EA02-025

TEXAS INSTRUMENTS, INC.'S 9/10/03 ATTACHMENT

REQUEST NO. 7

BOX 8

PART A-U

PART C

354-01-30

SAMPLE ORDER

ORDER NO: C092-57

REQUEST DATE: 11/20/92

CREDIT ACCOUNT: 5902

COST CENTER: 101

PRODUCT CODE: 088

CUSTOMER: [redacted]

CUSTOMER P.O. NO: 43375

TI PART NO: 77PSL3-1

CUSTOMER PART NO: F2AC 9F924 AA

QUANTITY: 30

PRICE: $10.00 EACH

TOOLING:

DELIVERY PROMISED: 11/20/92

SPECIAL INSTRUCTIONS: SHIP PARTS OVERNIGHT

BILL TO: [redacted]
DALLAS, TX [redacted]

SHIP TO: [redacted]
CARROLTON, TX [redacted]
ATT'N: [redacted]

XX PRODUCTION SAMPLES

ENGINEERING DEVELOPMENT SAMPLES

CC: ENGINEERING: STEVE OFFILER

PRODUCTION CONTROL: VAL EGGERT

SALES ENGINEER: NORM FREDA

ORDER filled by production on 11/20/92

TI-NHTSA 011380

PRESSURE SWITCH DATA Form 21605 TEST NO. 355-15-02

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
7785	9/11/95	Steve Officer	
PERFORMED BY	**DATE STARTED**	**DATE COMPLETED**	**APPROVED BY**
Jeffrey P. Romance	9/12/95		

PROJECT TITLE: Cruise Control

CUSTOMER:

PURPOSE OF TEST: Evaluation of 27713-2. This is the pass-car cap with the reduced disc envelope to eliminate disc looseness and vacuum dependency

PROCEDURE:
- take disc height measurement
- Vacuum parts
- retake disc height measurement
- review data to choose latchet and impulse parts
- after latch and impulse, reduce first 2 steps on these parts

* Sensors hand assembled and crimped on AMP

Device #	pre-VAC dimension	post-VAC dimension	latchet	impulse	hi-mt dimension	post-mt dimension	Remarks
355-15-01	47.1	47.4	✓	✓	47.7	47.7	
-02	46.4	46.5			46.6	46.8	
-03	46.5	46.6			46.8	46.9	
-04	46.7	46.7			47.0	47.1	
-05	46.9	47.1	✓		47.1	47.2	
-06	46.2	46.3			47.2	47.2	Thermal shift after 4.3
-07	46.4	46.4			46.3	46.5	
-08	46.5	46.6			46.6	46.7	
-09	46.3	47.1	✓		46.6	46.8	
-10	46.4	46.4			46.4	46.5	
-11	46.6	46.7			47.4	46.9	
-12	46.7	46.8			46.9	46.9	
-13	46.3	46.3	✓		46.4	46.6	
-14	47.1	47.2			47.9	45.0	
-15	46.0	46.2			46.2	46.3	
-16	46.7	46.7			46.6	46.8	
-17	47.0	47.2	✓		46.0	47.1	
-18	46.8	46.5			46.9	46.8	
-19	46.6	46.7			46.9	46.7	
-20	46.5	46.6			46.8	46.9	
-21	46.4	46.5	✓		46.6	46.6	
-22	46.4	46.6			46.7	46.9	
-23	46.3	46.4			46.9	46.7	
-24	46.8	47.0			47.2	47.1	
-25	45.7	45.8					
-26	46.7	46.7					
-27	46.4	46.4					

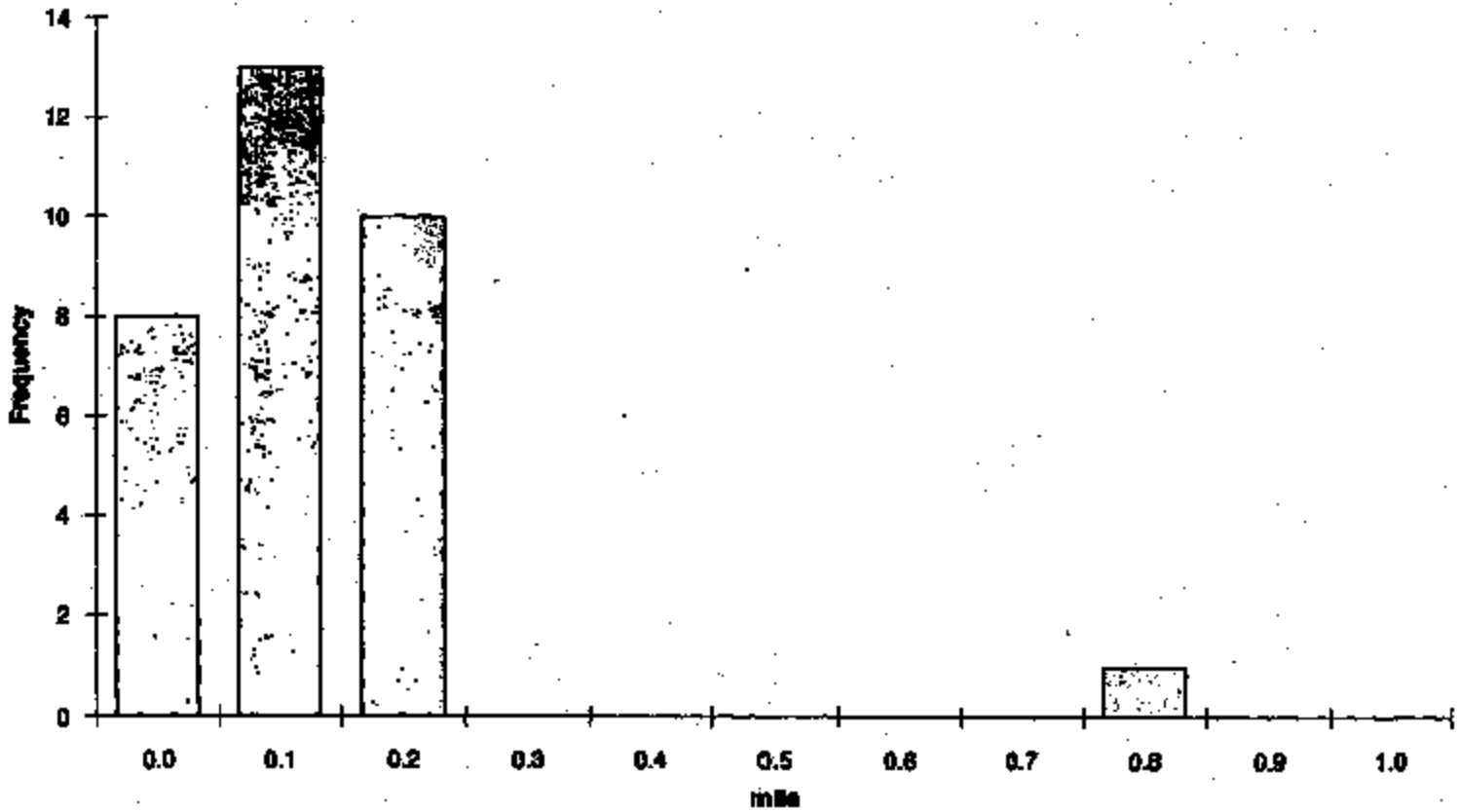
(OVER)

Modified Cup Evaluation

(27713-2)
First Pilot Lot - Low Act.

Device #	Pre-vac Dimension	Post-vac Dimension	delta	Hatchet	Impulse	Pre-vac Dimension	Post-vac Dimension	delta	Pre-vac delta Pre/post imp
355-15-01	47.4	47.4	0.0	*	*	47.7	47.7	0.0	0.3
355-15-02	46.4	46.5	0.1		*	46.6	46.6	0.0	0.2
355-15-03	46.5	46.6	0.1		*	46.8	46.9	0.1	0.3
355-15-04	46.7	46.7	0.0		*	47.0	47.1	0.1	0.3
355-15-05	46.9	47.1	0.2	*	*	47.1	47.2	0.1	0.2
355-15-06 *	46.7	46.7	0.0		*	47.2	47.2	0.0	0.5
355-15-07	46.4	46.4	0.0		*	46.3	46.5	0.2	-0.1
355-15-08	46.5	46.6	0.1		*	46.8	46.9	0.1	0.3
355-15-09	46.3	47.1	0.8	*	*	46.6	46.8	0.2	0.3
355-15-10	46.4	46.4	0.0		*	46.8	46.8	0.0	0.4
355-15-11	46.6	46.7	0.1		*	47.4	46.9	-0.5	0.8
355-15-12	46.7	46.8	0.1		*	46.9	46.9	0.0	0.2
355-15-13	46.3	46.3	0.0	*	*	46.4	46.8	0.4	0.1
355-15-14	47.1	47.2	0.1		*	47.9	48.0	0.1	0.8
355-15-15	46.0	46.2	0.2		*	46.2	46.3	0.1	0.2
355-15-16	46.7	46.9	0.2		*	46.6	46.8	0.2	-0.1
355-15-17	47.0	47.2	0.2	*	*	48.0	47.9	-0.1	1.0
355-15-18	46.3	46.5	0.2		*	46.8	46.8	0.0	0.5
355-15-19	46.6	46.8	0.2		*	46.8	46.9	0.1	0.2
355-15-20	46.5	46.6	0.1		*	46.8	46.8	0.0	0.3
355-15-21	46.4	46.5	0.1	*	*	48.6	48.6	0.0	2.2
355-15-22	46.4	46.6	0.2		*	46.9	46.8	-0.1	0.5
355-15-23	46.3	46.4	0.1		*	46.9	46.7	-0.2	0.6
355-15-24	46.8	47.0	0.2		*	47.2	47.1	-0.1	0.4
355-15-25	45.7	45.9	0.2						
355-15-26	46.7	46.7	0.0						
355-15-27	46.4	46.4	0.0						
355-15-28	46.5	46.6	0.1						
355-15-29	46.4	46.5	0.1						
355-15-30	46.7	46.8	0.1						
355-15-31	46.4	46.5	0.1						
355-15-32	46.8	47.0	0.2						
* NOTE: -06 Thermal Shift at +121C: base 90.9 pin 142.4 preload 4.3									
Mean	46.546875	46.675	0.128125			47.0125	47.05	0.0375	0.433333339
Median	46.5	46.6	0.1			46.85	46.9	0.05	0.3
Mode	46.4	46.5	0.1			46.8	46.8	0	0.3
Std. Dev.	0.31516	0.3212677	0.144209			0.5651888	0.5140886	0.17147	0.457486242
Variance	[illegible]	[illegible]	[illegible]			0.3194082	[illegible]	0.0294	0.209275362
Kurtosis	[illegible]	[illegible]	15.[illegible]451			1.804395	2.781982	3.81246	[illegible]
Skewness	[illegible]	[illegible]	[illegible]			1.294307	[illegible]	-1.0981	2.866301962
Range	1.7	1.8	0.8			2.4	2.3	0.9	2.3
Minimum	45.7	45.9	0			46.2	46.3	-0.5	-0.1
Maximum	47.4	47.4	0.8			48.6	48.6	0.4	2.2
Sum	1489.5	1493.6	4.1			1128.3	1129.2	0.9	10.4
Count	32	32	32			24	24	24	24

Modified Cup Evaluation (27713-2)
Vacuum Dependency Test

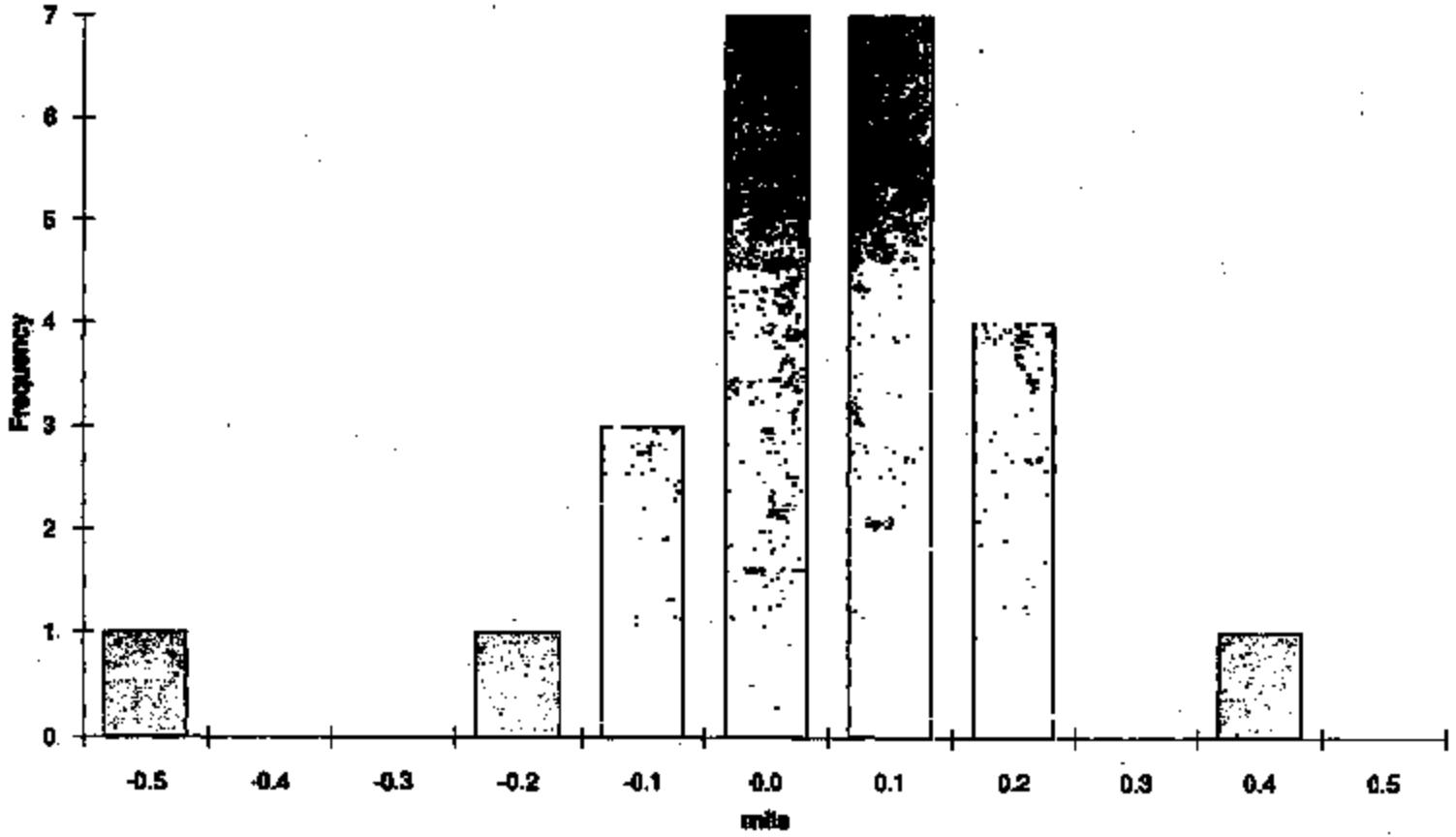


Vacuum dependency test before impulse

TEST355A.XLC
JAD 12/11/92

TL-NHTSA 011304

Modified Cup Evaluation (27713-2)
Vacuum Dependency Test

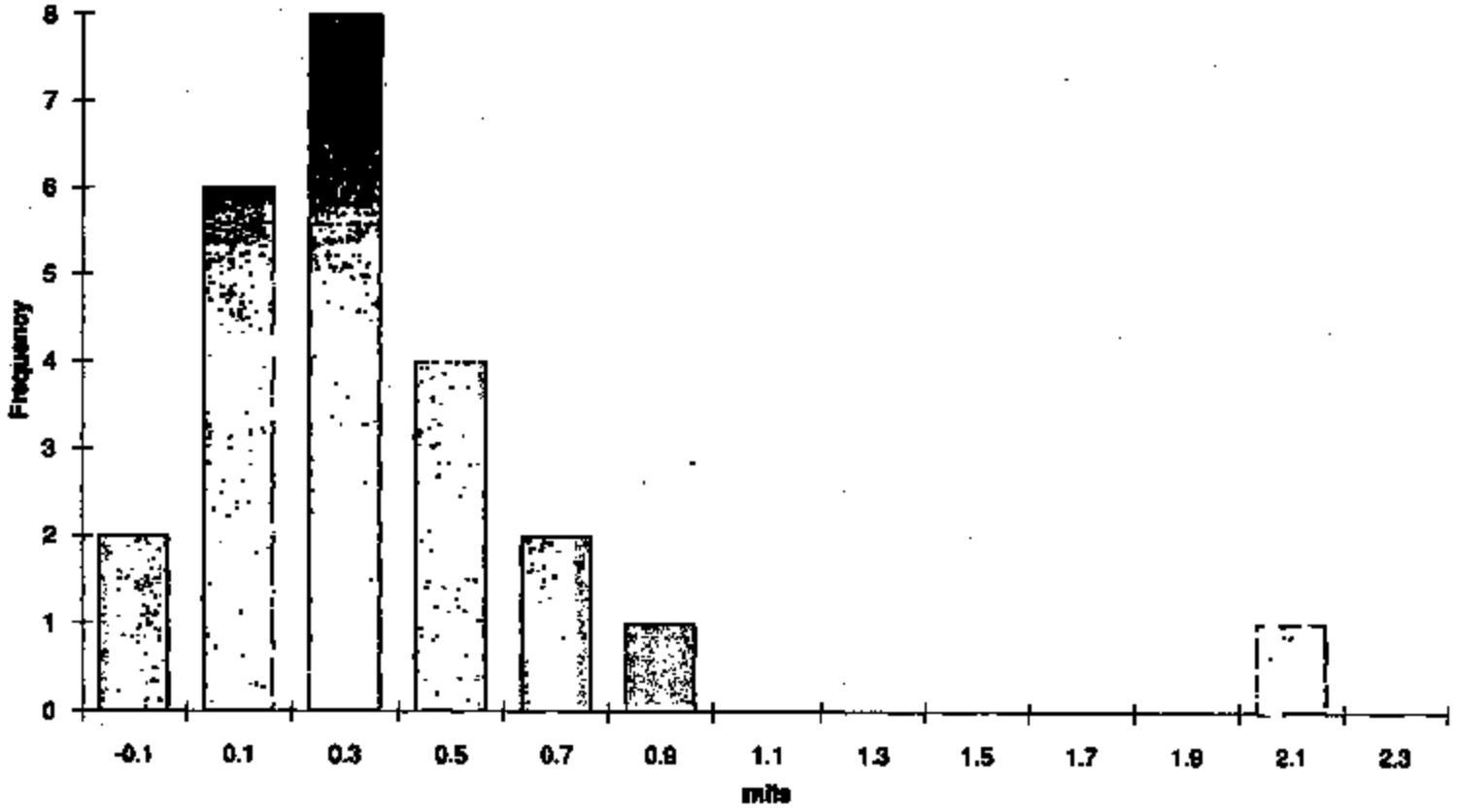


Vacuum dependency test after 500k impulses

TEST3558.XLC
JAD 12/11/92

TI-NHT9A 011385

Modified Cup Evaluation (27713-2)
Vacuum Dependency Test



Disc position delta after 500K impulses
(pre-vacuum measurements)

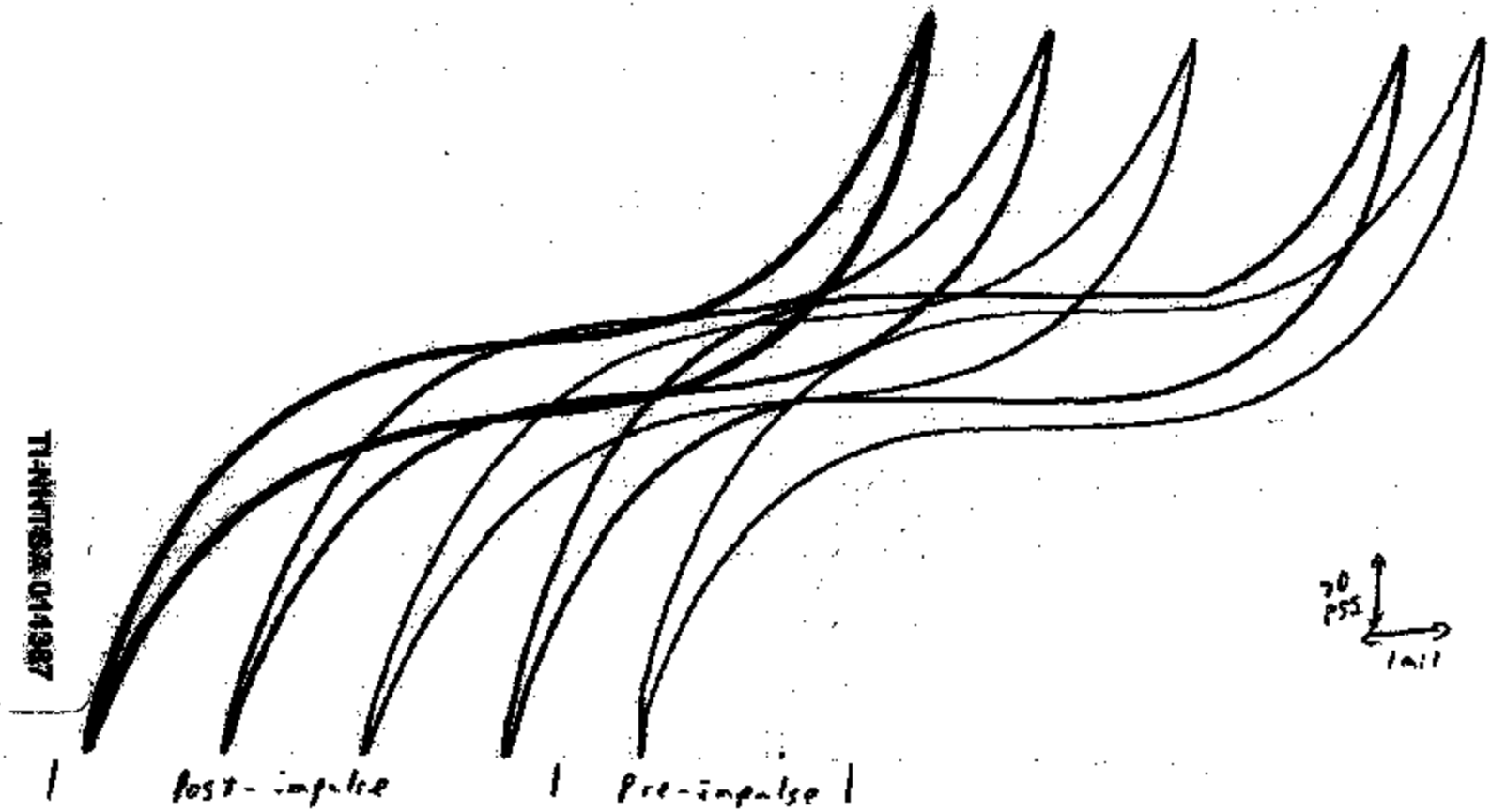
TEST355C.XLC
JAD 12/11/92

TI-NHTSA 011386

RANGES: 720.0mV 10.00V 2.400V
OFFSETS: 0.0V 0.0V 0.0V
TOTAL TIME: 1.000
POST-TRIG: 0.00
TRIGGER: MAN
16:05:33 29 JAN 98

JD

Test 355
27713-2 cup eval
Impulse test



TI-HHTSSR-041987

| post-impulse | pre-impulse |

12/11/92

ENGINEERING TEST MATRIX
27713-2 CUP EVALUATIONS
20.57/11.78 & 25.3/16.7 DISC EVALUATIONS

GROUP "A" 20.57 DISC & 27713-1 CUP
GROUP "B" 20.57 DISC & 27713-2 CUP
GROUP "C" 25.3 DISC & 27713-1 CUP
GROUP "D" 25.3 DISC & 27713-2 CUP

SERIALIZED SENSOR DIMENSION READINGS X.001"

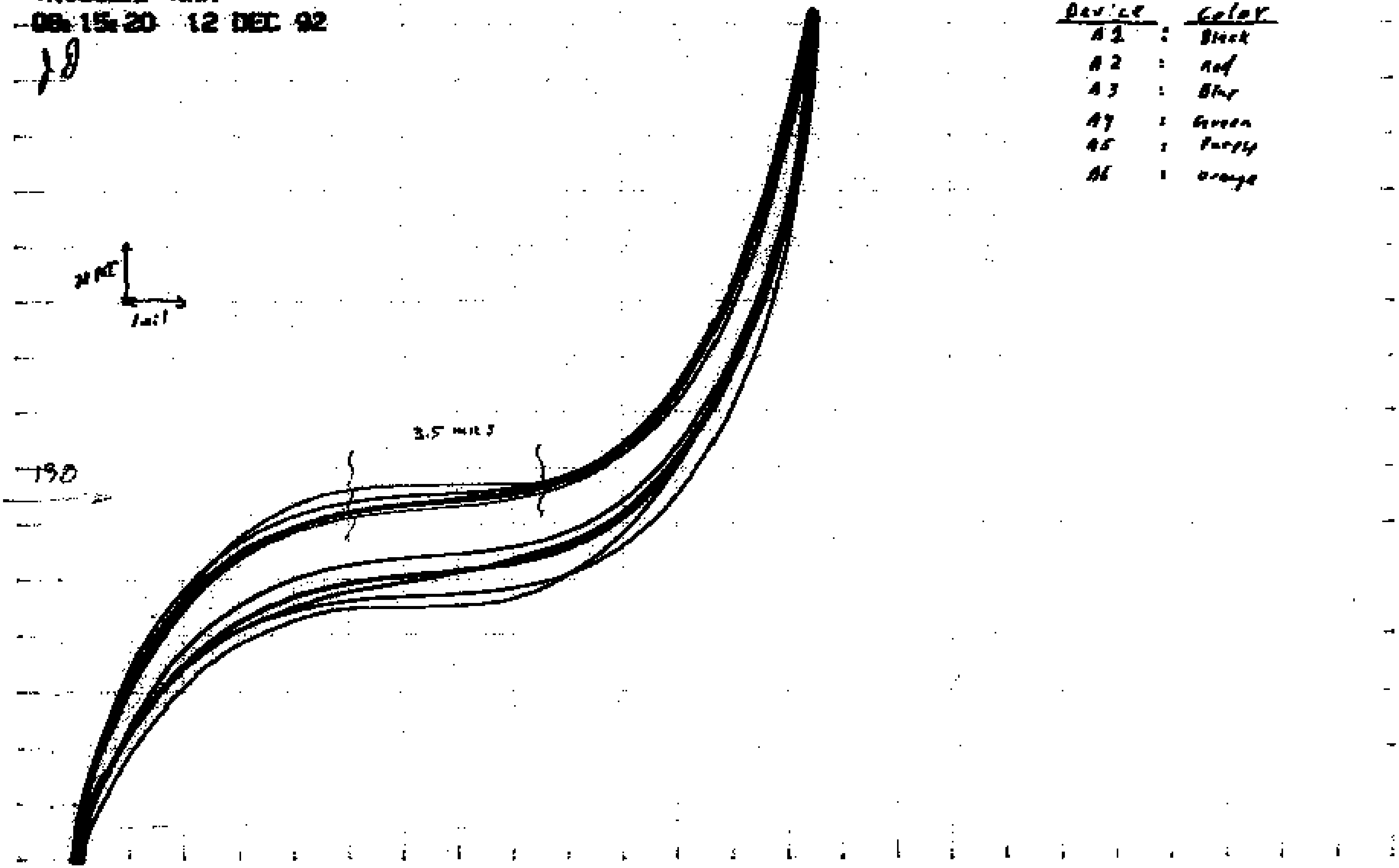
GROUP "A" CUP 27713-1 DISC 20.57		GROUP "B" CUP 27713-2 DISC 20.57		GROUP "C" CUP 27713-1 DISC 25.3		GROUP "D" CUP 27713-2 DISC 25.3	
A1	48.00	B1	47.60	C1	47.50	D1	47.80
A2	47.90	B2	46.70	C2	47.70	D2	47.70
A3	48.40	B3	49.10	C3	47.30	D3	47.20
A4	47.80	B4	46.50	C4	48.00	D4	47.00
A5	48.30	B5	48.20	C5	47.60	D5	47.70
A6	47.90	B6	47.50	C6	47.50	D6	48.30
A7	48.30	B7	48.40	C7	47.60	D7	48.70
A8	48.10	B8	47.70	C8	47.90	D8	48.80
A9	48.20	B9	47.60	C9	47.50	D9	47.20
A10	48.10	B10	47.80	C10	47.60	D10	47.60
A11	48.20	B11	48.70	C11	47.80	D11	48.00
A12	48.40	B12	47.90	C12	47.50	D12	48.50
MEAN	48.13	MEAN	48.04	MEAN	47.66	MEAN	47.84
SIGMA	0.20	SIGMA	0.80	SIGMA	0.21	SIGMA	0.65
Range 0.60		Range 1.60		Range 0.70		Range 1.90	

MJS 12/11/92 27713-2.XLS

TI-NHTSA 011388

Test 360-15-24
Group "A": 20.59 [illegible]/[illegible]-1 [illegible]

RANGES: 9.800V 10.00V 2.450V
OFFSETS: 0.0V 0.0V 0.1V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN
08:15:20 12 DEC 92



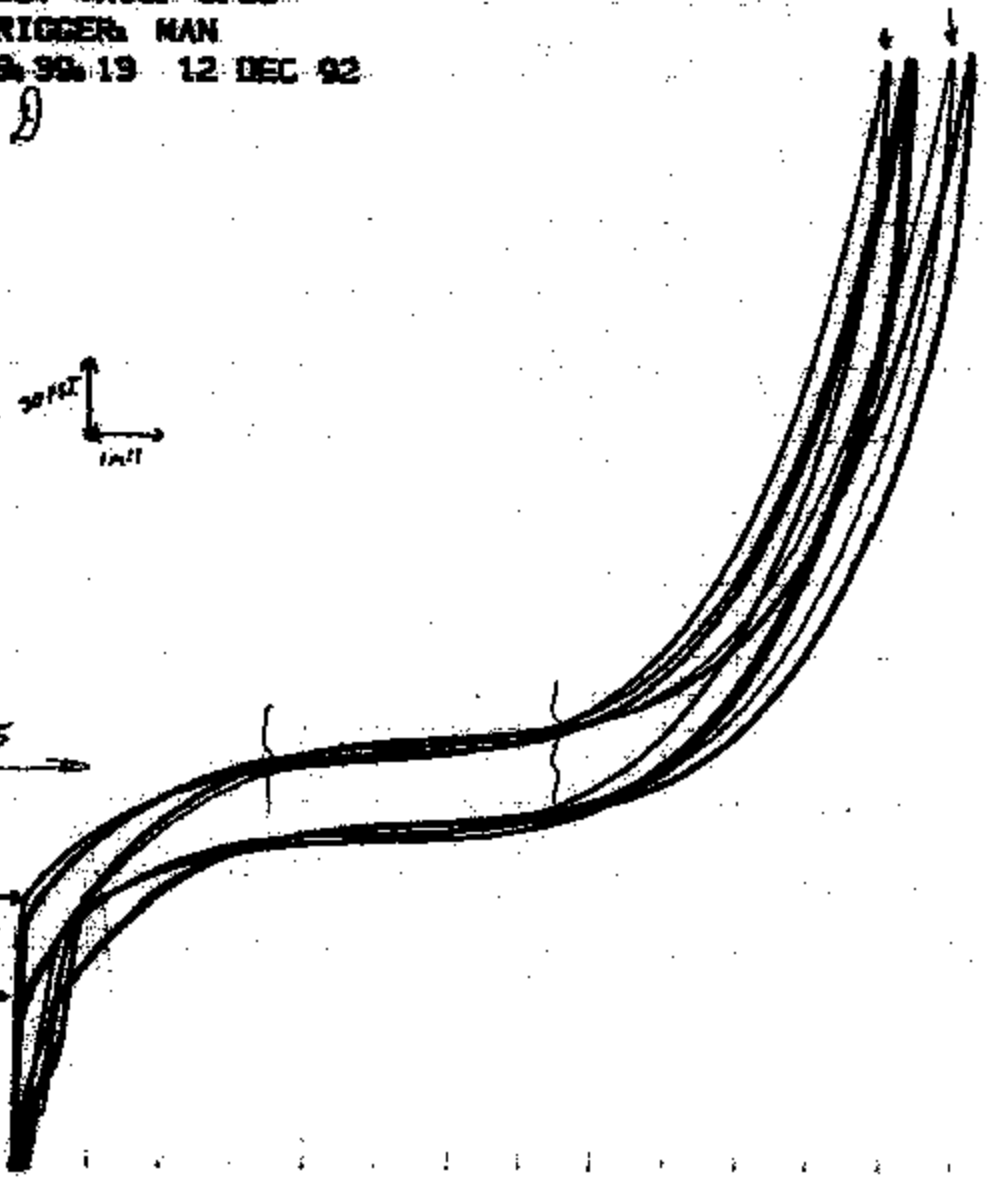
Device		Color
A1	:	Black
A2	:	Red
A3	:	Blue
A4	:	Green
A5	:	Purple
A6	:	orange

Test 360-15-29
Group "B": 20.57 disc / 3270-2 cup

RANGES: 9.000V | 10.00V | 2.450V
OFFSETS: 0.0V | 0.0V | 0.1V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN
06:30:19 12 DEC 92

B

Sensor	Color
B2	Black
B3	Red
B4	Blue
B5	Green
B6	Purple
B7	Orange

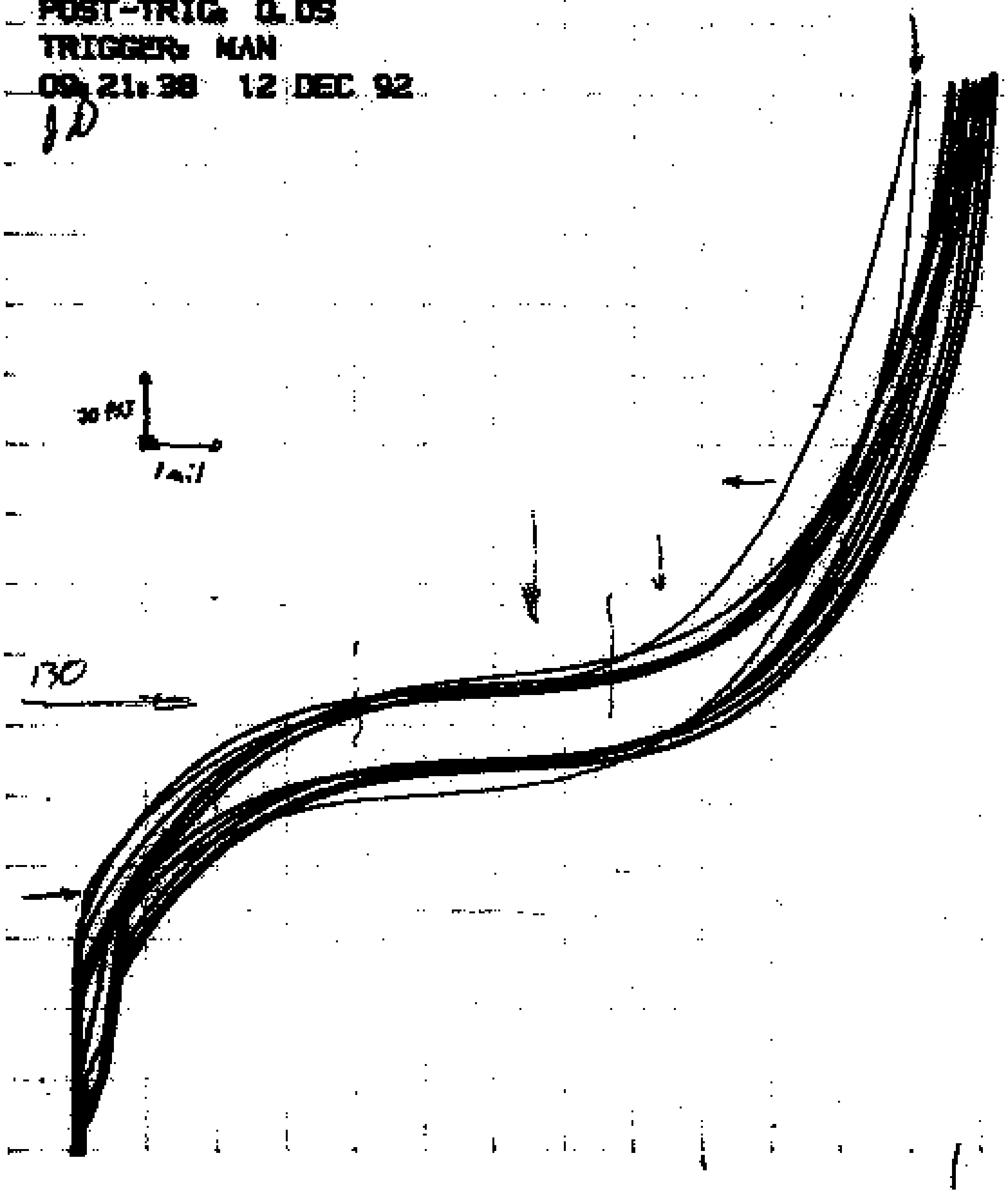


THERMTSA 013290

RANGES: 5.000V 10.00V 2.450V
OFFSETS: 0.0V 0.0V 0.1V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN
09:21:38 12 DEC 92

Test 360-15-24
Group "B" 25.9 deg/27 ... dep

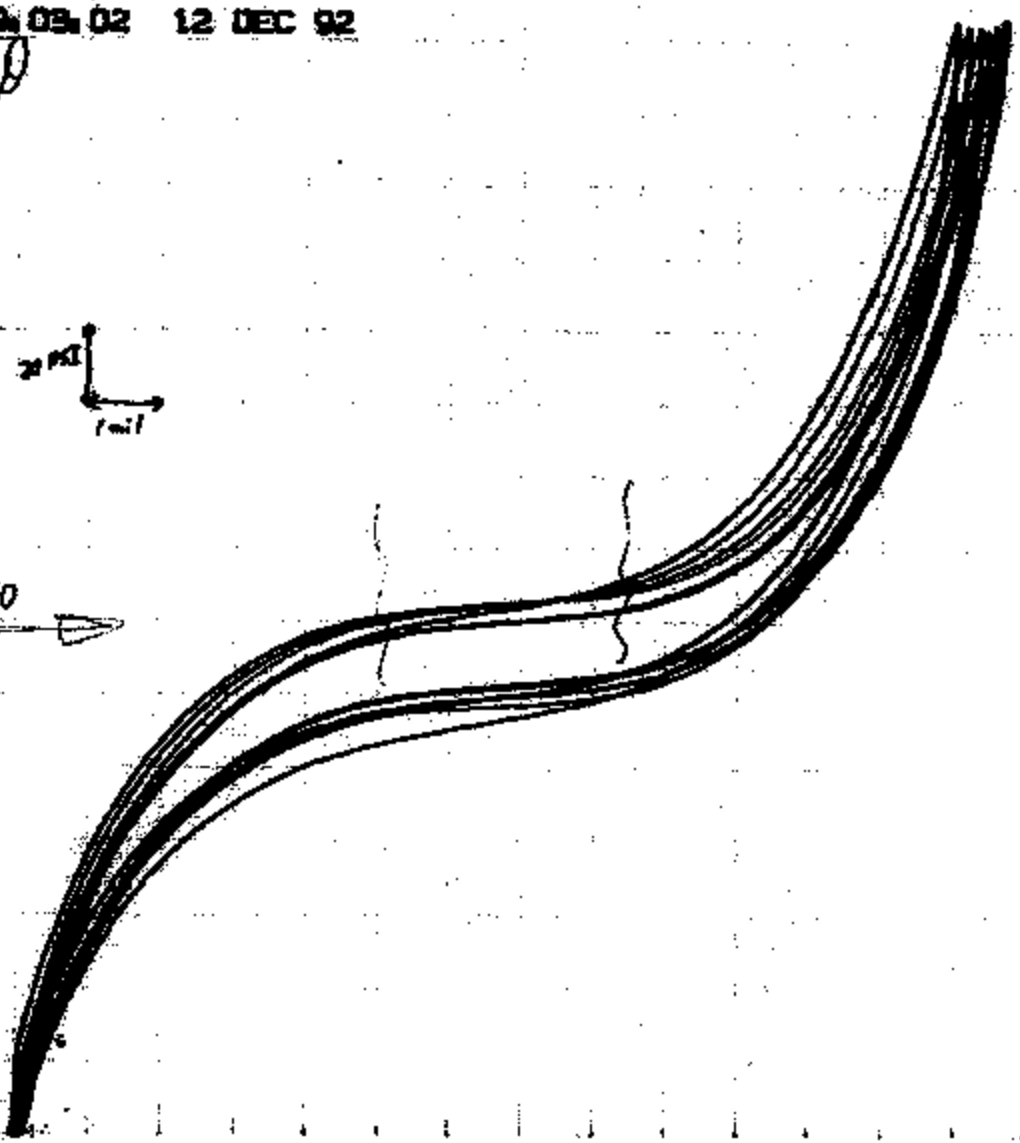
Sensor	Color
01 :	Black
02 :	Red
03 :	Blue
04 :	Green
05 :	Purple
06 :	Orange



RANGES: 3.000V | 10.00V | 2.450V
OFFSETS: 0.0V | 0.0V | 0.1V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN
09:09:02 12 DEC 92

Test 360-15-24
Grade "C": 25.3 deg/27413-1 cup

Sensor	Color
C1 :	Black
C2 :	Red
C3 :	Blue
C4 :	Green
C5 :	Purple
C6 :	Orange



TI-NHTSA 011592

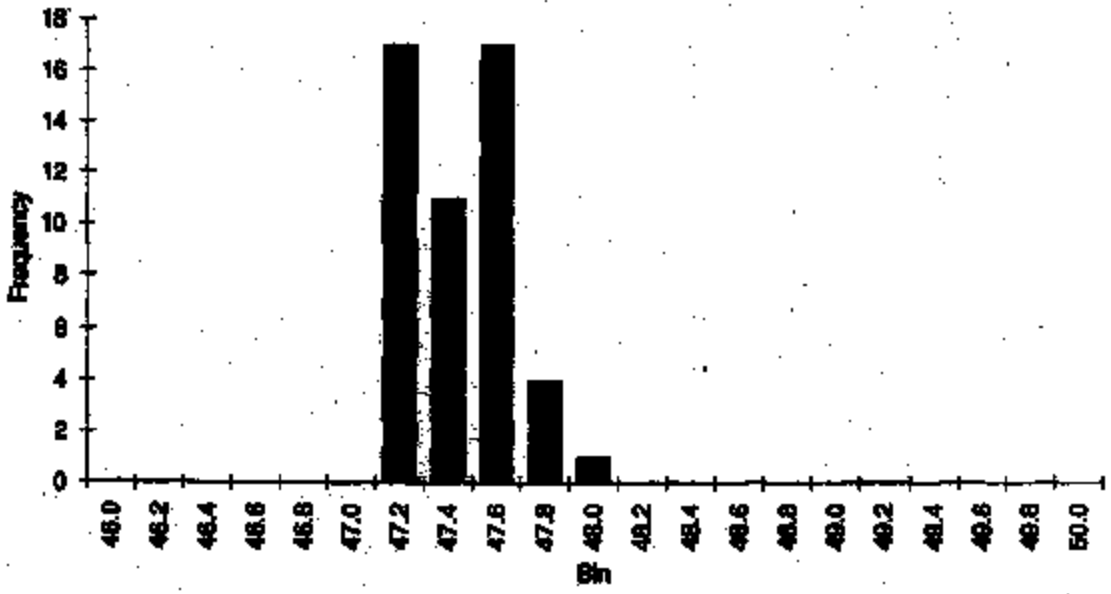
27713.XLS

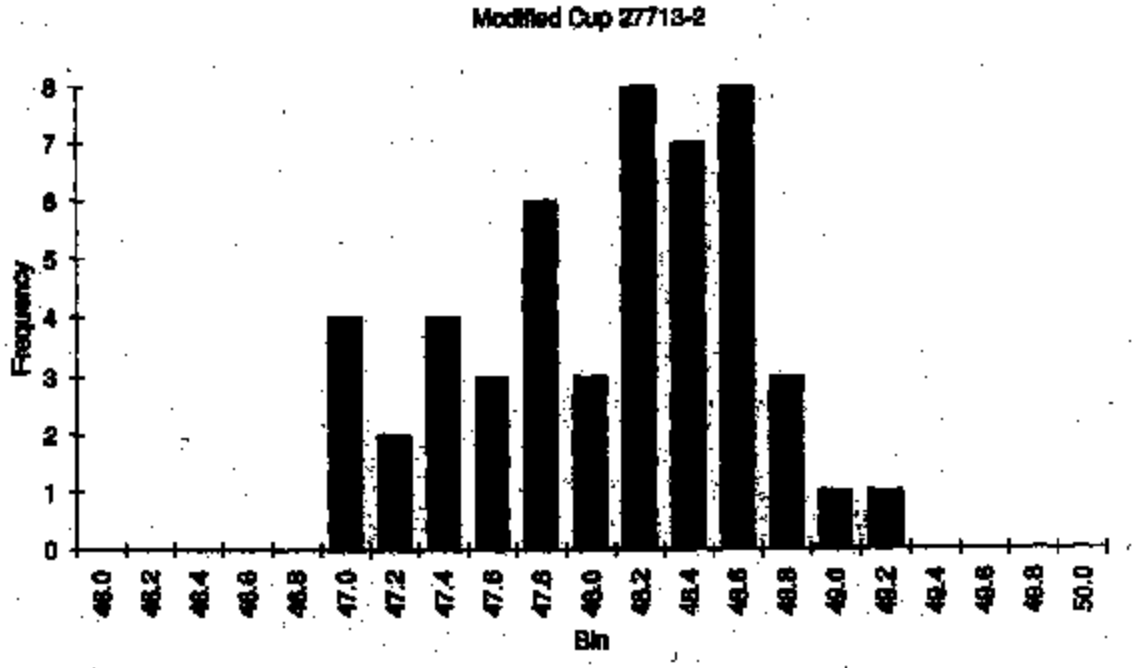
27713-1 LOT-"TYP" — Mold LOT ... 13.8 PSI

		Pass-Car Sct 2[illegible]				Pass-Car 27713-2
		Before Vac	After Vac	Delta		No Vac
1		47.7	48.0	.3		48.4
2		47.2	48.3	1.1		48
3		47.6	47.8	.2		47.9
4		47.9	48.0	.1		48.3
5		47.4	47.5	.1		48.4
6		47.2	47.6	.4		48
7		47.8	48.2	.4		47.9
8		47.4	47.4	.0		48.5
9		47.3	47.3	.0		47.9
10		47.7	49.5	1.8		47.8
11		47.4	47.5	.1		48.7
12		47.7	47.7	.0		47.6
13		47.4	48.5	1.1		48.3
14		47.8	48.6	.8		48.2
15		47.3	47.4	.1		47.2
16		47.3	47.3	.0		48.5
17		47.3	48.2	.9		48.1
18		47.3	47.4	.1		48.3
19		47.2	47.4	.2		47.1
20		47.3	47.4	.1		48.8
21		47.6	47.6	.0		47
22		47.7	47.7	.0		47.4
23		47.7	48.0	.3		48.7
24		47.6	47.6	.0		48.4
25		47.3	47.4	.1		48.5
26		47.4	47.6	.2		48.9
27		47.5	47.7	.2		48.2
28		47.6	47.6	.0		47.8
29		47.6	48.1	.5		47.4
30		47.5	47.6	.1		48.3
31		47.2	47.3	.1		47.9
32		47.2	47.6	.4		48.7
33		47.6	48.4	.8		47.6
34		47.3	47.4	.1		47.6
35		47.2	47.7	.5		47.2
36		47.6	48.0	.4		48.8
37		47.6	47.7	.1		48.8
38		47.6	47.7	.1		48.7
39		47.3	47.3	.0		48.9
40		47.5	48.0	.5		48.7
41		48.1	48.0	-.1		47.1
42		47.4	47.5	.1		48.2
43		47.2	47.3	.1		47.9
44		47.6	48.6	1.0		48.9
45		47.6	47.7	.1		48.3
46		47.7	47.6	-.1		47.1
47		47.5	47.5	.0		48
48		47.2	47.4	.2		48.2
49		47.7	47.7	.0		47.9
50		47.6	47.6	.0		48.4
	Mean	47.49	47.76	0.27		48.118
	Median	47.5	47.65	0.1		48.25
	Mode	47.6	47.6	0.1		48.3
	Standard Deviation	0.21[illegible]	0.45[illegible]	0.379177		0.57[illegible]1107
	Variance	0.0470[illegible]	0.159[illegible]7	0.143776		0.33[illegible]
	Kurtosis	-0.2[illegible]78	4.3[illegible]	4.811027		-0.[illegible]
	Skewness	0.4215[illegible]	1.73227	2.0[illegible]13		-0.2[illegible]767
	Range	0.9	2.2	1.9		2.2
	Minimum	47.2	47.3	-0.1		47
	Maximum	48.1	49.5	1.8		49.2
	Sum	2374.5	2388	13.5		2405.9
	Count	50	50	50		50

JAD 12/10/92

Standard Cup 27713-1



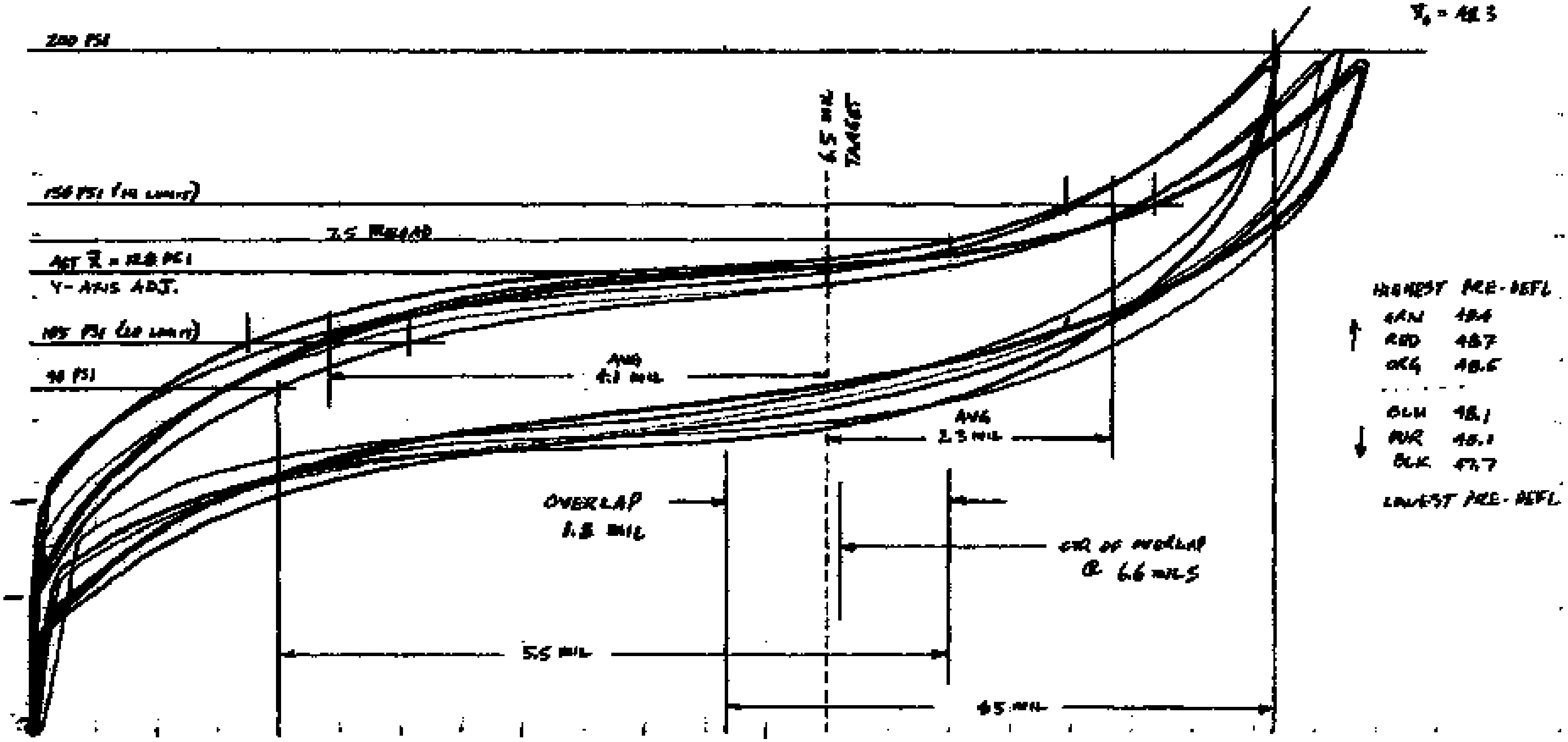

Modified Cup 27713-2
Frequency
0
1
2
3
4
5
6
7
8
46.0
46.2
46.4
46.6
46.8
47.0
47.2
47.4
47.6
47.8
48.0
48.2
48.4
48.6
48.8
49.0
49.2
49.4
49.6
49.8
50.0
Bin

27713-2 Cap

1ST PROD LOT 2ND PILOT ATTEMPT
(1ST PILOT LOW ACT)

RANGES: 1.600V 10.00V 1.250V
OFFSETS: 0.0V 0.0V 0.0V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN
09:28:92 08 DEC 92

X: 0.5 MIL /DIV
Y: 20 PSI /DIV



TI-NHTSA 011397

139.0; REL:

27; FIX 3; C= 0000000; BIN=BOOD ; MRSU=44.0; MRRO=
124.4; REL= 105.9; DIF= 19.5 PSI; ACTCK= 962.5ms;

25; FIX 4; C= 0000000; BIN=BOOD ; MRSU=43.4; MRRO=34.9; LEAK RATE= 1.3
121.7; REL= 92.4; DIF= 29.3 PSI; ACTCK= 798.3ms; RELCK= 5724.3

1

2-DEC-1992 11:10:56.98 OPEN DOOR DID NOT CLOSE

2-DEC-1992 11:11:[illegible] 0000000; BIN=BOOD ; MRSU=43.4; MRRO=34.9; LEAK RATE= 1.3
134.2; REL= 106.0; DIF= 28.2 PSI; ACTCK= 706.3ms; RELCK= 5634.3

2-DEC-1992 11:12:01.37 OPEN DOOR DID NOT CLOSE 1

7706 PRESSURE TESTER LOT REPORT

PART NO: 7706L5-2
LOT ID: 296AA-PILOT
LOT STARTED: 2-DEC-1992 11:07:37.80
LOT FINISHED: 2-DEC-1992 11:12:27.15

SETUP DATA:
DISC LOT ID: 0.00
DISC MEAN ACT: 2053 MEAN REL: 967
LIMIT (HC)
ACTUATION: 105.0 TO 150.0 PSI
RELEASE: 20.0 TO 135.0 PSI
DIFFERENTIAL: 15.0 TO 50.0 PSI
MAX MILLIVOLT: 200.0 mv
ACT CREEP TIME: 200.0 PSI
REL CREEP TIME: 200.0 PSI
NON CREEP TEST
PRECYCLE PRESS: 800.0 PSI
PRECYCLE COUNT: 2

NUMBER OF PIECES TESTED: 32
NUMBER OF PIECES GOOD: 31
YIELD: 96.88 %

REJECT COUNTS

BIN	COUNT	% OF REJECTS
LEAK	0	0.00 %
CONG	0	0.00 %
NOCR	0	0.00 %
ACLO	0	0.00 %
ACHI	0	0.00 %
RLHI	0	0.00 %
RLLO	0	0.00 %
DFLO	1	100.00 %
RLCR	0	0.00 %
DFHI	0	0.00 %

STATISTICS	MEAN	SIGMA	CPK
ACTUATION:	128.4	5.02	1.44
RELEASE:	101.5	4.75	2.35
MILLIVOLT:	0.0	0.00	0.00
DIFFERENTIAL:	26.8	4.45	0.89

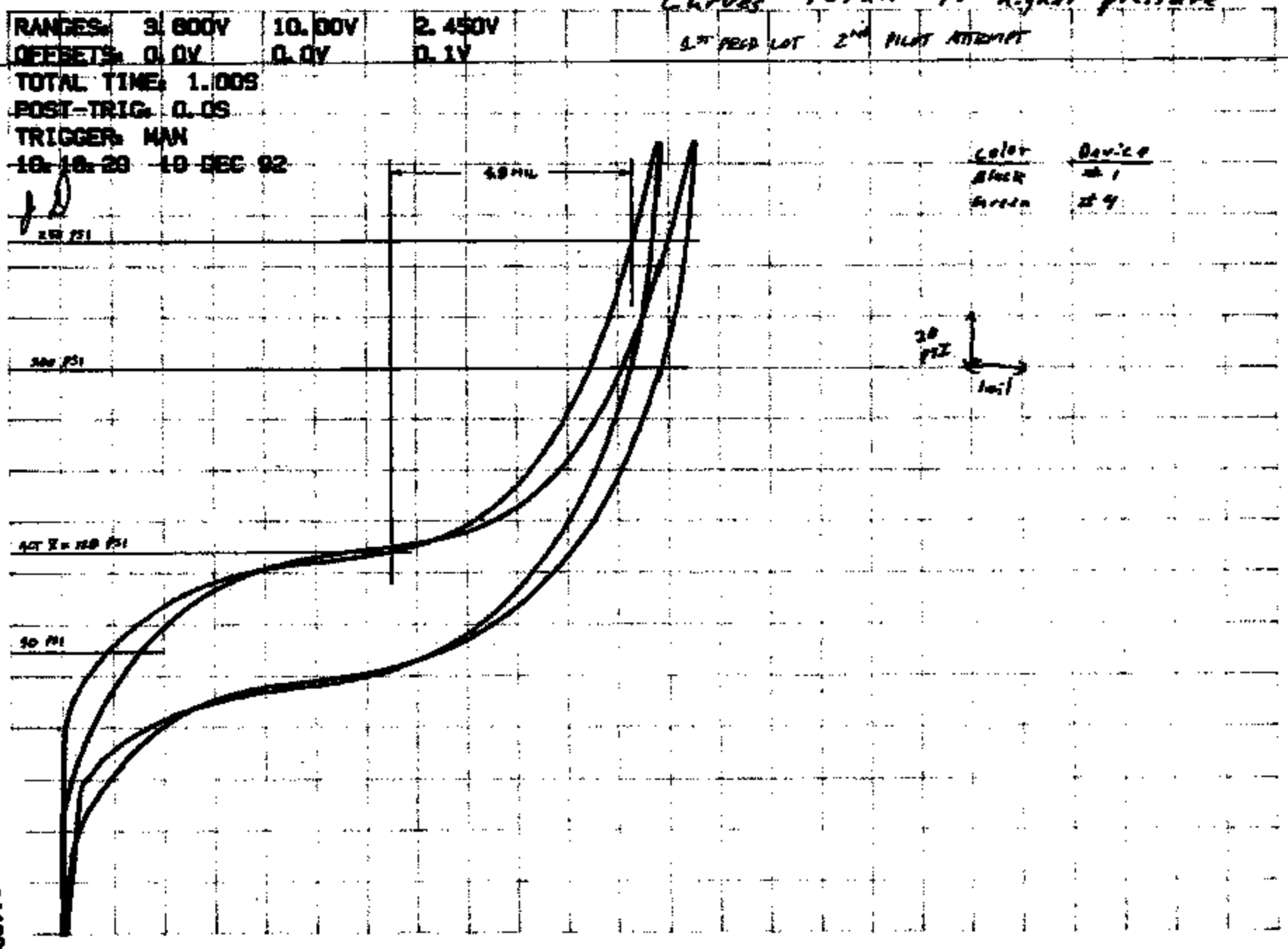
TI-NHTSA 011398

HISTOGRAM OF ACTUATION PRESSURE

27713-2 CUP

Curves reran to higher pressure

1st field lot 2nd pilot attempt



-MSG MS= 00147993 FR=SBO1 TO=SBO1 SENT=11/25/92 01:11 PM
SS=094 ST=C DIV=0050 CC=00101 BY=SBO1 AT=11/25/92 01:11 PM

TO: Dave Czarn SARN
Jeff DiDomenico DIDO
Charlie Douglas CHP1
George Holman HS12
Matt Sellers MJS2
Bill Sweet WS4
Jim Watt JW02

FR: Steve Offiler SBO1

SJ: Cup Modification for Silent Truck Devices

Based upon limited experimentation with the present car and truck cups (27713-1 and 27288-1 respectively) we have determined that NO MODIFICATION IS PRESENTLY REQUIRED TO 27288 for the silent truck application. However, the entire disc "negative preload" situation is still under review for both car and truck.

Measurements of the actual difference between disc dimension and disc envelope dimension (cup bump to converter bump) were made on car and truck using Kapton diaphragms with holes in the center. This removes the force which the diaphragm exerts on the converter button, and allows sensor reference dimensions to be taken with the disc in its lowest and highest possible positions by moving the converter manually thru the bezport.

NOTE: the data presented is avg, with min/max on 12-pc sample in ()

		CAR SENSOR	TRUCK SENSOR
44.7	Disc lowest position	50.5 (48.6-51.5)	49.8 (49.0-50.6)
43.1	Disc highest position	44.2 (43.8-44.6)	45.6 (45.4-45.9)
3.2	Delta, max neg. preload	6.3 (4.8- 7.5)	4.2 (3.3- 5.1)

surf chg 3.4

The production sensor reference dimension falls between these two extremes due to the aforementioned force exerted by the diaphragm which pushes the converter/disc towards the cup bump. One possible variable which requires further characterization is the change in this force over time.

46.6	Production position	47.5 (47.2-48.1)	46.1 (45.7-47.1)

The difference between the lowest-disc-position and the production position is 50.5-47.5= 3.0 mils for car; and 49.8-46.1= 3.7 for truck. This models the situation created when vacuum pulls the diaphragm away from the converter, and the magnitude (3-ish mils) coincides with the observed vacuum shift. This further confirms that the force of the diaphragm on the converter is essential to the stackup which determines the ultimate position of the disc; and brings up the issue of whether this force relaxes over time. More testing is required here.

The difference between the highest-disc-position and the production position is 47.5-44.2= 3.3 mils for car; and 46.1-45.6= 0.5 mils for truck. This models the actual gap between the disc and the cup bumps as-built in production. The car disc appears "loose" by over 3 mils; while the truck disc is essentially tight against the cup bumps. So, by making the 4.0 mil change to the car cup, the looseness is accomodated. However, the truck situation is different. Since there is no looseness, any change to reduce the total disc envelope will cause disc predeflection and a narrowing of the

pin window (assuming the force exerted by the diaphragm on the converter is larger than the force required to deflect the disc) - more testing is required here.

	CAR SENSOR	TRUCK SENSOR
Delta, max neg. preload	6.3 (4.8- 7.5)	4.2 (3.3- 5.1)
W/ modified car cup	2.3 (0.8- 3.5)	4.2 (3.3- 5.1)

With the 27713 modification, the max. negative preload for car is reduced to 2.3 mils versus the unmodified 4.2 mils for truck, an average difference of about 2 mils greater for truck now. However, the primary goal is to prevent the device from going open-circuit; i.e. with all shifts comprehended, the pinning preload falling below zero. The truck target preload is 3 mils greater than car, 9.5 vs. 6.5 mils. So, even with the additional 2 mils of potential (not actual) additional looseness, with the pinning 3 mils further to the right the truck ends up in a situation that is 1 mil more favorable than the modified car situation. This is the reason that no change to the truck cup is presently indicated. However, the attitude of Design Engineering is that more work is required to fully understand the situation, and ultimately further dimensional revisions may be required which would apply to both 27713 and 27288.

Regards, Steve O.

Quiet Truck Discs

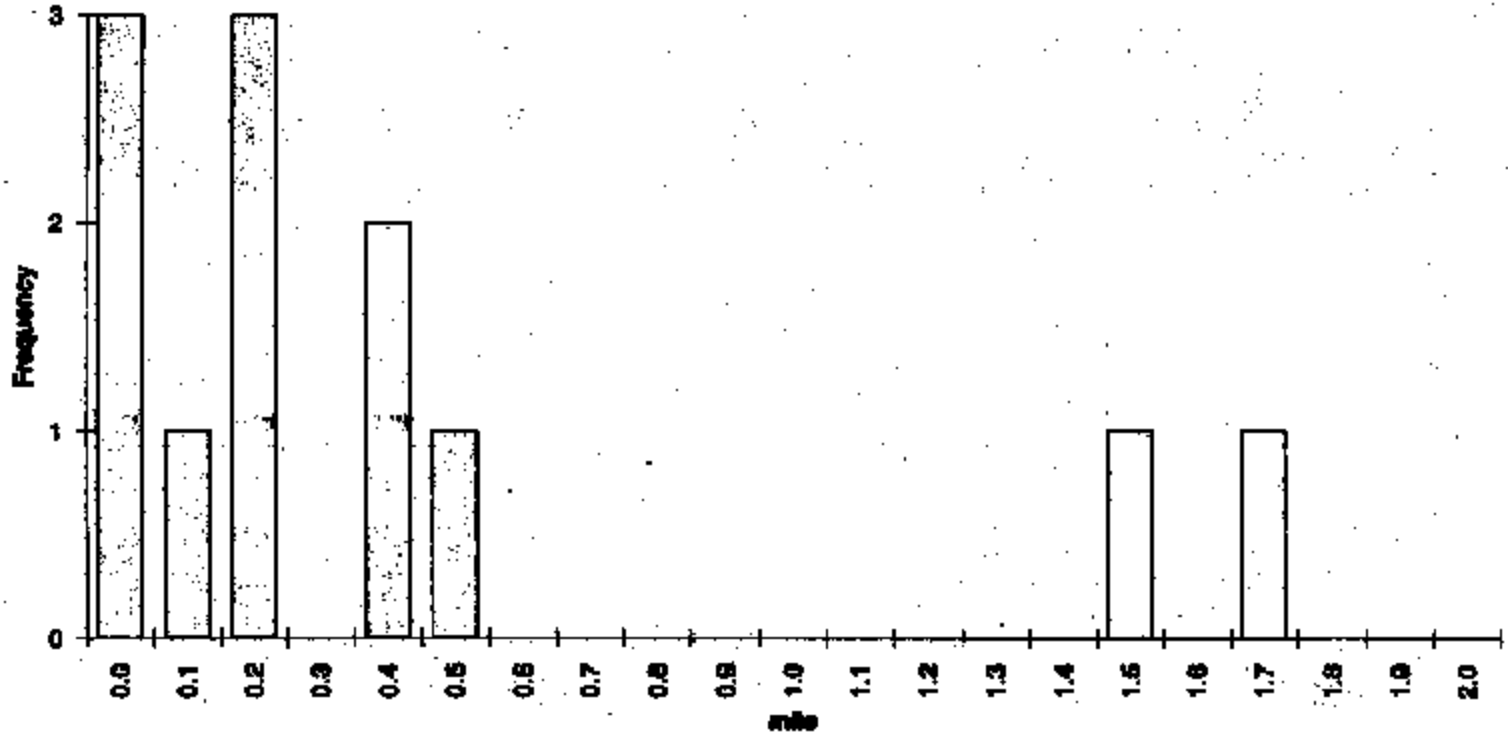
TRUCK

CAR

	Normal Devices from Prod. Run			Prod. Built No Diaphragm	Prod. Built Rubber Diaphragm	Holed Kapton, Hand-built in Lab		
	Pre-Vac	Post-Vac	Delta			Free Disc	Disc Raised to Bump	Delta
1	45.9	45.9	0.0	50.8	49.8	49.8	44.0	5.8
2	46.3	46.5	0.2	50.4	49.8	50.4	44.4	6.0
3	46.4	48.1	1.7	51.5	52.0	50.8	44.5	6.3
4	46.0	46.2	0.2	50.2	50.1	50.8	44.6	6.2
5	46.0	47.5	1.5	50.4	50.3	50.8	44.5	6.3
6	46.0	46.0	0.0	50.6	48.9	48.6	43.8	4.8
7	46.1	46.1	0.0	51.4	50.3	51.0	44.6	6.4
8	46.2	46.4	0.2	51.7	49.6	50.4	44.0	6.4
9	46.1	46.6	0.5	50.5	49.5	51.5	44.2	7.3
10	46.1	46.5	0.4	50.8	50.7	50.5	44.1	6.4
11	46.1	46.5	0.4	50.7	49.8	50.3	43.8	6.5
12	45.8	45.9	0.1		49.6	51.3	43.8	7.5
Mean	46.083333	46.516667	0.433333	50.836364	50.0333333	50.516667	44.1916667	6.325
Median	46.1	46.45	0.2	50.8	49.8	50.65	44.15	6.35
Mode	46.1	46.5	0	50.8	49.8	50.8	43.8	6.4
Std Dev	0.1642245	0.6803499	0.571017	0.492489	0.77263814	0.7577678	0.31754265	0.681075
Variance	0.0269697	0.4628606	0.326061	0.2425455	0.5969697	0.5742424	0.10083333	0.463864
Kurtosis	0.3349577	2.2618869	1.899083	-0.736917	3.47352614	3.2046759	-1.7252026	2.049975
Skewness	0.3174507	1.5942465	1.714934	0.6659783	1.45052503	-1.45651	0.02976463	-0.40465
Range	0.6	2.2	1.7	1.6	3.1	2.9	0.8	2.7
Minimum	45.8	45.9	0	50.2	48.9	48.6	43.8	4.8
Maximum	46.4	48.1	1.7	51.7	52	51.5	44.6	7.5
Sum	553	558.2	5.2	559.2	600.4	606.2	530.3	75.9
Count	12	12	12	11	12	12	12	12

TRKLOTS.XLS
JAD 11/23/92

Disc Height Delta After Vacuum



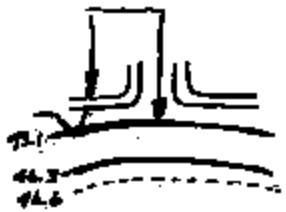
THNHTSA 011403

Silent Truck Discs, Production Built

TRKLOTS.XLC
JAD 11/23/92

(THESE DISCS ARE .002" LARGER @ DIP BUMP ϕ
THAN PRODUCTION LOT w/ KET 120/51)

	holed kapton	holed kapton			
Device #	disc down	disc up	delta	Device #	controls
359-15-01	46.6	42.5	4.0	359-15-13	47.1
359-15-02	46.6	42.7	3.9	359-15-14	46.1
359-15-03	45.9	43.3	2.6	359-15-15	47.1
359-15-04	46.1	42.8	3.3	359-16-16	46.6
359-15-05	45.9	42.6	3.3	359-16-17	46.3
359-15-06	46.4	43.9	2.5	359-15-18	46.7
359-15-07	46.6	43.5	3.1	359-15-19	46.6
359-15-08	45.8	43.4	2.4	359-16-20	46.1
359-15-09	46.3	43.5	2.8	359-16-21	46.6
359-15-10	46.6	42.7	3.9	359-15-22	46.5
359-15-11	46.1	43.0	3.1	359-15-23	46.3
359-15-12	46.3	42.9	3.4	359-15-24	46.5
Mean	46.25833333	43.06666667	3.191667		46.55
Median	46.3	42.95	3.2		46.5
Mode	46.6	42.7	3.9		46.5
Std. Dev.	0.293747985	0.441758567	0.651788		0.334392
Variance	0.086287879	0.195151515	0.30447		0.111818
Kurtosis	-1.428889843	-0.88620434	-1.14086		-0.53891
Skewness	-0.256023276	0.467322786	0.100476		0.402623
Range	0.8	1.4	1.6		1
Minimum	45.8	42.5	2.4		46.1
Maximum	46.6	43.9	4		47.1
Sum	555.1	516.8	38.3		558.6
Count	12	12	12		12



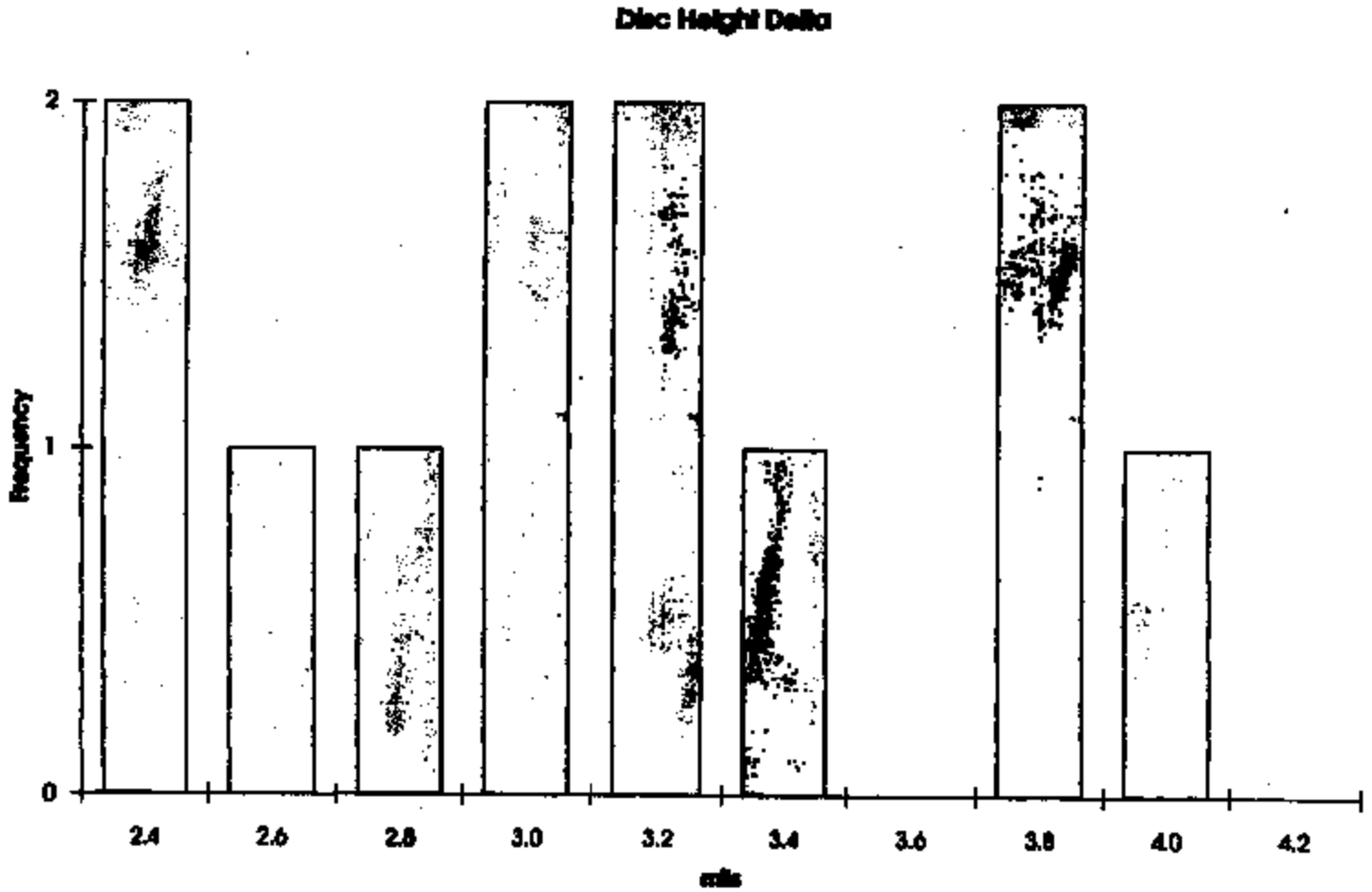
3.5 MILS PRE-DEFL.

TI-NHTBA 011404

TEST359.XLS
JAD 12/10/92

Modified Cup Evaluation

Holed Kapton, 27713-2 cup, High act. disc



TEST359A.XLC
JAD 12/10/92

ASC-UNIV DIFFERENT LOT	I	II	III	HALED KAPTON STUDY
1	.3386	.3389		.3385
2	.3386	.3386		.3386
3	.3389	.3388		.3388
4	.3391	.3391		.3391
5	.3389	.3390		.3390

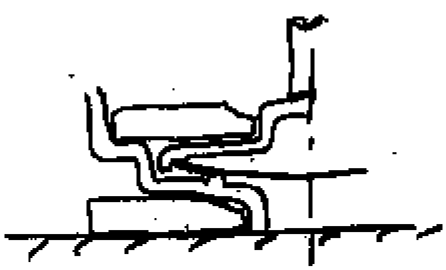
X̄ .3386
.0002

2ND PILOT 2813
(RED LOT RET 120PH 2916AA)

Δ .0012

1	.3373	.3373		.3373
2	.3376	.3377		.3376
3	.3378	.3376		.3377
4	.3378	.3376		.3377
5	.3377	.3376		.3377

X̄ .3376
.0012



1ST PLOT 20.57/11.78 1ST REF

1	.3374	.3373		.3373
2	.3372	.3370		.3371
3	.3370	.3373	.3374	.3372
4	.3372	.3372		.3372
5	.3374	.3371	.3370	.3372

X̄ .3372

Modified Cup Evaluation

(27713-2)

First Pilot Lot - Low Act.

ACT ~ 105 psi

Device #	Pre-vac Dimension	Post-vac Dimension	delta	Hatchet	Impulse	Pre-vac Dimension	Post-vac Dimension	delta	Pre-vac delta Previous Imp
355-15-01	47.4	47.4	0.0		•	47.7	47.7	0.0	0.3
355-15-02	46.4	46.5	0.1		•	46.6	46.8	0.2	0.2
355-15-03	46.5	46.6	0.1		•	46.8	46.9	0.1	0.3
355-15-04	46.7	46.7	0.0		•	47.0	47.1	0.1	0.3
355-15-05	46.9	47.1	0.2	•	•	47.1	47.2	0.1	0.2
355-15-06 *	46.7	46.7	0.0		•	47.2	47.2	0.0	0.5
355-15-07	46.4	46.4	0.0		•	46.3	46.5	0.2	-0.1
355-15-08	46.6	46.6	0.1		•	46.8	46.9	0.1	0.3
355-15-09	46.9	47.1	0.2 next	•	•	46.6	46.8	0.2	0.3
355-15-10	46.4	46.4	0.0		•	46.8	46.8	0.0	0.4
355-15-11	46.6	46.7	0.1		•	47.4	46.9	-0.5 next	0.8
355-15-12	46.7	46.8	0.1		•	46.9	46.9	0.0	0.2
355-15-13	46.3	46.3	0.0	•	•	46.4	46.8	0.4 next	0.1
355-15-14	47.1	47.2	0.1		•	47.9	48.0	0.1	0.8
355-15-15	46.0 next	46.2 next	0.2		•	46.2 next	46.3 next	0.1	0.2
355-15-16	46.7	46.9	0.2		•	46.8	46.8	0.2	-0.1
355-15-17	47.0	47.2	0.2	•	•	48.0	47.9	-0.1	1.0
355-15-18	46.3	46.5	0.2		•	46.8	46.8	0.0	0.5
355-15-19	46.6	46.8	0.2		•	46.8	46.9	0.1	0.2
355-15-20	46.6	46.8	0.1		•	46.8	46.8	0.0	0.3
355-15-21	46.4	46.6	0.1	•	•	46.6 next	46.6 next	0.0	2.2 n/a
355-15-22	46.4	46.6	0.2		•	46.9	46.8	-0.1	0.5
355-15-23	46.3	46.4	0.1		•	46.9	46.7	-0.2	0.6
355-15-24	46.8	47.0	0.2		•	47.2	47.1	-0.1	0.4
355-15-25	46.7	46.9	0.2						
355-15-26	46.7	46.7	0.0						
355-15-27	46.4	46.4	0.0						
355-15-28	46.6	46.6	0.1						
355-15-29	46.4	46.5	0.1						
355-15-30	46.7	46.8	0.1						
355-15-31	46.4	46.5	0.1						
355-15-32	46.8	47.0	0.2						
									$\bar{X}_{pv}$ 0.359
* NOTE: -06 Thermal Shift at +121C; base 90.9 psi, 142.4 pmicron 4.3									$\bar{R}_{pv}$ 0.444
Mean	46.546875	46.675	0.128125			47.0125	47.05	0.0375	0.4333333333
Median	46.5	46.6	0.1			46.85	46.9	0.05	0.3
Mode	46.4	46.8	0.1			46.8	46.8	0	0.3
Std. Dev	0.31519	0.3212677	0.144209			0.5651569	0.5149926	0.17147	0.4574662842
Variancy	0.0993446	0.1032259	0.020795			0.3194022	0.2652174	0.0294	0.2092753623
Kurtosis	1.9999997	0.2999981	15.55491			1.804325	2.791992	3.61849	9.560904175
Skewness	0.1999486	0.1799979	3.329004			1.224307	1.5995228	-1.0981	2.666301992
Range	1.7	1.6	0.8			2.4	2.3	0.9	2.3
Minimum	45.7	45.9	0			min 46.2	46.3	-0.5	min -0.1
Maximum	47.4	47.4	0.8			max 48.5	48.6	0.4	max 2.2
Sum	1489.5	1493.6	4.1			1128.3	1129.2	0.9	10.4
Count	32	32	32			24	24	24	24

+HI ~2.1 MAX MIS SHIFT: MEAN ~ MEAN

SIGMA ~ +2 MILS

TEST355.XLS
JAD 12/10/92

77PS CUP DEC.10,1992
27713

"A" DIMENSION

SAMPLE	713-1	713-2	DELTA	288-1
1	0.0900	0.0867	0.0033	0.0870
2	0.0898	0.0865	0.0033	0.0879
3	0.0901	0.0871	0.0029	0.0875
4	0.0900	0.0866	0.0034	0.0873
5	0.0890	0.0865	0.0025	0.0872
6	0.0900	0.08625	0.0038	0.0871
7	0.0903	0.08685	0.0034	0.0874
8	0.0901	0.0864	0.0037	0.0876
9	0.0903	0.08665	0.0037	0.0874
10	0.0902	0.08615	0.0040	0.0874
MEAN	0.0900	0.0866	0.0034	0.0873
SIGMA	0.00035	0.00026	0.00041	0.00024

VALENTINE TOOL & STAMPING, INC. INSPECTION REPORT

TI INSTRUMENTS INC

PART : 27713-1

DWG REV. A

P O :

F/O : 18461

Tool Samples

Date	12/28/81
Lot Size	55
Sample Size	5
Mat. Lot Number	9027
Prod. Lot Number	
Insp. By	

Code	CHARACTERISTIC	Use 1	2	3	4	5
1	.038/.041	.040	.0398	.0398	.040	.040
2	1.065 /1.069 #	1.068	1.0675	1.068	1.068	1.068
3	.835 /.839 #	838	837	835	836	837
4	.310 /.320	315	3152	314	317	3157
5	.012 /.015	.0132	.0133	.0137	.014	.0134
6	.090 /.092	.091	.0908	.0908	.0907	.0912
7	Note 2 .050 Ref	.056	.060	.056	.0594	.060
8	.003 /.007 R.	.006	TYP	—	—	—
9	.010 Max R. (n2)	.004	TYP	—	—	—
10	.005 Max R.	.0035	TYP	—	—	—
11	.910 Max #	.9015	.902	.9025	.9025	.902
12	.795 # Min Flat	.823	.8252	.8233	.8203	.827
13	.158 /.161 # thru .498 Min	.159	.159	.159	.159	.159
14	.468 /.472 #	.468	.4468	.4687	.468	.468
15	Flat .003 TIR	.007	.0015	.0013	.002	.002
16	.005 Max R	.005	TYP	—	—	—
17	.028 /.032 R	.030	"	—	—	—
18	// within .0015 TIR	.0013	.0002	.0013	.0003	.0003
19	Flat within .0015	.0013	.0003	.0002	.0003	.0002

TI-NHTSA 011409

VALENTINE TOOL & STAMPING, INC. INSPECTION REPORT

INSTRUMENTS INC	Date	11/19/92	/ /	/ /	/ /	/ /	/ /	/ /	/ /	/ /
PART 27713-2	Lot Size	10								
CUST REV.C	Sample Size	10								
P.O. 585138812	Mat. Lot Number	9970								
FAO 19285	Prod.Lot Number	1								
	Insp. By									

Code	CHARACTERISTIC	Uses								
1	.838 -.841	.839								
2	Ø 1.868 -1.869 -A-	1.4695								
3	0.835 -.839	.4385								
4	TP .005 B	.0026								
5	.310 -.320	.316 .319								
6	.012 -.015	.013 .012								
7	DIM "A"	.0878 .0878								
8	PARALLEL .0015 B	.003								
9	.050 REF	.059 .060								
10	R .015 MAX	.012								
11	FLAT .003	.001								
12	R .468 -.472	.471								
13	TP .005 A	.006								
14	DIM FLAT Ø .795	.821								
15	Ø .910 MAX	.9085								
16	NO BURR ALLOWED	✓								
17	R .005 MAX	.005								
18	R .015 MAX	.012								
19	VR	✓								

-MSG M#= 00533516 FR=VAGS TO=EBO1 SENT=12/10/92 03:43 PM
R#=190 ST=C DIV=0050 CC=00101 BY=VAGS AT=12/10/92 03:43 PM

TO: STEVE OFFILER EBO1
JIM WATT FCQA
CHARLIE DOUGLAS CPPC
BILL SWEET FCME
DAVE CHARN EAEN
ELAINE ROSE FCQA
TOM BURKE MFPC
DICK GARIEPY MFPC

FR: MATT SELLERS MJ62

RE: 77P8 QUIET PASS CAR MEETING

THANKS FOR THE ATTENDANCE. SORRY WE DIDN'T HAVE ENOUGH ACTION ITEMS TO GO AROUND, BUT HERE THERE ARE:

GENERAL NOTES:

WE CONFIRMED THAT THE CUP MODIFICATION TO THE 27713-2 WAS PERFORMED TO PRINT, AND THAT CUP DIMENSIONAL VARIABILITY IS NORMAL. HOWEVER, WHEN SENSORS ARE ASSEMBLED AND CRIMPED THE VARIABILITY OF SENSOR DEPTH DIMENSION INCREASES DRAMATICALLY WITH THE 27713-2 COMPARED TO THE 27713-1. 27713-1'S SIGMA IS IN THE .2 RANGE WHILE THE 27713-2'S SIGMA IS IN THE .5 RANGE.

SNAP CURVE ANALYSIS SHOWED THAT WHEN WE ASSEMBLED GOOD SENSORS USING THE MODIFIED CUP WE INTRODUCE ABOUT .001" DISC PRE-DEFLECTION, AND THAT THE SNAP CURVE DOES NOT HAVE THE NICE FLAT REGION WE TYPICALLY SEE.

THE DISC DEPARTMENT HAD SOME PROCESS ADJUSTMENT COINCIDENT WITH OUR ORDERING HIGHER ACTUATION DISC FOR THE 27713-2 CUP. WE NEED TO CLOSE WITH TED TO UNDERSTAND WHAT THIS ADJUSTMENT WAS AND WHETHER OR NOT THIS ADJUSTMENT COULD BE A CONTRIBUTOR TO THE DISC SNAP CURVE APPEARANCE.

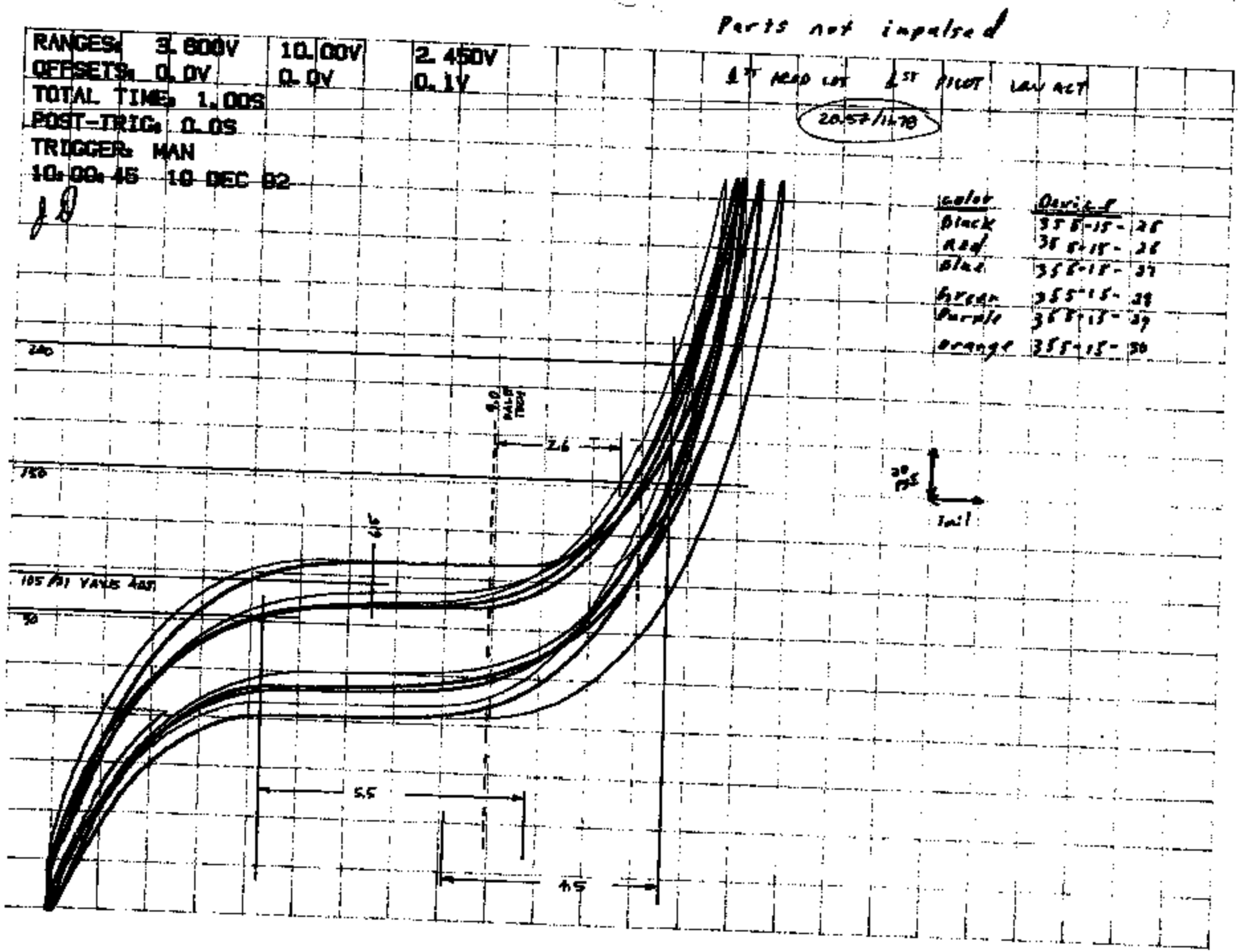
PRODUCTION SHIPMENT OUTLOOK:

L2-1'S	2618 DUE TO SHIP 12/15 NONE THE REST OF THE MONTH?	
L3-1'S	NONE UNTIL 12/24	
L5-2'S	1666 DUE TO SHIP 12/15 400 DUE TO SHIP 12/22	

ACTIONS:

QUARANTINE ALL PASS CAR SWITCHES MADE WITH 27713-2 CUP. THIS INCLUDE PACKED FINISHED GOODS, SALVAGE, SCRAP, AND IN-PROCESS SENSOR ASSEMBLIES. HOLD IN A SEPARATE AREA FOR ENGINEERING DISPOSITION. TOM/ SHEY MOB

DO NOT PILOT ANY ADDITIONAL L5-2'S, L3-1'S, OR

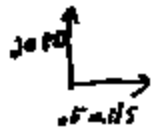


Test 355-15-32
Pre-Implant

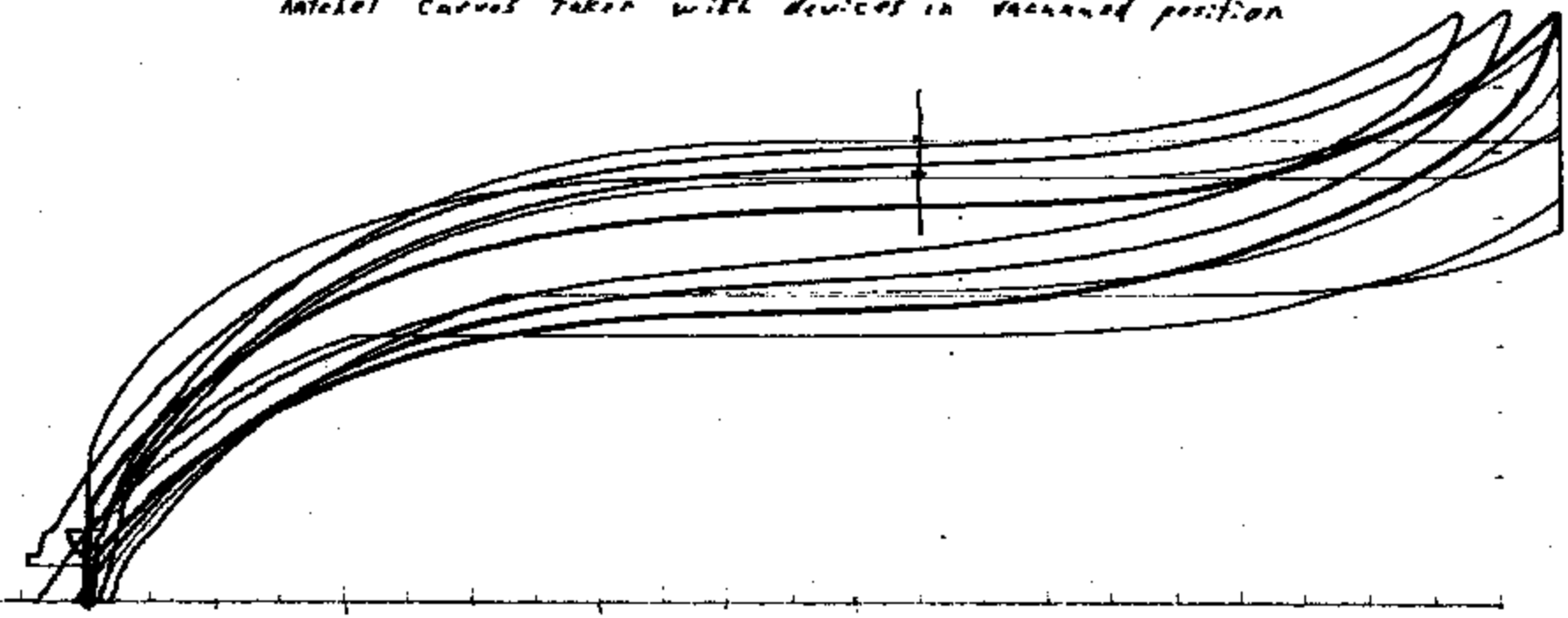
RANGES: 1.600V | 9.995V | 1.225V
OFFSETS: 0.0V | 0.0V | 0.15V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN
09:03:48 09 DEC 92

9D

color	device	Δ relative var.
Black	355-15-01	0.0
Red	355-15-05	0.2
Blue	355-15-09	0.9
Green	355-15-13	0.0
Purple	355-15-17	0.2
Orange	355-15-21	0.1



Datalet Curves taken with devices in recessed position



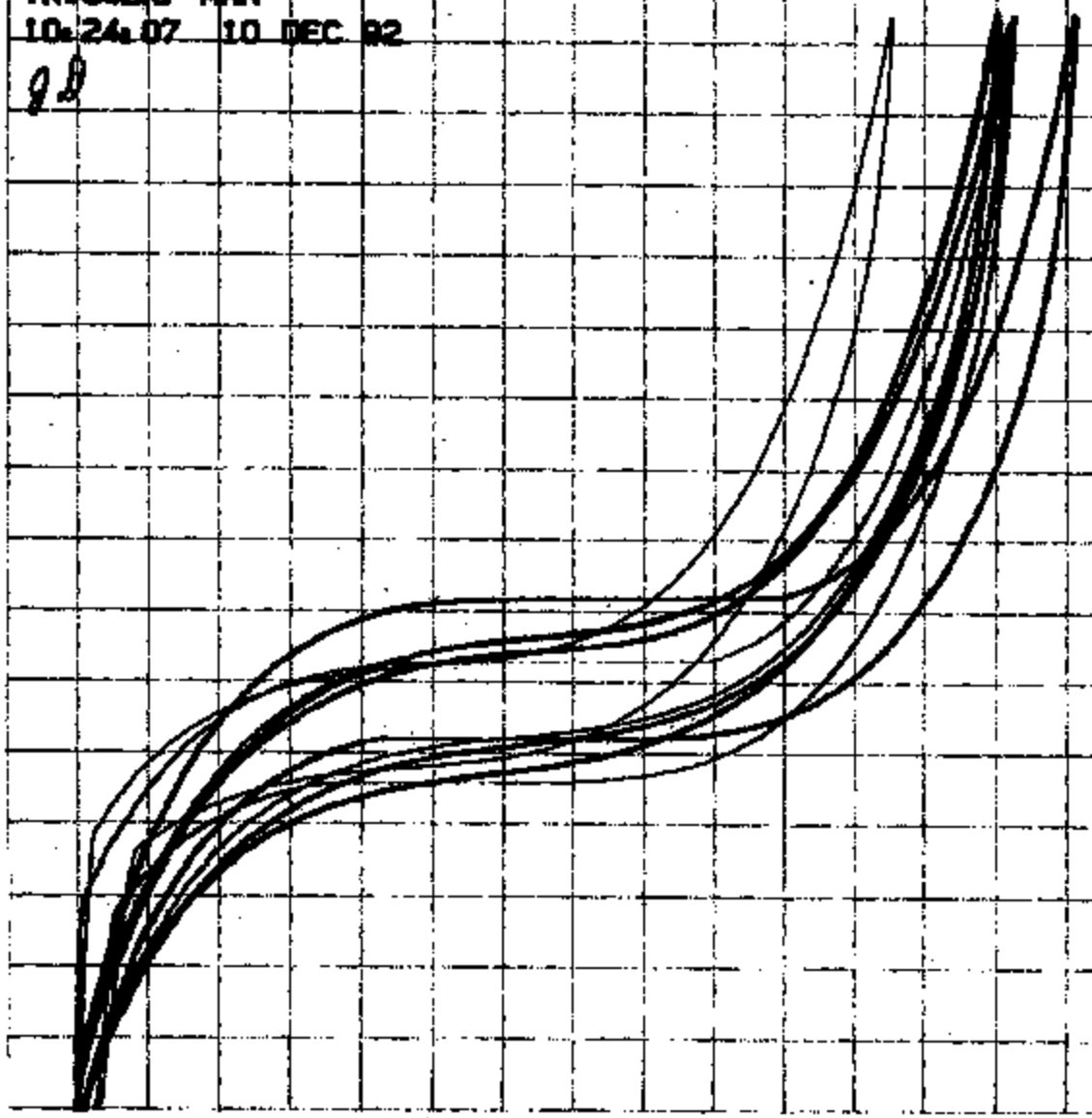
Post-impulse

1st prod of 1st pilot unit act

RANGES: 3.600V 10.00V 2.450V
OFFSETS: 0.0V 0.0V 0.1V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN
10:24:07 10 DEC 92

QB

color	device
black	355-15-01
red	355-15-02
blue	355-15-03
green	355-15-13
purple	365-15-17
orange	355-15-21



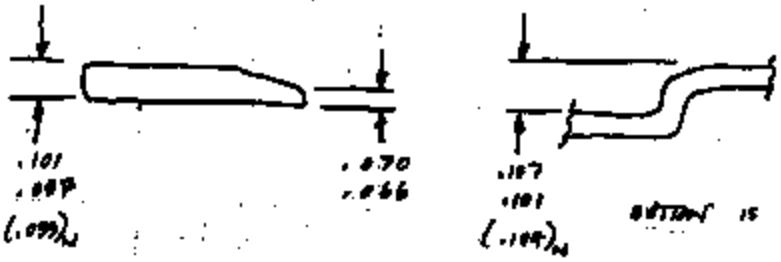
L2-1'S WITH THE 27713-2 CUP. HOLD ALL LOTS CURRENTLY ANY STAGE OF PROCESSING THAT ARE USING THE 27713-2 CUP. HOLD THESE LOTS FOR ENGINEERING DISPOSITION. — TOM/ SMIT NOW

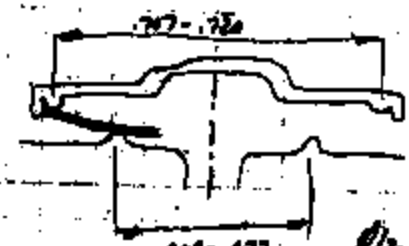
BEGIN PILOTING L2-1'S WITH 27713-1 CUP (OLD VERSION) IN PREPARATION FOR 12/15 SHIPMENT. PROCEED WITH SENSOR ASSEMBLY BUILD AND FINAL BUILD UNLESS NOTIFIED OTHERWISE. TOM/ SMIT NOW

CLOSE WITH TEVES TO DETERMINE NEED FOR 12/15 SHIPMENT OF L5-2'S. PUSH-OUT IF POSSIBLE TO ALLOW MORE DATA COLLECTION TIME. CONTACT MATT ASAP WITH NEW DATE. RUSTY NOW

ENGINEERING MEETING TO LAY OUT NEXT STEPS IN PROBLEM ANALYSIS/CORRECTIVE ACTION. STEVE/ MATT 12/11 10:00AM

REGARDS...MATT
X1245

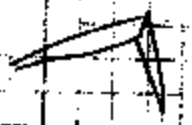




DISC / TPIN HOLES ~ 2K OF CONV BUTTON.

TONY GAGLIE 61-52-79-5652 (7.IN)

7:46 AM DAYLITE
3:45 PM EST



DRAWINGS AVAILABLE UPON REQUEST

-MSG MS= 04064555 FR=SPRT TO=SBC1 SENT=11/23/92 09:02 PM
R$=158 ST=C DIV=0050 CC=00101 BY=SPRT AT=11/24/92 11:58 AM

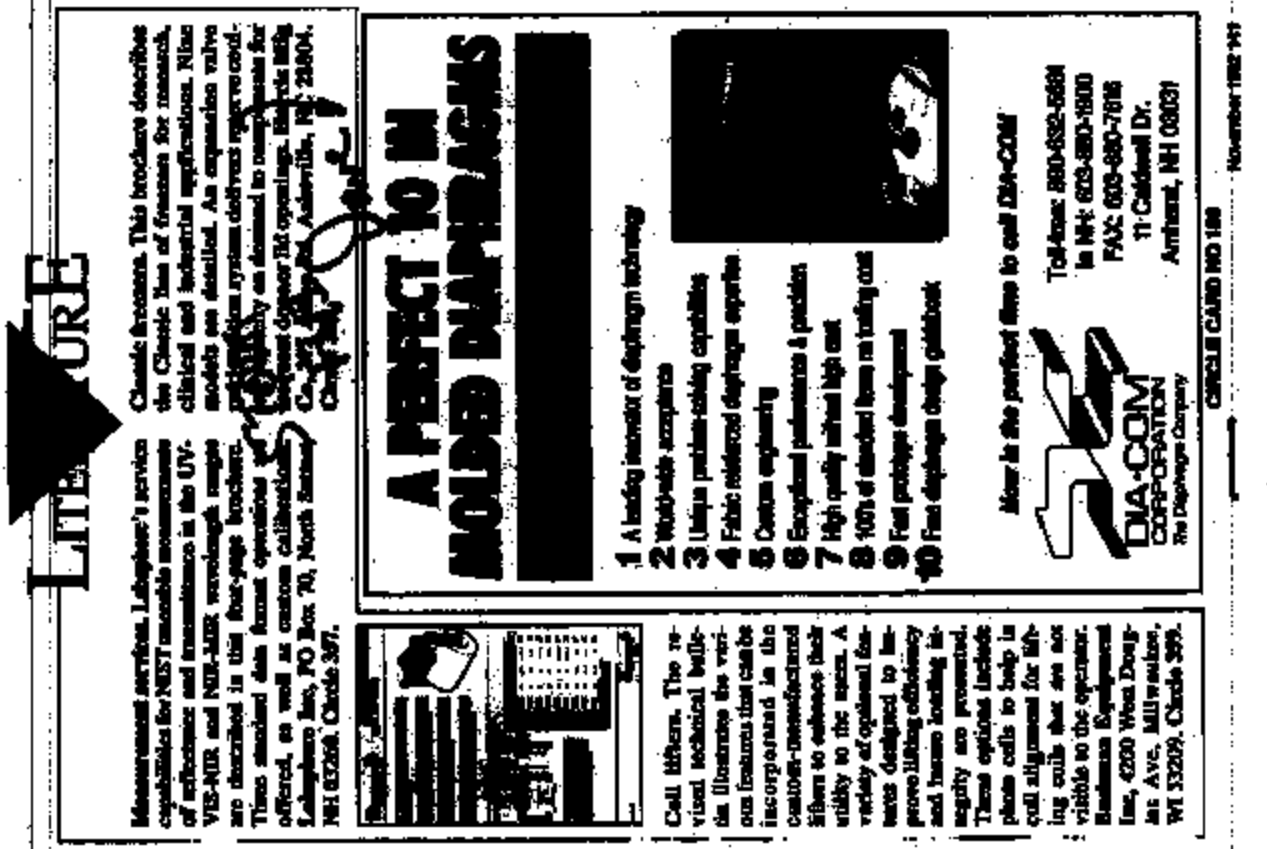
To: STEVE OFFILER SBC1

From: ANDY MCKENNA SPRT

Subj: RUBBER DIAPHRAGM STATUS

STEVE, THANKS FOR YOUR UPDATE (MSG #585455). WHEN YOU GET THE INFORMATION FROM DIA-COM, COULD YOU FAX OR SEND ME A COPY? FAX # 011-81-550-78-0331, M/S 4351, TI OYAMA, JAPAN. THANKS.

REGARDS,
ANDY



PRESSURE SWITCH - 21605 TEST NO. 350-15-M4

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
7715		Steve Officer	

PERFORMED BY	DATE STARTED	DATE COMPLETED	APPROVED BY
Jeffrey DiBenedetto	91124		

PROJECT TITLE: Cruise Control

CUSTOMER:

PURPOSE OF TEST: To quantify the change in preload after vacuum

PROCEDURE: Attain 50 base-cal and 50 L.T. point reserve. Measure disc-to-cup values and after vacuum. Reduce statistics and histograms in Excel.

TI-NHTSA 011421

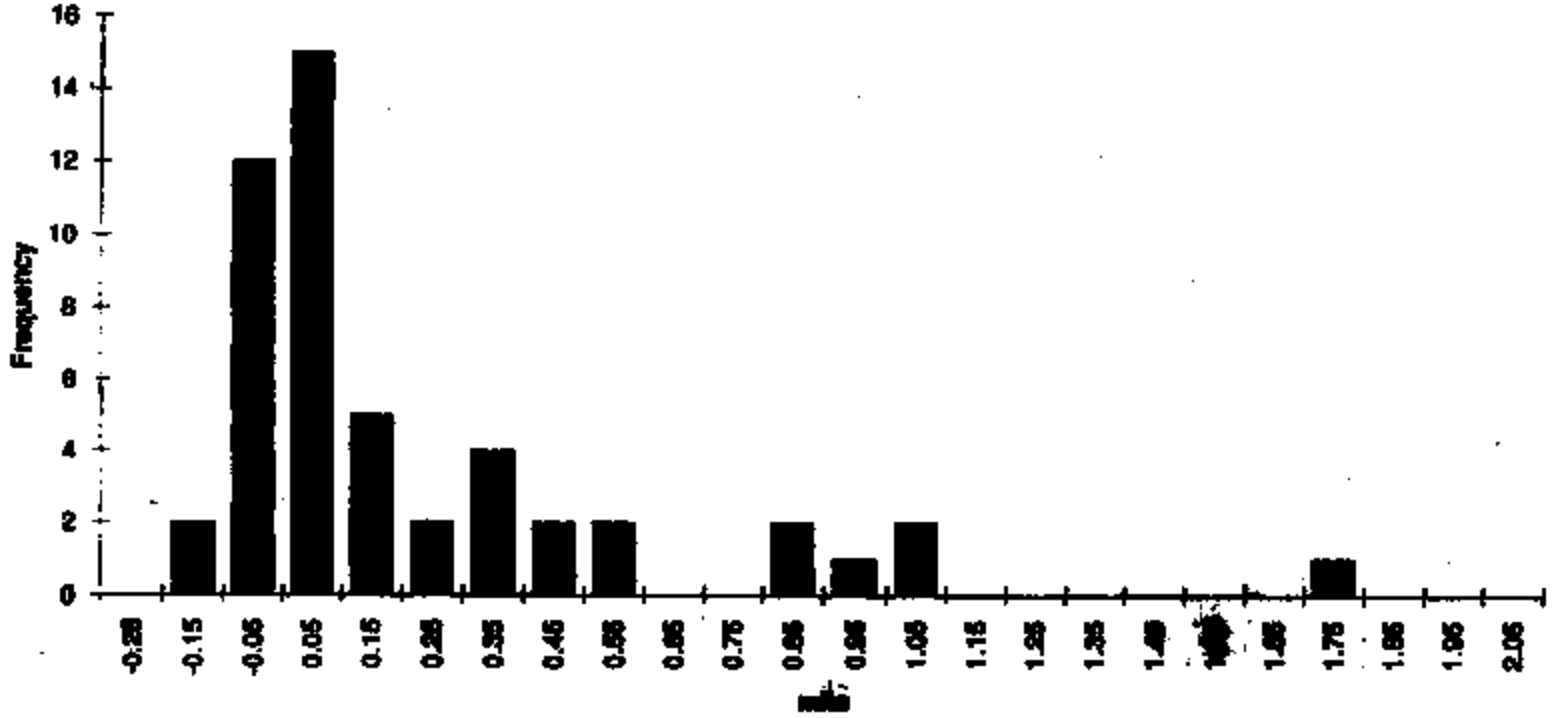
~~[illegible]~~

Test 250.XLS

	Pass-Car (oil 250)			Truck (engineering lot)		
	Before Vac.	After Vac	Delta	Before Vac.	After Vac	Delta
1	47.7	48.0	.3	46.1	46.2	0.10
2	47.2	48.3	1.1	45.8	46.0	0.20
3	47.6	47.8	.2	46.0	46.4	0.40
4	47.9	48.0	.1	45.9	46.9	1.00
5	47.4	47.5	.1	46.1	46.2	0.10
6	47.2	47.6	.4	46.2	46.2	0.00
7	47.8	48.2	.4	46.0	46.6	0.60
8	47.4	47.4	.0	46.0	46.0	0.00
9	47.3	47.3	.0	46.0	46.0	0.00
10	47.7	48.5	1.8	46.2	46.2	0.00
11	47.4	47.5	.1	46.2	47.1	0.90
12	47.7	47.7	.0	46.2	46.3	0.10
13	47.4	48.5	1.1	45.8	45.9	0.10
14	47.6	48.5	.9	46.2	46.5	0.30
15	47.3	47.4	.1	45.8	45.8	0.00
16	47.3	47.3	.0	46.0	47.0	1.00
17	47.3	48.2	.9	46.3	46.2	-0.10
18	47.3	47.4	.1	46.4	46.5	0.10
19	47.2	47.4	.2	46.6	46.6	0.00
20	47.3	47.4	.1	46.6	46.6	0.00
21	47.6	47.6	.0	46.3	46.3	0.00
22	47.7	47.7	.0	47.1	47.1	0.00
23	47.7	48.0	.3	46.1	47.7	1.60
24	47.5	47.5	.0	46.4	46.4	0.00
25	47.3	47.4	.1	46.2	47.4	1.20
26	47.4	47.6	.2	46.5	46.6	0.10
27	47.5	47.7	.2	46.2	46.3	0.10
28	47.5	47.5	.0	46.0	46.2	0.20
29	47.5	48.1	.6	46.7	46.8	0.10
30	47.5	47.6	.1	46.0	46.0	0.00
31	47.2	47.3	.1	45.7	45.8	0.10
32	47.2	47.6	.4	46.2	46.3	0.10
33	47.9	48.4	.5	46.2	46.2	0.00
34	47.3	47.4	.1	46.6	46.6	0.00
35	47.2	47.7	.5	46.6	46.7	0.10
36	47.6	48.0	.4	46.2	46.5	0.30
37	47.6	47.7	.1	46.3	46.3	0.00
38	47.6	47.7	.1	46.0	46.0	0.00
39	47.3	47.3	.0	46.2	46.2	0.00
40	47.5	48.0	.5	46.4	46.4	0.00
41	48.1	48.0	-.1	46.7	46.6	-0.10
42	47.4	47.5	.1	46.5	46.5	0.00
43	47.2	47.3	.1	46.3	46.4	0.10
44	47.6	48.6	1.0	45.8	46.2	0.40
45	47.6	47.7	.1	46.4	46.5	0.10
46	47.7	47.6	-.1	46.6	46.6	0.00
47	47.5	47.5	.0	46.2	46.1	-0.10
48	47.2	47.4	.2	46.0	47.2	1.20
49	47.7	47.7	.0	46.1	46.2	0.10
50	47.6	47.6	.0	45.9	47.3	1.40
Mean	47.40	47.76	0.37	46.146	46.456	0.31
Median	47.5	47.65	0.1	46.15	46.3	0.1
Mode	47.6	47.6	0.1	46.2	46.2	0
Standard Deviation	0.2188836	0.42806	0.378177	0.2887144	0.47818	0.4[illegible]
Variance	0.0479429	0.18327	0.143770	0.0834898	0.22884	0.219714
Kurtosis	-0.599876	4.89886	4.811027	1.7494821	0.87747	2.6[illegible]
Skewness	0.4810836	1.75827	2.088213	1.0014886	1.01831	1.779[illegible]
Range	0.9	2.2	1.9	1.4	2	1.[illegible]
Minimum	47.2	47.3	-0.1	45.7	45.8	-0.1
Maximum	48.1	48.5	1.8	47.1	47.8	1.[illegible]
Sum	2370.5	2388	18.6	2307.3	2322.8	15.[illegible]
Count	50	50	50	50	50	50

TI-NHTSA 011423

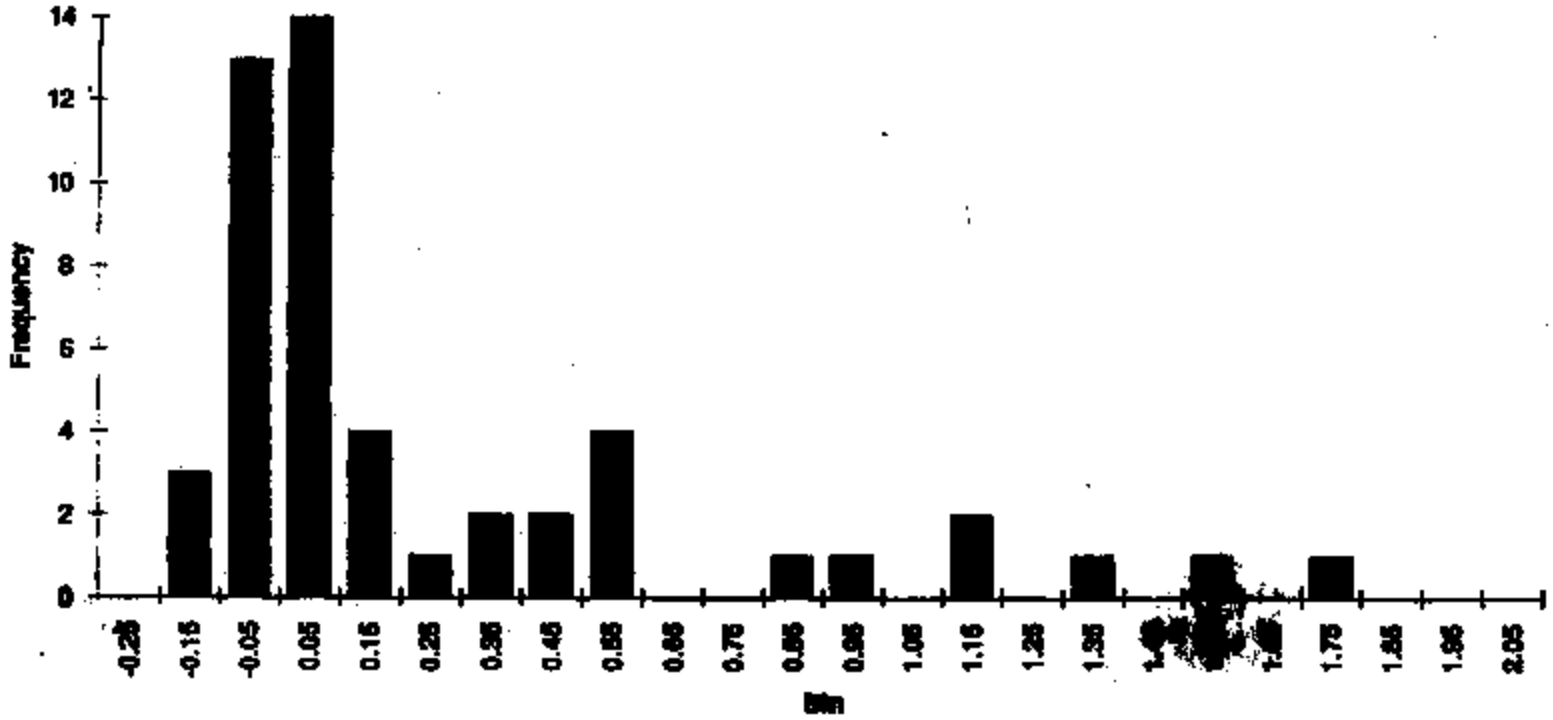
Silent Pass-Car Sensors
(lot 258)



Test 350A-XLC
JAD 11/23/92

TI-NHTSA 011424

Silent Truck Sensors
(engineering lot)



Test 350B.xlc
JAD 11/22/02

GENERAL THOUGHTS

I AM NOT REALLY CONVINCED THAT THE DISC ITSELF IS THE SOURCE OF THE NOISE. IT SEEMS THAT THERE ARE SEVERAL POSSIBLE SOURCES THAT WE HAVEN'T FINISHED CHECKING OUT YET.

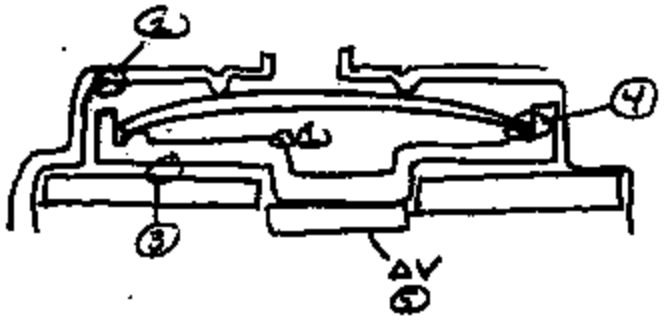
1) IMPACT OF THE DISC TO THE CONVERTOR ON ACTUATION. THE IMPACT IS THEN TRANSMITTED THRU THE CONVERTOR TO THE FLUID. (THE DISC ISN'T TOUCHING ANYTHING ELSE AT THIS POINT). THERE ARE WEAR MARKS IN THIS AREA ON PARTS THAT HAVE COMPLETED LIFE TEST. ON PAPER THE DISC DOES NOT HIT BUT IN REALITY THE DISC OVER TRAVELS BEFORE REACHING THE FINAL RESTING POSITION.

2) CONVERTOR IMPACTS THE CUP ON ACTUATION. THE ENERGY IS TRANSMITTED THRU THE CUP TO THE WASHER. THE WASHER VIBRATES AXIALLY SENDING THE SOUND DOWN THE HYDRAULIC FLUID. THERE ARE WEAR MARKS ON LIFE TEST PARTS. CAUSED IF FLOW TEST OR OVERPRESSURE. PROBABLY BOTH

3) ON RELEASE THE CONVERTOR IMPACTS THE WASHER

4) THE DISC TRANSMITS ITS ENERGY TO IT'S EDGES WHEN IT SNAPS. THE ENERGY THEN TRANSMITS THRU THE CONVERTOR. THIS WILL BEST WITH THE LOW DIFFERENTIAL DISC IMPROVEMENT ALREADY A LOW DIFFERENTIAL DISC WOULD ALSO HELP 1, 2, 3 BECAUSE OF LOWER CROWN HEIGHT & LOWER KINETIC ENERGY.

5) THE SUDDEN MOVEMENT OF THE CONVERTOR CAUSES THE FLUID TO [redacted] RAPIDLY FLOW INTO THE INCREASED VOLUME. IF THE FLOW RATE IS HIGH ENOUGH IT CAN GENERATE SOUND EVEN IF THE VOLUME IS SMALL. SINCE THE CONVERTOR PROBABLY MOVES ONLY .014" IN SEVERAL MILLISECONDS THIS SEEMS LIKELY. IN THIS CASE THE SNUBBER WOULD HAVE SOME EFFECT BECAUSE OF REDUCED FLOW RATE.



Acoustics

THERE IS TWO METHODS THAT SOUND CAN COUPLE TO THE MASTER CYLINDER. THE FIRST IS THROUGH THE METAL TO METAL COUPLING FROM THE DISC ALL THE WAY TO THE MASTER CYLINDER. THE SECOND IS THROUGH THE FLUID ITSELF. YOUR TEST WITH THE RUBBER HOSE WOULD SEEM TO INDICATE THAT IT IS THROUGH THE FLUID & NOT THE METAL. THIS FITS WITH ACOUSTIC THEORY BECAUSE THE RESISTANCE OF METAL TO SOUND IS MUCH GREATER THAN THE RESISTANCE OF FLUID. SO EVEN IF A METAL COUPLE EXISTS THE SOUND WILL TEND TO TRAVEL THROUGH THE FLUID. ACOUSTIC RESISTANCE TO SOUND IS A COMPLEX IMPEDANCE MUCH LIKE ELECTRICAL IMPEDANCE.

STEEL	=	39×10^6 kg/m²s (MKS RAYL)
CASTOR OIL	=	1.45×10^6 RAYLS
RUBBER	≈	$.06 \times 10^6$
AIR	=	428×10^0

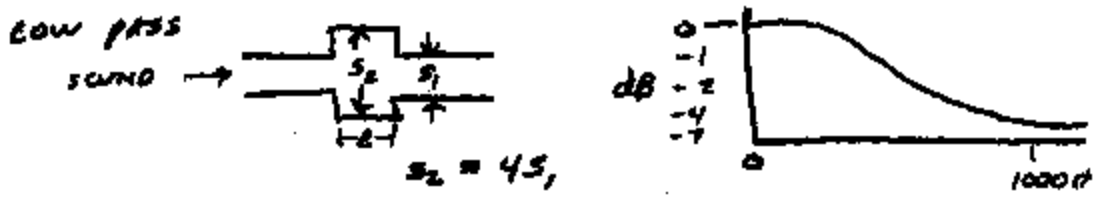
RESISTANCE OF STEEL IS 30 TIMES THAT OF OIL

IMPEDANCE $Z = \pm \rho_0 c$ FOR A PLANE WAVE

ρ_0 = equilibrium density
c = wave (sound) velocity

plane (rather than spherical) are commonly produced by a piston vibrating at one end of a fluid filled tube. this make the analysis easier.

if the sound is really traveling through the fluid then it is possible to build a sound filter if we know the frequencies to be filtered. a simple low pass filter can be built by changing the diameter of the pipe

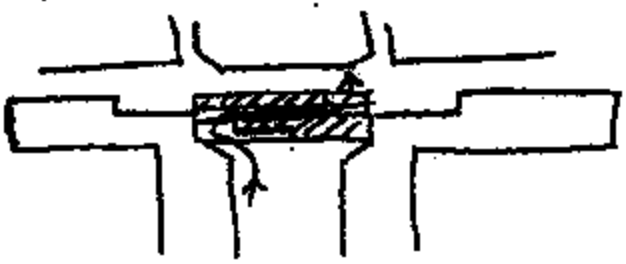


this is the theory behind mufflers & gun silencers

high pass

C = acoustic compliance (capacitor)
M = acoustic inertance (inductor)

using these ideas we maybe able to build a simple filter into the part



we have slot of width & length to play with. several plastic plates may due the trick. I built one just like mine. it had no effect but it may not be tuned to the right frequency. that's why the spectrum analysis could be important. I am sure GM has an acoustic expert who could help us with the filter de

SNUBBER (ORIFICE)

IF WAVELENGTH IS LARGE COMPARED TO DIAMETER OF HOLE THEN THE SOUND POWER TRANSMISSION COEFFICIENT IS

$$\alpha_c = \frac{4 S_1 S_2}{(S_1 + S_2)^2}$$

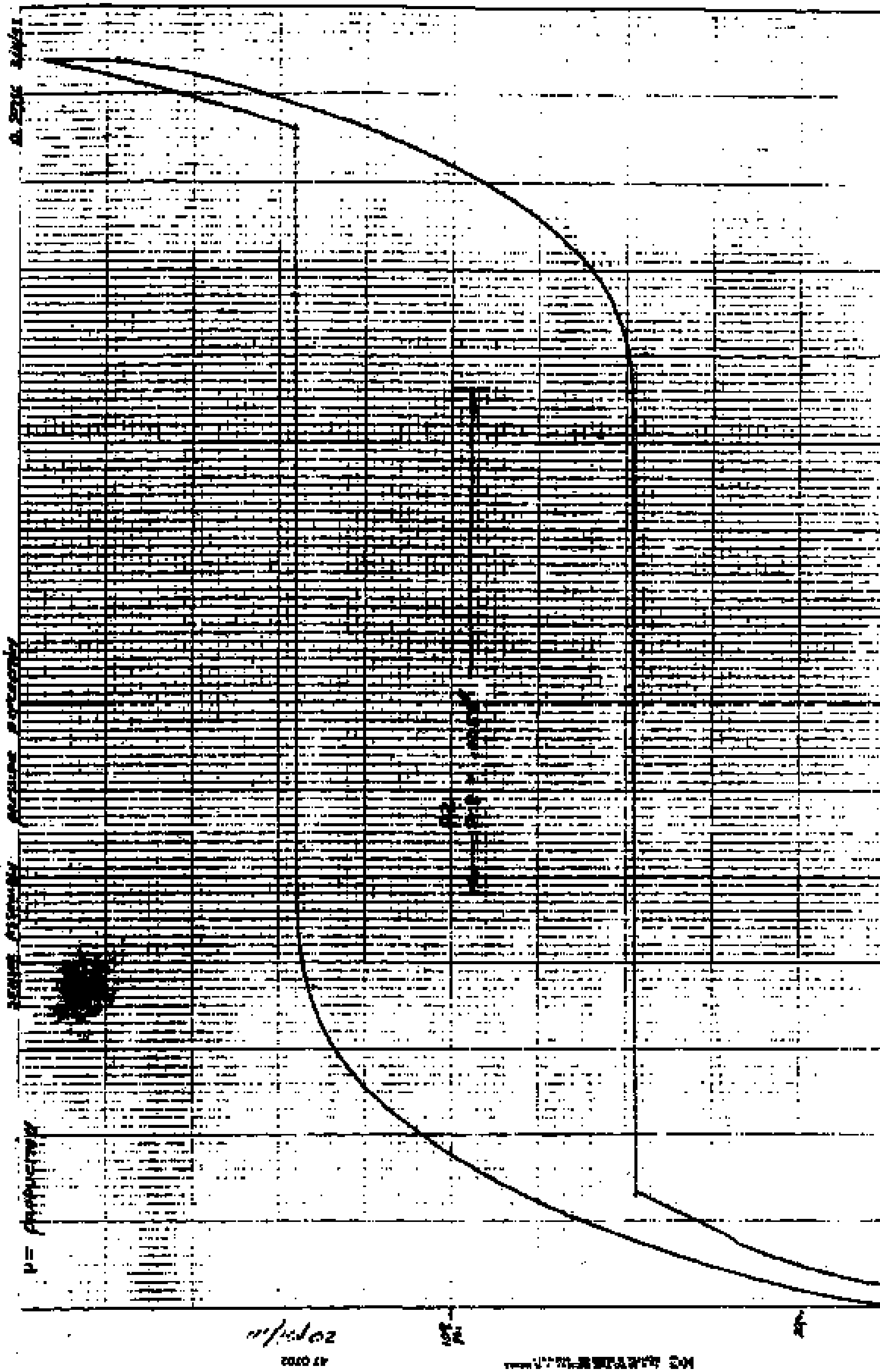
SOME ADDITIONAL THOUGHTS

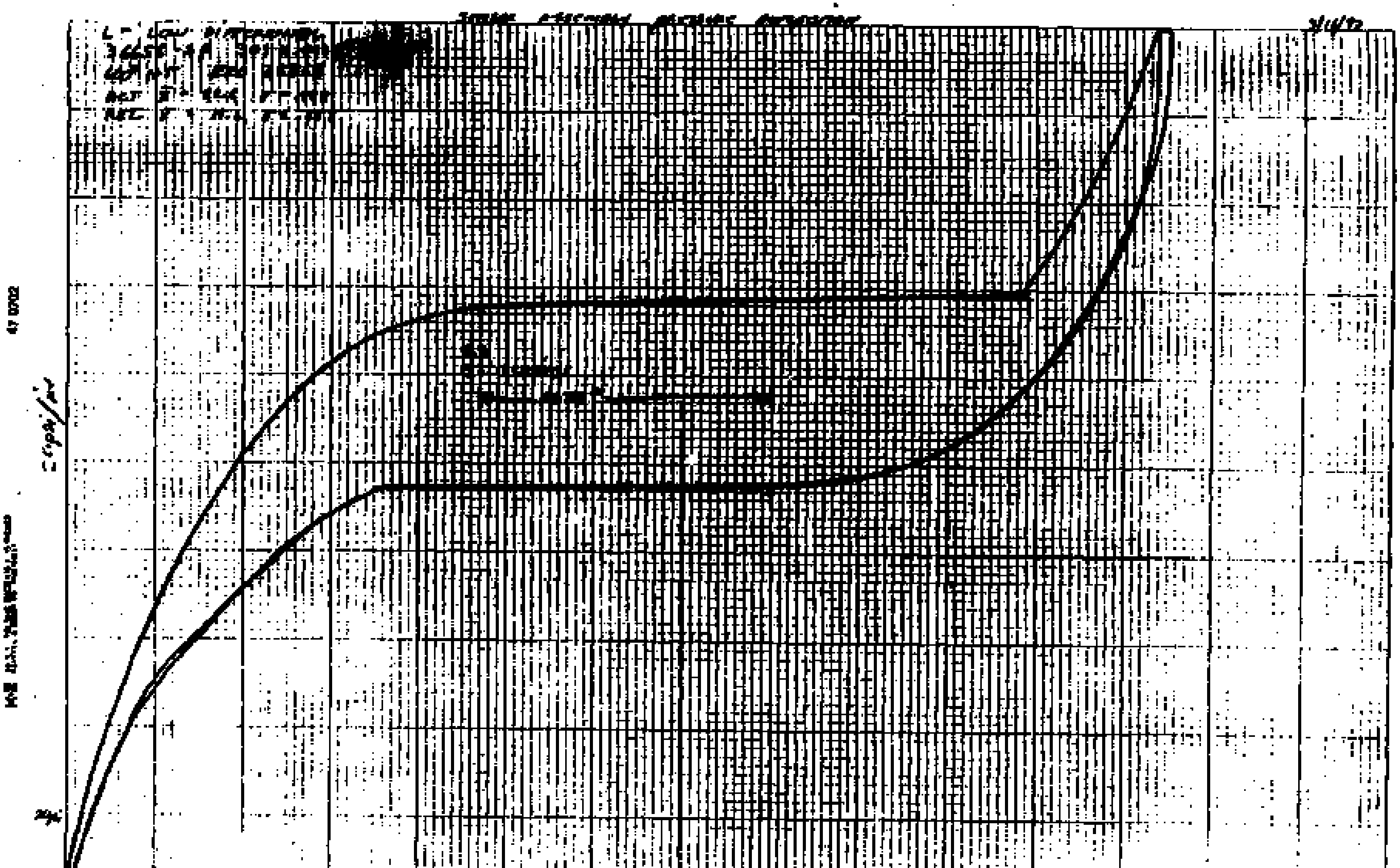
YOUR COMMENT ABOUT FEELING THE SOUND IN THE PEDAL IS INTERESTING. DO YOU ACTUALLY FEEL A MOTION. IF SO THEN IT'S PROBABLY DUE TO THE SUDDEN INCREASE IN THE FLUID VOLUME WHICH WOULD POINT TO FS AS THE PROBLEM.

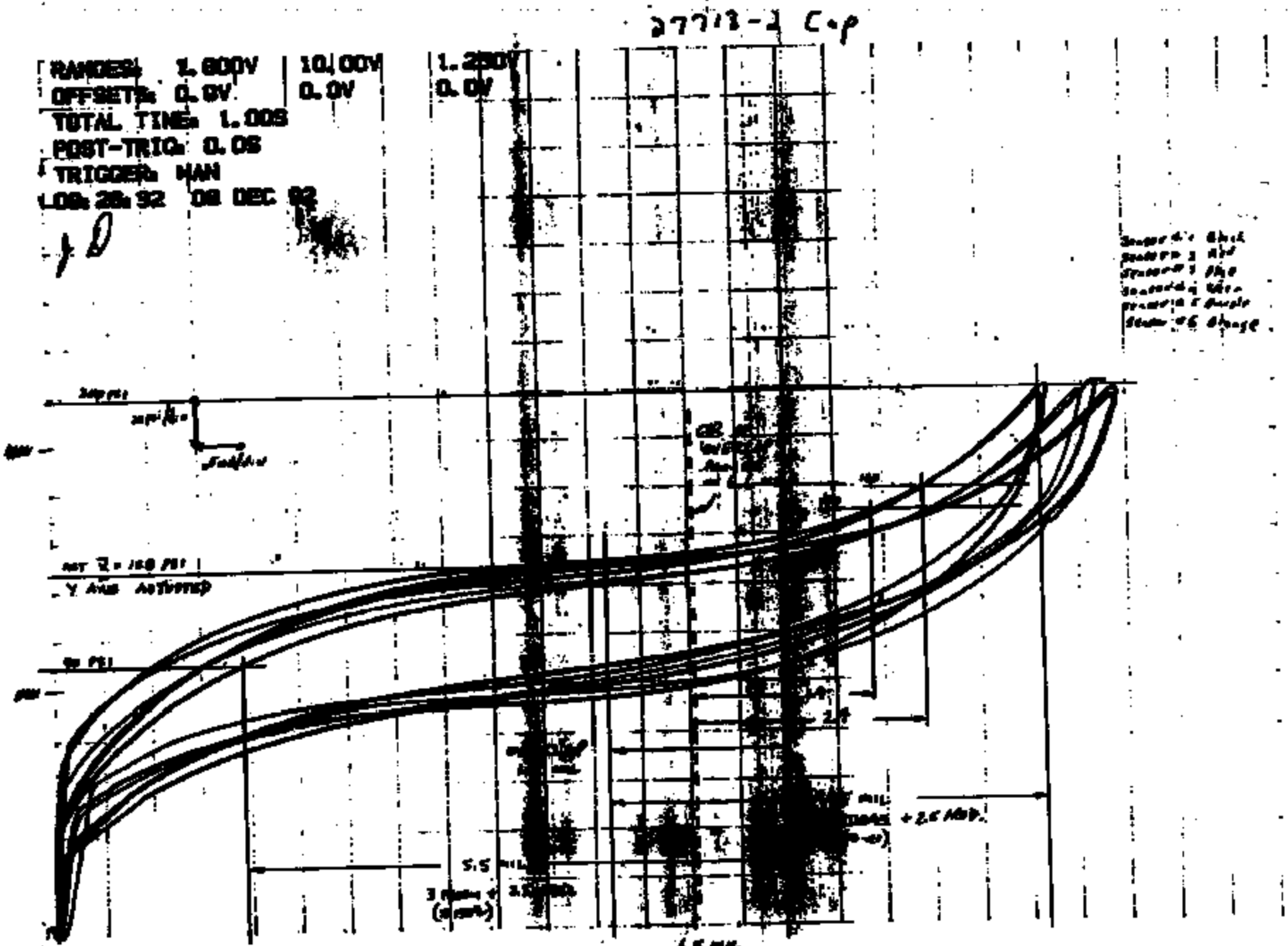
WE MAYBE ABLE TO SEPERATE MECHANICAL COUPLING FROM FLUID COUPLING BY PUTTING AN ACCELEROMETER ON THE SWITCH OR MASTER CYLINDER AND COMPARING TO THE MICROPHONE PICK UP. IF THE DISC DIRECTLY COUPLES TO THE FLUID THERE SHOULD BE VERY LITTLE VIBRATION. IF THE DISC IMPACTS SOME PART THE ACCELEROMETER SHOULD SEE IT. I TRIED DETECTING THE SNAP ON THE AIR CAPACITOR STAND WITH A ±2g ACCELEROMETER MOUNTED ON [redacted] THE DRIVE ARM. IT DID NOT DETECT ANYTHING. PROBABLY BECAUSE THE ACCELEROMETER ONLY MEASURES TO 1 kHz. WE NEED TO TRY A PIEZOELECTRIC TYPE THAT CAN MEASURE TO 50 OR 100 kHz.

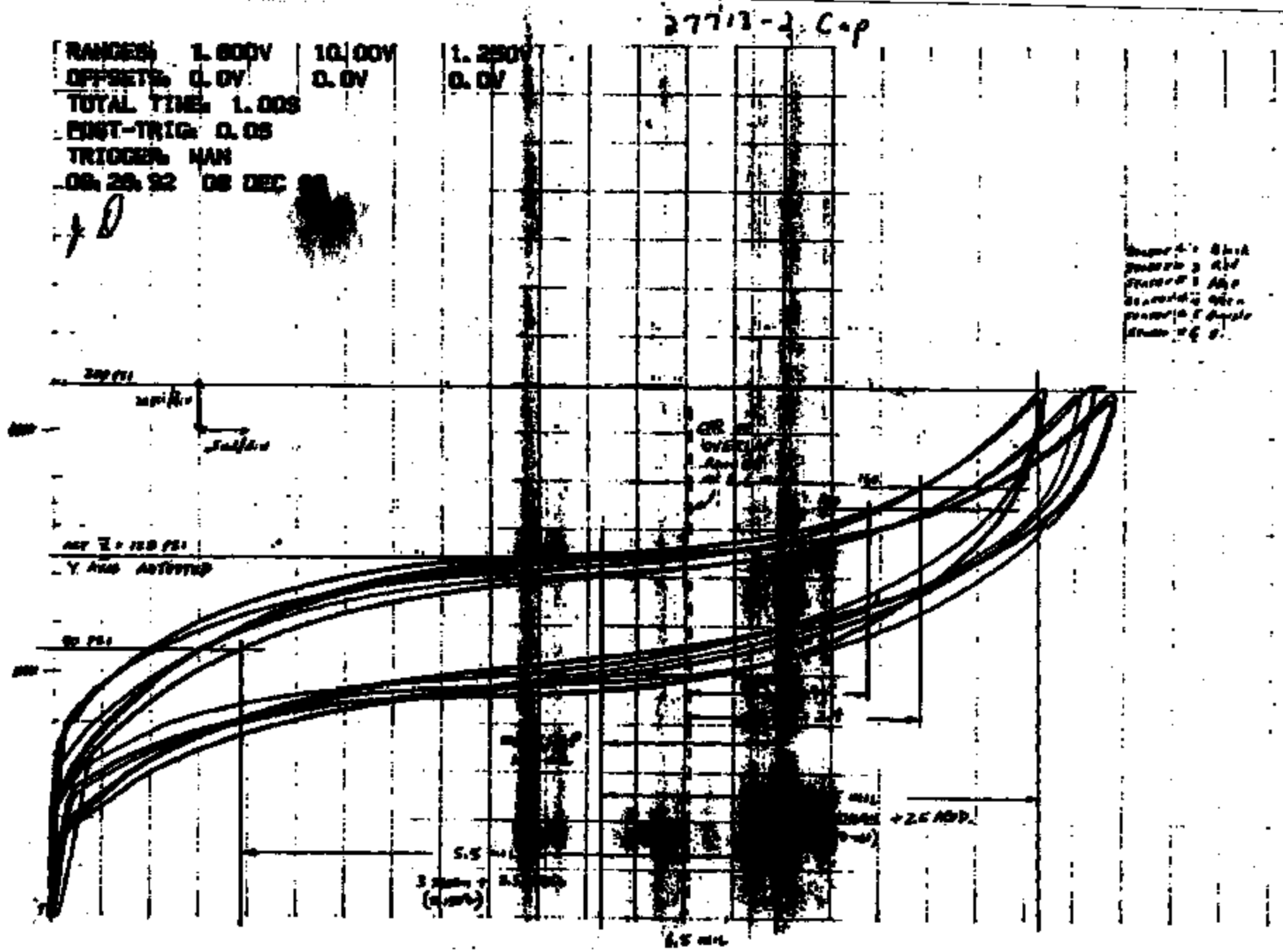
USING RIGID BRAKE LINE BETWEEN MC AND SWITCH YOU MAYBE ABLE TO BUILD AN ACOUSTIC FILTER BY TWISTING IT INTO A COMPLEX SHAPE SUCH AS A Z. THIS IS A HIT OR MISS PROPOSITION.

THE SPECTRUM ANALYZER USED FOR TESTING SHOULD BE ABLE TO MEASURE TO 25KHz OR BETTER. YOU CAN'T USE A SCOPE. IT'S TO SLOW. HUMANS CAN HEAR FROM 20 TO 15,000 HZ



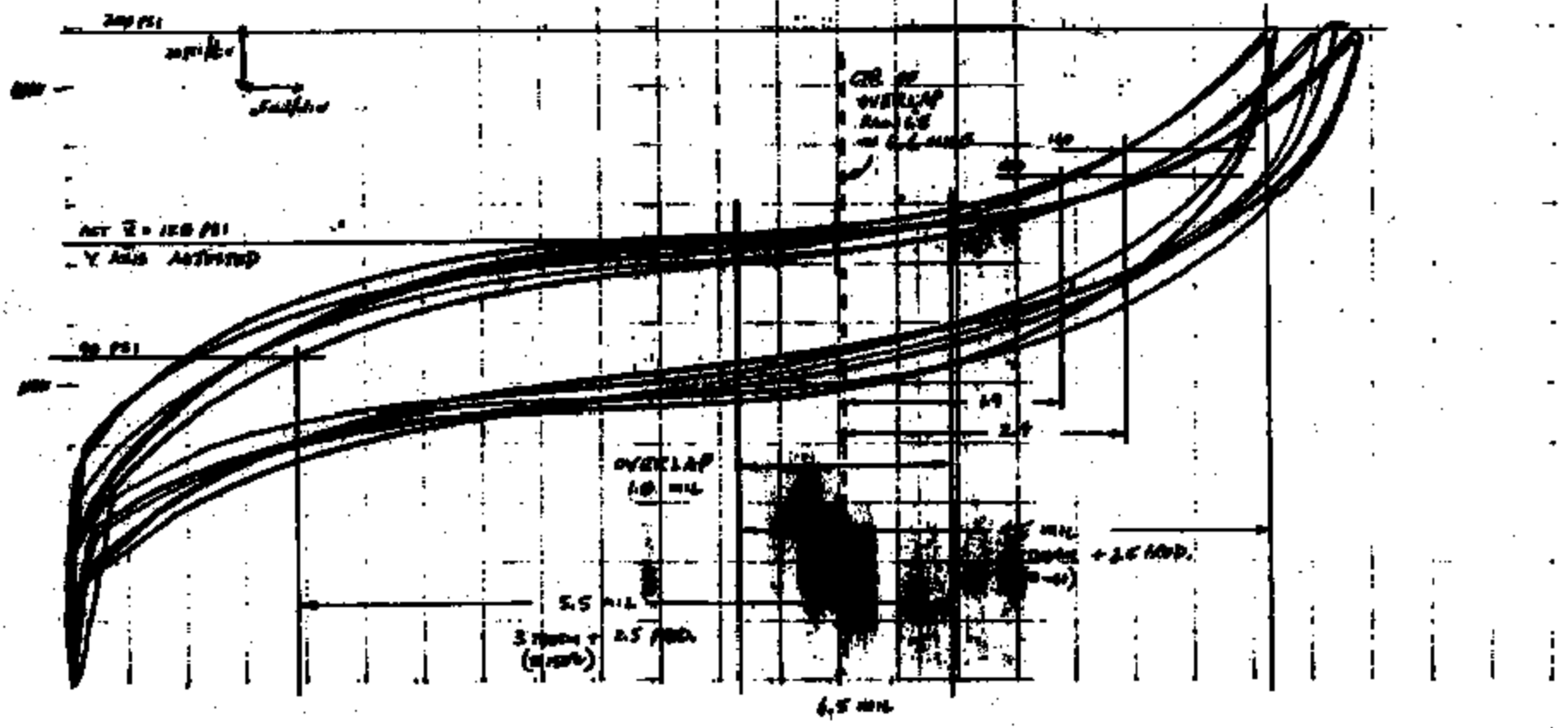




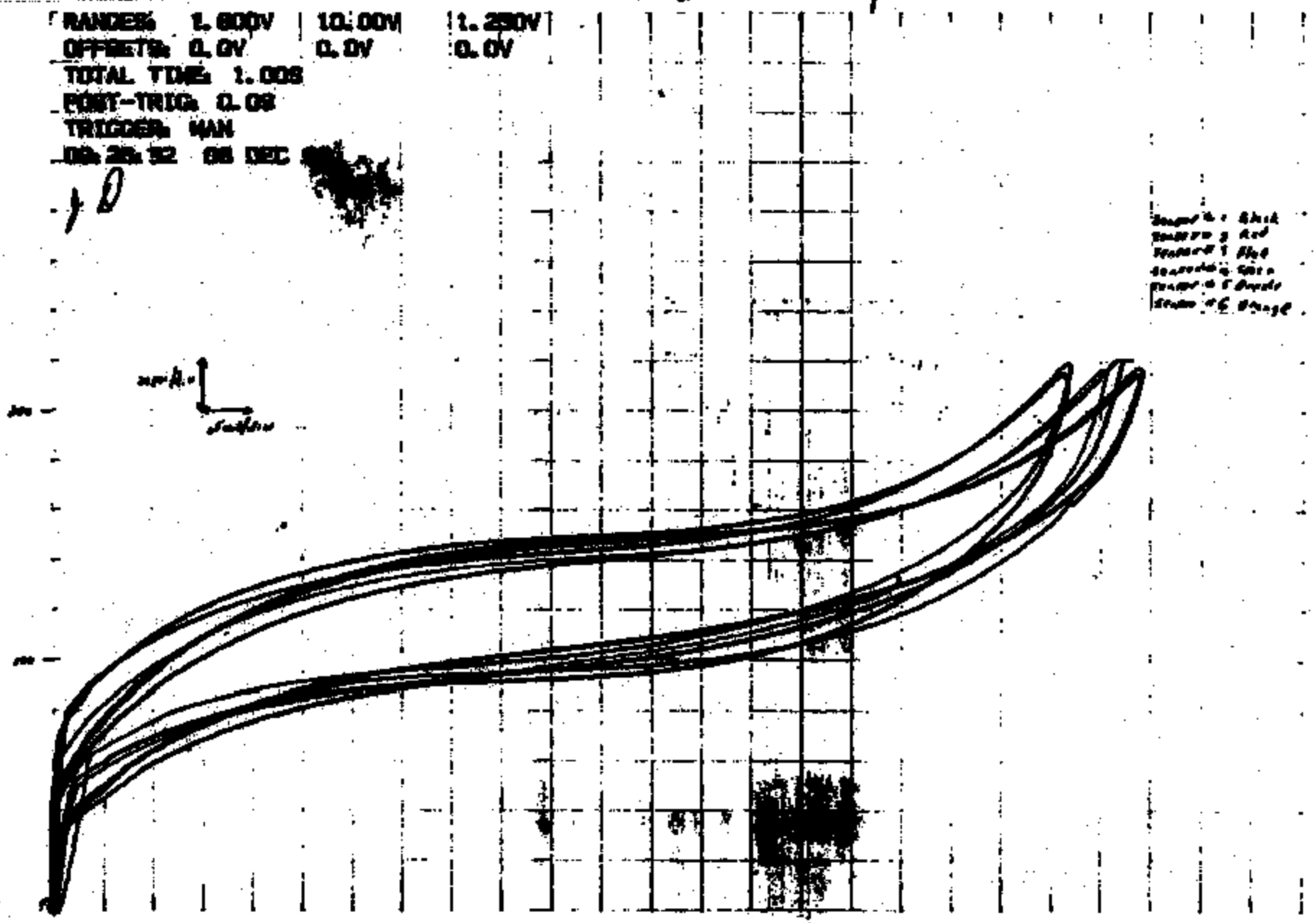


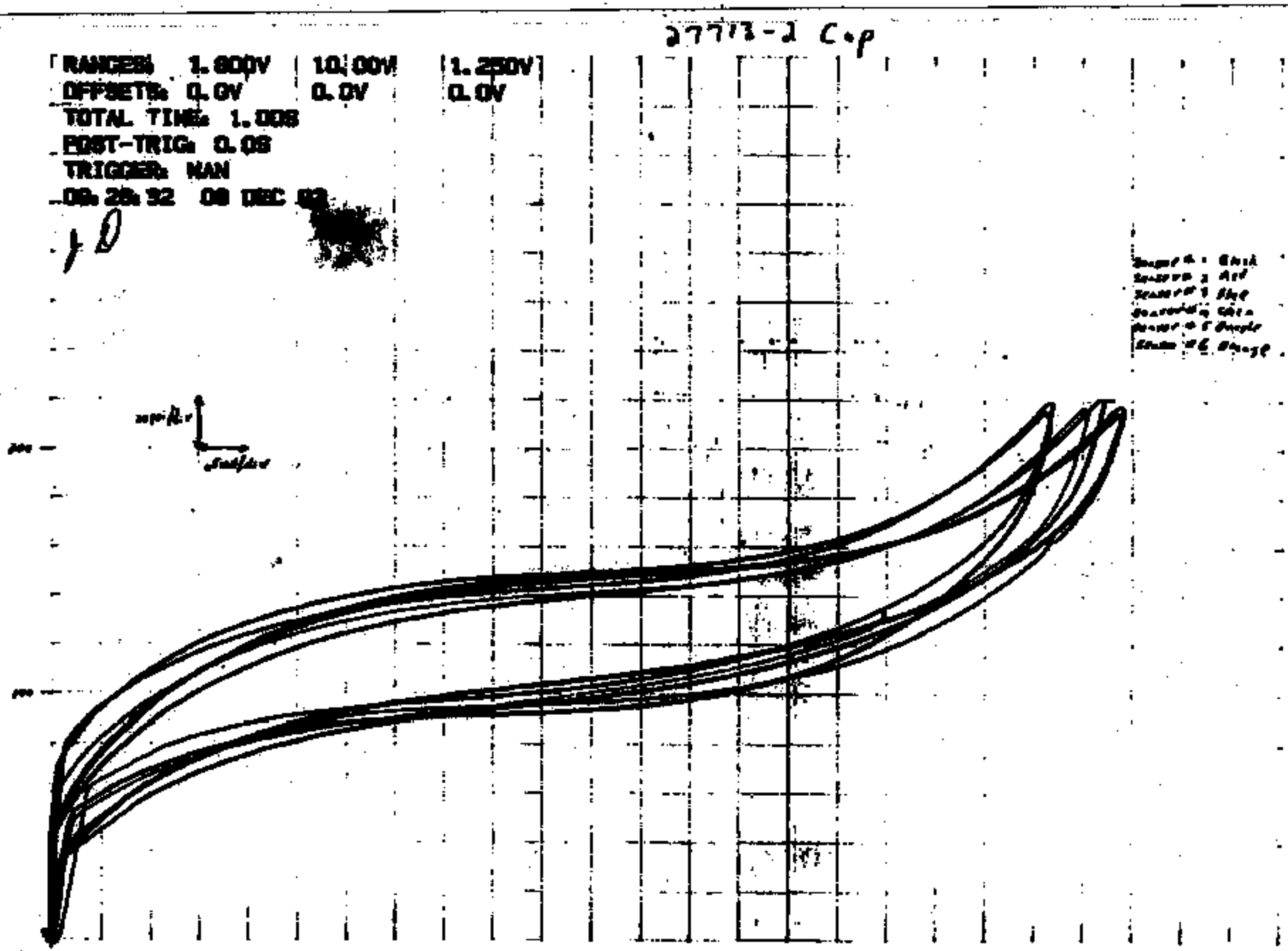
27713-1 Cop

RANGES: 1.000V | 10.00V | 1.250V
OFFSETS: 0.0V | 0.0V | 0.0V
TOTAL TIME: 1.000
POST-TRIG: 0.00
TRIGGER: MAN
08:28:32 08 DEC



TI-NHTSA 011434

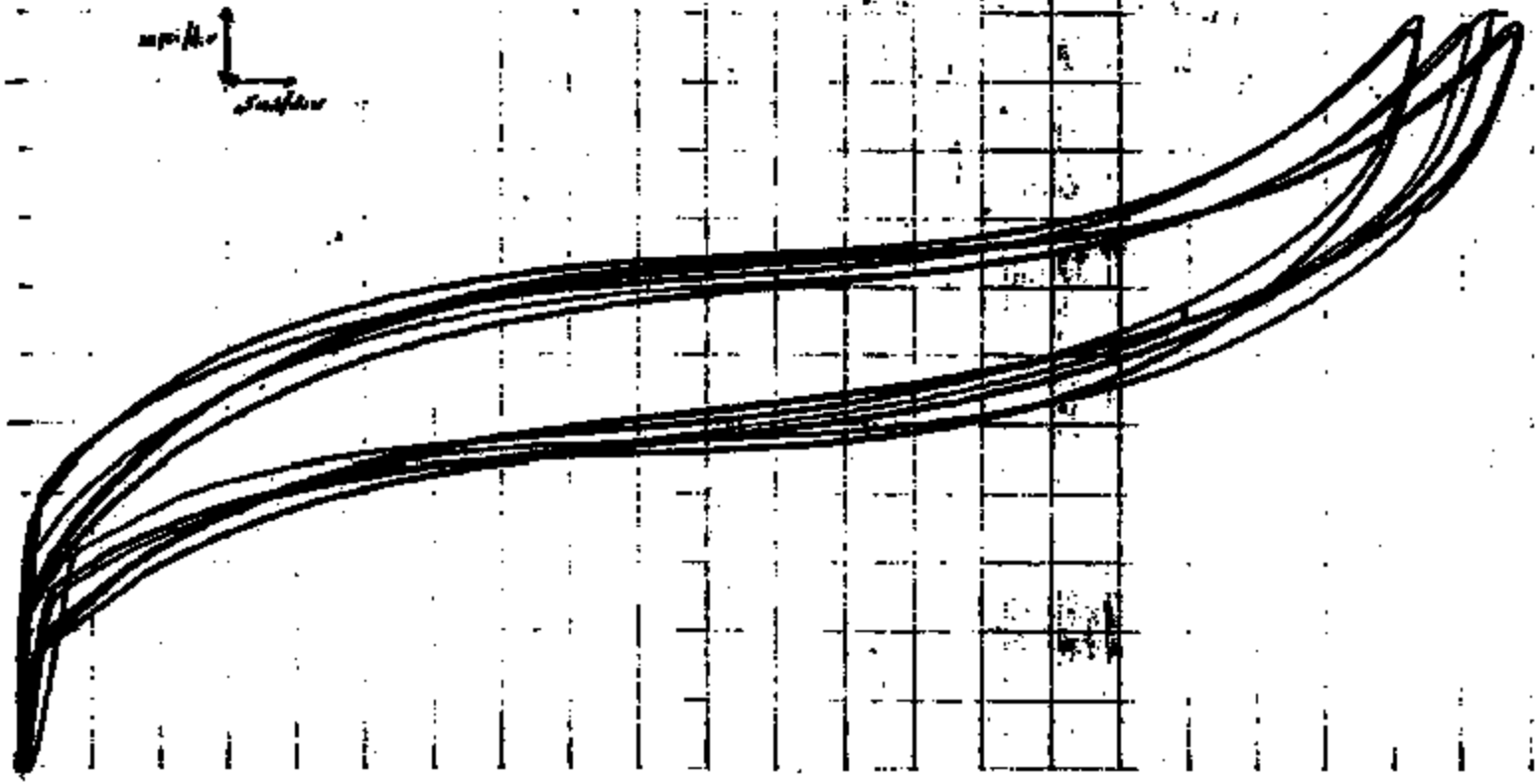




27713-2 C+P

RANGES: 1.000V | 10.00V | 1.250V
OFFSETS: 0.0V | 0.0V | 0.0V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN
08:26:52 08 DEC 92

1 D



THNHTSA 011497

PRESSURE SWITCH DATA Form 21605 TEST NO. 357-03-12

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
7785L3-1	92103	Steve Officer	
PERFORMED BY	**DATE STARTED**	**DATE COMPLETED**	**APPROVED BY**
Jeffrey DiBenedetto			

PROJECT TITLE: Cruise Control

CUSTOMER:

PURPOSE OF TEST: Diaphragm life after Vacuum. Test performed at request of Tim Andersen

PROCEDURE: Obtain 12 43-1's from prod line (Post pressure test)
Vacuum 6 per ES
Impulse all 12 to failure.

* Add 102K to Cont

Device #	Vacuum	Cyc to failure
357-03-01	yes	1196K
-02		1049K
-03		791.2K
-04		1179K
-05		1074K
-06	↓	1206K
357-03-07	no	1346K
-08		1170K
-09		1358K
-10		1206K
-11		998K
-12	↓	1411K

(OVER)

PRESSURE SWITCH DATA Form 21605 TEST NO. 359-15-24

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
7705	921218	Steve Office	
PERFORMED BY	**DATE STARTED**	**DATE COMPLETED**	**APPROVED BY**
Jeffrey P. Barnes	"	3/23/93	

PROJECT TITLE: Cruise Control

CUSTOMER:

PURPOSE OF TEST: To determine why discs are pre-deflected

PROCEDURE: hold held hydro sensors and controls.
Measure held hydro devices with disc all the way up and all the way down.
Measure controls as crimped.

Device	displacement	disc down	disc up	held by Raylon					
359-15-01	held	46.5	42.5						
-02		46.6	46.7						
-03		46.2	43.3						
-04		46.1	42.8						
-05		46.2	44.4						
-06		46.7	42.9						
-07		46.6	43.5						
-08		46.5	43.7						
-09		46.3	43.5						
-10		46.6	42.7						
-11		46.1	43.0						
-12	▼	46.3	44.9						
359-15-13	control			42.1					
-14				46.1					
-15				42.1					
-16				46.5					
-17				46.2					
-18				46.7					
-19				46.6					
-20				46.1					
-21				46.2					
-22				46.5					
-23				46.3					
-24	▼			46.5					

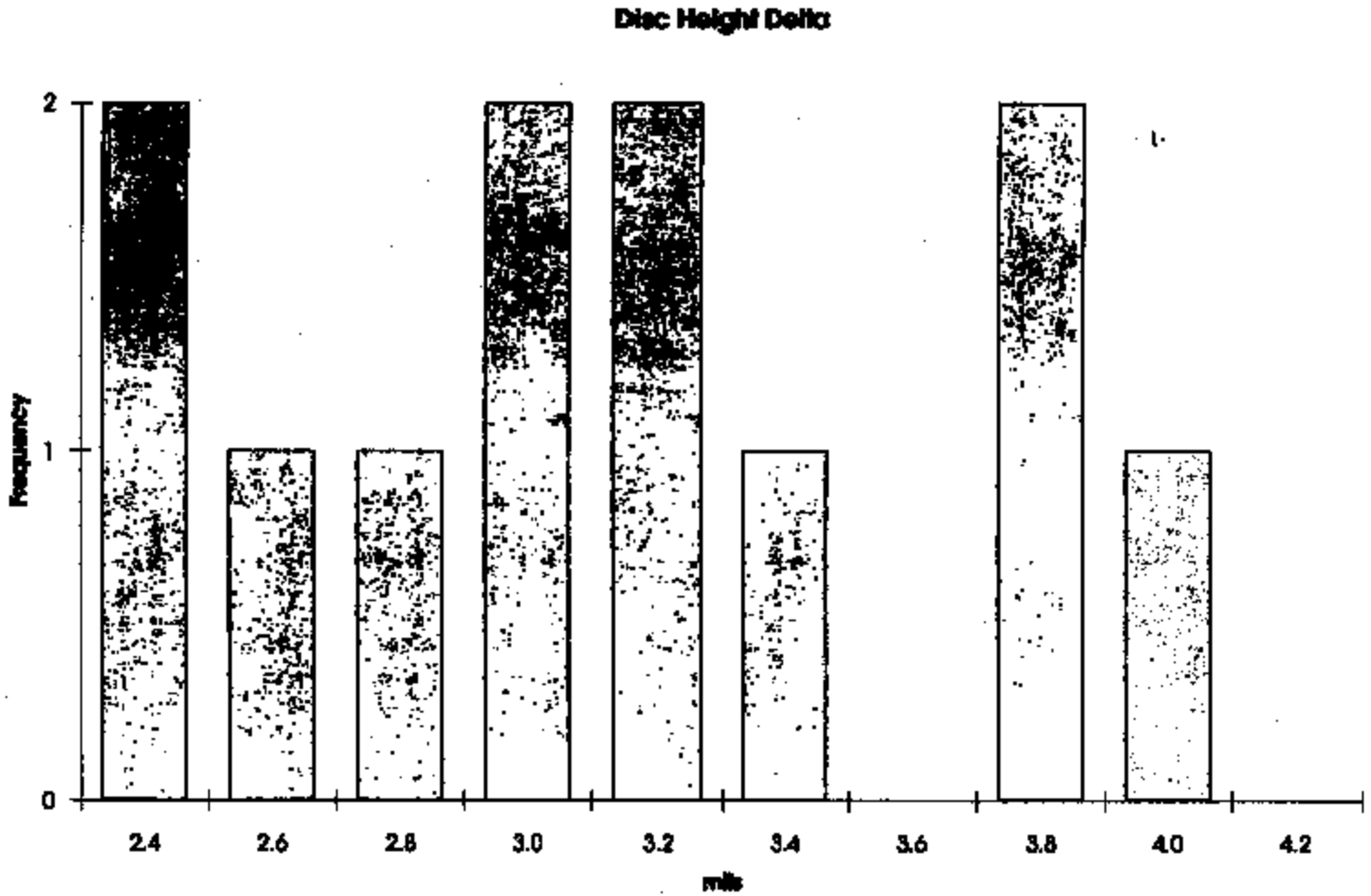
(OVER)

TI-NHTSA 011439

	holed kapton	holed kapton			
Device #	disc down	disc up	delta	Device #	controls
359-15-01	46.5	42.5	4.0	359-15-13	47.1
359-15-02	46.6	42.7	3.9	359-15-14	46.1
359-15-03	45.9	43.3	2.6	359-15-15	47.1
359-15-04	46.1	42.8	3.3	359-15-16	46.5
359-15-05	45.9	42.6	3.3	359-15-17	46.5
359-15-06	46.4	43.9	2.5	359-15-18	46.7
359-15-07	46.6	43.5	3.1	359-15-19	46.6
359-15-08	45.8	43.4	2.4	359-15-20	46.1
359-15-09	46.3	43.5	2.8	359-15-21	46.8
359-15-10	46.6	42.7	3.9	359-15-22	46.5
359-15-11	46.1	43.0	3.1	359-15-23	46.3
359-15-12	46.3	42.9	3.4	359-15-24	46.5
Mean	46.25833333	43.06666667	3.191667		46.55
Median	46.3	42.95	3.2		46.5
Mode	46.6	42.7	3.9		46.5
Std. Dev.	0.293747985	0.441759567	0.561788		0.334392
Variance	0.086287879	0.195151515	0.30447		0.111818
Kurtosis	-1.428899843	-0.88620424	-1.14286		-0.53891
Skewness	-0.256023276	0.487322786	0.100476		0.402623
Range	0.8	1.4	1.6		1
Minimum	45.8	42.5	2.4		46.1
Maximum	46.6	43.9	4		47.1
Sum	555.1	516.8	38.3		558.6
Count	12	12	12		12

Modified Cup Evaluation

Holed Kapton, 27713-2 cup, High act. disc



TH-HTBA 011441

TEST359A.XLC
JAD 12/10/92

PRESSURE SWITCH DATA Form 21605 TEST NO. 360-15-24

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
7705	9/18/13	Steve Officer	
PERFORMED BY	**DATE STARTED**	**DATE COMPLETED**	**APPROVED BY**
Jeffrey Bilanowicz	9/30/13		

PROJECT TITLE: Cruise control

CUSTOMER:

PURPOSE OF TEST: 27713-2 evaluation

PROCEDURE: Hotshot curves on cap/disc matrix

Lot E: 25.3 Disc, 27713-2 Cap; Reduced Converter button (.004")
Lot F: 25.3 Disc, 27713-2 Cap; Controls for Lot E
Lot G: 25.3 Disc, 27713-2 Cap; Reduced Converter button (.009")
Lot H: 25.3 Disc, 27713-2 Cap; Controls for Lot G

Lot E Sensor	E Measurement	Hotshot	Lot F Sensor	F Measurement	Hotshot
E1	42.4		F1	42.3	✓
E2	42.5	✓	F2	42.6	✓
E3	42.5		F3	42.7	✓
E4	42.1	✓			
E5	42.3				
E6	46.9	✓			
E7	46.9				
E8	42.3	✓			
E9	42.4				
E10	41.0	✓			
E11	42.2				
E12	46.5	✓			

Lot G Sensor	G Measurement	Hotshot	Lot H Sensor	H Measurement	Hotshot
G1	42.0		H1	42.3	✓
G2	42.2	✓	H2	42.2	✓
G3	42.4		H3	42.4	✓
G4	46.9	✓			
G5	42.2				
G6	42.5	✓			
G7	42.2				
G8	46.2	✓			
G9	42.6				
G10	42.3	✓			
G11	42.3				
G12	42.7	✓			

(OVER)

TI-NHTSA 011442

12/11/92

ENGINEERING TEST MATRIX
27713-2 CUP EVALUATIONS
20.57/11.78 & 25.3/16.7 DISC EVALUATIONS

GROUP "A" 20.57 DISC & 27713-1 CUP
GROUP "B" 20.57 DISC & 27713-2 CUP
GROUP "C" 25.3 DISC & 27713-1 CUP
GROUP "D" 25.3 DISC & 27713-2 CUP

SERIALIZED SENSOR DIMENSION READINGS X.001"

GROUP "A" CUP 27713-1 DISC 20.57		GROUP "B" CUP 27713-2 DISC 20.57		GROUP "C" CUP 27713-1 DISC 25.3		GROUP "D" CUP 27713-2 DISC 25.3	
A1	48.00	B1	47.60	C1	47.50	D1	47.00
A2	47.90	B2	48.70	C2	47.70	D2	47.70
A3	48.40	B3	49.10	C3	47.30	D3	47.20
A4	47.80	B4	48.50	C4	48.00	D4	47.00
A5	48.30	B5	48.20	C5	47.80	D5	47.70
A6	47.90	B6	47.50	C6	47.50	D6	48.30
A7	48.30	B7	48.40	C7	47.60	D7	48.70
A8	48.10	B8	47.70	C8	47.80	D8	48.60
A9	48.20	B9	47.60	C9	47.50	D9	47.20
A10	48.10	B10	47.80	C10	47.80	D10	47.60
A11	48.20	B11	48.70	C11	47.90	D11	48.00
A12	48.40	B12	47.00	C12	47.60	D12	48.50
MEAN	48.13	MEAN	48.14	MEAN	47.70	MEAN	47.84
SIGMA	0.20	SIGMA	0.63	SIGMA	0.21	SIGMA	0.63
Range	0.60	Range	1.60	Range	0.70	Range	1.90

MJS 12/11/92 27713-2.XLS

27713-2 CUP EVALUATION
REDUCED CONVERTER BUMP HEIGHT

GROUP "E" 25.3 DISC, 27713-2 CUP, CONVERTER BUMP HEIGHT REDUCED BY .004"
GROUP "F" 25.3 DISC, 27713-2 CUP, CONTROL FOR GROUP "E"
GROUP "G" 25.3 DISC, 27713-2 CUP, CONVERTER BUMP HEIGHT REDUCED BY .008"
GROUP "H" 25.3 DISC, 27713-2 CUP, CONTROL FOR GROUP "G"

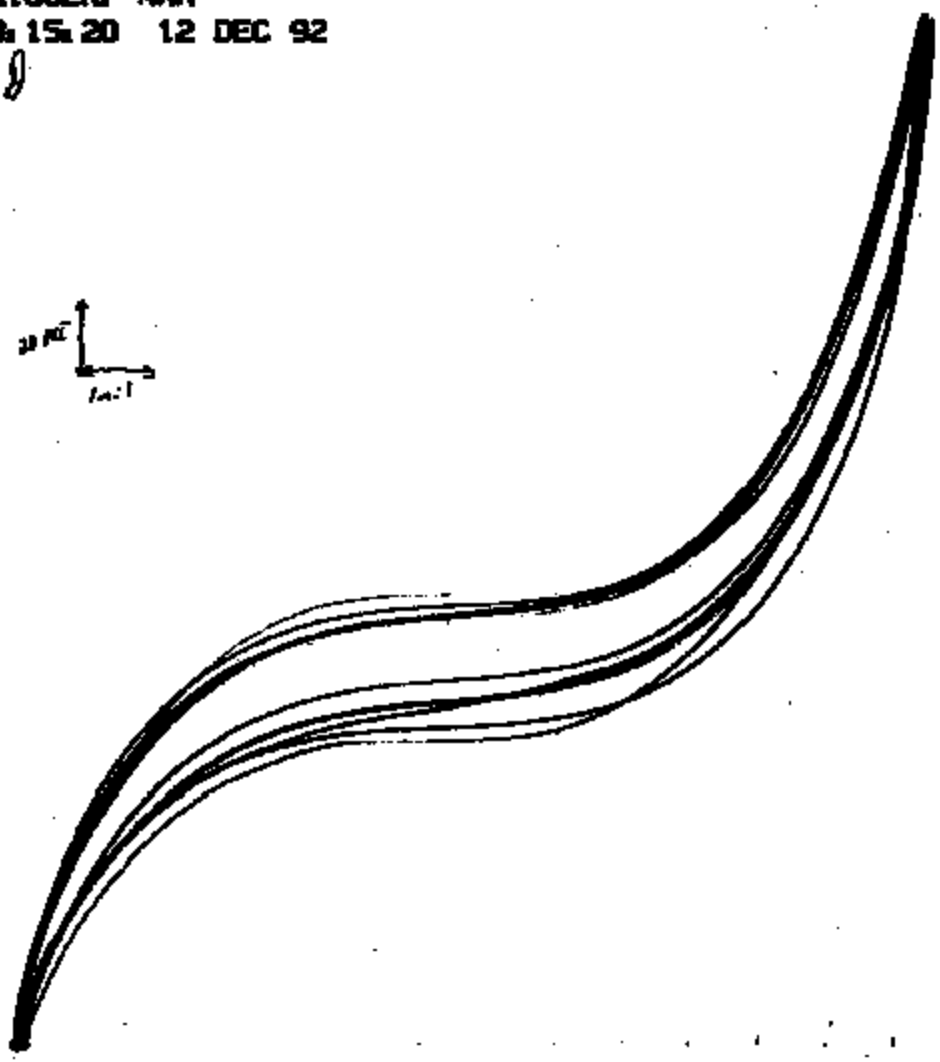
SERIALIZED SENSOR DIMENSION READINGS X.001"

GROUP "E" CUP "DISC CONV.	27713-2 "25.30 -.004"		GROUP "F" CUP DISC CONV.	27713-2 "25.30 NORMAL		GROUP "G" CUP "DISC CONV.	27713-2 25.30 -.008"		GROUP "H" CUP "DISC CONV.	27713-2 "25.30 NORMAL
E1	47.40		F1	47.20		G1	47.00		H1	47.30
E2	47.50		F2	47.60		G2	47.20		H2	47.70
E3	47.50		F3	47.40		G3	47.90		H3	47.40
E4	47.10					G4	46.80			
E5	47.40					G5	47.20			
E6	46.40					G6	47.50			
E7	46.90					G7	47.80			
E8	47.30					G8	46.20			
E9	47.40					G9	47.80			
E10	46.00					G10	47.80			
E11	47.20					G11	47.50			
E12	46.80					G12	47.70			
MEAN	47.22		MEAN	47.40		MEAN	47.58		MEAN	47.47
SIGMA	0.44		SIGMA	0.18		SIGMA	0.40		SIGMA	0.21

Test 360-15-24
Group "A" : 20.5° disc/37713-1 cuf

RANGES: 9.600V 10.00V 2.450V
OFFSETS: 0.0V 0.0V 0.1V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN
08:15:20 12 DEC 92

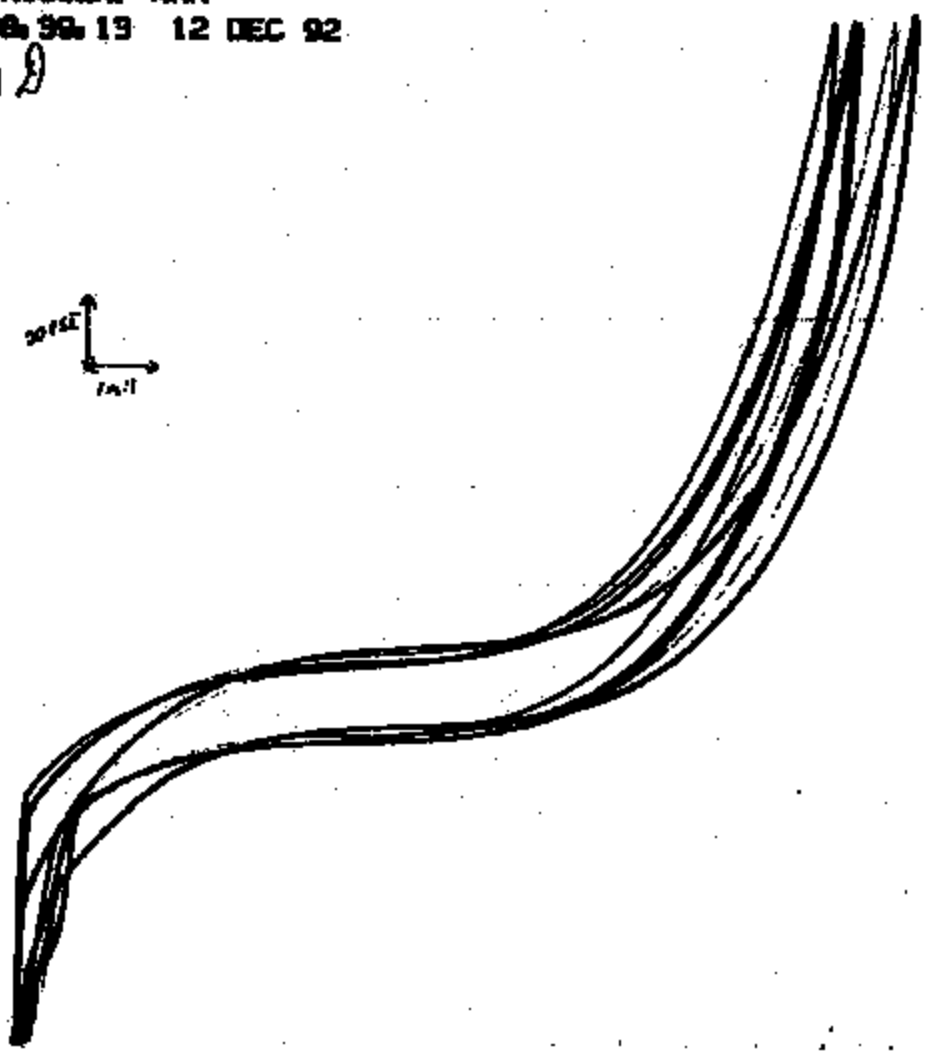
Device	Color
A1	Black
A2	Red
A3	Blue
A4	Green
A5	Purple
A6	Orange



RANGES: 3.600V 10.00V 2.450V
OFFSETS: 0.0V 0.0V 0.1V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN
08:39:13 12 DEC 92

Test 360-15-24
Group "B": 20.57 disc/2270-2 cup

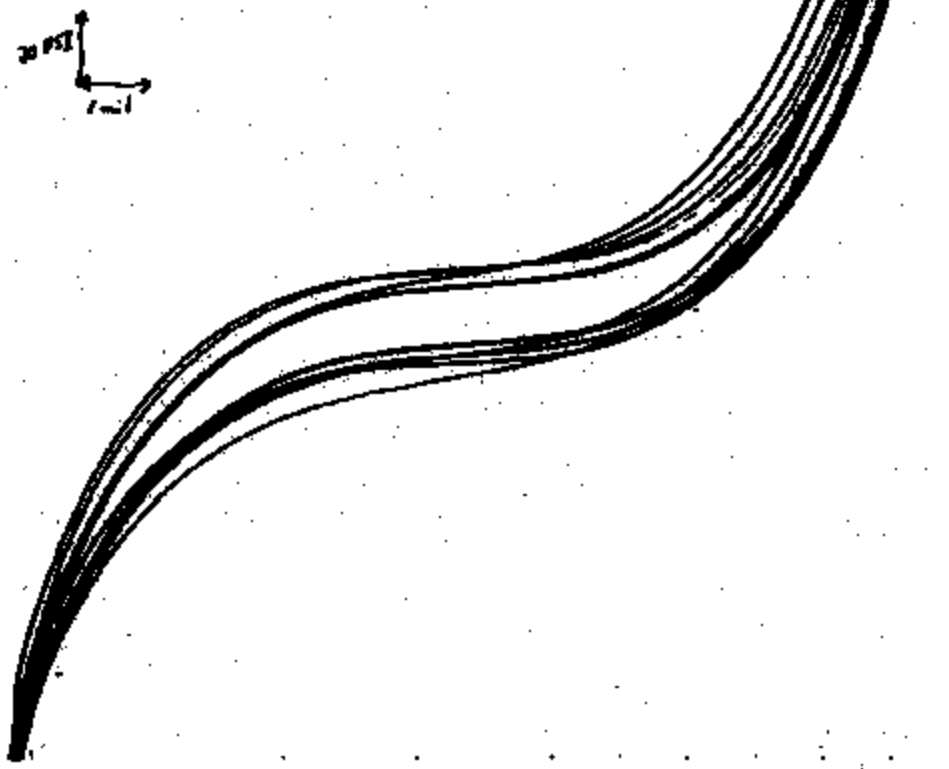
Station	Color
B2	Black
B3	Red
B4	Blue
B7	Green
B5	Purple
B6	orange



RANGES: 3.000V 10.00V 2.450V
OFFSETS: 0.0V 0.0V 0.1V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN
09:09:02 12 DEC 92

Test 360-15-29
Group "C": 35.3 disc/37713-1 cap

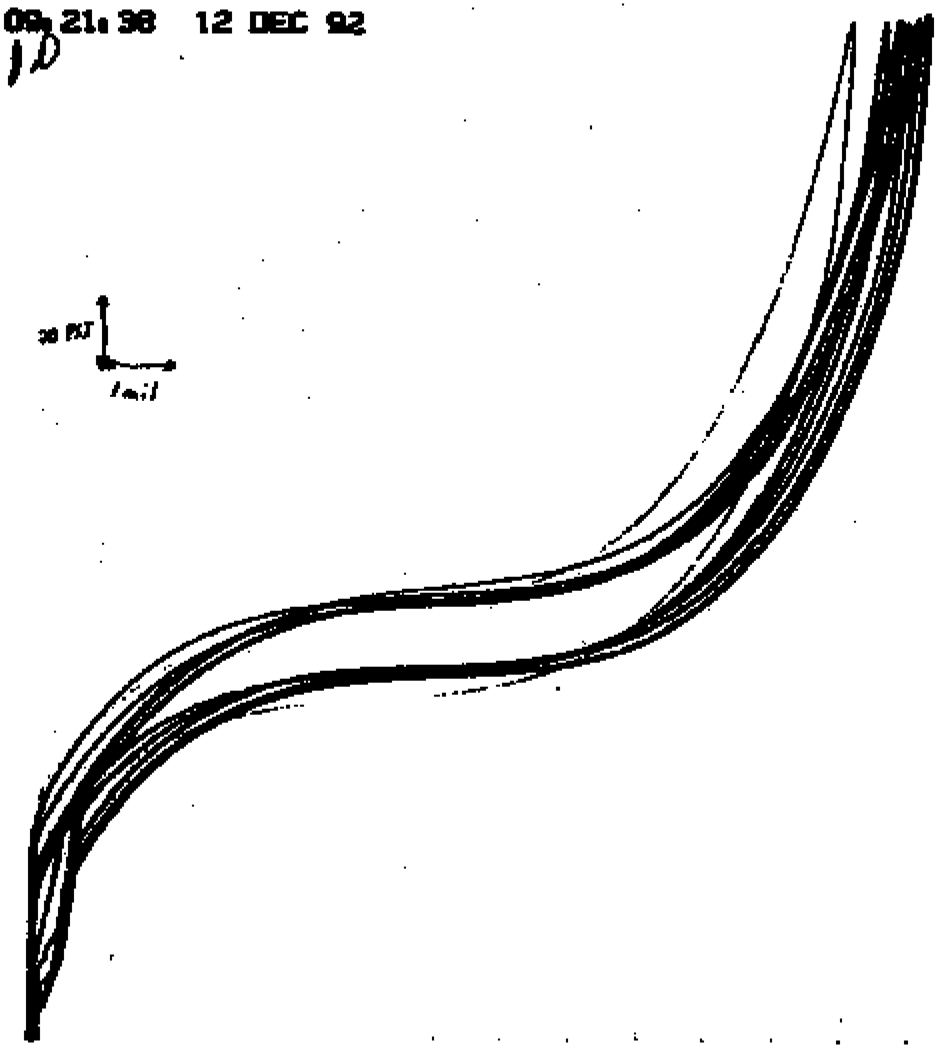
Sensor	Color
C1 :	Black
C2 :	Red
C3 :	Blue
C4 :	Green
C5 :	Purple
C6 :	Orange



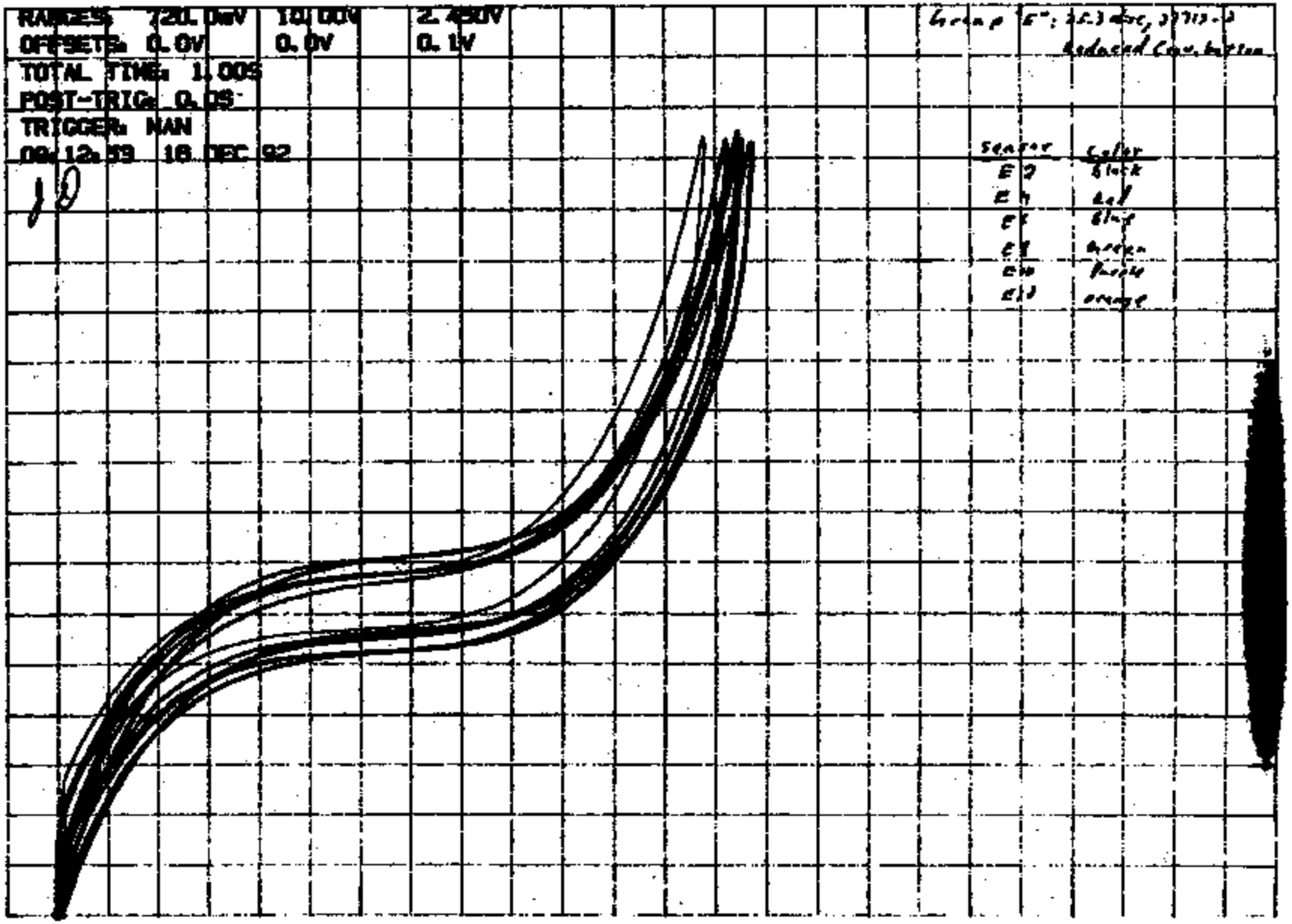
RANGES: 3.600V 10.00V 2.450V
OFFSETS: 0.0V 0.0V 0.1V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN
09:21:38 12 DEC 92
JD

Test 360-15-29
Group "B": 35.1 [illegible]/[illegible] Cap

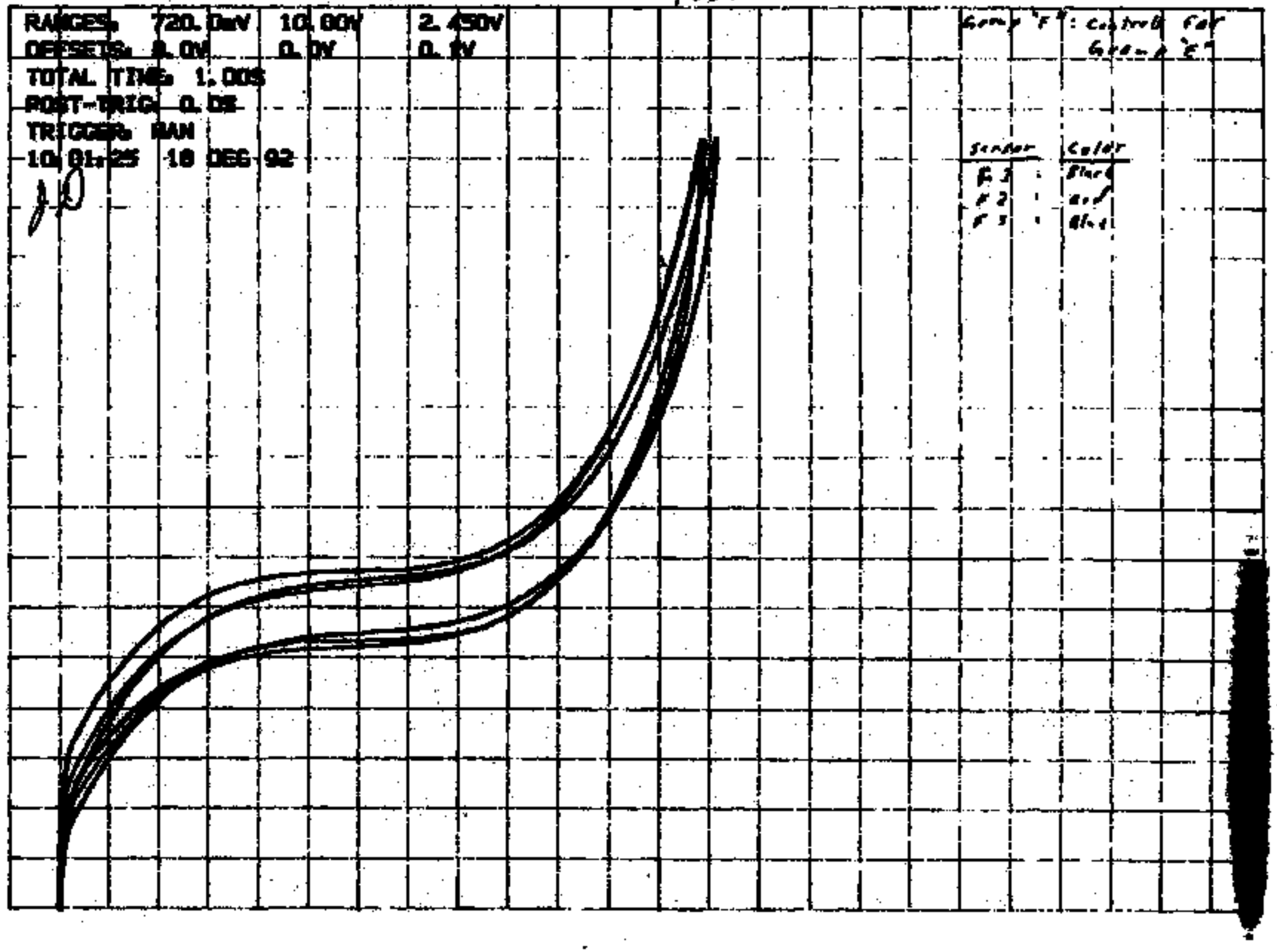
Sensor	Color
01 :	Black
02 :	Red
03 :	Blue
04 :	Green
05 :	Purple
06 :	Orange



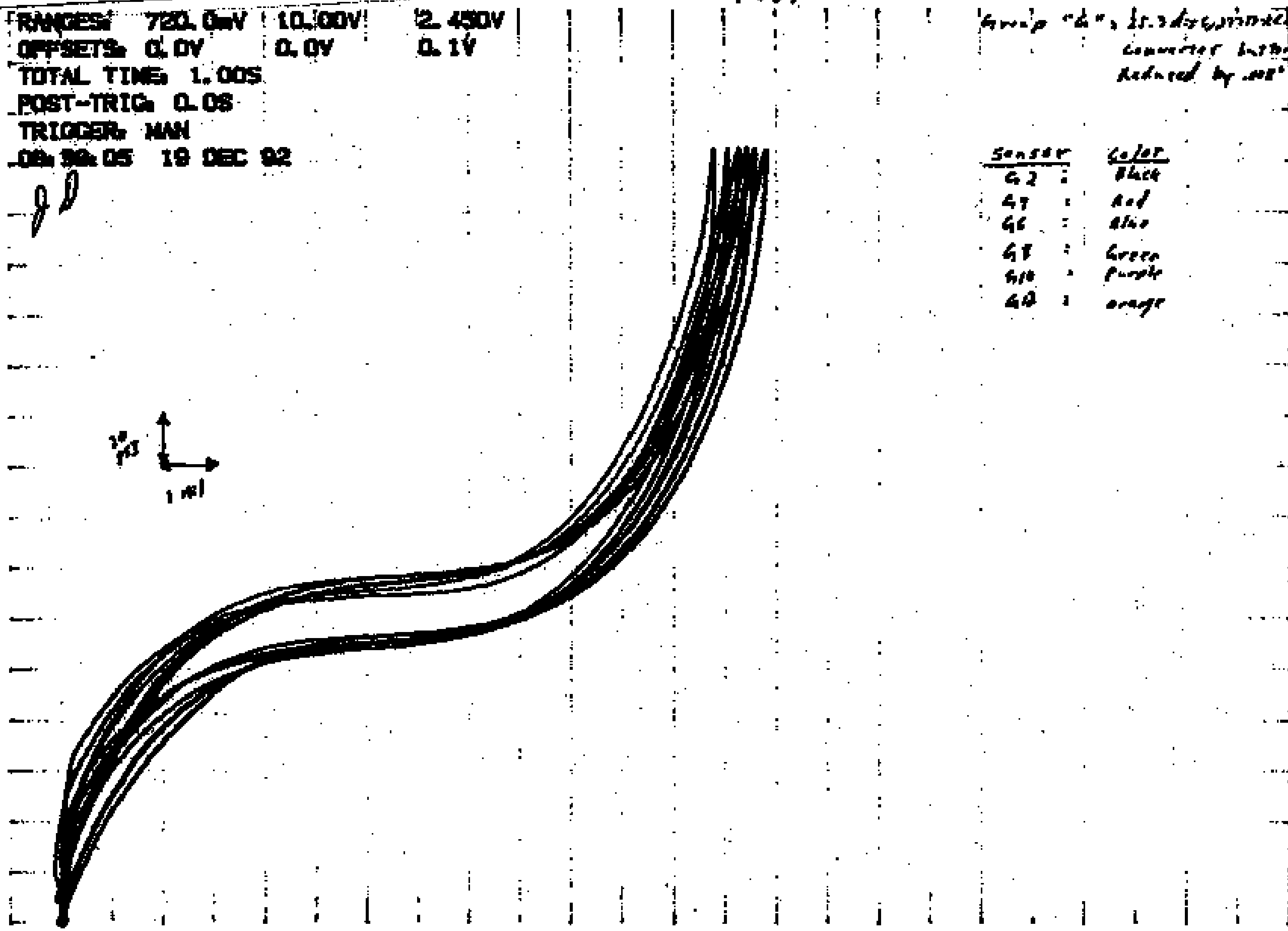
Test 360-15-24

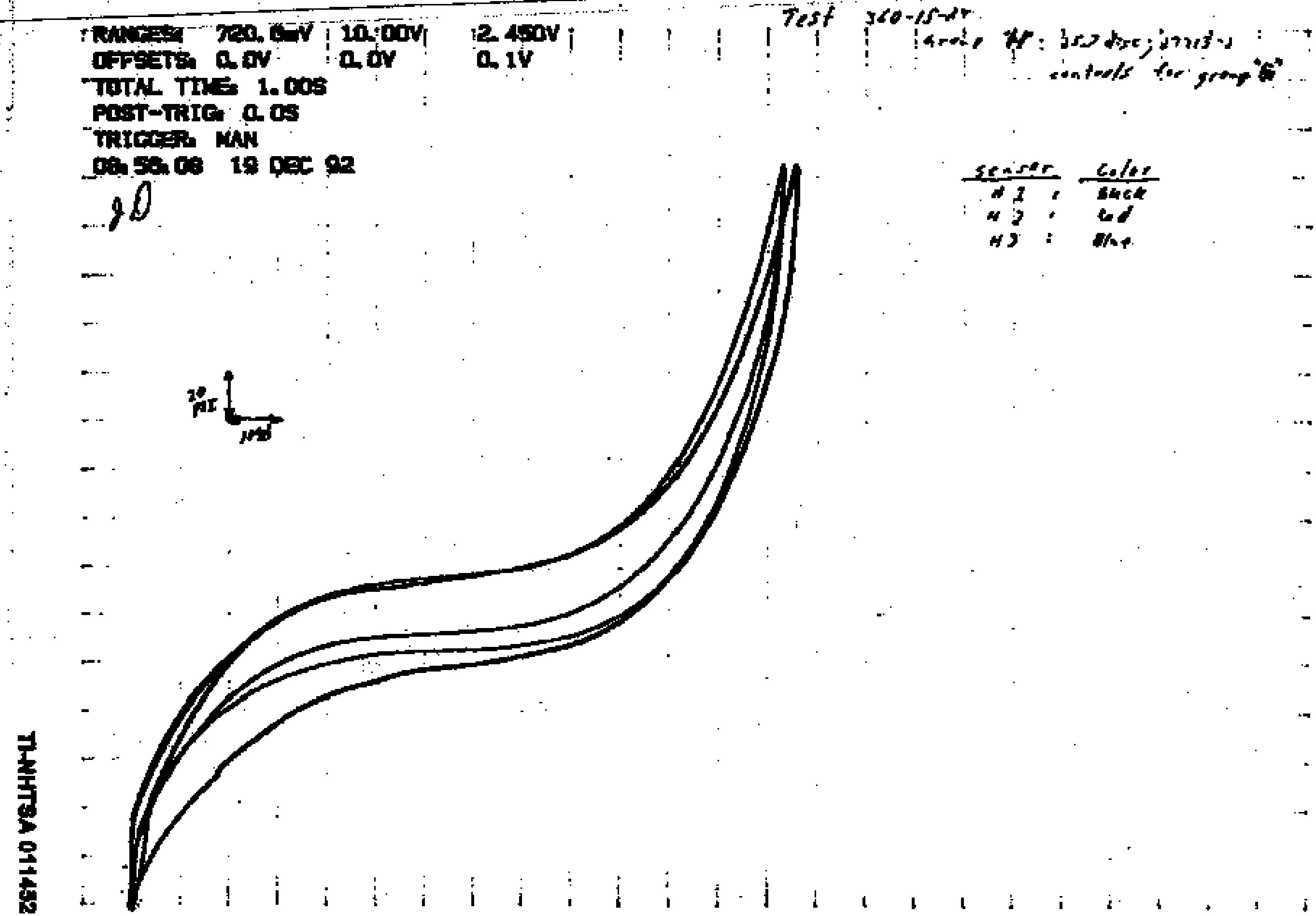


Test 320-15-24



Test 360-15-24





TI-NHTSA 011482

-MSG M#= 00533516 FR=VAGS TO=SB01 SENT=12/10/92 03:43 PM
R#=190 ST=C DIV=0050 CC=00101 BY=VAGS AT=12/10/92 03:43 PM

TO: STEVE OFFILER SB01
JIM WATT PCQA
CHARLIE DOUGLAS CPPC
BILL SWEET PCME
DAVE CZARN ZARN
ELAINE ROSE PCQA
TOM BURKE MFPC
DICK GARIEPY MFPC

FR: MATT SELLERS MJ32

RE: 77P8 QUIET PASS CAR MEETING

THANKS FOR THE ATTENDANCE. SORRY WE DIDN'T HAVE ENOUGH ACTION ITEMS TO GO AROUND, BUT HERE THERE ARE:

GENERAL NOTES:

WE CONFIRMED THAT THE CUP MODIFICATION TO THE 27713-2 WAS PERFORMED TO PRINT, AND THAT CUP DIMENSIONAL VARIABILITY IS NORMAL. HOWEVER, WHEN SENSORS ARE ASSEMBLED AND CRIMPED THE VARIABILITY OF SENSOR DEPTH DIMENSION INCREASES DRAMATICALLY WITH THE 27713-2 COMPARED TO THE 27713-1. 27713-1'S SIGMA IS IN THE .2 RANGE WHILE THE 27713-2'S SIGMA IS IN THE .5 RANGE.

SNAP CURVE ANALYSIS SHOWED THAT WHEN WE ASSEMBLED GOOD SENSORS USING THE MODIFIED CUP WE INTRODUCE ABOUT .001" DISC PRE-DEFLECTION, AND THAT THE SNAP CURVE DOES NOT HAVE THE NICE FLAT REGION WE TYPICALLY SEE.

THE DISC DEPARTMENT HAD SOME PROCESS ADJUSTMENT COINCIDENT WITH OUR ORDERING HIGHER ACTUATION DISC FOR THE 27713-2 CUP. WE NEED TO CLOSE WITH TED TO UNDERSTAND WHAT THIS ADJUSTMENT WAS AND WHETHER OR NOT THIS ADJUSTMENT COULD BE A CONTRIBUTOR TO THE DISC SNAP CURVE APPEARANCE.

PRODUCTION SHIPMENT OUTLOOK:

L2-1'S	2618 DUE TO SHIP 12/15 NONE THE REST OF THE MONTH?
L3-1'S	NONE UNTIL 12/24
L5-2'S	1666 DUE TO SHIP 12/15 400 DUE TO SHIP 12/22

ACTIONS:

QUARANTINE ALL PASS CAR SWITCHES MADE WITH 27713-2 CUP. THIS INCLUDE PACKED FINISHED GOODS, SALVAGE, SCRAP, AND IN-PROCESS SENSOR ASSEMBLIES. HOLD IN A SEPARATE AREA FOR ENGINEERING DISPOSITION. TOM/SHEY NOW

DO NOT PILOT ANY ADDITIONAL L5-2'S, L3-1'S, OR

L2-1'S WITH THE 27713-2 CUP. HOLD ALL LOTS CURRENTLY ANY STAGE OF PROCESSING THAT ARE USING THE 27713-2 CUP. HOLD THESE LOTS FOR ENGINEERING DISPOSITION.

TOM/SMNT — NOW

BEGIN PILOTING L2-1'S WITH 27713-1 CUP (OLD VERSION) IN PREPARATION FOR 12/15 SHIPMENT. PROCEED WITH SENSOR ASSEMBLY BUILD AND FINAL BUILD UNLESS NOTIFIED OTHERWISE.

TOM/SMNT — NOW

CLOSE WITH TEVES TO DETERMINE NEED FOR 12/15 SHIPMENT OF L5-2'S. PUSH-OUT IF POSSIBLE TO ALLOW MORE DATA COLLECTION TIME. CONTACT MATT ASAP WITH NEW DATE.

RUSTY — NOW

ENGINEERING MEETING TO LAY OUT NEXT STEPS IN PROBLEM ANALYSIS/CORRECTIVE ACTION.

STEVE/MATT — 12/11 10:00AM

REGARDS...MATT
X1245

MSG #: 254740 FR=SBO1 TO=SIX SENT=12/23/92 02:24 PM
R#=001 ST=C DIV=0050 CC=00101 BY=SBO1 AT=12/22/92 02:24 PM

To: Norm Freda MELS

: Dave Crain ZARN
Jeff DiDomenico DIDO
Aziz Rahman ZIZ

Fr: Steve Offiler SBO1

Sj: Vacuum / Diaphragm Life Test per Tim Andresen

Norm, as you may recall, Ford Australia contacted Tim A. a while ago regarding the high-vacuum evap&fill issue with the Australian Capri. We felt that this high vacuum was enough to cause some diaphragm displacement which led to wrinkles, stress concentrations, and shortened life. Tim asked us to run a test at the standard Engineering Specification vacuum callout, which is 3 inHg. We have done so, and I'd like you to take this information to Tim. I don't plan any formal writeup.

We ran a total of 12 devices, 6 test lot and 6 controls. The test lot saw 3 inHg vacuum before Impulse testing, and the controls saw no vacuum. (Remember, the ES does not specify vacuum prior to Impulse). All twelve ran to failure at the Impulse parameters: 0-1450 psi, 121 C ambient, and 135 C fluid temp. Failures were as follows:

Vacuum: 913, 1068, 1074, 1194, 1196, and 1206 K cycles
Control: 988, 1170, 1206, 1344, 1356, and 1411 K cycles

Using Weibull techniques, these failures produce a minimum calculated life of 739 K cycles for the vacuum lot and 763 K cycles for the controls, at the Ford ES-specified 90% reliability and 90% nfidence. Notice the vacuum lot fared slightly worse, but ither is anything to worry about relative to the 500 K cycle life requirement.

Norm, I'd also like to mention that I'll be moving to the PSM program first of the year, and Aziz Rahman will be taking over 7798 responsibility. It's truly been a pleasure working with you, and if you need me I'm still at x1382.

Happy Holidays! Steve O.

Dague

11.870
11 58.225