EA02025

TEXAS INSTRUMENTS, INC.'S

09/10/03 LETTER TO ODI

REQUEST 9

BOX 12

PART A – O

PART D

Work Plan- Brake Pressure Switch

Root Cause Investigation-

Identify flammability characteristics of switch components
- **AVT EESE Materials Engineering**

Identify switch contaminants in parts returned from the field
- **Central Lab analysis**

Identify potential source of contaminants
- **Central Lab analysis**

Identify potential for and possible sources of internal brake switch leaks
- **Central Lab and Texas Instrument**

Identify potential ignition sources during switch operation/malfunction
- **AVT EESE Chassis Electronics**

Simulate potential switch malfunctions in a laboratory environment to evaluate the potential for ignition
- **AVT EESE Chassis Electronics**

Collect additional field samples (including connectors) for laboratory analysis
- **LVC - Safety**

Root Cause Investigation Tasks

What are the combustibles?

AVT EESE Materials Engineering

Are the switch materials compatible with brake fluid?
by 2/18/99

Are the switch materials compatible with brake fluid in an electric field?
by 2/18/99

Are the switch materials compatible with brake fluid and contaminants?
by 2/18/99

Are the switch materials compatible with contaminated brake fluid in an electric field? by 2/18/99

Give to [redacted] Norm LaPointe 2/10/99

Flash points for all materials? by 2/18/99
T. I

What is the difference in the base materials that look different?
Texas Instruments by *complete*

[redacted] Pete

What are the material call-outs for 1992 and 1993?
Texas Instruments by 2/18/99

What are the contaminants in returned parts?

Central Lab analysis

Results of Memphis part analysis by 2/18/99

Results of testing with corrosion simulation?
AVT EESE Chassis Electronics by *complete*
Black corrosion recreated in lab on virgin parts. Given to Lab for analysis

Give To Norm LaPointe 2/10/99

TI analysis results of the Memphis parts (crease marks in diaphragm, etc) ?
Texas Instruments by 2/18/99

What is source of contaminants?

Central Lab analysis **by 2/18/99**

What causes brake fluid leakage? **By 2/24/99**

Central Lab and Texas Instrument

What does TI DFEMA say about this failure mode?

DFMEA to Norm LaPointe 2/15/99

Texas Instruments by 2/16/99

What are TI in-process test failures?

IP-testing worked with Fred P. 2/14/99

Texas Instruments by 2/16/99

Does the event occur only on vehicles with ABS?

LVC-Safety by 2/18/99

What heat source(s) start event?

AVT EESE Chassis Electronics

Analysis of harness pig-tails

AVT EESE OPD by 2/18/99

Recreate Event in Lab

AVT EESE Chassis Electronics

What does it take to start an event? by on-going

If a switch is contaminated can it start the event? by on-going

Switch with clean Brake fluid inside is being monitored for increase in leakage current.

If current is stopped does combustion stop?

Collect Field Samples

LVC - Safety

Collect Brake Pressure switches and speed control servos with harnesses attached. By 2/22/99

Miscellaneous

Can the switch act as a fuse?
Team by complete
No.
Could a fuse (e.g. 2 amp) be added in series between the stop lamp fuse and the brake pressure switch? Failure parameters would have to be known.

What are descriptions from AWS and CQIS?
LVC-Safety by 2/18/99

What are we seeing in returned Speed control modules (FRACAS)?
Visteon Speed Control by 2/17/99

Provide color photos of Econoline?
Texas Instruments by *complete*
There are no color photos.

Containment / Corrective Action Tasks

Competitive Vehicles

How is switch packaged?
Is it always Powered (HOT_ALL_TIME) ?
Are the contacts opened when pressure applied?
What is fuse limit?
What is being switched?
Is it a redundant switch?

AVT EESE Competitive Analysis **by** **2/24/99**

What does Speed control FMEA say about Brake Switch ?

Visteon Speed Control **by** *completed*

The Brake Pressure Switch (Deactivation Switch) coupled with the Stop Lamp switch are categorizes as "Automatic Deactivation". The FMEA lists Automatic Deactivation" as current design control for 66 different potential cause mechanical failures.

Brake Pressure Switch (Deactivator Switch) is one of the most important safety features.

When was non-Pressure actuated switched introduced?

AVT EESE Chassis Electronics **by** *completed*

95 Continental and T'Bird were first to use it.

Is the Circuit drive hi-side or low-side?

Visteon Speed Control **by** *completed*

Circuit is low side driven.

How does speed control use this switch?

Visteon Speed Control **by** *completed*

1. *Brake Pressure Switch provides electrical power to the speed control servo clutch circuit The clutch circuit needs to be energized for the servo motor to pull the cable.*

2. *Switch provides a redundant method of sensing brake application independent of the primary system deactivation mode; this is a SDS (SC-0005) requirement.*

- *Signal from the stop lamp switch is primary deactivation mode for brake application.*
- *<u>Under "hard" braking condition</u>: Brake Pressure Switch provides redundant brake signal to the speed control logic (similar to stop lamp switch signal) and disconnects power to the clutch circuit; causing the speed control servo pulley to immediately return to the idle position. Note: Under normal braking conditions, only the stop lamp switch signal cancels speed control operation.*

Do all Ford applications use switch between fuse and load?

Visteon Speed Control **by** *complete*

YES

Do all Ford applications have switch connected to HOT-ALL-TIMES?

AVT EESE OPD **by** **2/18/99**

Can Brake Pressure Switch function be removed from power feed circuit and placed in ground return circuit?

Visteon Speed Control **by** *completed*

1. *Would require redesign of the speed control electronics.*
2. *Additional isolated ground circuit is required.*
3. *From FMEA position switching the ground circuit is not as good as switching the B+ feed.*
   - *With a ground return circuit; short to ground (fault) it would override the deactivation switch.*
   - *With the current power feed circuit; short to ground make the speed control system inoperative. A short to power is required to override the deactivation switch; much lower potential to occur.*

Why is this switch connected to HOT-ALL-TIMES?

Visteon Speed Control **by** *completed*

Because the SDS requires it to be connected to the same fuse as the stop lamp.

What is SDS requirement number?

Visteon Speed Control **by** *completed*

SDS (SC-0068) states: The stop lamp switch and redundant deactivator switch must be on the same fused circuit.

Is it feasible to disconnect the switch as immediate containment?

Yes. The customer will not have use of the speed control.

Is it acceptable to Jumper out the switch as immediate containment?

Visteon Speed Control **by** *completed*

NO... Would eliminate an important safety feature of the speed control system. The Brake Pressure Switch provides the redundant method for sensing brake application independent of the primary system deactivation mode. This is an SDS (SC-0005) requirement.

Elimination of this feature requires the concurrence of the OGC.

Other recommendations for immediate containment?

All **by** **on-going**

Add fuse between the stop lamp fuse and the brake pressure switch?

A212

```
*****************************************************************************
*          Note printed by FPORTER on 10 Feb 1999 at 18:25:25              *
*****************************************************************************
```

From: JEVANS8 --DRBN005 Date and time 02/10/99 12:44:21
To: FPORTER --DRBN007 Porter, Fred

FROM: Joe Evans USAET(UTC -05:00)
Subject: Continental Teves Contact
Fred, the manager of the vehicle test group at Continental Teves is Brian Hildebrand, (248)340-8113. He will have access to the pressure traces that we need. I have not spoken to him but he should have been given a heads up by now. 906-248-6784

Regards, Joe Evans
Brakes, Vacuum Distribution and Chassis Control Systems
Core Brake Control Systems Engineering
Phone 32-23832 Fax 32-31947

~~Th / Friday~~

Tour Car prospective Joel Kurtz

ABS activate after locking pressure
maintain pressure
[illegible]
keep

release pressure
accumulation

[illegible]

2/10/99

4-5:15 Brainstorm w/ Lan

- Get Dow on Team
  ~~Help~~ ASK THEM HOW FIRE STARTS WITHIN CONSTRAINTS [14 v, Black Substance 15 AMP MAX CURRENT, VEH. TEMPERATURES.]
- Char'z REAL VEH Brake Pressure.
- " " " " " in ABS EVE
- Thermo-couple Brk Pr switch after 1 Veh. Driven & turned off.
- Take Rate of ABS
  " " " ABS w/TC
- Are Leaks/Fires common to 摩traction
- Black Substance: Copper, Zinc, Silver, Sul-
- Understand TC/ABS Pressure Pulse/ Brake Fluid.
  + HISTORY OF ELECTROLYSIS IN Brake Fluid.

Epstein, Sally

From: Rahman, Aziz [arahman@email.mc.tl.com]
Sent: Thursday, February 11, 1999 10:06 AM
To: McGuirk, Andy; Beringhause, Steven; Baumann, Russ; Dague, Bryan; Douglas, Charles; Sharpe, Robert; Sullivan, Martha; Rowland, Thomas; Baker, Gary
Subject: 77PS Day 2, 2/10/99 Summary

Day 2, 2/10/99 Highlights

Main event of the day was a team meeting to prep for the Executive Technical Review on 2/11. Joe Nemi of Large Vehicle Safety Group led the meeting. There were a lot of participants, including Fred Porter, Tom Masters from Engineering, Norm LaPointe AVT Design Analysis, Steve LaRouche from CRL, Ford legal folks, wiring, connector etc. TI was the only supplier represented.

TI is not invited to the Tech Rev. (whew?!)
Tech Rev will be a high level, broad overview of Town Car Underhood Fires
Numbers Joe has thus far:
149 Underhood Fires, Thermal Anomalies, Thermal Events
39 with engine off, 9 with engine on, no information on the rest
5 possible related to the Brake Pressure Switch (BPS), 17 potential other root causes, no information on the rest
Other root causes from above lists : 42 way connector, EEC wire harness, Relay pack.
At this point NHTSA response required on BPS, FZVC part only. Others may follow
Lengthy discussion on approach for the review. General consensus that presentation from technical side should be broad based, since sufficient info is not available for any deep dive.
General consensus that we need a lot more parts back from the field that were involved in these events.Oasis message discussed.
Someone inquired about TI answers to questions from last meeting. I responded that I had provided the information to Fred and Steve Reimers, and they acknowledged. Two other questions for TI:
Does TI sell the switch directly to aftermarket, like auto part stores. I replied that most probably not. We would go through Ford Service Parts for service parts. Is that accurate Charlie?
Does TI have fire experts on site who can determine origin of fires, as in experts who work on structural fires. I replied in the negative, but said I would follow up. Any inputs? Intent was to answer repeatedly asked question: Do we know where the fire originated. Outside - in, inside - out, what burned first, brake fluid, or plastic base??

Joe's meeting was followed by a vigorous brainstorming session with Fred, Tom, Norm, Steve & Len. This was all technical and I actively participated.
I reviewed TI report PS/98/14 on weibull life of quiet switch showing first leaker at 900k+ cycles. Gave copy to Norm. Bryan, need weibull data quickly on pass-car snap switch.
I reviewed our finding that the 92 through 97 Town Car, Grand Marquis, Crown Vic platforms had prop valve mounted switches and that in vehicles with ABS option, the prop valve is located downstream of the ABS module.
There was considerable discussion on pressure profile at such a location with Len saying that the switch probably sees full pressure reversals. We agreed that I would contact Teves for more info.
We discussed formation of electrolytic cell with Brake Fluid in the base cavity, and how a low resistance path to ground could be formed. Discussed the wattage available with a 15A fuse and 14Vdc system. Is that sufficient to generate enough heat through the ground path.
Discussed CRL analysis of Memphis part, and gave copy of Al's report to Norm. Bryan, per Norm, Al retained "spoonfuls" of the corrosion residue. Do you know if Al has done any compositional analysis (IR) as opposed to elemental only?
Kept getting back to source of fire. Ford has not yet been able to create a fire in a switch. Team decided that pulling in Dow Chemical was key to understand if we can create

a fire with given constraints.
I will start exposing the resistivity test here to temperature 2/11.

No phone yet. Andy has arranged for a cellular phone and pager. On the positive side, received invitation from Fred to join his team for a Section Lunch at the Hawaiian Cafe. Should be fun!

More tomorrow.

Regards
Aziz.

Baker, Gary

From: Hopkins, AL
Sent: Thursday, February 11, 1999 5:43 PM
To: Dague, Bryan; Baumann, Russell; Beringhause, Steven; McGuirk, Andrew; Douglas, Charles; Rahman, Aziz; Baker, Gary
Cc: Andres, Amy
Subject: RE: 77PS Day 2, 2/10/99 Summary

My comments are in olive color

Regards,

Al

From: Dague, Bryan
Sent: Thursday, February 11, 1999 1:13 PM
To: Hopkins, Alfred
Subject: FW: 77PS Day 2, 2/10/99 Summary

Al,

I think the answer is yes, but can you add your 2 cents worth??

Bry

From: Rahman, Aziz
Sent: Thursday, February 11, 1999 11:06 AM
To: McGuirk, Andy; Beringhause, Steven; Baumann, Russ; Dague, Bryan; Douglas, Charles; Sharpe, Robert; Sullivan, Martha; Rowland, Thomas; Baker, Gary
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Does TI have fire experts on site who can determine origin of fires, as in experts who work on structural fires. I replied in the negative, but said I would follow up.

Fran Finnegan used to be involved in a large number of fire/litigation issues for CS&C. He is retired now but I think that they have hired a replacement.

Any inputs? Intent was to answer repeatedly asked question: Do we know where the fire originated. Outside - in, inside - out,

I think important information can be obtained by x-raying the connector/switch assembly from each fire or otherwise examining the terminals. In particular, the amount of arcing that occurs on the terminals (especially the hot one) will give indications as to whether the fire likely started inside of the device or not. Also, it would be worthwhile to know which fuses were blown in the system. Also was there any arc ruputure of wire between switch and battery.

what burned first, brake fluid, or plastic base??

If the scenario that this question address is to assume that the switch was the source of the fire, I believe that the brake fluid would be the first thing to burn. Just from my own point of view, it seems to me that it would be kind of tough to get a real fire going without brake fluid to start it. I would guess that charring of the plastic would be more likely without the presence of brake fluid. This should be relatively easy to test, however,

Joe's meeting was followed by a vigorous brainstorming session with Fred, Tom, Norm, Steve & Len. This was all technical and I actively participated.
I reviewed TI report PS/96/14 on weibull life of quiet switch showing first leaker at 900k+ cycles. Gave copy to Norm. Bryan, need weibull data quickly on pass-car snap switch.
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Discussed CRL analysis of Memphis part, and gave copy of Al's report to Norm. Bryan, per Norm, Al retained "spoonfuls" of the corrosion residue. Do you know if Al has done any compositional analysis (IR) as opposed to elemental only?

The quantity was more like a dropful than spoonfuls. None the less, the Chem Lab examined the liquid phase that was

present in three areas and found that it was almost certainly brake fluid (I have seperately forwarded that memo to Bryan again). It wasn't possible to perform FT/IR analysis of the actual agglomeration of corrosion products and decomposed plastic.

Kept getting back to source of fire. Ford has not yet been able to create a fire in a switch. Team decided that pulling in Dow Chemical was key to understand if we can create a fire with given constraints.

Are they exploring my best guess hypothesis that you need the following components:

- Heat source within switch caused by high resistance short
  - Conductivity caused by brake fluid/water/conductive contamination mixture
  - Direct metallic contact (caused by broken arm blade for instance)
- Fuel
  - (Air/Heated brake fluid vapors) mixture is the most likely
- Arc source
  - Perhaps the drying out of a conductive, corrosion product bridge caused by resistance heating.
  - Since the above might be a random effect, it might be necessary to seperately create an arc in the switch cavity.

I will start exposing the resistivity test here to temperature 2/11.

No phone yet. Andy has arranged for a cellular phone and pager. On the positive side, received invitation from Fred to join his team for a Section Lunch at the Hawaiian Cafe. Should be fun!

More tomorrow.

Regards
Aziz.

Epstein, Sally

From: Steve Reimers (sreimers@ford.com]
Sent: Thursday, February 11, 1999 6:16 PM
To: Rahmen, Aziz
Subject: TI action

Aziz, I will not be in to work on Friday. See you Monday. What is TI doing to try and ignite the brake pressure switch?

Steve Reimers building 5 3C043
AVT Chassis E/E System Applications mail drop 5011
39-03286 SREIMERS sreimers@ford.com fax 39-03286 />

1

Field Problems 2/12/99

- Aziz helpful that he is on site.
- Spending full effort — Need solution for problem in 2 month
- How are we getting breach in seal at vehicles at half its life.
- How do we cause ignition

** - DOE - to affect seal wear
  - TI / Dupont - contaminants cause Kapton

* - How do we increase life of sensor
  - something else for the seal?

- Weibull for pressure, temperature, cycle life

* - [illegible] running

* → Quantitative way to characterize wear. - all 3 Kaptons

* [redacted] system w/ high current

→ [illegible] speed control module - 3 amp inductive load.

Epstein, Sally

From: Beringhause, Steven [sberinghause@email.mc.ti.com]
Sent: Friday, February 12, 1999 8:39 AM
To: 'Porter, Fred (Ford)'
Cc: McGuirk, Andy; Rahman, Aziz
Subject: Ford Town Car Issue



Fred,

Attached in this message is a 77PS overview document that discusses the seal for the 77FS. I think this puts into one document answers to several questions your team has been asking about the 77PS design(we will mail you a copy of the report with the attachments referenced in the report). I have also attached the schematic of the proposed relay circuit and a cover letter describing the use of that circuit. My understanding is that you did not receive the fax I sent to you on this on 2/8. Please send me a quick email just to confirm that you received this and you were able to open the attachments. The schematic did not scan well, it is a little hard to read. Aziz has a hard copy that can be photocopied if necessary. Please feel free to give me a call with any questions you have. (508)236-3378.

<<FordTC1>> <<77PSOverview>> <<present proposed2.ppt>>

Steve Beringhause

Steven Beringhause
Design Engineering Manager
Texas Instruments Incorporated
Attleboro, MA 02703

February 8, 1999

Fred,

As we discussed over the phone Friday, per your request we looked at the possibilities of adding a fuse in line with the pressure switch, however, we think a more appropriate solution might be to use a relay circuit (schematic attached). Our understanding of the application is that the brake pressure switch is a failsafe component to shut off the cruise control if the standard brake light switch fails. The brake switch therefore only needs to be powered when the cruise control is on. By placing a normally open relay in the circuit and only closing the relay when the cruise control is activated, the switch will only be powered when it needs to be, when the cruise control is enabled. If you are correct that the high current draw is the source of ignition a relay would be a better solution than an in line fuse because the relay prevents the high current situation from happening rather than reacting once it does occur. If you have any questions, please give me a call at 508-236-3378.

Regards,
Steven Beringhause

Proprietary Information

77PS Overview
2/10/99

TI's 77PS switch family has been specifically designed to operate in an automotive braking system. The pressure cavity of the switch has been designed to seal brake fluid pressure and transmit pressure and movement to the sensing portion of the switch over the life as defined in Ford ES -F2VC-9F924-AA.

Background:
The pressure cavity is composed of the hexport, gasket, and three Kapton ™ diaphragms (called out as "seal" on attachment 1.). The purpose of the gasket is to provide a fluid tight seal between the hexport and the diaphragms. The purpose of the Kapton ™ diaphragms is to provide a flexible fluid tight seal between the pressure cavity and the internal components of the switch. Furthermore, the diaphragms are intended to transfer pressure to the converter, and follow the movement of the converter as pressure in the pressure cavity (brake line pressure) is varied.

Two known ways that brake fluid may enter the contact cavity of TI's brake switches from the pressure cavity are i. brake fluid could leak past an impaired gasket seal, or ii. brake fluid could leak through a damaged or 'worn out' Kapton ™ diaphragm.

The Gasket:
In order to create a fluid tight elastomeric seal, there must be proper compression of the elastomer, sufficient backing of the elatomer to prevent movement when pressure is applied, and finally the elastomer must be compatible with the working fluid.

Fluid compatibility is typically established by the use of published tables. These tables list fluid groups and general material types. Lab testing is always done with the specific fluid that the customer has specified for the application along with the specific compound formulated by the selected gasket supplier. Ethylene Propylene is used in the 77PS and is standard throughout the industry for seal gasket materials. TI has been using this material in brake applications since 1988.

The gasket compression target was obtained from published industry standards (see Parker O-ring Handbook). In this particular design a nominal gasket compression of 24% was selected. The depth of the hexport gland shown on attachment #2 controls this attribute. This gland dimension is cut into the hexport at the time of manufacturing. As a result, this dimension in combination with the gasket dimensions determines the final gasket compression when the assembly is crimped together.

Lastly, the movement/position of the gasket when pressure is applied must be controlled and restrained. This design accomplishes this by selecting the outer diameter of the gasket to be slightly smaller than the inner diameter of the gasket gland of the steel plated hexport. Therefore, the hexport gland prevents the gasket from moving outwards when high pressure is applied to the switch.

The DFMEA outlines the types of tests that were selected and run to confirm that all of these parameters are selected correctly. The resulting design was exposed to test conditions that were intended to duplicate actual application conditions, and in some cases go beyond the intended limits to failure. See the DFMEA Document number 503794 and customer specification ES-F2VC-9F924-AA . Specifically, burst testing, impulse testing, and thermal cycle tests were performed to confirm that the gasket performed as intended. The specific details of these tests and the results can be seen in the PV test report numbers listed below: (copies can be provided on request).

Test Report #	TI Switch Part number	Year Tested
1. PS/91/48	77PSL2-1	1991
2. PS/91/49	77PSL2-1	1991
3. PS/92/49	77PSL3-1	1992
4. PS/92/80	77PSL5-2	1992
5. PS/92/82	77PSL3-1	1992
6 PS/93/11	77PSL6-1	1993
7. PS/93/44	77PSL4-1	1993

Gasket-manufacturing anomalies can be produced from out of spec gaskets, contamination of the gasket or sealing surfaces, and as a result, may cause leaks early in life. In order to protect TI's customer supply chain from gasket-manufacturing issues there are several preventative actions in place. These actions include: hair nets, protective smocks, and cleaning procedures for the equipment. In addition, TI's automated assembly equipment has sensors to detected presence and orientation of the gasket and the 3 Kapton ™ layers. TI's customer return rates indicated by past return and analysis records are less than 1 ppm (one leaker return in 5 years from master cylinder leak testing).

Kapton ™ Diaphragms:
A pressure switch diaphragm must seal the pressure cavity, transmit pressure forces to the converter, and follow the converter motion without significantly affecting the switch calibration points. In addition, the diaphragm material must be resistant to chemical attack by the brake fluid.

Basically, a single piece of Kapton ™ in this design consists of a 0.003-inch thick polyimide film laminated on both sides with a 0.001-inch thick FEP Teflon film. The polyimide film has the ability to stretch without breaking (strains on the order of 70% before rupture), and the Teflon film is compatible with a wide range of chemicals. As a result of this layered construction, Kapton ™ was selected for its mechanical and chemical properties. Moreover, TI has been using this material in pressure switch applications since 1981. In this application three stacked Kapton ™ layers were used as the diaphragm seal.

To confirm the correct material was selected for this application we refer to the DFMEA. Specifically, this document identifies burst testing, impulse testing, and thermal cycle testing. These tests confirmed the Kapton's ™ ability to meet the specified requirements (PV reports listed above). Since temperature, chemical exposure, and stress levels all affect the life expectancy of the Kapton ™ diaphragm, additional testing is commonly done. A typical impulse test would include pressure cycles to 1450 psi, constant temperature of 135 C, and a cycle rate of 120 cycles/minute. Depending on the factors listed above, the life expectancy of a TI brake pressure switch can vary, but typically is around 1 million cycles which is well above the 500,000 cycles specified in the Ford specification (ES-F2VC-9F924-AA). (See Life Testing to Failure (PS/98/14))

In addition, continued conformance testing has been ongoing for many years at TI. The purpose of this testing is to confirm that the components, materials, and processes have remained stable over time and that the design intent is consistently being achieved. See attached IF reports which confirm 100% successful passing of all tests defined in the specification.

Manufacturing & PV anomalies such as pinched Kapton ™ can affect the Kapton ™ diaphragm seal performance (see PFMEA Document # 503831). Material/chemical compatibility and stress/strain concentrations can also cause the Kapton ™ diaphragms to fatigue. See DFMEA Document number 503796. In order to verify the correct design parameters were selected, the switch was subjected to a number of tests designed to simulate accelerated life testing of the application. See PS reports called out

above. Life testing per the customer specification (ES-F2VC-9F924-AA) has shown acceptable performance.

Typically, Kapton ™ fatigue occurs well over 0.5 million full-scale pressure cycles in our history of simulated and accelerated life testing. When Kapton ™ fatigue does occur, there are visual signs of de-lamination, cracking, and embrittlement. The Kapton ™ diaphragms break down first in the areas of highest stress and or strain. Typically, the first region to show break down is the circumferential area surrounding the converter button. See Endurance Test (report # PS/98/53). Again, diaphragm life depends on stress levels (pressure magnitude applied), temperature, and chemical exposure. The above mentioned tests were conducted in TI's Life Test lab with relatively controlled conditions.

Water has been shown to accelerate the aging of the base polyimide. Water can be introduced in two known ways:

1) By entering the contact cavity via the electrical connector
2) By being in solution in the brake fluid and entering the switch via the pressure port.

When water enters the connector it will "age" the Kapton ™ diaphragms and make them appear as though they have reached the end of life. This condition leaves visual clues. Classic signs of chemical attack of the Kapton ™ include de-lamination of the Teflon from the base polyimide base, embrittlement, and cracking of the base polymer. See Endurance Test (report PS/98/53).

Authored by Bryan Dague. Call Andy Mcguirk or Bryan Dague with questions.

77PS Overview Appendix

1. Pressure Switch Cross Section
2. Hexport Print (TI # 36900)
3. Gasket Print (TI# 74353)
4. DFMEA for Gasket and Kapton Seal
5. Life Test to Failure Test Report (Weibull Analysis)
6. Customer Specification (ES-F2VC-9F924_AA)
7. PFMEA
8. IP Test Reports
9. Endurance Test Report

Steven Beringhouse
Design Engineering Manager
Texas Instruments Incorporated
Attleboro, MA 02703

February 8, 1999

Fred,

As we discussed over the phone Friday, per your request we looked at the possibilities of adding a fuse in line with the pressure switch, however, we think a more appropriate solution might be to use a relay circuit (schematic attached). Our understanding of the application is that the brake pressure switch is a failsafe component to shut off the cruise control if the standard brake light switch fails. The brake switch therefore only needs to be powered when the cruise control is on. By placing a normally open relay in the circuit and only closing the relay when the cruise control is activated, the switch will only be powered when it needs to be, when the cruise control is enabled. If you are correct that the high current draw is the source of ignition a relay would be a better solution than an in line fuse because the relay prevents the high current situation from happening rather than reacting once it does occur. If you have any questions, please give me a call at 508-236-3378.

Regards,
Steven Beringhouse

DRAWINGS AVAILABLE UPON REQUEST

9/4

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*************************************************************************
*          Note printed by FPORTER on 12 Feb 1999 at 12:02:52           *
*************************************************************************
```

From: DGOEL --DRBN005 Date and time 02/12/99 07:15:55
To: FPORTER --DRBN007

FROM: Deepak Goel USAET(UTC -05:00)
Subject: TOWN CAR INVESTIGATION
Fred,
From an infrastructure point of view is there anything that is not being done?
I thought we had a full time task force working on this already.

Call me pls.

Regards,
Deepak Goel, Manager Restraints,Power Supply,Chassis & EMC
Bldg #5, MD 5011, room 2A019
(313) 32-75771, Fax: 42-14682, E-Mail: dgoel@ford.com
*** Forwarding note from SCOLE1 --DRBN009 02/11/99 17:41 ***
To: TDONOVAN--DRBN005 DGOEL --DRBN005
cc: CWILSO33--DRBN005

From: Sam L. Cole USAET(UTC -05:00)
Subject: TOWN CAR INVESTIGATION
JUST A HEAD'S UP.

I JUST LEFT THE TECH REVIEW FOR THE TOWN CAR NHTSA INVESTIGATION. THIS IS VIEWED AS A SERIOUS ISSUE AND FORD IS LATE IN RESPONDING (FROM NHTSA'S VIEWPOINT).

JACK PASKUS REQUESTED A "TASK FORCE" BE FULL TIME ON THIS TO MAKE SURE WE 1) ESTABLISH ROOT CAUSES, 2) IDENTIFY WHICH VEHICLES ARE POTENTIALLY AFFECTED, 3) IDENTIFY CORRECTIVE ACTIONS AND 4) IMPLEMENT THE ACTIONS IN THE FIELD. NHTSA WILL BE IN NEXT WEEK TO MEET WITH ASO. ASO WILL ADVISE THEM THAT A TASK FORCE HAS BEEN STARTED AND WE WILL HAVE RESULTS IN 2 MONTHS.

JACK ASKED FOR A WEEKLY MEETING WITH HIM ON THIS. HE ASKED FOR EESE TO HAVE AN ELECTRICAL SYSTEM CHAMPION OVERSEE THE EFFORTS. TIM, I VOLUNTEERED YOUR NAME AND ADVISED JACK THAT I WILL ALSO HELP OUT. JACK REQUESTED THAT YOU AND/OR I ATTEND THE WEEKLY UPDATE MEETING WITH HIM.

DEEPAK AND TIM: WE NEED TO MAKE SURE OUR PEOPLE HAVE WHATEVER SUPPORT AND OVERTIME THEY NEED OVER THE NEXT SEVERAL WEEKS TO GET AHEAD OF THIS. I HAVE ASKED ROB ENGLISH TO TAKE THE LEAD ON LOOKING AT THE CONNECTOR TO DETERMINE IF THERE IS ANY POTENTIAL LEAKAGE PATH TO GROUND, EXTERNAL TO THE SWITCH THROUGH THE CONNECTOR OR WIRING. FRED HAS THE LEAD ON THE INTERNAL SWITCH INVESTIGATION. TOM HAS THE LEAD ON THE OVERALL SYSTEMS LOOK.

SOMEONE IN THE MEETING (NOT SURE WHO IT WAS) MENTIONED AN OUTSIDE AGENCY THAT FORD HAS USED BEFORE TO GO LOOK AT VEHICLES, TAKE PHOTOGRAPHS etc. AS THE VARIOUS CLAIMS COME IN. TOM WILL FOLLOW UP ON THIS.

I AM REQUESTING YOUR PERSONAL INVOLVEMENT OVER THE NEAR TERM UNTIL WE KNOW BETTER WHAT THE ISSUES ARE AND HOW LARGE THE CONCERN IS. THE PERCEPTION OF JACK AND THE TEAM IN TODAY'S MEETING IS THAT THIS MAY AFFECT ALL TOWN CARS BUILT SINCE 1992, AND POSSIBLY CROWN VIC & GRAND MARQUIS. PLEASE ADVISE IF YOU WOULD LIKE TO DISCUSS THIS FURTHER.

Work Plan- Brake Pressure Switch

Root Cause Investigation-

Identify flammability characteristics of switch components
- **AVT EESE Materials Engineering**

Identify switch contaminants in parts returned from the field
- **Central Lab analysis**

Identify potential source of contaminants
- **Central Lab analysis**

Identify potential for and possible sources of internal brake switch leaks
- **Central Lab and Texas Instrument**

Identify potential ignition sources during switch operation/malfunction
- **AVT EESE Chassis Electronics**

Simulate potential switch malfunctions in a laboratory environment to evaluate the potential for ignition
- **AVT EESE Chassis Electronics**

Collect additional field samples (including connectors) for laboratory analysis
- **LVC - Safety**

Root Cause Investigation Tasks

What are the combustibles?

AVT EESE Materials Engineering

Are the switch materials compatible with brake fluid?
by 2/18/99

Are the switch materials compatible with brake fluid in an electric field?
by 2/18/99

Are the switch materials compatible with brake fluid and contaminants?
by 2/18/99

Are the switch materials compatible with contaminated brake fluid in an electric field? by 2/18/99

Flash points for all materials? by 2/18/99

What is the difference in the base materials that look different?
Texas Instruments by *complete*

What are the material call-outs for 1992 and 1993?
Texas Instruments by 2/18/99

What are the contaminants in returned parts?

Central Lab analysis

Results of Memphis part analysis by 2/18/99

Results of testing with corrosion simulation?
AVT EESE Chassis Electronics by *complete*
Black corrosion recreated in lab on virgin parts. Given to Lab for analysis

TI analysis results of the Memphis parts (crease marks in diaphragm, etc) ?
Texas Instruments by 2/18/99

4/9

What is source of contaminants?

Central Lab analysis **by 2/18/99**

What causes brake fluid leakage? **By 2/24/99**

Central Lab and Texas Instrument

What does TI DFEMA say about this failure mode?

Texas Instruments by 2/16/99

What are TI in-process test failures?

Texas Instruments by 2/16/99

Does the event occur only on vehicles with ABS?

LVC-Safety by 2/18/99

What heat source(s) start event?

AVT EESE Chassis Electronics

Analysis of harness pig-tails

AVT EESE OPD by 2/18/99

Recreate Event in Lab

AVT EESE Chassis Electronics

What does it take to start an event? by on-going

If a switch is contaminated can it start the event? by on-going

Switch with clean Brake fluid inside is being monitored for increase in leakage current.

If current is stopped does combustion stop?

Collect Field Samples

LVC - Safety

Collect Brake Pressure switches and speed control servos with harnesses attached. By 2/22/99

5/9.

Miscellaneous

Can the switch act as a fuse?

Team by complete

No.
Could a fuse (e.g. 2 amp) be added in series between the stop lamp fuse and the brake pressure switch? Failure parameters would have to be known.

What are descriptions from AWS and CQIS?

LVC-Safety by 2/18/99

What are we seeing in returned Speed control modules (FRACAS)?

Visteon Speed Control by 2/17/99

Provide color photos of Econoline?

Texas Instruments by *complete*

There are no color photos.

6/9

Containment / Corrective Action Tasks

Competitive Vehicles

How is switch packaged?
Is it always Powered (HOT_ALL_TIME) ?
Are the contacts opened when pressure applied?
What is fuse limit?
What is being switched?
Is it a redundant switch?

AVT EESE Competitive Analysis by 2/24/99

What does Speed control FMEA say about Brake Switch ?

Visteon Speed Control by *completed*

The Brake Pressure Switch (Deactivation Switch) coupled with the Stop Lamp switch are categorizes as "Automatic Deactivation". The FMEA lists Automatic Deactivation" as current design control for 66 different potential cause/ mechanical failures.

Brake Pressure Switch (Deactivator Switch) is one of the most important safety features.

When was non-Pressure actuated switched introduced?

AVT EESE Chassis Electronics by *completed*

95 Continental and T/Bird were first to use it.

Is the Circuit drive hi-side or low-side?

Visteon Speed Control by *completed*

Circuit is low side driven.

How does speed control use this switch?

Visteon Speed Control by *completed*

1. *Brake Pressure Switch provides electrical power to the speed control servo clutch circuit The clutch circuit needs to be energized for the servo motor to pull the cable.*

2. *Switch provides a redundant method of sensing brake application independent of the primary system deactivation mode; this is a SDS (SC-0005) requirement.*

- *Signal from the stop lamp switch is primary deactivation mode for brake application.*
- *Under "hard" braking condition: Brake Pressure Switch provides redundant brake signal to the speed control logic (similar to stop lamp switch signal) and disconnects power to the clutch circuit; causing the speed control servo pulley to immediately return to the idle position. Note: Under normal braking conditions, only the stop lamp switch signal cancels speed control operation.*

Do all Ford applications use switch between fuse and load?

Vistaon Speed Control **by** *complete*

YES

Do all Ford applications have switch connected to HOT-ALL-TIMES?

AVT EESE OPD **by** **2/18/99**

Can Brake Pressure Switch function be removed from power feed circuit and placed in ground return circuit?

Vistaon Speed Control **by** *completed*

1. *Would require redesign of the speed control electronics.*
2. *Additional isolated ground circuit is required.*
3. *From FMEA position switching the ground circuit is not as good as switching the B+ feed.*
   - *With a ground return circuit; short to ground (fault) it would override the deactivation switch.*
   - *With the current power feed circuit; short to ground make the speed control system inoperative. A short to power is required to override the deactivation switch; much lower potential to occur.*

Why is this switch connected to HOT-ALL-TIMES?

Vistaon Speed Control **by** *completed*

Because the SDS requires it to be connected to the same fuse as the stop lamp.

8/9

What is SDS requirement number?

Visteon Speed Control **by** *completed*

SDS (SC-0068) states: The stop lamp switch and redundant deactivator switch must be on the same fused circuit.

Is it feasible to disconnect the switch as immediate containment?

Yes. The customer will not have use of the speed control.

Is it acceptable to Jumper out the switch as immediate containment?

Visteon Speed Control **by** *completed*

NO... Would eliminate an important safety feature of the speed control system. The Brake Pressure Switch provides the redundant method for sensing brake application independent of the primary system deactivation mode. This is an SDS (SC-0005) requirement.

Elimination of this feature requires the concurrence of the OGC.

Other recommendations for immediate containment?

All **by** **on-going**

Add fuse between the stop lamp fuse and the brake pressure switch?

Baumann, Russ
From: Beringhause, Steven
Sent: Friday, February 12, 1999 9:40 AM
To: Baumann, Russ
Subject: FW: Ford Town Car Issue

FYI

From: Beringhause, Steven
Sent: Friday, February 12, 1999 9:37 AM
To: 'Porter, Fred (Ford)'
Cc: McGuirk, Andy; Rahman, Aziz
Subject: Ford Town Car Issue

Fred,

Attached in this message is a 77PS overview document that discusses the seat for the 77PS. I think this puts into one document answers to several questions your team has been asking about the 77PS design(we will mail you a copy of the report with the attachments referenced in the report). I have also attached the schematic of the proposed relay circuit and a cover letter describing the use of that circuit. My understanding is that you did not receive the fax I sent to you on this on 2/8. Please send me a quick email just to confirm that you received this and you were able to open the attachments. The schematic did not scan well, it is a little hard to read. Aziz has a hard copy that can be photocopied if necessary. Please feel free to give me a call with any questions you have. (508)236-3378.

[redacted] FordTC1.doc [redacted] 77PSOverview.rtf [redacted] present proposed2.ppt

Steve Beringhause

Steven Beringhause
Design Engineering Manager
Texas Instruments Incorporated
Attleboro, MA 02703

February 8, 1999

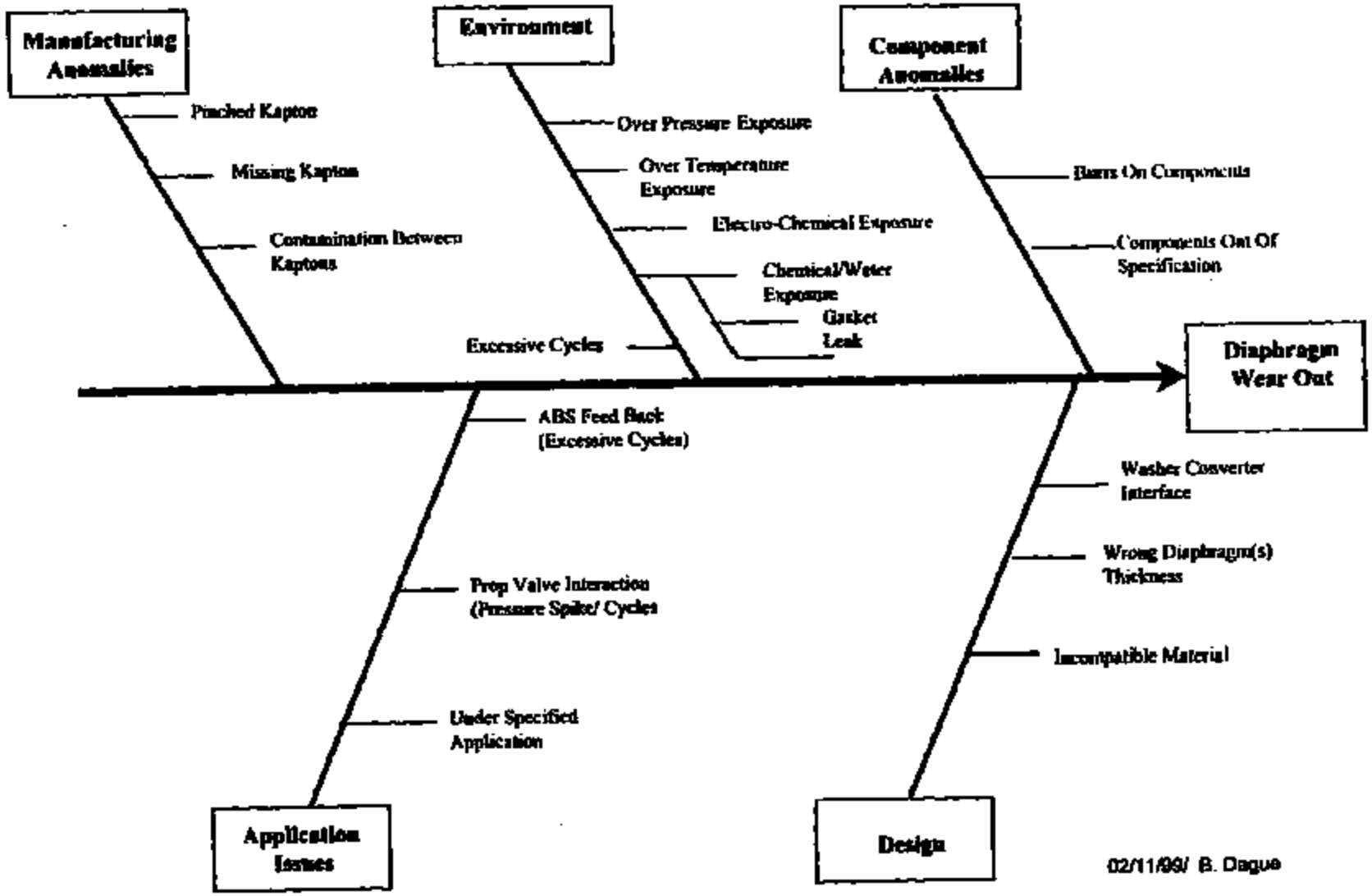
Fred,

As we discussed over the phone Friday, per your request we looked at the possibilities of adding a fuse in line with the pressure switch, however, we think a more appropriate solution might be to use a relay circuit (schematic attached). Our understanding of the application is that the brake pressure switch is a failsafe component to shut off the cruise control if the standard brake light switch fails. The brake switch therefore only needs to be powered when the cruise control is on. By placing a normally open relay in the circuit and only closing the relay when the cruise control is activated, the switch will only be powered when it needs to be, when the cruise control is enabled. If you are correct that the high current draw is the source of ignition a relay would be a better solution than an in line fuse because the relay prevents the high current situation from happening rather than reacting once it does occur. If you have any questions, please give me a call at 508-236-3378.

Regards,
Steven Beringhause

TEXAS INSTRUMENTS

Ford Electronic Speed Control Deactivation Pressure Switch
TI P/N 77PSL Series
Wear Out Fishbone



02/11/99/ B. Dague

Proprietary Information

77PS Overview
2/10/99

TI's 77PS switch family has been specifically designed to operate in an automotive braking system. The pressure cavity of the switch has been designed to seal brake fluid pressure and transmit pressure and movement to the sensing portion of the switch over the life as defined in Ford ES -F2VC-9F924-AA.

Background:
The pressure cavity is composed of the hexport, gasket, and three Kapton ™ diaphragms (called out as "seal" on attachment 1.). The purpose of the gasket is to provide a fluid tight seal between the hexport and the diaphragms. The purpose of the Kapton™ diaphragms is to provide a flexible fluid tight seal between the pressure cavity and the internal components of the switch. Furthermore, the diaphragms are intended to transfer pressure to the converter. and follow the movement of the converter as pressure in the pressure cavity (brake line pressure) is varied.

Two known ways that brake fluid may enter the contact cavity of TI's brake switches from the pressure cavity are i. brake fluid could leak past an impaired gasket seal, or ii. brake fluid could leak through a damaged or 'worn out' Kapton™ diaphragm.

The Gasket:
In order to create a fluid tight elastomeric seal, there must be proper compression of the elastomer, sufficient backing of the elastomer to prevent movement when pressure is applied, and finally the elastomer must be compatible with the working fluid.

Fluid compatibility is typically established by the use of published tables. These tables list fluid groups and general material types. Lab testing is always done with the specific fluid that the customer has specified for the application along with the specific compound formulated by the selected gasket supplier. Ethylene Propylene is used in the 77PS and is standard throughout the industry for seal gasket materials. TI has been using this material in brake applications since 1988.

The gasket compression target was obtained from published industry standards (see Parker O-ring Handbook). In this particular design a nominal gasket compression of 24%was selected. The depth of the hexport gland shown on attachment #2 controls this attribute. This gland dimension is cut into the hexport at the time of manufacturing. As a result, this dimension in combination with the gasket dimensions determines the final gasket compression when the assembly is crimped together.

Lastly, the movement/position of the gasket when pressure is applied must be controlled and restrained. This design accomplishes this by selecting the outer diameter of the gasket to be slightly smaller than the inner diameter of the gasket gland of the steel plated hexport. Therefore, the hexport gland prevents the gasket from moving outwards when high pressure is applied to the switch.

The DFMEA outlines the types of tests that were selected and run to confirm that all of these parameters are selected correctly. The resulting design was exposed to test conditions that were intended to duplicate actual application conditions, and in some cases go beyond the intended limits to failure. See the DFMEA Document number 503794 and customer specification ES-F2VC-9F924-AA . Specifically, burst testing, impulse testing, and thermal cycle tests were performed to confirm that the gasket performed as intended. The specific details of these tests and the results can be seen in the PV test report numbers listed below: (copies can be provided on request).

Test Report #	TI Switch Part number	Year Tested
1. PS/91/48	77PSL2-3	1991
2. PS/91/49	77PSL2-1	1991
3. PS/92/49	77PSL3-1	1992
4. PS/92/80	77PSL5-2	1992
5. PS/92/82	77PSL3-1	1992
6. PS/93/11	77PSL6-1	1993
7. PS/93/44	77PSL4-1	1993

Gasket-manufacturing anomalies can be produced from out of spec gaskets, contamination of the gasket or sealing surfaces, and as a result, may cause leaks early in life. In order to protect TI's customer supply chain from gasket-manufacturing issues there are several preventative actions in place. These actions include: hair nets, protective smocks, and cleaning procedures for the equipment. In addition, TI's automated assembly equipment has sensors to detected presence and orientation of the gasket and the 3 Kapton™ layers. TI's customer return rates indicated by past return and analysis records are less than 1 ppm (one leaker return in 5 years from master cylinder leak testing).

Kapton™ Diaphragms:
A pressure switch diaphragm must seal the pressure cavity, transmit pressure forces to the converter, and follow the converter motion without significantly affecting the switch calibration points. In addition, the diaphragm material must be resistant to chemical attack by the brake fluid.

Basically, a single piece of Kapton™ in this design consists of a 0.003-inch thick polyimide film laminated on both sides with a 0.001-inch thick FEP Teflon film. The polyimide film has the ability to stretch without breaking (strains on the order of 70% before rupture), and the Teflon film is compatible with a wide range of chemicals. As a result of this layered construction, Kapton™ was selected for its mechanical and chemical properties. Moreover, TI has been using this material in pressure switch applications since 1981. In this application three stacked Kapton™ layers were used as the diaphragm seal.

To confirm the correct material was selected for this application we refer to the DFMEA. Specifically, this document identifies burst testing, impulse testing, and thermal cycle testing. These tests confirmed the Kapton's™ ability to meet the specified requirements (PV reports listed above). Since temperature, chemical exposure, and stress levels all affect the life expectancy of the Kapton™ diaphragms, additional testing is commonly done. A typical impulse test would include pressure cycles to 1450 psi, constant temperature of 135 C, and a cycle rate of 120 cycles/minute. Depending on the factors listed above, the life expectancy of a TI brake pressure switch can vary, but typically is around 1 million cycles which is well above the 500,000 cycles specified in the Ford specification (ES-F2VC-9F924-AA). (See Life Testing to Failure (PS/98/14))

In addition, continued conformance testing has been ongoing for many years at TI. The purpose of this testing is to confirm that the components, materials, and processes have remained stable over time and that the design intent is consistently being achieved. See attached IP reports which confirm 100% successful passing of all tests defined in the specification.

Manufacturing & PV anomalies such as pinched Kapton™ can affect the Kapton™ diaphragm seal performance (see PFMEA Document # 503831). Material/chemical compatibility and stress/strain concentrations can also cause the Kapton™ diaphragms to fatigue. See DFMEA Document number 503796. In order to verify the correct design parameters were selected, the switch was subjected to a number of tests designed to simulate accelerated life testing of the application. See PS reports called out above. Life testing per the customer specification (ES-F2VC-9F924-AA) has shown acceptable performance.

Typically, Kapton™ fatigue occurs well over 0.5 million full-scale pressure cycles in our history of simulated and accelerated life testing. When Kapton™ fatigue does occur, there are visual signs of de-

lamination, cracking, and embrittlement. The Kapton™ diaphragms break down first in the areas of highest stress and or strain. Typically, the first region to show break down is the circumferential area surrounding the converter button. See Endurance Test (report # PS/98/53). Again, diaphragm life depends on stress levels (pressure magnitude applied), temperature, and chemical exposure. The above mentioned tests were conducted in TI's Life Test lab with relatively controlled conditions.

Water has been shown to accelerate the aging of the base polymide. Water can be introduced in two known ways:

1) By entering the connect cavity via the electrical connector
2) By being in solution in the brake fluid and entering the switch via the pressure port.

When water enters the connector it will "age" the Kaptop™ diaphragms and make them appear as though they have reached the end of life. This condition leaves visual clues. Classic signs of chemical attack of the Kapton™ include de-lamination of the Teflon from the base polymide base, embrittlement, and cracking of the base polymer. See Endurance Test (report PS/98/53).

Authored by Bryan Dague. Call Andy Mcguirk or Bryan Dague with questions.

77PS Overview Appendix

1. Pressure Switch Cross Section
2. Hexport Print (TI # 36900)
3. Gasket Print (TI# 74353)
4. DFMEA for Gasket and Kapton Seal
5. Life Test to Failure Test Report (Weibull Analysis)
6. Customer Specification (ES-F2VC-9F924_AA)
7. PFMEA
8. IP Test Reports
9. Endurance Test Report

Epstein, Sally

From: Rahman, Aziz [arahman@email.mcn.com]
Sent: Friday, February 12, 1999 10:29 AM
To: McGuirk, Andy; Beringhause, Steven; Dague, Bryan; Baumann, Russ; Sharpe, Robert; Douglas, Charles; Baker, Gary; Rowland, Thomas
Subject: 77PS, 2/11/99

Main event of the day was the Technical Review. Highlights:
Key participants were: Jack Pasques Chief Engineer, Luxury VC
Chuck Peake Program Engineer, Town Car
Ann O'Neill Quality Directory, Luxury VC
Sam Cola Manager Large Vehicles Electrical Systems

Next Tech Review: Every Thursday, implies core team prep meeting every Wednesday.

- There is a need to have the ability to implement, whatever solution is decided, in two months max.
- Next meeting with NHTSA is next week, as part of their regular quaterly meetings. Town Car underhood fires will be high on the discussion list, and the expectation (hope?) is that Ford will be able to get 2 months time to implement a solution.
- There is a very urgent need to re-create ignition in the lab. They kept coming back to this again and again.
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- There were strong feelings of "got to do more".
- Fred's statement that "TI Engineering is resident here" elicited a "Good" response.

I met with Fred 2/12 morning to capture his thoughts on follow up actions:
- Need a "raft" of experiments to accelerate kapton wear. Need to design and execute a DOE with temperature, moisture, disc energy, contaminants (soap, detergent), # of kapton layers etc as factors. I will close with Bryan on this. We need a plan with timing by next Wednesday.
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- No potential solution should be eliminated for cost reasons.
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With Fred out next week, Steve Reimers will be main TI liason. I do plan to continue my field assignment for another week, and will evaluate need for further extensions at the end of next week.

FYI, I have a phone & pager now. Thanks Andy. I felt like "Far From the Maddening Crowd " (Thomas Hardy) without the comm-link!
Phone: 508-208-6119
Pager: 1800-946-4646, pin 604-2042

Regards
Aziz.

Dague, Bryan

From:	Rahman, Aziz
Sent:	Friday, February 12, 1999 11:28 AM
To:	McGuirk, Andy; Beringhause, Steven; Dague, Bryan; Baumann, Russ; Sharpe, Robert; Douglas, Charles; Baker, Gary; Rowland, Thomas
Subject:	77PS, 2/11/99

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Aziz.

AL HOPKINS

McGuirk, Andy

From: Rahman, Aziz
Sent: Friday, February 12, 1999 11:28 AM
To: McGuirk, Andy; Beringhause, Steven; Dague, Bryan; Baumann, Russ; Sharpe, Robert; Douglas, Charles; Baker, Gary; Rowland, Thomas
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Regards
Aziz

DOE

McGuirk, Andy

From: McGuirk, Andy
Sent: Friday, February 12, 1999 12:09 PM
To: Beringhause, Steven; Baumann, Russ; Rahman, Aziz; Dague, Bryan
Cc: Sullivan, Martha; Reynolds, Steven; Pechonis, John; Douglas, Charles
Subject: Ford conference call

Aziz notified me of a plan for Aziz and Fred Porter to hold a conference call to me at 2:30 Friday today . I am planning to participate and have responded to the positive.

point, as I understand it from Aziz, would be to align the plans for Aziz for next week while Fred is out of the office.

Steve, I would like you to participate in this call with me and invite opinions about other participation.

a

AUTOMOTIVE SENSORS AND CONTROLS QRA MANAGER
34 FOREST ST M/S 23-05
ATTLEBORO, MA 02703
TEL : (508) 236-3080
FAX : (508) 236-1745
PAGE: (800) 467-3100 PIN 604-2044

below is Aziz day three feedback

attorney - client privileged communication

From: Rahman, Aziz
Sent: Friday, February 12, 1999 11:28 AM
To: McGuirk, Andy; Beringhause, Steven; Dague, Bryan; Baumann, Russ; Sharpe, Robert; Douglas, Charles; Baker, Gary; Rowland, Thomas
Subject: 77PS, 2/11/99

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	Chuck Peake	Program Engineer, Town Car
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Phone: 508-208-8119
Pager: 1800-946-4646, pin 604-2042

Regards
Aziz

McGuirk, Andy

Subject: FW: Ford conference call

AUTOMOTIVE SENSORS AND CONTROLS QRA MANGER
34 FOREST ST M/S 23-05
ATTLEBORO, MA 02703
TEL : (508) 236-3060
FAX : (508) 236-3746
PAGE: (800) 467-3700 PIN 604-2044

From: McGuirk, Andy
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Cc: Sullivan, Martha; Reynolds, Steven; Pechonis, John; Douglas, Charles
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AUTOMOTIVE SENSORS AND CONTROLS ORA MEMBER
34 FOREST ST M/S 23-06
ATTLEBORO, MA 02703
TEL : (508) 236-3080
FAX : (508) 236-3748
PAGE: (800) 467-3700 PIN 606-2644

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From: Rahman, Aziz
Sent: Friday, February 12, 1999 11:26 AM
To: McGuirk, Andy; Beringhause, Steven; Dague, Bryan; Baumann, Russ; Sharpe, Robert; Douglas, Charles; Baker, Gary; Rowland, Thomas
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Regards
Aziz.

Baumann, Russ
From: McGuirk, Andy
Sent: Friday, February 12, 1999 12:42 PM
To: Watt, Jim; Baumann, Russ; Dague, Bryan
Cc: Beringhause, Steven
Subject: FW: Ford conference call

attorney - client privileged communication

Jim

there is a building desire to be able to characterize switches in different states of life wear and to do so with recent samples.. I get the feeling that we are describing the situation and are not being able to 'show' same to the satisfaction of the receivers at Ford.

pls discuss with Bryan ideas we may have regarding sources of 'old' switches which might be available to aide in this direction in a prompt fashion.

I can guess that Ford will want Aziz or Bryan to 'characterize' samples from the field and this would be a base line for that...

a

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TEL : (508) 236-3080
FAX : (508) 236-3768
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Pager: 1800-946-4646, pin 604-2042

Regards
Aziz.

[redacted]

From:	Baker, Gary [gbaker@email.ma1.com]
Sent:	Friday, February 12, 1999 12:28 PM
To:	Rahman, Aziz
Cc:	McGuirk, Andy; Beringhause, Steven; Dague, Bryan; Baumann, Russ; Sharpe, Robert; Douglas, Charles; Rowland, Thomas
Subject:	RE: 7795, 2/11/99

Aziz,

Thanks for the update.

On the point that "Having the switch hot at all times is not a good practice", has Ford given us any reaction to our proposal to adding a relay in series with the pressure switch?

It may be important to get Ford on the record on this point.

Best regards,
Gary

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Sent: Friday, February 12, 1999 11:28 AM
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Morris, Irene

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Epstein, Kelly

From: McQuirk, Andy (a-mcquirk@email.mc.ti.com)
Sent: Friday, February 12, 1999 4:27 PM
To: Baumann, Russ; Beringhause, Steven; Degue, Bryan; Sullivan, Martha; Baker, Gary
Cc: Pacheco, John; West, Jim; Rowland, Thomas; Rahman, Aziz; Douglas, Charles; Sharpe, Robert
Subject: Ford conference call minutes of 2/12

attorney - client privileged communication

attendees...
attleboro....s beringhause, g baker, a mcquirk

detroit.....a rahman, fred porter of ford

draft of key points:

Ford management is 'allowing' two months for the development of cause and solution and 'going public' and has accelerated the focus on a timely solution....mostly toward Ford players as Fred explained to me... TI with Aziz on board was fully supporting and being proactive in approach and results.

Ford would like to know if there are any 'instant' solutions to much improved kapton wear out and/or much greater life of a switch ....we offered the APT pointing out it was brake qualified and much more cycle and seal robust....and ford would have to figure out how to wire in. TI owes data about APT capability

Ford wants to re-create ignition....and we agreed to be supportive but Ford must bring in Dow brake fluid folks next Tues./weds to develop the approach. we do not 'own' the responsibility of duplication of the process to ford...they (Ford) do.

Ford wants to understand relative typical 'wear' stages or life stage of switches...so TI will attempt to quantify indicators of typical wear stages for this use in order to estimate how long into life are samples that ford will pull from the field.

Ford wants TI to understand the key drivers to kapton wear out and requested a DOE around variables like temperature -fluid -water -power and pressure. TI agreed to work a switch level DOE around kapton wear beginning this weekend.

ford will present the vehicle history by vin number....all '92 and '93 towncars had ABS and some had traction 'enhancement'. this info might build a good is-is not table by ford. We pointed out powerwashing might inject contaminates into the switch so knowing resale and fleet history might be valuable.

TI requested Ford consider the use of power down during non-vehicle power periods through the relay switch idea....during this discussion Fred acknowledged (he said 'right') that removal of the power source would greatly reduce the likelihood of an event (baker said 99.99% in his mind) because of combination of no power time as well as the power might be driving some chemical or other event during the special cause periods of powerwash and splash events and maybe event eliminate the ignition source. Fred also said he did not see Ford idea executing this in the next couple months.

TI will summarize all the tests underway at TI in order to demonstrate to Ford upper mngt the we are working full speed toward defined ends

Ford admitted that the speed control module might have electrical issues that might drive up to 15 amps inductive through a cycling switch which TI would simulate to understand contact wear and internal wear to characterize if this is happening on event items. we talked about 3 amps inductive but summarized at possible 15 amps allowed by circuit.

there are a number of issues for TI to deliver around DAME, PI testing, materials used, and line details being delivered by TI.

Steve and Gary....pls advise if i missed a point

a

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- No potential solution should be eliminated for cost reasons.

- Having the switch hot at all times is not a good practice, and Ford will be internally working on a solution for this. I did not get a feeling that this is going to happen in the 2 month time frame established earlier.

- I have the formal workplan that Steve Reimers is coordinating. I will fax it to Andy today. Quite a few of the TI actions have been completed, but are open on the list. I will work with Steve to close these out.

I have a meeting with Central Labs folks at 1.00 today to look at kapton from non-fire, non-leak switches with varying mileage. This will be key in trying to correlate kapton aging in the field as opposed to lab tests. Bryan, can we do this with the switches we pulled from the field with known mileage. Can we swap parts in used cars, say at Tasca? Today PM, we will meet with Greg Stevens, materials guy at AVT who has been tasked with getting Dow in the loop.

With Fred out next week, Steve Reimers will be main TI liason. I do plan to continue my field assignment for another week, and will evaluate need for further extensions at the end of next week.

FYI, I have a phone & pager now. Thanks Andy. I felt like "Far From the Maddening Crowd " [Thomas Hardy) without the comm-link!
Phone: 508-208-6119

Fax#: [illegible]-946-4646, pin 604-2042

Regards
Attn.

Epstein, Sally

From: Steve Reimers (sreimers@ford.com)
Sent: Thursday, February 18, 1999 8:33 AM
To: jnemr@ford.com; slarouch@ford.com; Frederick J. Porta; rangle1@ford.com; eekber@ford.com; nlapent@ford.com; lmasters@ford.com; jsalsb@ford.com; Steve Reimers; techrady@visteon.com; Fred Kohl; tbazil@ford.com; jmcmann@ford.com; cbudzyna@visteon.com; patrices@visteon.com; dgoss@ford.com; tbrown@ford.com; scole1@ford.com; hwalter3@ford.com; gsteven1@ford.com; wabrams@ford.com; nmassa@ford.com; Rahmsn, Aziz; Sharpe, Robert
Subject: Brake Pressure Switch

FROM: Steve Reimers USAET(UTC -05:00)

Requester: Steve Reimers
Date to be scheduled: 02/24/99 - 06/30/99
Starting time: 02:00 PM
Ending time: 04:00 PM

Location: Bldg 5 3A039

Purpose: Team meeting

19 meetings will be scheduled. The dates are:
02/24/99 03/03/99 03/10/99 03/17/99 03/24/99 03/31/99
04/07/99 04/14/99 04/21/99 04/28/99 05/05/99 05/12/99
05/19/99 05/26/99 06/02/99 06/09/99 06/16/99 06/23/99
06/30/99

* *

Steve Reimers building 5 3C049
AVT Chassis E/E System Applications mail drop 5011
39-01286 SREIMERS sreimers@ford.com fax 39-01286 ;>

1/4

* Note printed by [illegible] on 12 Feb 1999 at 12:01:52 *

From: DGOEL --[illegible]   Date and time 02/11/99 07:15:[illegible]
To: FPORTER --[illegible]

FROM: Deepak Goel   (GMT/UTC -05:00)
Subject: TOWN CAR INVESTIGATION
Fred,
From an infrastructure point of view is there anything that is not being done? I thought we had a full time task force working on this already.

Call me pls.

Regards,
Deepak Goel, Manager Restraints, Power Supply, Chassis & EMC
Bldg 5, MD 5011, room 3A039
(313) 33-7[illegible]171, Fax: 32-14062, E-mail: dgoel@ford.com
*** Forwarding note from ECOLE1 --[illegible] 02/11/99 17:41 ***
To: [illegible]   DGOEL --[illegible]
cc: [illegible]

From: Tom L. Cole   (GMT/UTC -05:00)
Subject: TOWN CAR INVESTIGATION
JUST A HEAD'S UP.

I JUST LEFT THE TECH REVIEW FOR THE TOWN CAR [illegible] INVESTIGATION. THIS IS VIEWED AS A SERIOUS ISSUE AND FORD IS LATE IN RESPONDING (FROM [illegible]'S VIEWPOINT).

JACK [illegible] WE 1) [illegible] ROOT CAUSE, 2) IDENTIFY WHICH VEHICLES ARE POTENTIALLY AFFECTED, 3) IDENTIFY CONTAINMENT ACTIONS AND 4) IMPLEMENT THE ACTIONS IN THE FIELD. [illegible] THAT A TASK FORCE HAS BEEN FORMED AND WE WILL HAVE RESULTS IN 2 MONTHS.

JACK ASKED FOR A WEEKLY MEETING WITH HIM ON THIS. HE ASKED FOR SOME TO HAVE AN ELECTRICAL SYSTEM [illegible] THE [illegible]. TOM, I VOLUNTEERED YOUR NAME AND ADVISED JACK THAT I WILL ALSO HELP OUT. JACK REQUESTED THAT YOU AND/OR I ATTEND THE WEEKLY UPDATE MEETING WITH HIM.

DEEPAK AND TIM: WE NEED TO MAKE SURE OUR PEOPLE HAVE WHATEVER SUPPORT AND OVERTIME THEY NEED OVER THE NEXT SEVERAL WEEKS TO GET AHEAD OF THIS. I HAVE ASKED [illegible] TO TAKE THE LEAD OF LOOKING AT THE CONNECTOR TO DETERMINE IF THERE IS ANY POTENTIAL LEAKAGE PATH TO GROUND, EXTERNAL TO THE SWITCH THROUGH THE CONNECTOR OR WIRING. FRED HAS THE LEAD ON THE INTERNAL SWITCH INVESTIGATION. TOM HAS THE LEAD ON THE OVERALL SYSTEM LOOK.

SOMEONE IN THE MEETING (NOT SURE WHO IT WAS) MENTIONED AN OUTSIDE AGENCY THAT FORD HAS USED BEFORE TO GO LOOK AT VEHICLES, TAKE PHOTOGRAPHS etc. AS THE VARIOUS CLAIMS COME IN. TOM WILL FOLLOW UP ON THIS.

I AM REQUESTING YOUR PERSONAL INVOLVEMENT OVER THE NEXT WEEK UNTIL WE KNOW BETTER WHAT THE ISSUES ARE AND HOW LARGE THE CONCERN IS. THE PERCEPTION OF JACK AND THE TEAM IN TODAY'S MEETING IS THAT THIS MAY AFFECT ALL TOWN CARS BUILT SINCE 1992, AND POSSIBLY CROWN VIC & GRAND MARQUIS. PLEASE ADVISE IF YOU WOULD LIKE TO DISCUSS THIS FURTHER.

2/4

Work Plan- Brake Pressure Switch

Root Cause Investigation-

Identify flammability characteristics of switch components
- **AVT EESE Materials Engineering**

Identify switch contaminants in parts returned from the field
- **Central Lab analysis**

Identify potential source of contaminants
- **Central Lab analysis**

Identify potential for and possible sources of internal brake switch leaks
- **Central Lab and Texas Instrument**

Identify potential ignition sources during switch operation/malfunction
- **AVT EESE Chassis Electronics**

Simulate potential switch malfunctions in a laboratory environment to evaluate the potential for ignition
- **AVT EESE Chassis Electronics**

Collect additional field samples (including connectors) for laboratory analysis
- **LVC - Safety**

Miscellaneous

Can the switch act as a fuse?
Texas
No. by complete
Could a fuse (e.g. 2 amp) be added in series between the stop lamp fuse and the brake pressure switch? Failure parameters would have to be known.

What are descriptions from AWB and CQIS?
LVC-Safety by 2/18/99

What are we missing in returned Speed control modules (FRACAS)?
Visteon Speed Control by 2/17/99

Provide color photos of Econoline?
Texas Instruments by complete
There are no color photos.

Containment / Corrective Action Tasks

Competitive Vehicles
How is switch packaged?
Is it always Powered (HOT_ALL_TIME) ?
Are the contacts opened when pressure applied?
What is fuse limit?
What is being switched?
Is it a redundant switch?
AVT EESE Competitive Analysis by 2/24/99

What does Speed control FMEA say about Brake Switch ?
Visteon Speed Control by *completed*
The Brake Pressure Switch (Deactivation Switch) coupled with the Stop Lamp switch are categorized as "Automatic Deactivation". The FMEA lists Automatic Deactivation" as current design control for 66 different potential causal mechanical failures.

Brake Pressure Switch (Deactivator Switch) is one of the most important safety features.

When was non-Pressure actuated switched introduced?
AVT EESE Chassis Electronics by *completed*
93 Continental and TBird were first to use it.

Is the Circuit drive hi-side or low-side?
Visteon Speed Control by *completed*
Circuit is low side driven.

How does speed control use this switch?
Visteon Speed Control by *completed*
1. *Brake Pressure Switch provides electrical power to the speed control servo clutch circuit. The clutch circuit needs to be energized for the servo motor to pull the cable.*

2. *Switch provides a redundant method of causing brake application independent of the primary system deactivation mode; this is a SDS (SC-0005) requirement.*

Epstein, Sally

From: Steve Reimers [sreimers@ford.com]
Sent: Saturday, February 13, 1999 3:48 PM
To: Rahman, Aziz
Cc: Sharpe, Robert
Subject: TI actions

Fred mentioned you may be already working on the following.
Plausible wearout explanation for leaking switches.
Recommendations to increase life say by a factor of 3.
Matrix of tests planned and in progress.

Steve Reimers building 5 3C043
AVT Chassis E/E System Applications mail drop 5011
39-03286 SREIMERS sreimers@ford.com fax 39-03286 ;>

Work Plan for Field Returned Brake Pressure Switch & Connector Assy.

0. Set up a spread sheet to *record* all observations vs VIN. & field notes.

1. Do not separate wire connector from switch until step 3. Check for short to ground between both terminal wires and switch housing. Separate into two groups according to short measurements, i.e. open vs resistance.

2. Check for correct engagement of connector to switch base; if NOT correct, conduct X ray to determine fit-up between base lip and red seal.

3. Separate connector from switch. *Verify that connector had made a good seal to switch base.* Visual check of red seal inside connector; determine dirt lines and <u>indentation marks</u>, should be 360 degrees. (The indentation marks on the red seal may start to recover & may disappear over time...so check the seal first.) Check lip on switch base for breaks or loss of edge.

4. Check for evidence of less than full *engagement* by dirt witness lines on mated housings.

5. Check external wire insulation for cuts or openings that would permit *contamination* to enter wires. Check gray seal for contamination leakage paths.

6. Cut wire insulation longitudinally and check for *corrosion* due to wicking along the wires. If present determine FROM / TO direction. Identify color and morphology. Save samples if feasible.

7. Visual check of base terminal cavity for corrosion or debris or discoloration on brass terminals. Save samples of corrosion for chemical id.

8. Isolate those connectors that show contamination based upon above inspection for pressure tests at UTA.

file/coninsp_wp_rvl.

Post-it® Fax Note 7671

To Steve Reimers	Date 2-15-99 # of pages ▶ 1
Co./Dept. ... E&SA	From N.E. LaPointe
Phone # 39-03286	Co. Dcs. Eng.
Fax # 39-03286	Phone # x42686
	Fax #

TI-NHTSA 016347

Electrical properties:

Switch w/ harness (before disengagement)

	@ 0 psid	@ 180 psid
Wire 1 to Wire 2 resistance		
Wire 1 to Hex Port resistance		
Wire 2 to Hex Port resistance		

Harness w/o switch

Wire 1 to Wire 2 resistance	
~~Wire 1 to Hex Port resistance~~	
~~Wire 2 to Hex Port resistance~~	
Current Leakage ~~Terminal~~ Wire 1 to 2	

Switch w/o harness

Terminal 1 to Terminal 2 resistance		
Terminal 1 to Hex Port resistance		
Terminal 2 to Hex Port resistance		
Voltage drop @ 750 milliamps		
Current Leakage Terminal 1 to Hex Port		
Current Leakage Terminal 2 to Hex Port		
Current Leakage Terminal 1 to 2		
Hex Port to Cap resistance		

Mechanical properties:

Switch opening pressure	
Switch closing pressure	— @ ___ psi
Proof Test for fluid leakage	
mileage	

KAPTON

PROFILE ▭ equivalent cycles (miles)

Epstein, Sally

From:	areimers@ford.com
Sent:	Monday, February 15, 1999 10:05 AM
To:	Rahman, Aziz
Subject:	File BPWORKPL.DOC_PC

Work Plan- Brake Pressure Switch

Root Cause Investigation-

Identify the combustibles?
AVT EESE Materials Engineering

Identify the contaminants in returned parts?
Central Lab analysis

Identify source of contaminants?
Central Lab analysis

Identify causes of brake fluid leakage?
Central Lab and Texas Instrument

Identify heat source(s) start event?
AVT EESE Chassis Electronics

Create Event in Lab
AVT EESE Chassis Electronics

Collect Field Samples
LVC - Safety

Root Cause Investigation Tasks

What are the combustibles?

AVT EESE Materials Engineering

Are the switch materials compatible with brake fluid?
by 2/18/99

Are the switch materials compatible with brake fluid in an electric field?
by 2/18/99

Are the switch materials compatible with brake fluid and contaminants?
by 2/18/99

Are the switch materials compatible with contaminated brake fluid in an electric field? by 2/18/99

Flash points for all materials? by *completed*
TI provided to Norm LaPointe

Get Dow assistance by 2/16/99

How can a fire start with the switch given the constraints:

Continuous Battery voltage applied between switch electrical components and the hydraulic connection, circuit fused at 15 amps, inductive load current of 0.5 amps switched when speed control is turned off, the switch cavity contains a black material containing at least copper, zinc, sulfur, and brake fluid (probably containing water), vehicle underhood temperatures.

By 2/22/99

What is the difference in the base materials that look different?

Texas Instruments by *complete*

Color of plastic base identifies calibration. Also, plastic material change from Cellanex 4300 to Noryl GTX430 in MY 1995 when P:N changed from F2VC to F2AC

What are the material call-outs for 1992 and 1993?

Texas Instruments by 2/15/99

Base plastic = Cellanex 4300
Gasket = EPDM
Diaphragm = 3 Layers of Kapton
Transfer pin = Steatite Ceramic
Environmental Seal = Silcone
Metals = ??????

What are the contaminants in returned parts?

Central Lab analysis

Results of Memphis part analysis by 2/18/99

Results of testing with corrosion simulation?

AVT EESE Chassis Electronics by *complete*

Black corrosion recreated in lab on virgin parts. Given to Lab for analysis

TI analysis results of the Memphis parts (crease marks in diaphragm, etc) ?

Texas Instruments by *complete*

TI gave to Norm LaPointe on 2/10/99. Crease mark caused by degradation of Kapton. TI chemical analysis matches Ford analysis.

What is source of contaminants?

Central Lab analysis by 2/18/99

What causes brake fluid leakage? By 2/24/99

Central Lab and Texas Instrument

What does TI DFEMA say about this failure mode?

Texas Instruments by 2/16/99

TI identifies potential for leaks. Copy to Norm Lapointe.

What are TI in-process test failures?

Texas Instruments by *completed*

TI provided IP and Weibull test reports to Fred Porter and Norm Lapointe. First leaker observed at 994,000 cycles. Test suspended at 1.6 million cycles. Leaker was by Kapton diaphragm.

Provide TI end-of-life lab test parts to Norm Lapointe.
TI by 2/18/99

Does the event occur only on vehicles with ABS?
LVC-Safety by 2/18/99

Characterize the real vehicle brake pressure seen at the switch.
AVT Chassis Brakes by

Characterize the real vehicle brake pressure during ABS and TC events seen at the switch . AVT Chassis Brakes by

DOE work plan for TI activities.
TI by 2/16/99

What heat source(s) start event?

AVT EESE Chassis Electronics

Analysis of harness pig-tails
AVT EESE OPD by 2/18/99

Use thermocouple to record switch temperature during and after driving. AVT EESE OPD by 2/18/99

Recreate Event in Lab

AVT EESE Chassis Electronics

What does it take to start an event? by on-going

If a switch is contaminated can it start the event? by on-going

Switch with clean Brake fluid inside is being monitored for increase in leakage current.

If current is stopped does combustion stop?

Collect Field Samples

LVC - Safety

Collect Brake Pressure switches and speed control servos with harnesses attached. By 2/22/99

Miscellaneous

Can the switch act as a fuse?
Team by complete

No.
Could a fuse (e.g. 2 amp) be added in series between the stop lamp fuse and the brake pressure switch? Failure parameters would have to be known.

What are descriptions from AWS and CQIS?
LVC-Safety by 2/18/99

What are we seeing in returned Speed control modules (FRACAS)?
Visteon Speed Control by 2/17/99

Provide color photos of Econoline?
Texas Instruments by *complete*
There are no color photos.

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Are the contacts opened when pressure applied?
What is fuse limit?
What is being switched?
Is it a redundant switch?

AVT EESE Competitive Analysis **by** **2/24/99**

What does Speed control FMEA say about Brake Switch ?

Visteon Speed Control **by** *completed*

The Brake Pressure Switch (Deactivation Switch) coupled with the Stop Lamp switch are categorizes as "Automatic Deactivation". The FMEA lists Automatic Deactivation" as current design control for 66 different potential cause: mechanical failures.

Brake Pressure Switch (Deactivator Switch) is one of the most important safety features.

When was non-Pressure actuated switched introduced?

AVT EESE Chassis Electronics **by** *completed*

95 Continental and T/Bird were first to use it.

Is the Circuit drive hi-side or low-side?

Visteon Speed Control **by** *completed*

Circuit is low side driven.

How does speed control use this switch?

Visteon Speed Control **by** *completed*

1. *Brake Pressure Switch provides electrical power to the speed control servo clutch circuit The clutch circuit needs to be energized for the servo motor to pull the cable.*

2. *Switch provides a redundant method of sensing brake application independent of the primary system deactivation mode; this is a SDS (SC-0005) requirement.*

- *Signal from the stop lamp switch is primary deactivation mode for brake application.*
- *Under "hard" braking condition: Brake Pressure Switch provides redundant brake signal to the speed control logic (similar to stop lamp switch signal) and disconnects power to the clutch circuit; causing the speed control servo pulley to immediately return to the idle position. Note: Under normal braking conditions, only the stop lamp switch signal cancels speed control operation.*

Do all Ford applications use switch between fuse and load?

Visteon Speed Control **by** *complete*

YES

Do all Ford applications have switch connected to HOT-ALL-TIMES?

AVT EESE OPD **by** **2/18/99**

Can Brake Pressure Switch function be removed from power feed circuit and placed in ground return circuit?

Visteon Speed Control **by** *completed*

1. *Would require redesign of the speed control electronics.*
2. *Additional isolated ground circuit is required.*
3. *From FMEA position switching the ground circuit is not as good as switching the B+ feed.*
    - *With a ground return circuit; short to ground (fault) it would override the deactivation switch.*
    - *With the current power feed circuit; short to ground make the speed control system inoperative. A short to power is required to override the deactivation switch; much lower potential to occur.*

Why is this switch connected to HOT-ALL-TIMES?

Visteon Speed Control **by** *completed*

Because the SDS requires it to be connected to the same fuse as the stop lamp.

What is SDS requirement number?

Visteon Speed Control **by** *completed*

SDS (SC-0068) states: The stop lamp switch and redundant deactivator switch must be on the same fused circuit.

Is it feasible to disconnect the switch as immediate containment?

Yes. The customer will not have use of the speed control.

Is it acceptable to Jumper out the switch as immediate containment?

Visteon Speed Control **by** *completed*

NO... Would eliminate an important safety feature of the speed control system. The Brake Pressure Switch provides the redundant method for sensing brake application independent of the primary system deactivation mode. This is an SDS (SC-0005) requirement.

Elimination of this feature requires the concurrence of the OGC.

Other recommendations for immediate containment?

All **by** **on-going**

Add fuse between the stop lamp fuse and the brake pressure switch?

Recommendations for increased Life of switch.

TI **by** **3/5/99**

TI suggested looking at an Automotive ceramic diaphragm pressure transducer (not a switch) that is used for ABS.