLAR (UNUSED)	T16	1.162	1.167	2.354	2.344	1.165	1.184	2.349	2.389	0.748	HTC	-36.50
980 C	T20	1.155	1.156	2.342	2.348	1.156	1.175	2.345	2.385	0.754	HTC	-36.50
	B10	1.141	1.160	2.333	2.355	1.151	1.170	2.344	2.384	0.752	HTC	-40.25
	B2	1.140	1.135	2.352	2.323	1.138	1.157	2.338	2.377	0.743	HTC	-37.00
SCHUMACHER	5	1.173	1.190	2.373	2.362	1.182	1.202	2.368	2.408	0.808	HTC	-30.75
SOLAR (USED)	9	1.168	1.150	2.332	2.327	1.159	1.179	2.330	2.369	0.803	HTC	-26.75
980 C	13	1.138	1.132	2.347	2.332	1.135	1.154	2.340	2.379	0.803	HTC	-31.75
	17	1.146	1.156	2.341	2.354	1.151	1.171	2.348	2.387	0.775	HTC	-24.75
	21	1.108	1.109	2.342	2.360	1.109	1.127	2.351	2.391	0.790	HTC	-34.50
IFP LAYCER-DOE	6	1.525	1.513	2.300	2.289	1.519	1.545	2.295	2.333	0.745	HTC	-69.50
(USED)	10	1.501	1.511	2.298	2.303	1.506	1.532	2.301	2.339	0.762	HTC	-73.25
870 C	14	1.492	1.500	2.301	2.305	1.496	1.521	2.303	2.342	0.763	HTC	-59.00
	20	1.434	1.444	2.293	2.298	1.439	1.463	2.296	2.334	0.759	HTC	-83.00
	24	1.429	1.443	2.308	2.311	1.436	1.460	2.310	2.349	0.773	HTC	-89.75
SCHUMACHER	4	1.147	1.143	2.342	2.346	1.145	1.164	2.344	2.384	0.759	HTC	-268.00
KRW 7068	8	1.136	1.134	2.355	2.352	1.135	1.154	2.354	2.393	0.747	HTC	-304.00
(UNUSED) 650 C												
SCHUMACHER	4	1.158	1.158	2.343	2.342	1.158	1.178	2.343	2.382	0.751	HTC	-181.50
KRW 7052	8	1.140	1.147	2.355	2.342	1.144	1.163	2.349	2.388	0.760	HTC	-206.75
(USED) 650 C	12	1.130	1.133	2.349	2.346	1.132	1.151	2.348	2.387	0.759	HTC	-238.00
	16	1.113	1.111	2.352	2.348	1.112	1.131	2.350	2.390	0.768	HTC	-241.00
SCHUMACHER	4	1.168	1.169	2.331	2.338	1.169	1.188	2.335	2.374	0.759	HTC	-223.25
KRW 7067	8	1.143	1.142	2.343	2.338	1.143	1.162	2.341	2.380	0.763	HTC	-247.50
(USED) 650 C	12	1.129	1.131	2.335	2.337	1.130	1.149	2.336	2.376	0.773	HTC	-250.25
	16	1.108	1.111	2.346	2.341	1.110	1.128	2.344	2.383	0.764	HTC	-246.25
EXTRA TESTING =====												
SCHUMACHER	T9	1.158	1.162	2.314	2.324	1.160	1.180	2.319	2.358	0.736	RTT(E)	27.00
SOLAR (UNUSED)												
IFP LAYCER	12	1.565	1.582	2.328	2.335	1.574	1.600	2.332	2.371	0.786	RTT(E)	45.00
(UNUSED)												
SCHUMACHER	B13 870	1.146	1.128	2.348	2.319	1.137	1.156	2.334	2.373	0.748	HTT(E)	34.25
SOLAR (UNUSED)	B14 870	1.146	1.125	2.353	2.320	1.136	1.155	2.337	2.376	0.726	HTT(E)	30.75
	B15 870	1.128	1.144	2.344	2.316	1.136	1.155	2.330	2.369	0.744	HTT(E)	28.50

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SPECIMEN	SPECIMEN TEST NUMBER		Ri (in.)	Ro (in.)	w (in)	R=Ri(T) R=Ro(C)	STRESS (psi)	STRESS (MPa)		STRESS (psi)	STRESS (MPa)
(USED)	11	RTC	0.57	1.19	0.77	1.19	3206	22.11	AVE=	3018	20.81
	15	RTC	0.56	1.19	0.76	1.19	2830	19.51	STD=	140	0.97
	19	RTC	0.56	1.20	0.76	1.20	2900	20.00			
SCHUMACHER	T5	HTC	0.61	1.20	0.75	1.20	564	3.89	MAX=	564	3.89
SOLAR (UNUSED)	T16	HTC	0.59	1.19	0.75	1.19	502	3.46	MIN=	489	3.37
980 C	T20	HTC	0.59	1.19	0.75	1.19	490	3.38	AVE=	516	3.56
	B10	HTC	0.58	1.19	0.75	1.19	536	3.70	STD=	29	0.20
	B2	HTC	0.58	1.19	0.74	1.19	489	3.37			
SCHUMACHER	5	HTC	0.60	1.20	0.81	1.20	396	2.73	MAX=	396	2.73
SOLAR (USED)	9	HTC	0.59	1.18	0.80	1.18	349	2.41	MIN=	319	2.20
980 C	13	HTC	0.58	1.19	0.80	1.19	385	2.65	AVE=	368	2.54
	17	HTC	0.59	1.19	0.78	1.19	319	2.20	STD=	30	0.20
	21	HTC	0.56	1.20	0.79	1.20	391	2.70			
IFP LAYCER-DOE	6	HTC	0.77	1.17	0.75	1.17	2828	19.50	MAX=	2828	19.50
(USED)	10	HTC	0.77	1.17	0.76	1.17	2755	19.00	MIN=	2135	14.72
870 C	14	HTC	0.76	1.17	0.76	1.17	2135	14.72	AVE=	2589	17.85
	20	HTC	0.73	1.17	0.76	1.17	2587	17.84	STD=	242	1.67
	24	HTC	0.73	1.17	0.77	1.17	2637	18.18			
SCHUMACHER	4	HTC	0.58	1.19	0.76	1.19	3492	24.08	AVE=	3681	25.38
KRW 7068	8	HTC	0.58	1.20	0.75	1.20	3870	26.69	STD=	189	1
(UNUSED) 650 C											
SCHUMACHER	4	HTC	0.59	1.19	0.75	1.19	2473	17.05	MAX=	2986	20.58
KRW 7052	8	HTC	0.58	1.19	0.76	1.19	2662	18.35	MIN=	2473	17.05
(USED) 650 C	12	HTC	0.58	1.19	0.76	1.19	2986	20.58	AVE=	2740	18.89
	16	HTC	0.57	1.19	0.77	1.19	2840	19.58	STD=	192	1.33
SCHUMACHER	4	HTC	0.59	1.19	0.76	1.19	3129	21.57	MAX=	3207	22.11
KRW 7067	8	HTC	0.58	1.19	0.76	1.19	3207	22.11	MIN=	2930	20.20
(USED) 650 C	12	HTC	0.57	1.19	0.77	1.19	3128	21.57	AVE=	3098	21.36
	16	HTC	0.56	1.19	0.76	1.19	2930	20.20	STD=	103	0.71

EXTRA TESTING =====

SCHUMACHER	T9	RTT(E	0.59	1.18	0.74	0.59	784	5.40			
SOLAR (UNUSED)											
IFP LAYCER	12	RTT(E	0.80	1.19	0.79	0.80	2784	19.20			
(UNUSED)											
SCHUMACHER	B13	870HTT(E	0.58	1.19	0.75	0.58	927	6.39	AVG=	853	5.88
SOLAR (UNUSED)	B14	870HTT(E	0.58	1.19	0.73	0.58	853	5.88	STD=	61	0.42
	B15	870HTT(E	0.58	1.18	0.74	0.58	778	5.36			

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SPECIMEN	SPECIMEN NUMBER	CORRECTED			CORRECTED			WIDTH	TEST	LOAD
		I.D. 1 (in.)	I.D. 2 (in.)	O.D. 1 (in.)	O.D. 2 (in.)	AVE. I.D. (in.)	I.D. (in.)	AVE. O.D. (in.)	O.D. (in.)	
	B22 925	1.135	1.157	2.312	2.341	1.146	1.165	2.327	2.366	0.736 HTT(E 35.00
	B23 900	1.165	1.167	2.349	2.368	1.166	1.186	2.359	2.398	0.785 HTT(E 35.75
	B11 910	1.126	1.139	2.313	2.335	1.133	1.152	2.324	2.363	0.751 HTT(E 36.75
	B12 920	1.147	1.155	2.339	2.358	1.151	1.171	2.349	2.388	0.743 HTT(E 35.75
	T21 925	1.151	1.161	2.358	2.342	1.156	1.176	2.350	2.390	0.750 HTT(E 38.50
	T23 950	1.131	1.133	2.338	2.317	1.132	1.151	2.328	2.367	0.725 HTT(E 28.25
	T22 980	1.147	1.150	2.358	2.345	1.149	1.168	2.352	2.391	0.756 HTT(E 21.75
DIDIER UNUSED	1 980	1.511	1.505	2.354	2.346	1.508	1.534	2.350	2.390	0.776 HTT(E 14.00
IFP LAY UNUSED	1 980	1.578	1.576	2.311	2.308	1.577	1.604	2.310	2.349	0.761 HTT(E 14.75

05/20/91

SPECIMEN	SPECIMEN TEST NUMBER	Ri (in.)	Ro (in.)	w (in)	R=Ri(T) R=Ro(C)	STRESS (psi)	STRESS (MPa)	STRESS (psi)	STRESS (MPa)
	B22 925HTT(E	0.58	1.18	0.74	0.58	985	6.79		
	B23 900HTT(E	0.59	1.20	0.79	0.59	936	6.46		
	B11 910HTT(E	0.58	1.18	0.75	0.58	995	6.86		
	B12 920HTT(E	0.59	1.19	0.74	0.59	978	6.74		
	T21 925HTT(E	0.59	1.19	0.75	0.59	1050	7.24		
	T23 950HTT(E	0.58	1.18	0.73	0.58	789	5.44		
	T22 980HTT(E	0.58	1.20	0.76	0.58	581	4.00		
DIDIER UNUSED	1 980HTT(E	0.77	1.19	0.78	0.77	720	4.96		
IFP LAY UNUSED	1 980HTT(E	0.80	1.17	0.76	0.80	999	6.89		

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APPENDIX D
C-RING TESTING DATA

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05/01/93
schvrywd

VARYING WIDTH TESTS OF SCHUMACHER

	SPECIMEN NUMBER	ID 1 in.	ID 2 in.	OD 1 in.	OD 2 in.	WIDTH in.	TEST	ABS LOAD lb	LOAD lb	-----FERBER EQUATION----- STRESS psi	STRESS MPa		Small Sample Standard Deviation
SCHUMACHER F40 (FROM SOLAR) VARY WIDTHS UNUSED 0.75" Compression @980°C	5	1.137	1.166	2.340	2.376	0.744	HTC	30.5	-30.5	410	2.82	Ave MPa= 3.44	
	13	1.136	1.150	2.371	2.334	0.753	HTC	41	-41	538	3.71	STD = 0.31	0.35
	21	1.110	1.105	2.378	2.333	0.792	HTC	45	-45	513	3.54		
	29	1.096	1.092	2.385	2.365	0.771	HTC	47	-47	518	3.57	Ave Width 0.770	
	35	1.095	1.091	2.364	2.386	0.791	HTC	48	-48	514	3.55	STD = 0.019	0.022
SCHUMACHER F40 (FROM SOLAR) VARY WIDTHS UNUSED 0.50" Compression @980°C	6	1.150	1.132	2.346	2.353	0.480	HTC	21	-21	432	2.98	Ave MPa= 3.28	
	14	1.148	1.164	2.370	2.335	0.503	HTC	22	-22	446	3.07	STD = 0.39	0.43
	22	1.124	1.112	2.376	2.330	0.500	HTC	28.5	-28.5	530	3.65		
	30	1.101	1.106	2.386	2.340	0.530	HTC	25	-25	417	2.88	Ave Width 0.505	
	36	1.102	1.105	2.390	2.363	0.514	HTC	33	-33	556	3.84	STD = 0.016	0.018
SCHUMACHER F40 (FROM SOLAR) VARY WIDTHS UNUSED 0.75" Compression @870°C	7	1.166	1.147	2.377	2.348	0.733	HTC	59.5	-59.5	815	5.62	Ave MPa= 5.68	
	15	1.142	1.336	2.343	2.382	0.744	HTC	54.5	-54.5	899	6.20	STD = 0.34	0.40
	23	1.134	1.130	2.384	2.345	0.743	HTC	64.5	-64.5	819	5.65		
	31	1.119	1.076	2.388	2.341	0.733	HTC	64	-64	760	5.24	Ave Width 0.738	
							HTC					STD = 0.005	0.006
SCHUMACHER F40 (FROM SOLAR) VARY WIDTHS UNUSED 0.50" Compression @870°C	8	1.142	1.108	2.368	2.329	0.495	HTC	21	-21	404	2.78	Ave MPa= 4.36	
	16	1.138	1.135	2.349	2.369	0.509	HTC	35	-35	662	4.56	STD = 0.95	1.10
	24	1.113	1.109	2.330	2.354	0.519	HTC	38.5	-38.5	690	4.76		
	32	1.102	1.106	2.341	2.379	0.518	HTC	45	-45	773	5.33	Ave Width 0.510	
							HTC					STD = 0.010	0.011
							RTT		0	ERR	ERR	Ave MPa= ERR	
							RTT		0	ERR	ERR	STD = ERR	ERR
							RTT		0	ERR	ERR		
							RTT		0	ERR	ERR	Ave Width ERR	
							RTT		0	ERR	ERR	STD = ERR	ERR
							RTT		0	ERR	ERR	Ave MPa= ERR	
							RTT		0	ERR	ERR	STD = ERR	ERR
							RTT		0	ERR	ERR		
							RTT		0	ERR	ERR	Ave Width ERR	
							RTT		0	ERR	ERR	STD = ERR	ERR

05/01/93
schvrywd

VARYING WIDTH TESTS OF SCHUMACHER

	SPECIMEN NUMBER	ID 1 in.	ID 2 in.	OD 1 in.	OD 2 in.	WIDTH in.	TEST	ABS LOAD lb	LOAD lb	-----FERBER EQUATION----- STRESS psi	STRESS MPa		Small Sample Standard Deviation
SCHUMACHER F40 (FROM SOLAR) VARY WIDTHS UNUSED 0.75" Tension @980°C	1	1.145	1.151	2.351	2.331	0.788	HTT	20	20	527	3.63	Ave MPa= 4.60	
	9	1.120	1.131	2.354	2.332	0.768	HTT	22	22	573	3.95	STD = 1.52	1.75
	17	1.470	1.183	2.369	2.341	0.791	HTT	30	30	1047	7.22		
	25	1.200	1.111	2.335	2.383	0.789	HTT	20	20	521	3.59	Ave Width 0.778	
	33	1.090	1.103	2.368	2.346	0.752	HTT		BROKE	DURING	INST.	STD = 0.015	0.018
SCHUMACHER F40 (FROM SOLAR) VARY WIDTHS UNUSED 0.50" Tension @980°C	2	1.164	1.134	2.390	2.348	0.509	HTT	14.5	14.5	573	3.95	Ave MPa= 4.32	
	10	1.160	1.121	2.388	2.353	0.511	HTT	17.5	17.5	679	4.68	STD = 0.40	0.46
	18	1.128	1.122	2.367	2.329	0.492	HTT	17	17	687	4.74		
	26	1.214	1.091	2.361	2.343	0.512	HTT	14	14	564	3.89	Ave Width 0.511	
	34	1.102	1.095	2.385	2.236	0.530	HTT		BROKE	DURING	INST.	STD = 0.012	0.014
SCHUMACHER F40 (FROM SOLAR) VARY WIDTHS UNUSED 0.75" Tension @870°C	3	1.165	1.143	2.362	2.337	0.743	HTT	34	34	949	6.55	Ave MPa= 6.74	
	11	1.162	1.142	2.331	2.372	0.758	HTT	37	37	1007	6.94	STD = 0.60	0.69
	19	1.122	1.119	2.378	2.356	0.755	HTT	33.5	33.5	858	5.91		
	27	1.223	1.191	2.387	2.342	0.757	HTT	37.5	37.5	1097	7.57	Ave Width 0.753	
							HTT					STD = 0.006	0.007
SCHUMACHER F40 (FROM SOLAR) VARY WIDTHS UNUSED 0.50" Tension @870°C	4	1.135	1.143	2.335	2.341	0.495	HTT	20.5	20.5	851	5.87	Ave MPa= 6.11	
	12	1.136	1.142	2.345	2.330	0.518	HTT	21	21	833	5.75	STD = 0.31	0.36
	20	1.128	1.137	2.386	2.372	0.505	HTT	24	24	922	6.36		
	28	1.127	1.102	2.397	2.341	0.520	HTT	25.5	25.5	937	6.46	Ave Width 0.510	
							HTT					STD = 0.010	0.012
							RTC		0	ERR	ERR	Ave MPa= ERR	
							RTC		0	ERR	ERR	STD = ERR	ERR
							RTC		0	ERR	ERR		
							RTC		0	ERR	ERR	Ave Width ERR	
							RTC		0	ERR	ERR	STD = ERR	ERR
							RTC		0	ERR	ERR	Ave MPa= ERR	
							RTC		0	ERR	ERR	STD = ERR	ERR
							RTC		0	ERR	ERR		
							RTC		0	ERR	ERR	Ave Width ERR	
							RTC		0	ERR	ERR	STD = ERR	ERR

02/25/93

505vrywd

VARYING WIDTH TESTS FROM 0.50" TO 1.25"

	SPECIMEN NUMBER	ID 1 in.	ID 2 in.	OD 1 in.	OD 2 in.	WIDTH in.	TEST	ABS LOAD lb	LOAD lb	-----FERBER EQUATION----- STRESS psi	STRESS MPa		Small Sample Standard Deviation
REFRACTRON 50/5 WITH 505 BINDER VARY WIDTHS 0.50" UNUSED #8	2	1.593	1.581	2.347	2.337	0.508	RTT	20.2	20.2	1990	13.72	Ave MPa= 14.47	
	13	1.563	1.559	2.337	2.343	0.482	RTT	21.7	21.7	2118	14.60	STD = 1.40	1.57
	23	1.575	1.579	2.368	2.377	0.475	RTT	18.4	18.4	1772	12.22		
	33	1.568	1.573	2.364	2.370	0.510	RTT	26.3	26.3	2348	16.19	Ave Width 0.490	
	43	1.534	1.532	2.339	2.342	0.475	RTT	24.5	24.5	2262	15.59	STD = 0.016	0.018
REFRACTRON 50/5 WITH 505 BINDER VARY WIDTHS 0.75" UNUSED #8	3	1.583	1.591	2.343	2.352	0.740	RTT	30.4	30.4	2032	14.01	Ave MPa= 15.25	
	14	1.570	1.562	2.350	2.346	0.742	RTT	32.7	32.7	2064	14.23	STD = 1.19	1.34
	24	1.541	1.545	2.334	2.334	0.743	RTT	35.5	35.5	2176	15.00		
	34	1.543	1.533	2.339	2.332	0.739	RTT	41.4	41.4	2512	17.32	Ave Width 0.741	
	44	1.550	1.544	2.349	2.349	0.740	RTT	37.8	37.8	2278	15.71	STD = 0.001	0.002
REFRACTRON 50/5 WITH 505 BINDER VARY WIDTHS 1.00" UNUSED #8	5	1.558	1.560	2.320	2.321	1.121	RTT	49.5	49.5	2154	14.85	Ave MPa= 15.46	
	15	1.559	1.559	2.342	2.342	1.001	RTT	47.0	47	2188	15.09	STD = 0.98	1.09
	25	1.545	1.545	2.335	2.335	0.990	RTT	50.4	50.4	2325	16.03		
	35	1.546	1.533	2.337	2.330	1.019	RTT	46.7	46.7	2071	14.28	Ave Width 1.026	
	45	1.529	1.533	2.330	2.334	1.001	RTT	55.8	55.8	2475	17.06	STD = 0.048	0.054
REFRACTRON 50/5 WITH 505 BINDER VARY WIDTHS 1.25" UNUSED #8	6	1.557	1.564	2.321	2.332	1.277	RTT	62.7	62.7	2374	16.37	Ave MPa= 15.97	
	16	1.570	1.577	2.358	2.364	1.254	RTT	56.9	56.9	2107	14.53	STD = 0.98	1.10
	26	1.571	1.560	2.367	2.356	1.288	RTT	62.0	62	2190	15.10		
	36	1.559	1.553	2.356	2.351	1.259	RTT	69.0	69	2476	17.07	Ave Width 1.267	
	46	1.530	1.539	2.334	2.344	1.256	RTT	69.2	69.2	2432	16.77	STD = 0.013	0.015
REFRACTRON 50/5 WITH 505 BINDER HEAT TREATED TO 980°C (0.50") UNUSED #8	1	1.571	1.571	2.322	2.323	0.490	RTT	18.4	18.4	1882	12.97	Ave MPa= 12.91	
	12	1.562	1.570	2.340	2.347	0.513	RTT	19.3	19.3	1779	12.26	STD = 0.46	0.51
	22	1.567	1.575	2.359	2.368	0.495	RTT	19.6	19.6	1818	12.54		
	32	1.534	1.539	2.332	2.341	0.493	RTT	21.3	21.3	1926	13.28	Ave Width 0.491	
	42	1.533	1.532	2.337	2.337	0.464	RTT	20.6	20.6	1958	13.50	STD = 0.016	0.018
							RTT		0	0	0.00	Ave MPa= 0.00	
							RTT		0	0	0.00	STD = 0.00	0.00
							RTT		0	0	0.00		
							RTT		0	0	0.00	Ave Width 0.478	
							RTT		0	0	0.00	STD = 0.005	0.006

02/25/93

505vrywd

VARYING WIDTH TESTS FROM 0.50" TO 1.25"

	SPECIMEN NUMBER	ID 1 in.	ID 2 in.	OD 1 in.	OD 2 in.	WIDTH in.	TEST	ABS LOAD lb	LOAD lb	-----FERBER EQUATION-----		Small Sample Standard Deviation	
										STRESS psi	STRESS MPa		
REFRACTRON 50/5 WITH 505 BINDER VARY WIDTHS 0.50" UNUSED #8	8	1.558	1.553	2.323	2.319	0.481	RTC	40.7	-40.7	2739	18.88	Ave MPa= 19.20	
	18	1.580	1.577	2.369	2.368	0.499	RTC	44.3	-44.3	2739	18.89	STD = 0.57	0.64
	28	1.566	1.570	2.359	2.365	0.492	RTC	45.6	-45.6	2813	19.40		
	38	1.549	1.545	2.345	2.349	0.486	RTC	48.3	-48.3	2933	20.22	Ave Width 0.489	
	48	1.549	1.533	2.351	2.343	0.485	RTC	45.2	-45.2	2700	18.62	STD = 0.006	0.007
REFRACTRON 50/5 WITH 505 BINDER VARY WIDTHS 0.75" UNUSED #8	9	1.567	1.554	2.328	2.324	0.758	RTC	54.2	-54.2	2322	16.01	Ave MPa= 18.12	
	19	1.558	1.572	2.346	2.356	0.766	RTC	68.9	-68.9	2780	19.17	STD = 1.88	2.10
	29	1.564	1.553	2.355	2.347	0.769	RTC	71.1	-71.1	2800	19.31		
	39	1.550	1.552	2.351	2.354	0.736	RTC	57.0	-57	2283	15.74	Ave Width 0.754	
	49	1.518	1.517	2.325	2.323	0.742	RTC	76.9	-76.9	2955	20.37	STD = 0.013	0.015
REFRACTRON 50/5 WITH 505 BINDER VARY WIDTHS 1.00" UNUSED #8	10	1.599	1.592	2.371	2.366	1.022	RTC	85.9	-85.9	2735	18.86	Ave MPa= 17.87	
	20	1.553	1.548	2.340	2.337	1.021	RTC	75.6	-75.6	2256	15.56	STD = 1.51	1.69
	30	1.542	1.536	2.338	2.329	1.013	RTC	81.8	-81.8	2404	16.57		
	40	1.551	1.548	2.348	2.344	0.997	RTC	93.9	-93.9	2808	19.36	Ave Width 1.013	
	50	1.561	1.556	2.369	2.361	1.014	RTC	95.4	-95.4	2753	18.98	STD = 0.009	0.010
REFRACTRON 50/5 WITH 505 BINDER VARY WIDTHS 1.25" UNUSED #8	11	1.597	1.590	2.376	2.368	1.263	RTC	107.0	-107	2716	18.72	Ave MPa= 18.69	
	21	1.582	1.579	2.375	2.369	1.264	RTC	118.3	-118	2880	19.86	STD = 1.65	1.85
	31	1.565	1.554	2.362	2.350	1.265	RTC	98.9	-98.9	2346	16.17		
	41	1.551	1.550	2.351	2.351	1.246	RTC	108.6	-109	2575	17.75	Ave Width 1.259	
	51	1.510	1.519	2.311	2.327	1.258	RTC	133.6	-134	3037	20.94	STD = 0.007	0.008
REFRACTRON 50/5 WITH 505 BINDER HEAT TREATED TO 980°C (0.50") UNUSED #8	7	1.555	1.568	2.322	2.330	0.529	RTC	36.8	-36.8	2266	15.62	Ave MPa= 16.73	
	17	1.556	1.557	2.340	2.342	0.494	RTC	41.0	-41	2561	17.66	STD = 1.10	1.23
	27	1.573	1.568	2.370	2.363	0.501	RTC	38.0	-38	2294	15.82		
	37	1.539	1.549	2.341	2.346	0.474	RTC	37.6	-37.6	2340	16.13	Ave Width 0.495	
	47	1.524	1.519	2.327	2.323	0.479	RTC	44.4	-44.4	2669	18.40	STD = 0.019	0.022
							RTC		0	0	0.00	Ave MPa= 0.00	
							RTC		0	0	0.00	STD = 0.00	0.00
							RTC		0	0	0.00		
							RTC		0	0	0.00	Ave Width 0.478	
							RTC		0	0	0.00	STD = 0.005	0.006

VARYING WIDTH TESTS

[illegible]

VARYING WIDTH TESTS

[illegible]

05/01/93
703vrywd

UNUSED REFRACTRON 70/3 w/442-T BINDER

VARYING WIDTH TESTS

[illegible]

05/01/93
703vrywd

UNUSED REFRACTRON 70/3 w/442-T BINDER

VARYING WIDTH TESTS

	SPECIMEN NUMBER	ID 1 in.	ID 2 in.	OD 1 in.	OD 2 in.	WIDTH in.	TEST	ABS LOAD lb	LOAD lb	-----FERBER EQUATION-----		Small Sample STD
										STRESS psi	STRESS MPa	
REFRACTRON 70/3 WITH 442-T BINDER 980°C (1800°F) 0.50 inch Compression	8	1.548	1.568	2.319	2.337	0.485	HTC	16.5	-16.5	1090	7.52	Ave MPa= 8.61
	20	1.523	1.553	2.328	2.340	0.488	HTC	20.7	-20.7	1257	8.67	STD = 0.94
	32	1.552	1.534	2.358	2.332	0.490	HTC	21.0	-21.0	1256	8.66	
	44	1.529	1.535	2.358	2.339	0.484	HTC	19.8	-19.8	1149	7.92	Ave Width 0.486
	56	1.520	1.514	2.357	2.332	0.484	HTC	26.6	-26.6	1489	10.27	STD = 0.002
REFRACTRON 70/3 WITH 442-T BINDER 870°C (1600°F) 0.50 inch Compression	10	1.578	1.541	2.352	2.325	0.478	HTC	36.7	-36.7	2407	16.60	Ave MPa= 17.94
	22	1.563	1.525	2.333	2.350	0.477	HTC	44.3	-44.3	2753	18.98	STD = 0.80
	34	1.546	1.545	2.334	2.365	0.494	HTC	43.2	-43.2	2553	17.60	
	46	1.524	1.551	2.340	2.365	0.484	HTC	45.5	-45.5	2659	18.33	Ave Width 0.482
	58	1.537	1.521	2.334	2.346	0.477	HTC	44.3	-44.3	2638	18.19	STD = 0.007
REFRACTRON 70/3 WITH 442-T BINDER ROOM TEMP 0.50 inch Compression	12	1.546	1.577	2.319	2.326	0.464	RTC	44.0	-44.0	3117	21.49	Ave MPa= 19.42
	24	1.553	1.539	2.357	2.317	0.485	RTC	41.6	-41.6	2587	17.84	STD = 1.35
	36	1.541	1.518	2.348	2.330	0.483	RTC	48.7	-48.7	2875	19.83	
	48	1.509	1.515	2.328	2.362	0.497	RTC	48.8	-48.8	2617	18.05	Ave Width 0.481
	60	1.533	1.498	2.339	2.352	0.475	RTC	50.9	-50.9	2883	19.88	STD = 0.011
							HTC		0.0	ERR	ERR	Ave MPa= ERR
							HTC		0.0	ERR	ERR	STD = ERR
							HTC		0.0	ERR	ERR	
							HTC		0.0	ERR	ERR	Ave Width ERR
							HTC		0.0	ERR	ERR	STD = ERR
							RTT		0.0	ERR	ERR	Ave MPa= ERR
							RTT		0	ERR	ERR	STD = ERR
							RTT		0	ERR	ERR	
							RTT		0	ERR	ERR	Ave Width ERR
							RTT		0	ERR	ERR	STD = ERR

05/01/93
505htrt

REFRACTRON 50/5 w/505: HEAT TREATED UNUSED #11

>1 HOUR AT 1200°C

PRECUT A (1-5)	SPECIMEN NUMBER	ID 1	ID 2	OD 1	OD 2	WIDTH	TEST	ABS LOAD	LOAD	-----FERBER EQUATION-----		Small Sample STD	
POSTCUT A (6-12)		in.	in.	in.	in.	in.		lb	lb	STRESS psi	STRESS MPa		
PRECUT B (1-5)													
POSTCUT B (6-12)													
REFRACTRON 50/5	A1	1.536	1.534	2.362	2.344	0.729	RTT	30.9	30.9	1822	12.56	Ave MPa= 11.68	
WITH 505 BINDER	A3	1.507	1.523	2.346	2.348	0.741	RTT	31.2	31.2	1746	12.04	STD = 1.43	1.60
UNUSED (#11)	A5	1.545	1.515	2.346	2.360	0.746	RTT	31.0	31.0	1765	12.17		
PRECUT C-rings	B2	1.444	1.489	2.341	2.364	0.749	RTT	26.2	26.2	1286	8.87	Ave Width 0.744	
HEAT TO 1200°C	B4	1.543	1.515	2.344	2.351	0.754	RTT	32.6	32.6	1852	12.77	STD = 0.009	0.010
REFRACTRON 50/5	A6	1.538	1.542	2.361	2.359	0.755	RTT	33.4	33.4	1897	13.08	Ave MPa= 12.52	
WITH 505 BINDER	A8	1.530	1.537	2.360	2.367	0.740	RTT	34.2	34.2	1939	13.37	STD = 1.39	1.56
UNUSED (#11)	A10	1.535	1.528	2.362	2.352	0.756	RTT	34.6	34.6	1935	13.34		
HEAT TO 1200°C	B7	1.517	1.516	2.359	2.367	0.751	RTT	26.3	26.3	1413	9.74	Ave Width 0.751	
POSTCUT C-ring	B9	1.515	1.507	2.357	2.361	0.753	RTT	35.5	35.5	1893	13.05	STD = 0.006	0.006
REFRACTRON 50/5	A2	1.509	1.529	2.343	2.358	0.728	RTC	49.3	-49.3	1820	12.55	Ave MPa= 13.20	
WITH 505 BINDER	A4	1.537	1.545	2.354	2.346	0.743	RTC	54.3	-54.3	2102	14.49	STD = 0.73	0.81
UNUSED (#11)	B1	1.460	1.540	2.368	2.335	0.747	RTC	57.0	-57.0	1933	13.33		
PRECUT C-rings	B3	1.491	1.503	2.369	2.347	0.757	RTC	58.4	-58.4	1908	13.16	Ave Width 0.740	
HEAT TO 1200°C	B5	1.540	1.475	2.376	2.336	0.725	RTC	51.2	-51.2	1810	12.48	STD = 0.012	0.013
REFRACTRON 50/5	A7	1.518	1.528	2.353	2.357	0.741	RTC	52.1	-52.1	1892	13.04	Ave MPa= 15.46	
WITH 505 BINDER	A9	1.515	1.537	2.373	2.358	0.753	RTC	56.7	-56.7	1994	13.75	STD = 2.00	2.24
UNUSED (#11)	B6	1.533	1.544	2.348	2.364	0.759	RTC	59.7	-59.7	2213	15.26		
HEAT TO 1200°C	B8	1.528	1.539	2.353	2.362	0.739	RTC	64.6	-64.6	2413	16.64	Ave Width 0.748	
POSTCUT C-ring	B10	1.514	1.524	2.365	2.347	0.748	RTC	76.1	-76.1	2698	18.61	STD = 0.007	0.008
REFRACTRON 50/5	A11	1.513	1.526	2.357	2.356	0.700	HTT	45.6	45.6	2680	18.48	Ave MPa= 18.73	
w/505 (Unused #11)	A12	1.533	1.545	2.364	2.381	0.758	HTT	52.4	52.4	2886	19.90	STD = 0.69	0.80
HEAT TO 1200°C	B11	1.493	1.506	2.356	2.347	0.751	HTT	49.7	49.7	2625	18.10		
POSTCUT C-ring	B12	1.530	1.523	2.341	2.364	0.810	HTT	51.4	51.4	2675	18.44	Ave Width 0.755	
HTT at 980°C							HTT					STD = 0.039	0.045
REFRACTRON 50/5	1	1.499	1.565	2.314	2.373	0.477	RTT	Load cell off				Ave MPa= 20.02	
w/505 (Unused #11)	2	1.493	1.518	2.329	2.353	0.484	RTT	35.2	35.2	2984	20.58	STD = 0.96	1.11
Refractron heated	3	1.509	1.559	2.332	2.376	0.486	RTT	32.8	32.8	2888	19.91		
cut c-rngs 1200°C	4	1.513	1.518	2.322	2.370	0.479	RTT	35.2	35.2	3057	21.08	Ave Width 0.480	
POSTCUT C-ring	5	1.496	1.543	2.321	2.374	0.474	RTT	30.4	30.4	2685	18.52	STD = 0.004	0.005

[illegible]

	SPECIMEN	ID 1	ID 2	OD 1	OD 2	WIDTH	TEST	ABS LOAD	LOAD	-----FERBER EQUATION-----		Small Sample STD
	NUMBER	in.	in.	in.	in.	in.		lb	lb	STRESS psi	STRESS MPa	
SCHUMACHER TET CONTROL SAMPLE Heated to 870°C for 500 hours TENSION @ 870°C	2	1.175	1.187	2.381	2.376	0.508	HTT	25.4	25.4	1045	7.20	Ave MPa= 7.92
	4	1.176	1.172	2.381	2.385	0.489	HTT BROKE					STD = 0.71 1.01
	6	1.173	1.184	2.373	2.386	0.480	HTT	28.9	28.9	1252	8.63	
							HTT					Ave Width 0.492
							HTT					STD = 0.012 0.014
SCHUMACHER TET CONTROL SAMPLE Heated to 870°C for 500 hours COMPR. @ 870°C	1	1.137	1.153	2.388	2.381	0.504	HTC	25.2	-25.2	472	3.25	Ave MPa= 4.49
	3	1.200	1.173	2.394	2.368	0.490	HTC	39.7	-39.7	848	5.85	STD = 0.93 1.07
	5	1.177	1.181	2.380	2.378	0.473	HTC	30.7	-30.7	670	4.62	
	7	1.190	1.147	2.395	2.373	0.478	HTC	29.4	-29.4	614	4.23	Ave Width 0.486
							HTC					STD = 0.012 0.014
SCHUMACHER TET 100hr/870°C/20%H2O 95ppm NaCl/No Pulse TENSION @ 870°C	1 A	1.183	1.189	2.353	2.376	0.504	HTT	17.0	17.0	723	4.98	Ave MPa= 4.85
	3 A	1.194	1.171	2.383	2.356	0.522	HTT	16.0	16.0	649	4.48	STD = 0.27 0.33
	5 A	1.186	1.169	2.372	2.332	0.494	HTT	17.0	17.0	738	5.09	
	A						HTT					Ave Width 0.507
	A						HTT					STD = 0.012 0.014
SCHUMACHER TET 100hr/870°C/20%H2O 95ppm NaCl/No Pulse COMPR @ 870°C	2 A	1.177	1.191	2.382	2.358	0.494	HTC	28.5	-28.5	611	4.22	Ave MPa= 3.93
	4 A	1.183	1.195	2.361	2.384	0.476	HTC	28.0	-28.0	628	4.33	STD = 0.48 0.59
	6 A	1.154	1.175	2.335	2.376	0.505	HTC	23.0	-23.0	471	3.25	
	A						HTC					Ave Width 0.492
	A						HTC					STD = 0.012 0.015
							RTT		0.0	ERR	ERR	Ave MPa= ERR
							RTT		0	ERR	ERR	STD = ERR
							RTT		0	ERR	ERR	
							RTT		0	ERR	ERR	Ave Width ERR
							RTT		0	ERR	ERR	STD = ERR

	SPECIMEN		ID 1	ID 2	OD 1	OD 2	WIDTH	TEST	ABS	LOAD	-----FERBER EQUATION-----		Small
	NUMBER		in.	in.	in.	in.	in.		lb	lb	STRESS psi	STRESS MPa	Sample STD
SCHUMACHER TET	1	B	1.178	1.195	2.365	2.385	0.520	HTT	3.5	3.5	142	0.98	Ave MPa= 1.79
100hr/980°C/20%H2O	3	B	1.178	1.194	2.356	2.391	0.521	HTT	7.0	7.0	285	1.96	STD = 0.60
65ppm NaCl	5	B	1.178	1.171	2.350	2.387	0.509	HTT	8.5	8.5	350	2.41	
		B						HTT					Ave Width 0.517
TENSION @ 980°C		B						HTT					STD = 0.005
													0.007
SCHUMACHER TET	2	B	1.180	1.195	2.351	2.403	0.507	HTC	8.0	−8.0	167	1.15	Ave MPa= 1.29
100hr/980°C/20%H2O	4	B	1.172	1.201	2.361	2.302	0.509	HTC	10.0	−10.0	223	1.54	STD = 0.17
65ppm NaCl	6	B	1.189	1.184	2.372	2.401	0.480	HTC	8.0	−8.0	173	1.19	
		B						HTC					Ave Width 0.499
COMPR @ 980°C		B						HTC					STD = 0.013
													0.016
SCHUMACHER TET	1	C	1.227	1.211	2.426	2.388	0.467	HTT	8.6	8.6	395	2.72	Ave MPa= 2.69
475hr/980°C/20%H2O	3	C	1.204	1.229	2.404	2.410	0.498	HTT	10.6	10.6	454	3.13	STD = 0.37
65ppm NaCl ("500hr")	5	C	1.221	1.202	2.409	2.405	0.465	HTT	7.1	7.1	323	2.23	
		C						HTT					Ave Width 0.477
TENSION @ 980°C		C						HTT					STD = 0.015
													0.019
SCHUMACHER TET	2	C	1.220	1.227	2.368	2.378	0.454	HTC	22.7	−22.7	580	4.00	Ave MPa= 2.98
475hr/980°C/20%H2O	4	C	1.213	1.191	2.427	2.420	0.465	HTC	21.0	−21.0	458	3.16	STD = 0.91
65ppm NaCl ("500hr")	6	C	1.208	1.211	2.427	2.395	0.530	HTC	13.0	−13.0	259	1.78	
		C						HTC					Ave Width 0.483
COMPR @ 980°C		C						HTC					STD = 0,034
													0.041
								RTC		0	ERR	ERR	Ave MPa= ERR
								RTC		0	ERR	ERR	STD = ERR
								RTC		0	ERR	ERR	
								RTC		0	ERR	ERR	Ave Width ERR
								RTC		0	ERR	ERR	STD = ERR

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EXPOSURE TESTS: SCHUMACHER F40 DIA-SCHUMALITH

	SPECIMEN NUMBER	ID 1 in.	ID 2 in.	OD 1 in.	OD 2 in.	WIDTH in.	TEST	ABS LOAD lb	LOAD lb	-----FERBER EQUATION----- STRESS psi	STRESS MPa		Small Sample STD
SCHUMACHER TET	1 D	1.206	1.195	2.388	2.403	0.431	HTT	7.8	7.8	382	2.63	Ave MPa= 2.51	
575hr/980°C/20%H ₂ O	3 D	1.207	1.206	2.386	2.418	0.486	HTT	8.9	8.9	387	2.67	STD = 0.20	0.25
65ppm NaCl(*1000hr*)	5 D	1.208	1.180	2.373	2.353	0.559	HTT	8.3	8.3	323	2.23		
	D						HTT					Ave Width 0.492	
TENSION @ 980°C	D						HTT					STD = 0.052	0.064
SCHUMACHER TET	2 D	1.208	1.185	2.386	2.413	0.488	HTC	11.4	-11.4	243	1.68	Ave MPa= 1.46	
575hr/980°C/20%H ₂ O	4 D	1.178	1.200	2.383	2.401	0.517	HTC	11.4	-11.4	228	1.57	STD = 0.24	0.30
65ppm NaCl(*1000hr*)	6 D	1.151	1.146	2.393	2.377	0.520	HTC	8.9	-8.9	163	1.12		
	D						HTC					Ave Width 0.508	
COMPR @ 980°C	D						HTC					STD = 0.014	0.018
							HTT		0.0	ERR	ERR	Ave MPa= ERR	
							HTT		0.0	ERR	ERR	STD = ERR	ERR
							HTT		0.0	ERR	ERR		
							HTT		0.0	ERR	ERR	Ave Width ERR	
							HTT		0.0	ERR	ERR	STD = ERR	ERR
							HTC		0.0	ERR	ERR	Ave MPa= ERR	
							HTC		0.0	ERR	ERR	STD = ERR	ERR
							HTC		0.0	ERR	ERR		
							HTC		0.0	ERR	ERR	Ave Width ERR	
							HTC		0.0	ERR	ERR	STD = ERR	ERR
							RTC		0	ERR	ERR	Ave MPa= ERR	
							RTC		0	ERR	ERR	STD = ERR	
							RTC		0	ERR	ERR		
							RTC		0	ERR	ERR	Ave Width ERR	
							RTC		0	ERR	ERR	STD = ERR	

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	SPECIMEN		ID 1	ID 2	OD 1	OD 2	WIDTH	TEST	ABS	LOAD	-----FERBER EQUATION-----		Small
	NUMBER		in.	in.	in.	in.	in.		LOAD	lb	STRESS	STRESS	Sample
									lb	lb	psi	MPa	STD
SCHUMACHER TET	2	E	1.178	1.159	2.389	2.344	0.484	HTT	17.8	17.8	765	5.27	Ave MPa= 5.72
100hr/870°C/15%H2O	4	E	1.168	1.171	2.384	2.381	0.469	HTT	19.8	19.8	863	5.95	STD = 0.32
20ppm NaCl	6	E	1.161	1.185	2.371	2.344	0.482	HTT	19.6	19.6	861	5.93	
		E						HTT					Ave Width 0.478
TENSION @ 870°C		E						HTT					STD = 0.007
													0.008
SCHUMACHER TET	1	E	1.173	1.179	2.381	2.364	0.481	HTC	18.1	-18.1	390	2.69	Ave MPa= 4.07
100hr/870°C/15%H2O	3	E	1.182	1.160	2.376	2.365	0.460	HTC	27.8	-27.8	620	4.28	STD = 0.84
20ppm NaCl	5	E	1.155	1.171	2.388	2.380	0.459	HTC	29.5	-29.5	633	4.37	
	7	E	1.158	1.175	2.399	2.368	0.529	HTC	38.2	-38.2	718	4.95	Ave Width 0.482
COMPR @ 870°C		E						HTC					STD = 0.028
													0.033
SCHUMACHER TET	2	F	1.156	1.165	2.351	2.358	0.453	HTT	7.4	7.4	340	2.35	Ave MPa= 4.76
400hr/870°C/15%H2O	4	F	1.170	1.185	2.359	2.385	0.463	HTT	20.6	20.6	932	6.43	STD = 1.75
20ppm NaCl	6	F	1.183	1.164	2.391	2.383	0.462	HTT	18.0	18.0	797	5.49	
		F						HTT					Ave Width 0.459
TENSION @ 870°C		F						HTT					STD = 0.004
													0.006
SCHUMACHER TET	1	F	1.165	1.168	2.341	2.368	0.509	HTC	32.0	-32.0	655	4.52	Ave MPa= 4.22
400hr/870°C/15%H2O	3	F	1.169	1.179	2.352	2.390	0.533	HTC	34.0	-34.0	659	4.54	STD = 0.46
20ppm NaCl	5	F	1.163	1.157	2.389	2.369	0.503	HTC	32.4	-32.4	635	4.38	
	7	F	1.157	1.162	2.373	2.388	0.458	HTC	23.2	-23.2	498	3.43	Ave Width 0.501
COMPR @ 870°C		F						HTC					STD = 0.027
													0.031
								RTT		0.0	ERR	ERR	Ave MPa= ERR
								RTT		0	ERR	ERR	STD = ERR
								RTT		0	ERR	ERR	
								RTT		0	ERR	ERR	Ave Width ERR
								RTT		0	ERR	ERR	STD = ERR

05/01/93 EXPOSURE TESTS: SCHUMACHER F40 DIA-SCHUMALITH
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	SPECIMEN NUMBER	ID 1 in.	ID 2 in.	OD 1 in.	OD 2 in.	WIDTH in.	TEST	ABS LOAD lb	LOAD lb	-----FERBER EQUATION----- STRESS psi	STRESS MPa		Small Sample STD
SCHUMACHER TET 500hr/870°C/15%H ₂ O 20ppm NaCl TENSION @ 870°C	2 G	1.206	1.202	2.395	2.395	0.475	HTT	28.9	28.9	1292	8.91	Ave MPa= 8.43	
	4 G	1.205	1.198	2.393	2.383	0.486	HTT	25.9	25.9	1137	7.84	STD = 0.44	0.54
	6 G	1.186	1.181	2.379	2.394	0.451	HTT	26.9	26.9	1240	8.55		
	G						HTT					Ave Width 0.471	
	G						HTT					STD = 0.015	0.018
SCHUMACHER TET 500hr/870°C/15%H ₂ O 20ppm NaCl COMPR @ 870°C	1 G	1.198	1.210	2.378	2.399	0.462	HTC	26.0	-26.0	607	4.19	Ave MPa= 5.01	
	3 G	1.197	1.190	2.395	2.380	0.464	HTC	30.0	-30.0	681	4.70	STD = 0.69	0.79
	5 G	1.195	1.192	2.398	2.391	0.494	HTC	41.7	-41.7	880	6.06		
	7 G	1.191	1.197	2.394	2.383	0.506	HTC	35.4	-35.4	737	5.08	Ave Width 0.482	
	G						HTC					STD = 0.019	0.022
SCHUMACHER TET 1000h/870°C/15%H ₂ O 20ppm NaCl TENSION @ 870°C	2 H	1.118	1.146	2.419	2.358	0.528	HTT	18.5	18.5	672	4.64	Ave MPa= 4.64	
	4 H	1.158	1.188	2.398	2.388	0.488	HTT	16.2	16.2	674	4.65	STD = 0.00	0.01
	6 H	1.172	1.179	2.354	2.406	0.475	HTT	BROKE					
	H						HTT					Ave Width 0.497	
	H						HTT					STD = 0.023	0.028
SCHUMACHER TET 1000h/870°C/15%H ₂ O 20ppm NaCl COMPR @ 870°C	1 H	1.185	1.166	2.402	2.377	0.487	HTC	21.0	-21.0	434	2.99	Ave MPa= 3.37	
	3 H	1.181	1.161	2.396	2.351	0.482	HTC	24.2	-24.2	513	3.54	STD = 0.23	0.26
	5 H	1.147	1.170	2.367	2.362	0.488	HTC	23.8	-23.8	490	3.38		
	7 H	1.175	1.184	2.395	2.380	0.528	HTC	26.8	-26.8	517	3.57	Ave Width 0.496	
	H						HTC					STD = 0.018	0.021
							RTC		0	ERR	ERR	Ave MPa= ERR	
							RTC		0	ERR	ERR	STD = ERR	
							RTC		0	ERR	ERR		
							RTC		0	ERR	ERR	Ave Width ERR	
							RTC		0	ERR	ERR	STD = ERR	

	SPECIMEN NUMBER	ID 1 In.	ID 2 In.	OD 1 In.	OD 2 In.	WIDTH In.	TEST	ABS LOAD lb	LOAD lb	-----FERBER EQUATION----- STRESS psi STRESS MPa			Small Sample STD
Refractron 50/5 w/505 100hr/870°C/15%H2O 20ppm NaCl 'IF&P Layer' TENSION @ 870°C	2 ♦	1.548	1.574	2.347	2.350	0.474	HTT	21.2	21.2	2067	14.25	Ave MPa= 13.72	
	4 ♦	1.552	1.567	2.345	2.351	0.503	HTT	21.7	21.7	1988	13.71	STD = 1.24	1.43
	6 ♦	1.550	1.576	2.334	2.373	0.500	HTT	23.9	23.9	2197	15.15		
	8 ♦	1.549	1.552	2.336	2.364	0.529	HTT	20.1	20.1	1705	11.76	Ave Width 0.502	
	♦						HTT					STD = 0.019	0.022
Refractron 50/5 w/505 100hr/870°C/15%H2O 20ppm NaCl 'IF&P Layer' COMPR. @ 870°C	1 ♦	1.569	1.558	2.350	2.355	0.534	HTC	34.9	−34.9	2003	13.81	Ave MPa= 13.85	
	3 ♦	1.557	1.564	2.338	2.361	0.519	HTC	34.5	−34.5	2033	14.02	STD = 0.35	0.41
	5 ♦	1.563	1.558	2.367	2.344	0.504	HTC	34.6	−34.6	2069	14.26		
	7 ♦	1.576	1.543	2.364	2.343	0.513	HTC	32.8	−32.8	1930	13.31	Ave Width 0.518	
	♦						HTC					STD = 0.011	0.013
*****NOTE***** The above candle is a 50/5 w/505 candle (not a 70/3 w/442−T)							HTT		0.0	ERR	ERR	Ave MPa= ERR	
							HTT		0.0	ERR	ERR	STD = ERR	ERR
							HTT		0.0	ERR	ERR		
							HTT					Ave Width ERR	
							HTT					STD = ERR	ERR
							HTC		0.0	ERR	ERR	Ave MPa= ERR	
							HTC		0.0	ERR	ERR	STD = ERR	ERR
							HTC		0.0	ERR	ERR		
							HTC					Ave Width ERR	
							HTC					STD = ERR	ERR
							RTT		0.0	ERR	ERR	Ave MPa= ERR	
							RTT		0	ERR	ERR	STD = ERR	
							RTT		0	ERR	ERR		
							RTT		0	ERR	ERR	Ave Width ERR	
							RTT		0	ERR	ERR	STD = ERR	

05/01/93 tetref EXPOSURE TESTS: REFRACTRON 70/3 w/442-T BINDER

	SPECIMEN NUMBER	ID 1 in.	ID 2 in.	OD 1 in.	OD 2 in.	WIDTH in.	TEST	ABS LOAD lb	LOAD lb	-----FERBER EQUATION----- STRESS psi	STRESS MPa	Small Sample STD
Refract. 70/3 w/442-T 100hr/870°C/15%H ₂ O 20ppm NaCl/No Pulse FRONT CANDLE TENSION @ 870°C	2 4 6 I I	1.544 1.547 1.539 	1.548 1.545 1.553 	2.345 2.348 2.355 	2.354 2.352 2.362 	0.484 0.473 0.517 	HTT HTT HTT 	25.3 24.4 27.6 	25.3 24.4 27.6 	2323 2290 2330 	16.02 15.79 16.06 	Ave MPa= 15.96 STD = 0.12 Ave Width 0.491 STD = 0.019 0.023
Refract. 70/3 w/442-T 100hr/870°C/15%H ₂ O 20ppm NaCl/No Pulse FRONT CANDLE COMPR. @ 870°C	1 3 5 7 I	1.558 1.543 1.557 1.536 	1.544 1.540 1.544 1.538 	2.358 2.345 2.358 2.357 	2.370 2.357 2.348 2.359 	0.504 0.491 0.482 0.499 	HTC HTC HTC HTC 	37.3 46.0 41.8 41.0 	-37.3 -46.0 -41.8 -41.0 	2121 2692 2549 2290 	14.63 18.56 17.58 15.79 	Ave MPa= 16.64 STD = 1.53 Ave Width 0.494 STD = 0.008 0.010
Refract. 70/3 w/442-T 100hr/870°C/15%H ₂ O 20ppm NaCl/No Pulse REAR CANDLE TENSION @ 870°C	2 4 6 I I	1.556 1.549 1.552 	1.567 1.555 1.555 	2.358 2.356 2.362 	2.365 2.370 2.351 	0.486 0.486 0.552 	HTT HTT HTT 	33.6 24.5 23.5 	33.6 24.5 23.5 	3114 2212 1900 	21.47 15.25 13.10 	Ave MPa= 16.61 STD = 3.55 Ave Width 0.508 STD = 0.031 0.038
Refract. 70/3 w/442-T 100hr/870°C/15%H ₂ O 20ppm NaCl/No Pulse REAR CANDLE COMPR. @ 870°C	1 3 5 7 I	1.554 1.550 1.551 1.548 	1.570 1.511 1.558 1.543 	2.367 2.347 2.356 2.370 	2.371 2.364 2.385 2.351 	0.494 0.490 0.485 0.489 	HTC HTC HTC HTC 	40.1 44.9 39.1 39.5 	-40.1 -44.9 -39.1 -39.5 	2377 2519 2299 2296 	16.39 17.37 15.85 15.83 	Ave MPa= 16.36 STD = 0.62 Ave Width 0.490 STD = 0.003 0.004
							RTC	0	ERR	ERR	ERR	Ave MPa= ERR
							RTC	0	ERR	ERR	ERR	STD = ERR
							RTC	0	ERR	ERR	ERR	
							RTC	0	ERR	ERR	ERR	Ave Width ERR
							RTC	0	ERR	ERR	ERR	STD = ERR

05/01/93 tetref EXPOSURE TESTS: REFRACTRON 70/3 w/442-T BINDER

	SPECIMEN	ID 1	ID 2	OD 1	OD 2	WIDTH	TEST	ABS	LOAD	LOAD	-----FERBER EQUATION-----		Small
	NUMBER	in.	in.	in.	in.	in.		lb	lb	psi	MPa		Sample
													STD
Refract. 70/3 w/442-T 100hr/870°C/15%H2O 20ppm NaCl TENSION @ 870°C	2 J	1.544	1.508	2.335	2.345	0.466	HTT	22.9	22.9	2121	14.62	Ave MPa= 13.85	
	4 J	1.541	1.524	2.347	2.339	0.484	HTT	20.8	20.8	1873	12.91	STD = 0.71	0.87
	6 J	1.524	1.551	2.339	2.332	0.500	HTT	22.7	22.7	2033	14.02		
	J						HTT					Ave Width 0.483	
	J						HTT					STD = 0.014	0.017
Refract. 70/3 w/442-T 100hr/870°C/15%H2O 20ppm NaCl COMPR. @ 870°C	1 J	1.521	1.540	2.349	2.324	0.499	HTC	45.8	-45.8	2642	18.21	Ave MPa= 16.60	
	3 J	1.535	1.526	2.325	2.345	0.491	HTC	40.3	-40.3	2371	16.35	STD = 0.98	1.13
	5 J	1.535	1.520	2.343	2.321	0.501	HTC	41.0	-41.0	2359	16.27		
	7 J	1.528	1.535	2.333	2.329	0.570	HTC	44.0	-44.0	2259	15.57	Ave Width 0.515	
	J						HTC					STD = 0.032	0.037
Refract. 70/3 w/442-T 400hr/870°C/15%H2O 20ppm NaCl TENSION @ 870°C	2 K	1.518	1.522	2.365	2.362	0.467	HTT	21.8	21.8	1897	13.08	Ave MPa= 11.97	
	4 K	1.515	1.515	2.351	2.386	0.480	HTT	22.3	22.3	1849	12.75	STD = 1.35	1.65
	6 K	1.523	1.515	2.363	2.365	0.488	HTT	17.6	17.6	1461	10.07		
	K						HTT					Ave Width 0.478	
	K						HTT					STD = 0.009	0.011
Refract. 70/3 w/442-T 400hr/870°C/15%H2O 20ppm NaCl COMPR. @ 870°C	1 K	1.514	1.501	2.362	2.355	0.490	HTC	31.1	-31.1	1617	11.15	Ave MPa= 12.14	
	3 K	1.514	1.526	2.356	2.386	0.488	HTC	33.8	-33.8	1779	12.27	STD = 0.59	0.68
	5 K	1.527	1.518	2.375	2.374	0.516	HTC	36.9	-36.9	1836	12.66		
	7 K	1.501	1.520	2.358	2.373	0.488	HTC	34.9	-34.9	1809	12.47	Ave Width 0.496	
	K						HTC					STD = 0.012	0.014
							RTC		0	ERR	ERR	Ave MPa= ERR	
							RTC		0	ERR	ERR	STD = ERR	
							RTC		0	ERR	ERR		
							RTC		0	ERR	ERR	Ave Width ERR	
							RTC		0	ERR	ERR	STD = ERR	

05/01/93 tetref EXPOSURE TESTS: REFRACTRON 70/3 w/442-T BINDER

	SPECIMEN NUMBER	ID 1 in.	ID 2 in.	OD 1 in.	OD 2 in.	WIDTH in.	TEST	ABS LOAD lb	LOAD lb	-----FERBER EQUATION----- STRESS psi	STRESS MPa		Small Sample STD
Refract. 70/3 w/442-T 500hr/870°C/15%H ₂ O 20ppm NaCl TENSION @ 870°C	2 L	1.533	1.513	2.357	2.345	0.502	HTT	28.3	28.3	2364	16.30	Ave MPa= 15.36	
	4 L	1.533	1.519	2.367	2.370	0.514	HTT	29.3	29.3	2327	16.04	STD = 1.15	1.40
	6 L	1.535	1.518	2.356	2.388	0.515	HTT	25.3	25.3	1994	13.75		
	L						HTT					Ave Width 0.510	
	L						HTT					STD = 0.006	0.007
Refract. 70/3 w/442-T 500hr/870°C/15%H ₂ O 20ppm NaCl COMPR. @ 870°C	1 L	1.520	1.469	2.352	2.366	0.524	HTC	21.5	-21.5	1005	6.93	Ave MPa= 9.10	
	3 L	1.530	1.531	2.358	2.366	0.502	HTC	26.1	-26.1	1407	9.70	STD = 1.25	1.45
	5 L	1.530	1.520	2.384	2.392	0.501	HTC	28.6	-28.6	1431	9.87		
	7 L	1.517	1.531	2.387	2.383	0.479	HTC	27.3	-27.3	1434	9.89	Ave Width 0.502	
	L						HTC					STD = 0.016	0.018
Refract. 70/3 w/442-T 1000h/870°C/15%H ₂ O 20ppm NaCl TENSION @ 870°C	2 M	1.516	1.526	2.359	2.339	0.496	HTT	34.6	34.6	2923	20.15	Ave MPa= 18.96	
	4 M	1.546	1.508	2.353	2.356	0.542	HTT	36.4	36.4	2823	19.47	STD = 1.24	1.51
	6 M	1.525	1.519	2.328	2.333	0.510	HTT	29.3	29.3	2503	17.26		
	M						HTT					Ave Width 0.516	
	M						HTT					STD = 0.019	0.024
Refract. 70/3 w/442-T 1000h/870°C/15%H ₂ O 20ppm NaCl COMPR. @ 870°C	1 M	1.502	1.539	2.341	2.355	0.493	HTC	30.8	-30.8	1696	11.70	Ave MPa= 12.20	
	3 M	1.538	1.541	2.360	2.346	0.484	HTC	38.0	-38.0	2231	15.39	STD = 1.87	2.16
	5 M	1.543	1.526	2.346	2.332	0.493	HTC	27.0	-27.0	1586	10.94		
	7 M	1.519	1.509	2.322	2.354	0.484	HTC	27.8	-27.8	1566	10.80	Ave Width 0.489	
	M						HTC					STD = 0.004	0.005
							RTT		0.0	ERR	ERR	Ave MPa= ERR	
							RTT		0	ERR	ERR	STD = ERR	
							RTT		0	ERR	ERR		
							RTT		0	ERR	ERR	Ave Width ERR	
							RTT		0	ERR	ERR	STD = ERR	

05/01/93 EXPOSURE TESTS: REFRACTRON 70/3 w/442-T BINDER

tetref

	SPECIMEN NUMBER	ID 1 in.	ID 2 in.	OD 1 in.	OD 2 in.	WIDTH in.	TEST	ABS LOAD lb	LOAD lb	-----FERBER EQUATION----- STRESS psi	STRESS MPa		Small Sample STD
Refract. 70/3 w/442-T 100hr/980°C/15%H ₂ O 20ppm NaCl TENSION @ 980°C	2 N	1.515	1.510	2.360	2.355	0.504	HTT	15.3	15.3	1227	8.46	Ave MPa= 8.52	
	4 N	1.512	1.529	2.356	2.370	0.502	HTT	14.0	14.0	1136	7.83	STD = 0.55	0.64
	6 N	1.502	1.527	2.364	2.373	0.491	HTT	15.1	15.1	1223	8.43		
	8 N	1.515	1.506	2.352	2.377	0.508	HTT	17.4	17.4	1360	9.37	Ave Width 0.501	
	N						HTT					STD = 0.006	0.007
Refract. 70/3 w/442-T 100hr/980°C/15%H ₂ O 20ppm NaCl COMPR. @ 980°C	1 N	1.525	1.514	2.358	2.344	0.511	HTC	14.0	-14.0	736	5.08	Ave MPa= 5.76	
	3 N	1.512	1.516	2.356	2.367	0.452	HTC	14.7	-14.7	839	5.79	STD = 0.55	0.67
	5 N	1.523	1.503	2.371	2.354	0.493	HTC	17.9	-17.9	932	6.42		
	7 N	1.511	1.525	2.364	2.355	0.509	HTC	BROKE				Ave Width 0.491	
	N						HTC					STD = 0.024	0.027
Refract. 70/3 w/442-T 400hr/980°C/15%H ₂ O 20ppm NaCl TENSION @ 980°C	2 O	1.484	1.488	2.411	2.405	0.493	HTT	5.1	5.1	360	2.48	Ave MPa= 2.28	
	4 O	1.514	1.519	2.392	2.410	0.504	HTT	5.6	5.6	418	2.88	STD = 0.58	0.67
	6 O	1.515	1.490	2.387	2.418	0.491	HTT	4.8	4.8	356	2.45		
	8 O	1.548	1.526	2.415	2.387	0.516	HTT	2.5	2.5	191	1.32	Ave Width 0.501	
	O						HTT					STD = 0.010	0.012
Refract. 70/3 w/442-T 400hr/980°C/15%H ₂ O 20ppm NaCl COMPR. @ 980°C	1 O	1.510	1.508	2.416	2.434	0.494	HTC	4.9	-4.9	219	1.51	Ave MPa= 1.72	
	3 O	1.506	1.508	2.365	2.405	0.426	HTC	4.9	-4.9	276	1.90	STD = 0.31	0.34
	5 O	1.509	1.513	2.409	2.399	0.436	HTC	5.7	-5.7	304	2.09		
	7 O	1.514	1.519	2.414	2.416	0.515	HTC	4.0	-4.0	179	1.23	Ave Width 0.469	
	9 O	1.501	1.480	2.397	2.411	0.473	HTC	5.8	-5.8	269	1.85	STD = 0.034	0.038
							RTC		0	ERR	ERR	Ave MPa= ERR	
							RTC		0	ERR	ERR	STD = ERR	
							RTC		0	ERR	ERR		
							RTC		0	ERR	ERR	Ave Width ERR	
							RTC		0	ERR	ERR	STD = ERR	

05/01/93 EXPOSURE TESTS: REFRACTRON 70/3 w/442-T BINDER

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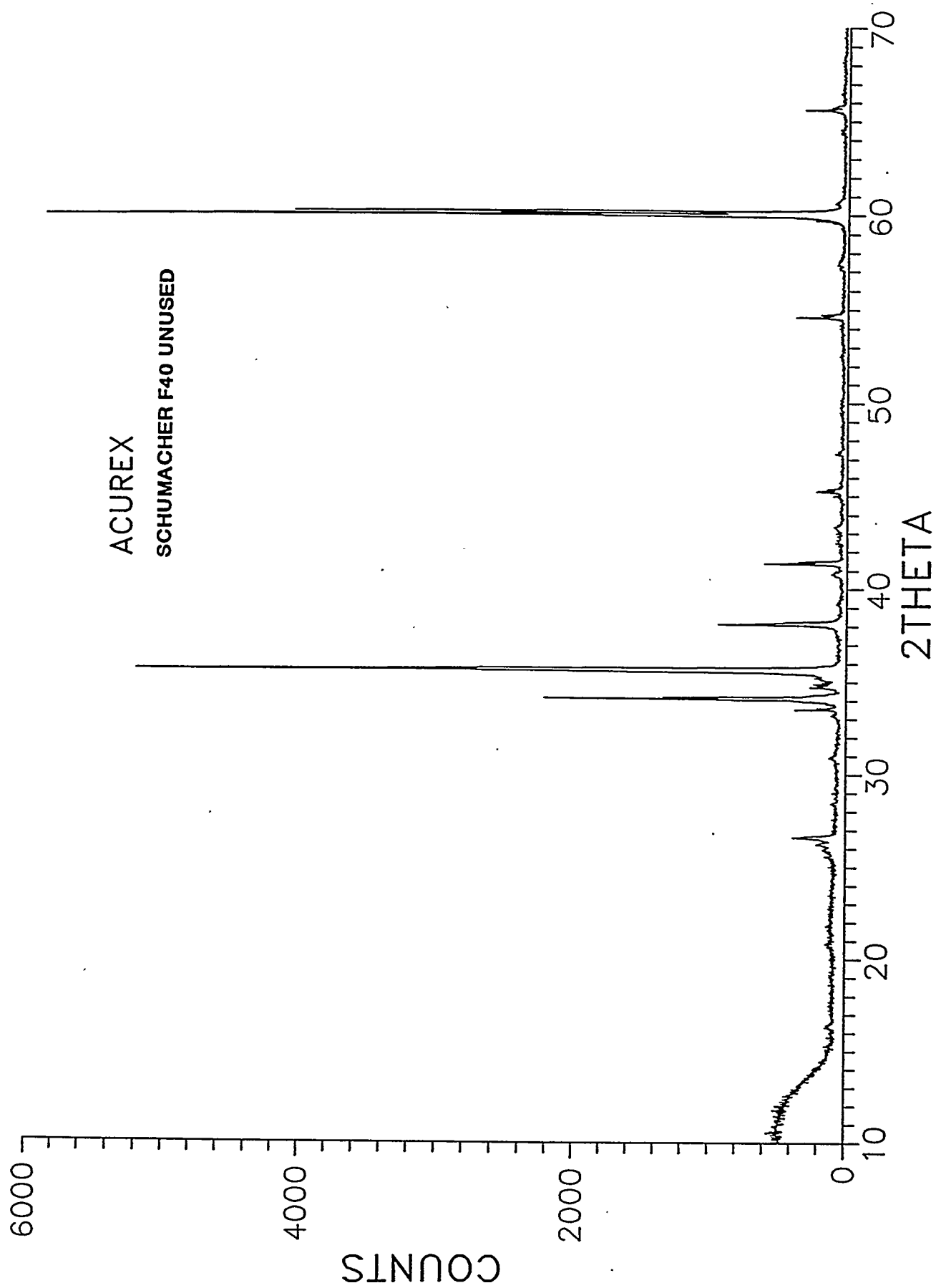
	SPECIMEN NUMBER	ID 1 In.	ID 2 in.	OD 1 in.	OD 2 in.	WIDTH in.	TEST	ABS LOAD lb	LOAD lb	-----FERBER EQUATION----- STRESS psi	STRESS MPa		Small Sample STD
Refract. 70/3 w/442-T 500hr/980°C/15%H ₂ O 20ppm NaCl TENSION @ 980°C	2 P	1.517	1.481	2.368	2.389	0.477	HTT	3.3	3.3	261	1.80	Ave MPa= 1.68	
	4 P	1.504	1.498	2.386	2.372	0.482	HTT	2.7	2.7	212	1.46	STD = 0.15	0.17
	6 P	1.506	1.506	2.381	2.371	0.491	HTT	3.4	3.4	266	1.84		
	8 P	1.494	1.422	2.375	2.387	0.492	HTT	3.4	3.4	237	1.64	Ave Width 0.486	
	P						HTT					STD = 0.006	0.007
Refract. 70/3 w/442-T 500hr/980°C/15%H ₂ O 20ppm NaCl COMPR. @ 980°C	1 P	1.497	1.507	2.365	2.378	0.482	HTC	3.7	-3.7	187	1.29	Ave MPa= 1.17	
	3 P	1.501	1.495	2.372	2.387	0.482	HTC	3.0	-3.0	147	1.01	STD = 0.18	0.20
	5 P	1.505	1.487	2.371	2.389	0.489	HTC	3.8	-3.8	182	1.26		
	7 P	1.506	1.512	2.366	2.386	0.456	HTC	3.7	-3.7	200	1.38	Ave Width 0.506	
	9 P	1.441	1.429	2.347	2.379	0.621	HTC	4.0	-4.0	132	0.91	STD = 0.059	0.066
Refract. 70/3 w/442-T 1000h/980°C/15%H ₂ O 20ppm NaCl TENSION @ 980°C	2 Q	1.523	1.476	2.541	2.477	0.459	HTT	6.5	6.5	430	2.96	Ave MPa= 2.32	
	4 Q	1.540	1.513	2.516	2.469	0.506	HTT	6.2	6.2	402	2.77	STD = 0.55	0.64
	6 Q	1.510	1.543	2.461	2.463	0.496	HTT	3.6	3.6	251	1.73		
	8 Q	1.556	1.503	2.480	2.441	0.513	HTT	3.9	3.9	265	1.83	Ave Width 0.494	
	Q						HTT					STD = 0.021	0.024
Refract. 70/3 w/442-T 1000h/980°C/15%H ₂ O 20ppm NaCl COMPR. @ 980°C	1 Q	1.515	1.471	2.426	2.437	0.517	HTC	6.4	-6.4	258	1.78	Ave MPa= 2.31	
	3 Q	1.540	1.549	2.514	2.426	0.520	HTC	7.0	-7.0	298	2.05	STD = 0.84	0.93
	5 Q	1.516	1.531	2.470	2.480	0.554	HTC	6.4	-6.4	239	1.65		
	7 Q	1.495	1.517	2.434	2.459	0.531	HTC	7.8	-7.8	307	2.12	Ave Width 0.526	
	9 Q	1.512	1.548	2.405	2.418	0.506	HTC	12.0	-12.0	572	3.94	STD = 0.016	0.018
							RTC		0	ERR	ERR	Ave MPa= ERR	
							RTC		0	ERR	ERR	STD = ERR	
							RTC		0	ERR	ERR		
							RTC		0	ERR	ERR	Ave Width ERR	
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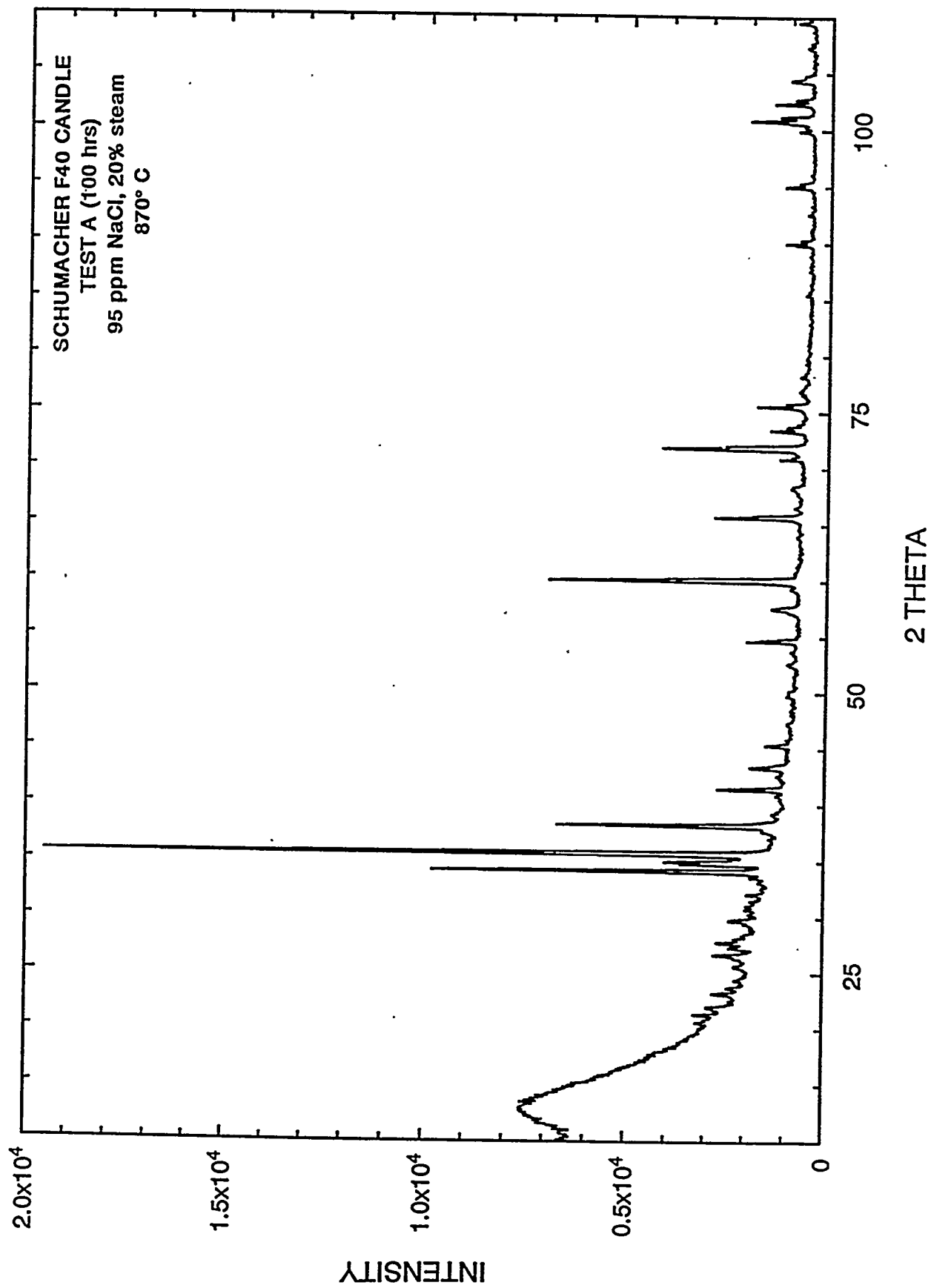
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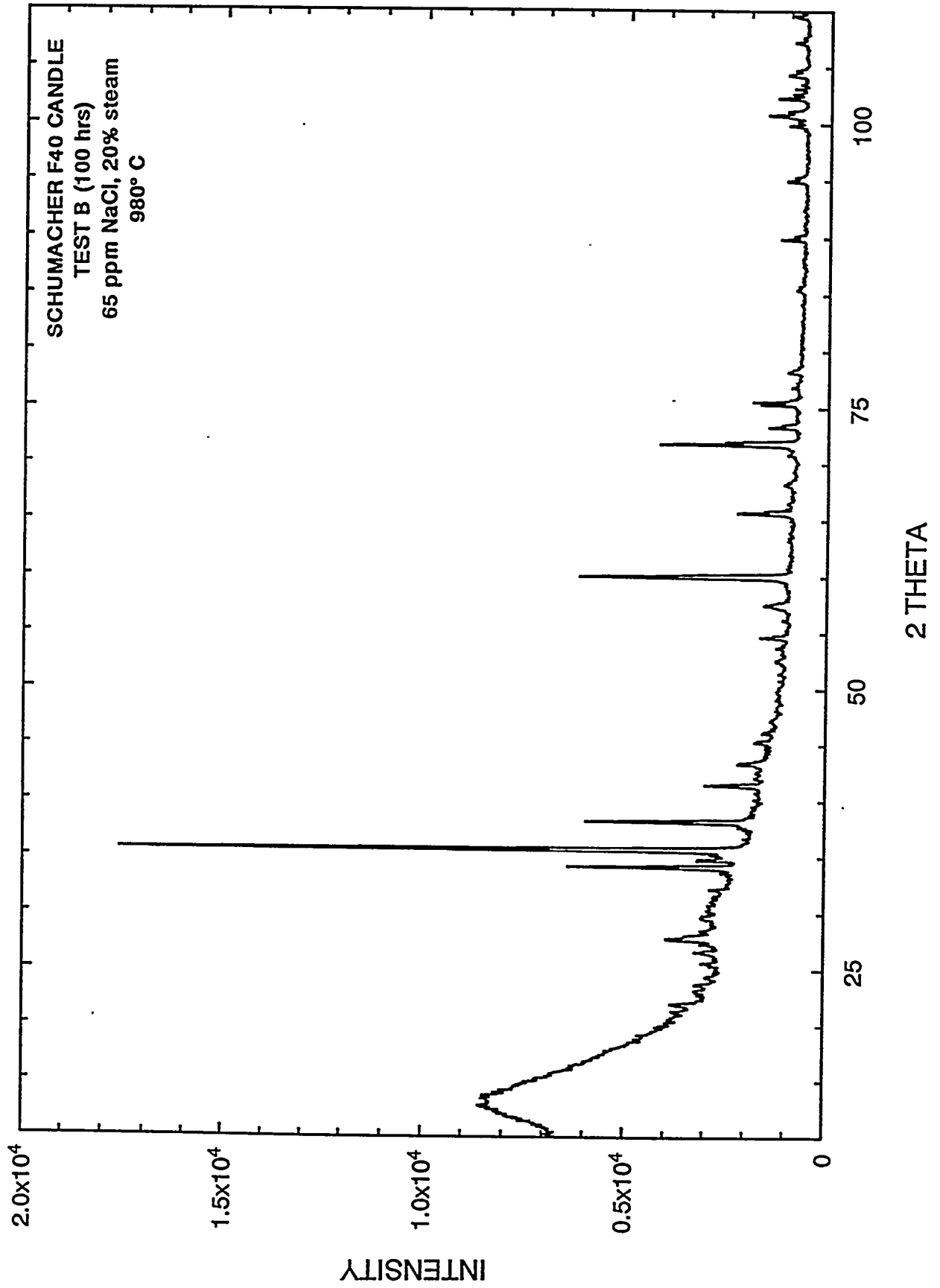
APPENDIX E
X-RAY DIFFRACTION DATA

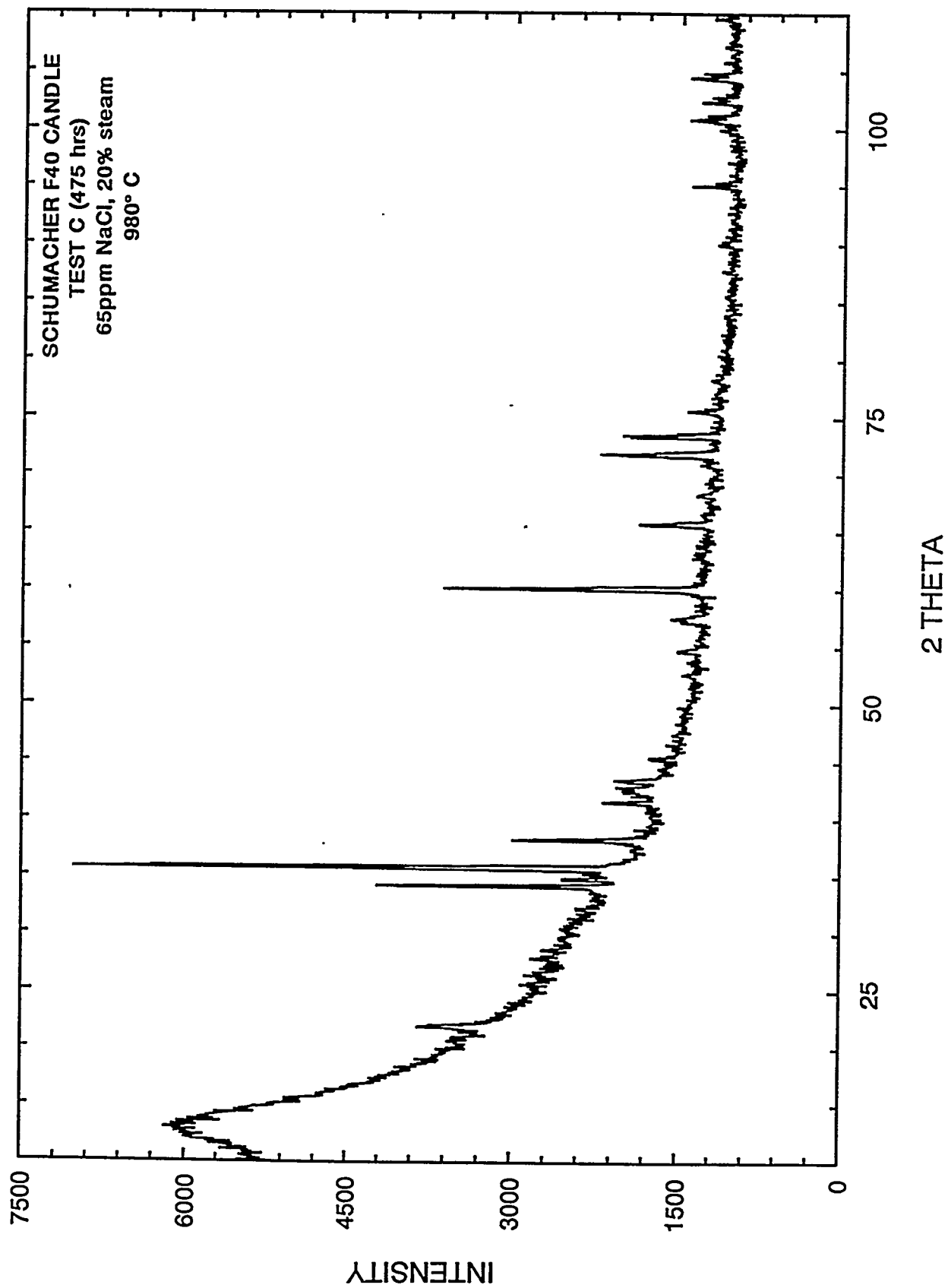
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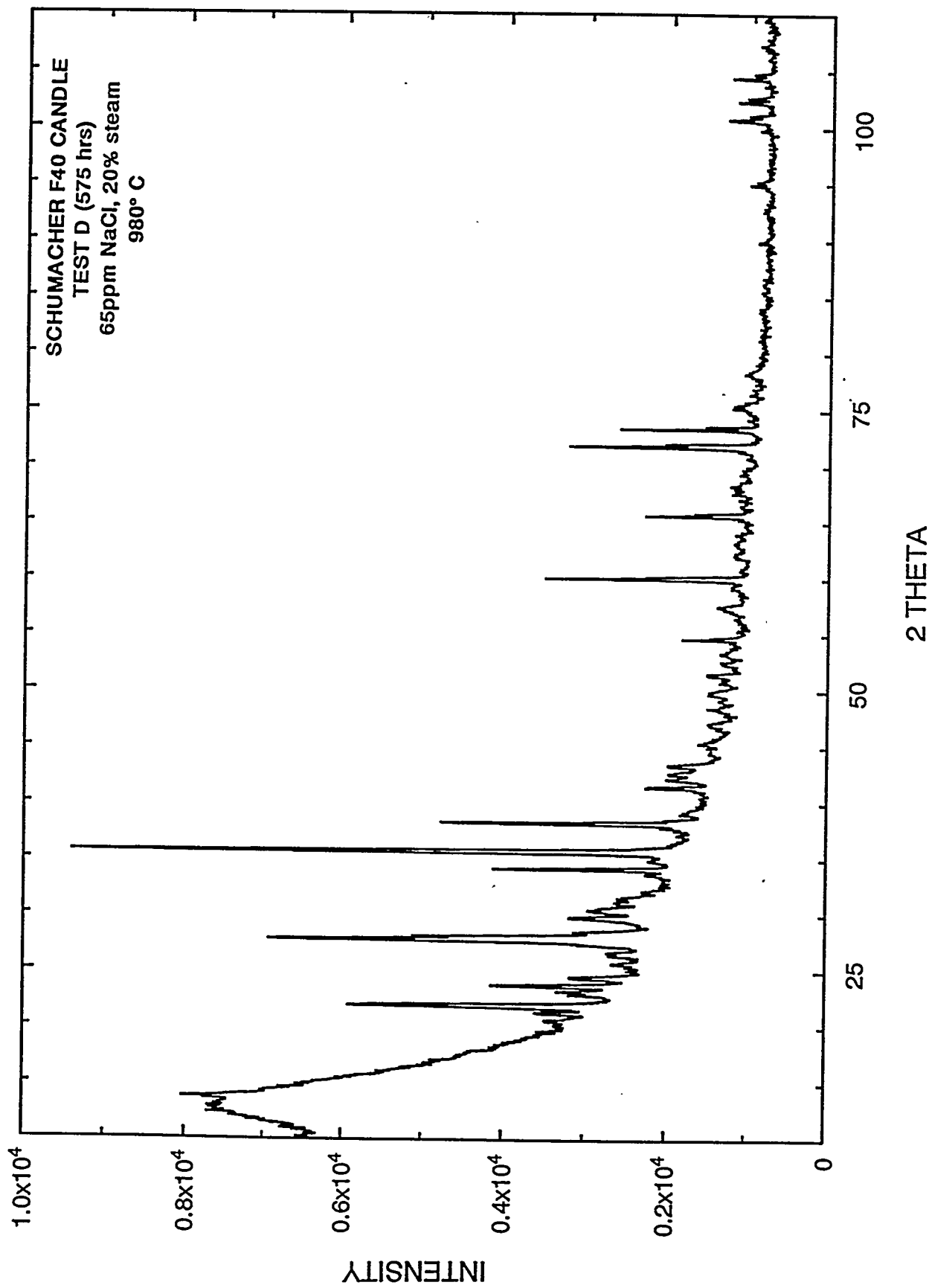
TEST IDENTIFICATION		SILICON CARBIDE: SiC												SILICA: SiO2				NaAlSi3O8		Al2O3
		1-1119 SILICON CARBIDE	4-0756 SILICON CARBIDE	22-1273 SILICON CARBIDE	22-1316 SILICON CARBIDE	29-1127 SILICON CARBIDE	29-1129 SILICON CARBIDE	19-1138 MOISSANITE	29-1128 MOISSANITE	29-1130 MOISSANITE	29-1131 MOISSANITE	18-1169 SILICON DIOXIDE	27-0605 SILICON DIOXIDE	34-1382 SILICON DIOXIDE	11-0665 CRISTOBALITE	10-0393 ALBITE	20-0572 ALBITE	10-0173 CORUNDUM		
SCHUMACHER UNUSED																				
F40 CANDLE																				
TEST A (100 hrs) 95 ppm NaCl 20% steam 870° C		1-1119													11-0665 11-0665 11-0665			10-0173 10-0173 10-0173		
TEST B (100 hrs) 65 ppm NaCl 20% steam 980° C															11-0665 11-0665 11-0665			10-0173 10-0173 10-0173		
TEST C (475 hrs) 65ppm NaCl 20% steam 980° C			4-0756 4-0756 4-0756										27-0605 27-0605 27-0605		11-0665 11-0665 11-0665			10-0173 10-0173 10-0173		
TEST D (575hrs) 65ppm NaCl 20% steam 980° C															11-0665 11-0665 11-0665			10-0173 10-0173 10-0173		
TEST G 20ppm 15% steam 870°C 500 hrs				22-1273 22-1273 22-1273		29-1127 29-1127 29-1127					18-1169 18-1169 18-1169	27-0605 27-0605 27-0605			11-0665 11-0665 11-0665			10-0173 10-0173 10-0173		
TEST H 20ppm 15% steam 870°C 1000 hrs											18-1169 18-1169 18-1169	27-0605 27-0605 27-0605	34-1382 34-1382 34-1382					10-0173 10-0173 10-0173		
REFRACTRON UNUSED					22-1316	29-1127	29-1129				29-1131							10-0173 10-0173 10-0173		
70/3 WITH 442-T					22-1316	29-1127	29-1129				29-1131							10-0173 10-0173 10-0173		
TEST L 20ppm 15% steam 870°C 500 hrs				22-1273 22-1273 22-1273	22-1316 22-1316 22-1316	29-1127 29-1127 29-1127	29-1129				29-1131					10-0393 10-0393 10-0393	20-0572 20-0572 20-0572	10-0173 10-0173 10-0173		
TEST M 20ppm 15% steam 870°C 1000 hrs							29-1129									10-0393 10-0393 10-0393	20-0572 20-0572 20-0572	10-0173 10-0173 10-0173		
TEST Q 20ppm 15% steam 980°C 1000 HRS						29-1127 29-1127 29-1127					18-1169 18-1169 18-1169	27-0605 27-0605 27-0605			10-0393 10-0393 10-0393	20-0572 20-0572 20-0572	10-0173 10-0173 10-0173			

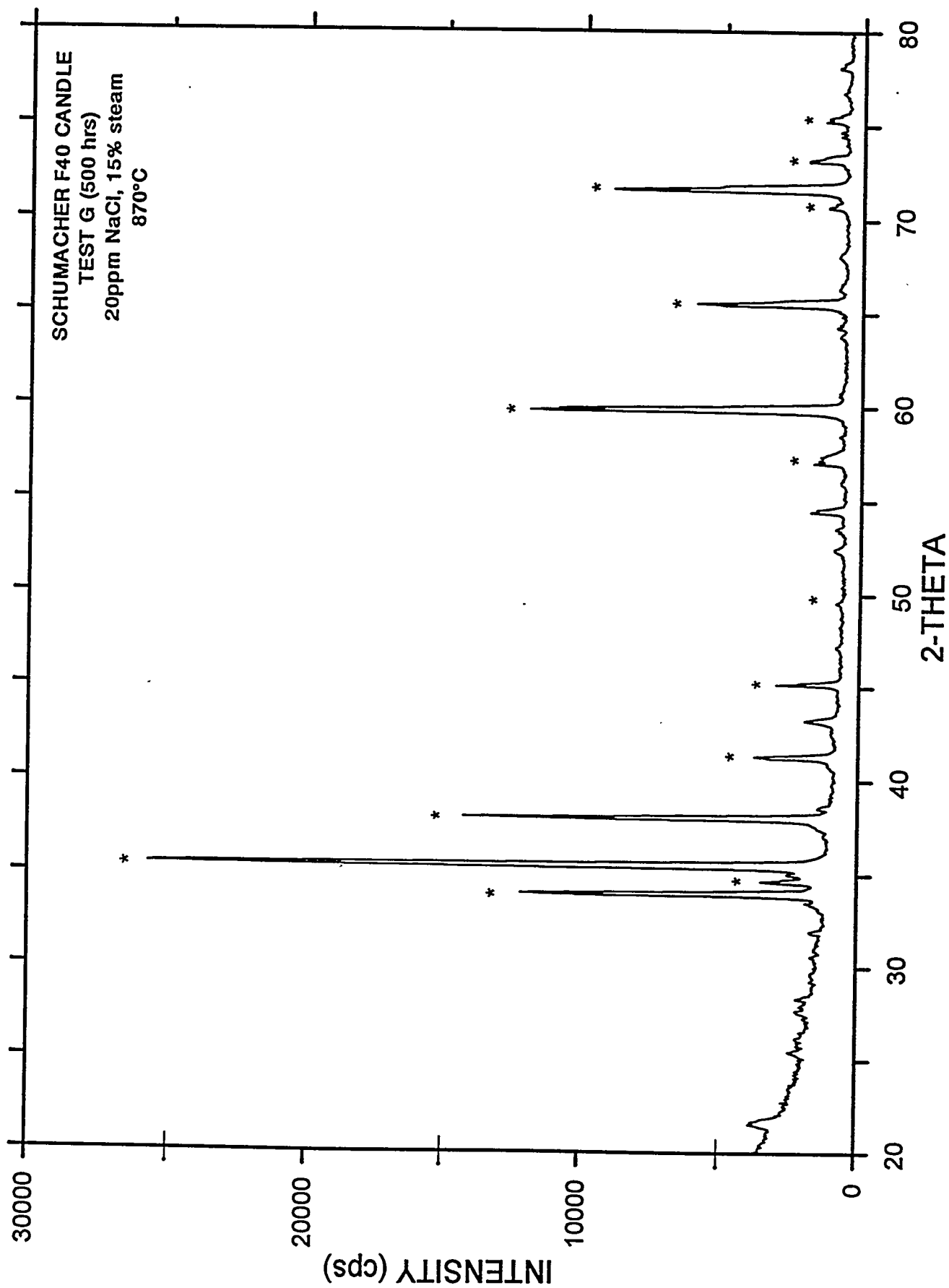


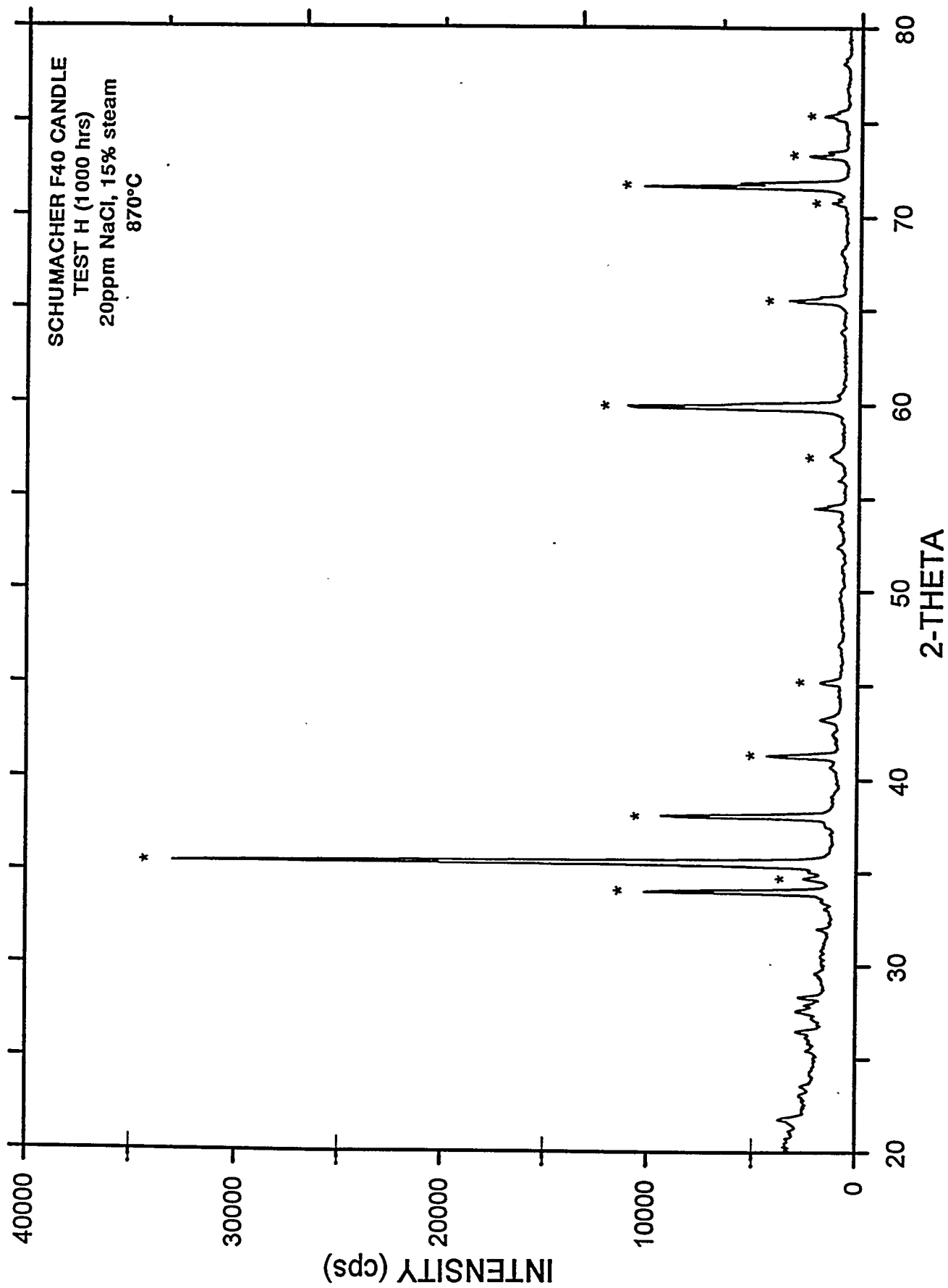


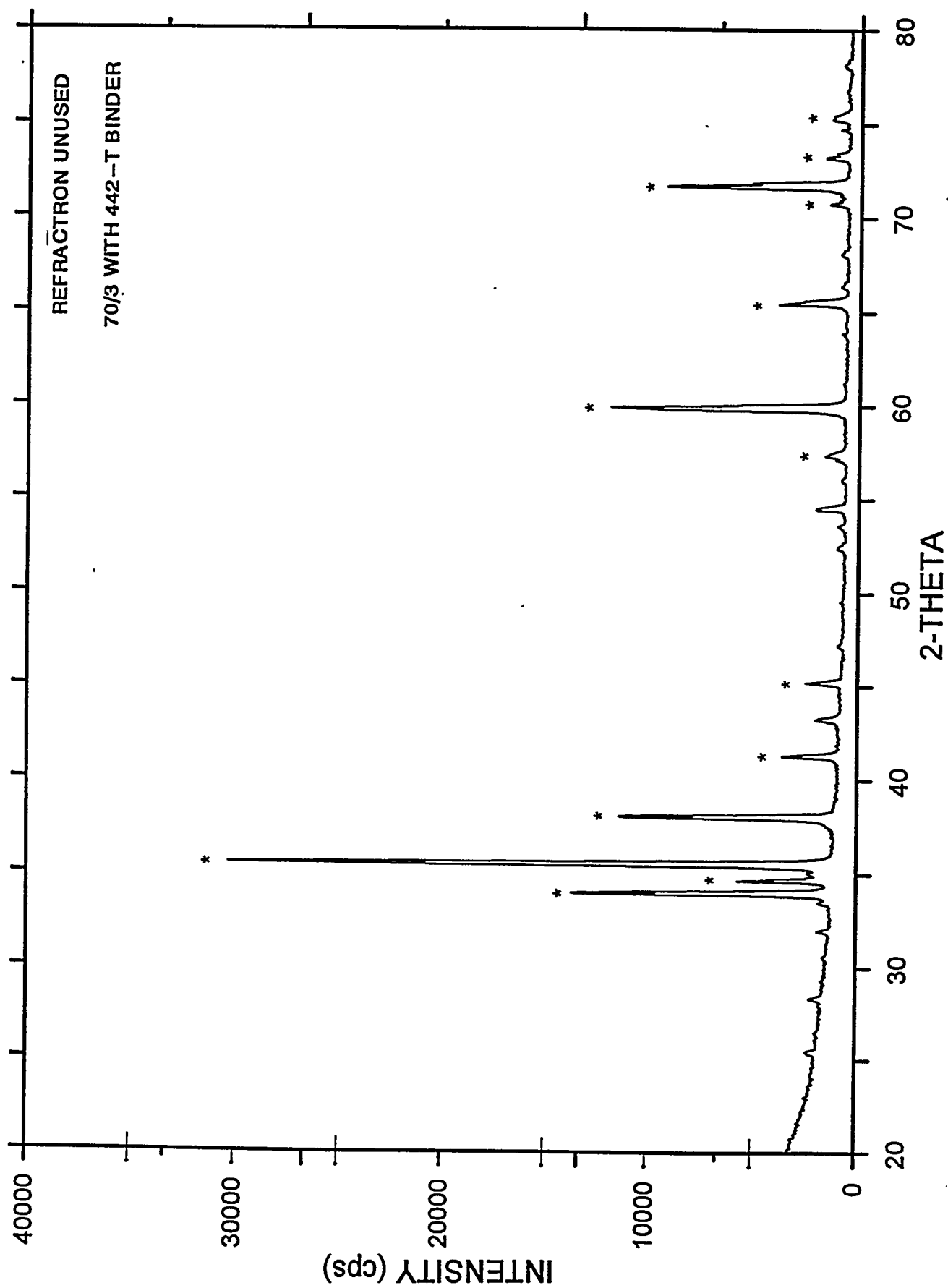


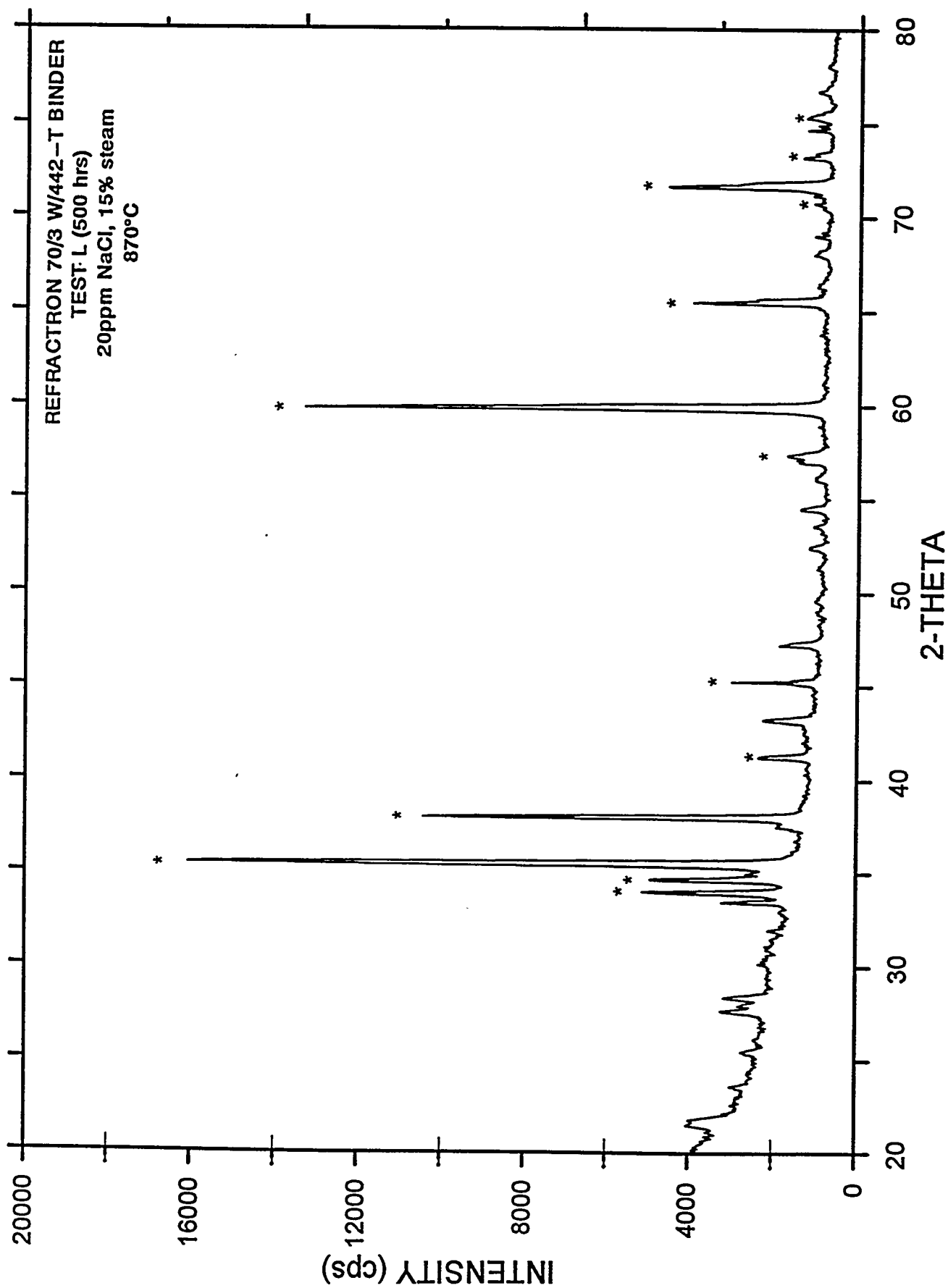


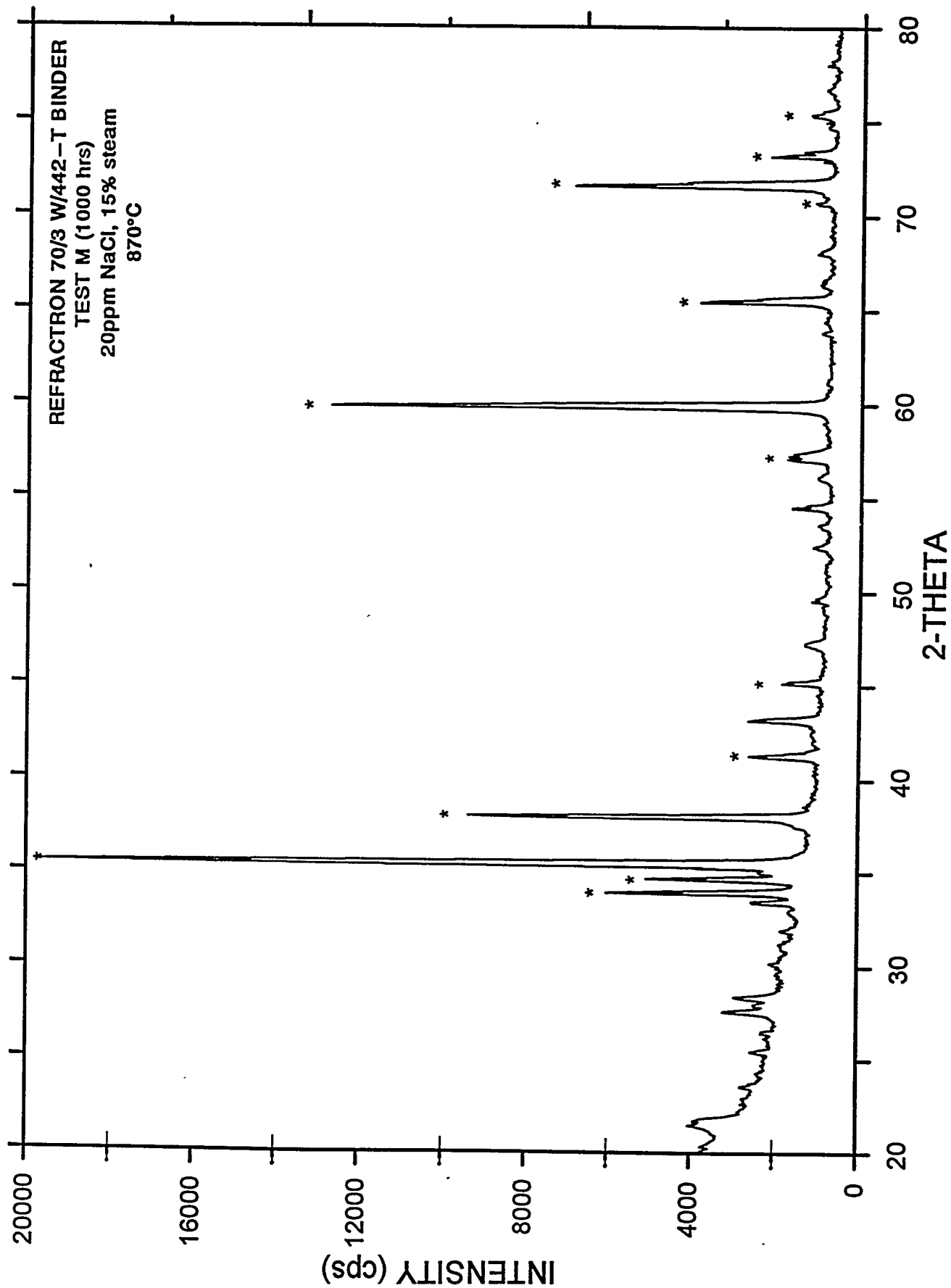


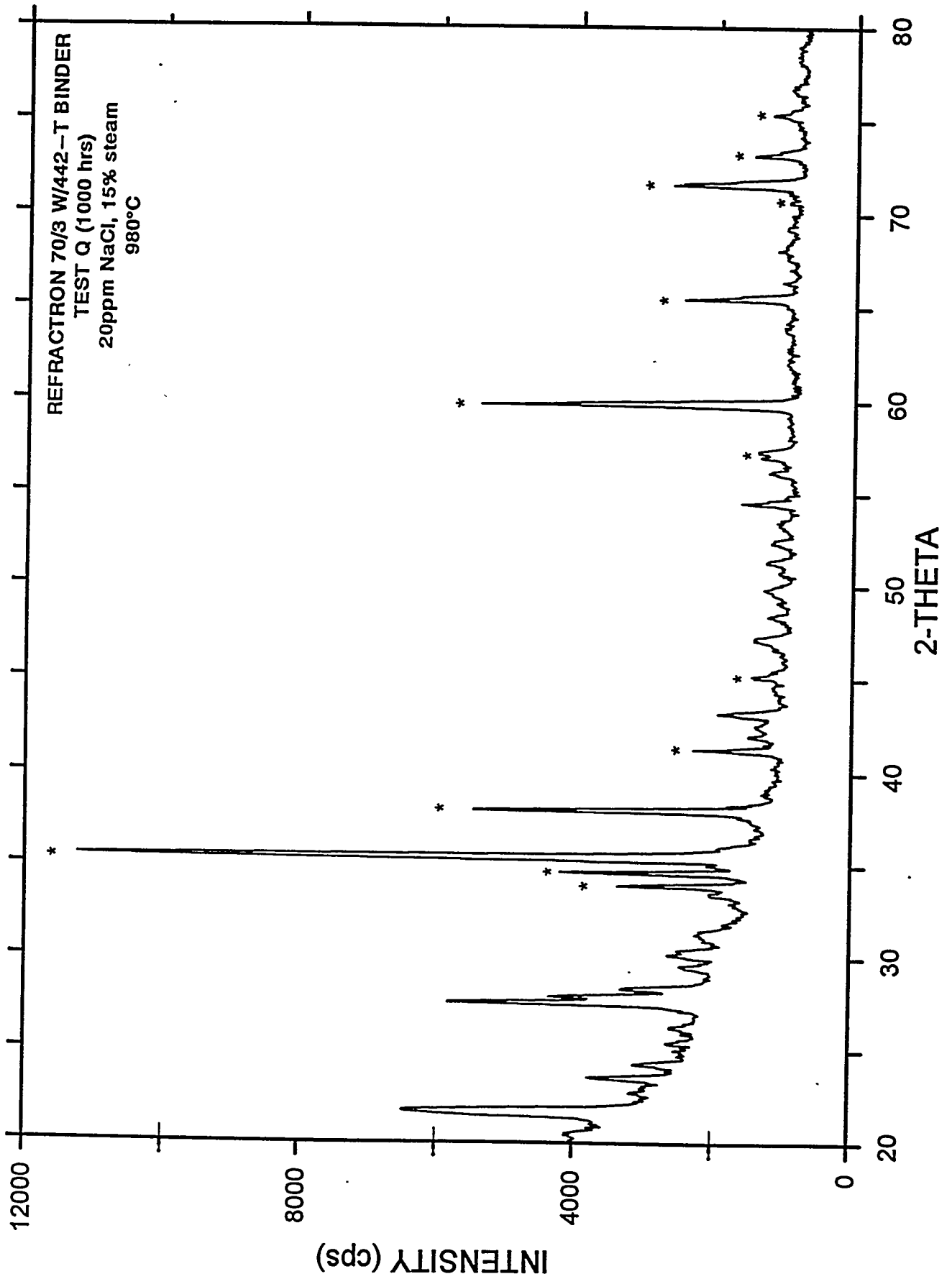












APPENDIX F

REPORT: "ANALYSIS OF CANDLE FILTERS FROM THE KRW GASIFIER"

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APPENDIX G
RAW DATA FROM ALUMINA ROD MEASUREMENTS
FOR TUBESHEET DEFLECTION DETECTION

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Raw Alumina Rod Height Measurements (mm)

temp (F) or
elapsed
hours

Alumina rod positions

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	C1	C2	C3	C4
room temp 04/08/94 16:09	44.1	44.1	45.2	43.2	44.4	43.3	42.7	44.1	41.9	43.5	44.1	42.6	44.3	42.8	42.7	43.6	42.4	43.3	29.1	31.1	26.5	28.8
room temp 04/09/94 08:23	44.3	44.6	45.6	43.4	44.8	43.7	42.8	44.6	42.3	43.5	44.4	42.6	44.3	43.1	42.8	43.9	41.9	43.4	29.1	31	26.4	28.9
room temp 04/10/94 12:09	44.3	44.5	45.6	43.4	44.6	43.6	42.5	44.4	42.2	43.8	44.4	42.5	44.3	43	42.8	43.9	42.2	43.7	29.2	30.9	26.4	28.7
room 04/11/94 08:35	44.3	44.5	45.6	43.6	44.6	43.2	42.8	44.3	42.1	43.2	44.3	42.5	43.9	43	42.5	44.5	42.9	44.3	29.1	30.9	26.3	28.5
1400 04/11/94 14:20	44.6	44.7	46.5	44.5	45.9	44.6	43	45	42.7	43.2	44.5	42.2	44.1	43.6	42.9	44.5	42.9	44.3	29.1	31.7	26.3	28.5
1500 04/11/94 15:50	44.1	45.8	45.7	43.8	45.2	43.5	42.3	44.2	41.6	41	43.9	41.6	43.5	42.6	42.2	43.5	42.5	43.5	28.8	31.1	25.8	28.2
1570 04/11/94 17:00	43.9	44	45.5	42.9	44.4	42.5	41.4	43.4	41.4	39.3	43.2	41.1	42.9	42.1	41.9	43.1	42	42.8	28.5	30.9	25.6	28.1
1619 04/12/94 09:12	42.8	42.9	44.3	41.7	43.2	41.2	40.1	41.9	40	38.5	43.2	40.9	42.6	41.8	41.7	42.8	42	42.9	28.6	30.6	25.3	27.9
24.42 04/12/94 17:26	42.8	42.5	44.1	41.7	43.2	41.1	40.2	41.7	39.5	33.7	41.5	39.6	41.5	40.2	40.2	41.4	40.5	41.4	27.8	30	24.1	26.8
25.66 04/12/94 18:40	42.9	42.5	44.3	42	43.5	41.1	40.2	41.7	40.2	33.7	41.5	39.6	41.5	40.2	40.2	41.4	40.9	40.9	28	29.9	24.5	27.1
39.55 04/13/94 08:33	42.3	42.6	44.1	42.2	43.3	41.2	40	41.6	40	33.3	41.3	39.6	41.3	39.8	40	41.3	40.8	41.8	27.5	29.8	24.4	26.9
48.22 04/13/94 17:14	42.1	41.9	43.8	41.9	42.5	40.9	40	41.2	39.9	33.2	41.1	39.6	41.1	39.6	40	41.1	40.5	41.5	27.5	29.8	24.2	26.9
63.48 04/14/94 08:29	42.3	42.2	43.7	42.1	43.2	40.5	39.6	41.6	40.1	33.4	41.5	39.6	41.2	40	40	41.1	40.7	41.5	27.6	29.9	24.4	26.9
71.32 04/14/94 16:20	42.2	42.2	43.6	41.9	42.9	40.3	39.5	41.3	39.8	33	41.2	39.5	41.1	40	39.9	41	40.5	41.5	27.6	29.9	24.2	26.9
87.16 04/15/94 08:10	42.2	42.3	43.7	41.9	43.2	40.6	39.5	41.4	39.7	32.9	41	39.3	41.2	40	39.9	41.2	40.4	41.4	27.7	29.9	24.3	26.9
94.29 04/15/94 15:18	42.2	42.2	43.8	42.1	43.1	40.7	39.7	41.4	39.8	32.9	41.3	39.2	41.3	40.1	39.9	41.2	40.4	41.6	27.6	29.9	24.1	26.6
114.45 04/16/94 11:27	42	42.2	43.6	41.7	43.2	40.7	39.5	41.4	39.9	32.9	41.3	39.6	41.2	39.9	40.3	41.1	40.9	41.9	27.7	29.9	24.4	26.7
138.35 04/17/94 11:22	42	42	43.6	42	43.1	40.5	39.7	41.3	39.3	32.6	41.3	39.6	41.1	39.8	40	41	40	41.6	27.7	29.9	24.4	26.7
144.28 04/17/94 17:17	41.9	41.9	43.6	42	43.1	40.7	39.6	41.3	39.3	32.6	41.1	39.6	41.1	39.8	39.9	41	40	41.6	27.7	29.9	24.3	26.7
160.30 04/18/94 09:19	41.9	41.9	43.5	41.2	42.8	40.4	39.6	41.3	39.6	32.6	41.3	39.6	41.1	39.8	39.9	41	40	41.6	27.5	29.9	24.3	26.7
166.37 04/18/94 15:23	41.9	42	43.4	42	42.9	40.5	39.5	41.1	39.6	32.7	40.9	39.3	41.1	39.8	39.8	41	40.8	41.4	27.5	29.9	24.3	26.7
183.65 04/19/94 08:39	41.9	41.8	43.3	41.8	42.8	40.6	39.5	41.4	39.9	32.6	41.7	39.1	41.4	39.7	40.3	41.2	40.5	41.5	27.5	29.8	24.3	26.9
186.08 04/19/94 11:05	41.9	41.8	43.3	41.6	42.8	40.6	39.6	41.4	39.9	32.6	42	39.3	41.3	39.7	40.4	41.3	40.4	41.6	27.7	29.6	24.1	26.9
207.59 04/20/94 08:36	42.1	41.9	43.6	41.5	43	40.7	39.8	41.4	40	32.8	42	39.5	41.3	39.7	40.4	41.3	40.4	41.6	27.7	29.6	24.1	26.9
231.25 04/21/94 08:16	42.2	41.8	43.7	41.5	43.1	40.8	39.9	41.6	40.3	32.4	41.9	39.3	41.2	39.6	40.3	41.2	40.7	41.8	27.8	29.6	24.2	26.9
255.39 04/22/94 08:24	42.3	41.9	43.7	41.4	43	40.7	40	41.4	40.2	32.2	41.9	39.4	41.2	39.4	40.3	41.1	40.4	41.7	27.8	29.8	24.2	26.9
279.18 04/23/94 08:12	42.3	41.9	43.7	41.4	43	40.6	39.7	41.5	40.3	31.9	42	39.4	41.2	39.6	40.2	40.9	40.4	41.7	27.9	29.6	24.2	26.9
308.45 04/24/94 13:28	42.3	41.6	43.9	41.4	42.9	40.7	39.8	41.5	40.2	32.3	42.1	39.4	41.3	39.5	40.2	41.1	40.5	41.7	27.7	29.7	24.2	26.9
327.45 04/25/94 08:28	42.4	41.7	43.5	41.3	42.8	40.5	39.6	41.4	40.2	32	41.9	39.3	41.2	39.4	40.1	40.9	40.5	41.7	27.8	29.6	24.2	27.1
351.55 04/26/94 08:34	42.4	41.7	43.8	41.4	43	40.7	39.6	41.4	40.3	32.3	41.9	39.3	41.2	39.5	40.1	41	40.5	41.8	27.8	29.7	24.3	27.1
375.26 04/27/94 08:16	42.3	41.7	43.8	41.5	42.9	40.5	39.7	41.5	39.6	32.2	41.9	39.4	41.2	39.4	40.2	41.1	40.5	41.6	27.8	29.8	24.2	27
399.46 04/28/94 08:28	42.3	41.6	43.6	41.4	42.9	40.5	39.5	41.3	39.6	32.2	41.9	39.3	41.2	39.5	40.1	41.1	40.5	41.7	27.8	29.8	24.3	27
425.06 04/29/94 10:04	42.3	41.5	43.5	41.4	42.9	40.5	39.4	41.4	39.6	32.1	41.9	39.1	41.2	39.4	40.1	40.8	40.5	41.6	27.8	29.7	24.3	27
454.54 04/30/94 15:33	42.2	41.6	43.5	41.3	42.8	40.5	39.3	41.3	39.4	32.1	41.9	39.3	41.1	39.3	40.1	41	40.5	41.6	27.9	29.9	24.2	27
477.08 05/01/94 14:05	42.2	41.6	43.6	41.4	43	40.3	39.4	41.3	39.6	32	41.9	39.1	41	39.2	40	40.8	40.3	41.6	27.9	29.8	24.3	27
494.61 05/02/94 07:37	42.2	41.7	43.7	41.4	42.9	40.4	39.4	41.2	39.4	31.9	41.8	39.1	41	39.1	40.1	40.9	40.4	41.6	27.8	29.8	24.2	27
501.33 05/02/94 14:20	42.2	41.6	43.7	41.3	42.9	40.4	39.4	41	39.6	31.9	41.9	39.1	40.9	39.1	39.9	40.8	40.4	41.6	27.8	29.9	24.1	27
503.99 05/02/94 17:01	41.9	41.5	42.8	41	42.9	39.5	38.9	40.5	39.2	31.6	41.3	39.1	40.4	38.6	39.5	39.7	39.6	41.6	27.3	29.1	23.4	26.4
504.98 05/02/94 17:59	40.9	40.6	42.8	40.6	41.8	39.2	38.6	40.5	39.3	30.8	40.9	39.1	40.5	38.2	39.2	39.1	39.1	40.2	27.2	28.8	23.2	25.9
519.61 05/03/94 08:37	40.1	38.8	41.3	38.5	41	38	37.4	39.2	37.1	30.1	40.2	37.6	39.5	36.8	37.4	38.4	37.8	38.4	26.4	28.1	21.9	25
522.89 05/03/94 11:54	40	38.4	41.3	38.6	40.5	37.5	36.8	38.8	36.9	28.4	39.8	37.3	38.7	36.5	36.9	37.5	36.6	39.3	26.1	27.5	21.4	24.9
528.18 05/03/94 17:12	39.9	38.2	41.2	38.1	40.5	37.3	36.4	37.2	36.4	28.3	39.5	37.3	38.4	35.7	36.7	37.6	36.3	38.3	25.9	27.3	21.4	24.6
544.23 05/04/94 09:14	40	38.2	41.2	39.2	40.5	37.2	36.6	38.5	36.9	29.3	39.7	37.2	39.1	36.3	36.7	38.1	37.1	39.2	26.1	27.4	21.5	24.7
568.61 05/05/94 09:37	40.2	37.9	41.2	39.2	40.5	36.8	36.7	37.6	36.5	28.4	39.8	37.2	38.3	36.3	36.7	38.3	37.3	39	25.9	27.3	21.5	24.5

Corrected alumina rod displacement measurements (mm)

measured at 870 C

Alumina Rod Positions

elapsed hours	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	C1	C2	C3	C4
0 04/11/94 17:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.93 04/11/94 18:56	0.225	0	0.125	0	0	0	0.025	0.025	0.025	0.625	0	0.025	0.125	0.125	0.025	0	0	0	-0.1	0.3	0.3	0
16.19 04/12/94 09:12	0	0	0.1	0.1	0.1	0.2	0.2	0.4	0.3	4.1	0.7	0.1	0.5	1.1	0.9	0.8	0.4	1.1	0.7	0.9	1.5	1.3
24.42 04/12/94 17:26	0.05	0.25	0.35	0.15	0.15	0.35	0.35	0.65	0.85	4.55	1.05	0.85	0.65	1.15	0.95	0.95	0.75	1.65	0.7	0.9	1.5	1.1
25.66 04/12/94 18:40	0.1	0.6	0.3	0	0	0.5	0.3	0.8	0.3	4.7	0.8	0.6	0.5	1	0.8	0.8	0.2	0.7	0.5	1	1.1	1.1
39.55 04/13/94 08:33	0.475	0.275	0.275	0	0	0.175	0.275	0.675	0.275	4.875	0.775	0.375	0.475	1.175	0.775	0.675	0.075	0.675	1	1.1	1.2	1.2
48.22 04/13/94 17:14	0.575	0.875	0.475	0	0.675	0.375	0.175	0.975	0.275	4.875	0.875	0.775	0.575	1.275	0.675	0.775	0.275	0.875	1	1.1	1.4	1.4
63.48 04/14/94 08:29	0.525	0.725	0.725	0	0.125	0.925	0.725	0.725	0.225	4.825	0.625	0.425	0.625	1.025	0.825	0.925	0.225	1.025	0.9	1	1.2	1.2
71.32 04/14/94 16:20	0.575	0.675	0.775	0	0.375	1.075	0.775	0.975	0.475	5.175	0.875	0.475	0.675	0.975	0.875	0.975	0.375	0.975	0.9	1	1.4	1.2
87.16 04/15/94 08:10	0.65	0.65	0.75	0	0.15	0.85	0.85	0.95	0.65	5.35	1.15	0.75	0.65	1.05	0.95	0.85	0.55	1.15	0.7	1	1.3	1.2
94.29 04/15/94 15:18	0.525	0.625	0.525	0	0.125	0.625	0.525	0.825	0.425	5.225	0.825	0.525	0.625	0.925	0.825	0.825	0.425	1.025	0.8	1.2	1.3	1.4
114.45 04/16/94 11:27	0.675	0.575	0.675	0	0	0.575	0.675	0.775	0.275	5.175	0.675	0.675	0.375	0.775	0.775	0.675	0.375	0.775	0.9	1	1.5	1.5
138.35 04/17/94 11:22	0.8	0.9	0.8	0	0.2	0.7	0.6	0.9	0.5	5.5	0.8	0.4	0.6	1.1	0.5	0.9	0	0.6	0.8	1	1.2	1.4
144.28 04/17/94 17:17	0.85	0.95	0.75	0	0.15	0.85	0.55	0.95	0.95	5.55	0.75	0.35	0.65	1.15	0.75	0.95	0.85	0.85	0.8	1.2	1.2	1.4
160.30 04/18/94 09:19	0.825	0.925	0.825	0.575	0.425	0.925	0.625	0.925	0.925	5.525	0.925	0.325	0.625	1.125	0.825	0.925	0.825	0.825	0.8	1.2	1.3	1.4
166.37 04/18/94 15:23	0.775	0.775	0.875	0	0.275	0.775	0.675	1.075	0.575	5.375	1.075	0.575	0.575	1.075	0.875	0.875	0	0.975	1	1.2	1.3	1.4
183.65 04/19/94 08:39	0.85	1.05	1.05	0	0.45	0.75	0.75	1.05	0.35	5.55	0.35	0.85	0.35	1.25	0.45	0.75	0.35	0.95	1	1.1	1.3	1.2
186.08 04/19/94 11:05	0.925	1.125	1.125	0.225	0.525	0.825	0.725	0.925	0.325	5.625	0.125	0.525	0.525	1.325	0.725	0.725	0.425	1.225	0.7	1.1	1.2	1.3
207.59 04/20/94 08:36	0.6	0.9	0.7	0.2	0.2	0.6	0.4	0.8	0.2	5.3	0	0.6	0.4	1.2	0.3	0.6	0.4	0.8	0.8	1.3	1.5	1.2
231.25 04/21/94 08:16	0.525	1.025	0.625	0.225	0.125	0.525	0.325	0.625	0	5.725	0.125	0.625	0.525	1.325	0.425	0.725	0.125	0.625	0.8	1.3	1.4	1.2
255.39 04/22/94 08:24	0.45	1.05	0.55	0.35	0.25	0.65	0.25	0.85	0.05	5.95	0.15	0.55	0.55	1.55	0.45	0.85	0.45	0.75	0.7	1.1	1.6	1.2
279.18 04/23/94 08:12	0.475	0.975	0.675	0.375	0.275	0.775	0.575	0.775	0	6.275	0.075	0.575	0.575	1.375	0.575	1.075	0.475	0.775	0.6	1.3	1.4	1.2
308.45 04/24/94 13:28	0.45	1.25	0.45	0.35	0.35	0.65	0.45	0.75	0.05	5.85	0	0.55	0.45	1.45	0.55	0.85	0.35	0.75	0.8	1.2	1.4	1.2
327.45 04/25/94 08:28	0.375	1.175	0.875	0.475	0.475	0.875	0.775	0.875	0.075	6.175	0.175	0.675	0.575	1.575	0.675	1.075	0.375	0.775	0.7	1.3	1.4	1.1
351.55 04/26/94 08:34	0.45	1.25	0.65	0.45	0.35	0.75	0.75	0.95	0.05	5.95	0.25	0.75	0.65	1.55	0.75	1.05	0.45	0.75	0.7	1.2	1.3	1.1
375.26 04/27/94 08:16	0.525	1.225	0.625	0.325	0.425	0.925	0.625	0.825	0.725	6.025	0.225	0.625	0.625	1.625	0.625	0.925	0.425	0.925	0.7	1.1	1.4	1.1
399.46 04/28/94 08:28	0.565	1.325	0.825	0.425	0.425	0.925	0.825	1.025	0.725	5.925	0.225	0.725	0.625	1.525	0.725	1.125	0.525	0.825	0.7	1.2	1.3	1.1
425.06 04/29/94 10:04	0.55	1.45	0.95	0.45	0.45	0.95	0.95	0.95	0.75	6.15	0.25	0.95	0.65	1.65	0.75	1.25	0.45	0.95	0.7	1.1	1.3	1.1
454.54 04/30/94 15:33	0.675	1.375	0.975	0.575	0.575	0.975	1.075	1.075	0.975	6.175	0.275	0.775	0.775	1.775	0.775	1.075	0.475	0.975	0.6	1	1.4	1.1
477.08 05/01/94 14:05	0.625	1.325	0.825	0.425	0.325	1.125	0.925	1.025	0.725	6.225	0.225	0.925	0.825	1.825	0.825	1.225	0.625	0.925	0.8	1.1	1.3	1.1
494.61 05/02/94 07:37	0.625	1.225	0.725	0.425	0.425	1.025	0.925	1.125	0.925	6.325	0.325	0.925	0.825	1.925	0.725	1.125	0.525	0.925	0.7	1.1	1.4	1.1
501.33 05/02/94 14:20	0.625	1.325	0.725	0.525	0.425	1.025	0.925	1.325	0.725	6.325	0.225	0.925	0.925	1.925	0.925	1.225	0.525	0.925	0.7	1	1.5	1.1