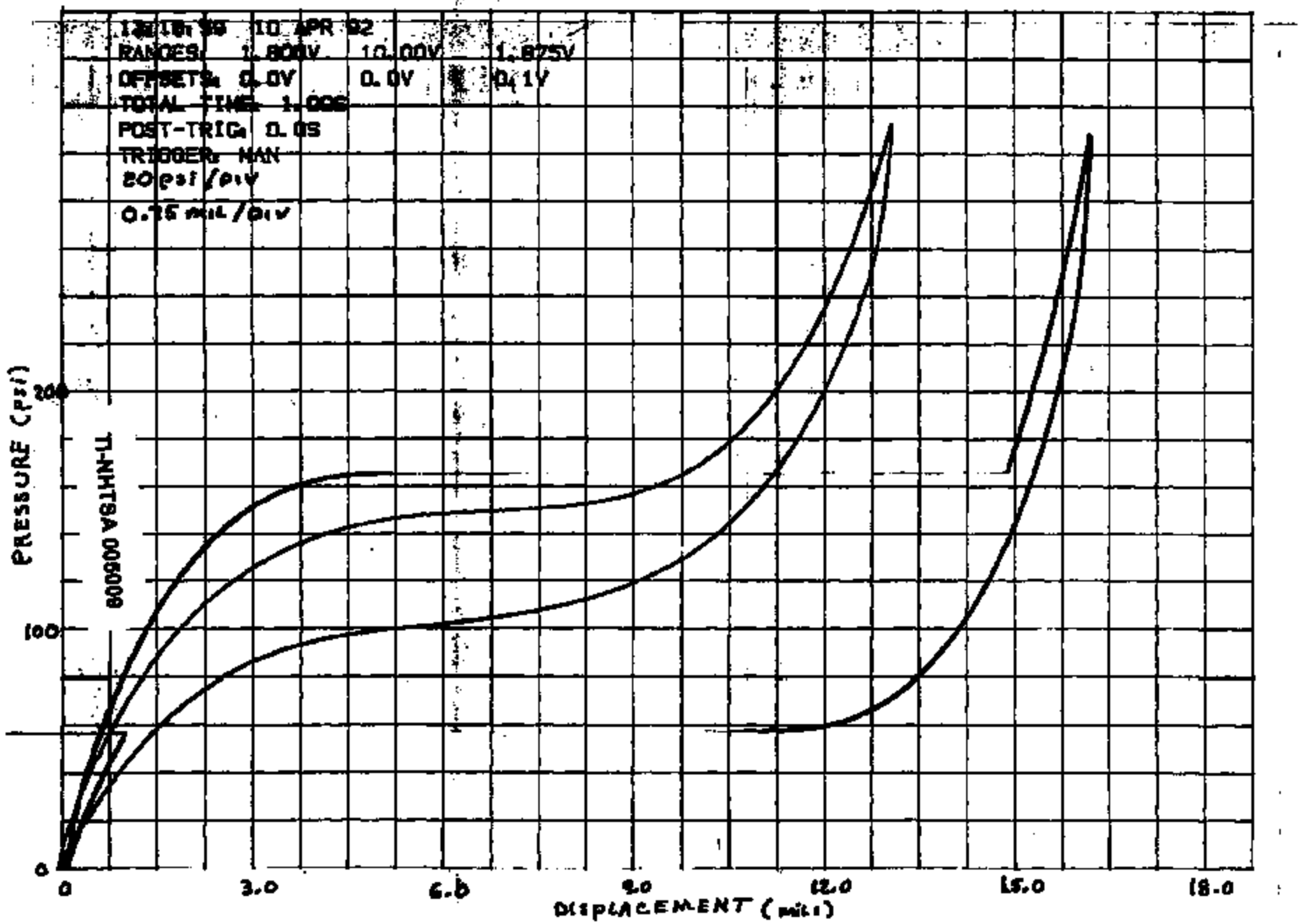

10 APR 92
RANGES: 1.800V 10.00V 1.875V
OFFSETS: 0.0V 0.0V 0.1V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN
20 psi/div
0.25 mil/div
PRESSURE (psi)
200
100
0
0
3.0
6.0
9.0
12.0
15.0
18.0
DISPLACEMENT (mils)
800908 V81HH-TL

PS 92/78

QUIET SWITCH STUDIES
ALTERNATIVE CONFIGURATIONS

PURPOSE

There is a need for a quiet cruise control pressure switch to prevent noises from being transmitted into the passenger compartment. A silent switch was developed by using a low differential disc. This quiet switch is assigned part number 77psl3-1. During the development of this switch a number of alternative configurations were investigated in the hope of finding a simpler solution to control sound. This report describes the results of tests on the alternative configurations.

CONFIGURATIONS

Seven configurations were tested. Six with a noisy wide differential disc (standard production disc).

A) A sheet of 0.003" thick silicone rubber was placed between the convertor and the cup (figure 1). The theory was that the convertor maybe hitting the cup when the disc snaps and the impact generates a noise.

B) A sheet of 0.003" thick silicone rubber was placed between the disc and the convertor (figure 1). The theory was to see if the sound generated by the disc could be blocked from transmitting to the convertor.

C) A sheet of 0.0003" thick silicone rubber was placed between the convertor and the washer (figure 1). The theory was that when the convertor impacts the washer on switch release that it generates a sound.

D) A metal labyrinth was installed inside the hexport, just below the diaphragm. The theory was that by proper acoustical tuning the passage could be made to absorb the sound wave as it tried to travel down the passage. The labyrinth consisted of two brass pieces with horizontal slots cut in them. The pieces were stacked so as to create a "Z" channel (figure 2).

E) A rubber labyrinth with four holes was installed inside the hexport, just below the diaphragm (figure 3). This was an advancement on the theory behind #4, in that the rubber would provide more absorption. The rubber piece also tired to take advantage of the sloped walls of the hexport to reflect the sound wave. The rubber piece design was selected to have a manufacturable shape.

F) Same as 5 except for 2 holes.

G) A hex shaped metal insert to create a snubber (figure 4). The theory is that the hydraulic fluid cannot fill the void left by the instantaneous disc snap as quickly, thus slowing down the hydraulic turbulence that creates sound. This was tested with a quiet disc to see if it could be made more quiet.

EVALUATION METHOD

Each piece was tested by ramping air from 0-400psi at a fixed rate till the switch actuated. There was a microphone located in the tubing just below the switch to listen for the sound. The microphone was attached to a B&K spectrum analyzer. for some of the tests there was also an accelerometer attached to the top of the cup to measure the acceleration generated by the snap. The spectrum analyzer was used to measure the intensity of the sound and to look for resonances.

Later a test was devised to measure the sound in a hydraulic system using a high frequency pressure transducer. Some of the pieces were evaluated with this method. In all cases the sound level was compared to a know noisy switch to evaluate the effect of the change. On the hydraulic system the sound level is defined by the magnitude of the negative pressure pulse generated when the fluid tries to rush in and fill the void left by the disc snap. A noisy switch is typically -40psi. A quiet switch is 0.0psi.

RESULTS

The intensity plots for a standard noisy switch are shown in figure 5. The top scale shows the magnitude of the acceleration. The bottom scale shows the magnitude of the sound. The setup was not calibrated so the scales are for relative comparison only. Form the plot it is clear that sound is generated in the 700 to 2k frequency range.

Figure 6 shows the same plot for a quiet switch using a low differential disc. The magnitude of the acceleration and sound has decreased by 2/3rd's. This is called a moderately quiet switch. During later testing with the hydraulic system it was determined that even this sound level was to loud. An even lower differential disc was developed. The lower differential disc was not measured with air because the sound could not be detected.

Case A) The rubber between the convertor and the cup did not show a noticeable decrease in the sound level. No plot is available because the plotter malfunctioned.

Case B) The rubber between the disc and convertor did reduce the sound level as seen in figure 7. The level is approximately the same as the moderate quiet switch. Figure 8 shows the same switch plotted as intensity vs time. This shows that a sound pulse is still being generated.

Case C) The rubber between the convertor and the washer is shown in figures 9 & 10. Again the sound is reduced, in this case slightly more than even the previous case.

Case D) The metal labyrinth did not reduce the level (figure 10). A slight increase in the sound level was noted.

Case E) The rubber 4 hole plug was tested hydraulically because no sound could be detected with air. It had a -38.8psi pulse, just as noisy as the standard noisy part. This piece was also tested by FORD on a SHO taurus and deemed to be noisy.

Case F) The 2 hole rubber part had a pulse of -27.6psi. Quieter than the 4 hole but still noisy.

Case G) The metal hex snubber insert a no sound, pulse level was 0.0psi. This part was tested by FORD on a SHO taurus, and deemed quiet. Note this had a quiet disc.

DISCUSSION

During the development of the quiet switch it was determined that any noisy detected on an air system is to much. This means that cases A-D will not work.

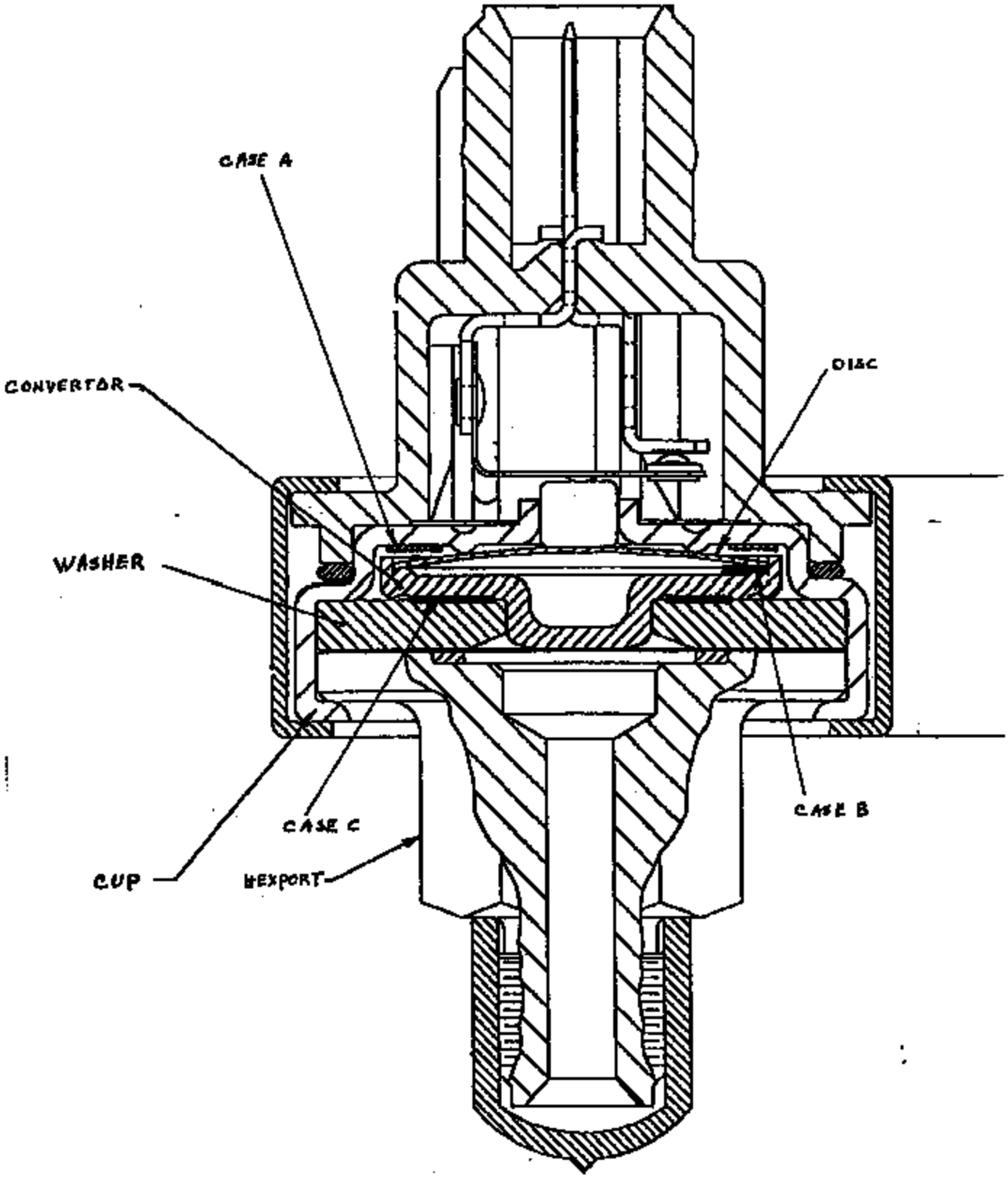
Case E & F were rejected because the vehicle test showed they were noisy.

Case G was not expected to be noisy because it had a quiet disc. If the quiet disc without a snubber is at zero sound then it cannot be reduced by additional snubbing. This piece shows that a snubber really offers no benefit.

Based on these results the decision was made to convert to a quiet disc without any other changes. It was chosen because it was the only solution that FORD brake engineers felt was quiet enough and had a low enough feel.

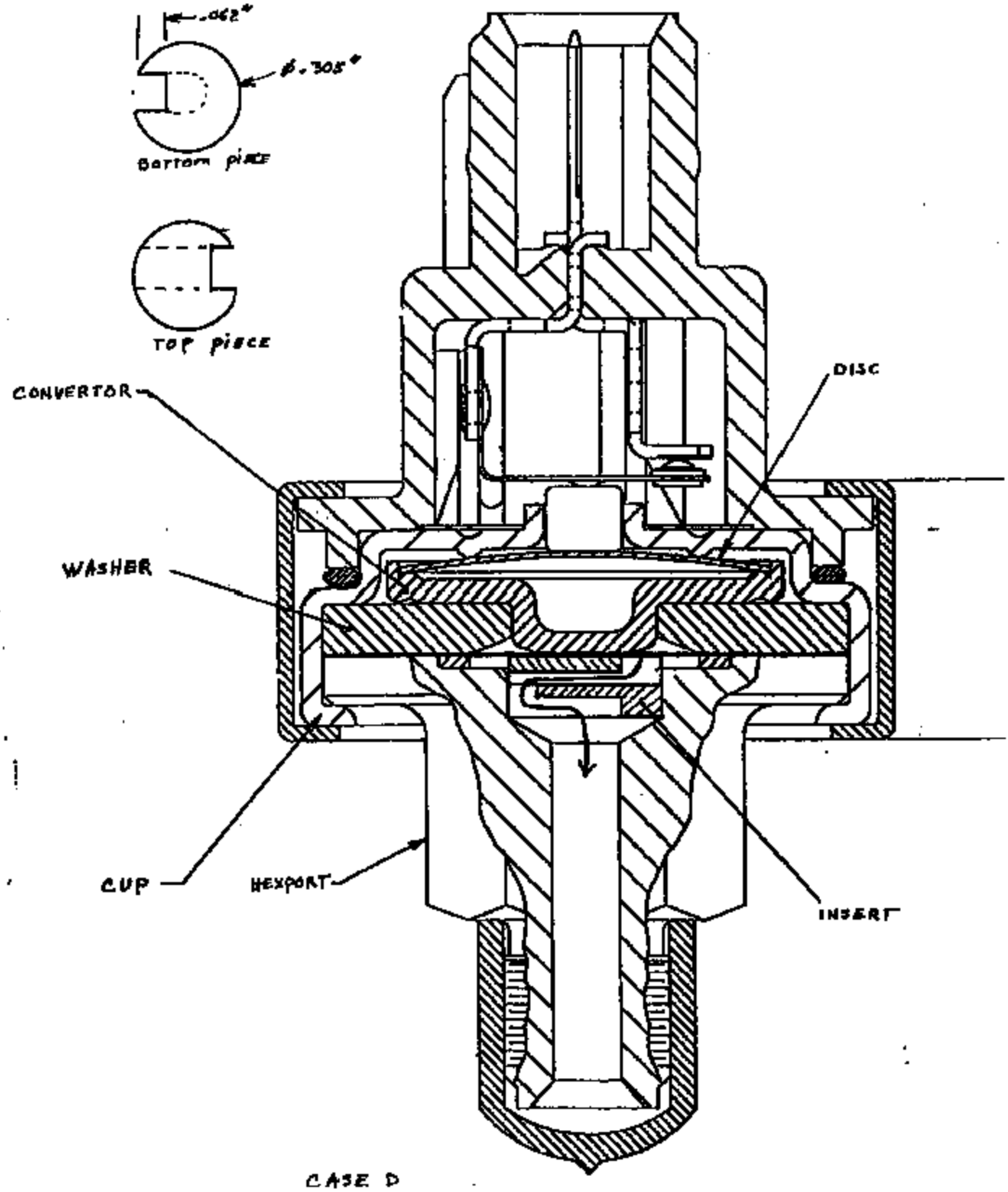
CONCLUSION

A wide selection of creative solutions to control switch sound were tested. the only solution that was quiet was a low differential disc. This solution was implemented at the start of production in June of 1992.

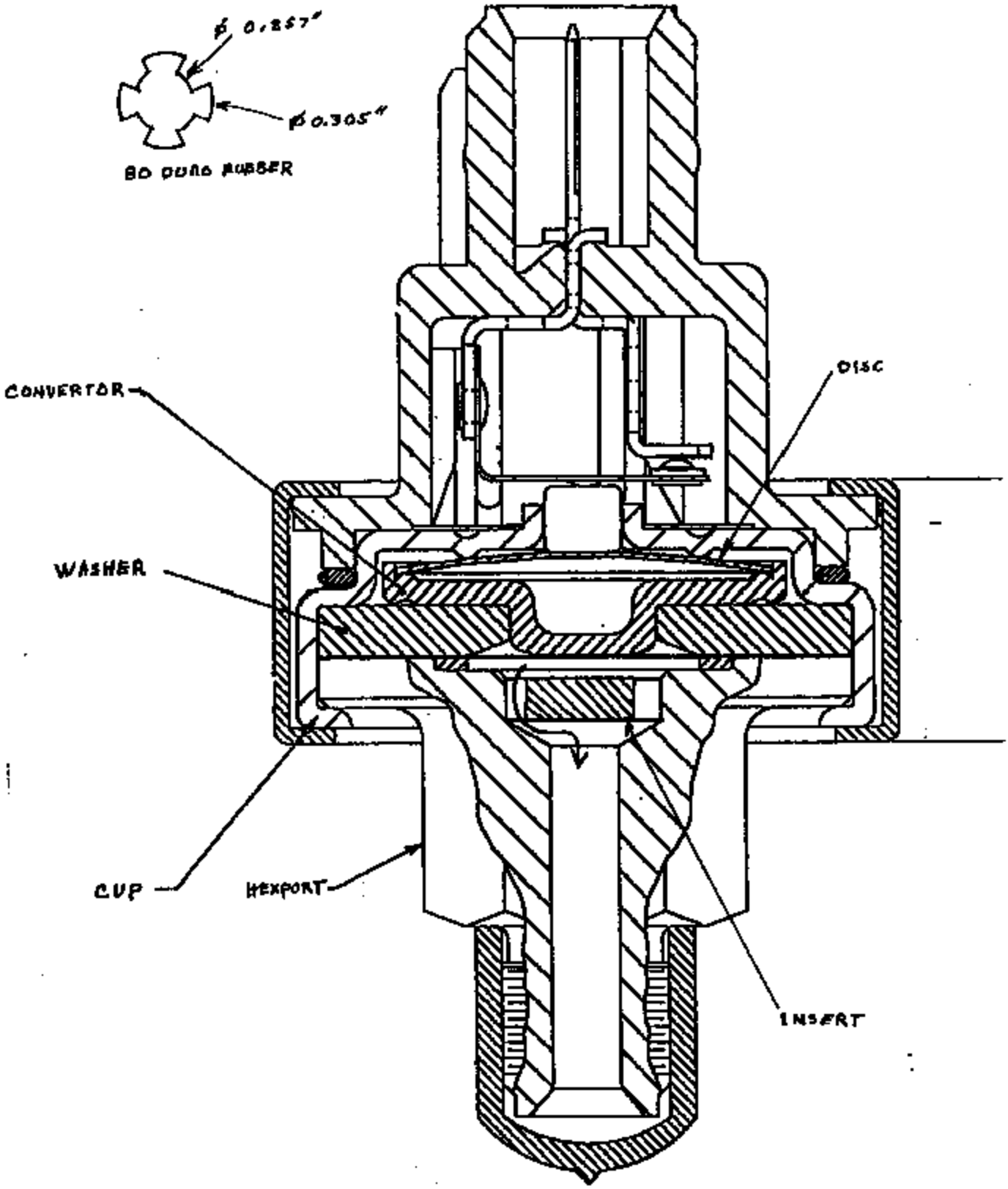


TI-NHTSA 005013

FIGURE 1

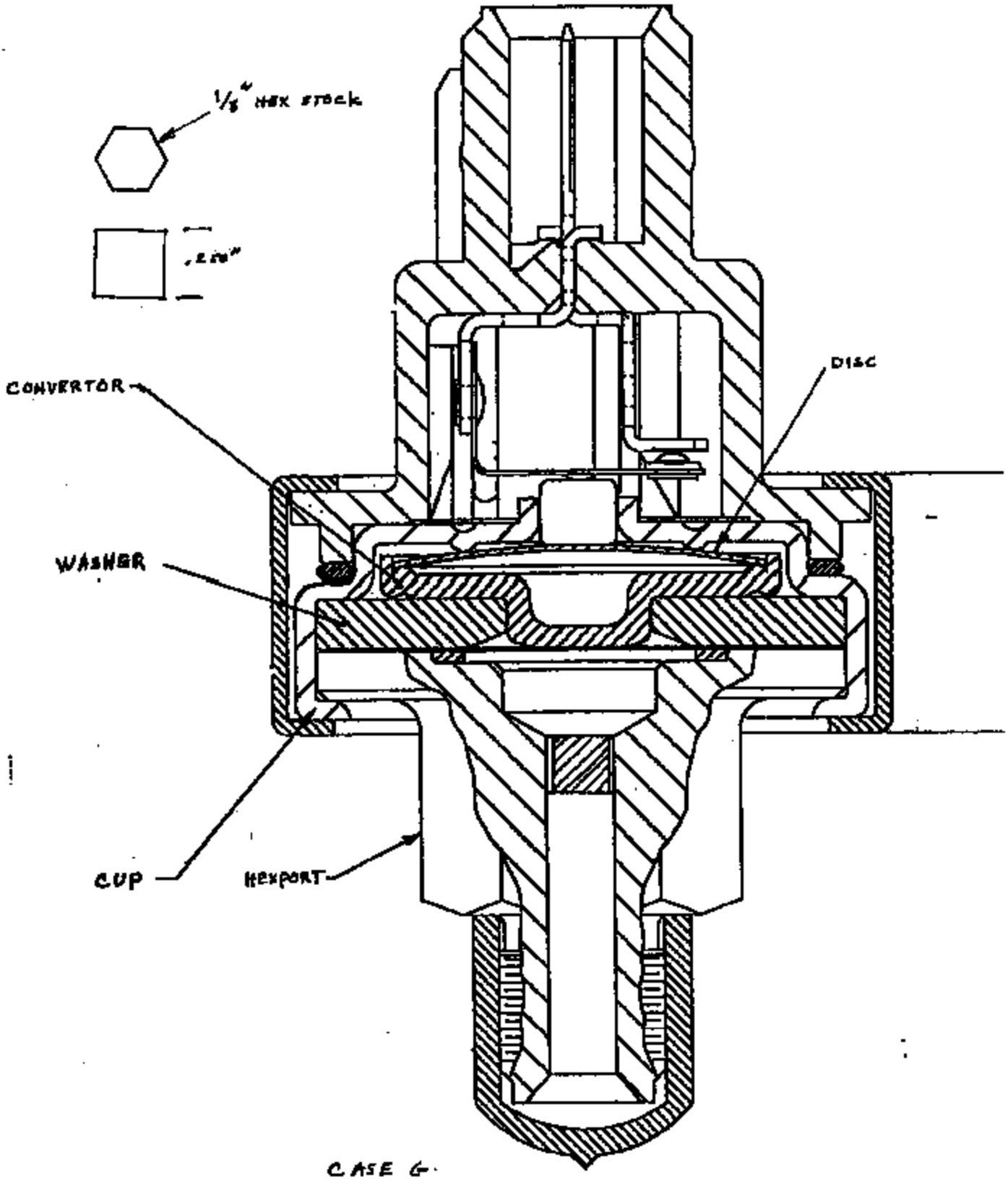


CASE D
FIGORE 2



CASE E
FIGURE 3

TI-NHTSA.005015



CASE 6

FIGURE 4

Brüel & Kjær

Type 2034

Page No.
39

Sign.:

Meas.
Object:

pt. restraint
slow ramp
Acc = 13.4 psi
Ref = 58
AIR

Comments:

A = microphone
B = accelerometer
(enclosed)

noisy switch

TL-NHTSA 005017

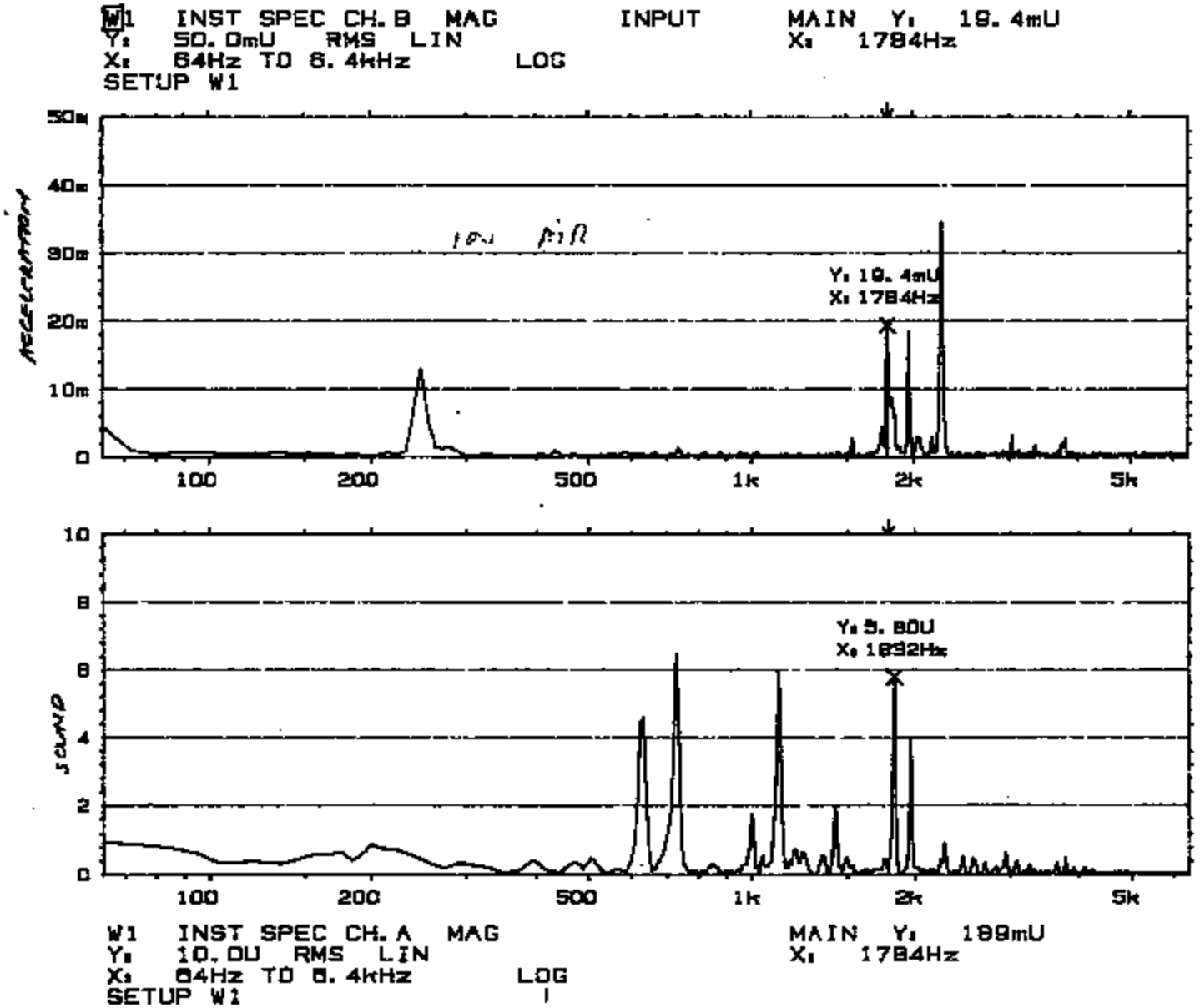


FIG 5

Brüel & Kjær

Type 2034

Page No.
45

Sign.:

Mode.
Object:

Q1. quiet switch
RETURN
slow ramp
AIR

TRUCK DISC ?

Comments:

QUIET SWITCH

TLNHTSA 005018

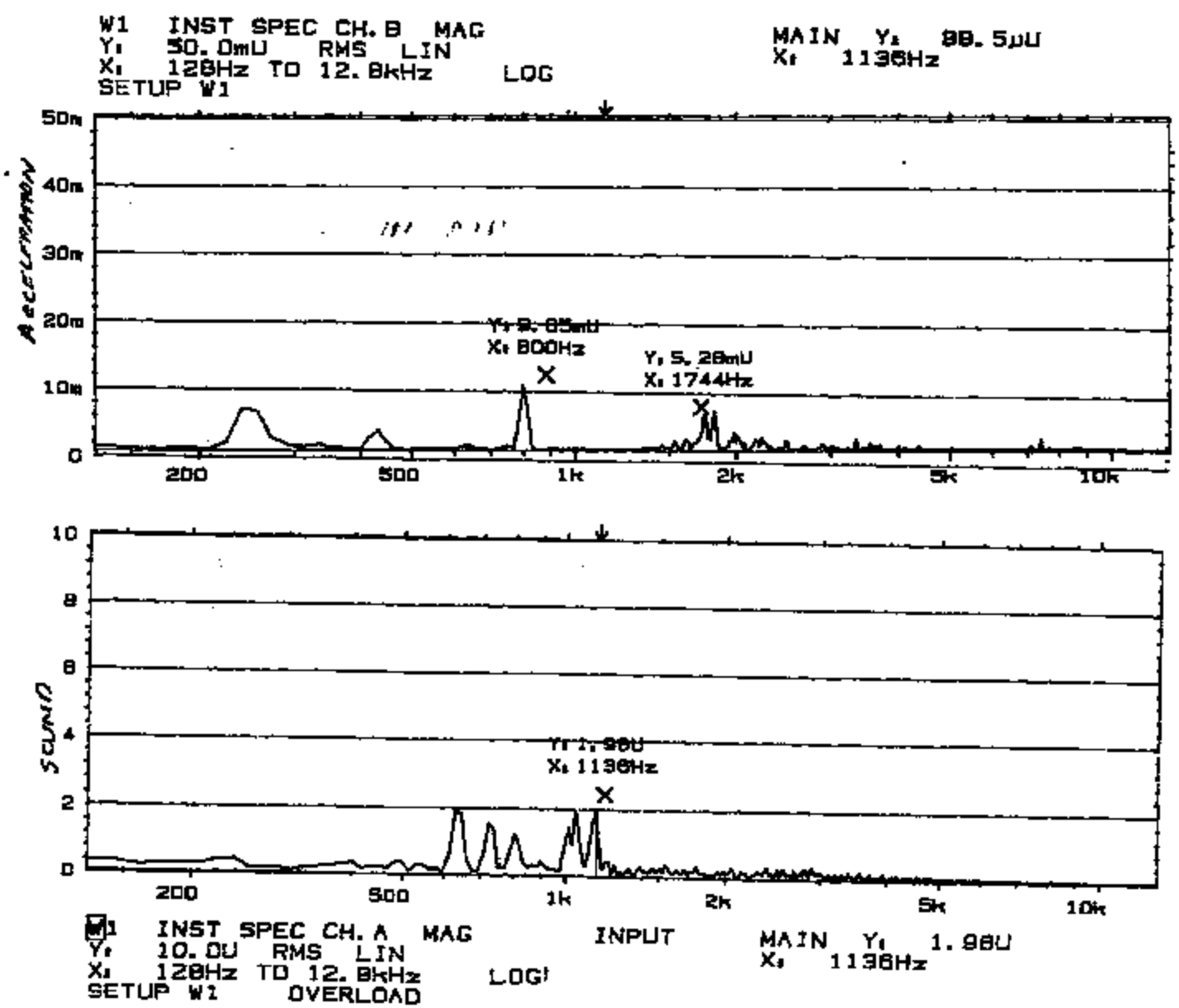


FIG 2

Brüel & Kjær

Type 2034

Page No.
47

Sign.:

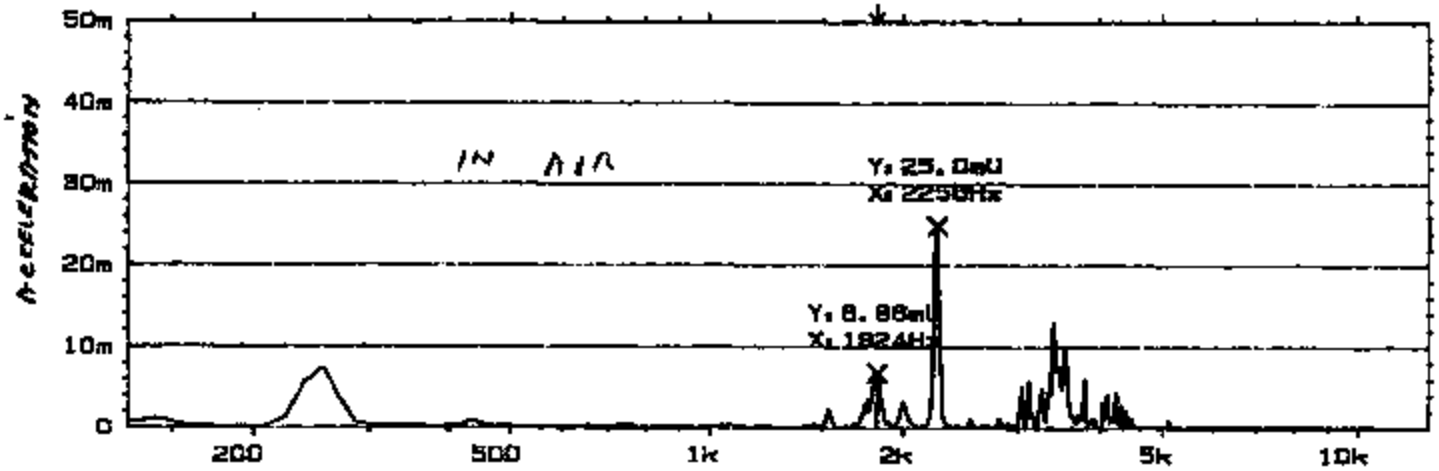
Meas.
Object:

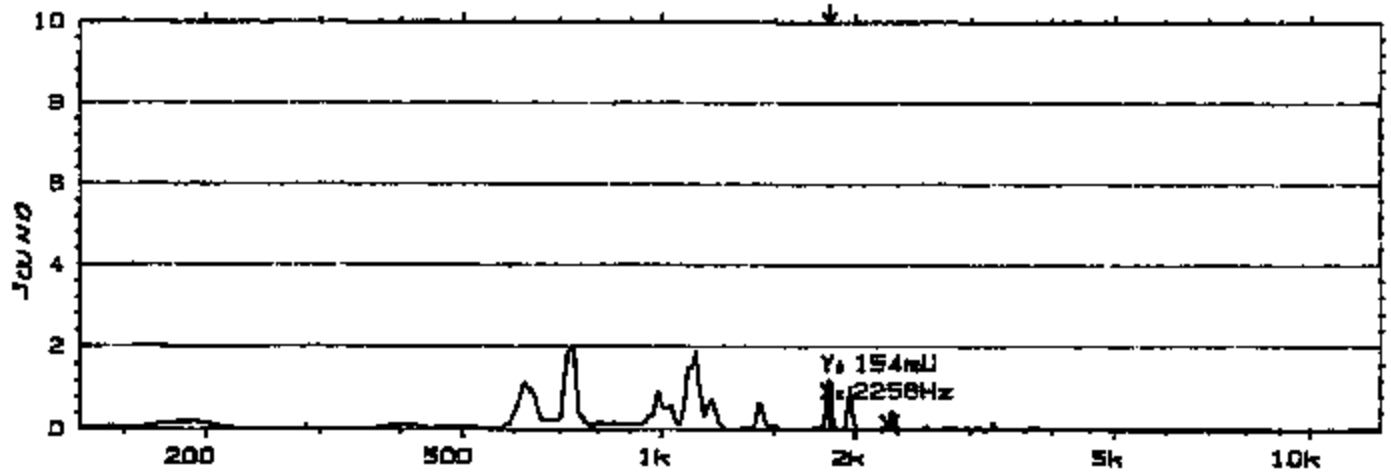
R2 - RUBBER
INSIDE CONVEYOR
RETURN
AIR

Comments:

RUBBER BETWEEN
DISC & CONVEYOR

W1 INST SPEC CH. B MAG INPUT MAIN Y: 6.86mU
Y: 50.0mU RMS LIN X: 1824Hz
X: 128Hz TO 12.8kHz LOG
SETUP W1 OVERLOAD





W1 INST SPEC CH. A MAG MAIN Y: 1.24U
Y: 10.0U RMS LIN X: 1824Hz
X: 128Hz TO 12.8kHz LOG
SETUP W1 OVERLOAD

CASE B
FIGURE 7

TI-NHTSA 005016

Brüel & Kjær

Type 2034

Page No.
87

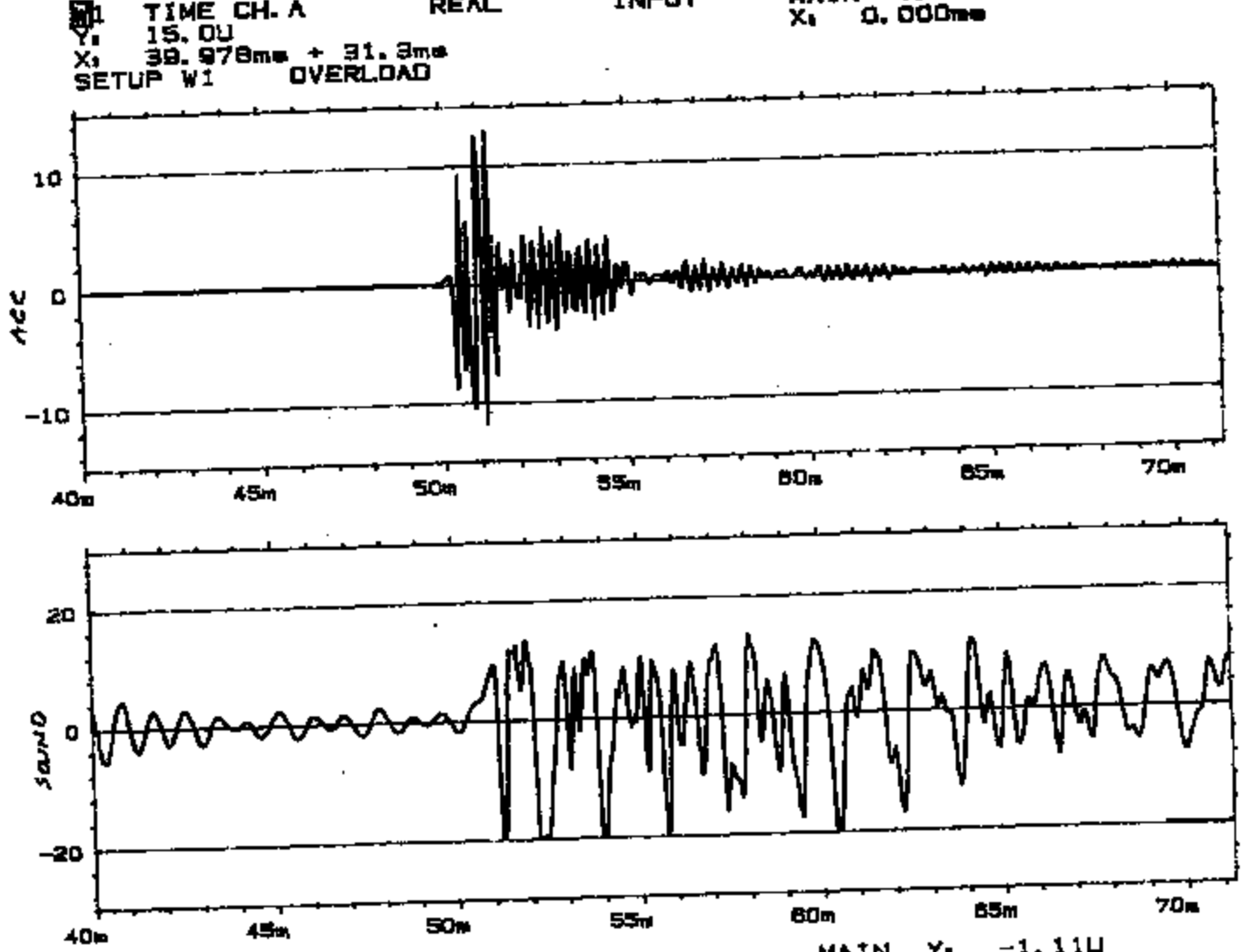
Sign.:

Meas.
Object:

R2 accelerometer
on R
Rubber insulator
connector

Comments:

10mV/g
9/12/91
Rubber between
disc & connector A



CASE B

FIGURE 8

Brüel & Kjær

Type 2034

Page No.
48

Sign.:

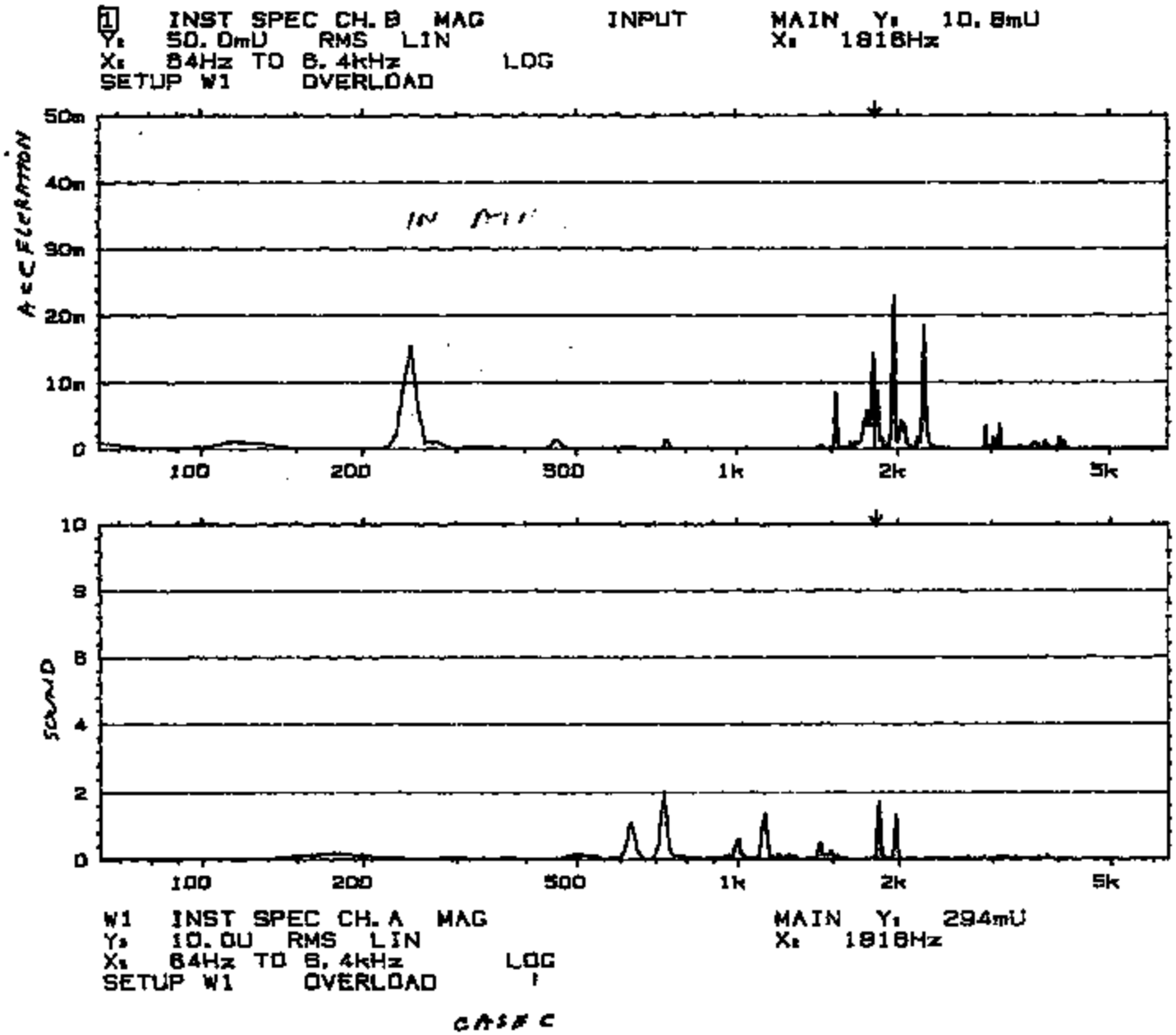
Meas.
Objects:

AS ACQUISITION
MIC
SLOW RAMP
RUBBER BETWEEN
DISC & CONVERTER

Comments:

RUBBER BETWEEN
CONVERTER &
WASHER

TI-NHT8A 005021



CASE C

FIGURE 9

Brüel & Kjær

Type 2034

Page No.
84

Sign.:

Meas.
Objects:

B3 perforation
H.R.
Rubber between
pick & conveyor roll

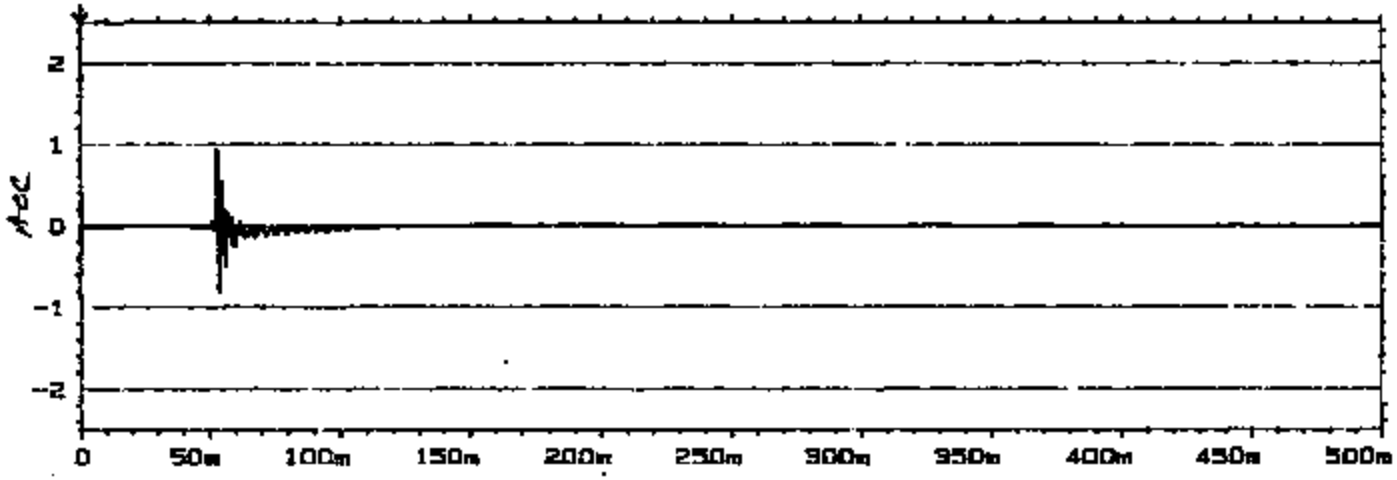
Comments:

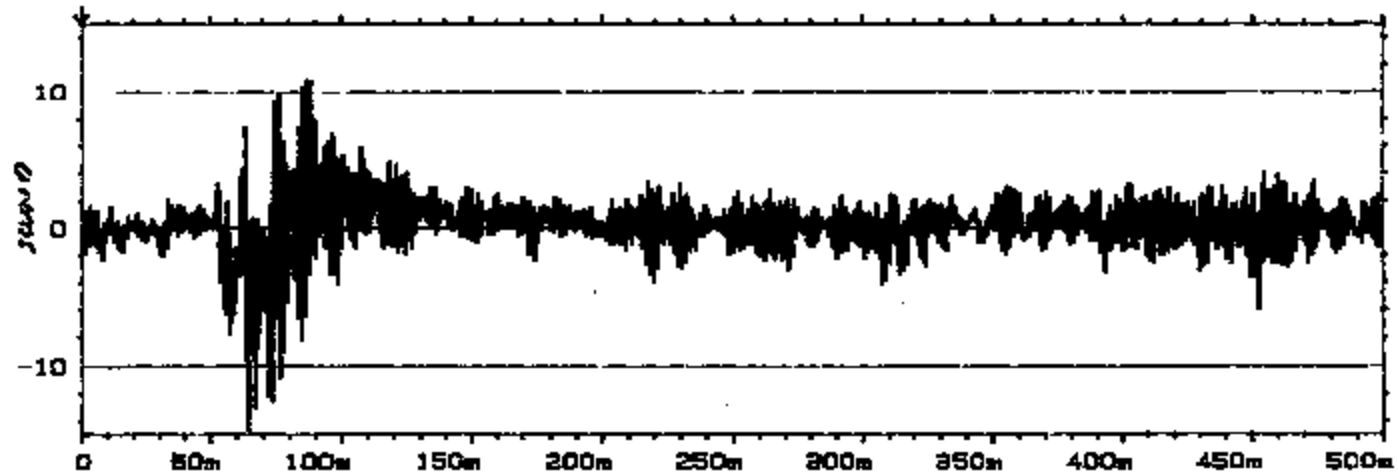
3/13/92 PRS

Rubber between
conveyor & wall bar

TI-NHTSA 005022

W1 TIME CH. A REAL MAIN Y: 9.32E-9U
Y: 2.50U X: 0.00ms
X: 0.00ms + 500ms
SETUP W1 OVERLOAD





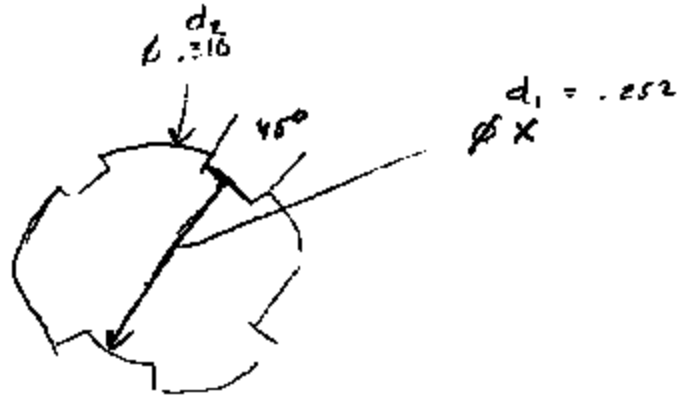
W1 TIME CH. B REAL INPUT MAIN Y: -2.27U
Y: 15.0U X: 0.00ms
X: 0.00ms + 500ms
SETUP W1 OVERLOAD

CASE C
FIGURE 10

R1 = RUBBER AT CUP

R2 = RUBBER INSIDE CONVERTOR

R3 = RUBBER BETWEEN CONVERTER & WASHER



$$A_R = \frac{1}{2}\left[\frac{\pi d_2^2}{4} - \frac{\pi d_1^2}{4}\right]$$

$$A_R = A_{SMASHER} = \frac{\pi (.127)^2}{4} = .01267 in^2$$

$$\frac{\pi d_2^2}{2} = \frac{\pi d_2^2}{4} - \frac{\pi d_1^2}{4}$$

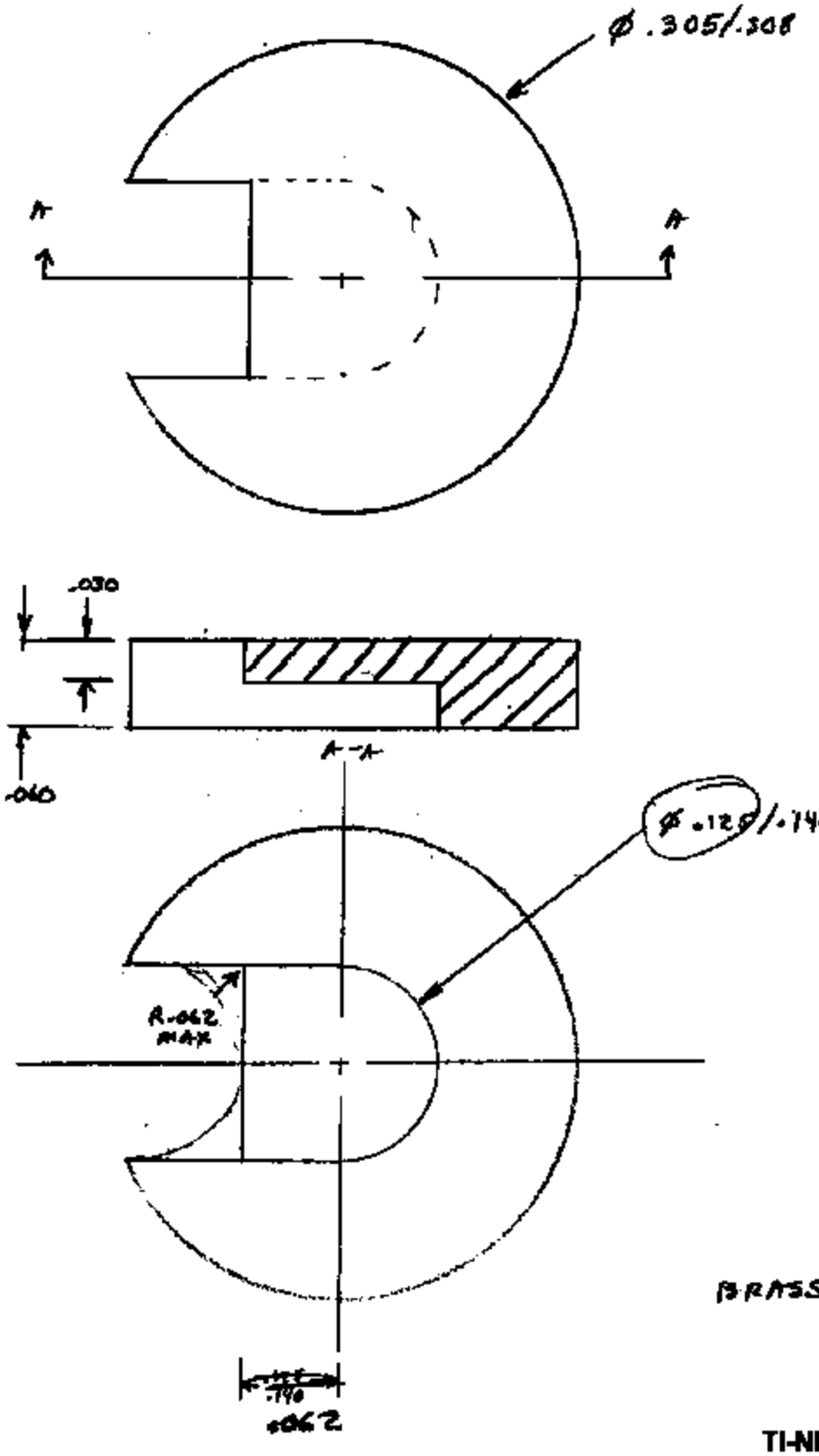
$$2d_2^2 = d_2^2 - d_1^2$$

$$2(.127)^2 = .310^2 - d_1^2$$

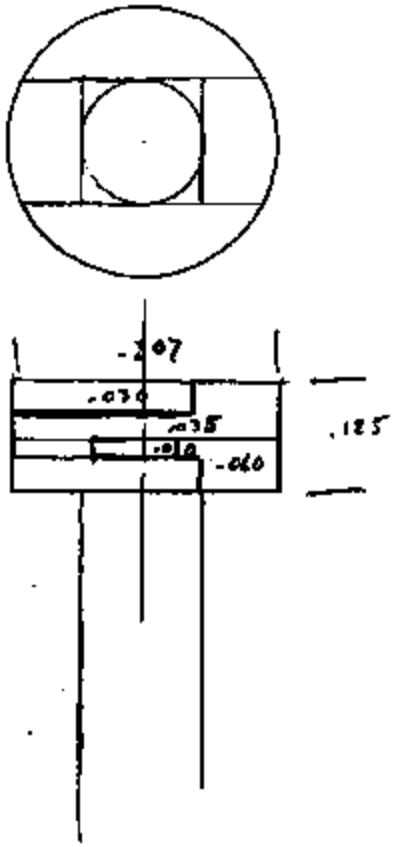
$$d_1^2 = .0638$$

$$d_1 = .2527$$

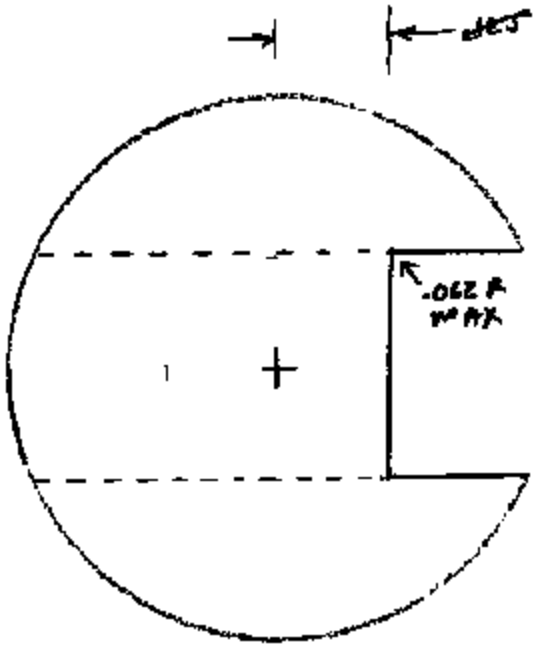
DATE 5-6-98 3/18/99

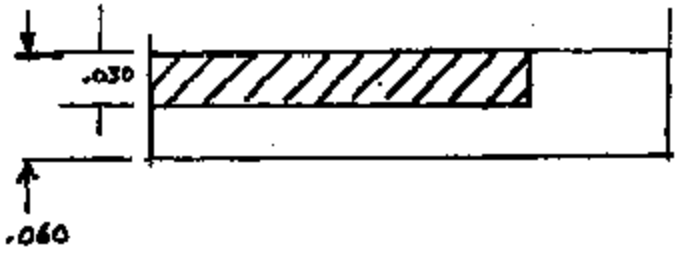


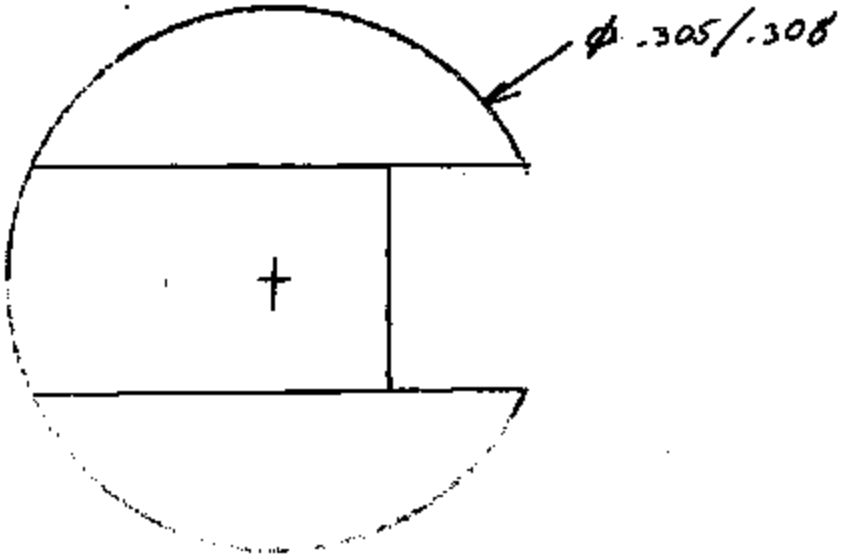
BRASS


.207
.030
.035
.010
.060
.125

DATE SCAN 3/18/92

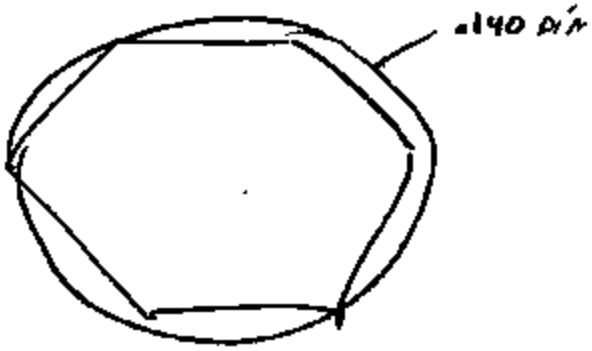




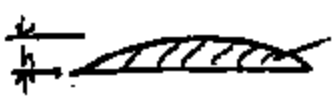


single $\frac{\pi(.020)^2}{4} = .00031\ in^2$

$L = .060''$ $\frac{L}{A} = \frac{.060}{.00031} = 190.9$



FLATS $.125 \times 1.154 = .1443$ CORNERS



$A_1 = \frac{1}{2}[rL - c(r-h)]$

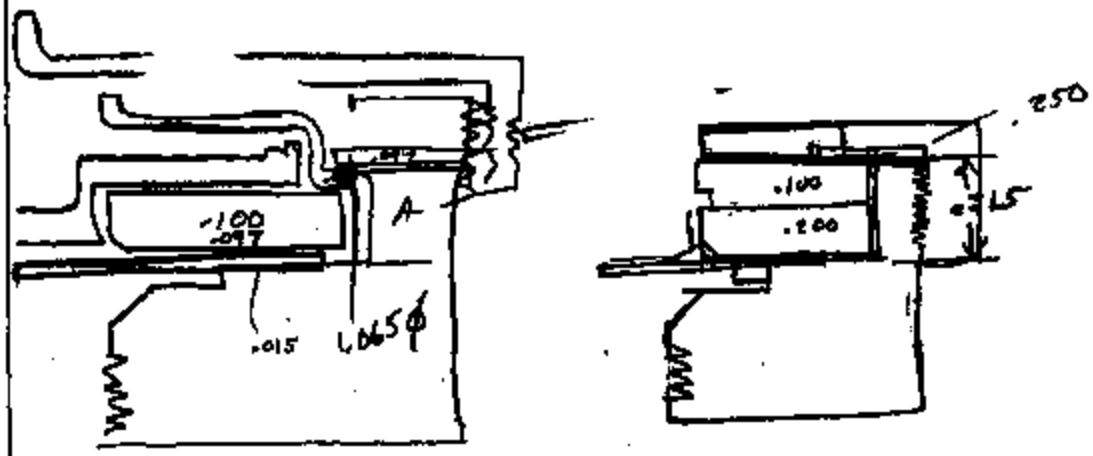
$\text{Single} = \frac{.140^2\pi}{4} = .015393\ in^2$

$\text{Hex} = 3.464r^2 - 3.464\left(\frac{.125}{2}\right)^2 = .013531\ in^2$

$C - H = .00186\ in^2$ VS $.00031\ in^2$

$\frac{L}{A} =$ $\frac{L}{A} = 190.9$

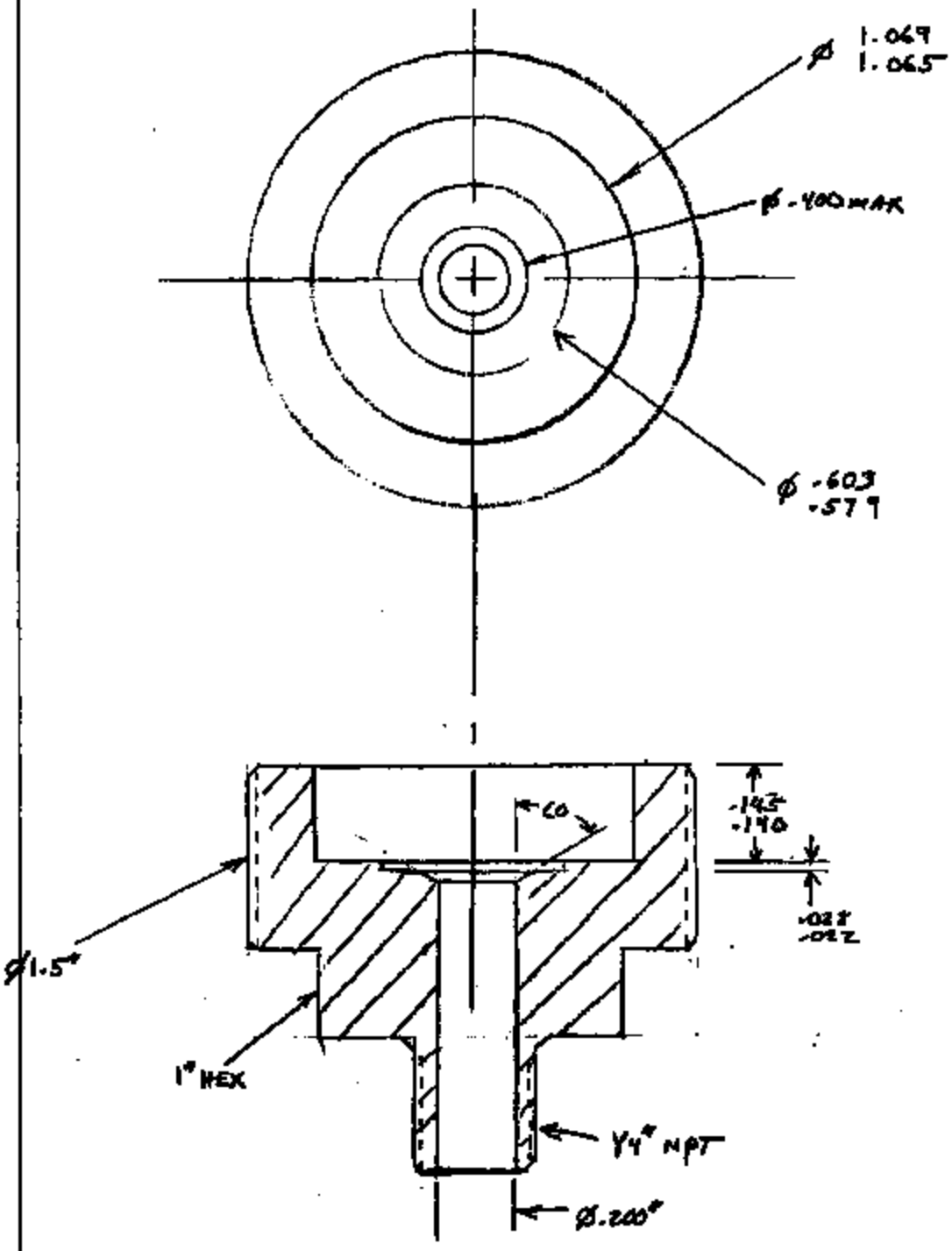
$L = .355$



$A = .015 + .097 + .030 = .142$

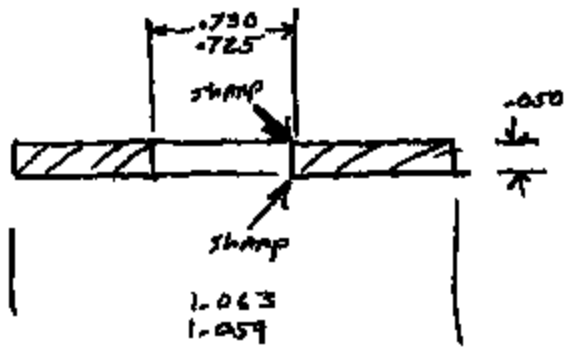
$A = \frac{.315}{.097}$

DISC FIXTURE - BASE | DATE 3/30/92



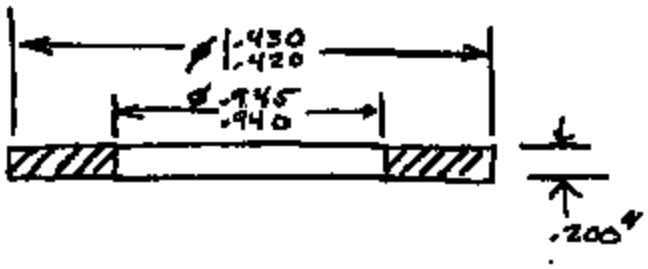
BRASS

DISC FIXTURE - CAP | DATE SAVED 3/26/92



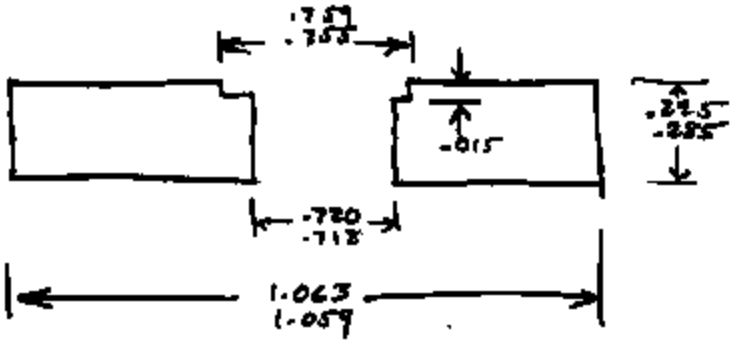
steel

DISC FIXTURE - SPACER | DATE SCALE 3/30/97



Steel

	PLEC FIXTURE - SEAT	DATE SCALE 3/30/92



STEEL

proposed spec

AET ~~300~~ 80 – 160

110 – 150

REL 0 – 120

DIFF 15 – ~~45~~

HIERARCHY OF BAD CALL OUT

DRAWINGS AVAILABLE UPON REQUEST

DALE SOGGE 4-30-92

PROPOSED SPEC FOR QUIET DISC 36656-35

VALUES ARE FOR DISC AFTER FINAL HEAT TREATMENT

MATERIAL PART # 35525-2
BLANK STRIP # 7437-2

ACTUATION MEAN : AS REQUIRED BY MFG ENGINEERING (NOMINAL TARGET : 22 psi)

ACT MEAN TOLERANCE: ±1.0psi

ACT SIGMA MAX: 1.0 psi

MAXIMUM MEAN DIFFERENTIAL: 5.5psi

DIFFERENTIAL SIGMA MAX : 1.0 psi

MOD A-B

MINIMUM MEAN TRAVEL TO 14psi ON ACTUATION : 0.0035 inches

MAX SIGMA, TRAVEL TO 14psi ON ACTUATION : TO BE DETERMINED

MINIMUM MEAN TRAVEL TO 32 psi ON ACTUATION : 0.0240 inches

MAXIMUM SIGMA, TRAVEL TO 32 psi ON ACTUATION : TO BE DETERMINED

PRESSURE CALIBRATION

1) METHOD

MEASUREMENT TO BE TAKEN IN A STANDARD FIXTURE PRINT # XXX, USING THE FOLLOWING MEASUREMENT PROCEDURE;

A. CYCLE DISC THREE TIMES ACTUATION TO RELEASE

B. FROM RELEASE INCREASE PRESSURE TO 14psi ± 0.5 psi AND RECORD DISC TRAVEL.

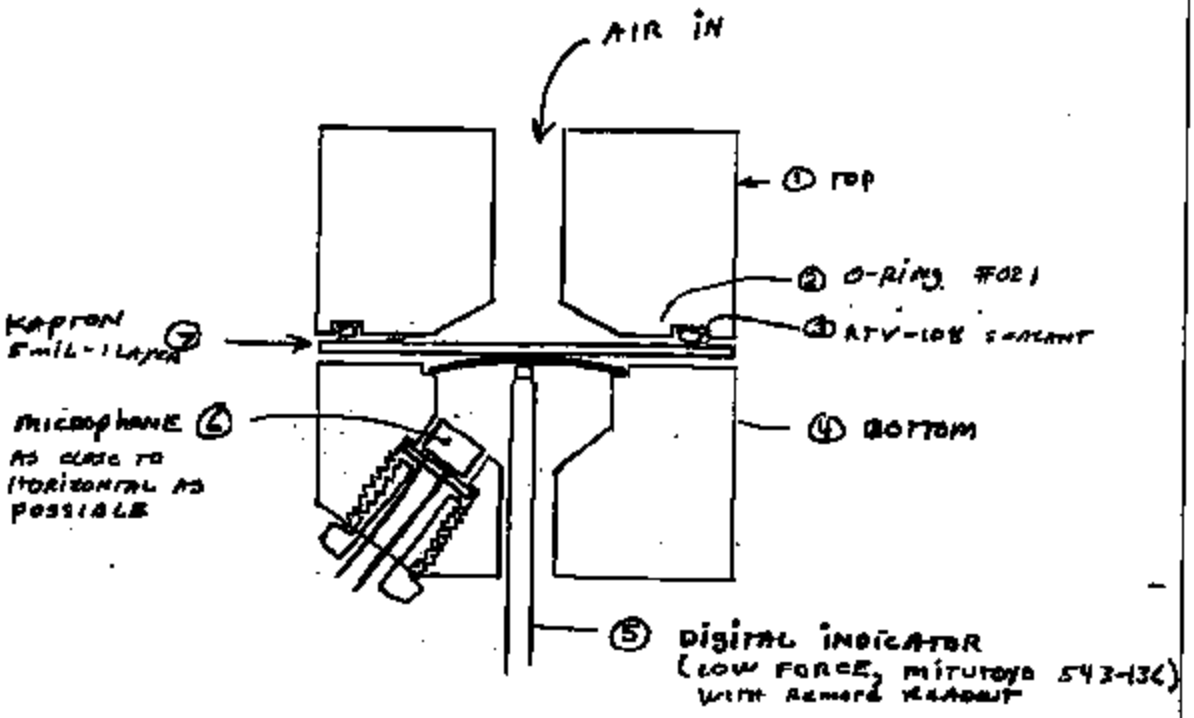
C. CONTINUE PRESSURE INCREASE UNTIL ACTUATION. RECORD ACTUATION PRESSURE.

D. INCREASE PRESSURE TO 32psi ± 0.5psi AND RECORD DISC TRAVEL.

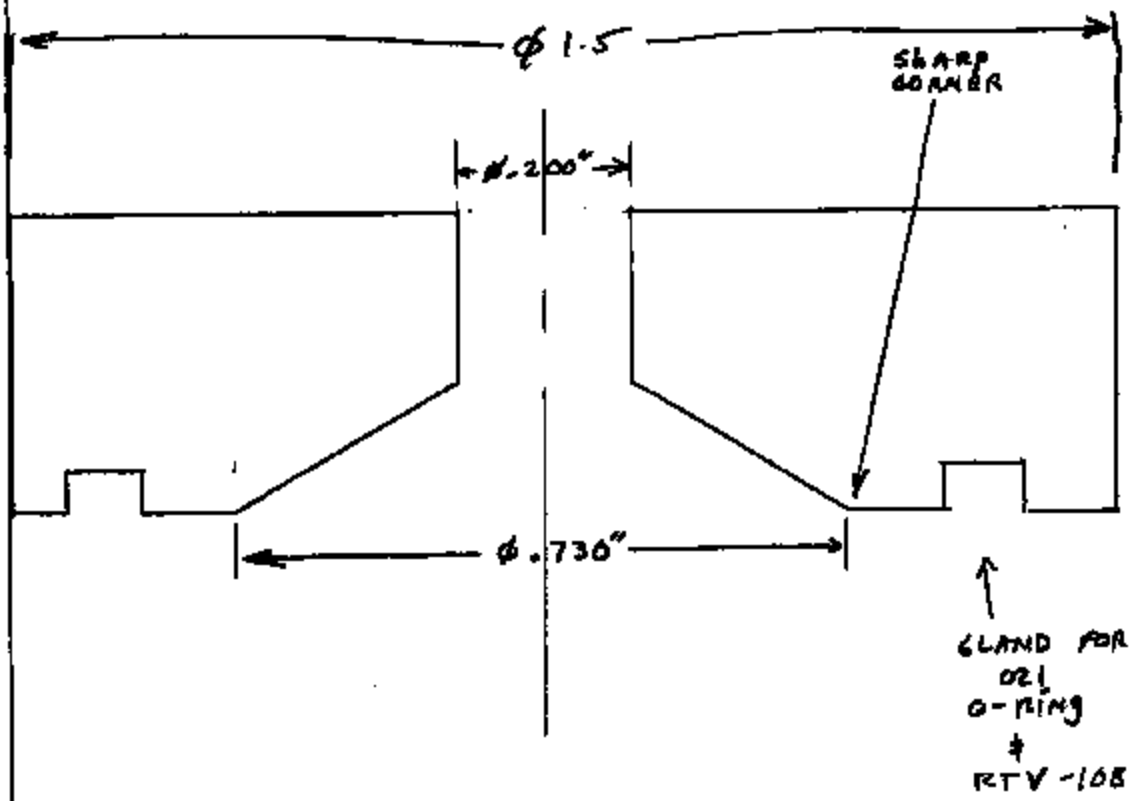
E. DECREASE PRESSURE TO RELEASE AND RECORD RELEASE PRESSURE

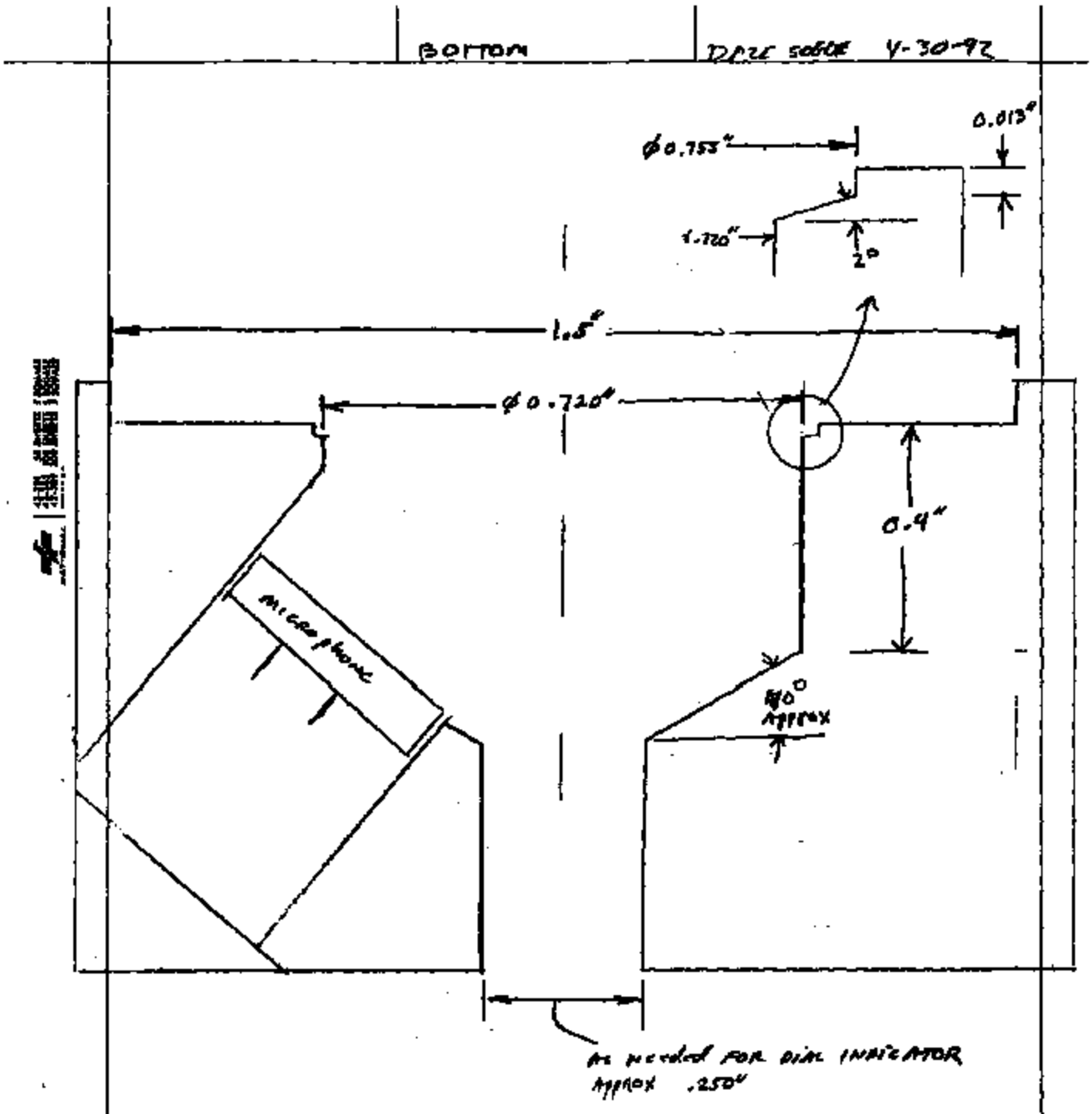
ALL RAMP RATES SHALL BE LESS THAN 0.5 psi/SEC.

DISC FIXTURE | DATE SCALE 4-30-92

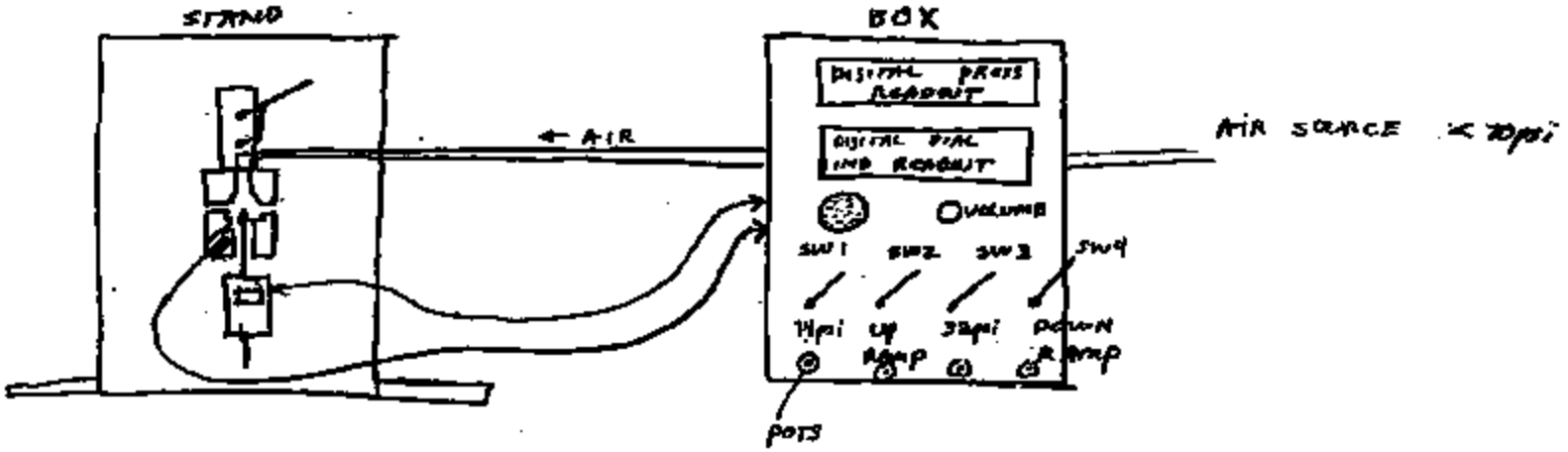


TOP DAVE SOUCIE 4-30-92





LOW DIFFERENTIAL DISC CHECK SYSTEM



STAND
- STEGO CLAMP FIXTURE
- MITUTOYO DIGITAL LOW FORCE INDICATOR (# 543-136 WITH OUTPUT)
- STANDARD MICROPHONE OR SMALLER

BOX
- 11 CASE DIGITAL PRESSURE READOUT
- MITUTOYA REMOTE DIGITAL READOUT (# 572-011)
- FEEDBACK PRESSURE REGULATOR FOR CONTROLLED RAMPS
- SWITCHES & RESISTORS TO CONTROL REGULATOR

POTS TO SET PRESSURE POINTS (MAKES STAND USABLE FOR ALL 3/4" DISC'S)

BUD BOX OR PORTABLE CABINET

OPERATOR MUST BE ABLE TO USE SWITCH 2 & 4 TO STOP PRESSURE AT ANY POINT WHEN SHE SEES OR HEARS SNAP.

SPEAKER & AMPLIFIER

POSSIBLE CIRCUIT TO STOP UP & DOWN RAMPS BASED ON SOUND SNAP

DALE SOGER 6-20-92

TI-NHTBA 009044

4-9-92

NORYL BASES
OFF ~~PROTO~~ TO PROD TOOL
BUILT WITH F DISCS BY CLAIR.
PINNED BY HAND, BUILT ON PRODUCTION LINE

SER 1; FIX 1; C= 0023012; BIN=CONT ; MRRU=43.5; MRRD=62.2; LEAK RATE= 3.4 11.1 - packard
ACT= 331.6; REL= 165.8; DIF= 165.8 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 2; FIX 2; C= 0023010; BIN=CONT ; MRRU=43.5; MRRD=62.2; LEAK RATE= 3.4 11.1
ACT= 274.3; REL= 165.8; DIF= 108.5 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 3; FIX 3; C= 0023010; BIN=CONT ; MRRU=43.5; MRRD=62.2; LEAK RATE= 3.4 10.8
ACT= 206.9; REL= 165.8; DIF= 41.0 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 4; FIX 4; C= 0003011; BIN=ACCR ; MRRU=43.5; MRRD=62.2; LEAK RATE= 3.4 10.9
ACT= 181.0; REL= 162.1; DIF= 19.0 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 5; FIX 1; C= 0001011; BIN=ACCR ; MRRU=43.7; MRRD=62.0; LEAK RATE= 3.8 10.8
ACT= 175.7; REL= 152.5; DIF= 23.1 PSI; ACTCR= 200.0ms; RELCR= 57.8

SER 6; FIX 2; C= 0023010; BIN=CONT ; MRRU=43.7; MRRD=62.0; LEAK RATE= 3.8 10.9
ACT= 256.0; REL= 166.8; DIF= 89.2 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 7; FIX 3; C= 0023010; BIN=CONT ; MRRU=43.7; MRRD=62.0; LEAK RATE= 3.8 10.9
ACT= 215.8; REL= 166.8; DIF= 48.9 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 8; FIX 4; C= 0023001; BIN=CONT ; MRRU=43.7; MRRD=62.0; LEAK RATE= 3.8 10.7
ACT= 162.0; REL= 139.4; DIF= 22.6 PSI; ACTCR= 200.0ms; RELCR= 200.0

8-APR-1992 16:08:11.89 OPER DOOR DID NOT CLOSE 1

SER 9; FIX 1; C= 0023010; BIN=CONT ; MRRU=43.3; MRRD=62.0; LEAK RATE= 3.9 11.2
ACT= 254.2; REL= 165.7; DIF= 88.6 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 10; FIX 2; C= 0023010; BIN=CONT ; MRRU=43.3; MRRD=62.0; LEAK RATE= 3.9 10.9
ACT= 235.0; REL= 165.7; DIF= 69.3 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 11; FIX 3; C= 0023010; BIN=CONT ; MRRU=43.3; MRRD=62.0; LEAK RATE= 3.9 10.6
ACT= 201.8; REL= 165.7; DIF= 36.1 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 12; FIX 4; C= 0023006; BIN=CONT ; MRRU=43.3; MRRD=62.0; LEAK RATE= 3.9
ACT= [illegible] DIF= [illegible] PSI; ACTCR= [illegible] RELCR= 200.0

8-APR-1992 16:08:35.28 OPER DOOR DID NOT OPEN 1

8-APR-1992 16:09:01.45 TABLE DID NOT COMPLETE INDEX 1

8-APR-1992 16:09:10.43 TABLE CAM SWITCH NOT IN POSITION 1

		HYPOT @ 250psi AC Kilovolts	
① 310 A	297 R	2.5	350psi FOR HYPOT
② 260 A	237 R	.6	300psi HYPOT
③ 198 A	172 R	.5	
④ 180 A	159 R	.7	
⑤ 172 A	163 R	.8	
⑥ 248 A	241 R	.35	
⑦ 204 A	196 R	.5	
⑧ 160 A	149 R	1.1	
⑨ 242	224 R	.2	
⑩ 222	211 R	.4	
⑪ 198A -	186 R	.5	

BUILT WITH F DISCS BY CLAIR
PINNED BY HAND TO 11mil PACKAGE. BUILT ON PRODUCTION LINE

Empirical Bracket Curve

Steve's 30 pieces for ISIR

10-APR-1992 07:57:56.97 CAP STA PRESS CAP NOT EQS 1

10-APR-1992 07:57:57.05 CAP STA PRESS CAP NOT HOME 1

SER 1; FIX 1; C= 0000000; BIN=GOOD ; MRRU=43.6; MRRD=47.3; LEAK RATE= 1.9
ACT= 139.7; REL= 108.1; DIF= 31.6 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 2; FIX 2; C= 0000000; BIN=GOOD ; MRRU=43.6; MRRD=47.3; LEAK RATE= 1.9
ACT= 127.2; REL= 95.3; DIF= 32.0 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 3; FIX 3; C= 0000000; BIN=GOOD ; MRRU=43.6; MRRD=47.3; LEAK RATE= 1.9
ACT= 130.8; REL= 97.6; DIF= 33.2 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 4; FIX 4; C= 0000000; BIN=GOOD ; MRRU=43.6; MRRD=47.3; LEAK RATE= 1.9
ACT= 132.6; REL= 102.8; DIF= 29.8 PSI; ACTCR= 200.0ms; RELCR= 200.0

96.1 sensor
.141

10-APR-1992 07:58:15.35 OPER DOOR DID NOT CLOSE 1

SER 5; FIX 1; C= 0000000; BIN=GOOD ; MRRU=43.9; MRRD=47.7; LEAK RATE= 1.9
ACT= 131.4; REL= 98.6; DIF= 32.8 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 6; FIX 2; C= 0000000; BIN=GOOD ; MRRU=43.9; MRRD=47.7; LEAK RATE= 1.9
ACT= 135.9; REL= 95.0; DIF= 40.9 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 7; FIX 3; C= 0000000; BIN=GOOD ; MRRU=43.9; MRRD=47.7; LEAK RATE= 1.9
ACT= 126.3; REL= 85.7; DIF= 40.6 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 8; FIX 4; C= 0000000; BIN=GOOD ; MRRU=43.9; MRRD=47.7; LEAK RATE= 1.9
ACT= 131.4; REL= 99.9; DIF= 31.5 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 9; FIX 1; C= 0000000; BIN=GOOD ; MRRU=44.1; MRRD=47.6; LEAK RATE= 1.7
ACT= 132.2; REL= 98.1; DIF= 34.1 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 10; FIX 2; C= 0000000; BIN=GOOD ; MRRU=44.1; MRRD=47.6; LEAK RATE= 1.7
ACT= 133.4; REL= 106.3; DIF= 27.1 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 12; FIX 4; C= 0000000; BIN=GOOD ; MRRU=44.1; MRRD=47.6; LEAK RATE= 1.7
ACT= 127.9; REL= 95.6; DIF= 32.2 PSI; ACTCR= 200.0ms; RELCR= 200.0

10-APR-1992 07:59:01.71 OPER DOOR DID NOT CLOSE 1

10-APR-1992 07:59:21.71 OPER DOOR STILL DID NOT CLOSE 1

SER 13; FIX 1; C= 0000000; BIN=GOOD ; MRRU=43.9; MRRD=47.6; LEAK RATE= 1.9
ACT= 135.1; REL= 108.6; DIF= 26.5 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 14; FIX 2; C= 0000000; BIN=GOOD ; MRRU=43.9; MRRD=47.6; LEAK RATE= 1.9
ACT= 129.5; REL= 99.3; DIF= 30.3 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 15; FIX 3; C= 0000000; BIN=GOOD ; MRRU=43.9; MRRD=47.6; LEAK RATE= 1.9
ACT= 132.2; REL= 105.7; DIF= 26.6 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 16; FIX 4; C= 0000000; BIN=GOOD ; MRRU=43.9; MRRD=47.6; LEAK RATE= 1.9
ACT= 128.2; REL= 91.9; DIF= 36.3 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 17; FIX 1; C= 0000000; BIN=GOOD ; MRRU=44.0; MRRD=48.0; LEAK RATE= 1.7
ACT= 133.1; REL= 95.9; DIF= 37.1 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 18; FIX 2; C= 0000000; BIN=GOOD ; MRRU=44.0; MRRD=48.0; LEAK RATE= 1.7
ACT= 131.7; REL= 98.6; DIF= 33.1 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 19; FIX 3; C= 0000000; BIN=GOOD ; MRRU=44.0; MRRD=48.0; LEAK RATE= 1.7
ACT= 129.0; REL= 94.9; DIF= 34.2 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 20; FIX 4; C= 0000000; BIN=GOOD ; MRRU=44.0; MRRD=48.0; LEAK RATE= 1.7
ACT= 135.2; REL= 106.5; DIF= 28.7 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 21; FIX 1; C= 0000000; BIN=GOOD ; MRRU=43.9; MRRD=47.3; LEAK RATE= 1.6
ACT= 130.4; REL= 102.0; DIF= 28.4 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 22; FIX 2; C= 0000000; BIN=GOOD ; MRRU=43.9; MRRD=47.3; LEAK RATE= 1.6
ACT= 132.5; REL= 89.7; DIF= 42.8 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 23; FIX 3; C= 0000000; BIN=GOOD ; MRRU=43.9; MRRD=47.3; LEAK RATE= 1.6
ACT= 128.4; REL= 95.7; DIF= 32.7 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 24; FIX 4; C= 0000000; BIN=GOOD ; MRRU=43.9; MRRD=47.3; LEAK RATE= 1.6
ACT= 126.8; REL= 100.5; DIF= 26.3 PSI; ACTCR= 200.0ms; RELCR= 200.0

10-APR-1992 08:00:42.29 OPER DOOR DID NOT CLOSE 1

SER 25; FIX 1; C= 0000000; BIN=GOOD ; MRRU=44.1; MRRD=47.7; LEAK RATE= 1.9
ACT= 130.2; REL= 91.1; DIF= 39.1 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 26; FIX 2; C= 0000000; BIN=GOOD ; MRRU=44.1; MRRD=47.7; LEAK RATE= 1.9
ACT= 127.5; REL= 89.7; DIF= 37.7 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 27; FIX 3; C= 0000000; BIN=GOOD ; MRRU=44.1; MRRD=47.7; LEAK RATE= 1.9
ACT= 130.2; REL= 93.3; DIF= 36.9 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER 28; FIX 4; C= 0000000; BIN=GOOD ; MRRU=44.1; MRRD=47.7; LEAK RATE= 1.9
ACT= 130.9; REL= 98.3; DIF= 32.6 PSI; ACTCR= 200.0ms; RELCR= 200.0

```
SER  29; FIX 1; C= 0000000; BIN=GOOD ; MRRU=44.0; MRRD=47.2; LEAK RATE= 2.0
ACT= 130.4; REL= 105.4; DIF= 25.0 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER  30; FIX 2; C= 0000000; BIN=GOOD ; MRRU=44.0; MRRD=47.2; LEAK RATE= 2.0
ACT= 137.0; REL= 107.9; DIF= 29.1 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER  31; FIX 3; C= 0000000; BIN=GOOD ; MRRU=44.0; MRRD=47.2; LEAK RATE= 2.0
ACT= 127.0; REL=  96.2; DIF= 30.8 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER  32; FIX 4; C= 0000000; BIN=GOOD ; MRRU=44.0; MRRD=47.2; LEAK RATE= 2.0
ACT= 129.6; REL=  96.2; DIF= 33.4 PSI; ACTCR= 200.0ms; RELCR= 200.0


SER  33; FIX 1; C= 0000000; BIN=GOOD ; MRRU=44.6; MRRD=47.4; LEAK RATE= 1.9
ACT= 130.5; REL=  95.9; DIF= 34.6 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER  34; FIX 2; C= 0000000; BIN=GOOD ; MRRU=44.6; MRRD=47.4; LEAK RATE= 1.9
ACT= 128.7; REL=  93.6; DIF= 35.1 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER  35; FIX 3; C= 0000000; BIN=GOOD ; MRRU=44.6; MRRD=47.4; LEAK RATE= 1.9
ACT= 133.7; REL= 107.4; DIF= 26.3 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER  36; FIX 4; C= 0000000; BIN=GOOD ; MRRU=44.6; MRRD=47.4; LEAK RATE= 1.9
ACT= 127.0; REL=  94.5; DIF= 32.5 PSI; ACTCR= 200.0ms; RELCR= 200.0


SER  37; FIX 1; C= 0000000; BIN=GOOD ; MRRU=43.9; MRRD=47.5; LEAK RATE= 2.0
ACT= 131.9; REL= 105.5; DIF= 26.4 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER  38; FIX 2; C= 0000000; BIN=GOOD ; MRRU=43.9; MRRD=47.5; LEAK RATE= 2.0
ACT= 125.9; REL=  97.7; DIF= 28.2 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER  39; FIX 3; C= 0000000; BIN=GOOD ; MRRU=43.9; MRRD=47.5; LEAK RATE= 2.0
ACT= 124.5; REL=  90.4; DIF= 34.1 PSI; ACTCR= 200.0ms; RELCR= 200.0

SER  40; FIX 4; C= 0000000; BIN=GOOD ; MRRU=43.9; MRRD=47.5; LEAK RATE= 2.0
ACT= 131.9; REL= 100.5; DIF= 31.6 PSI; ACTCR= 200.0ms; RELCR= 200.0


10-APR-1992 08:02:22.70  OPER DOOR DID NOT CLOSE        1


10-APR-1992 08:02:42.75  OPER DOOR STILL DID NOT CLOSE        1


10-APR-1992 08:03:01.79  TOOL CYCLE TIMEOUT        1
```

77PS PRESSURE TESTER LOT REPORT

RATING:77PSL2-1
LOT ID:TEST
LOT STARTED:10-APR-1992 07:57:54.90
LOT FINISHED:10-APR-1992 08:03:49.29

SETUP DATA:
DISC LOT ID: 0.00
DISC MEAN ACT: 26.1 MEAN REL: 14.1
LIMIT (NC)
ACTUATION: 90.0 TO 160.0 PSI
RELEASE: 20.0 TO 120.0 PSI
DIFFERENTIAL: 0.0 TO 160.0 PSI
MAX MILLIVOLT: 200.0 PSI
ACT CREEP TIME: 25.0 PSI
REL CREEP TIME: 150.0 PSI
PRECYCLE PRESS: 800.0 PSI
PRECYCLE COUNT: 2

NUMBER OF PIECES TESTED: 40
NUMBER OF PIECES GOOD: 40
YIELD: 100.00 %

REJECT COUNTS

BIN	COUNT	% OF REJECTS
LEAK	0	0.00 %
CONT	0	0.00 %
ACCR	0	0.00 %
ACLO	0	0.00 %
ACHI	0	0.00 %
RLHI	0	0.00 %
RLLO	0	0.00 %
DFLO	0	0.00 %
RLCR	0	0.00 %
DFHI	0	0.00 %

STATISTICS	MEAN	SIGMA	CPK
ACTUATION:	130.9	3.39	2.86
RELEASE:	98.4	5.76	1.25
MILLIVOLT:	0.0	0.00	9.00
DIFFERENTIAL:	32.6	4.46	2.44

```
                5   10   15   20   25   30   35   40   45   50
               ----+----+----+----+----+----+----+----+----+----+
UNDER    0|
125.0    2|**
127.5   10|**********
130.0    9|*********
132.5   12|************
135.0    4|****
137.5    2|**
140.0    1|*
 OVER    0|
```

HISTOGRAM OF RELEASE PRESSURE

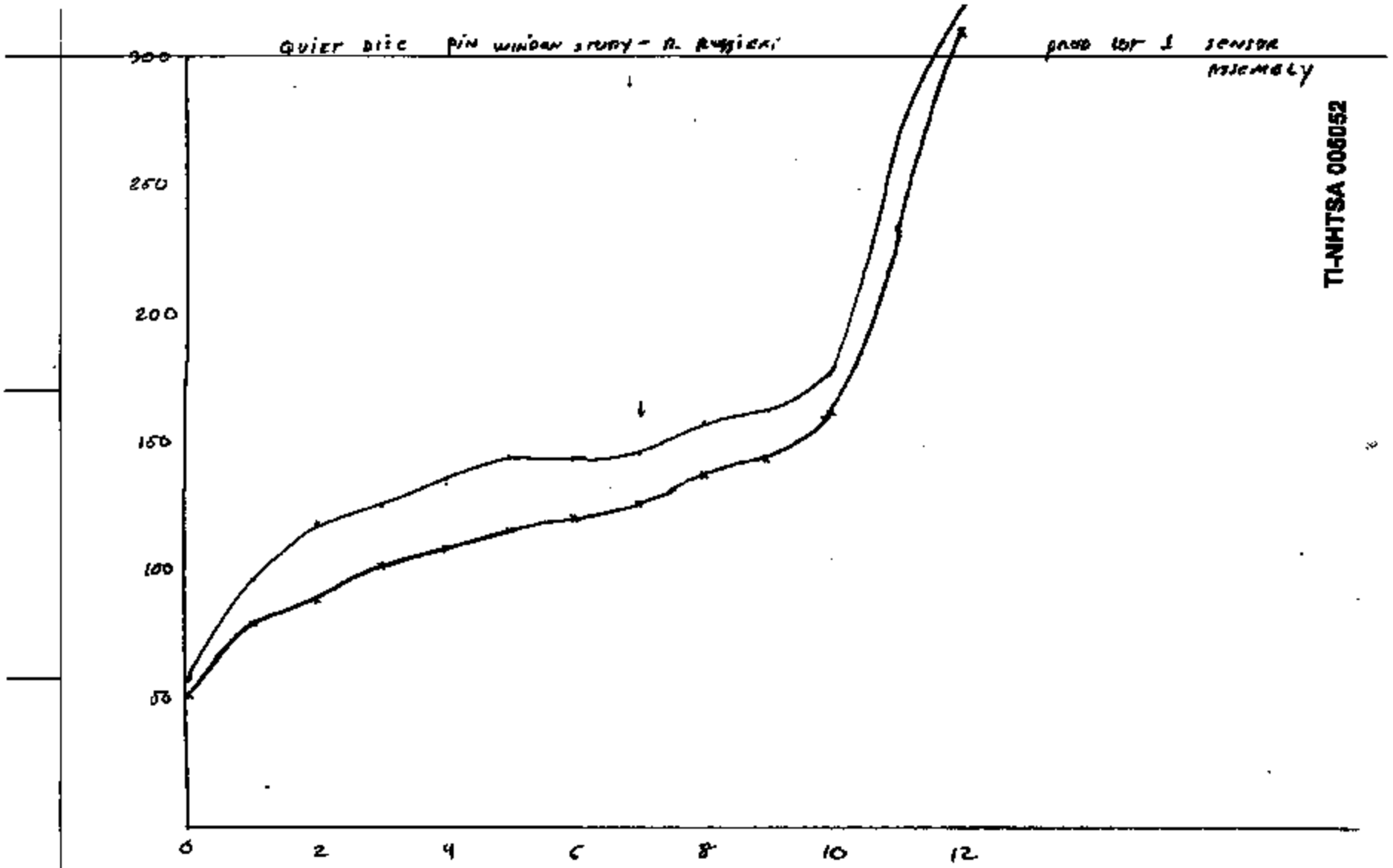
```
                5   10   15   20   25   30   35   40   45   50
               ----+----+----+----+----+----+----+----+----+----+
UNDER    0|
 85.0    1|*
 90.0    5|*****
 95.0   12|************
100.0   12|************
105.0    7|*******
110.0    3|***
 OVER    0|
```

HISTOGRAM OF DIFFERENTIAL PRESSURE

```
                5   10   15   20   25   30   35   40   45   50
               ----+----+----+----+----+----+----+----+----+----+
UNDER    0|
 25.0    7|*******
 30.0   13|*************
 35.0   14|**************
 40.0    5|*****
 45.0    1|*
 OVER    0|
```

HISTOGRAM OF ACTUATION CREEP

```
                5   10   15   20   25   30   35   40   45   50
               ----+----+----+----+----+----+----+----+----+----+
UNDER    0|
 35.0    0|
 OVER   40|****************************************
```



PRESSURE SWITCH DATA Form 2160S **TEST NO.** _____

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
	04-10-92	D SOGGE	

PERFORMED BY	DATE STARTED	DATE COMPLETED	APPROVED BY
R. RUGGIERI	04-10-92		

PROJECT TITLE: QUIET DISC pin window study

CUSTOMER:

PURPOSE OF TEST:

PROCEDURE:

BASE -089

PIN	CONTACT PRE LOAD	ACT	REL
141	0	58	52
142	1	96	79
143	2	118	89
144	3	126	103
145	4	137	107
146	5	144	114
147	6	144	120
148	7	147	126
149	8	158	137
150	9	161	143
151	10	178	162
152	11	265	232
153	12	323	307

(OVER)

FIRST 375 production NOMEX BASE FOR
QUIET switches with prop NOMEX BASE mylar
AT 7 mil

.0756
.0237

.0870

.0553
.0574
.0514

.0751 87.80 ± 1

.0474

.0672
.0677
.0632
.0672
.0791
.0771

.0756
.0435
.0474
.0435
.0513
.0474

253

7mil trigger built by CLAIR, BLACK MORY & BASES on production line with LOT 9 DISCS

			Hypot
1-16	SER 1; FIX 1; C= 0003000; BIN=ACCR ; MPRU=44.2; MPRD=47.2; LEAK RATE= 2.1 ACT= 132.6; REL= 113.1; DIF= 19.4 PSI; ACTCR= 200.0ms; RELCR= 200.0	7.0	1.10k
17	SER 2; FIX 2; C= 0003010; BIN=ACCR ; MPRU=44.2; MPRD=47.2; LEAK RATE= 2.1 ACT= 145.1; REL= 124.4; DIF= 20.7 PSI; ACTCR= 200.0ms; RELCR= 200.0	7.5	.90
18	SER 3; FIX 3; C= 0003000; BIN=ACCR ; MPRU=44.2; MPRD=47.2; LEAK RATE= 2.1 ACT= 122.1; REL= 100.7; DIF= 21.4 PSI; ACTCR= 200.0ms; RELCR= 200.0	7.0	1.55
21	SER 4; FIX 4; C= 0003000; BIN=ACCR ; MPRU=44.2; MPRD=47.2; LEAK RATE= 2.1 ACT= 128.1; REL= 106.0; DIF= 22.1 PSI; ACTCR= 200.0ms; RELCR= 200.0	6.9	1.15

9-APR-1992 14:20:36.74 OPER DOOR DID NOT CLOSE 1

22	SER 5; FIX 1; C= 0003000; BIN=ACCR ; MPRU=44.5; MPRD=47.5; LEAK RATE= 2.0 ACT= 132.5; REL= 114.9; DIF= 17.3 PSI; ACTCR= 200.0ms; RELCR= 200.0	7.2	1.15
23	SER 6; FIX 2; C= 0003000; BIN=ACCR ; MPRU=44.5; MPRD=47.5; LEAK RATE= 2.0 ACT= 136.4; REL= 118.1; DIF= 20.3 PSI; ACTCR= 200.0ms; RELCR= 200.0	7.2	.90
24	SER 7; FIX 3; C= 0003000; BIN=ACCR ; MPRU=44.5; MPRD=47.5; LEAK RATE= 2.0 ACT= 137.5; REL= 118.1; DIF= 19.4 PSI; ACTCR= 200.0ms; RELCR= 200.0	7.3	.95
25	SER 8; FIX 4; C= 0003000; BIN=ACCR ; MPRU=44.5; MPRD=47.5; LEAK RATE= 2.0 ACT= 137.9; REL= 118.1; DIF= 19.8 PSI; ACTCR= 200.0ms; RELCR= 200.0	6.9	1.05
26	SER 9; FIX 1; C= 0003000; BIN=ACCR ; MPRU=44.5; MPRD=47.4; LEAK RATE= 2.0 ACT= 132.5; REL= 113.2; DIF= 19.3 PSI; ACTCR= 200.0ms; RELCR= 200.0	7.3	1.3kv
27	SER 10; FIX 2; C= 0003000; BIN=ACCR ; MPRU=44.5; MPRD=47.4; LEAK RATE= 2.0 ACT= 125.6; REL= 106.0; DIF= 19.6 PSI; ACTCR= 200.0ms; RELCR= 200.0	7.3	1.0kv
28	SER 11; FIX 3; C= 0023012; BIN=CONT ; MPRU=44.5; MPRD=47.4; LEAK RATE= 2.0 ACT= 160.1; REL= 141.7; DIF= 18.4 PSI; ACTCR= 200.0ms; RELCR= 200.0	9.7	.90kv
29	SER 12; FIX 4; C= 0003010; BIN=ACCR ; MPRU=44.5; MPRD=47.4; LEAK RATE= 2.0 ACT= 139.4; REL= 121.2; DIF= 18.1 PSI; ACTCR= 200.0ms; RELCR= 200.0	9.9	1.2 kv
30	SER 13; FIX 1; C= 0023012; BIN=CONT ; MPRU=44.7; MPRD=47.4; LEAK RATE= 1.8 ACT= (178.3) REL= 141.3; DIF= 37.1 PSI; ACTCR= 200.0ms; RELCR= 200.0	9.9	.4 kv
31	SER 14; FIX 2; C= 0003010; BIN=ACCR ; MPRU=44.7; MPRD=47.4; LEAK RATE= 1.8 ACT= 143.7; REL= 127.6; DIF= 16.1 PSI; ACTCR= 200.0ms; RELCR= 200.0	9.8	.97 kV
32	SER 15; FIX 3; C= 0003010; BIN=ACCR ; MPRU=44.7; MPRD=47.4; LEAK RATE= 1.8 ACT= 148.0; REL= 131.0; DIF= 17.0 PSI; ACTCR= 200.0ms; RELCR= 200.0	9.6	.95kV
	SER [redacted] ACT= [redacted]		

9-APR-1992 14:21:48.80 OPER DOOR DID NOT CLOSE 1

77PS PRESSURE TESTER LOT REPORT

RATING:77PSL2-1
LOT ID:N
LOT STARTED: 9-APR-1992 14:20:10.44
LOT FINISHED: 9-APR-1992 14:22:40.90

SETUP DATA:
DISC LOT ID: 0.00
DISC MEAN ACT: 27.1 MEAN REL: 13.3
LIMIT (NC)
ACTUATION: 90.0 TO 160.0 PSI
RELEASE: 20.0 TO 120.0 PSI
DIFFERENTIAL: 0.0 TO 160.0 PSI
MAX MILLIVOLT: 200.0 PSI
ACT CREEP TIME: 25.0 PSI
REL CREEP TIME: 150.0 PSI
PRECYCLE PRESS: 800.0 PSI
PRECYCLE COUNT: 2

NUMBER OF PIECES TESTED: 16
NUMBER OF PIECES GOOD: 0
YIELD: 0.00 %

REJECT COUNTS

BIN	COUNT	% OF REJECTS
LEAK	0	0.00 %
CONT	3	18.75 %
ACCR	13	81.25 %
ACLO	0	0.00 %
ACHI	0	0.00 %
RLHI	0	0.00 %
RLLO	0	0.00 %
DFLO	0	0.00 %
RLCR	0	0.00 %
DFHI	0	0.00 %

STATISTICS	MEAN	SIGMA	CPK
ACTUATION:	135.6	7.68	1.06
RELEASE:	116.4	8.76	0.14
MILLIVOLT:	0.0	0.00	0.00
DIFFERENTIAL:	19.3	1.75	3.68

HISTOGRAM OF ACTUATION PRESSURE

```
                5   10   15   20   25   30   35   40   45   50
               ----+----+----+----+----+----+----+----+----+----+
UNDER    0|
122.5    1|*
125.0    1|*
127.5    1|*
130.0    0|
132.5    3|***
135.0    0|
137.5    3|***
140.0    1|*
142.5    1|*
```

```
147.5    1|  |*
 OVER    0|  |
```

HISTOGRAM OF RELEASE PRESSURE

```
                5   10   15   20   25   30   35   40   45   50
               ----+----+----+----+----+----+----+----+----+----+
UNDER    0|  |
100.0    1|  |*
105.0    2|  |**
110.0    0|  |
115.0    3|  |***
120.0    4|  |****
125.0    1|  |*
130.0    2|  |**
 OVER    0|  |
```

HISTOGRAM OF DIFFERENTIAL PRESSURE

```
                5   10   15   20   25   30   35   40   45   50
               ----+----+----+----+----+----+----+----+----+----+
UNDER    0|  |
 15.0    3|  |***
 20.0   10|  |**********
 OVER    0|  |
```

HISTOGRAM OF ACTUATION CREEP

```
                5   10   15   20   25   30   35   40   45   50
               ----+----+----+----+----+----+----+----+----+----+
UNDER    0|  |
 35.0    0|  |
 OVER   13|  |*************
```

HISTOGRAM OF RELEASE CREEP

```
                5   10   15   20   25   30   35   40   45   50
               ----+----+----+----+----+----+----+----+----+----+
UNDER    0|  |
165.0    0|  |
 OVER   13|  |*************
```

'F' LOT DISC
PRODUCTION BUILD

		LAB PERF RELEASE		HI-POT		
1	SER 1; FIX 1; CH 000000; BINs=ACCR ; MFRU=44.5; MFRD=61.1; LEAK RATE= 2.3 ACT= 134.4; REL= 112.3; DIFF= 22.1 PSI; ACTCR= 0.0 ms; RELCR= 0.0	89		1.35kV	138 p	
2	SER 2; FIX 2; CH 000000; BINs=ACCR ; MFRU=44.5; MFRD=61.1; LEAK RATE= 2.3 ACT= 135.3; REL= 120.0; DIFF= 15.3 PSI; ACTCR= 200.0ms; RELCR= 138.0	86		——	> 1.0kV	
3	SER 3; FIX 3; CH 000000; BINs=ACCR ; MFRU=44.5; MFRD=61.1; LEAK RATE= 2.3 ACT= 137.1; REL= 120.9; DIFF= 16.2 PSI; ACTCR= 200.0ms; RELCR= 200.0	88.5	ACT 139 psi REL 130 psi		1.0kV	
4	SER 4; FIX 4; CH 000000; BINs=ACCR ; MFRU=44.5; MFRD=61.1; LEAK RATE= 2.3 ACT= 131.1; REL= 111.3; DIFF= 19.7 PSI; ACTCR= 200.0ms; RELCR= 200.0	88	136 psi 115 psi		1.1 kV	

6-MAR-1992 13:45:02.19 DOOR DOOR DID NOT CLOSE 1

6-MAR-1992 13:46:02.22 DOOR DOOR STILL DID NOT CLOSE 1

5	SER 5; FIX 5; CH 000000; BINs=ACCR ; MFRU=44.5; MFRD=61.1; LEAK RATE= 2.4 ACT= 121.1; REL= 97.4; DIFF= 24.1 PSI; ACTCR= 200.0ms; RELCR= 200.0	84.5	121 115		1.75kV	
6	SER 6; FIX 6; CH 000000; BINs=ACCR ; MFRU=44.5; MFRD=61.1; LEAK RATE= 2.4 ACT= 133.1; REL= 111.1; DIFF= 22.1 PSI; ACTCR= 200.0ms; RELCR= 87.0	88.9	140 126		1.1 kV	
7	SER 7; FIX 3; CH 000000; BINs=ACCR ; MFRU=44.5; MFRD=61.1; LEAK RATE= 2.4 ACT= 147.1; REL= 131.1; DIFF= 17.0 PSI; ACTCR= 200.0ms; RELCR= 200.0	88	146 128		.8kV	
8	SER 8; FIX 4; CH 000000; BINs=ACCR ; MFRU=44.5; MFRD=61.1; LEAK RATE= 2.4 ACT= 148.1; REL= 146.3; DIFF= 17.3 PSI; ACTCR= 200.0ms; RELCR= 200.0	89.5	165 128		.65kV	
9	SER 9; FIX 1; CH 000000; BINs=ACCR ; MFRU=44.5; MFRD=61.1; LEAK RATE= 2.0 ACT= 137.1; REL= 122.1; DIFF= 15.0 PSI; ACTCR= 200.0ms; RELCR= 200.0	89.7	137 126		.9 kV	
10	SER 10; FIX 2; CH 000000; BINs=ACCR ; MFRU=44.5; MFRD=61.1; LEAK RATE= 2.0 ACT= 132.5; REL= 111.2; DIFF= 21.3 PSI; ACTCR= 200.0ms; RELCR= 200.0	89.3	124 119		1.5kV	
11	SER 11; FIX 3; CH 000000; BINs=ACCR ; MFRU=44.5; MFRD=61.1; LEAK RATE= 2.0 ACT= 134.1; REL= 114.7; DIFF= 19.4 PSI; ACTCR= 200.0ms; RELCR= 200.0	89	127 113		0.2kV	
12	SER 12; FIX 4; CH 000000; BINs=ACCR ; MFRU=44.5; MFRD=61.1; LEAK RATE= 2.0 ACT= 131.1; REL= 105.4; DIFF= 25.8 PSI; ACTCR= 200.0ms; RELCR= 200.0	89	128 123		1.1	

6-MAR-1992 16:40:11.06 OPEN DOOR DID NOT CLOSE 1

13	SER 13; FIX 1; CH 000000; BINs=ACCR ; MFRU=44.5; MFRD=61.1; LEAK RATE= 2.4 ACT= 135.1; REL= 118.1; DIFF= 17.0 PSI; ACTCR= 200.0ms; RELCR= 200.0	87.5	161 114		.75	
14	SER 14; FIX 2; CH 000000; BINs=ACCR ; MFRU=44.5; MFRD=61.1; LEAK RATE= 2.4 ACT= 134.1; REL= 114.1; DIFF= 19.9 PSI; ACTCR= 200.0ms; RELCR= 200.0	88	150 130		.75	cancelled on
15	SER 15; FIX 3; CH 000000; BINs=ACCR ; MFRU=44.5; MFRD=61.1; LEAK RATE= 2.4 ACT= 141.1; REL= 121.1; DIFF= 20.0 PSI; ACTCR= 200.0ms; RELCR= 200.0	87.5	145 127		0.1	
16	SER 16; FIX 4; CH 000000; BINs=ACCR ; MFRU=44.5; MFRD=61.1; LEAK RATE= 2.4 ACT= 128.1; REL= 111.1; DIFF= 17.0 PSI; ACTCR= 200.0ms; RELCR= 200.0	89	141 124		.95	

8-APR-1992 13:46:38.15 DPER DOOR DID NOT CLOSE 1

17 SER 17; PIX 1; CH 0065000; BIN=ACCR ; MFRU=44.1; MFRD=61.4; LEAK RATE= 2.5 89 149 .7
MCT= 146.1; RELH= 129.3; DIFF= 16.7 PSI; HCTCH= 200.0mm; RELCH= 200.0 134

18 SER 18; PIX 2; CH 0065000; BIN=ACCR ; MFRU=44.1; MFRD=61.4; LEAK RATE= 2.5 88 153 -8
MCT= 135.4; RELH= 118.0; DIFF= 17.4 PSI; HCTCH= 200.0mm; RELCH= 200.0 135

19 SER 19; PIX 3; CH 0065000; BIN=ACCR ; MFRU=44.1; MFRD=61.4; LEAK RATE= 2.5 88.5 137 .85
MCT= 130.4mm; RELH= 112.7; DIFF= 17.7 PSI; HCTCH= 200.0mm; RELCH= 200.0 131

20 SER 20; PIX 4; CH 0065000; BIN=ACCR ; MFRU=44.1; MFRD=61.4; LEAK RATE= 2.5 87.3 199 .65
MCT= 151.4mm; RELH= 137.5; DIFF= 13.8 PSI; HCTCH= 200.0mm; RELCH= 200.0 137

8-APR-1992 13:47:06.79 OPER DOOR DID NOT CLOSE 1

8-APR-1992 13:47:20.80 OPER DOOR STILL DID NOT CLOSE 1

TPMS PRESSURE TESTER LOT REPORT

[illegible]
LOT IDENTIFICATION:
LOT STARTED: 6-MAR-1992 13:44:34.84
LOT FINISHED: 6-MAR-1992 13:48:30.41

SETUP DATA:
DISC LOT ID: 0.00
DISC MEM ALT: 27.5 MEM FAIL: 1.4
LIMIT (PSI)
ALTERNATION: 30.0 TO 200.0 PSI
RELEASE: 30.0 TO 200.0 PSI
DIFFERENTIAL: 0.0 TO 150.0 PSI
MAX MILLIVOLTS: 2500.0 PSI
ACT CREEP TIME: 15.0 PSI
REL CREEP TIME: 15.0 PSI
PRECYCLE PRESS: 600.0 PSI
PRECYCLE COUNT: 2

NUMBER OF PIECES TESTED: 21
NUMBER OF PIECES GOOD: [illegible]
YIELD: [illegible]

REJECT COUNTS
BIN COUNT % OF REJECTS
LEAK 0 0.00 %
CONT 0 0.00 %
REJ 20 100.00 %
MILL 0 0.00 %
MECH 0 0.00 %
PART 0 0.00 %
RELO 0 0.00 %
BLOW 0 0.00 %
ALIG 0 0.00 %
OPEN 0 0.00 %

[illegible]

[illegible] OF MILLIVOLT MEASURE

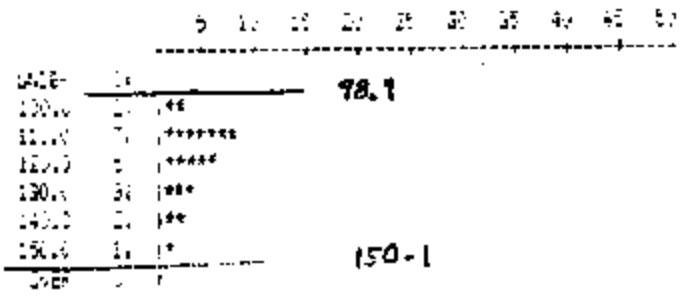
[illegible]

124.7

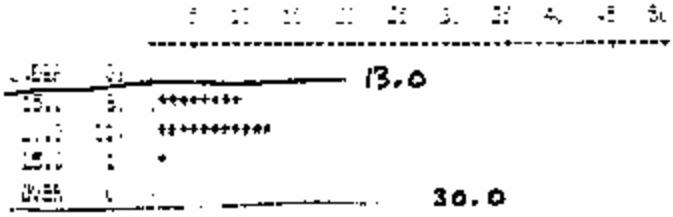
TC

TI-NHTSA 005061

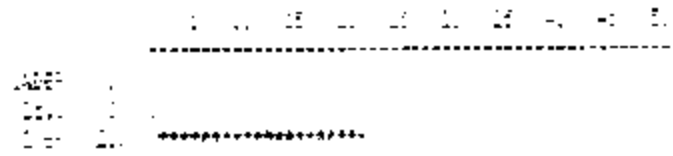
HISTOGRAM OF RELEASE PRESSURE



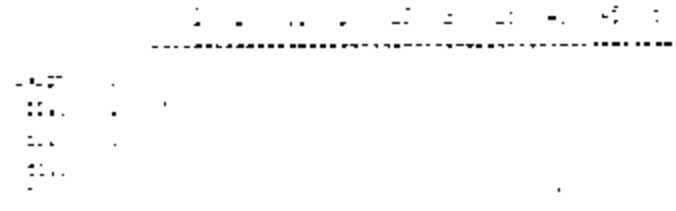
HISTOGRAM OF DIFFERENTIAL PRESSURE



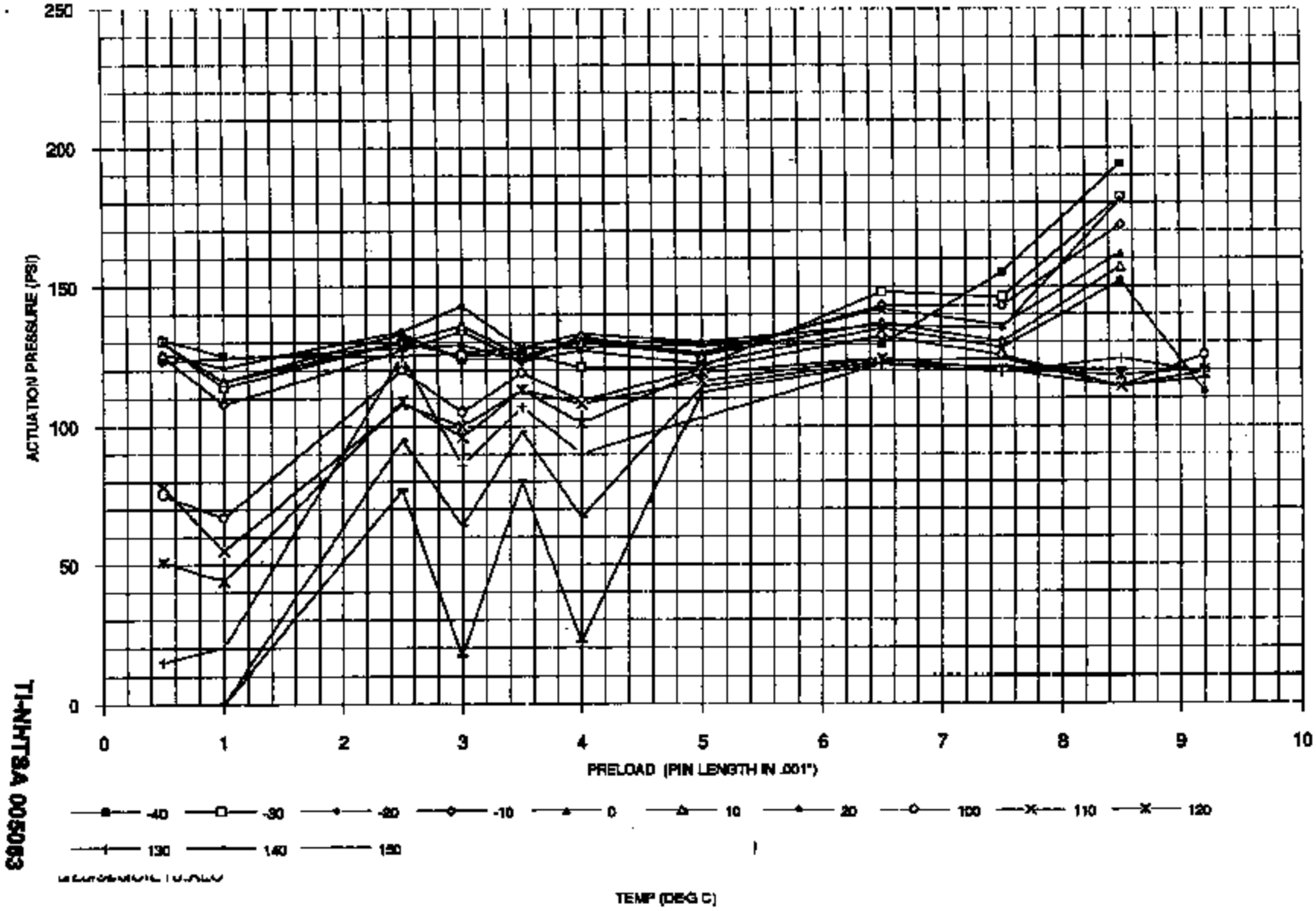
HISTOGRAM OF ACTUATION TIME



HISTOGRAM OF RELEASE TIME



Pressure shift vs pin length at various temps: MOHYL



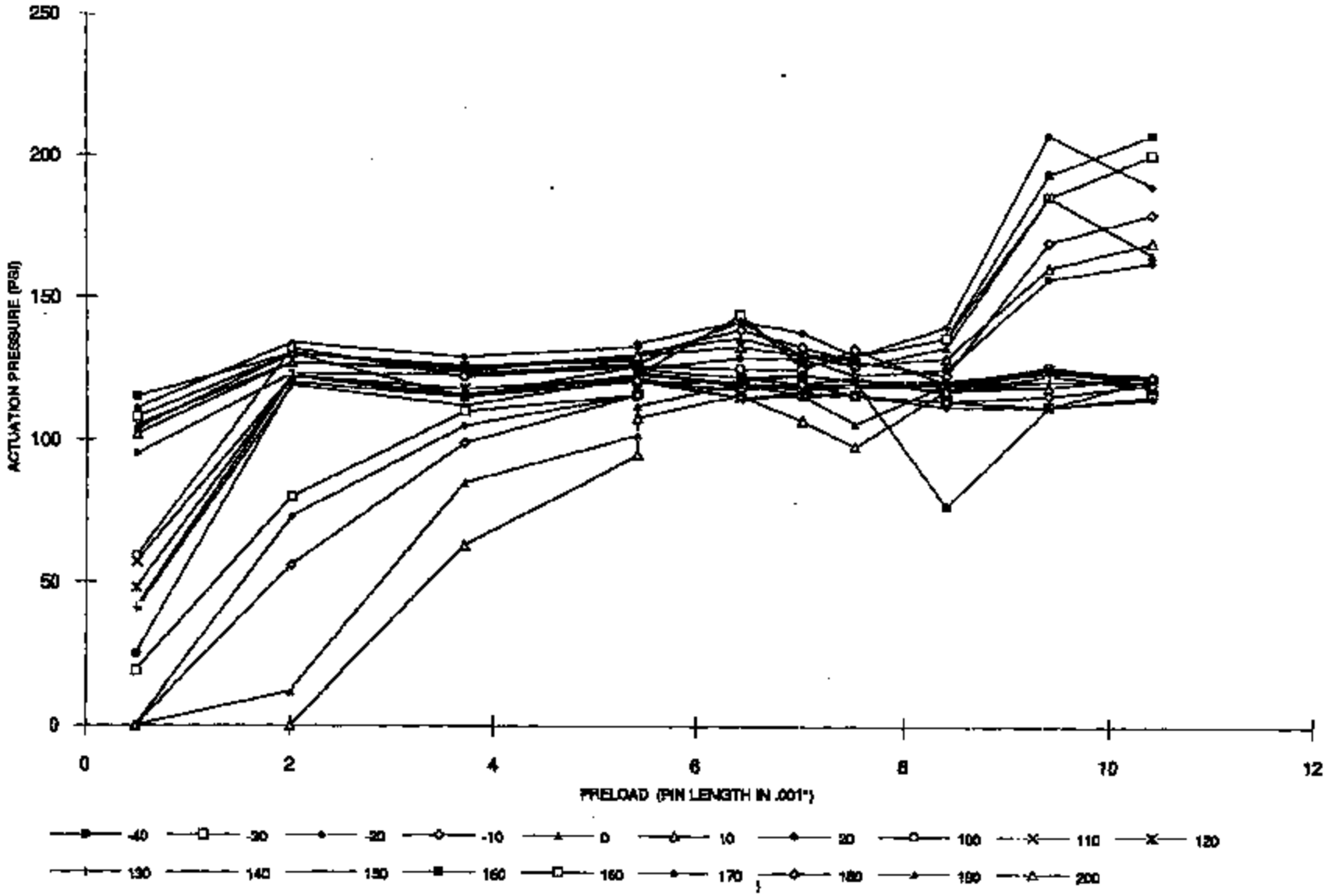
TI-NHTSA 005063

hypot correlation study			&low temp stability test									
	A"	B"									continuity	
SENSOR NUMBER	sensor depth	base calibration	CALCULA preload	abs preload (mils)		before 8 PSI			+22C	+10c	0c	-10c
9.1	0.0967	0.099	0.0097	9.7	0.0464	0.0695	0.1449	0.009				
2	0.0991	0.0985	0.0105	10.6	0.047	0.0688	0.1449	0.0093				-10
3	0.0959	0.0986	0.0073	7.3	0.045	0.0678	0.1417	0.0091				
4	0.096	0.0986	0.0094	9.4	0.0456	0.0675	0.1422	0.0091				
5	0.0979	0.0988	0.0111	11.1	0.0466	0.0674	0.1437	0.0097			0	-10
6	0.0958	0.0989	0.0089	8.9	0.0445	0.0672	0.1415	0.0098				
7	0.0978	0.0977	0.0101	10.1	0.0458	0.0688	0.1439	0.0093				
8	0.0988	0.0983	0.0095	9.5	0.0457	0.0689	0.145	0.0095				
9	0.0988	0.099	0.0098	9.8	0.0463	0.0693	0.1448	0.0092				
10	0.0992	0.0996	0.0094	9.4	0.0457	0.0699	0.145	0.0094				
								0				
10.1	0.0996	0.0993	0.0103	10.3	0.0458	0.0696	0.1456	0.0102				
2	0.0978	0.0971	0.0107	10.7	0.0452	0.0673	0.1433	0.0108				
3	0.1002	0.0994	0.0108	10.8	0.0455	0.0901	0.1461	0.0105				-10
4	0.0967	0.0967	0.012	12.0	0.0461	0.0678	0.1448	0.0109		10	0	-10
5	0.0989	0.0992	0.0097	9.7	0.0453	0.0694	0.1448	0.0102				
6	0.1013	0.0997	0.0116	11.6	0.0464	0.0699	0.1469	0.0106		10	0	-10
7	0.0952	0.097	0.0082	8.2	0.0439	0.087	0.1411	0.0106				
8	0.0992	0.099	0.0092	9.2	0.044	0.0692	0.1439	0.0107				
9	0.0989	0.0985	0.0101	10.1	0.0459	0.0688	0.1451	0.0104				
10	0.0971	0.0968	0.0103	10.3	0.0454	0.0671	0.1431	0.0106				
								0				
11.1	0.0985	0.0969	0.0116	11.6	0.0456	0.0675	0.1446	0.0116		10	0	-10
2	0.1	0.0992	0.0108	10.8	0.0454	0.0695	0.1459	0.011				
3	0.0978	0.0972	0.0106	10.6	0.0446	0.0675	0.144	0.0119			0	-10
4	0.0977	0.0973	0.0104	10.4	0.0453	0.0675	0.1439	0.0111				
5	0.0975	0.0996	0.0079	7.9	0.0478	0.0699	0.1499	0.0117		10	0	-10
6	0.1026	0.0994	0.0132	13.2	0.0476	0.0694	0.1466	0.0116		10	0	-10
7	0.0999	0.0997	0.0102	10.2	0.0454	0.0692	0.146	0.0114				
8	0.0995	0.0995	0.01	10.0	0.0459	0.0699	0.1459	0.0111				

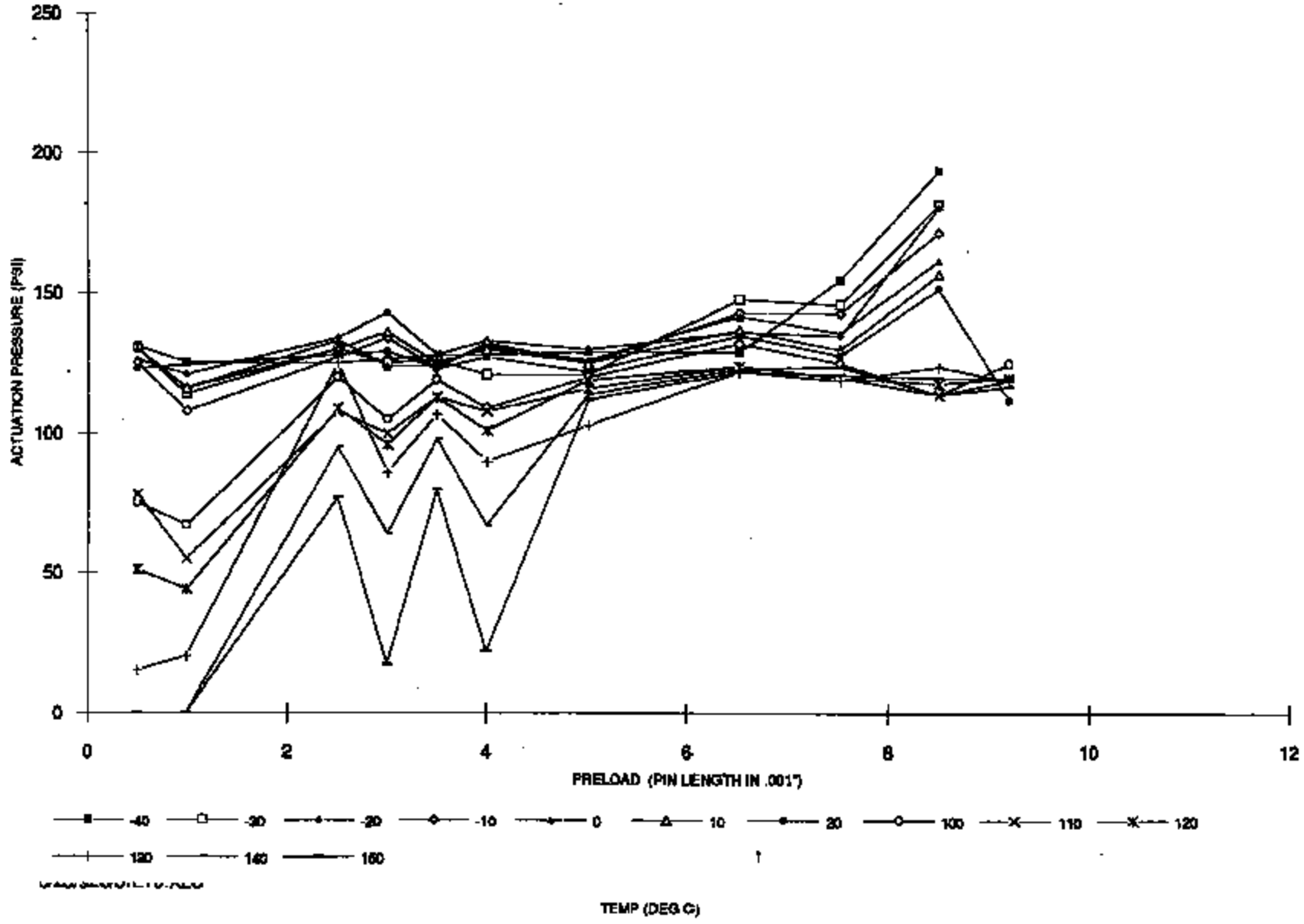
9	0.09995	0.0994	0.01155	11.6	0.046	0.0887	0.1462	0.0115		10	0	-10
10	0.1018	0.0897	0.0121	12.1	0.0466	0.0897	0.1477	0.0116		10	0	-10
								0				
12.1	0.1009	0.0897	0.0112	11.2	0.0441	0.0902	0.1457	0.0124		10	0	-10
2	0.1003	0.0893	0.011	11.0	0.0444	0.0895	0.146	0.0121				
3	0.0977	0.0865	0.0112	11.2	0.0447	0.0868	0.1439	0.0124		10	0	-10
4	0.1	0.0892	0.0108	10.8	0.0448	0.0892	0.1459	0.0119				
5	0.1021	0.0906	0.0115	11.5	0.0453	0.0904	0.1479	0.0122		10	0	-10
6	0.0998	0.0892	0.0106	10.6	[redacted]	0.0894	0.1455	0.0122				
7	0.1036	0.0909	0.0127	12.7	0.0463	0.0908	0.1494	0.0123		10	0	-10
8	0.1002	0.0899	0.0113	11.3	0.0445	0.0891	0.1457	0.0121		10	0	-10
9	0.1038	0.0897	0.0141	14.1	0.0469	0.0904	0.1494	0.0121		10	0	-10
10	0.1018	0.0902	0.0116	11.6	0.0448	0.0905	0.1477	0.0124		10	0	-10
			0	0.0								
			0	0.0								
			0	0.0								

, DRS, 6/23/92 QUIET2.XLC

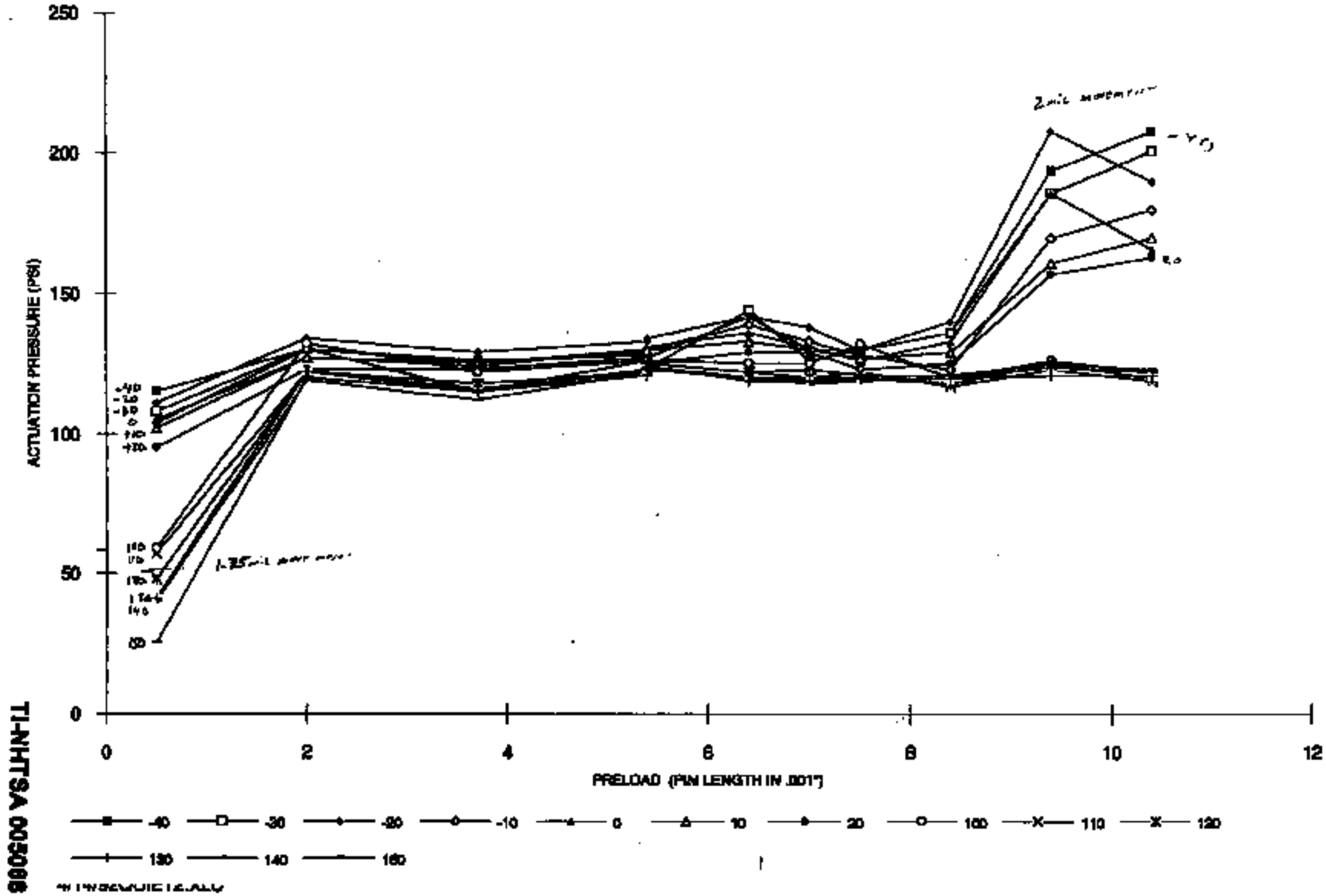
Pressure shift vs pin length at various temps: NOSRL



Pressure shift vs pin length at various temps: CHLXHHX

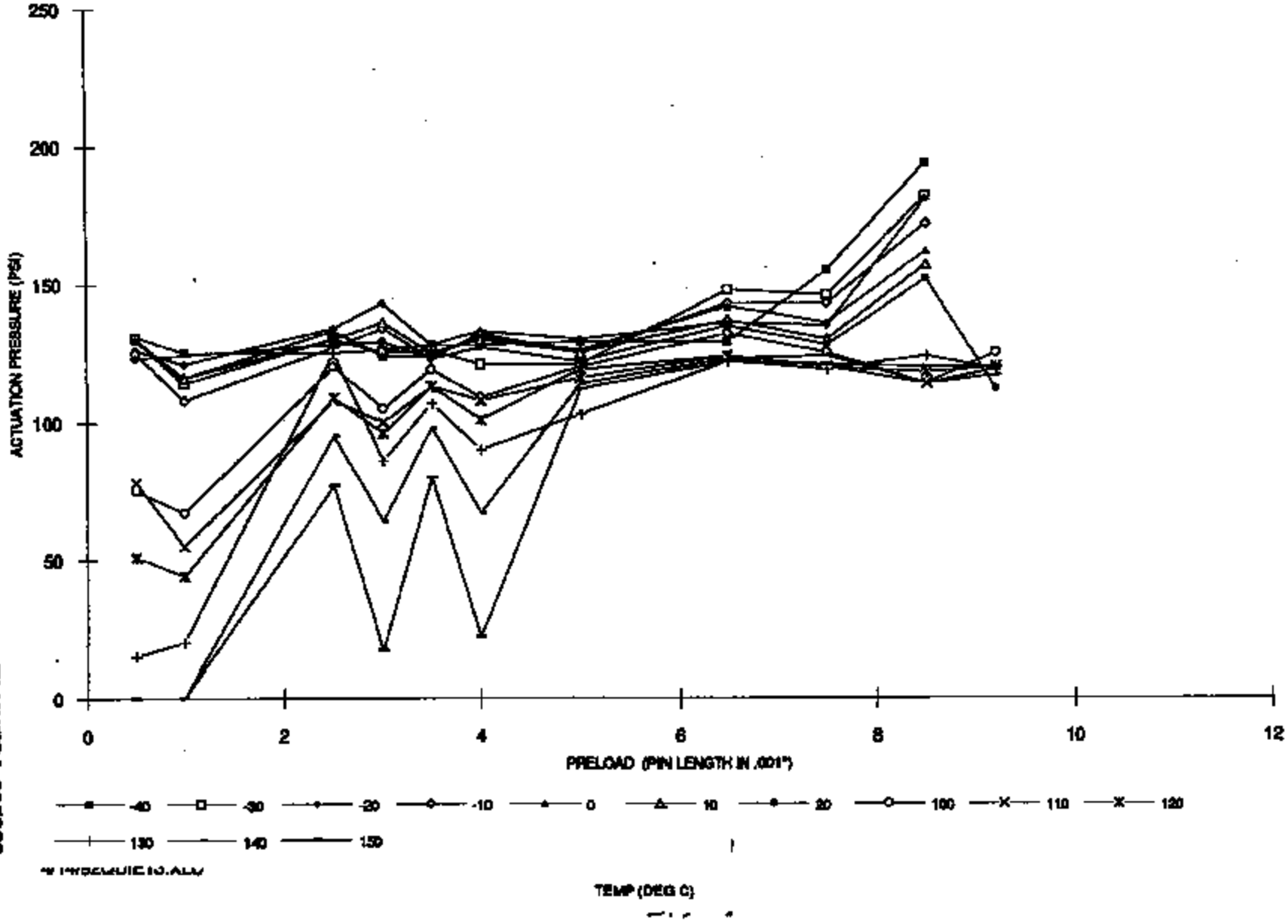


Pressure shift vs pin length at various temps: FORTL



TI-NHTSA 000986

Pressure shift vs pin length at various temps: CHROMX



TI-NHTSA 000068

Celmax

F2L

							DATE	w 14.4pin SENSOR	BIN	BIN PERIOD
F7	SER 1; FIX 1; C= 0001000; BIN=ACCR ; MRRU=44.4; MRRD=47.1; LEAK RATE= 1.9						106	1025	147	0.5
	ACT= 107.9; REL= 90.3; DIF= 17.6 PSI; ACTCR= 122.6ms; RELCR= 0.2									
F25	SER 2; FIX 2; C= 0023012; BIN=CONT ; MRRU=44.4; MRRD=47.1; LEAK RATE= 1.9						96.8 Continuity	102	153	9.2
	ACT= 178.2; REL= 141.2; DIF= 36.9 PSI; ACTCR= 200.0ms; RELCR= 200.0									
F24	SER 3; FIX 3; C= 0001000; BIN=ACCR ; MRRU=44.4; MRRD=47.1; LEAK RATE= 1.9						106	102	148	1.0
	ACT= 107.9; REL= 75.3; DIF= 32.6 PSI; ACTCR= 109.0ms; RELCR= 0.1									
F23	SER 4; FIX 4; C= 0000000; BIN=GOOD ; MRRU=44.4; MRRD=47.1; LEAK RATE= 1.9						99.5	1025	149	3.0
	ACT= 120.2; REL= 91.5; DIF= 28.7 PSI; ACTCR= 5.6ms; RELCR= 0.6									

8-APR-1992 15:13:09.73 OPER DOOR DID NOT CLOSE 1

F22	SER 5; FIX 1; C= 0000000; BIN=GOOD ; MRRU=44.5; MRRD=48.1; LEAK RATE= 1.9						98.5	102	149	3.5
	ACT= 112.2; REL= 89.2; DIF= 23.0 PSI; ACTCR= 1.3ms; RELCR= 0.1									
F27	SER 6; FIX 2; C= 0000000; BIN=GOOD ; MRRU=44.5; MRRD=48.1; LEAK RATE= 1.9						106	102	151	4.0
	ACT= 120.2; REL= 84.8; DIF= 35.5 PSI; ACTCR= 3.9ms; RELCR= 1.1									
F28	SER 7; FIX 3; C= 0000000; BIN=GOOD ; MRRU=44.5; MRRD=48.1; LEAK RATE= 1.9						96	102	149	5.0
	ACT= 116.7; REL= 91.5; DIF= 25.2 PSI; ACTCR= 0.7ms; RELCR= 2.0									

F2 1

F21	SER 8; FIX 4; C= 0000000; BIN=GOOD ; MRRU=44.5; MRRD=48.1; LEAK RATE= 1.9						99.5	102	149	2.5
	ACT= 123.6; REL= 85.9; DIF= 37.6 PSI; ACTCR= 6.2ms; RELCR= 0.1									

8-APR-1992 15:13:39.80 OPER DOOR DID NOT CLOSE 1

F30	SER 9; FIX 1; C= 0003000; BIN=ACCR ; MRRU=45.0; MRRD=47.2; LEAK RATE= 1.6						98	1025	151	2.5
	ACT= 123.7; REL= 103.7; DIF= 20.0 PSI; ACTCR= 200.0ms; RELCR= 200.0									
F31	SER 10; FIX 2; C= 0003000; BIN=ACCR ; MRRU=45.0; MRRD=47.2; LEAK RATE= 1.6						985	102	153	7.5
	ACT= 123.7; REL= 108.1; DIF= 15.6 PSI; ACTCR= 200.0ms; RELCR= 200.0									
F32	SER 11; FIX 3; C= 0003010; BIN=ACCR ; MRRU=45.0; MRRD=47.2; LEAK RATE= 1.6						100	1025	155	8.5
	ACT= 150.5; REL= 131.2; DIF= 19.3 PSI; ACTCR= 200.0ms; RELCR= 200.0									
	SER 12; FIX 4; C= 0023005; BIN=CONT ; MRRU=45.0; MRRD=47.2; LEAK RATE= 1.6						Dummy			
	ACT= 74.5; REL= 16.0; DIF= 58.5 PSI; ACTCR= 200.0ms; RELCR= 200.0									

77PS PRESSURE TESTER LOT REPORT

RATING: 77PSL2-1
LOT ID: CELLENAX
LOT STARTED: 8-APR-1992 15:12:48.90
LOT FINISHED: 8-APR-1992 15:14:16.51

SETUP DATA:
DISC LOT ID: 0.00
DISC MEAN ACT: 27.5 MEAN REL: 13.4
LIMIT (NC)
ACTUATION: 90.0 TO 160.0 PSI
RELEASE: 20.0 TO 120.0 PSI
DIFFERENTIAL: 0.0 TO 160.0 PSI
MAX MILLIVOLT: 200.0 PSI
ACT CREEP TIME: 25.0 PSI
REL CREEP TIME: 150.0 PSI
PRECYCLE PRESS: 800.0 PSI
PRECYCLE COUNT: 2

NUMBER OF PIECES TESTED: 12
NUMBER OF PIECES GOOD: 5
YIELD: 41.67 %

REJECT COUNTS

BIN	COUNT	% OF REJECTS
LEAK	0	0.00 %
CONT	2	28.57 %
ACOR	5	71.43 %
ACLO	0	0.00 %
ACHI	0	0.00 %
RLHI	0	0.00 %
RLLO	0	0.00 %
DFLO	0	0.00 %
RLOR	0	0.00 %
DFHI	0	0.00 %

STATISTICS	MEAN	SIGMA	CPK
ACTUATION:	120.6	12.18	0.84
RELEASE:	95.2	15.68	0.53
MILLIVOLT:	0.0	0.00	0.00
DIFFERENTIAL:	25.5	7.77	1.09

HISTOGRAM OF ACTUATION PRESSURE

```
                5   10   15   20   25   30   35   40   45   50
               ----+----+----+----+----+----+----+----+----+----+
   UNDER    0| |
   107.5    2| |**
   110.0    0| |
   112.5    1| |*
   115.0    0| |
   117.5    1| |*
   120.0    2| |**
```

```
 127.5   0|
 130.0   0|
 132.5   0|
 135.0   0|
 137.5   0|
 140.0   0|
 142.5   0|
 145.0   0|
 147.5   0|
 150.0   1|*
  OVER   0|
```

HISTOGRAM OF RELEASE PRESSURE

```
                5   10   15   20   25   30   35   40   45   50
               ----+----+----+----+----+----+----+----+----+----+
 UNDER   0|
  75.0   1|*
  80.0   0|
  85.0   2|**
  90.0   4|****
  95.0   0|
 100.0   0|
 105.0   1|*
 110.0   1|*
 115.0   0|
 120.0   0|
 125.0   0|
 130.0   1|*
  OVER   0|
```

HISTOGRAM OF DIFFERENTIAL PRESSURE

```
                5   10   15   20   25   30   35   40   45   50
               ----+----+----+----+----+----+----+----+----+----+
 UNDER   0|
  15.0   1|*
  20.0   3|***
  25.0   2|**
  30.0   1|*
  35.0   2|**
  40.0   1|*
  OVER   0|
```

HISTOGRAM OF ACTUATION CREEP

```
                5   10   15   20   25   30   35   40   45   50
               ----+----+----+----+----+----+----+----+----+----+
 UNDER   0|
```

	3.0	0	
	4.0	1	*
	5.0	0	
	6.0	2	**
	7.0	0	
	8.0	0	
	9.0	0	
	10.0	0	
	11.0	0	
	12.0	0	
	13.0	0	
	14.0	0	
	15.0	0	
	16.0	0	
	17.0	0	
	18.0	0	
	19.0	0	
	20.0	0	
	21.0	0	
	22.0	0	
	23.0	0	
	24.0	0	
	25.0	0	
	26.0	0	
	27.0	0	
	28.0	0	
	29.0	0	
	30.0	0	
	31.0	0	
	32.0	0	
	33.0	0	
	34.0	0	
	35.0	0	
	OVER	5	*****

HISTOGRAM OF RELEASE CREEP

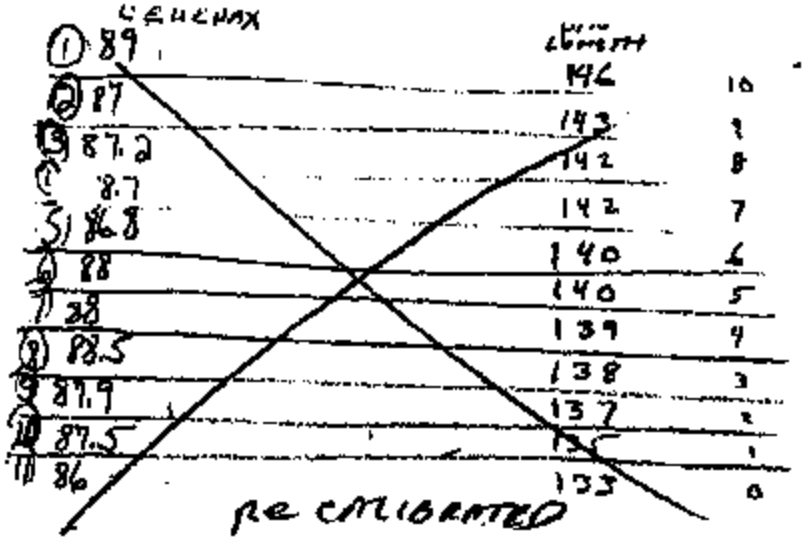
		5 10 15 20 25 30 35 40 45 50
		----+----+----+----+----+----+----+----+----+----+
	UNDER	0	
	0.0	7	*******
	5.0	0	
	10.0	0	
	15.0	0	
	20.0	0	
	25.0	0	
	30.0	0	
	35.0	0	
	40.0	0	
	45.0	0	
	50.0	0	
	55.0	0	
	60.0	0	
	65.0	0	
	70.0	0	
	75.0	0	
	80.0	0	
	85.0	0	
	90.0	0	

105.0	0	|
110.0	0	|
115.0	0	|
120.0	0	|
125.0	0	|
130.0	0	|
135.0	0	|
140.0	0	|
145.0	0	|
150.0	0	|
155.0	0	|
160.0	0	|
165.0	0	|
170.0	0	|
175.0	0	|
180.0	0	|
185.0	0	|
OVER	3	|***

ECU Connector #8

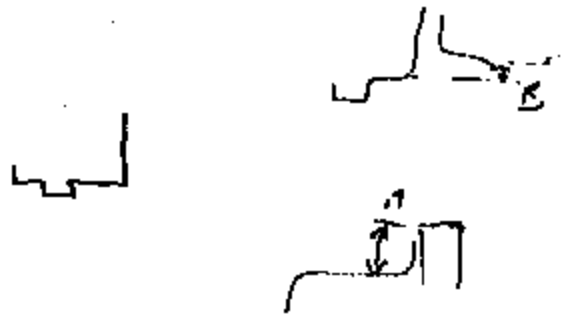
(8)

149 pin



.102 - .089 .013

.143 pin clips 96



A = B-.70

Vary

	Inner	Pin
1 100 — remake		154
2 98	0	145
3 100	9	154
4 99	2	148
5 99.8	3	150
6 99.1	4	151
7 99.9	5	152
8 99.6	6	153
9 99.1	7	154
10 100.1	8	155
11 100.1	1	155

Celerity

1	100	0	147
1	96.8	—	153
1	100	1	148
1	99.5	2	149
1	98.5	3	149
1	100	4	151
1	96	5	148
8	remake 91.5	—	
1	98	6	151
1	98.5	7	151
1	100	8	155

'F' DISC, SENSORS BUILT ON PRODUCTION LINE
BASES CALIBRATED BY CLAIR ON PRODUCTION LINE

NORYL
PLANNED BY FRAN
CRIMPED ON PROD LINE

F33

				BASE	W.199 pin SENSOR	BIN	PRELOAD
F'	SER 1; FIX 1; C= 0000000; BIN=GOOD ; MRRU=45.0; MRRD=47.2; LEAK RATE= 1.6 ACT= 115.7; REL= 87.9; DIF= 27.8 PSI; ACTCR= 0.6ms; RELCR= 14.6			100	102	154	7.0
F34	SER 2; FIX 2; C= 0003000; BIN=ACCR ; MRRU=45.0; MRRD=47.2; LEAK RATE= 1.6 ACT= 94.5; REL= 71.4; DIF= 23.1 PSI; ACTCR= 200.0ms; RELCR= 200.0			98	1025	145	0.5
F35	SER 3; FIX 3; C= 0000000; BIN=GOOD ; MRRU=45.0; MRRD=47.2; LEAK RATE= 1.6 ACT= 112.9; REL= 87.9; DIF= 25.0 PSI; ACTCR= 0.6ms; RELCR= 16.6			100	1025	154	7.5
F36	SER 4; FIX 4; C= 0001000; BIN=ACCR ; MRRU=45.0; MRRD=47.2; LEAK RATE= 1.6 ACT= 114.4; REL= 87.9; DIF= 26.5 PSI; ACTCR= 36.0ms; RELCR= 0.8			99	102	148	2
F37	SER 5; FIX 1; C= 0000000; BIN=GOOD ; MRRU=45.0; MRRD=47.5; LEAK RATE= 1.8 ACT= 115.5; REL= 78.2; DIF= 37.3 PSI; ACTCR= 2.2ms; RELCR= 0.3			99.8	1025	150	3.7
F38	SER 6; FIX 2; C= 0000000; BIN=GOOD ; MRRU=45.0; MRRD=47.5; LEAK RATE= 1.8 ACT= 116.3; REL= 88.8; DIF= 27.4 PSI; ACTCR= 0.9ms; RELCR= 0.2			99.1	1025	151	5.4
F39	SER 7; FIX 3; C= 0000000; BIN=GOOD ; MRRU=45.0; MRRD=47.5; LEAK RATE= 1.8 ACT= 116.8; REL= 92.4; DIF= 24.5 PSI; ACTCR= 0.8ms; RELCR= 0.7			99.9	102	152	5.4
F40	SER 8; FIX 4; C= 0001000; BIN=ACCR ; MRRU=45.0; MRRD=47.5; LEAK RATE= 1.8 ACT= 120.7; REL= 98.7; DIF= 21.9 PSI; ACTCR= 200.0ms; RELCR= 103.5			99.6	102	153	6.4
F	F4 SER 9; FIX 1; C= 0003000; BIN=ACCR ; MRRU=45.2; MRRD=47.6; LEAK RATE= 2.1 ACT= 122.5; REL= 105.8; DIF= 16.7 PSI; ACTCR= 200.0ms; RELCR= 158.5			99.1	1025	156 ~~154~~	10.4 ~~9.4~~
F42	SER 10; FIX 2; C= 0001000; BIN=ACCR ; MRRU=45.2; MRRD=47.6; LEAK RATE= 2.1 ACT= 116.2; REL= 98.0; DIF= 18.2 PSI; ACTCR= 200.0ms; RELCR= 97.2			100.1	1025	155	8.4
F43	SER 11; FIX 3; C= 0003000; BIN=ACCR ; MRRU=45.2; MRRD=47.6; LEAK RATE= 2.1 ACT= 135.3; REL= 114.7; DIF= 20.6 PSI; ACTCR= 161.4ms; RELCR= 200.0			100.1	1025	~~154~~ 156	~~8.4~~ 9.4
	SER 12; FIX 4; C= 0023005; BIN=CONF ; MRRU=45.2; MRRD=47.6; LEAK RATE= 2.1 ACT= 74.2; REL= 16.3; DIF= 57.9 PSI; ACTCR= 200.0ms; RELCR= 200.0			Dummy			

8-APR-1992 15:12:01.10 OPER DOOR DID NOT CLOSE 1

8-APR-1992 15:12:21.11 OPER DOOR STILL DID NOT CLOSE 1

8-APR-1992 15:12:40.26 TOOL CYCLE TIMEOUT 1

7798 PRESSURE TESTER LOT REPORT

RATING:7795L2-1
LOT ID:NORYL
LOT STARTED: 6-APR-1992 15:11:07.84
LOT FINISHED: 8-APR-1992 15:12:46.89

SETUP DATA:
DISC LOT ID: 0.00
DISC MEAN ACT: 27.5 MEAN REL: 13.4
LIMIT (MC)
ACTUATION: 90.0 TO 160.0 PSI
RELEASE: 20.0 TO 120.0 PSI
DIFFERENTIAL: 0.0 TO 160.0 PSI
MAX MILLIVOLT: 200.0 PSI
ACT CREEP TIME: 25.0 PSI
REL CREEP TIME: 150.0 PSI
PRECYCLE PRESS: 800.0 PSI
PRECYCLE COUNT: 2

NUMBER OF PIECES TESTED: 12
NUMBER OF PIECES GOOD: 5
YIELD: 41.67 %

REJECT COUNTS

BIN	COUNT	% OF REJECTS
LEAK	0	0.00 %
CONT	1	14.29 %
ACGR	6	85.71 %
ACLO	0	0.00 %
ACHI	0	0.00 %
RLHI	0	0.00 %
RLLO	0	0.00 %
DFLO	0	0.00 %
RLGR	0	0.00 %
DFHI	0	0.00 %

STATISTICS	MEAN	SIGMA	CPK
ACTUATION:	116.4	9.54	0.92
RELEASE:	92.0	12.09	0.77
MILLIVOLT:	0.0	0.00	0.00
DIFFERENTIAL:	24.5	5.58	1.46

HISTOGRAM OF ACTUATION PRESSURE

```
                5   10   15   20   25   30   35   40   45   50
               ---+----+----+----+----+----+----+----+----+----+
   UNDER   0|  |
    95.0   1|  |*
    97.5   0|  |
   100.0   0|  |
   102.5   0|  |
   105.0   0|  |
   107.5   0|  |
   110.0   0|  |
   112.5   1|  |*
   115.0   4|  |****
   117.5   2|  |**
```

TI-NHTSA 005079

```
122.5    1|  |*
125.0    0|  |
127.5    0|  |
130.0    0|  |
132.5    0|  |
135.0    1|  |*
 OVER    0|  |
```

HISTOGRAM OF RELEASE PRESSURE

```
                5   10   15   20   25   30   35   40   45   50
               ---+----+----+----+----+----+----+----+----+----+
UNDER    0|  |
 70.0    1|  |*
 75.0    0|  |
 80.0    1|  |*
 85.0    0|  |
 90.0    5|  |*****
 95.0    0|  |
100.0    2|  |**
105.0    1|  |*
110.0    0|  |
115.0    1|  |*
 OVER    0|  |
```

HISTOGRAM OF DIFFERENTIAL PRESSURE

```
                5   10   15   20   25   30   35   40   45   50
               ---+----+----+----+----+----+----+----+----+----+
UNDER    0|  |
 15.0    1|  |*
 20.0    3|  |***
 25.0    5|  |*****
 30.0    1|  |*
 35.0    1|  |*
 OVER    0|  |
```

HISTOGRAM OF ACTUATION CREEP

```
                5   10   15   20   25   30   35   40   45   50
               ---+----+----+----+----+----+----+----+----+----+
UNDER    0|  |
 1.0     4|  |****
 2.0     1|  |*
 3.0     0|  |
 4.0     0|  |
 5.0     0|  |
 6.0     0|  |
 7.0     0|  |
 OVER    0|  |
```

```
 10.0    0|
 11.0    0|
 12.0    0|
 13.0    0|
 14.0    0|
 15.0    0|
 16.0    0|
 17.0    0|
 18.0    0|
 19.0    0|
 20.0    0|
 21.0    0|
 22.0    0|
 23.0    0|
 24.0    0|
 25.0    0|
 26.0    0|
 27.0    0|
 28.0    0|
 29.0    0|
 30.0    0|
 31.0    0|
 32.0    0|
 33.0    0|
 34.0    0|
 35.0    0|
OVER     6|******
```

HISTOGRAM OF RELEASE CREEP

```
                5   10   15   20   25   30   35   40   45   50
              ---+----+----+----+----+----+----+----+----+----+
UNDER    0|
  0.0    4|****
  5.0    0|
 10.0    0|
 15.0    2|**
 20.0    0|
 25.0    0|
 30.0    0|
 35.0    0|
 40.0    0|
 45.0    0|
 50.0    0|
 55.0    0|
 60.0    0|
 65.0    0|
 70.0    0|
 75.0    0|
 80.0    0|
 85.0    0|
 90.0    0|
 95.0    1|*
100.0    0|
105.0    1|*
110.0    0|
115.0    0|
120.0    0|
125.0    0|
130.0    0|
```

```
 140.0    0|  |
 145.0    0|  |
 150.0    0|  |
 155.0    0|  |
 160.0    1|  |*
 165.0    0|  |
 170.0    0|  |
 175.0    0|  |
 180.0    0|  |
 185.0    0|  |
  OVER    2|  |**
```

SER 1; FIX 1; C= 0023012; BIN=CONT ; MXRU=44.3; MXRD=47.6; LEAK RATE= 2.1
ACT= 165.5; REL= 140.8; DIF= 24.8 PSI; ACTDR= 200.0ms; RELDR= 200.0

SER 2; FIX 2; C= 0003010; BIN=ACCS ; MXRU=44.3; MXRD=47.6; LEAK RATE= 2.1
ACT= 156.3; REL= 133.4; DIF= 22.4 PSI; ACTDR= 200.0ms; RELDR= 200.0

SER 3; FIX 3; C= 0023005; BIN=CONT ; MXRU=44.3; MXRD=47.6; LEAK RATE= 2.1
ACT= 74.3; REL= 16.3; DIF= 58.0 PSI; ACTDR= 200.0ms; RELDR= 200.0

SER 4; FIX 4; C= 0023005; BIN=CONT ; MXRU=44.3; MXRD=47.6; LEAK RATE= 2.1
ACT= 74.3; REL= 16.3; DIF= 58.0 PSI; ACTDR= 200.0ms; RELDR= 200.0

9-APR-1992 08:47:07.57 OPER DOOR DID NOT OPEN 1

QUIET SWITCH - PRELIMINARY STUDIES

TI CONFIDENTIAL
TI STRICLY PRIVATE

I) Plastic connector stability

Purpose: To determine the acceptable pin lengths for quiet switch production given that the quiet disc has a smaller pin window. Also to evaluate the effects of a connector material change to increase the pin window so the device could be manufactured cost effectively.

Procedure: Devices were assembled at various contact preloads (pin lengths) using both celenax and noryl connectors. If the material changes dimensional with temperature it can result in an increased or decreased actuation pressure. The actuation and release pressures were measured at low and high temps.

Results: The results for Celenax are shown in Figure 1. Norly results are shown in Fig 2. The Noryl provided stable actuation and release pressure over a greater pin range. This matches other test results showing greater dimensional stability with noryl. During the test the parts were exposed to temps from -40 to +150, one cycle and there was no visual impact on the material.

II) Plastic connector stability

Purpose: Understand the ability of Noryl material to survive the typical underhood automotive environment.

Procedure: Connectors were fully qualified in Norly material for an underhood Automotive Pressure Transducer (APT). This includes thermal cycling, chemical resistance, dimensional stability, impulse testing, impact strength, etc.

Results: The Norly is fully qualified as a connector to 135C. Long term storage has been acceptable at 150C.

III) Quiet Disc development

Purpose: A lower differential disc was needed to reduce the sound generated when the disc snapped.

Procedure: Various discs were developed. The differential was measured by building the disc into a sensor assembly and then measuring the disc deflection vs pressure with an lvdt(linear variable differential transformer).

Results: Figure 3 shows both a noisy production disc and a quiet disc. Note that the differential has been reduce from 100psi to approx 30psi. Correspondingly the available pin window has been reduce from 14.5 mils to 10 mils.

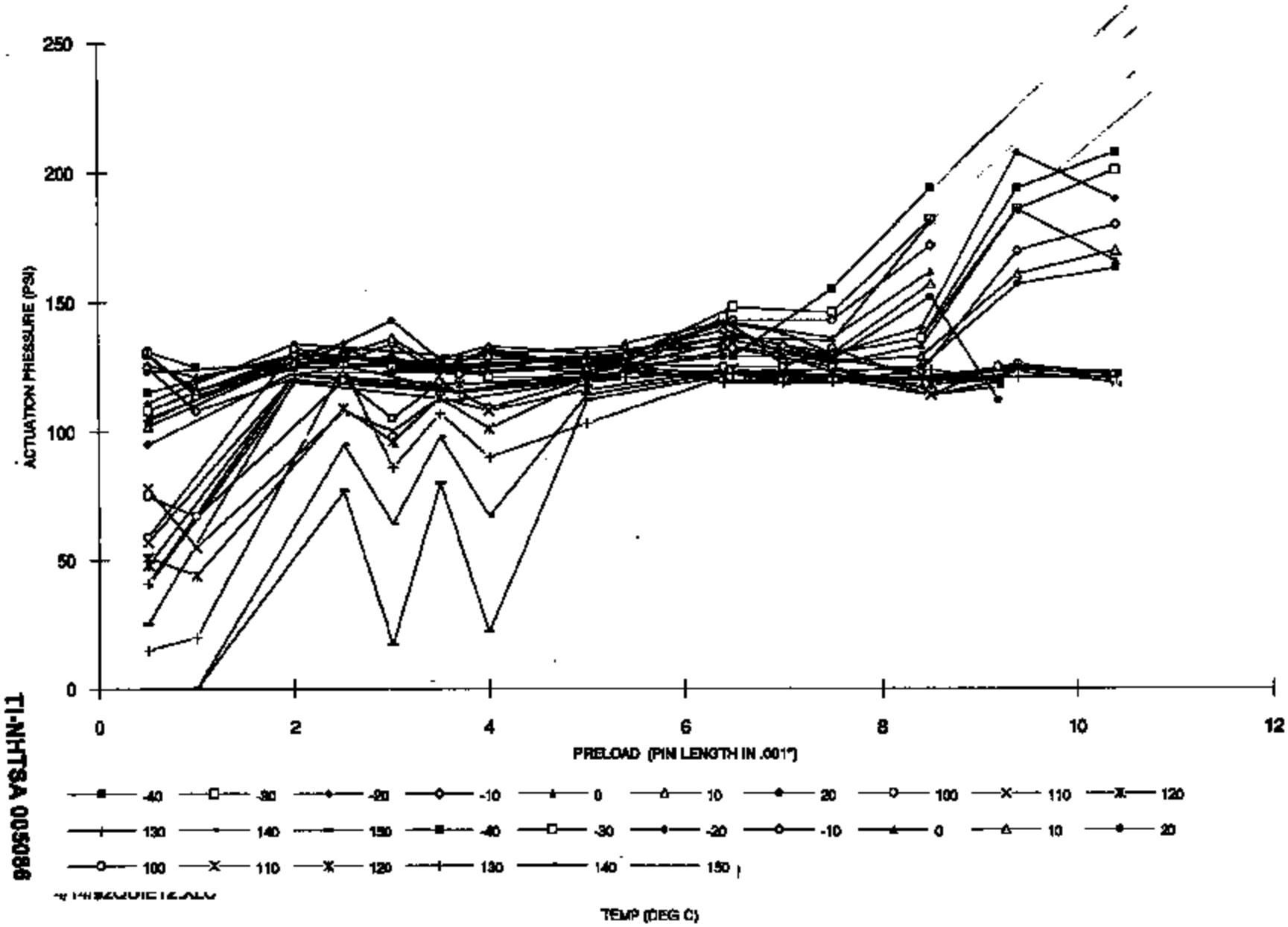
IV) Switch sound evaluation

Purpose: To quantify the sound level form different switch configurations and to identify the source of the sound.

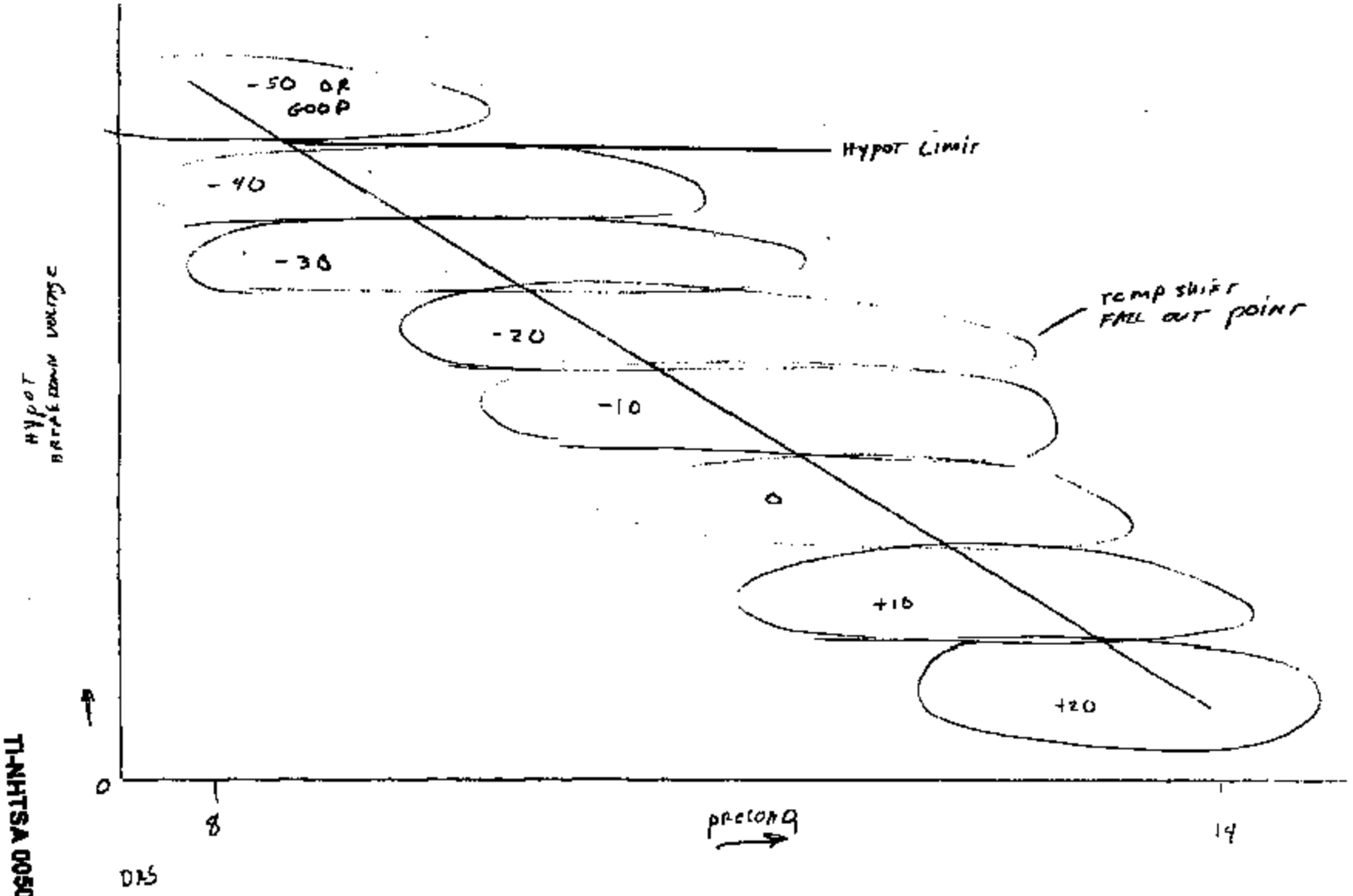
Procedure: Switches were mounted on an air calibration stand. An accelerometer was attached to the top of the switch using beeswax. The accelerometer axes was along the long axis of the switch. A microphone was mounted on a "t" fitting to the switch pressure port. The accelerometer and microphone signal were feed into a spectrum analyzer.

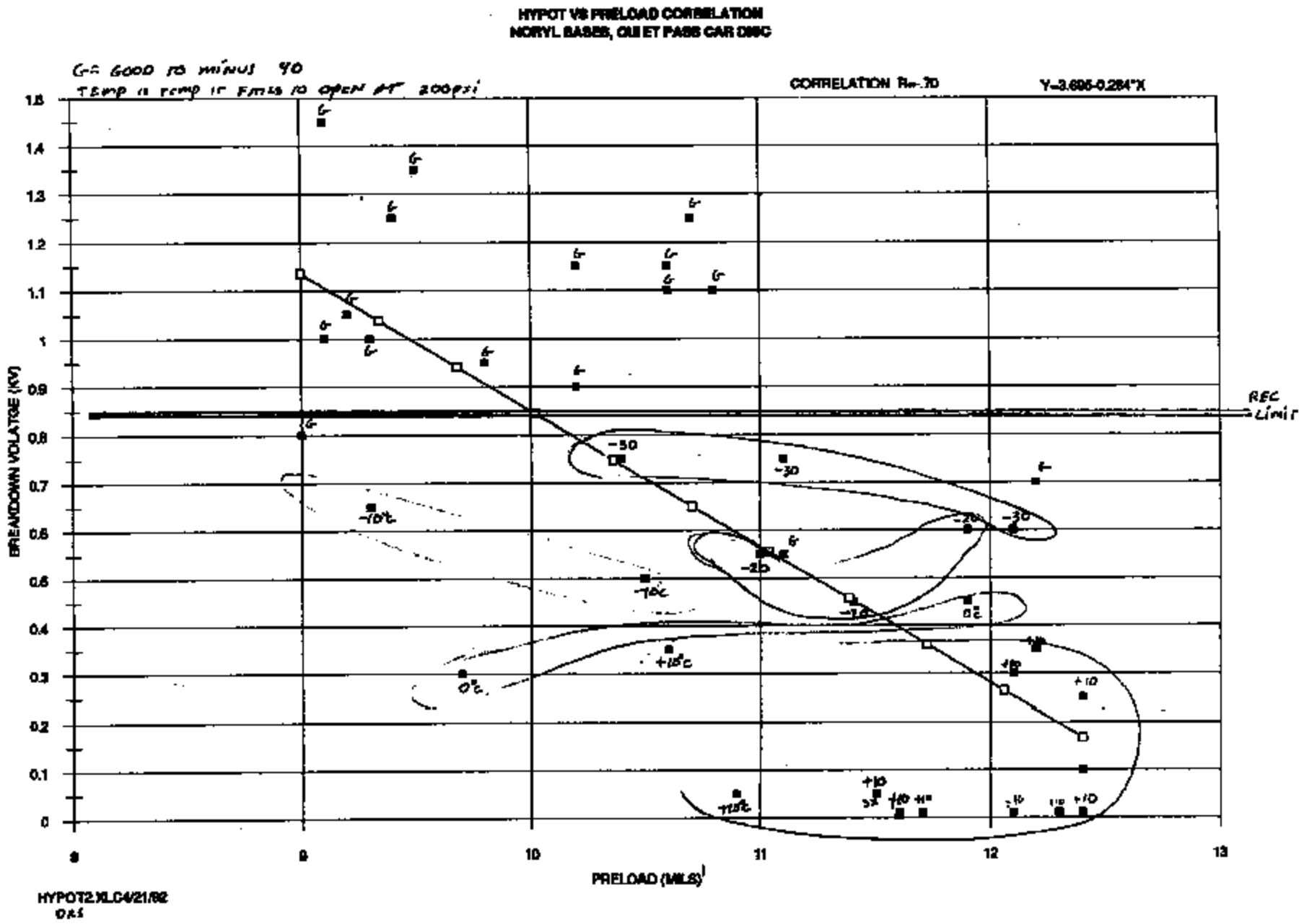
Results: The result for a production 'noisy' switch is shown in Figure 4 & 5. Figure 4 shows the frequency decay, while figure 5 shows the frequency spectrum or resonant frequency. Figure 6 shows a quiet disc. The quiet disc clearly produces less acceleration and less noise. The same evaluation held true on a hydraulic system.

Pressure shift vs pin length at various temps: NORTL & CHLORAZ



EXPECTED DISTRIBUTION





		Sheave	Beam	Pin	Unload	5	6	Sheave	Beam	Pin	Unload	11	12	13
	1													
9-1	2	.0464	.0885	.1449	.009		11-1	.0456	.0875	.1442	.0115			
9-2	3	.047	.0882	.1449	.0093		11-2	.0454	.0895	.1459	.011			
9-3	4	.045	.0876	.1417	.0091		11-3	.0446	.0875	.144	.0119			
9-4	5	.0456	.0875	.1422	.0091		11-4	.0453	.0870	.1439	.0112			
9-5	6	.0466	.0874	.1437	.0097		11-5	.0478	.0898	.1493	.0117			
9-6	7	.0445	.0872	.1415	.0098		11-6	.0476	.0894	.1486	.0116			
9-7	8	.0458	.0888	.1439	.0093		11-7	.0454	.0892	.146	.0114			
9-8	9	.0457	.0898	.145	.0095		11-8	.0459	.0888	.1456	.0111			
9-9	10	.0463	.0893	.1448	.0092		11-9	.046	.0887	.1462	.0115			
9-10	11	.0457	.0899	.145	.0094		11-10	.0465	.0897	.1477	.0115			
	12													
10-1	13	.0458	.0896	.1456	.0102		12-1	.0441	.0902	.1467	.0124			
10-2	14	.0452	.0873	.1433	.0108		12-2	.0444	.0895	.146	.0121			
10-3	15	.0455	.0904	.1461	.0105		12-3	.0447	.0886	.1439	.0124			
10-4	16	.0461	.0878	.1448	.0109		12-4	.0448	.0892	.1459	.0118			
10-5	17	.0452	.0894	.1446	.0102		12-5	.0453	.0904	.1479	.0122			
10-6	18	.0464	.0899	.1469	.0106		12-6	.0439	.0894	.1455	.0122			
10-7	19	.0435	.087	.1411	.0106		12-7	.0463	.0908	.1494	.0123			
10-8	20	.044	.0892	.1439	.0107		12-8	.0445	.0891	.1457	.0121			
10-9	21	.0457	.0888	.1451	.0104		12-9	.0469	.0909	.1494	.0121			
10-10	22	.0454	.0871	.1431	.0106		12-10	.0448	.0905	.1477	.0124			
	23													
	24													
	25													
	26													
	27													
	28													
	29													
	30													
	31													

	-10°C	0psi	200psi
9-1	C		✓
2	C		✓
3	C		✓
4	C		✓
5	C		✓ ✓
6	C		✓
7	C		✓
8	C		✓
9	C		✓
10	C		✓
10-1	C		
2	C		
3	C		
4	C		✓
5	C		
6	C		✓
7	C		
8	C		
9	C		
10	C		
14-1	C		✓
2	C		
3	C		
4	C		
5	C		✓
6	C		✓
7	C		
8	C		
9	C		C
10	C		C
12-1	C		✓
2	C		✓
3	C		✓
4	C		
5	C		✓
6	C		
7	C		✓
8	C		✓
9	C		✓
10	C		✓

	0°C		-10°C		-20°C	-30	-40
	0psi	200psi	0psi	200psi	0psi	200psi	200psi	200
9-1								
2				✓		✓	✓	
3								
4								
5		✓		✓		✓	✓	
6								
7								
8								
9								
10								
10-1								
2								
3				✓		✓	✓	
4		✓		✓		✓	✓	
5								
6		✓		✓		✓	✓	
7								
8								
9							✓	
10								
11-1		✓		✓		✓	✓	
2						✓	✓	
3		✓		✓		✓	✓	
4							✓	
5		✓		✓		✓	✓	
6		✓		✓		✓	✓	
7						✓	✓	
8								
9		✓		✓		✓	✓	
10		✓		✓		✓	✓	
12-1		✓		✓		✓	✓	
2							✓	
3		✓		✓		✓	✓	
4						✓	✓	
5		✓		✓		✓	✓	
6								
7		✓		✓		✓	✓	
8		✓		✓		✓	✓	
9		✓		✓		✓	✓	
10		✓		✓		✓	✓	

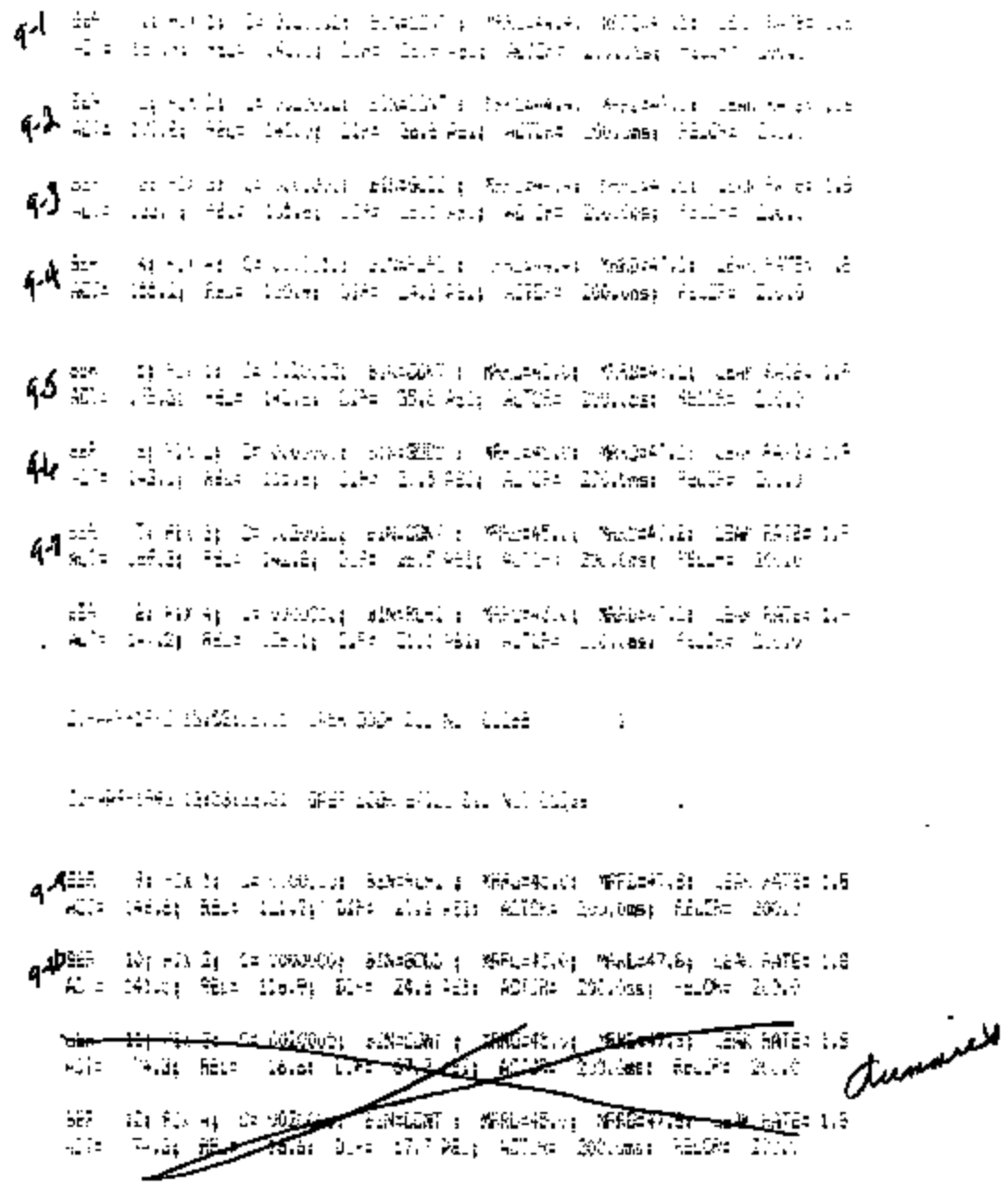
Air continuity

V= continuity

TI-NHTSA 005091

	200psi -40	210psi -40	220psi -40	14POF (kV)
9-1				.7
2	✓			.65
3				1.45
4				1.00
5	✓	✓	✓	0.30
6				0.95
7				1.00
8				1.35
9				1.05
10				1.25
10-1				.90
2				1.10
3	✓	✓		0.50
4	✓	✓	✓	0.05
5				1.15
6	✓	✓	✓	0.35
7				1.15
8				1.25
9	✓			0.75
10				1.10
11-1	✓	✓	✓	.05
2				.55
3	✓			.95
4				.75
5	✓	✓	✓	.01
6	✓	✓	✓	.01
7	✓			.45
8				.55
9	✓	✓	✓	.05
10	✓	✓	✓	.05
12-1	✓	✓	✓	.25
2				.60
3	✓		✓	.10
4	✓			.60
5	✓	✓	✓	.35
6				.70
7	✓	✓	✓	.01
8	✓	✓	✓	.30
9	✓	✓	✓	.01
10	✓	✓	✓	.01

Hyper correction



10-3

10-4

10-5

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11-1

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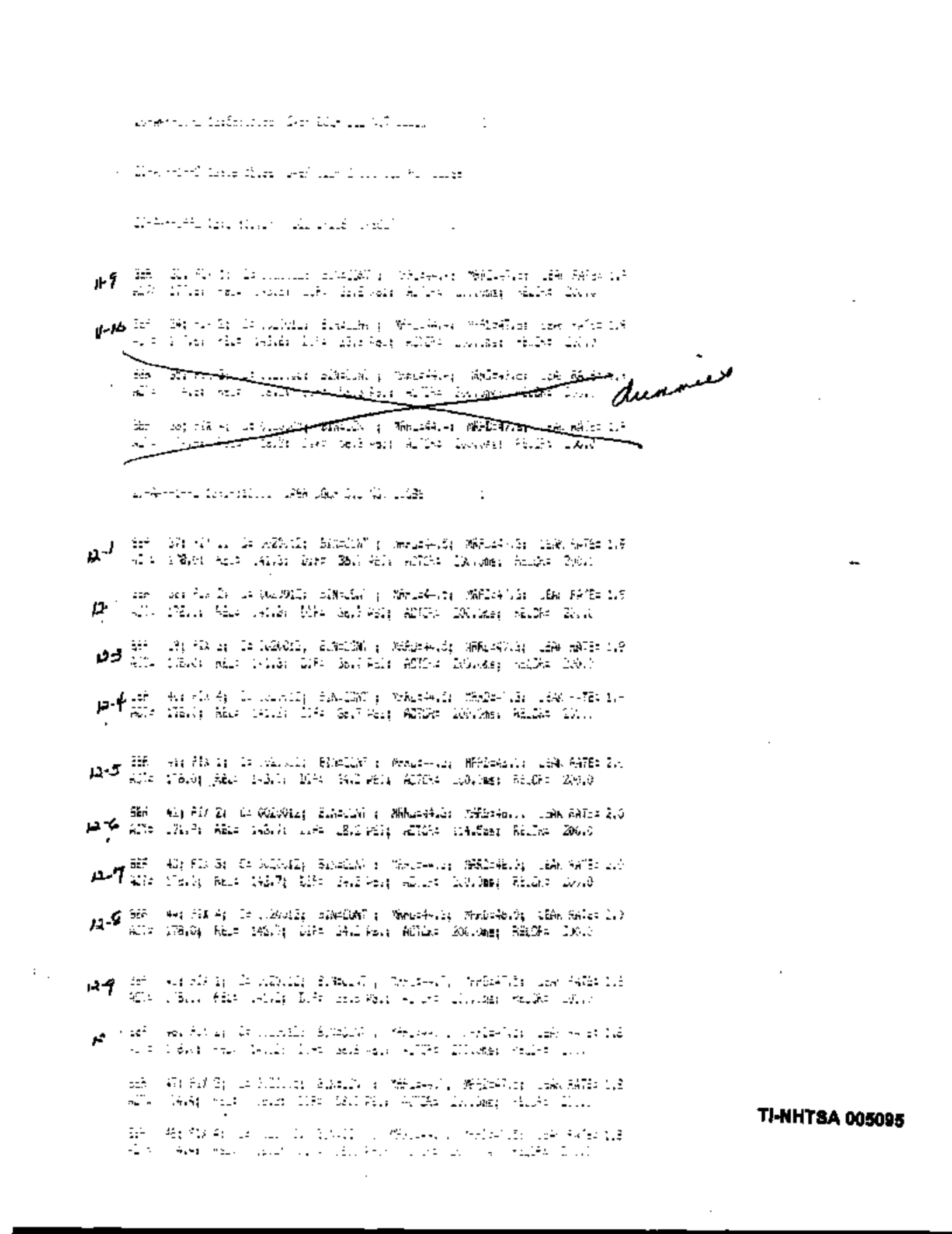
11-4

11-5

11-6

11-7



TI-NHTSA 005095

[illegible]

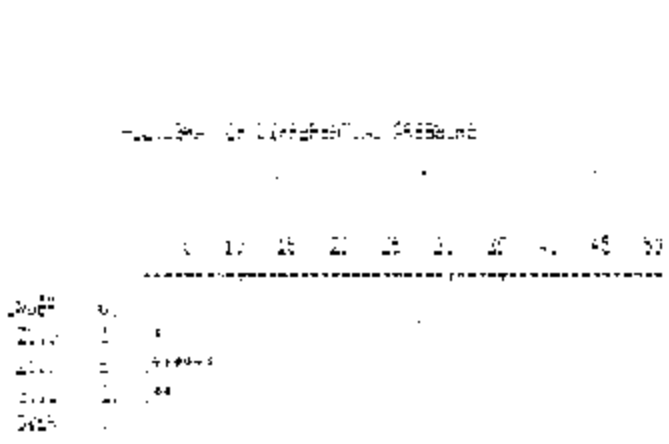
[illegible]

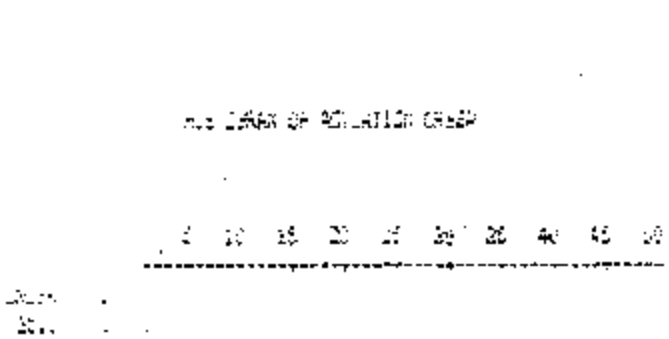
STATISTICS	MEAN	SIGMA	[illegible]
ACTUATION	144.9	[illegible]	0.83
RELEASE	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
DIFFERENTIAL	25.2	[illegible]	[illegible]

HISTOGRAM OF ACTUATION PRESSURE

[illegible]

TI-NHTSA 006096





TITLE: Noryl Base Thermal Shift Characterization to 182 C

PURPOSE: To characterize the amount of shift observed between RT and 182 C to determine if the Light Truck F-series high-temp limit poses potential problems.

SCOPE: The twelve devices from "Group II" of the previous 150 C characterization are used. Since this previous test showed no differences in thermal shift due to color, the data for all four colors has been grouped together. Measurement technique is the same as the previous test.

DATA:

	RT	182 C	Delta
	0.4749	0.4797	0.0048
Tan	0.4750	0.4808	0.0058
	0.4749	0.4804	0.0055
	0.4738	0.4784	0.0046
Black	0.4740	0.4789	0.0049
	0.4744	0.4793	0.0049
	0.4745	0.4793	0.0048
Red	0.4741	0.4800	0.0059
	0.4742	0.4798	0.0056
	0.4758	0.4804	0.0046
Grey	0.4758	0.4815	0.0057
	0.4754	0.4803	0.0049
	avg	-->	0.0052
	std	-->	0.0005
	max	-->	0.0059

RESULTS: Temp shift at 182 C has increased by an additional 2 mils (approx) versus the 150 C characterization. The average of 0.0052 at 182 C compares with the average of .0030 at 150 C; and the max observed (12 data points) of 0.0059 at 182 C compares with 0.0040 (24 data points) at 150 C.

SBO/920808/FILE: NORYL182

SO 920909

Group 2

Base #	Color	Room Temp	150°C	Δ	$\bar{X}_\Delta$	RT	182°C	Δ	$\bar{X}_\Delta$
34-15-13	Tan	.4755	.4780	.0025		.4749	.4797	.0048	
-17	↓	.4756	.4785	.0029	.00267	.4750	.4808	.0058	.00537
-15	↓	.4754	.4780	.0026		.4747	.4804	.0055	
34-15-11	black	.4744	.4770	.0026		.4738	.4784	.0046	
-17	↓	.4747	.4773	.0026	.00260	.4740	.4789	.0049	.00483
-19	↓	.4750	.4776	.0026		.4744	.4793	.0049	
34-15-19	Red	.4753	.4777	.0024		.4745	.4793	.0048	
-20	↓	.4747	.4775	.0028	.00270	.4741	.4800	.0059	.00572
-21	↓	.4751	.4780	.0029		.4742	.4798	.0056	
101-15-23	Grey	.4764	.4789	.0025		.4758	.4804	.0046	
-23	↓	.4760	.4791	.0029	.00270	.4753	.4810	.0057	.00507
-24	↓	.4760	.4787	.0027		.4754	.4803	.0049	
							$\bar{X}$	.0052	
							σ_{-1}	.0005	
							MAX	.0059	

TITLE: Noryl Base Thermal Shift Characterization

PURPOSE: To characterize the amount of shift observed between RT and 150 C for each of the four Noryl colors, to determine if any significant differences exist.

SCOPE: Bases (no terminals) are crimped to "dummy" sensors, which are cut away to expose the cup bump as a reference surface. The measurement from this bump to the floor of the base is recorded. Four Noryl colors (tan, black, red, and gray) are being compared. Only 12 dummy sensors are available, giving 3 test parts per color. Since a greater quantity is desired, two separate lots are run for a total of six data points per base color.

DATA: (average and standard deviation is given below each column of numbers)

Group I

Tan			Black			Red			Gray		
RT	150 C	Delta	RT	150 C	Delta	RT	150 C	Delta	RT	150 C	Delta
0.4755	0.4791	0.0036	0.4750	0.4775	0.0025	0.4751	0.4785	0.0034	0.4760	0.4798	0.0038
0.4751	0.4784	0.0033	0.4753	0.4785	0.0032	0.4751	0.4779	0.0028	0.4765	0.4805	0.0040
0.4752	0.4792	0.0040	0.4747	0.4784	0.0037	0.4750	0.4788	0.0038	0.4762	0.4797	0.0035
0.4753	0.4789	0.0036	0.4750	0.4781	0.0031	0.4751	0.4784	0.0033	0.4762	0.4800	0.0038
0.0002	0.0004	0.0003	0.0002	0.0004	0.0005	5E-005	0.0004	0.0004	0.0002	0.0004	0.0002

Group II

Tan			Black			Red			Gray		
RT	150 C	Delta	RT	150 C	Delta	RT	150 C	Delta	RT	150 C	Delta
0.4755	0.4780	0.0025	0.4744	0.4770	0.0026	0.4753	0.4777	0.0024	0.4764	0.4789	0.0025
0.4756	0.4785	0.0029	0.4747	0.4773	0.0026	0.4747	0.4775	0.0028	0.4762	0.4791	0.0029
0.4754	0.4780	0.0026	0.4750	0.4776	0.0026	0.4751	0.4780	0.0029	0.4760	0.4787	0.0027
0.4755	0.4782	0.0027	0.4747	0.4773	0.0026	0.4750	0.4777	0.0027	0.4762	0.4789	0.0027
8E-005	0.0002	0.0002	0.0002	0.0002	0	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002

Combined

Tan			Black			Red			Gray		
RT	150 C	Delta	RT	150 C	Delta	RT	150 C	Delta	RT	150 C	Delta
0.4755	0.4791	0.0036	0.4750	0.4775	0.0025	0.4751	0.4785	0.0034	0.4760	0.4798	0.0038
0.4751	0.4784	0.0033	0.4753	0.4785	0.0032	0.4751	0.4779	0.0028	0.4765	0.4805	0.0040
0.4752	0.4792	0.0040	0.4747	0.4784	0.0037	0.4750	0.4788	0.0038	0.4762	0.4797	0.0035
0.4755	0.4780	0.0025	0.4744	0.4770	0.0026	0.4753	0.4777	0.0024	0.4764	0.4789	0.0025
0.4756	0.4785	0.0029	0.4747	0.4773	0.0026	0.4747	0.4775	0.0028	0.4762	0.4791	0.0029
0.4754	0.4780	0.0026	0.4750	0.4776	0.0026	0.4751	0.4780	0.0029	0.4760	0.4787	0.0027
0.4754	0.4785	0.0031	0.4749	0.4777	0.0029	0.4751	0.4781	0.0030	0.4762	0.4795	0.0032
0.0002	0.0005	0.0005	0.0003	0.0006	0.0004	0.0002	0.0004	0.0005	0.0002	0.0006	0.0006

RESULTS: It can be noted that Group II seemed to shift less than Group I overall. No hypothesis has been generated yet to explain this. Note the increase in the st dev when the two groups are combined, relative to either group alone. Comparisons of the different colors within each group show no significant difference attributable to color. The maximum observed shift was .0040", which occurred twice (1-tan and 1-gray), while the overall average shift was .0030".

SBO/920807/FILE: NORYL

SBO 720807

PRESSURE SWITCH DATA Form 21605 TEST NO. 302-15-24

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
7705 Basis (Noryl)		Steve Officer	
PERFORMED BY	DATE STARTED	DATE COMPLETED	APPROVED BY
Jeffrey DiBenedetto	930727		

PROJECT TITLE:

CUSTOMER:

PURPOSE OF TEST: To insure that Noryl pigmented with different colors have similar thermal expansion properties

PROCEDURE: Crimp leads to dummy sensors. Measure flow. Cut loop to have floor of room temp and 150°C.

group 1

Basis #	Color	Room Temp	150°C	Δ	$\bar{X}_D$
302-15-01	Tan	.4755	.4791	.0036	
-02	↓	.4751	.4784	.0033	.00363
-03	↓	.4752	.4792	.0040	
302-15-04	Black	.4750	.4775	.0025	
-05	↓	.4753	.4785	.0032	.00313
-06	↓	.4747	.4784	.0037	
302-15-07	Red	.4751	.4795	.0044	
-08	↓	.4751	.4779*	.0028	.00333
-09	↓	.4750	.4788	.0038	
302-15-10	Grey	.4760	.4799	.0038	
-11	↓	.4765	.4805	.0040	.00377
-12	↓	.4760	.4797	.0035	

* ERRONEOUS - ACTUAL IS .4779

(OVER)

Group 2

Bale #	Color	Room Temp	150°C	Δ	$\bar{X}_D$				
304-15-13	Tan	.4755	.4780	.0025					
-14	↓	.4756	.4785	.0029	.00267				
-15	↓	.4754	.4780	.0026					
30-15-11	black	.4744	.4770	.0026					
-12	↓	.4747	.4773	.0026	.00260				
-19	↓	.4750	.4776	.0026					
304-K-19	Red	.4753	.4777	.0024					
-20	↓	.4747	.4775	.0028	.00270				
-21	↓	.4751	.4780	.0029					
301-5-22	Grey	.4764	.4789	.0025					
-23	↓	.4762	.4791	.0029	.00270				
-24	↓	.4760	.4787	.0027					

QUOTE ANALYSIS

PROJECT DEVICE 77PS PART NAME JS12/SNUBBER PART# EX3355-113 EAU QTY _____

TARGET OR CURRENT COST _____

BYER P. KOTCH DES MFG ENG DALE SOGGE

		SUPPLIER 1	SUPPLIER 2	SUPPLIER 3
	NAME			
	CATEGORY	S OR L	S OR L	S OR L
	NAME	ADAPTO	POHL MAN	CSM
TOOLING $		—	$ 23,900.	$ 2,800.
LEAD TIME		8-10 MOS.		10 WKS
PIECE PRICE (EACH)	VOLUME 100 K		1.39	.720
RECOMMENDED BUY QTY	500 K		1.31	.688
MONTHLY / QUARTERLY / SEMI ANNUALLY / ANNUALY / OTHER SPECIFY	1,000 K	.907 EA	1.29	
	2,000K	.847 EA	1.27	
ANNUAL SAVINGS		4-29-92	4-23-92	4-20-92
PAYBACK NOTE: IF NO PAYBACK 3YR COST	YEARS			
	IRR			
FACTORS	MATERIAL COST $/K	MT'L CHANGE TO 12L14 AND 1117 BI AS OPTIONS.		MT'L 12L14
	PRECIOUS METAL CONTENT			
	CAVITIES			
	LIFE OF TOOL			
	CAPACITY / HR			
EXCEPTIONS OR COMMENTS		SUBJECT TO LONG TERM PURCHASE AGREEMENT.		NEED: 12L14 .010" RUNOUT - CHAM FER TO THREAD. .006" ON LENGTH

OTHER SUPPLIERS WHO NO QUOTED	
SUPPLIER	REASON
PEERLESS	NONE GIVEN

RECOMMENDATION AND REASONS

TI-NHTSA 005103

RANGES: 2.250V 10.00V 3.750V
OFFSETS: 0.0V 0.0V 0.0V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN

2.5 psi/div
1.5 mil/div

DISC FORM

TI-NHTSA 005104

RANGES: 2.250V 10.00V 3.750V
OFFSETS: 0.0V 0.0V 0.0V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN

2.5 psi/piv
1-5 mft/piv

TI-NHTSA 005106

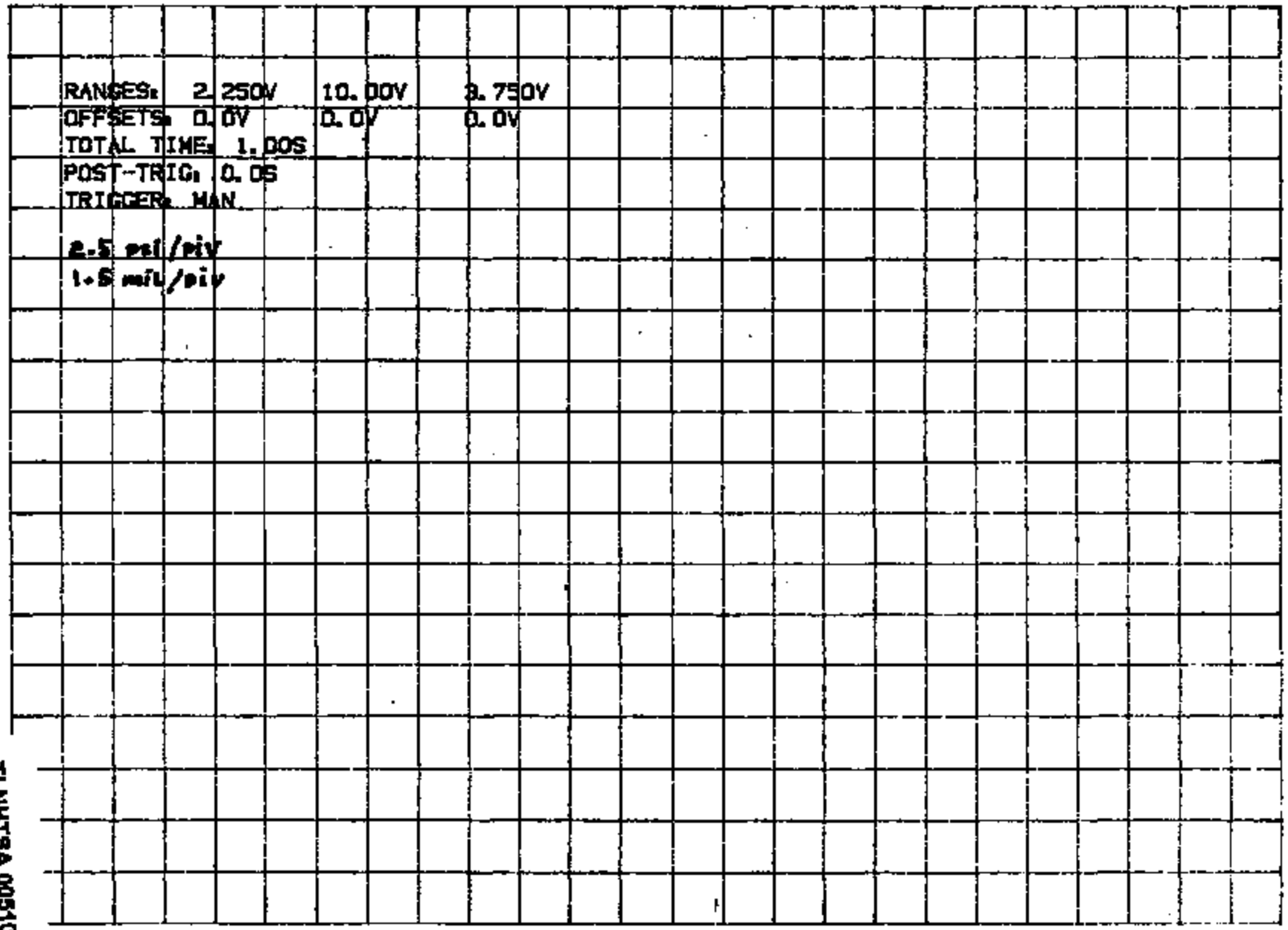
DISC FORM

RANGES: 2.250V 10.00V 2.750V
OFFSETS: 0.0V 0.0V 0.0V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN

2.5 psi/div
1.5 mil/div

TI-NHTSA 000106

DISC FORM



RANGES: 2.250V 10.00V 3.750V
OFFSETS: 0.0V 0.0V 0.0V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN

e-5 psi/div
1-5 mil/div

TI-NHTSA 005108

DISC FORM

RANGES: 2.250V 10.00V 3.750V
OFFSETS: 0.0V 0.0V 0.0V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN

2.5 psi/div
1.5 mil/div

DISC FORM

TI-NHTSA 006109

RANGES: 2.250V 10.00V 3.750V
OFFSETS: 0.0V 0.0V 0.0V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN

2.5 psi/div
1.5 mil/div

TI-NHTSA 005110

DISC FORM

RANGES:	2.250V	10.00V	3.750V
OFFSETS:	0.0V	0.0V	0.0V
TOTAL TIME:	1.00S		
POST-TRIG:	0.0S		
TRIGGER:	MAN		

6.5 psi/div

1-5 mil/div

TI-NHT8A 00511

DISC FORM

RANGES: 2.250V 10.00V 9.750V
OFFSETS: 0.0V 0.0V 0.0V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN

2.5 psi/div
1.5 mil/div

RANGES: 2.250V 10.00V 3.750V
OFFSETS: 0.0V 0.0V 0.0V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN

2.5 psi/piV
1.5 mil/piv

DISC FORM

TI-NHTSA 005113

RANGES: 2.250V 10.00V 3.750V
OFFSETS: 0.0V 0.0V 0.0V
TOTAL TIME: 1.000S
POST-TRIG: 0.0S
TRIGGER: MAN

2.5 psi/div
1.5 mil/div

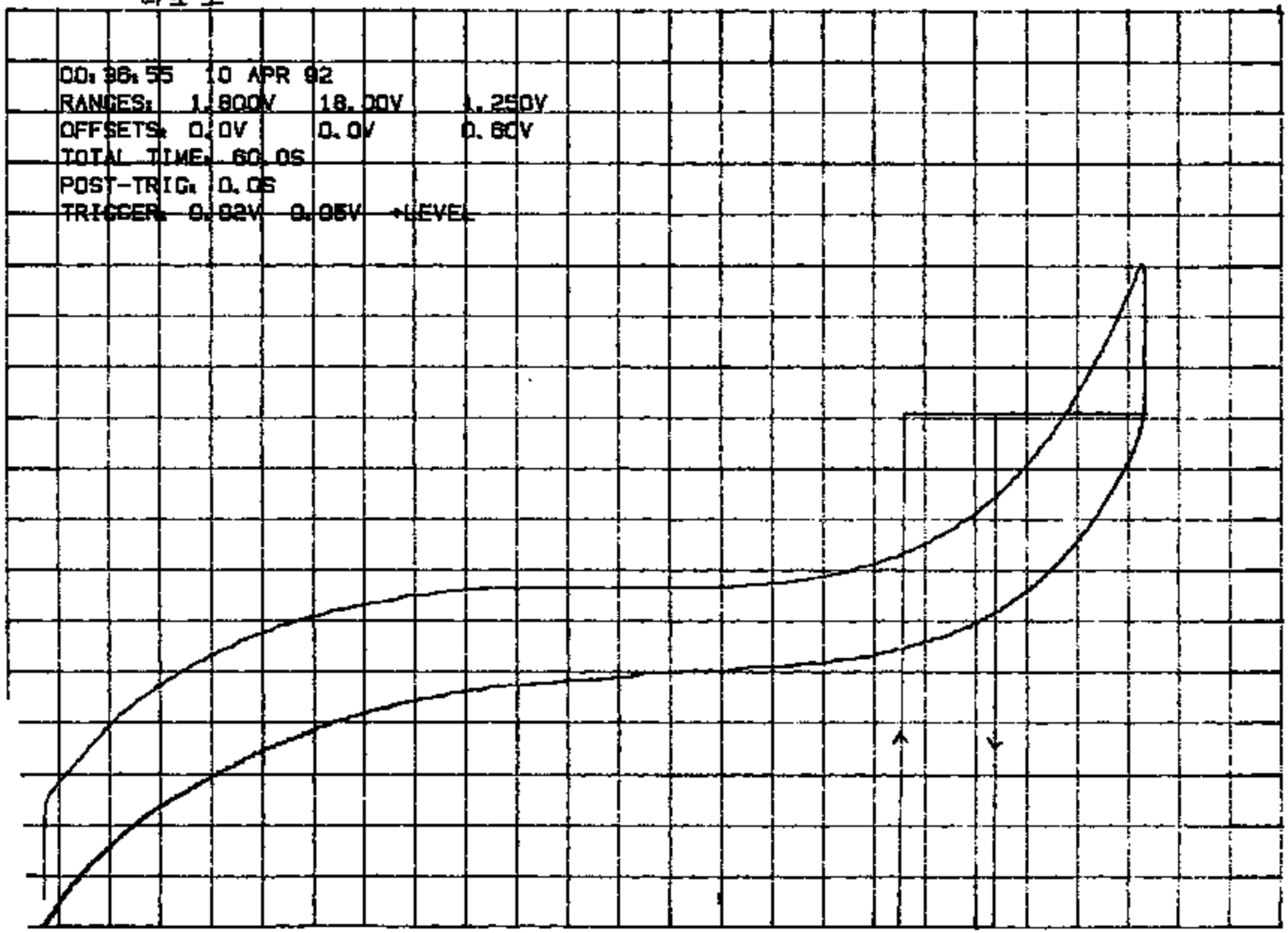
TI-NHTSA 005114

DISC FORM

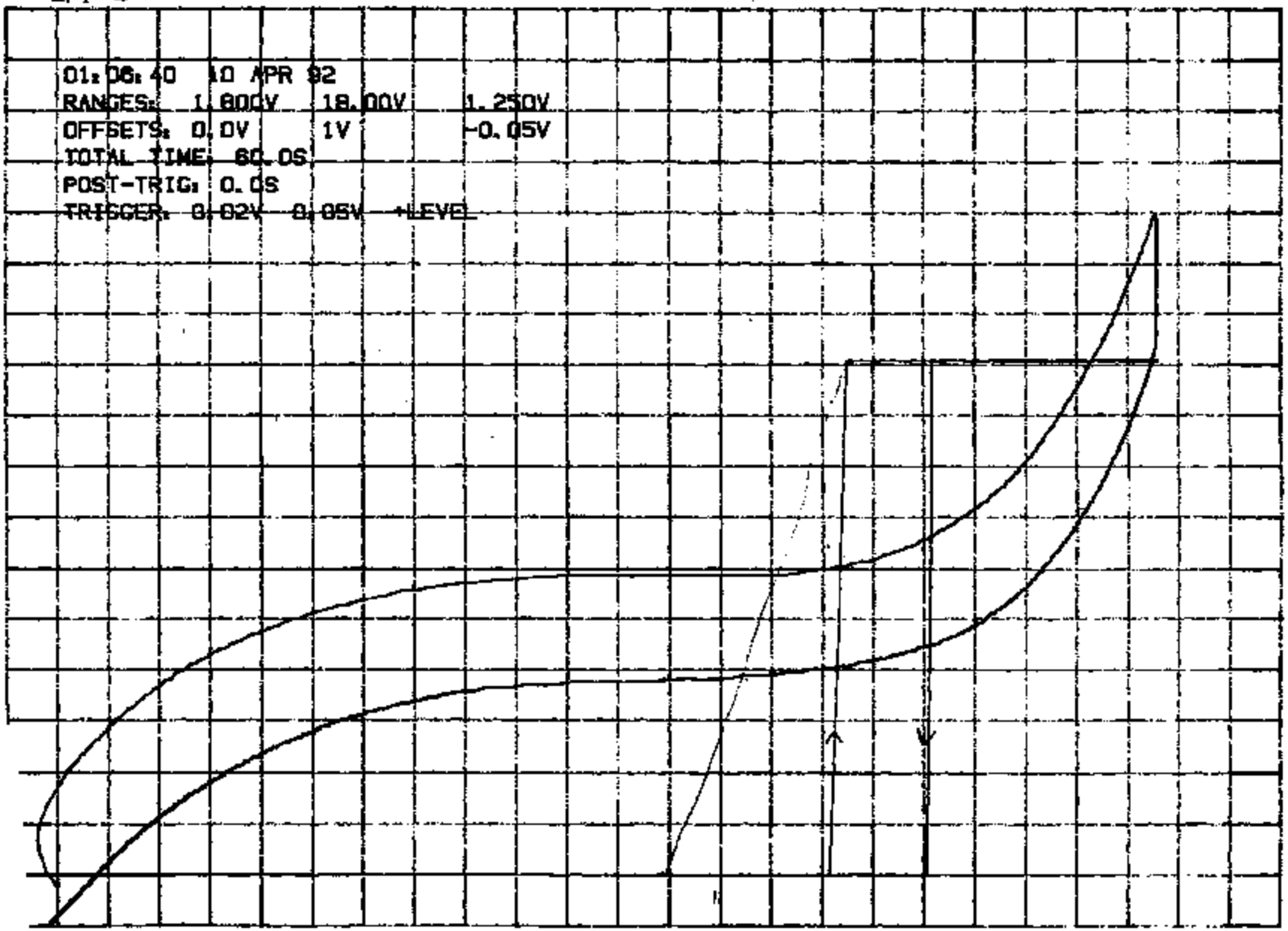
RANGES: 2.250V 10.00V 3.750V
OFFSETS: 0.0V 0.0V 0.0V
TOTAL TIME: 1.00S
POST-TRIG: 0.0S
TRIGGER: MAN

2.5 psi/div
1.5 mil/div

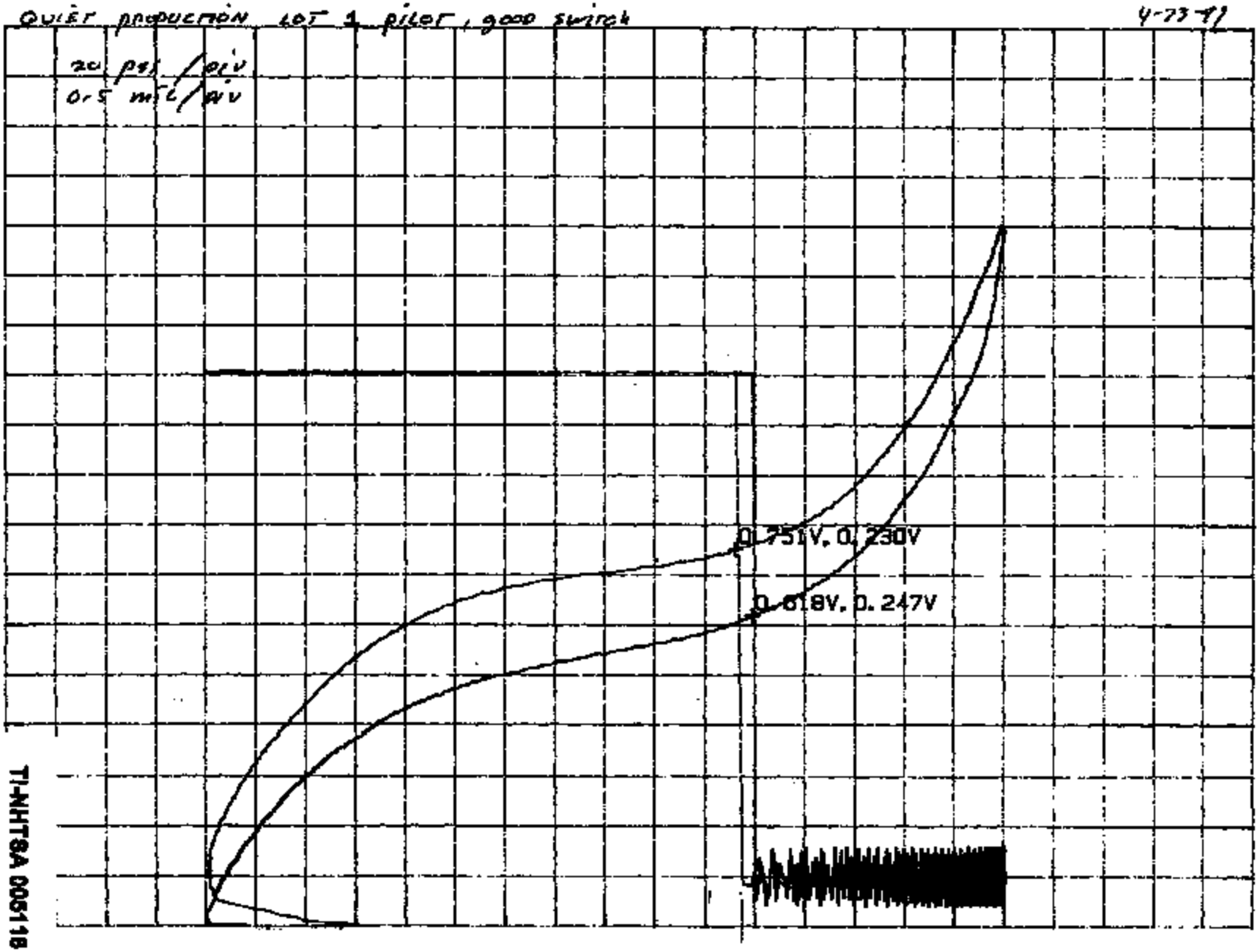
LT4-1



LT 1-2

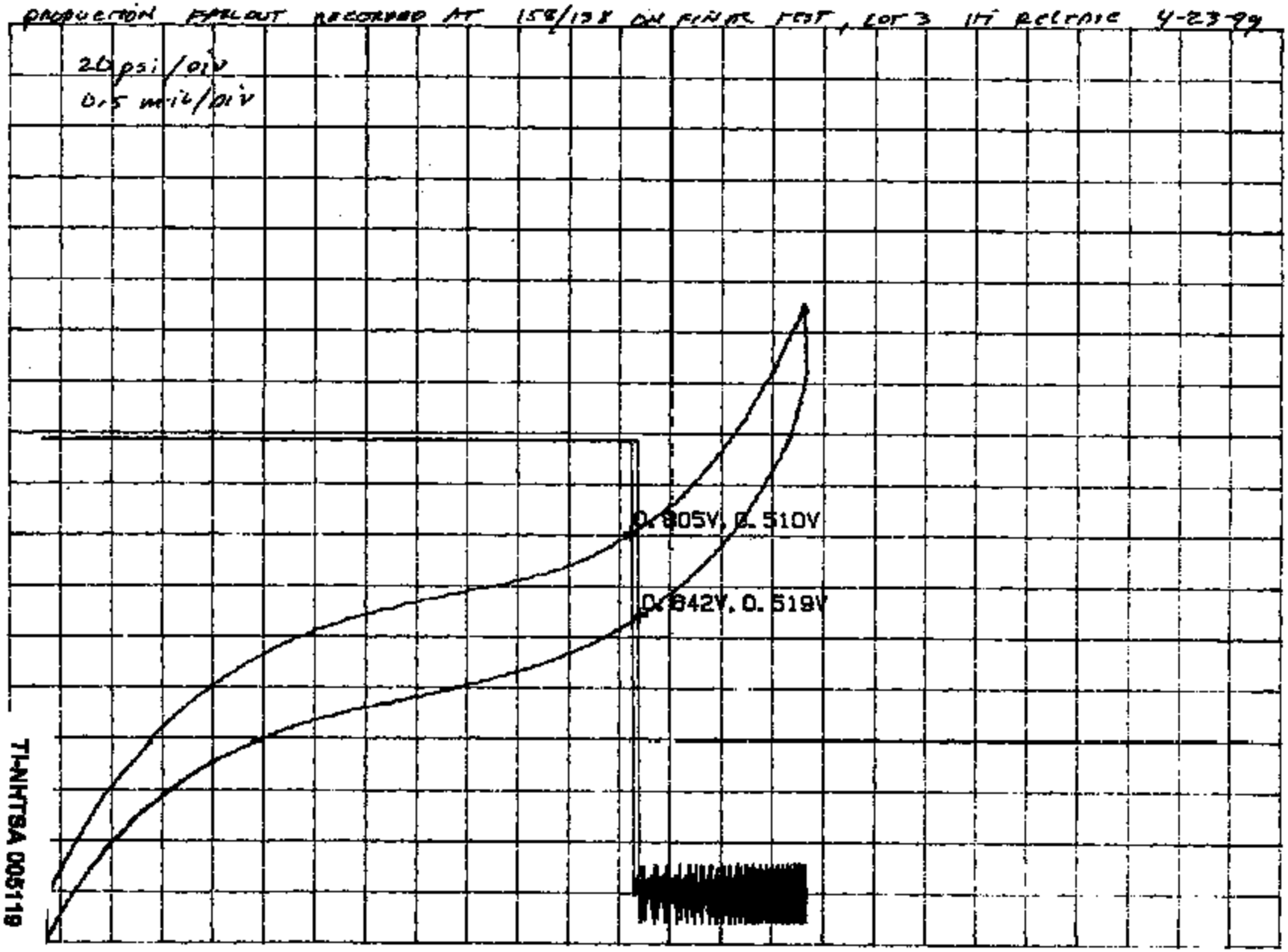


Quiet production lot 1 pilot, good switch



TI-NHTSA 006118

PRODUCTION FALLOUT RECORDED AT 158/138, LOT 3, IM RELEASE 4-23-92



DRAWINGS AVAILABLE UPON REQUEST

QT= Quiet switch

DISK RECORD

TEST NAME: Hypervelic sound test
TEST DATE: 4-27-92
RECORDED BY: DAEC

MASTER TEST NO.: QT-1
SAMPLE ORDER NO.:
SENSOR NO.:

OTHER INFORMATION:

Disc # 1

RECORD #	SENSOR #	Outputs: Kistler	TI	p-p psi Date	COMMENTS
1-1					
2					
3					
4					
5					
6					
7					
8					
9	P2	50 psi/V	(production-Noisy)		P2, Bleed, Resistive load
10	P1				No Bleed
11	P1				BLEED
12	Q1		(quiet switch)		No Bleed
13	Q1				Bleed
14	Q2				No Bleed
15	Q2				Bleed
16	Steves #2			38.8	Bleed Rubber T-Hole noisy disc - significant number of
17	Steves #1			ZERO	Bleed Fibre Quiet disc Epic snubber - zero noise on card
18	Steves #3			ZERO	Bleed Hex steel snubber quiet disc
19	2-hole Rubber		-.522 V	27.6	Bleed
20	Quiet disc c/snubber			ZERO	Bleed

Channel A
4 volts full scale
10 V power supply
Differential set-up

Channel B
2 volts full scale
Trig on B

Kistler
short time constant
50 psi / volt

DISK RECORD

TEST NAME: Hydraulic sand test
TEST DATE: 4-27-92
RECORDED BY: Dave

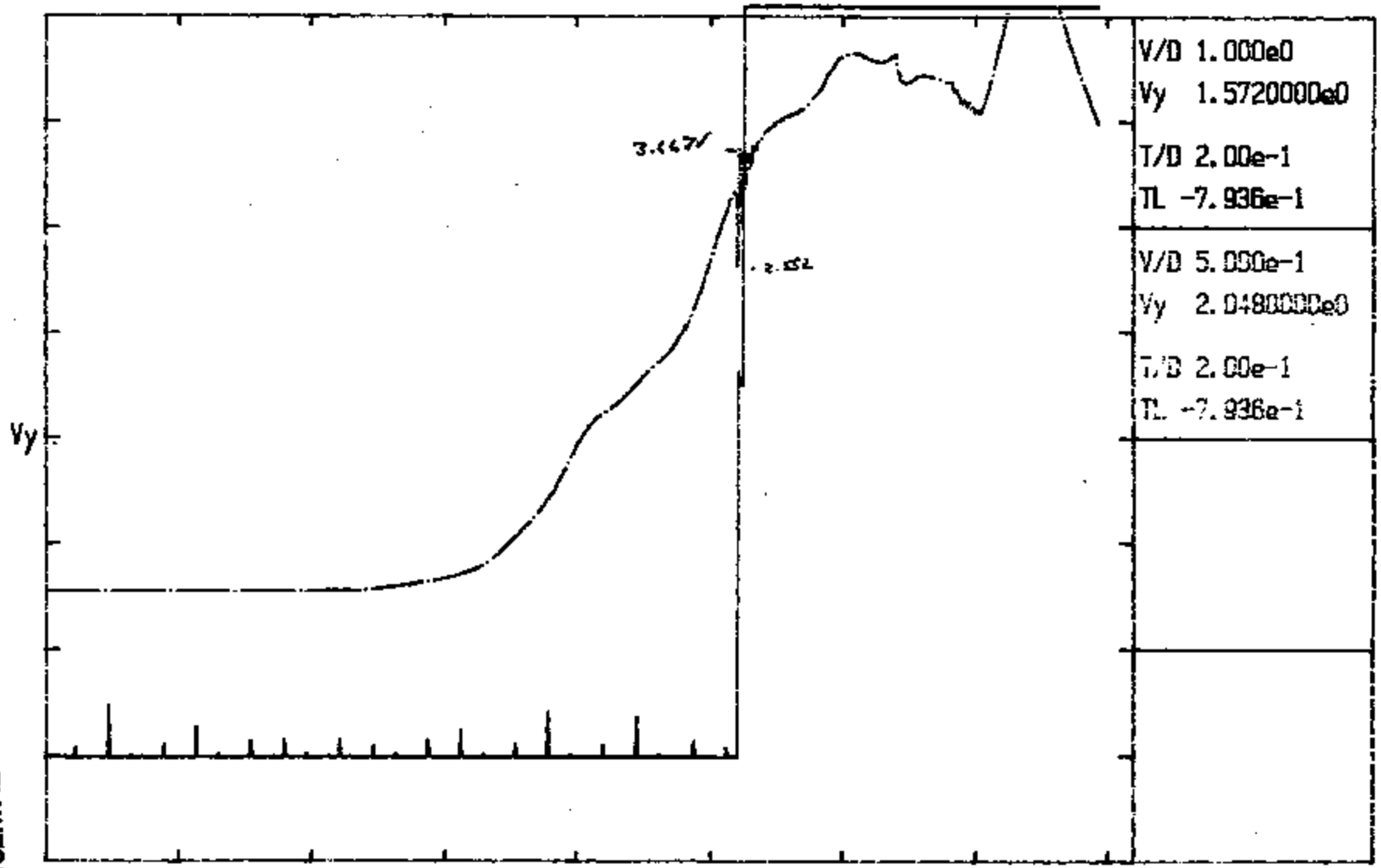
MASTER TEST NO.: 92-1
SAMPLE ORDER NO.:
SESSION NO.:

OTHER INFORMATION:

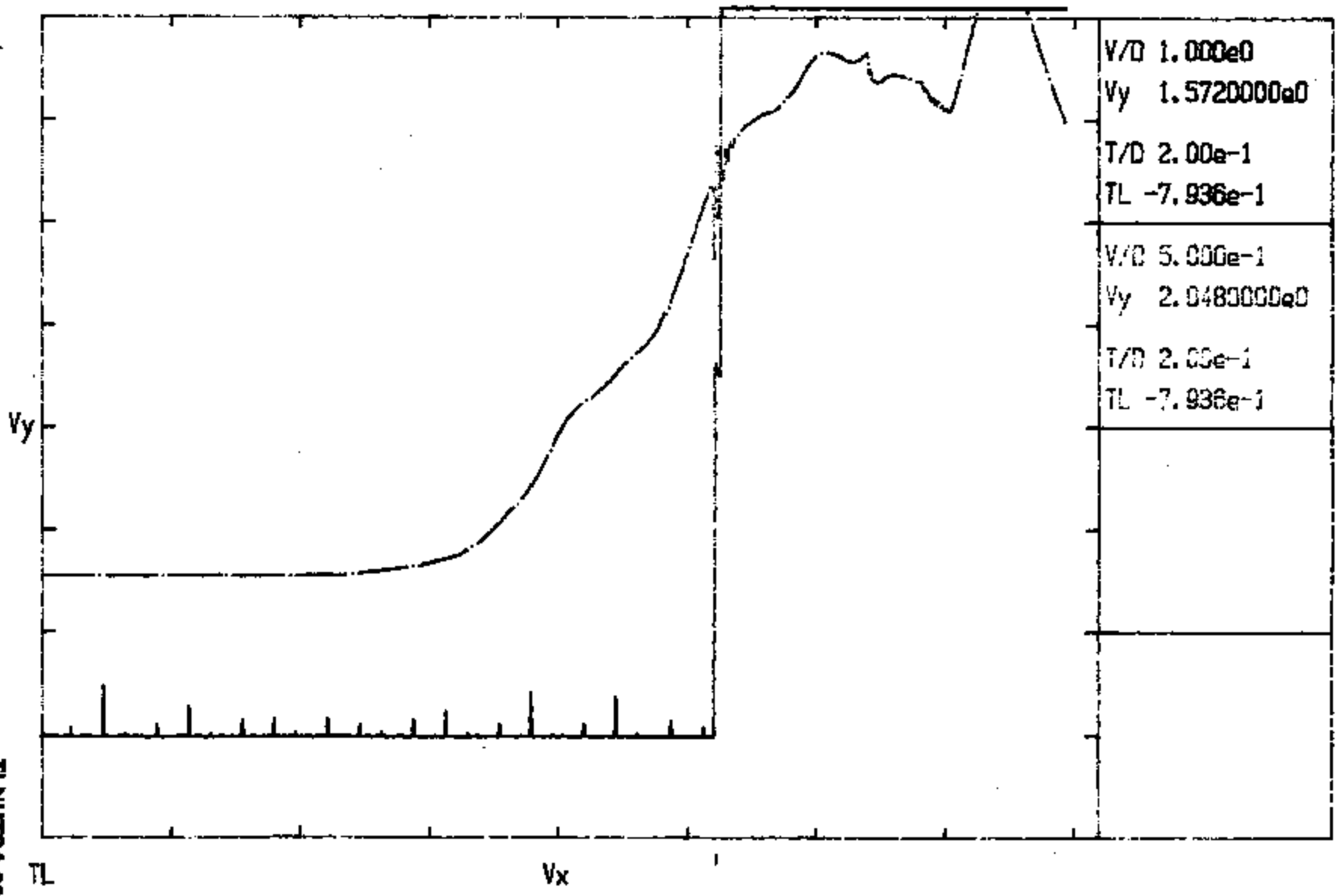
disc # 2

RECORD #	SENSOR #	Output → Kistler	T.I.	Date	COMMENTS
1	T1	Noisy	Production	truck	94psi
2	AA13	QUIET	"	TRUCK	
3	AA13				
4	AA13				
5	Hystat				52psi
6	Hystat				35psi

peak to peak

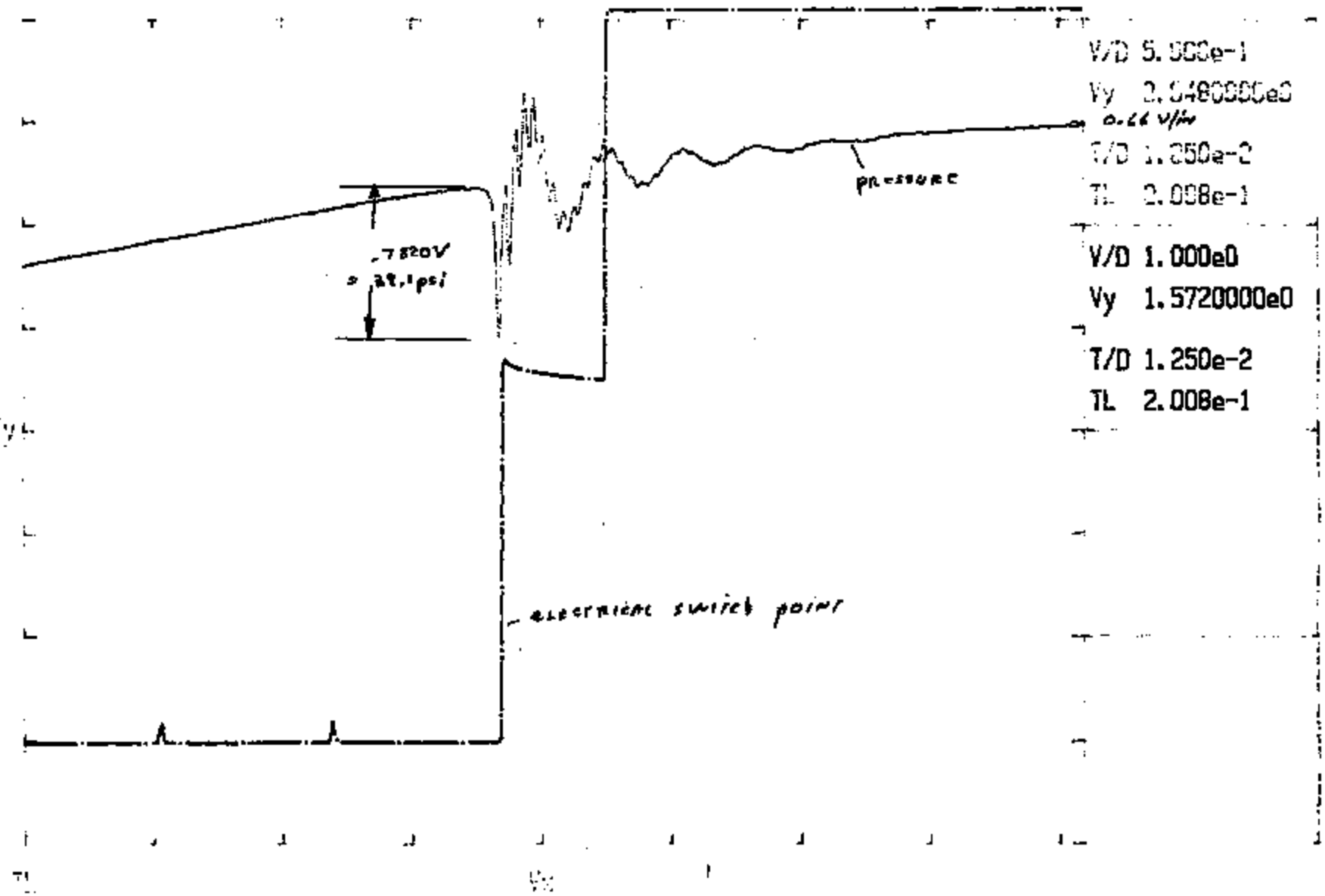


RECORD 1, every point ... 200ms, INT

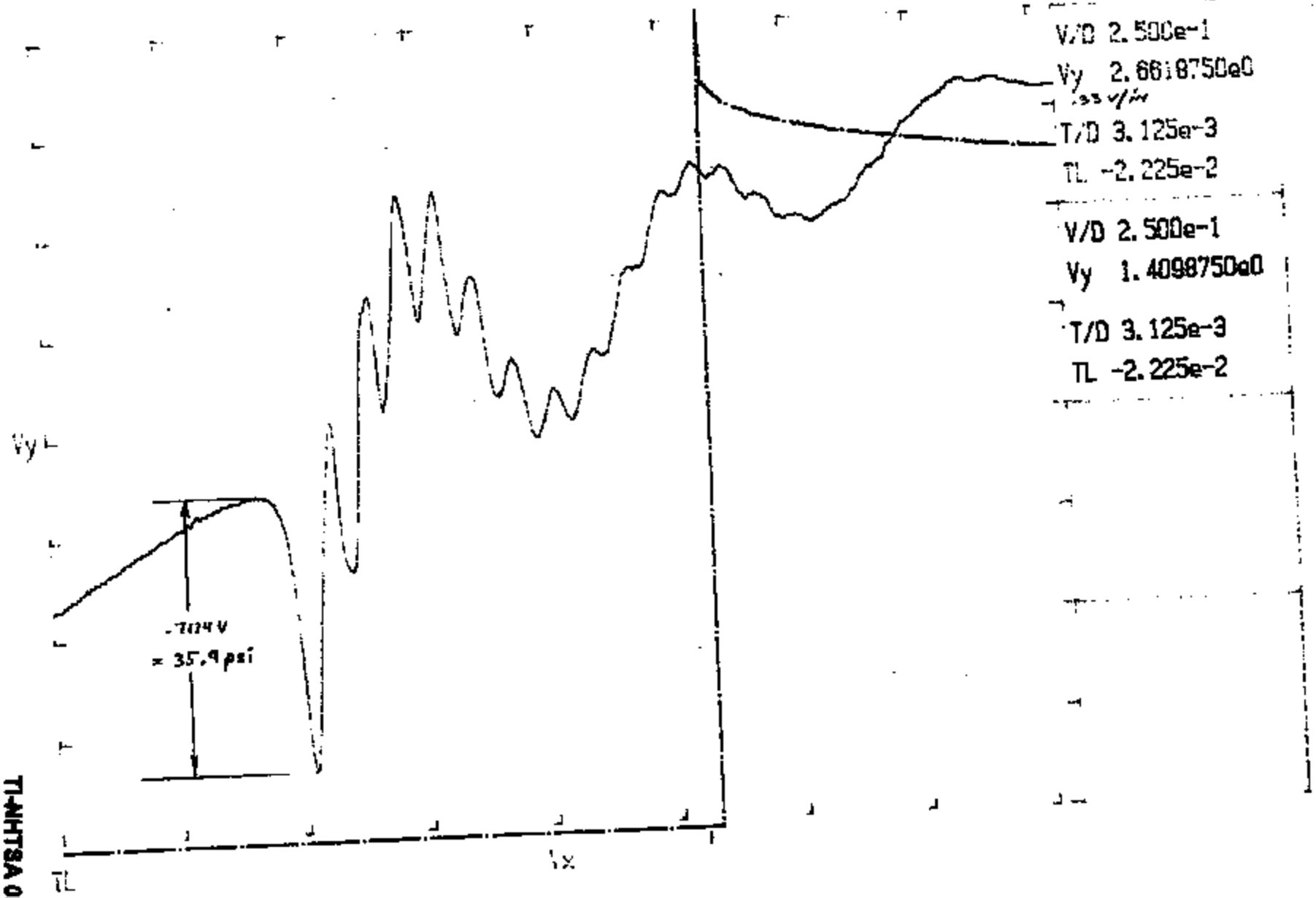


TI-NHTBA 005128

RECORD 1, NOISY production switch, pressure side
20 us/point

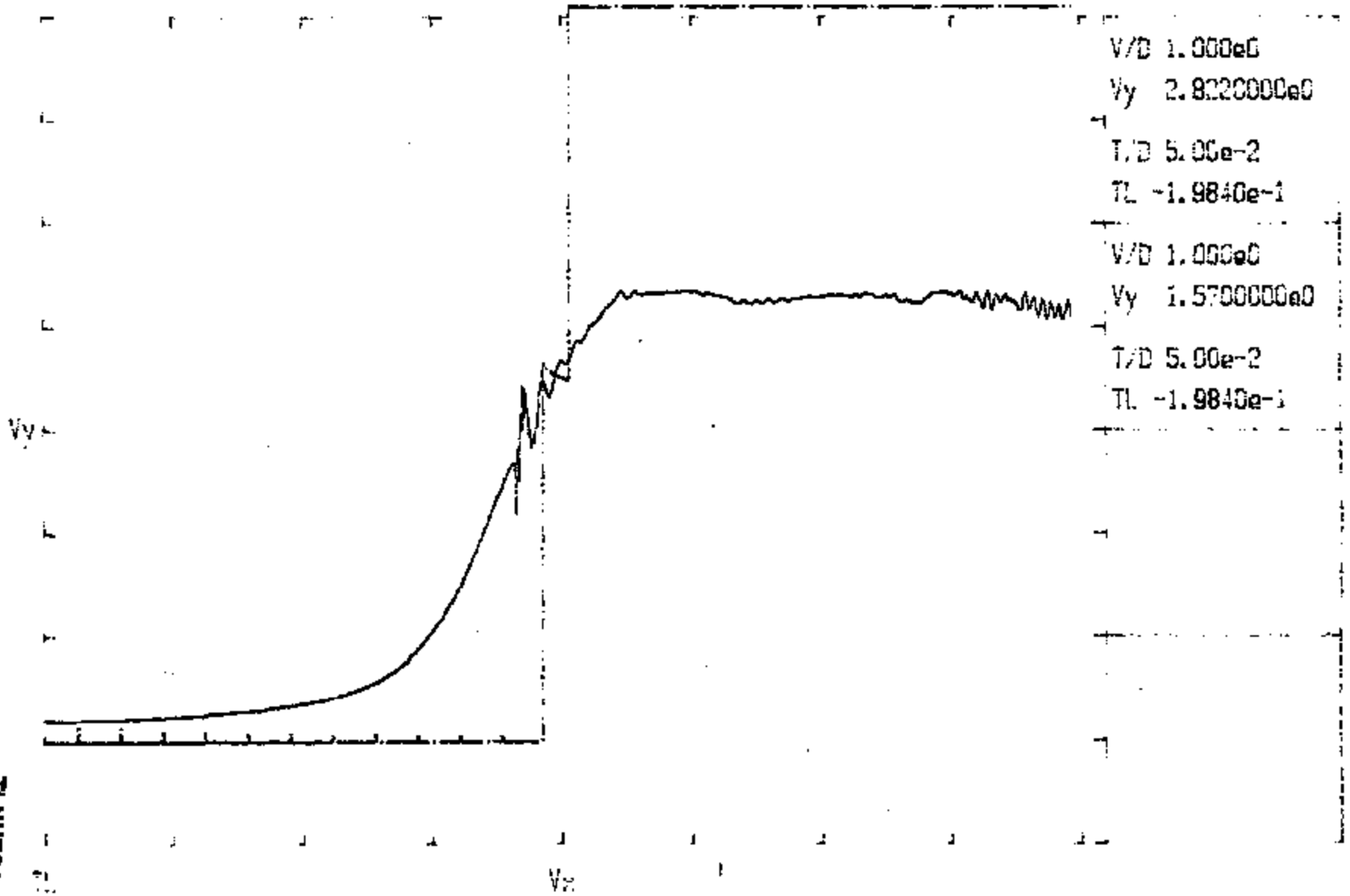


RECORD of [illegible] pressure [illegible] passing ca [illegible]
50 ms/div

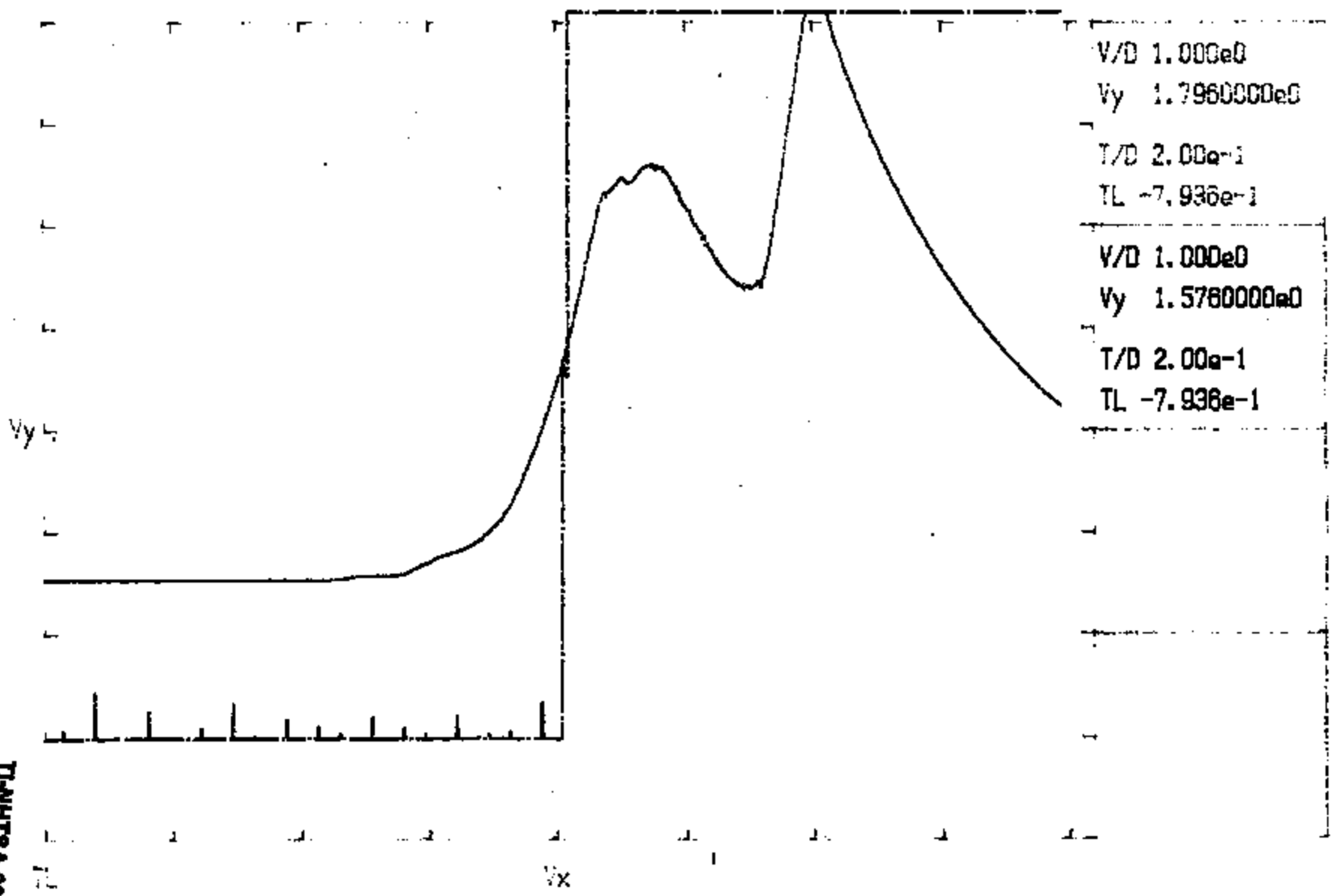


TI-AHTSA 00313

RECORD 4, NOISY PROPULSION SWITCH, PASSENGER SIDE
50MS/PT EXPANDED

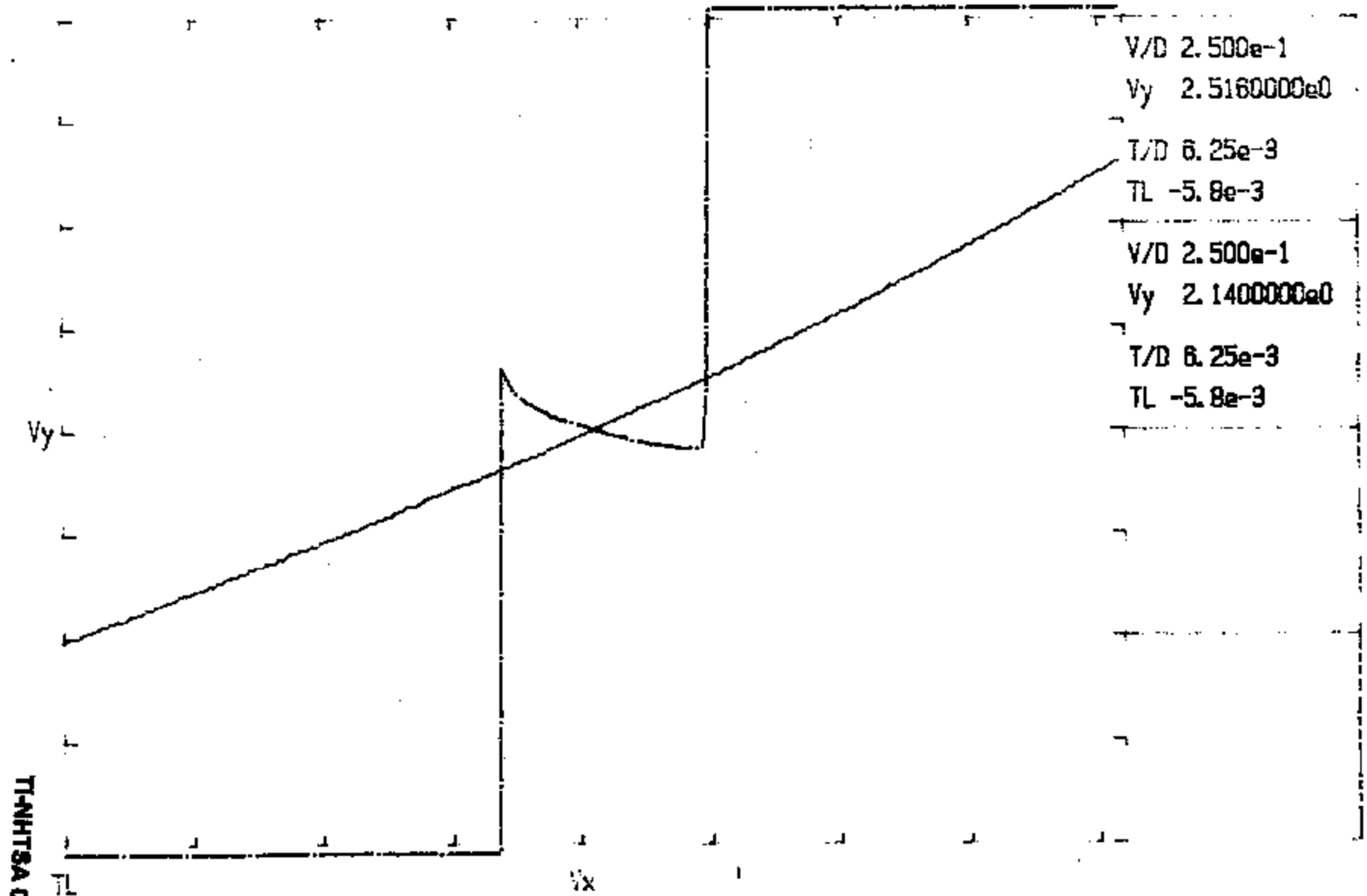


RECORD 5, QUIET PASSENGER CAR SWEEP
200MS/F



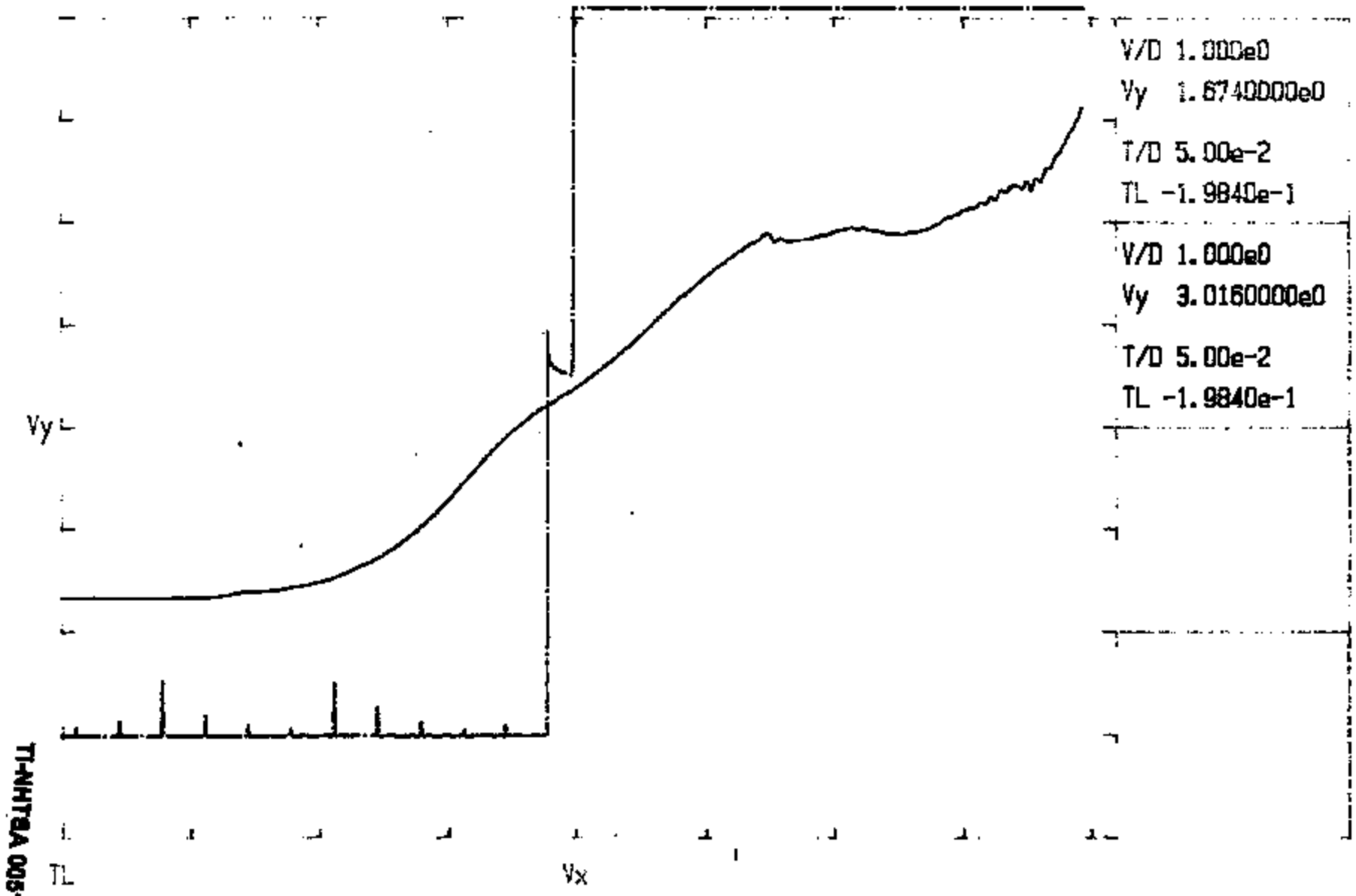
TI-NHTSA 005132

KEEURD = 4 WAY passenger door system
2 doors/ air expanded



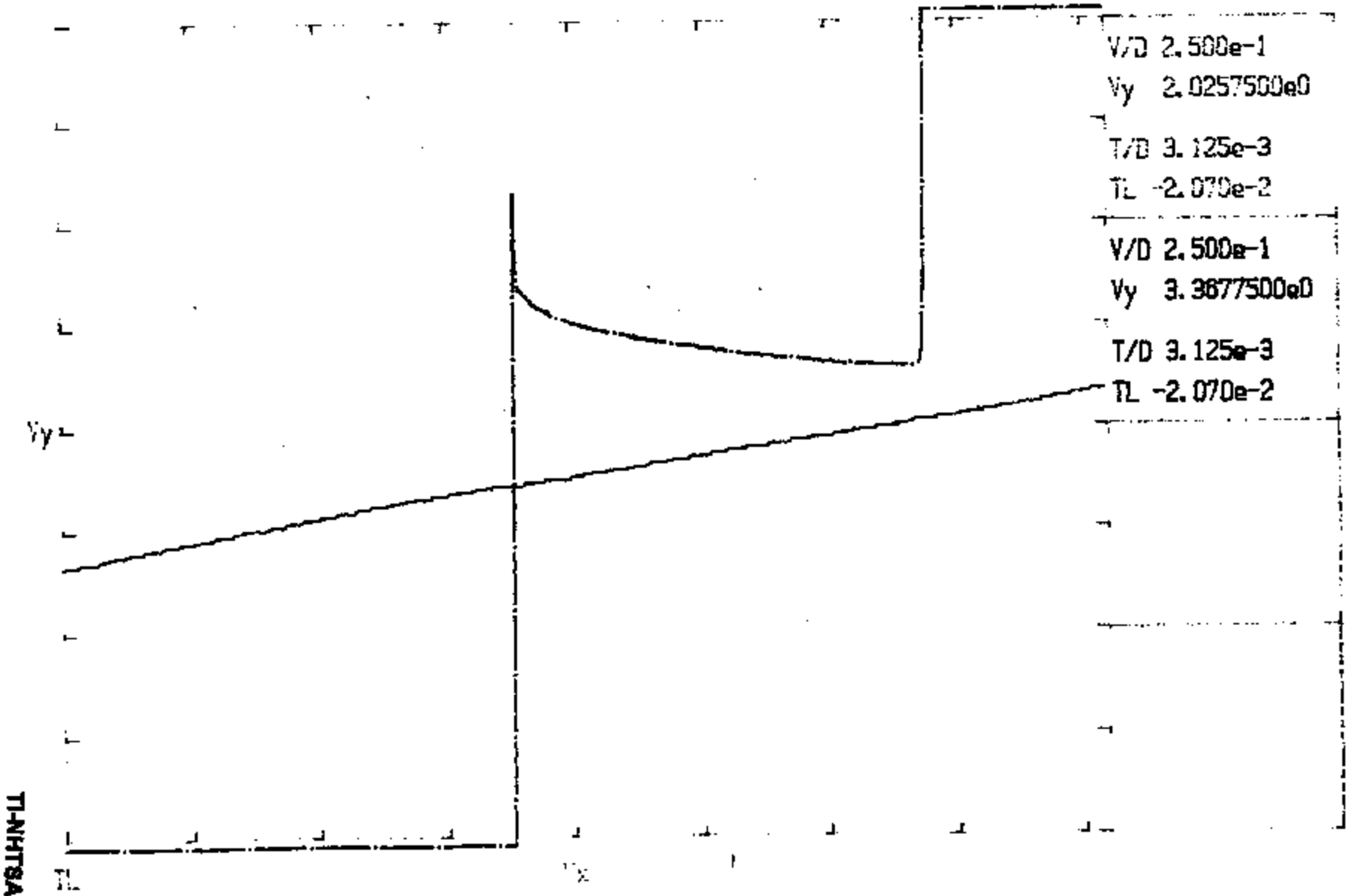
TL-NHTSA 006133

RECORD 01, QUIET PASSENGER CAR SYSTEM
50 MPH +1



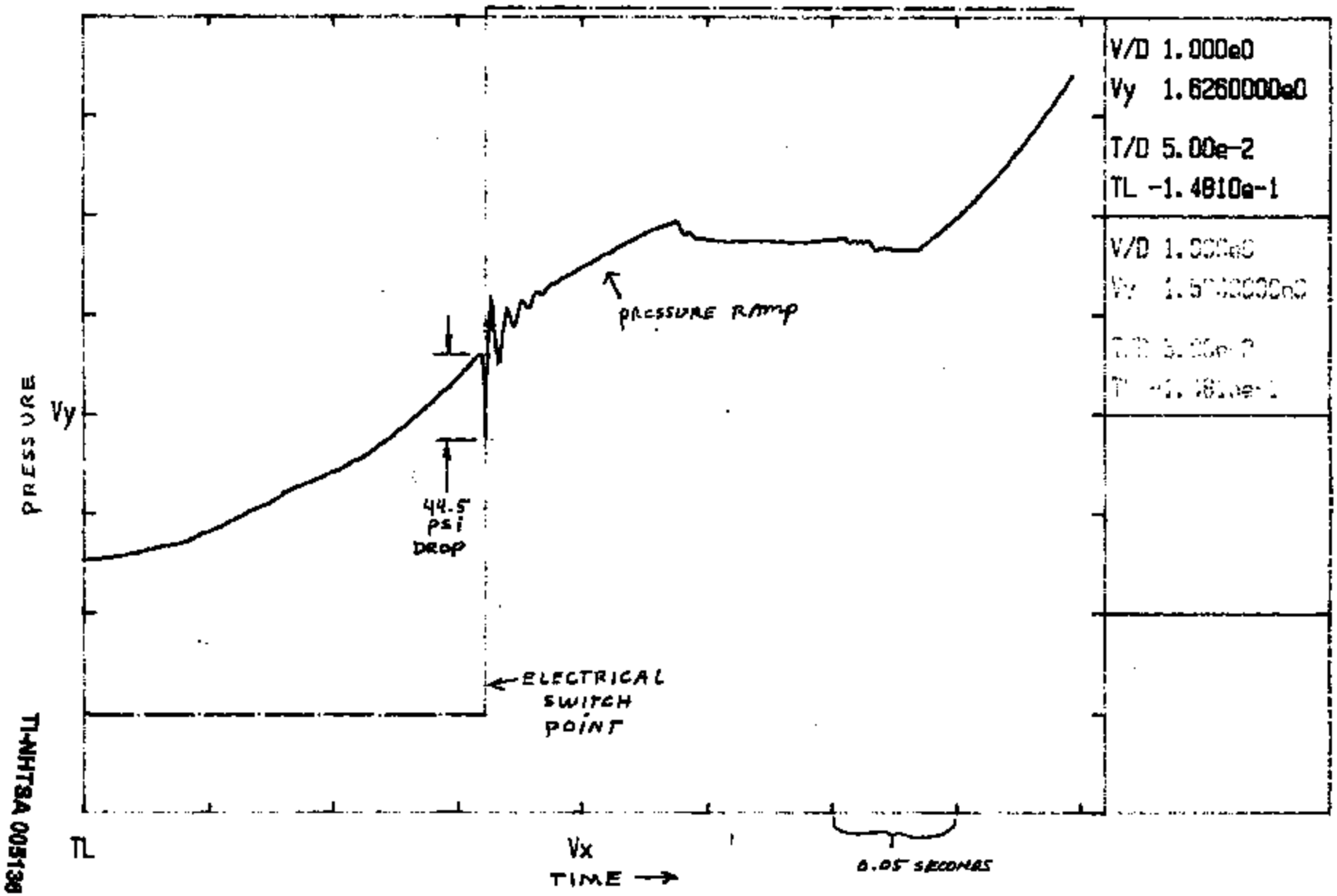
TI-NHTSA 005134

RECORD OF ORAL PRESENTATION FOR SAFETY COMPLAINT EXPANDED



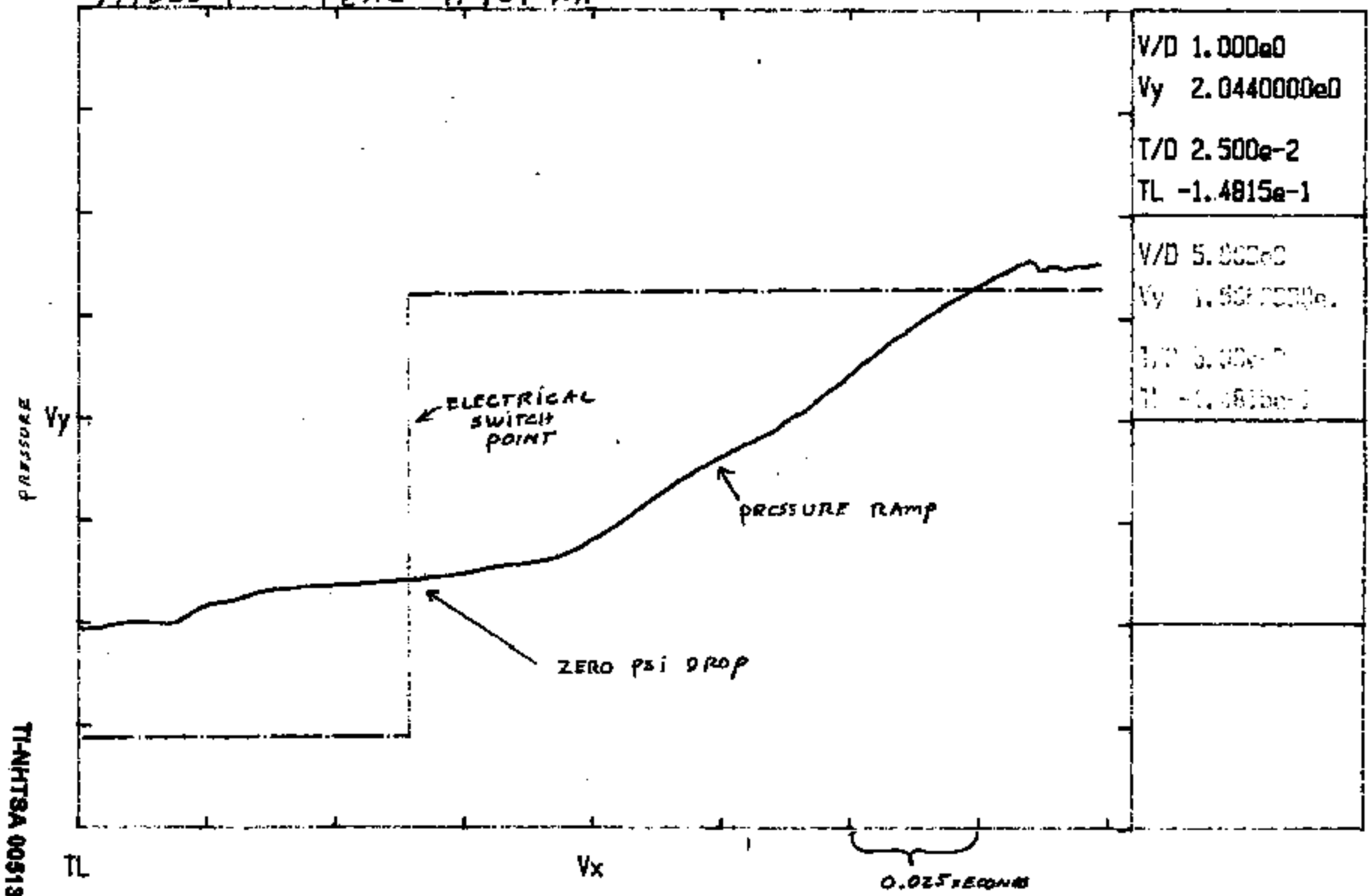
RECORD 9

T7PS2-1 F2VC-9F924-AB



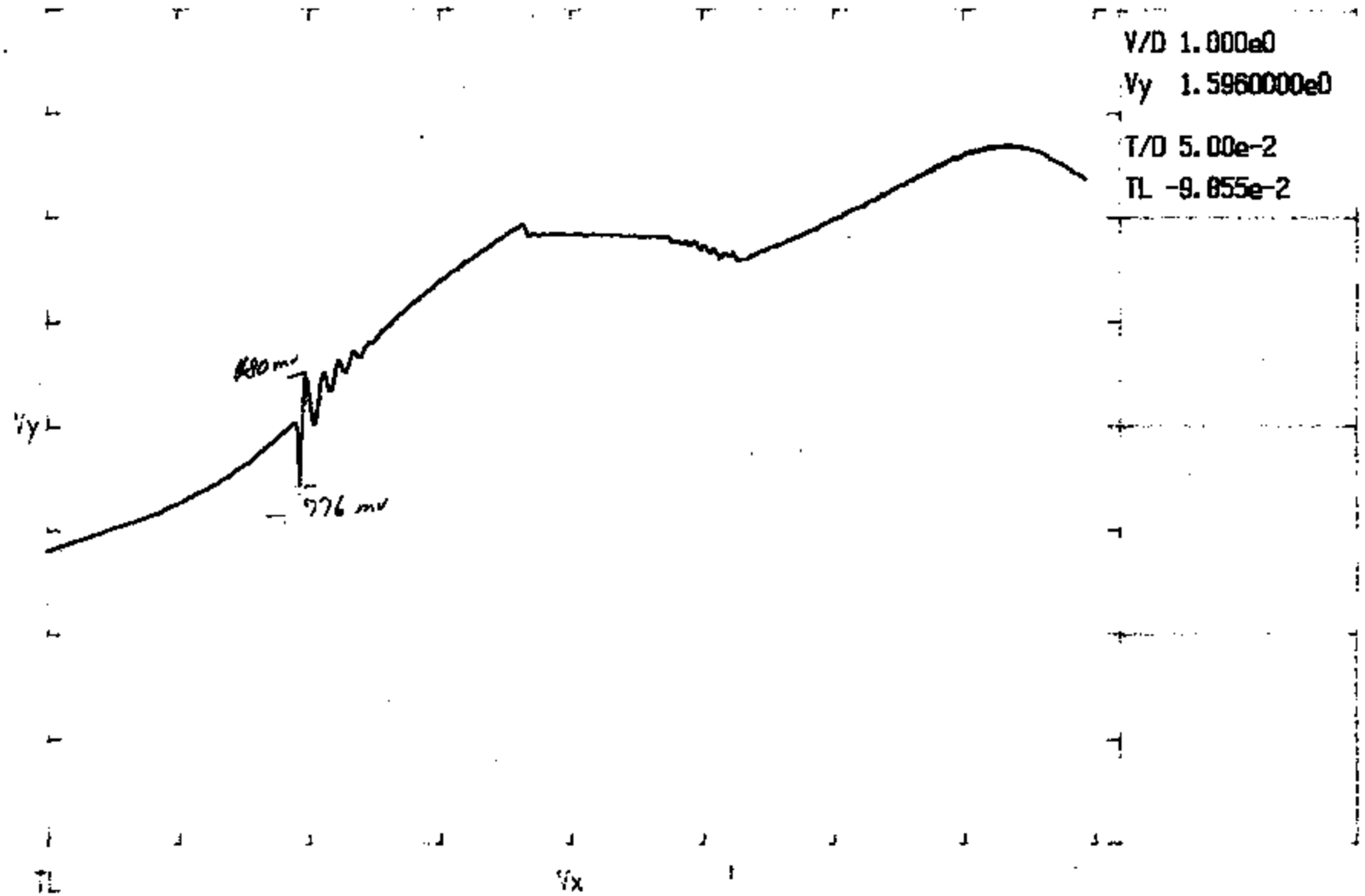
RETRO IS QUIET P. MSR CAR

77PSL3-1 F2AC-9F924-AA



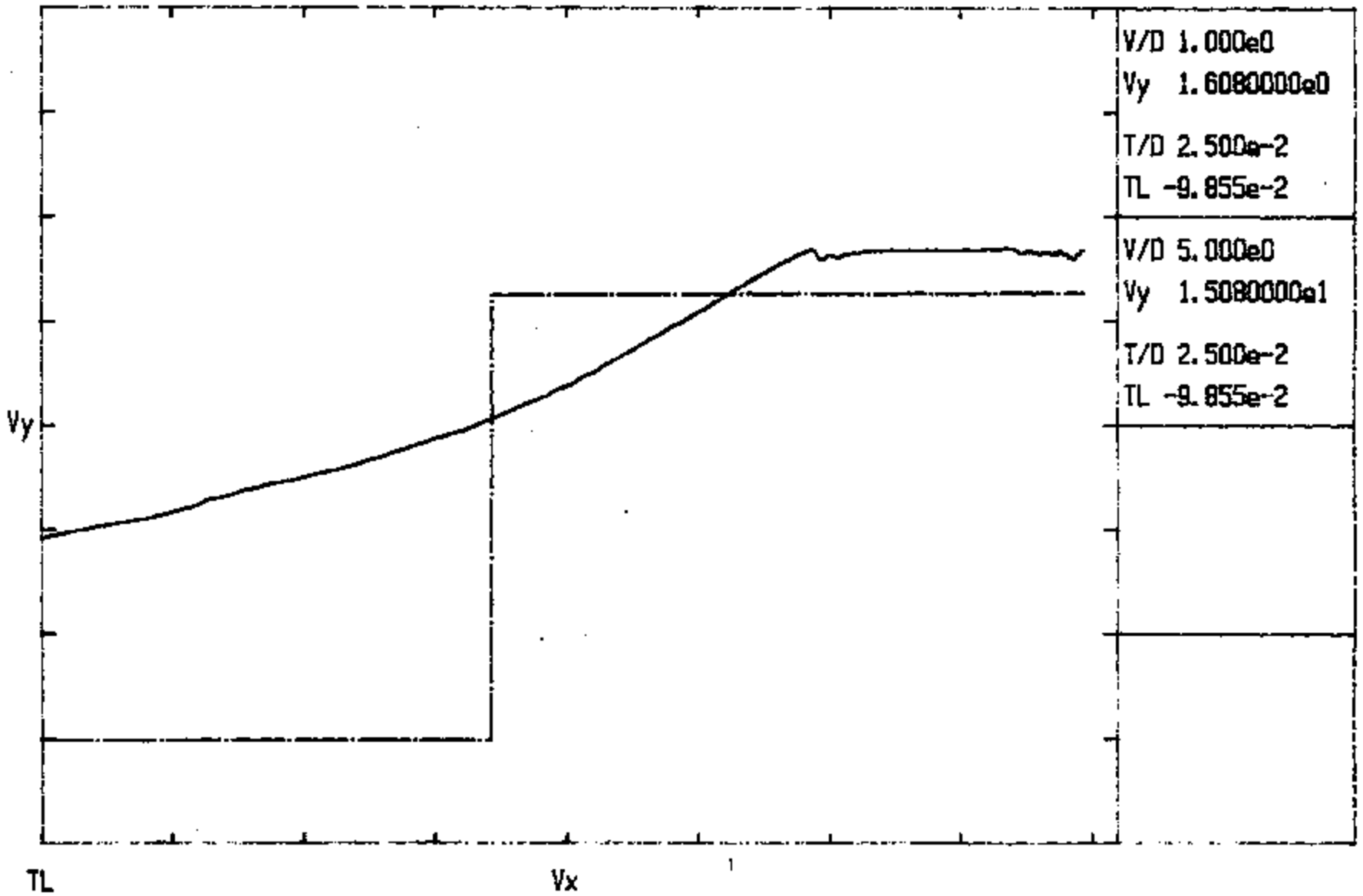
TI-NHTSA 009137

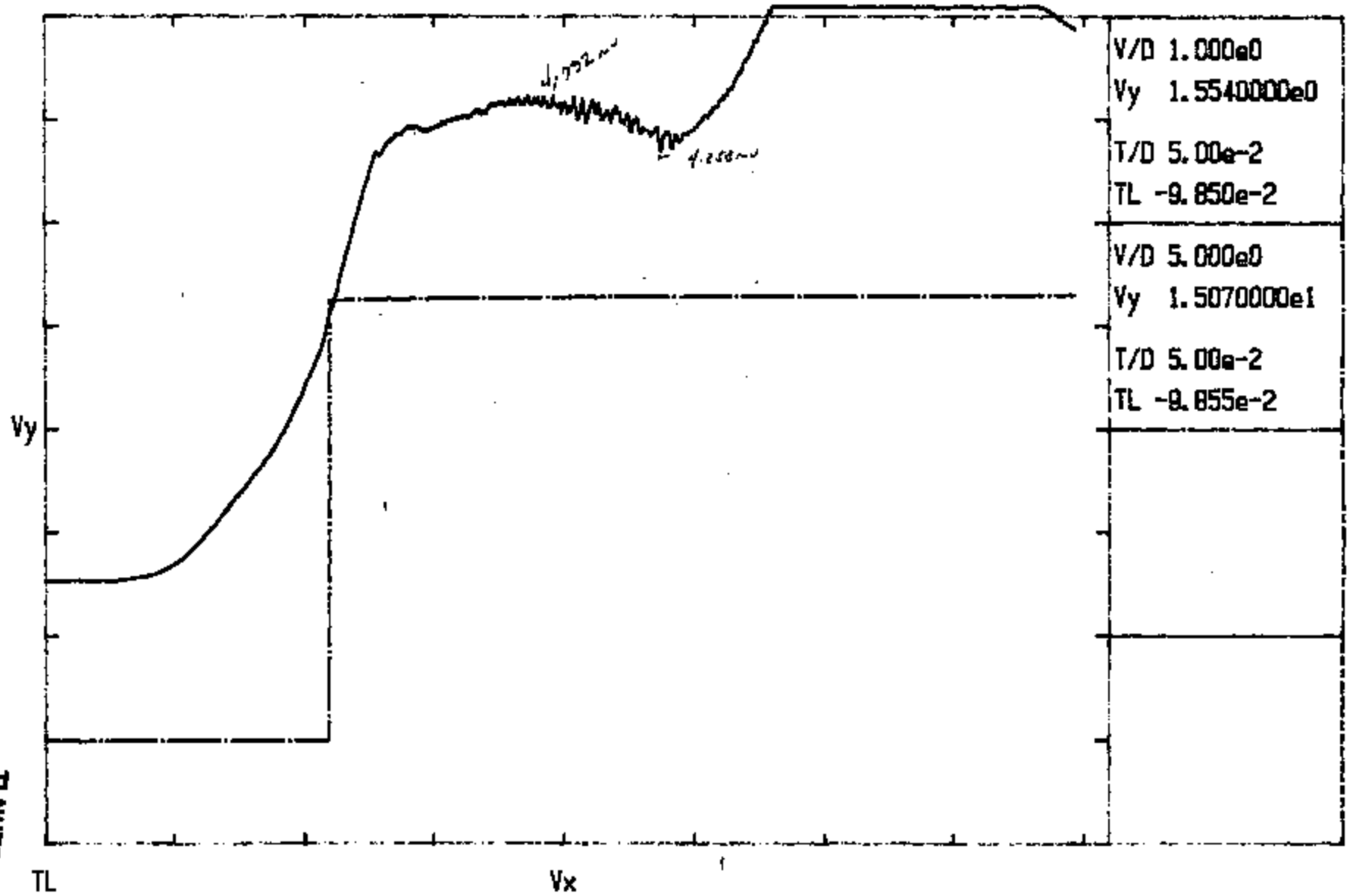
16 FT
Hours #2
Rubber labyrinth
(4 holes)



TI-NHTSA 006136

RECORD 17
SAME AS 1
SAME AS





TI-NHTBA 005140