EA02-025

TEXAS INSTRUMENTS, INC.'S

9/10/03

REQUEST NO. 7

BOX 9

PART A – R

PART G

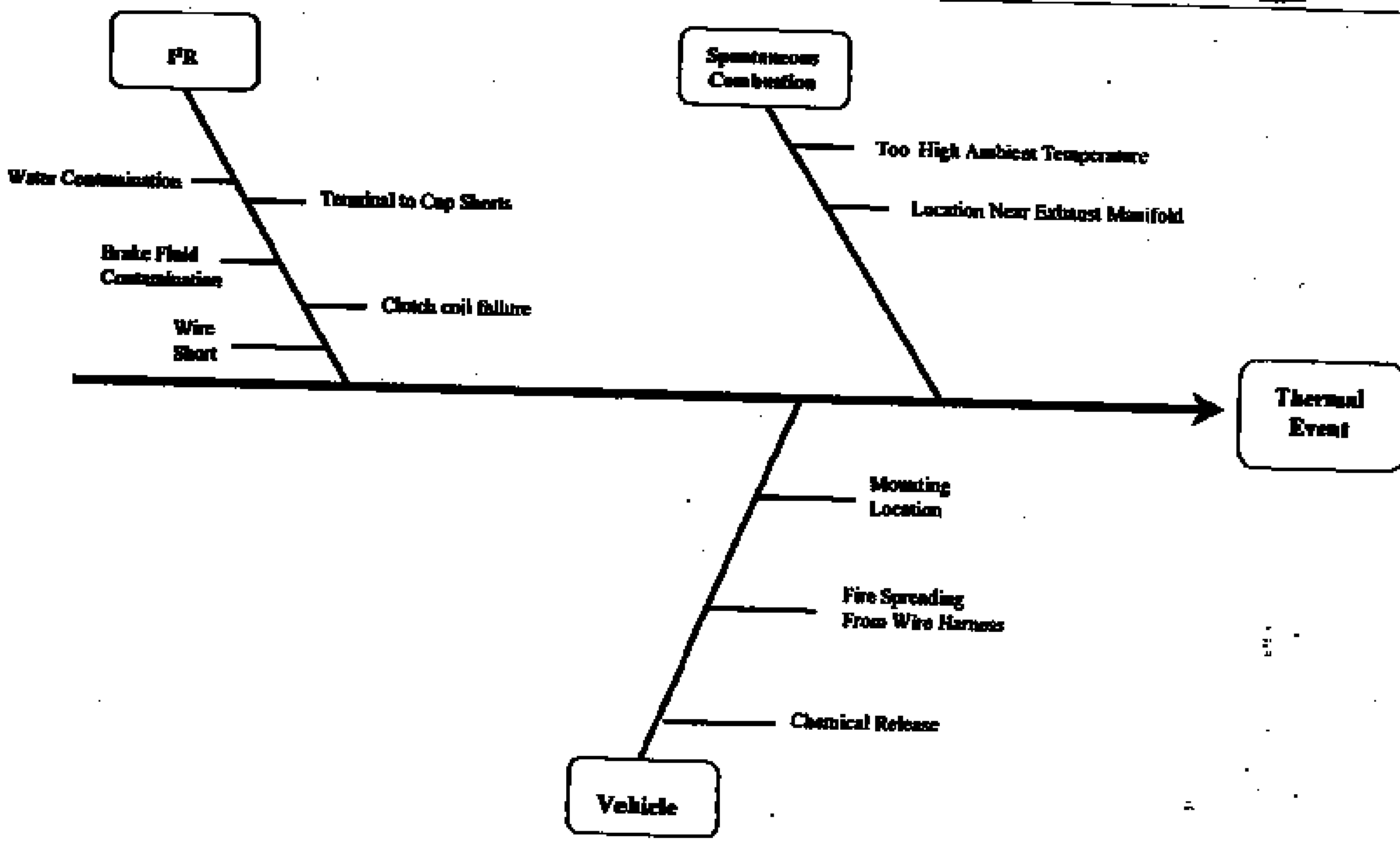
77PS THERMAL EVENT THEORY

STEVE BERINGHAUSE

TI-NHTSA 013948

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

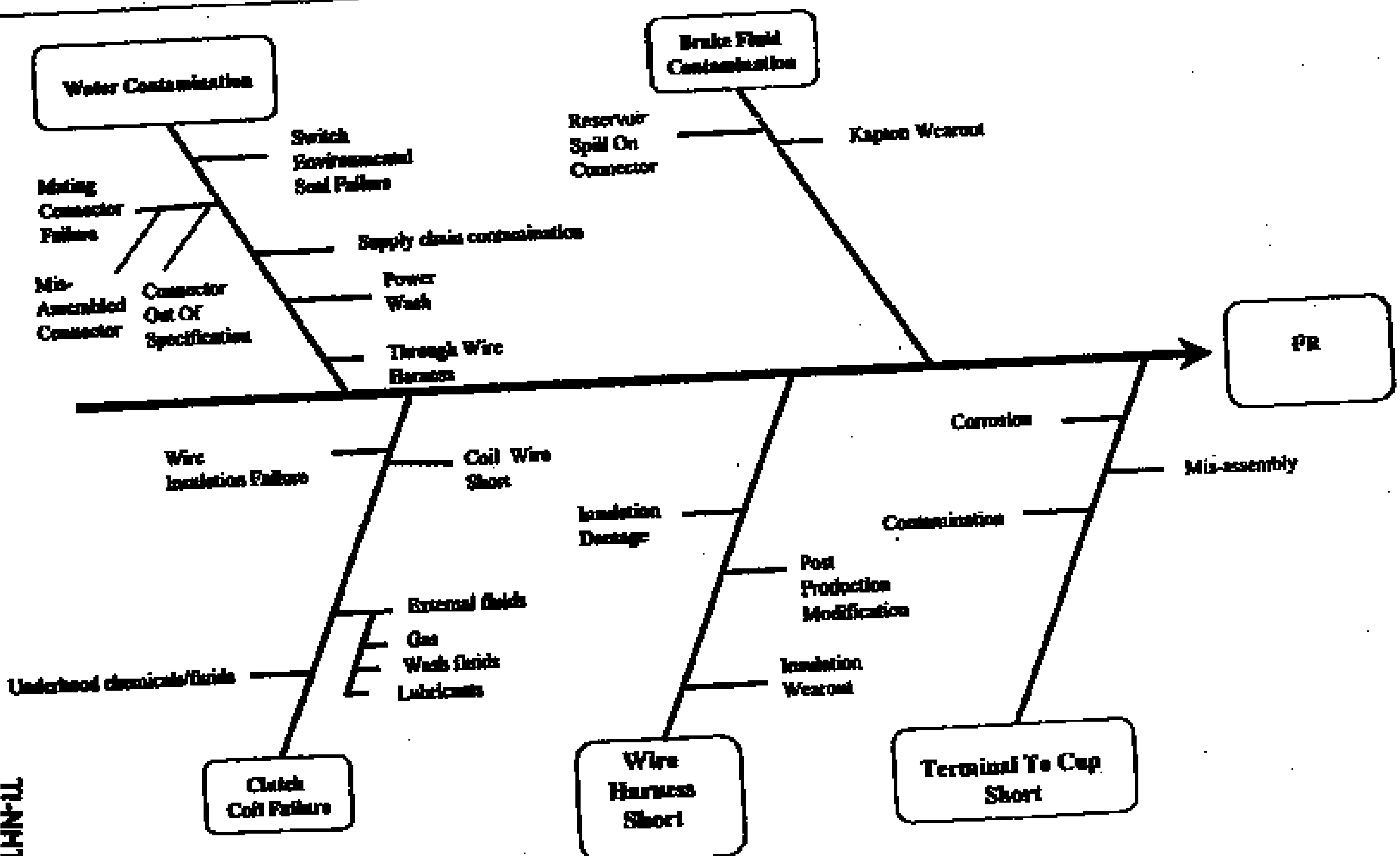


TI-NHTSA 013947

C:/McGrath/99presentations/Ford

Attachment

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

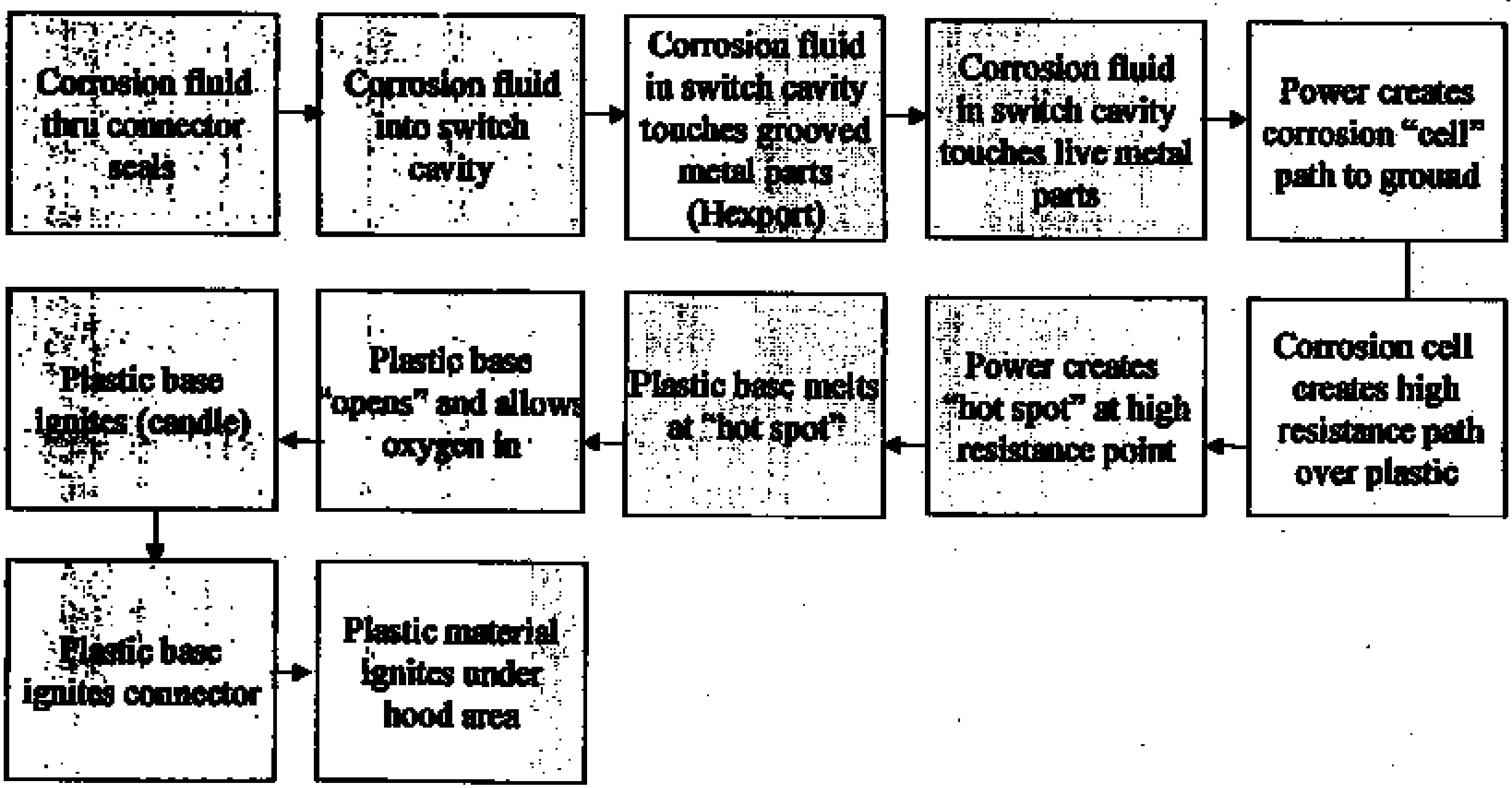


Attachment

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

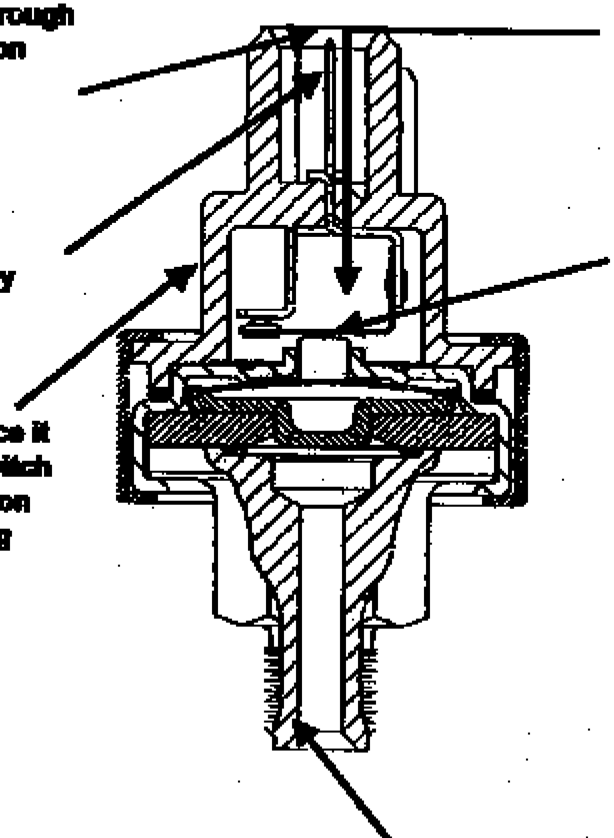
PROCESS FLOW DIAGRAM
"CORROSION" POTENTIAL CAUSE FLOW ANALYSIS



TI-NHTSA 013949

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

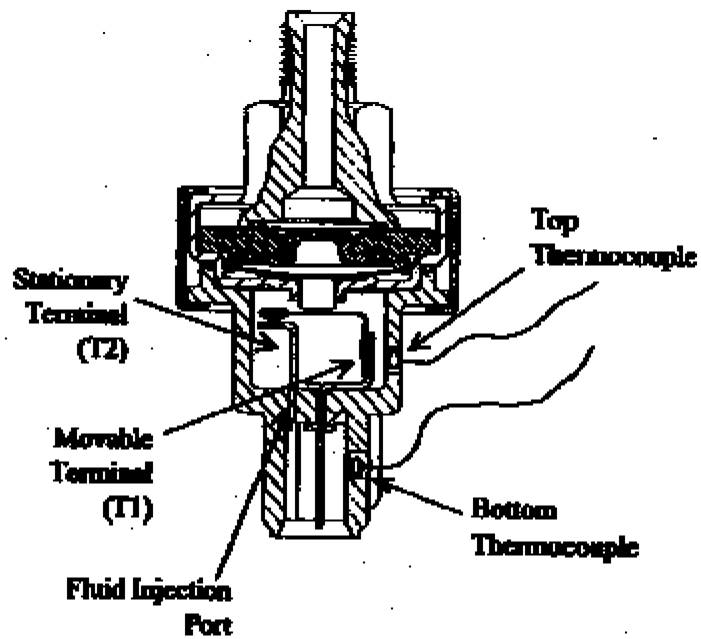


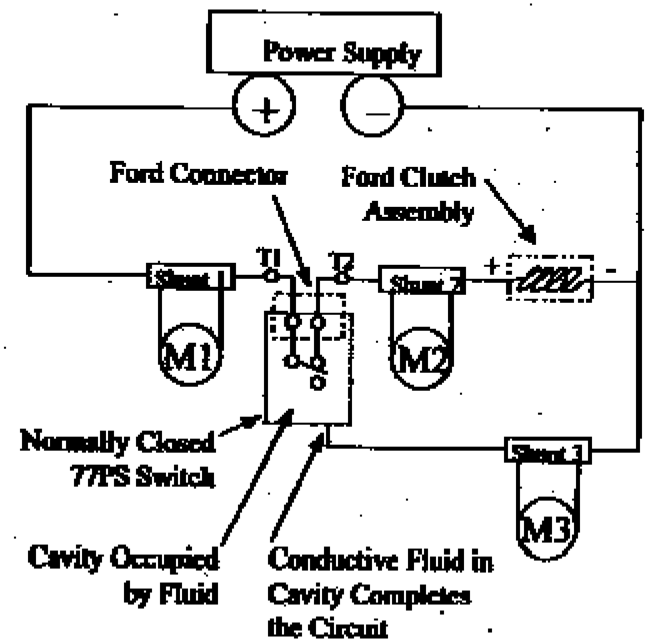
TI-NHTSA 013980

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

5% Salt Water Ingress Experiment
Test 1





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

Test 1: Figure 1 and Figure 2.

TI-NHTSA 013961

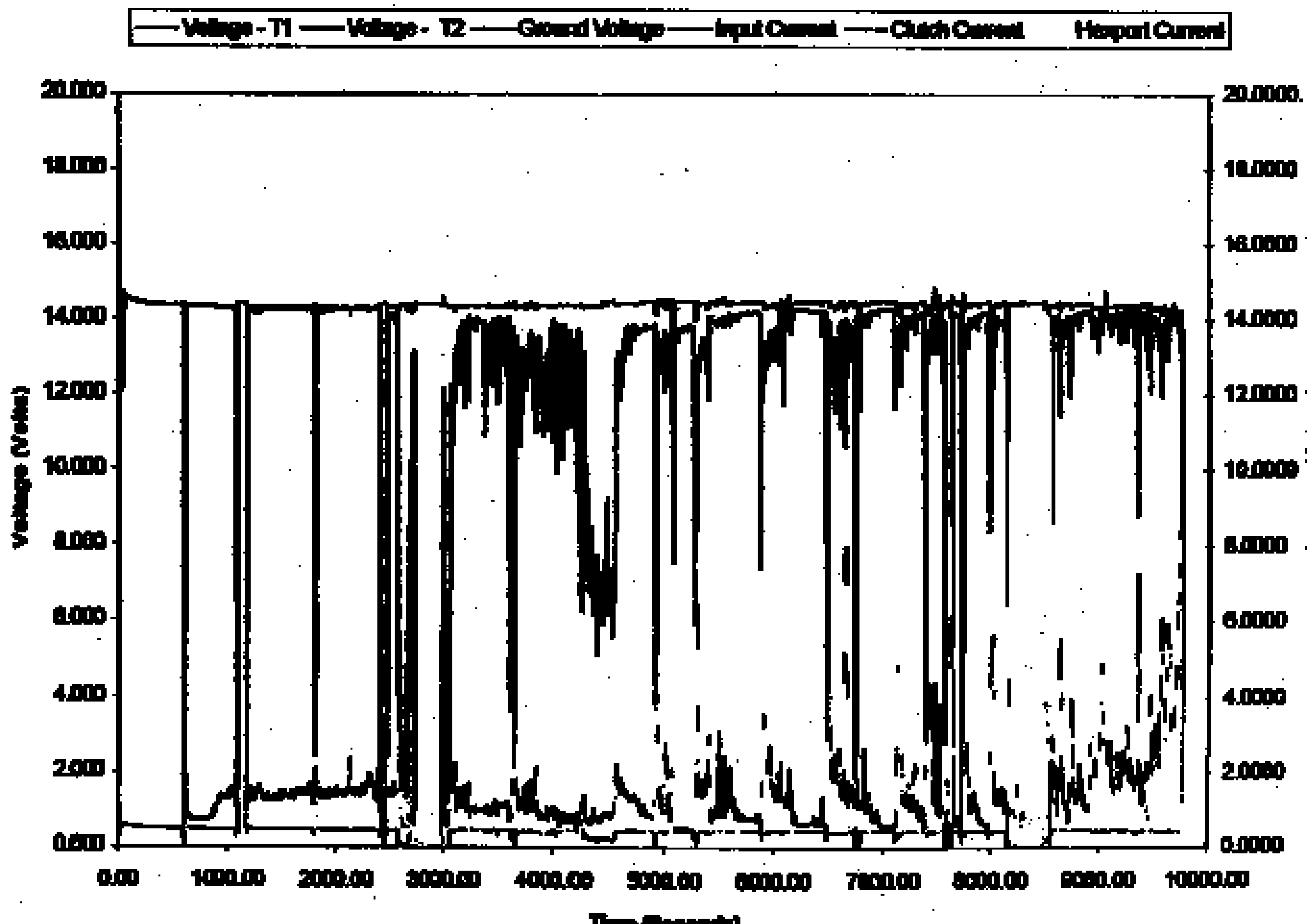
C:\McGuirk\99presentation\Ford

Attachment

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

TEXAS INSTRUMENTS

5% Salt Water Ingress Experiment



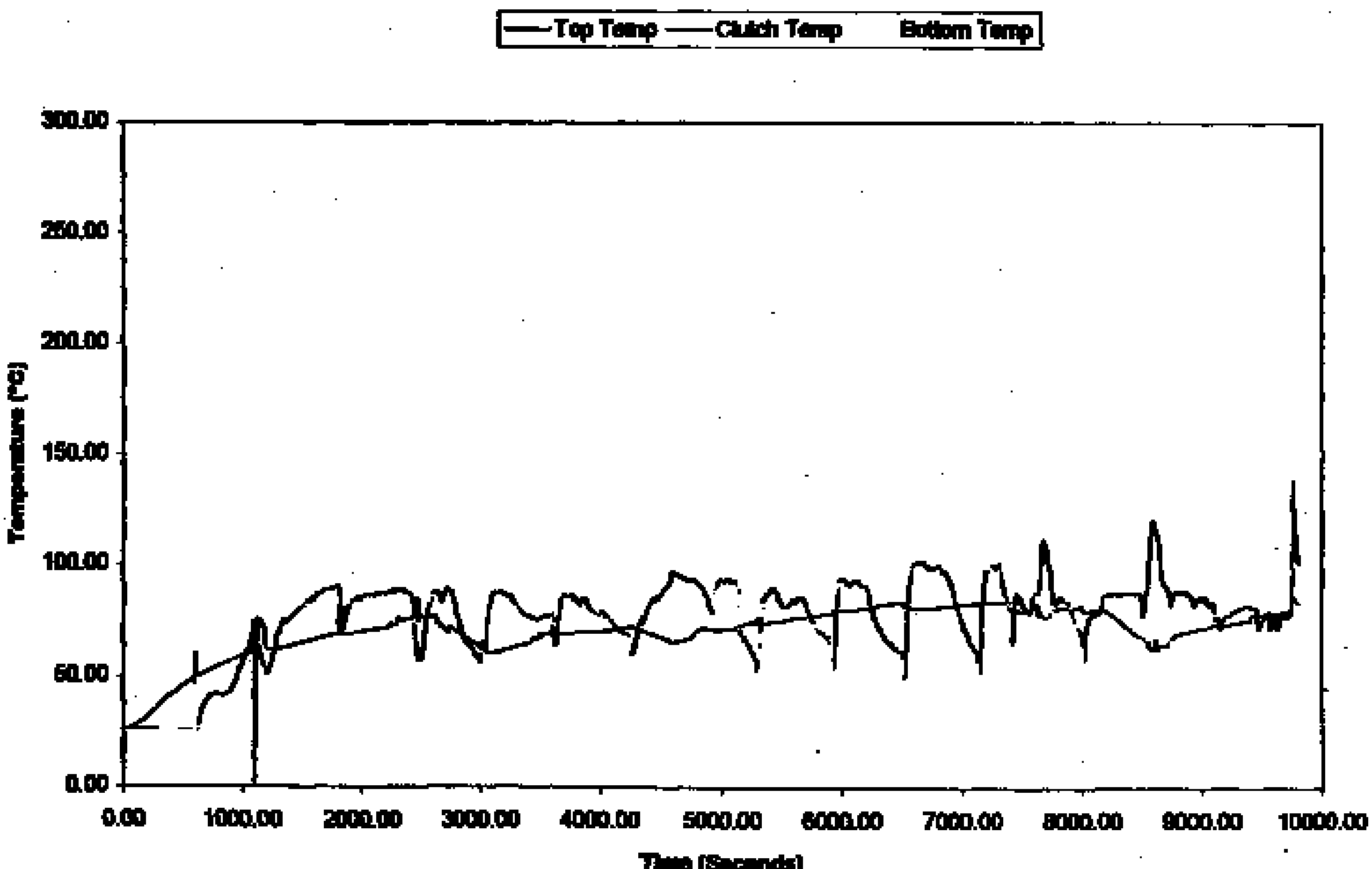
INTENTIONAL IGNITION CREATED THRU TI FLUID INGRESS LAB TEST PS/99/13' Attachment

TI-NHTSA 013962

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

5% Salt Water Ingress Experiment
Temperature vs. Time

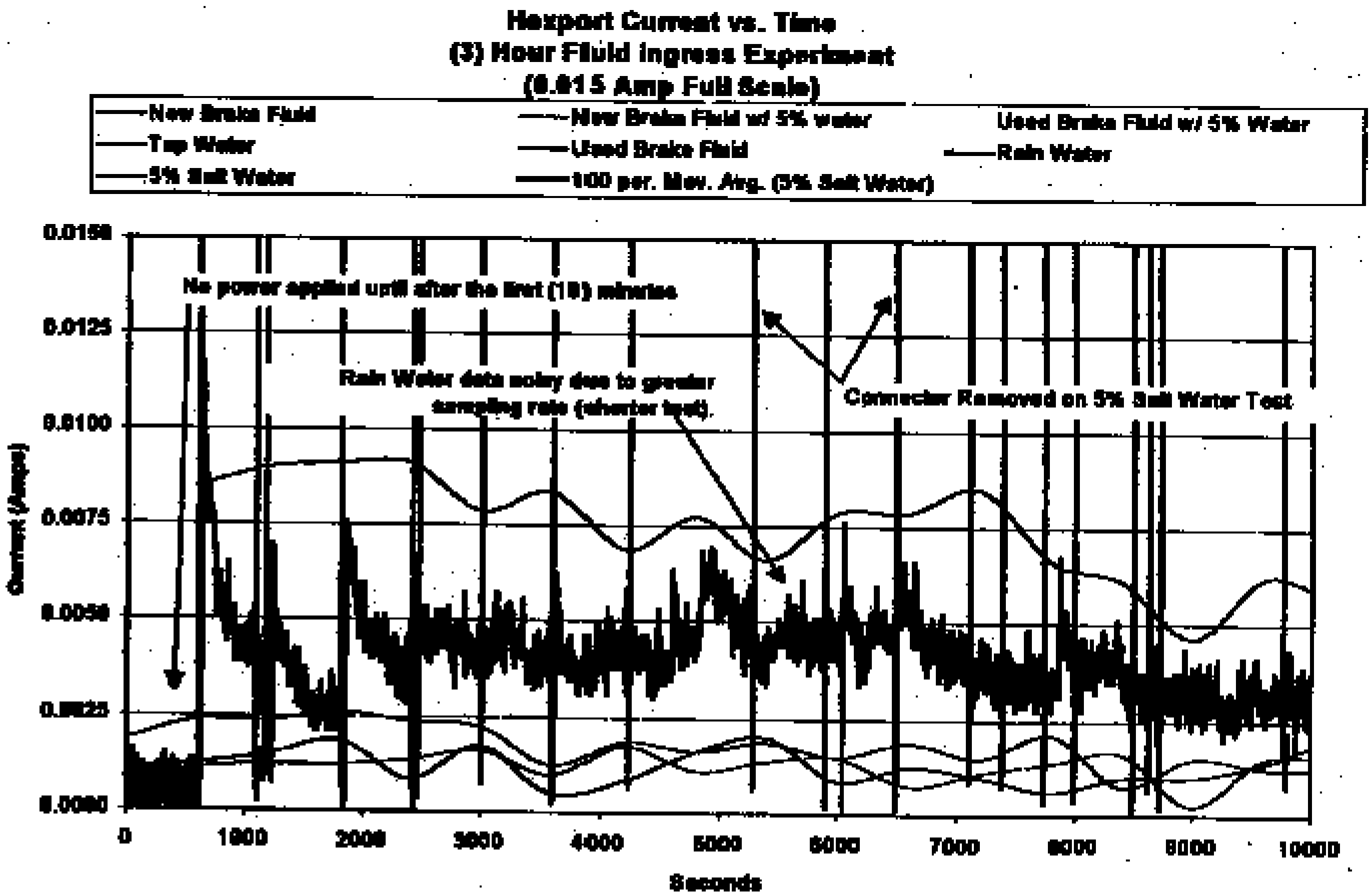


INTENTIONAL IGNITION CREATED THRU TI FLUID INGRESS LAB TEST PS/99/13" Attachment

TI-NHTSA 013953

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99



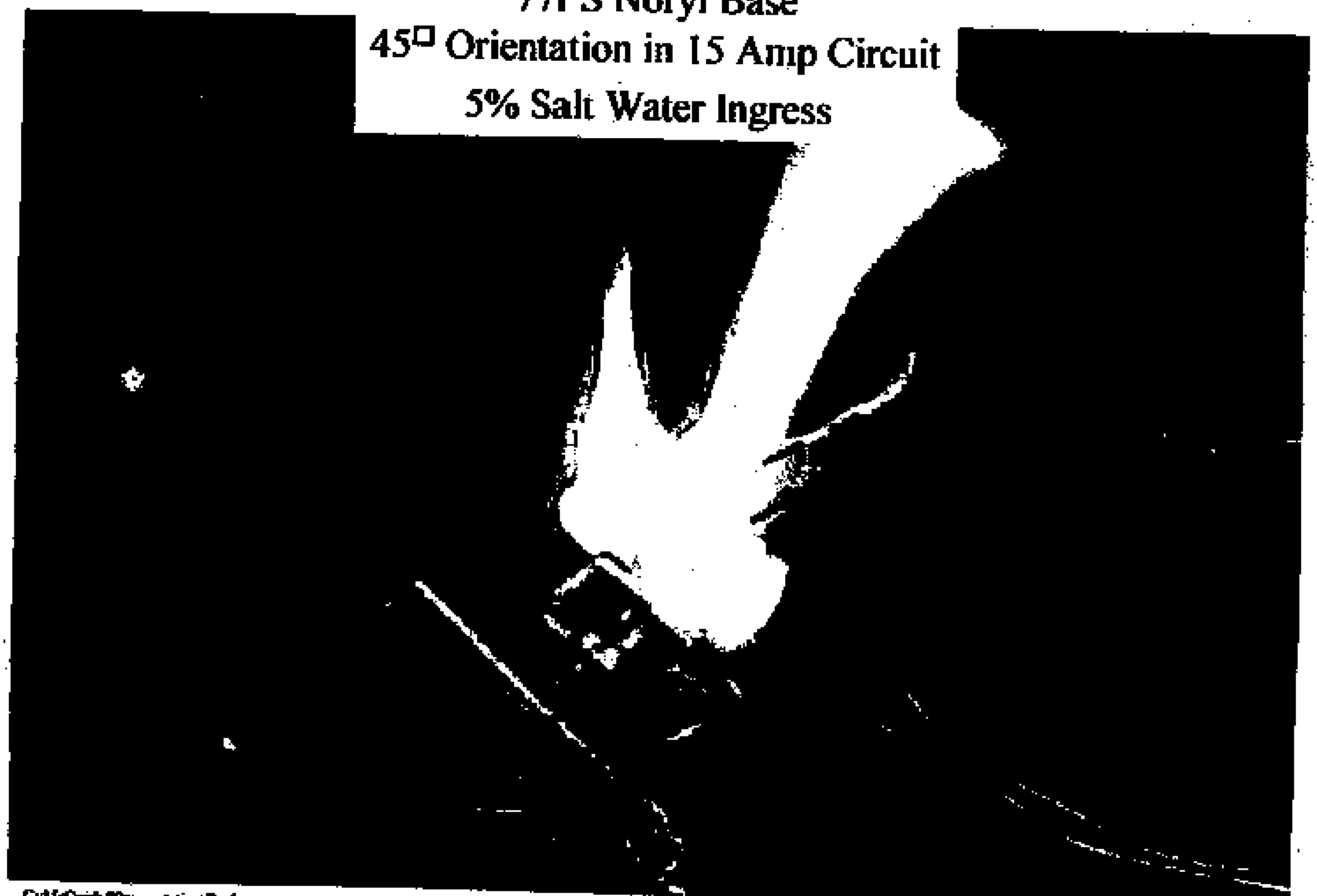
TI-NHTSA 013984

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

Ford

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



INTENTIONAL IGNITION CREATED THRU TI FLUID INGRESS LAB TEST PS/99/13' Attachment

TI-NHTSA 013986

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

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

INTENTIONAL IGNITION CREATED THRU TI FLUID INGRESS LAB TEST PS 99-13 Attachment

Not Enough Printer Memory -- See User's Guide

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

Ford

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

Cellanex 4300 Base

Cellanex 3316 Base

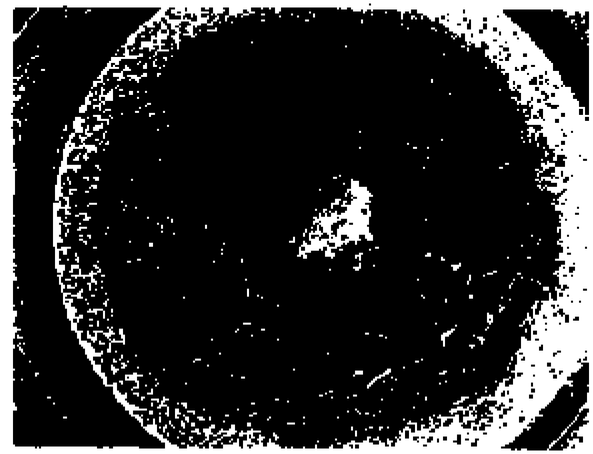
C. [illegible]

INTENTIONAL IGNITION CREATED THRU TI FLUID INGRESS LAB TEST

Attachment

TI-NHTSA 013967

Lab Experiment- "New" Brake Fluid and Continuous Power (300 hours)

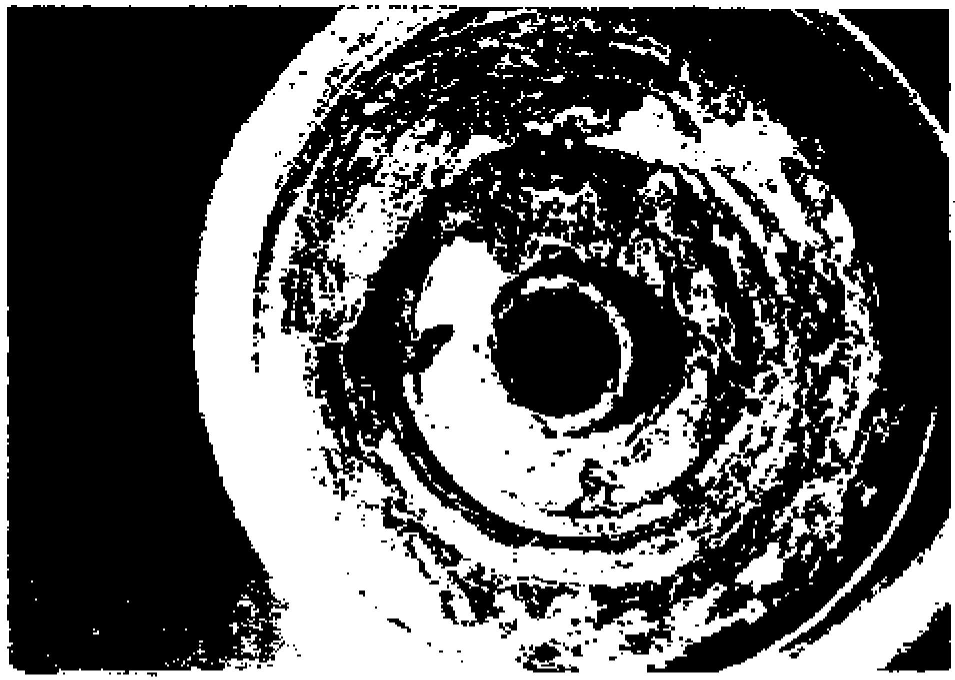


- Contact arm (Cu) corrodes - chemical analysis shows presence of Cu, C, and O on the cup surface.

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

Memphis Switch Analysis



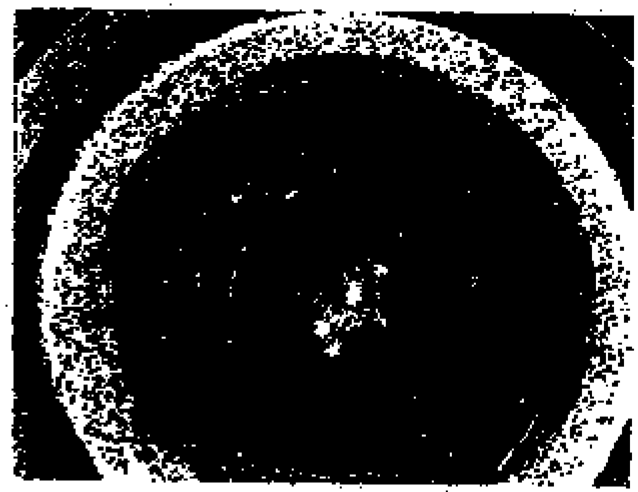
- **Chemical analysis reveals K, S, Cu, C, and O.**

TI-NHTSA 013949

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

Lab Experiment "New" Brake Fluid and Continuous Power (550 hours)



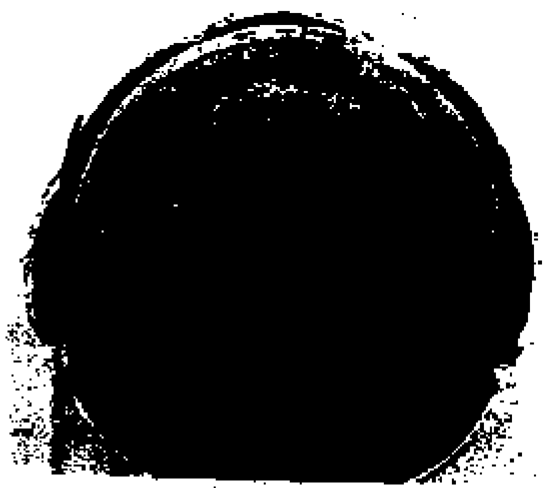
- **Contact arm (Cu) corrodes - chemical analysis shows presence of Cu, C, and O on the cup surface.**

TI-NHTSA 013960

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

Lab Experiment-5% NaCl/H_2O and Continuous Power



- Contact arm (Cu) corrodes - chemical analysis shows presence of Na, Cl, Cu, and O on the cup surface

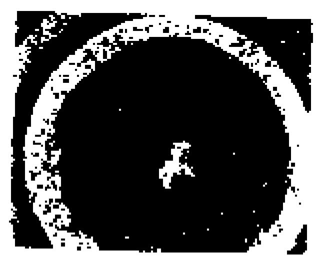
TI-NHTSA 013961

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

Ford

Lab/Field Comparisons - Impact of Continuous Power

Experiment	Cup Visual Inspection	Chemical Analysis (Cup)
Lab/Salt Water		Na, Cl, Cu, C, O
Lab/Brake Fluid		Cu, C, O
Field/Memphis Switch		K, S, Cu, C, O

TI-NHTSA 013982

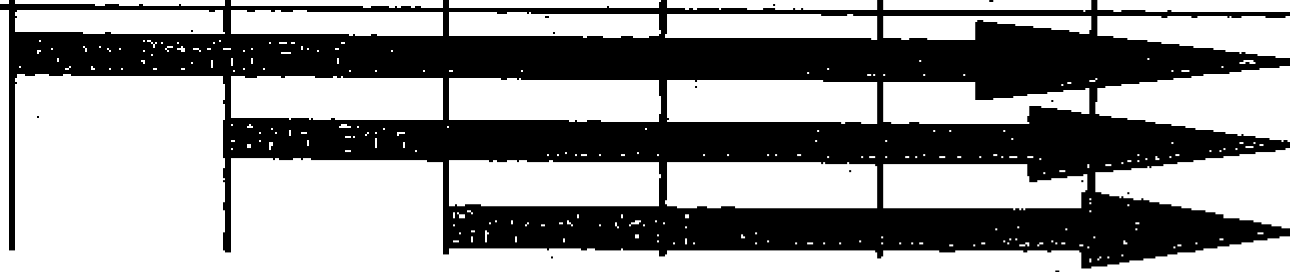
TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

NA Hydraulic Switch History

Time Period:	'83	'87	'90	'91	'98	'99
Application:	Power Steering	Power Steering Suspension	Power Steering Suspension Transmission	Power Steering Suspension Transmission Cruise	Power Steering Suspension Transmission Cruise Clutch	Power Steering Suspension Transmission Cruise Clutch

Fluid:



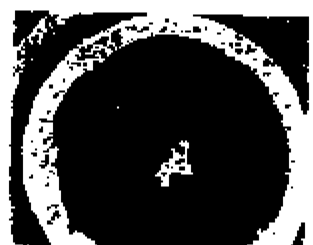
- TI has some 16 years and 130 million units accumulated experience in hydraulic applications using multiple fluids
- TI has some 12 years of brake system application experience working with brake fluids

TI-NHTSA 013963

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

Lab/Field Comparisons - Impact of Continuous Power

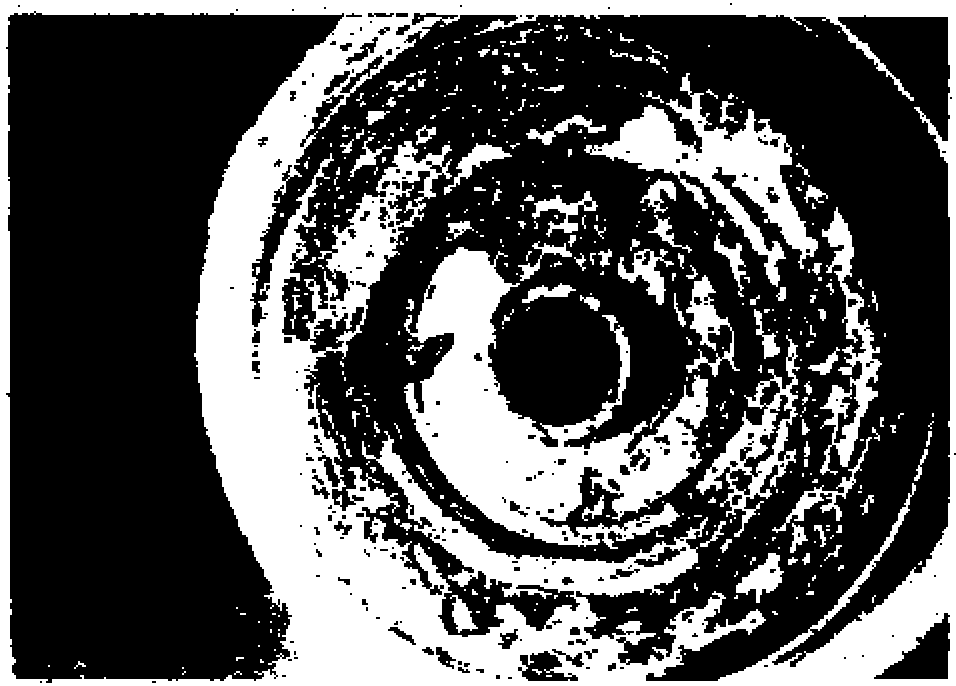
Experiment	Cup Visual Inspection	Chemical Analysis (Cup)
Lab/Salt Water		Na, Cl, Cu, C, O
Lab/Brake Fluid		Cu, C, O
Field/Memphis Switch		K, S, Cu, C, O

TI-NHTSA 013964

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

Memphis Switch Analysis



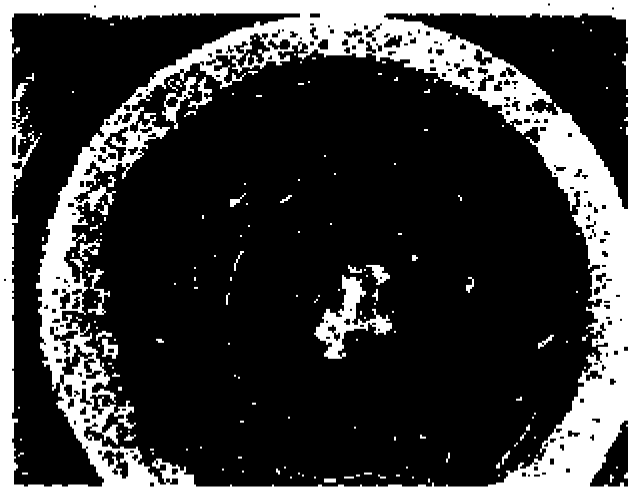
- Chemical analysis reveals K, S, Cu, C, and O.

TI-NHTSA 013865

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

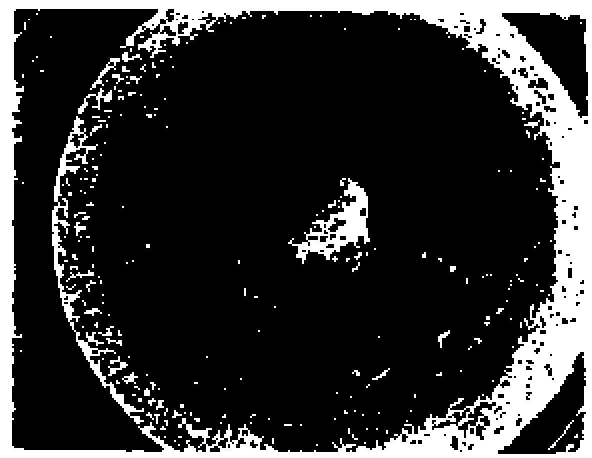
Lab Experiment "New" Brake Fluid and Continuous Power (550 hours)



- Contact arm (Cu) corrodes - chemical analysis shows presence of Cu, C, and O on the cup surface.

TI-NHTSA 013986

Lab Experiment- "New" Brake Fluid and Continuous Power (300 hours)



- **Contact arm (Cu) corrodes - chemical analysis shows presence of Cu, C, and O on the cup surface.**

TI-NHTSA 013987

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

Lab Experiment-5% NaCl/H_20 and Continuous Power

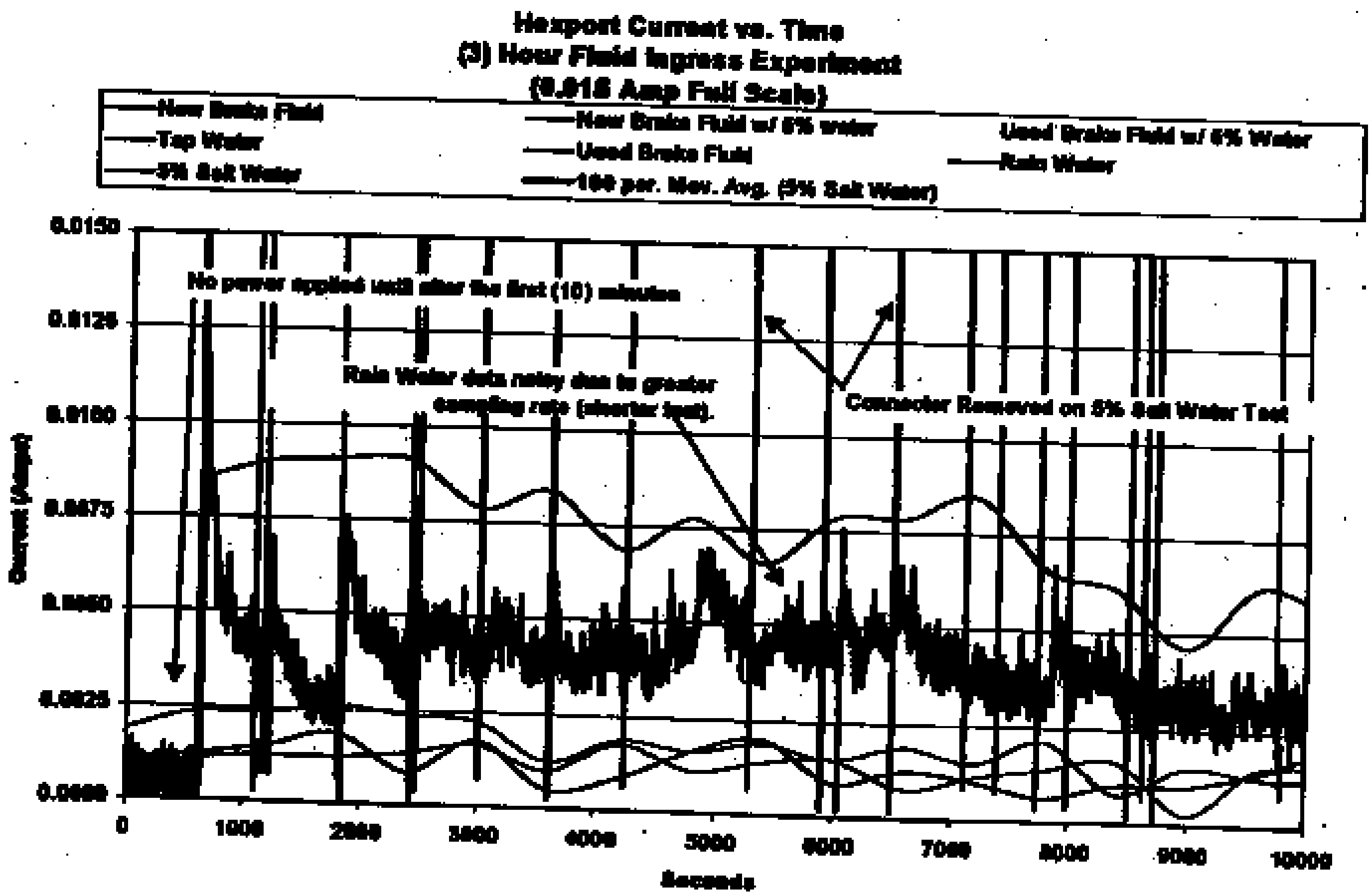
- **Contact arm (Cu) corrodes - chemical analysis shows presence of Na, Cl, Cu, and O on the cup surface**

TI-NHTSA 013998

Brake Pressure Switch
Potential Thermal Event Theory Profile 8/02/99

TEXAS INSTRUMENTS

[redacted]



TI-NHTSA 013969

Attachment

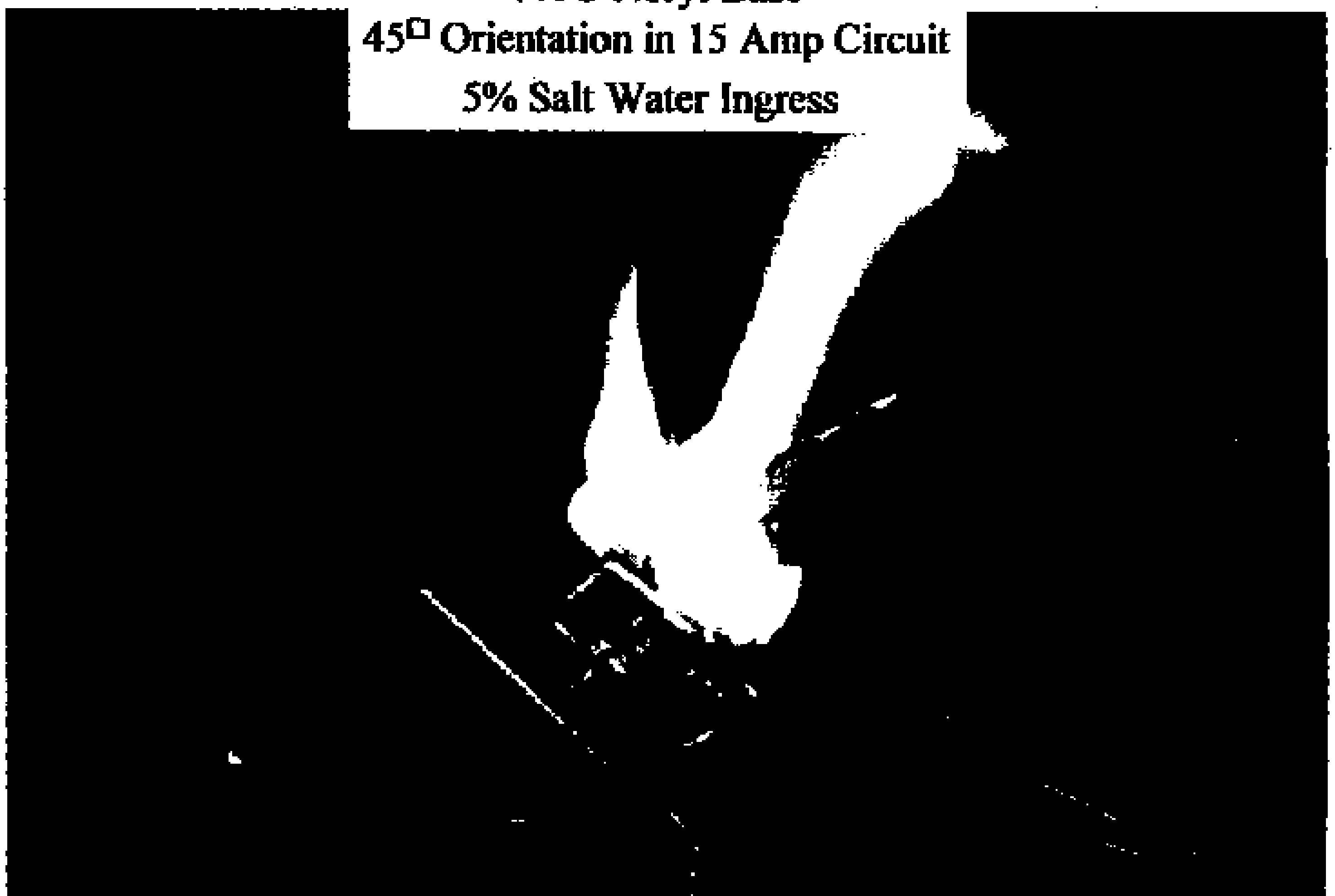
Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

77PS Noryl Base

45° Orientation in 15 Amp Circuit

5% Salt Water Ingress



INTENTIONAL IGNITION CREATED THRU TI FLUID INGRESS LAB TEST PS/99/13' Attachment

TI-NHTSA 013970

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

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

Cellanex 4300 Base

Cellanex 3316 Base

INTENTIONAL IGNITION CREATED THRU TI FLUID INGRESS LAB TEST PS/99/13

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Attachment

TI-NHTSA 013874

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

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

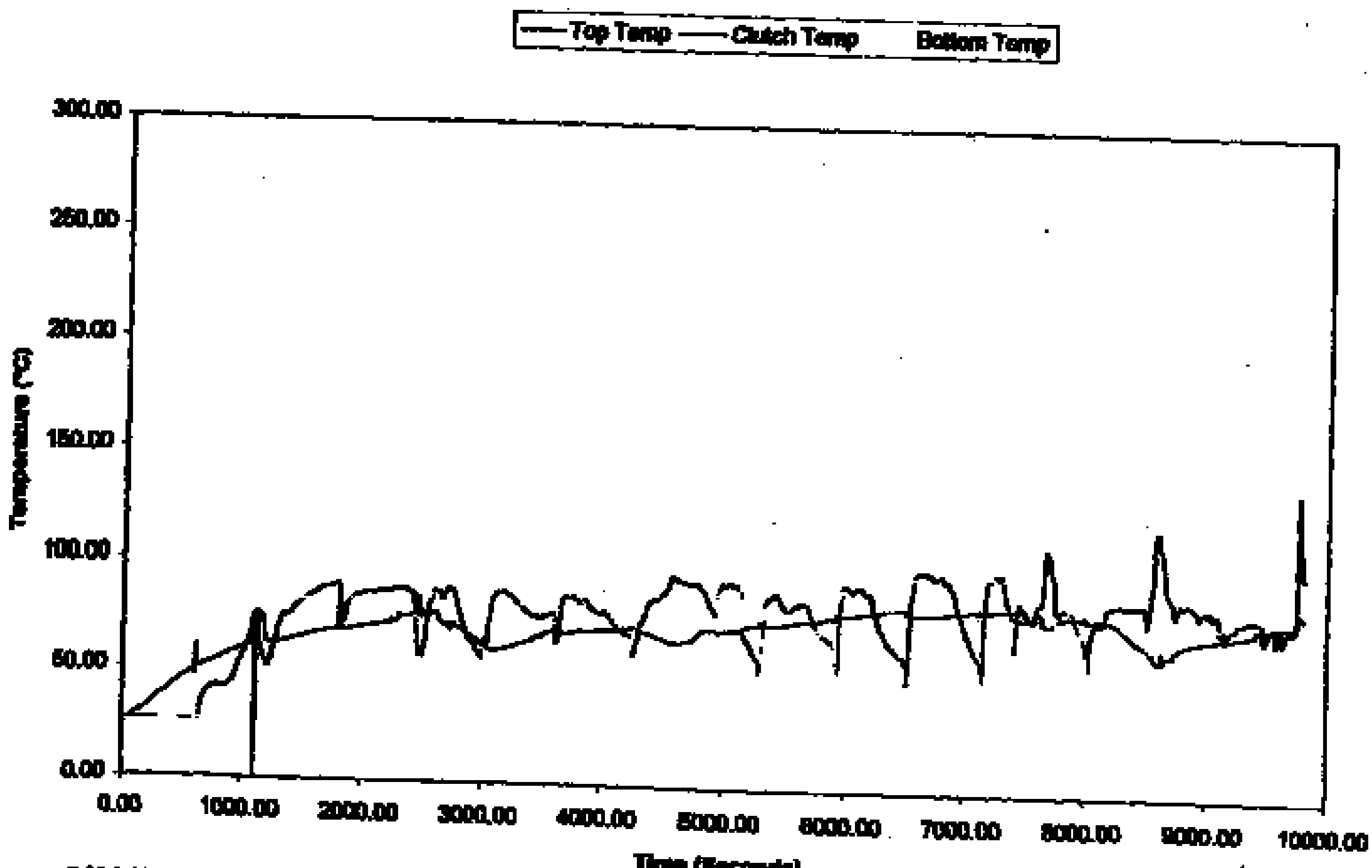
INTENTIONAL IGNITION CREATED THRU TI FLUID INGRESS LAB TEST PS/99/13

TI-NHTSA 013972

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

5% Salt Water Ingress Experiment
Temperature vs. Time

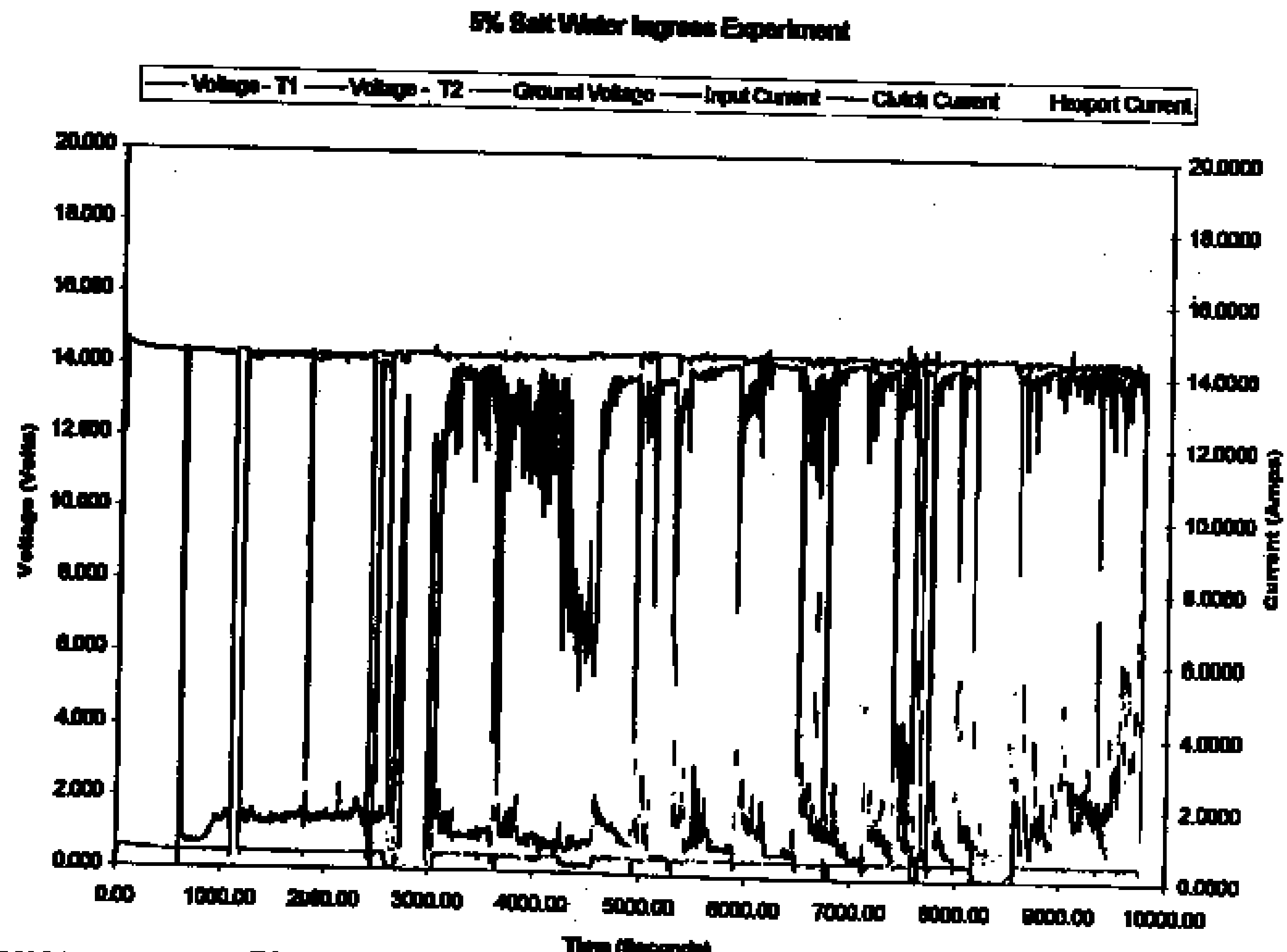


INTENTIONAL IGNITION CREATED THRU TI FLUID INGRESS LAB TEST PS/99/13' Attachment

TI-NHTSA 013973

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99



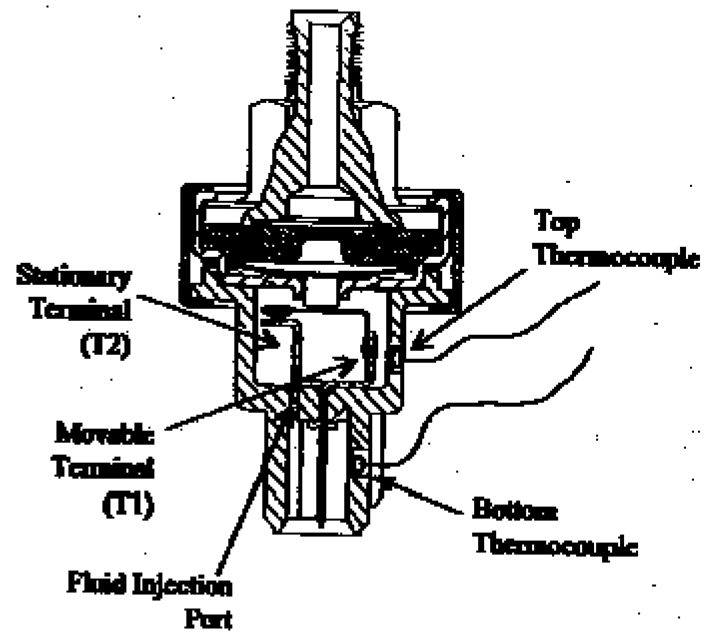
TI-NHTSA 013974

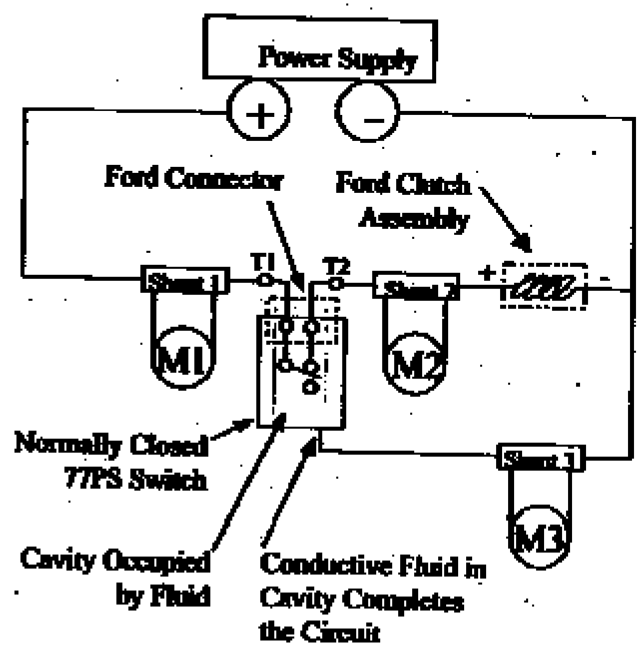
INTENTIONAL IGNITION CREATED THRU TI FLUID INGRESS LAB TEST PS/99/13' Attachment

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

5% Salt Water Ingress Experiment
Test 1





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

Test 1: Figure 1 and Figure 2.

TI-NHTSA 013976

C:/...Ford

Attachment

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

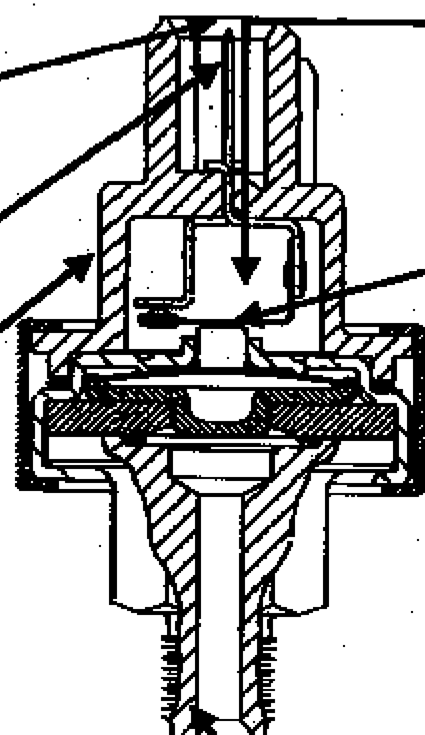
5. High current flow to case through water and ionic contamination

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

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

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

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



3. Hexport grounded accelerates corrosion

TI-NHTSA 013978

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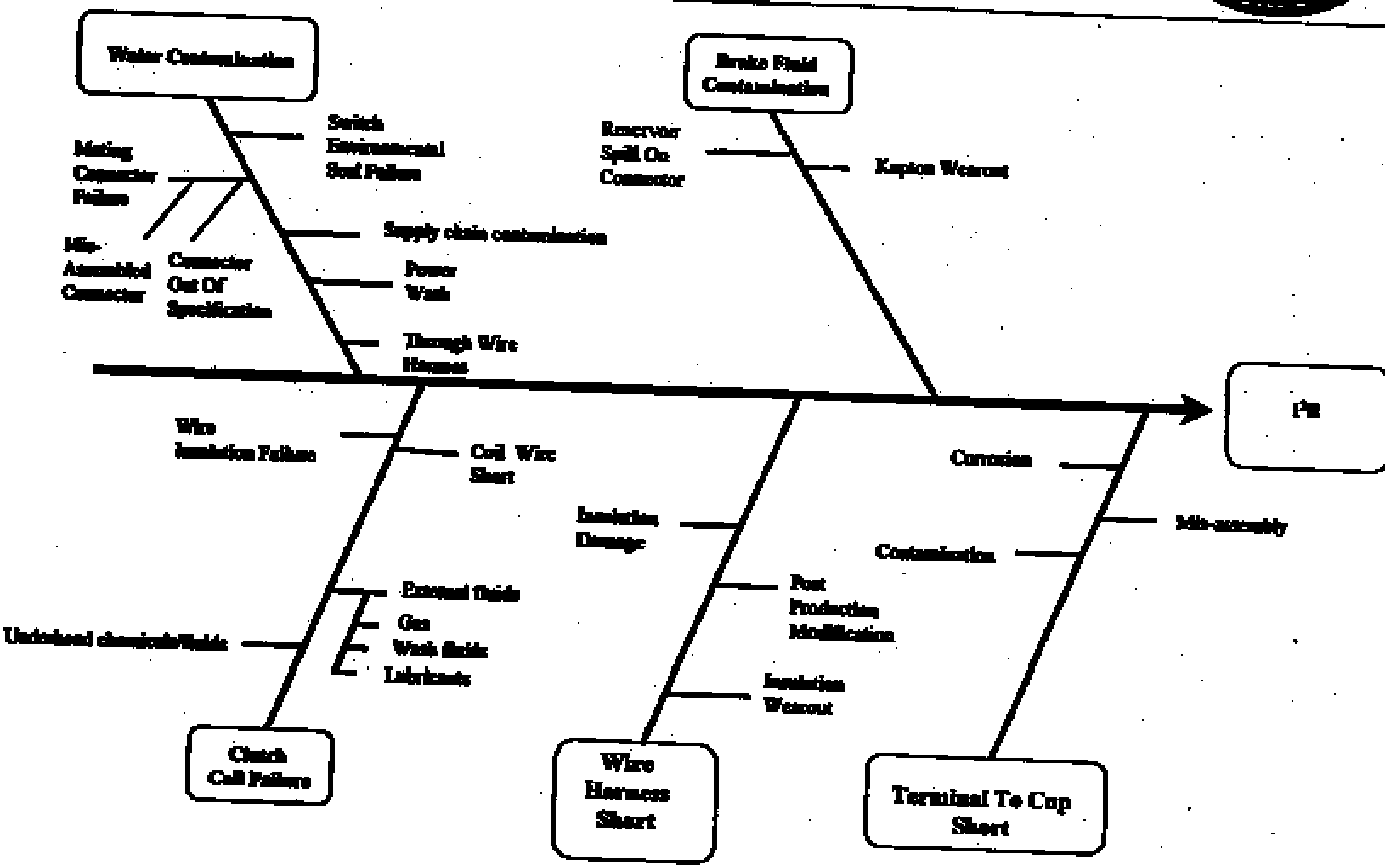
Attachment

PROCESS FLOW DIAGRAM
"CORROSION" POTENTIAL CAUSE FLOW ANALYSIS

1. [illegible]
2. [illegible]
3. Corrosion fluid in switch cavity bridges grooved [illegible]
4. Corrosion fluid [illegible] switch cavity bridges live metal [illegible]
5. [illegible] Power creates corrosion [illegible] path to ground [illegible]
6. Corrosion [illegible] creates high resistance path over plastic
7. [illegible] Power creates "hot spot" at high resistance point
8. [illegible] plastic base melts at "hot spot" [illegible]
9. [illegible]
10. [illegible]
11. [illegible]
12. [illegible] plastic material [illegible] ignites [illegible]

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99



TI-NHTSA 013978

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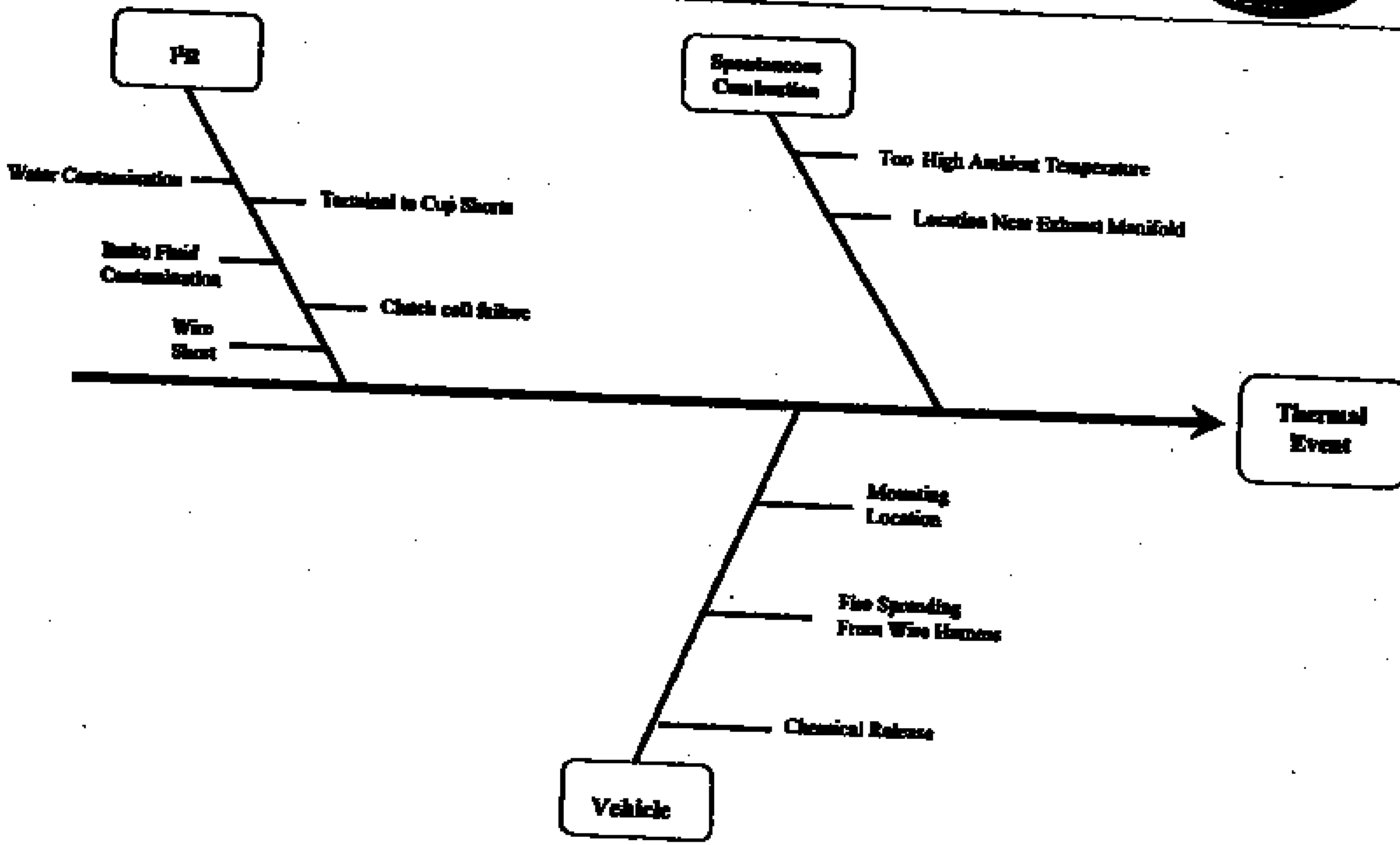
Attachment

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99



TI-NHTSA 013979

Attachment

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 6/02/99

NA Hydraulic Switch History

Time Period:	'83	'87	'90	'91	'98	'99
Application:	Power Steering	Power Steering Suspension	Power Steering Suspension Transmission	Power Steering Suspension Transmission Cruise	Power Steering Suspension Transmission Cruise Clutch	Power Steering Suspension Transmission Cruise Clutch
Fluid:	Power Steering Fluid					
		Brake Fluid				
			Transmission Fluid			

- TI has some 16 years and 130 million units accumulated experience in hydraulic applications using multiple fluids
- TI has some 12 years of brake system application experience working with brake fluids

TI-NHTSA 013980

1999 YEAR TO DATE
Impulse Testing 77PSL2_1.xls
FORD P.N. F2VC-9F924-AB
(FOR REFERENCE ONLY)

TI P/N: 77PSL2-1
Ford P/N: F2VC-9F924-AB

Date	Lot Size	Qty Impulse Tested	Qty Pass	Qty Leak	Comments	Comments
22-May-99	2,022	5	5	0	Calibration Creep Release, Lot 196	Base OS, Pin US
22-May-99	2,008	5	5	0		
21-May-99	1,994	5	5	0		
21-May-99	1,993	5	5	0	Calibration Creep Release, Lot 185	Incorrect Pin
21-May-99	1,975	5	5	0		
21-May-99	2,362	5	5	0		
18-May-99	2,659	5	5	0		
17-May-99	2,000	5	5	0		
13-May-99	2,103	5	5	0		
13-May-99	2,143	5	5	0		
12-May-99	1,995	5	5	0		
11-May-99	1,872	5	5	0		
10-May-99	1,984	5	5	0		
8-May-99	2,000	5	5	0		
7-May-99	2,200	5	5	0		
5-May-99	2,000	5	5	0		
4-May-99	2,012	5	5	0		
26-Apr-99	1,430	5	5	0		
8-Mar-99	1,970	5	5	0		
1-Feb-99	No	77PSL2-1	Mfg	n/a	No 77PSL2-1 switches mfg	
1-Jan-99	No	77PSL2-1	Mfg	n/a	No 77PSL2-1 switches mfg	

Totals	38,722	95	95	0

Prepared by Jim Watt 6/2/99

TI-NHTSA 013983

Low Cost
Automotive Pressure Switches

TI's pressure switches provide low cost, on/off controls for many automotive systems. The snap action disc reacts to changing pressure by reversing its curvature and activating electrical switch contacts.

Key Features Include:

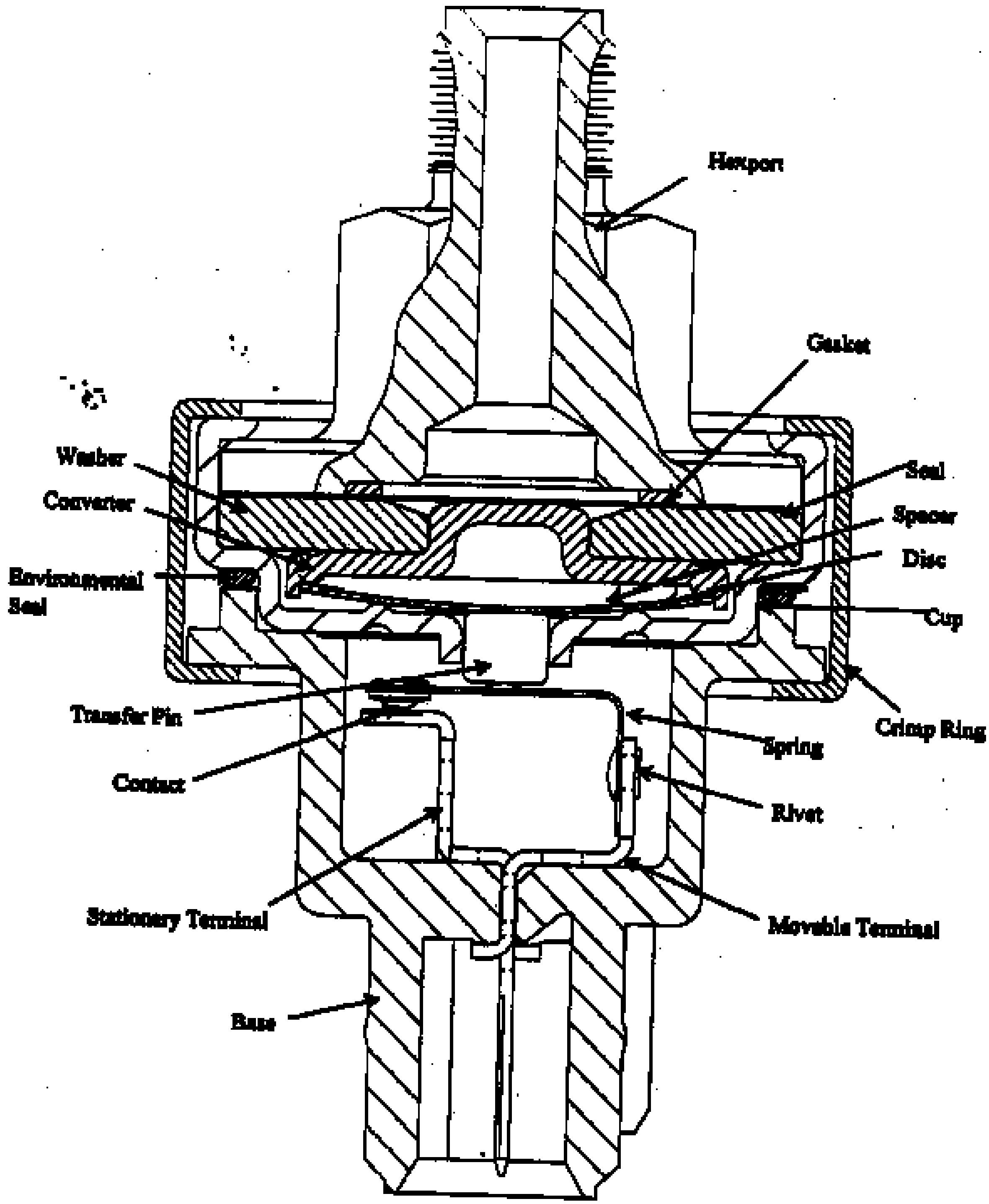
- Designed for underhood environment
- Designed for line or pump mount applications
- Low weight
- Custom packaging for specific application needs
- Automotive temperature range of -30 to 125°C
- Normally open and normally closed contact logic
- Industry proven since 1984

Typical Applications

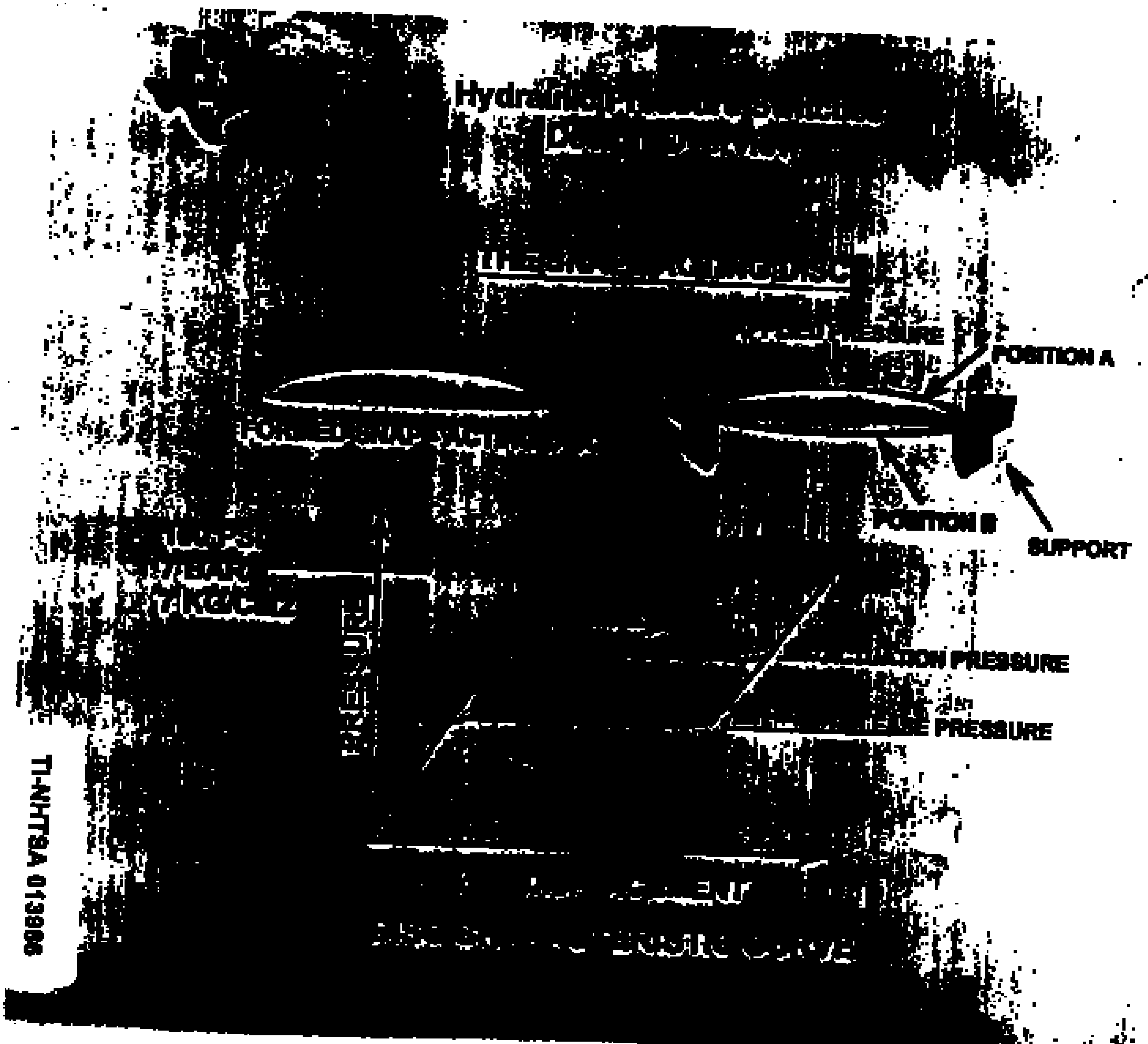
- A/C systems
- Power Steering Systems
- Cruise Control Systems
- Brake Systems
- Transmissions
- Suspension

TI-NHTSA 013984

Hydraulic Pressure Switch Cross Section



TI-NHTSA 013905



TI-NHTSA 013986

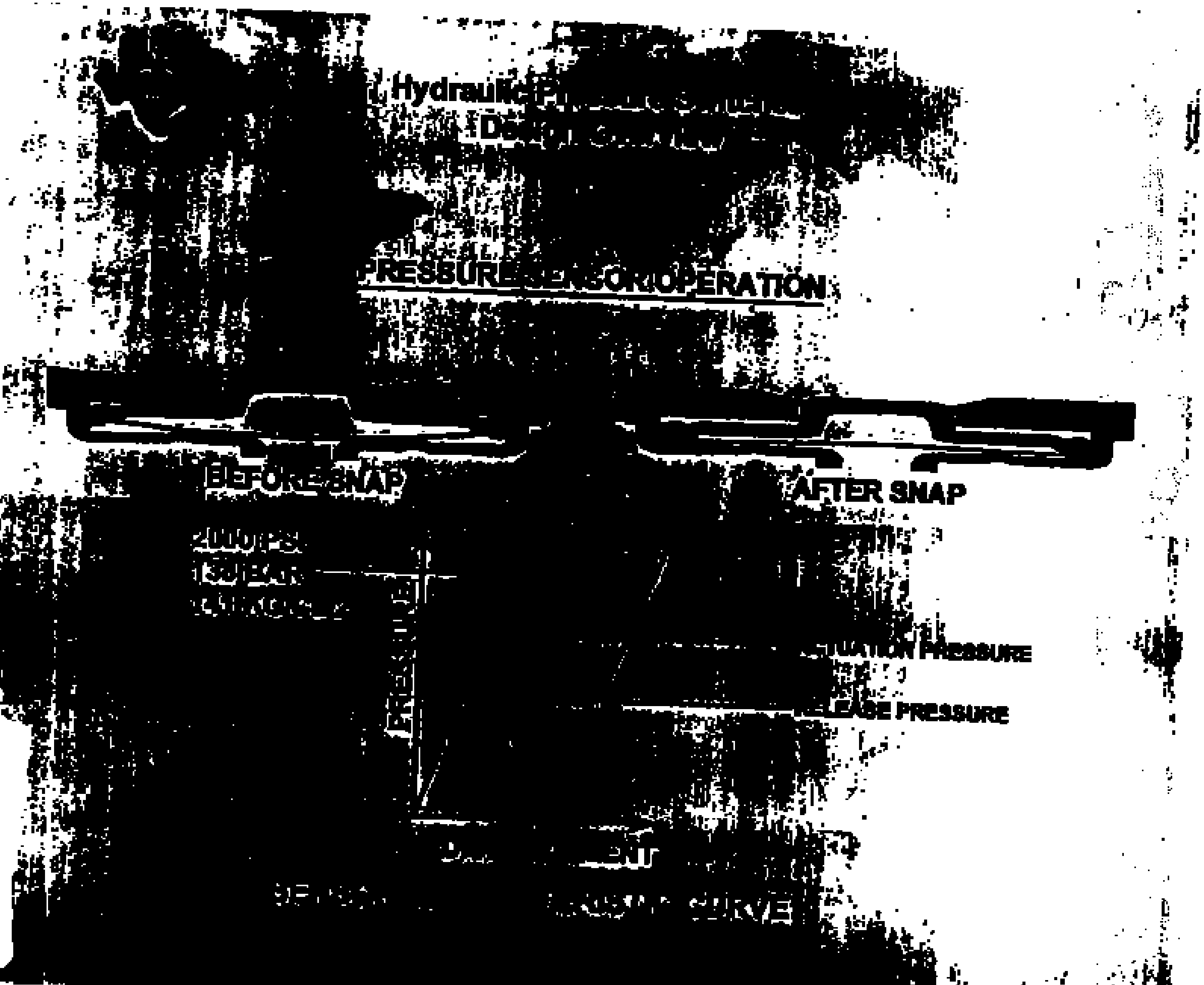
Hydraulic Pressure Switches

AMPLIFYING DISC PRESSURE USING A PRESSURE CONVERTER

FORCE ON DISC = PRESSURE X EFFECTIVE AREA

EFFECTIVE AREA IS INFLUENCED BY THE CONVERTER/ WASHER DESIGN AND THE WAY THE DIAPHRAGM CONFORMS TO THE CONVERTER

TI-NHTSA 013887

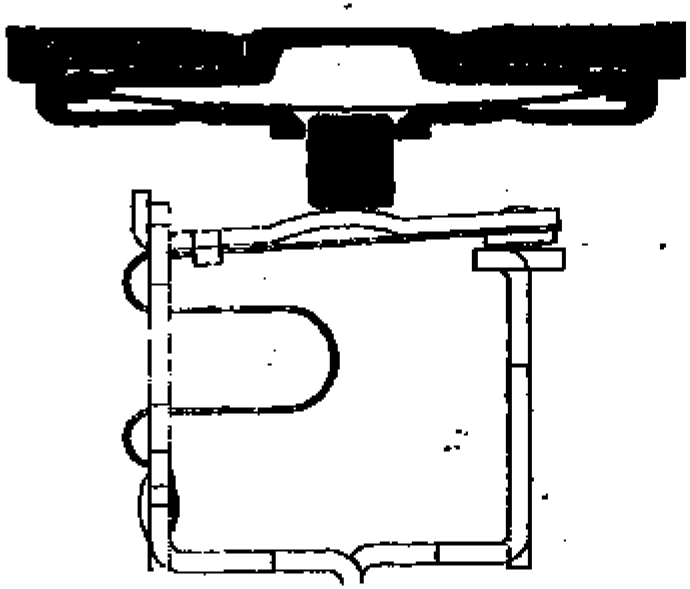


TI-NHTSA 013988

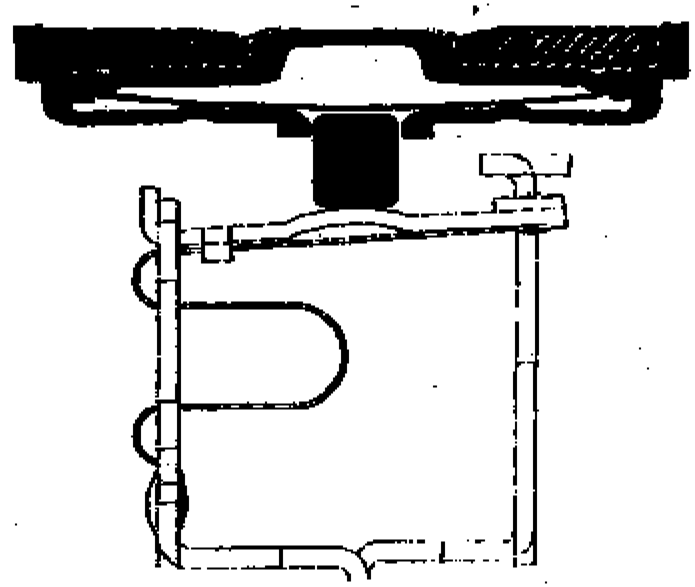
Hydraulic Pressure Switches
Design Overview

PRESSURE SWITCH LOGIC

NORMALLY CLOSED



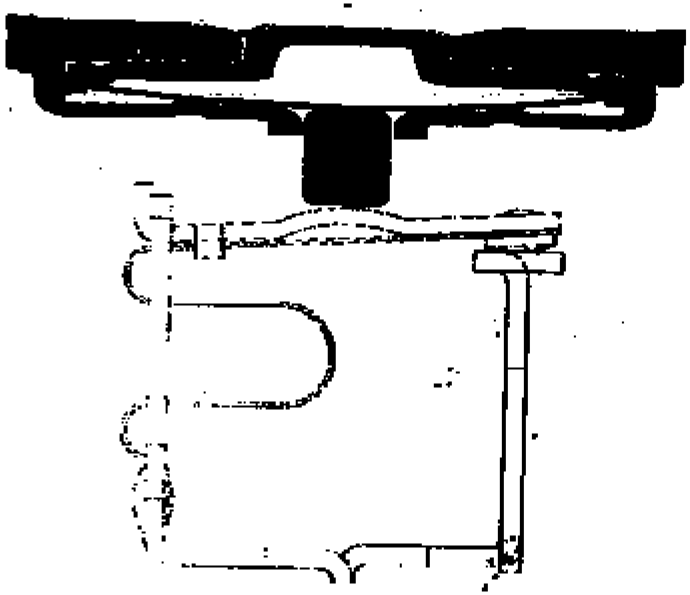
NORMALLY OPEN



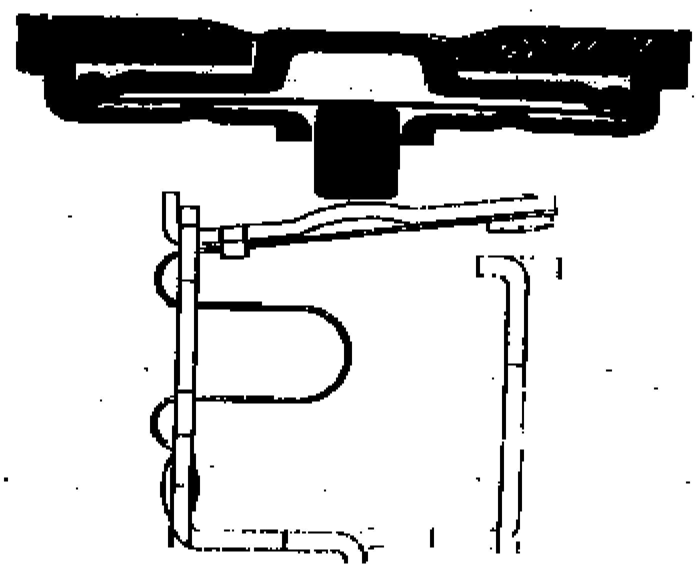
TI-NHTSA 013889

USING DISC MOTION TO MAKE / BREAK CONTACTS

BEFORE SNAP



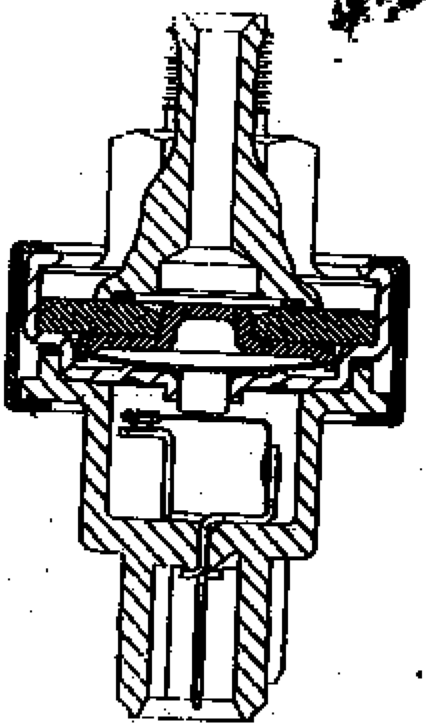
AFTER SNAP



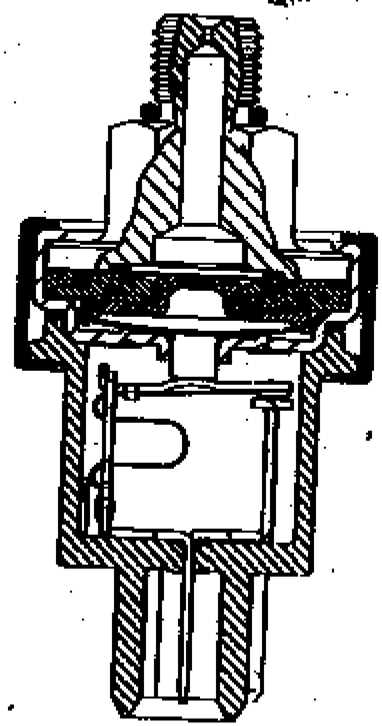
TI-NHTSA 013990

Hydraulic Pressure Switches
Design Overview

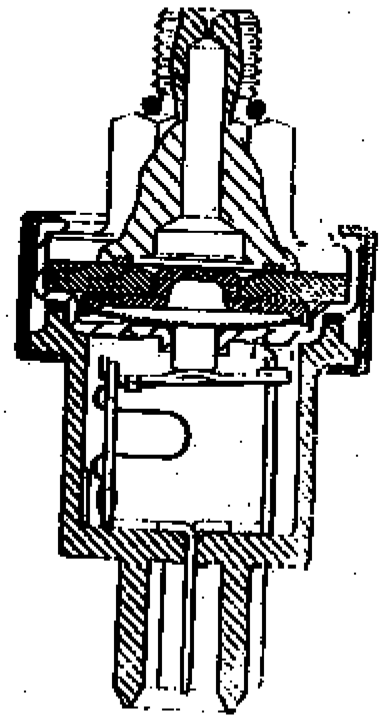
PRESSURE SWITCH ASSEMBLIES



L - SHAPED SPRING
NORMALLY CLOSED



S - SHAPED SPRING
NORMALLY CLOSED



S - SHAPED SPRING
NORMALLY OPEN

25 Jun 99 BJD 05068357 HPSdesign.ppt

TI-NHTSA 013891

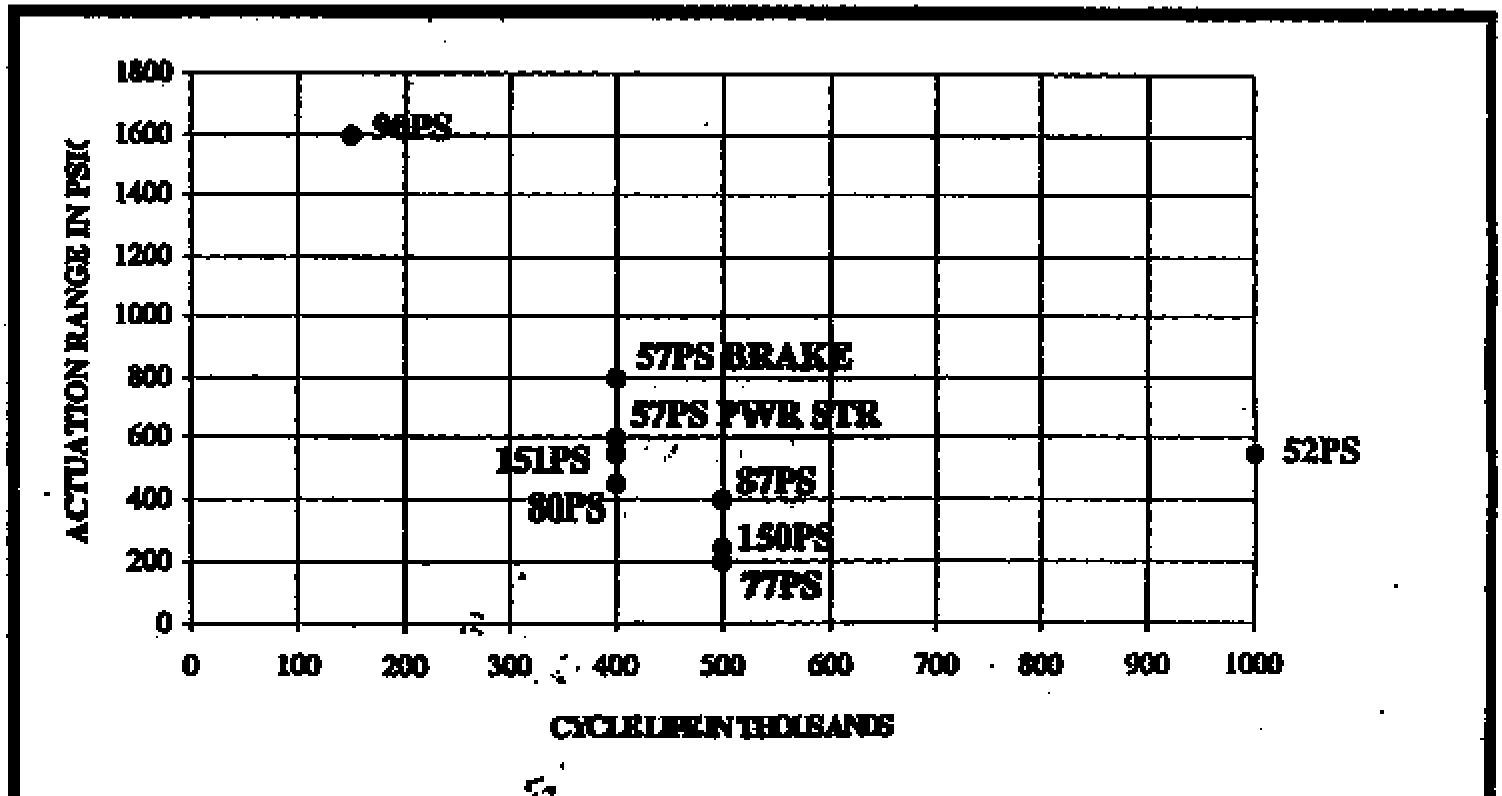
SNAP SENSOR CHARACTERISTIC CURVE

Hydraulic Pressure Switches
Design Overview

QUIET VS SNAP SENSORS

TI-NHTSA 013992

Hydraulic Pressure Switches
Design Overview



TI-NHTSA 013993

Low Cost
Automotive Pressure Switches

TI's pressure switches provide low cost, on/off controls for many automotive systems. The snap action disc reacts to changing pressure by reversing its curvature and activating electrical switch contacts.

Key Features Include:

- Designed for underhood environment
- Designed for line or pump mount applications
- Low weight
- Custom packaging for specific application needs
- Automotive temperature range of -30 to 125°C
- Normally open and normally closed contact logic
- Industry proven since 1984

Typical Applications

- A/C systems
- Power Steering Systems
- Cruise Control Systems
- Brake Systems
- Transmissions
- Suspension

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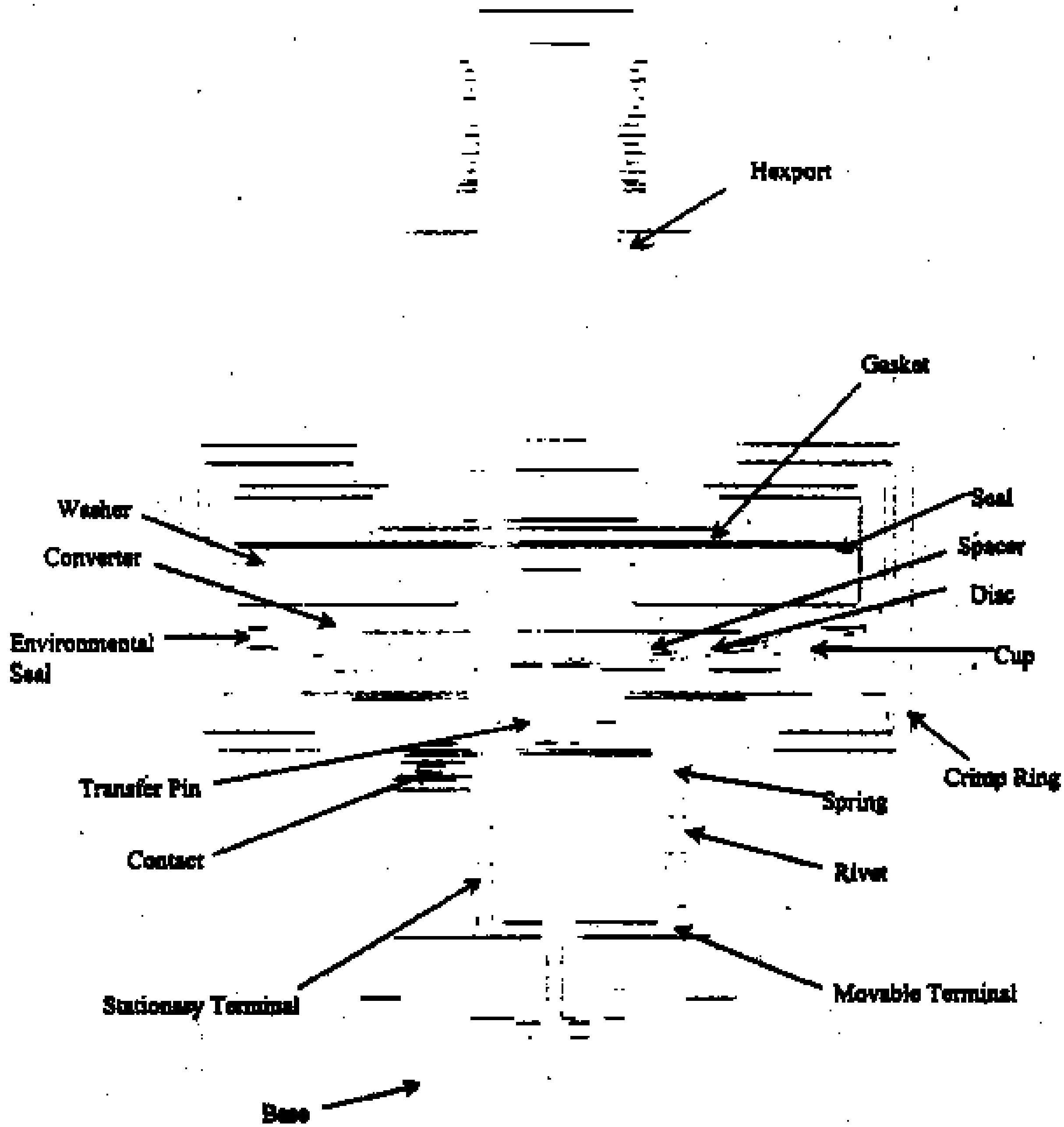
Hydraulic Pressure Switch Cross Section



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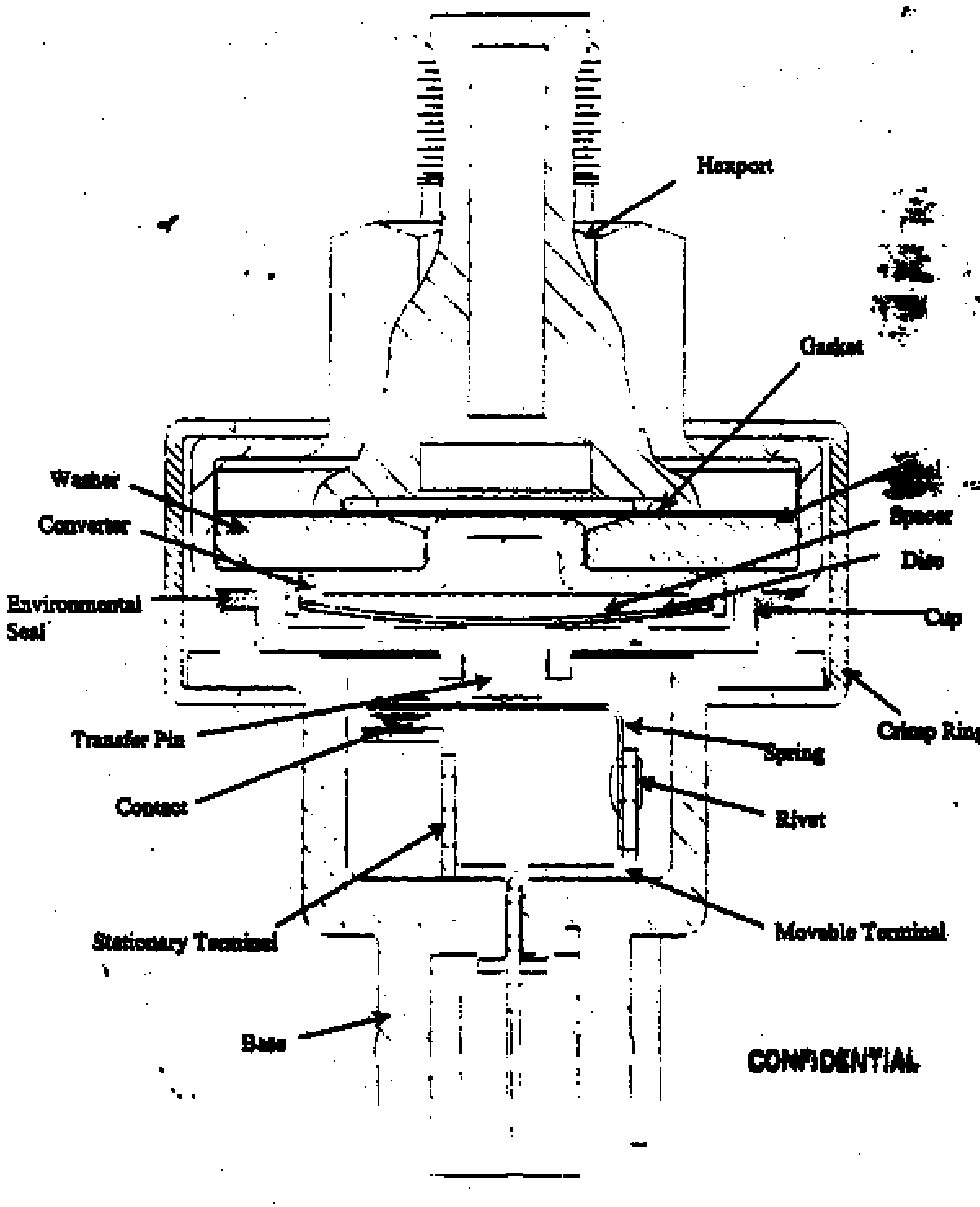
Hydraulic Pressure Switch Cross Section



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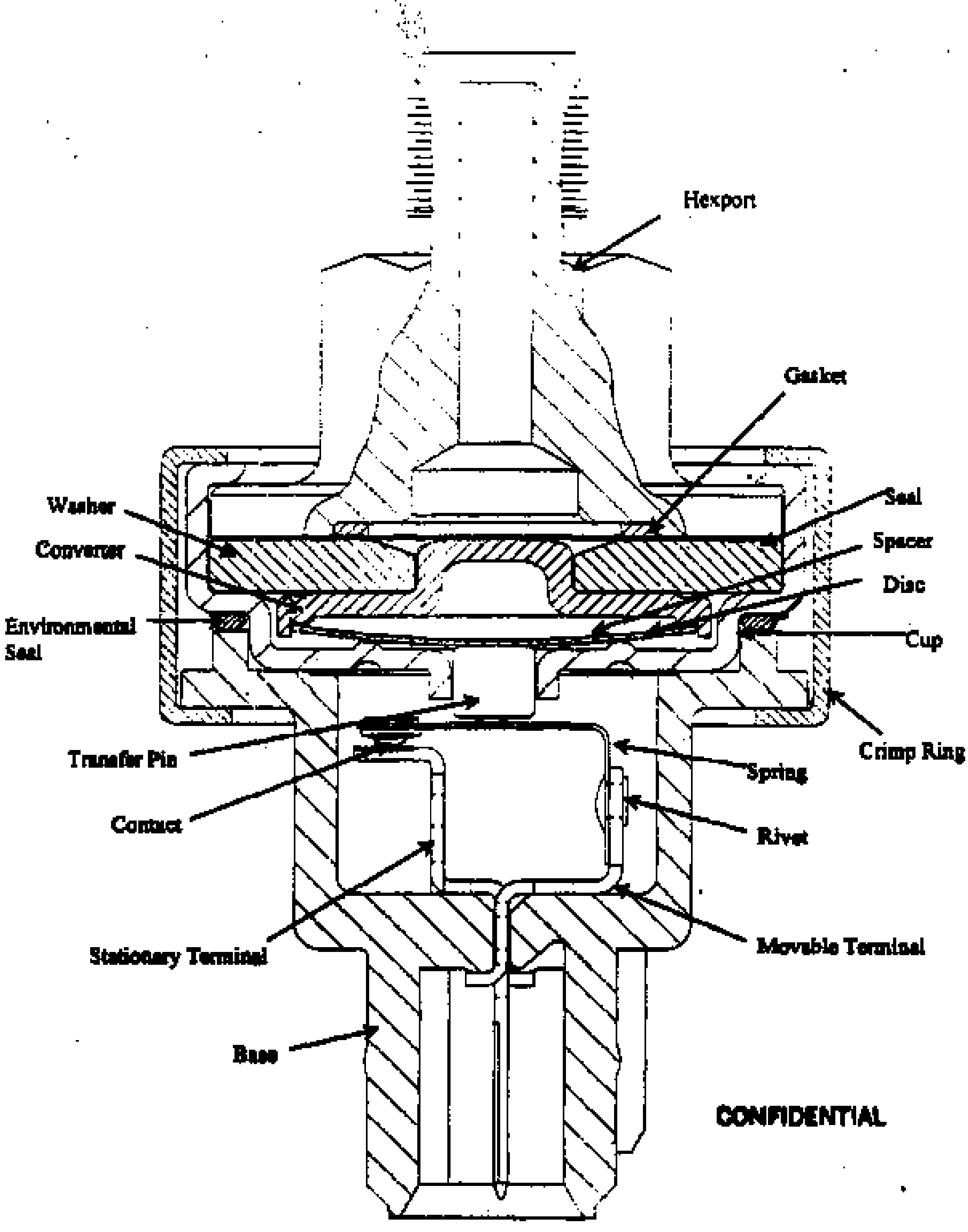
Hydraulic Pressure Switch Cross Section



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Low Cost
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- A/C systems
- Power Steering Systems
- Cruise Control Systems
- Brake Systems
- Transmissions
- Suspension

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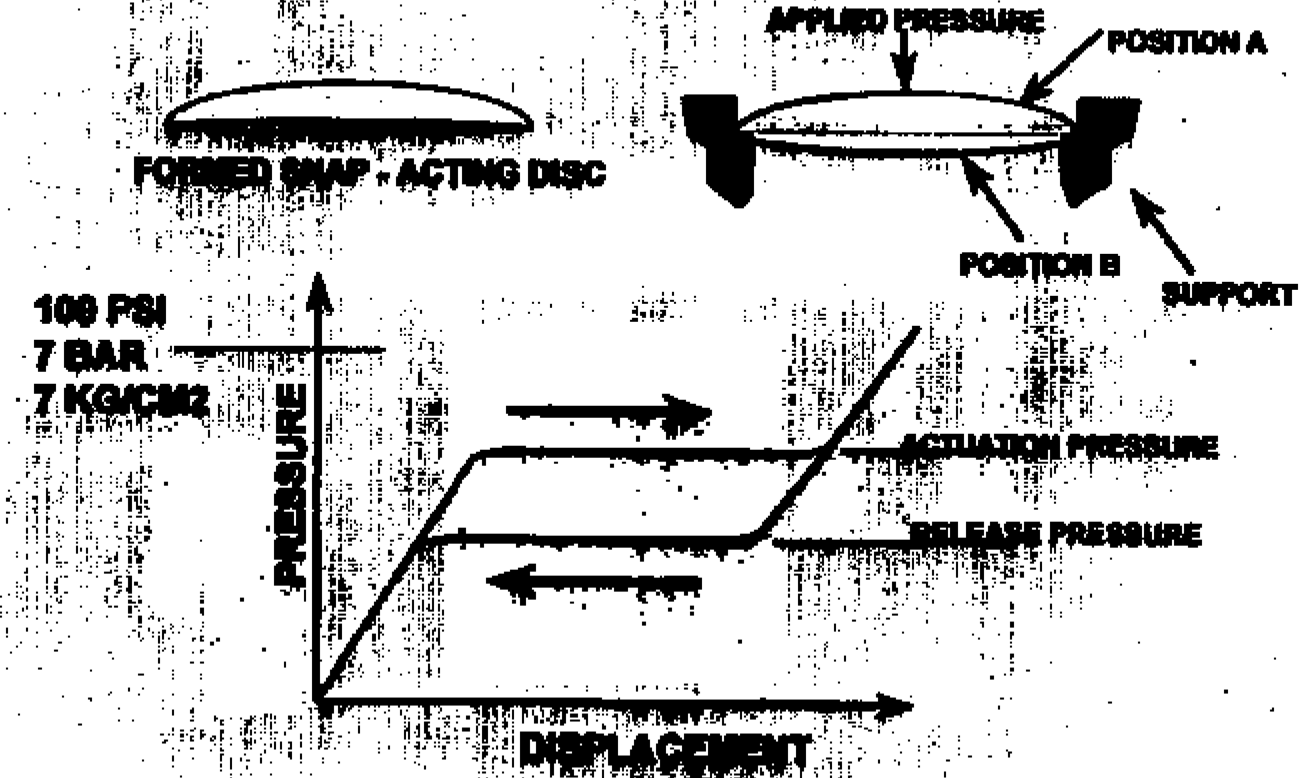
Hydraulic Pressure Switches
Design Overview

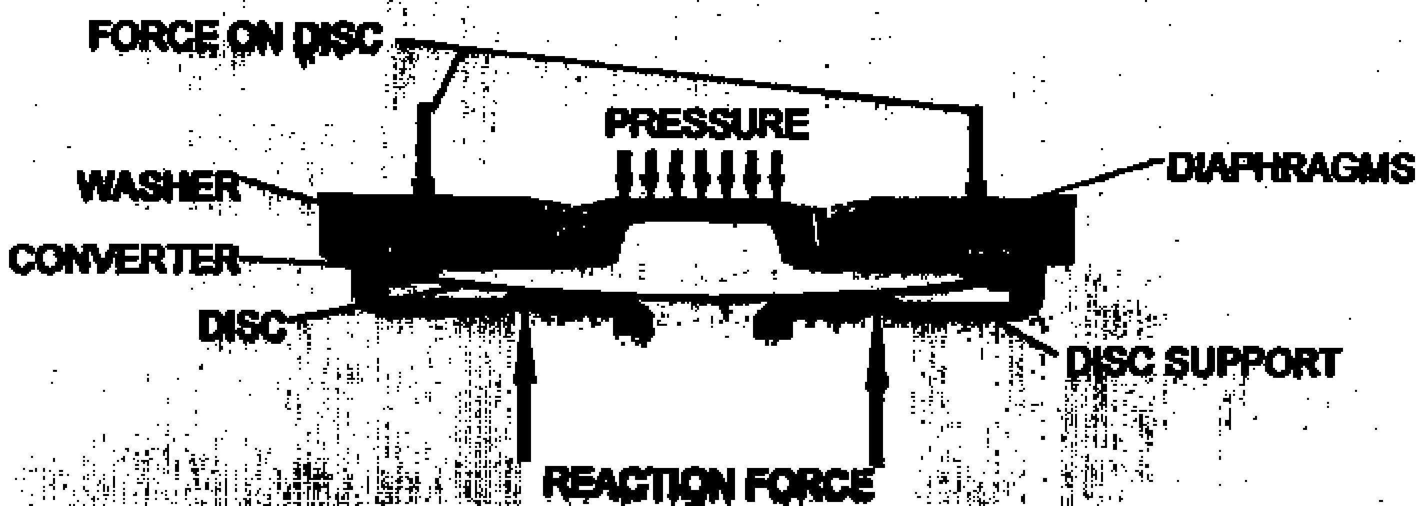
THE SNAP - ACTING DISC



DISC CHARACTERISTIC CURVE

Hydraulic Pressure Switches
Design Overview

AMPLIFYING DISC PRESSURE USING A PRESSURE CONVERTER



FORCE ON DISC = PRESSURE x EFFECTIVE AREA

EFFECTIVE AREA IS INFLUENCED BY THE CONVERTER / WASHER DESIGN AND THE WAY THE DIAPHRAGM CONFORMS TO THE CONVERTER

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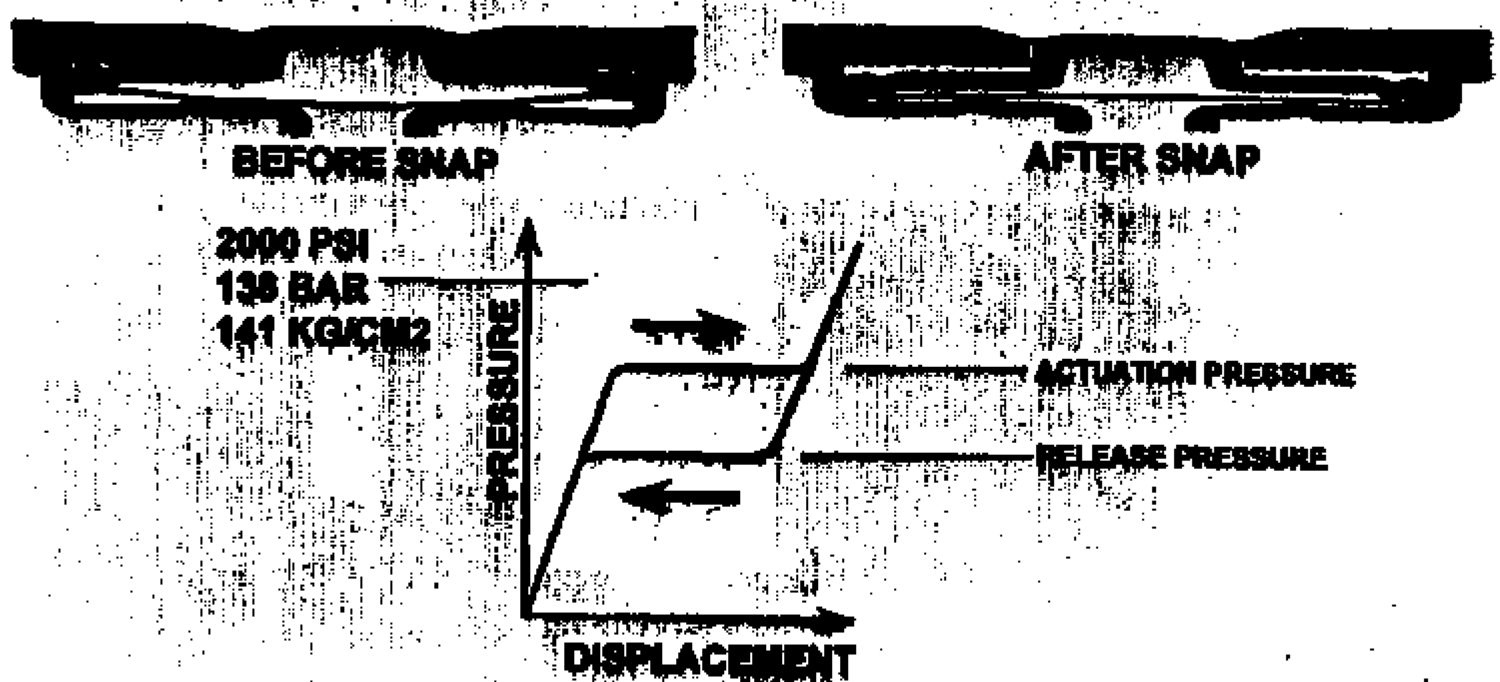
Hydraulic Pressure Switches
Design Overview

PRESSURE SENSOR OPERATION



SENSOR CHARACTERISTIC CURVE

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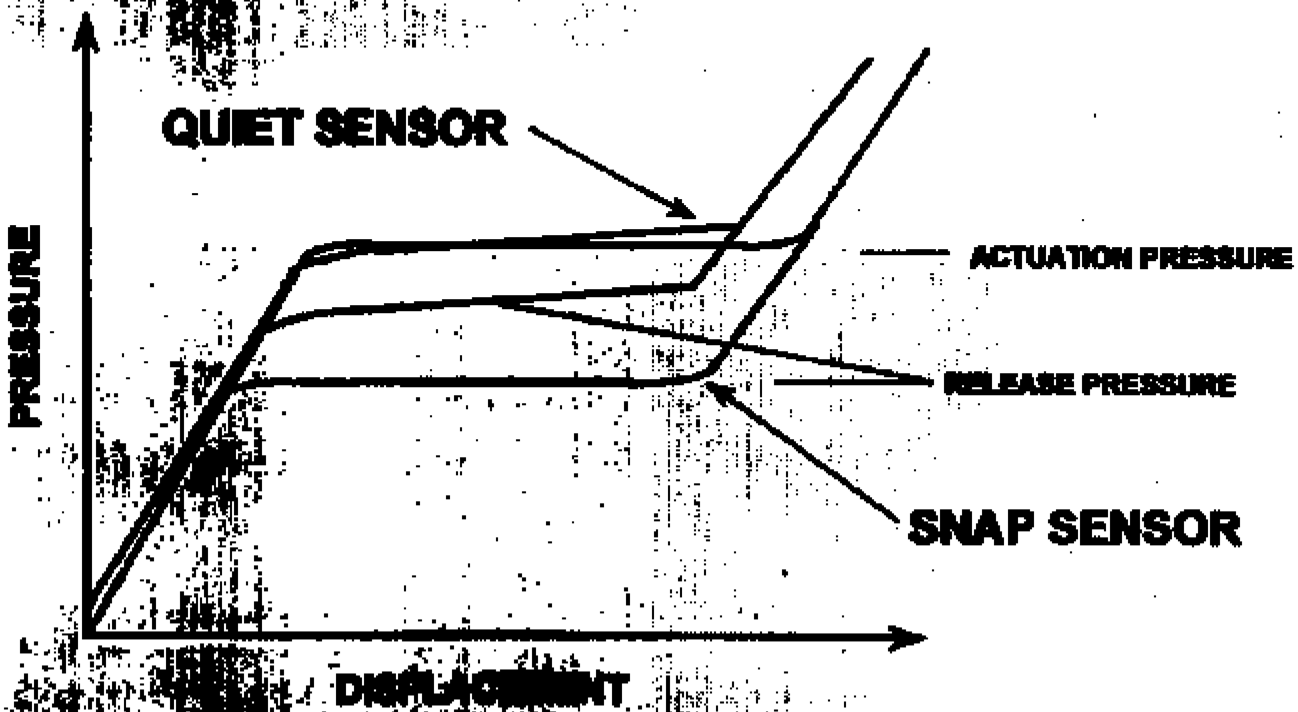
SNAP SENSOR CHARACTERISTIC CURVE

Hydraulic Pressure Switches
Design Overview

QUIET VS SNAP SENSORS



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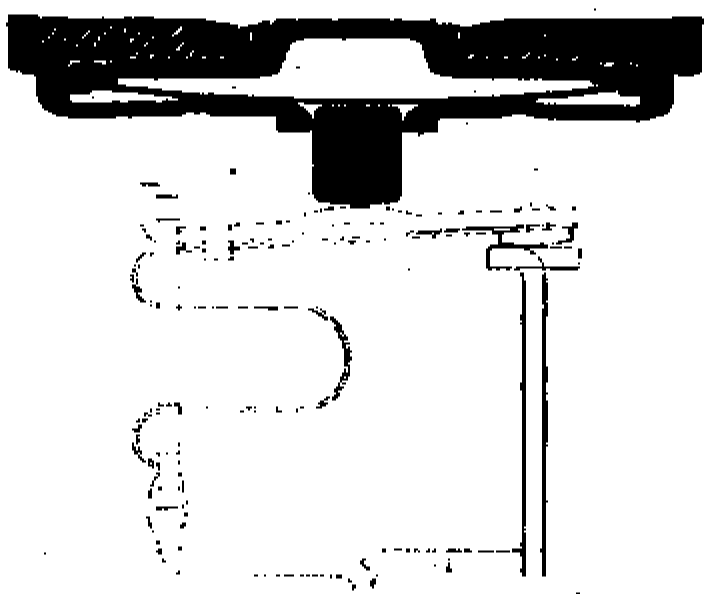
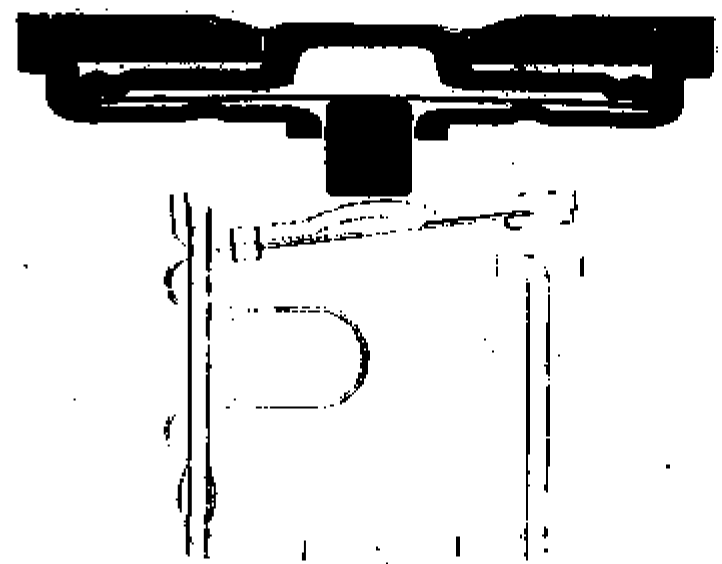
Hydraulic Pressure Switches
Design Overview

USING DISC MOTION TO MAKE / BREAK CONTACTS

BEFORE SNAP



AFTER SNAP



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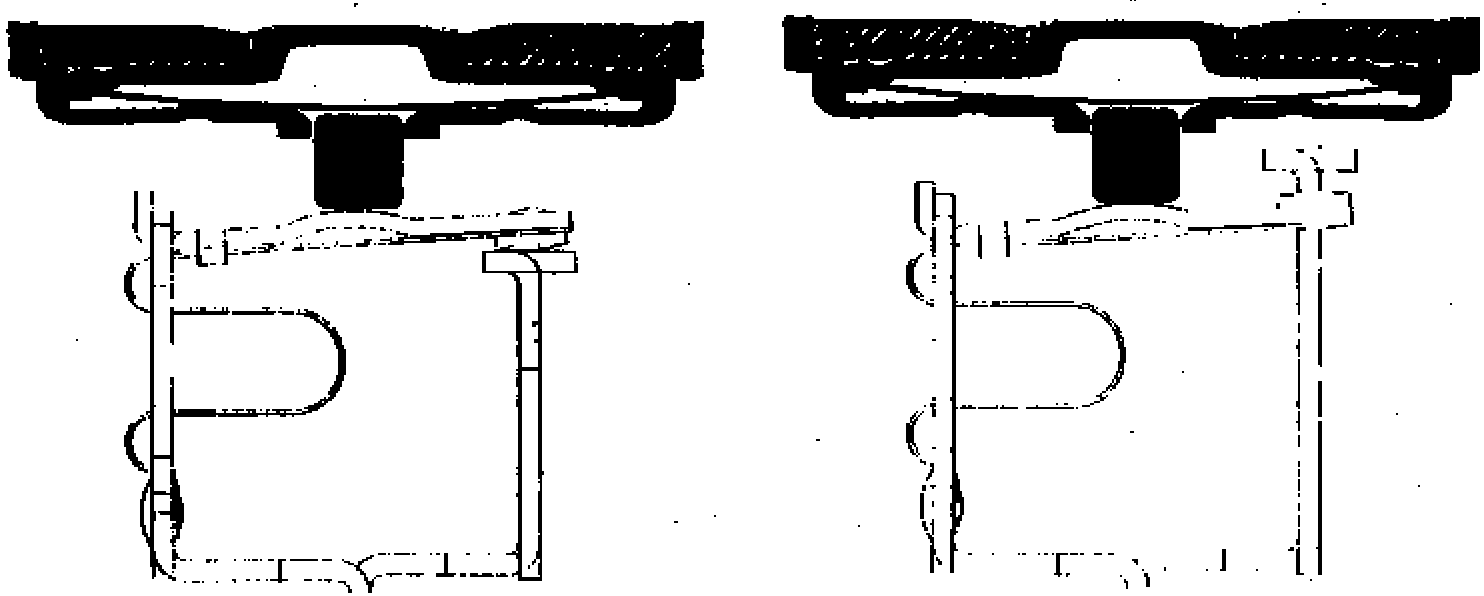
Hydraulic Pressure Switches
Design Overview

PRESSURE SWITCH LOGIC

NORMALLY CLOSED | **NORMALLY OPEN**



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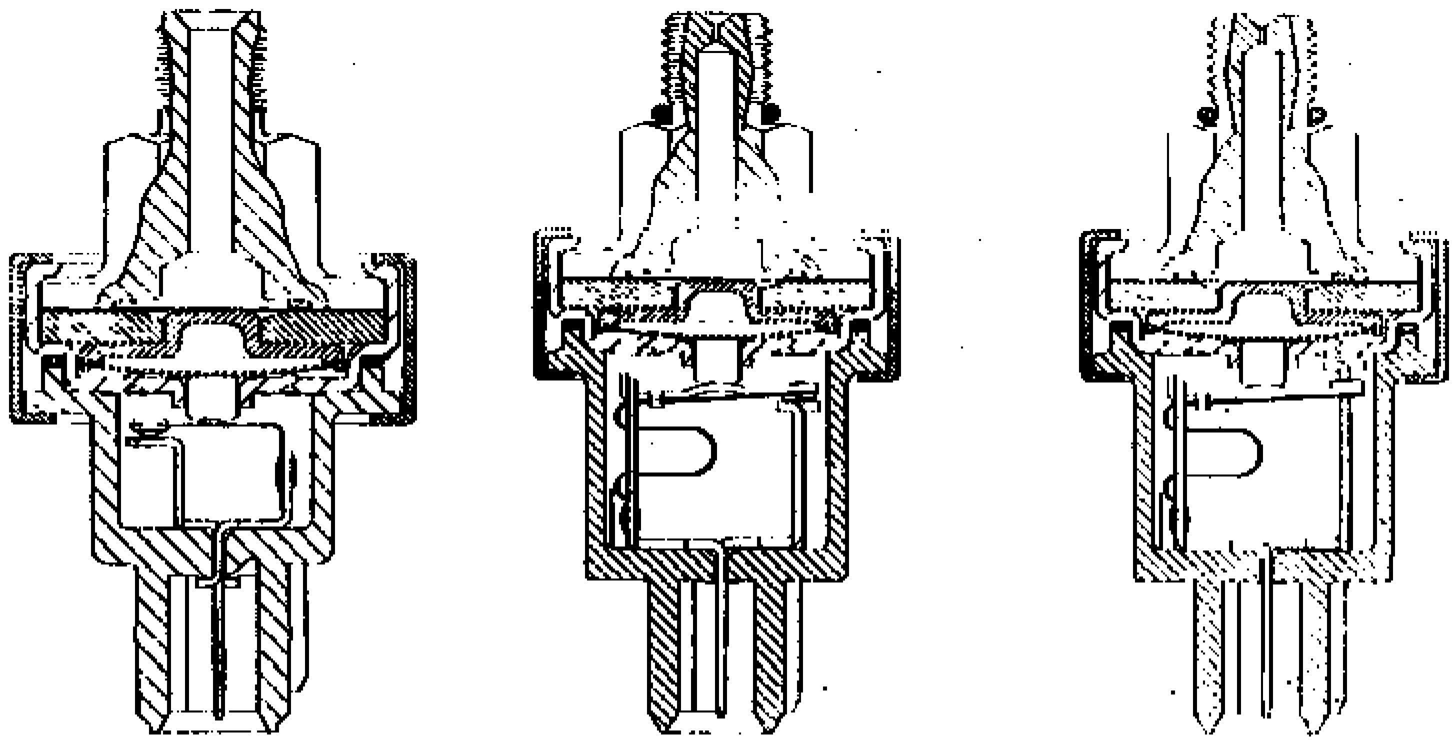
Hydraulic Pressure Switches
Design Overview

PRESSURE SWITCH ASSEMBLIES



L - SHAPED SPRING NORMALLY CLOSED | S - SHAPED SPRING NORMALLY CLOSED | S - SHAPED SPRING NORMALLY OPEN

TI-HHT8A 014006

Central® Tools, Inc.

Your Automotive Measuring People

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Cranston, RI 02910
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(800) TOOLCTR 866-5287
Fax: (401) 461-3670

AX TO: BRYAN DARUE

FROM: STEVE OPPILER

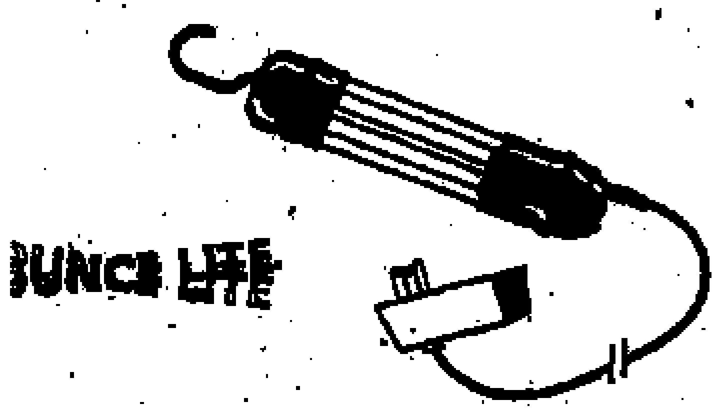
AX #: 1-508-236-3586

DATE: 6/14/99

OMPANY: T.I.

PAGE: 1 OF 2

IMPORTANT DOCUMENT, PLEASE HAND-DELIVER.



WINNER OF UNDERCAR DIGEST'S 1997 TOP TEN TOOLS AWARD!!!

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Date	Brief Synopsis
July 26, 1991	Build of both PC and LT validation parts on sensor AMI
August 16, 1991	Impulse Test: 1/2 on virgins, 1/2 on Field Ret. parts; Virgin 1/2 of both PC and LT are
August 23, 1991	LT have passed 800K; PC parts have failed; analysis focusing on 77PS PC/LT diffs, primarily cup; and to previous 57PS work where diff is hand-line build
August 29, 1991	4-way matrix (AMI and hand-line, model shop and prod cups) and 3-way (AMI pre-crimp, AMI no pre-crimp, hand-line pre-crimp); Full paper shows higher pres and bending on
September 6, 1991	Matrices are producing confusing results; "control" (prod-rep. the val parts) is now doing just fine. Decision to rebuild PC validation parts even though cause of problem is not
September 13, 1991	Original LT val parts returned to test, failures place them second-worst (next to PC) since trouble began. Rebuild of PC devices started producing early failures again. Re-rebuild commenced with additional care given to Kapton placement. Early failures again. "Modified" testing (lower pressures etc) commenced, apparently without Ford inputs.
September 20, 1991	Further matrix testing: limited converter travel (mod washers); Kapton clamping (mod
September 27, 1991	Matrix results: limited conv travel isn't working (no diff relative to control); Kapton clamping worse than control; hand-line built parts are still showing an excellent track record for as yet unknown reasons. Mfg Eng finds air pressure on AMI crimp cylinders
October 18, 1991	Test of devices w/ varying crimp pressure shows higher pressures produce slightly reduced life; debatable if any significant diff exists at all; focus shifts to washer
October 25, 1991	The "teardrop" shape that sometimes appears in the Kapton is first discovered. Influence of crimp dies to be tested. Matrix of AMI and Hand-line crimpers each running AMI and
November 1, 1991	Result of crimp die matrix shows hand-line dies on AMI crimper is best. "Of course, we still have no concrete idea why..." Also, a new technique of lathe-cutting the hexport to allow observation of the Kapton in the as-crimped condition is developed. Using this on previous test devices, it is found that low-life parts have a teardrop and the perforation is
November 8, 1991	Yet another rebuild attempt for PC validation. Two lots built, one on AMI and one on hand line, using "best performing" crimp dies (hand-line) and washers.
November 22, 1991	Results of latest validation testing: AMI built parts (w/ hand line dies) are performing significantly better than the hand-line built parts; although ALL of them have passed the required 800K. Work commences on full-round Kapton to explore fundamental
December 20, 1991	Addendum to original PC ISR is written. Hand-line dies on both AMI and hand-line crimpers all passed the test. The report is written to include both production processes.
January 31, 1992	Full-round Kapton performs better than square Kapton cut from exactly the same sheet of material. In turn the sample-sheet square Kapton does quite a bit better than .
May 22, 1992	A high-temperature impulse test is run for Light Truck in response to their discovery that in certain F-series applications (460 gas engine if memory serves me) the switch is positioned very close to the exhaust manifold. A temperature of 170 C is used, and results are "dismal". 12 devices failed between 222K and 282K cycles, producing a
July 31, 1992	A new high-temp thermal ramp and impulse test for LT saw seven failures in the "normal diaphragm rupture mode". Also noted is that we are sharing information with Andy McKenna who is working in Japan at this time. There is much concern in Japan over use
August 14, 1992	Ford-Australia is talking about a very high vacuum requirement (0.3 mm Hg versus US spec of 3-5 mm Hg). "Initial tests show the Kapton is sucked out of place at higher
October 9, 1992	Diaphragm life test with exposure to 0.4 miller vacuum is aborted at 2.7 million cycles. No rubber diaphragm parts failed. Full-round Kapton fared second-best. Control lots (production devices, without vacuum and with vacuum) were third and fourth respectively, significantly behind rubber and full-round. Note that vacuum performed worse than no-vacuum as expected. None had issues below 800K cycles.

TI 77PS Test Synopsis

This document is a synopsis of tests conducted by Texas Instruments during the 77PS investigation. The intent of this document is to highlight test findings which drove the investigation to its current state. Throughout the investigation, several tests were conducted with the same objective. When each objective was met, efforts were refocused to obtain a new level of understanding and to establish a new set of objectives. As such, tests have been categorized into (5) levels, representing the level of knowledge obtained from the group of tests conducted. Each level is listed below with a short description of the objective:

Level 1: Create a laboratory switch ignition without any restrictions on methods.
Level 2: Create a laboratory switch ignition using only conditions found in the switch operating environment.
Level 3: Understand the laboratory ignition mechanism.
Level 4: Compare factors contributing to laboratory ignition.
Level 5: Evaluate recommendations.

Refer to <u>Brake Pressure Switch Test Log</u>.

Level 1 Objective: Determine if a switch ignition can be created in the laboratory.

- Test 1

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Switch contact cavity flooded with brake fluid mixed with varying amounts of % H_20.
14 volts applied to one terminal, second terminal electrically floating. (No electrical load across switch terminals).
Switch hexport electrically grounded.

Results: (8) samples were tested total:
(2) with 4% H_20 in brake fluid.
(2) with 6% H_20 in brake fluid.
(2) with 10% H_20 in brake fluid.
(2) with 75% H_20 in brake fluid.

No ignition occurred. No significant temperature rise observed in all samples. Current draw ranged from 0.5 mAmps to 5 mAmps over a period greater than (250) hours.

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- Test 2

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Switch contact flooded with brake fluid.
14 volts applied to one terminal, second terminal connected to a 14 Ω resistor which is tied to ground. (1 Amp load across switch terminals).
Switch hexport electrically grounded.

Results: (2) samples were tested. No ignition occurred. No significant temperature rise observed for a period over (250) hours.

Conclusion: A (1) Amp load through switch terminals did not ignite brake fluid in the contact cavity of switches.

- Test 6

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Heater element installed in contact cavity of the switch.
Power applied to the heater element until plastic base melts.
Spark generated in contact cavity of switch.
Brake fluid present in the contact cavity (wet device) and absent in the contact cavity (dry device).

Results: (2) dry devices were tested and (1) wet device was tested. Ignition occurred in all devices.
Wet device: The internal temperature of a wet device reached 660°F. A hole burned through the base of the switch (close to the heating element). The applied spark ignited the fumes in the contact cavity of the switch and engulfed the base material of the switch.
Dry device: The internal temperature of a dry switch reached over 1000°F. The switch base flopped over. The applied spark ignited the fumes in the contact cavity of the switch and engulfed the base material of the switch.

Conclusion: A switch ignition can occur under the following laboratory conditions:

Heater element installed in the switch contact cavity.
5 watts of power dissipated in heating element.
Spark generated in the contact cavity of the switch.

Brake fluid did not contribute to the ignition process.

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Level 2: Objective: Determine if a laboratory ignition can occur using only switch components and elements found in the switch environment.

- Test 6a

Objective: Determine if corrosive degradation of switch electrical components can cause an increase in electrical resistance (and thus a source of heat) in the switch, which may lead to an ignition.

Results: (1) out of (15) samples tested increased resistance to 5 Ωs. A solution of 5 wt. % NaCl in H_20 can corrode the electrical components of the switch and cause an increase in electrical resistance. Repeated injections of the solution of 5 wt. % NaCl in H_20 into the contact cavity of a switch, with the switch continuously powered at 14 Volts, can cause an ignition.

Conclusion: A switch ignition can occur under the following laboratory conditions:

A solution of 5% NaCl in H_20 is injected into contact cavity of a switch.
Continuous 14 Volt power applied to the switch.
Hexport is grounded.
Current is limited at 15 Amps.

- Test 6c

Objective: Determine if brake fluid with metal shavings is conductive enough to create an ignition.

Results: (3) devices with various size metal particles were tested. No significant current increase detected.

Conclusion: Metal shavings did not significantly increase conductivity brake fluid. Current levels measured were well below levels necessary to create an ignition.

- Test 7

Objective: Determine if switch meets cycle life specification.

Results: Tests conducted during the first quarter of 1999 show that switches exceed cycle life specification.
In the first quarter of 1999, a total of (42) 77PSL2-1 snap switches were impulse tested to over 1,000,000 cycles with only (1) leak below 1,000,000 cycles, which

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occurred at 728,000 cycles. A Weibull analysis showed 99.9% reliability at 500,000 cycles at 95% confidence level.

Conclusions: Switches meet cycle life specification. First quarter, 1999 tests confirm impulse test findings made during the period between 1991 and 1992. During that period, (6) impulse tests on 144 devices of 57PS and 77PS construction, had no leaks when tested to 500,000 cycles. A Weibull analysis of first quarter, 1999 tests, showed 99.9% reliability at 500,000 cycles at 95% confidence level.

- Test 15a

Objective: Determine the long term corrosive effects of brake fluid on the electrical components of switches which are continuously powered at 14 Volts.

Results: Test was suspended after 550 hours of testing. (6) samples were tested with continuous 14 Volts power. The contact cavity of (4) switches contained new brake fluid and (2) switches contained old brake fluid. Switches with old brake fluid drew very little hexport current and showed a decrease in hexport current over time to less than 1/10 mAmp. Samples with new brake fluid showed an increase in hexport current to over 20 mAmps toward the end of the 550 hours of testing. Analyses of (1) sample with new brake fluid and (1) sample with old brake fluid revealed electrolytic corrosion of the contact arm of both switches. There was a much lower level of corrosion in the sample with used brake fluid than the sample with new brake fluid.

Conclusion: Brake fluid in the contact cavity of switches, which are at 14 Volts continuous power for over 500 hours, can cause electrolytic corrosion of the switch contact arm and an increase in hexport current.

- Test 17

Objective: Quantify the long term corrosive effects of new brake fluid on the electrical components of switches under the following laboratory conditions:

Contact cavity of switch flooded with new brake fluid.
Switches at continuous 14 Volts power.
Switches subjected to vibration for (1) hour per day.
Switches subjected to 100°C for (1) hour per day.

Results: Test suspended after (312) hours. (50) samples tested. The average hexport current draw after (312) hours is 1.9 mAmps with a standard deviation of 1.8 mAmps. These results are consistent with results previously found in Test 15a at the 300 hour point.

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Conclusion: New brake fluid in the contact cavity of switches, has not caused an increase in hexport current after (312) hours at continuous 14 Volts power.

Level 3: Objective: Understand the laboratory ignition process, determine the current path and establish a repeatable ignition method.

- Test 6b

Objective: Understand the ignition process, determine the current path and establish a repeatable ignition method.

Results: Multiple attempts at laboratory ignition, via injection of a solution of 5 wt. % NaCl in H_20 into the contact cavity of switches, has resulted in a repeatability rate of approximately 50%. Plots of hexport current verses time show an increase in current until the point of ignition.

Conclusion: A repeatable laboratory method for switch ignition was established. Based on hexport current measurements, the current path is from switch terminals to hexport body.
When a solution of 5 wt. % NaCl in H_20 is repeatedly injected into the contact cavity of powered switches, electrolytic corrosion of the switch terminal results in an increase in terminal resistance. When sufficient power is drawn through the corrosive resistance, switch elements heat up and begin to glow red hot. A hole burns through the switch base and ignition occurs. There is arcing visible throughout the corrosion process which may provide the spark necessary for ignition.

Level 4: Objective: Compare and contrast variables influencing ignition using the established laboratory ignition method

- Test 13a

Objective: Compare various fluids in the established ignition method.

Results: The following fluids were tested.
(1) NaCl in H_20.
(1) tap water
(1) rain water
(1) used brake fluid
(1) used brake fluid with 5 wt. % H_20
(1) new brake fluid
(1) new brake fluid with 5 wt. % H_20
The switch filled with 5 wt. % NaCl in H_20 resulted in an ignition when average hexport current exceeded 2.5 Amps. Switches that were filled with tap water and rain water drew less than 10 mAmps over a (3) hour test and showed little signs of

corrosion. Switches filled with a matrix of new and used brake fluids, with water and without water, all drew less than 3 mAmps hexport current draw and showed no signs of corrosion over the (24) hour test.

Conclusion: Brake fluid is not conductive enough to cause the electrolytic corrosion and necessary current draw to create an ignition within a 3 hour lab test. Because of its' significantly higher conductivity, an ionic rich fluid such as NaCl in H_2O can cause an ignition in a 3 hour lab test exposure..

- Test 15

Objective: Compare the ignition characteristics of various plastics as switch base material.

Results: When 5 wt. % NaCl in H_2O was injected into switches with different base materials, the following results were obtained: Cellanex 4300 ignited 3 out of 5 attempts. Noryl ignited 2 out of 5 attempts. Zytel ignited 1 out of 5 attempts.

Conclusions: All plastics tested can ignite using the established laboratory ignition method.

- Test 15b

Objective: Determine if switch ignition can occur in the vertical position and 45° orientation. Determine if switch ignition can occur and at different rotational angles in the 45° orientation.

Results: Switch ignitions can occur in both the vertical and 45° orientation using the established laboratory ignition method.

Conclusion: Switch ignition does not appear to be sensitive to vertical orientation verses 45° orientation nor to rotational angle in the 45° orientation.

Level 5 Objective:

Test 16

- Objective: Test proposed relay circuit.

Results: (1) switch was injected with a solution of 5 wt. % Nacl in H_2O and placed in the proposed current limiting circuit for (48) hours. The current draw remained constant at 180 mAmps throughout the test. There was no activity observed and the contact arm remained mostly intact.
(1) switch was brought to an impending burn condition using the established burn method. An impending burn is a condition where a corrosive resistance has built

up in the switch and an ignition is imminent. The switch was then placed in the proposed relay circuit for(18) hours where it drew 160 mAmps, showed no visible activity and did not result in an ignition.
Because the proposed relay circuit acts as a resistor which limits current to the switch, the maximum power to the switch is limited to .75 Watts. A resistive wire was wrapped around the base of (1) switch and 0.75 Watts of power was dissipated in the wire. The wire became warm to the touch but had no effect on the switch.

Conclusion: 0.75 Watts, the maximum power in the proposed circuit design, is insufficient to cause substantial electrolytic corrosion or significant switch terminal heating, which is necessary to create an ignition. In previous tests, using a resistor as the heating element (see Test 6), approximately 5 Watts of power was necessary to create an ignition.

Brake Pressure Switch Test Log, Updated 6/22/99

Category	Test	Location	Test Parameters	Results Update
Lab Simulation	1	TI	Vary water concentrations in 'new' Brake Fluid	250+ hours, Current draw in the 0.5mA to 5mA range
of Potential Ignition			14Vdc to one terminal, hexport grounded	Fluid has discolored.
in Switch			Water Conc: 4%, 6%, 10%, 75%	No Significant Temperature Rise. Test Suspended.
				Internal Analysis suspended.
	2	TI	New Brake Fluid	250+ hours. Constant temperature.
			1 Amp through switch terminals	No significant temperature rise with time
			14Vdc to one terminal, hexport grounded	Test Suspended.
	3	AVT	new/ Brake Fluid in Switch, 24 VDC to one	> 800 hours into test, max current 7mA
			terminal. Hexport Grounded	No significant change with time. Test suspended
	4	AVT	new/ Brake Fluid in Switch, 24 VDC to one	16 hours into test max current 5mA
			terminal. Hexport Grounded, Ambient at 100 C	No significant temperature rise with time. Test suspended.
	5	AVT	new/ 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	new/ Brake Fluid in Switch approx. 50 Amps	Temperature rose to approx. 270 F. No smoke. No ignition
			through Switch Terminals	Test suspended.
	6	TI	Build heater elements into Switch.	3 tested. Smoke observed, ignition observed on part w/heater
			Heat till failure, include sparking.	See attachment
			(1) w/ solution of Brake Fluid and 6 wt. % H_2O	Test complete
				Brake fluid in cavity slows down heat build-up
				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 5% water solution into switch
			repeatability and current path.	Current path is through hexport.
				See plots and video.
				Additional test include tap water, old BF, new BF and other.
	6c	TI	Pure 'new' brake fluid with metal shavings	Metal shavings do not contribute significantly to brake fluid

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Brake Pressure Switch Test Log, Updated 6/22/99

				coductivity
[redacted]				
Life Cycle Reliability	7	TI	0-1400 psig pressure pulses at 135C	First leak observed at 728,000 cycles.
of Pressure Switch			per ES	Test Completed. See attached Weibull Chart.
[redacted]				
Diaphragm Wear	8	TI	0-1400 psig pressure pulses at 135C.	Parts withdrawn every 200k cycles, characterized for wear
[redacted]				
Field vs Lab Correlation	9	Central Labs	Field returns, from dealer lots, junkyards	Parts in Central Labs, see Ford spreadsheet
[redacted]				
Design Of Experiments (1)	10	TI	Vary water concentrations in 'new' Brake Fluid	Test Report being written investigation continues.
Evaluating Factors			12 snap + 12 quiet switches w/ 0 % water in BF	Suspended at 1.3 million cycles with no leaks observed.
Effecting Diaphragm Wear			12 snap + 12 quiet switches w/ 5 % water in BF	Snap samples suspended at 1.3 million cycles with 2 leaks
Impulse test				observed at 1.3M. Quiet samples suspended at 500k cycles to
				assess fixturing anomalies.
[redacted]				
On-Vehicle Characterization	11	AVT	Monitor Pressure and Temperature	Test at AVT.....see Ford charts...>600k in car?
of Pressure & Temperature			at Switch Location for ABS and non-ABS	
Profile in Town Car			braking events.	
[redacted]				
Brake fluid analysis	11a	TI	Analyze used brake fluid at the master cylinder	Test complete.
Used fluid at master cylinder.			(UMC), used brake fluid at the caliper (UCA)	UMC: Cu = 415 (ug/ml), Fe = 6.6 (ug/ml), Cr = 0.06 (ug/ml), 1.1 %H20.
			and new brake fluid (NEW) for metal and water	UCA: Cu = 882 (ug/ml), Fe = 5.5 (ug/ml), Cr = 1.9 (ug/ml), 1.1 %H20.
			content.	NEW: Cu = <0.01 (ug/ml), Fe = 0.92 (ug/ml), Cr = <.01 (ug/ml), 0.3 %H20.
[redacted]				
Spark /Arc Study	12	Central Labs	Determine if arc/spark forms in switch	Equipment set-up in progress at Central Labs.
			using clutch loads and high speed video.	TI Experimented with no 'significant' sparks observed
			Use dry switches as well as switches with	
			various brake fluid water mixes.	
[redacted]				
Characterization of	13	Central Labs	Characterize electrical, mechanical	Data log and analysis procedure set up complete.
switches retrieved from field			and chemical aspects of returned switches	Analysis of switches in progress.
junkyards & other sources				
[redacted]				
Fluid Ingress Tests	13a	TI	Repeat ignition simulation with different fluids.	Test complete.
			(3) hour tests:	5% NaCl sample resulted in an ignition.
			5% NaCl in tap water	All brake fluid samples drew less than 3 mAmps. No corrosion
			rain water	visible on brake fluid samples.
			(24) hour tests:	Rain water and tap water samples drew <10 mAmps and showed
			tap water	some signs of corrosion.

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Brake Pressure Switch Test Log, Updated 6/22/99

			used brake fluid	Chemical anlysis in process.
			used brake fluid w/ 5% H_2O	
			new brake fluid	
			new brake fluid w/ 5% H_2O	
[redacted]				
Design Of Experiments (2)	13b	TI	Vary water concentrations in 'new' Brake Fluid	Test suspended. Analysis in process to assess test fixturing.
Repeat of test 10			10 amp + 20 quiet switches w/ 0 % water in BF	
			10 amp + 20 quiet switches w/ 5 % water in BF	
[redacted]				
Compatibility of Kapton	14	Dupont	Characterize change in properties of Kapton	Test in progress (100) hours completed. Oxalic acid shows
with Oxalic Acid			with various % oxalic acid in brake fluid.	similar effects that water has on Kapton properties.
[redacted]				
Evaluation of Plastic	15	TI	Assess properties and moldability of different	Test suspended.
Materials with Improved			grades of plastic resin with additives	Celanese and Noryl ignited 3/5 and 2/5 trials
Parameters			to improve plastic part performance	ZYTEL samples tested 1/5 ignitions
[redacted]				
Long duration brake fluid	15a	TI	(4) samples with new brake fluid	Test suspended (580) hours completed.
ingress test.			(2) samples with used brake fluid	Used brake fluid current dropped off to <1/10 mAmp.
				New BF hexport current can increases w/ time under cont. power.
[redacted]				
Evaluation of Switch	15b	TI	Assess ignition sensitivity to switch orientation.	Test complete. Ignition is independent of switch orientation.
Orientation			Test vertical verses 45 degree.	simulated switch ignition can occur in vertical or 45 degree angle.
			Test rotational sensitivity in 45 deg. orientation.	Ignition appears not sensitive to switch rotational alignment.
[redacted]				
Relay Circuit	16	TI	Repeat test 13a in Ford relay circuit for (48) hrs.	Test complete. No ignition. Corrosion rate drastically reduced.
Test			Bring switch to impending ignition in (15) Amp	Insufficient power in circuit to create or move toward ignition in lab
			circuit then place in relay circuit for (18) hrs.	Heater element was warm to the touch.
			Input max. circuit power into heater on switch.	
[redacted]				
Long duration brake fluid	17	TI	(50) samples filled with new brake fluid	Test suspended. (312) hours completed.
Ingress test number 2.			(1) hour of vibration per day	Average hexport current is 1.9 mAmp (stdeviation = 1.8 mAmps)
			(1) hour soak at 100 deg C per day	

TI-NHTSA 014017

Brake Pressure Switch Test Log. Updated 8/22/00

Category	Test	Location	Test Parameters	Results Update
Lab Simulation	1	TI	Vary water concentrations in 'new' Brake Fluid	250+ hours, Current draw in the 0.5mA to 5mA range
of Potential Ignition			14Vdc to one terminal, hexport grounded	Fluid has discolored.
in Switch			Water Conc: 4%, 6%, 10%, 75%	No Significant Temperature Rise. Test Suspended.
				Infrared Analysis suspended.
	2	TI	'New' Brake Fluid	250+ hours. Constant temperature.
			1 Amp through switch terminals	No significant temperature rise with time
			14Vdc to one terminal, hexport grounded	Test Suspended.
	3	AVT	new' Brake Fluid in Switch, 24 VDC to one	> 300 hours into test, max current 7mA
			terminal. Hexport Grounded	No significant change with time. Test suspended
	4	AVT	new' Brake Fluid in Switch, 24 VDC to one	18 hours into test max current 5mA
			terminal. Hexport Grounded, Ambient at 100 C	No significant temperature rise with time. Test suspended.
	5	AVT	new' Brake Fluid in Switch, 10 Amps	Temperature rise of 20 C above room temp
			Through switch terminals	Delta T reached steady state at 20 C. Test suspended.
	5a	AVT	new' Brake Fluid in Switch approx. 50 Amps	Temperature rose to approx. 270 F, No smoke, No ignition
			through Switch Terminals	Test suspended.
	6	TI	Build heater elements into Switch.	3 tested. Smoke observed, ignition observed on part w/heater
			Heat till failure, include sparking.	See attachment
			(1) w/ solution of Brake Fluid and 6 wt. % H_2O	Test complete
				Brake fluid in cavity slows down heat build-up
				Smoke observed at 575 F, Base melts and falls off at 580 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 magnetions
			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 and current path.	Current path is through hexport.
				See plots and video.
				Additional test include tap water, old BF, new BF and other.
	6c	TI	Pure 'new' brake fluid with metal shavings	Metal shavings do not contribute significantly to brake fluid

TI-NHTSA 014018

Brake Pressure Switch Test Log, Updated 6/22/99

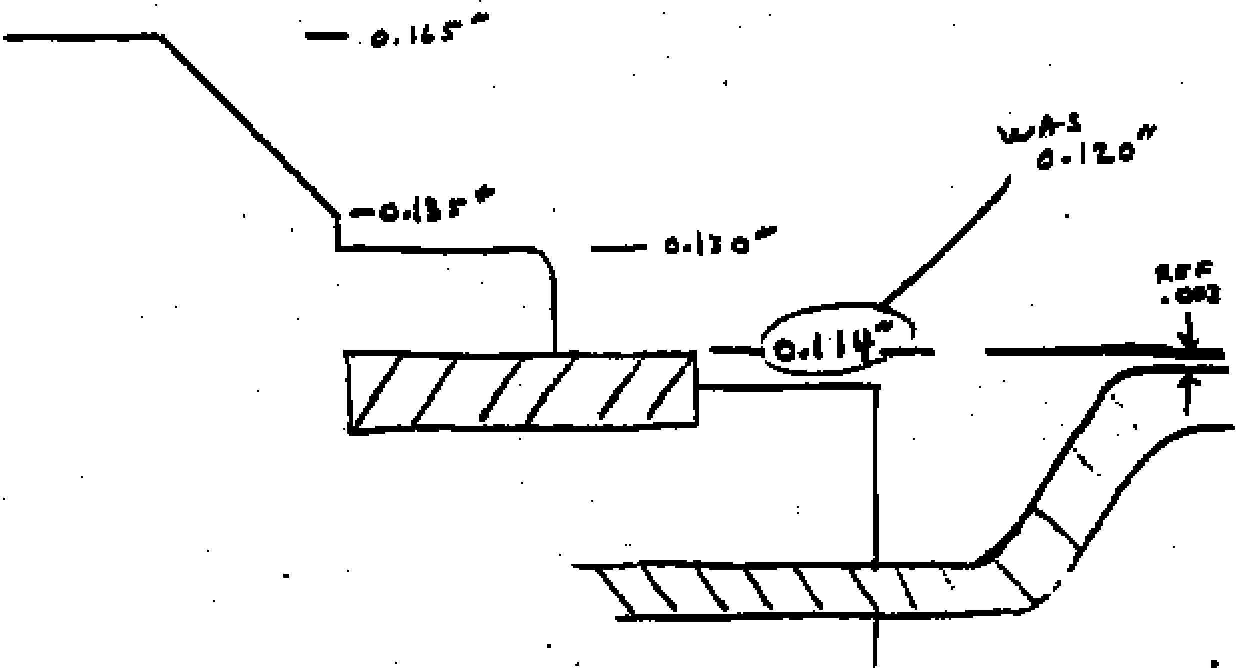
			used brake fluid	Chemical anlysis in process.
			used brake fluid w/ 5% H_2O	
			new brake fluid	
			new brake fluid w/ 5% H_2O	
[redacted]				
Design Of Experiments (7)	13b	TI	Vary water concentrations in 'new' Brake Fluid	Test suspended. Analysis in process to assess test findings.
Repeat of test 10			10 snap + 20 quiet switches w/ 0 % water in BF	
			10 snap + 20 quiet switches w/ 5 % water in BF	
[redacted]				
Compatibility of Kapton	14	Dupont	Characterize change in properties of Kapton	Test in progress (100) hours completed. Oxalic acid shows
with Oxalic Acid			with various % oxalic acid in brake fluid	similar effects that water has on Kapton properties.
[redacted]				
Evaluation of Plastic	15	TI	Assess properties and moldability of different	Test suspended.
Materials with Improved			grades of plastic resin with additives	Celanese and Noryl ignited 3/5 and 2/5 trials
Parameters			to improve plastic part performance	ZYTEL samples [illegible] 1/5 ignitions
[redacted]				
Long duration brake fluid	15a	TI	(4) samples with new brake fluid	Test suspended (500) hours completed.
ingress test.			(2) samples with used brake fluid	Used brake fluid current dropped off to <1/10 mAmp.
				New BF leakport current can increase w/ time under cont. power.
[redacted]				
Evaluation of Switch	15b	TI	Assess ignition sensitivity to switch orientation.	Test complete. Ignition is independent of switch orientation.
Orientation			Test vertical versus 45 degree	simulated switch ignition can occur in vertical or 45 degree angle.
			Test rotational sensitivity at 45 deg orientation.	Ignition appears not sensitive to switch rotational alignment.
[redacted]				
Relay Circuit	10	TI	Repeat test 13a w/ and relay circuit for (48) hrs.	Test complete. No ignition. Corrosion rate drastically reduced.
Test			Hang switch to impending ignition in (15) Amp	Insufficient power in circuit to create or move toward ignition in lab
			circuit then place in relay circuit for (18) hrs.	Heater element was warm to the touch.
			Input max circuit power into heater on switch.	
[redacted]				
Long duration brake fluid	17	TI	(50) samples filled with new brake fluid	Test suspended. (312) hours completed.
ingress test number 2.			(1) hour of vibration per day	Average leakport current is 1.9 mAmp (stdeviation = 1.6 mAmps)
			(1) hour soak at 100 deg C per day	

TI-NHTSA 014020

D. Sogge 6/22/99

N/O switch, Disc Seat Depth Adjustment

THE WALL THAT HOLDS THE DISC IN PLACE IS INCREASED IN height BY 0.006" TO HOLD THE DISC IN PLACE BETTER. DONE BY DROPPING THE DISC SEAT & CONTACT AND ALL RELATED FEATURES DOWN BY 0.006"



Post-it® Fax Note 7671	Date 6/22 # of pages ▶ 1
To Dennis Breen	From SEAN [illegible]
Co./Dept. CAPSONIC	Co. TI
Phone #	Phone #
Fax # (847) 888-4929	Fax #

77PS part differences.

	77PS2-1	77PS3-1	77PS4-1	
description	part number	part number	part number	EFFECT
CUP	27713-1	27713-1	27713-2	Spacer seat to bump height 4/1000 larger on -1 than on -2
HEXPORT	36900-1	36900-1	37067	4-1 C'Bore is .330 (.13 deeper than 2-1)
DISC	36656-27	36656-35	36656-35	"-35 measured height = .0275 +/- .0003"
(OR)	36656-28	36656-41	36656-41	"-41 measured height = .0291 +/- .0003"
				"-27 measured height = .0286 +/- .0003"
				"-28 measured height = .0310 +/- .0003"
				Crown height on 4-1 are ~ 2/1000 to 4/1000 lower than 2-1 (measured)
Base	46515-2	46515-3	46515-3	
DATE stamp	6260	7184	9046	

TI-NHTSA 014090

TEXAS INSTRUMENTS INC. | MATERIALS & CONTROLS GROUP | SITE

PARTS LIST ! PROJECT !PART NUMBER: 77PSL2-1 !REV LTR: L CLS: 650
EXPLOSION | NUM: 3423 !DWG PFX: NUM:77PSL2-1 !ECN INC.DT: 98/02/24

.TLE: PRESSURE SWITCH (CUST P/N F2VC-9F924-AB)

LV	CNT	QTY/UM	BITM	PART/DRAWING NUMBER	RV	NOMENCLATURE/PARM DATA
01	1	REF		36952-1		FINAL ASSEMBLY
				36952-1	A	
01	2	1	27	27759-10		BASE ASSEMBLY
				27759SH1	L	
02	3	1	2	46515-2		BASE (BROWN)
				46515	N	
02	4	1	3	36888-1		STATIONARY TERMINAL
				36888	D	
02	5	1	4	36897-2		MOVABLE TERMINAL ASM
				36897SH1	H	
03	6	1	2	36887-1		MOVABLE TERMINAL
				36887	D	
03	7	1	3	74916-1		RIVET
				74916	G	

TCW 725 01 02 A ADAIMA PRO

2-1
3-1
4-1 } SEM CONVERTER washer all same

TI-NHTSA 014031

03	8	1		4	36889-1		SPRING ARM
					36889	B	
04	9	AR		2	27716-1		SPR MAT'L STR SPEC(.216 LBS/K)
					27716SH1	D	
03	10	1		5	28744-1		MOVABLE CONTACT
					28744	D	
.	11	1		24	27293-13		SENSOR ASSEMBLY
					27293SH2	W	
02	12	1		2	36900-1		MOD SAE J512 HEXPORT
					36900	H	
02	13	1		3	74353-1 ✓		GASKET
					74353	H	
02	14	1		4	27713-1		CUP
					27713	F	
02	15	3		5	74176-1 ✓		SEAL
					74176	C	
03	16	AR			27225-1 ✓		KAPTON STRIP SPEC (.175 LBS/K)
					27225	AB	
02	17	1		6	27639-1 ✓		WASHER
					27639	F	
02	18	1		7	27406-1 ✓		CONVERTER
					27406	F	
02	19	1		8	73958-2 ✓		SPACER
					73958	J	

TCW 725 01 02 A ADAIMA PRO

02	20	OR	8	73958-3 ✓ 73958	J	SPACER
03	21	AR		74224-1 74224	F	KAPTON TAPE (.100 LBS/K)
02	22	1	9	36656-(27) 36656SH1	BM	3/4" FORMED DISC
	23	OR	9	36656-(28) 36656SH1	BM	3/4" FORMED DISC
01	24	1	14	74797-1 ✓ 74797	B	CRIMP RING
01	25	1	18	74078-143 ✓ 74078	G	TRANSFER PIN
01	26	1	21	74247-4 74247	L	ENVIRONMENTAL SEAL
01	27	1	22	74888-1 74888	A	THREAD CAP
01	28	AR		27318-1 27318	D	CARTON ASM.

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02	29	1	2	74219-1		CARTON
				74219	D	
02	30	3	3	74218-1		ROW SEPARATOR
				74218	D	
02	31	2	4	27317-1		DEVICE SEPARATOR
				27317	D	
_	32	AR	5	13608-4		CLOSURE TAPE
				13608-4		

| NOTES, REV.DATA, DISTRIBUTION, OPERATING CHARACTERISTICS, SPECIAL REQUIREMENTS |

REV DESC: CHG 74408-1 TO 28744-1 ! CCB APPROVAL DATE: 98/02/24

DFTG WORK GROUP: PRECISION CONTROLS ! ECN ORIGINATOR: DI T HA

NOTES:

1 - ACTUATION PRESSURE ---------------- 90 -160 PSIG

2 - RELEASE PRESSURE------------------- 20 PSIG MIN.

3 - DEVICE TO BE MARKED PER CODING SPECIFICATION 75871-1

TCW 725 01 02 A ADAIMA PRO

DETAILED REVISION DESCRIPTION:

99 CR M39209, 28744-1 CONTACT (MOV) WAS 74408-1
STOCK DISPOSITION
FINISHED DEVICES - USE
PARTS & SUB ASMS - USE SUBS, HOLD PARTS

TCW 725 01 02 A ADAIMA PRO

TEXAS INSTRUMENTS INC. | MATERIALS & CONTROLS GROUP | SITE

PARTS LIST | PROJECT |PART NUMBER: 77PSL3-1 |REV LTR: H CLS: 650
EXPLOSION | NUM: 3423 |DWG PFX: NUM: 77PSL3-1 |ECN INC.DT: 98/02/24

TITLE: PRESSURE SWITCH (CUST P/N F2AC-9F924-AA)

LV	CNT	QTY/UM	BITM	PART/DRAWING NUMBER	RV	NOMENCLATURE/PARM DATA
01	1	REF		36952-1		FINAL ASSEMBLY
				36952-1		
01	2	1	27	27759-9		BASE ASSEMBLY
				27759SH1		
02	3	1	2	46515-3		BASE (NATURAL)
				46515		
02	4	1	3	36886-1		STATIONARY TERMINAL
				36886		
02	5	1	4	36897-2		MOVABLE TERMINAL ASM
				36897SH1		
03	6	1	2	36887-1		MOVABLE TERMINAL
				36887		
03	7	1	3	74916-1		RIVET
				74916		
03	8	1	4	36889-1		SPRING ARM
				36889		
04	9	AR	2	27716-1		SPR MAT'L STR SPEC(.216 LBS/K)
				27716SH1		
03	10	1	5	28744-1		MOVABLE CONTACT
				28744		
01	11	1	24	27293-25		SENSOR ASSEMBLY
				27293SH3		
02	12	1	2	36900-1		MOD SAE J512 HEXPORT
				36900		
2	13	1	3	74353-1		GASKET
				74353		
02	14	1	4	27713-1		CUP
				27713		
02	15	3	5	74176-1		SEAL
				74176		
03	16	AR		27225-1		KAPTON STRIP SPEC (.175 LBS/K)
				27225		
02	17	1	6	27639-1		WASHER
				27639		
02	18	1	7	27406-1		CONVERTER
				27406		
02	19	1	8	73958-2		SPACER
				73958		
02	20	OR	8	73958-3		SPACER
				73958		
03	21	AR		74224-1		KAPTON TAPE (.100 LBS/K)
				74224		
02	22	1	9	36656-35		3/4" FORMED DISC
				36656SH1		
02	23	OR	9	36656-41		3/4" FORMED DISC
				36656SH1		
01	24	1	14	74797-1		CRIMP RING
				74797		
01	25	1	18	74078-SEL		TRANSFER PIN
				74078		
01	26	1	21	74247-4		ENVIRONMENTAL SEAL
				74247		
1	27	1	22	74888-1		THREAD CAP
				74888		
01	28	AR		27318-1		CARTON ASM.
				27318		
02	29	1	2	74219-1		CARTON

					74219			
02	30	3		3	74218-1			ROW SEPARATOR
					74218			
02	31	2		4	27317-1			DEVICE SEPARATOR
					27317			
72	32	AR		5	13608-4			CLOSURE TAPE
					13608-4			

! NOTES, REV.DATA,DISTRIBUTION,OPERATING CHARACTERISTICS,SPECIAL REQUIREMENTS !

REV DESC: CHG 74408-1 TO 28744-3 ! CCB APPROVAL DATE: 98/02/24

DFTG WORK GROUP: PRECISION CONTROLS ! ECN ORIGINATOR: DI T HA

NOTES:

1 - ACTUATION PRESSURE ---------------- 90-160 PSIG

2 - RELEASE PRESSURE ------------------ 20 PSIG MIN.

3 - DIFFERENTIAL PRESSURE ------------- 55 PSI MAX.

4 - DEVICE TO BE MARKED PER CODING SPECIFICSTION 75871-3

DETAILED REVISION DESCRIPTION:

99 CR M39209, 28744-1 CONTACT (MOV) WAS 74408-1
STOCK DISPOSITION
FINISHED DEVICES - USE
PARTS & SUB ASMS - USE SUBS, HOLD PARTS

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TEXAS INSTRUMENTS INC. | MATERIALS & CONTROLS GROUP | SITE

PARTS LIST ! PROJECT ! PART NUMBER: 77PSL4-1 | REV LTR: J CLS: 65(
EXPLOSION | NUM: 3423 | DWG PFX: NUM: 77PSL4-1 | ECN INC.DT: 98/02/2

.TLE: PRESSURE SWITCH (CUST P/N 94DA-9F924-AA)

LV	CNT	QTY/UM	BITM	PART/DRAWING NUMBER	RV	NOMENCLATURE/PARM DATA
01	1	REF		37007-1		FINAL ASSEMBLY
				37007-1	B	
01	2	1	27	27759-9		BASE ASSEMBLY
				27759SH1	L	
02	3	1	2	46515-3		BASE (NATURAL)
				46515	N	
02	4	1	3	36888-1		STATIONARY TERMINAL
				36888	D	
02	5	1	4	36897-2		MOVABLE TERMINAL ASM
				36897SH1	H	
03	6	1	2	36887-1		MOVABLE TERMINAL
				36887	D	
03	7	1	3	74916-1		RIVET
				74916	G	

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03	8	1	4	36889-1		SPRING ARM
				36889	B	
04	9	AR	2	27716-1		SPR MAT'L STR SPEC(.216 LBS/K)
				27716SH1	D	
03	10	1	5	28744-1		MOVABLE CONTACT
				28744	D	
	11	1	24	27293-29		SENSOR ASSEMBLY
				27293SH3	AD	
02	12	1	2	37067-1		HEXPORT
				37067	E	
02	13	1	3	74353-1		GASKET
				74353	H	
02	14	1	4	27713-2		CUP
				27713	F	
02	15	3	5	74176-1		SEAL
				74176	C	
03	16	AR		27225-1		KAPTON STRIP SPEC (.175 LBS/K)
				27225	AB	
02	17	1	6	27639-1		WASHER
				27639	F	
02	18	1	7	27406-1		CONVERTER
				27406	F	
02	19	1	8	73958-2		SPACER
				73958	J	

TCW 725 01 02 A ADAIMA PRO

02	20	OR	8	73958-3 ✓		SPACER
				73958	J	
03	21	AR		74224-1		KAPTON TAPE (.100 LBS/K)
				74224	F	
02	22	1	9	36656-35		3/4" FORMED DISC
				36656SH1	BM	
	23	OR	9	36656-41		3/4" FORMED DISC
				36656SH1	BM	
02	24	1	10	74951-4		O-RING
				74951	D	
01	25	1	14	74797-1		CRIMP RING
				74797	B	
01	26	1	18	74078-SEL		TRANSFER PIN
				74078	G	
01	27	1	21	74247-5		ENVIRONMENTAL SEAL
				74247	L	
01	28	1	22	74888-1		THREAD CAP
				74888	A	

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TI-NHTSA 014040

01	29	AR			27318-1		CARTON ASM.
					27318	D	
02	30	1		2	74219-1		CARTON
					74219	D	
02	31	3		3	74218-1		ROW SEPARATOR
					74218	D	
	32	2		4	27317-1		DEVICE SEPARATOR
					27317	D	
02	33	AR		5	13608-4		CLOSURE TAPE
					13608-4		

! NOTES, REV.DATA,DISTRIBUTION,OPERATING CHARACTERISTICS,SPECIAL REQUIREMENTS !

REV DESC: CHG 74408-1 TO 28744-1 ! CCB APPROVAL DATE: 98/02/24

DFTG WORK GROUP: PRECISION CONTROLS ! ECN ORIGINATOR: DI T HA

NOTES:

1 - ACTUATION PRESSURE ---------------- 90-160 PSIG

2 - RELEASE PRESSURE ------------------ 20 PSIG MIN.

3 - DIFFERENTIAL PRESSUERE ------------ 55 PSI MAX.

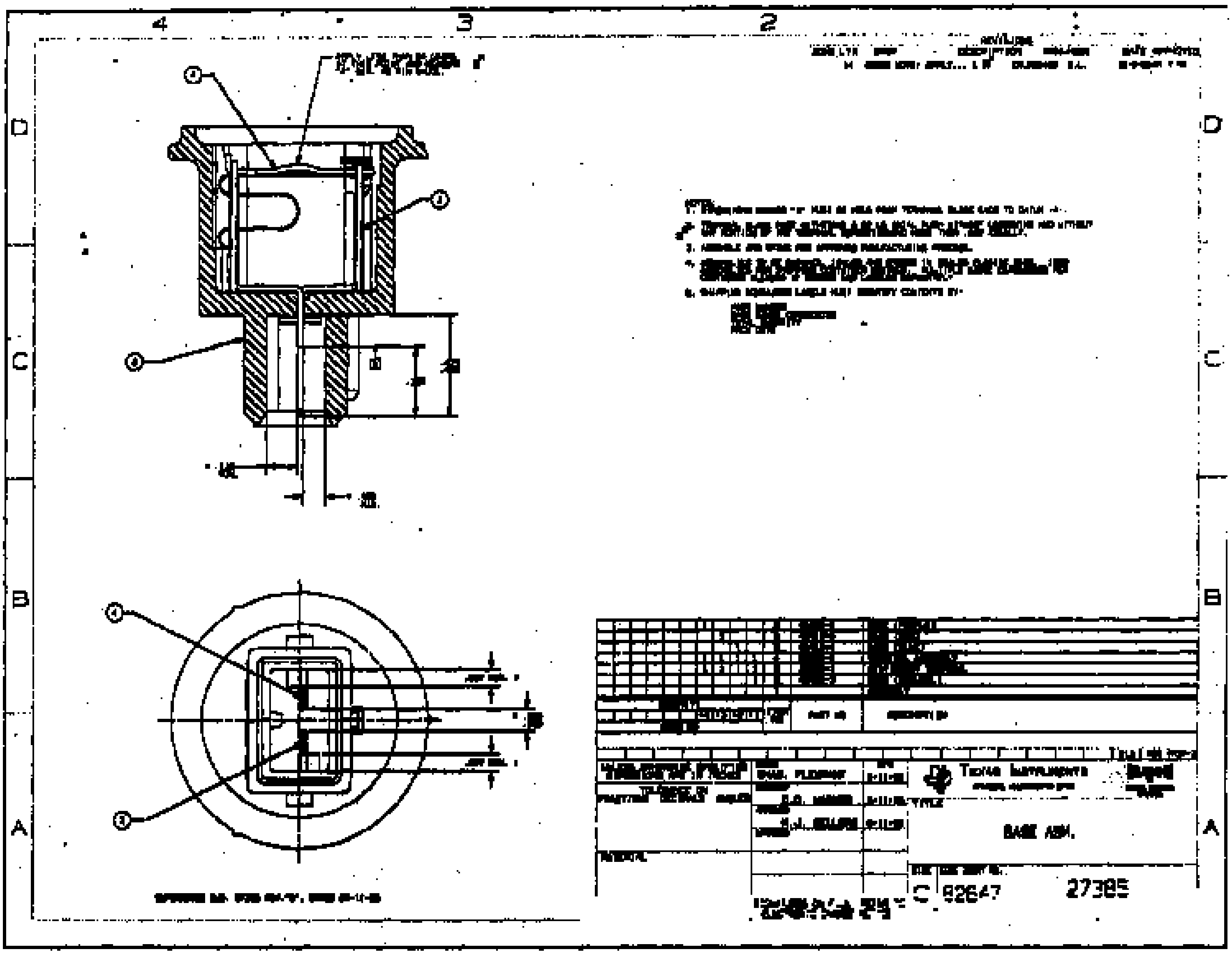
TCW 725 01 02 A ADAIMA PRO

. 4 - DEVICE TO BE MARKED PER CODING SPECIFICATION 75871-6.

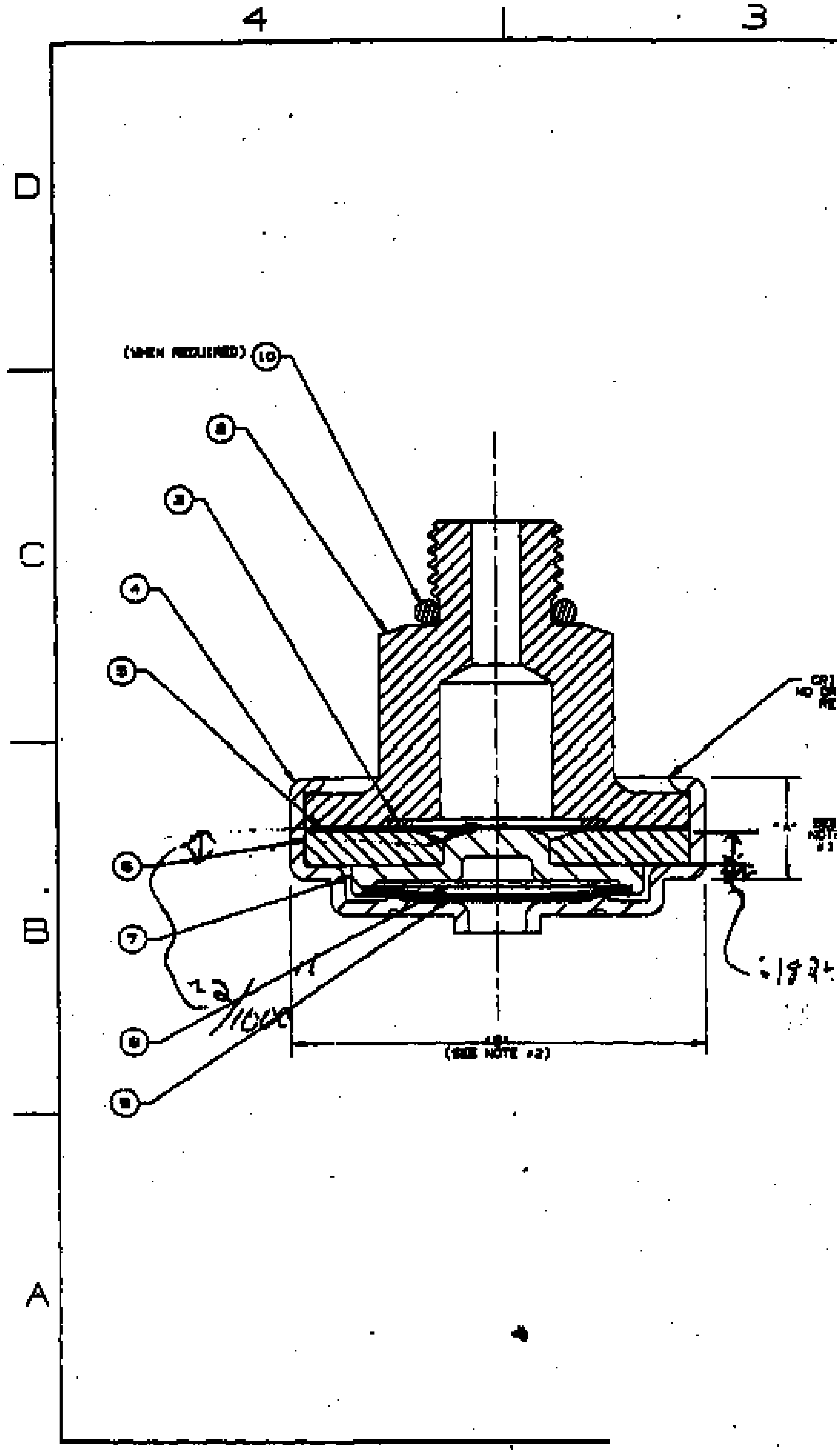
DETAILED REVISION DESCRIPTION:

99 CR M39209, 28744-1 CONTACT (MOV) WAS 74408-1
STOCK DISPOSITION
FINISHED DEVICES - USE
PARTS & SUB ASMS - USE SUBS, HOLD PARTS

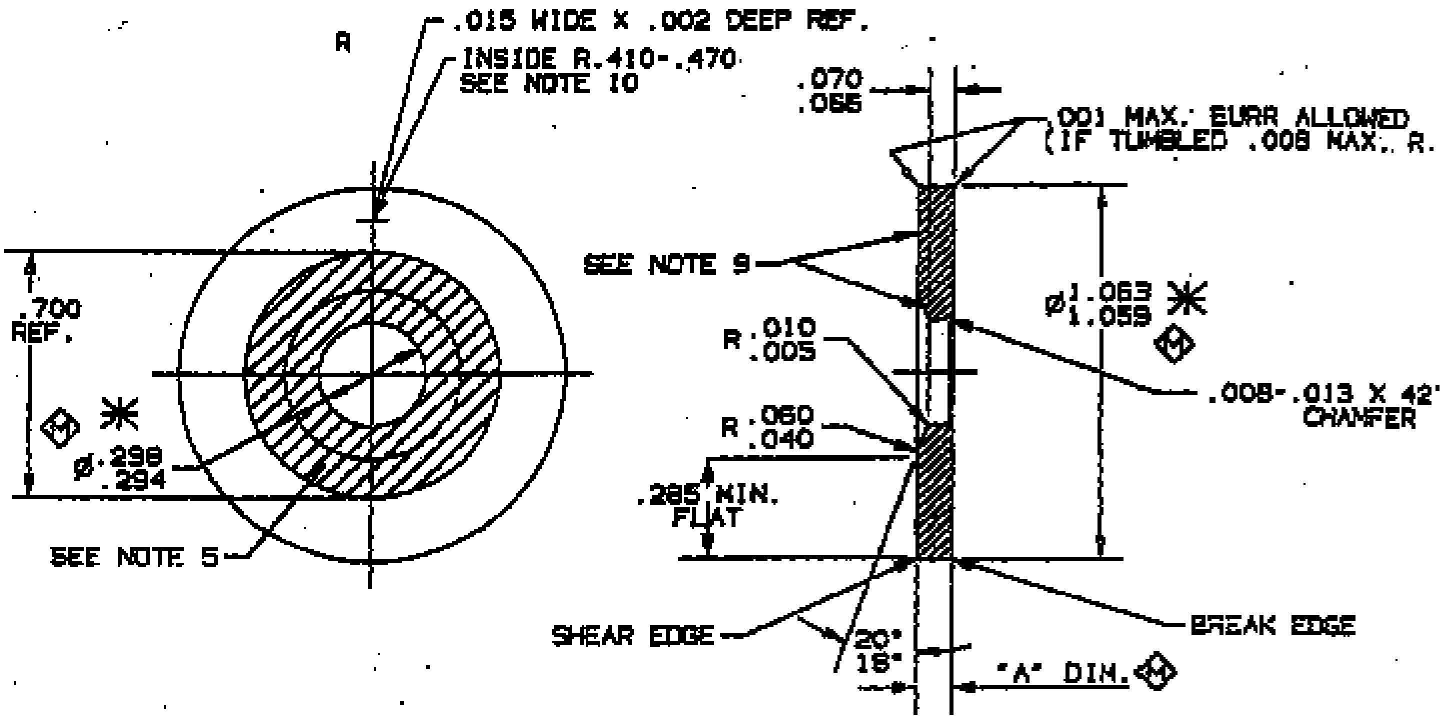
TCW 725 01 02 A ADAIMA PRO



TI-NHTSA 014043



TI-NHTSA 014044



NOTES:

1. PART MUST BE FLAT TO WITHIN .006 T.I.R..
2. DIAMETERS MARKED WITH ✳ MUST BE CONCENTRIC TO WITHIN .004 T.I.R..
3. PARTS TO BE SHIPPED, ISSUED, AND STORED WITH APPLIED RUST PREVENTIVE BEFORE PLATING. AFTER PLATING, PARTS TO BE SHIPPED, ISSUED, AND STORED IN SEALED PLASTIC BAGS.
4. ENTIRE THICKNESS OF PART MUST BE HARDENED BY AN INTERUPTED QUENCHING PROCESS.
5. NO TOOL MARKS ALLOWED IN THE SHADED AREA ON BEVELED SIDE OF WASHER.
6. THIS PART IS LOT CONTROLLED. ANY PRESS CHANGE, NEW SETUP, PUNCH CHANGE, MAJOR TOOL WORK OR MATERIAL LOT CHANGE WILL SIGNIFY START OF A NEW LOT. NO MINIMUM LOT SIZE. EACH BOX WILL HAVE A LOT NUMBER. EACH LOT WILL HAVE IT'S OWN PACKING SLIP WITH LOT IDENTIFICATION.
7. MATERIAL CERTIFICATION REQUIRED WITH EACH SHIPMENT.
8. DIM.'A' TO BE MEASURED WITH STANDARD WASHER GAUGE.
9. THESE SURFACES MUST BE SMOOTH AND FREE OF ANY PLATING ASPERITIES OR INCLUSIONS. (i.e. NO FROSTED EFFECTS OR PARTICULATE CONTAMINATION IN THE PLATING.)
10. IDENTIFICATION MARK ALLOWED BETWEEN R.470-.410. IDENTIFICATION MARK MAY BE ONE STRAIGHT OR CURVED MARK. CODE SHALL BE CLEARLY VISIBLE AFTER PLATING. NO BURR OR SHARP EDGES PERMITTED.

THIS DWG. SUPERSEDES 27639 REV.'E' DATED 8-28-95.