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

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 Momphis part analysis

by 2/18/99

Results of testing with corrosion simulation?

AVT EESE Chassis Electronics by

complete

30,

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

2/18/99

To Norm TI analysis of La Poite 2/10/99

S. Retmers RPWORKPL dec page 2 of 7

2/10/99 printed 10:15 AM

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

OFMEA What does TI DFEMA say about this failure mode?

to Norm Roll to 2/15/99 Texas Instruments

2/16/99

bγ 2/16/99

What are TI in-process test failures?

Texas Instruments

We keek 14/55

Does the event occur only on vehicles with ABS?

LVC-Safety

bv 2/18/99

What heat source(s) start event?

AVT EESE Chassis Electronics

Analysis of harness pig-tails

AVT EESE OPD

2/18/99

Recreate Event in Lab

AVT EESE Chassis Electronics

What does it take to start an event?

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 2/22/99 attached. B۷

RPWORKPL.doc

page 3 of 7

2/10/99 priored 10:15 AM

Miscellaneous

Can the switch act as a fuse?

Team

by complete

.Vo.

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.

S. Reimen BPWORKPL.doc

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2/10/99 printed 10:15 AM

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?

Visteou 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 serva clutch circuit The clutch circuit needs to be energized for the serva motor to pull the cable.

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

S. Reimers SPWORKPL.doc page 5 of 7

2/10/99 printed 10:15 AM

- 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.
- Additional isolated ground circuit is required.
- 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.

S. Reimers BPWORKPL.doc

page 6 of 7

2/10/99 printed (0:15 AM

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

y 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?

ΔII

by on-going

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

S. Reimers BPWORKPL.doc

capa 7 of 7.

2/10/99 primed 10:15 AM Note printed by FPORTER on 10 Feb 1999 at 18:25:25

Prom: JEVANSS -- DRBN005

Date and time

02/10/99 12:44:21

To: FPORTHR -- DRBNOG7 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. 906-248-6-784 by now.

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

The 1- riche Tree Kutz

ABJ artisti of a books from

relesse premie

2/10/99 4-5-15 Brainsborn Wan - Get DOW ON TEAM HASK THEM HOW FIRE STARTS WITHIN CONSTRAINTS [14 v, Black Substance 15 AMP MAX CURRINT, VEH, TEMPERATURES.] - Charz RUL VEH Brake Pressure. 10 ABS - Thermo-couple Brk Pr switch after 1. Veh. Driven & turned off. - Take Rate of ABS

1 1 AB5 W/TC

- Are Lanks/ Fires common to straction "

- Black Substance: Copper, Zinc, Silver, Sul-

- Understand TC/ABS Pressura Pulse/

THOTORY OF ELECTROLYSIS IN Brake Flind.

Epstein, Sally

From: Sent: Rahman, Aziz (arahman@email.mc.tl.com) Thursday, Fabruary 11, 1999 10:06 AM

To:

McGuirk, Andy; Beringhause, Steven; Baumann, Russ; Dogue, Sryen; 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 prop for the Executive Technical Review on 2/11. Joe Nami 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 zest

5 possible related to the Brake Freesure Switch (BPS), 17 potential other root causes, no information on the rest

Other root causes from above line : 42 way connector, BEC wire harmone, Relay pack.

At this point WHTSA 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. Ossis massage 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 sail 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 II 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 bess??

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 weibuil life of quiet switch showing first leaker at 900k+ cycles. Gave copy to Norm. Bryan, need weibuil 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 Taves 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 nath.

Discussed CRL analysis of Memphis part, and gave copy of Al's report to Norm. Bryan, par Norm, Al retained "spoonfuls" of the corresion 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

. 1 .

a fire with given constraints.

[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!

,2 -

Mose tomorrow.

Regerds Aziz.

Baker, Gery

From:

Hopkins, AL

Sent:

Thursday, February 11, 1998 5:43 PM

To:

Degue, Bryan; Baumenn, Fussell; Beringhause, Steven; McGuirk, Andrew; Douglas, Charles;

Rahmen, Aziz; Baker, Gary

Ce:

Andree, Arny

Subject.

RE: 77PS Day 2, 2/10/99 Summery

My comments are in clive color

Regards,

Αl

From:

Degus, 5/yen

Bent: .

Thursday, February 11, 1999 1:13 PM

Ta:

Hopidne, Affect

Subj

FW: 77P8 Day 2, 2/10/99 Summary

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

Bry

From:

Rahman, Aziz

Bent:

Thursday, February 11, 1999 11:05 AM

To:

McGuiri, Andy; Beringhause, Sieven; Baumerer, Russ; Dague, Bryon; Douglas, Charles; Sharps, Robert; Sullivan, Mortha; Rowland, Thomas; Baker, Gary 77PS Day 2, 2/10/99 Summary

Subject

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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 select question: Do we know where the fire originated. Quiside - 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 pleatic 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,

Joo's meeting was followed by a vigneous brainstorming section with Fred, Tom, Norm, Steve & Len. This was all technical and I actively carticipated.

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

Page 2

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 to a switch, Team decided that pulling in Dow Chamical 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 separately create an arc in the switch davity.

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

No phose yet. Andy has arranged for a callabe phose and pager. On the positive ride, received invitation from Fred to join his town for a Section Lunch at the Hawalian Cofe, Should be first

More tomorrow.

Regards Aziz.

Epstein, Sally

From: Sent: Steve Reimers (sreimers@ford.com) Thursday, February 11, 1999 6:16 PM

To: Subject: Rahmen, Aziz 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 Reimera AVT Chassis E/E System Applications 39-03286 SREIMERS speimers@ford.com building 5 3C043 mail drop 5011 fax 39-03286 Fict Balls 2/12/97 .

- Aziz help? I that he or on size - Spending hill affort - Meed sold in the public in 2 -the are we goting bossion in seal at viliales at hellis-- How he se carry by firm

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- Had do we horeast the of sursol

- weight for prosent tensioner cycle like

- okat at the runing

-> Pareline use to chrockise wear - all 3 tapling

I he great outed module - 3%-pito-chur

Epstein, Sally

From: Sent:

Seringhause, Steven (aberinghause@ernail.mc.ti.com)

Friday, February 12, 1999 B:39 AM

To:

Ç¢:

Porter, Fred (Ford) McGuirk, Andy; Rehmen, Aziz

Subject

Ford Town Car Issue

Frad,

Attached in this message is a 77PS overview document that discusses the seal for the 77gs. I think this puts into one document answers to several questions your team has been asking about the 77gS design(we will small 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 ment 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. schematic did not scan wall, it is a little hard to read. Axis 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.

<<FordTCl>> <<77P8Overview>> <<pre><<pre><<pre><<pre>ceant proposed2.ppt>>

Steve Seringhause

Steven Beringhause Design Engineering Manager Texas lastruments Incorporated Attlebero, MA 02703

February 8, 1999

Fred.

As we discussed over the phone Priday, 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 (achematic 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

Th's 17PS switch furnily has been specifically designed to operate in an animotive braking system. The pressure cavity of the switch has been designed to seek brake fluid pressure and transmit pressure and movement to the musing portion of the switch over the tide as defined in Ford ES -F2VC-9F924-AA.

Background:

The presence cavity is composed of the hasport, gasket, and three Kayton TM disphragmas (called out as "soal" on attachment 1.). The purpose of the gasket is to provide a fluid tight seal between the hesport and the disphragma. The purpose of the Kayton TM disphragma is to provide a fluiditie fluid tight seal between the presence cavity and the internal components of the switch. Furthermore, the disphragma are intended to transfer presence to the converter, and follow the movement of the converter as pressure in the pressure cavity (brake lists pressure) is varied.

Two known ways that braite finid may enter the contact cavity of TI's brake rwitches from the pressure cavity are i. brake fluid could leak through a damaged or 'worn out' Kapton ^{IM} displacages.

The Carbot

In order to create a fluid tight elastomeric scal, there must be proper comprassion of the elastomer, sufficient backing of the clastomer to prevent movement when pressure is applied, and fluidly the clastomer must be compatible with the working fluid.

Freid comparigitity 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 gashet supplier. Ethylene Propylene is used in the 77PS and is standard throughout the industry for soul gashet materials. Ti has been using this material in braits applications since 1988.

The gasket compression target was obtained from published industry standards (see Purker O-ring Handbook). In this personner dusign a nominal gasket compression of 24% was selected. The depth of the keppert gland shows on attackment #2 controls this attribute. This gland discontion is cut two the hexport at the time of manufacturing. As a result, this dimension is combination with the gasket dimensions determines the final gasket compression when the assembly is crimped together.

Lastly, the movement/position of the gaples when pressure is applied sturt be controlled and restrained. This design accomplishes this by miscoing the outer diameter of the gasket to be slightly smaller than the inner diameter of the gasket gland of the steel plated happent. Therefore, the import 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 deplicate actual applications equilibrium, and its sound cases up beyond the intended limits to failure. See the DFMEA Decement regular 201794 and customer specification ES-F2VC-9P924-AA. Specifically, burst testing, impulse testing, and thermal cycle tests were performed to confirm that the gallest performed as intended. The appoints of these tests and the results can be seen in the PV test report numbers listed below: (copies can be provided on require).

Test Report #	TI Switch Pert number	Year Tested
L. PS/91/48	77PSL2-1	1991
2. PS/91/49	77P51.2-1	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

Clasket-manufacturing anomalies can be produced from out of spec grakets, contamination of the gasket or scaling surfaces, and as a result, may cause leaks early in life. In order to protect TI's customer supply chain from gasket-manufacturing lagues there are several preventative actions to place. These actions include: bair nets, presentive 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 Kepton TM layers. TI's customer return rates indicated by past return and analysis records are less then I pum (one leaker rotum in 5 years from master cylinder leak testing).

Kanton™ Piophrague:

A pregions switch displaying arest and the pentitre cavity, Interests pressure forces to the converter, and follow the converter motion without significantly affecting the switch calibration points. In addition, the displaying material must be resistant to chemical attack by the broke fluid.

Barically, a single piece of Kapton TM in this design commits of a 0.003-inch thick polyimide film laminated on both sides with a 0.001-inch thick PEP Tellon film. The polymide film has the shifty to strated without breaking (strates on the order of 70% before myture), and the Tellon film is compatible with a wide range of chemicals. As a result of this layered construction, Kapton TM was selected for its mechanical and chemicals properties. Moreover, TI has been using this unsertial in pressure switch applications since 1981. In this application three stacked Kapton TM layers were used as the displanges and

To confirm the convex enterial was calented for this application we refer to the DFMEA. Specifically, this document identifies borst testing, impulse testing, and thermal cycle testing. These tests confirmed the Kapton's TM ability to meet the specified requirements (PV reports listed above). Since temperature, chemical exposures, and stress levels all affect the life expectancy of the Kapton. TM displanagem, additional testing is commonly done. A typical impulse test would include pressure cycles to 1450 psi, constant temperature of 135 C, and a cycle see of 120 cycles/estates. Depending on the factors listed above, the life expectancy of a TI brake pressure puticle can very, but typically is around 1 million cycles which is well above the 500,000 cycles specified in the Ford specification (BS-F2VC-9F924-AA). (See Life Testing to Failure (PS-99/14))

In addition, continued conformance testing has been origing for eathly years at IT. The purpose of this testing is to confirm that the compounds, materials, and processes have remained stable over time and that the design intent is confirm being actioned. See attached IP separts which confirm 100% successful passing of all tests defined in the specification.

Manufacturing & PV connection such as pinched Kapton TM can affect the Kapton TM displacage, settle performance (see PFMEA Document # 503431). Manufall-chaosical composibility and streen/atrain contractivations can also charact the Kapton TM displacages to fatigue. See DFMEA Document number 503796. In order to variety this current chaign parameters were selected, the switch was subjected to a number of instended to simulate accelerated life testing of the application. See PS reports called out

above. Life testing per the customer specification (ES-F3VC-9F924-AA) has shown acceptable performance.

Typically, Kapton TM fatigue occurs well over 0.5 million full-scale pressure cycles in our history of simulated and accelerated life testing. When Kapton TM fatigue does occur, there are visual signs of delapsination, cracking, and embrittement. The Kapton TM diaphragms break flows first in the areas of highest stress and or strain. Typically, the first region to show break down is the circumferential area surrounding the converse busine. See Endurance Test (report * PS/98/51). Again, diaphragm life depends on stress levels (pressure suggested applied), temperature, and chemical exposure. The above mentioned tests were conducted in Tt's Life Test lab with relatively controlled conditions.

Water has been shown to accelerate the aging of the lane polymide. Water can be introduced in two knows easy;

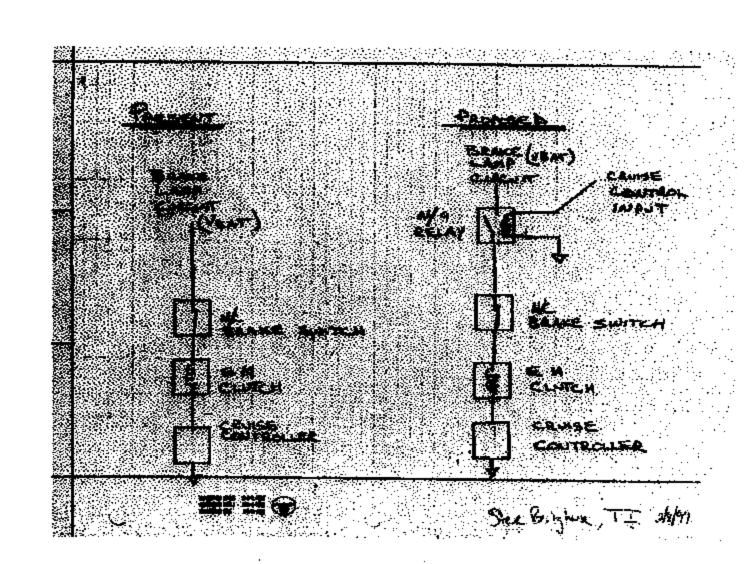
- 1) By entering the contact cavity via the electrical connector
- 2) By being in solution in the brake fluid and entering the switch via the pressure part.

When water outers the connector it will "age" the Kapton ^{the} disphanges and make them appear as though they have reached the end of life. This condition leaves visual close. Classic signs of characteristics of the Kapton ^{the} include de-lumination of the Teflon from the base polymide base, embrintement, and cracking of the base polymer. See Endowned Test (report PS/98/53).

Anthored by Beyon Degue. Call Andy Meguitte or Bryan Degue with questions.

77PS Overview Appendix

- L. Pressure Switch Cross Section
- 2. Hexport Print (Ti # 36900)
- 3. Gasket Print (TIN 74353)
- DFMEA for Gasket and Kapton Saul
 Life Test to Failure Test Report (Weibull Analysis)
 Customer Specification (ES-F2VC-9F924_AA)
 PFMEA
- B. IP Test Reports
- 9. Endurance Test Report



Stoven Beringhame Design Engineering Manager Tenne Instruments (neorgovated Attlebore, MA 62703

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 fallsafe component to skut 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 lightion 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

94

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

Prom. DGOSL -- DERMOGS

Date and time | 02/12/69 07:35:55

To: FPORTER -- DESMOOT

UBART (UTC -08:00)

FRUM: Despait Gool Subject: TORK CAR INVESTIGATION

fred,

From an infrastructure point of view is there may thing that is not being dene? I thought we had a full time tank force working on this electly.

Call me pla.

Ragards, Despak Goel, Manager Rostraints. Power Eupply, Chassis & EMC 11dg #6, MD 8011, room 28019 (312) 12-75771, Fax: 42-14562, 2-Hail: dgoel@ford.com *** Forwarding note from ECOLE1 -- DEREGOS 02/11/99 17:41 *** DOCKL --CHESTOOS To: TOCHOVAN -- CREMOOS CC: CWILDO33 -- DEEMOOS

From: San L. Cole Subject: TORN CAR INVESTIGATION UMART (UTC -05:00)

I JUST LEFT THE THEM REVIEW FOR THE TORK CAR METER INVESTIGATION. THIS IS VIEWED AS A SENIOUS LESUE AND PORD IS LATE IN RESPONDING (FROM METSA'S VIENDOINT).

JACK PASSUS RECOESTED A "TASK PORCE" BY FULL TIME OF THIS TO MAKE SURE WHEN PARKUE RECORDED A "LABOR FORCE" HE FORD THEN ON THE SU PARKE SURE HE 1) RETARLIES 2007 CAMERS, 1) INNETTRY WEIGH VERYCLES ARE POTENTIALLY APPROVED, 1) INNETTRY COMMENTIVE ACTIONS AND 4| INSLEED THE ACTIONS IN THE FIELD, MEYER WILL BE 18 MEET WEEK TO HERY WITH ASD, AND WILL ADVISE THEM TELT A TRUE PORCE HAS REEN STRATED AND WE WILL HAVE RESULTS IN 2 HONTER .

JACK ASKED FOR A WESKLY HESTING WITH RIN OF TELS. HE ASKED FOR HEST TO HAVE AN ELECTRICAL SYSTEM CRANDION OVERSES THE SPECIES. TIM. I VOLUNTHERED YOUR MANS AND ADVISED JACK TRAT I WILL ALSO SELF OUT. JACK REQUESTED THAT YOU ARD/OR I ATTEND THE WHENLY OFDERE MEETING WITH HIM.

DERIVAR AND TIM: WE REED TO MAKE SUME OUR PROPER MAVE WHATEVER SUPPORT AND OVERTING THEY MEED OVER THE MEET SEVERAL WEEKS TO GET ARRAD OF TRIES. I HAVE ASKED BOD ENGLISH TO TAKE THE LEAD ON LOCALISM AT THE CONDUCTOR TO DETERMINE IF THERE IS ANY POTENTIAL LEADANN PAIN TO CHOOSE, MITTERIAL TO THE MULTCE THEOTHE THE COMPETCE OF WILLIAM PRINT HAS THE LEAD ON THE INTERNAL STATES INVESTIGATION, THE EAS THE LEAD OF THE OVERALL SYSTEMS LOCK

SCHEOUT IN THE MENTING (NOT SURE WHO IT WAS) NUMERICATED AN OUTSIDE ASSECT THAT FORD HAS USED SEPORE TO GO LOOK AT VEHICLES, TAKE PROTOGRAPES ONG. AS THE VARIOUS CLAIMS COME IN. TON WILL POLICY UP OF TRUE.

I AM REQUESTED TOOK PERSONAL ENVOLVEMENT OVER THE REAL TERM CHIEF WE KNOW BRITER WEAT THE ISSUES AND NOW LARGE THE CONCERN IS. THE PERCEPTION OF JACK AND THE THAN IN TODAY'S MEETING IS THAT THIS MAY AFFECT ALL TODS CARS BUILT SINCE 1992, AND POSSIBLY CROSS VIC & GRAND MARQUIS. FLERSY 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 Electronies

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 cell-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 corresion simulation?

AVT EESE Chaseis 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 disphragm, etc)?

Texas Instruments

by 2/18/99

S. Reimers mPWORKPL.doc min 2 of 7

2/10/99 prised 10:15 AM 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

y 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 beat source(s) start event?

AVT EESE Chassis Electronics

Analysis of harness pig-tails

AVT BESE OPD

by 2/18/99

Recreate Event in Lab

AVT EESE Chassis Electronics

What does it take to start an event?

by co-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 serves with harmesses attached.

By 2/22/99

8. Reimers BPWORKPL.doc pup 3 of 7

2/10/99 printed 10:35 AM

5/4.

Miscellaneous

Can the switch act as a flise?

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

w 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 opered when pressure applied? What is fuse limit? What is being switched? is it a redundant switch?

> AVT EESE Competitive Analysis 2/24/99

What does Speed control FMEA say about Brake Switch?

Visteon Speed Control bу completed The Brake Pressure Switch (Deactivation Switch) coupled with the Stop Lamp switch are categorises 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 completed 95 Continental and T/Bird were first to use it.

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

Visteon Speed Control completed Circuit is low side driven.

How does speed control use this switch?

Visteen Speed Control completed Brake Pressure Switch provides electrical power to the speed control

- servo chitch circuit. The clutch circuit needs to be energized for the servo motor to pull the cable.
- Switch provides a redundant method of sensing brake application independent of the primary system deactivation mode; this is a SDS (SC-0005) requirement.

Reimera BPWORKPL.doc 7000 5 of 7

2/10/99 printed 10:15 AM

1/9

- Signal from the stop lump 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 broking conditions, only the stop lamp switch signal cancels speed control operation.

Do all Ford applications use switch between fuse and load? Vistors 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?

Vistoon Speed Control

by completed

- Would require redesign of the speed control electronics.
- 2. Additional isolated ground circuit is required.
- 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?

Vistage Speed Control by completed
Because the SDS requires it to be connected to the same fuse as the stop lamp.

S. Retgans 257WORKPL.doe page 6 of 7

2/30/99 primed 10:15 AM What is SDS requirement number?

Vistom 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 discounce 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?

Visteen 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?

S. Roimers EUFWOOLKPL.doc

page 7 of 7

2/10/99 polsmá 19:15 AM Baumañn, Russ

Beringhause, Steven From:

Sent: Friday, February 12, 1999 9:40 AM

To: Baumann, Russ

FW: Ford Town Car Issue Subject:

FYI

From:

Sent To:

Seringheuse, Steven Friday, February 12, 1999 9:37 AM 'Porter, Frad (Ford)'

McGuirk, Andy; Platiman, Aziz

Bubject

Ford Town Car labbe

Attached in this message is a 77PS overview document that discusses the seal 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 enhantetic of the proposed relay circuit and a cover letter describing the use of that circuit. My understanding is that you did not receive the tax 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 seen 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.doc



77FSOwww.rd



present proposed2.ppt

Stave Beringhauss

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

February 8, 1999

Fred.

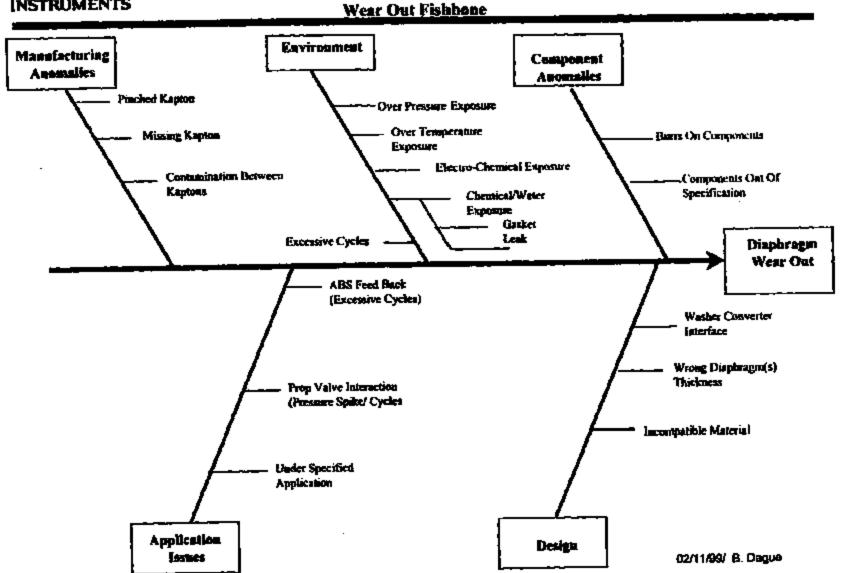
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Regards, Steven Beringhause

TEXAS INSTRUMENTS

Ford Electronic Speed Control Deactivation Pressure Switch

TI P/N 77PSL Series



Proprietary Epformation

71PS Overview 2/10/99

II'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.

Beckeround:

The pressure cavity is composed of the hexport, gasket, and three Kapton ^{fM} disphragms (called out as "seal" on attachment 1.). The purpose of the gasket is to provide a fluid tight seal between the hexport and the disphragms. The purpose of the Kapton ^{fM} disphragms is to provide a flexible fluid tight seal between the pressure cavity and the internal components of the switch. Furthermore, the disphragms 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 seel, or ii. brake fluid could leak through a damaged or 'worn out' Kapton TM 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 teating is always done with the specific fluid that the distorner 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. It 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 solected. The depth of the bexport 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 bexport 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 quatomer 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	
ī.	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 thate are several preventative actions in place. These actions include: hair nots, protective smocks, and cleaning procedures for the equipment. In addition, TI's automated assembly equipment has actsors to detected presence and orientation of the gasket and the 3 Kapton TM layers. TI's customer return rates indicated by past return and analysis records are less then 1 ppm (one leaker return in 5 years from master cylinder leak testing).

Kapton™ Disphragms:

A pressure switch disphragm 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 disphragm material must be resistant to chemical attack by the brake fluid.

Basically, a single piece of Kapton ^{the} in this design consists of a 0.003-inch thick polyimide film luminated on both sides with a 0.001-inch thick FEP Teston film. The polyimide film has the ability to strench without breaking (strains on the order of 70% before repture), and the Teston film is compatible with a wide range of chemicals. As a result of this layered construction, Kapton ^{Net} 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 ^{the} layers were used as the disphragm 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 TM shility to meet the specified requirements (PV reports listed above). Since temperature, chemical exposure, and stress levels all affect the life expectancy of the Kapton TM 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% asscensful passing of all tests defined in the specification.

Manufacturing & PV anomalies such as pinched Kapton TM can affect the Kapton TM dispiragm seel performance (see PPMEA Document # 503831). Material/chemical compatibility and stress/strain concentrations can also cause the Kapton TM disphragms 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 embrittement. The Kapton TM displangers 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, displanger 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:

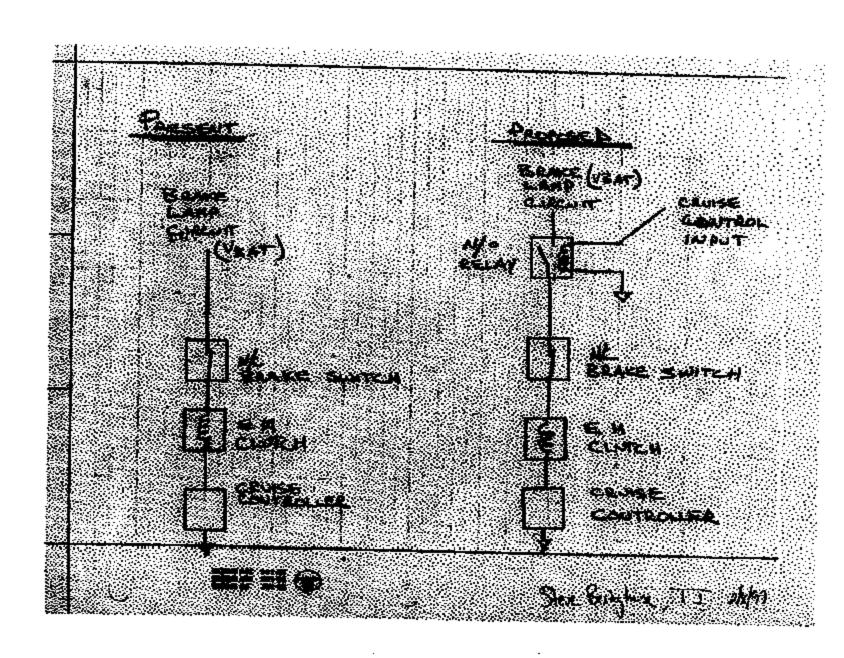
- 1) By entering the contact cavity via the electrical connector
- 2) By being in solution in the brake fluid and entering the switch via the pressure post.

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

Authored by Bryan Dagos. Call Andy Megnick or Bryan Dagos 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

Prom: Bent:

Rahman, Aziz (arahman@email.mc.ti.com)

Friday, February 12, 1999 10:29 AM

Ta:

McGuirk, Andy; Beringhause, Steven; Dague, Bryan; Baumenn, Ruse, Sherpe, 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 Peeke Program Engineer, Town Car Ann O'Weill Quality Directory, Luxury VC Sam Cole 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 MHTSA is next week, as part of their regular quaterly meetings. Town Car underhood fires will be high on the discussion list, and the expectation (hops?) 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.
- There was considerable concern that the field data set is not complete, and Joe Newi has been tasked to get a clearer picture of the events breakdown. - There were strong feelings of "got to do more".

- Fred's statement that "TI Engineering is resident bers" elicited a "Good" response.

I met with Fred 2/12 morning to capture his thoughts on follow up actions:

- Reed a "raft" of experiments to accelerate kepton wear. Need to design and execute a DOE with temperature, moisture, disc emergy, contaminents (seep, detergent), # of kapton layers atc as factors. I will close with Bryan on this. We need a plan with timing by next Wednesday.
- Looks like we may need 2 3x life. Will need to metablish real application requirement for 10yr/150k miles. 500k is not enough. What solutions can TI evaluate and put into place in 2 months.
- Wo potential solution should be eliminated for cost ressons.
- 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 kepton 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. Szyan, can we do this with the switches we pulled from the field with known mileage. Can we swap parts in used care, say at Tasca? Today PM, we will meet with Greg Stevens, materials quy at AVT who has been tasked with getting Dow in the loop.

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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, pln 604-2042

Regards Aziz.

.1 .

Dague, Bryan

Front

Rohman, Aziz

Sent

Friday, February 12, 1989 11:28 AM

To:

McGuirk, Andy; Beringhause, Steven; Dague, Brysn; Beumenn, Rues; Sherpe, Robert; Douglas, Charles; Baker, Gary;

Rowland, Thomas

Bebject:

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FYI, I have a phone & pager now. Thanks Andy. I felt like "Far From the Maddening Crowd" (Thomas Hardy).

without the comm-ink! Phone: 508-208-8119

Pager: 1800-948-4846, pin 604-2042

Regerda ᄺ

Page 1

tcCuirk, Andy

From:

McGuirk, Andy

Sent

Friday, February 12, 1999 12:09 PM

TO: œ

Beringhause, Steven: Baumann, Russ: Rahman, Aziz: Dague, Bryan 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 colinions about other participation.

ARTONOTTYE BENGORE AND CONTROLS ORA HANGER 74 FOREST ST N/S 23-05 ATTLEBORO, HA D2703 TRL | (508) 234-308 PAK | 1508) 236-745 PAK | 1608) 467-3700 PIM 604-2044

below is Aziz day three feedback

stromey - client privileged communication

Pront:

Rahman, Aziz

Sant:

Friday, February 12, 1899 11:28 AM

TB:

McCairk, Andy; Beringhause, Steven; Dague, Bryan; Baumann, Ruse; Sharpe, Robert; Couglas,

Charles; Baker, Gary; Rowland, Thomas

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77PS, 2/11/89

Main event of the day was the Technical Review, Highlights:

Key perticipents were:

Jack Pasques Chief Engineer, Luxury VC

Chuck Peake

Program Engineer, Town Car

Ann O'Nell

Sam Cole

Quality Directory, Lunary VC Manager Large Vehicles Electrical Systems

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Every Thursday, implies core team prep meeting every Wednesday.

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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 mak with Fred 2/12 morning to capture his thoughts on follow up actions:

 Need a "raft" of experiments to accelerate kepton weer. Need to design and execute a DOE with temperature, moisture, disc energy, contaminents (soep, detergent), # of kepton layers etc as factors. I will oldes with Bryan on this. We need a plan with timing by next Wednesday.

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Phone: 508-208-8119

Pager: 1800-948-4648, pin 804-2042

Regards Aziz.

McGuirk, Andy

Subject

PW: Ford conference call

AUTOMOTIVE SCHOOLS AND CONTROLL ONE MANGER 14 FOREST ST N/S 23-05 ATTIMOMO, NA 02703 TEL: (504) 236-3080 PAC: (808) 236-3748 PAGE: 1800) 467-3700 UZM 606-2044

Front:

McGuirk, Andy

Sent:

Friday, February 12, 1999 12:09 PM

To: Ce:

Baringhause, Steven; Baumann, Russ; Rahman, Aziz; Cague, Bryen Sullivan, Martha; Reynolds, Steven; Pechonis, John; Douglas, Charles

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AUTOROTIVE BINSORS AND CONTROLS ONA MADELE 24 FOREST ST N/S 22-05 ATTLEGORO, NA 02703 TEL : (508) 238-2080 FAR : (208) 238-2146 FAR : (408) 667-3700 PIN 604-2044

below is Aziz day three feedback

attorney - client privileged communication

Frant:

Rahman, Aziz

Sent

Friday, February 12, 1999 11:28 AM

To:

McGuirk, Andy; Beringhause, Steven; Dague, Bryan; Saumann, Russ; Sharpa, Robert; Douglas,

Charles; Baker, Cary; Rowland, Thomas 77PS, 27(1/99

Subject:

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Ann O'Nell

Program Engineer, Town Cer Quality Directory, Luxury VC Manager Large Vehicles Electrical Systems

Sam Cole

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- MANUAL BAPPINACKS

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Phone: 508-208-8119

Pager: 1500-945-4545, pin 504-2042

Regards Aziz

Page 2

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From:

McGuirk, Andy

Sent

Friday, February 12, 1939 12:09 PM

To:

Beringhause, Steven; Baumarm, Ruse; Rahman, Aziz, Dague, Bryan Sulivan, Martha; Reynolds, Steven; Pechonia, John; Douglas, Charles

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A

AUTOMOTIVE SEGMONS AND CONTROLS ORA MARKES

24 FOREST ST N/8 21-05 ATTLEBORO, MA 02703 TEL : (502) 256-3080

TEL : (608) 236-3080 FAE : (60%) 236-3748

PAGE: (800) 467-3700 PER 604-2844

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; Beumann, Russ; Sharpe, Robert; Douglas, Charles;

Baker, Gary; Rowland, Thomas

Subject:

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Phone: 508-208-6119

Pager: 1800-945-4845, pin 804-2042

Regards Aziz.

Bournann, Ruse

From: McGuirk, Andy

Sent: Friday, February 12, 1999 12:42 PM

To: Watt, Jim; Baumann, Russ; Oague, Bryan

Co: Beringhause, Sleven
Subject: FW: Ford conference call

attomey - client privileged communication

Jim

there is a building desire to be able to characterize switches in different states of life weer 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.

ple discuss with Bryan ideas we may have regarding sources of 'old' ewitches 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...

.

AUTOMOTIVE SEMBORS AND CONTROLS ORA MANDES 24 PORTET BY K/S 22-03 ATTLEBORO, NA 02703 TEL : (308) 234-2080 FAZ : (508) 234-1748 FAGE: (800) 467-3700 PEN 604-2044

From: McGuirk, Andy

Sent:

Friday, February 12, 1999 12:09 PM

To:

Beringheuse, Sieven; Beumenn, Ruse; Rohmen, Aziz: Degue, Bryan Sullivan, Martha: Reynolds, Steven; Peohonia, John; Douglas, Charles

Co: Subject:

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AUTOMOTIVE BENEGOS AND CONTROLS QUA MANUER 34 FOREST ST N/S \$3-05 ACTLESORO, NA 02703 VEL : (508) 234-3080 VAX : (508) 234-3742

below is Aziz day three feedback

attorney - client privileged communication

From:

Ashman, Aziz 1

Sent:

Friday, February 12, 1999 11:28 AM

Tos

McGuirk, Andy: Seringhauss, Steven; Dague, Bryan; Baumann, Ruse; Sharpe, Robert;

Douglas, Charles; Baker, Gary; Rowland, Thomas

Subjecti

77PS, 2/11/99

Main event of the day was the Technical Review. Highlights:

Key perticipents were: Jack Pasquae Chief Engineer, Luxury VC Chuck Peake Program Engineer, Town Car Quality Directory, Luxury VC

Ann O'Nelli Sam Cole

Manager Large Vehicles Electrical Systems

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Phone: 508-208-5119

Pager: 1800-945-4546, pin 604-2042

Regards Aziz.

Montele, Saffy

Sant:

Balier, Chry (gheisr@emel.me.1.com) Friday, Peintery 12, 1999 12:29 PM

Tex

Rahman, Agig McCluiri, Araby, Beringhasse, Steven; Dagus, Bryan; Bausware, Ruse; Shirper, Robert; Dougles, Charles; Roberts, Thomas

ubject: RE: 77PS, 211/90

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

from: Rahman, Aziz

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

To: McGuirk, Andy: Beringhause, Steven: Dague, Sryam: Baumann, Russ: Sharps, Robert: Douglas, Charles: Baker, Gary: Rowland, Thomas Subject: 7795, 2/11/99

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Chuck Pesks Program Engineer, Town Car
Ann C'Heill Quality Directory, Luxury VC
Sam Cole Manager Large Vehicles Electrical Systems

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Pager: 1800-945-4646, pin 604-2042

Regards Aziz.

Morris, Irene

From:

Rahman, Aziz

Sent:

Friday, February 12, 1999 12:28 PM

To:

McGuirk, Andy; Beringhause, Steven; Dague, Bryan; Baumann, Russ; Sharpa, Robert; Douglas,

Charles; Baker, Gary, Rowland, Thomas

Subject:

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Sam Cole

Manager Large Vehicles Electrical Systems

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Pager: 1800-948-4846, pin 604-2042

Regards AzĒ.

Contain, Lifty.

Franci Soni:

McGuirk, Araly (s-maguirle) email.mo.tr.com) Friday, February 12, 1988 427 PM

To; Ċa:

Baumann, Rium; Seringheuse, Steven; Cegue, Bryen; Sulhum, Marthe; Baler, Chary Fechonic, John; Wall, Jim; Raydand, Thomas; Rahman, Assi; Douglae, Charles; Sharpe, Robert

Subject Ford conference call minutes of 2/12

attorney - client privileged communication

attendess...

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

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

draft of key points:

Ford management is 'sllowing' 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 ... II 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 switchwe 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 eamples 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 kepton 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 this info might build a good is-is not table by ford. We pointed out poweroushing 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 admowledged (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 chamical or other event during the special cause periods of powerwash and splash events and maybe event pliminate the ignition source. Fred also said he did n 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 mugt the we are working full speed toward defined ends

Ford admitted that the apead 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 west and internal wear to characterize if this is happening on event items. talked about 3 amps inductive but summarised 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

AUTOMOTIVE SENSORS AND CONTROLS QRA MANGER

34 FOREST ST M/8 23-05 ATTLEBORO, NA 02703 TEL : (508) 236-1080 FAX : (508) 236-3745

PAGE: (800) 467-3700 PIN 604-2044

Promi

McGuirk, Andy Friday, February 12, 1999 12:09 FM Sent:

To: Beringhause, Steven; Seumann, Ruse; Rahman, Aziz; Dague, Bryan Co: Sullivan, Martha; Reynolds, Steven; Fechonia, 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 Axiz, would be to align the plans for Axiz 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.

AUTOMOTIVE SENSORS AND CONTROLS ORA MANGER 34 FOREST ST M/S 23-05 ATTLEBORG, MA 02703

TEL : (508) 236-3080 FAX : (508) 236-3745

PAGE: (800) 467-3700 PIN 604-2044

below is Aziz day three feedback

attorney - client privileged communication

Rehmen, Aziz FEDRU

Sent: friday, February 12, 1999 11:28 AM

To: McGuirk, Andy; Seringhause, Steven; Deque, Bryan; Baumann, Ruse; Sherpe, Robert;

Douglas, Charles; Baker, Gary; Rowland, Thomas

77PS, 2/11/99 Subject:

Main event of the day was the Technical Raview. Highlighter Key participants were: Jack Pasques Chief Engineer, Luxury VC Chuck Peske Program Engineer, Town Car Ann O'Weill Quality Directory, Luxury VC

Sam Cole Manager Large Vehicles Electrical Systems

Mext Tech Review: Every Thursday, implies core team prep mesting every Wednesday.

- There is a need to have the ability to implement, whatever solution is decided, in two months max.
- Next meeting with NWTSA 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.
- There was considerable concern that the field data set is not complete, and Joe Newi has been tasked to get a clearer picture of the events breakdown.

 - There were strong feelings of "got to do more".

 - Fred's statement that "TI Engineezing is resident here" elicited a "Good" response.

I met with Fred 2/12 morning to cepture his thoughts on follow up sations: - Need a "raft" of experiments to accelerate kapton wear. Need to design and execute a DOE with temperature, moisture, disc energy, contaminents (soap, detergent), 0 of kapton layers etc as factors. I will close with Bryan on this. We need a plan with timing by next Wednesday.

- Looks like we may need 2 3x life. Will need to establish real application requirement for 10yr/150k miles. 500k is not enough. What solutions can TI evaluate and put into place in 2 months.
- No potential solution should be eliminated for cost reasons.
- Kaving 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. Quits 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 Labe folks at 1.00 today to look at kapton from non-fire. non-lesk 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 away parts in used cars, say at Tasca? Today PM, we will meet with Greg Stevens, materials guy at AVT who has been tasked with cetting 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

Fages: 1912-946-4646, pin 604-2042

Aegasus Auto, Spetale, Saffy

From: Cont:

To:

Sieve Reimers (preimers@ford.com)
Thursday, February 18, 1986 6:33 Air
[neme@ford.com; stercush@ford.com; Frederick J. Parts; ranglist @ford.com; stester@ford.com; rispants@ford.com;
[mailers@ford.com; plants@ford.com; Sterve Reimers; technoly@metsen.com; Fred Koh; thubl@ford.com; promers@ford.com;
chudipre@retsen.com; patrices@vetsen.com; dgosi@ford.com; foreun@ford.com; ecost @ford.com; hundred@ford.com;
gathers 1@ford.com; websertaci@ford.com; nemesa@ford.com; Rainman, Atta: Sharps, Robert

Subject:

Braice Pressure Switch

FROM: Stove Reimers

USAET (UTC -05:00)

Requester:

Steve Reimeza

Date to be scheduled: 02/24/99 - 06/30/99

Starting time: Ending time:

02:00 PM 04:00 PM

Location: Bldg 5 3A039

Purpose:

Team Meeting

06/30/99

Stave Reimers

AVT Chassis E/E System Applications 39-03286 SREINERS sreiners@ford.com fax 39-03286

building 5 30043 meil drop 5011

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From: Despt. -- DESERTE

Date and time #3/13/48

13/13/10 17:25:EI

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Requiries
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(312) 13-78171, Park 62-14862, Sepail: devalations, our
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From: See L. Cole Robject: 7000 CAR 1896931982500 2007 A 2010/5 UF. WEART (WTC -03, 80)

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Work Plan- Brake Pressure Switch

Root Cause Investigation-

Identify flammability characteristics of switch components
- AVT EESE Materials Engineering

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

Identify potential source of contembants
- 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 to a laboratory environment to evaluate the potential for ignition

AVT EESE Chassis Electronies

Collect additional field samples (including connectors) for laboratory analysis

- LVC - Safety

Minorlianeous

Can the switch set as a fose?

Team

كالمرابع

Cauld a fine (e.g. 2 amp) he added in series between the step lamp fine and the brain pressure switch? Failure parameters would have to be income.

What are descriptions from AWS and CQUS?

LVC-Sector

2/18/99

What are we assing in constant Speed control modules (FRACAS)?

Vinteen Speed Control

by 2/17/99

Provide coint phone of Econoline?

Terres Indicated a There are no color photos.

PHF 4 167

COMPLETE

Containment / Corrective Action Tacks

Competitive Vehicles

How is switch packaged? Is it abvers Percent (HOT_ALL_TIME) ? Are the contacts opened when pressure applied? What is feen final? What is being switched?

Is it a reductiont entitle?

AVT EENE Competitive Australy by

What dom Speed control FMEA my about Broke Switch?

Visione Spend Countral The Bridge Pressure Switch (Denoctronian Switch) complete with the Step by completed Lamp writch are consection as "Automotic Description". The PMEA lists Automatic Descrivation" on current design control for 56 different potential compet mechanical follows.

throtic Protecter Selects (Desectionity Switch) to one of the most important ±¶dly ftallers.

When was non-Pressure estimated switched introduced?

AVT EESE Charite Discharica

completed

93 Combinated and T/Bird wave first to use it.

Is the Circuit drive bi-side or invested

Vision Speed Control

COPYRIGHTS

Circuit is low side driven.

How does speed control are this arrival?

Visions Speed Control

by completed

- 1. Broke Pressure Switch provides electrical power to the speed control sarrio church streng. The church circuit neads to be energized for the servo motor to pull the cubic.
- 2. Switch provides a redundary method of masting braits application makependien of the primary system descripsion mode; then is a SDS (SC-0005) regularment

2/18/99 private Walf AM

TI-002054

23091

1. Reimer APPROBLEM.

7]-1020第

Epetein, Salty

From: Sent:

Stave Reimers [sreimers@ford.com] Saturday, February 13, 1999 3:48 PM Rahman, Aziz Sharpe, Robert

To: ÇE;

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.

Stave Reimors AVT Chassis E/E System Applications 39-03266 SREIMERS sreimers&ford.com building 5 30043 mail drop 5011 fax 39-03286

Work Plan for Field Raturned Brake Pressure Switch & Connector Assv.

- Set up a spread sheet to record all observations vs VIN. A field notes. D.
- Do not separate wire connector from switch until step 9. Check for short to ground between both terminal wires and switch housing. Separate into two proups. according to short measurements, i.e. open vs resistance.
- Check for correct engagement of connector to awitch base; if NOT correct. conduct X ray to determine fit-up between base lip and red seet.
- Separate connector from switch. Varily that connector had made a good seal to awitch base. Visual check of red seat halde connector; determine dirt lines and indentation marks, should be 360 degrees. (The indentation marks on the red seal may start to recover & may disappear over time...so check the seel first.) Check to on switch base for breaks or loss of edge.
- Check for evidence of less than full engagement by dirt witness lines on maled housings.
- Check external wire insulation for cuts or openings that would permit contamination to enter wires. Check gray seal for contamination leakage paths.
- Cut wire insulation longitudinally and check for corrector due to wicking along the wirse. If present determine PROM / TO direction. Identify color and morphology. Save samples if feasible.
- Visual check of base terminal cavity for corrosion or debris or discoloration on brass terminals. Save samples of corrosion for chemical id.
- legists those connectors that show contamination based upon above inspection for pressure tests at UTA.

file/coninsp_wp_mt.

Period For Moss	7677	2-15-49 14-> /
THE PER	2625	N.C. LAPLUTE
7/2 char	454	Des frac.
ST-072	Z	Page 143686
Par 34-0328	6	P=1

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Reimers: Steve J

	Switch w/ harriess (before disengagement) Wire 1 to Wire Previous Wire 2 to Hex Port resistance Wire 2 to Hex Port resistance	€ 0 pskt	€ 160 paid			
•	Harness w/o switch 2. Wire 1 to Wire Affectance Wire 1 to Hex Port resistance Wire 2 to Hex Port resistance Current Laskage Terminal 4 to 2 Current Switch w/o harness			Joseph John		
	Terminal 1 to Terminal 2 resistance Terminal 1 to Hex Port resistance Terminal 2 to Hex Port resistance Voltage drop @ 750 milliampe Current Leakage Terminal 1 to Hex Port Current Leakage Terminal 2 to Hex Port Current Leakage Terminal 1 to 2 Hex Port to Cup resistance			ρνν.		
Mark.	Mechanical properties: Switch opening pressure Switch closing pressure Proof Teet for fluid leakage mileage					
	KAFTON PROFILE		equivalent	cycles (miles)		

Epstein, Sally

From; Sent; To: Subject;

āreimers@ford.com Monday, Pebruary 15, 1999 18:05 AM Rahman, Aziz File BPWORKPL.COC_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

9. Retmers BPWQRKPL.doc page 1 of 7

revised 2/13/99 primed 2:16 PM

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 competible with contaminated brake fluid in an

electric field?

by 2/18/99

Flash points for all materials?
TI provided to Norm LaPointe

by completed

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

S. Reimen APWORKPL.doc page 2 of 7

revised 2/13/99 printed 2:16 PM 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?

Toxas Instruments

by 2/16/99

II 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.

S. Reimens BPWORKPL.doc page 1 of 7

revised 2/13/99 printed 2:16 PM Provide TI end-of-life lab test parts to Norm Lapointe.

ΤI

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

bу

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.

ΤI

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

S. Reimers BPWORKPL.doc page 4 of 7

nevised 2/13/99 printed 2:16 PM

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.

S. Reimers BPWQRKPL.doc page 5 of 7

revised 2/13/99 printed 2:16 PM

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
Lamb Switch are extensives as "Automatic Deactivation". The EMEA lists

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

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

S. Raimers BPWORKPL doc page 6 of 7

printed 2:16 PM

- 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.
- 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.

5. Reimers BPWORKPL.doc page 7 of 7

revised 2/13/99 printed 2:16 PM

What is SDS requirement number?

Visteou 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? Vinteen Speed Control by containment?

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?

ΑI

y od-going

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

Recommendations for increased Life of switch.

TI

by 3/5/99

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

S. Reimens BPWORKPL.doc page 8 of 7

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