

308
Scientific Notebook #074
Q200002070013

S149
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CNWRA S/N No. 074B

account book S149

Available in 150 and 300 pages

This CNWRA Scientific Notebook No. 074B was first issued to Mikko Ahola, then used by SURE staff member Alan Pickers, under the direction of Sitakanta Mohanty of the CNWRA. In 3/93 two (2) No. 074 notebooks were incorrectly issued, to two different individuals and projects. This has been designated as S/N No. 074B.

Record Ruled, 27 Lines

GEN
JANICE MORRIS
CNWRAQA
3/17/2000

Reorder number stamped on backbone of this book

CNWRA
CONTROLLED
COPY 074 B GEN
074 B was issued to
Mikko Ahola in 3/93 for
The Seismic Rock Mechanics
project. GEN
3/17/2000



Wilson Jones
Chicago, Illinois 60648

Made in Korea

Name: Coupled thermal-mechanical-hydrological experiment.
Objective

The objective of the coupled TMH experiment is to study the mechanical-effect dependent saturated and unsaturated fluid flow, primarily through fracture in rocks. The research is organized to progress from simple to more complex activities. ~~The~~ initial stage of the experiment will focus on mechanical-hydrological coupling effects of single jointed tuff specimen. Subsequently, the thermal effect will be incorporated in the coupled process.

The experiments will be conducted by Alan Picken.

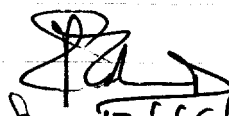
Equipment and material to be implemented:

The direct shear test apparatus has been modified for saturated and unsaturated flow experiments. The flow arrangements require same equipment as described in the corresponding section in Note Book 106.

A profilometer is used for fracture surface characterization.
Measurement parameters:

Flow rates, pressure drop, dimensions.

The profilometer measures vertical depth from a reference height.

Signature 
12/16/94

3/17/93

REMOVED SPECIMEN SRM 13.2.3/13.1.2. SPECIMEN
WAS SUBMERGED IN WATER.

3/30/93

REMOVED SPECIMEN FROM WATER. PERFORMED
SCHMIDT HAMMER REBOUND TESTS.

SRM 13.2.3 TOP BLOCK SIDES

1	58	9	57
2	62	10	58
3	60	11	55
4	58	12	58
5	53	13	59
6	58	14	54
7	57	15	58
8	59	16	56

SRM ~~13.1.2~~^{P 3/10} 13.2.3 JOINT SURFACE

1	48	7	54
2	50	8	56
3	56	9	54
4	60	10	52
5	57	11	55
6	56	12	55

A. Fickes

3/30/93

SRM 13.1.2 BOTTOM BLOCK SIDES

1	53	9	55
2	55	10	53
3	56	11	53
4	53	12	52
5	59	13	49
6	56	14	53
7	57	15	50
8	54	16	53

SRM 13.1.2 JOINT SURFACE

1	55	7	55
2	55	8	55
3	50	9	50
4	51	10	58
5	57	11	52
6	55		

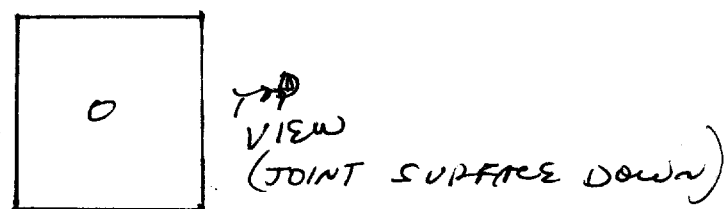
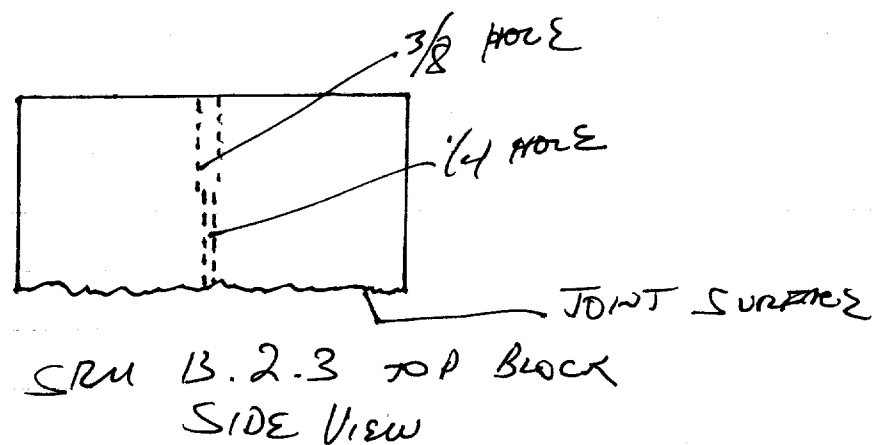
PERFORMED TILT ANGLE TEST-

SIDE 1-3 59°

SIDE 3-1 49°

TOP BLOCK NET WEIGHT WAS 18.8 LBS
DRAINED A 1/4" HOLE THROUGH THE CENTER
OF THE TOP BLOCK FOLLOWED BY A 2" DEEP
3/8" HOLE AS ILLUSTRATED ON PAGE 4.

A. Fickes



GROUTED SPECIMENS WITH FOLLOWING RECIPE:

1 POUND 10 OZ WATER

20gms PARACEM

3 POUNDS 5 OZ GROUT TYPE III

P# 5 OZ SAND

A 3/8 SS TUBE WAS GROUTED INTO PLACE WITH THE TOP BLOCK. SPECIMENS WERE RESUBMERGED UNDER WATER. P

4/12/93

ALL LOAD CELLS WERE CALIBRATED. SEE 3 RING LAB NOTEBOOK FOR DOCUMENTATION.

APC 4/23

4/23/93

RAN PROFILE T31PTBBT.DAT WITH 25 MIL INCREMENTS ON PROFILEN.P

4/26/93

RAN PROFILE T31PBBT1.DAT WITH SAME COORDINATES AS THE TOP BLOCK.P

4/28/93

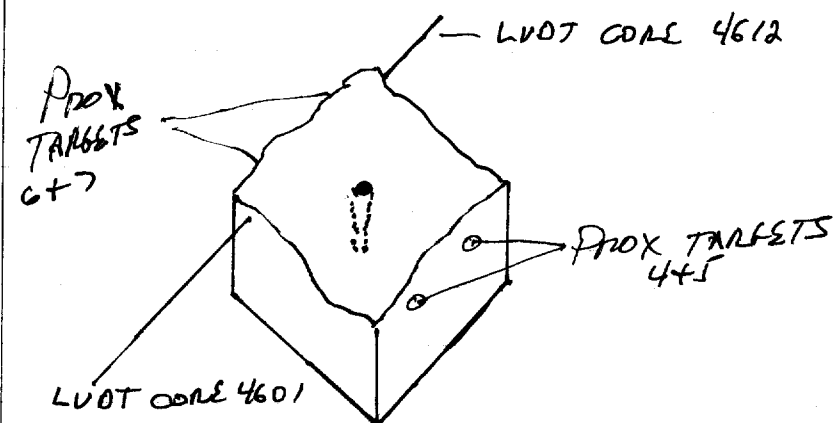
RAN PROFILE T31PBBT.DAT P

4/29/93

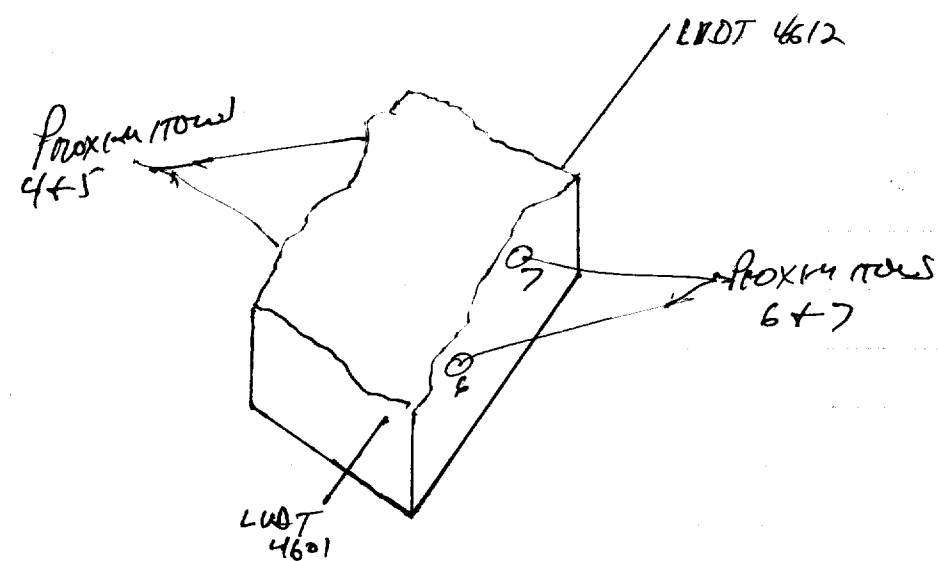
RESUBMERGED SPECIMENS P

5/2/93

INSTUMENTED SPECIMENS AS ILLUSTRATED BELOW.



TOP BLOCK SRM 13.2.3



BOTTOM BLOCK SRM 13.1.2

APC 4/23

5/3/93
5/3/93

Following is CALIBRATION DATA FOR THE
INSTRUMENTATION USED:

COMP CHAN	XDCR	CAL	CAL DATE
0	VLC1	10000 #/V	4/12/93
1	VLC2	10,000 #/V	4/12/93
2	VLC3	10,000 #/V	4/12/93
3	HL TVL	10000 #/V	4/12/93
4	LVD1 HL	10000 #/V	4/13/93
5	LVD2 LVD1	0.20 "/V	4/30/93
6	PROX4 LVD2	0.20 "/V	4/30/93
7	PROX5 PROX4	101 MILS/V	4/29/93
8	PROX6 PROX5	89 MILS/V	4/29/93
9	PROX7 PROX6	99 MILS/V	4/29/93
10	PROX7	103 MILS/V	4/29/93
11	PROX DSP.	0.3 "/V	4/29/93

Following are VOLTAGE READINGS FOR LVD1
4601

2	10.01	2	10.12
1.5	7.52	1.5	7.58
1	4.98	1	5.05
0.5	2.526	.5	2.521
0	0.003	0	-0.005
-1.5	-2.111	-1.5	-2.551
-1	-5.07	-1	-5.07
-2	-10.10	-2	-7.58

CAL = 0.20 "/VOLT

-2 -10.10

CAL = 0.20 "/VOLT

5/3/93

VOLTAGE READINGS FOR PROX.

PROX 4	5	6	7
50 0.89	0.90	0.74	0.83
100 1.33	1.37	1.16	1.27
150 1.87	1.94	1.67	1.79
200 2.44	2.49	2.21	2.34
250 2.99	3.09	2.82	2.88
300 3.52	3.65	3.32	3.38
350 3.88	4.12	3.83	3.86
400 4.43	4.72	4.31	4.29
450 4.96	5.36	4.79	4.77
500 5.45	5.88	5.28	5.25
550 5.89	6.57	5.76	6.08
600 6.20	6.94	6.19	6.36

CAL 101 "/V 89 "/V 99 "/V 103 "/V

Documentation with INSTRUMENTS USED FOR CALIBRATION
is in 3-RING LAB NOTEBOOK

RAN T31NS1-5.DAT BEARING OFFSETS WERE
441, 418, 422, 432 RESPECTIVELY.

WITH NO VERTICAL LOAD 5/3/93

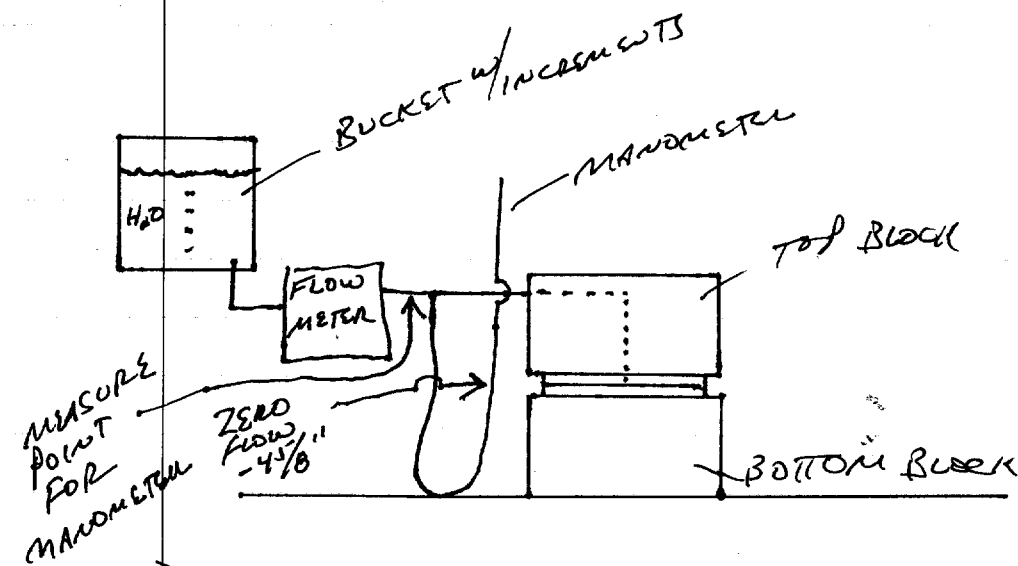
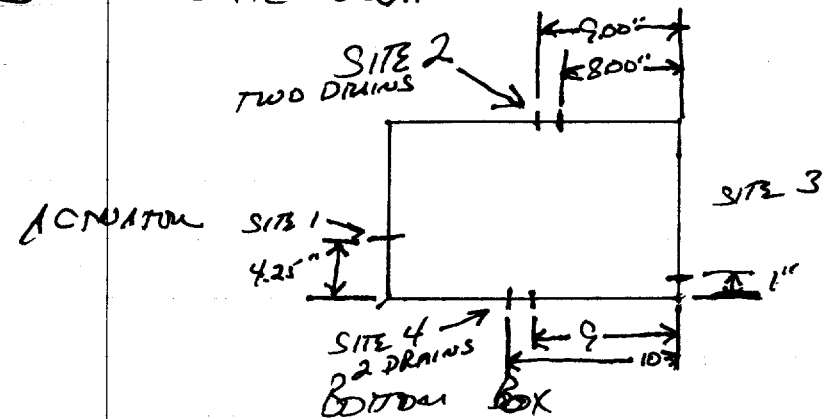
5/4/93

FLOWED WATER AT 200 CCM. NO VERTICAL LOAD.
3 MINUTE TIME PERIOD. COLLECTED 55 CC ML AT
SITE 2, COLLECTED 60 CC ML AT SITE 3, 480 ML AT
SITE 4. SEE NEXT PAGE FOR SITE LOCATIONS.

APRICKS

5/4/83

SITE LOCATIONS



A. Pickens

5/4/83

FLOWED AT 400 CCM FOR 3 MINUTES

SITE 1 - NO WATER
 SITE 2 - 170 ml
 SITE 3 - 70 ml
 SITE 4 - 935 ml

1 MPa VERTICAL LOAD, FLOWED 200 CCM FOR 3 MINUTES

SITE 1 - NO WATER
 SITE 2 - 50 ml
 SITE 3 - 55 ml
 SITE 4 - 490 ml

2 MPa VERTICAL LOAD, FLOWED 200 CCM FOR 3 MINUTES

SITE 1 - NO WATER
 SITE 2 - 15 ml
 SITE 3 - 60 ml
 SITE 4 - 510 ml

NO FLOW - ~~40 5/8~~ ^{45 3/8} MANOMETER (EVEN WITH JOINT SURFACE) 3 MPa

100 CCM - 3/4"
 200 CCM + 3 1/8"
 300 CCM + 9 1/8"

NO FLOW 5 MPa NO FLOW - 4 5/8"

(SEE 131 FLOW DATA) 5/13/83

100 CCM - 1 1/8"
 200 CCM + 2 5/8"
 300 CCM + 7"

A. Pickens

5/4/93

7 MPa NO FLOW - $4\frac{5}{8}"$ 100 ccM - $-3\frac{3}{4}"$ 200 ccM + $3\frac{5}{16}"$

300 ccM + 9"

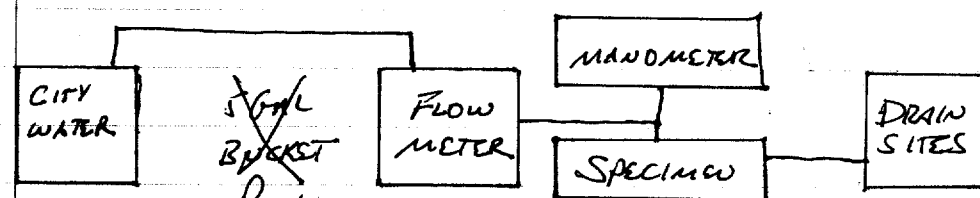
3 MPa NO FLOW - $4\frac{5}{8}"$ 100 ccM - $2\frac{1}{8}"$ 200 ccM + $3\frac{1}{4}"$ 300 ccM + $4\frac{1}{2}"$

5/5/93

RAN TESTS T31NSIA - JA.DAT

5/6/93

RECONFIGURED TEST SET-UP AS ILLUSTRATED BELOW.



3 minute	Flow	0 MPa	1 MPa	3 MPa	5 MPa	7 MPa
(HEAD)	100 ccM	$1\frac{3}{8}"$	$2\frac{3}{16}"$	$3\frac{7}{8}"$	$5"$	$6\frac{5}{16}"$
Flow	SITE 1	0	0	0	0	0
(ml)	SITE 2	15	15	10	15	20
	SITE 3	25	25	10	10	10
	SITE 4	245	260	260	255	270

SEE T31FLOWA.DAT 5/6

A. HICKS

5/6/93

Flow	0 MPa	1 MPa	3 MPa	5 MPa	7 MPa
200 ccM	$3\frac{1}{4}"$	$5\frac{3}{4}"$	$8\frac{7}{8}"$	$11\frac{1}{2}"$	$15\frac{1}{2}"$
SITE 1	0	0	0	0	0
SITE 2	45	40	40	55	60
SITE 3	35	30	20	20	15
SITE 4	510	530	510	520	520

300 ccM	5 MPa	9 MPa	14 MPa	18 MPa	20 MPa
SITE 1	0	0	0	0	0
SITE 2	100	110	120	120	105
SITE 3	40	25	25	20	20
SITE 4	795	785	800	725	575

NOTICED LOTS OF AIR BUILDING UP IN TUBES. A
 RECONFIGURED SYSTEM BY ADDING A 5 GAL
 BUCKET BETWEEN THE CITY WATER AND THE FLOW
 METER. SEE T31FLOWA.DAT T31FLOW3.DAT

3 minute	0 MPa	1 MPa	3 MPa
Flow	UP DOWN	UP DOWN	UP DOWN
100 ccM	$1\frac{1}{16}"$ 2"	$2\frac{1}{2}"$ 3	$3\frac{5}{16}"$ $3\frac{3}{4}"$
200 ccM	$3\frac{7}{8}"$ $4\frac{3}{4}"$	$5\frac{1}{4}"$ $6\frac{1}{4}"$	$7\frac{1}{8}"$ $8\frac{1}{16}"$
300 ccM	$6\frac{3}{16}"$ $6\frac{7}{8}"$	$8\frac{5}{16}"$ $10\frac{3}{8}"$	$11\frac{1}{2}"$ $13\frac{5}{8}"$

	5 MPa	7 MPa
	UP DOWN	UP DOWN
100 ccM	$3\frac{7}{16}$	$4\frac{5}{16}$
200 ccM	$8\frac{9}{16}$	$9\frac{1}{4}$
300 ccM	$14\frac{1}{16}$	$15\frac{1}{2}$

5/12/83

3 minute	0 MPa		1 MPa		3 MPa	
Flow	UP	DN	UP	DN	UP	DN
100 cm	2	2 1/2	3	3 1/2	4 1/4	4 1/2
200 cm	4 1/8	4 7/8	6 1/16	6 7/8 7 1/2	8 7/8	9 3/4
300 cm	6 7/8	8	10 5/8	12 3/8	14 1/4	16 1/6

	5 MPa	
	UP	DOWN
100 cm	4 3/4	5 5/8
200 cm	10 7/16	10 3/4
300 cm	17 1/16	18 3/8

	7 MPa	
	UP	DOWN
100 cm	5 7/16	11 3/4
200 cm	11 3/4	18 1/2
300 cm	18 1/8	

SEE T3/FLWA.DAT

3 minute	0 MPa		1 MPa		3 MPa	
Flow	UP	DN	UP	DN	UP	DN
100 cm	1 5/16	2	3 1/4	3 5/8	4 5/16	4 5/8
200 cm	4 1/8	4 1/2	6 7/8	7 3/8	9 5/8	10
300 cm	7 1/8	7	11 1/4	12 3/4	15 3/8	16 7/8

	5 MPa	
	UP	DN
100 cm	5 3/16	5 1/2
200 cm	11 5/8	12
300 cm	17 7/8	19 1/16

7 MPa

6 1/8

13 1/8

20 1/2

SEE T3/FLWB.DAT

APKES

5/13/83

HEAD (")

F

L

O

W

(ml)

3-minute	0 MPa		1 MPa		3 MPa		5 MPa		7 MPa	
Flow	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN
40 cm	1 1/16	2 3/8	1 1/16	2 3/8	1 1/2	2 3/8	2	2 3/16	2 3/16	
SITE 1	φ	φ	φ	φ	φ	φ	φ	φ	φ	φ
SITE 2	DROPS	DROPS	DROPS	DROPS	DROPS	DROPS	DROPS	DROPS	DROPS	DROPS
SITE 3	<5	DROPS	DROPS	DROPS	<5	DROPS	DROPS	DROPS	DROPS	DROPS
SITE 4	73	72	72	71	69	71	70	71	70	

60 cm	1 7/16	4 1/8	2	4	2 3/16	4 7/16	3 5/16	4 9/16	4 11/16	
SITE 1	φ	φ	φ	φ	φ	φ	φ	φ	φ	0
SITE 2	6	6	6	5	6	6	6	5	5	
SITE 3	7	7	6	5	5	5	<5	5	5	
SITE 4	145	140	145	155	140	150	150	145	145	

80 cm	1 3/4	4 7/8	3 1/16	5 3/8	4 3/8	6 1/4	5 1/16	6 3/4	7"	
SITE 1	φ	φ	φ	φ	φ	φ	0	φ	0	
SITE 2	10	8	11	6	9	8	10	8	12	
SITE 3	9	8	9	7	8	7	8	7	7	
SITE 4	185	200	210	205	200	210	215	215	215	

SEE T3/FLWC.DAT

RAN TESTS T3/INSIB.DAT THRU T3/INS5B.DAT (FIVE FILES)

RAN AIR PERMEABILITY TESTS. DATA FOLLOWING.

SEE T3/AIR1.DAT

APKES

5/17/93

Flow	1 MPa		3 MPa	
	SLPM(AIR)	UP DN	UP DN	
1		1/2 1/2	1 1/16 1 1/16	
2		7/8 7/8	1 1/8 1 1/4	
3		1 3/8 1 3/8	1 7/8 2	
4		2 1 1 7/8	2 3/4 2 7/8	
5		2 1/2 2 5/8	3 5/8 3 3/16	
6		3 3/8 3 1/4	4 1/2 4 1/16	
7		3 1/2 4 1/16	5 1/2 5 13/16	

Flow	5 MPa		7 MPa	
	UP DN	UP DN	UP DN	
1	7/8 7/8	1 1/2 1 1/2	1 1/2 1 1/2	
2	1 3/8 1 1/2	2 3/8 2 3/8	2 1/8 2 1/16	
3	2 3/8 2 3/8	3 3/4 3 3/4	3 3/4 3 3/4	
4	3 1/4 3 3/8	4 3/8 4 7/16	4 7/8 4 7/8	
5	4 3/8 4 7/16	5 3/8 5 5/8	5 3/8 5 3/8	
6	5 3/8 5 5/8	6 1/8 6 1/4	6 1/8 6 1/4	
7	6 5/8 6 7/8	7 5/8 7 5/8	7 5/8 7 5/8	

Flow	8 MPa	
	UP DN	UP DN
1	1 1/2 1 1/2	2 1/2 2 1/2
2	1 5/8 1 5/8	3 1/4 3 1/4
3	2 3/4 2 3/4	4 1/4 4 1/4
4	3 1/8 3 1/8	5 1/8 5 1/8
5	4 1/8 4 1/8	6 1/8 6 1/8
6	5 1/8 5 1/8	7 1/8 7 1/8
7	6 1/8 6 1/8	8 1/8 8 1/8

A. Pickens

6/1/93
6/3/93

Raw TESTS T3INSI-5C.DAT (5 Files). A

VERTICAL LOAD						
3 min. Flow (a)	0 MPa		1 MPa		3 MPa	
45ccm	UP	DN	UP	DN	UP	DN
HEAD	0.90"	1.30"	1.30"	1.92	1.86	2.52
Flow	130	130	130	130	130	130
62ccm						
HEAD	1.25	1.74	1.90	2.70	2.60	3.57
Flow	185	185	185	185	185	185
83ccm						
HEAD	1.70	2.80	2.65	3.74	3.80	5.10
Flow	250	250	250	250	250	250
105ccm						
HEAD	2.20	3.10	3.40	4.90	4.90	6.62
Flow	310	305	305	310	305	310
5 MPa 7 MPa 8 MPa						
45ccm	HEAD	2.30	2.95	2.75	3.12	3.10
	Flow	130	135	135	135	130
62ccm	HEAD	3.38	4.10	4.05	4.42	4.50
	Flow	185	185	185	185	185
83ccm	HEAD	4.70	5.80	5.80	6.15	6.44
	Flow	250	245	250	240	245
105ccm	HEAD	6.46	7.74	7.60	8.40	8.42
	Flow	310	310	310	310	310

A. Pickens

6/2/93

NOTES: (FOR PREVIOUS DATA AS IS)

- (1) HEAD "Ø" WAS 4.6" FROM TABLE TOP
- (2) 3 MINUTE FLOW TIME
- (3) NORMAL LOAD WAS INCREASED AND DECREASED AT 1 MPa/min.
- (4) SEE FILE T31FLOW.D.DAT FOR CLOSURE DATA.
- (5) ACCURACY OF FLOW METER WAS 5% OF FULL SCALE (100ccm)
- (6) FLOW RATES WERE DETERMINED BY ALLOWING WATER TO FLOW IN A GRADUATED CYLINDER FOR THREE MINUTES AND MEASURING THE AMOUNT FLOWED. *A*

6/3/93

RAN TEST T31INSI-5.D.DAT (5 FILES) JOINT WAS SEPARATED BEFORE TEST SERIES.

(HEAD PRESSURES)	0 MPa		1 MPa		3 MPa	
	UP	DN	UP	DN	UP	DN
13 ccm		0.35		0.45		0.50
24 ccm		0.40		0.55		0.64
33 ccm		0.50		0.65		0.80
45 ccm	0.50	0.60	0.64	0.78	0.84	1.00
62 ccm	0.66	0.70	0.84	1.00	1.10	1.30
83 ccm	0.70	0.88	1.08	1.30	1.42	1.70
105 ccm	0.82	1.00	1.30	1.60	1.78	2.12

A. Pickens

6/3/93

	5 MPa		7 MPa		8 MPa
	UP	DN	UP	DN	
13 ccm		0.56			
24 ccm		0.80			
33 ccm		0.95			
45 ccm	1.00	1.15	1.10	1.34	1.20
62 ccm	1.30	1.45	1.50	1.58	1.60
83 ccm	1.75	1.95	2.04	2.14	2.15
105 ccm	2.16	2.40	2.50	2.62	2.70

NOTES:

- 1) HEAD "Ø" LEVEL WAS 4.5" FROM TABLE TOP.
 - 2) NORMAL LOADS WERE INCREASED AND DECREASED AT 1 MPa/min.
 - 3) SEE FILE T31FLOWE.DAT FOR CLOSURE DATA. *if*
- SEPARATED JOINT - RAN 5 NORMAL TESTS: T31INSI-5.D.DAT (5)

	0 MPa		1 MPa		3 MPa	
	UP	DN	UP	DN	UP	DN
13 ccm	0.34	0.45	0.46	0.62	0.75	0.72
24 ccm	0.50	0.55	0.62	0.78	0.78	0.95
33 ccm	0.58	0.65	0.75	0.85	1.00	1.20
45 ccm	0.68	0.78	0.94	1.20	1.24	1.50
62 ccm	0.88	1.00	1.25	1.62	1.70	2.20
83 ccm	1.10	1.28	1.60	2.12	2.20	2.85
105 ccm	1.30	1.55	2.00	2.65	2.80	3.60

A. Pickens

6/4/93

	5 MPa		7 MPa		8 MPa	
	UP	DN	UP	DN	UP	DN
13 CCM	0.65	0.25	0.25	0.80	0.80	1.10
24 CCM	0.90	1.05	1.02	1.12	1.10	1.45
33 CCM	1.20	1.35	1.35	1.48	1.45	1.88
45 CCM	1.50	1.20	1.72	1.82	1.88	2.65
62 CCM	2.08	2.44	2.42	2.62	2.65	3.60
83 CCM	2.80	3.25	3.30	3.52	3.60	"
105 CCM	3.50	4.18	4.20	4.50	4.60	

NOTES:

- 1) Head "0" LEVEL STARTED AT 4.6" FROM TABLE TOP
- 2) SEE FILE T31 FLOW F. DAT FOR CLOSURE DATA.
- 3) NORMAL LOAD WAS INCREASED AND DECREASED AT 1 MPa / MIN.

6/7/93

SEPARATED THE JOINT. RAN 5 NORMAL SHEAR TESTS.
T31 NS1-5 F. DAT (5 FILES)

	0 MPa		1 MPa		3 MPa	
	UP	DN	UP	DN	UP	DN
13 CCM	0.40	0.28	0.45	0.45	0.55	0.65
SITE 1	0	0	0	0	0	0
SITE 2	4	2	2	4	5	4
SITE 3	5	5	6	6	6	6
SITE 4	33	36	32	33	31	34

APR 1993

6/7/93

	5 MPa		7 MPa		8 MPa	
	UP	DN	UP	DN	UP	DN
13 CCM	0.65	0.25	0.75	0.84	0.80	
SITE 1	0	0	0	0	0	
SITE 2	5	5	5	5	4	
SITE 3	6	6	7	7	6	
SITE 4	31	33	32	33	32	
	0 MPa		1 MPa		3 MPa	
	UP	DN	UP	DN	UP	DN
24 CCM	0.60	0.40	0.85	0.70	1.02	1.08
SITE 1	0	0	0	0	0	0
SITE 2	6	6	10	9	12	10
SITE 3	9	9	10	9	10	10
SITE 4	56	57	51	54	51	53
	5 MPa		7 MPa		8 MPa	
	UP	DN	UP	DN	UP	DN
24 CCM	1.20	1.25	1.34	1.36	1.34	
SITE 1	0	0	0	0	0	
SITE 2	11	11	10	10	10	
SITE 3	10	10	15	10	9	
SITE 4	51	52	53	52	51	

APR 1993

6/7/83

	0 Mpa		1 Mpa		3 Mpa	
	UP	DN	UP	DN	UP	DN
33ccm	0.80	0.60	1.15	1.05	1.45	1.50
SITE 1	Ø	Ø	Ø	Ø	Ø	Ø
SITE 2	12	14	17	15	18	8
SITE 3	11	12	12	12	12	13
SITE 4	77	73	70	71	70	70
	5 Mpa		7 Mpa		8 Mpa	
	UP	DN	UP	DN	UP	DN
33ccm	1.68	1.76	1.80	1.84		1.85
SITE 1	Ø	Ø	Ø	Ø		Ø
SITE 2	17	18	17	17		13
SITE 3	12	12	12	12		12
SITE 4	69	70	70	70		70
	0 Mpa		3 Mpa		5 Mpa	
	UP	DN	UP	DN	UP	DN
45ccm	0.95	0.80	1.50	1.44	2.02	2.00
SITE 1	0	0	0	0	0	0
SITE 2	23	25	26	26	30	27
SITE 3	15	14	14	14	15	14
SITE 4	95	91	90	90	85	87

APR 83

6/7/83

	5 Mpa		7 Mpa		8 Mpa	
	UP	DN	UP	DN	UP	DN
45ccm	2.25	2.38	2.50	2.60		2.62
SITE 1	0	0	0	0		Ø
SITE 2	27	28	26	27		21
SITE 3	14	14	14	13		14
SITE 4	88	87	88	87		86
	0 Mpa		1 Mpa		3 Mpa	
	UP	DN	UP	DN	UP	DN
62ccm	1.34	1.24	2.15	2.20	2.64	3.10
SITE 1	0	0	0	0	0	0
SITE 2	45	47	47	47	45	47
SITE 3	16	16	16	16	16	16
SITE 4	127	124	125	123	118	123
	5 Mpa		7 Mpa		8 Mpa	
	UP	DN	UP	DN	UP	DN
62ccm	3.50	3.60	3.88	4.02	4.00	4.00
SITE 1	0	0	0	0	44	0
SITE 2	47	48	44	46	44	44
SITE 3	16	15	16	15	12	16
SITE 4	120	120	125	125	124	

APR 83

6/7/93

	0 MPa		1 MPa		3 MPa	
	UP	DN	UP	DN	UP	DN
83CCM	1.80	1.70	2.92	3.10	4.10	4.35
SITE 1	0	0	0	0	0	0
SITE 2	69	70	70	73	71	71
SITE 3	16	16	17	16	17	16
SITE 4	164	164	165	160	160	161
	5 MPa		7 MPa		8 MPa	
	UP	DN	UP	DN		
83CCM	4.84	5.20	5.45	5.72	5.80	
SITE 1	0	0	0	0	0	
SITE 2	72	71	76	70	70	
SITE 3	16	16	16	16	16	
SITE 4	165	165	170	161	165	
	0 MPa		1 MPa		3 MPa	
	UP	DN	UP	DN	UP	DN
100CCM	2.25	2.20	3.66	4.02	5.18	5.70
SITE 1	0	0	0	0	0	0
SITE 2	99	97	101	97	99	97
SITE 3	18	16	17	16	16	16
SITE 4	195	194	201	195	200	196

A. P. K. E. S.

6/7/93

	5 MPa		7 MPa		8 MPa	
	UP	DN	UP	DN		
8105CCM						
SITE 1						
SITE						
	5 MPa		7 MPa		8 MPa	
	UP	DN	UP	DN		
105CCM	6.30	6.80	7.20	7.40	8.64	
SITE 1	0	0	0	0	0	
SITE 2	93	96	96	98	94	
SITE 3	16	16	17	17	16	
SITE 4	205	205	210	200	205	P

NOTES:

- 1) FLOW TIME WAS 3 MINUTES.
- 2) VERTICAL LOAD WAS INCREASED AND DECREASED AT 1 MPa / MIN.
- 3) SEE FILE T31 FLOW 6.DAT FOR CLOSURE DATA.
- 4) HEDS "0" LEVEL WAS 5.2" FROM TABLE TOP. P

RECOVERED SPECIMEN SRM 10.3.3/10.2.2(3)-A.

PERFORMED SCHMIDT HAMMER REBOUNDS NTS

SRM 10.3.3 TOP ROCK, SIDES

1	58	8	55	14	58
2	54	9	58	15	60
3	58	10	57	16	56
4	57	11	58		
5	59	12	60		
6	58	13	47		
7	58				

6/9/93

SRM 10.3.3 TOP ROCK, JOINT SURFACE

1	50.	8	43.
2	49.	9	49.
3	50.	10	48.
4	50.	11	53.
5	47.	12	54.
6	40.	13	48.
7	50.	14	44.

SRM 10.2.2 ③-A BOTTOM ROCK, SIDES

1	56	9	50
2	52	10	58
3	53	11	60
4	53	12	56
5	56	13	51
6	54	14	51
7	60	15	54
8	58	16	58

SRM 10.2.2 ③-A BOTTOM BLOCK, JOINT SURFACE

1	44	8	39
2	48	9	50.
3	43	10	57
4	45	11	48.
5	50	12	56
6	49	13	56
7	48	14	49.

6/9/93

TOP BLOCK NET WEIGHT WAS 19.57#

TILT ANGLE - SIDE 1-3 = 56° SIDE 3-1 54.5°

6/14/93

SUBMERGED SPECIMEN SRM 10.3.3/10.2.2 ③-A

6/25/93

(731) 0 MPa 1 MPa 3 MPa

UP DN UP DN UP DN

6ccm

HEAD 5.8 8.6 6.5 8.7 6.5 8.8

FLOW 19 22 18 21 19 21

10ccm 5.85 8.5

HEAD 5.55 8.7 6.7 8.95 6.85 8.2

FLOW 30 31 31 31 32 32

20ccm

HEAD 6.2 9.1 7.1 9.5 7.4 10.1

FLOW 61 60 57 61 60 62

30ccm

HEAD 6.5 9.5 7.5 10.2 8.0 10.8

FLOW 92 94 91 93 92 92

40ccm

HEAD 7.45 9.9 8.0 10.7 8.5 11.7

FLOW 123 124 123 126 123 124

Accuracy

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6/25/93

	5 cm		7 MPa		8 MPa	
	UP	DN	UP	DN	UP	DN
6 cm						
HEAD	6.66	8.0	6.3	8.1	7.7	
Flow	19	19	19	20	19	
10 cm						
HEAD	6.9	9.4	8.8	8.5	9.6	
Flow	32	31	29	33	35	
20 cm						
HEAD	7.6	10.3	11.2	10.6	10.9	
Flow	59	60	62	62	63	
30 cm						
HEAD	8.3	11.3	12.4	11.7	12	
Flow	92	93	93	92	93	
40 cm						
HEAD	8.9	12.5	13.1	12.95	13.1	
Flow	117	125	124	123	123	

HEAD PRESSURE - ϕ LOAD, ϕ FLOW = $5\frac{1}{2}$ "

FLOW TIME WAS 3 MINUTES

VERTICAL LOAD WAS RAMPED AT 1 MPa/min

DATA GATHERED BY MARK POWELL AND ALBERTO GARCIA.

Alberto Garcia

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SOUTHWEST RESEARCH INSTITUTE
LABORATORY DATA LOG

TEST ITEM IDEN. T 31 SERIES 7/2/93 PAGE ¹³1 OF 2
TEST PROCEDURE REF. R. MANTEUFEL S. HSUNG PROJECT NO: 20 5704 039
TEST NAME HYDROSTATIC FLOW

Date	Time	Observations											
		0 MPa		1 MPa		3 MPa		5 MPa		7 MPa		8 MPa	
7/2/93 am	6 cm	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN
	HEAD	7.2	5.3	7.1	5.4	6.9	5.5	6.7	5.7	6.3	5.9	6.1	
	10 cm												
	HEAD	7.4	5.4	7.5	5.5	7.3	5.8	7.0	6.0	6.7	6.2	6.4	
	20 cm												
	HEAD	8.0	5.6	8.3	6.0	8.2	6.5	8.0	6.8	7.6	7.1	7.4	
	30 cm												
	HEAD	10.1	5.9	10.65	6.4	10.8	7.1	10.4	7.5	9.7	7.9	9.2	
	40 cm												
	HEAD	10.5	6.9	11.0	7.6	11.5	8.5	11.5	9.1	10.6	9.7	10.2	
	0 cm												
	HEAD	6.6	5.1		5.1		5.1		5.3	5.7	5.4	5.6	

NOTES:

- VERTICAL LOAD WAS APPLIED AT 1 MPa/min.
- FLOW WAS READ DIRECTLY FROM FLOWMETER, GILMONT MODEL 150 MM VOLUME/TIME WAS NOT USED.
- DEAERATED H₂O WAS USED.
- HEAD @ 0 FLOW - 6.6" H₂O
- BEGINNING W/ 3 MPa, HEAD @ 0 FLOW DROPPED TO 5.7"
- REASON UNKNOWN

Test Conducted by:

Witness: SwRI Gov't

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APICAW

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SOUTHWEST RESEARCH INSTITUTE LABORATORY DATA LOG

TEST ITEM IDEN. T 31 SERIES 7/2/93 PAGE 14 OF 2
 TEST PROCEDURE REF. R. MANTEUFEL S. HSUNG PROJECT NO: 20 5704 039
 TEST NAME HYDROSTATIC FLOW

Date	Time	Observations											
		0 MPa		1 MPa		3 MPa		5 MPa		7 MPa		8 MPa	
7/2/93 1:30 PM - 2:52 PM		UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN
	0 cc	4.9	4.8	5.0	4.9	5.0	4.95	5.0	4.95	5.0	4.95	5.0	5.0
	6 cc	5.15	5.1	5.3	5.2	5.3	5.3	5.35	5.2	5.4	5.4	5.4	5.4
	10 cc	5.3	5.2	5.4	5.4	5.5	5.5	5.6	5.6	5.65	5.65	5.7	5.7
	20 cc	5.5	5.45	5.8	5.75	5.9	6.0	6.1	6.2	6.3	6.3	6.35	6.35
	30 cc	5.7	5.7	6.05	6.05	6.45	6.5	6.7	6.75	6.9	6.9	7.0	7.0
	40 cc	5.95	5.85	6.35	6.4	7.0	7.0	7.3	7.35	7.6	7.6	7.65	7.65
NOTES		• VERTICAL LOAD WAS APPLIED AT 1 MPa/min • FLOWRATE TAKEN FROM GILMONT FLOWMETER - MODEL 150 MM • 2 ND RUN FOR THE DAY; 1 ST RUN DATA WAS INCONSISTENT • H ₂ O WAS DEAERATED PRIOR TO TEST											

Test Conducted by:

M. W. POWELL

A. GARCIA

Witness: SwRI Gov't

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APK 5/93

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SOUTHWEST RESEARCH INSTITUTE LABORATORY DATA LOG

TEST ITEM IDEN. 7/20/93 PAGE 15 OF 15
 TEST PROCEDURE REF. S. MOHANTY PROJECT NO: 20-5704-039
 TEST NAME HYDROSTATIC FLOW, GLYCEROL

Date	Time	Observations											
		0 MPa		1 MPa		3 MPa		5 MPa		7 MPa		8 MPa	
		UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN
	0 cc	4.2	3.5	4.0	3.7	4.0	3.7	3.9	3.7	3.8	3.9	3.9	3.9
	50 cc	5.1	5.4	5.7	6.3	6.6	6.6	6.1	7.0	6.9	7.3	7.4	7.4
	100 cc	9.3	10.4	12.1	15.2	15.3	14.1	12.9	14.1	14.6	16.3	15.2	15.2
	150 cc	15.6	17.8	19.8	19.8	-	-	21.7	-	-	-	-	-
	200 cc	22.6	22.9	-	-	-	-	-	-	-	-	-	-
	TIME	11:24	14:45	14:32	16:05	9:40	15:41	12:32	15:09	14:30	-	12:25	-
VOLUME - N (mL) - S		57	63	51	37	20	21	13	16	15	-	12	-
		80	19	24	15	11	6	8	2	2	-	4	-
		185	202	204	173	97	85	84	59	75	-	63	-
NOTES		• 2959 ₂ GLYCEROL 95% H ₂ O BY WEIGHT, Sp. Gr. = 30.2 cp • FLOW RATES ARE H ₂ O RATES, FLOW METER NEED TO BE ADJUSTED TO GLYCEROL FLOW RATES • VERTICAL LOAD APPLIED @ 1 MPa/min • CLOSURE DATA - T31FLOWJ.DAT • FLOW RATE "PULSED", REASON UNKNOWN, POSSIBLY CAUSED BY PUMP • "-" REPRESENTS OUT OF MANOMETER RANGE											

Test Conducted by:

M. W. POWELL

M. W. POWELL

Witness: SwRI Gov't

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APK 5/93

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**SOUTHWEST RESEARCH INSTITUTE
LABORATORY DATA LOG**

TEST ITEM IDEN. T31 SERIES PAGE 16 OF 1
 TEST PROCEDURE REF. M.W. POWELL PROJECT NO: 20-5704-039
 TEST NAME FLOWMETER CALIBRATION FOR GLYCERIN @ 30 cp

Date	Time	Observations		
7/21/93	9:03 AM 10:41 AM	FLOWMETER - GILMONT, Model 150 MM PART GF-5531-2627 0-200 ccm H ₂ O		
		READING (ccm H ₂ O)	Flow Vol. (mL)	TIME (min:sec)
		20	8	5:19
		40	19	5:02
		50	26	5:16
		60	35	5:10
		80	60	5:11
		100	90	5:02
		120	130	5:17
		140	170	5:07
		150	195	5:25
		160	225	5:19
		180	265	5:19
		200	335 ^{MP} 310	5:06
		Notes:		

Test Conducted by:

M.W. POWELL 7/21/93Mark W. Powell

Witness: SwRI Gov't

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APakes

7/23/93
8/19/93

Ran Profiles T31PBBAT.DAT + T31PTBAT.DAT.
 Performed Retest on submerged sample

SRM 10.3.3 TOP BACK SIDES

1	57	8	57
2	54	10	58
3	59	11	59
4	57	13	58
5	58	13	57
6	56	14	60
7	58	15	60
8	54	16	56

JOINT SURFACE

1	46	6	51
2	49	7	50
3	49	8	48
4	52	9	46
5	51	10	50

SRM 10.2.2 (3A) BOTTOM BACK SIDES

1	53	8	54	15	52
2	55	9	55	16	48
3	55	10	56		
4	48	11	56		
5	44	12	47		
6	58	13	42		
7	56	14	53		

8/19/83

SDM 10.2.2(3)A JOINT SURFACE

1	48	10	39
2	49	11	56
3	42	12	52
4	50	13	47
5	43	14	50
6	47	15	51
7	28	16	42
8	43		
9	46		

TILT ANGLE - SIDE 3-1 53°
 SIDE 1-3 56°

TOP BLOCK - 19.87# NET WEIGHT

8/20/83

GROUTED SPECIMENS WITH THE FOLLOWING
 RECIPE:

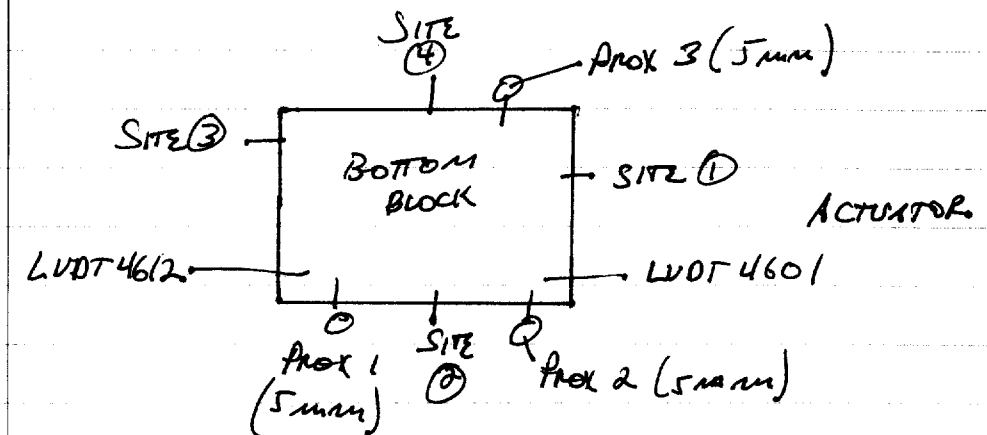
1 # 1002 WATER
 20 gm DMSACM
 3 # 502 TYPE III CEMENT
 8 # 102 SAND

PLACED SPECIMENS IN 26°C OVEN FOR
 48 HRS.

APR 83

8/23/83

INSTRUMENTED SPECIMEN AS ILLUSTRATED BELOW



THE TOP BLOCK WAS INSTRUMENTED WITH THE
 CORRESPONDING TARGETS AND LVDT CORES.

8/25/83

REASSEMBLED APPARATUS.

8/26/83

RAN NORMAL AND FLOW TESTS ON SPECIMEN
 DATA IS ON FOLLOWING 2 PAGES.

APR 83

**SOUTHWEST RESEARCH INSTITUTE
LABORATORY DATA LOG**

TEST ITEM IDEN. T32 SERIES PAGE 1 OF 2
 TEST PROCEDURE REF. S. MOHANTY PROJECT NO: 205704039
 TEST NAME HYDROSTATIC FLOW

SECTION 3020 SHEETS 3 SQUARE

Date

Time

Observations

8/26/93

RAN NORMAL TESTS T32 US1-F.DAT (5 FILLS)
WATER WAS FLOWING THROUGH JOINT DURING
THESE NORMAL TESTS.

	0 MPa		1 MPa		3 MPa		5 MPa		7 MPa		8 MPa	
	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN
10 CCN	7.0	5.00	6.60	5.10	6.02	5.25	5.60	5.25	5.45	5.35	5.40	
SITE 1	30	30	32	32	31	30	32	30	30	32	30	
SITE 2	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	
SITE 3	18	18	17	17	16	17	17	17	15	16	15	
SITE 4	Ø	Ø	Ø	DROPS	DROPS	Ø	DROPS	Ø	DROPS	Ø	DROPS	
30 CCN	7.12	5.10	6.70	5.20	6.25	5.40	5.80	5.45	5.60	5.55	5.60	
SITE 1	77	77	70	70	66	65	65	63	65	64	64	
SITE 2	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	
SITE 3	29	35	28	30	28	32	29	32	30	31	29	
SITE 4	Ø	Ø	DROPS	Ø	9	Ø	10	3	9	6	9	
50 CCN	7.20	5.20	6.82	5.35	6.45	5.55	6.00	5.65	5.90	5.75	5.80	
SITE 1	120	115	110	105	105	100	100	100	100	95	95	
SITE 2	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	
SITE 3	39	45	40	45	42	47	43	47	43	52	44	
SITE 4	DROPS	Ø	13	DROPS	16	8	17	41	17	14	17	
100 CCN	7.35	5.40	7.12	5.70	7.00	6.00	6.50	6.10	6.45	6.30	6.40	
SITE 1	250	225	190	190	185	165	170	155	170	160	170	
SITE 2	Ø	Ø	Ø	Ø	20	29	18	35	20	20	20	
SITE 3	61	78	82	92	85	83	88	82	90	92	90	
SITE 4	17	5	31	23	41	28	37	33	40	37	39	

Test Conducted by:

ANAN M PERINIS

Witness: SwRI Gov't

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APICKS

**SOUTHWEST RESEARCH INSTITUTE
LABORATORY DATA LOG**

TEST ITEM IDEN. T32 SERIES PAGE 2 OF 2
 TEST PROCEDURE REF. S. MOHANTY PROJECT NO: 205704039
 TEST NAME 16X20 STATK FLOW

Date	Time	Observations																																																																													
8/26/93	160 con	<table border="1"> <thead> <tr> <th colspan="2">0 MPa</th> <th colspan="2">1 MPa</th> <th colspan="2">3 MPa</th> <th colspan="2">5 MPa</th> <th colspan="2">7 MPa</th> <th>8 MPa</th> </tr> <tr> <th>UP</th> <th>DN</th> <th>UP</th> <th>DN</th> <th>UP</th> <th>DN</th> <th>UP</th> <th>DN</th> <th>UP</th> <th>DN</th> <th></th> </tr> </thead> <tbody> <tr> <td>7.52</td> <td>7.50</td> <td>7.40</td> <td>5.90</td> <td>7.45</td> <td>6.80</td> <td>7.00</td> <td>6.50</td> <td>7.00</td> <td>6.85</td> <td>6.85</td> </tr> <tr> <td>325</td> <td>270</td> <td>255</td> <td>230</td> <td>245</td> <td>210</td> <td>250</td> <td>195</td> <td>210</td> <td>195</td> <td>200</td> </tr> <tr> <td>Ø</td> <td>Ø</td> <td>30</td> <td>40</td> <td>60</td> <td>50</td> <td>71</td> <td>56</td> <td>73</td> <td>73</td> <td>71</td> </tr> <tr> <td>111</td> <td>110</td> <td>130</td> <td>115</td> <td>120</td> <td>110</td> <td>115</td> <td>115</td> <td>110</td> <td>105</td> <td>105</td> </tr> <tr> <td>34</td> <td>17</td> <td>50</td> <td>36</td> <td>59</td> <td>44</td> <td>58</td> <td>49</td> <td>61</td> <td>62</td> <td>59</td> </tr> </tbody> </table> <p> SITE 1 SITE 2 SITE 3 SITE 4 </p> <p> - HEAD AT "0" WAS 6.9" - FLOW TIME WAS 3 MINUTES - WATER WAS DEAERATED </p>	0 MPa		1 MPa		3 MPa		5 MPa		7 MPa		8 MPa	UP	DN	UP	DN	UP	DN	UP	DN	UP	DN		7.52	7.50	7.40	5.90	7.45	6.80	7.00	6.50	7.00	6.85	6.85	325	270	255	230	245	210	250	195	210	195	200	Ø	Ø	30	40	60	50	71	56	73	73	71	111	110	130	115	120	110	115	115	110	105	105	34	17	50	36	59	44	58	49	61	62	59
0 MPa		1 MPa		3 MPa		5 MPa		7 MPa		8 MPa																																																																					
UP	DN	UP	DN	UP	DN	UP	DN	UP	DN																																																																						
7.52	7.50	7.40	5.90	7.45	6.80	7.00	6.50	7.00	6.85	6.85																																																																					
325	270	255	230	245	210	250	195	210	195	200																																																																					
Ø	Ø	30	40	60	50	71	56	73	73	71																																																																					
111	110	130	115	120	110	115	115	110	105	105																																																																					
34	17	50	36	59	44	58	49	61	62	59																																																																					

Test Conducted by:

APICKS

Witness: SwRI Gov't

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APICKS

8/27/93

T32 SERIES TESTING:

- ALLOWED ROCK TO SATURATE OVERNIGHT.
- INCREASED FLOW TO 100 CCM AT 6.55" HEAD.
- INCREASED NORMAL LOAD TO 3 MPa, FLOW RATE WAS 98 CCM, 6.78" HEAD.
- LOAD WAS 3 MPa, FLOW RATE 100 CCM, HEAD 6.72"
- LOAD TO 5 MPa, FLOW RATE 100 CCM, HEAD 6.82"

Amur Mckenzie

SW

**SOUTHWEST RESEARCH INSTITUTE
LABORATORY DATA LOG**

TEST ITEM IDEN. T32 SERIES PAGE OF

TEST PROCEDURE REF. SITAKANTA MONASTY PROJECT NO: 20 5701 039

TEST NAME

Date	Time	Observations											
9/7/93		RAW NORMAL TESTS TRANSI-5B.DAT (5 FILES). GLYCERIN/WATER MIXTURE WAS FLOWING THROUGH ROCK JOINT BEFORE AND DURING THESE NORMAL TESTS. MIXTURE WAS 80% GLYCERIN AND 20% WATER BY WEIGHT. (WESTERN 1000# DATA CELL, 9/24/80041; MICRO MEAS. GAP STRAW GATE CONDITION 9/24/80076; ALL CALIBRATE BEFORE USE; FLUXE MODEL 87 DMM, 9/25/502012, CAL'D ON 26 AUG 93.)											
				0 MPa		1 MPa		3 MPa		5 MPa		7 MPa	8 MPa
				UP	DN	UP	DN	UP	DN	UP	DN	UP	DN
	10 CCM	HEAD	5.00		5.55		5.40						
	SITE 1	F	DROPS		3		3						
	SITE 2	L	Ø		Ø		Ø						
	SITE 3	O	Ø		DROPS		DROPS						
	SITE 4	W	Ø		Ø		DROPS						
	50 CCM	HEAD	5.45		5.75		5.85						
	SITE 1	F	6		5		2						
	SITE 2	L	Ø		DROPS		DROPS						
	SITE 3	O	DROPS		DROPS		DROPS						
	SITE 4	W	Ø		Ø		Ø						
	100 CCM	HEAD	6.95		7.65		8.25						
	SITE 1	F	8		9		9						
	SITE 2	L	9		6		5						
	SITE 3	O	DROPS		DROPS		DROPS						
	SITE 4	W	Ø		DROPS		DROPS						

Test Conducted by:

Witness: SwRI Gov't

Amur Mckenzie

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Amur Mckenzie

**SOUTHWEST RESEARCH INSTITUTE
LABORATORY DATA LOG**

TEST ITEM IDEN. T32 SERIES PAGE ____ OF ____
 TEST PROCEDURE REF. SITAKANTA MONASTY PROJECT NO: 20-5704-038
 TEST NAME _____

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NOTES:

- 1) INSTRUMENTATION AND SITE COLLECTION WAS AS IN THE TESTING ON 8/26/93
- 2) HEAD PRESSURE AT "O" WAS 4.8" FROM TABLE TOP.

Test Conducted by:

Alan McKee

Witness: SwRI Gov't

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STEADY STATE COULD NOT BE REACHED
TESTING WAS STOPPED.

Alan McKee

**SOUTHWEST RESEARCH INSTITUTE
LABORATORY DATA LOG**

TEST ITEM IDEN. T32 SERIES PAGE ____ OF ____
 TEST PROCEDURE REF. SITAKANTA MONASTY PROJECT NO: 20-5704-038
 TEST NAME _____

Date	Time	Observations											
9/8/93	100 CCN	0 MPa	1 MPa		3 MPa		5 MPa		7 MPa		8 MPa		
			UP	DN	UP	DN	UP	DN	UP	DN	UP	DN	
		UP	5.75										
		DN											
	SITE 1	F											
		O											
		W											
	200 CCN	HEAD	7.30										
		F	14										
		L	7										
	SITE 2	O	1										
		W	8										

Test Conducted by:

Alan McKee

Witness: SwRI Gov't

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Alan McKee

SOUTHWEST RESEARCH INSTITUTE
LABORATORY DATA LOG

TEST ITEM IDEN. T32 Series PAGE OF
 TEST PROCEDURE REF. SITAKANTA MONASTI PROJECT NO: 20 5704 039
 TEST NAME

Date	Time	Observations
	400ccm SITE 1 SITE 2 SITE 3 SITE 4	<div style="display: flex; justify-content: space-around;"> <div>0 MPa UP DN</div> <div>1 MPa UP DN</div> <div>3 MPa UP DN</div> <div>5 MPa UP DN</div> <div>7 MPa UP DN</div> <div>8 MPa UP DN</div> </div>
	480ccm SITE 1 SITE 2 SITE 3 SITE 4	

NOTES:

- 1) HEAD AT "0" WAS 4.9" FROM TABLE TOP.
- 2) FLOW RATES WERE AS INDICATED ON FLOWMETER
SEE FLOW METER CALIBRATION FOR ACTUAL FLOW RATES.
- 3) FLOW DURATION WAS 3 MINUTES.

Test Conducted by:

APICKARD

Witness: SwRI Gov't

--	--	--	--

COULD NOT MAINTAIN STEADY FLOW RATE—
TESTING STOPPED.

Auto Post

9/17/93

APPARATUS WAS DISASSEMBLED. SPECIMENS WERE
PLACED IN $\approx 60^{\circ}\text{C}$ OVEN TO DRY. A

9/18/93

TURVED OVEN OFF LEAVING DOORS CLOSED TO
PREVENT CONDENSATION ON SAMPLES. A
 PLACED SPECIMENS B.2.3/13.1.2 IN 150°C
 OVEN FOR 24 HRS. A

12/15/93

TURVED OVEN OFF. LEFT DOORS CLOSED TO
PREVENT CONDENSATION. A

12/16/93

COATED 5 SURFACES OF EACH SAMPLE WITH
SILICONE RUBBER. A

12/27/93

GROUTED BOTTOM BLOCK USING RECIPE LISTED
ON PAGE 4. A

12/28/93

GROUTED TOP BLOCK WITH SAME RECIPE. A

12/29/93

PLACED SPECIMENS IN 130°F OVEN.

12/29/93

REMOVED SPECIMENS FROM OVEN.

1/2/94

ASSEMBLED APPARATUS AND PULLED A VACUUM
AT 28" Hg.

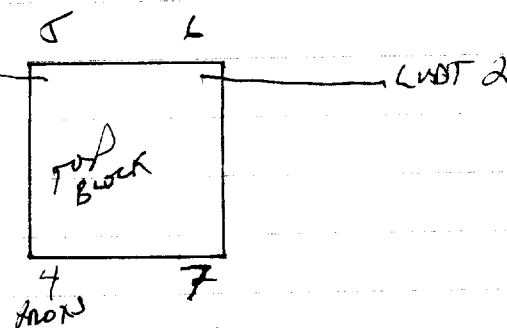
1/6/94

INSTUMENTED SPECIMEN. RAW PROFILES T37PBBBT.DAT
AND T37PTBBT.DAT AT 25 MIL INCREMENTS.

1/19/94

LIST 1

ACTUATOR



BOTTOM BLOCK INST. MARKERS TOP BLOCK.

APICKARD

1/27/94

FABRICATED INPUT + OUTPUT MANIFOLDS AND ATTACHED THEM TO THE TOP BLOCK WITH SILICONE RUBBER. INSTALLED RUBBER BOUNT VACUUM SEALS TO UPPER + LOWER BOWLS WITH SILICONE RUBBER.

2/3/94

ASSEMBLED APPARATUS. PULSED A 28" ~~Hg~~ VACUUM. TURN PUMP OFF, VACUUM LOSS ≈ 10 " / MIN.

2/14/94

RAN 5 NORMAL TESTS WITH VERTICAL LOAD WAS INCREASED 3700FF TO COMPENSATE FOR THE RUBBER BOUNT SEALS. SEE T37NS1-5. DAT (5 FILES). RAN THE FOLLOWING TEST MATRIX FLOWING NITROGEN:

SLPM	1 MPa (PSI)		3 MPa		5 MPa	
	UP	DN	UP	DN	UP	DN
1	0.394		0.398		0.394	
2	0.773		0.774		0.774	
3	1.419		1.414		1.437	
4	2.389		2.376		2.372	
5	3.552		3.672		3.690	
6	5.099		5.037		5.187	

	UP 7 MPa DN		8 MPa	
	UP	DN	UP	DN
1	0.395		0.399	
2	0.796		0.788	
3	1.436		1.434	
4	2.419		2.413	
5	3.678		3.683	
6	5.16		5.079	

2/21/94

RAN FOLLOWING FLOW MATRIX:

Flow (SLPM)	Pressure (PSI)	
	Front	Rear
0.233	0.05	0
0.506	0.11	0
0.757	0.19	0.002
1.08	0.29	0.007
1.30	0.36	0.009
1.58	0.48	0.009
1.84	0.58	0.011
2.12	0.71	0.014

Flow measurements were 5 point avg values taken from a HUMPHRIES model 650 primary flow standard, S/N 4104. Pressure measurements were a 30 point avg taken with a model 87 FLUKE, S/N JN 02012, CAL DUE 26 AUG 94. Vertical load with 5 MPa.

2/22/94

RAN FOLLOWING LEAK AND VACUUM LOSS TESTS:

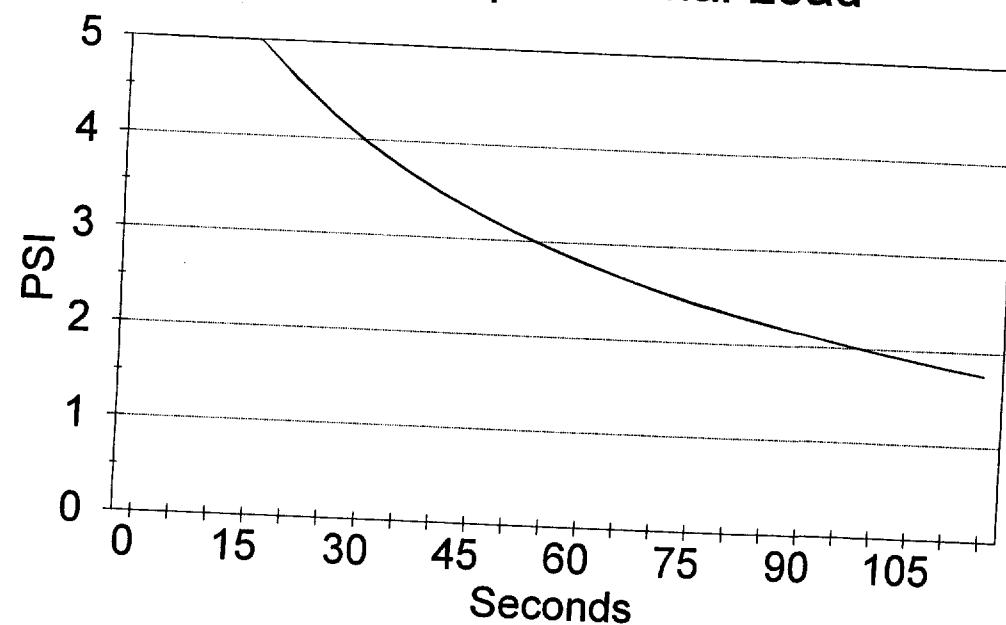
LOADED NORMALLY TO 1 MPa. PRESSURED FRACTURE TO 5 PSI. TURNED VALVE OFF AND DISCONNECTED BOTTLE. COLLECTED DATA AT 5 SEC INTERVALS.

Nick

44

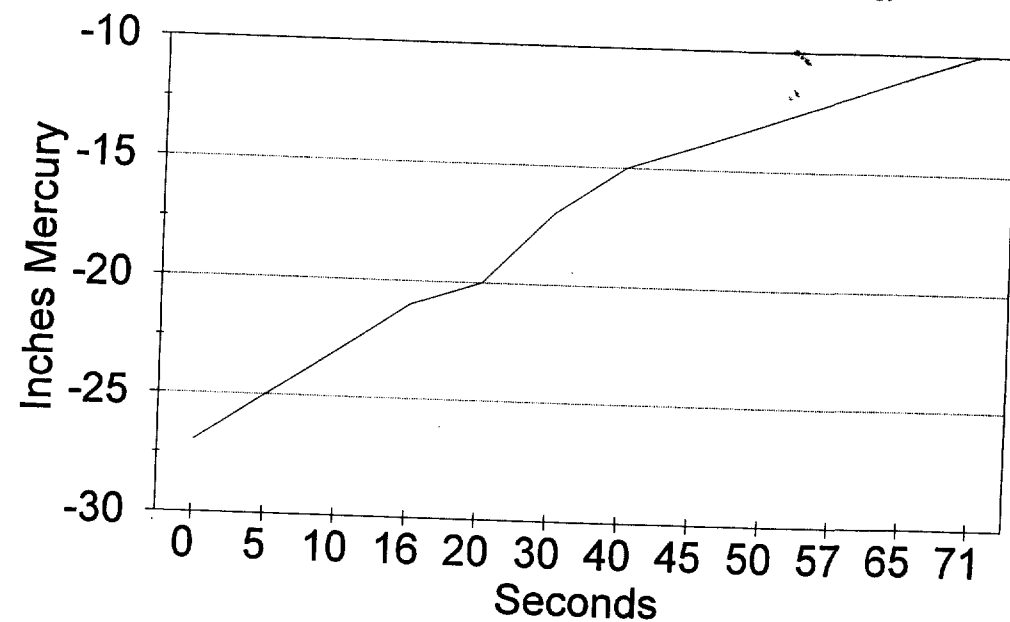
Pressure Loss Rate

2/22/94 1 Mpa Normal Load



Vacuum Loss Rate

2/22/94 20,000# Normal Load

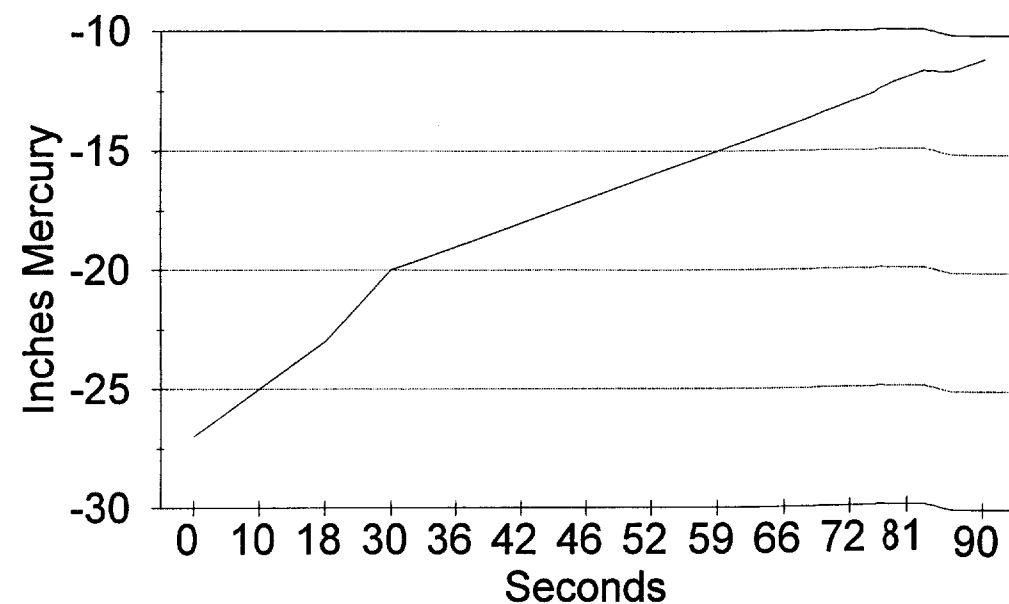


APK

45

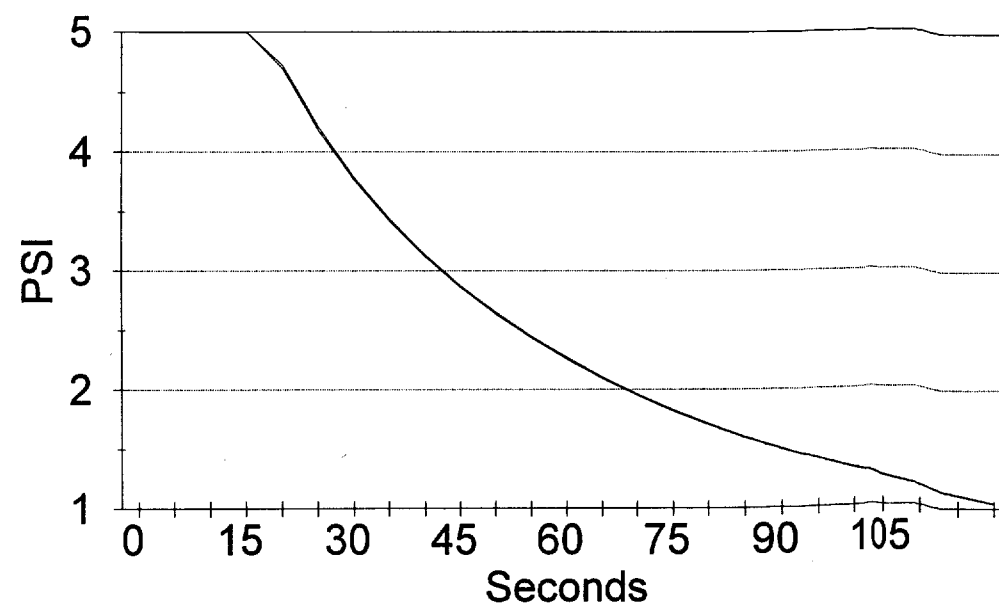
Vacuum Loss Rate

2/22/94 5 Mpa Normal Load



Pressure Loss Rate

2/22/94 5 Mpa Normal Load



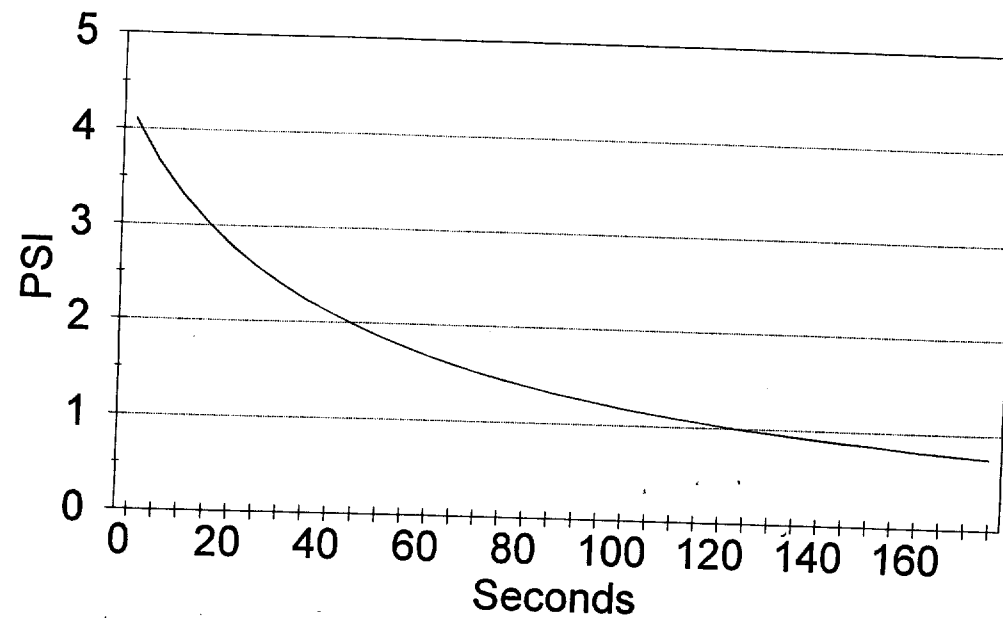
APK

46

C6N

Pressure Loss Rate

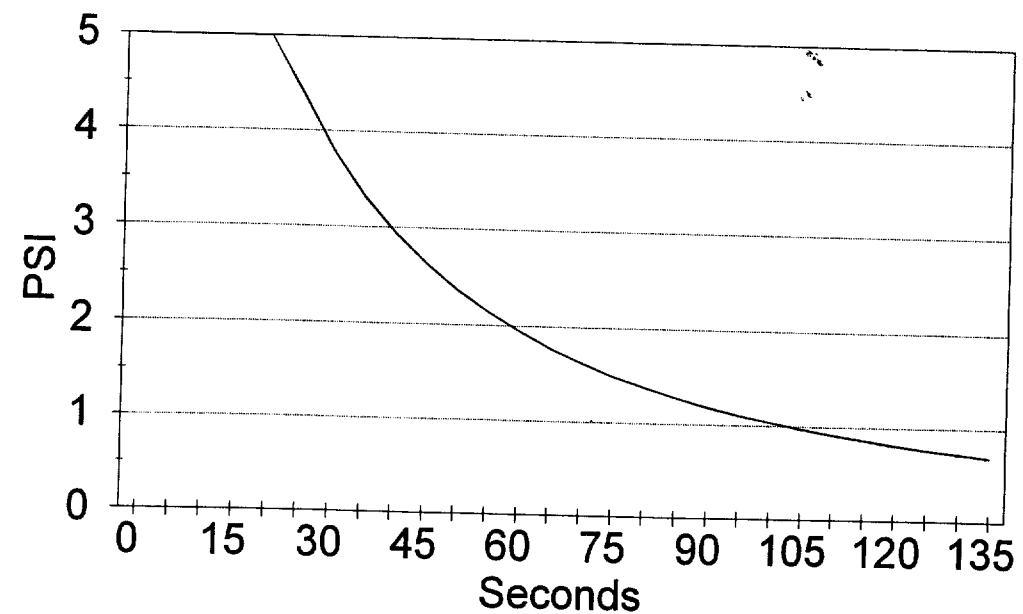
2/23/94 5 Mpa Normal Load



Held - WITHIN PRESSURE FOR 1 HOUR.

Pressure Loss Rate 5 Mpa

2/23/94 Immediate Pres. Rel.

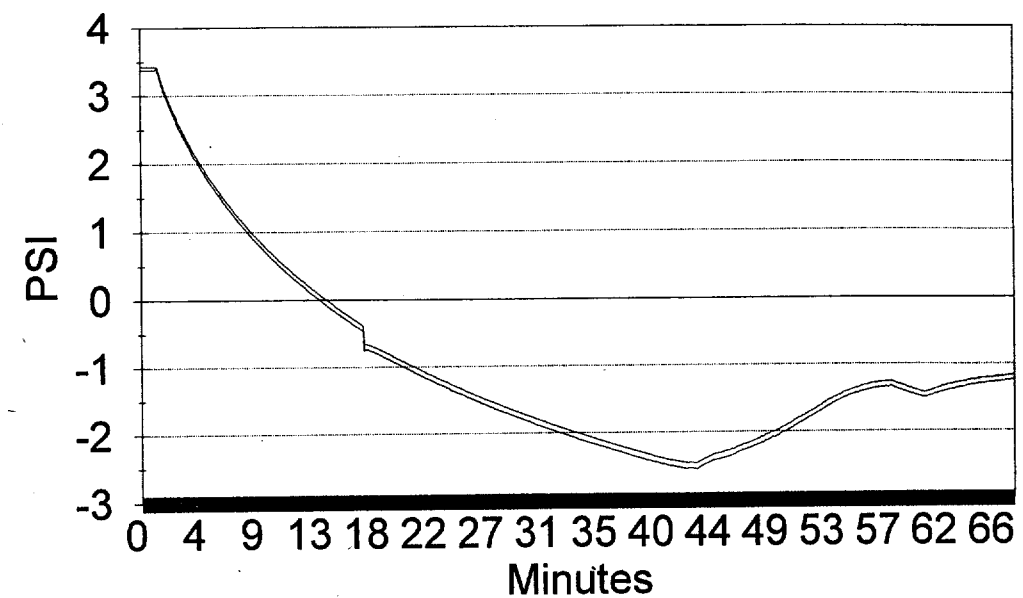


47

C6N

Pressure Loss Rate

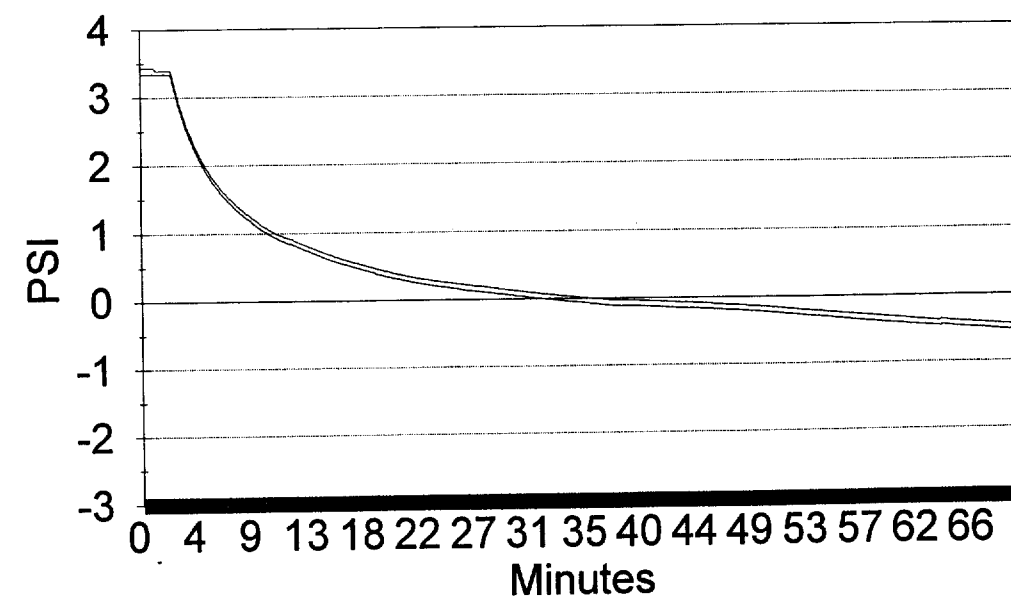
2/25/94 1Mpa Saturated



C6N

Pressure Loss Rate

2/28/94 1 Mpa Saturated (14 hrs.)



2/23/94 Found BOA VALVE + VACUUM GAUGE, REPLACED AND RAN LOSS RATES ON 2/25 + 2/28. *P*

2/24/94 RAN TEST T37HYD1.DAT + T37HYD2.DAT. SEE DATA FILES FOR PARAMETERS & DATA. *P*

2/25/94 RAN TEST T37HYD3.DAT. RAN TESTS T37HYD5 + 6.DAT. RAN TEST T37AIR7.DAT *P*

2/28/94 RAN TEST T37HYD4.DAT *P*

3/2/94 RAN TEST T37HYD5.DAT *P*

3/3/94 RAN TEST T37HYAR1.DAT *P*

3/4/94 T37HYAR2.DAT *P*

3/2/94 RAN T37HYAR3.DAT *P*

3/23/94 RAN TEST T37AIR8.DAT *P*

4/1/94 RAN NORMAL TESTS T37ASIA-JA.DAT

4/6/94 RAN TEST T37HYD6.DAT *P*

4/7/94 RAN TEST T37HYD7+8.DAT (2 FILES) *P*

4/7/94 RAN TEST T37HYD9.DAT

4/20/94 RAN TEST T37HYD10.DAT. ALL TESTS ON THIS PAGE WERE RUN TO PROBLEM SHOOT THE SETUP. NO DATA COLLECTED WAS USABLE DUE TO THE INSTABILITY OF PRESSURES. TESTS WITH "AIR" IN THE FILENAME HAD N_2 FLOWING. TESTS WITH "HYD" IN THE FILENAME HAD H_2O FLOWING. TESTS WITH "HYAR" HAD WATER FOLLOWED BY N_2 . *P*

APes

4/25/94 DURING T37HYD10.DAT TESTING A DIFFERENTIAL PRESSURE TRANSDUCER WAS INSTALLED ACROSS THE JOINT. A STABLE SIGNAL WAS NOT OBTAINABLE. THE EXIT SIDE OF THE SPECIMEN WAS RASCO APPROX 2 1/2 FEET AHD PRODUCE A LEVEL OF BACK PRESSURE. RAN TESTS T37HYD11.DAT + T37HYD12.DAT. AGAIN DATA WAS NOT STABLE FROM DIFFERENTIAL PRESSURE XDCR *P*

4/26/94 RAN TEST T37HYD13.DAT WITH DIFFERENTIAL PRESSURE XDCR DISCONNECTED FROM FRACTURE TO ATMOSPHERIC. *P*

4/28/94 RAN TEST T37HYD14.DAT. HYDRAULIC HOSE BROKE TEST WAS STOPPED. *P*

5/2/94 RAN TEST T37HYD15.DAT. TOOK DATA AT 0.5, 1.0, 2.0, 4.0, 8.0, 15.0 + 30.0 ml/min AT 0, 1, 5, 7 + 8 MPa. *P*

5/3/94 RAN TEST T37HYD16.DAT. CHANGED HYDRAULIC PRESSURE MID TEST. COULD NOT FINISH MATRIX. RAN TEST T37HYD17.DAT TOOK FLOW PRESSURE DATA AT 0.5, 1, 2, 4, 8, 15, 30, 60, + 120 ml/min AT 1, 5, + 8 MPa. *P*

5/4/94 RAN TEST T37HYD18.DAT. INSTALLED 0-5" H_2O ~~Δ~~ PRESSURE GAGE ACROSS JOINT FRACTURE. TOOK DATA AT 0.5, 1, 2, 4 + 8 ml/min AT 1, 5 + 8 MPa. *P*

APes

5/5/94
5/6/94

RAN TEST T37HYD19.DAT. P
RAN TEST T37HYD20.DAT. RAN 5 ml/min
AT 0 THRU 8 MPa. SAME FOR T37HYD19.DAT. P

5/9/94

RAN TEST T37HYD21.DAT. 4 ml/min +
0 THRU 8 MPa UP + DOWN. RAN TEST
T37HYD22.DAT. SAME AS T37HYD21.DAT. P

5/16/94

RAN TEST T37HYD23.DAT DATA STARTS AT
10:21:48. RAN TEST T37HYD24.DAT. T37HYD25.DAT. P

5/18/94

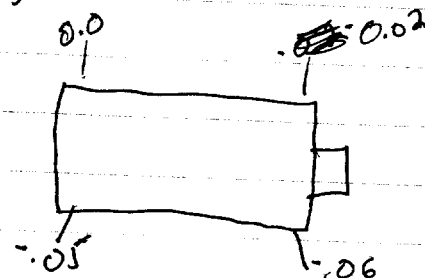
RAN TEST T37HYD26.DAT, 4 ml/min FLOW.
BEFORE TESTING THE HYDRAULIC SYSTEM RESPONSE
WAS RESET. THE GAIN FOR THE VERTICAL CONTROL
WAS FOUND TO BE OUT OF ADJUSTMENT. RAN TEST
T37HYD27.DAT. PARAMETERS DICTATED VERTICAL
LOAD TO GO FROM 0 TO 8 TO 0 MPa AT 4 ml/min
FLOW. DURING LOAD INCREASE THE PARAMETERS
WENT INTO OSCILLATION DURING 4 TO 5 MPa
INCREASE. RAN TEST T37HYD28.DAT. (3700#
VERTICAL LOAD AT 4 ml/min FLOW FOR 20S) P

5/19/94

RAN TEST T37HYD29.DAT SAME AS T37HYD28 ABOVE.
TURNED PUMP ON AT 10:33:20 P

5/20/94

RAN TEST T37HYD30.DAT. (4 ml/min, 0 TO 8 TO 0
MPa)



SCRIBED LINES RELATIVE
TO EACH OTHER
(IN INCHES)

H. P. CRES

5/20/94

PUMP REFILL POINTS FOR T37HYD30.DAT.
Start actual Elbow clock time
11:46:02 14 ml remaining
13:54:02 3.0 ml remaining same as computer clock time.
16:03:45 7 ml remaining
18:12:13 3 ml remaining P

5/23/94

RAN TEST T37HYD31.DAT. 0, 2, 4, 6 + 8 MPa;
4 ml/min; 45 min PAM DATA POINT.
08:56:22 ADJUSTED HYDRAULIC POWER SUPPLY. PUMP
WAS PULSING. REFILLED PUMP AT 9:00. TEST WAS
STOPPED DATA STILL NOT GOOD. P RAN TEST T37HYD32.DAT

5/24/94

ACQUIRED NEW ROSEMOUNT DP XDCR FROM DIV. 8.
(T37HYD33.DAT)
EVACUATED SYSTEM, PARAMETERS ARE 0-8-0 MPa, FLOW
4 ml/min WATER. ALLOW 10 min PER LOAD FOR
STEADY STATE. REFILLED PUMP AT 12:18:00 DATA TIME. P

5/26/94

RAN TEST T37HYD34.DAT. SOME PARAMETERS AS
T37HYD33 ABOVE. REFILLED PUMP AT 11:03:51 BETWEEN
5 + 6 MPa ON THE WAY UP. REFILLED PUMP AT
13:07:31 DURING 1 MPa ON THE WAY DOWN. P

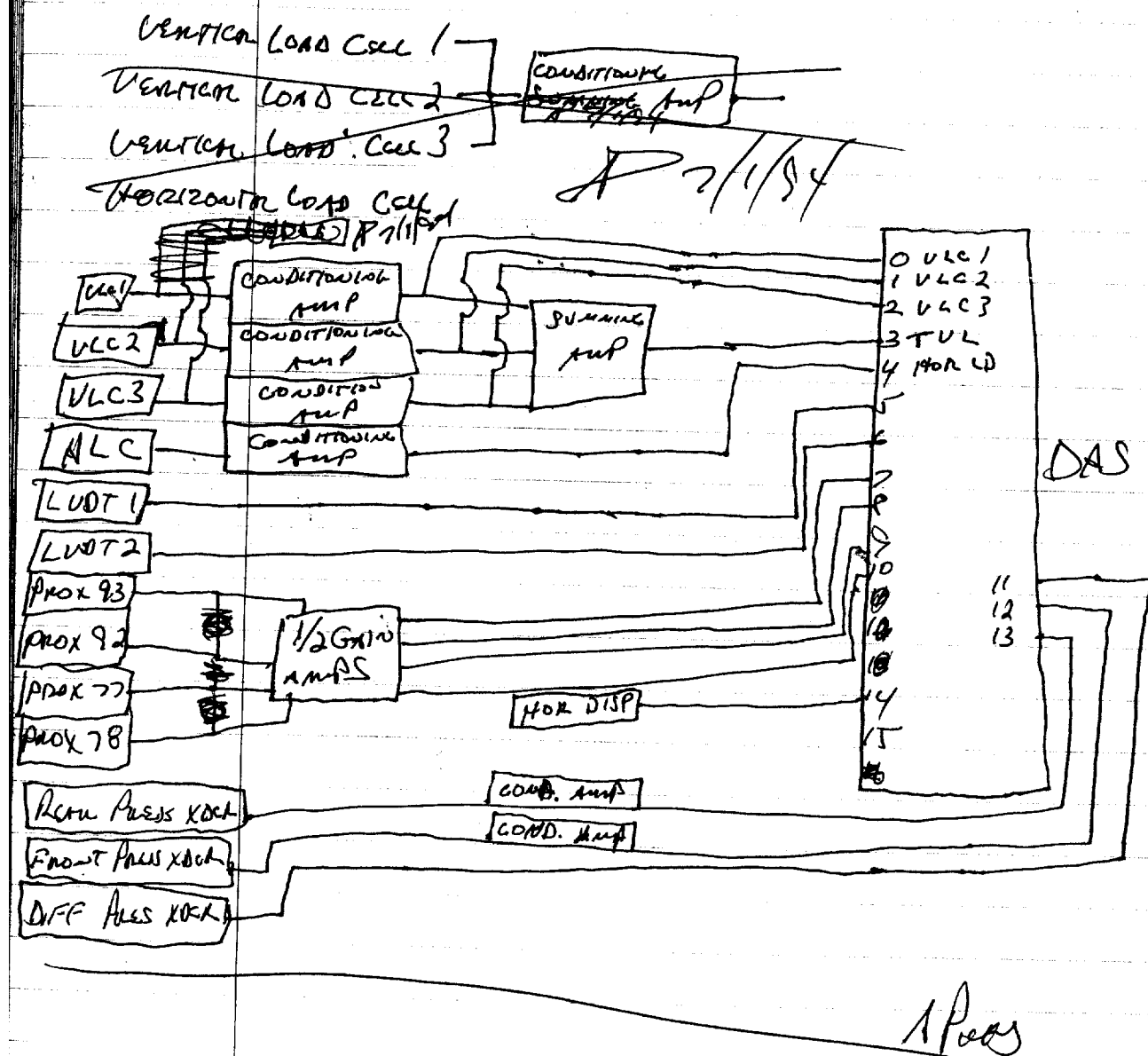
H. P. CRES

6/28/94

Using Specimens SRM 13.2.3/13.1.2 FOR THE
"T37" SERIES TESTING ALSO FOR "T38" SERIES.

7/1/94

THE SPECIMENS WERE EVACUATED + RESATURATED. *P*
REASSEMBLING INSTRUMENTATION AS FOLLOWS:



7/1/94

COMPUTER CHANNELS ARE AS FOLLOWS:

CHNL	XOCR	CAL. VALUE	CAL. DUE
0	VLC 1	10000 #/V	10/20/94
1	VLC 2	10000 #/V	10/20/94
2	VLC 3	10,000 #/V	10/20/94
3	TUL	10,000 #/V	10/20/94
4	HOR LD CELL	5,000 #/V	9/12/94
5	LVDT 1 (FRONT)	0.20"/V	11/1/94
6	LVDT 2 (Rear)	0.20"/V	11/1/94
7	Prox 93 (4)	0.5 mm/V	7/1/95
8	Prox 92 (5)	0.2/V	7/1/95
9	Prox 77 (6)	107/V	7/1/95
10	Prox 78 (7)	110/V	7/1/95
11	Press XOCR (FRONT)	0.5 PSI/V	11/1/95 (7/1/94)
12	Press XOCR (Rear)	0.5 PSI/V	11/1/95 (7/1/94)
13	DIFF Press XOCR	0.6 PSI/V	7/6/95
14	HOR DISP.	0.25"/V	11/1/94
15	NOT USED		

A Press

7/1/94

25 mm Prox Cr.

EQUIPMENT USED: FLUKE MODEL 87 DMM, S/N 51502012, CAL
DUE 26 AUG 94; MITUTOYO DIGITAL CALIPERS MODEL 500-351,
S/N 7113064, CAL DUE 12/9/94; STEEL TARGET.

	VOLTS			
MILS	PROX/PS			
	(4) 93/281	(5) 92/927	(6) 77/280	(7) 78/487
0	0.422	0.457	0.371	0.441
50	0.722	0.789	0.643	0.750
100	1.109	1.210	0.996	1.142
150	1.577	1.706	1.439	1.611
200	2.099	2.256	1.940	2.118
250	2.643	2.817	2.476	2.650
300	3.165	3.356	2.995	3.152
350	3.648	3.860	3.493	3.612
400	4.082	4.380	3.936	4.022
450	4.550	4.990	4.370	4.450
500	5.050	5.650	4.860	4.910
550	5.520	6.260	5.340	5.340
600	5.940	6.780	5.780	5.720
	105 MILS/V	92 MILS/V	107 MILS/V	110 MILS/V

MILS

7/6/92

ROSEMOUNT DIFF PRES. XDCR CALIBRATION

MODEL # 1151, S/N 529978; FLUKE MODEL 8842A
DMM, S/N 3923084, CAL DUE 7 JUN 95; CALIBRATION
CART W/9018 PRESS INDICATOR, CAL RECORD IN
NOTEBOOK; 28VDC POWER SUPPLY; 100 OHM 1% RESISTOR.
CALIBRATED TO 5" H₂O FULL SCALE

VOLTAGE DROP

ACROSS 500Ω RES.

IN H₂O

2.023	0.00
2.860	0.50
3.670	1.03
4.485	1.53
5.23	2.00
6.04	2.50
6.92	3.05
7.64	3.50
8.48	4.03
9.28	4.54
10.03	5.01

0.62" H₂O/VOLT

MILS

7/11/94

RAN TEST T38HYD1.DAT. ^{7/11/94} PARAMETERS WERE AS FOLLOWS: Flow 4ml water/min.; Start at 0 mpa to 8 mpa to 0 mpa in 1 mpa increments. Refilled pump after 4 mpa. 262 ml left in Pump. Refilled Pump after 8 mpa. 235 ml left in Pump. Refilled Pump after 4 mpa going down 317 ml left in Pump. A

7/12/94

RAN TEST T38HYD2.DAT. At 0 mpa run 4 ml/min for 1 hour. RAN TEST T38HYD3.DAT. USED 800 samples/sec Program Structure. RAN TEST T38HYD4.DAT. Parameters were 4 ml/min at 3 mpa for 1 hour. RAN TEST T38HYD5.DAT. Parameters were: 4 ml/min flow, 0 to 8 to 0 mpa vertical load in 1 mpa increments. A

7/15/94

RAN TEST T38HYD6.DAT. Parameters were the same as T38HYD5 ABOVE. Refilled Pump at 7 mpa on the way down. Allowed Pump to run for 10 minutes before restarting data acquisition. A

7/16/94

INSTALLED SIDE ROSS ON APPARATUS. RAN TEST T38HYD7.DAT PARAMETERS WERE THE SAME AS T38HYD5 ABOVE. Refilled Pump during 8 mpa. ~ 100 ml left in Pump. A

7/20/94

RAN TEST T38HYD8.DAT PARAMETERS WERE - Flow H₂O at 4 ml/min; Normal Load from 0 to 8 to 0 mpa at 1 mpa increments; Hold each normal level for 5 minutes. Started w/full Pump. A

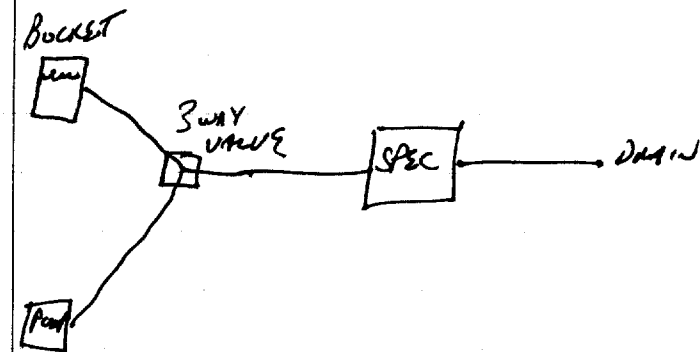
APCS

7/20/94

RAN TEST T38HYD9.DAT. Parameters were same as T38HYD8.DAT. A

8/1/94

INSTALLED A 3WAY VALVE AT INLET SIDE OF SPECIMEN. SUSPENDED 5 GALLON BUCKET FILLED WITH WATER APPROX. 10 FEET IN THE AIR.



RAN TEST T38HYD10.DAT. INCREASED LOAD TO 3700# ADJUST. STARTED TO FLOW WATER AT 4 ml/min. ΔP was ≈ 1.0 "/water. AFTER 5 MINUTES FLOW AT 4 ml/min WAS STOPPED AND WATER FROM BUCKET WAS ALLOWED TO FLOW THROUGH SPECIMEN. DAS WAS STOPPED DURING BUCKET FLOW. ALLOWED BUCKET TO FLOW FOR $\approx 3-5$ MINUTES. RESTARTED PUMP. ΔP RETURNED TO ≈ 1 "/water AFTER APPROX 1 MINUTE. LOAD INCREASED TO 2 MPa. ALLOWED WATER TO FLOW AT 4 ml/min FOR 5 MINUTES. ΔP WAS ≈ 1.2 "/water. REPEATED SAME PARAMETERS AS ABOVE. ΔP RETURNED TO ≈ 1.15 TO 1.2"/water AFTER $\approx 3-4$ MINUTES. A

APCS

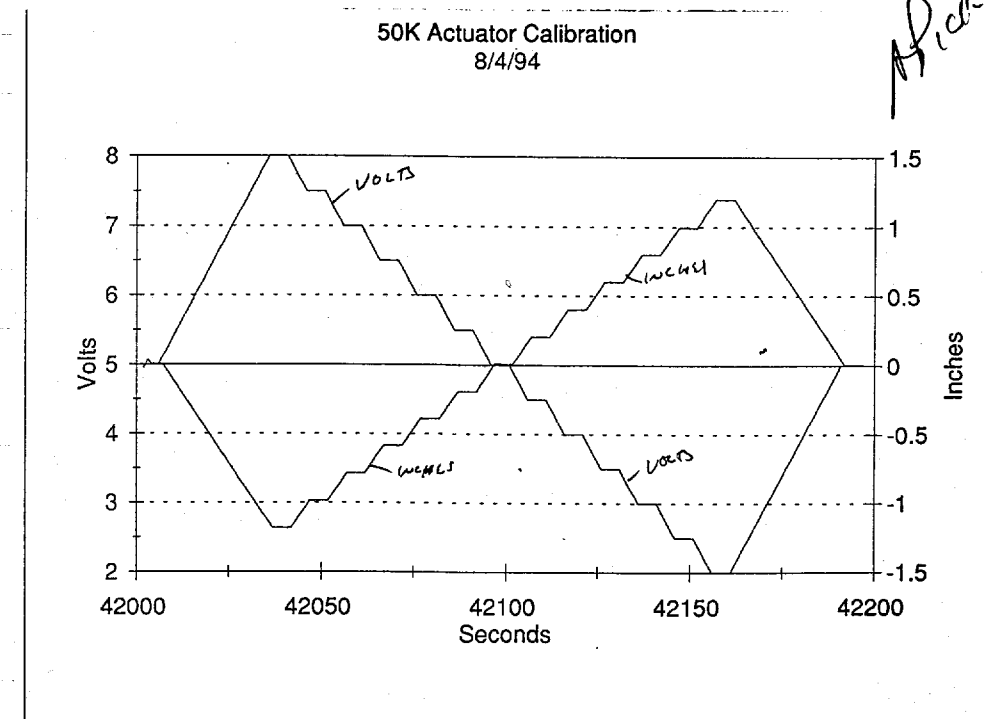
8/2/94
 Ran test T38HYD11.DAT. Parameters were
 INCREASE Venturi Load to 0 mpa (3700 ft) to
 COMPRESS RUBBER SET. Start flow at 4 ml/min
 and take data for 5 min. Shear Spec to
 0.25" toward actuator. Take data for 7 min.
 Shear Rate = 0.10"/min. Observed ~~no~~ leaks.
 $\Delta P \approx 0.90 - 1.00$. Test was stopped early.
 No valuable data was acquired.

Ran test T38HYD12.DAT. Parameters were:
 INCREASE normal load to 2 mpa, take data
 for four (4) minutes, Shear 0.25" with Pump
 OFF + bucket ON, Turn bucket OFF turn Pump ON
 (4 ml/min) take data for 4 min. Repeat
 shear procedure at 0.5, 0.75 + 1.0". Repeat
 above procedure for 5 + 8 mpa. Stopped test
 after 2 mpa.

Ran test T38HYD13.DAT. Parameters were as above
 in HYD12 with shorter times at shear (1.5 min),
 Load (1.5 min) + data acquisition (2.5) stopped
 test after 2 mpa. Distance from front edge of
 top box to front edge of bottom box was 1.25".
 Back edge to edge was 2.30".

Heads

8/3/94
 Ran test T38HYD14.DAT. Started 4 ml/min
 flow. INCREASE normal load to 2 mpa. Take
 data 2 1/2 minutes. Move to 0.25" horizontal.
 Take data 2 1/2 min. Repeat for 0.50" 0.75" + 1.0".
 Return to 0.25" taking data every 0.25" for
 2 1/2 minutes. INCREASE load to 5 mpa +
 Repeat shear procedure. Repeat again for 8 mpa.
 Leak around 12:25:15 computer time in data file
 Leak around 13:32:14 computer time. (Very slight)
 INSTRUMENT AND CALIBRATED ^{HORIZONTAL} ~~VERTICAL~~ ΔP BETWEEN. CALIBRATION
 = 0.40"/VOLT.



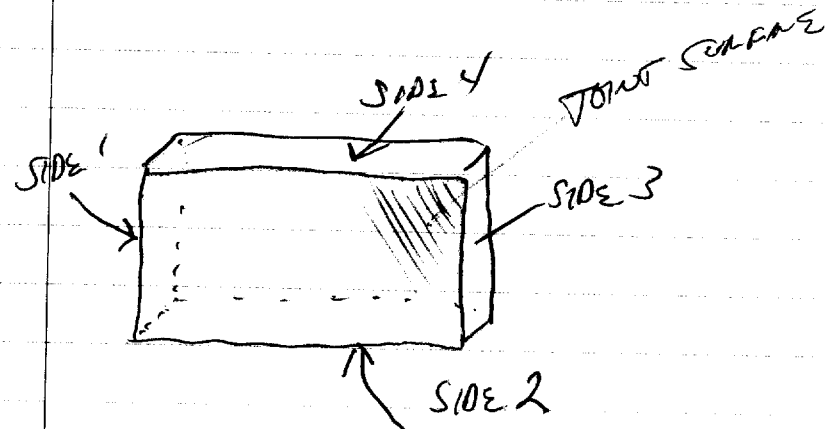
Heads

8/5/94

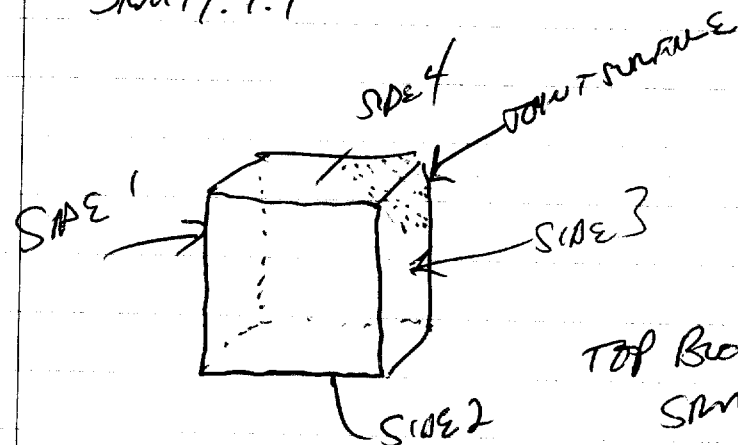
RAN TEST T3P HYD15.DAT. Parameters were:
 INCREASE NORMAL LOAD TO 2 MPa, MOVE ROCK TO
 0.25" OFF CENTER TOWARD RIGHT. Flow water
 AT 4ml/min. TAKE DATA FOR FOUR(4) MINUTES.
 MOVE ROCK TO 0.50" OFF CENTER TOWARD RIGHT.
 TAKE DATA AS ABOVE. REPEAT FOR 0.75" + 1.0"
 POSITIONS. REPEAT FOR 4, 5, + 6 MPa.

10/12/94

RAN PROFILES T43PSID2.DAT + T43PSID4.DAT.
 PROFILES WERE AS ILLUSTRATED BELOW



BOTTOM BLOCK
 SRM A.1.1

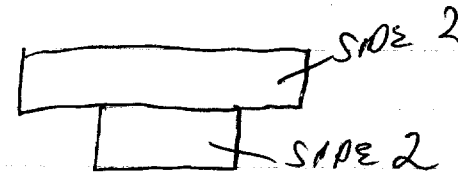


TOP BLOCK
 SRM A.1.2

After

10/12/94

PROFILES WERE OF SIDE OF SPECIMEN, SIDE 2 + SIDE 4

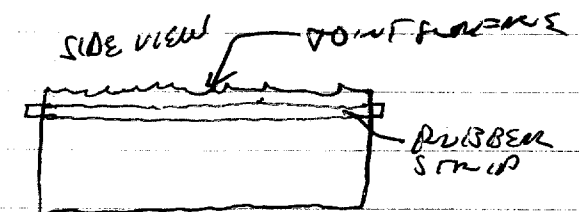
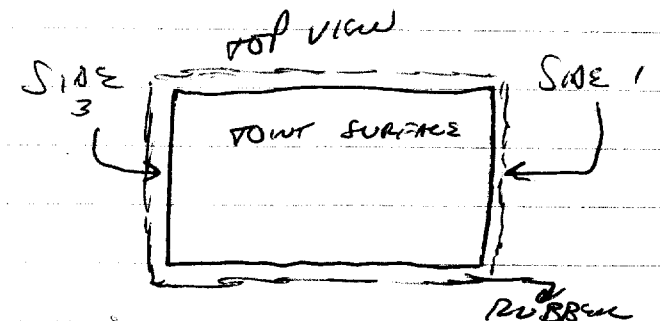


10/24/94

RAN PROFILE T43PBBB6.DAT.

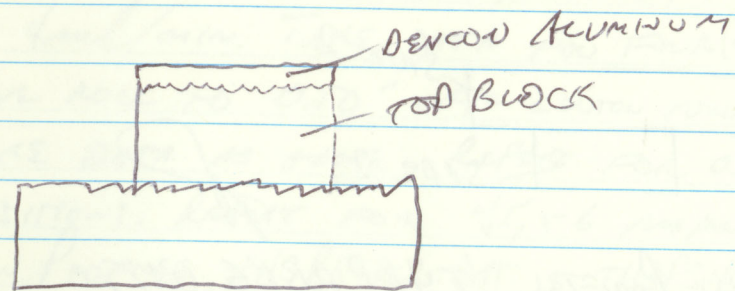
ATTACHED 1/2" RUBBER STRIPS AROUND PERIMETER
 OF SPECIMEN ~ 1/2" - 1/4" FROM JOINT SURFACE.

MAX X 12370
 MAX Y 8348
 X OFF 528
 Y OFF 301
 INDEX 4



After

10/25/94 Poured DENCON LIQUID ALUMINUM ON THE TOP OF THE TOP BLOCK.



10/26/94 AFTER DENCON SETUP OVERNIGHT THE TOP WAS MACHINED PARALLEL WITH THE BOTTOM SURFACE OF THE BOTTOM BLOCK.
RAN PROFILE T43PTOP.DAT AT 200 INK INC. OF TOP SURFACE.

10/27/94 RAN PROFILE T43PBBTS.DAT SAME AS T43PBBB6.DAT ON 10/24.

10/31/94 RAN PROFILE T43PTBTS.DAT

T43PBBTS.DAT

MAX X 12376

MAX Y 8374

X OFF 582

Y OFF 298

INDEX 2

T43PTBTS.DAT

MAX X 8450

MAX Y 8306

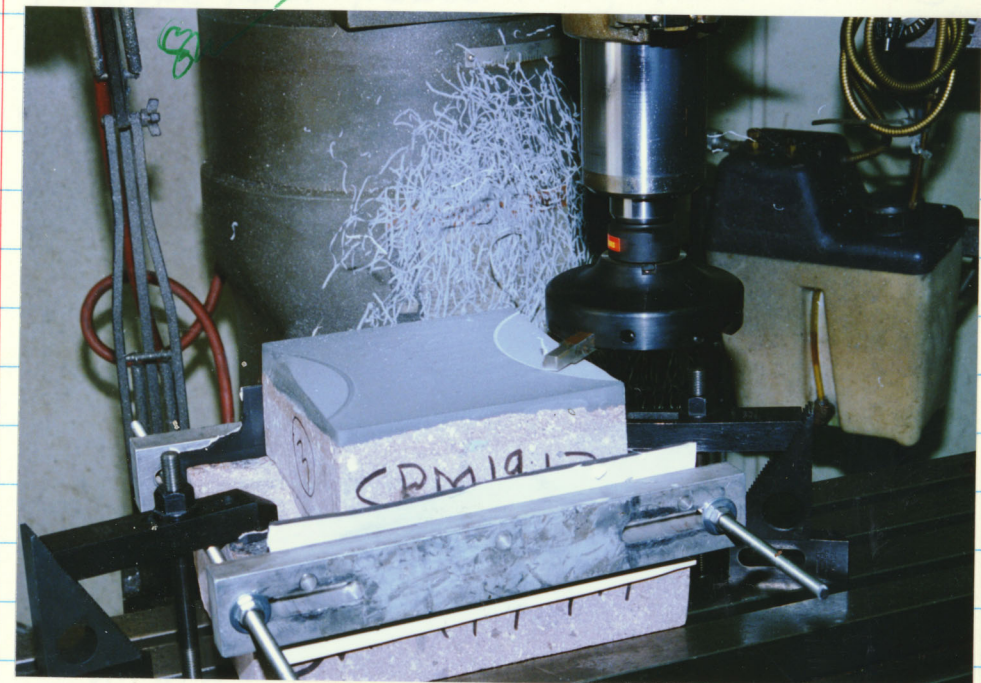
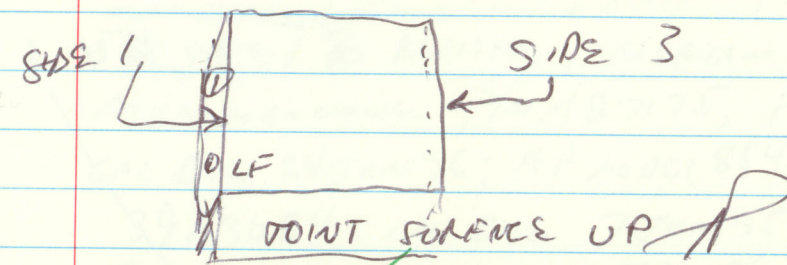
X OFF 409

Y OFF 416

INDEX 1

AmPac

10/31/94 T43PTBTS.DAT



TOP BLOCK TOP SURFACE BEING MACHINED
PARALLEL TO BOTTOM SURFACE.

Wes

Pages 1 through 63 of this Scientific Notebook were reviewed for compliance with QAP-001 in response to Corrective Action Request 94-02. Corrections and clarifications were made as appropriate. In some cases, the date of a change will reflect the date of this review rather than the date of the original Scientific Notebook entry.

Randy Zolt
SWRE-QA
12/16/94

4/25/95

ROSEMOUNT DIFFERENTIAL PRESSURE XOCR

CALIBRATION

^{7/4/21/95}
EQUIPMENT: ~~ROSEMOUNT MODEL 1151 DIFF. PRESS.~~
~~XOCR, S/N 1527282~~; ^{7/4/95} KOPIN DE POWER SUPPLY;
500 OHM 1% RESISTOR; MERIAM MODEL #34FR2
MICROMANOMETER, S/N A27175, PRIMARY STANDARD,
CAL DUE 24 JAN 96; HP MODEL 8542 DMM, S/N
3923084, CAL DUE 7 JUN 95; ROSEMOUNT DIFF
PRESSURE XOCR MODEL 1151, S/N 3145733;
POWER SUPPLY AT 28 VAC

VOLTAGE DROP ACROSS

IN. WATER

500 OHM RES.

1.989	0.00
2.719	0.50
3.539	1.00
4.348	1.50
5.156	2.00
5.930	2.50
6.748	3.00
7.555	3.50
8.364	4.00
9.168	4.50
9.985	5.00

MZ

66

4/13/85

Raw Profile 4-16 BLK4-16. DAT. A

176

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9/25/95

CODE DEVELOPMENT for TMH Studies (Related to the experimental Activities)

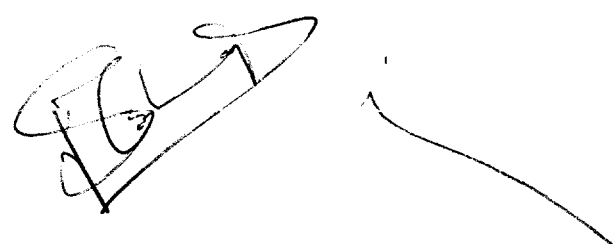
Codes *smnetwork.f* and *smaprt.f*

The objective of the codes *smaprt.f* and *smnetwork.f* are to study fracture flow and support in the design of TMH experiment.

The above mentioned codes have been developed by Sitakanta Mohanty. *Smmaprt.f* code uses data from the laboratory obtained by using noncontacting laser surface profilometer.

Code *smmaprt.f* calculates fracture aperture distribution from the raw data collected by the surface profilometer. Theoretically, one can place any piece of rock (size is the only constraint) in the surface profilometer and measure surface profile data. However, retrieval of aperture data from surface profiles requires careful planning of the experiment and the development of program is very dependent on the procedure adopted in data acquisition by the profilometer. The details of the procedure can be found in CNWRA Report#__-95. This program is also very specific to a specimen whose profile data are stored in file BLK4_16.DAT. Improper use of this code will result in retrieving wrong data.

Code *smnetwork.f* is a 2-d steady-state flow simulator for a heterogeneous permeability field. This used a standard finite difference scheme whose description can be found in any numerical simulation text book. No-flow boundary condition have been imposed in the flow direction and constant pressure boundary conditions have been imposed in the flow direction. This code has been tested by applying it to field with parallel and series beds of different permeabilities. The results from these tests are presented in the following descriptions. Here the two permeabilities (i.e. conductances)



Permeabilities in series arrangement

Input data file: series.dat

```

0.001 0.001 1.000 1.000 1.000 1.000 0.001 0.001
0.001 0.001 1.000 1.000 1.000 1.000 0.001 0.001
0.001 0.001 1.000 1.000 1.000 1.000 0.001 0.001
0.001 0.001 1.000 1.000 1.000 1.000 0.001 0.001
0.001 0.001 1.000 1.000 1.000 1.000 0.001 0.001
0.001 0.001 1.000 1.000 1.000 1.000 0.001 0.001
0.001 0.001 1.000 1.000 1.000 1.000 0.001 0.001
0.001 0.001 1.000 1.000 1.000 1.000 0.001 0.001

```

Output:

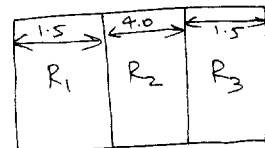
xsmall and xlarge= 8.333333333333D-08 8.333333333333D-02

```

qtot( 2)= 2.3333325560272D-06
qtot( 3)= 2.3333325560272D-06
qtot( 4)= 2.3333325564802D-06
qtot( 5)= 2.3333325560916D-06
qtot( 6)= 2.3333325552867D-06
qtot( 7)= 2.3333325550906D-06
0.0000001944 0.0000001944

```

Exact Solution:



$$R_1 = R_3$$

$$\begin{aligned}
 R'' &= R_1 + R_2 + R_3 \\
 \text{or } \frac{h}{k} &= \frac{h_1}{k_1} + \frac{h_2}{k_2} + \frac{h_3}{k_3} = \frac{k_3 k_2 h_1 + k_1 k_3 h_2 + k_1 k_2 h_3}{k_1 k_2 k_3} \\
 \text{or } k &= \frac{h k_1 k_2 k_3}{k_1 k_2 h_3 + k_1 k_3 h_2 + k_2 k_3 h_1} \\
 &= \frac{7.0 \times 8.333 \times 10^{-2} \times (8.333 \times 10^{-8})^2}{8.333 \times 10^{-8} \times 8.333 \times 10^{-2} \times 1.5 + (8.333 \times 10^{-8})^2 \times 4.0 + 8.333 \times 10^{-8} \times 8.333 \times 10^{-2} \times 1.5} \\
 &= \frac{4.050925877 \times 10^{-15}}{1.041666208 \times 10^{-8} + 2.777777756 \times 10^{-14} + 1.041666658 \times 10^{-8}} \\
 &= \frac{1.94444 \times 10^{-7}}{2.083336094 \times 10^{-8}} = 1.94444 \times 10^{-7}
 \end{aligned}$$

Handwritten signature

Permeabilities in parallel arrangement

Input data file: parallel.dat

```

0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001
0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000
1.000 1.000 1.000 1.000 1.000 1.000 1.000 1.000
0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001
0.001 0.001 0.001 0.001 0.001 0.001 0.001 0.001

```

Output:

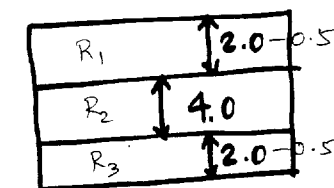
xsmall and xlarge= 8.333333333333D-08 8.333333333333D-02

```

qtot( 2)= 0.57142957142957
qtot( 3)= 0.57142957142957
qtot( 4)= 0.57142957142957
qtot( 5)= 0.57142957142957
qtot( 6)= 0.57142957142957
qtot( 7)= 0.57142957142957
0.0476190833 0.0476190833

```

Exact solution:



$$\begin{aligned}
 K' &= \frac{1}{R'} = \frac{1}{R_1} + \frac{1}{R_2} = K_1 + K_2 \\
 K'' &= \frac{1}{R''} = \frac{1}{R'} + \frac{1}{R_3} = K' + K_3
 \end{aligned}$$

$$\begin{aligned}
 K'' &= K_1 + K_2 + K_3 \\
 &= (8.33 \times 10^{-8} \times 3.0 + 8.33 \times 10^{-2} \times 4.0) / (3 + 4) \\
 &= 0.047600035
 \end{aligned}$$

Handwritten signature

I am surrendering this
Scientific notebook because
the project went away and
the notebook is no longer
in use.

— Sitakanta Mohanty
2/07/2000.
Sh
2/9/2000

This scientific notebook has been properly kept.
The notebook is closed.

Gordon Wittmeyer
2/8/2000

ADDITIONAL INFORMATION FOR SCIENTIFIC NOTEBOOK #: 074B

Document Date:	12/16/1994
Availability:	Southwest Research Institute® Center for Nuclear Waste Regulatory Analyses 6220 Culebra Road San Antonio, Texas 78228
Contact:	Southwest Research Institute® Center for Nuclear Waste Regulatory Analyses 6220 Culebra Road San Antonio, TX 78228-5166 Attn.: Director of Administration 210.522.5054
Data Sensitivity:	<input checked="" type="checkbox"/> "Non-Sensitive" <input type="checkbox"/> Sensitive <input type="checkbox"/> "Non-Sensitive - Copyright" <input type="checkbox"/> Sensitive - Copyright
Date Generated:	12/12/1995
Operating System: (including version number)	Windows, Version 3.1
Application Used: (including version number)	Fortran
Media Type: (CDs, 3 1/2, 5 1/4 disks, etc.)	1 CD
File Types: (.exe, .bat, .zip, etc.)	Various
Remarks: (computer runs, etc.)	Media contains: Fortran code; input data files (ASCII)