EA02-025

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

REQUEST NO. 7

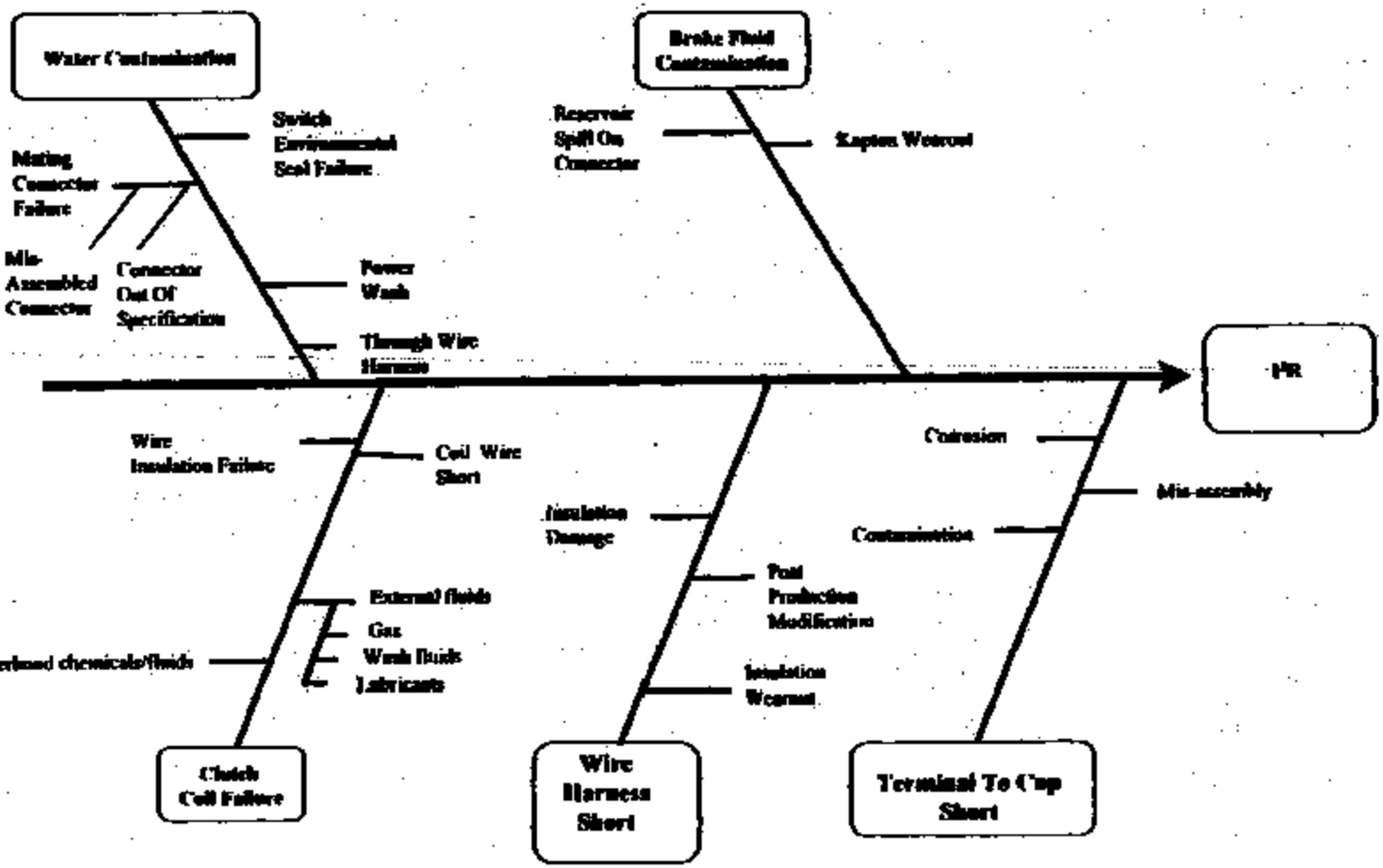
BOX 8

PART A-U

PART Q

Brake Pressure Switch

Texas Instruments Potential Thermal Event Theory Profile 3/24/99

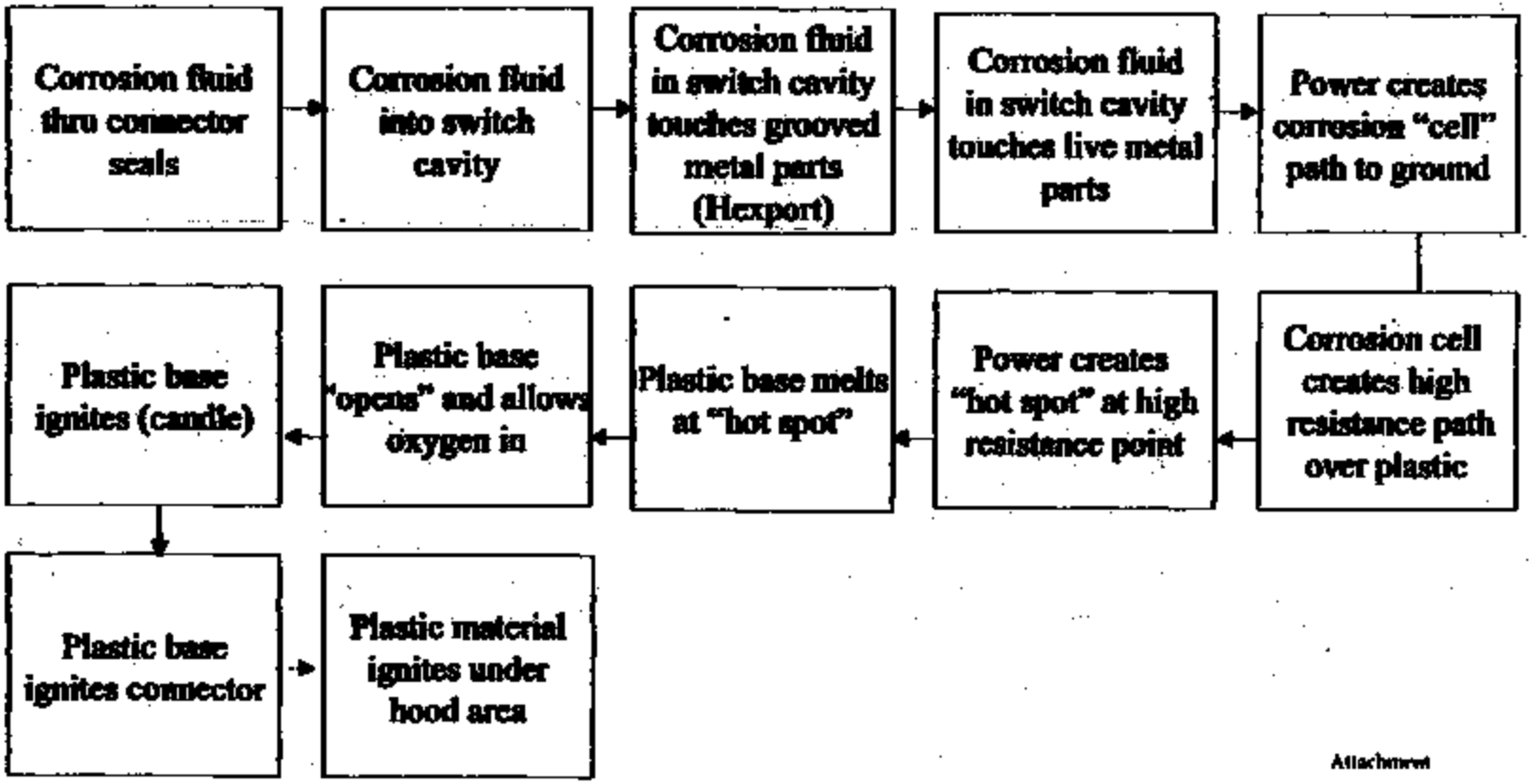


TI-NHTSA 013017

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 3/24/99

PROCESS FLOW DIAGRAM
"CORROSION" POTENTIAL CAUSE FLOW ANALYSIS

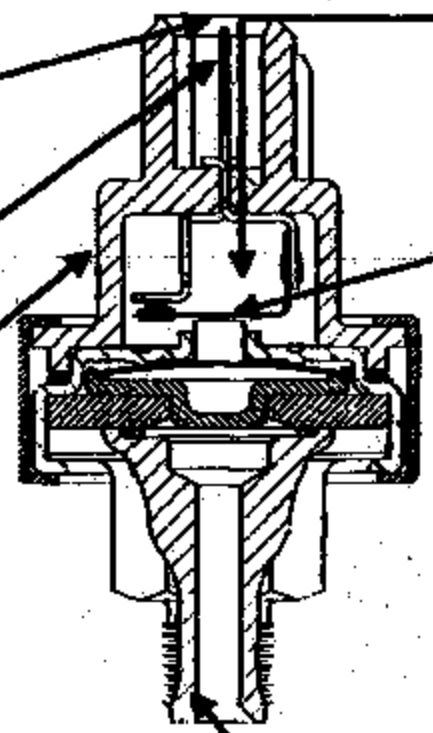


Attachment

TI-NHTSA 013018

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 3/24/99



1. Water and "ionic" contamination (e.g. NaCl or cleaner) enters the switch cavity

2. 12V Battery source to drive corrosion and provide energy

3. Hexport grounded accelerates corrosion

4. Contact arm& terminal corrosion increases resistance (acts like heater wire).

5. High current flow to case through water and ionic contamination

6. Plastic connector melts. Once it opens, oxygen enters the switch cavity. Arm terminal/corrosion becomes "RED HOT" igniting the plastic

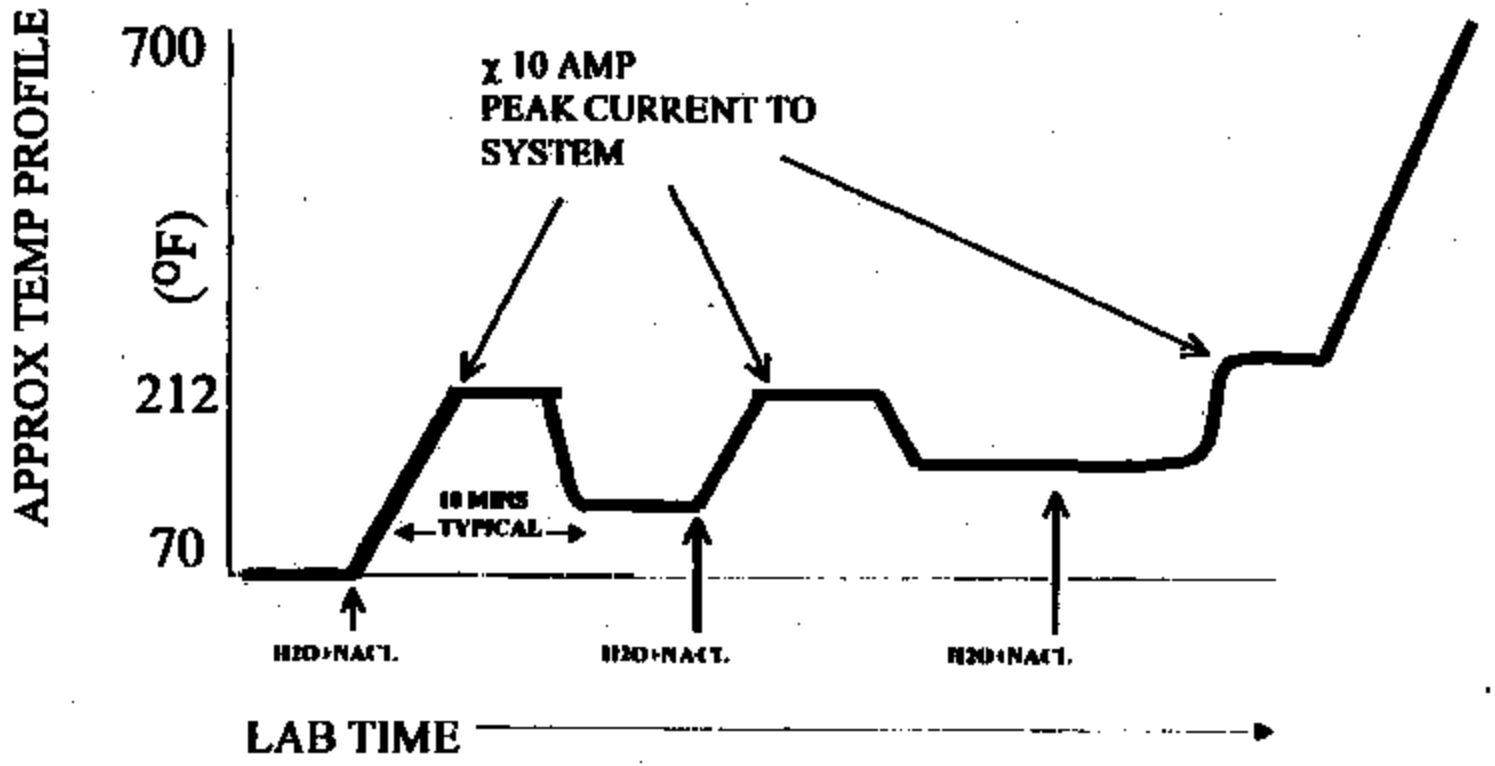
Attachment 2

TMHTBA 013019

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 3/24/99

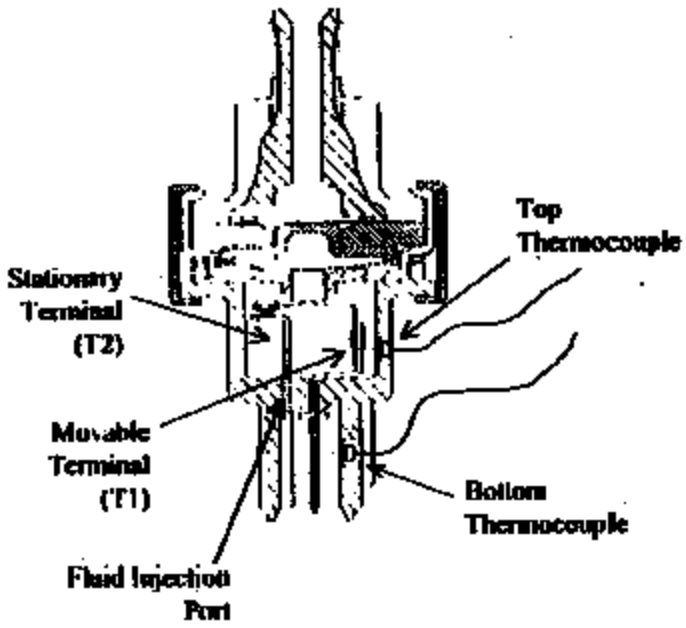
"INITIAL ROUGH PROFILE"



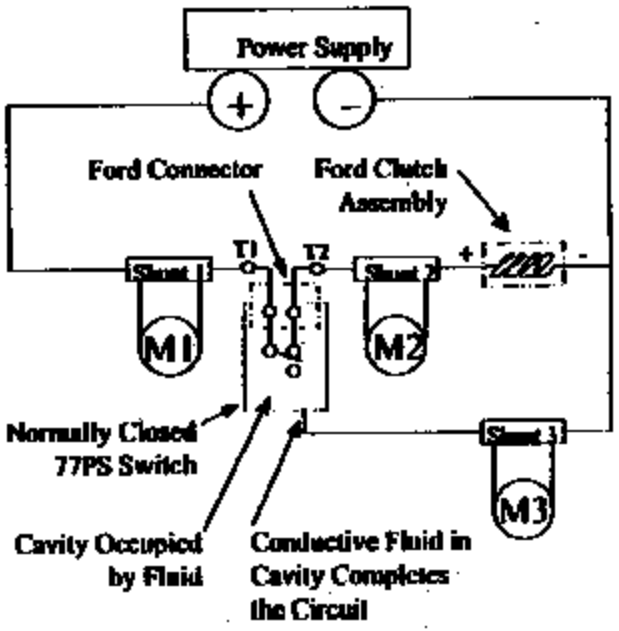
Attachment 4

TMHTSA 013020

5% Salt Water Ingress Experiment
Test 1



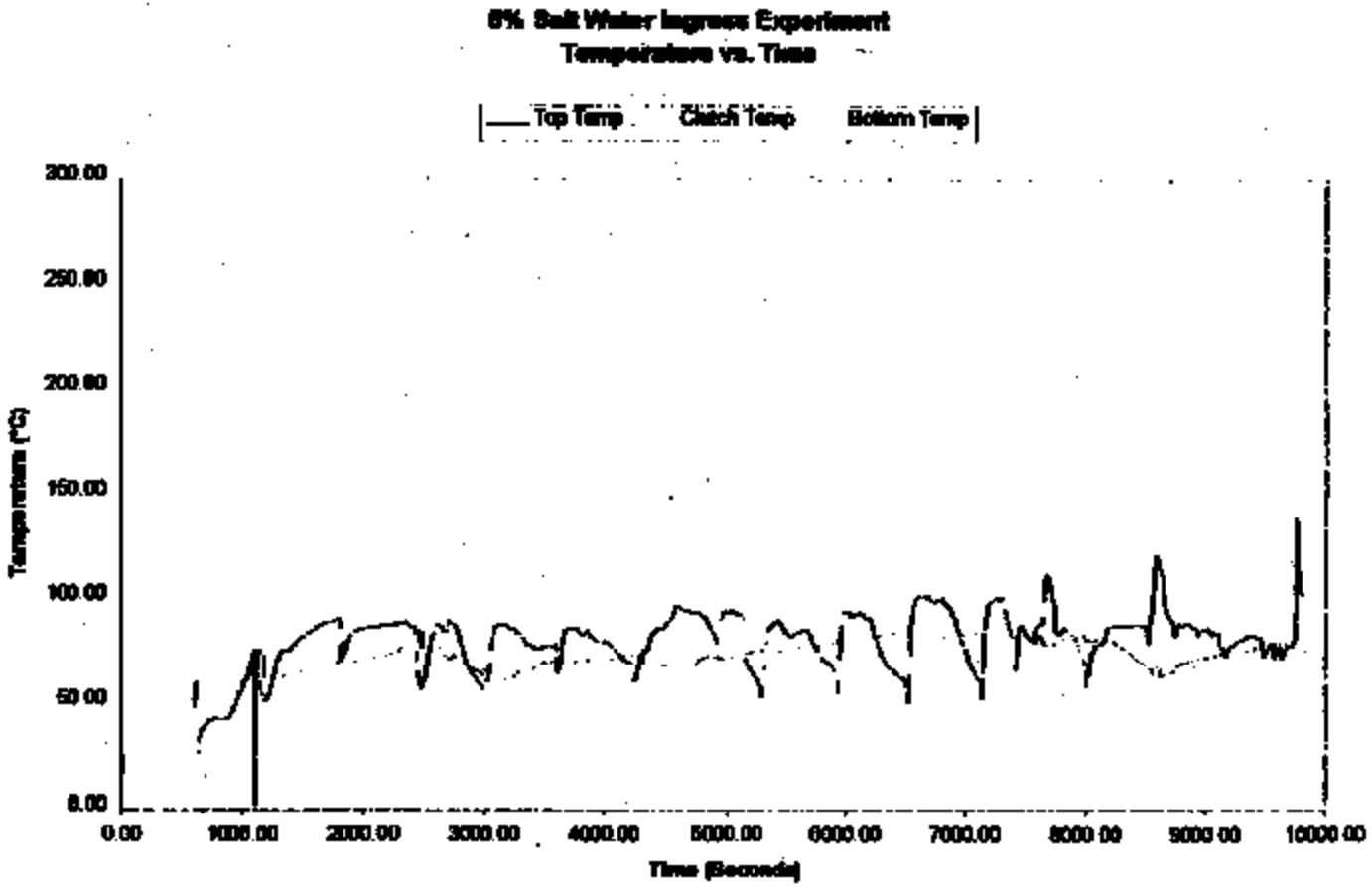
TI Report PS/99/12
03/15/99



Test 1: Figure 1 and Figure 2.

Texas Instruments

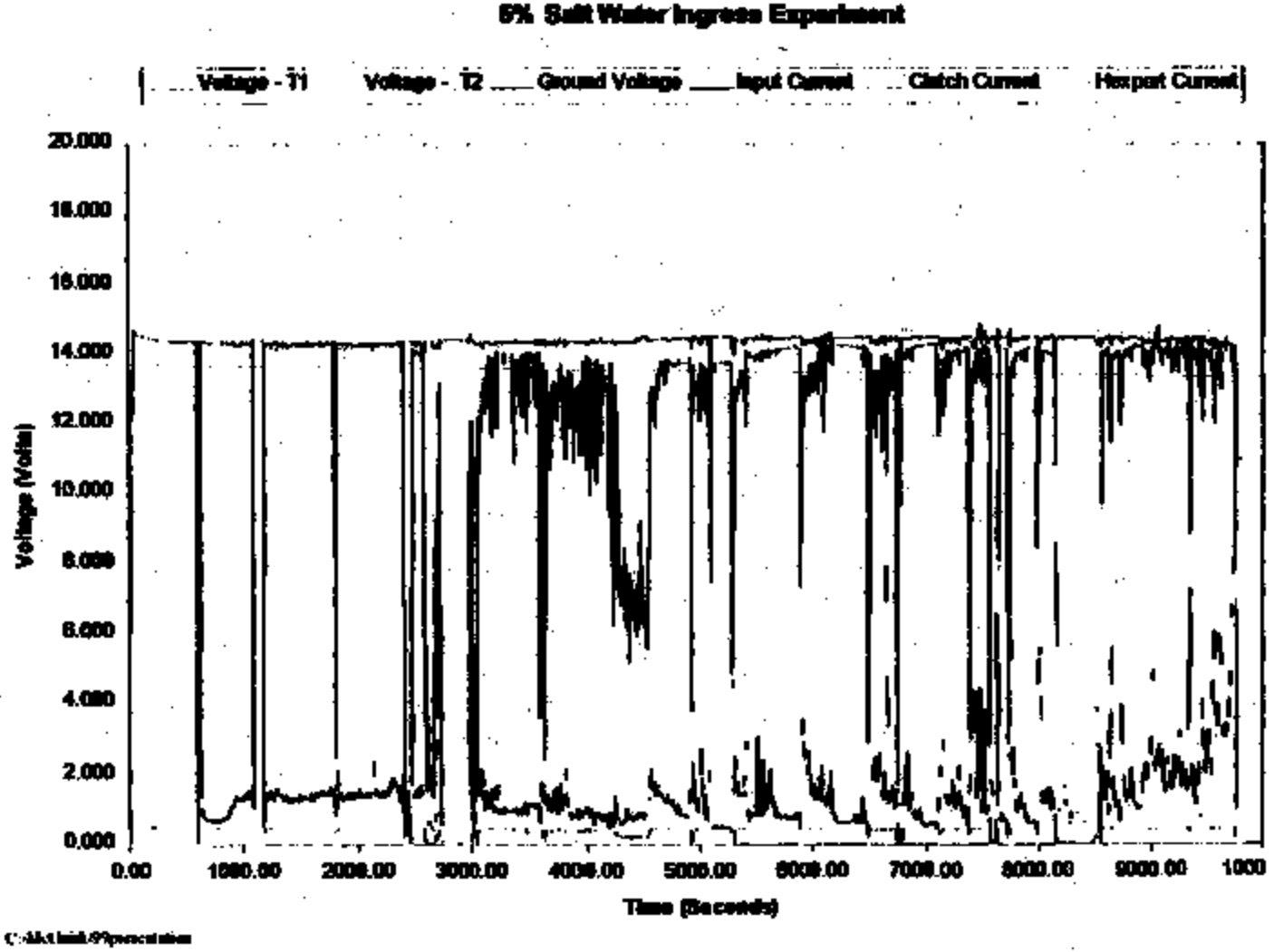
Brake Pressure Switch
Potential Thermal Event Theory Profile 3/24/99



TI-NHTBA 013022

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 3/24/99

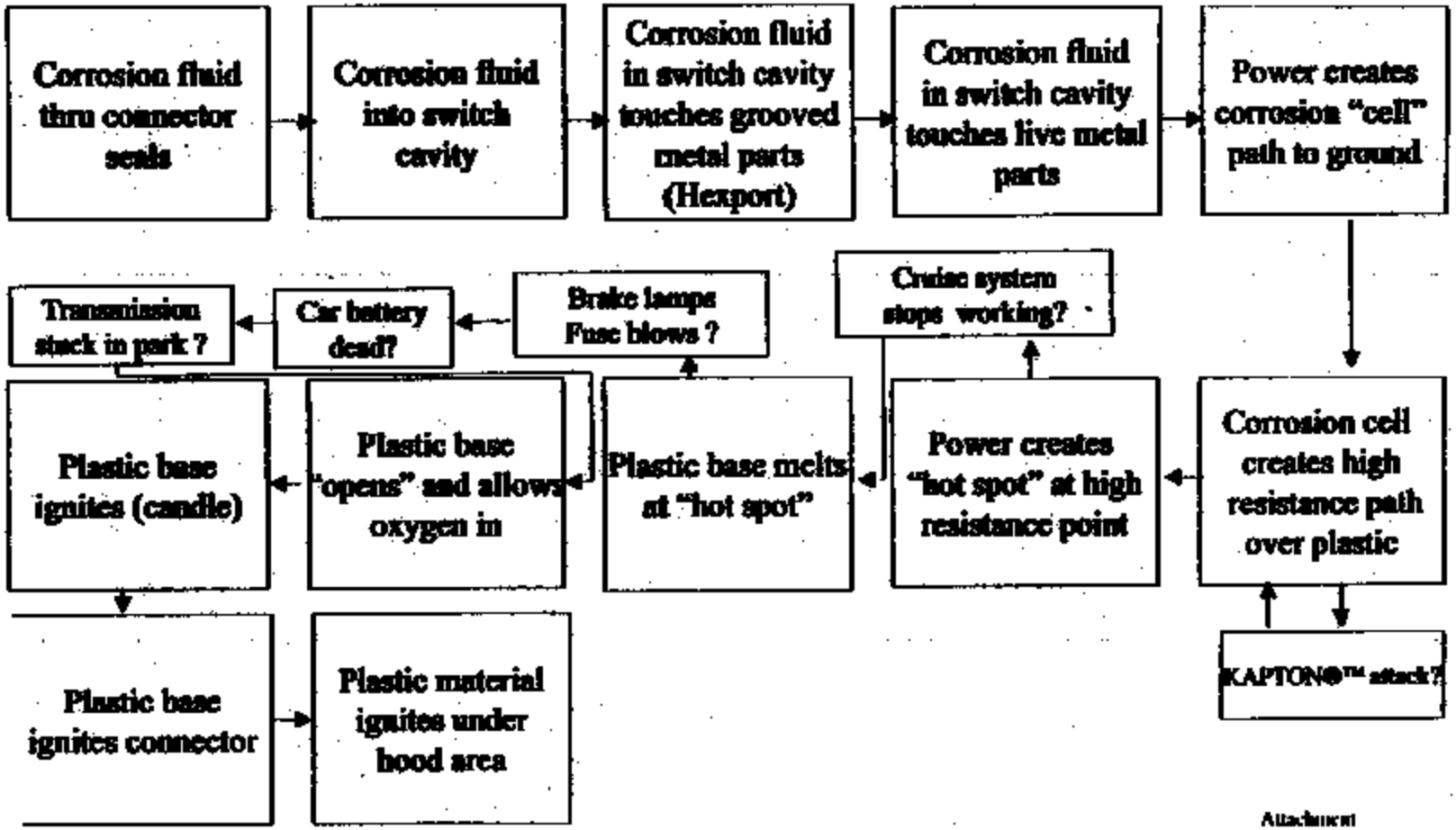


TI-NHTSA 013023

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 3/24/99

PROCESS FLOW DIAGRAM
"CORROSION" POTENTIAL CAUSE FLOW ANALYSIS



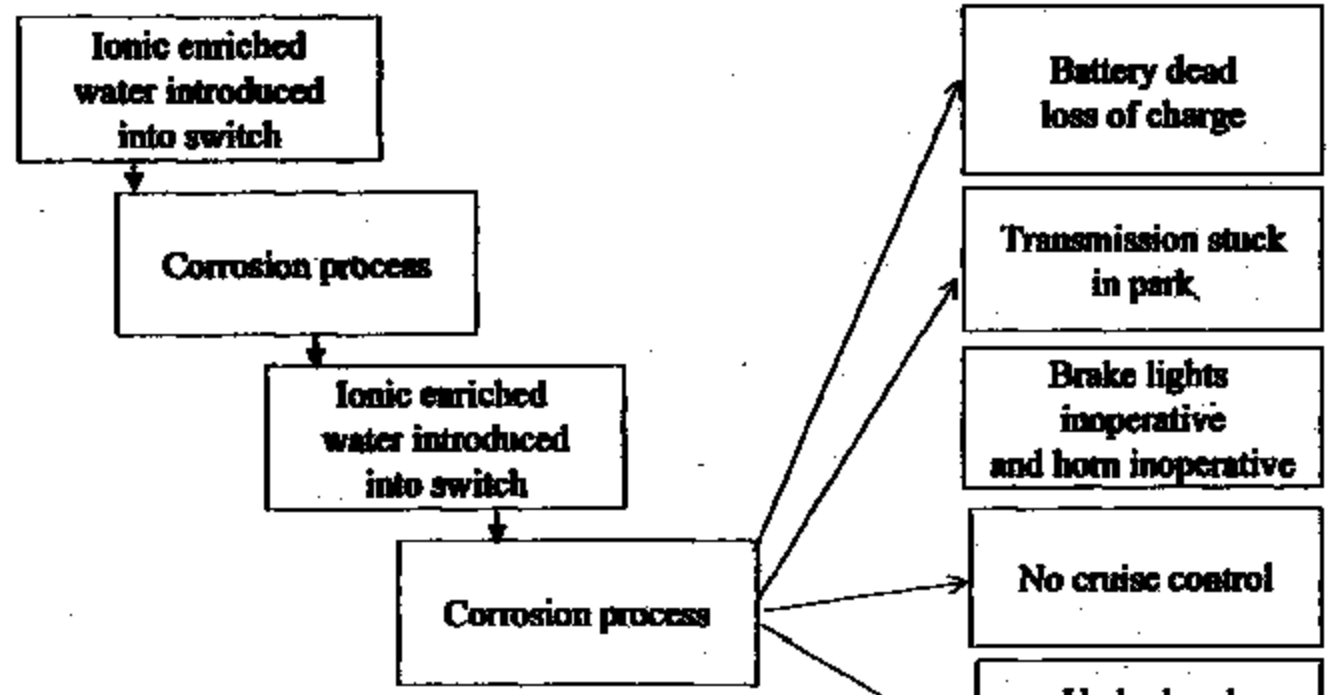
Attachment

TI-NHTSA 013024

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 3/24/99

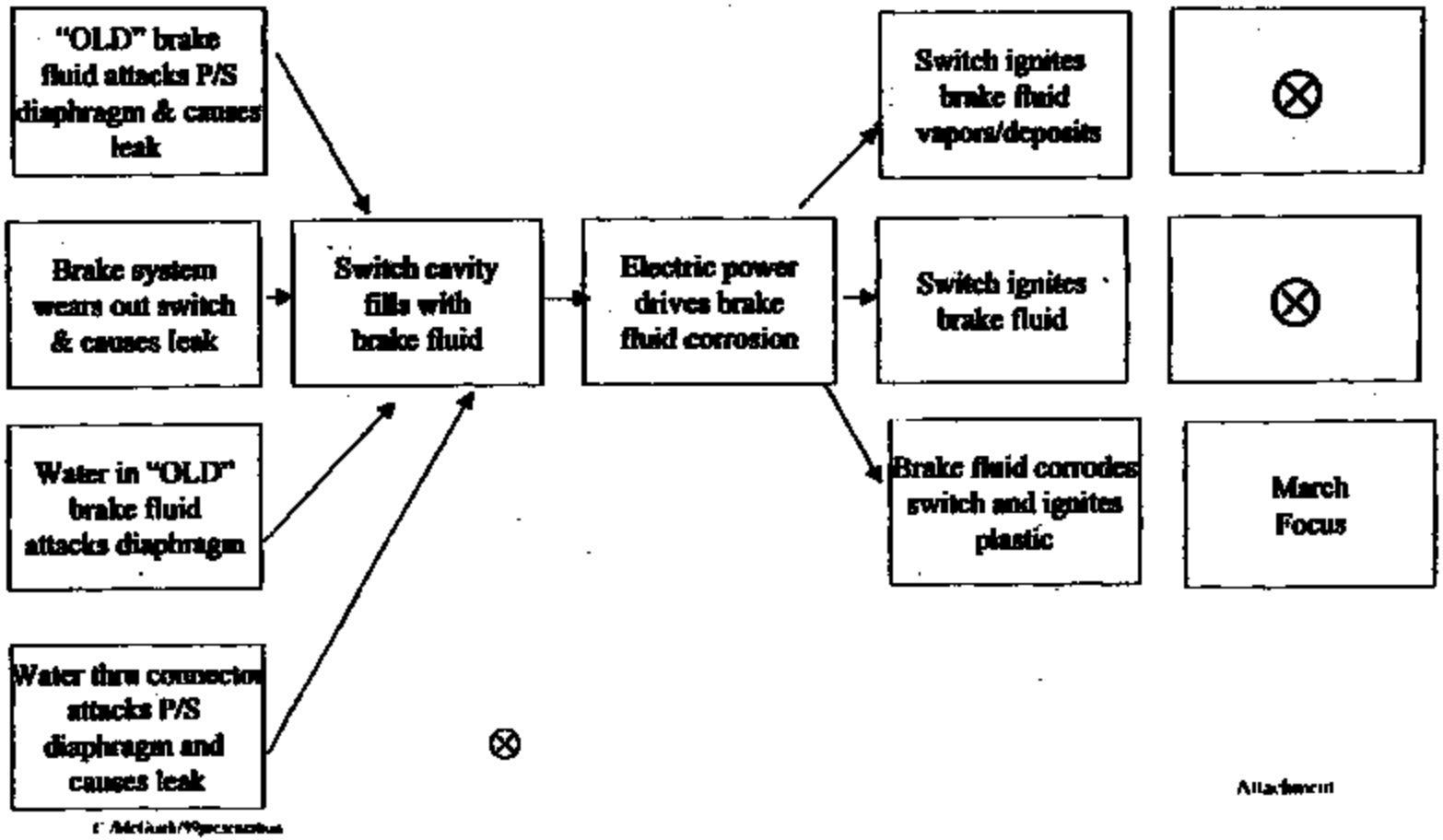
"Corrosion" potential cause time line
Theory Time Line

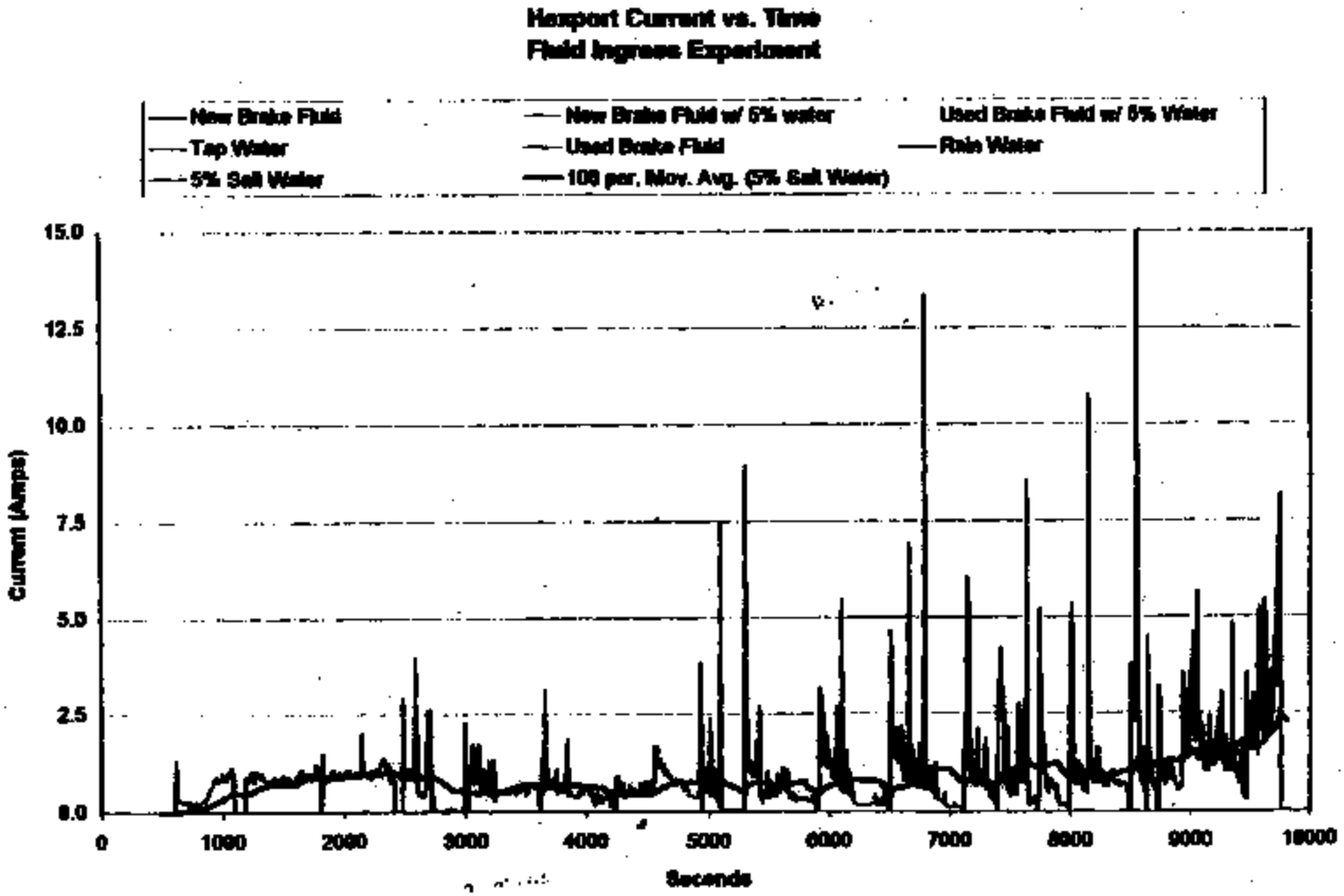


Attachment

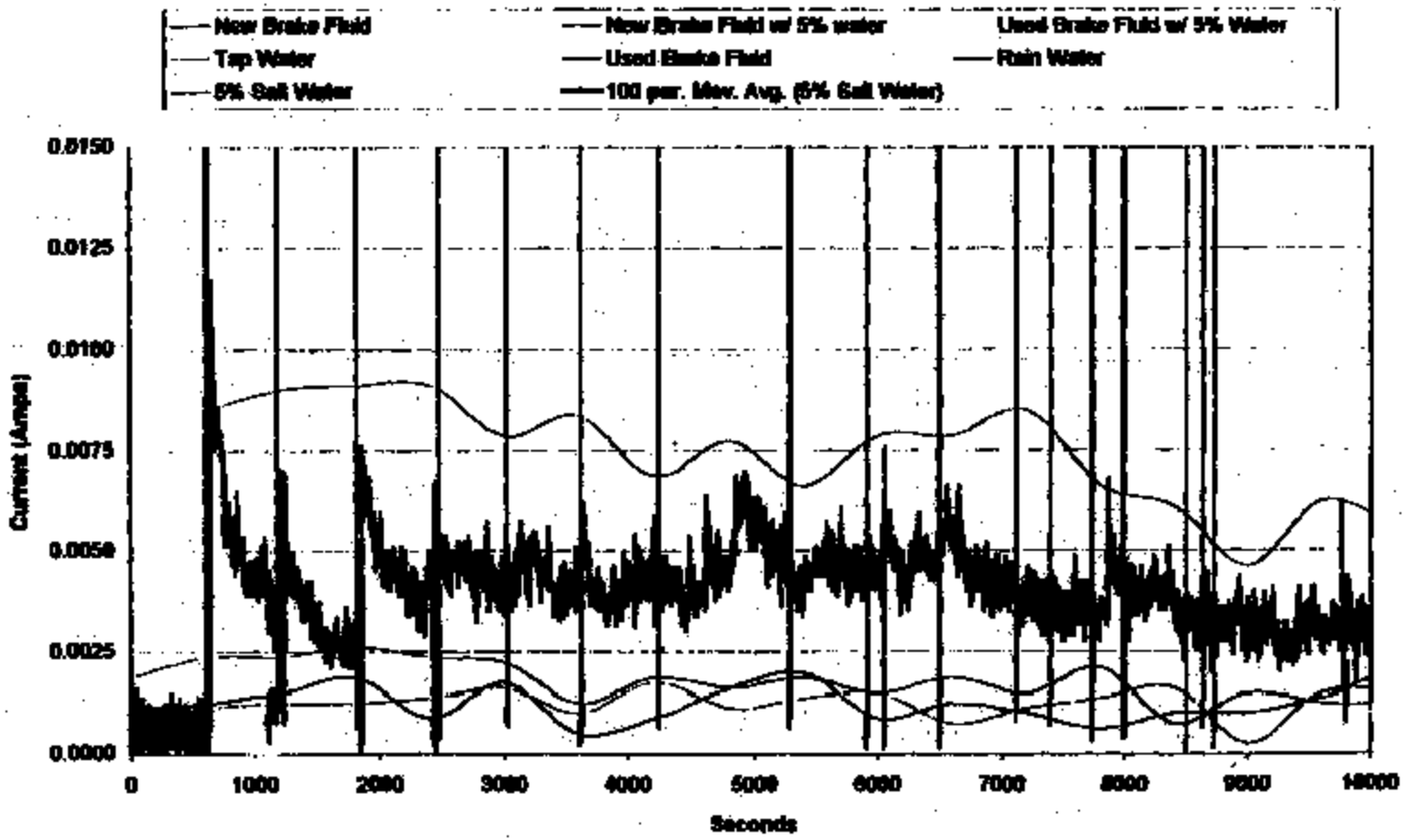
TI-NHTSA 013025

REFINED BRAKE FLUID IGNITION THEORY
POSSIBLE CAUSE THEORIES
"FEB '99 FOCUS"





Hexport Current vs. Time
Fluid Ingress Experiment



Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 3/24/99

1. Connector Seal to P/S
   13

2. Power continuously available
   10, 16

3. Switch orientation
   90 degree elbow

4. Current limit / fuse
   9, 9a, 1.5 amp fuse

5. Hexport isolation
   1, 2, 3, 4, 11

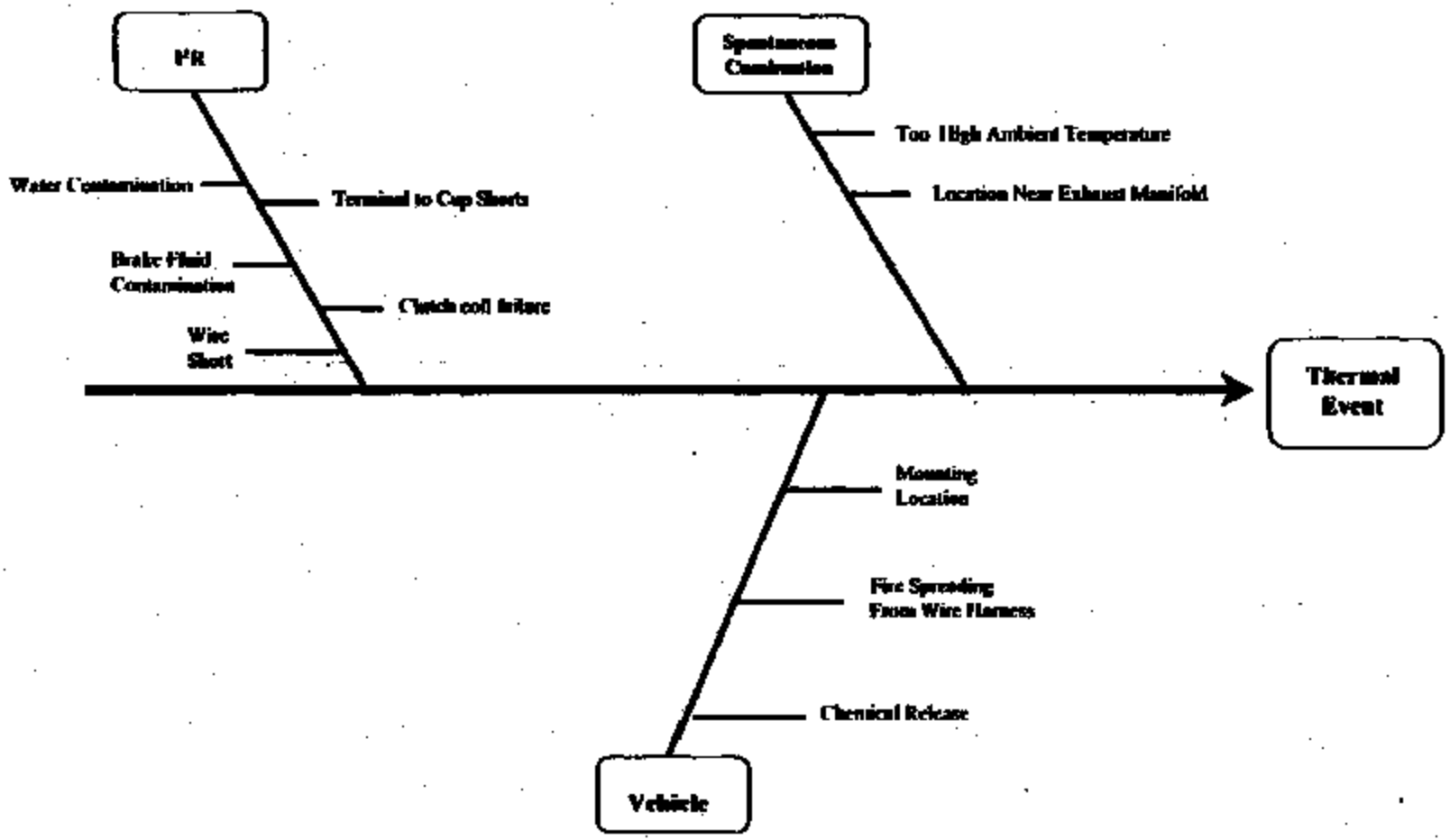
6. Plastic ignition robustness
   14

7. Kapton seal of P/S
   5, 6, 7, 8, 15

8. Environmental seal of P/S

Brake Pressure Switch
Potential Thermal Event Theory Profile 3/24/99

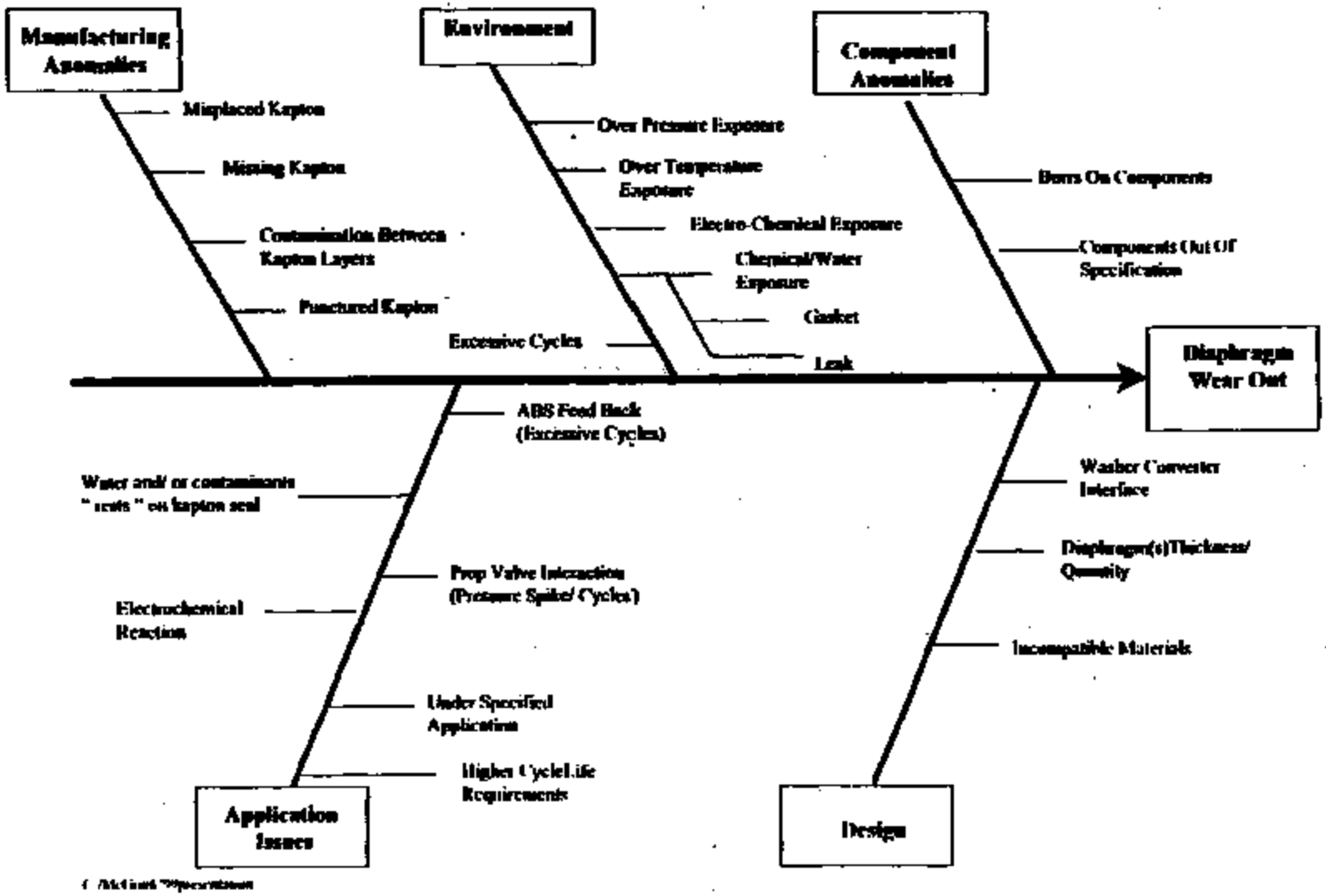
TEXAS INSTRUMENTS



TI-HHTBA 013030

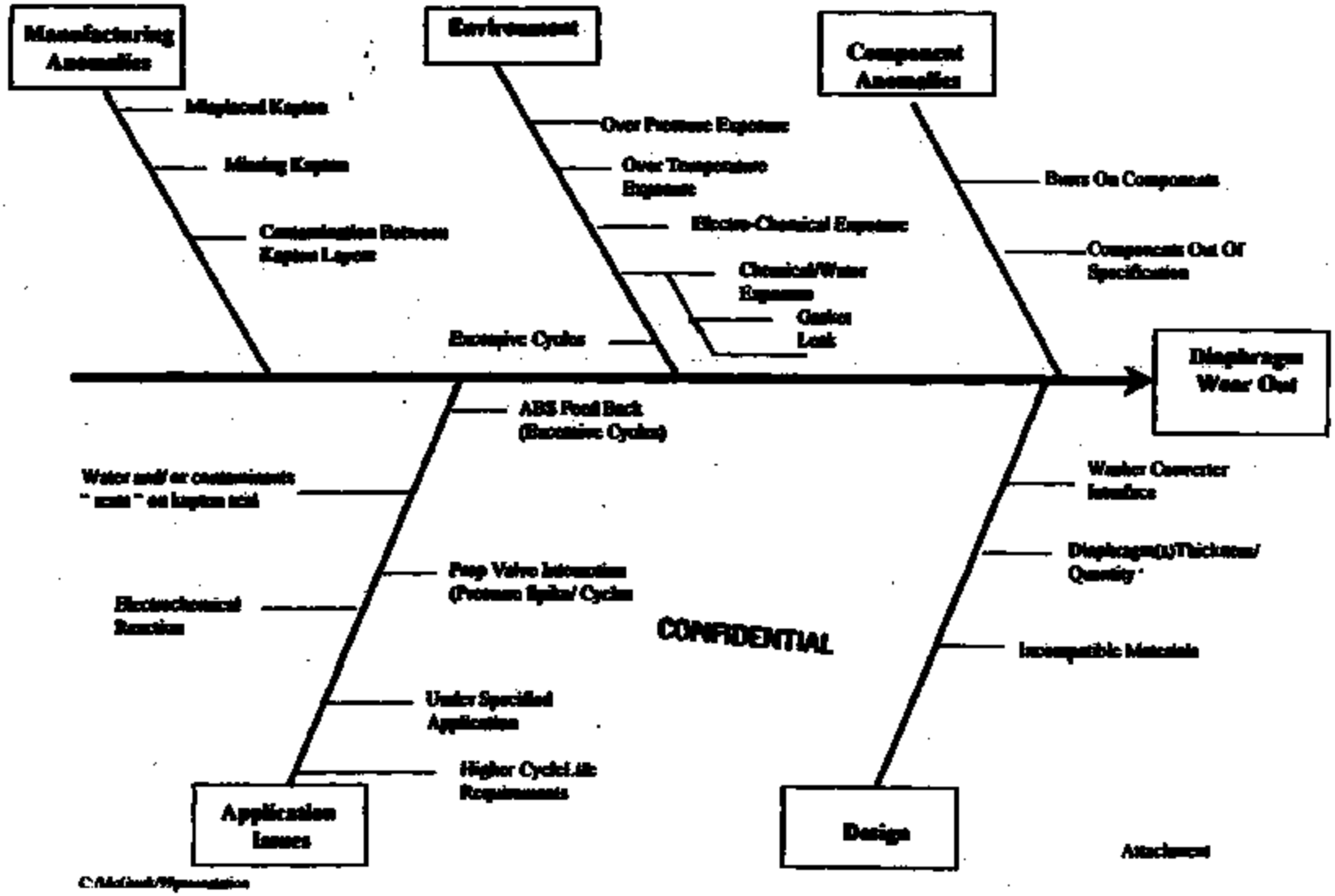
TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 3/24/99



TI-NHTSA 013031

Brake Pressure Switch
Texas Instruments Potential Thermal Event Theory Profile 3/24/99



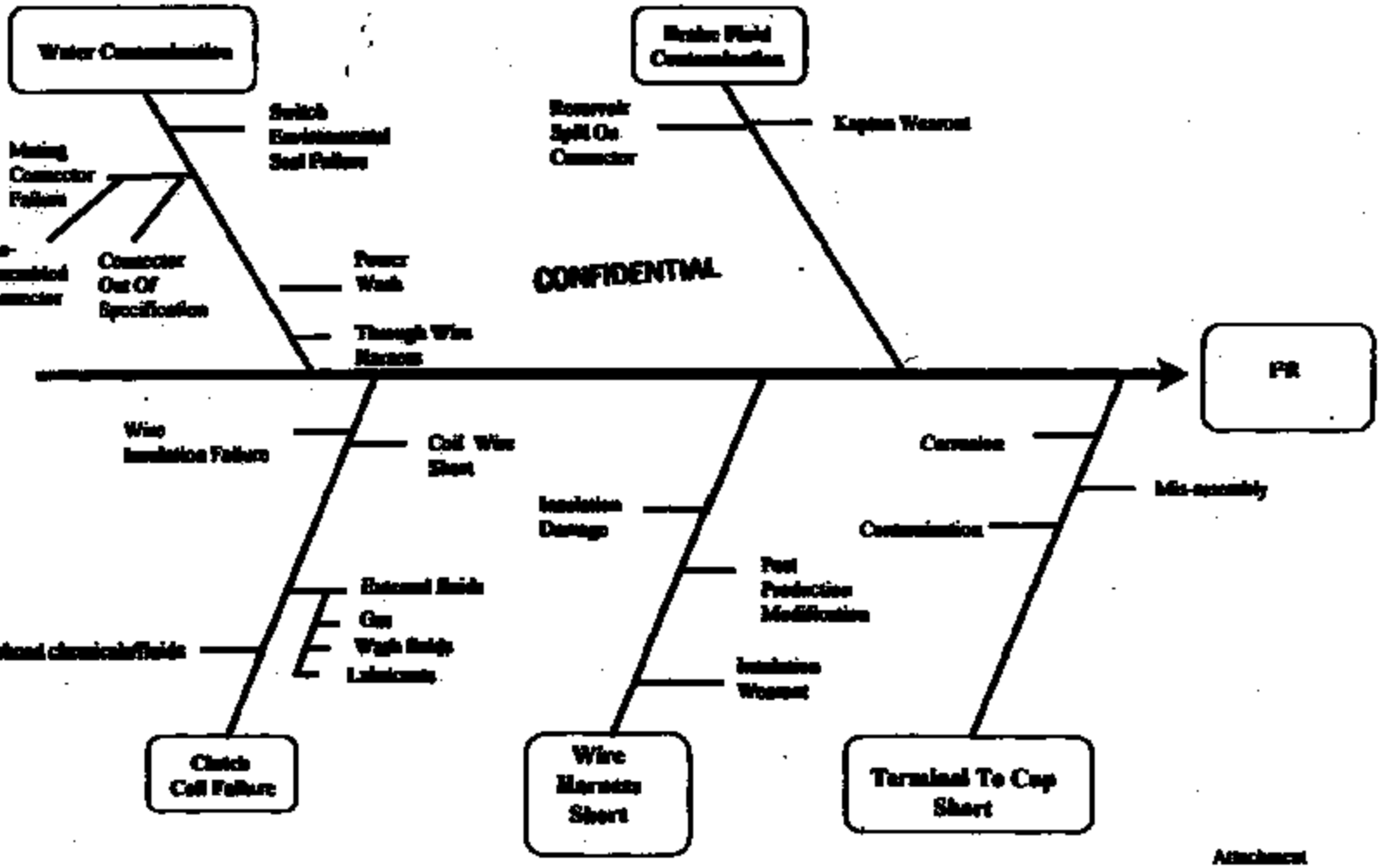
CONFIDENTIAL

Attachment

TI-NHTSA 013032

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 3/24/99



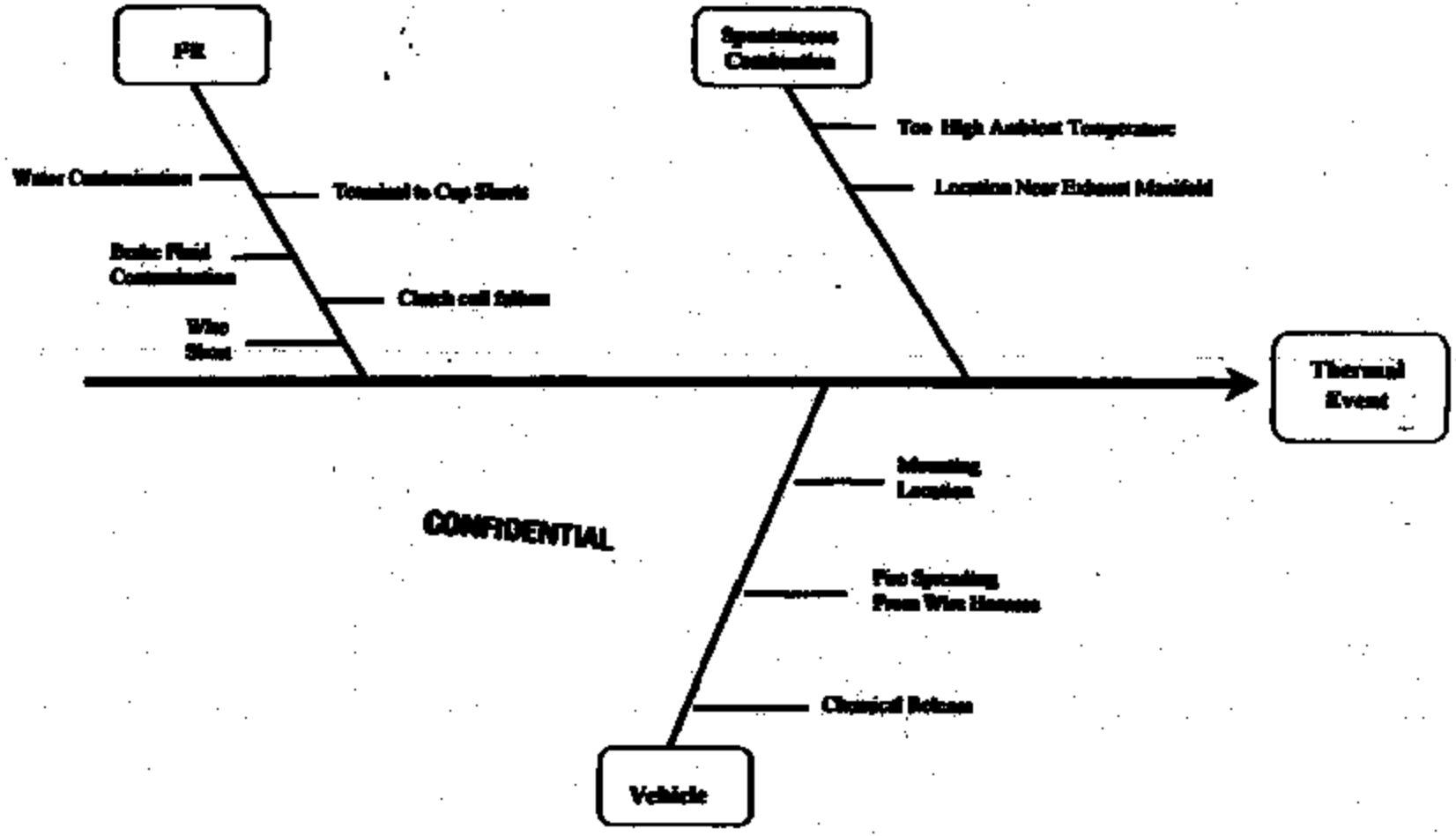
Attachment

C:\McCloskey\Presentation

TI-NHTSA 013033

Brake Pressure Switch
Potential Thermal Event Theory Profile 3/24/99

TEXAS INSTRUMENTS



CONFIDENTIAL

Attachment

TI-NHTSA 013094

March 24, 1999

TEXAS INSTRUMENTS

FACSIMILE TRANSMITTAL

TO: **Name:** **Bryan Dague**
Texas Instruments

Location: **Windham Peach Tree Conf. Ctr.**

Phone Number: **(770) 487-2000**

FAX Number: **(770) 487-4428**

FROM: **Sean P. Mulligan**
Mechanical Design
Precision Controls

TEXAS INSTRUMENTS MS 12-29

Phone Number: **(508) 236-2535**
FAX Number: **(508) 236-3586**

Total number of pages (including header page): 7

COMMENTS: Bryan, I faxed this info to Andy: Regarding the Weibull Analysis:

I did a Weibull analysis on (4) separate sets of 2-1 data. (Note there were no failures on DOE test)
Test set 1: Life Cycle Test Data (including 728K pt.) + DOE test
Test set 2: Life Cycle Test Data (excluding 728K pt.) + DOE test
Test set 3: Life Cycle Test Data (including 728K pt.)
Test set 4: Life Cycle Test Data (excluding 728K pt.)

Depending on the Ford spec, the best plots are
Page 5: Test set 1; 95% Confidence = 99.9% Reliability with a lower confidence limit at 95%
Page 6: Test set 2; 99% Confidence = 100% Reliability with a lower confidence limit at 99.9%
Page 7: Test set 4; 95% Confidence = 100% Reliability with a lower confidence limit at 99.9%

Sean

TEXAS INSTRUMENTS INCORPORATED * PO BOX 2964 * 34 FOREST STREET * ATTLEBORO, MA 02703

(42) 77PSI2-1 DATA POINTS FROM (2) TESTS COMBINED (728K pt. Included)

%CONFIDENCE	%RELIABILITY(@500,000 cycles)	Lower Confidence Limit (@500,000 cycles) (%)	Upper Confidence Limit (@500,000 cycles) (%)
99.9	99.9	47.4	100
99	99.9	83.77	100
95	99.9	95	100
90	99.9	97.3	100

(41) 77PSI2-1 DATA POINTS FROM (2) TESTS COMBINED (728 K pt. Excluded)

%CONFIDENCE	%RELIABILITY(@500,000 cycles)	Lower Confidence Limit (@500,000 cycles) (%)	Upper Confidence Limit (@500,000 cycles) (%)
99.9	100	99.24	100
99	100	99.84	100
95	100	99.99	100
90	100	100	100

(30) 77PSI2-1 DATA POINTS FROM Life Cycle Test (728 pt. Included)

%CONFIDENCE	%RELIABILITY(@500,000 cycles)	Lower Confidence Limit (@500,000 cycles) (%)	Upper Confidence Limit (@500,000 cycles) (%)
99.9	99.87	0	100
99	99.87	0	100
95	99.87	0.21	100
90	99.87	29.62	100

(29) 77PSI2-1 DATA POINTS FROM Life Cycle Test (728 pt.Excluded)

%CONFIDENCE	%RELIABILITY(@500,000 cycles)	Lower Confidence Limit (@500,000 cycles) (%)	Upper Confidence Limit (@500,000 cycles) (%)
99.9	100	37.08	100
99	100	97.11	100
95	100	99.98	100
90	100	99.97	100

Confidence Interval Summary

TL-NHTSA 013036

column A — B — C — D

(42) 77PSI2-1 DATA POINTS FROM (2) TESTS COMBINED

%CONFIDENCE	%RELIABILITY(@500,000 cycles)	Lower Confidence Limit (@500,000 cycles) (%)	Upper Confidence Limit (@500,000 cycles) (%)
99.9	99.9	47.4	100
99	99.9	53.77	100
95	99.9	95	100
90	99.9	97.3	100

↑ % Reliability from straight line on plots

↑ lower Confidence limit At 500,000 cycle

upper confidence limit (column D)

% Reliability (column B)

lower confidence limit (column C)

i.e.,

% Reliability (= 1 − % unreliability)

500,000

Andy, Just FYI

Explanation

-3-

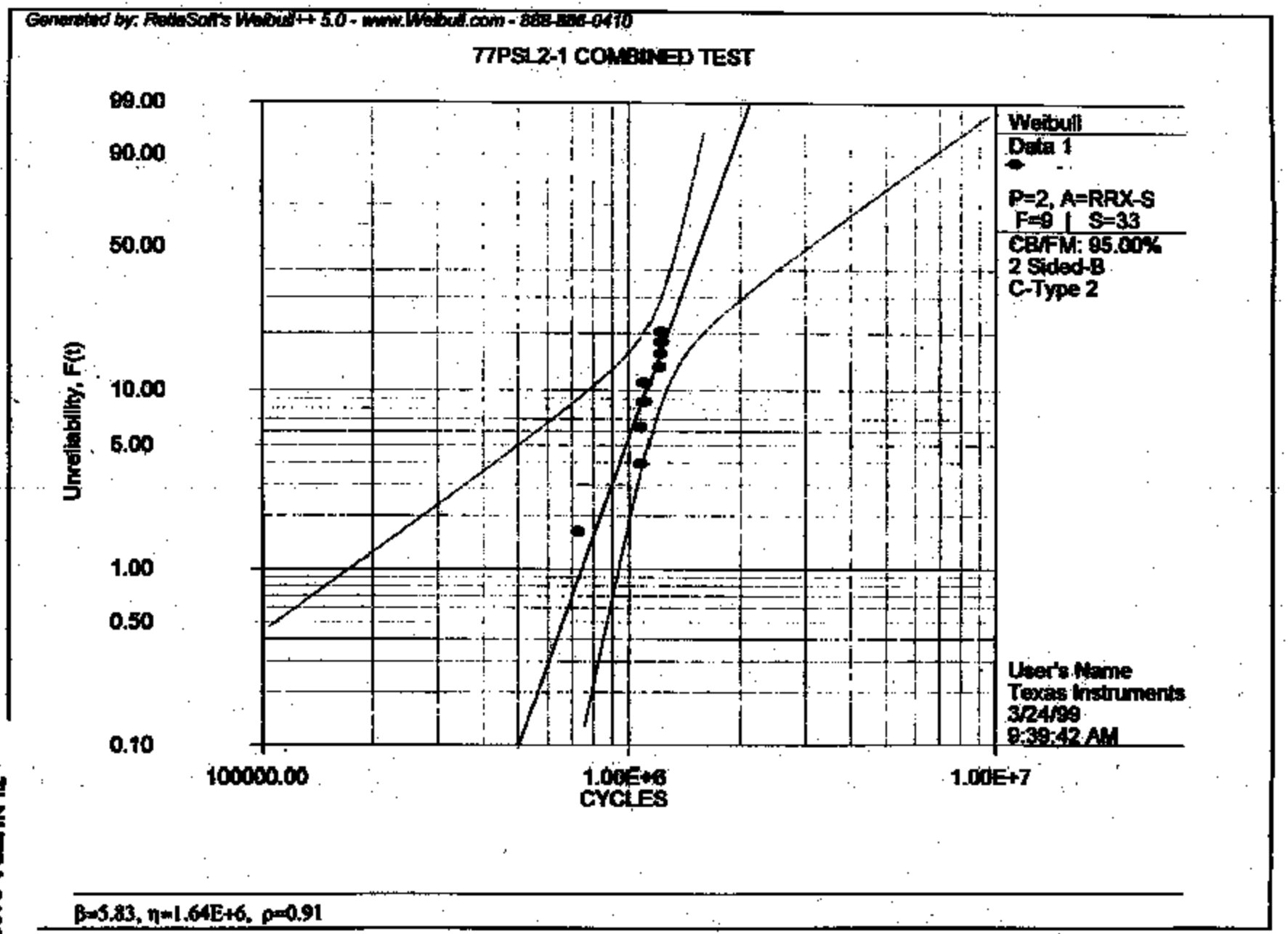
77PSL2-1 pure brake Fluid

Data

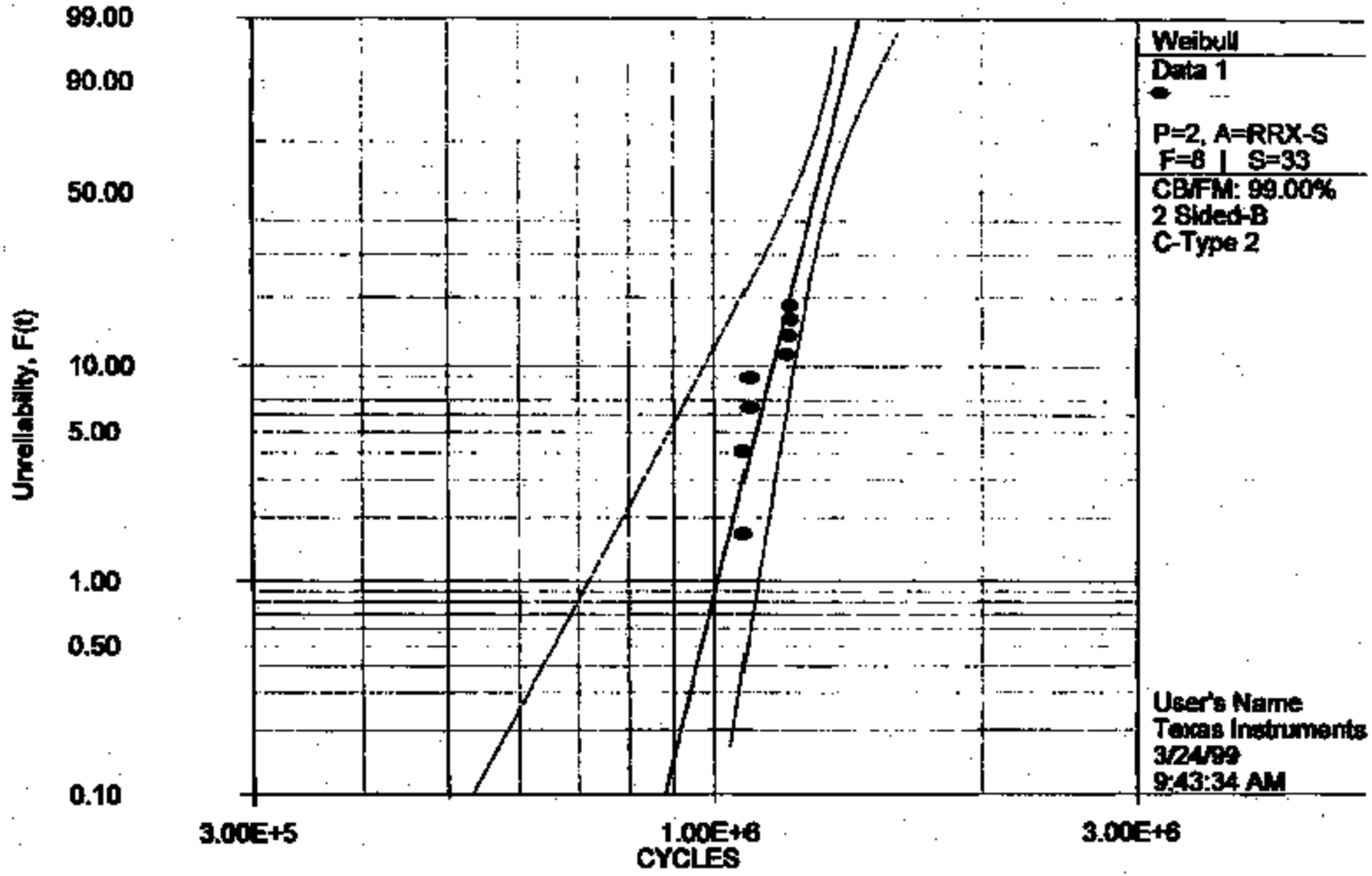
included or excluded

Data ID	State For S	Time to For S	Subset ID
1	F	75000	
2	F	1070000	
3	F	1210000	
4	F	1280000	
5	F	1290000	
6	F	1300000	
7	F	1300000	
8	F	1310000	
9	F	1310000	
10	S	1310000	
11	S	1310000	
12	S	1310000	
13	S	1310000	
14	S	1310000	Life Cycle Test
15	S	1310000	
16	S	1310000	
17	S	1310000	
18	S	1310000	
19	S	1310000	
20	S	1310000	
21	S	1310000	
22	S	1310000	
23	S	1310000	
24	S	1310000	
25	S	1310000	
26	S	1310000	
27	S	1310000	
28	S	1310000	
29	S	1310000	
30	S	1310000	
31	S	1310000	
32	S	1310000	
33	S	1310000	
34	S	1310000	
35	S	1310000	DOE TEST
36	S	1310000	
37	S	1310000	
38	S	1310000	
39	S	1310000	
40	S	1310000	
41	S	1310000	
42	S	1310000	
43			
44	Beta = 0.8513		
45	Eta = 1310000.0		
46	Rank Regression on X - SRM		
47	Fmp / S=23		
48			

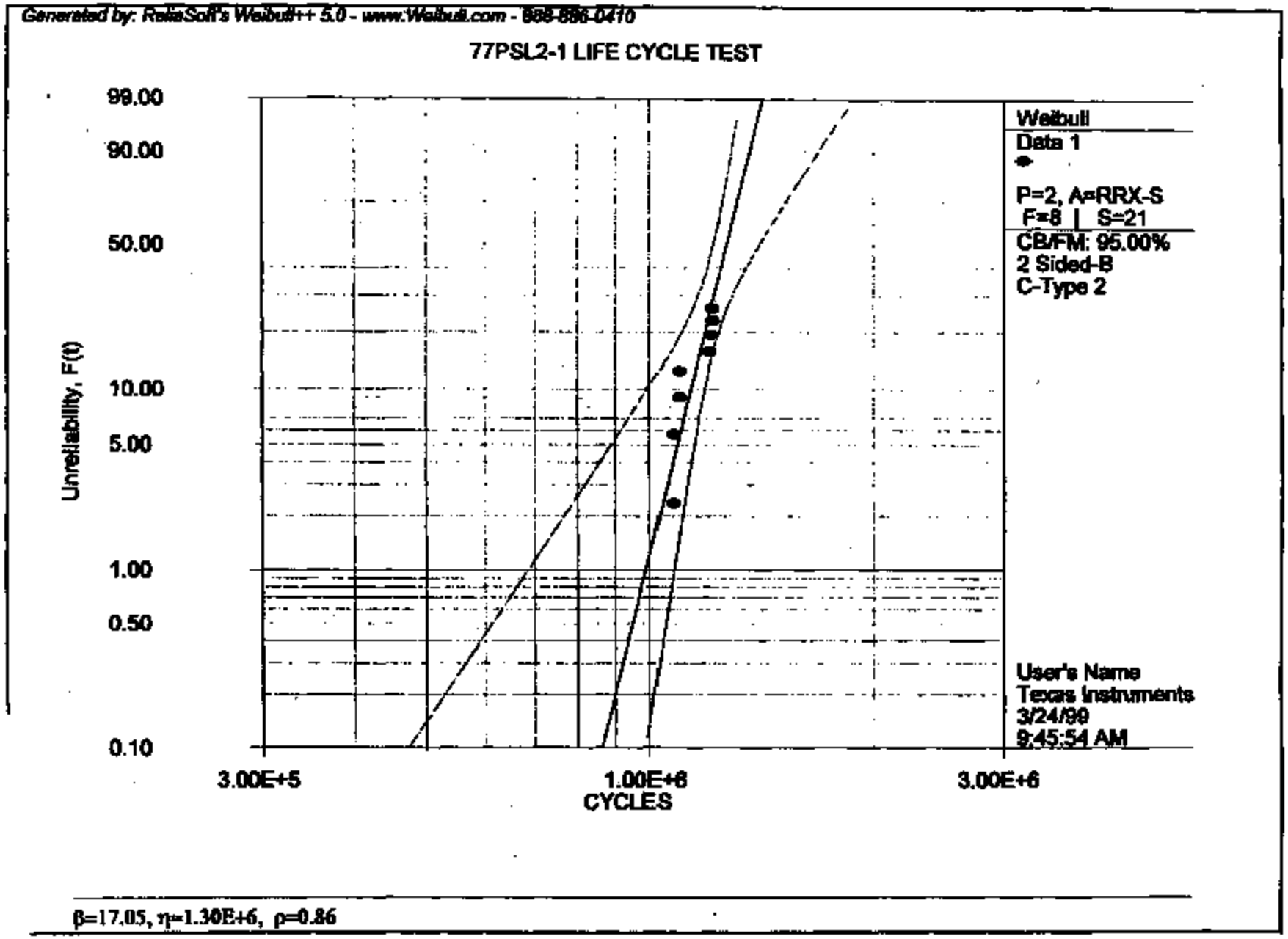
TI-NHTSA 013038



77PSL2-1 COMBINED TEST



β=16.80, η=1.33E+6, ρ=0.86



TEXAS INSTRUMENTS

March 24, 1999

Faxed 9:53

FACSIMILE TRANSMITTAL

TO:

Name: Andy McGuirk
c/o Rob Sharpe

Location: Detroit

Phone Number: (248) 305-5729

FAX Number: (248) 305-5734

FROM:

Sean P. Mulligan
Mechanical Design
Precision Controls

TEXAS INSTRUMENTS MS 12-29

Phone Number: (508) 236-2535
FAX Number: (508) 236-3586

Total number of pages (including header page): 7

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Sean

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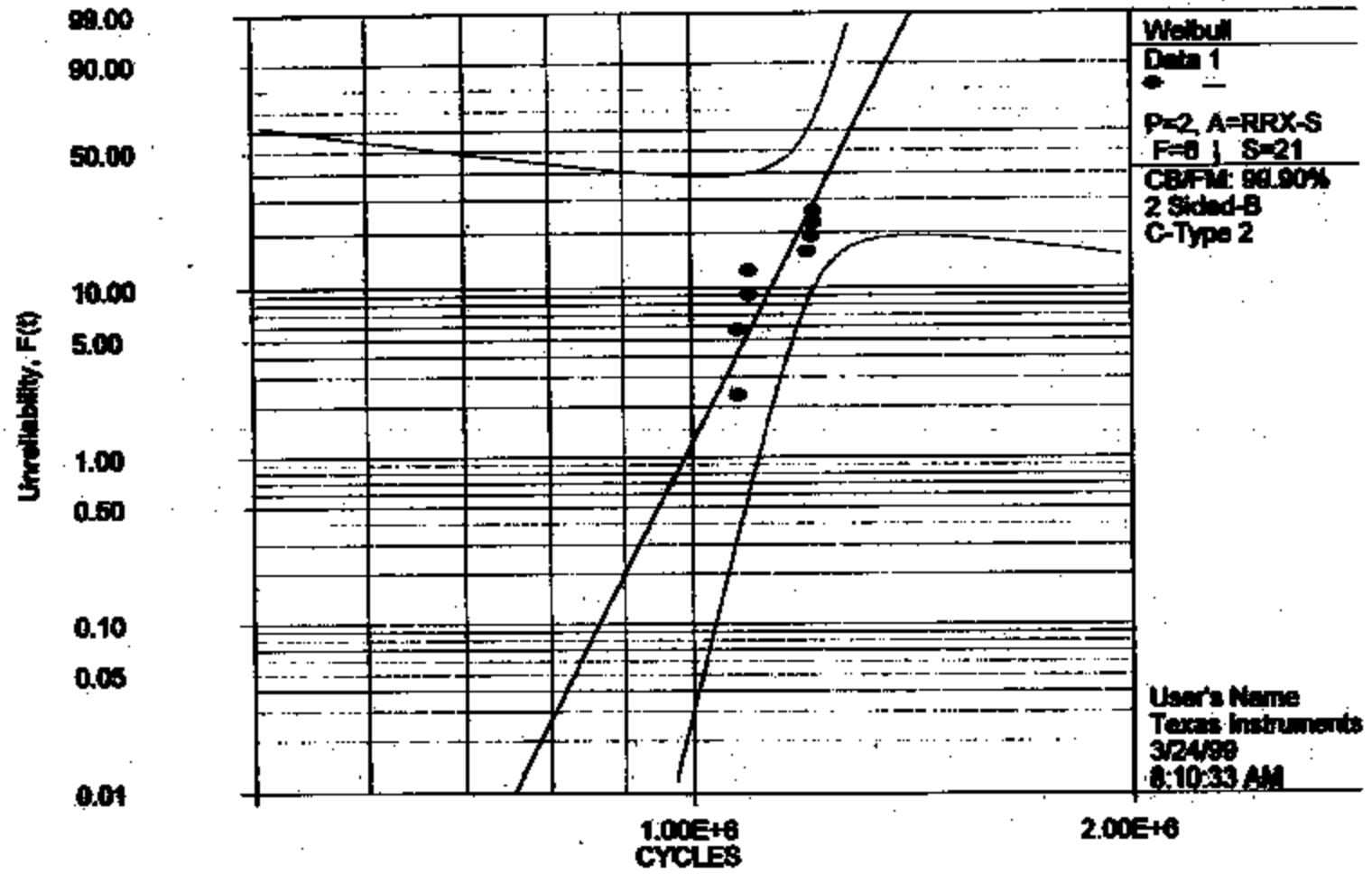
728 pt
excluded

77PSL2-1 LIFE CYCLE TEST



β=17.85, η=1.30E+6, ρ=0.86

TI-NHTSA 013044

Date: 3/24/99
User: User's Name
Company: Texas Instruments

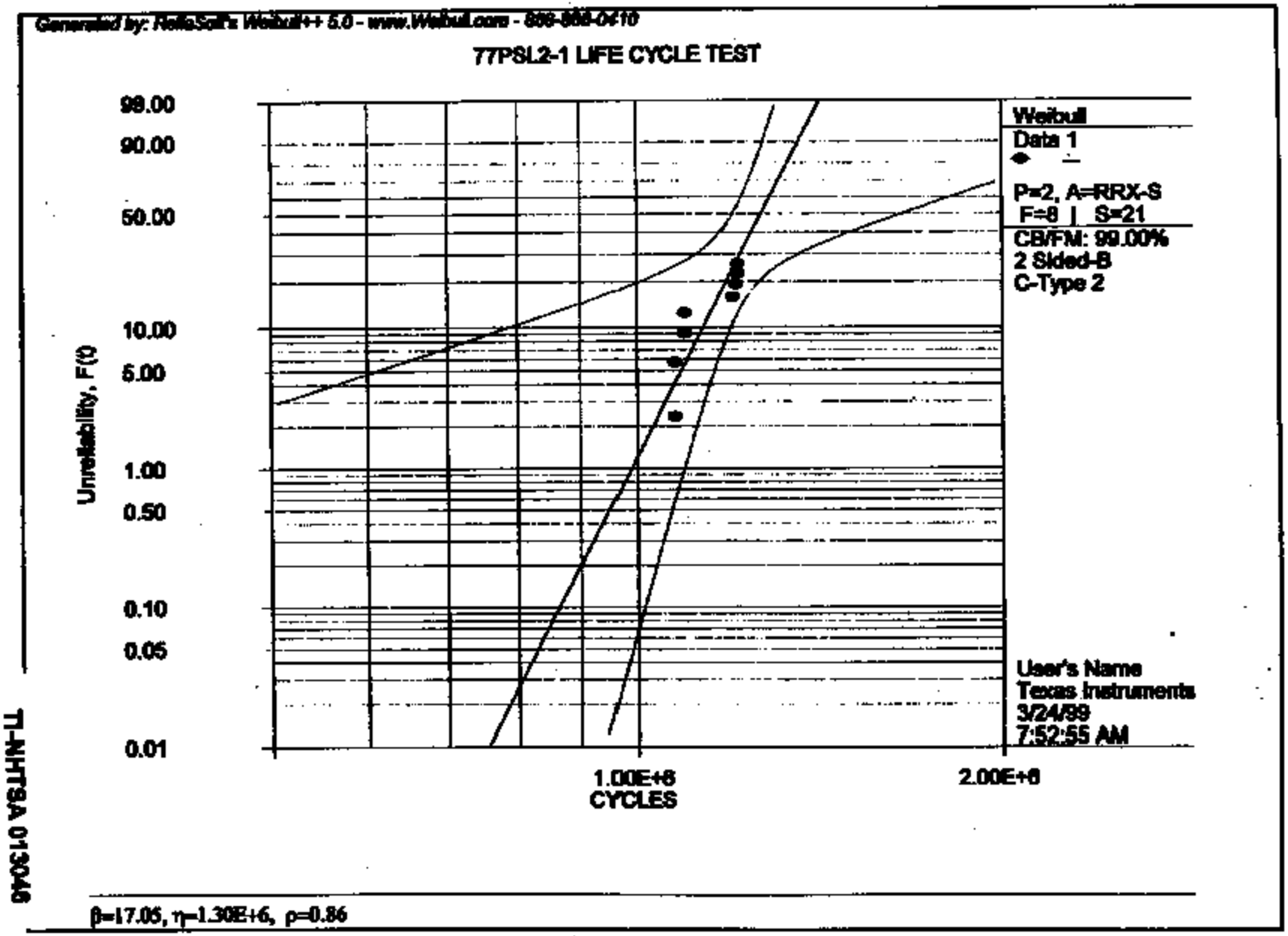
User Input:

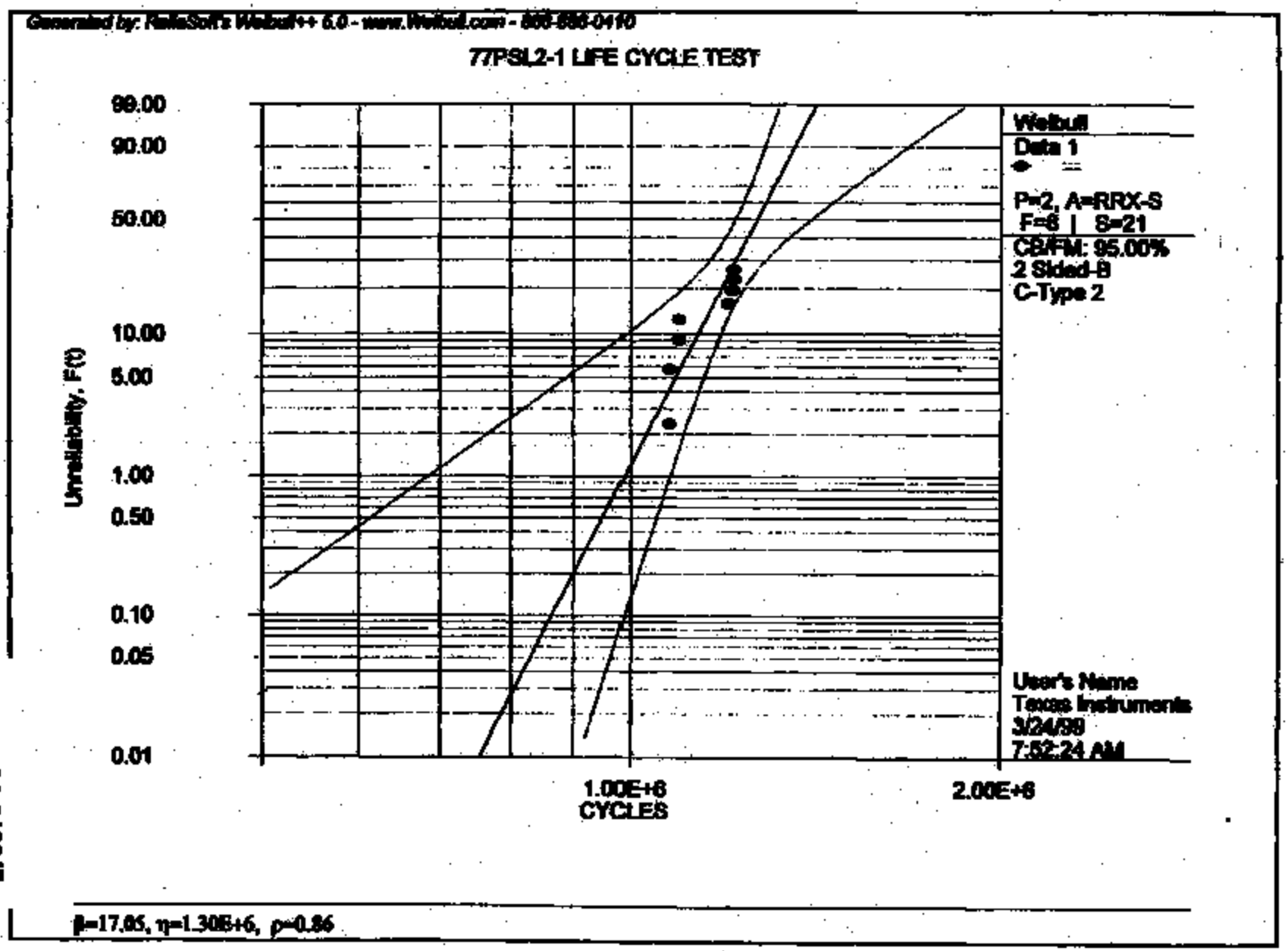
Mission End Time: = 500000
Confidence Bounds Used: 2-Sided

Confidence Level: = 0.999
On the parameters:
Lower=5.8377 Beta=17.0464 Upper=49.7765
Lower=11.7466E+6 Eta=12.9501E+6 Upper=14.2765E+6
Weibull++ Output :

Lower CL: = 0.3709
Reliability: = 1.0000
Upper CL: = 1.0000
Confidence: = 26 @ 0.999

ReliaSoft QCP End of Quick Results





THHTSA 01304

Date: 3/24/99
User: User's Name
Company: Texas Instruments

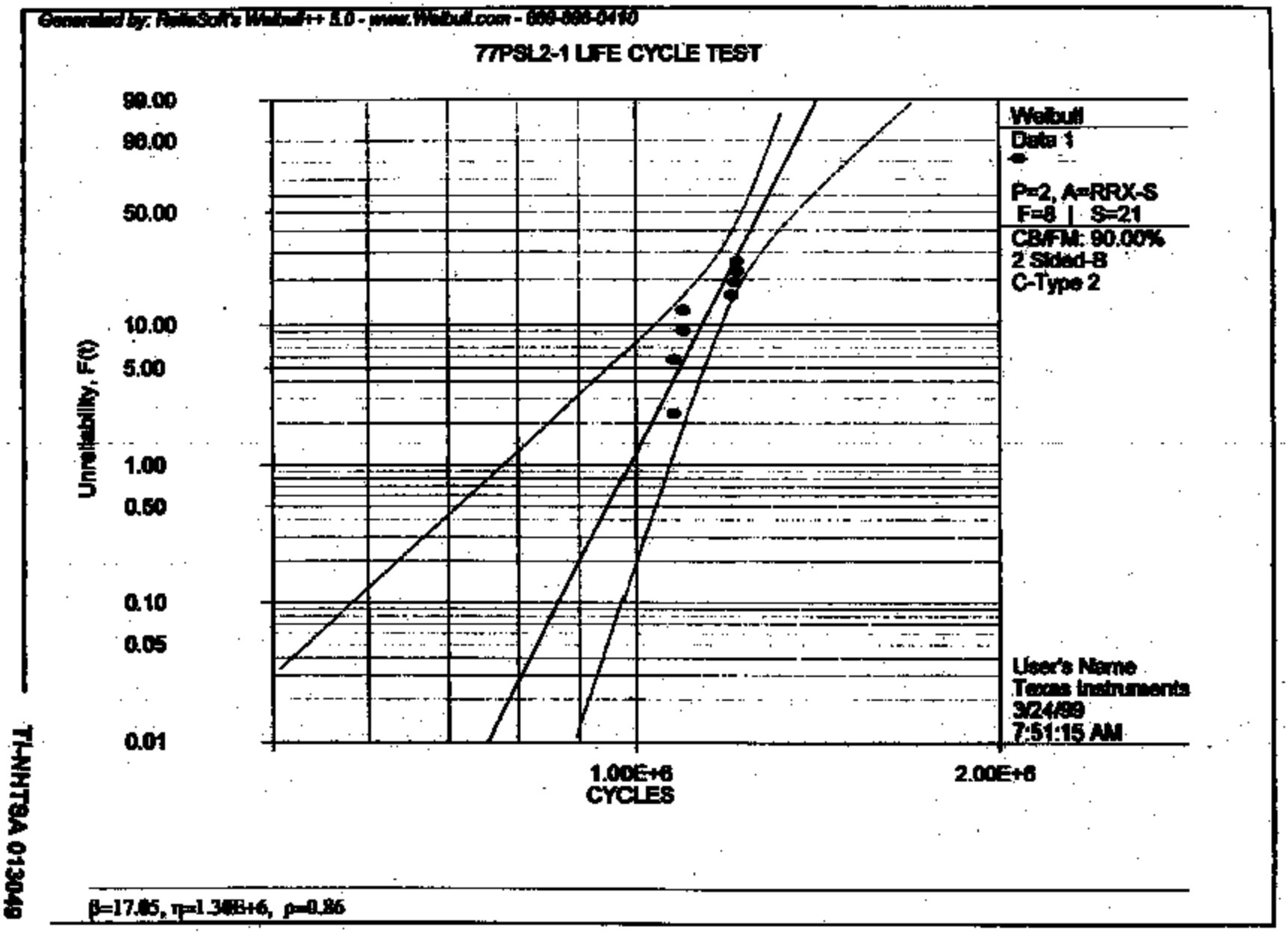
User Input:

Mission End Time: = 500000
Confidence Bounds Used: 2-Sided

Confidence Level: = 0.95
On the parameters:
Lower=8.0030 Beta=17.0464 Upper=32.2759
Lower=12.2191E+5 Eta=12.9501E+5 Upper=13.7248E+5
Weibull++ Output:

Lower CL: = 0.9986
Reliability: = 1.0000
Upper CL: = 1.0000
Confidence: = 28 @ 0.96

ReliaSoft QCP End of Quick Results



TLHNHT8A 013049

Date: 3/24/99
User: User's Name
Company: Texas Instruments

User Input:

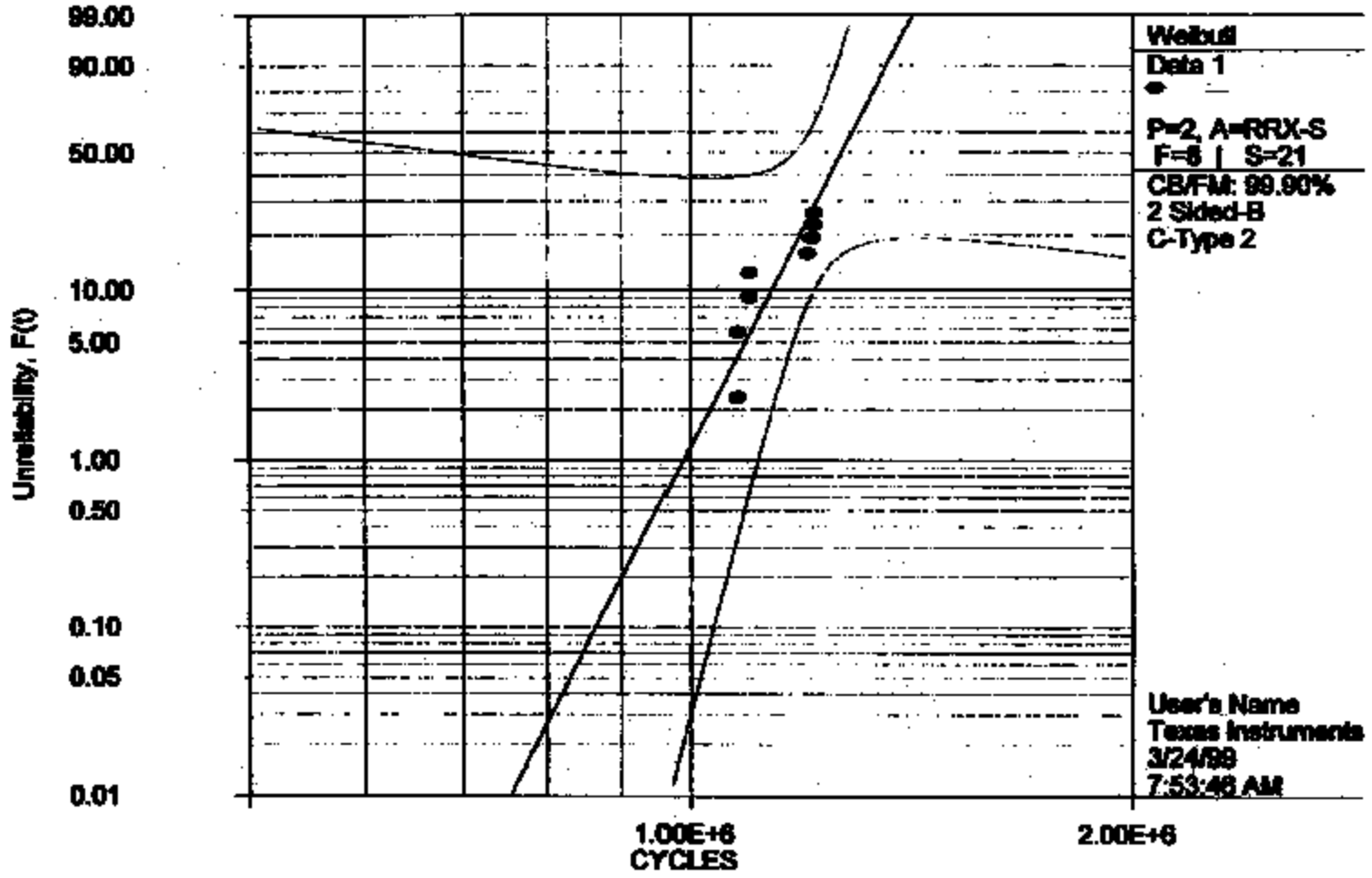
Mission End Time: = 600000
Confidence Bounds Used: 2-Sided

Confidence Level: = 0.90
On the parameters:
Lower=9.9761 Beta=17.0464 Upper=29.1276
Lower=12.3337E+6 Eta=12.9501E+6 Upper=13.6972E+6
Weibull++ Output :

Lower CL: = 0.9997
Reliability: = 1.0000
Upper CL: = 1.0000
Confidence: = 2S @ 0.90

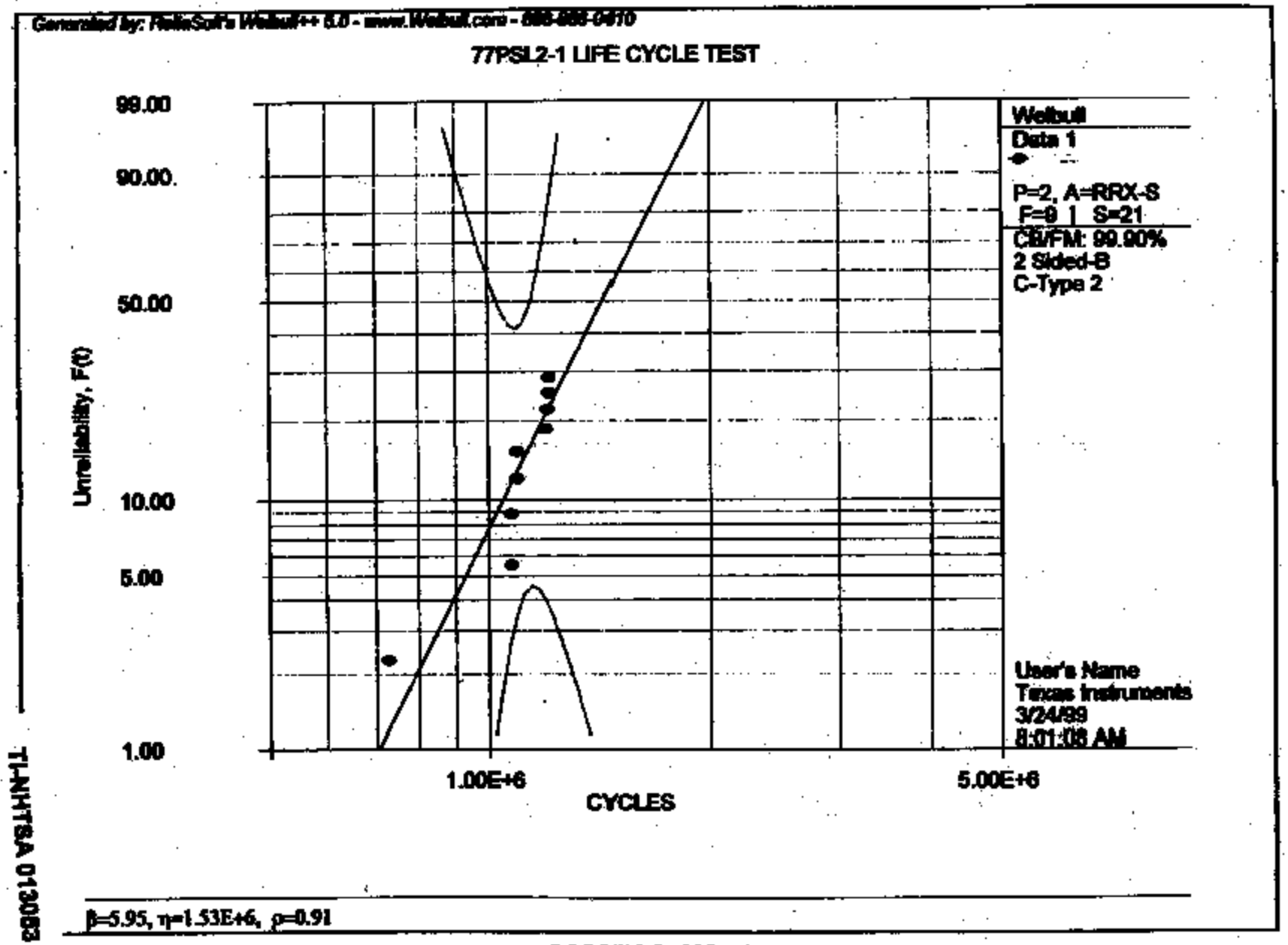
ReliaSoft QCP End of Quick Results

77PSL2-1 LIFE CYCLE TEST



β=17.05, η=1.30E+6, ρ=0.86

728 pt
included



TI-NHTSA 013063

Date: 3/24/99
User: User's Name
Company: Texas Instruments

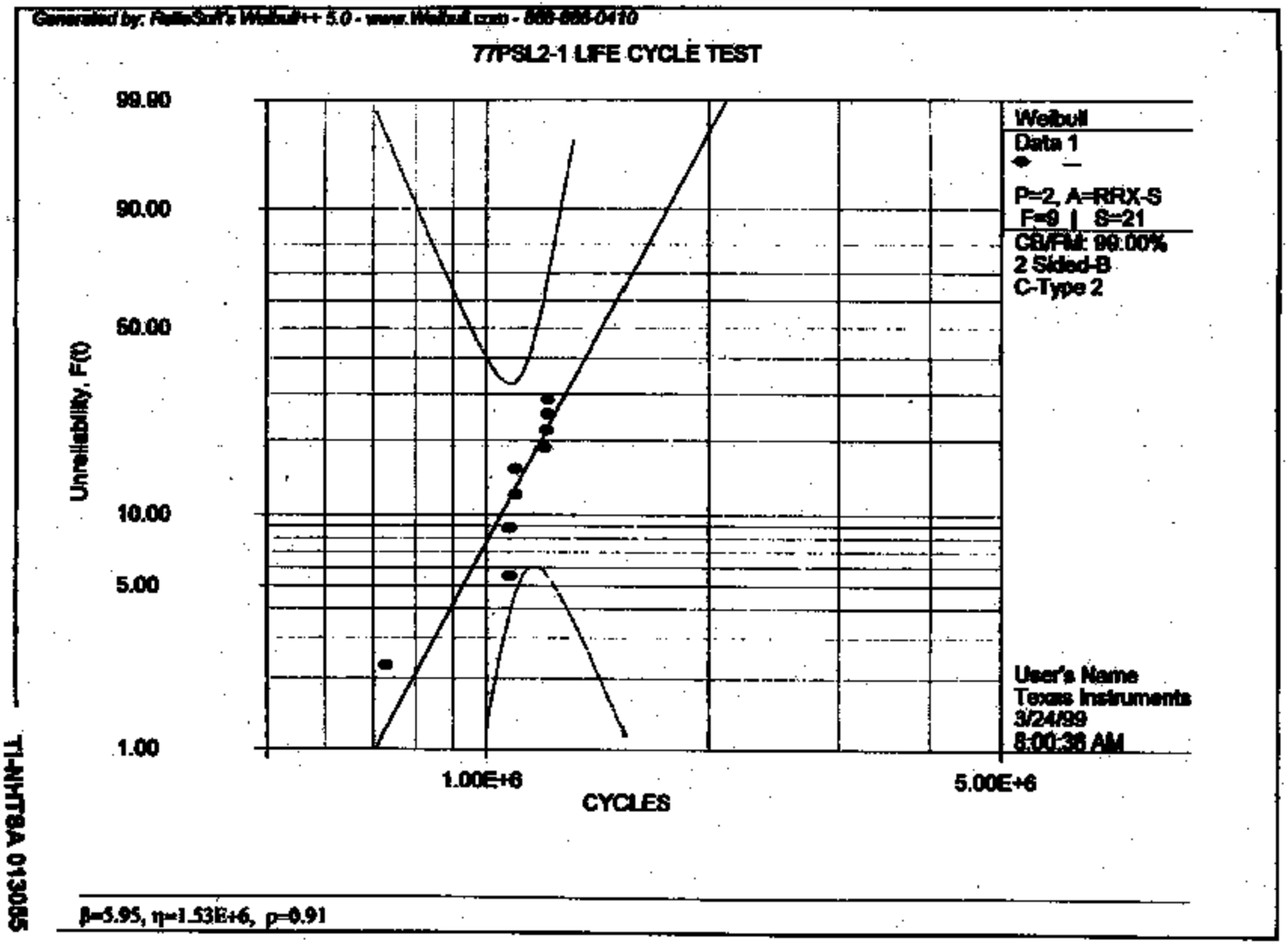
User Input:

Mission End Time: = 500000
Confidence Bounds Used: 2-Sided

Confidence Level: = 0.999
On the parameters:
Lower=0.3116 Beta=5.9474 Upper=113.5661
Lower=59.8593E+4 Eta=16.2840E+5 Upper=39.2214E+6
Weibull++ Output :

Lower CL: = 0.0000
Reliability: = 0.9987
Upper CL: = 1.0000
Confidence: = 25 @ 0.999

ReliaSoft QCP End of Quick Results



TI-NHTBA 013095

Date: 3/24/99
User: User's Name
Company: Texas Instruments

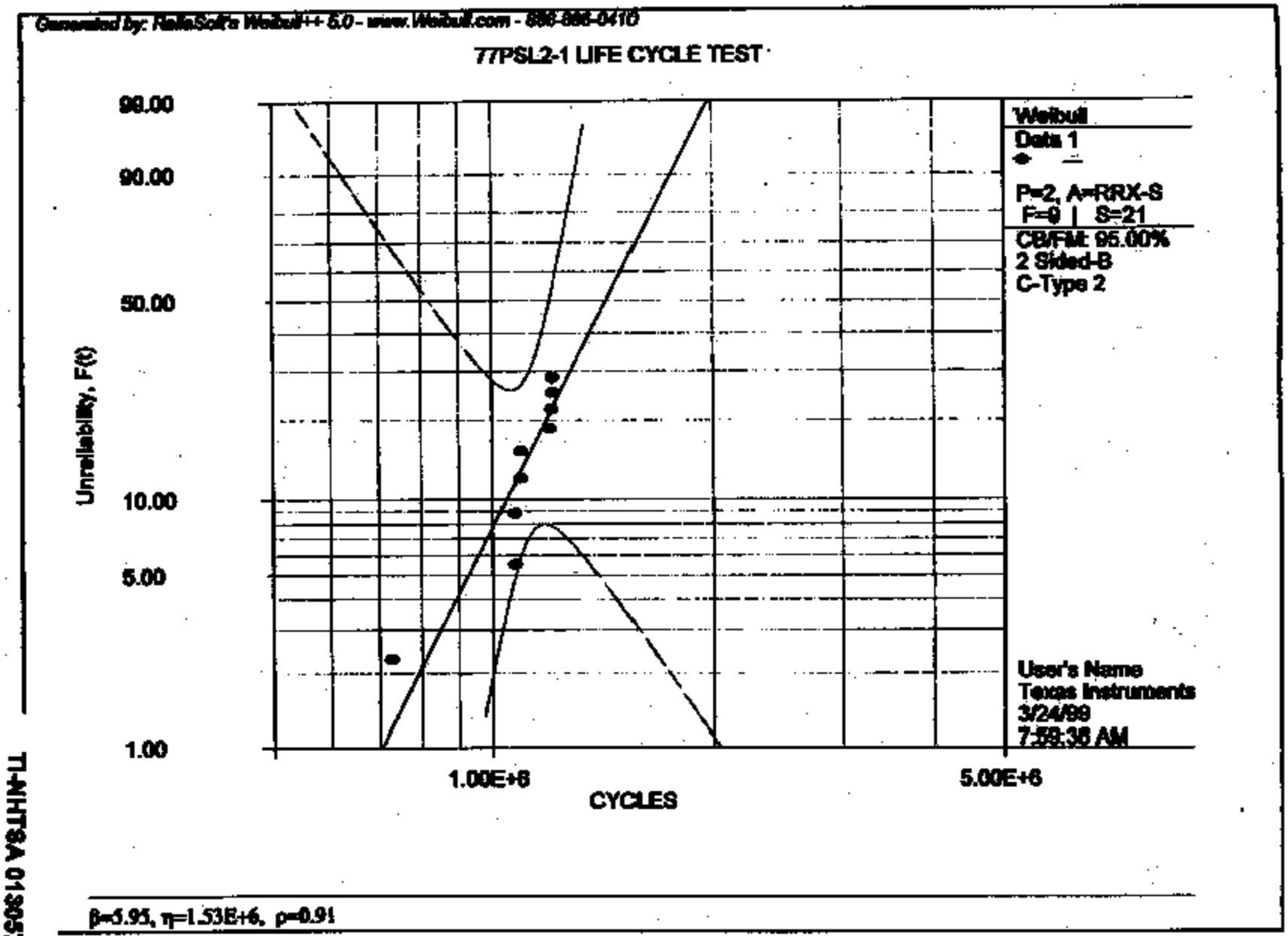
User Input:

Mission End Time: = 500000
Confidence Bounds Used: 2-Sided

Confidence Level: = 0.99
On the parameters:
Lower=0.6909 Beta=5.9474 Upper=59.8887
Lower=73.0633E+4 Eta=15.2840E+5 Upper=31.9636E+6
Weibull++ Output :

Lower CL: = 69.2968E-40
Reliability: = 0.9967
Upper CL: = 1.0000
Confidence: = 28 @ 0.99

ReliaSoft QCP End of Quick Results



TI-NHTSA 013057

Data: 3/24/99
User: User's Name
Company: Texas Instruments

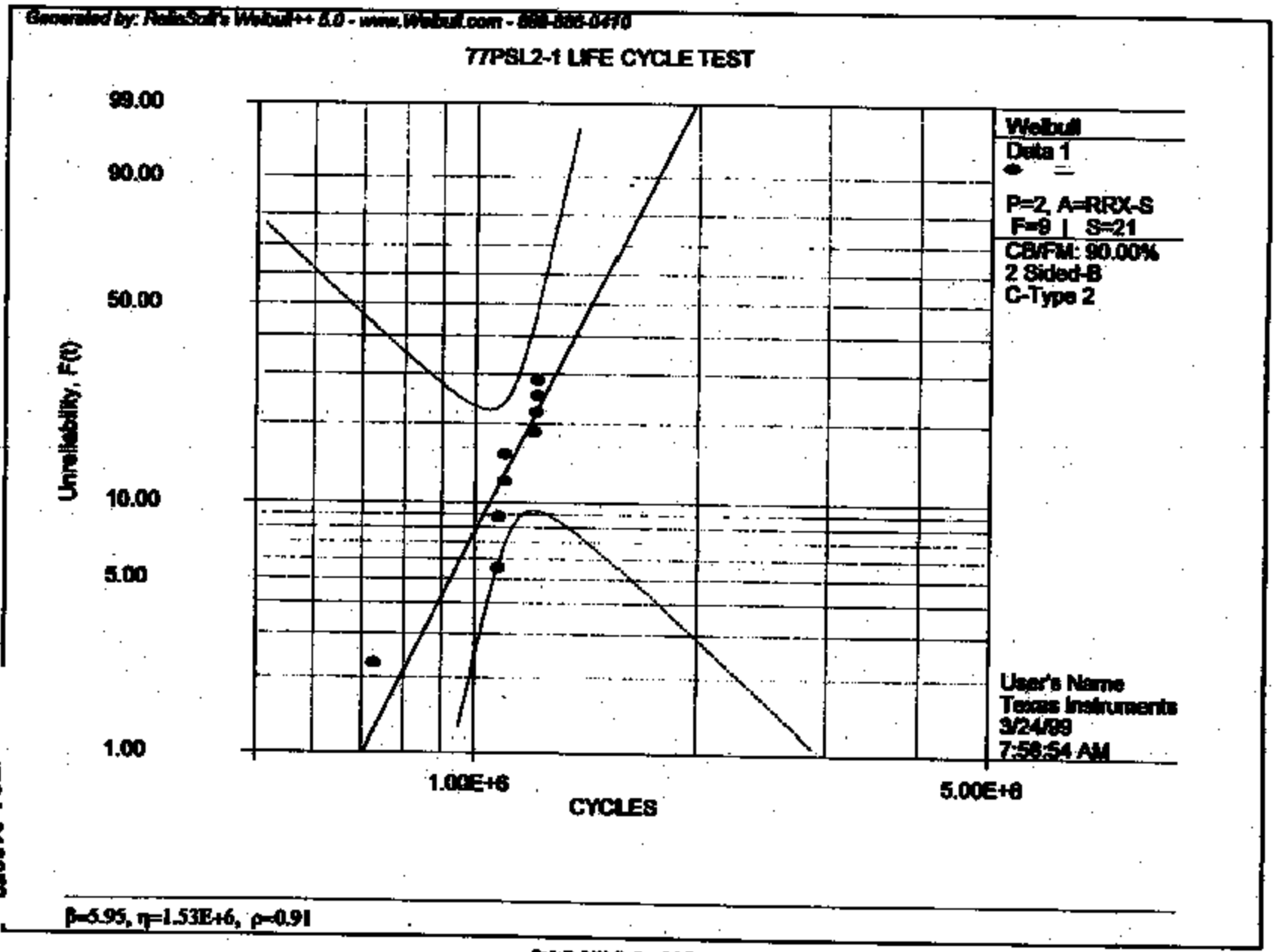
User Input:

Mission End Time: = 500000
Confidence Bounds Used: 2-Sided

Confidence Level: = 0.95
On the parameters:
Lower=1.0262 Beta=5.9474 Upper=34.4675
Lower=87.1793E+4 Eta=15.2840E+6 Upper=26.7954E+6
Weibull++ Output :

Lower CL: = 0.0021
Reliability: = 0.9987
Upper CL: = 1.0000
Confidence: = 2S @ 0.95

ReliaSoft QCP End of Quick Results



TI-NHTSA 013058

Date: 3/24/99
User: User's Name
Company: Texas Instruments

User Input:

Mission End Time: = 500000
Confidence Bounds Used: 2-Sided

Confidence Level: = 0.90
On the parameters:
Lower= Beta=5.9474 Upper=
Lower= Eta=15.2840E+5 Upper=
Weibull++ Output :

Lower CL: = 0.2062
Reliability: = 0.9987
Upper CL: = 1.0000
Confidence: = 28 @ 0.90

ReliaSoft QCP End of Quick Results

Date: 3/24/99
User: User's Name
Company: Texas Instruments

User Input:

Mission End Time: = 500000
Confidence Bounds Used: 2-Sided

Confidence Level: = 0.99
On the parameters:
Lower=7.3570 Beta=17.0464 Upper=39.4433
Lower=11.9981E+6 Eta=12.8501E+6 Upper=13.9776E+6
Weibull++ Output :

Lower CL: = 0.9711
Reliability: = 1.0000
Upper CL: = 1.0000
Confidence: = 29 @ 0.99

ReliaSoft QCP End of Quick Results

Plastic Generation Matrix
(FOR REFERENCE ONLY)

FORD Part Number	Texas Instruments Part Number	Generation Of Plastic Material	UL Designation
F2VC-9F924-AB	77PSL2-1	Celanex 4300	UL (HB)
F8LC-9F924-AA	77PSL2-3	Celanex 4300	UL (HB)
F2VC-9F924-AB	77PSL2-1	Celanex 4300	UL (HB)
F8LC-9F924-AA	77PSL2-3	Celanex 4300	UL (HB)
F2AC-9F924-AA	77PSL3-1	GE Noryl GTX 830	UL (HB)
94DA-9F924-AA	77PSL4-1	GE Noryl GTX 830	UL (HB)
F9DC-9F924-AA	77PSL5-2	GE Noryl GTX 830	UL (HB)
F2AC-9F924-AA	77PSL3-1	GE Noryl GTX 830	UL (HB)
F2VC-9F924-AB	77PSL2-1	Celanex 4300	UL (HB)
F9DC-9F924-AA	77PSL5-2	GE Noryl GTX 830	UL (HB)
F9TA-9F924-CA	77PSL3-3	GE Noryl GTX 830	UL (HB)
F58A-9F924-AA	77PSL3-2	GE Noryl GTX 830	* UL (HB)

* UL(HB)= Horizontal Burn

Prepared by TI Employee 3/25/99

1999 3 25 10:33:01 AM MVC-FD91

Digital Mavica images

4 mavica images 747 Kbytes free

C016

MVC-001X.JPG	1999	3	25	10:30:54	AM
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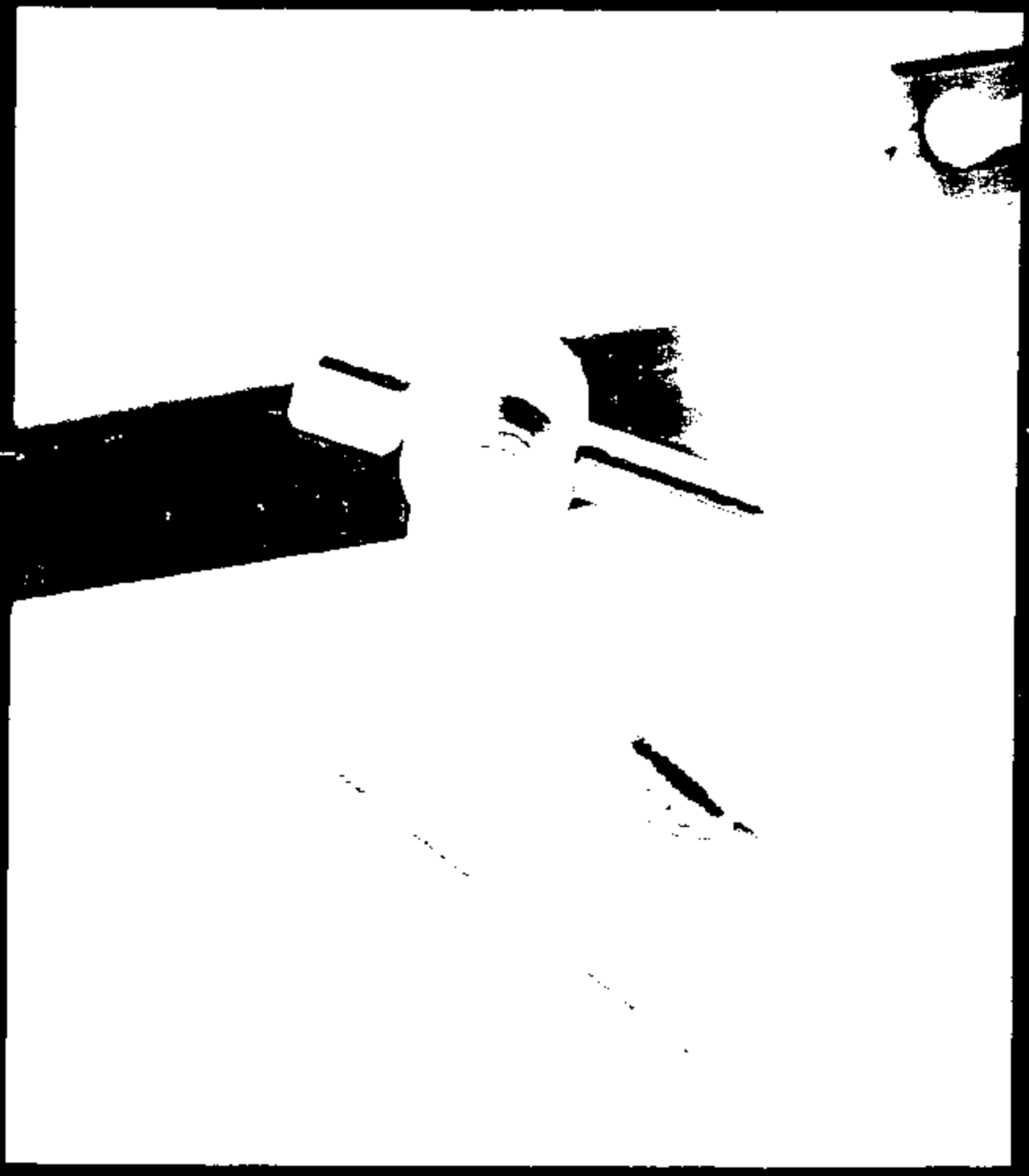
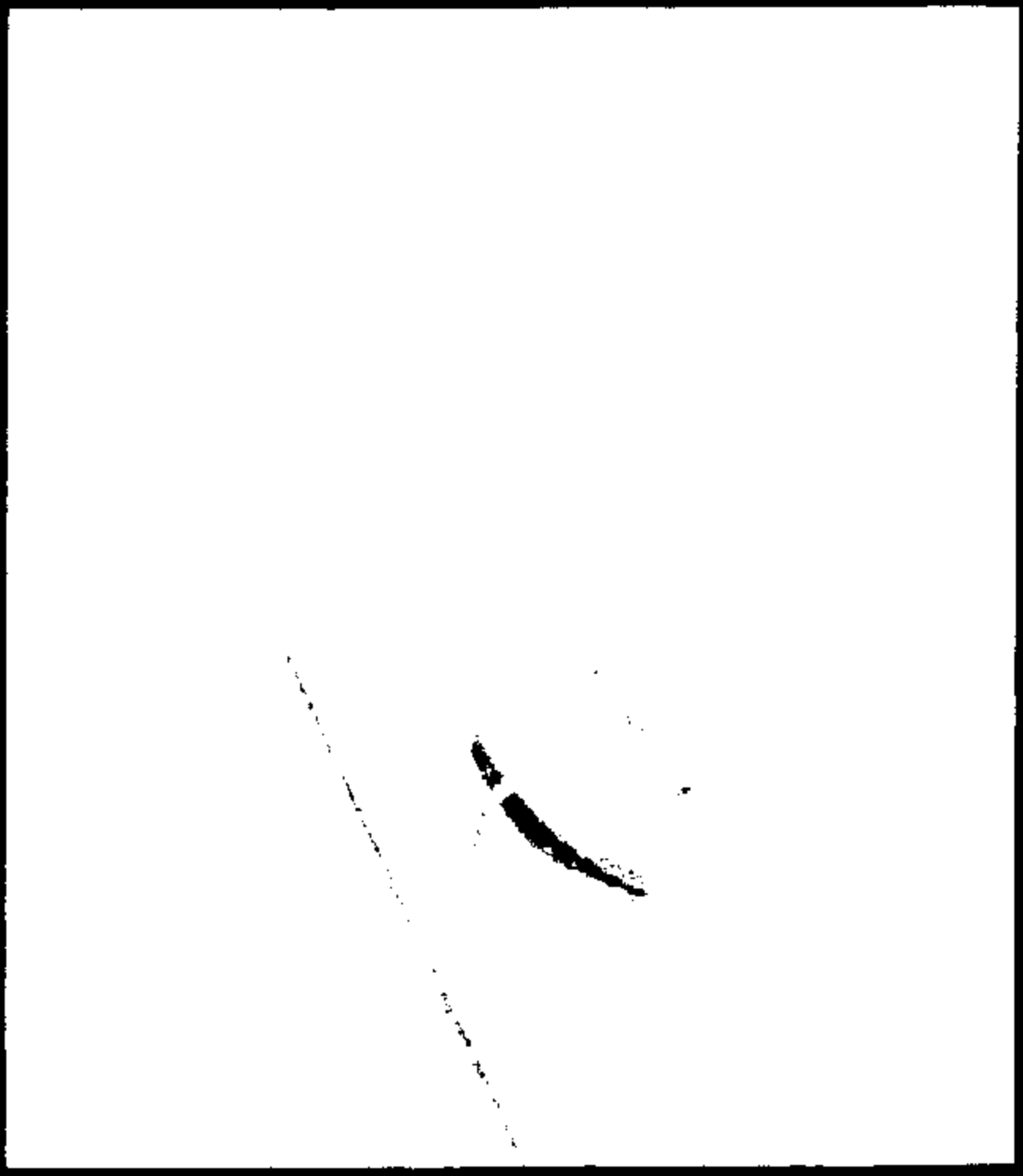
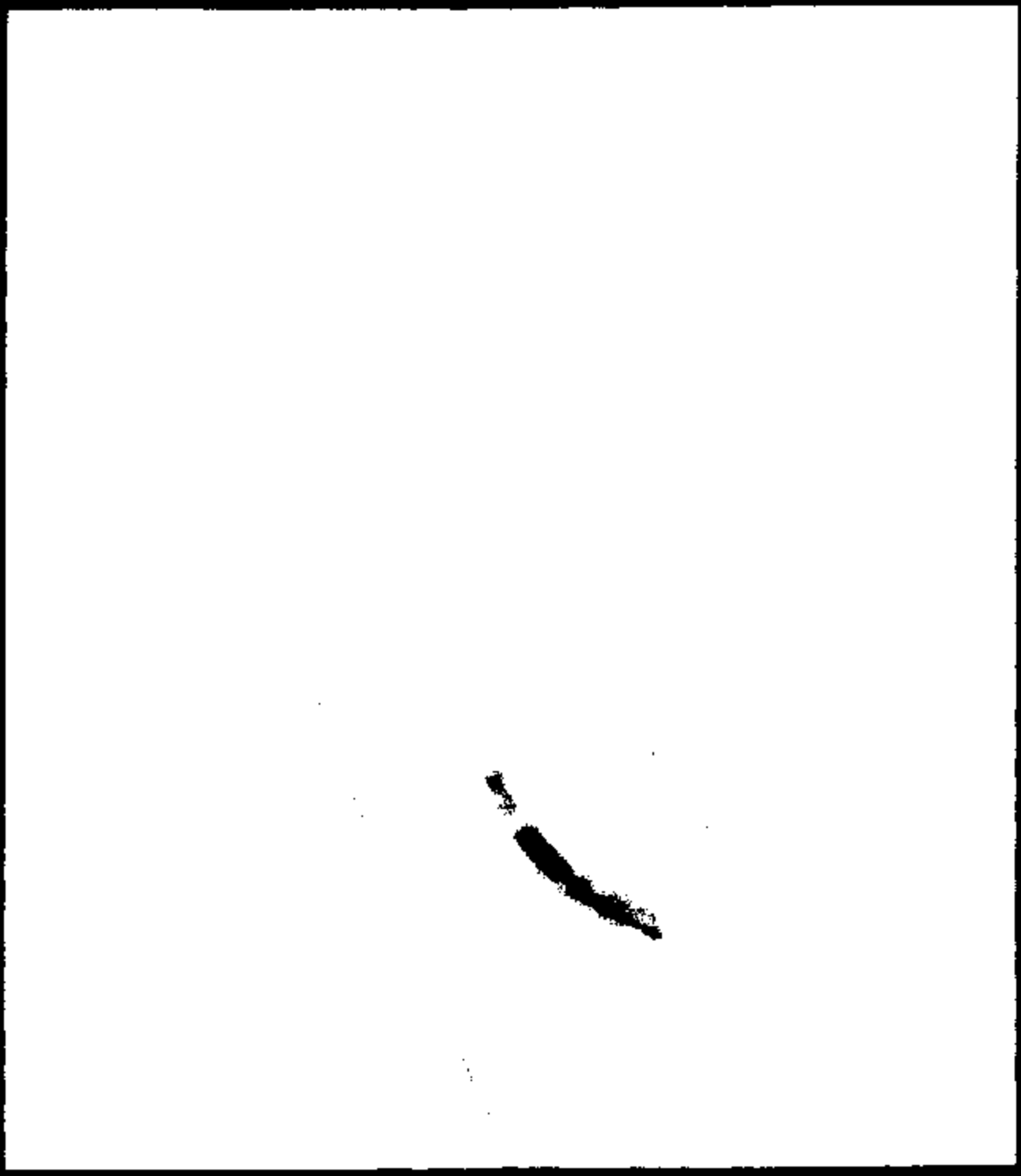
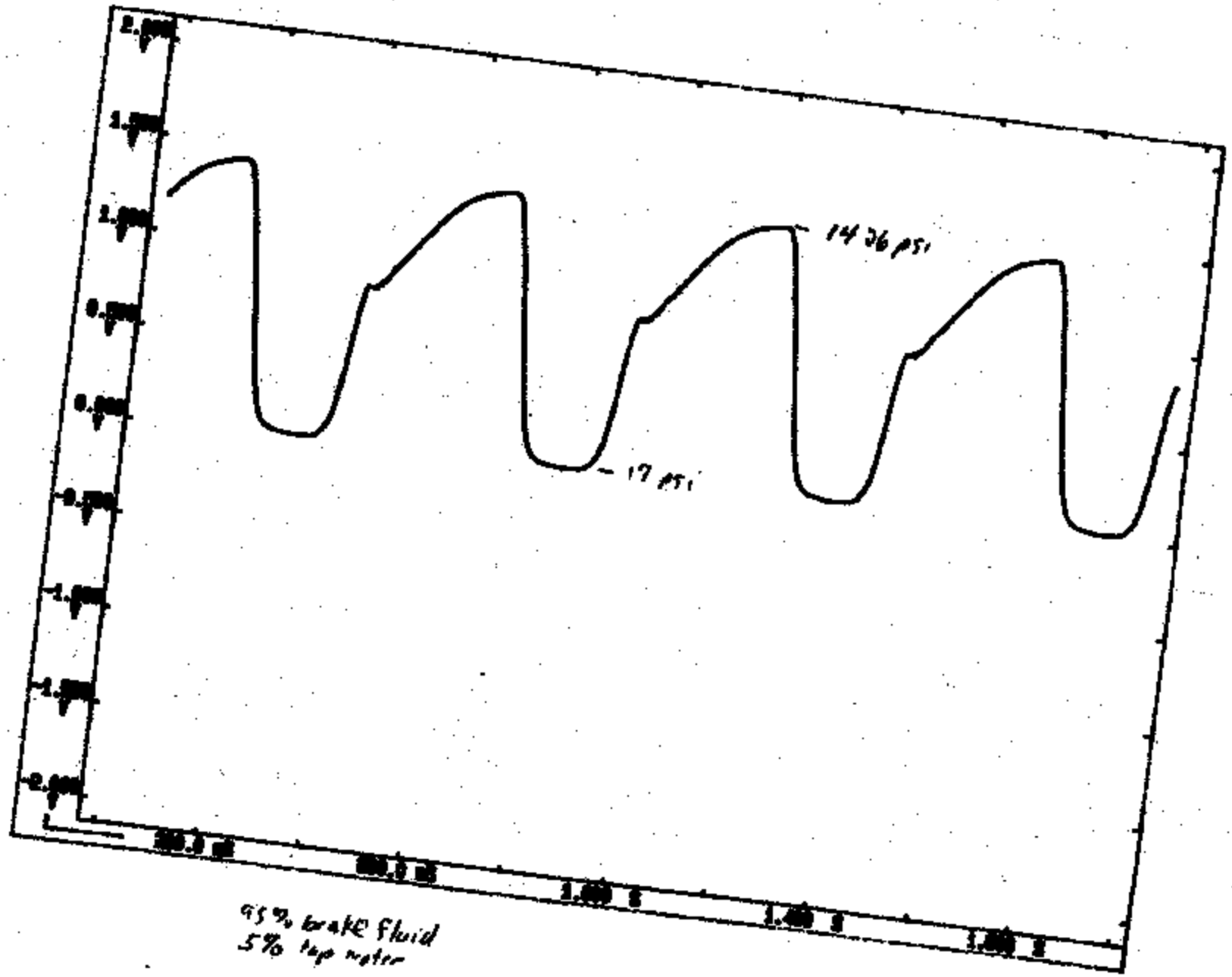


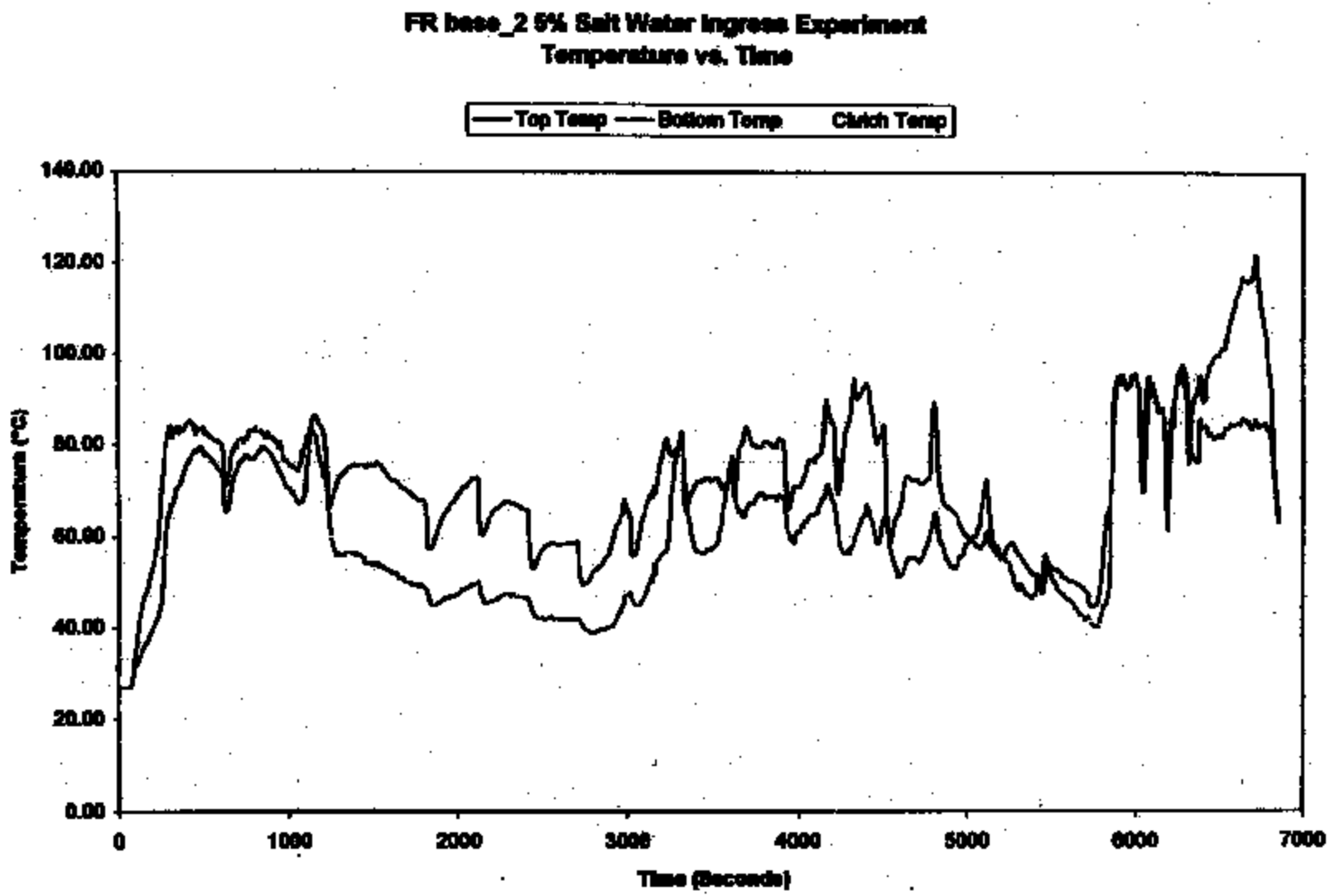




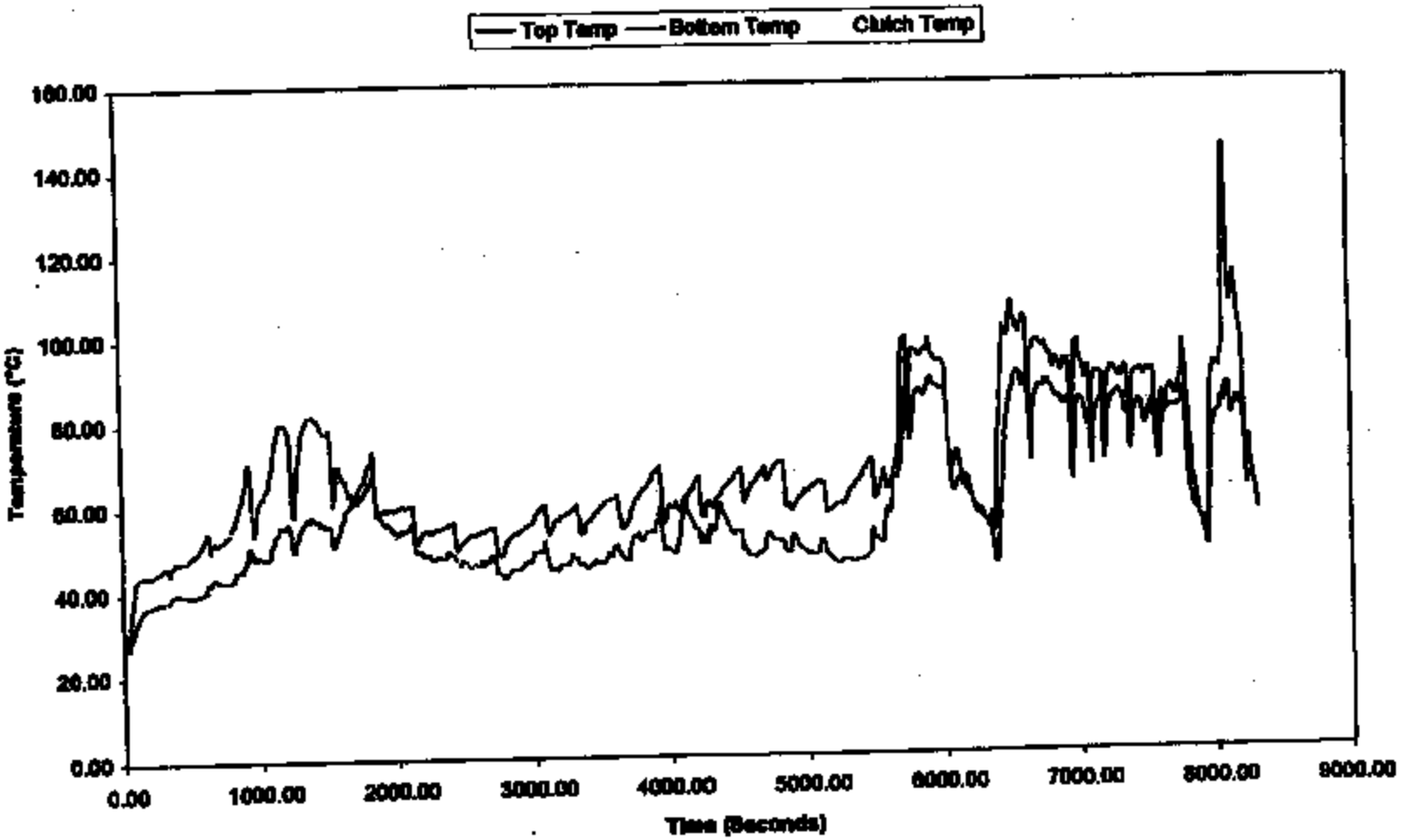


3/29/99

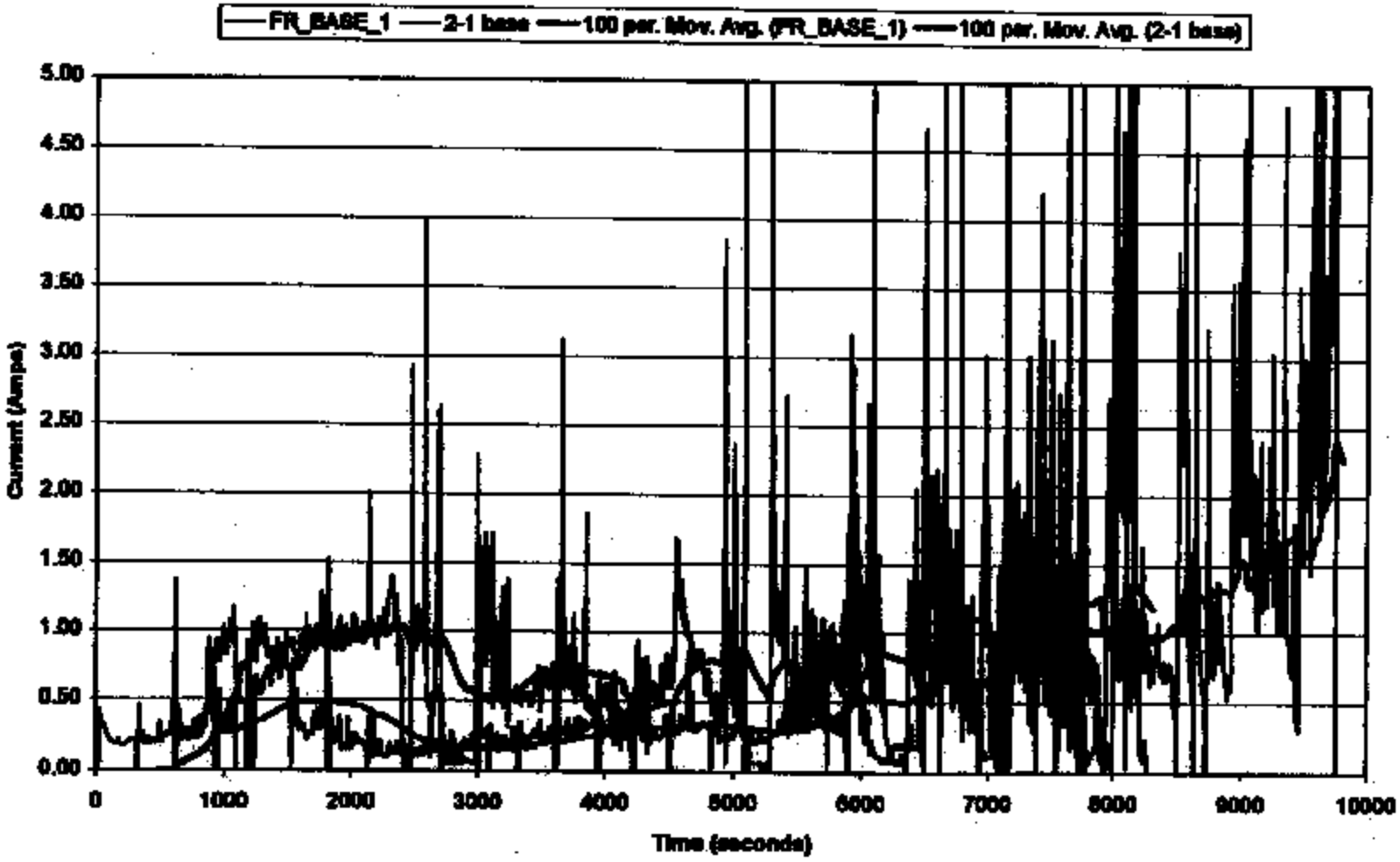
95% brake fluid
5% tap water



FR base 5% Salt Water Ingress Experiment
Temperature vs. Time

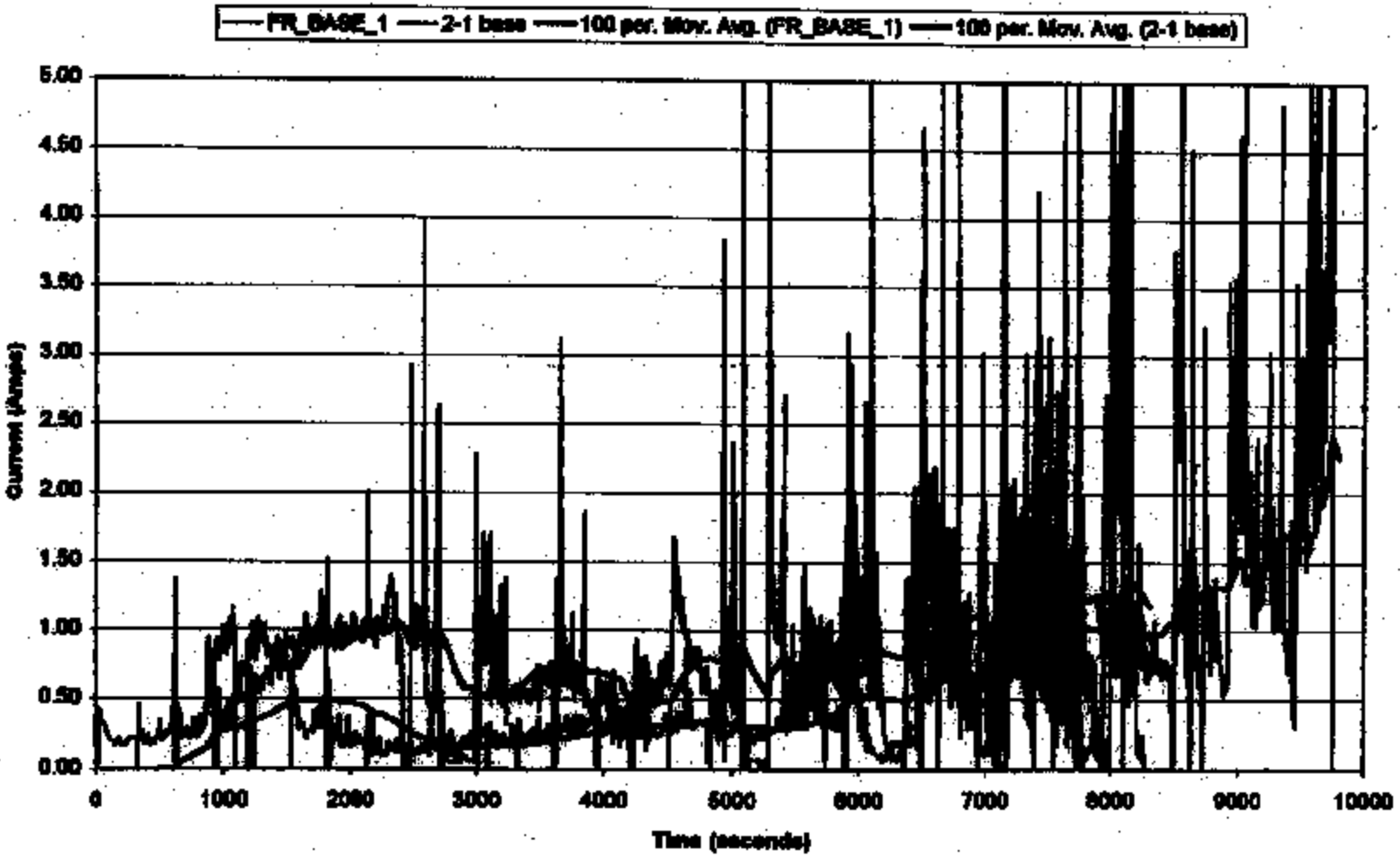


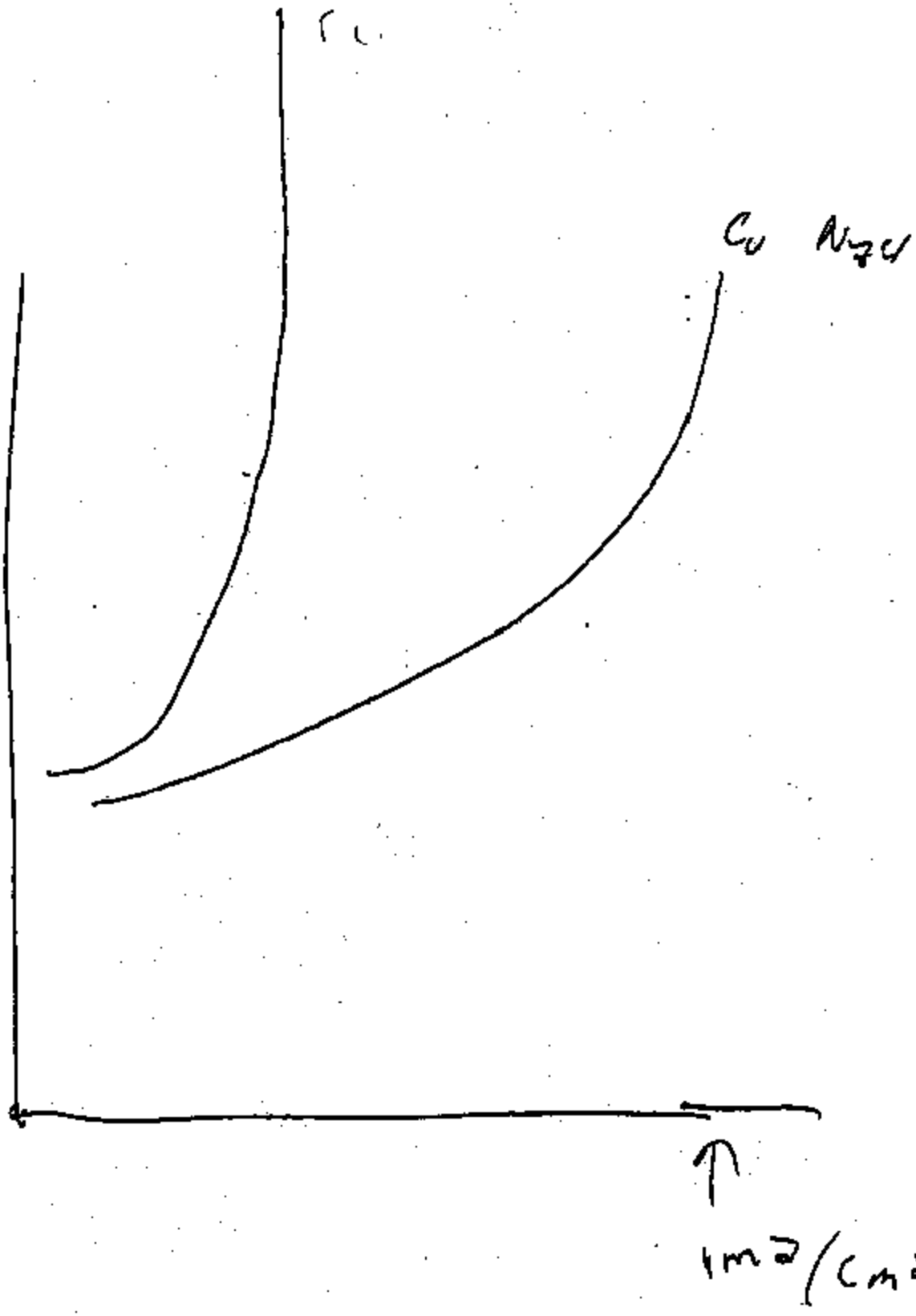
5% SALT WATER INGRESS EXPERIMENT
HEXPORT CURRENT vs. Time



TH-NHTSA 013071

5% SALT WATER INGRESS EXPERIMENT
HEXPORT CURRENT vs. Time





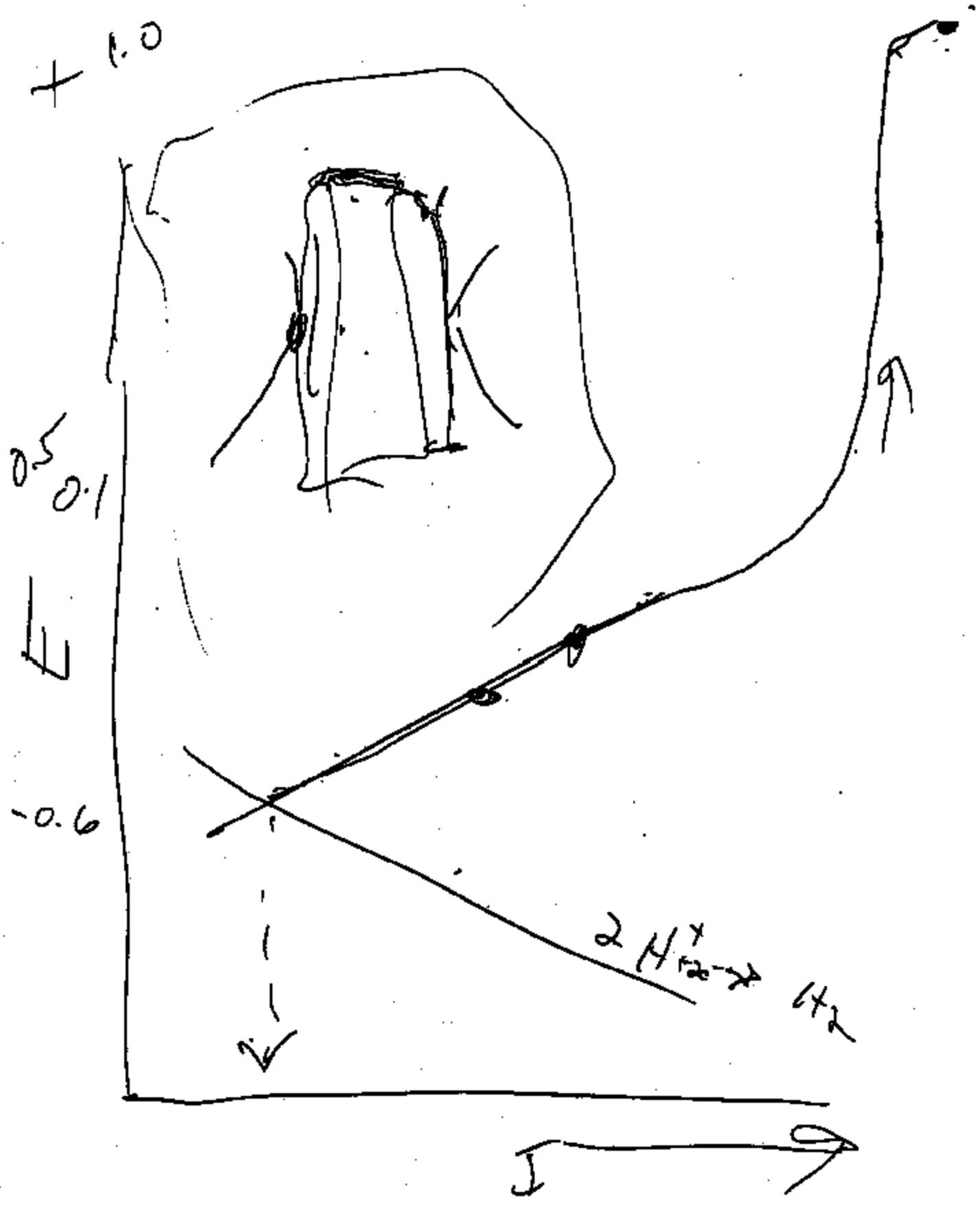


Figure 1.

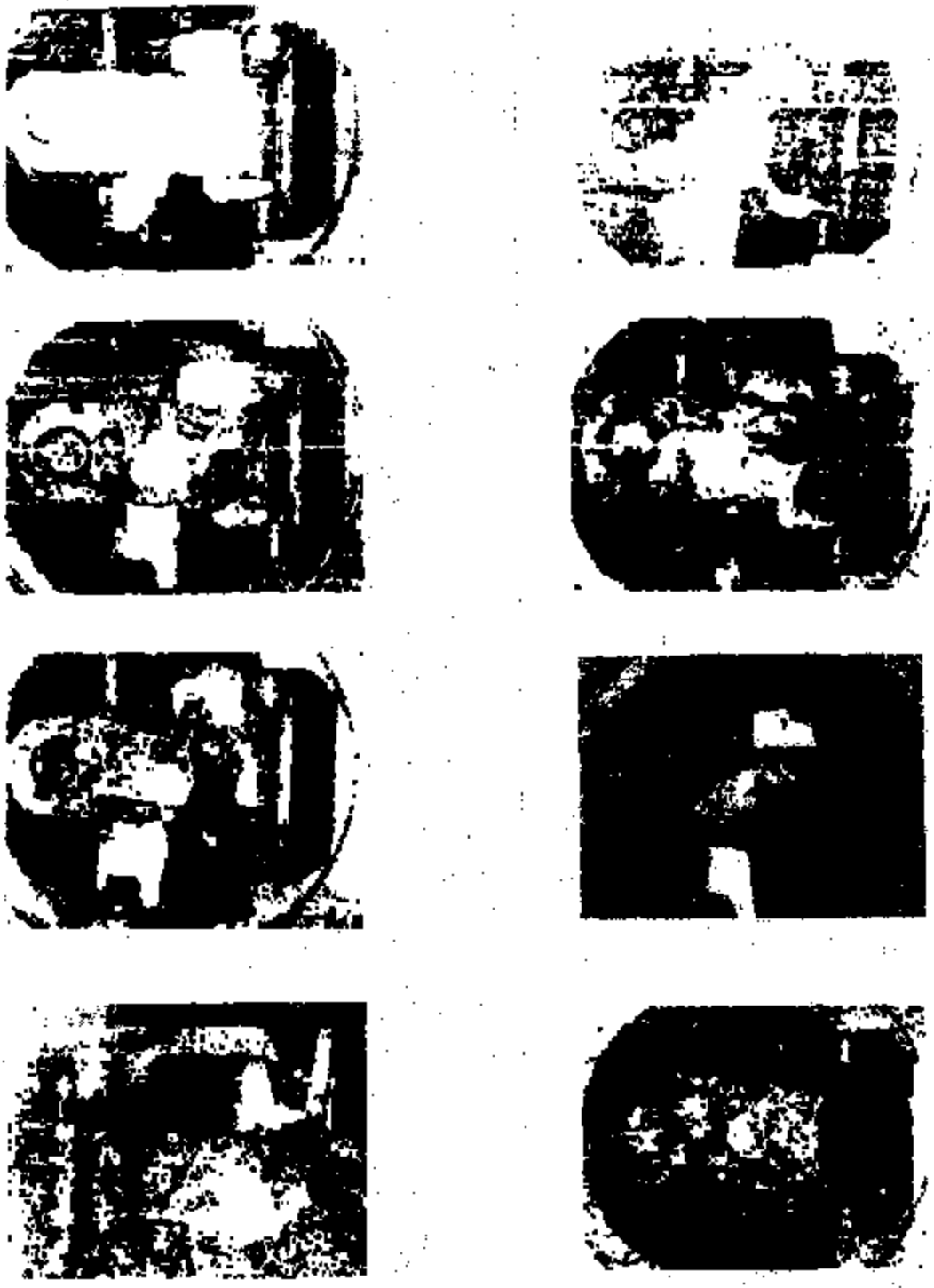
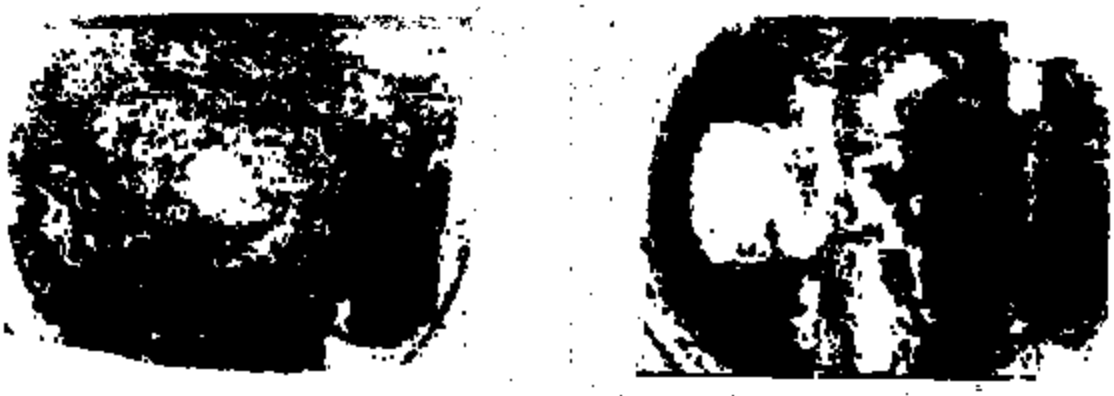


Figure 2.



Salt water corrosion of switch 3A.

3/29/99

Plastic Generation Matrix
(FOR REFERENCE ONLY)

P.N. 46515 (Base) -10 (+ pouch)

* Need 10 pcs each (-1, -2, -3, -7) (77PS)
* just Bases (-6, -8, -11, -12) (87PS)
A54P

FORD Part Number	Texas Instruments Part Number		Generation Of Plastic Material	UL Designation	
F2VC-9F924-AB	77PSL2-1	46515-2	Celanex 4300	UL (HB)	Blend Black
F6LC-9F924-AA	77PSL2-3	46515-1	Celanex 4300	UL (HB)	
F2VC-9F924-AB	77PSL3-1		Celanex 4300	UL (HB)	
F6LC-9F924-AA	77PSL3-3		Celanex 4300	UL (HB)	
F2AC-9F924-AA	77PSL3-1	46515-3	GE Noryl GTX 830	UL (HB)	Natural
94DA-9F924-AA	77PSL4-1	"	GE Noryl GTX 830	UL (HB)	"
F3DC-9F924-AA	77PSL5-2	"	GE Noryl GTX 830	UL (HB)	"
F2AC-9F924-AA	77PSL3-1		GE Noryl GTX 830	UL (HB)	
F2VC-9F924-AB	77PSL3-1		Celanex 4300	UL (HB)	
F3DC-9F924-AA	77PSL5-2		GE Noryl GTX 830	UL (HB)	
F3TA-9F924-CA	77PSL3-3	46515-7	GE Noryl GTX 830	UL (HB)	Red
F6A-9F924-AA	77PSL3-2	46515-10	GE Noryl GTX 830	UL (HB)	dk grey

Brake Pressure Switch Table:

Definitions:

Resistance Measurement #1 = Resistance reading between connector terminals (NC switch)

Resistance Measurement #2 = Resistance reading between sensor case and threaded fitting.

Resistance Measurement #3 = Resistance reading between both connector pins and sensor case.

	Sensor	Id Code:	Date:	Zip Code:	Res. #1	Res. #2	Res.#3	
	#1	PY754375	5-93	42621	0.2 Ohm	167.0 Ohms	Inf. Resistance	
	#2	NY740208	6-92	53237	0.3 Ohm	0.3 Ohms	Inf. Resistance	
	#3	PY688795	1-93	NA	0.3 Ohm	4.48 M Ohms	Inf. Resistance	
	#4	PX629934	11-92	68302	0.2 Ohm	1.5 Ohms	Inf. Resistance	
	#5	PY650225	10-92	72114	0.2 Ohm	1.7 Ohms	Inf. Resistance	
	#6	PX638867	12-92	55333	0.3 Ohm	17 K Ohms	Inf. Resistance	
	#7	PX665270	4-93	66689	0.3 Ohm	2.9 Ohms	Inf. Resistance	
	#8	PX643515	12-92	43531	0.2 Ohm	0.4 Ohms	Inf. Resistance	
	#9	PX623672	10-92	94145	0.2 Ohm	24 M Ohms	Inf. Resistance	
	#10	PY695374	1-93	NA	0.2 Ohm	11.30 M Ohms	Inf. Resistance	
"E"	#11	NX758774	7-92	97199	0.2 Ohm	6.79 M Ohms	Inf. Resistance	
	#12	BY639984	9-93	97199	0.2 Ohm	0.2 Ohms	Inf. Resistance	
"D"	'Leaking sensor' VIN 2FALP71W1VX145373				0.4 Ohm	1.1 Ohms ← 1.34	4.80 M Ohms 140K GROWING TO 6M DRAIN	
	New sensor #1				0.2 Ohm	0.4 Ohm	Inf. Resistance	
	New sensor #2				0.2 Ohm	1.1 Ohm	Inf. Resistance	UNSTABLE

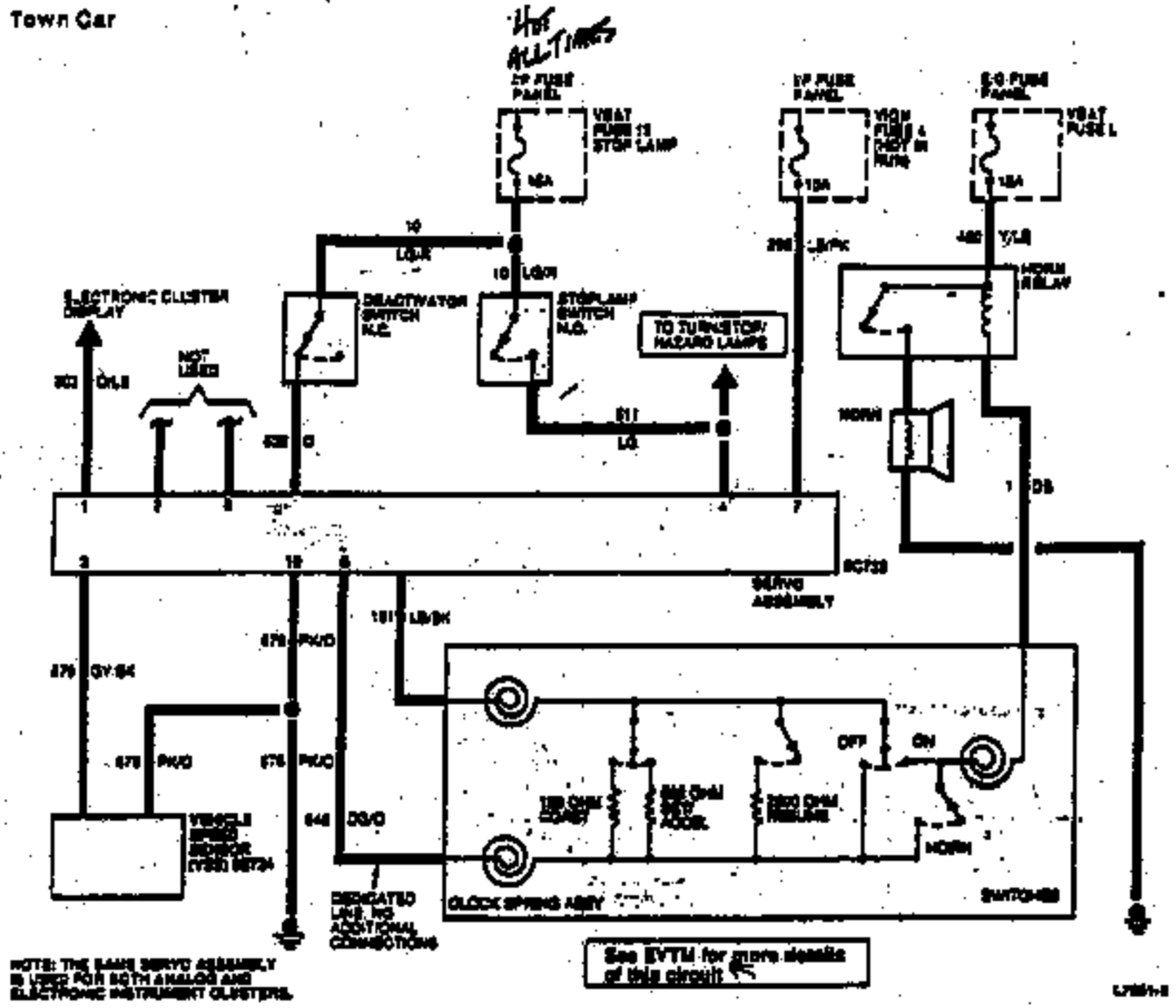
"F" PIPELINE 2126 1LNLM82W1NY760055 4MΩ 300K - 2M

116117

TI-NHTSA 013078

DIAGNOSIS AND TESTING (Continued)

Town Car



NOTE: THE SAME SERVO ASSEMBLY IS USED FOR BOTH ANALOG AND ELECTRONIC INSTRUMENT CLUSTERS.

TI-NHTSA 013079

DRAWINGS AVAILABLE UPON REQUEST

Brake Pressure Switch Test Log, Updated 3/10/99

Category	Test	Location	Test Parameters	Results Update
Lab Simulation	1	TI	Various Levels of Brake Fluid, Water Switch	250+ hours, Current draw in the 0.5mA to 5mA range
of Potential Ignition			14Vdc to one terminal, bezport grounded	Fluid has discolored.
to Switch			Water Conc: 0%, 4%, 6%, 10%, 70%	No Significant Temperature Rise. Test Suspended.
				Internal Analysis in Progress.
	2	TI	Various Levels of Brake Fluid, Water,	250+ hours. Constant temperature.
			1 Amp through switch terminals	No significant temperature rise with time
				Test Suspended.
	3	AVT	Brake Fluid in Switch, 24 VDC to one terminal	> 300 hours into test, max current 7mA
			Hexport Grounded	No significant change with time. Test ongoing
	4	AVT	Brake Fluid in Switch, 24 VDC to one terminal	16 hours into test max current 5mA
			Hexport Grounded, Ambient at 100 C	No significant temperature rise with time. Test suspended.
	5	AVT	Brake Fluid in Switch, 16 Amps	Temperature rise of 20 C above room temp
			Through switch terminals	Delta T reached steady state at 20 C. Test suspended.
	5a	AVT	Brake Fluid in Switch apprx. 60 Amps through	Temperature rose to approx. 270 F. No smoke. No ignition
			Switch Terminals	Test suspended.
	6	TI	Build heater elements into Switch.	2 tested. Smoke observed, ignition observed on part wheeler
			Heat till failure, include sparking.	See attachment
			With Fluid & Dry	Test complete
			Pure brake fluid with metal shavings	Brake fluid in cavity slows down heat build-up
			6% brake fluid solution	Smoke observed at 675 F, Base melts and falls off at 800 F
	6a	TI	Create heater by corroding spring arm	One out of 15 devices increased resistance to 5 ohms.
			Salt water solution, 14V between spring	Others either very low resistance or megaohms
			and hexport	It took about 100 hours to reach the 5 ohm stage.
				The 5 ohm device ignited under conditions similar to test 6.
	6b	TI	Re-run ignition test to understand	Switch ignition with repeated 6% water solution into switch
			repeatability, current path	Current path is through hexport.
				See plots and video.
				Additional test include tap water, old BF, new BF and other.

TI-NHTSA 013091

CAN OLD/NEW
— BRAKE FLUID CREATE A FIRE

HOW COULD IS IT GET INTO SWITCH

— BRAKE FLUID LEAK PUMPED INTO SWITCH CAVITY

WISH — ELECTRICALLY CYCLED SWITCH & BRAKE LEAK PROCESS ..... PUMP FLUID INTO

WISH HIGHER AMBIENT PRESS ??

★ DIFFERENCES PRESSES ON DIFFERENT CARS

SWAP / QUIET →
↓ ↓
WEATHER →

— SEND FAIL LETTER?
— DOCUMENTING PROCESS

TLNHTSA 0130B2

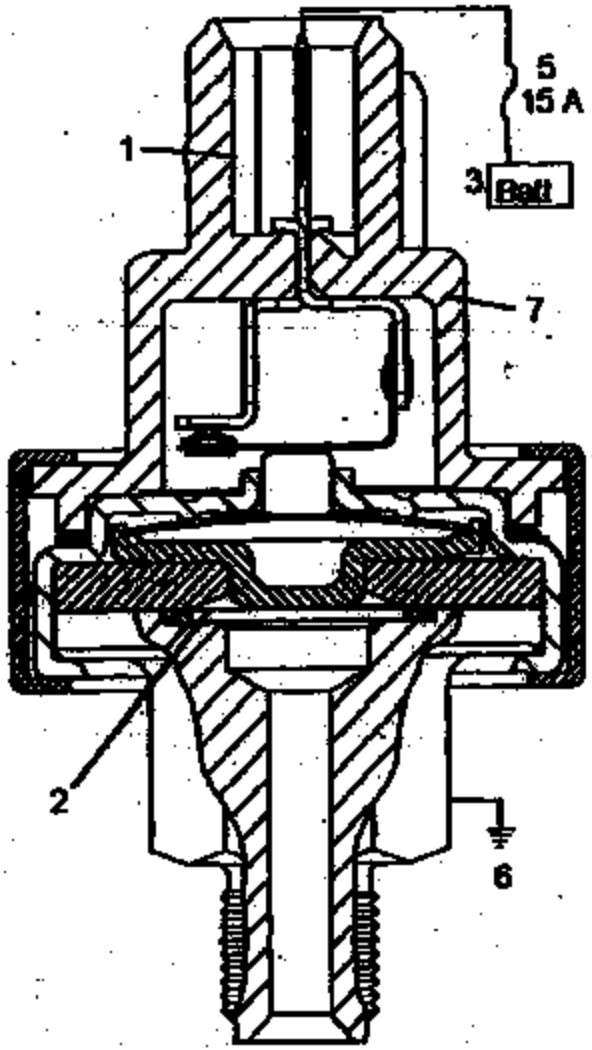
Potential Actions

	Improve connector seal	Re-orient connector	Re-locate switch to brake pedal	Improve kapton diaphragm	Insert in-line fuse with switch	Add power off switch	Re-locate switch to ground side	Re-locate switch to RUN circuit	Insulate switch from prop valve	Use flame retardant plastic
Connector Seal	□	□	■							
Kapton Life			■	□						
Continuous Power					□	■	■	■	■	
Switch Orientation		□	■						□	
Current Capability					□	■	■		■	
Grounded Hi-pot			■				■		■	
Plastic Parameters										□

■ = fixed
□ = improved

TI-NHTSA 013063

Contributing Factors

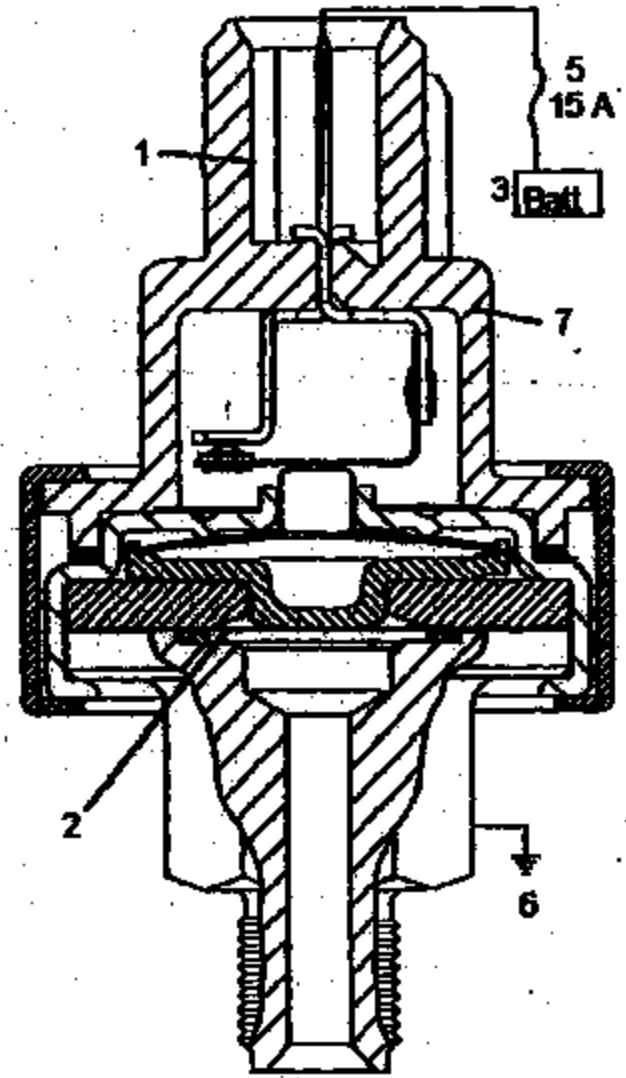


1. Connector Seal
2. Kapton Life
3. Continuous Power
4. Switch Orientation
5. Current Capability
6. Grounded Hex-Port
7. Plastic Parameters

TI-NHTSA 015564

Delivered

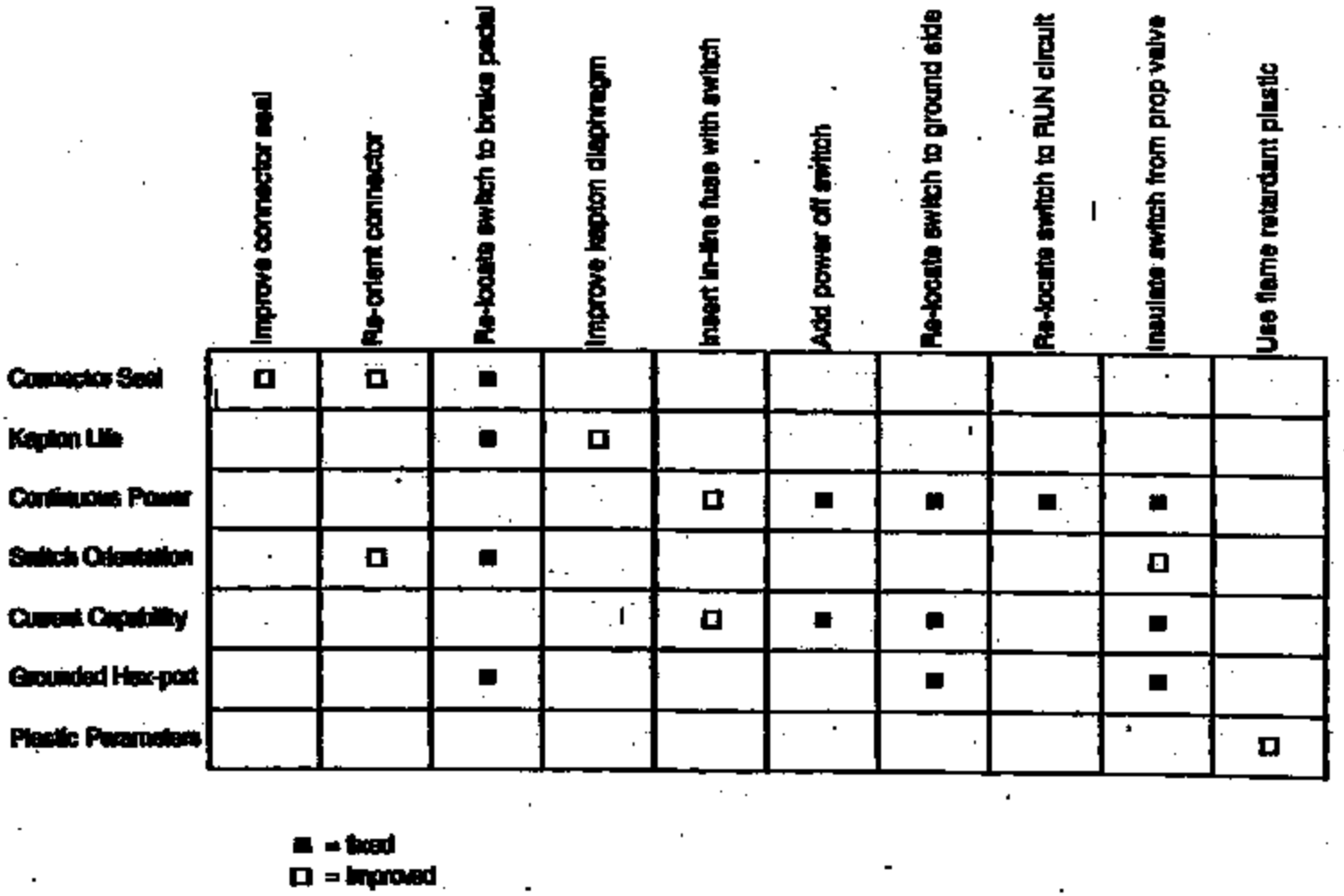
Contributing Factors



1. Connector Seal
2. Kapton Life
3. Continuous Power
4. Switch Orientation
5. Current Capability
6. Grounded Hex-Port
7. Plastic Parameters

TI-MHTSA 013086

Potential Actions



TI-NHTSA 013066

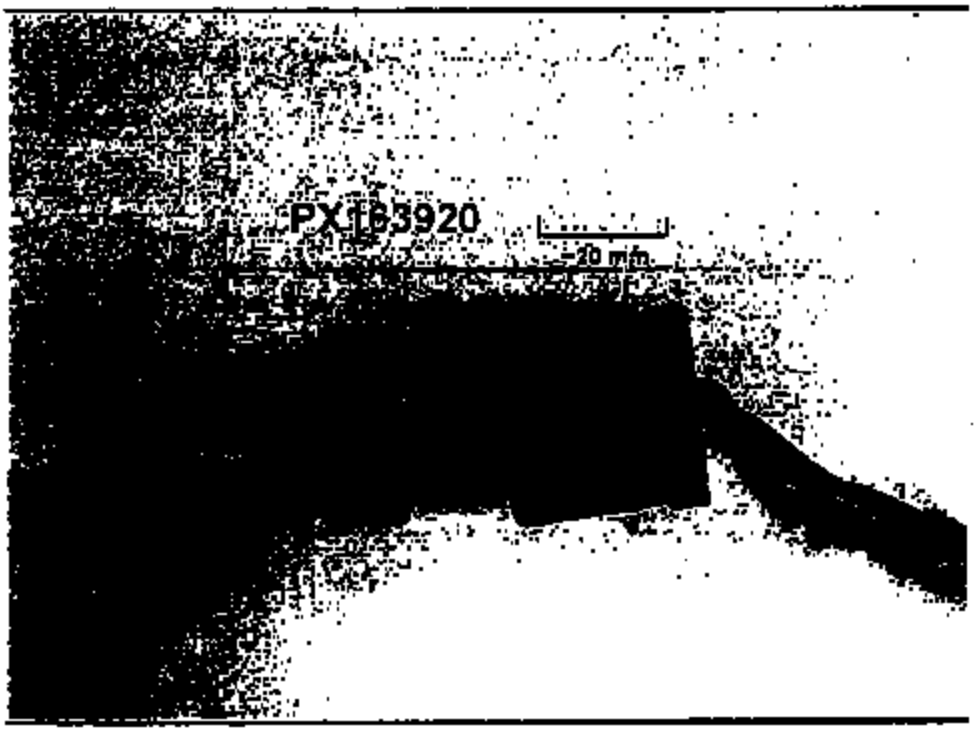


Figure 1: PX163920.

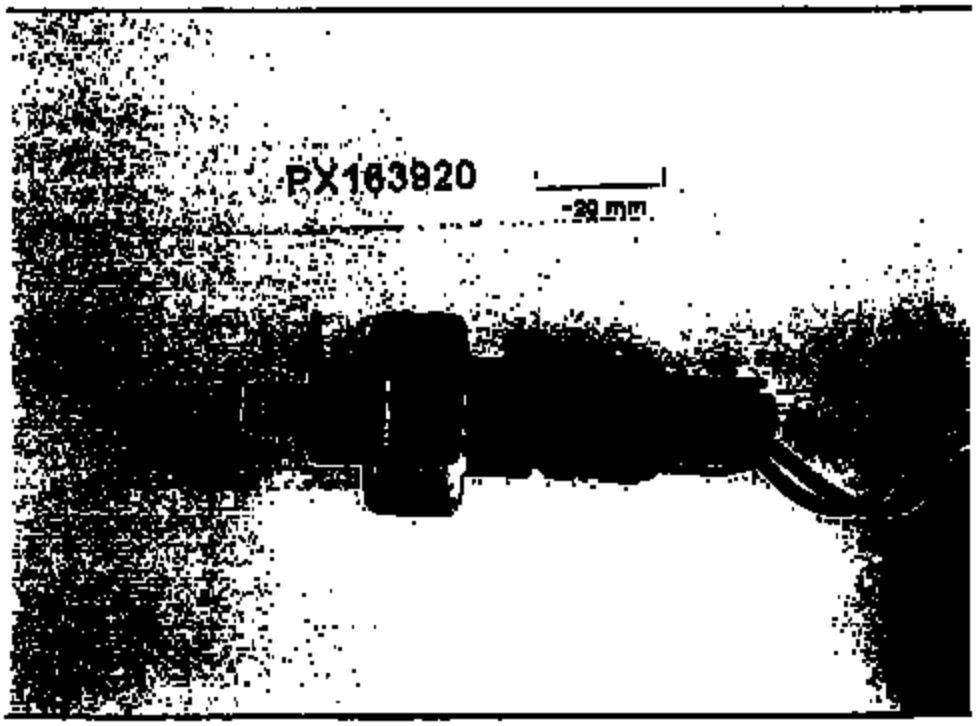


Figure 2: PX163920.

Note: Nominal magnifications given for photomicrographs.

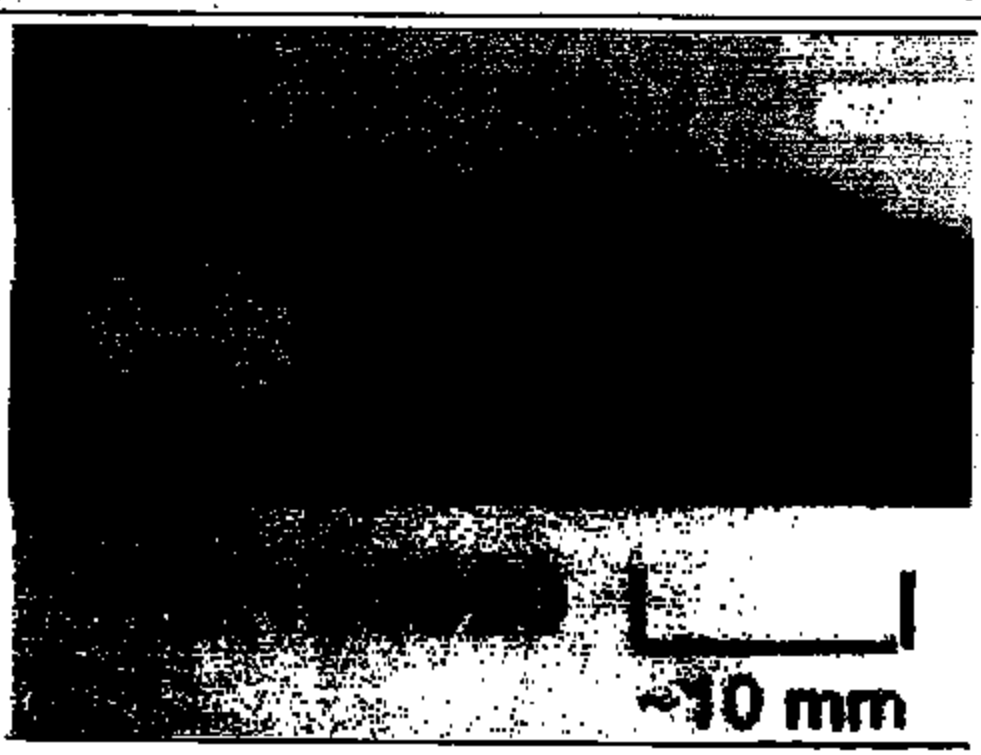


Figure 3: PX183920.

Figure 4: PX183920.

Note: Nominal magnifications given for photomicrographs.

Figure 5: PX163920.

Figure 6: PX163920.

Note: Nominal magnifications given for photomicrographs.

Figure 7: PX163920.

Figure 8: PX163920.

Note: Nominal magnifications given for photomicrographs.

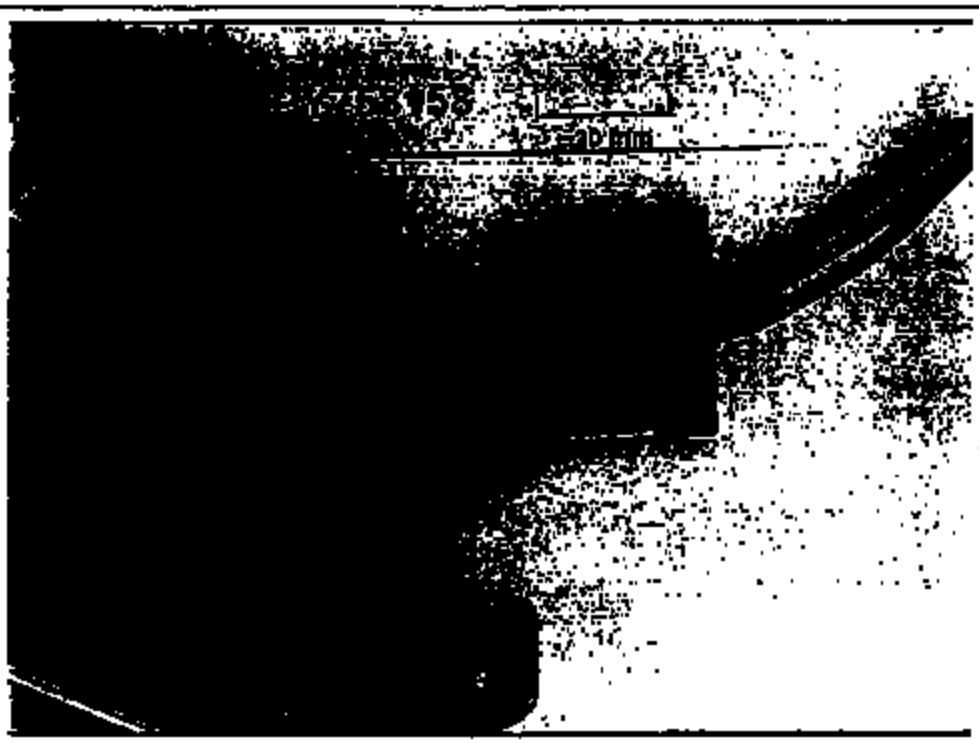


Figure 9: PY758158.

Figure 10: PY758158.

Note: Nominal magnifications given for photostrographs.

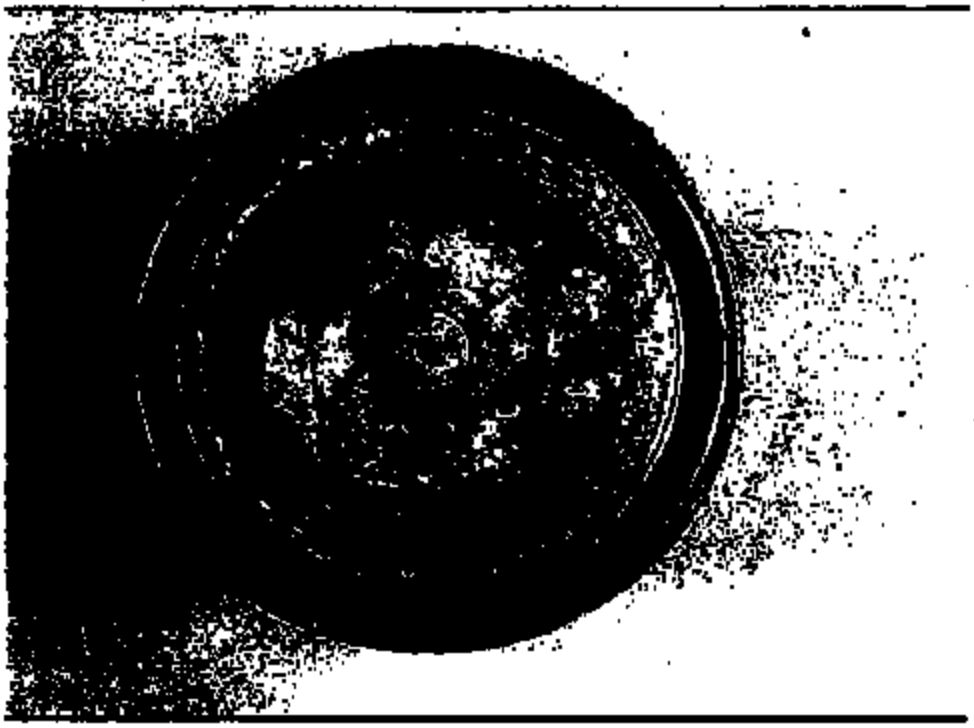


Figure 11: PY758158.

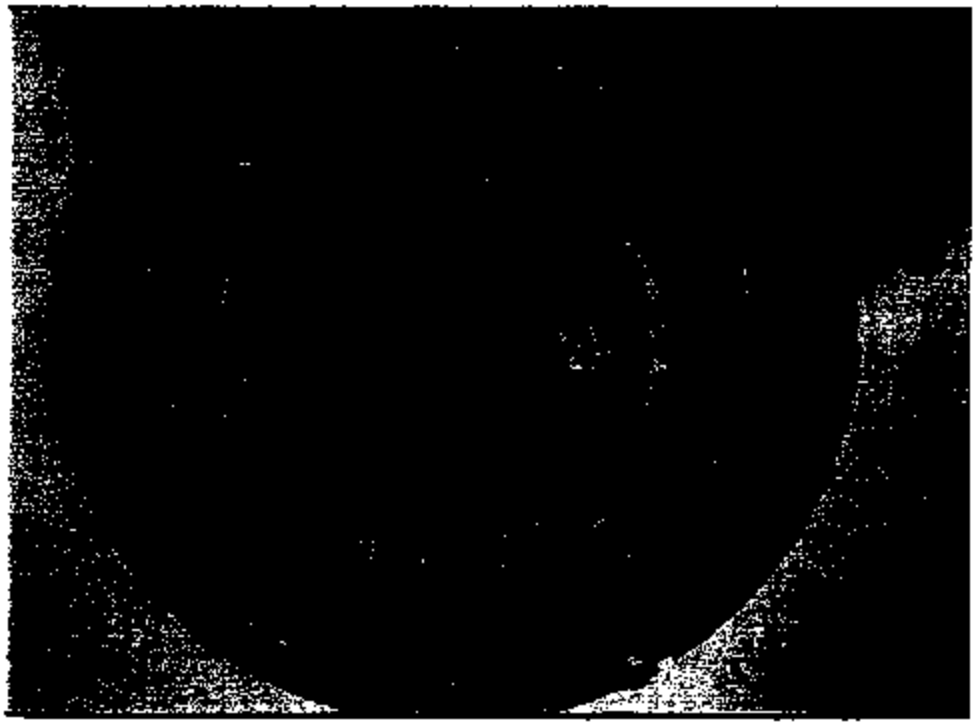


Figure 12: PY758158.

Note: Nominal magnifications given for photomicrographs.

Figure 13: PY758158.

Figure 14: PY758158.

Note: Nominal magnifications given for photomicrographs.

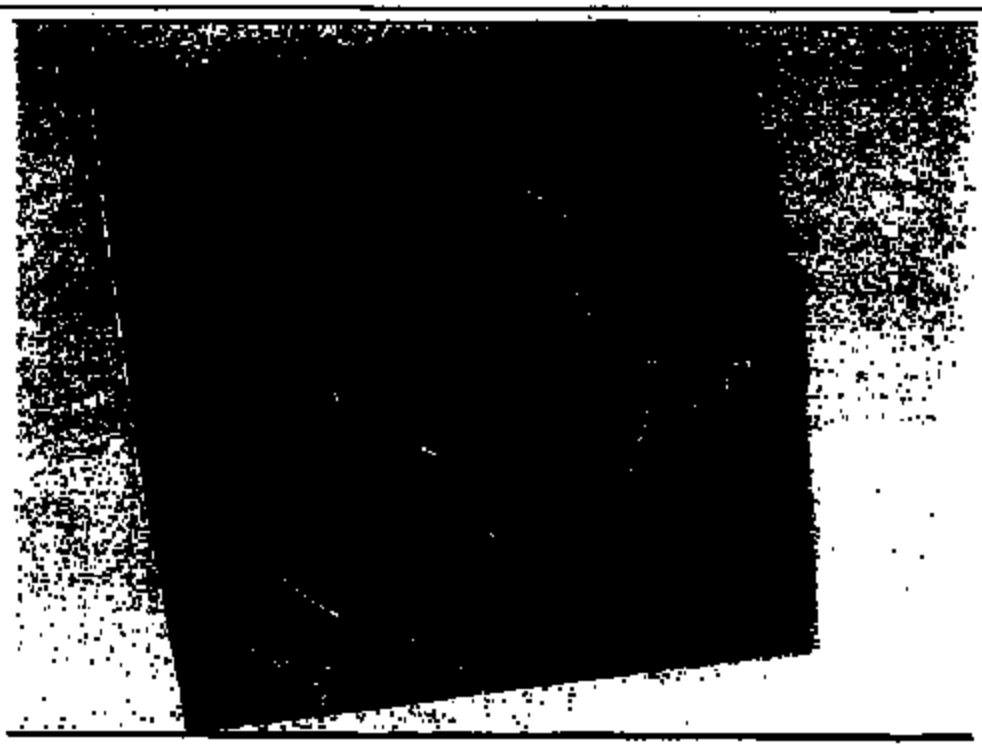


Figure 15: PX163920, seal 1 fluid side.

Figure 16: PX163920, seal 1 fluid side.

Note: Nominal magnifications given for photomicrographs.

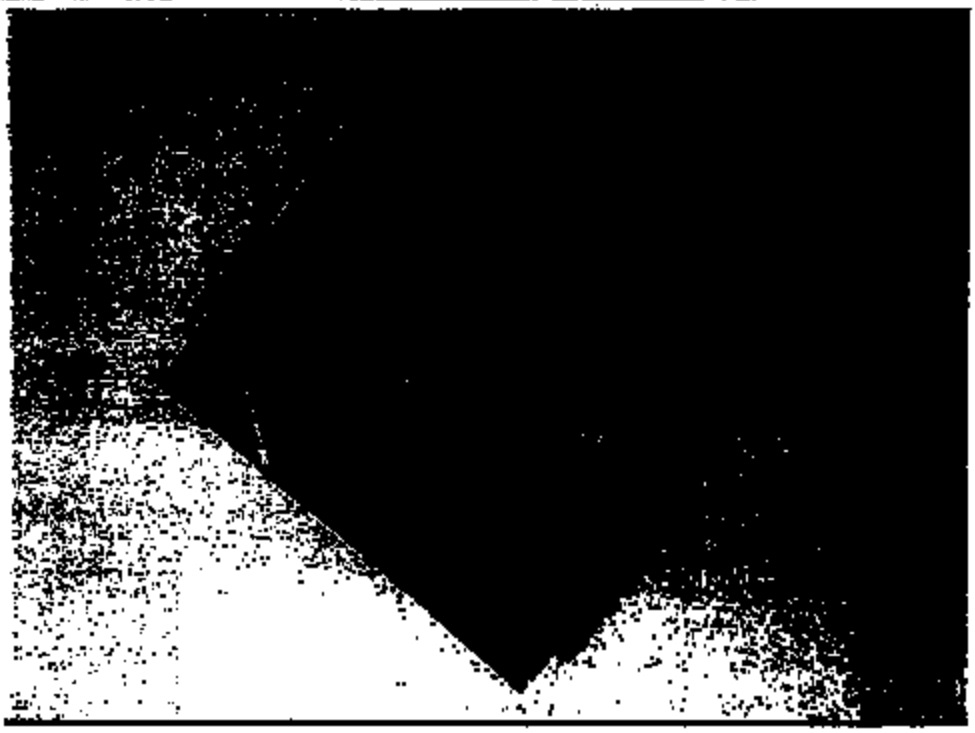


Figure 17: PX163920, seal 2.

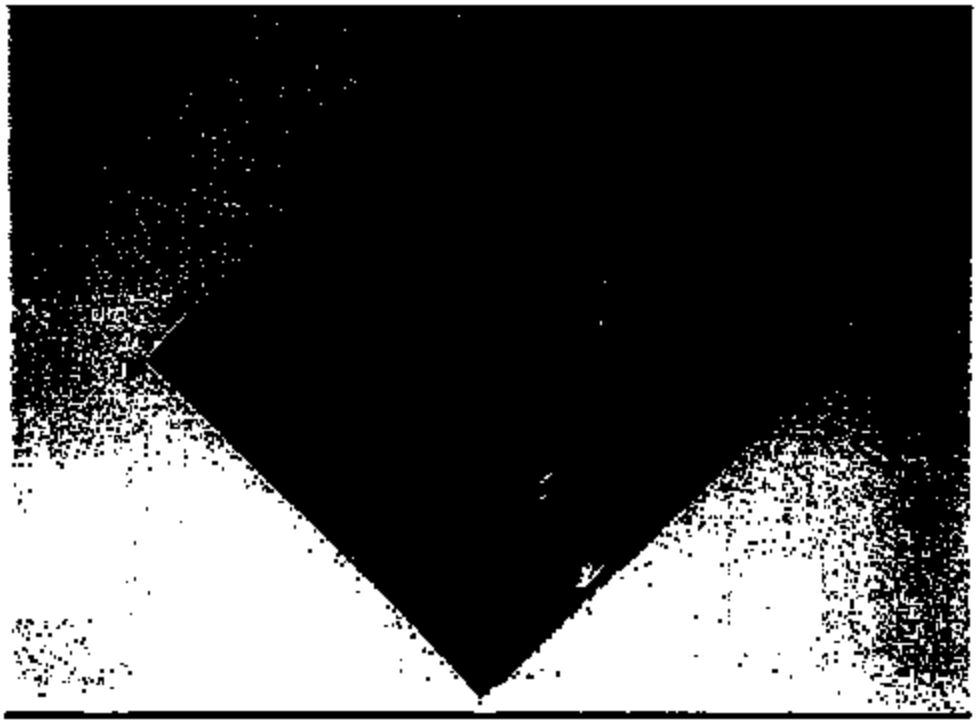


Figure 18: PX163920, seal 3.

Note: Nominal magnifications given for photomicrographs.

Figure 19: PX163920, cup, washer, converter, disc.

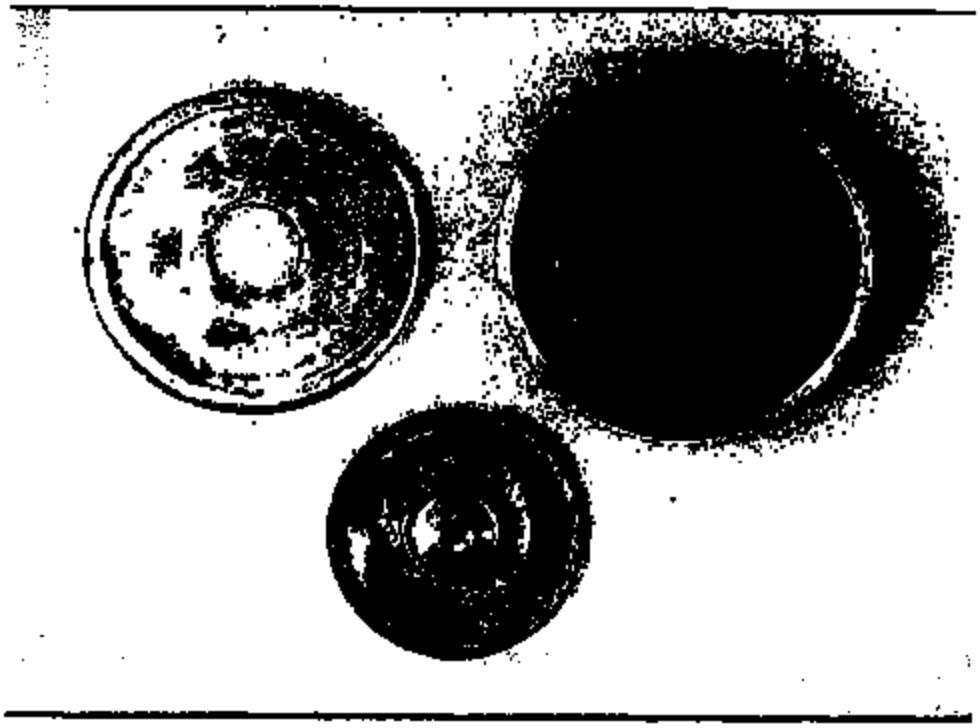


Figure 20: PX163920, cup, washer, converter, disc.

Note: Nominal magnifications given for photomicrographs.

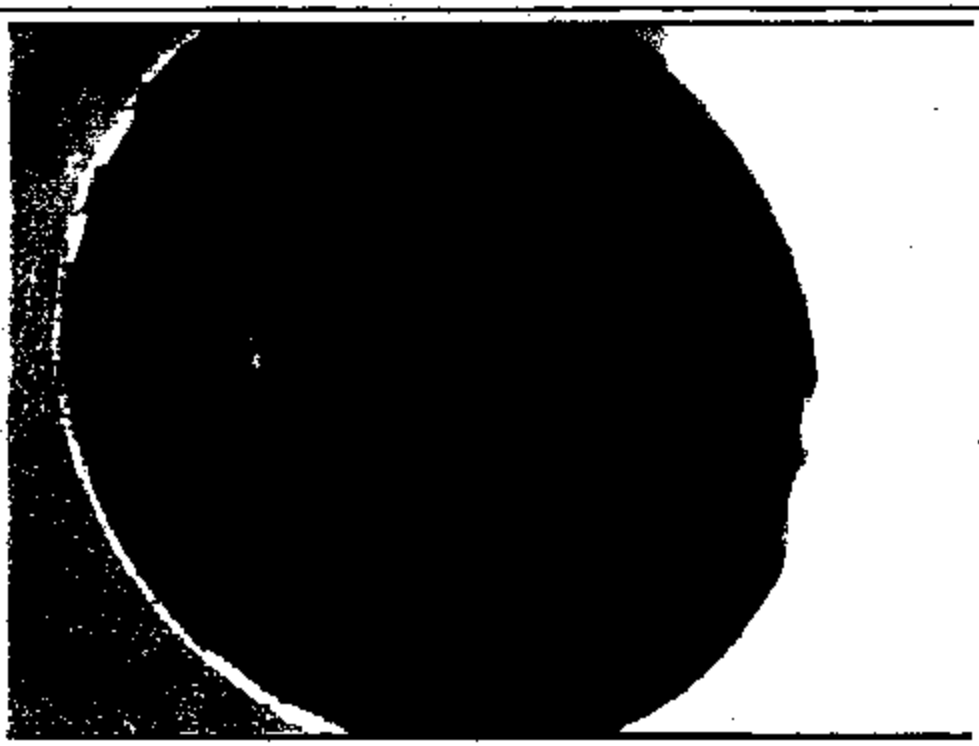


Figure 21: PX1653920, hexport cavity.

Note: Nominal magnifications given for photomicrographs.

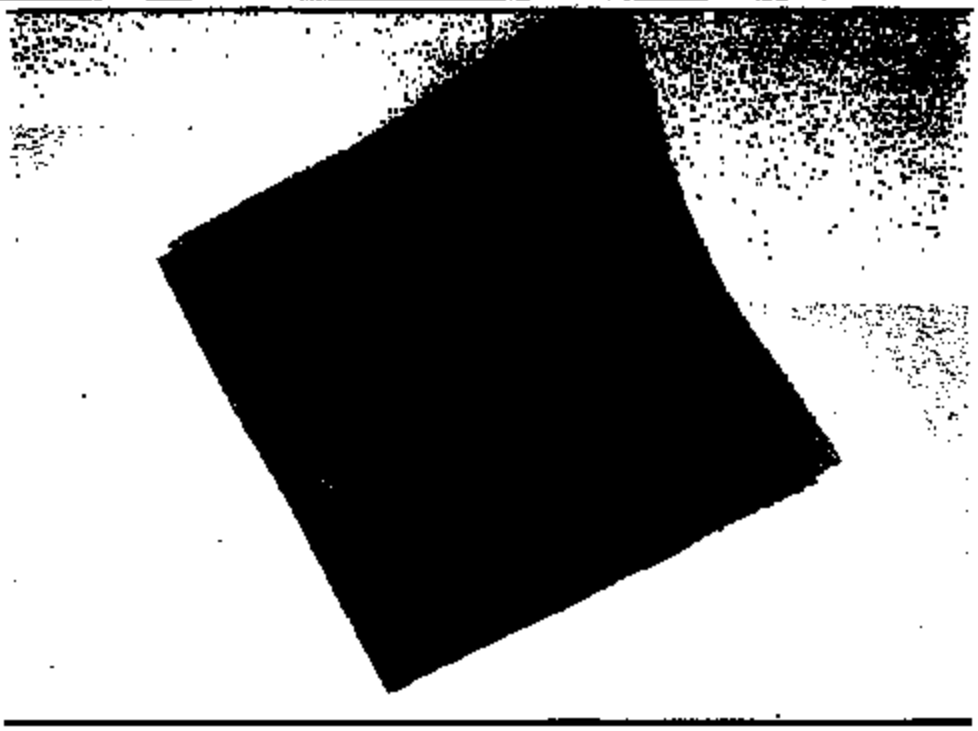


Figure 22: PY758158, seal 1 fluid side.

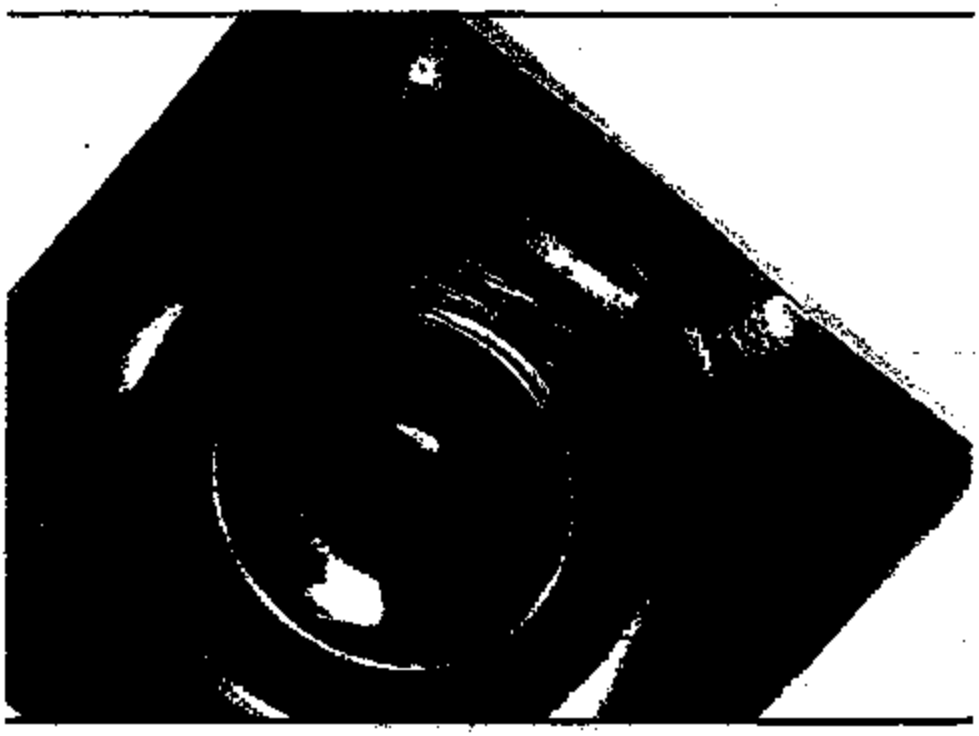


Figure 23: PY758158, seal 1 fluid side.

Note: Nominal magnifications given for photomicrographs.

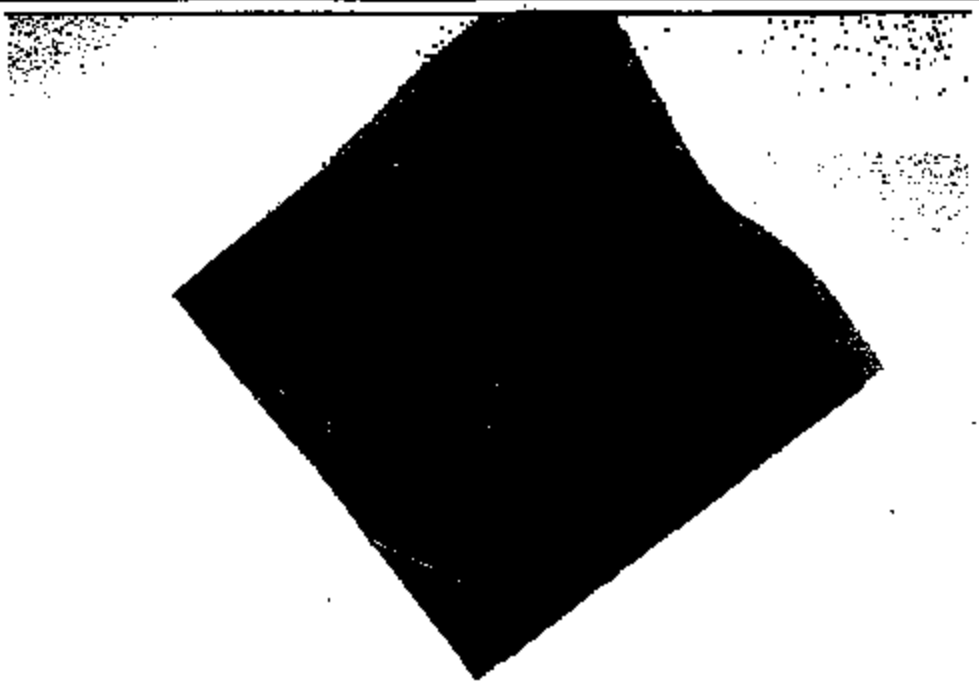


Figure 24: PY758158, seal 2.

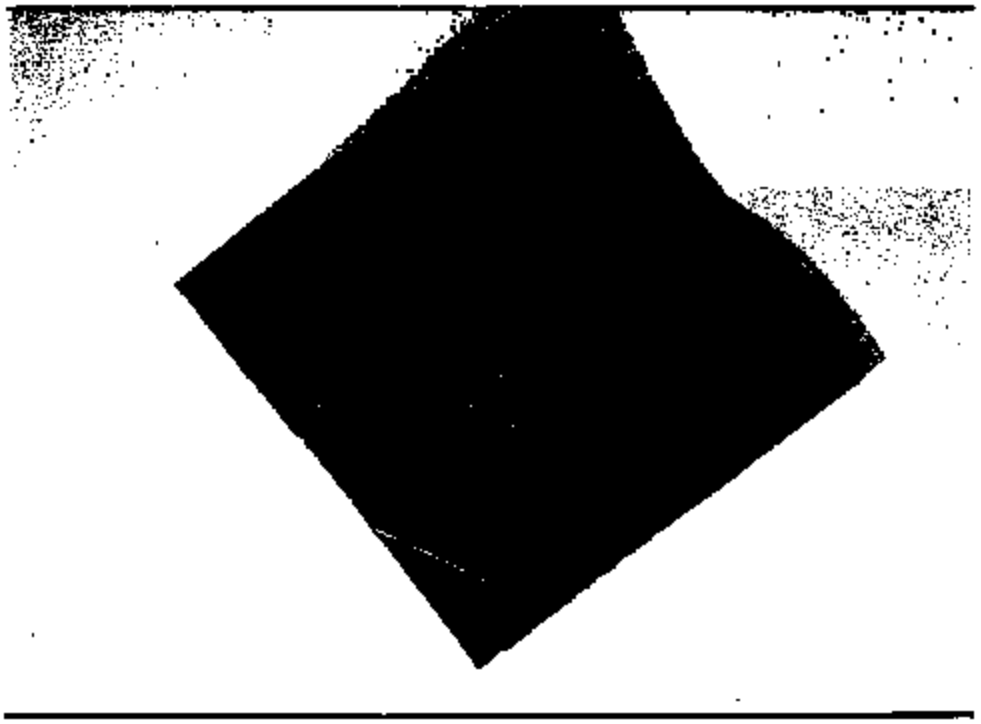


Figure 25: PY758158, seal 3.

Note: Nominal magnifications given for photomicrographs.

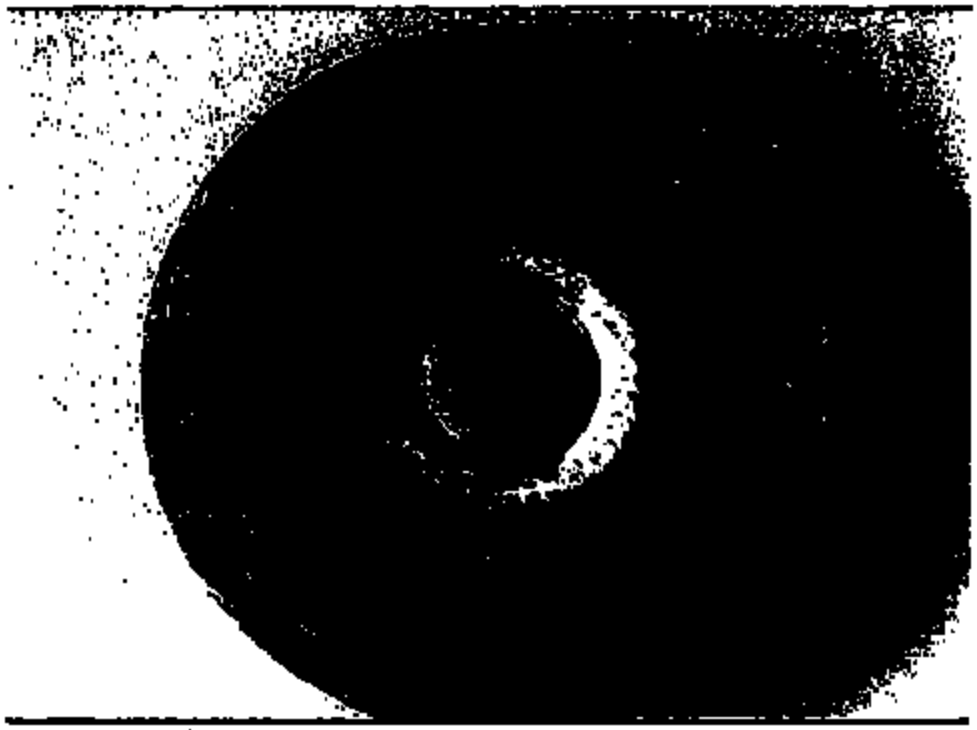


Figure 26: PY758158, cup, washer, converter, disc.

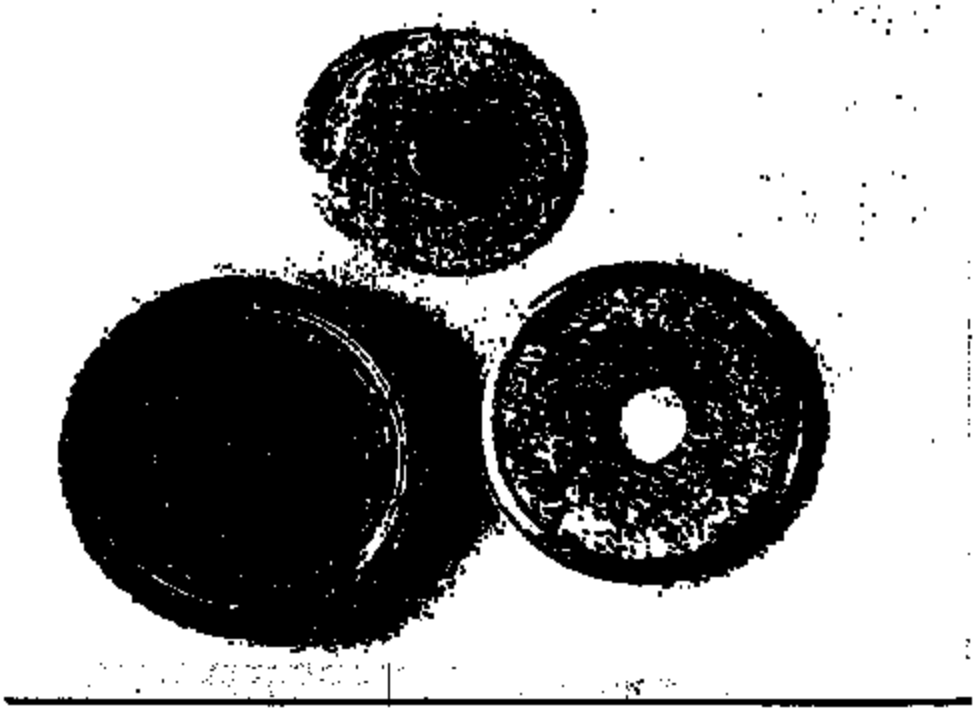


Figure 27: PY758158, cup, washer, converter, disc.

Note: Nominal magnifications given for photomicrographs.

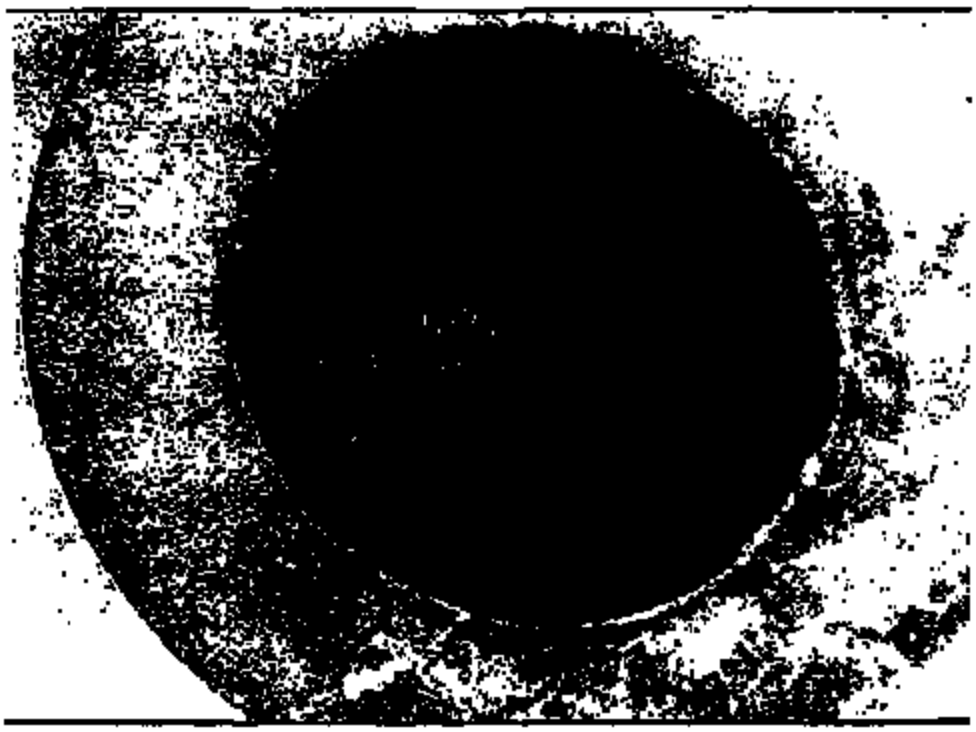
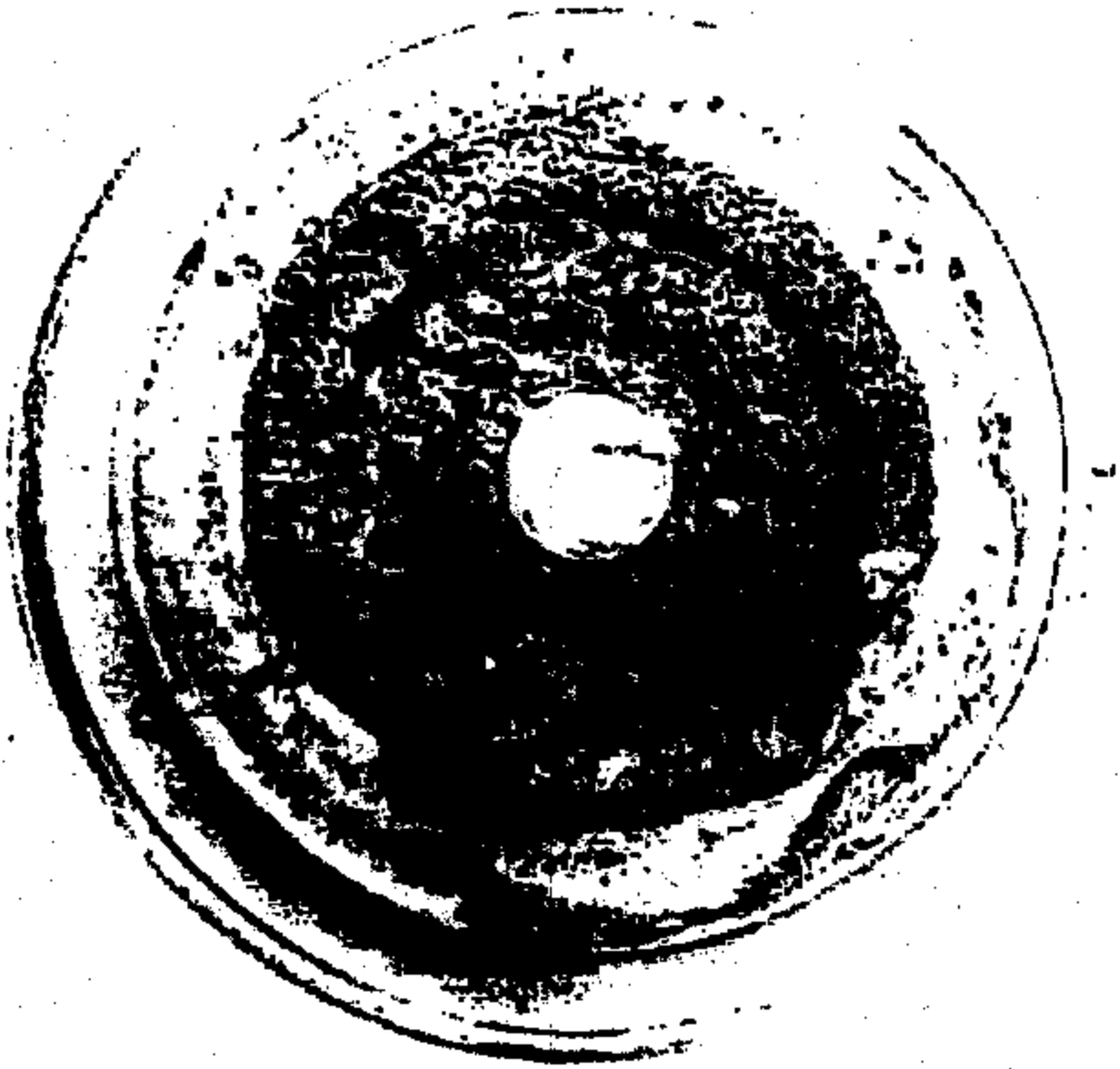
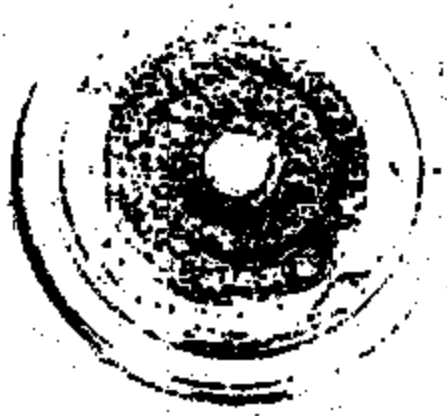
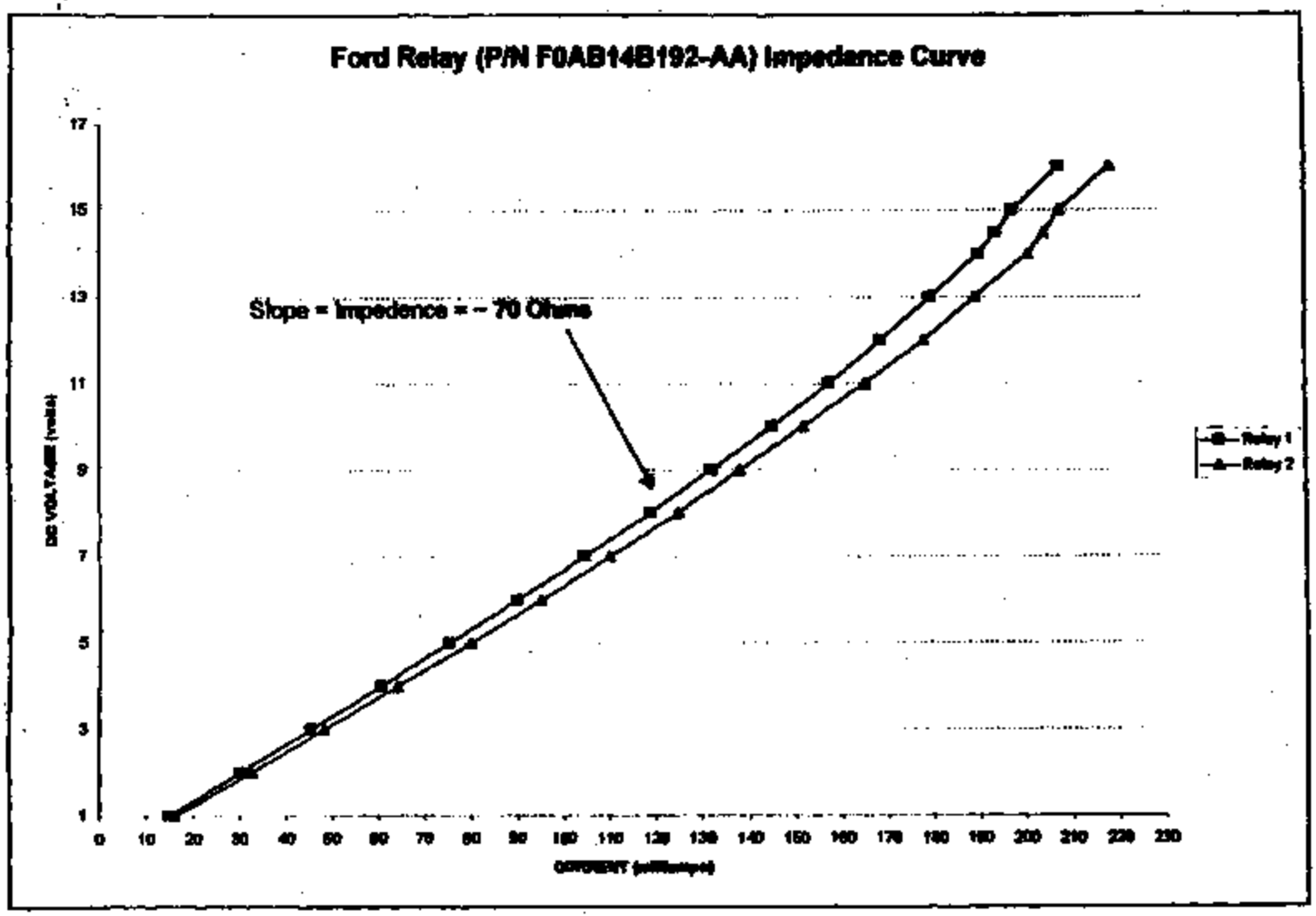


Figure 28: PY7561B8, hexport cavity.

Note: Nominal magnifications given for photomicrographs.






Ford Relay (P/N F0AB14B192-AA) Impedance Curve
Slope = Impedence = ~ 70 Ohms
DC VOLTAGE (volts)
CURRENT (milliamps)
Relay 1
Relay 2

Relay #1

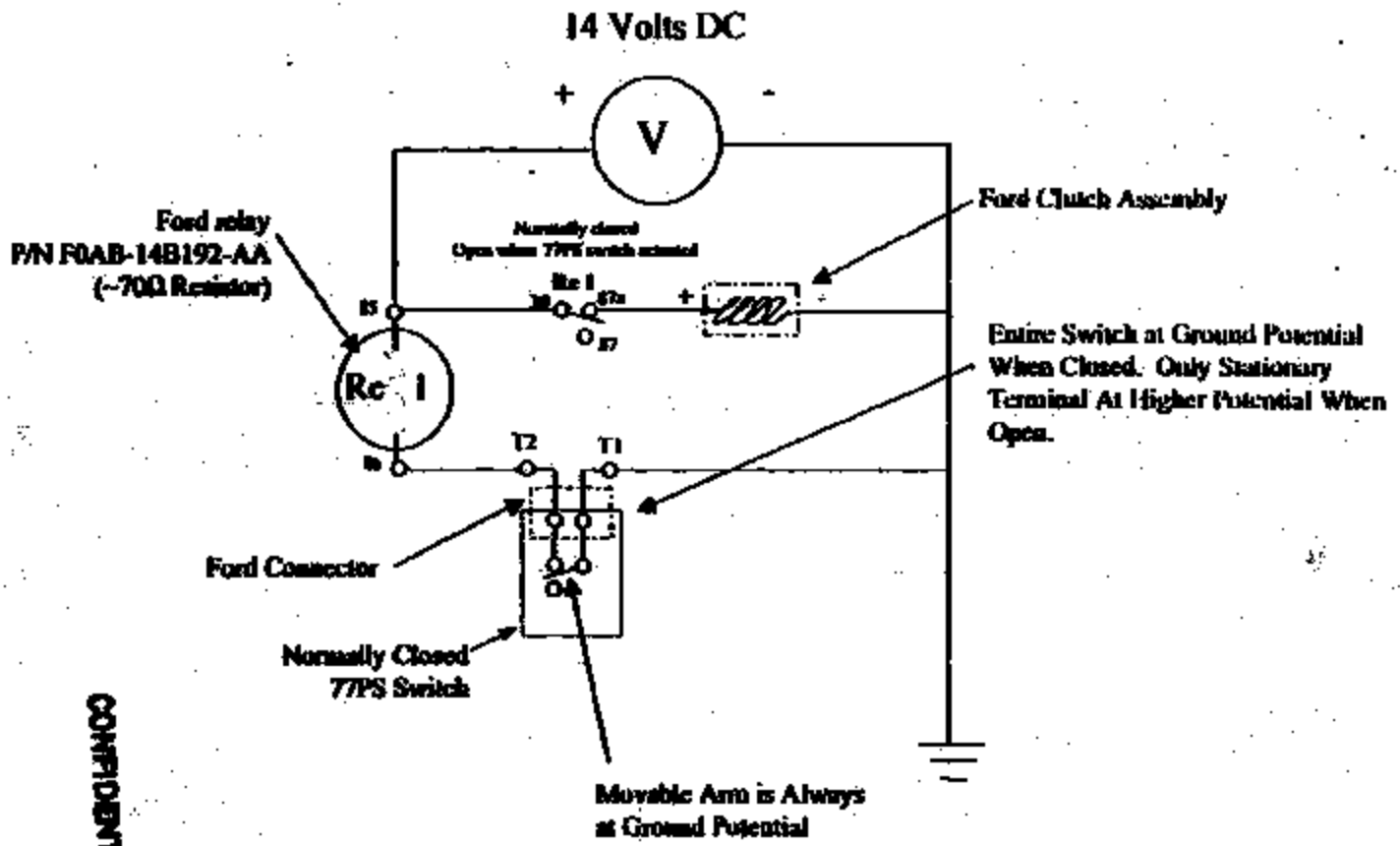
Voltage (DC)	Current
1.0	14.86 mA
2.0	29.95 mA
3.0	45.20 mA
4.0	60.40 mA
5.0	75.30 mA
6.0	90.20 mA
7.0	104.8 mA
8.0	118.90 mA
9.0	132.10 mA
10.0	145.0 mA
11.0	157.4 mA
12.0	168.70 mA
13.0	179.40 mA
14.0	190.0 mA
14.5	194.0 mA
15.0	197.6 mA
16.0	207.5 mA

Relay #2

Voltage	Current
1.0	16.15 mA
2.0	32.48 mA
3.0	48.2 mA
4.0	64.1 mA
5.0	80.1 mA
6.0	95.4 mA
7.0	110.4 mA
8.0	125.0 mA
9.0	138.0 mA
10.0	151.8 mA
11.0	165.2 mA
12.0	178.0 mA
13.0	189.2 mA
14.0	200.8 mA
14.5	204.3 mA
15.0	207.7 mA
16.0	218.4 mA

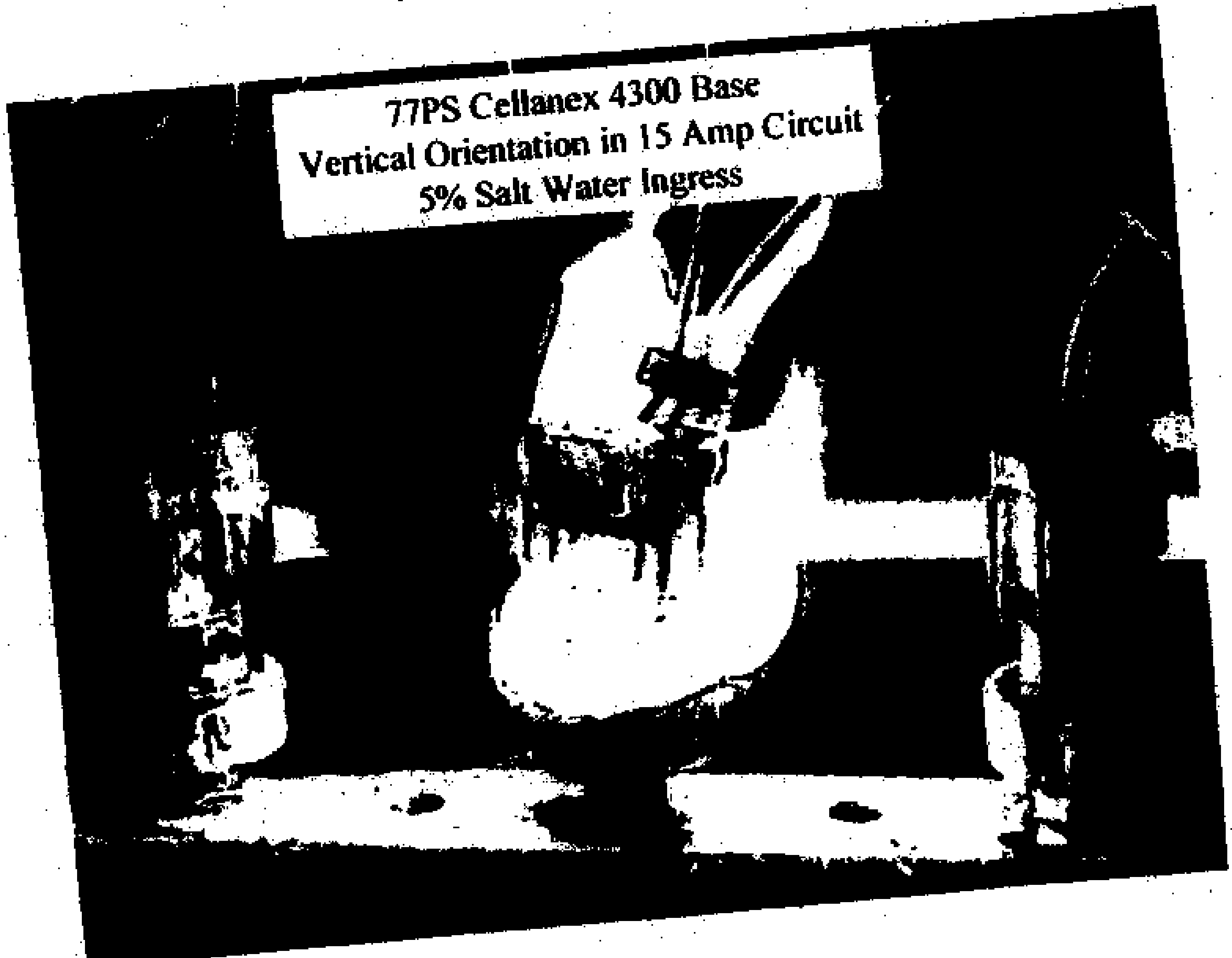
Note: Current drifts down as time passes and voltage held steady.

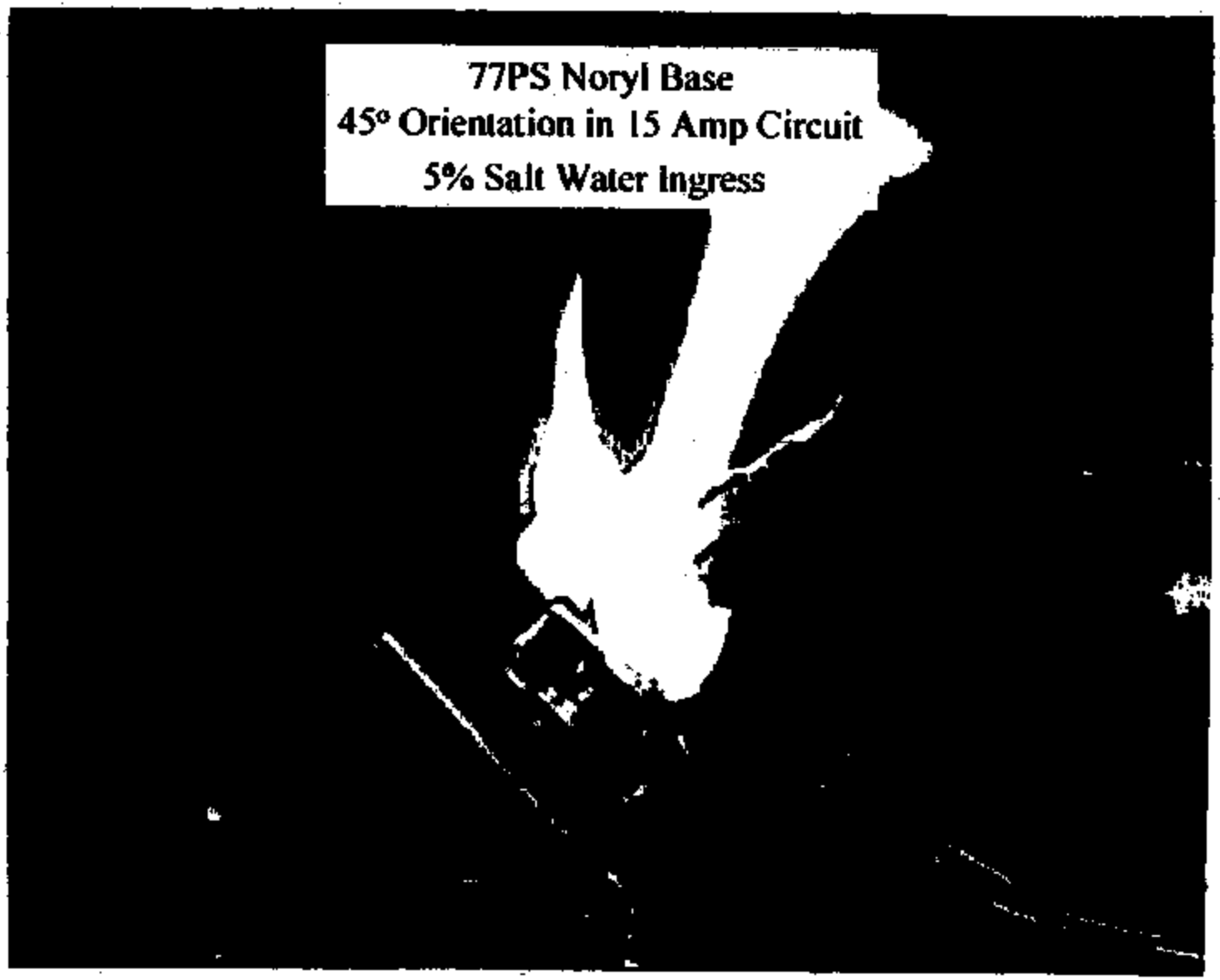
77PS Proposed Wiring Schematic



CONFIDENTIAL

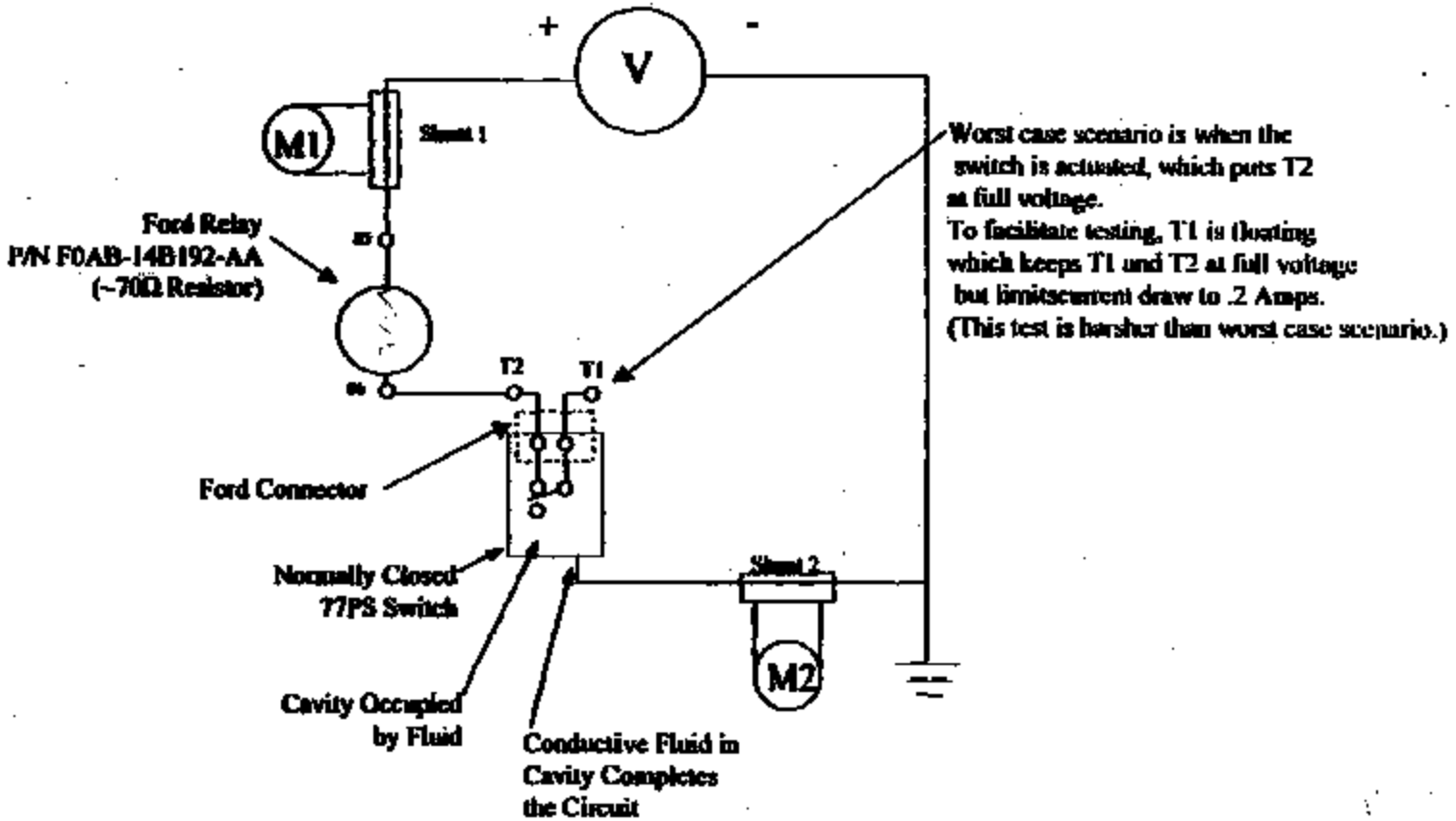
TI-NHTSA 013107


77PS Cellanex 4300 Base
Vertical Orientation in 15 Amp Circuit
5% Salt Water Ingress



200 mAmp Current Limit Circuit
Test Setup

14 Volts DC



77PS
45° Orientation in 15 Amp Circuit
5% Salt Water Ingress

Cellanex 4300 Base

Cellanex 3316 Base

77ps_partlist.xls

Bryan, FYI

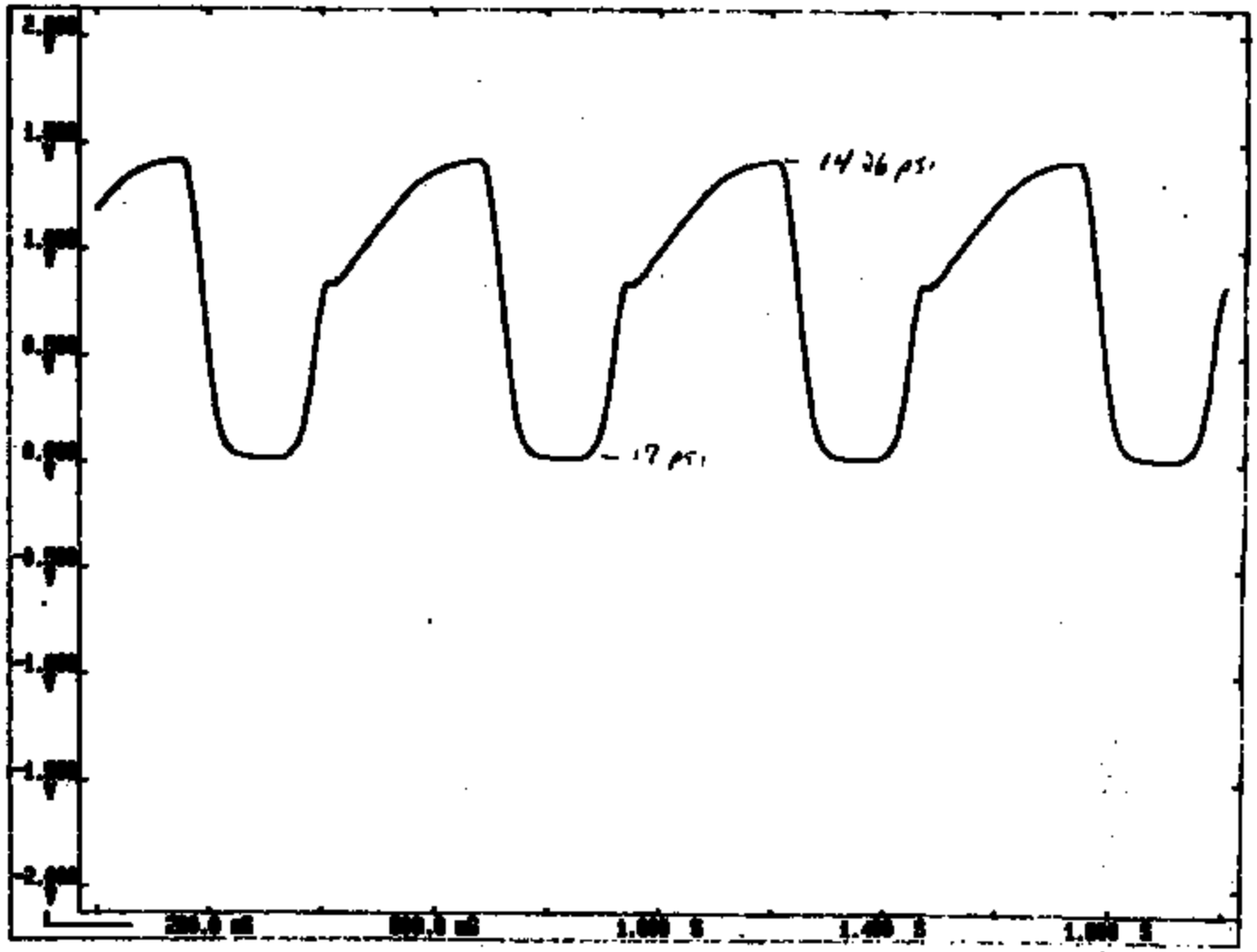
77PS part differences

description	77PS2-1 part number	77PS3-1 part number	77PS4-1 part number	EFFECT
CUP	27713-1	27713-1	27713-2	Spacer seat to bump height 4/1000 larger on -1 than on -2
HEXPORT	39808-1	39880-1	31467	4-1 C'Bore is .338 (.13 deeper than 2-1)
DISC	39868-27	39868-35	39868-35	"-35 measured height = .0275 +/- .0003"
(OR)	39868-28	39868-41	39868-41	"-41 measured height = .0291 +/- .0003"
				"-27 measured height = .0298 +/- .0003"
				"-28 measured height = .0310 +/- .0003"
				Crown height on 4-1 are ~ 2/1000 to 4/1000 lower than 2-1 (measured)
Base	49816-2	49815-3	49815-3	
DATE stamp	6280	7184	8048	

↑ T1

~~3-1 disc~~

3-1 = 4-1 disc in 2-1 cup



95% brake fluid
5% hop water

3/29/99

TO: SEAN MULLIGAN
[redacted]

SUBJECT: 98-181; TSL # 151700: PRELIMINARY FINDINGS ON LINCOLN SIMULATION SAMPLES

OBJECTIVE:
Determine if there are similarities between the original sample that Ford had hand-carried in (TSL # 150709) and the simulation samples.

DISCUSSION:
Be advised that these are very, very preliminary findings. We have had a host of equipment problems for the last two weeks and I haven't had the opportunity to do a thorough job.

There are a number of findings that point to a similarity in the failure mode between the hand-carried sample (Memphis) and the simulation sample that had been dosed with sodium-chloride solution through the connector. In particular, both the simulation and the Memphis sample show the following characteristics:

- Corrosion of the brass contact/terminal assemblies
- Arcing at the broken ends of those assemblies.
- Presence of large amounts of decomposed plastic base material.

There are, however, other findings that indicate that this certainly isn't a precise simulation; especially in regards to the nature of the fluid which caused the corrosion as is shown below:

- The simulation sample shows a vast amount of sodium and chlorine in the corrosion deposit; the Memphis sample didn't show a significant amount.
- The Memphis sample showed a substantial amount of potassium and sulfur with lesser and variable amounts of phosphorous; the Simulation sample didn't. Potassium is an element that is often associated with detergents used to clean autos. Although this certainly isn't conclusive, it is suggestive..
- The simulation sample showed very substantial corrosive attack on the top surface of the cup while the Memphis sample showed a much smaller amount.

We have not seen significant similarities between the Memphis sample and the "24 Hour-Used Brake Fluid with 5% Water" sample in regards to the terminal/contact assemblies.

The data was collected under the guidelines of TSL-8-71, Rev A which can be accessed at http://www-mod.ge.ti.com/tsl/. SEM-EDAX (Scanning Electron Microscope with Energy Dispersive Analysis of X-rays) analysis was used in the above described analysis. The data will be sent through the internal mail.

AL HOPKINS MS6 ID: AHOP PHONE: 508/236-2040

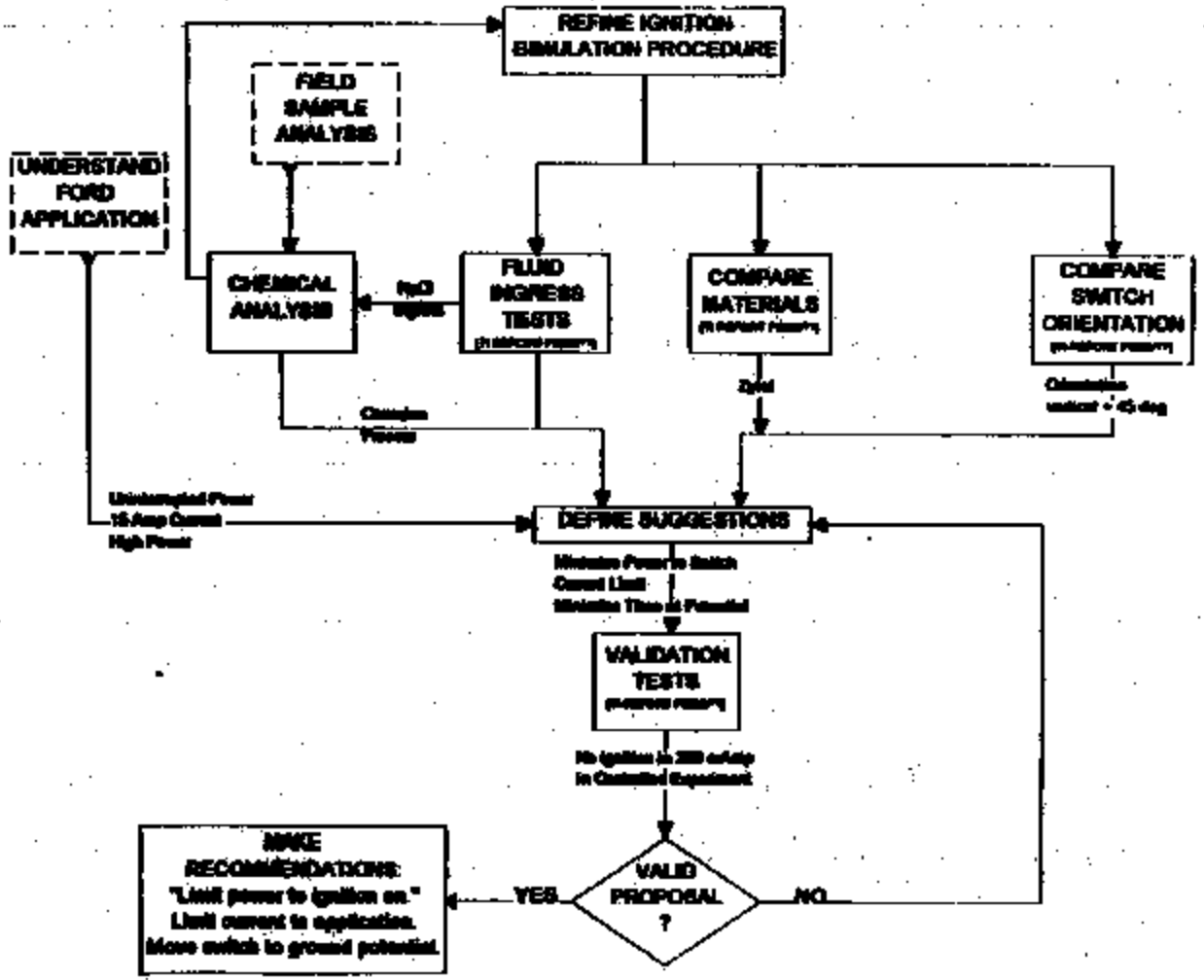
3/30/09

7/PS Converter washer test
(S = sloppy ID, OD clearance between the converter and washer).
(T = tight ID, OD clearance between the converter and washer).

Device	Description	K Cycle to Leakage
S-1	Converter/washer combo from 3-1 (#1), all other components are 2-1.	
S-2	Converter/washer combo from 3-1 (#2), all other components are 2-1.	465
S-3	Converter/washer combo from 3-1 (#3), all other components are 2-1.	
S-4	4-1 switch from product line.	446
S-5	4-1 switch from product line.	278
S-6	4-1 switch from product line.	462
T-1	Converter/washer combo from 2-1 (#1), all other components are 4-1.	480
T-2	Converter/washer combo from 2-1 (#2), all other components are 4-1.	
T-3	Converter/washer combo from 2-1 (#3), all other components are 4-1.	
T-4	2-1 switch from product line.	462
T-5	2-1 switch from product line.	495
T-6	2-1 switch from product line.	

Common factor of S-(1-3) and T-(1-3) is new Kapton

TI 77PS INVESTIGATION
UNDERSTAND FORD APPLICATION
FIELD SAMPLE ANALYSIS
PPAPS
CYCLELIFE-ES CAPABILITY
8D REPORT
APPLICATION
SUPPLY CHAIN
SHEAR
SWITCH CHANGE HISTORY
PROCESS CHANGE HISTORY
FORD RIA
CONNECTOR
TRACTION CONTROL
ABS
DEFINE TEST MECHANISMS
CORROSION TESTS
HEATER TESTS
FLUID TESTS
PS ANALYSIS PROTOCOL
CREATE IGNITION SIMULATION ?
NO
YES
REFINE IGNITION SIMULATION PROCEDURE



Epstein, Sally

From:	Rose, Elaine [eross@email.mc.ti.com]
Sent:	Wednesday, March 31, 1999 1:23 PM
To:	Hay, D
Cc:	Degus, Bryan; Prola, Stephen; McGuirk, Andy; Flynn, Ruth
Subject:	IP-2 TEST FAILURE ANALYSIS

In reviewing the post fluid resistance;post impulse & humidity failures, here are the findings:

serial # 538-15-60 (device # 19-30) post impulse fall out:

this test/lab # reserved 11/12/97

#19, 23 & 30 auto pressure test failure of ZPLF, inaccurate reading
#25 low actuation
#26 passed actuation
#29 low actuation
measurement of the base,pin & sensors indicate normal wear &/or mispinning

base/contact configuration has since changed since product build: 10/23/97 (produce is 17 months old)

>> (device # 7-18) post humidity fall out:

F/A INCONCLUSIVE..

base/contact configuration has since changed since product build: 10/23/97

regards,
elaine rose
LAL/QATECH
ph. # 508-236-1907
fax # 508-236-2326

Epstein, Sally

From: Rose, Elaine (erose@email.mc.ll.com)
Sent: Wednesday, March 31, 1999 5:00 PM
To: Hay, D
Cc: Dague, Bryan; Proia, Stephen; McGuirk, Andy; Flynn, Ruth
Subject: RE: IP-2 TEST FAILURE ANALYSIS

resend; post humidity # 43-48
regards,
elaine rose
LAL/QATECH
ph. # 508-236-1907
fax # 508-236-2326

From: Rose, Elaine
Sent: Wednesday, March 31, 1999 2:23 PM
To: Hay, Daniel
Cc: Dague, Bryan; Proia, Stephen; McGuirk, Andy; Flynn, Ruth
Subject: IP-2 TEST FAILURE ANALYSIS

In reviewing the post fluid resistance;post impulse & humidity failures, here are the findings:

serial # 538-15-60 (device # 19-30) post impulse fail out:

this test/lab # reserved 11/12/97

#19, 23 & 30 auto pressure test failure of EPLF, inaccurate reading
#25 low actuation
#26 passed actuation
#29 low actuation
measurement of the base,pin & sensors indicate normal wear &/or misspinning

base/contact configuration has since changed since product build: 10/23/97 (produce is 17 months old)

>> (device # 43-48) post humidity fail out:

F/A INCONCLUSIVE..

base/contact configuration has since changed since product build: 10/23/97

regards,
elaine rose
LAL/QATECH
ph. # 508-236-1907
fax # 508-236-2326