

**EA02-025**

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

**REQUEST NO. 7**

**BOX 8**

**PART A-U**

**PART I**

PRESSURE SWITCH DATA

FORM 21605

TEST NO. 522-15-54

DEVICE 77 PSL 2-1	DATE REQUESTED 1/6/97	REQUESTED BY DI HA	REQUESTED COMPL. DATE
PERFORMED BY RICHARD STANDER	DATE STARTED 1/8/97	DATE COMPLETED	APPROVED BY
PROJECT TITLE:			

CUSTOMER: FORD

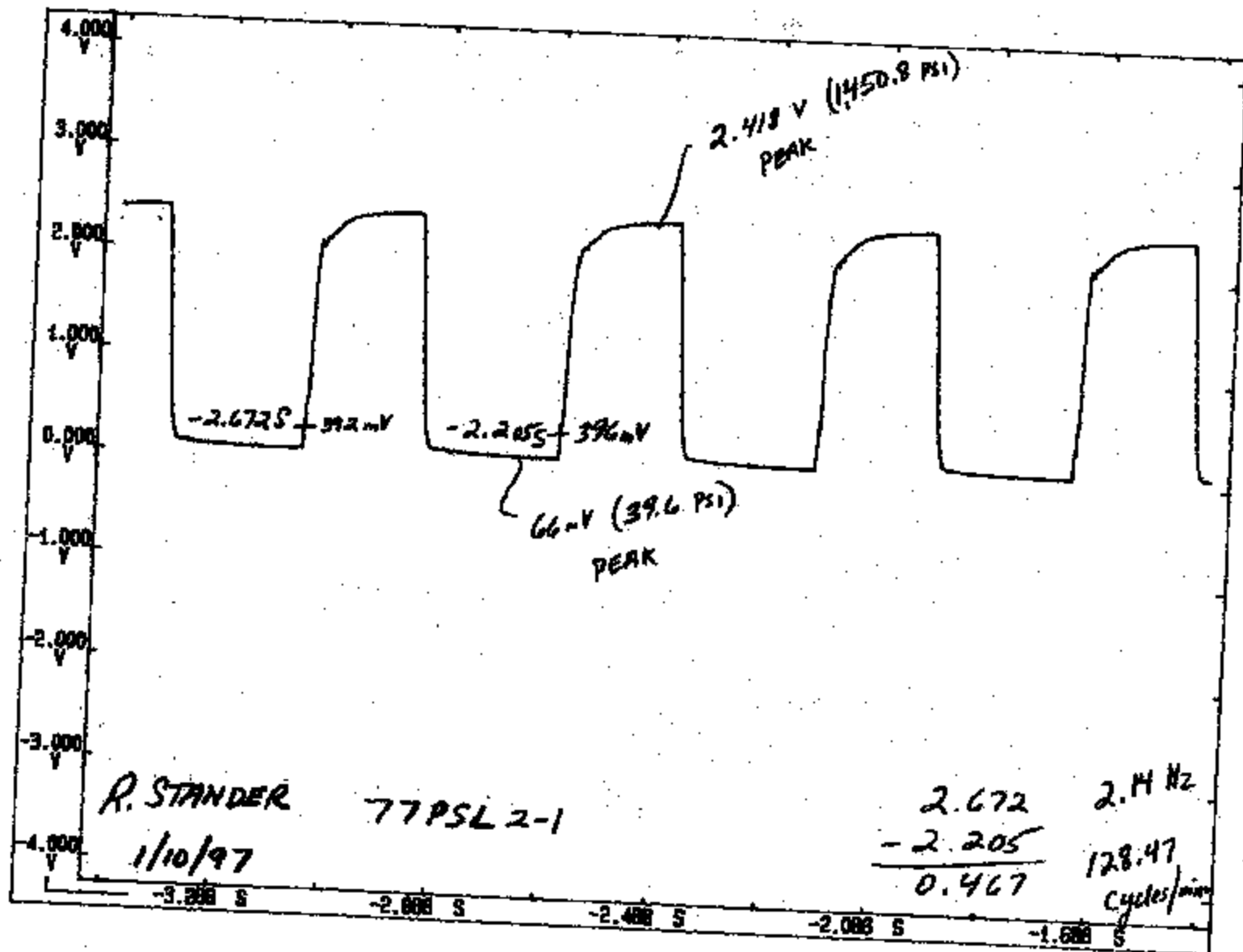
PURPOSE OF TEST: IN PROCESS IMPULSE TESTING

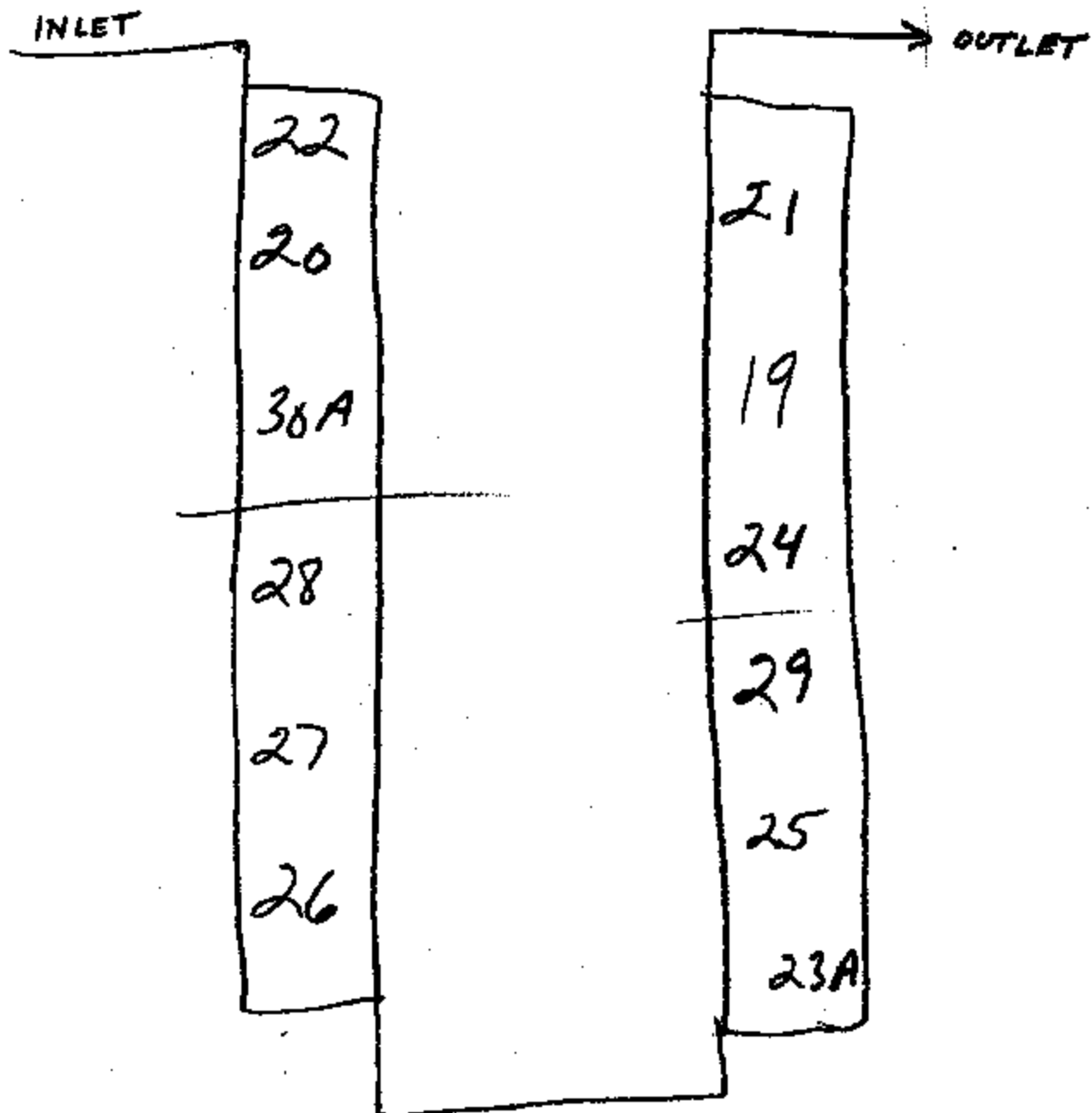
PROCEDURE: INITIAL CHARACTERIZATION (ACT, REL, T-T, MVD - IN AIR)  
 IMPULSE TESTING (PER FORD SPEC. - ATTACHED)  
 POST TEST CALIBRATION (ACT, REL, T-T, MVD - IN AIR)

DEVICE	PRE - TEST				POST - TEST			
	ACT	REL	T-T	MVD	ACT	REL	T-T	MVD
19	130	58	1.4/0.8	0.09	130	62	CA/0.7	0.50
20	128	56	1.8/0.7	0.08	116	58	13.6/0.8	0.13
21	128	61	1.7/1.0	0.16	113	60	1.8/0.7	0.56
22	133	61	1.7/0.8	0.08	117	59	2.5/0.7	0.16
23 A	130	64	1.8/0.9	0.07	115	62	CA/0.1	10.85
24	132	62	1.7/0.7	0.08	117	58	13.7/0.0	110.98
25	135	61	1.6/0.9	0.22	117 *	61	13.1/0.2	10.30
26	131	64	1.6/0.8	0.10	119	64	CA/0.3	0.58
27	127	60	1.4/0.9	0.17	116	61	1.6/0.9	1.80
28	127	52	1.5/0.8	0.15	111 *	56	CA/0.7	1.70
29	128	65	1.6/0.8	0.09	114	63	2.0/0.9	32.24
30 A	134	66	1.4/1.2	0.07	124	69	CA/0.8	0.33

\* ACCIDENTALLY SHORTED (~ 1 sec) ACROSS SWITCH DURING DISMOUNT (POST-READING)

TI-NHTSA 012066





K. STANDER  
1/10/97

F

POST TESTS

P/N:		77PCL2-1		DATE:		1/14/87			
A. CALIBRATION SPEC				POST TEST					
ACT		90-180		A.S.M.P.					
REL		20 MIN		A.S.M.P.		LAB TEST # 833-18-84			
B. MILLIVOLT DROP < 200				A.S.M.P.					
C. CURRENT LEAKAGE				A.S.M.P.					
D. PROOF				3000psi A.S.M.P.					
POST TESTS:						IP-3 TEST		POST TESTS:	
DEVICE #	PROOF	ACT	REL	MVD	CURLIC	VIBRATION	A,B,C,D		
1	OK	134	58.6	0.18	OK	# 1-6			
2	OK	121.4	58.8	0.32	OK				
3	OK	134.7	58.8	0.21	OK				
4	OK	131.8	78.4	0.21	OK				
5	OK	128.4	60.4	0.22	OK				
6	OK	131.3	61.3	0.25	OK				
7	OK	133.6	68.4	0.28	OK	VACUUM	A,B,C,D		
8	OK	134.4	68.7	0.21	OK	# 7-12			
9	OK	128.8	60	0.29	OK				
10	OK	122.4	65.3	0.22	OK				
11	OK	127.8	68.6	0.21	OK				
12	OK	124.7	62.8	0.19	OK				
13	OK	113.6	67.5	0.18	OK	TEMP CYCLE	A,B,C,D		
14	OK	125.4	68.7	0.28	OK	# 13-18			
15	OK	128.4	64.4	0.41	OK				
16	OK	118.8	60.8	0.18	OK				
17	OK	121.8	61.8	0.21	OK				
18	OK	118.8	63.2	0.28	OK				
19	OK	120.1	68.4	0.27	OK	FLUID RES.	E,S,H,J WA. 1/YR ONLY		
20	OK	114.4	64.8	0.24	OK	# 19-24	IMPULSE	A,B,C,D	
21	OK	114.8	61.2	0.28	OK		# 25-30		
22	OK	117.1	63.1	0.59	OK				
23	OK	114.4	68.1	1.18	OK				
24	OK	117.4	63.4	0.83	OK				
25	OK	118.2	68.6	0.71	OK				
26	OK	114.6	64.4	0.5	OK				
27	OK	114.6	67.5	0.38	OK				
28	OK	110.6	66.6	0.31	OK				
29	OK	112.8	68.4	0.34	OK				
30	OK	123.8	72.8	0.32	OK				
31	OK	130.8	68.6	0.31	OK		TEMP STR	A,B,C,D	
32	OK	134.6	68.6	0.24	OK		831-42		
33	OK	128.8	60.2	0.22	OK				
34	OK	131.6	63.4	0.22	OK				
35	OK	128.1	68.8	0.27	OK				
36	OK	121.8	64.6	0.68	OK				
37	OK	124.4	68.8	0.23	OK				
38	OK	137	63.8	0.37	OK				





## IN-PROCESS IP-2 TEST SUMMARY (PS 97-14)

### 1.0 GENERAL

- 1.1 Customer: Ford Motor Company
- 1.2 TI Part Number: 77PSL2-1
- 1.3 Customer Part Number: (delta) F2VC-9F924-AB
- 1.4 Specifications: Ford Engineering Specification number  
(delta) ES-F2VC9F924-AA
- 1.5 Date Of Completion: 97/03/16
- 1.6 Quantity Of Units Tested: 54
- 1.7 Disposition Of Tested Units :
- Devices tested were retained by Texas Instruments.
- 1.8 TI test series number: #1 through #6 (Vibration)  
#7 through #12 (Vacuum)  
#13 through #18 (Temp Cycling)  
#19 through #54 (Fluid Resistance)

### 2.0 TEST PROCEDURES AND RESULTS

All switches were tested to Ford Engineering Specification (delta) ES-F2VC-9F924-AA. Tests were completed with production parts, selected on a random basis to represent the entire production population as much as possible.

Pre-test and post-test actual switch test results are attached at the end of this test summary.

#### 2.1 Calibration

Procedure: Calibration was checked at room temperature (18 degrees C to 95 degrees C) using ambient air as the pressure medium. Calibration settings, as specified on the part drawing, are actuation (electrical contacts opening) at 90 - 180 psig, and release (contacts reclosing) at 20 psig minimum. All tests were accomplished after the third cycle with the switch conducting 700 - 800 millamps at 12.0 - 14.0 volts DC. The rate of pressure change (ramp-up, ramp down) was accomplished at 60 psig/sec.

Pre-test and Post-test results are in the Vibration/Vacuum/ Temp Cycling/Fluid Resistance test portions respectively.

CUSTOMER: Ford Motor Co.	TEST: IN-PROCESS IP-2 TEST SUMMARY	PAGE 1 OF 8
TESTED BY: E. Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED MATERIALS & CONTROLS GROUP ATTLEBORO, MASSACHUSETTS 02706	DEVICE: 77PSL2-1
APPROVED BY: Jim Wall, QRA		DOC.: PS 97-14
DATE: March 17, 1997		FILE NAME: IP TESTING



## IN-PROCESS IP-2 TEST SUMMARY (PS 97-14)

### 2.2 Voltage Drop

The voltage drop across the contact area is automatically checked by the test equipment.

Pre-test and Post-test results are in the Vibration/Vacuum/ Temp Cycling/ Fluid Resistance test portions respectively.

### 2.3 Current Leakage

Current leakage was measured with 500 volts , 60 hertz alternating current. The current leakage checked were:

Between the switch leads with contacts open.

Between the terminals and case (switch housing) with contacts closed.

Between either terminal and case (switch housing) with contacts open.

Pre-test and Post-test results are in the Vibration/Vacuum/ Temp Cycling/ Fluid Resistance test portions respectively.

### 2.4 Proof

Calibration readings were recorded only after proof testing . Test pressure was 4000 psig per the part drawing. Equipment is Enerpak model P-392 hydraulic hand pump using Enerpak hydraulic fluid as the pressure medium. Fluid is removed from the device using a combination of vacuum and residue-free solvent Sprayon (TM) HI-Tech 02002 TF Electric Contact Cleaner. US Gauge #33714 reading to 5000psig with 100 psig increments, resolvable to 50 psig, calibrated quarterly. Custom TI designed and built safety enclosure.

Pre-test and Post-test results are in the Vibration/Vacuum/ Temp Cycling test portions respectively.

CUSTOMER: Ford Motor Co.	TEST: IN-PROCESS IP-2 TEST SUMMARY	PAGE 2 of 8
TESTED BY: E. Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED MATERIALS & CONTROLS GROUP ATTLEBORO, MASSACHUSETTS 02708	DEVICE: 77P6L2-1
APPROVED BY: Jim Webb, CRA		DOC.: PS 97-14
DATE: March 17, 1997		FILE NAME: IP TESTING

## IN-PROCESS IP-2 TEST SUMMARY (PS 97-14)

### 2.5 Vibration

Devices tested: T1 #1 through #8.

Equipment used: Vibration table, Ling, model A206 with Hewlett-Packard model 5427 controls. Air tank with 850 psig minimum pressurized Nitrogen used to actuate devices with at least 1.1 times maximum actuation specification on part drawing;  $300 \text{ psig} \times 1.1 = 330 \text{ psi}$  minimum. Switches were mounted in the test port using the currently released electrical connector before the start of the test. Switches were vibrated in all 9 planes with electrical continuity monitored during the entire test, in ambient air. Internal pressure was maintained at zero Kpa G when the switch was in the closed position, and 1.1 times max actuation pressure shown on the print when the switch was in the open position. The switches were vibrated at 1.5mm displacement (peak to peak) while varying the frequency uniformly from 5 to 60 to 5 Hz over a 5 minute period, in alternate one-hour periods in the open and closed positions for a total of 8 hours in each plane, for a total test time of 24 hours.

Calibration Pre-test Results: The average actuation was 133.8 psig, and the standard deviation was 3.3. All values were well within the specification. The average release was 56.7 psig, and the standard deviation was 7.4. All values were well within the 20 psig minimum specification.

Calibration Post-test Results: The average actuation was 130.3 psig, and the standard deviation was 4.8. All values were well within the specification. The average release was 64.9, and the standard deviation was 8.4. All values were well within the 20 psig minimum specification.

Voltage Drop Pre-test Results: Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

Voltage Drop Post-test Results: Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

Current Leakage Pre-test Results: Statistics not calculated. All values were well below the specification of 100 microamps.

Current Leakage Post-test Results: Statistics not calculated. All values were well below the specification of 100 microamps.

Proof Pre-test Results: No evidence of fluid leakage and no drop in test pressure observed on any device.

Proof Post-test Results: No evidence of fluid leakage and no drop in test pressure observed on any device.

All six switches met the acceptance criteria in the Ford E8 specification.

CUSTOMER: Ford Motor Co.	TEST: IN-PROCESS IP-2 TEST SUMMARY	PAGE 3 OF 5
TESTED BY: E. Ross/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED	DEVICE: 77PBL2-1
APPROVED BY: Jim Wall, CRA	MATERIALS & CONTROLS GROUP	DOC.: PS 97-14
DATE: March 17, 1997	ATLANTIC, MASSACHUSETTS 01908	FILE NAME: IP TESTING

## IN-PROCESS IP-2 TEST SUMMARY (PS 97-14)

### 2.8 Vacuum

Devices tested: T1 #7 through #12.

Equipment used: Kinney vacuum pump. Senotec pressure transducer, serial no. 188033 Model T1e 727-02, range 0-25 psia calibrated quarterly, with Fluke model 8020B Digital Multimeter readout, calibrated quarterly.

Switches were mounted in the test at room temperature, ambient air as the pressure medium. Switches were subjected to 5 cycles of vacuum from atmospheric pressure (760mm Hg) to an absolute pressure of 3-8 mm Hg, maintaining vacuum for 60 seconds.

Note: 3mm Hg = 0.058 psi = 0.400kPa  
6mm Hg = 0.116 psi = 0.800kPa

Calibration Pre-test Results: The average actuation was 128.5 psig, and the standard deviation was 680. All values were well within the specification. The average release was 62.7 psig, and the standard deviation was 4.8. All values were well within the 20 psig minimum specification.

Calibration Post-test Results: The average actuation was 129.2 psig, and the standard deviation was 4.5. All values were well within the specification. The average release was 65.3, and the standard deviation was 3.4. All values were well within the 20 psig minimum specification.

Voltage Drop Pre-test Results: Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

Voltage Drop Post-test Results: Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

Current Leakage Pre-test Results: Statistics not calculated. All values were well below the specification of 100 microamps.

Current Leakage Post-test Results: Statistics not calculated. All values were well below the specification of 100 microamps.

Proof Pre-test Results: No evidence of fluid leakage and no drop in test pressure observed on any device.

Proof Post-test Results: No evidence of fluid leakage and no drop in test pressure observed on any device.

All six switches met the acceptance criteria in the Ford ES specification.

CUSTOMER: Ford Motor Co.	TEST: IN-PROCESS IP-2 TEST SUMMARY	PAGE 4 OF 8
TESTED BY: E. Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED	DEVICEN 77P5L2-1
APPROVED BY: Jim Wall, GRA	MATERIALS & CONTROLS GROUP	Doc. 1 PS 97-14
DATE: March 17, 1997	ATLANTIC, MASSACHUSETTS 02701	FILE NAME: IP TESTING

## IN-PROCESS IP-2 TEST SUMMARY (PS 97-14)

### 2.7 Temperature Cycle

Devices tested: TI #19 through #18.

Equipment used: Thermotron model S-4 Mini-Max environmental chamber capable of - 55 degrees C to + 200 degrees C, humidity controlled. Custom TI designed and built cycler, utilizing Enerpak integrated hydraulic pressure source, TI915 Programmable Logic Controller, Moog servovalve and controller, Simpson signal generator, and opposing-piston fluid isolators, to produce a hydraulic-fluid flow-type primary with a brake-fluid dead-end -type secondary terminated with a 24-station manifold equipped with internal heaters. Capability to 5 Hz at 0-1500 psig cycle. Custom TI designed and built 24 station Switch Monitor Circuit which automatically stops the cycler in the event of abnormal switch action, defined as continuity change which does not track the signal from the signal generator. Thermocouple readouts calibrated quarterly.

Calibration Pre-test Results: The average actuation was 129.7 psig, and the standard deviation was 4.5. All values were well within the specification. The average release was 53.8 psig, and the standard deviation was 4.3. All values were well within the 20 psig minimum specification.

Calibration Post-test Results: The average actuation was 120.3 psig, and the standard deviation was 4.5. All values were well within the specification. The average release was 59.6, and the standard deviation was 2.9. All values were well within the 20 psig minimum specification.

Voltage Drop Pre-test Results: : Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

Voltage Drop Post-test Results: : Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

Current Leakage Pre-test Results. Statistics not calculated. All values were well below the specification of 100 microamps.

Current Leakage Post-test Results. Statistics not calculated. All values were well below the specification of 100 microamps.

Proof Pre-test Results: No evidence of fluid leakage and no drop in test pressure observed on any device.

Proof Post-test Results: No evidence of fluid leakage and no drop in test pressure observed on any device.

All six switches met the acceptance criteria in the Ford E9 specification.

CUSTOMER: Ford Motor Co.	TEST: IN-PROCESS IP-2 TEST SUMMARY	PAGE 5 OF 8
TESTED BY: E. Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED MATERIALS & CONTROLS GROUP ATLUSBORO, MASSACHUSETTS 02708	REVISED: 77P0L2-1
APPROVED BY: Jim West, CFA		DEPT: PS 97-14
DATE: March 17, 1987		FILE NAME: IP TESTS

TI-NHTSA 012075

## IN-PROCESS IP-2 TEST SUMMARY (PS 97-14)

### 2.8 Fluid Resistance (These were not repeated as this series of tests are once/ year only)

Devices tested: TI #19 through #54.

Equipment: Fluids as called out in ES table (frame 12 of 18); appropriate beakers and storage apparatus; vented hood.

Results: The 36 devices were divided into groups as follows for subsequent testing. Results of these tests are reported below.

Impulse:	#19 through 30
Terminal Strength:	#31 through 42
Humidity:	#43 through 48
Salt Spray:	#49 through 54

#### 2.8.1 Impulse (#19 through 30)

Calibration Pre-test Results: The average actuation was 139.4 psig, and the standard deviation was 6.9. All values were well within the specification. The average release was 108.7 psig, and the standard deviation was 6.8. All values were well within the 20 psig minimum specification.

Calibration Post-test Results: The average actuation was 126.8 psig, and the standard deviation was 5.8. All values were well within the specification. The average release was 96.6, and the standard deviation was 3.8. All values were well within the 20 psig minimum specification.

Voltage Drop Pre-test Results: Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

Voltage Drop Post-test Results: Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

Current Leakage Pre-test Results: Statistics not calculated. All values were well below the specification of 100 microamps.

Current Leakage Post-test Results: Statistics not calculated. All values were well below the specification of 100 microamps.

Proof Pre-test Results: No evidence of fluid leakage and no drop in test pressure observed on any device.

Proof Post-test Results: No evidence of fluid leakage and no drop in test pressure observed on any device.

All twelve switches met the acceptance criteria in the Ford EB specification.

customer: Ford Motor Co.	TEST: IN-PROCESS IP-2 TEST SUMMARY	PAGE 6 OF 8
TESTED BY: E. Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED MATERIALS & CONTROLS GROUP ATLANTON, MASSACHUSETTS 02705	DIVISION: 77P6L2-1
APPROVED BY: Jim Watt, QRA		DOS: PS 97-14
DATE: March 17, 1997		FILE NAME: IP TESTS02

## IN-PROCESS IP-2 TEST SUMMARY (PS 97-14)

### 2.8.2 Terminal Strength (#31 through 42)

**Calibration Pre-test Results:** The average actuation was 141.5 psig, and the standard deviation was 5.4. All values were well within the specification. The average release was 105 psig, and the standard deviation was 6.6. All values were well within the 20 psig minimum specification.

**Calibration Post-test Results:** The average actuation was 136.8 psig, and the standard deviation was 5.8. All values were well within the specification. The average release was 103.6, and the standard deviation was 6.2. All values were well within the 20 psig minimum specification.

**Voltage Drop Pre-test Results:** Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

**Voltage Drop Post-test Results:** Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

**Current Leakage Pre-test Results:** Statistics not calculated. All values were well below the specification of 100 microamps.

**Current Leakage Post-test Results:** Statistics not calculated. All values were well below the specification of 100 microamps.

**Proof Pre-test Results:** No evidence of fluid leakage and no drop in test pressure observed on any device.

**Proof Post-test Results:** No evidence of fluid leakage and no drop in test pressure observed on any device.

All twelve switches met the acceptance criteria in the Ford ES specification.

### 2.8.3 Humidity (#43 through 48)

**Calibration Pre-test Results:** The average actuation was 144 psig, and the standard deviation was 6.2. All values were well within the specification. The average release was 103.2 psig, and the standard deviation was 12.1. All values were well within the 20 psig minimum specification.

**Calibration Post-test Results:** The average actuation was 137.7 psig, and the standard deviation was 4.2. All values were well within the specification. The average release was 98.3, and the standard deviation was 4.1. All values were well within the 20 psig minimum specification.

**Voltage Drop Pre-test Results:** Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

**Voltage Drop Post-test Results:** Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

CUSTOMER: Ford Motor Co.	TEST: IN-PROCESS IP-2 TEST SUMMARY	PAGE 7 OF 8
TESTED BY: E. Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED	DEVICE: 77P8L2-1
APPROVED BY: Jim Watt, QRA	MATERIALS & CONTROLS GROUP	DOC.: PS 97-14
DATE: March 17, 1997	ATLIDBORO, MASSACHUSETTS 02708	FILE NAME: IP TESTING

## IN-PROCESS IP-2 TEST SUMMARY (PS 97-14)

**Current Leakage Pre-test Results:** Statistics not calculated. All values were well below the specification of 100 microamps.

**Current Leakage Post-test Results:** Statistics not calculated. All values were well below the specification of 100 microamps.

**Proof Pre-test Results:** No evidence of fluid leakage and no drop in test pressure observed on any device.

**Proof Post-test Results:** No evidence of fluid leakage and no drop in test pressure observed on any device.

All six switches met the acceptance criteria in the Ford ES specification.

### 2.8.4 Salt Spray (#49 through 54)

**Calibration Pre-test Results:** The average actuation was 142.5 psig, and the standard deviation was 2.7. All values were well within the specification. The average release was 106.7 psig, and the standard deviation was 4.5. All values were well within the 20 psig minimum specification.

**Calibration Post-test Results:** The average actuation was 138 psig, and the standard deviation was 4.5. All values were well within the specification. The average release was 100.3, and the standard deviation was 4.5. All values were well within the 20 psig minimum specification.

**Voltage Drop Pre-test Results:** Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

**Voltage Drop Post-test Results:** Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

**Current Leakage Pre-test Results:** Statistics not calculated. All values were well below the specification of 100 microamps.

**Current Leakage Post-test Results:** Statistics not calculated. All values were well below the specification of 100 microamps.

**Proof Pre-test Results:** No evidence of fluid leakage and no drop in test pressure observed on any device.

**Proof Post-test Results:** No evidence of fluid leakage and no drop in test pressure observed on any device.

All six switches met the acceptance criteria in the Ford ES specification.

Pre-test and post-test actual switch test results are attached at the end of this test summary.

<b>CUSTOMER:</b> Ford Motor Co.	<b>TEST:</b> IN-PROCESS IP-2 TEST SUMMARY	<b>PAGE:</b> 8 OF 8
<b>TESTED BY:</b> E. Ross/ Eng Lab	<b>TEXAS INSTRUMENTS INCORPORATED</b>	<b>DEVICED:</b> 77P8L2-1
<b>APPROVED BY:</b> Jim Wall, QRA	<b>MATERIALS &amp; CONTROLS GROUP</b>	<b>DOC.:</b> PS 97-14
<b>DATE:</b> March 17, 1997	<b>ATLIDBORO, MASSACHUSETTS 02708</b>	<b>FILE NAME:</b> IP TESTS83

## IN-PROCESS IP-2 TEST SUMMARY (PS 97-14)

### 1.0 GENERAL

- 1.1 Customer: Ford Motor Company
- 1.2 TI Part Number: 77PSL2-1
- 1.3 Customer Part Number: (delta) F2VC-9F924-AB
- 1.4 Specifications: Ford Engineering Specification number  
(delta) ES-F2VC8F924-AA
- 1.5 Date Of Completion: 97/03/15
- 1.6 Quantity Of Units Tested: 54
- 1.7 Disposition Of Tested Units :
- Devices tested were retained by Texas Instruments.
- 1.8 TI test series number: #1 through #6 (Vibration)  
#7 through #12 (Vacuum)  
#13 through #18 (Temp Cycling)  
#19 through #54 (Fluid Resistance)

### 2.0 TEST PROCEDURES AND RESULTS

All switches were tested to Ford Engineering Specification (delta) ES-F2VC-9F924-AA. Tests were completed with production parts, selected on a random basis to represent the entire production population as much as possible.

Pre-test and post-test actual switch test results are attached at the end of this test summary.

#### 2.1 Calibration

Procedure: Calibration was checked at room temperature (18 degrees C to 35 degrees C) using ambient air as the pressure medium. Calibration settings, as specified on the part drawing, are actuation (electrical contacts opening) at 90 - 180 psig, and release (contacts reclosing) at 20 psig minimum. All tests were accomplished after the third cycle with the switch conducting 700 - 800 milliamps at 12.0 - 14.0 volts DC. The rate of pressure change (ramp-up, ramp down) was accomplished at 50 psig/sec.

Pre-test and Post-test results are in the Vibration/Vacuum/ Temp Cycling/Fluid Resistance test portions respectively.

CUSTOMER: Ford Motor Co.	TEST: IN-PROCESS IP-2 TEST SUMMARY	PAGE 1 OF 8
TESTED BY: E. Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED MATERIALS & CONTROLS GROUP ATLISBORO, MASSACHUSETTS 02708	DEVICE: 77PSL2-1
APPROVED BY: Jim Watt, QRA		DOC.: PS 97- 14
DATE: April 04, 1997		FILE NAME: IP TESTING



## IN-PROCESS IP-2 TEST SUMMARY (PS 87-14)

### 2.2 Voltage Drop

The voltage drop across the contact area is automatically checked by the test equipment.

Pre-test and Post-test results are in the Vibration/Vacuum/ Temp Cycling/ Fluid Resistance test portions respectively.

### 2.3 Current Leakage

Current leakage was measured with 500 volts , 60 hertz alternating current. The current leakage checked were:

Between the switch leads with contacts open.

Between the terminals and case (switch housing) with contacts closed.

Between either terminal and case (switch housing) with contacts open.

Pre-test and Post-test results are in the Vibration/Vacuum/ Temp Cycling/ Fluid Resistance test portions respectively.

### 2.4 Proof

Calibration readings were recorded only after proof testing . Test pressure was 4000 psig per the part drawing. Equipment is Enerpak model P-382 hydraulic hand pump using Enerpak hydraulic fluid as the pressure medium. Fluid is removed from the devices using a combination of vacuum and residue-free solvent Sprayon (TM) Hi-Tech 02002 TF Electric Contact Cleaner. US Gauge #33714 reading to 5000psig with 100 psig increments, readable to 50 psig, calibrated quarterly. Custom TI designed and built safety enclosure.

Pre-test and Post-test results are in the Vibration/Vacuum/ Temp Cycling test portions respectively.

CUSTOMER: Ford Motor Co.	TEST: IN-PROCESS IP-2 TEST SUMMARY	PAGE 2 OF 8
TESTED BY: E. Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED	DEVICE: 77PBL3-1
APPROVED BY: Jim Watt, CRA	MATERIALS & CONTROLS GROUP	DOC.: PS 87-14
DATE: April 04, 1987	ATTLEBORO, MASSACHUSETTS 02703	FILE NAME: IP TESTING

## IN-PROCESS IP-2 TEST SUMMARY (PS 97-14)

### 2.5 Vibration

Devices tested: TI #1 through #6.

Equipment used: Vibration table, Ling, model A395 with Hewlett-Packard model 5427 controls. Air tank with 350 psig minimum pressurized Nitrogen used to actuate devices with at least 1.1 times maximum actuation specification on part drawing; 300 psig x 1.1 = 330 psig minimum. Switches were mounted in the test part using the currently released electrical connector before the start of the test. Switches were vibrated in all 3 planes with electrical continuity monitored during the entire test, in ambient air. Internal pressure was maintained at zero Kpa G when the switch was in the closed position, and 1.1 times max actuation pressure shown on the print when the switch was in the open position. The switches were vibrated at 1.5mm displacement (peak to peak) while varying the frequency uniformly from 5 to 50 to 5 Hz over a 5 minute period, in alternate one-hour periods in the open and closed positions for a total of 8 hours in each plane, for a total test time of 24 hours.

Calibration Pre-test Results: The average actuation was 133.8 psig, and the standard deviation was 3.3. All values were well within the specification. The average release was 56.7 psig, and the standard deviation was 7.4. All values were well within the 20 psig minimum specification.

Calibration Post-test Results: The average actuation was 130.3 psig, and the standard deviation was 4.6. All values were well within the specification. The average release was 64.3, and the standard deviation was 6.4. All values were well within the 20 psig minimum specification.

Voltage Drop Pre-test Results: Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

Voltage Drop Post-test Results: Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

Current Leakage Pre-test Results: Statistics not calculated. All values were well below the specification of 100 microamps.

Current Leakage Post-test Results: Statistics not calculated. All values were well below the specification of 100 microamps.

Proof Pre-test Results: No evidence of fluid leakage and no drop in test pressure observed on any device.

Proof Post-test Results: No evidence of fluid leakage and no drop in test pressure observed on any device.

All six switches met the acceptance criteria in the Ford ES specification.

CUSTOMER: Ford Motor Co.	TEST: IN-PROCESS IP-2 TEST SUMMARY	PAGE 3 OF 8
TESTED BY: E. Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED	DEVICE: 77P8L2-1
APPROVED BY: Jim Welt, QRA	MATERIALS & CONTROLS GROUP	DOS: PS 97-14
DATE: April 04, 1997	ATLUSORO, MASSACHUSETTS 02703	FILENAME: IP TESTING

## IN-PROCESS IP-2 TEST SUMMARY (PS 97-14)

### 2.6 Vacuum

Devices tested: TI #7 through #12.

Equipment used: Kinney vacuum pump, Senotec pressure transducer, serial no. 199033 Model T16 727-02, range 0-25 psia calibrated quarterly, with Fluke model 8020B Digital Multimeter readout, calibrated quarterly.

Switches were mounted in the test at room temperature, ambient air as the pressure medium. Switches were subjected to 5 cycles of vacuum from atmospheric pressure (760mm Hg) to an absolute pressure of 3-8 mm Hg, maintaining vacuum for 60 seconds.

Note: 3mm Hg = 0.058 psi = 0.400kPa

8mm Hg = 0.116 psi = 0.800kPa

Calibration Pre-test Results: The average actuation was 128.5 psig, and the standard deviation was 890. All values were well within the specification. The average release was 62.7 psig, and the standard deviation was 4.6. All values were well within the 20 psig minimum specification.

Calibration Post-test Results: The average actuation was 128.2 psig, and the standard deviation was 4.6. All values were well within the specification. The average release was 65.3, and the standard deviation was 3.4. All values were well within the 20 psig minimum specification.

Voltage Drop Pre-test Results: Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

Voltage Drop Post-test Results: Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

Current Leakage Pre-test Results: Statistics not calculated. All values were well below the specification of 100 microamps.

Current Leakage Post-test Results: Statistics not calculated. All values were well below the specification of 100 microamps.

Proof Pre-test Results: No evidence of fluid leakage and no drop in test pressure observed on any device.

Proof Post-test Results: No evidence of fluid leakage and no drop in test pressure observed on any device.

All six switches met the acceptance criteria in the Ford ES specification.

CUSTOMER: Ford Motor Co.	TEST: IN-PROCESS IP-2 TEST SUMMARY	PAGE 4 OF 8
TESTED BY: E. Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED	DEVICE: 77PSL2-1
APPROVED BY: Jm Watt, GRA	MATERIALS & CONTROLS GROUP	DOC.: PS 97-14
DATE: April 04, 1997	ATTLEBORO, MASSACHUSETTS 01703	FILE NAME: IP TESTING

## IN-PROCESS IP-2 TEST SUMMARY (PS 97-14)

### 2.7 Temperature Cycle

Devices tested: TI #13 through #18.

Equipment used: Thermotron model 9-4 Mini-Max environmental chamber capable of -55 degrees C to +200 degrees C, humidity controlled. Custom TI designed and built cycler, utilizing Enerpak integrated hydraulic pressure source, TI315 Programmable Logic Controller, Moog servovalve and controller, Simpson signal generator, and opposing-piston fluid isolators, to produce a hydraulic-fluid flow-type primary with a brake-fluid dead-end -type secondary terminated with a 24-station manifold equipped with internal heaters. Capability to 5 hz at 0-1500 psig cycle. Custom TI designed and built 24 station Switch Monitor Circuit which automatically stops the cycler in the event of abnormal switch action, defined as continuity change which does not track the signal from the signal generator. Thermocouple readouts calibrated quarterly.

Calibration Pre-test Results: The average actuation was 129.7 psig, and the standard deviation was 4.3. All values were well within the specification. The average release was 63.6 psig, and the standard deviation was 4.3. All values were well within the 20 psig minimum specification.

Calibration Post-test Results: The average actuation was 129.3 psig, and the standard deviation was 4.6. All values were well within the specification. The average release was 59.6, and the standard deviation was 2.9. All values were well within the 20 psig minimum specification.

Voltage Drop Pre-test Results: : Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

Voltage Drop Post-test Results: : Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

Current Leakage Pre-test Results. Statistics not calculated. All values were well below the specification of 100 microamps.

Current Leakage Post-test Results. Statistics not calculated. All values were well below the specification of 100 microamps.

Proof Pre-test Results: No evidence of fluid leakage and no drop in test pressure observed on any device.

Proof Post-test Results: No evidence of fluid leakage and no drop in test pressure observed on any device.

All six switches met the acceptance criteria in the Ford ES specification.

CUSTOMER: Ford Motor Co.	TEST: IN-PROCESS IP-2 TEST SUMMARY	PAGE 5 OF 8
TESTED BY: E. Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED	DEVICE: 77P8L2-1
APPROVED BY: Jim Watt, CRA	MATERIALS & CONTROLS GROUP	REQ.: PS 97-14
DATE: April 04, 1997	ATLSONO, MASSACHUSETTS 01915	FILE NAME: IP TESTING

## IN-PROCESS IP-2 TEST SUMMARY (PS 97-14)

2.8 Fluid Resistance (The Fluid Resistance portion of testing was not repeated as this series of tests are once/ year only)

Devices tested: TI #19 through #54.

Equipment : Fluids as called out in ES table (frame 12 of 18); appropriate beakers and storage apparatus; vented hood.

Results: The 38 devices were divided into groups as follows for subsequent testing. Results of these tests are reported below.

Impulse:	#19 through 30
Terminal Strength:	#31 through 42
Humidity:	#43 through 48
Salt Spray:	#49 through 54

### 2.6.1 Impulse (#19 through 30)

Calibration Pre-test Results: The average actuation was 129.6 psig, and the standard deviation was 3.5. All values were well within the specification. The average release was 64.3 psig, and the standard deviation was 5.7. All values were well within the 20 psig minimum specification.

Calibration Post-test Results: The average actuation was 116.1 psig, and the standard deviation was 3.4. All values were well within the specification. The average release was 65.2, and the standard deviation was 3.9. All values were well within the 20 psig minimum specification.

Voltage Drop Pre-test Results: Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

Voltage Drop Post-test Results: Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

Current Leakage Pre-test Results: Statistics not calculated. All values were well below the specification of 100 microamps.

Current Leakage Post-test Results: Statistics not calculated. All values were well below the specification of 100 microamps.

Proof Pre-test Results: No evidence of fluid leakage and no drop in test pressure observed on any device.

Proof Post-test Results: No evidence of fluid leakage and no drop in test pressure observed on any device.

All twelve switches met the acceptance criteria in the Ford ES specification.

CUSTOMER: Ford Motor Co.	TEST: IN-PROCESS IP-2 TEST SUMMARY	PAGE 6 OF 8
TESTED BY: E. Ross/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED	DEVICE: 77P8L2-1
APPROVED BY: Jim West, QRA	MATERIALS & CONTROLS GROUP	DOC.: PS 97-14
DATE: April 04, 1997	ATTLEBORO, MASSACHUSETTS 02708	FILE NAME: IP TESTING

## IN-PROCESS IP-2 TEST SUMMARY (PS 97-14)

### 2.8.2 Terminal Strength (#31 through 42)

**Calibration Pre-test Results:** The average actuation was 120.9 psig, and the standard deviation was 5.2. All values were well within the specification. The average release was 61.7 psig, and the standard deviation was 5.8. All values were well within the 20 psig minimum specification.

**Calibration Post-test Results:** The average actuation was 131.3 psig, and the standard deviation was 4.7. All values were well within the specification. The average release was 64.5, and the standard deviation was 4.8. All values were well within the 20 psig minimum specification.

**Voltage Drop Pre-test Results:** Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

**Voltage Drop Post-test Results:** Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

**Current Leakage Pre-test Results:** Statistics not calculated. All values were well below the specification of 100 microamps.

**Current Leakage Post-test Results:** Statistics not calculated. All values were well below the specification of 100 microamps.

**Proof Pre-test Results:** No evidence of fluid leakage and no drop in test pressure observed on any device.

**Proof Post-test Results:** No evidence of fluid leakage and no drop in test pressure observed on any device.

All twelve switches met the acceptance criteria in the Ford ES specification.

### 2.8.3 Humidity (#43 through 48)

**Calibration Pre-test Results:** The average actuation was 132 psig, and the standard deviation was 3.9. All values were well within the specification. The average release was 61.4 psig, and the standard deviation was 1.8. All values were well within the 20 psig minimum specification.

**Calibration Post-test Results:** The average actuation was 141.4 psig, and the standard deviation was 6.6. All values were well within the specification. The average release was 63.8, and the standard deviation was 6.1. All values were well within the 20 psig minimum specification.

**Voltage Drop Pre-test Results:** Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

CUSTOMER: Ford Motor Co.	TEST: IN-PROCESS IP-2 TEST SUMMARY	PAGE 7 OF 8
TESTED BY: E. Ross/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED MATERIALS & CONTROLS GROUP ATLANTIC, MASSACHUSETTS 02708	DEVICE: 77PBL2-1
APPROVED BY: Jim Wall, QRA		DOC.: PS 97-14
DATE: April 04, 1997		FILE NAME: IP TESTING

## IN-PROCESS IP-2 TEST SUMMARY (PS 97-14)

**Voltage Drop Post-test Results:** Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

**Current Leakage Pre-test Results:** Statistics not calculated. All values were well below the specification of 100 microamps.

**Current Leakage Post-test Results:** Statistics not calculated. All values were well below the specification of 100 microamps.

**Proof Pre-test Results:** No evidence of fluid leakage and no drop in test pressure observed on any device.

**Proof Post-test Results:** No evidence of fluid leakage and no drop in test pressure observed on any device.

All six switches met the acceptance criteria in the Ford ES specification.

### 2.8.4 Salt Spray (#49 through 54)

**Calibration Pre-test Results:** The average actuation was 131.7 psig, and the standard deviation was 3.8. All values were well within the specification. The average release was 87.9 psig, and the standard deviation was 5.3. All values were well within the 20 psig minimum specification.

**Calibration Post-test Results:** The average actuation was 136.9 psig, and the standard deviation was 5.8. All values were well within the specification. The average release was 88.0, and the standard deviation was 5.9. All values were well within the 20 psig minimum specification.

**Voltage Drop Pre-test Results:** Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

**Voltage Drop Post-test Results:** Statistics not calculated. All values were well within the specification of 200 millivolts maximum.

**Current Leakage Pre-test Results:** Statistics not calculated. All values were well below the specification of 100 microamps.

**Current Leakage Post-test Results:** Statistics not calculated. All values were well below the specification of 100 microamps.

**Proof Pre-test Results:** No evidence of fluid leakage and no drop in test pressure observed on any device.

**Proof Post-test Results:** No evidence of fluid leakage and no drop in test pressure observed on any device.

<b>CUSTOMER:</b> Ford Motor Co.	<b>TEST:</b> IN-PROCESS IP-2 TEST SUMMARY	<b>PAGE</b> 8 <b>OF</b> 8
<b>TESTED BY:</b> E. Ross/ Eng Lab	<b>TEXAS INSTRUMENTS INCORPORATED</b>	<b>DEVICE:</b> 77P8L2-1
<b>APPROVED BY:</b> Jim West, QRA	<b>MATERIALS &amp; CONTROLS GROUP</b>	<b>DOC.:</b> PS 97-14
<b>DATE:</b> April 04, 1997	<b>ATTLEBORO, MASSACHUSETTS 02703</b>	<b>FILE NAME:</b> IP TESTING

**IN-PROCESS IP-2 TEST SUMMARY (PS 97-14)**

All six switches met the acceptance criteria in the Ford ES specification.

Pre-test and post-test actual switch test results are attached at the end of this test summary.

<b>CUSTOMER:</b> Ford Motor Co.	<b>TEST:</b> IN-PROCESS IP-2 TEST SUMMARY	<b>PAGE:</b> 8 OF 8
<b>TESTED BY:</b> E. Ross/ Eng Lab	<b>TEXAS INSTRUMENTS INCORPORATED</b> MATERIALS & CONTROLS GROUP ATTLEBORO, MASSACHUSETTS 02703	<b>DEVICE:</b> 77PSL2-1
<b>APPROVED BY:</b> Jim Walk, QRA		<b>DOC.:</b> PS 97-14
<b>DATE:</b> April 04, 1997		<b>FILE NAME:</b> IP TESTING



**IN-PROCESS IP-2 TEST SUMMARY (PS 97-14)**

<b>CUSTOMER:</b> Ford Motor Co.	<b>TEST:</b> IN-PROCESS IP-2 TEST SUMMARY	<b>PAGE</b> 10 <b>OF</b> 8
<b>TESTED BY:</b> E. Rose/ Eng Lab	<b>TEXAS INSTRUMENTS INCORPORATED</b> MATERIALS & CONTROLS GROUP ATLEBORO, MASSACHUSETTS 02703	<b>DEVICE:</b> 77P8L2-1
<b>APPROVED BY:</b> Jim Watt, QRA		<b>DOC.:</b> PS 97-14
<b>DATE:</b> Apr 04, 1997		<b>FILE NAME:</b> IP TESTING

**TI-NHTSA 012088**

**IP -2 TESTS****FORD REQ'MT**

\*\*\* SCHEDULED FOR SPRING & FALL YEARLY PER TI BASED ON FORD REQ'MT  
FOLLOW FORD SPEC REQ'MT PER TEST

PART #	TIME FRAME	TEST PERFORMED
77P8L3-3	Jun-86	ALL
87P8F3-3	Oct-86	ALL
77P8L3-2	Jan-88	ALL
57P8L2-2	Aug-86	ALL
77P8L6-2	Aug-86	ALL
77P8L3-1	Mar-87	PARTIAL no fluid resistance
77P8	DUE 10/87	

90<sup>7</sup>  
70

2424

3314

**IP -2 TESTS****FORD REQ'NT**

\*\*\* SCHEDULED FOR SPRING & FALL YEARLY PER TI BASED ON FORD REQ'NT  
FOLLOW FORD SPEC REQ'NT PER TEST

<b>PART #</b>	<b>TIME FRAME</b>	<b>TEST PERFORMED</b>
77P8L3-3	Jun-86	ALL
57P8F3-3	Oct-86	ALL
77P8L3-2	Jan-86	ALL
87P8L2-2	Aug-86	ALL
77P8L3-2	Aug-86	ALL
77P8L2-1	Mar-87	PARTIAL no fluid resistance
77P8	DUE 1Q/87	

77 Yields

Hi Joe,

These are the yields for 77P8L3-1 for '95, '96, '97.

I am also sending you the customer returns we have gotten since '95. There were 15 devices returned with trouble not found, and a bulk return of 25 devices which was a failure due to the customer. Even those were not result of functional failure.

In terms of specs, this is the 77P8L3-1 data

Device	funct.	Activation	Release
77P8L3-1	brake	90-200	20 min

Our internal specs are much tighter.

Let me know if you need anything else.

Regards,  
Valentina

Post-It <sup>®</sup> brand fax transmittal memo 7571		# of pages > 5
To: JOE KORLEZ	From: Valentina Vidava	
Co:	Co:	
Dept:	Phone: (508) 236-1953	
Fax: (508) 237-2086	Fax: (508) 236-3586	

77PS PRESSURE TEST YIELDS

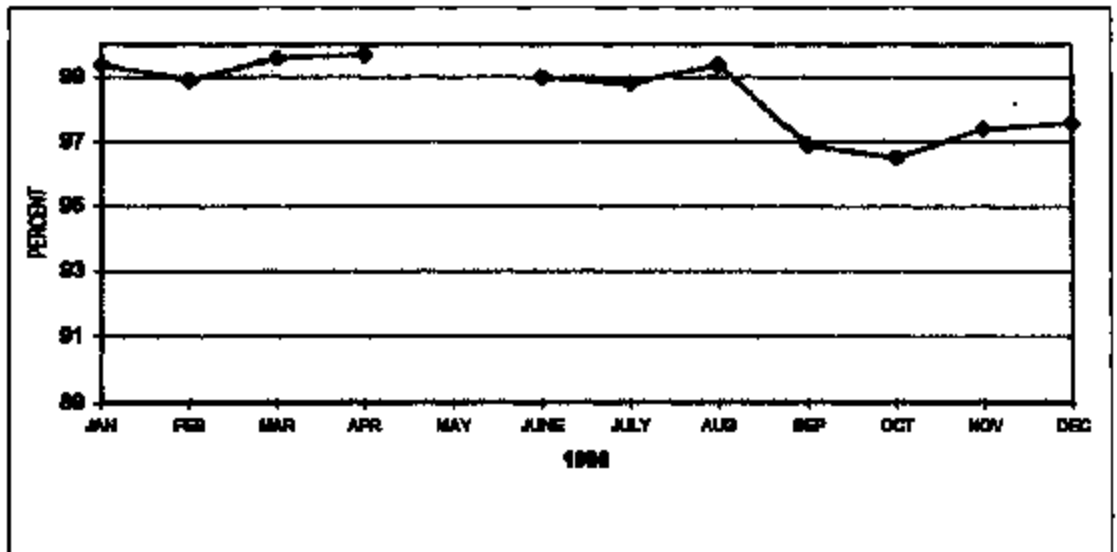
DEVICE: 77PSL3-1

MONTH OF: Dec-96

TESTED	26918		
GOOD	26211	GOOD	97.5%
BAD	707	BAD	2.4%

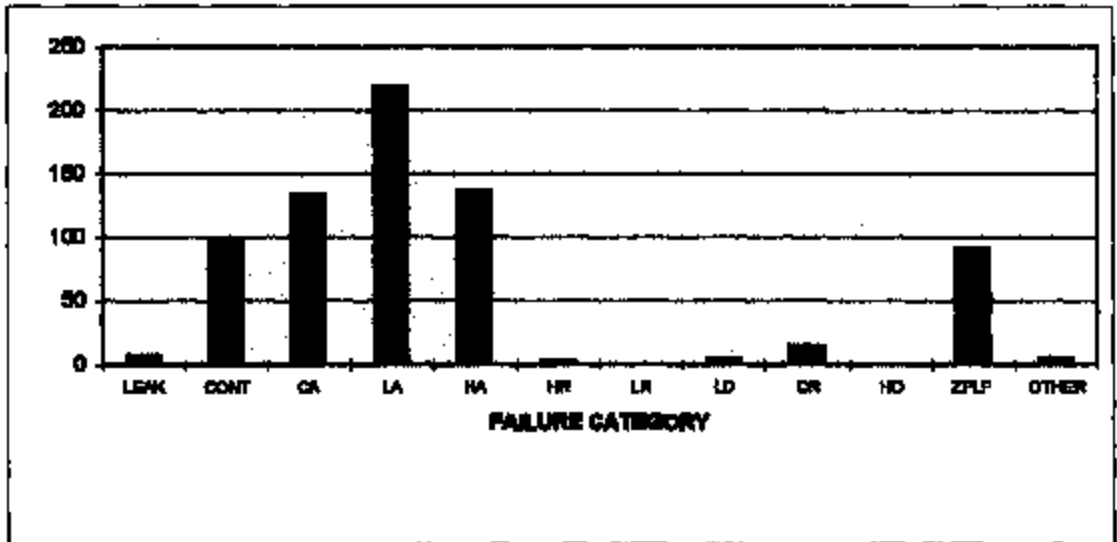
1996 MONTHLY YIELDS

JAN	99.4
FEB	98.9
MAR	99.6
APR	99.7
MAY	
JUNE	99.0
JULY	98.8
AUG	99.4
SEP	98.9
OCT	98.5
NOV	97.4
DEC	97.6



FALLOUT:

LEAK	7	.02%
CONT	98	.33%
CA	133	.48%
LA	219	.78%
HA	136	.47%
HR	3	.01%
LR	0	.00%
LD	4	.01%
CR	14	.05%
HD	0	.00%
ZPLF	90	.31%
OTHER	6	.02%



COMMENTS:

TI-NHTSA 012093

77PS PRESSURE TEST YIELDS

DEVICE: 77PSL3-1

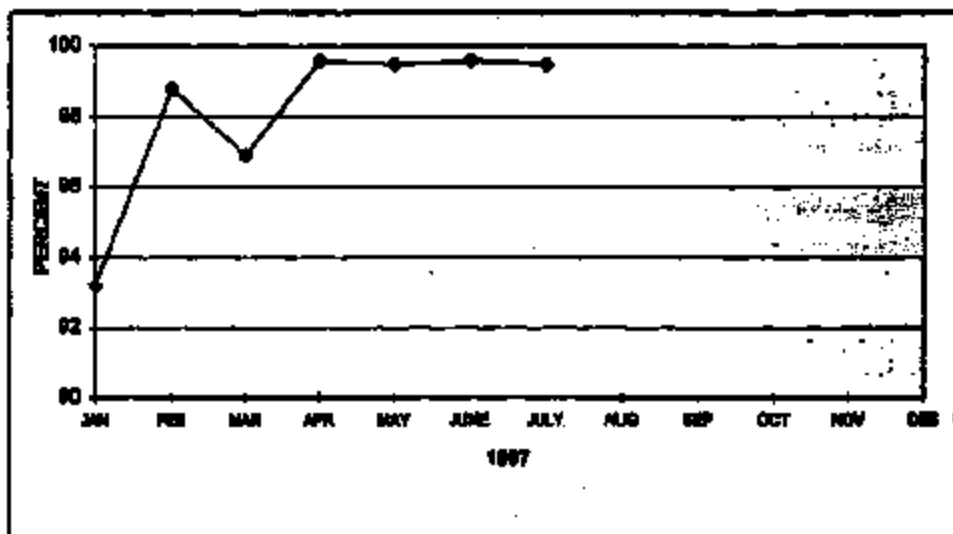
MONTH OF: Jul-87

TESTED 32438  
 GOOD 32266  
 BAD 171

GOOD 99.5%  
 BAD 0.5%

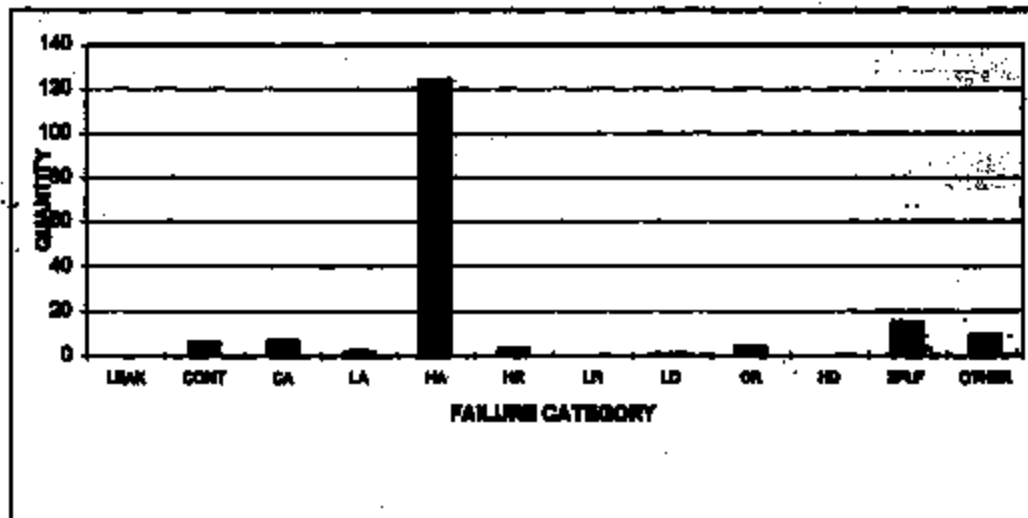
1987 MONTHLY YIELDS

JAN 93.2  
 FEB 98.5  
 MAR 99.9  
 APR 99.8  
 MAY 99.5  
 JUNE 99.6  
 JULY 99.6  
 AUG  
 SEP  
 OCT  
 NOV  
 DEC



FALLOUT:

LEAK  
 CONT 6 .02%  
 CA 7 .02%  
 LA 2 .01%  
 HA 124 .38%  
 HR 3 .01%  
 LR  
 LD 1 .00%  
 CR 4 .01%  
 HD  
 ZPLF 15 .05%  
 OTHER 9 .03%



COMMENTS:

TI-NHTBA 012094

77PS PRESSURE TEST YIELDS

DEVICE: 77PSL3-1

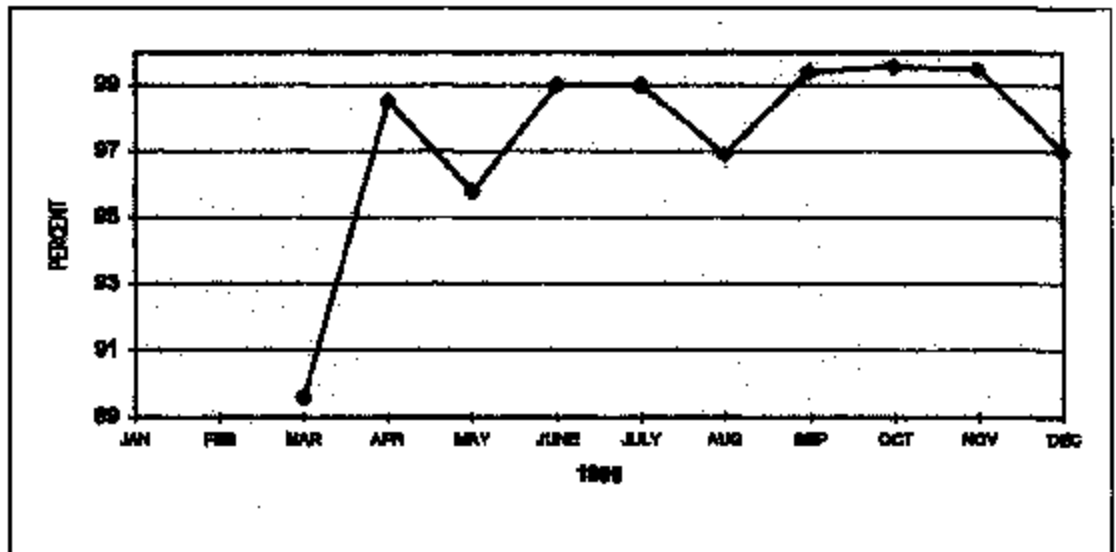
MONTH OF: Dec-85

TESTED 28719  
 GOOD 27857  
 BAD 862

GOOD 97.0%  
 BAD 3.0%

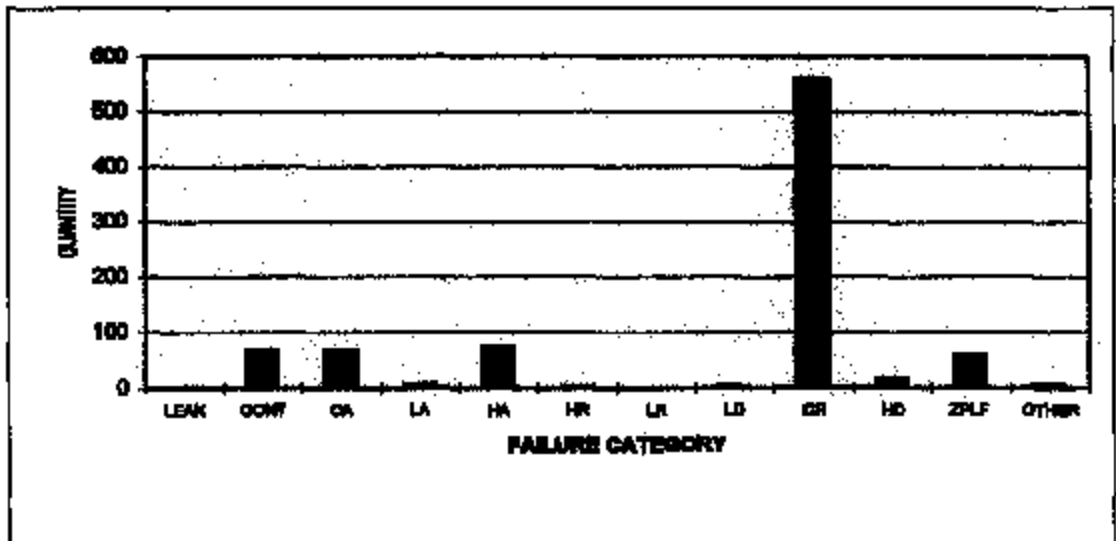
1985 MONTHLY YIELDS

JAN  
 FEB  
 MAR 89.6  
 APR 98.5  
 MAY 95.8  
 JUNE 98.0  
 JULY 99.0  
 AUG 98.9  
 SEP 99.4  
 OCT 99.8  
 NOV 99.5  
 DEC 97.0



FALLOUT:

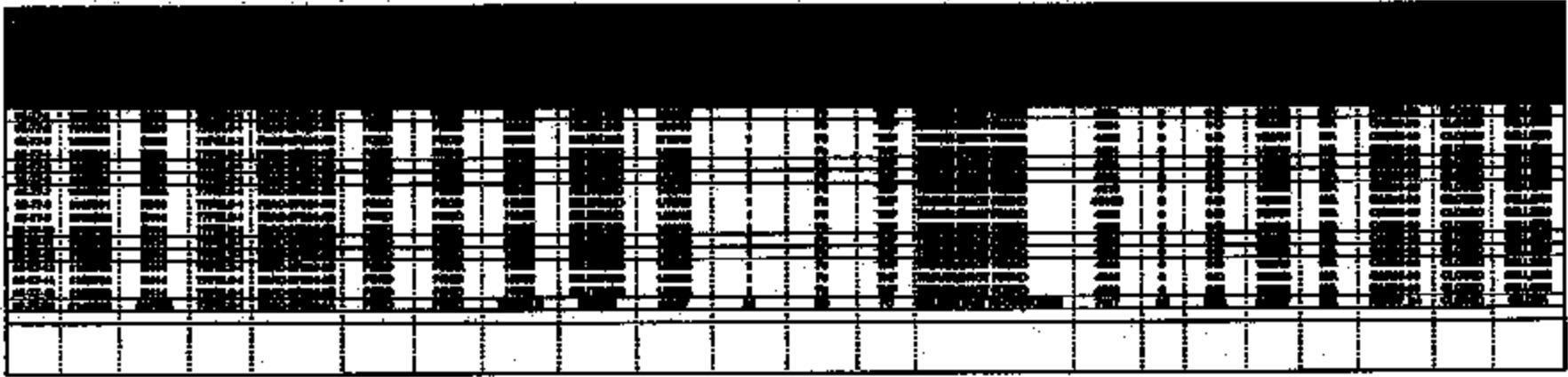
LEAK 1 .00%  
 CONT 68 .24%  
 CA 68 .24%  
 LA 7 .02%  
 HA 73 .25%  
 HR 3 .01%  
 LR 0 .00%  
 LD 4 .01%  
 CR 560 1.95%  
 HD 16 .06%  
 ZPLF 67 .20%  
 OTHER 5 .02%



COMMENTS:

TI-NHTSA 012093





The table content is almost entirely obscured by a large black redaction box. Only a few faint, illegible characters are visible at the top and bottom edges of the redacted area.

TI-NHTSA 012098

Joe,

This would be the summary of the 77PSL3-1 test settings:

24 pilots are made by hand. Those pilots are pressure tested. The pressure tester limits are:

Actuation	105 to 150 PSI
Release	20 to 135 PSI
Differential	15 to 130 PSI

In order for the device to go to production, the pilot mean actuation value has to be between 117 - 133 PSI; both actuation and release standard deviation has to be less than 8 PSI, and the mean differential has to be less than 50 PSI.

All the pilots have to test good in order for that lot to go to production.

All the production devices have to test good within the pressure tester limits stated above.

If there is anything else you need, please let me know.

Regards,  
Valentin

Phone: (508) 233-1253  
Page: (508) 236-1010, pg. # 1248  
Email: vvildeva@dl.com

TI-NHTSA 012097



34 Forest Street  
P.O. Box 2894  
Andover, MA 02702-0894

(603) 236-1800  
October 17, 1997

Bosch Automotive  
Brake Systems  
375 Bolvedere Drive  
Gallatin, TN 37066

Attn: Ms. Kerry Perry  
Supplier Quality Engineer

Subj: Allied Signal Pressure Switch P.N. 2234330  
TI P.N. 77FSL3-1

Ref: Your October 17, 1997 Telephone Call

Dear Kerry,

Enclosed, please find the Engineering Analysis Report for the recently switches. As we had discussed on the phone, the following information is provided relative to the (2) Bosch Automotive Pressure Switch P.N. 2234330 returned due to inoperative switches, caused by foreign debris on the terminals.

We would like to assist Bosch Automotive Brake Systems in identifying the source of the foreign debris on the terminals.

Please let me know if you have any questions. I can be reached at (308) 236-1719.

Regards,



Jim Watt  
DQA Engineer  
Automotive Sensors & Controls Business

encl: Engineering Analysis Report

cc: ~~James Masak~~, MS 23-4; John Pechonis, MS 12-29  
Joe Kozel, Supplier Quality Management Contact Engineer, Bosch, South Bend, IN  
Bob Dodd, TI-FER, Novi Michigan  
Andy McCruick, MS 23

TI-NHTSA 012098

**TEXAS INSTRUMENTS INCORPORATED  
CORRECTIVE ACTION REPORT**

<b>CAR Report Number:</b>	<b>CAR97_64</b>
<b>CAR Description:</b>	<b>Returned Device Analysis</b>

<b>TI Return Device Reference # (if any):</b>	<b>77-12 &amp; 77-13</b>
<b>TI CARE #:</b>	<b>2439881</b>

<b>Customer:</b>	<b>Bosch Brakes Systems</b>
<b>Customer Part Number:</b>	<b>2334330</b>
<b>TI Part Number:</b>	<b>77P8L3-1</b>
<b>Customer Rejection # (if any):</b>	<b>none noted</b>
<b>Customer Contact:</b>	<b>Kerry Perry</b>

<b>Date of initial report:</b>	<b>10/17/97</b>
<b>Date of this updated report:</b>	<b>10/17/97</b>
<b>Next report update due:</b>	<b>10/24/97</b>

<b>CAR Status:</b>	<b>OPEN</b>
--------------------	-------------

**Champion and Team Members**

<b>Quality Assurance Engineering:</b>	<b>Jim Watt(Champion)</b>
<b>Manufacturing Engineering:</b>	<b>Valentina Videva</b>
<b>Design Engineering:</b>	<b>Di Ha</b>
<b>Manufacturing Superintendent:</b>	<b>Scott Martin</b>
<b>Manufacturing Supervisor</b>	<b>Joe Carmen</b>
<b>Marketing:</b>	<b>Joanne Masak</b>

**Problem Description**

On October 15, 1997, Texas Instruments was notified by Bosch Braking Systems Kerry Perry, Supplier Quality Engineer, that (12) 77P8L3-1 devices were reportedly found discrepant by the Ford St. Thomas, Canada, assembly plant. The switches were reportedly discrepant during the end of vehicle diagnostic run-up test, where the diagnostic discrepancy code indicated the switch as discrepant. (2) devices were returned to Texas Instruments and were received on 10/16/97 for analysis. The remaining devices were reportedly discarded by the Ford St. Thomas, Canada, assembly plant. The device date codes were noted as 7174, which indicates the switches were made in the June 1997 timeframe.

### Containment and Short Term Corrective Actions

Review and analysis of our internal fallout from the production tester did not indicate any unusual continuity fallout during the reported timeframes.

### Definition and Verification of Root Cause

1. **X-Ray:** Both returned devices were X-rayed, and did not reveal any anomalies. The contacts appeared to be in place, the contact arm appeared normal, and the ceramic pin appeared to be in position.
2. **Dielectric Testing:** Dielectric testing was conducted on both switches to assess whether particulate contamination could be affecting the contacts electrically. Dielectric breakdown voltage showed nominal on both switches. (Subsequent dielectric testing with a mating connector harness showed high voltage, up to 850 V, most probably due to the foreign debris causing a high resistance to the mating connector.)
3. **Calibration Testing:** Both devices were subsequently tested in the laboratory using T.I.'s custom designed pressure testers. A summary of results is shown in the table below. Calibration readings for actuation and release pressures were noted to be in the nominal range. Additionally, markings on the aluminum crimp showed that both switches were tested through production tester #3, and both successfully passed the production calibrator during calibration. (The calibrator has pogo pins, that only make contact with the top of the tips of the terminals. The calibrator does not engage any other part of the switch terminal.)
4. **Visual examination:** It was visibly noticeable that both switches had some type of foreign debris on the surface of the terminals. The substance and potential source of the observed foreign debris is being analyzed by the Texas Instruments' Technical Services Lab (TSL) on site. Scanning Electron Microscope (SEM) and Auger analysis can be utilized. We expect to have preliminary results by 10/24/97.
5. **Conclusion:** It appears that the foreign debris on the surface of the terminals are causing the noted anomalies at the St. Thomas assembly plant. The source of the debris may be from a process operation at the brake assembly plants in Gallatin, Tn, or San Luis, Mexico, or from the connector harness at the St. Thomas assembly plant. We have requested some additional information from Bosch Braking Systems, Gallatin, Tn as to the potential source of debris to the switch terminals after the subassembly leaves Gallatin, Tn. This information is significant in pursuing the source of the debris on the terminals.

### Life Test Laboratory Calibrations

Specification (77PSL3-1):

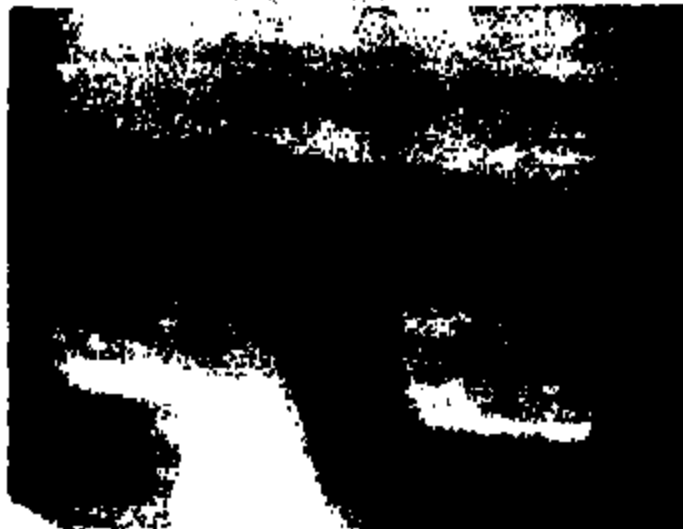
Actuation: 90 - 200 psig

Release: 20 psig minimum

TI Ref #	Date Code	Continuity Closed/Open	Pressure Test In Life Test @ Room Temp			Notes
			Act (psl)	Rel (psl)	mVD (mV)	
97-77-12	7174	Closed	132.8	101.2	0.3	
97-77-13	7174	Closed	134.0	100.1	0.3	

### Production Calibrations (Calibrator #3)

TI Ref #	Date Code	Continuity Closed/Open	Pressure Test In Calibration Tester #3 @ Room Temp			Notes
			Act (psl)	Rel (psl)	mVD (mV)	
97-77-12	7174	Closed	129.4	97.4	pass	
97-77-13	7174	Closed	131.0	100.9	pass	



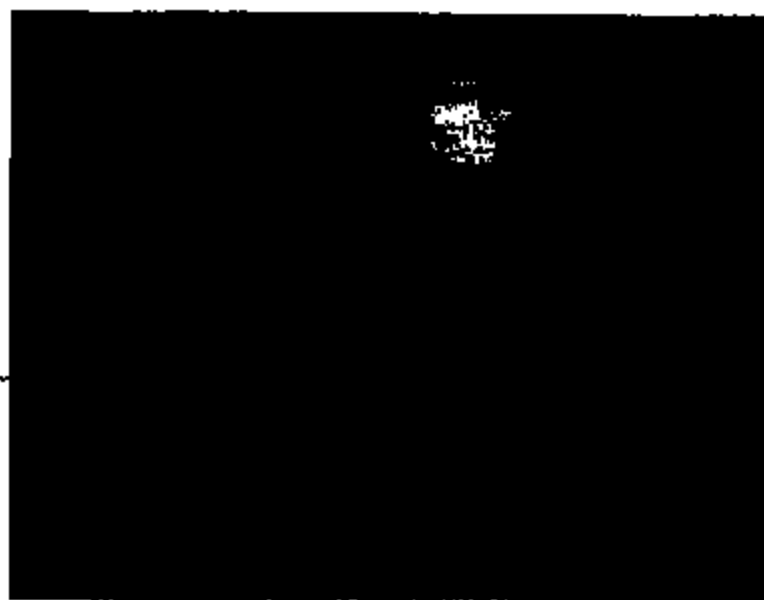
#12



#12



#13



#13



**Hopkins, Al**

---

**From:** Hopkins, Al  
**Sent:** Wednesday, October 29, 1997 7:52 AM  
**To:** Pechonis, John; Watt, Jim  
**Cc:** Kil, Elizabeth; Andras, Amy; Ha, Di; Sluzdak, Allan  
**Subject:** RE: 97-444: TSL # 1448833: CHECK FOR CORROSION ON TERMINALS OF 77PSC 3-1

No, they are not similar at all. This is not material that you would deliberately put on your terminals. As I said, it is something like a varnish in consistency.

Hope this helps.

Al

---

**From:** Watt, Jim  
**Sent:** Wednesday, October 29, 1997 7:41 AM  
**To:** Hopkins, Al; Pechonis, John  
**Subject:** RE: 97-444: TSL # 1448833: CHECK FOR CORROSION ON TERMINALS OF 77PSC 3-1

Al

Thanks for the update,

Can we conclude preliminary the source of the film from:

Wash/ cleaning process? I.e., elements similar to what is found in wash solutions?

Thanks,

Jim Watt, ms 12-33; msg id: jw02 page (0898)  
Ph (508) 238-1719; fax (508) 238-3163

-----Original Message-----

**From:** Hopkins, Al  
**Sent:** Tuesday, October 28, 1997 4:14 PM  
**To:** Ha, Di  
**Cc:** Andras, Amy; Kil, Elizabeth; Sluzdak, Allan; Watt, Jim  
**Subject:** 97-444: TSL # 1448833: CHECK FOR CORROSION ON TERMINALS OF 77PSC 3-1

**OBJECTIVE:**

Check for corrosion on terminals and determine cause.

**CONCLUSIONS:**

We didn't see large amounts of corrosion. Instead, the deposits are due to an organic film that has coated the terminals. This film would be expected to cause contact resistance problems.

**RESULTS AND DISCUSSION:**

The samples were examined by means of SEM-EDAX (Scanning Electron

Microscope with Energy Dispersive Analysis of X-rays) analysis and FT/IR analysis. The former showed that the darkish deposits had the same composition as the lighter material which covered all areas of the terminal except where it had been pushed away. This material contained mainly carbon with some oxygen. We also saw sporadic and lesser amounts of other species such as aluminum and silicon but I suspect that they are from dust or dirt particles which were entrained into the organic matrix. We also saw some tin-rich areas; what is the mating contact material.

Please explore with the customer what could be the source of this organic contamination. It has the consistency of a dried varnish-like material. The FT/IR analysis was inconclusive. However, if it is necessary, there are some avenues that could be taken to attempt to get a better ID of this material. Let us know what the customer has to say.

The data will be sent through the internal mail by Bernadette Maynard (3044).

AL HOPKINS

MSG ID: AHOP

PHONE: 508/236-3040

**Hopkins, Al**

---

**From:** Hopkins, Al  
**Sent:** Friday, November 28, 1997 1:45 PM  
**To:** Ha, DI  
**Subject:** RE: 97-444: TSL # 1445833: CHECK FOR CORROSION ON TERMINALS OF 77PSC 3-1

Di,

Did you get what you needed? The data is being sent to you by Bernadette.

Regards,

Al

**From:** Hopkins, Al  
**Sent:** Tuesday, October 28, 1997 4:18 PM  
**To:** Ha, DI  
**Co:** Andree, Amy; KIL, Elizabeth; Skuzdak, Allen; Watt, Jim  
**Subject:** 97-444: TSL # 1445833: CHECK FOR CORROSION ON TERMINALS OF 77PSC 3-1

**OBJECTIVE:**

Check for corrosion on terminals and determine cause.

**CONCLUSIONS:**

We didn't see large amounts of corrosion. Instead, the deposits are due to an organic film that has coated the terminals. This film would be expected to cause contact resistance problems.

**RESULTS AND DISCUSSION:**

The samples were examined by means of SEM-EDAX (Scanning Electron Microscope with Energy Dispersive Analysis of X-rays) analysis and FT/IR analysis. The former showed that the darkish deposits had the same composition as the lighter material which covered all areas of the terminal except where it had been pushed away. This material contained mainly carbon with some oxygen. We also saw sporadic and lesser amounts of other species such as aluminum and silicon but I suspect that they are from dust or dirt particles which were entrained into the organic matrix. We also saw some tin-rich areas; what is the mating contact material.

Please explore with the customer what could be the source of this organic contamination. It has the consistency of a dried varnish-like material. The FT/IR analysis was inconclusive. However, if it is necessary, there are some avenues that could be taken to attempt to get a better ID of this material. Let us know what the customer has to say.

The data will be sent through the internal mail by Bernadette Maynard (3044).

AL HOPKINS

MSG ID: AHOP

PHONE: 508/236-3040

**Hopkins, Al**

---

**From:** Ha, DI  
**Sent:** Tuesday, December 02, 1997 8:37 AM  
**To:** Hopkins, Al  
**Subject:** RE: 97-444: TSL # 1448833: CHECK FOR CORROSION ON TERMINALS OF 77PSC 3-1

Al,

Thank you for your help. We have passed the information along to our customer and they will look in their process to see where the contamination may have come from.

Regards,  
DI

---

**From:** Hopkins, Al  
**Sent:** Friday, November 28, 1997 1:41 PM  
**To:** Ha, DI  
**Subject:** RE: 97-444: TSL # 1448833: CHECK FOR CORROSION ON TERMINALS OF 77PSC 3-1

DI,

Did you get what you needed? The data is being sent to you by Bernadette.

Regards,

Al

---

**From:** Hopkins, Al  
**Sent:** Tuesday, October 28, 1997 4:16 PM  
**To:** Ha, DI  
**Cc:** Andrea, Amy; KUI, Elizabeth; Skuzdek, Allen; West, Jim  
**Subject:** 97-444: TSL # 1448833: CHECK FOR CORROSION ON TERMINALS OF 77PSC 3-1

**OBJECTIVE:**

Check for corrosion on terminals and determine cause.

**CONCLUSIONS:**

We didn't see large amounts of corrosion. Instead, the deposits are due to an organic film that has coated the terminals. This film would be expected to cause contact resistance problems.

**RESULTS AND DISCUSSION:**

The samples were examined by means of SEM-EDAX (Scanning Electron Microscope with Energy Dispersive Analysis of X-rays) analysis and FT/IR analysis. The former showed that the darkish deposits had the same composition as the lighter material which covered all areas of the terminal except where it had been pushed away. This material contained mainly carbon with some oxygen. We also saw sporadic and lesser amounts of other species such as aluminum and silicon but I suspect that they are from dust or dirt particles which were entrained into the organic matrix. We also saw some tin-rich areas; what is the mating contact material.

Please explore with the customer what could be the source of this organic contamination. It has the consistency of a dried varnish-like material.

The FT/IR analysis was inconclusive. However, if it is necessary, there are some avenues that could be taken to attempt to get a better ID of this material. Let us know what the customer has to say.

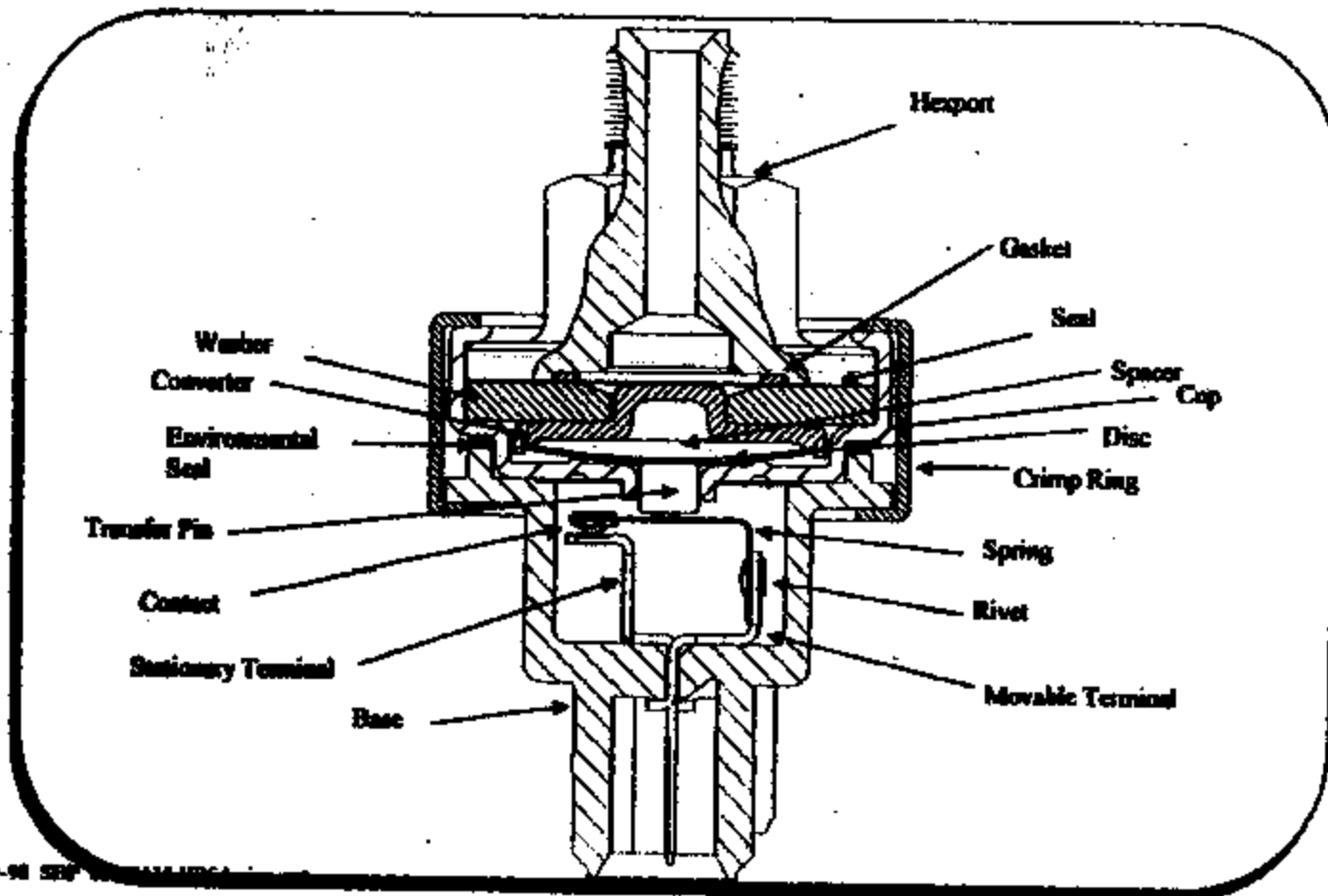
The data will be sent through the internal mail by Bernadette Maynard (3044).

AL HOPKINS

MSG ID: AHOP

PHONE: 508/236-3040

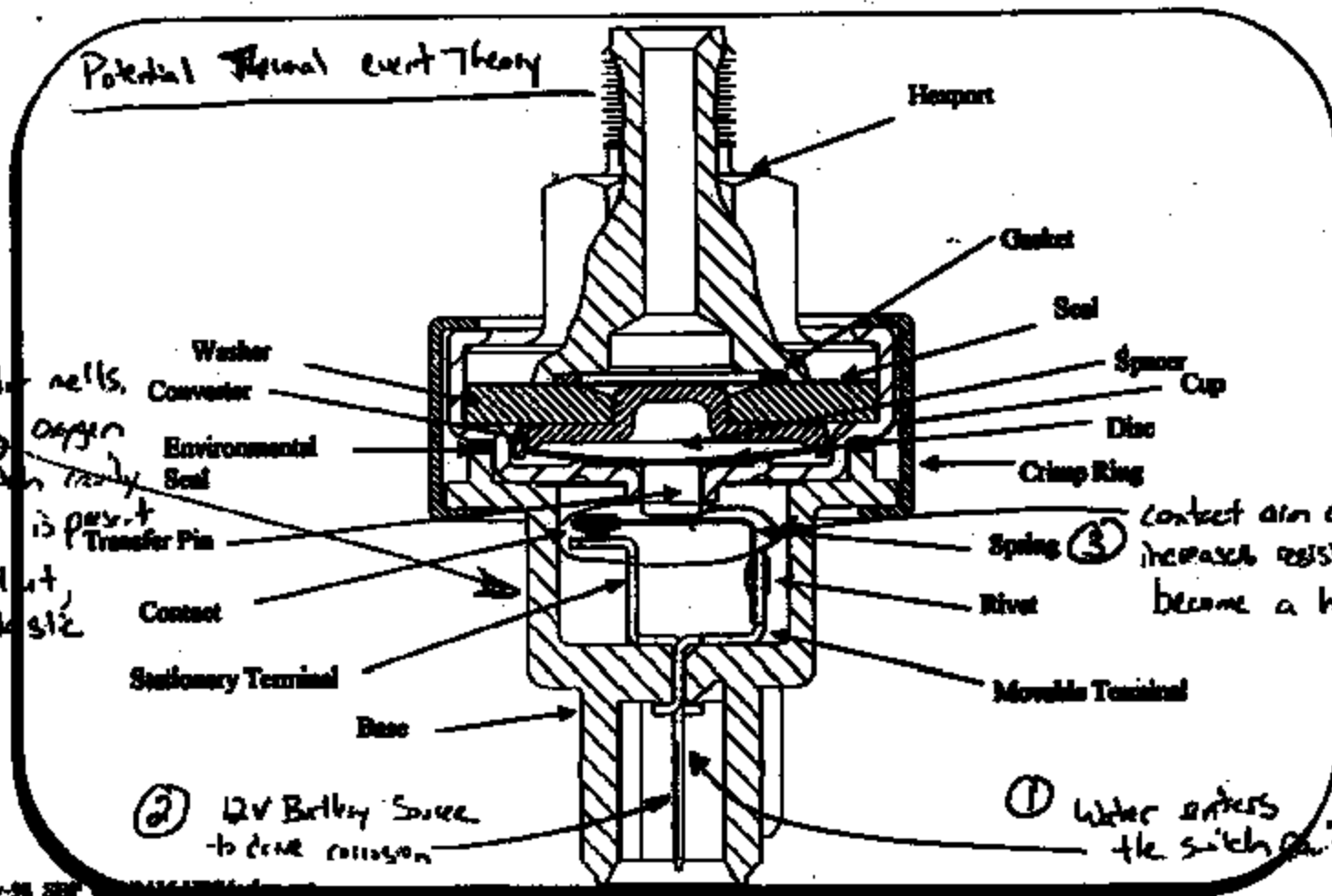
**Pressure Switch Cross Section**



CONFIDENTIAL

TI-NHTSA 012110

**Pressure Switch Cross Section**



Potential Thermal event Theory

⑤ Plastic connector melts. Once it opens oxygen enters the switch cavity. If any activity is present, a fire can start, during the plastic

③ Contact air corrosion increases resistance to become a heater

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

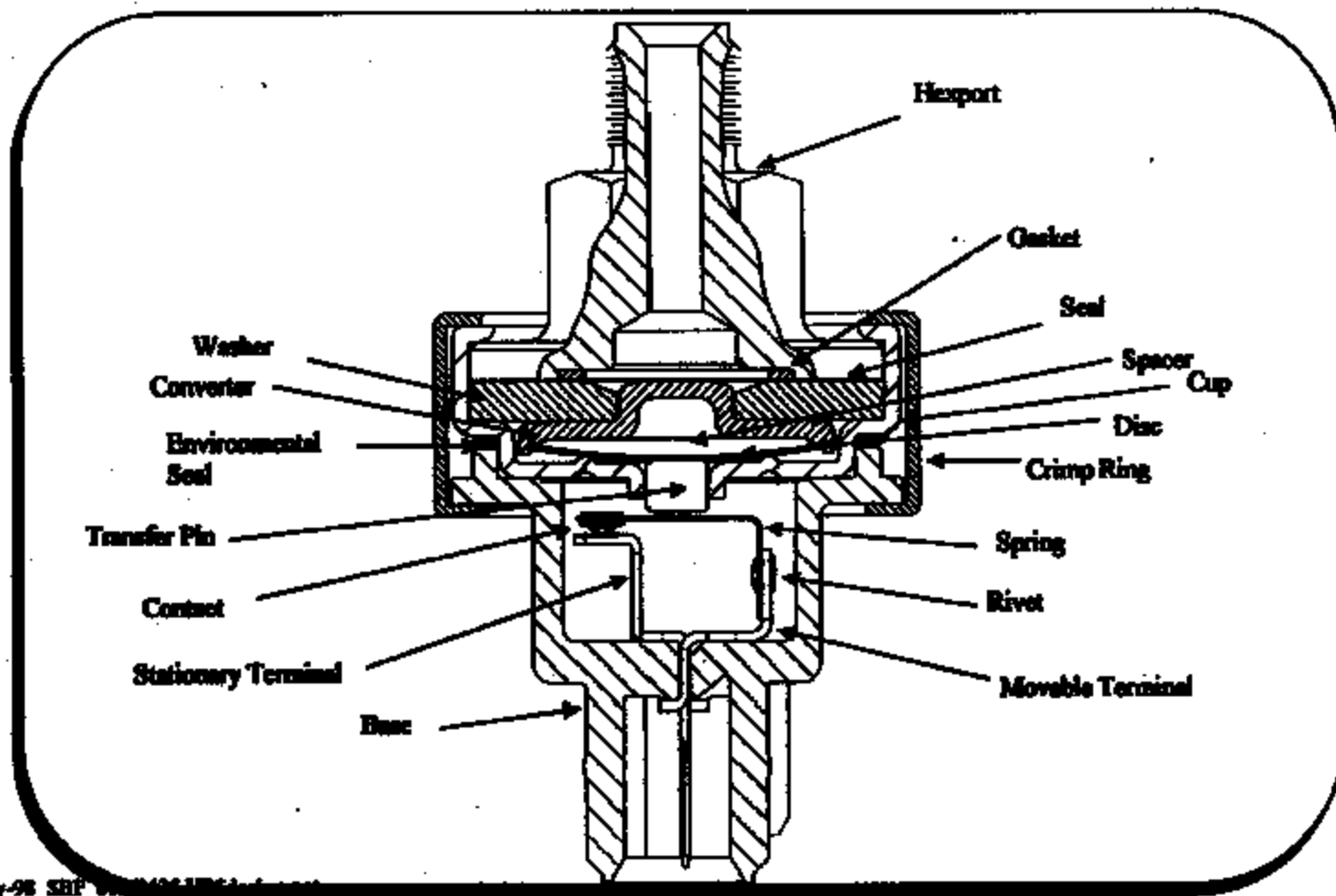
① Water enters the switch cavity

④ Damaged short to ground causes high current to pass through the switch

TI-NHTSA 012111

6 May 58

**Pressure Switch Cross Section**



TI-NHT9A 012112



PS/98/14

### Life Testing (to Failure) of 77PS Style Devices Summary of Test Series 559-15-24

Author: DI Ha. Design Engineering  
Date: April 8, 1998  
Report No.: PS/98/14

#### Purpose

The purpose of this test was to study the life expectancy of a 77PS style hydraulic pressure switch. The endurance test was run out to failure and a Weibull analysis performed. Failure was considered to be a leaking device.

#### Sample Description

The devices placed on test was a 77PS brake pressure switch with a quiet disc. The use of a quiet disc results in less energy in the system due to a smaller displacement of the disc during actuation and release. The 77PSL3-4 device was used for test. Calibration requirements for this device are as follows:

Actuation Pressure: 200-300 psig  
Release Pressure: 40 psig min.

#### Procedure

24 switches were built on the manufacturing line. These parts were then calibrated prior to impulse testing. Results are included in this report.

Endurance testing was run to the following specifications:

Temperature: 135C  
Frequency: 2Hz  
Total Cycles: 500,000  
Electrical Load:  
0-475,000 cycles: 13V +/- 1V, trace current  
475,001-500,000 cycles: 13 +/- 1V, 750 +/- 50 mA  
Operating Pressure:  
Pressure (Low): 0-40psig  
Pressure (High): 1400-1500 psig

After the completion of the 500,000 cycles, the switches were taken off test and calibrated to ensure they were functioning properly. They were then replaced on test and cycled to failure. The number of cycles at which each switch failed/leaked was noted. The test was stopped at 1,634,921 cycles. Six devices were on test when the test was suspended.

TI-NHT8A 012113

### **Results**

All 24 switches passed the specification requirement of 500,000 cycles. Actuation drift after cycling was normal, averaging less than 5%. All devices were within specification after the post-500K calibrations.

Failure of the devices was first seen at 994K. Failures were seen up to 1,634,921 cycles, when the test was stopped.

### **Conclusions**

Reliability of the switches to 500K cycles is 100 percent. However, we cannot guarantee a life cycle requirement of 1 million cycles, as there were leakage failures prior to the completion of 1 million cycles.

TI-NHTSA 012114

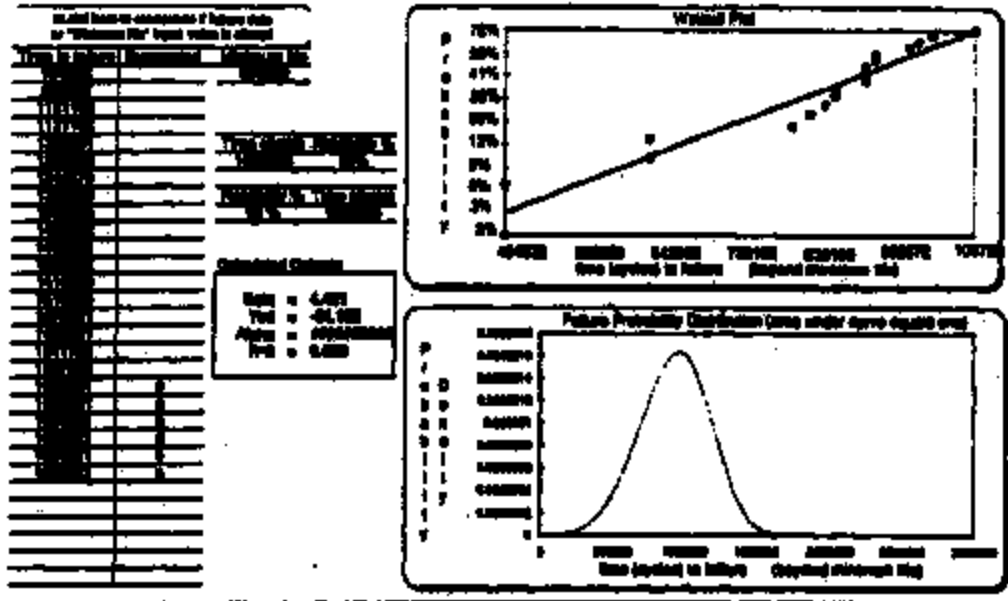
### Raw Data

Device	Pre-Fat Data			Post S99K			DHF (psi)	sprD (Lbf/Tool)	Act % Def	# Cycles to Failure
	Attention (psi)	Release (psi)	DMT (psi)	Attention (psi)	Release (psi)	DMT (psi)				
1	255.4	186.8	68.8	249.8	182.0	63.8	0.18	-3.8	**	
2	253.6	184.1	69.5	243.5	178.5	65.0	0.15	-4.0	1,587,699	
3	248.3	187.3	61.0	243.3	183.6	59.9	0.13	-1.9	**	
4	249.5	182.0	67.3	240.2	177.6	62.6	0.16	-3.7	**	
5	241.1	175.4	65.7	230.7	172.4	60.3	0.12	-3.5	1,403,523	
6	248.8	183.1	65.7	244.0	186.0	58.0	0.09	-1.9	1,302,691	
7	255.4	187.9	67.9	238.4	179.3	59.1	0.12	-6.8	1,344,675	
8	247.5	185.9	61.6	246.3	184.9	61.6	0.13	-0.4	1,403,523	
9	245.7	178.1	67.6	233.0	178.8	54.2	0.1	-5.2	1,403,523	
10	249.9	184.1	65.8	240.4	179.9	61.1	0.13	-3.8	1,131,102	
11	264.1	197.2	66.9	232.8	193.7	56.1	0.1	-4.3	994,232	
12	258.1	187.5	67.6	247.9	183.3	64.6	0.32	-2.8	**	
13	248.2	186.2	62.0	239.0	176.2	62.8	0.3	-3.7	1,488,321	
14	281.4	189.6	71.8	250.3	191.3	58.8	0.07	-4.2	994,232	
15	230.4	189.0	62.4	248.1	181.2	58.9	0.09	-4.1	1,131,102	
16	259.1	183.4	71.7	248.7	176.7	64.0	0.31	-5.6	1,399,679	
17	244.2	176.2	68.0	234.7	176.3	58.3	0.11	-3.9	1,418,290	
18	251.5	187.8	63.7	248.1	183.1	57.8	2.37	-4.5	1,472,621	
19	234.0	192.2	61.6	247.1	182.1	63.0	3.48	-2.7	1,311,786	
20	256.8	190.7	66.1	232.2	189.6	62.6	0.3	-1.8	1,418,290	
21	251.7	182.3	69.4	241.6	182.4	59.2	0.08	-4.0	1,323,190	
22	230.1	183.6	66.5	239.7	182.9	56.8	0.12	-4.3	1,359,699	
23	249.1	188.4	68.7	246.6	182.4	64.2	0.23	-1.0	**	
24	257.4	184.1	73.3	246.6	183.4	63.2	0.26	-4.2	**	
Average	251.9	183.2	66.7	242.8	182.8	60.8	0.4	-3.6	**	
Stdev	5.3	4.9	3.4	5.4	4.9	3.8	0.8	1.4	**	

\*\* indicates that these devices were impedance tested to 1,634,921 cycles without failure.  
The test was stopped with 1,434,921 cycles on 4/1/98.

# Weibull Analysis

## 2 and 3 parameter WEIBULL ANALYSIS



NOTE: 7700LL is inputting Young's

SI No. 4758

Charles Beebe

Status of Projects  
As of the week ending 5/8/98

**Two-piece Hexcup**

All FV testing is complete and results are under evaluation. Two switches failed Pressure Thermal cycling Test one because of creep(#1) the other because of leaking(#2). Upon inspection of switch 1 a reddish substance was found on the movable contact. The switch was sent to Al Hopkins at TSL for analysis. Inspection of switch 2 found that the kapton had ripped believed to have been caused by deformation of the washer that resulted from over crimping. A crimping matrix to determine the thrush hole crimping force on the HTT that will supply satisfactory burst pressure without deforming the washer is being determine. Maria, Mario and myself will run the matrix ASAP. Because of the demand to build ahead on the HTT, getting time to perform this test could be difficult. I will keep you and Al apprised of the situation.

One control switch failed Durability testing for continuity. Analysis is under way and results should be available next week.

**Misc.**

Perform several RDAs and prep work for Delphi visit for Al.

TI-NHTSA 012117



**Life Testing (to Failure) of 77PS Style Device  
Summary of Test Series 559-15-24**

**Author:** Di Ha, Design Engineering  
**Date:** April 8, 1998  
**Report No.:** PS/98/14

**Purpose**

The purpose of this test was to study the life expectancy of a 77PS style hydraulic pressure switch. The endurance test was run out to failure and a Weibull analysis performed. Failure was considered to be a leaking device.

**Sample Description**

The devices placed on test was a 77PS brake pressure switch with a quiet disc. The use of a quiet disc results in less energy in the system due to a smaller displacement of the disc during actuation and release. The 77PSL3-4 device was used for test. Calibration requirements for this device are as follows:

Actuation Pressure: 200-300 psig  
Release Pressure: 40 psig min.

**Procedure**

24 switches were built on the manufacturing line. These parts were then calibrated prior to impulse testing. Results are included in this report.

Endurance testing was run to the following specification:

Temperature: 135C  
Frequency: 2Hz  
Total Cycles: 500,000  
Electrical Load:  
0-475,000 cycles: 13V +/- 1V, trace current  
475,001-500,000 cycles: 13 +/- 1V, 750 +/- 50 mA  
Operating Pressures:  
Pressure (Low): 0-40psig  
Pressure (High): 1400-1500 psig.

After the completion of the 500,000 cycles, the switches were taken off test and calibrated to ensure they were functioning properly. They were then replaced on test and cycled to failure. The number of cycles at which each switch failed/leaked was noted. The test was stopped at 1,634,921 cycles. Six devices were on test when the test was suspended.

### **Results**

All 24 switches passed the specification requirement of 500,000 cycles. Actuation drift after cycling was normal, averaging less than 5%. All devices were within specification after the post-500K calibrations.

Failure of the devices was first seen at 994K. Failures were seen up to 1,634,921 cycles, when the test was stopped.

### **Conclusion**

Reliability of the switches to 500K cycles is 100 percent. However, we cannot guarantee a life cycle requirement of 1 million cycles, as there were leakage failures prior to the completion of 1 million cycles.



### Raw Data

Device	Pre-Test Data			Post 500K			mVD (LMBTest)	Act % Drift	# Cycles to Failure
	Actuation (psig)	Release (psig)	DIV (psig)	Actuation (psig)	Release (psig)	DIV (psig)			
1	255.6	186.8	68.8	245.8	182.0	63.8	0.18	-3.8	**
2	253.6	184.1	69.5	243.5	178.5	65.0	0.15	-4.0	1,587,659
3	248.3	187.3	61.0	243.5	183.6	59.9	0.13	-1.9	**
4	249.5	182.0	67.5	240.2	177.6	62.6	0.16	-3.7	**
5	241.1	175.4	65.7	232.7	172.4	60.3	0.12	-3.5	1,403,522
6	248.8	183.1	65.7	244.0	186.0	58.0	0.09	-1.9	1,302,691
7	255.8	187.9	67.9	238.4	179.3	59.1	0.12	-6.8	1,344,673
8	247.5	185.9	61.6	246.5	184.9	61.6	0.13	-0.4	1,403,522
9	245.7	176.1	67.6	233.0	178.8	54.2	0.1	-5.2	1,403,522
10	249.9	184.1	65.8	240.4	179.3	61.1	0.13	-3.8	1,131,102
11	264.1	197.2	66.9	252.8	193.7	59.1	0.1	-4.3	994,232
12	255.1	187.5	67.6	247.9	183.3	64.6	0.32	-2.8	**
13	248.2	186.2	62.0	239.0	176.2	62.8	0.3	-3.7	1,488,221
14	261.4	189.6	71.8	230.3	191.5	58.8	0.07	-4.2	994,232
15	250.4	188.0	62.4	240.1	181.2	58.9	0.09	-4.1	1,131,102
16	255.1	183.4	71.7	240.7	176.7	64.0	0.31	-5.6	1,359,659
17	244.2	176.2	68.0	234.7	176.2	58.5	0.11	-3.9	1,418,250
18	251.5	187.8	63.7	240.1	183.1	57.0	2.37	-4.5	1,472,621
19	254.0	192.2	61.8	247.1	182.1	65.0	3.48	-2.7	1,511,726
20	256.8	190.7	66.1	252.2	189.6	62.6	0.3	-1.8	1,418,250
21	251.7	182.3	69.4	241.6	182.4	59.2	0.08	-4.0	1,325,190
22	250.1	183.6	66.5	239.7	182.9	56.8	0.12	-4.2	1,359,659
23	249.1	180.4	68.7	246.6	182.4	64.2	0.22	-1.0	**
24	257.4	184.1	73.3	246.6	183.4	63.2	0.24	-4.2	**
Average	251.9	183.2	66.7	242.8	182.0	60.8	0.4	-3.6	**
Sigma	5.3	4.9	3.4	3.4	4.9	3.0	0.8	1.4	

\*\* Indicates that these devices were impulse tested to 1,634,921 cycles without failures.  
The test was stopped with 1,634,921 cycles on 4/1/98.



\*\*\*\*\***APPENDIX**\*\*\*\*\*

B. Dague 6/17/98

The following 2 pages were generated from historical data. This data was collected from switches that were similar to, but not exactly like the current 150PS. In addition, the test conditions were similar, but not exactly the same. Specifically, the following 2 tests were run with no vacuum cycles; positive pressure only. The type of brake fluid used in these tests was not documented, and these tests were run in 1993.

**Conclusions:**

Water in solution with brake fluid will degrade the performance of the diaphragm material. Since there are many undefined differences in these tests, the rate of degradation is difficult to define.





**Pechonis, John**

---

**From:** Proia, Stephen  
**Sent:** Thursday, October 22, 1998 12:13 PM  
**To:** Rowland, Thomas  
**Cc:** McGuirk, Andy; Bancosh, Bob; Tourangeau, Ray; Snyder, Gary; Beringhouse, Steven; Deque, Bryan; Charboneau, Tom; Pechonis, John; Meyer, Rick; Wozniak, John; Wellman, Stacy; Nichols, Winston; Fritzsche, Robert; Sherman, Paul; Suh, Sang-Hak; Tanaka, Akihiko; Braekema, Geert  
**Subject:** Hikes for week ending October 23, 1998

- We recently received approval from GM for our Phase III - final move to Mexico. As of November 2, 1998 our first shipment of 52PS will be shipped from the Mexico built inventory. TRW/Chrysler is the only customer remaining on our list that has not officially approved the transfer. In preparation of our PPAP for TRW we discovered discrepancies in TRW's print compared to the TI / Chrysler prints. TRW is currently working on correcting these errors and is reviewing TI's PPAP for approval. We will continue to work with TRW to insure a timely approval.
- Aeroquip Europe has returned (7) - 93PS devices that failed in the field due to no continuity. Initial results of our analysis show there is an interface problem between T2 terminal and the disc seat. Inputs from IMT concerning the T2 terminal issue confirm that this is in fact an issue they are aware of and are having difficulty maintaining T2 height capability. T2 terminal height is critical to the function of the device because it serves as an electrical contact to the disc seat. Without a reliable contact we will have no continuity / intermittent devices. Our efforts to contain this issue in the short term include 100% light meter test prior to shipment. Longer term we will be meeting with IMT and reviewing our production test capability to ensure we are capable of capturing bad/marginal product.
- We recently implemented a new automatic lubrication system on the HPS AMI2 sensor assembly line. The goal of this system was to improve crimp consistency, production throughput and minimize safety/quality issues. Preliminary data from the AMI crimp station shows that we have been successful in achieving a tighter distribution having reduced our standard deviation from 0.003" to 0.001". Future efforts will focus on quantifying this improvement in the form of final test yield.
- The new 5/8" IDFE line for Mexico is ready to test in the full auto feedback mode. Our heat treat correlation with oven bake study is complete with tests showing excellent repeatability. Efforts are now being focused on optimizing Force/deflection repeatability. As for training, Gabriel Vallejo is progressing well in his familiarity with machine operation and process trouble shooting.
- We continue to work with Delphi/DAC to understand the 91PS PMPS application. We have had (2) conference calls to-date including representatives from TIK, DAC, Delphi and TIA. The intent of these meetings have been to drive closure around DWMC vehicle test conditions and to accurately capture the driving conditions the switch will have to satisfy. In summary, our 91PS does not meet the current Delphi product specification as written today. Delphi has approved the use of the 0.010" snubber based on vehicle test performance which we have recently discovered does not include high speed testing and we are being challenged to deliver the first (4,000) unit production shipment by the end of November. Our team will be holding a management review of this program the week of 10/26 to discuss in further detail.

Regards,

LAST REVISION 11/81 by AW & LM

**PRESSURE SWITCH CROSS-REFERENCE LIST**

See changes

**TO BE USED FOR REFERENCE ONLY**

**INTERNAL DATA**

ITEM	CUSTOMER	PART NO.	DESCRIPTION	Unit	Actuator		Notes	port fitting/thread details				
					PSI	Temp		Port	Thread	Size	Material	Finish
1 77PBL3-1	FMC-SPRINT	77PBL3-1	Pressure Switch	Each	0-100	25 min	1/2" NPT	1/2" NPT	1/2"	304 SS	Polished	Opt
2 77PBL3-2	FMC-SPRINT	77PBL3-2	Pressure Switch	Each	0-100	40 min	1/2" NPT	1/2" NPT	1/2"	304 SS	Polished	Opt
3 77PBL3-3	FMC-SPRINT	77PBL3-3	Pressure Switch	Each	0-100	25 min	1/2" NPT	1/2" NPT	1/2"	304 SS	Polished	Opt
4 77PBL3-4	FMC-SPRINT	77PBL3-4	Pressure Switch	Each	0-100	25 min	1/2" NPT	1/2" NPT	1/2"	304 SS	Polished	Opt
5 77PBL3-5	FMC-SPRINT	77PBL3-5	Pressure Switch	Each	0-100	40 min	1/2" NPT	1/2" NPT	1/2"	304 SS	Polished	Opt
6 77PBL4-1	FMC-SPRINT	77PBL4-1	Pressure Switch	Each	0-100	25 min	1/2" NPT	1/2" NPT	1/2"	304 SS	Polished	Opt
7 77PBL4-2	FMC-SPRINT	77PBL4-2	Pressure Switch	Each	0-100	25 min	1/2" NPT	1/2" NPT	1/2"	304 SS	Polished	Opt
8 77PBL4-3	FMC-SPRINT	77PBL4-3	Pressure Switch	Each	0-100	25 min	1/2" NPT	1/2" NPT	1/2"	304 SS	Polished	Opt

TRANSBA 012127

**Dague, Bryan**

---

**From:** Douglas, Charles  
**Sent:** Tuesday, December 16, 1998 2:22 PM  
**To:** Dague, Bryan  
**Subject:** FW: Potential modes of failure for leakage

Charlie

**Charlie Douglas**  
**(508) 236-3687 (P)**  
**(508) 236-1588 (F)**  
**c-douglas2@it.com**

---

**From:** Ha, Di  
**Sent:** Thursday, October 29, 1998 11:26 AM  
**To:** Douglas, Charles  
**Subject:** Potential modes of failure for leakage

Charlie,  
Here's the list you requested for potential causes of switch leakage:

**System:**

- |   |                        |
|---|------------------------|
| • Device not screwed in properly  | Leakage at thread area |
| • Improper sealing due to mating part damage  | Leakage at thread area |
| • Device exposed to excessive pressure  | Burst device           |
| • Device exposed to excessive temperature   | Gasket seal impaired   |
| • Device exposed to excessive number of cycles  | Diaphragm leakage      |
| • Water (or other contaminants) in system degrades Kapton diaphragm                         | Diaphragm leakage      |
| • Water (or other contaminants) increases switch through base and causes Kapton degradation | Diaphragm leakage      |

**Manufacturing:**

- Misplaced/misling gasket
- Misplaced/misling Kapton
- Improper gasket material (incompatible with brake fluid)
- Incorrect # of Kapton (switches require 3 diaphragms because brake fluid is more aggressive)
- Incorrect sensor crimp
- Incorrect device crimp (fluid works its way in from the crimp to the base cavity into the sensor easy)

\*\*Note: Items in red would be associated with infant mortality

FYI, we have had a car fire occurrence involving our switch in the past. See PB/98/34 in which a 52PS device was analyzed after a car fire. Diagnostics showed that the switch leakage occurred after the fire due to the high temp, and not the other way around.

Please let me know if you need anything further.

Regards,  
Di

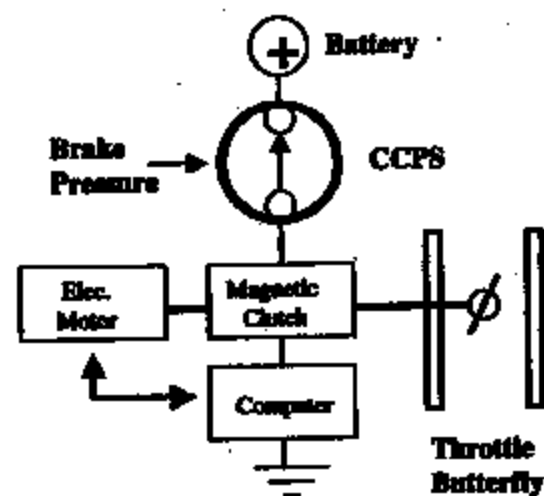


## Overview

- The CCPS is a redundant safety device designed for use in a vacuum-less electronic cruise control system.
- Functionally, it replaces the present vacuum dump valve by de-energizing a clutch which connects the throttle to an electronic actuator.
- It is plumbed into the brake line. When the driver applies pressure to the brake pedal, the normally-closed switch opens, disconnecting the actuator from the throttle butterfly.

### Specifications:

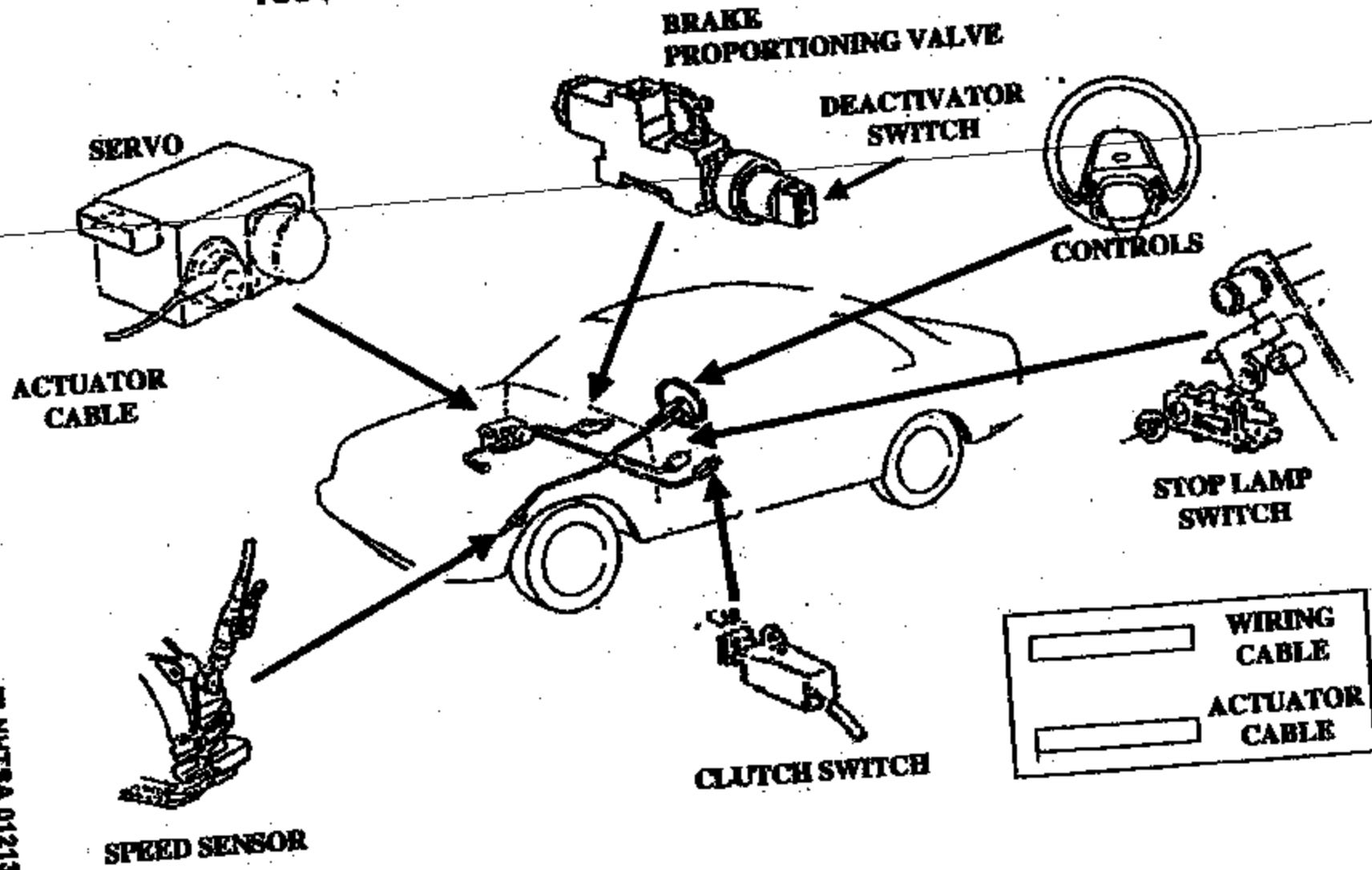
Actuation:	125 PSI +/- 35 250 PSI +/- 50
Release:	20 PSI min 40 PSI min
Burst:	7000 PSI
Proof:	3000 PSI 4000 PSI
Cycles:	500K, 0 - 1450 PSI, 2 Hz
Voltage:	Battery
Current:	0.75 AMP Inductive





# Automotive Sensors & Controls Cruise Control Pressure Switch

## 1991 Next Generation Speed Control System



71-NHTSA 01213



**TEXAS  
INSTRUMENTS**

**FACSIMILE TRANSMITTAL**

---

**TO:** *Rob Sharpe*

**COMPANY:** *Kovi*

Phone Number:

Fax Number: *248-305-5734*

**FROM:** *Charlie Douglas*

**TEXAS INSTRUMENTS INCORPORATED**

Phone Number: (508) 234-3657

FAX Number: (508) 234-1598

Total number of pages (including header page): 3

**COMMENTS:**

TI-NHTSA 012131

TEXAS INSTRUMENTS INCORPORATED • PO BOX 294 • 34 FOREST STREET • ATTLEBORO, MA 01735

TI-NHTBA 012132



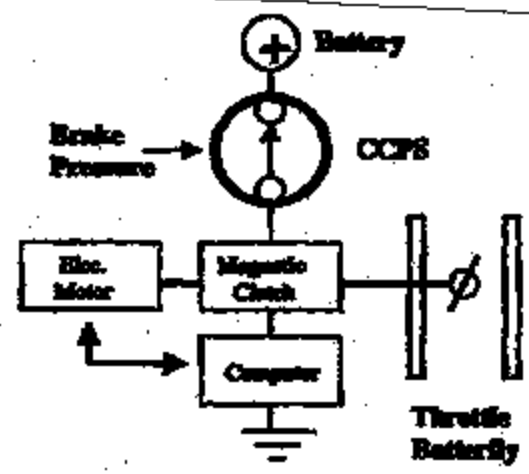
# Automotive Sensors & Controls Cruise Control Pressure Switch

## Overview

- The CCPS is a redundant safety device designed for use in a vacuum-less electronic cruise control system.
- Functionally, it replaces the present vacuum damp valve by de-energizing a clutch which connects the throttle to an electronic actuator.
- It is plumbed into the brake line. When the driver applies pressure to the brake pedal, the normally-closed switch opens, disconnecting the actuator from the throttle butterfly.

### Specifications:

Activation:	125 PSI +/- 35 250 PSI +/- 50
Release:	20 PSI min 40 PSI min
Burst:	7000 PSI
Proof:	3000 PSI 4000PSI
Cycles:	500K, 0 - 1450 PSI, 2 H <sub>2</sub>
Voltage:	Battery
Current:	0.75 AMP Inductive



**1991 Next Generation Speed Control System**

