EA02025

TEXAS INSTRUMENTS, INC.'S 09/10/03 LETTER TO ODI

REQUEST 11

BOX 13
PART A - C
PART A

Morrie, Irene

Fram:

Ha, D

Sent

Thursday, October 29, 1998 12:25 PM

To:

Douglas, Charles

Subject:

Potential modes of failure for leakage

Here's the list you requested for potential causes of switch issistage:

System:

Davice not screwed in properly

Leakage at thread area Leskage at thread area

Improper sealing due to mating port demage

Burst device

Device exposed to exceesive pressure Device exposed to excessive temperature

Gasket seel kropshed

Disphreum leakege

Device exposed to excessive number of cycles

Wester (or other contaminants) in system degrades Kapton disphragm Disphragm leakage

Water (or other contaminants) ingresses switch through base and Displacem leakage causes Kapton degradation

Manufacharing:

- Misplaced/missing gasket
- Mapiececkmissing Kepton
- improper gasket material (incompatible with brake fluid)
- incorrect # of Kepton (switches require 3 displyagms because brake fluid is more aggressive)
- incorrect maneor crimo
- incorrect device crimp (fluid works its way in from the crimp to the base cavity into the sensor easy)

FYI, we have had a car fire occurrence involving our switch in the past. See PS/96/34 in which a 52PS device was analyzed after a car fire. Disposals showed that the exitch leakage occurred after the fire due to the high temps, and not the other way around.

Please let me know if you need anything further.

Recerds.

a

TI-05 15749

[&]quot;Note: Hems in rad would be associated with infent mortality

Degue, Brytin

Frenk

Douglas, Charles

Sant

Tuesday, December 15, 1905 2:22 PM

Tex

Degus, Bress

Subject

PW: Potential modes of fedure for leakage

Charlie

Charfe Dougles (906) 235-3657 (P) (506) 236-1 538 (F) c-dougles2@tl.com

Truming October 29, 1998 11:25 AM

L Ch

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CONFIDENTIAL

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Evaluate

Device not screwed in properly

Letitage at thread area Lealance at thread area

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Burst device

Device exposed to expositive terrograture

Improper sealing due to mating pari demage

Gaeint seei impaired Claphragm leakage

Device expand to expansive number of cycles Water (or other contaminants) in system degrades Kapton disphragmDisphragm issuage

Water (or other conteminants) ingresses switch through base and causee Kapton degradation

Disphragm legisage

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Please let me know if you need anything further.

Recerds.

ы

[&]quot;Note: Name in red would be associated with infant mortality

Epstein, Sally

From: Sent:

Hopkins, AL (ahopkins@email,mc.ti.com) Tuesday, December 15, 1998 3:27 PM

To:

McGuirk, Andy; Pachonis, John; Gildes, Robert; Watt, Jim; Douglas, Charles; Prois, Stephen

Subject

RE: 77PS - 8D updates

The only addition I would make is that the Ford returns didn't show any attack on that part of the terminal that was within the switch cavity itself. In contrast, both the New Terminals found at Bassler and two of the devices brought back by Bob from Sumter showed the corrosion within the switch cavity area of the terminal.

Regards,

Al

Prois, Stephen Promi

Sentı Tuesday, December 15, 1998 1:39 PM

To: McGuirk, Andy; Pedhonis, John; Hopkins, AL; Gildea, Robert; Watt, Jim; Douglas, Charles Subject: 17PS - 8D updates

<<file: car98_49a.doc>><<file: car98_49b.doc>>

Team,

I have not made any changes to "car98-494".

I've taken a first out at the terminal supplier 8D in "car98-49h". Please take a look with a skeptical eye and let me know your comments.

M,

You may find that I need to better define the splash/finger print stains. Please let me know. It looks O.K. to me considering the purpose of this exercise.

Bob.

Continue working with Bassler and understand what we can do to minimize terminal strip handling. Can we update their process spac, pimes, atc.

I'd like to get these out by tomorrow afternoon.

Regards,

Stave

Epstein, Sally

From: Sent:

To:

Cc:

Terino, Gerard [gterino@email.mc.ll.com] Wednesday, December 18, 1998 5:07 PM Sharpe, Robert; Hall, Allson; Dodd, Bob McGulrk, Andy; Pachonis, John; Watt, Jim

Importance:

High

Sensitivity:

Confidential

12/16/9B

ROB SHARPE - ALISON HALL - BOB DODD, PLEASE GIVE ME A CALL TOMORROW.

FORD HAS REPORTED A POSSIBLE ISSUE WITH AN ASSEMBLY FROM HILITES IND.

ı

I LEFT A MSG WITH THE QC PEOPLE AT HILITES AND FORD I WILL UPDATE, AS SOON I HAVE A CONFIRMED ISSUE.

I KNOW THIS IS NOT MUCH INFO - PLEASE BEAR WITH ME.

REGARDS , GERRY TERINO TEL . 508-236-3009 FAX 508-236-2328 MAIL STOP 12-37 MSID GTRR GTERINOSTI.COM

TEXAS INSTRUMENTS INC. 34 FOREST STREET ATTLEBORG, MA 02703-0964 - 21 fires tetal > 20 myra
-> 10 left from when well 1 m-43
-> 4 finging
-> 2 mic Area

	Dones Reserves Filed
ı)	. 3/22/97 -> Vehicle purchused used (LFF-24 hours off)
9)	. 8/at /97 -> Venic & purenessed now Housen, Th
	- Shore circuit in ignition willing
3)	• 1/10/07 -> Verice proceed uses Membra FL
	- Egine comportment, rain during day
4)	• 1/4 ing -> Vehicle purchased used
3)	· No dece or details
6)	· 6/24/97 -> Venicle purchased used
	- Nexted remplasion" then fire (Share circuit in ong re)
	- HIGE Frying -> soid to be engine specific
(ד	· 10/23/96 -> Vehicle purchased used
	- mirer explasion
	- leaver on recall of \$17 m vehicles ciary
	facility ignition solved including midd Teal Col
(8	. 5/8/98 > Pressure switch Noted as cied in
	which fire iniciated -> broke find lear
	Shorting out electrical connected
4)	· 126/97 -> Fire relectional in Notuce Florid
10)	*12/0/97 -> Vencie porchused used Helicalco, GA
	- Probable engine comportment mal-function
(3)	· No doze incident occurred in Figride
	- LEF Soure (between "RELAY CENTER" CITY (

(LFF) . = 12/25/46 Venicle purchused New ,2 - Reserve stoked awareness of 1420 similar fires JECKSEN, MS Venicle purchased used - 4130/48 13) - Short circuit in wire homes Vehicle purchased used - 11/28/97 (+1 Orlando, FL Vehicle purchused used · 7/1/98 15) Floride / No details - 6/13/96 14) dute Not Necred / report field 4/21/46 мучз (T) Florida MY3 Vehicle purchased used • 5/48 吃) - Short IN WITING

TI-NHTSA 018587

Baker, Gary

From:

Sent

McGuirk, Andy Monday, January 04, 1899 10:24 AM Beringhause, Staven; Baker, Gary

To: Ca:

Pachonis, John; Rowland, Thomas; Couglas, Charles; Dague, Gryen Ford Lincoln '92 town car 'thermal events'

Subject:

We have now had an opportunity to understand Ford's position and relevant facts regarding 'thermal events' with the '92 Town Car associated with our power absering pressure switch.

ANTOHOTIVE SERVICES HAD CONTROLS OF A HARRIE 14 FOREST OF N/H 21-05 ATTLEMAN, NA. 02703 THE : [804] 226-3762 THE : [804] 226-3746 PAGE: (804) 487-3180 PTP 484-2844

Morris, Irene

From:

Cougtas, Charles

Sent:

Tuesday, January 06, 1999 1:25 PM Degue, Bryan; Hopkine, AL; Profe, Stephen.

To: Ce:

Baker, Gary; Baumann, Russ; Beringhause, Staven; McGuirk, Andrew; Pachonia, John; Sharpe,

Robert

Subject:

RE: Ford 77PS Town Car Visit

Team.

Here is the latest update on the visit. Visit will definitely take place on Thursday. When all is said and done, we may only have one visitor from Ford. Fred Porter will not be coming in. Norm LaPointe will definitely be coming in and one additional visitor may also be coming.

Norm will be flying in Thursday marning and leaving on the 7 PM flight. Since Rob cannot make it, 1 will pick up Norm at the sirport. The meeting will start at 9:30 and witi be housed in 12-1B.

Ti participants should be limited to those directly addressed. Also, at both Norm and Fred Porter's request, no presentations or line tours will take place to start the meeting. Beyond introductions, we will go right into the tear down analysis per the protocol that Al will publish later today.

At this point, unless you has rotherwise, assume assuet dress for this visit.

Arry questions / issues, please let me know.

Regerde,

Charlie

Chartie Dougtas (508) 236-3657 (P) (508) 238-1598 (F) c-douglas2@ti.com

From:

Dougles, Charles

Sent

Monday, January 04, 1999 2:18 PM

To:

Degue, Bryan; Gilden, Robert, Hopkins, AL; Prole, Stephen; Douglas, Charles

Ça;

Buker, Gary, Bounsonn, Russ; Beringhsuse, Steven; McGuirk, Andy; Pechonis, John; Sharpe, Robert

Bubject

RE: Ford 77PS Town Car Viet

As an update, it rise different people at Ford have made three different sate of reservations for coming out here — > one flying in Truesday evening for Wednesday visit, and one flying in Truesday evening for Truesday visit. The Ford folks are currently working to coordinate their schedules so we may not know until tomorrow morning whether the visit is Wednesday or Thursday though my best guess at this point would be a Thursday visit.

Regards,

Charlle

Cherse Douglas (506) 236-3657 (P) (508) 236-1596 (F) c-douglas**2@ti.co**m From: Douglas, Charles

Sent: Monday, January 04, 1996 12:17 PM

To: Degue, Bryan; Gildea, Robert; Hapkins, AL; Prois, Stephen Co: Belter, Gary; Beumann, Ruse; Serbahause, Stewer; McCuis

Beker, Gary; Baumenn, Ruse; Seringhause, Steven; McGuirk, Andy; Pechonie, John; Sharpe, Robert

Subject Ford 77PS Town Car Visit

Teem,

A quick mag on this subject. There is some question as to whether this visit will take place on Wednesday or Thursday. Rob is currently working to nall this down. Weather in Detroit may be keeping Ford personnal out today or resulting in them getting into the office late today.

Relative to framework for an agenda, we are going to keep it fairly simple. Before actually conducting the teer down analysis, we should present a process overview and take them up to the aggerbby line. Also, we should have both P and D free's available.

Bryen,

Any information we can put together from the MY92 Econoline excursion wit also be of use.

The meeting is going to be housed in 12-1B.

More information will be forthcoming hopefully by late afternoon.

Regards,

Charlie

Charile Douglas (508) 236-3687 (P) (508) 236-1586 (P) c-douglas2(2ti,com Beumenn, Russ

Prote: Hapkins, AL

Sert:

Tuesday, January 05, 1999 6:38 PM

Te

Dague, Bryen; Prote, Stephen: Douglas, Charles

Ga:

Baumann, Ruse; Baker, Gary: McGuirk, Andy: Beringhause, Steven; Andrea, Arny;

Siuzdak, Allen; Pavad. Joe

Eubject:

99-003: PROPOSED PROTOCOL FOR DISASSEMBLY AND ANALYSIS OF

SWITCH FROM 77PS FROM LINCOLN TOWN CAR

Here's a rough pass, what do you guys chink?

PROPOSED PROTOCOL FOR DISASSEMBLY AND ANALYSIS OF SWITCH FROM 77PS PROM LIMCOLM TONG CAR

- . Review Ford's Analysis data that they ere bringing in.
- Examine threads and determine if it is OK to just chase the threads to get a good seal or should we remove material for analysis.
- Pressure Look Test the device (15 minute static-hold, mixpressurized test).
- Decide if we should remove any material or try any other enalysis before we start disassembling the device.
- Do a practice decap using the below procedure on a deliberately fractured part (to mimic the condition that the returned device will be in) before performing it on the real sample. Bryan, you and I could do this now.
- · Procedure to remove aluminum criso ring
- Use aluminum foil (or plastic if Ford prefers) to mak the analysis surface.
- Also create a paper/tape shield to further radice chance of contemination during cutting of crisp ring.
- Place a piece of tape over the erem to be cut.
- Cut crimp ring using jewelers saw or Dramal cutoff wheel in one of the two areas indicated on optical photo.
- . Cut corners of ring at 180 degree orientation
- Unfold crise ring
- Optically examine revealed surfaces. Take optical photographs (Digital camera with macro less plus instant microphotography) and document observations where appropriate. Examine the following areas
 - . Inside surface of crimp ring.
 - . Seel area and underside of base
 - · Top of Cap
- Start SEM-SEM (Scanning Electron Microscope with Energy Dispersive Analysis of X-rays) analysis on the inside of the ring and on various surfaces of the plantid base.
- Reprotect the top surface and remove the cap. Bryan had originally suggested just using an end mill to remove the cap. I wouldn't, however, go all the way through with the end mill. I would leave some material behind as a shield. I would suggest them bending the cap off.
- · Optically document all revealed surfaces starting with cap.

TI-NHTSA 018591

- Meanwhile, start SEN-EDX analysis on top side of cap. Particularly focus in on the edges of the ceramic pin quide and on the indented ring that lines up with interior wall of the switch cavity. Particularly look for evidence of corrosion or arging.
- Decide if we should try to flake off any of the overlaying debris to try to examine the underlying metal surface.
- Proceed to perform SEN-EDX analysis on other component surfaces revealed by removal of cap.
- Mon-destructively probe inside of the grounds to determine its resilience which will give us an indication of the temperature that it saw. Another indication might be the depth of the indentations left by the grounds saal rings in the wire.
- Decide if it makes sense to further examine the mating connector or grownet seal.

Regards,

A1

TI-NHTSA 018692

year to the letter

Graveline, Dora

From:

Proia, Stephen

Sent:

To:

Wednesday, Jenuary 08, 1999 7:52 AM Douglet, Charlee; Hopkins, AL; McQuirk, Andy; Baker, Gary; Degue, Bryan; Baumann, Russ 77ps.ppt

Subject:



Sere's the "Cause & Effect" diagram we discussed yesterday. Please review and comment. Thanks

Regards,

Steve

Page 1

TI-NHTSA 018893

From: McGuirk, Andy

Sent: Wednesday, January 06, 1999 8:08 AM

Dougles, Charles; Hopkins, AL; Beker, Gary; Dague, Bryan; Baumann, Russ; Prola,

Stephen

To:

Co: Pechonis, John Bubject: RE: 77pe.ppt

ateve, thanks for a great job pulling the preliminary draft together for theories about possible contributors to a thermal event.

I think the heading needs to be very descriptive about just what the document is intended to be.....possible theories of contributors to thermal events in '92-93 town care.

I am struggling with how to pull in the concept of that this document is the product of some "brainstormed" kiess...should be stated and revision control dated so history will know it was the product of a few key people and when in time it was done. (also, we probably should also subject the ideas to other respected contributors in the business like beringhause and maybe-dodd as well as key supplier inputs like roy.) further, we have 'mixed' together ideas about what might contribute or cause (as in a true cause and affect degram) as well as facts and data surrounding the situations (which is informational, but not correct). we need to fix that mixing,

I have to run to a meeting and will pick up these ideas in an hour

8 ADRESSTVE SEMECHS AND CONTROLS ORA MANUEL 34 FOREST ST M/S 23-05 ATTIGEORO; NA 02703 TAX: (508) 236-3080 FAX: (508) 236-3745 FAX: (800) 487-2700 FEE 504-2044

From: Prole, Stephen

Sept: Wechenity, January 06, 1999 7:52 AM

Tec Dougles, Charles; Hopkins, AL; McGuirk, Andy; Baker, Gary; Dague, Bryan; Baumann,

Rimit

Bubject: 77pe.ppt

<<File: 77pe.ppi>>

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Regards.

Steve

Baker, Gary

From:

Prois, Stephen

Sent:

To:

Wednesday, January 08, 1999 8:52 AM Douglas, Charles; Hopkins, AL; McGuirk, Andy; Baker, Gary; Dague, Bryan; Baumann, Russ

Subject: 77pe.ppt



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Regards,

Steve

Graveline, Dora

From:

Dague, Bryan

Sent:

Wednesday, January 06, 1999 8:04 AM

Ta:

Prois, Stephen, Douglas, Charles; Hopkins, AL.

Cc:

Baumann, Russ; Baker, Gary; McGuirk, Andy; Beringhause, Steven; Andrea, Arny; Siuzdak, Allan;

Peveo, Joe

Subject:

RE: 99-003: PROPOSED PROTOCOL FOR DISASSEMBLY AND ANALYSIS OF SWITCH FROM

77PS FROM LINCOLN TOWN CAR

Looks praity good to me. We can also make changes as we go through it with Ford on Thursday.

Please make sure Fred passes this along to Norm.

Recerds. 8ry

From:

Hopkins, AL

Servi:

Tuesday, January 05, 1999 7:37 PM

Tot

Degue, Bryan: Prots. Stachen: Cougles. Charles

Ce: Subject Baumann, Russ; Beker, Gary; McGuirk, Anth; Beringhause, Steven; Andres, Arny; Statelek, Allen: Pevec, Joe 88-083: PROPOSED PROTOCOL FOR DISASSEMBLY AND ANALYSIS OF SWITCH FROM 779S FROM

LINCOLN TOWN CAR

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 - Inside surface of crisp ring.

Page 1

TI-NHT8A 018596

- . Seal area and underside of base
- · Top of cap
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Regards.

Al

Epstein, Sally

From:

McGuirk, Andy [a-mcguirk@email.mc.ti.com]

Sent:

Wednesday, Jenuary 95, 1999 5:08 AM

To:

Douglas, Charles; Hopkins, AL; Saker, Gary; Dague, Bryan; Baumann, Russ; Proje, Stephen

Ce; Bublect: Pechonia, John RE: 77pa.ppt

steve, thanks for a great job pulling the preliminary draft together for theories about possible contributors to a thermal event.

i think the heading needs to be very descriptive about just what the document is intended to be.....possible theories of contributors to thermal events to '92-93 town cars.

i am struggling with how to pull in the concept of that this document is the product of some 'brainstormed' ideas...should be stated and revision control dated so history will know it was the product of a few key people and when in time it was done. (also, we probably should also subject the ideas to other respected contributors in the business like besinghause and maybe dodd as well as key supplier inputs like roy.) further, we have 'mixed' together ideas shout what might contribute or cause (as in a true cause and effect diagram) as well as facts and data surrounding the situations (which is informational, but not correct). We need to fix that mixing.

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AUTOMOTIVE SEMBORS AND CONTROLS ORA MANGER

34 FUREST ST M/S 23-05 ATTLEBORO, MA 02703

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

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

From: Proim, Stephen

Sent: Wednesday, January 06, 1999 7:52 AK

To: Douglas, Charles: Hopkins, AL; McGuirk, Andy: Baker, Gary:

Dague, Bryan; Baumann, Russ Subject: 77ps.ppt

<<?ile: 77ps.ppt>>
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Ī

Regards,

Steve

Baker, Gary

From:

McGulrk, Andy

Sent:

Wednesday, January 96, 1999 10:07 AM

To:

Douglas, Charles; Hopkins, AL; Baker, Gary; Degue, Bryan; Baumann, Russ; Prois, Stephen

Ce:

Pechonis, John

Bubject: RE: 77ps.ppt

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ALTONOTIVE EMBORE MEI CONTROLE QUA PRESEN 14 FOREST ST N/S 21-05 ATTLEBOSO, MA 01701 TEL : 1906: 316-1060 FRR: (1906: 216-1746 PAGE: (1906: 467-1740 FZN 604-2044

From:

Prois, Stephen

Sont

Wednesday, January 05, 1999 7:52 AM

Ta:

Dougles, Charles; Hopkins, AL; McGuirk, Andy; Bakur, Gary; Degue, Bryan; Baumenn, Ruse

Subject 77ps.ppt

<<Fle: 77ps.ppt>>

Here's the "Cause & Effect" diagram we discussed yesterday. Please review and

comment. Thanks

Regards,

Steve

Saumann, Ruice

From: MoGuink, Andy

Sent Monday, January 11, 1999 2:48 PM To: Sulliver, Martha: Rowland, Thomas

Baumann, Russ: Dougles, Charles; Pechonis, John Co:

Subject Lingoln Town Car "thermal events"

Our core Pressure Switch team is assisting Ford Motor Co. in understanding the cruise control (77P/S farrity) pressure switch design as part of an investigation into MY '92 & '93 Lincoln Town Car "thermal events". Ford representatives indicated some 20 events have been reported in the MY '92 Town Car.

On January 7th we hosted two Ford representatives and completed a tailure analysis of a 77P/S pressure switch reported to be involved in a MY '95 Town Car Issue. We are providing complete technical support and the preliminary results regarding pressure switch involvement from this fallure analysis are inconclusive.

Charlie Cougles, from our Marketing Leadership, continues to lead the process for TI with excellent support from Russ Saumann supported by Snon Degut, Al Hopkins, and Stove Profe.

MITCHOTETE SOCIELI AND CONTROLS OFA HABOUR

14 FOREST ST NVE 23-05 PAGE: 11001 316-5066 PAZ: (388) 316-5761 PAGE: 11001 647-3706 PEK 404-3344

Gravetkie, Dora

From:

McGuirk, Andy

Sent:

Monday, January 11, 1999 3:48 PM

To: Ce: Sulliven, Martha; Rowland, Thomas Baumann, Russ; Douglas, Charles; Pechonia, John

Subject:

Lincoln Town Cer "thermal events"

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Charlie Douglas, from our Marketing Leadership, continues to lead the process for TI with excellent support from Ruse Beumenn supported by Bryan Dague, Al Hopkins, and Stave Profe.

AUTOHOTTY'S STREET, MICE CONTROLS ON MATERIAL ATTIMORE BY N/M 23-05 ATTIMORO, 39, 82903 TEL : (508) 234-3080 39AT , (808) 234-3748 29AZH: (888) 487-3766 PIN 484-3844

Epstein, Sally

From:

Hopkins, AL [shopkins@email.mc.tf.com]

Sent:

Friday, January 15, 1999 5:08 PM

To:

Lincoln, Maureen

Cc: Subject Degue, Bryan; Prola, Stephen; McGuirk, Andy; Chura, Stephen; Pavec, Joe

99-030: TSL # 150366: HIGH FALLOUT RATE ON ASSEMBLY LINE DUE TO N C-

CONTINUITY: Status Report

OBJECTIVE:

Perform SEM analysis on Terminal 2 stationary contact to check for contamination.

RESULTS AND DISCUSSION:

The original samples were from a lot that was giving high fallout. I examined all the samples visually and only found one that gave indications to me that there was a significant amount of contamination present. SEM-EDW analysis of this sample showed mainly particles of the PPS plastic base and the glass fibers that are used to reinforce the plastic.

At this point I asked Maureen to send over some known failures. She sent over four samples and out of this group, one had a visible particle on the contact and another had a plastic fiber on it. We removed the large particle on the first sample and determined that it was again PPS. Do you want us to have the Chem Lab determine the identity of the plastic fiber on the second sample?

We also examined one of the devices that didn't have any optically detectable (by me) contamination on it. Again, we found that particles of the casing plastic and fragments of glass reinforcing fibers were the main constituents.

This is not to say that there weren't other species present on the above devices. We found sodium, chlorine, titanium, potassium, etc; the amounts, however, weren't large enough to explain the problem.

We will be looking at the last of this group of 4. Maureen, you also had sent over a base that was still attached to the brass hex; it didn't come apart easy. I don't know if I caused damage during my disassembly or if all those drill holes were the cause. Please let me know more about this particular sample. Also, could I have a schematic of the device?

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

AL HOPKINS

MSG ID: AHOP

PHONE: 508/236-3040

18 4145 TO 99483865734

P.**61/6**1

Print H Fax Note 7871 Date 1/18/99 Form 6

For Chartis Destates Co.

Co From TI - Attale to 100

From 6

For Scot 236-365 7

For Scot 236-365 7

January 15, 1998

The cup is partiety covered with a greenigh residue. Residue appears to be primarily an exide of the brane content material with possibly a sulfur compound. This suggests transfer of oxige or corresion product from the brase contents to the cup.

The stationary context sublitis intergranular cracks which indicate stress corresion cracking (SCC). TCC is caused by combination of a specific corresive environment and a sustained specific stress (s on the localized). Ammonia, ammonia compounds, suffer compounds, and moisture are known to rever SCC in brass. The context material has been reported to be 360 brass, which is highly nurseptible to SCC.

The presence of brake fluid on the switch side of the disphrage has been determined. Black residues in the hex port and on the cup, converter, and disc appear to be compounds which may neve formed from a reaction between decomposition products (soids) of the polyecter base, the tracks fluid, and metals in the switch. This suggests that the brake fluid was present on both sides of the disphrage during the thermal event.

All three disphragms withink what appears to be mechanical densage. The damage does not match up with any making parts of the switch. This suggests that demage may have occurred prior to expensive. The disphragms has become british and cracked in the vicinity of the demage. Brake fluid has become entrained between the layers (Teffon and captors) of the disphragms.

The good of the movable contact meliod back into the buildhead between the evitor and terminal cavilles of the base. There is also are demage (localized meting) to one corner of the bridge of the stationary contact. This demage appears freth (surfaces bright and shirty) which suggests that it may have occurred in the later stages of the thornal event.

If the terminals exhibit deposits which appear to be primarily sulfur compounds of the terminal material (the plates). Although these deposits appear visually similar to the deposit found on the cup, they appear to be of different composition.

The white residue found in the connector cavity combins elements found in dry chemical fire or inquisities (Muscovite and phosphorus)

- . Service history on 21 NHCA vence Stave LaRouche
- . Fuse slow blow or fost them?

TI-NHTSA 018603

Epstein, Sally

From: Sent: Hopkins, Al. (ahopkins@email.mc.ti.com) Wednesday, January 20, 1999 10;22 AM

To;

Degue, Bryan; Baumann, Russ McGuirk, Andy; Andrea, Amy

Cc: Subject:

99-033; TBL # 150709; ANALYSIS OF MATERIAL REMOVED FROM 77PS THER MAL

EVENT

ATTORNEY-CLIENT PRIVILEGED COMMUNICATION

OBJECTIVE:

Determine nature of deposit; in particular, determine if it is consistent with the results from Ford's analysis.

SUMMARY:

The results were very similar to those found by Ford. The main difference is that our EDX detector has a much better low energy outoff than did the Ford detector. Their detector is unable to detect carbon and oxygen. Our analysis showed large amounts of carbon and oxygen on all three samples.

RESULTS AND DISCUSSION:

All of the samples were comprised of a mixture of different phases that had agglomerated together. A description of our findings is shown belows

BLACK FLAKE FROM TROUGH: We found the following elements which are listed in a very approximate decreasing order of preponderance: copper, oxygen, carbon, chrome, zinc, potassium, sulfur, and silver.

MATERIAL SCRAPPED FROM CUP ASSEMBLY: There were a very large number of glass fibers present which had the composition that is typically used in plastics for reinforcing purposes. In other words, this is almost certainly from thermal decomposition of the plastic base. The EDK detectable elements in these fibers are calcium, aluminum, silicon and oxygen. The rest of the material was very similar in composition to that reported for the above sample although we also detected some phosphorous in this sample.

GREEN MATERIAL ON CUP: This material was similar to that found on the first sample although the amount of chrome was much less.

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

AL HOPKINS

MSG ID: ANOP

PHONE: 508/236-3040

From:

Sent:

Sharpe, Robert Thursday, January 21, 1999 7:53 AM Beringhause, Blaven; Cougles, Charles

To: Cc:

Baumann, Rues: Dodd, Bob

Subject

Lincoln Town Car Testing at Ford 1/25/99

Next weeks letting/analysis of the brake switch will be conducted at Ford's Central Labe in Dearborn. Stove LaRouche will coordinate this testing and can be reached directly at (\$15) 848-4876. This analysis will begin at 8:30cm on Monday, 1/25/99. It appears that Stove's priority will be to examine 4 brake switches returned from Lincoln Town Car's (3 from cars that experienced solusi thermal events, 1 removed se a reported "lasker" (no thermal events). In addition, Ford has 2-3 samples removed from high mile milestic vehicles in Florids that may be examined on Monday if time allows.

Steve B., I will pick you up at the Courtyard Marriett in Courtorn (located on Marcury Drive, between Ford Rd and Michigan Ave, East of the Gouthfield Frey, ph# 313-271-1400) on Monday morning between 8:00am and 6:15am. If you need to contact me over the weekend, my home phone# is (617) 552-6697. My car phone is (248) 558-6642.

Best Regards,

Rob Sharpe **Texas Instruments** Phase (248) 305-5729 Fox (248) 305-5734 reforpe@til.com

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- 1) Need to affect application
- 2) TI INTEREST
- 3) Be responsive to Ford

* Volume production ending on 12-1

- * Run testing to re-create fire conditions
- * List all items which can lead to water in breite fluid
- * ppm level on leak related defects
- * 15185 CHEDIE / Application
- * List of tæsts TI will run

Epstein, Sally

Fram: Bent:

Douglas, Charles [o-douglas2@email.me.ti.com] Thursday, February 04, 1999 12:57 PM

To: Ce: Subject: Bullivan, Martha: Baumenn, Ruse; McGeldt, Andy Beringhause, Steven; Baker, Gary; Royland, Thomas

RE: Ford Lincoln Cruise control

attorney - client privileged information.

As additional and new information. Fred Porter just phoned in and this whole situation appears to be escalating. Ford is very concerned that MHTGA is going to issue a final ruling (with or without Ford input) and that the ruling could literally come down within the next few days. I did not attempt to get into specifics as to implications from a AMERICA ruling.

Nob Sharpe has been called in to attend an emergency mesting at ford at 2:00 pm today. Only questions Rob will be prepared to enswer center around capacity on the 7798 assembly line. Meeting was called by Fred Porter's group.

Fred had several technical requests all of which were deferred to Steve. Fred elso requested an assembly process overview. If there are any issues with honoring this request, please let me know agep as I have committed to a response of no later than Friday

Regards,

Charlie

Charlie Douglas (508) 236-3697 (P) (500) 236-1598 (F) á-deuglasifti.com

> From McGuirk, Andy

Sent: Thursday, Pabruary 04, 1999 12:45 PM

TOI Sullivan, Martha: Sausann, Russ

Douglas, Charles; Beringhause, Steven; Baker, Gary Cas

Ford Lincoln Cruise control

attorney - client privileged communication

We have spent a little time estimating what we think the typical Ford Dealar cruise control pressure switch replacement labor time might be for the platform of discussion.

A check through our contacts at Tasca Mazoury dealership indicates the 'computer' saye 1.5 hours or \$50 plus switch (service charges \$17.44 for a pressure switch). We thought this was very high given that the switch is so easy to scores on the proportional valve in the engine compartment. We are theorizing that the labor is so high because of a pass to evecuate and refill the system with brake fluid and possibly bleed the system.

We had brain-stormed a replacement scenario prior to communiting with Teacs of a 'swap out strategy' whereby one would pre-fill the switch 'port' davity of the switch with fluid to eliminate air and insert into the proportional valve 'loosely' such that one could 'bleed' out the micro-emount of trapped mir (via leakage around port threads). this were the replacement process and it worked then we would be talking about ten minutes which probably charges out at 1/2 hour service cycle.

STEEDS FOR

223 % dars in '92 and '43 Town Car platform.... attrition At \$5% results in 212 k

vehicles on the road

212 k at \$93 each ! 90 labor and 3 cost of switch) results in \$ 19,716 K per the 'computer'

(if the speedy swap is viable, it would be 212 K at \$33 (30 labor and 3 switch) resulting in \$6,996 K)

this dislogue led us (Charlie Douglas and Andy McGuirk) to a number of vehicle specific questions.... the '92 model had 6 (six)) service bulletins published for brakes. (one for ABS 'coming on' during just rough road driving, one for ABS 'staying on' when had a said fails to veture to purely up doubtion ')

brake padal fails to return to normal up position !}

Did each bulletin result in vehicle brake service and evapuation ? is the fluid in the southern states water contaminated because of humidity ? have the thermal event vehicles been serviced multiple times for brakes ? is there a connection here that creates the environment for a thermal event ? Is ABS a common element? We'll need to generate some questions and enawers here.

AUTOMOTIVE SENSORS AND CONTROLS GRA HANGER 34 FOREST ST N/S 23-05 ATTLEBORO, NA 02703. TEL 1 (508) 236-3080 FAX 1 (508) 236-3745 PAGE: (800) 467-3700 PIN 504-2044

Morrie, Irene

From:

Sulliven, Merthe

Sent:

Friday, February 05, 1999 8:03 AM

Tø:

Rowland, Thomas

Subject:

χ.

FW: Ford Lincoln Crules control

There has been discussion about tapping Aziz Rahman to be resident at Ford. Please be prepared to discuss this at the meeting today.

REDACTED

REDACTED

REDACTED-

REDACTED

Baumann, Ause

From: McGuirk, Andy

Bent: Saturday, February 06, 1999-10:55 AM To: Baumann, Russ; Rose, Elaine; Watt, Jim

Co: Beringhause, Steven; Dague, Bryan; Pechonis, John; Rowland, Thomas; Sullivan,

Martha; Baker, Gary, Rahmer, Aziz, Sharpe, Robert

Subject: 77 p/s 'durability' baseline information

attorney - client privileged communication

Jim and Elgins, as I mentioned in my telecons, I would like us to move forward in quickly assembling data that we can use to help Ford understand our 'sensor' essembly durability baseline in the brake switch package. This, as I see it, would be composed of 3 major sections per below (please feel free to insert your ideas also) and for the most part needs to be delivered early w/o Feb 8th:

- A) I want to demonstrate that manufacturing anomalies did not escape to the field in the form of a projection of hydrautic field leakers through the supply chain.... and we can help achieve this objective by assembling data that demonstrates our history of hydrautic leak rates in the subject time-frame of MY92 and MY 93 as seen in our factory floor and/or customer feedback. Jim, please take the lead on getting this done ASAP. We should consider customer AIQ aprendaheats and RMR data coupled with 80's of the time to build a case for the low PPM leak rates of the sensor assembly further protected by downstream supply chain feeting at the TIER-one and OEM. Also, there may be an opportunity to integrate manufacturing test data as a validator of that leak rate number as well as using the leak test data from impulse testing as an alternate source. Itners will be a building need to deliver data and syldence by Tuesday via Aziz and we should consider an alternate path of enecdatal estimate should the records not be readily available. (I know we will need to identify and recall records and that will take time)
- S) I want to demonstrate that the sensor assembly is mechanically durable and surpasses the 'expected' life cycles as expressed on the Ford space...,and we can achieve this objective by assembling ES 'impulse' testing data from the timetrame of interest. In an ideal situation we would take this raw data and project into WEIBULL success-testing estimate of cycle capability in the 'accelerated simulated' cyclers used in our process controls. Elaine please coordinate the data collection here. (We will likely turn to reliability experienced quality engineers Paul spaceman and Tuetter Perith to convert the data to information). Again, should we run out of time, we will need to turn to whatever relevant 'recent' data we have to propose our position and support with historical based data cince we sort through the files and record receil process. Bryan, please inject any life test data from other qualification platforms here so we have 'test-to-injure' data if available.

Also, we should make a side note of the pressure profits used in the cycler process for future use with Aziz during his upcoming disloques with Ford.

C) I want to demonstrate that the sensor is chemically resistant per the IP and PPAP testing and surpasses 'expected' exposures per the Ford Specs... and we can achieve this by essembling both relevant IP testing and PPAP results to demonstrate compliance. There may slee be other testing history of the period that would convey that durability of the switch assembly in the typical automotive fluid environment of gas-of-coclent-fluids in the proper orientation and connector protection. Elaine, please assemble this data and we will provide to Aziz to deliver to Ford. Again, should we run out of time, delivery of the readily available records from '95-'96-'97 per your Friday work would suffice as a starting point.

To provide some further clarity, I have included the focal part numbers from Charlie Douglas below. As we assemble data and translate into information please track the differences between 57 and 77 and 87 styles but also integrate the brake sensor assembly data and treat it as a family. As you discover the level of effort and resource needs, pis see John or me for help in getting people assigned or priority provided.

thank you for your continued support here.

a

AUTOMOTIVE SEMBORS AND CONTROLS GRA EMBORS 14 FOREST ET N/S 21-05 ATTLEBORO. MA 02703 TEL : (508) 236-2080 PAX : (508) 230-3745 PAGE: (400) 467-3788 FIN 804-2044

From: Dougles, Charles

Friday, February 05, 1999 8:43 AM Sent: To: McGuirk, Andy; Rose, Etaine

77P8 Metrix Subject:

Andy / Elaine,

Per our dequesion:

Limate dos

Récerds.

Chartie

Charlie Dougles (508) 236-3657 (P) (506) 236-1508 (F) c-dougles2@ti.com

Potential Cruise Control Circuit Modification

- Present cruise control circuit results in a continuous application of battery voltage to the cruise control pressure switch
- Water ingress into the switch due to misuse (power washing) or seal degradation presents an electrolyte to the switch electrical conductors
 - accelerated corrosion can result
 - Kapton degradation can result
- Cruise control circuit modification to remove continuous application of battery voltage is recommended
 - Insertion of a Normally Open relay in series (upstream) of the cruise control pressure switch, that is closed (energized) only when cruise control is switched on is recommended
- This circuit change will remove the continuously applied batteryvoltage as a potential source of ignition of brake and other automotive fluids

Morris, Irene

From:

McGuirk, Andy

Sent: To: Saturday, February 06, 1999 11:54 AM Baumann, Rusa; Rose, Elaine; Watt, Jim

Cc:

Beringhause, Steven; Dague, Bryan; Pechonis, John; Rowland, Thomas; Sulliven, Martha; Baker,

Gary, Rahman, Aziz, Sharpe, Robert

Subject:

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attorney - client privileged communication

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Also, we should make a side note of the pressure profile used in the cycler process for future use with Aziz during his apcorning disloques with Ford.

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thank you for your continued support here,

ANYMOTIVE SEMECHA AND CONTROLS CHA MARGES.
34 FEBRET ST M/S 21-08
ATTLEBORO, NA 02703
THE : (508) 216-1080
FAX : (508) 236-3745
FAXE: (600) 467-3700 FIN 604-2044

From;

Douglas, Charles

Sont:

Friday, February 05, 1999 8:43 AM McGuirk, Andy, Rose, Elaine

To:

Bubject

77P8 Metrix

Andy / Elaine,

Per our discussion:



Regarde,

Charlie

Charlie Douglas (508) 235-3657 (P) (306) 236-1898 (F) c-dougles2@ti.com

Epotein, Saily

from:

Cast: Tet

Douglas, Charles (c-douglas2@email.mc.H.com) Monday, February 08, 1999 12:42 PM McGuirk, Andy, Sullivan, Martha

Ca:

Seringhause, Steven; Rowland, Thornes

Quelect

RE: Ford ISAC Meeting





Martha,

Andy asked me to provide as much of the consolidated information as I as aware of. Attached, please find two pieces of direct correspondence from myself to Ford delineating application usage information:

<description = description = <incoln.doc>>

In addition, we have provided the following in direct response to Ford requests / questions:

Overview of switch design / function

Copy of 8D delineating mating consector issue on Econoline Component level prints for 7798

Assembly process flow for 7798

Melt / Char temperature information related to Moryl GTE material and Kapton

Design change matrix / history (will be carried out by Azis tonight) Hosted Ford visit on Jemusry 6 to perform joint failure analysis on

one switch captured from fire vehicle Ideas for fusing the switch in circuit (Discussion between Steve B. and Fred P.)

Information we owe / questions we have been asked:

Process change history (likely complete tomorrow) Flash points for all components / materials used in switch

Are material opecs submitted to Ford the same as the deterial specs used on the MY92/93 applications

Does our DYNEA or PYNEA identify any potential fire occurrences

How do we control terminal positioning in production, any chance of the terminals to short?

Has our in-process testing showed any failures or concerns

Are there naterial differences between the different colored bases (will be answered by Design Change Matrix)

What testing / investigating is TI doing internally

Do we wall the brake switch outside of Ford applications (yes, Land ROVEE!

Provide color pictures of Econoline failure analysis report

Steve.

if there are other questions which Fred may have put to you directly that I am not aware of, or additional information we may have volunteered (i.e. in-line relay?) please add to this mag.

Regarde,

Charlie

Charlie Douglas (508) 236-3657 (P) (506) 236-1598 (2) c-dougles26ti.com

Prom: Sullivan, Martha Sent: Monday, Pebruary 08, 1999 9:02 AM To: McGuirk, Andy

Co: Douglas, Charles: Beringhause, Steven; Rowland, Thomas Subject: Ford ISAC Meeting

I am leaving for a Pord ISAC meeting tomorrow. Given reports of executive level exposure on the Town Car issue, I expect some questions. Could you please consolidate the questions we've been asked and our responses to date.

McQuirk, Andy

To:

Baumann, Russ; Rose, Elaine; Watt, Jim

CC:

Beringhause, Steven; Dague, Bryan; Pechonis, John; Rowland, Thomas; Suilivan,

Martha: Baker, Gary; Rahman, Aziz; Sharpe, Robert

Sublect:

77 p/s 'durability'data

attorney - client phylloged communication

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thank you for your continued support here.

•

AUTOMOTIVE SINGLES AND CONTROLS OFF HENCES

TI-NHT\$A 018617

14 FOREST AT 4/8 21-DB ATTIEBORD, NA 02701 750 | 508: 214-1080 74K | 508: 218-1745 24KE: :600| 467-3700 FM 664-2044

From:

Sent: TO:

Douglas, Charles Friday, February 05, 1999 8:45 AM

McGuirk, Andy; Rose, Blaine

Subject: 77PS Matrix

Andy / Elaine,

Per our discussion:



Regarde,

Charlie

Charile Douglae (508) 236-3667 (P) (508) 236-1586 (P) c-douglas2@1.com

Dague, Billian

From:

Bouglas, Charles

Sent

Monday, February 08, 1999 1:50 PM

To:

Degue, Bryan

Subject

FW: Ford ISAC Meeting

Charlie

Chartie Douglas (500) 236-3687 (P) (506) 258-1596 (F) 0-douglas2@1.com

Frontk

Doughas, Charles

Sont: To: Mondey, February 06, 1986 1:41 PM McGuirk, Andy; Sullivan, Martha

Cox

Motsum, Amoy; Sulevan, Martina Gennghaups, Staven; Mordand, Thomas

Subject

RE: Fort ISAC Mexico

Martha.

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ings Hebbs - Spec Count Beach...



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- Component level prints for 77P8
- Assembly process flow for 77PB
- Meit / Char temperature information related to Noryl GTX material and Kapton
- Design change matrix / history (will be carried out by Aziz tonight)
- House Ford visit on January 8 to perform joint failure enalysis on one switch ceptured from the vehicle
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- Are material opacs submitted to Ford the same as the material opace used on the MY\$293 applications
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- Are there meterial differences between the different colored bases (will be answered by Design Change Matrix)
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Steve.

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Regards.

Charlie

Charlie Gougles (506) 236-3607 (P) (506) 236-1606 (F) c-doughts2@11.com

Sulliver, Martie Handay, Politicary DS, 1986 1:02 Add

Maduire, Andy

Couples, Charles; Beringhause, Blever; Revisins, Thomas Fard ISAC Meeting

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Morris, Irene

From:

McGuirk, Andy

Sent:

Monday, February 08, 1999 2:64 PM

To:

Rahmen, Aziz; Degue, Bryan

Cc:

Baumenn, Ruse

Subject

FW: Ford ISAC Meeting

Importance:

High

for your meating this pm

ACTOMOTIVE SERVICE AND CONTROLS (MA TRACES. 14 PORMET ST X/8 21-05 ATTLEBORO, 30. 01703 TEL : (108) 236-1080

PAK : (900) 236-3746

PAGE: (408) 487-3700 PEF 804-2044

From: Dougles, Charles

Sent: Tec Cq:

Monday, February 08, 1986 1:41 PM McGuirk, Andy; Suffren, Merthe Beringhause, Steven; Rowland, Thomas

Subject

RE: Ford ISAC Meeting

Martha,

Andy asked me to provide so much of the consolidated information as I am aware of. Attached, please find two pieces of direct correspondence from myself to Ford delineating application usage information:





In addition, we have provided the following in direct response to Ford requests / questions:

- Overview of switch design / function
- Copy of 80 delineating meting compater issue on Econoline
- Component level prints for 77PB
- Assembly process flow for 77PS
- Melt / Cher temperature information related to Noryl GTX meterial and Kepton
- Design change metrix / history (will be carried out by Aziz tonight)
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- What testing / investigating is TI doing internally
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- Provide color pictures of Econoline failure enalysis report

Steve.

if there are other questions which Fred may have put to you tilrectly that I am not aware of, or additional information we may have volunteered (i.e. in-line relay?) please add to this mag.

Regards,

Charile

Charile Douglas (508) 236-3657 (P) (508) 235-1598 (F) c-doughes2@il.com

Prom:

Sullivan, Martha

Sent

Monday, February 06, 1999 9:02 AM

To:

McGuirk, Andy

Ca:

Douglas, Charles; Beringhause, Shrver; Rowland, Thomas Ford ISAC Meeting

Subject

I am leaving for a Ford ISAC meeting tomorrow. Given reports of executive level exposure on the Town Car leave. I expect some questions. Could you please consolidate the questions we've been select and our responses to date.

Fæd,

I believe that your list includes some service part numbers, older rev levels, as well as pre-production or protetype part numbers. Overall, including Ford Australia, there are eight different production parts. Differences from part to part are fairly minor and include, actuation calibration, release pressure, heapert style, position tab / color of connector hase, thread style, and snap noise associated with the pressure disc. The following matrix, helps summarise this information:

Part Number Actuation	Ralance Base	Hemort	Thread	Ser O
FZVC 9F924 AB 90-160 (1)	20 min Prown / pos 2	J512	3/8-24M	Snap
P6LC 9F924 AA 200-300 (2)	40 min. Black / pos 1	J512	3/8-24M	Snap
F2AC 9F924 AA 90-200 (3)	20 min. Natural/pos 2	I512	3/8-24M	Qalet
F58A 9F924 AA 90-160 (4)	20 min Grey/post	1512	3/B-24M	Quiet
F3TA 9F924 CA 200-300 (5)	40 min Red/pos 1	J512	3/8-24M	Snap
94DA 9F924 AA 90-160 (6)	20 min Natural/pos 2	o-ring	MOLEDIM	Quiet
F3DC 9P924 AA 90-160 (7)	20 min. Natural/pos 2	Saubber	3/8-24M	Quiet
941A 9F924 AB 90-160 (8)	20 min Grey/post	o-ring	3/8-24M	Oalet

Vehicle - Part Number Correlation

- (1) Crown Vic, Grand Marquis, Mark, Town Car
- (2) Boundine, Chib Wagon

- Crown Vic, Grand Marquia, Mark, Town Car
 Winster
 Brosco, F-Series, Ranger, Explorer, Navigator, Expedition, Secundine, Club Wagon
- (6) Falcon
- (7) SHO Taurus
- (8) Capel

TI P/N Correlation to Above

- (1) 77PSL2-1
- (2) 77PSL2-3
- (3) 77P8L3-1
- (4) 77PSL3-2 (5) 77PSL3-3
- (6) 77PSLA-L
- (7) 77PSL5-2
- (8) 77PSL6-1

Dague, Bryan

From:

McGuirk, Andy

Sent:

Monday, February 08, 1999 1:54 PM

To:

Rahman, Aziz; Dague, Bryan

œ

Baumann, Russ

Sublect:

FW: Ford ISAC Meeting

importance:

High

for your meeting this pm

MUTUALIVE SIDERES AND CONTREMS OF MUSICAL 34 FOREST ST M/S 23-05 ATTLEMON, M. 02763 TEL : (806) 235-3050 FAX : (506) 236-3745

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

From:

Douglas, Charles

Sent:

Monday, February 08, 1999 1:41 PM McGuirk, Andy: Sullivan, Martha

Kα Cet

Beringhause, Steven: Rowland, Thomas

Subject:

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imedrudas

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- Melt / Char temperature information related to Noryl GTX material and Kapton
- Design change matrix / history (will be carried out by Aziz tonight)
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if there are other questions which Fred may have put to you directly that I am not aware of, or additional information we may have volunteered (i.e. in-line relay?) please add to this mag.

Regards,

Charlie

Charile Douglas (608) 236-3867 (P) (808) 236-1598 (F) c-douglas2@ti.com

From:

Sullivan, Martha

Seni:

Monday, February 06, 1999 9:02 AM

To:

McGuirk, Andy

Ce:

Dauglas, Charles; Beringhause, Steven; Rowland, Thomas

Subject:

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Sent:

Monday, February 08, 1999 1:50 PM

To:

Dague, Bryan

Subject:

FW: Ford ISAC Meeting

Charlie

Chartie Douglas (508) 236-3657 (P) (506) 236-1598 (F) c-douglas2@ti.com

From:

Douglas, Charles

Sent: To: Monday, February 08, 1999 1:41 PM McGuirk, Andy; Suffivan, Martha

Co:

Beringhause, Steven; Rowland, Thomas

Subject:

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Records.

To:

bdague@ti.com; sberinghause@ti.com

Subject:

Manufacturer List from Performance Polymers



http://perfpoly.ideminc.com/

Dague, Bryan

From:

Hookins, AL

Seni: To: Thuriday, March 04, 1999 10:39 AM Beringhause, Steven; Dague, Bryan

Subject:

CONCENTRATIONS OF OXALIC ACID CLEANING SOLUTIONS

I just spoke to a tech representative from Cakite which is a major supplier of industrial cleaning solutions. He told me that most of their products that they sell for removing rust from steel and which contain oxalic acid, do so in the S-10% range. Furthermore, the instructions say to dilute these solutions at the 4-5 ounces per gallon of water level. This works out to about the 0.3% level

I also did some internet research and found that many people recommend using Oxalic acid at the 5-10% level for uses around the home and in the garage; with much fewer concerns about saftey.

Regards,

X1

Dague, Bryan

From:

Rahman, Aziz

Seni:

Tuesday, March 02, 1999 5:11 PM

To:

McGuirk, Analy: Dague, Bryan; Douglas, Charles; Sharpe, Robert; Baumann, Russ;

Beringhause, Steven

Subject:

FW: SAE paper discuss at Ford meeting:

Steve/Bryan

Sounds like a good paper for info on brake fluid degradation. It may be available online??

Frame Sent

Kitt, Michael (MB)(SMTP:mkitt@cow.com) Trunsday, Fishruary 25, 1999 9:03 AM

Tax

'cziz@11.com'

Subject

SAE paper discuss at Ford meeting.

The SAR paper that discusses brake fluid corrosion is SAE paper # 971007. It from the Corrosion Prevention (SP-1265) series of papers. Hope this helps, Mike Ritt

<u>Dague, Bryan</u>

From:

Rahman, Aziz

Sent:

Tuesday, March 02, 1999 4:24 PM

To:

McGulrk, Andy; Dague, Bryan; Douglas, Charles; Sharpe, Robert; Baumann, Russ;

Beringhause, Steven

Subject:

FW: Central Lab Analyses

М

Froms

LaRouche, Steve (5.) (SMIP:starouch@ford.com)

Bent

Tuesday, March 02, 1999 11:56 AM

Tox.

Porter, Fred (F.J.); LaPainte, Norman (N.R.); Relmers, Steve (S.J.); "A. Rahman"; McCarthy, Shoun (S.L.); LaRouche.

Steve (5.)

We have found three switches so far (including the one to be analyzed by the Sci Lab), that will not open electrically when disc is heard to snap under application of air pressure. I sectioned one of these switches and found what appears to be water (it evaporated rather quickly at room temp) and corresion product. I found that the transfer pin has been stuck in place by the corrosion products. What this means, is that even if the disc snaps, the pin will not pull back, and the contacts will not open. None of these switches showed evidence of diaphragm leakage on the test stand.

Steve LaRouche (SLAROUCH) Metallurgy Section, Central Laboratory, Room N410 (313) 845-4876 (313) 322-1614 FAX

Dague, Bryan

PIOITI:

Amore, Alan

Sent: To:

Tuesday, March 02, 1999 12:01 PM Douglas, Charles: Dague, Bryan

Bublect:

Info on plastic base materials

The attached info was gathered from material properties data sheets and from the MSDS system.

Not all data is complete but probably could be completed if the right plastics people were identified.

I would say that the Ulterna and the Fortrons are probably best from ignition standpoints while the Fortrons and Stanyle are best from a the standpoint of strength and deflection temps.

if you need more info, let me know.



BEST REGARDS,

AZ ATRAGE

Dague, Bryan

From:

Watt, Jim

Sent:

Monday, March 01, 1999 4:84 PM

To:

Bournann, Russ: Beringhause, Steven; Dague, Bryan; Pechonis, John; Rohman, Aziz;

Rowland, Thomas; Douglas, Charles; Pawlowski, Robin; Baker, Gary; O'Nelli, Ed; Haskeli,

Beth; Sharpe, Robert; McGuirk, Andy

Subject:

RE: FORD P/S TRANSITIONS OF CURRENT INTEREST

Andy,

Below are the files you were requesting:

1. Town Car Switch Usage Sequence:



7775/meine.ool

2. 77PS Suppliers' Request For Engineering Analysis (SREA) history:



Part Number 46515 (77PS Molded Base Material History);



Jim Worlf , GRA, magld: Jw02; mail station 12-33; page (508)236-1010, no. (0896) ph (508) 236-1719; fax (806)236-3153

From:

McGuirk, Andy

Sent:

Monday, March 01, 1999 10:22 AM

To:

Baumann, Russ: Beringhause, Steven; Dague, Bryan; Pechonis, John; Rohman, Aziz; Rowland, Thomas;

Douglas, Charles; Watt, Jim: Pawlowski, Robin; Baker, Gary; O'Nell, Ed: Haskell, Beth: Sharpe,

Robert

Subject:

FORD P/S TRANSITIONS OF CURRENT INTEREST

JIM WATT, PLS PULL TOGETHER THE TEAM OF CHARLIE DOUGLAS AND ROBIN PAWLOWSKI AND OTHERS TO RECONSTRUCT THE TIME-LINE OF TI PRESSURE SWITCH 77PS FAMILY.

SPECIFIC AREAS OF INTEREST ARE QUIET SWITCH AND NORMAL SWITCH AS WELL AS GE PLASTIC AND CELENEX PLASTIC AS INSTALLED INTO THE FORD TOWN CAR PLATFORM IN MODEL YEAR '92 AND '93. I UNDERSTAND WE ARE ABLE TO DEFINE THE TIER-ONE CUSTOMERS AND THERE WILL BE A NEED TO CONNECT THEM TO THIS PLATFORM AND YOU SHOULD USE VARIOUS AVENUES TO ACCOMPLISH SAME.

PLEASE PLAN A 'MINI' TEAM MEETING WITH JOHN PECHONIS AND CHARLIE DOUGLAS AND YOURSELF (AND OTHER IF YOU FEEL VALUE IS ADDED) (AT JOHN'S OFFICE) TO REVIEW OUR STATUS LATER TODAY...SAY 4-ISH. IT IS IMPORTANT THIS INFO BE ACCURATE AS WELL AS PROMPT. THE RESULTING PRODUCT WOULD BE REVIEWED WITH RUSS TOMORROW MORNING BY ME.

٨

AUTOMOTIVE SESSENS AND CONTROLS QUA MANUEL 34 FOREST ST M/S 23-05 ATTLEMENTO, ER 02783 THL: (508) 236-3766 PARE: (800) 447-3708 PIN 604-2046

Epstein, Sally

Prom: Sent:

Watt, Jrn [watt@email.mc,tj.com] Monday, Pebruary 08, 1999 3:32 PM

Ta: Subject McGuirk, Andy; Dougles, Cheries RE: 77 p/s 'durability' baseline information

importance: densitivity:

High Confidential

Andy,

the below \$-D file geferences the only leaker for the data base that I forwarded to you earlier today. The leaver was found and returned from Tokico USA, Berea, XY, and caused by a misplaced gasket on a sensor 4649Pbly1

<<car95_30.doc>>

Jim Watt, QRA, magid: jw02; mail station 12-33; page (\$081236-1010, no. (0696) ph (504) 236-1719; fax (508)236-3153

McGuirk, Andy Frant

Saturday, Fabruary 06, 1999 10:54 AM Saugenn, Russ, Rose, Claims, Matt, Jim Jent: Tot

Beringhause, Staven; Dague, Eryan: Fathonis, John: Rowland, Ces Thomas; Sullivan, Martha; Baker, Gary; Rahman, Asiz; Sharpe, Robert Subject: 77 p/s 'durability' baseline information

Subject:

attorney - client privileged communication

Jim and Elains, as I mentioned in my telecons, I would like us to move forward in quickly essembling data that we can use to help Ford understand our 'esseet' assembly durability baseline in the brake switch package. This, as I see it, would be composed of 3 major sections per below (please feel free to insert your ideas also) and for the most part meads to be delivered early w/o Feb 5th:

A) I want to demonstrate that manufacturing anomalies did not escape to the field in the form of a projection of hydraulic fluid leskers through the supply chain... and we can help achieve this objective by assembling data that demonstrates our history of hydraulic leak rates in the subject time-frame of MY92 and MY 93 as sean in our factory floor and/or customer feedback. Jim, please take the lead on getting this done AIAF. we should consider customer AIQ spreadsheets and ROR data coupled with 8D's of the time to build a case for the law PPM leak rates of the sensor assembly further protected by downstreem supply chain testing at the TIER-one and OM. Also, there may be an apportunity to integrate menufacturing test data as a validator of that look rate number as well as using the lask test data from impulse testing as an alternate source.

TI-NHTSA 018632

there will be a building need to deliver data and evidence by Tuesday via Aniz and we should consider an elternate path of anacdotal estimate should the records not be readily available. I know we will need to identify and recall records and that will take time:

B! I want to demonstrate that the sensor assembly is mechanically durable and surpasses the 'expected' life cycles as expressed on the Ford space...and we can achieve this objective by assembling ES 'impulse' testing data from the timeframe of interest. In an ideal situation we would take this raw data and project into WEIBULL success-testing estimate of cycle Capability in the 'accelerated simulated' cyclers used in our process controls. Ilaine please Coordinate the data collection here. (We will likely turn to reliability experienced quality engineers Paul spacemen and Tushar Parikh to convert the data to information). Again, should we run out of time, we will need to turn to whatever relevant 'recent' data we have to propose our position and support with historical based data once we soot through the files and record recall process. Bryan, please inject any life test data from other qualification platforms here so we have 'test-to-failure' data if available.

Also, we should make a side note of the pressure profile used in the cycler process for future use with Axir during his uponning dialogues with Ford.

C) I want to demonstrate that the sensor is chemically resistant per the IP and PPAP testing and surpasses 'empected' emposures per the Ford Space... and we can achieve this by assembling both relevant IP testing and FPAP results to demonstrate compliance. There may also be other testing history of the period that would convey that durability of the switch assembly in the typical automotive fluid environment of gas-oil-coolant-fluids in the proper crientation and connector pretection. Elains, places assemble this data and we will provide to Asis to deliver to Ford. Again, should we run out of time, delivery of the reedily available records from '95-'96-'97 per your Friday work would suffice as a starting point.

To provide some further clarity, I have included the focal part numbers from Charlie Soughas below. As we assemble data and translate into information please track the differences between \$7 and 77 and 87 styles but also integrate the brake sensor assembly data and treat it as a family. As you discover the level of effort and resource needs, pls see John or me for help in getting people assigned or priority provided.

thank you for your continued support here,

AUTOMOTIVE SENSORS AND CONTROLS GRA WANGER 34 FOREST ST 36/5 23-05 ATTLEBORG, MR. 02703 THE: (508) 236-3080 FMB: (508) 236-3745 PARK: (800) 447-3700 PIN 504-2044

From: Souglas, Charles Seat: Friday, Fabruary 05, 1999 8:43 AM To: McGuirt, Andyy Ross, Elaine Subject: 7798 Matrix

Andy / Elaine.

Per our discussion:

<<file: Lincoln.dog>>
Regards.
Charlie

Charite Dougles (508) 236-3657 (9) (508) 236-1598 (F) c-dougles28ti.com

Epstein, Sally

From:

McGuirk, Andy (e-meguirk@email.me.ti.com)

Sent; To: Tuesday, February 09, 1999 10:35 AM

Subject:

Rehman, Aziz; Beringhause, Steven FW: 77 p/s 'durability' baseline information

Importance: Sensitivity:

High Confidential

AUTOMOTIVE SENSORS AND CONTROLS GRA MANGER

34 FOREST ST M/8 23-05 ATTLEBORD, MA 02703 TEL : (508) 236-3080

FAX : (508) 236-3745

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

From: Watt, Jim

Sent: Monday, Tebruary 08, 1999 4:31 PM

To: McGuirk, Andy, Douglas, Charles

Subject: RE: 77 p/s 'durability' baseline information

Importance: High

Sensitivity: Confidential

λοdy,

the below 8-D file references the only leaker for the data base that I forwarded to you earlier today. The leaker was found and returned from Tokico USA, Barea, KY, and caused by a misplaced gasket on a sensor assembly:

<<car95 30.dog>>

Jim Watt, QRA, magid: jw02; mail station 12-33; page (508)236-1010, no. (0696) ph (508) 236-1719; fax (508)236-3153

From: McGuirk, Andy

Sent: Seturday, Pubruary 06, 1999 10:54 AM To: Baumann, Russ; Rose, Elaine; Watt, Jim

Co: Beringhause, Steven; Dague, Bryan; Pechonia, John; Rowland, Thomas; Sullivan,

.Martha; Baket, Gary; Rahman, Asis; Sharpe, Robert Subject: 77 p/s 'durability' baseline information

attorney - client privileged communication

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thank you for your continued support here,

L

AUTOMOTIVE SENSORS AND CONTROLS ORA MANGER 34 FOREST ST M/S 23-05 ATTLEBORO, NA 02703 TEL: (508) 236-3080 FAX: (508) 236-3745 PAGE: (800) 467-3700 PIN 604-2044

Prom: Douglas, Charles Sent: Friday, February 05, 1999 8:43 AM To: McGuirk, Andy, Rose, Elaine Subject: 77PS Matrix Andy / Elaine,

Per our discussion:

<<File: Lincoln.doc>> Regards,

Charlie

Charlie Douglas (508) 236-3657 (P) (508) 236-1598 (F) c-douglas28ti.com

TEXAS INSTRUMENTS INCORPORATED CORRECTIVE ACTION REPORT

Status:

Closed

Report Number:

car95 30,dec

Date Opened:

June 26, 1995 (original)

Update: Customer: October 13, 1995 Tableo USA

TI p/n (s);

77PSL3-3

Dovice look

Customer p/n (s): CAR description: F3TA-9F924-CA

(Step 1) Champion and Term Mombers

Matt Sollera

Manufacturing Engineering

(Champion)

Ann Res Keith Rosiello Manufacturing Engineering Design Engineering

Jim Watt

Ocality Engineering

Claire Balthazer

Learning Analysis Lab (LAL) Constinutor

Poggy Allen

Manufacturing Supervisor

Chris Wasser

Design Engineering

Lou Roche

R&M

(Step 2) Problem Description

Barry Stewart, Tokico quality, reported one 77PSL3-3 pressure switch falling and of line pressure decay testing at Tokico fleatities in Beres, KT. (Castomer rejection # 448. TI CARE # 1408266.). Specific Telrico test parameters are unknown at this point - Ilea Watt follow-up.

There is no history of any past leak failures at Tokico USA, and no additional failures have been reported by Tokico to data.

Date code of the returned switch is 5124. May 4, 1995.

Failure analysis at TI Attichoro demonstrated a pressure decay rate and calibration within final test: finite, however, further lab fine look testing confirmed leak rates higher than normal. Diseasembly inspection was performed and the internal gucket was found outside of the hexport gusket gland.

Further visual analysis confirms that the sensor secondly was assembled on the automated sensor assembly machine as evidenced by the presence of pre-orisip marks around the cup periphery. All other device characteristics appear normal and according to standard production.

July 14, 1995 applate:

No additional failures have been reported by Tokico to date.

August 25, 1995 update:

Tokico test parameters were received.

Tokico reported one additional 77PSL3-3 pressure switch fulling end of line pressure decay testing. (Customer rejection # 566, TI CARE # 1461501)

Date code of switch is 5201, which corresponds to July 20, 1995.

Again, failure analysis at TI Attleboro demonstrated pressure decay rate and calibration within final test limits. Lab analysis confirmed higher than normal leak rates. The device was diseasembled and the internal gashet was found cutnide of the hexport gashet gland. All other device characteristics appear normal.

The device was assembled automatically on the sensor assembly machine.

September 1, 1995 update:

Regarding Tokico Contenuer rejection # 566, TI CARE # 1461501. Upon further analysis it has been determined that the out of place gasket was due to a pilot handling procedural error - not related to the pre-crimp station located on the sensor assembly machine as was the previous switch related to Tokico Customer rejection # 448, TI CARE # 1408266.

This procedural error is under review by Peggy Allen (Manufacturing Supervisor). Immediate actions were taken to highlight the error to all associated pilot makers.

September 8, 1995 update:

No additional failures have been reported by Tokico to date.

October 13, 1995 update:

No additional failures have been reported by Tokico to date.

(Step 3) Containment and Short Term Corrective Actions

Review LAL team post-mortem analysis reports of confirmed. final function test look fallout. Align LAL team sensitivity.

Ralthagar Complete

Next 8D update to Tokico is 10/13/95.

Sellers Complete

(Step 4) Definition and Verification of Root Cause

July 14, 1995 update:

Customer rejection # 448. TI CARE # 1408266. Likely cause is inadequate pre-crimp prior to puck transfer. See C/A's for actions to prevent. TO-OCCUPTORIOG.

August 25, 1995 update:

Customer rejection # 448. TI CARE # 1408266, Likely cause is inadequate pre-crimp prior to puck transfer. See C/A's for actions to prevent re-occurrence.

September 1, 1995 update:

Tokico Customer rejection # 566, TI CARE # 1461501. Pilot heading procedural error is the determined cause.

(Step 5) <u>Permanent Corrective Actions</u>

July 14, 1995 update:

 Augment sensor assembly process specification ast-up procedures. with improved pre-crimp impection criteria.

Sollers Complete

Determine feasibility of go no-go pro-crimp number.

Sellers Complete

September 1, 1995 updata:

 Complete build and qualification of pre-crimp go/no-go master. P. Spec set-up instructions updated.

Res

Complete

September 8, 1995 update:

 Evaluate perm. design-solution. (Gasket/Gasket gland enhancements)
 (No reasonably valid pressure switch design solutions have been highlighted as warranting further action). Rosiello Complete

(Step 6) Verification of Permanent Currective Actions

* On-going LAL post-mortem review of all leak fallout at final function test.

Baithazar Complete

 Jun Watt will continue to close with Tokico USA on installation and final leak test fallout.

Watt Complete

(Stop 7) Prevent Becurrence

- Completion of sensor assembly process set-up procedure enhancements and pilot procedural handling training with all associated pilot makers provides good confidence in the prevention of mis-placed gashets.
- * Enhancements to 'Tt's detection capebility to match the sensitivity level specified by Tokico internal engineering standards would require significant modifications to 'Tt's assembly/test processes. Prevention of the enoughy will continue to be the primary focus of the TI QOS operations team. We place high priority in continuously improving our processes.
- * Further engineering discussions are necessary as more refined look detection expebility is required. Ti contacts are line Watt, Matt Sellers, and Keith Rodello.

- caid report -

Epetein, Selly

Front: Sent: To:

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McGuirk, Andy (e-moguirk@email.mc.ti.com) Wednesday, February 10, 1999 2:06 PM Beumann, Russ RUSB; Dague, Bryan

Cc:

Beringhause, Steven; 'Raitman, Aziz ZiZ'; Watt, Jim

Subject:

RE: 77PS Design explanation

Attorney Client Privileged Information

overall, an outstanding document draft. I made a number of changes and am on callback to discuss my thoughts.

i think it might be of value to discuss weibull success factor projections from the 'millions' of 'es' test results we must have? we should also speak to the thunderbird applications? maybe refer to the econoline issue of '93 with connector issues?

we need some summary statement as to the ending of this document.....

A AUTOMOTIVE SENSORS AND CONTROLS ORA MANGER 34 FOREST ST M/S 23-05 ATTLEBORO, MA 02703 TEL : (508) 236-3080 FAX : (508) 236-3745 PAGE: (800) 457-3700 FIN 604-2044

From: Daque, Bryan

Sent: Wednesday, February 10, 1999 1:24 PM

To: Saumann, Russ RUSB

Co: Seringhause, Steven; Rabman, Aziz 212; McGuirk, Andy

Subject: 7775 Design explanation

Folks,

Rere is a summary of how and why the 77PS is designed as it is. Flease give me any comments you might have.

Aziz,

Read this and use the information as you see fit, but do not distribute it until we all agree on the wording.

Regards, Bryan

Attorney Client Privileged Information

Srake Fluid Intrusion

2/10/99

TI's 7798 switch family has been specifically designed to operate in an automotive braking system. The pressure devity of the switch has been designed to seal brake fluid and transmit force and movement to the sensing portion of the switch over the life of the 500,000 cycle specification which in turn translates into an electrical switching reaction used in the automobile system as a redundant safety related cruise control shutoff switch..

Background:

The pressure cavity is composed of the hexport, gasket, and Kapton

disphragms (Called out as "seal" on attachment 1.). The purpose of the gasket is to provide a fluid tight seal between the hemport and disphragms. The purpose of the Kapton 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 is varied.

There are two different ways that brake fluid may enter the contact cavity of II's brake switches from the pressure cavity. Brake fluid could potentially leak past an impaired gasket seal, or leak through a damaged or 'worn out' Kapton diaphragm.

The Gaskets

In order to create a fluid tight elastomeric seal, these must be proper compression of the elastomer, sufficient backing of the seal material to prevent movement when pressure is applied, and finally the elastomer must be competible with the working fluid and expected thermal ranges of the environment and application.

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

The gasket compression target was obtained from publish industry standards (see Parker O-ring Mandbook). In this particular design a nominal gasket compression of 249was selected. The depth of the hemport gland shown on attachment #2 controls this attribute. This gland dimension is cut into the hemport 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 crimp 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 herport. Therefore, the hexport gland prevents the gasket from moving outwards when high pressure is applied to the switch.

The DFMTA outlines the types of tests that were selected and run to confirm that all of these parameters are selected correctly. The resulting design was emposed to test applications that were intended to duplicate actual application conditions, and in some cases go beyond the intended limits to failure. See the DFMTA Document number 503794 and customer specification ES-72VC-97924-AA . Specifically, burst testing, impulse testing, and thermal cycle tests were performed to confirm that the gasket performed as intended. The specifics details of these tests and the results can be seen in a number the following FV test reports:

Te	st Report #	TI Meitch	Part number	Year Tested
1.	PS/91/48	77721,2-3	1991	
2.	PS/91/49	779\$12-1	1991	
3.	PB/92/49	77 0 863-1	1992	
4.	78/92/80	77PSL5-2	1992	
5.	28/92/82	77 PSL3-1	1992	
ß.	98/93/11	77 0516-1	1993	
7.	PS/93/44	772524-1	1993	

also, there are IP-2 tests of 6/95, 10/95, 1/95 and 8 /96 that are readily at hand and show fluid capability resistances

In order to protect TI's customer supply chain from gasket-manufacturing issues there are several preventative actions in place. These actions include: heir nets, protective smocks, and cleaning procedures for the equipment

As a result of the process and product controls, II's customer return rates including line fallout rates and and of line acceptance tests indicate gasket-manufacturing anomalies are below massurable limits (one leak return in 5 years from master cylinder leak testing or less than 1 ppm). 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 but in our expert opinion not in late life without early leak signs.

Kapton Diaphragms:

A pressure switch disphragm must seal the pressure cavity, transmit pressures 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 of the brake fluid.

Basically, a single piece of Kapton in this design consists of a '0.003-inch thick polythide film laminated on both sides with a 0.001-inch thick FEP Teflon film. The polymide 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 a wide variety of pressure switch applications since 1981.

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 capability to meet the specified requirements (see FV reports listed above). Since temperature, chemical emposure, and stress levels all affect the life expectancy of the Kapton diaphragus, 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 is around 1 million cycles which is well above the 500,000 cycles specified in the Ford (E3-F2VC-9F524-AA) See Life Testing to Failure (P5/98/14).

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.

While the similar manufacturing anomalies listed above can affect the Kapton diaphragus (see FINEA Document # 503831), additional factors can cause leakage via the Kapton diaphragus. Material/chemical compatibility and stress/strain concentrations can also cause the Kapton diaphragus to leak. See DINEA 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 fatigus occurs well over 0.5 million full-scale pressure cycles in our history of simulated and accelerated life testing. When Kapton rupture does occur, there are visual signs of de-lamination, cracking, and embritlement. The Kapton disphragms break down first in the areas of highest stress and or strain. In our empert opinion, the first region to show break down is the circumferential area surrounding the converter button. See Endurance Test (report \$ \$5/98/53). Again, disphragm life depends on stress levels (pressure magnitude applied), temperature, and

chemical exposure.

 ${\bf e}^{\gamma g}$

The above_mentioned tests were conducted in TI's Life Test lab with relatively controlled conditions. Water will accelerate the aging of the base polymide. Chemical attach can come from two directions:
1) By entering the contact devity via the electrical connector,

- 2) By being in solution in the brake fluid and entering the switch vie the pressure port.

When water enters the connector it will "age" the Kapton diaphraque and make them appear as though they have reached the end of life. This condition leaves visual cluss. 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 P\$/98/53).

End of Document.

-MGG M#= 947390 FR=DAGU TO-RUSB SENT=02/10/99 12:24 PM R#=059 ST=C DIV=0050 CC=00357 BY=DAGU AT=02/10/99 12:24 FM

To: Baumann Russ RUSB <9≜umann> RUSB

-py: Beringhause

Steven Rahman Aziz ZIZ McGuirk Andv <Beringhause>

<aberinghauseGemail.mc.ti.com>

<Rahman> ZIZ

<McGuirk>
<a-mcguirk@email.mc.ti.com>

From: "Dague, Bryan" <bddague@email.mc.ti.com>

Subj: 77PS Design explanation

Falks,

Here is a summary of how and why the 77PS is designed as it is. Please give me any comments you might have.

Aziz.

Read this and use the information as you see fit, but do not distribute it until we all agree on the wording.

Regards,

Attorney Client Privileged Information

Brake Fluid Intrusion, 2/10/99

'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 and transmit force and movement to the sensing portion of the switch over the life of the application.

Background:

The pressure cavity is composed of the hexport, gasket, and 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 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 is varied.

There are two different ways that brake fluid may enter the contact cavity of TI's brake switches from the pressure cavity. Brake fluid could potentially lesk past an impaired gasket seal, or leak through a damaged 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 seal material 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, ase 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 casket supplier. Etylene Propylene for brake applications is common practice throughout the industry, and TI has been using this material in

TI-NHTBA 018646

brake applications since 1988.

The gasket compression target was obtained from publish industry standards (see Parker O-ring Handbook). In this particular design a nominal gasket compression of 245was selected. The depth of the hexport gland shown on reachment #2 controls this attribute. This gland dimension is cut into the xport 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 crimp together.

Lastly, the movement/position of the gasket when pressure is applied must be controlled. 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 specifics details of these tests and the results can be seen in a number the following PV test reports:

Test	Report #	TI Switch Part number	Year Tested
1.	£5/91/48	77 08L2-3	1991
2.	PS/91/49	77 PSL2-1	1991
Э.	PS/92/49	77P8L3-1	1992
4.	P5/92/80	77 P 9L5-2	1992
5.	PS/92/82	7 798L3-1	1992
6	PS/93/11	77 PSL6-1	1993
	PS/93/44	77PSL4-1	1993

In order to protect TI's customers from gasket-manufacturing issues there are several preventative actions in place. These actions include: hair nets, protective smocks, and cleaning procedures for the equipment As a result, TI's customer return rates, line fallout rates, and end of line acceptance tests indicate gasket-manufacturing anomalies are below measurable limits (less then 1 ppm). 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.

Kapton Diaphragma:

A pressure switch diaphragm must seal the pressure cavity, transmit pressures forces to the converter, and follow the converter motion without significantly affecting the switch calibration points. In addition, the diaphragm material must resistant chemical attack of the brake fluid.

Basically, a single piace of Kapton consists of a 0.003-inch thick polyimide film laminated on both sides with a 0.001-inch thick FEP Teflon film. The polymide 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.

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 ility to meet the specified requirements (see 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 is around 1 million cycles. 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, writerials, and processes have remained stable over time. See attached IP . Forts.

While the similar manufacturing anomalies listed above can affect the Kapton diaphragms (see PFMEA Document # 503831), additional factors can cause leakage via the Kapton diaphragm. Material/chemical compatibility and stress/strain concentrations can also cause the Kapton diaphragms to leak. 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. When Kapton rupture does occur, there are visual signs of de-lamination, cracking, and embattlement. The Kapton diaphragms break down first in the areas of highest stress and or strain. The first region to show break down is the circumferential area surrounding the convertor 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 leb with relatively controlled conditions. Water will accelerate the aging of the base polymide. Chemical attach can come from two directions:

- By entering the contact cavity via the connector,
- By being in solution in the brake fluid and entering the switch via the pressure port.

in water enters the connector it will "age" the Kapton disphragms 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 FB/98/53).

End of Document.

Epstein, Sally

From: Sant:

-1

Parith, Tusher [tperith@email.mc.ti.com] Thursday, February 11, 1999 7:42 AM

To: Ce: Watt, Jim McGuirl, Andy

Subject:

Impulse Test: Reliability Demonstration

Jim.

After talking to you and Andy yesterday, I have done my literature research last night. The following is my findings:

This test falls into reliability demonstration category as reliability life tests terminated at prescranged time.

Brief Description of the test:

It is based on DON Handbook H108. This kind of life test is stopped upon reaching a computed termination time (number of operation, cycles , etc) T provided the specified number of failures (in this case 1) did not occur before. The test is also stopped if the specified number of failures is reached before time T. This procedure is applicable to testing with or without replacement of failed parts.

The acceptability of a lot is determined by the time required for a predetermined number of failures, rf (in this case 1), to occur in a sample size n (in this case 5), and a comparison of this time with the test termination time T multiplied by a constant k. The value of constant k with .05 % producer's tick, for a sample size of 6 is .009. A lot is accepted if the predetermined number of failures rf (One) has not yet occurred before tegmination time T is reached.

T- K * mean life specified as acceptable

Mean life (specified Ford) = 500,000

T- .009 * 500,000=4500 Cycles

From the data provided to me yesterday, if the product does not fail before 4500 cycles during impulse Test, then we can make the statement that " the lot is acceptable and would have minimum mean life of 500,000 cycles." In our case, we need six samples that would have gone through at least 4500 cycles without any failure. The number Andy gave me has six samples about twenty five times and fifty cycles. That is about 1250 cycles so far, for six samples, far short of 4500 cycles. If we have ninety times of fifty cycle test with six number of samples without any failure, than our statement would be valid.

I will talk to Bick to find out whether we could find all the date to support our calculation.

Let me know if this makes any sense to you.

Thanks.

Best Regards,

Tushar Parikh

Graveline, Dora

From:

Dague, Bryan

Sent:

Thursday, February 11, 1999 8:48 AM

To:

Baumann, Russell; Baringhause, Steven; Rahman, Aziz; McGuirk, Andrew

Subject:

77PS Overview

Guys,

Here is the fixial draft. Aziz to deliver to the customer??

Please advise if I need to fax it to somppe.

I am having copies of the appendix made today.

Bry

.......

Proprietary Information

77PS Overview 2/10/99

TTs 77PS switch family has been specifically designed to operate in an entomotive 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 -P2VC-9F924-AA.

Backgrounds

The pressure cavity is composed of the hexport, gasket, and three Kapton TM displaying (called out as "seal" on attachment 1.). The purpose of the gasket is to provide a fluid tight seal between the heaport and the disphragms. The purpose of the Kapton displarages is to provide a flexible fluid tight seal between the presents cavity and the internal components of the switch. Furthermore, the disphragms are intended to transfer processes 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 "* displicages.

The Gasketi

In order to create a fluid tight classomeric seal, there must be proper compression of the elessomer, 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 heaport 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 is combination with the gashet dimensions determines the final gashet corneression when the assembly is crimped together.

Landy, the movement/position of the gashet when pressure is applied must be controlled and restrained. This design Page 1

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 placed 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 across application conditions, and in some cases go beyond the intended limits to faikure. 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 4s intended. The specific desails of these tests and the results can be seen in the PV test report numbers listed below: (copies can be provided on request).

Τe	si Report #	11 Switch Part number	Year Tested
Ι.	PS/91/48	77 PSL2 -3	19 9 1
2.	PS/91/49	77PSL2-1	1991
3.	PS/92/49	77PSL3-1	1 99 2
4.	PS/92/80	77PSL5-2	1992
٤.	PS/92/82	77PSL3-1	19 92
6.	PS/93/11	77 PSL6 -1	19 93
7.	PS/93/44	77PSL4-1	1 99 3

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 TT'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. 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 [™] Diaphregue:

A pressure switch displacem mass 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 displacem material must be resistant to chemical article by the brake fluid.

Basically, a single piece of Kapton TM in this design consists of a 0.003-inch thick polyimide film laminated on both sides with a 0.001-inch thick FEP Tetlon film. The polymide film has the shifty to stretch without breaking (strains on the order of 70% before repture), and the Tetlon film is compatible with a wide range of chemicals. As a result of this layered construction, Kapton TM 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 TM layers were used as the displanages seal.

To confirm the correct material was selected for this application we refer to the DFMEA. Specifically, this document identifies burst trating, impulse testing, and thermal cycle testing. Those tests confirmed the Kapton's ^{IM} 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 ^{IM} displragms, additional testing is commonly dose. A typical impulse test would include pressure cycles to 1450 psi, constant temperature of 135 C, and a cycle rate of 120 cycles/minuts. 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 TM can affect the Kapton TM disphragm seal performance (see PFMEA Document # \$03831). 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 singulate accelerated life testing of the application. See PS reports called out above. Life testing per the customer specification (ES-P2VC-9F924-AA) has shown acceptable performance.

Typically, Kapton ^{IM} fatigue occurs well over 0.5 million full-scale pressure cycles in our history of simulated and accelerated life testing. When Kapton ^{IM} fetigue does occur, there are visual signs of de-lamination, cracking, and embrittement. The Kapton ^{IM} disphragms 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 converser button. See Endurance Test (report # PS/98/53). Again, disphragm life depends on stress levels (pressure magnitude applied), temperature, and chemical exposure. The shove mentioned tests were conducted in TPs Life Test lab with relatively controlled conditions.

Water has been shown to accederate 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 port.

When water enters the connector it will "age" the Kapton TM displaragms 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. TM 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 Meguirk or Bryan Dague with questions.

77PS Overview Appendix

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

Currey, Pat

From:

Beringhause, Steven [sberinghause@email.mc.ti.com]

Sent:

Thursday, February 11, 1999 9:10 AM

To: Subject: Sullivan, Martha FW: 77PS Overview

Front: Dague, Bryan

Sent: Thur:

Thursday, February 11, 1999 8:48 AM

To: Baumann, Rüssell; Beringhause, Steven; Rahman, Aziz; McGuirk, Andrew

Subject: 77FS Overview

Guys,

Here is the finial draft. Aziz to deliver to the customer??

Please advise if I need to fax it to somene.

I am having copies of the appendix made today.

Regards, Bry

Proprietary Information

7799 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 TS -F2VC-9F924-AA.

Background:

The pressure cavity is composed of the hexport, gasket, and three Kapton TM 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 TM 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 seal, or ii. brake fluid could leak through a damaged or 'worn out' Kapton TM diaphrage.

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.

TI-NHTSA 018653

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 Bandbook). In this particular design a nominal gasket compression of 240was 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 BS-FZVC-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 numb	ber Year	Tested
1.	29/91/48	77PSL2~3	199	1	
2.	PS/91/49	77 PS L2~1	1993	ì	
3.	PS/92/49	77 PSL3-1	199	2	
4.	PS/92/60	77 PSL 5-2	199	2	
5.	PS/92/82	77PSL3-1	199	2	
6.	PS/93/11	77 PSL6-1	1993	3	
7.	P9/93/44	77P9L4-1	199	3	

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 ections in place. These actions include: hair nets, protective smocks, and cleaning procedures for the equipment. TI's customer return rates indicated by past return and analysis records are less then I ppm (one leaker return in 5 years from master cylinder leak testing).

Kapton TM Diaphragms:

A pressure switch disphragm must seal the pressure davity, transmit pressure forces to the converter, and follow the converter motion without significantly affecting the switch calibrate approach. In addition, the disphragm material must be resistant to the contact by the brake fluid.

Basically, a single piece of Kapton TM $10^{-100} - 10^{-100}$ in consists of a 0.003-inch thick polymeide film laminates 0.001-inch thick FEP Teflon film. The polymeide film 0.03 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 TM 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 TM layers were used as the diaphragm seal.

To confirm the correct material was selected for this application we refer to the DEMEA. Specifically, this document identifies burst 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 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% successful passing of all tests defined in the specification.

Manufacturing & PV anomalies such as pinched Kapton TM can affect the Kapton TM disphragm seal performance (see PEMEA Document § 503831).

Material/chemical compatibility and stress/strain concentrations can also cause the Kapton TM disphragms to fatigue. See PEMEA 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-RA) 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 de-lamination, cracking, and subrittement. The Kapton TM disphragus break down first in the areas of highest stress and or strain. Typically, the first region to show break down is the circumferential eres surrounding the converter button. See Enchrence Test (report # FS/98/53). Again, disphragm 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.

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

 By entering the contact cavity via the electrical connector
 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 TM disphragms 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 TM include de-lamination of the Tailon from the base polymide base, ambrittlement, 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.

7798 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
- 3. Life Test to Failure to [Weibull Analysis]
 6. Customer Specification [ES-F2VC-9F924 AA)
 7. PFMEA
 8. IP Test Reports
 9. Endurance Test Report

Graveline, Dora

From:

Rehmun, Aziz

Sent

Thursday, February 11, 1999 11:02 AM

To:

Baumann, Rusa; Baringhause, Steven; McGuirk, Andy; Dague, Bryan

Subject

RE: 77PS Overview

Team.

Thanks for the info below. I have reviewed test report 98/14 with them and will review this info at the next opportune time. I will let you know if I need a hard copy.

from:

Cogue, Brywn

Sent:

Thereday, February 11, 1999 8:48 AM

Te:

Saumenn, Russel; Beringheuse, Staven; Rehmen, Aziz; McGuirk, Andrew

Subject

77PS Overview

Guys,

Here is the finial draft. Axis to deliver to the customer??

Please advise if I need to fax it to somone.

I am having copies of the appendix made today.

Regards,

Bry

Preprietary Information

77**P3 Overview** 2/10/99

IT'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.

Reckereund

The pressure cavity is composed of the beaport, gasket, and three Kapton TM displangers (called out as "seal" on attachment 1.). The purpose of the gasket is to provide a fluid right seal between the beaport and the displangers. The purpose of the Kapton TM displangers is to provide a fluid tight seal between the pressure cavity and the internal components of the switch. Furthermore, the displangers 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 ¹⁴ disphragm.

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 competible with the working fluid.

Page 1

TI-NHTSA 018667

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 clong with the specific compound formulated by the selected garden 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 placed hexport. Therefore, the hexport gland prevents the gazlest 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 resting, impulse testing, and thermal cycle tests were performed to confirm that the gashet 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
I. PS/91/48	77PSL2-3	1991
2. PS/91/49	77P8L2-1	1991
3. PS/92/49	77 PSL 3-1	1992
4. PS/92/80	77PSL5-2	1992
5. PS/92/\$2	77PSL3-1	1992
6. PS/93/11	77PSL6-1	1 99 3
7. PS/93/44	77PSL4-1	1993

Gasket-manufacturing enomalies can be produced from our of spec gaskets, contamination of the gasket or scaling surfaces. and as a result, may cause leaks early in life. In order to protect TTs customer supply chain from gasket-manufacturing issues there are several preventative actions in place. These actions include: hair nots, protective smooths, and cleaning procedures for the equipment. The 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 terting).

Kapton ¹⁵⁶ Disphragum:
A pressure switch disphragm sums real the pressure cavity, transmit pressure forces to the converter, and follow the converter motion without significantly affecting the switch cultivation points. In addition, the disphragm material must be resistant to chemical attack by the brake fluid.

Basically, a single piece of Kapton TM in this design consists of a 0.003-inch thick polyimide film laminated on both sides with a 0.001-inch thick FEP Teflog film. The polymide film has the shilty to swetch without breaking (strains on the order of 70% before rupture), and the Tetlon film is compatible with a wide range of chemicals. As a result of this layered construction, Kapton ^{1M} 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 ¹⁶⁴ 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 ^{lot} ability to meet the specified requirements (PV reports listed above). Since temperature, electrical exposure, and stress levels all affect the life expectancy of the Kapton TM displacation, additional testing is commonly dose. A typical impulse test would include

pressure cycles to 1450 pri, 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 Faihne (PS/98/14))

In addition, continued conformance testing has been ungoing for many years at Tl. 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 TM can affect the Kapton TM disphragm seal 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 team 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 TM firtigue occurs well over 0.5 million full-scale pressure cycles in our history of simulated and accelerated life testing. When Kapton TM farigue does occur, there are visual signs of de-lantination, emcking, and embrittement. The Kapton TM displacements 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 buston. See Endurance Test (report # PS/98/53). Again, displacement life depends on stress levels (pressure magnitude applied), temperature, and chemical exposure. The above mentioned tests were conducted in TTs 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 port.

When water enters the connector it will "age" the Kapton. The disphragms and make them appear as though they have reached the end of life. This condition leaves visual clues. Classic signs of observed smack of the Kapton. It includes deliamination of the Taflon from the base polymer, see Endurance Test (report PS/98/53).

Authored by Bryan Dagua. Call Andy Meguirk or Bryan Dague with questions.

77PS Overview Appendix

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

Proprietary Information

77PS Overview 2/10/99

TT's 77PS switch family has been specifically designed to operate is an automotive braicing 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-9P924-AA.

Background

The pressure cavity is composed of the hexport, gasket, and three Kapton. TM disputages (called out as "seal" on attachment 1.). The purpose of the gasket is to provide a fluid tight seal between the hexport and the displyragess. The purpose of the Kapton TM displyrages is to provide a flexible fluid tight seal between the pressure cavity and the internal components of the switch. Furthermore, the displyrages 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 knows ways that brake fluid may onter the contact cavity of TI's brake switches from the pressure cavity are i. brake fluid could leak part as impaired gasket seal, or it, brake fluid could leak through a damaged or 'worn out' Kapton TM disphragm.

The Garket

In order to create a fluid tight electromeric scal, there must be proper compression of the electromer, sufficient backing of the electromer to prevent movement when pressure is applied, and finally the electromer 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. If has been using this material in brake applications since 1988.

The gasket compression target was obtained from published industry standards (see Parion O-ring Handbook). In this particular design a nominal gasket compression of 24 fews selected. The depth of the hexport gland slower on attackment #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 gashet compression when the assumbly in crimped together.

Lastly, the movement/position of the gasket when pressure is applied must be controlled and restrained. This design accomplishes this by solecting the outer dismeter 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 DEMEA outlines the types of tests that were selected and run to confirm that all of them 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 faults to failure. See the DEMSA Document sustable S03794 and customer specification RS-F2VC-9F924-AA. Specifically, burst stating, impulse testing, and thermal cycle tests were performed to confirm that the gustast performed as intended. The specific details of these tests and the results can be zeen in the PV test report numbers listed below: (copies can be provided on request).

Te	st Report #	TI Switch Part number	Year Tested
1.	P3/9L/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
S.	PS/92/12	77PSL3-1	1992
6.	PS/93/11	77PSL6-1	L993
7.	PS/93/44	772SL4-1	1993

Gasket-manufacturing anomalies can be produced from out of spec gaskets, contamination of the gasket or senting surfaces, and as a result, may cause leaks early in life. In order to protect TI's customer supply chain from gasket-ensurfacturing issues there are several preventative actions in place. These sections include: hair nets, protective amocks, and cleaning procedures for the equipment. 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 cyticaler leak testion).

Kepten ™ Disphragms:

A pressure awitch disphragm must seed the pressure davity, 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 TM is this design consists of a 0.003-inch thick polyimide film luminated on both sides with a 0.001-inch thick PEP Telion film. The polymide film has the ability to stretch without breaking (strains on the order of 70% before rupture), and the Telion film is compatible with a wide range of chemicals. As a result of this layered construction, Kapton TM was aslacted for its merchanical and chemical proporties. Moreover, TI has been using this material in pressure switch applications since 1981. In this application three stacked Kapton TM layers were used as the displaying scal.

To confirm the correct material was selected for this application we refer to the DPMBA. Specifically, this document identifies beret 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 exposure, and stress levels all affect the life expectancy of the Kapton TM displacages, additional testing is commonly done. A typical impulse test would include pressure cycles to 1450 pst, 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 very, but typically is around 1 million cycles which is well above the 500,000 cycles specified in the Fool specification (ES-F2VC-9F924-AA). (See Life Testing to Fallure (PS/94/14))

In addition, continued conformance testing has been ongoing for many years at TL. The purpose of this testing is to confirm that the components, naterials, 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 assumides such as pinched Kapton TM can affect the Kapton TM displanges real performence (see PFMEA Document # 503831). Material/chemical compatibility and strengthrain constnatations can also cause the Kapton TM displanges in fatigue. See DFMEA Document number 503796. In order to verify the correct during 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™ futigue occurs well over 0.5 million full-scale pressure cycles to our history of simulated and accelerated life testing. When Kapton™ futigue does occur, there are visual signs of de-

lamination, cracking, and embrittement. The Kapton TM disphragms 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 convertor button. See flacturace Test (report # PS/98/53). Again, disphragm life depends on stress levels (proteste traggelands applied), temperature, and chemical exposure. The above mentioned tests were conducted in TI's Life Test (so with relatively controlled conditions.

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

- () 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 weter enters the connector it will "age" the Kapton TM displictions and make them appear as though they have reached the end of life. This condition leaves visual clues. Classic signs of chemical stack of the Kapton TM (actude de-lamination of the Toflon from the base polymide base, embrittlement, and cracking of the base polymer. See Endurance Test (report PS/94/33).

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

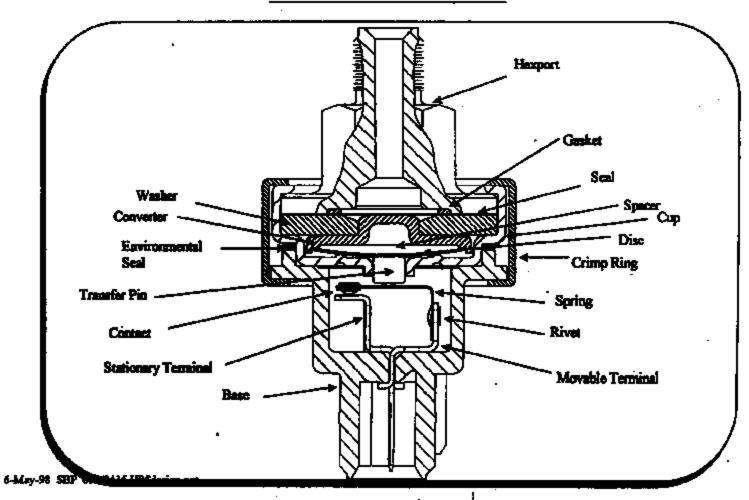
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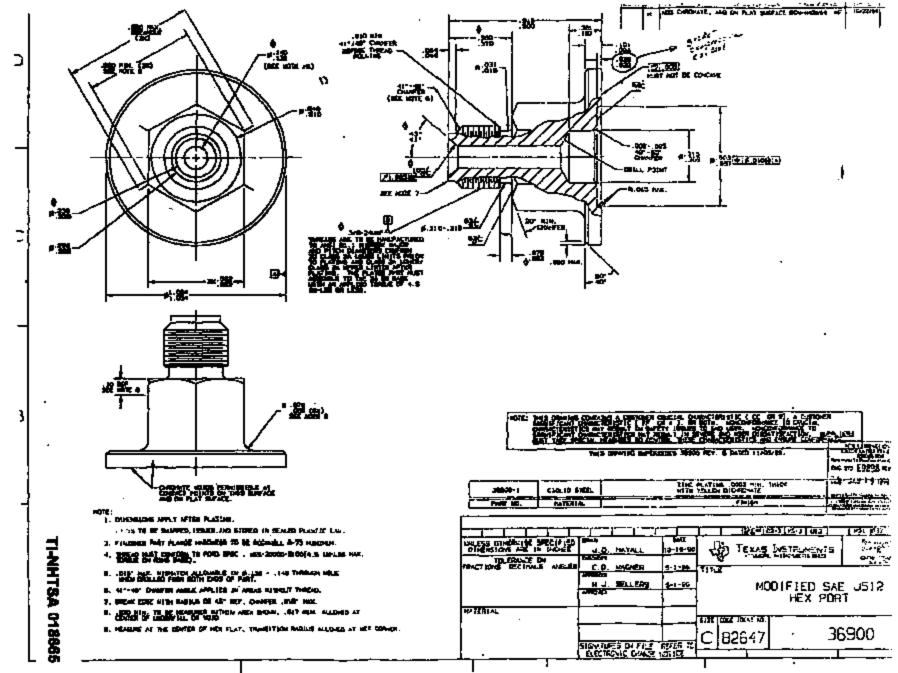
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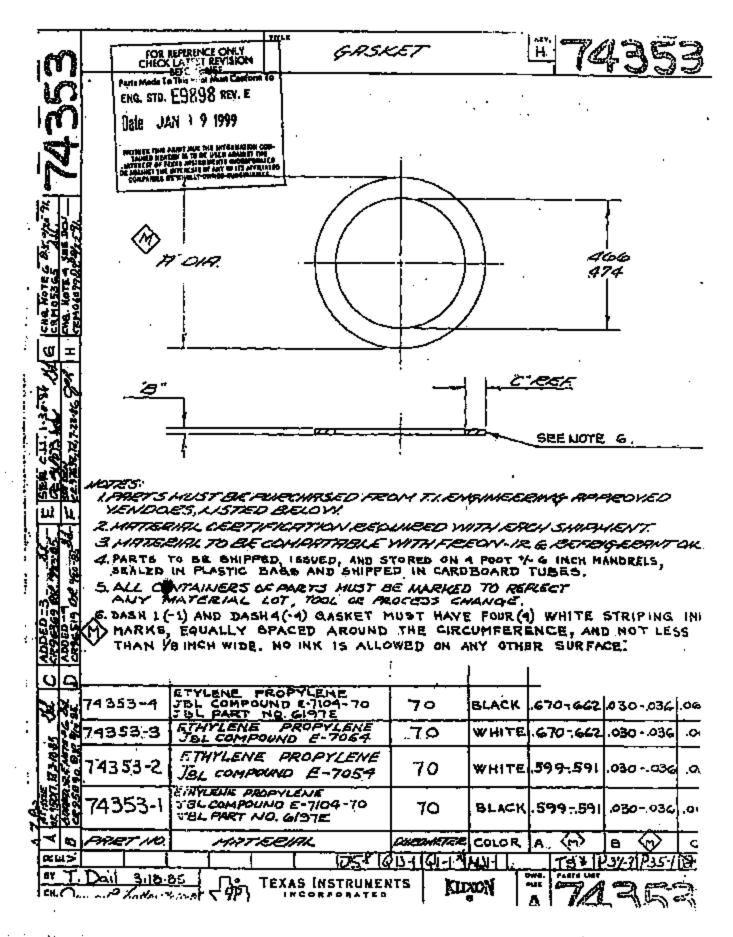
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Pressure Switch Cross Section







POTENTIAL PAULINE MODE AND EFFECTS ANALYSIS (DEMON FREA)

Document Number Revision Date 4-Nov-96

Page 1

Cost Team Design Engineering, Magnetoring Engineering, Manufacturing, Costity

Design Responsibility Pressure Switch Group

Original (Spitial) (Late 20-Dec-83

Model Yestfaj Webblie(s) <u>Verlous</u>

Prepared By C. Westner

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TI-NHTSA 018667

POTENTIAL PARLING MODEL AND EFFECTS ANALYSIS (DESIGN PINEA) Comment Number 603796
Perinten Level D
Revision State 4-Nov-66

Page 2

Cosign Responsibility <u>Proposum Switch Group</u>

Original (Initial) Data 20-Oco-85

Madel Year(s) Visibility Various

Key Dule 1663

Prepared By <u>C. Wagner</u>

Core Team Dealer Englassing, Manufacture Englassing, Manufacture, Carolin

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POTENTIAL FAILURE MODE AND SPYCETS AMALYSIS (DEMON PAEA)

Dosument Humber 609784

Revision Level G

Revision Date 4-95x-95

Page 1

X Component Pressure Sellicia

Donlar Responsibility <u>Респеция выбы</u> <u>Group</u>

Original (Initial) Data 20-Dec/93

Model Yearls)/Vehicle(4) <u>Various</u> Key Sate 1885

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Prepared By <u>C. Wegner</u>

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PS/98/14

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

Author:

Di Ha, Design Engineering

Date:

April 8, 1998 PS/98/14

Ригрозе

Report No.:

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

Sample Description

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

Actuation Pressure: 200-300 palg Release Pressure: 40 paig min.

Procedure

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

Endurance testing was run to the following specification:

Temperature: 135C Frequency: 2Hz Total Cycles: 500,000 Electrical Load:

> 0-475,000 cycles: 13V +/- 1V, trace current 475,001-500,000 cycles: 13 +/- 1V, 750 +/- 50 mA

Operating Pressures:

Pressure (Low): 0-40prig Pressure (High): 1400-1500 prig

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

Results

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

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

Conclusion

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

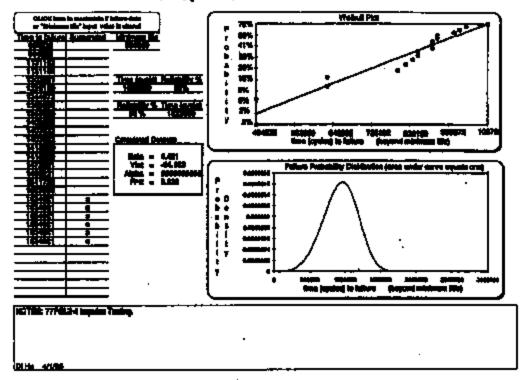
Raw Data

	Fre-Test Dat	4		Pest SOLK					
	Actuation	Rolemo	DUT	Actuation	Refease	DW	 -₽	Áct	# Cycles to
Device	(palg)	(پياسم)	(polg)	(polg)	(pale)	(palg)	(LifeTest)	% DetA	Fallure
1	255.6	LEG.S	68.8	245.8	182.0	63.4	0.18	-3.6	**
2	253.6	LB4.1	49 .5	243.5	178.5	65.0	0.15	4.0	1,587,659
3	248.3	187.3	€L.O	243.5	163.4	59.9	0.13	-1.9	**
4	249.5	182-0	47.5	240.2	177.6	62.6	0.16	-3.7	**
5	241.1	175.4	65.7	212.7	172.4	60.3	0.12	-3.5	1,403,522
6	248.8	183.1	65.7	244.D	L86.0	\$ 1.0	0.09	-1.9	1,302,691
7	255.8	L87.9	67.9	238.4	L79.3	5 9 .1	0.12	-6.8	1,344,673
8	247.5	185.9	6L4	246.5	184.9	61.6	0.13	-0.4	1,403,522
9	245.7	176-1	67.6	233.0	174.8	54.2	Oι	-5.2	1,403,522
, IO	249.9	184.1	65.4	240.4	179.3	61.1	0.13	-3.8	1,131,102
Ĩ IL	264.1	197.2	66.9	252.€	193.7	59.1	Δl	43	994,232
12	255.1	187.5	67.6	247.9	183.3	64.6	0.32	-2.8	. ••
13	248.2	186.2	62.0	239.0	176.2	62.4	0.3	-3.7	1,488,321
14	261.4	129.6	71.8	250.3	191.5	58.6	0.07	42	994,232
15	250.4	0.881	62.4	240.1	141.2	\$8.9	0.09	-4.1	1,131,102
16	255.1	183.4	71.7	240.7	176.7	64.0	031	-5.6	1,359,659
27	244.2	176.2	61.0	234.7	176.2	SIL5	0.11	-3.9	1,418,250
12	251.5	187.5	63.7	240.L	143.1	\$7.0	2.37	-4,5	1,472,621
19	254.0	192.2	61.2	247. L	181.1	65.0	3.48	-2.7	1,511,726
20	256.8	190.7	66.1	252.2	149.6	62.6	0.3	-1.2	1,41 0,2 50
21	251.7	182.3	69.4	241.6	142.4	59.2	60.0	-4.0	1,325,190
21	250.6	183.6	66.5	239.7	1819	56.8	Œ13	4.2	1,359,659
23	249.1	180.4	68.7	246.6	182.4	64.2	0.22	-1.0	••
24	257.4	184.1	73.3	246.6	183.4	63.2	0.24	-4.2	••
Average	251.9	125.2	66.7	242.6	182.0	40.6	0.4	-3.6	**
Steme	53	4.9	3.4	5.4	4.9	3.0	a	1.4	

 $^{^{**}}$ Indicates that these devices were impulse tested to 1,634,921 cycles without failures. The test was stopped with 1,634,921 cycles on 47/98.

Weibuil Analysis

2 and 8 parameter WEIBULL ANALYSIS



Xonument 6: \$0968*

POTENTIAL FAILLIRE MODE AND EFFECTS ANALYSIS (PROCESS FMEA)

TRICESS: AUTOMATED SENSOR ASSESSLY

PROCESS RESPONSIBILITY: WATT SELLERGIANN REA

400EL YEARYSMANICLE(ST; 52/57/77/60/67PS

DEGRECALALIANTS RESPONSED ITY: KEITH ROBELLO / JAM WATT / PEGGY ALLEN

PREPARED BY: MATT SELLERS

FIMEA DATE (ORIG.) 420000 FIMEA REVISION, B

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PROCESS: AUTOMATED SENSOR ASSEMBLY

PROCESS RESPONSIBILITY: MATT SELLERSWAN REA

400ELYEAR(B)/VEHICLE(S): 38/37/7/40/4798

DEGNOUNLANTS RESPONSIBILITY: NOTH FROSTELLO / JAN WATT / PEDSY ALLEN

PAGEA DATE (CRIS.) 42946 PAGEA PREVISION: B

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PROCESS: AUTOMATED SENSOR ASSEMBLY

PROCESS RESPONSIBILITY: MATT SELLERS/WIN REA

ACCIEL YEARINANDHICLE(8): \$867/7786467PS

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DEGNOUNLANFO PERFENNENTLTY: KEITH ROBBELLO / JIM WATT / PERGY ALLEN

FMEA DATE (OFIG.) 488/06 FMEA REVISION: B

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PROCESS: AUTOMATED SERISOR ASSESSELY

PROCESS ACEPONEBLITY: MATT SELLERS/ANN REA

MODEL YEAR(B)/VEHICLE(B); \$957/77/90/97PB

DECINICIALISTS RESPONSIBILITY: KETH ROBELLO / JAK WATT / PERGY ALLEN

PMEA DATE (ORKS.) 4/21/09 PMEA REVISION: 8

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PROCESS: AUTOMATED & ENGLAR ASSESSELY

PROCEIS RESPONSELITY: MATT SELLERSANN REA

MODEL YEAR(S)/VEHICLE(S): \$2/\$7/77/00/\$7FS

DEGNICUALAGE PERFORMENTY: KEITH POSIELO/JM WATT/PEGGY ALLEN

FMEA DATE (ORIG.) 4/28/06 FMEA REVISION: 8

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PROCESS: AUTOMATED PRIVACIN ASSEMBLY

PROCESS RESPONDEUTY: MATT SELLEAGONN REA

ACORL YEAR(S)/VEHICLE(S): 52/57/7/80/97PS

DSGN/QUALANTS (TESFONOBILITY: KETH FIORIELLO / JM WATT / PESGY ALLEN

PIMEA DATTÉ (ORIG.) 4/20/06 PIMEA PRÉVISION: B

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*ROCESS: ALTOMATED SENSOR ASSISMELY
ACCIEL YEAR(SAMERICLESS): SINSTITUTIONS/PS

PROCESS RESPONSIBILITY: MATT BELLERBANN REA

DEGNIQUALAGED RESPONSEMENTY: KEITH ROSIELLO / JIM WATT / PEDGY ALLEN $^{\prime}$

FMEA DATE (ORIG.) 422008 FMEA REVISION: 8

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PROCESS: AUTOMATED SENSOR ARRESTULY

PROCESS RESPONSIBILITY: MATT SELLERGIANNI REA

400GL YEAR(SIAVEHOLE(S): SMETTTHANETPE

DEGREQUELANTO PERPONERILITY: KEITH ROBBLEO / JAN WATT / PERRY ALLEN

FMEA DATE (ORIO.) 4/20/05 FMEA REVISION: B

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PROCESIS: ALITOMATED SENSOR ASSEMBLY

PROCESS RESPONSIBILITY: MATT SQLUENGAMM REA

ACOSI, YGARQIDAGHICLE(S): 82/87/77/90/97P8

DSGN/QUALAKFO PEOPCHARMLITY: RETTY MOSIELLO / JEZ WATT / PEOSY ALLEN

FMEA DATE (OPIG.) 4/29/96 FMEA PEVISION: 8

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PROCESS: AUTOMATED SENSOR ASSEMBLY

PROCESS RESPONSIBILITY: MATT SELLETSWAN REA

ACCEL YEAR(S) A ENCLE(S): \$957/77/MAR7PG

DEGRACIONALAIRO RESPONSIBILITY: KEITH PORKELLO / JIM WATT / PEGGY ALLEN

FINEA DATE (OFIG.) 429/00 FINEA REVISION: 8

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PROCESS: AUTOMATED SENSOR ASSEMBLY

PROCESS RESPONSIBILITY: MATT SELLERSWAM REA

ACCEL YEAR(BOVEHICLE)#4: SHITITIMORITES

DOGNICUALANFO RESPONSIBILITY: KEETH ROSIBLEO / MM WATT / PEGGY ALLIEN

RMEA CATE (OPIG) 429/96 RMEA REVISION: B

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1.0 GENERAL

1.1 Customer: Ford Motor Company

1.2 TI Part Number: 77PSL2-1

1.3 Customer Part Number: (delta) F2VC-9F924-A8

1.4 Specifications: Ford Engineering Specification number

(delta) ES-F2VC9F924-AA

1.5 Date Of Completion; 97/03/15

1.6 Quantity Of Units Tested: 64

1.7 Disposition Of Tested Units:

Devices tested were retained by Texas Instruments.

1.8 Ti test series number: #1 through #6 (Vibration)

#7 through #12 (Vacuum) #13 through #18 (Temp Cycling) #19 through #54 (Fluid Resistance)

2.0 TEST PROCEDURES AND RESULTS

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

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

2.1 Calibration

Procedure: Calibration was checked at room temperature (16 degrees C to 35 degrees C) using emblent air as the pressure medium. Calibration settings, as specified on the part drawing, and extuation (electrical contacts opening) at 90 - 160 psig, , and release (contacts reclosing) at 20 psig minimum. All tests were accomplished after the third cycle with the switch conducting 700 - 800 milliamps at 12.0 - 14.0 volts DC. The rate of pressure change (ramp-up, ramp down) was accomplished at 60 psiglesc.

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

TI-NHTSA 018685

		FAGE OF 8
TESTED BY: E. Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED	DEVICE: 77PSL2-1
APPROVED BY: Jkn Wett, ORA	MATERIALS & CONTROLS GROUP	DOC. 1 PS 97-14
DATE: April 04, 1997	ATTLEBORO, MASSACHUSETTS 02/03	PILE NAME: IP TESTING

2.2 Voltage Drop

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

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

2.3 Current Leakage

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

Between the switch leads with contacts open.

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

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

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

2.4 Proof

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

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

TI-NHT8A 018686

CUSTOMER: Ford Motor Co.	TEST: IN-PROCESS IP-2 TEST SUMMARY	PAGE 2 OF 8
TESTED BY: E. Rose/ English	TEXAS INSTRUMENTS INCORPORATED	CIEVICE: 77PSL2-1
APPROVED BY: Jim Walt, CRA		00C.1 PS 97-14
DATE: April 04, 1907	ATTLEBORO, MASSACHUSETTS 02703	FILE MANE: IP TESTING

2.5 Vibration

Devices tested: TI #1 through #6.

Equipment used: Vibration table, Ling, model A395 with Hewlett-Peckerd model 5427 controls. Air tank with 350 psig minimum pressurized Nitrogen used to actuate devices with at least 1,1 times maximum actuation specification on part drawing; 300 psig x 1.1 = 330 psi minimum. Switches were mounted in the test port using the currently released electrical connector before the start of the test. Switches were vibrated in all 3 planes with electrical continuity monitored during the entire test, in ambient air. Internal pressure was maintained at zero Kpa G when the switch was in the closed position, and 1.1 times max actuation pressure shown on the print when the switch was in the open position. The switches were vibrated at 1,6mm displacement (peak to peak) while varying the frequency uniformly from 5 to 50 to 5 Hz over a 5 minute period, in alternate one-hour periods in the open and closed positions for a total of 8 hours in each plane, for a total test time of 24 hours.

Calibration Pre-test. Results: The average actuation was 133.6 psig, and the standard deviation was 3.3. All values were well within the specification. The average release was 56.7 psig, and the standard deviation was 7.4. All values were well within the 20 psig minimum specification.

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

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

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

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

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

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

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

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

TI-NHTSA 018687

CUSTOMER: Pord Motor Co.	TEST: EN-PROCESS IP-2 TEST GUIDNARY	PAGE 3 OF 5
TESTED BY: E. Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED	DEVICE: 77PSL2-1
APPROVED BY: Jim Wett, CIRA	MATERIALE & CONTROLS GROUP	DOC. : PS 97-14
DATE: April 04, 1997	ATTLEBORO, MASSACHUSETTS CERUS	FILE MANE: IP TESTING

2.6 Vacuum

Devices tested: Ti #7 through #12,-

Equipment used: Kinney vacuum pump. Sensotec pressure transducer, serial no. 198033 Model Tile. 727-02, range 0-25 pala calibrated quarterly, with Fluke model 80208 Digital Multimeter readout, celibrated quarterly.

Switches were mounted in the test at room temperature, ambient air as the pressure medium. Switches were subjected to 5 cycles of vacuum from atmosphic pressure (760mm Hg) to an absolute pressure of 8-6 mm Hg, maintaining vacuum for 60 seconds.

Note: 3mm Hg = 0.058 psl = 0.400KPe: 6mm Hg = 0.116 psl = 0.800kpe

Calibration Pre-test. Results: The average actuation was 126.5 palg, and the standard deviation was 880. All values were well within the specification. The average release was 82.7 palg, and the standard deviation was 4.6. All values were well within the 20 palg minimum specification.

Calibration Post-test. Results: The average actuation was 125.2 paig, and the standard deviation was 4.5. All values were well within the specification. The average release was 65.3, and the standard deviation was 3.4. All values were well within the 20 paig minimum specification.

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

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

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

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

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

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

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

CUSTOMER: Ford Motor Co.	TEST: 01-PROCESS IF-4 TEST SUBMARY	PAGE 4 OF 8
TESTED BY: E. Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED	DEVICE: 77PSL2-1
APPROVED BY: Jim Watt, CIRA		DOG. 1 PS 97-14
GATE: April 04, 1997	ATTI, EBORO, MASSACHUSETTS 02769	FILE NAME: IP TESTING

2.7 Temperature Cycle

Devices tested: Ti #13 through #18.

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

Calibration Pre-test. Results: The average actuation was 129.7 psig, and the standard deviation was 4.3. All values were well within the specification. The average release was 63.8 psig, and the standard deviation was 4.3. All values were well within the 20 psig minimum specification.

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

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

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

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

Current Leakage Post-lest Results. Statistics not exiculated. All values were well below the specification of 100 microsmos.

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

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

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

CUSTOMER: Ford Motor Co.	TRET: HEPROGESS P-2 TRET SUMMARY	PAGE 5 OF 8
TESTED BY: E. Rose/ Eng Leb	TEXAS INSTRUMENTS INCORPORATED	DEVICE: 77PSL2-1
APPROVED BY: Jim Wett, QRA		000.: PS 97-14
DATE: April 04, 1997	ATTLEBORO, MASSACHUSETTS 02703	FILE HAME: P TESTING

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

Devices tested: Ti #19 through #54.

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

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

impulse:

#18 through 30

Terminal Strength:

#31 through 42

Humidity:

Carlotte Broken

#43 through 48

Salt Spray:

#49 through 54

2.8.1 Impulse (#19 through 30)

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

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

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

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

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

Current Leakage Post-lest Regults. Statistics not calculated. All values were well below the specification of 100 microstype.

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

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

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

CUSTOMBR: Ford Motor Co.	TEST: M-PROCESS IF-S TEST BUILDARY	PAGE & OF 8
TRATED BY: E. Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED	DEVICE: 77PSL2-1
APPROVID BY: JIM WILL, CIRA	MATERIALI & CONTROLS GROUP	000: PS 97-14
DATE: April 04, 1997	ATTLEBORO, MASSACHUSETTS 02703	FILE MANGE IF TRETTING

2.8.2 Terminal Strength (#31 through 42)

Calibration Pre-test Results: The average actuation was 129.9 psig, and the standard deviation was 5.2. All values were well within the specification. The average release was 61.7 psig, and the standard deviation was 5.8 All values were well within the 20 psig minimum specification.

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

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

Vottage Drop Post-test Results: Statistics not calculated . All values were well within the specification of 200 millivoits meximum.

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

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

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

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

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

2.8.3 Humidity (#43 through 48)

Calibration Pre-test Results: The average actuation was 132 paig, and the standard deviation was 3.9. All values were well within the specification. The everage release was 61.4 paig, and the "standard deviation was 1.5. All values were well within the 20 paig minimum specification.

Calibration Post-teet Regular: The average actuation was 141.4 pelg, and the standard deviation was 5.6. All values were well within the specification. The average release was 83.6, and the standard deviation was 5.1. All values were well within the 20 pelg minimum specification.

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

TENHTSA 018691

CUSTOMER Ford Motor Co.	TRET: IN-PROCESS IP-2 TEST SUBSIANTY	PAGE 7 OF 8
TESTED BY: & Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED	DEWICE: 77P8L2-1
APPROVED BY: Jim Well, ORA	MATERIALIS & CONTROLS GROUP	000.1 PS 97- 14
DATE: April 04, 1997	ATTLEBORO, MARSACHUSETTS 02703	PELE NAME: IF TEXTING

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

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

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

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

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

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

2.8.4 Salt Spray (#49 through 64)

Calibration Pre-test. Results: The everage actuation was 131.7 psig, and the standard deviation was 3.8. All values were well within the specification. The average release was 57.9 psig, and the standard deviation was 5.3. All values were well within the 20 psig minimum specification.

Calibration Post-test Results: The average actuation was 135.9 palg, and the standard deviation was 8,6. All values were well within the specification. The average release was 58.0, and the standard deviation was 5.9. All values were well within the 20 palg minimum specification.

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

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

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

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

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

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

CUSTOMER: Ford Motor Co.	TENT: HI-PROCESS IN-2 TENT BUILDINGS	PAGE 5 OF 8
TESTIED SY: E. Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED	
APPROVED BY: Jim Walt, CIRA		00G.: P8 97-14
OATE: April 04, 1997	ATTLEBORO, MASSACHUSETTS 02705	FILE NAME: IP TESTING

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

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

GUSTOMER: Ford Motor Co.	TRETS OFFRICEDO IF-2 TEST SURSIARY	PAGE 9 OF 8
TESTED BY: E. Rose/ Eng Lab	TEXAS INSTRUMENTS INCORPORATED	DEVICE 77PSL2-1
APPROVED BY: Jim Well, QRA	MATERIALS & CONTROLS GROUP	DOC. : PS 97-14
OATE: April 04, 1997	ATTLEBORO, MARSACHUSETTS 02799: No.	PILE HAME: IP TESTING

CUSTOMER: Ford Motor Co.	TEST: IN-PROCESS #-2 YEST SUMMARY	PAGE 10 OF 8
TESTED BY: E. Rose' Eng Lab	TEXAS INSTRUMENTS INCORPORATED	DEVICE: 77PSL2-1
APPROVED BY: Jim Wett, QRA	MATERIALS & CONTROLS GROUP	DOC. : PB 97-14
DATE: April 04, 1997	ATTLEBORO, MASSACHUSETTS 02783	FILE MAKE: IP TESTING

CC: Toe Chimberess

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Tike Cemattis

Info Dibonesico

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Charlia Doug'to .Steve Mrjor .Cary Soyder .dim Wott PROCE TOPES TOPES

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aènt

5.0 / 14415.cm 1 Information on 7788L2-1 Page Can ISA Failures Termony agency against a famous extra agent agent against a company against a failures against a failures agains

Jan 1 Pen by whome convergetion, the following aperage attends to answer the questions posed by Source Magnett (Supv. Peca Con Souls grap,) with factual dotail. I caution you to use this wisely, is this is decidedly consitive information.

1' premise the problem is made detail, including a description of the actual Failure mode.

Answers This is limited to Pass Car product which is crimped on the automatic assembly equipment. Light Truck product does not have this problem regardless of assembly technique, nor dost Pass Car product which is princed on the manual equipment. The problem is runtured Kapton disphragms during Impulse tasting at Ford spot princed satural conditions: Five brake applications per mile for thought satural conditions: Five brake applications per mile for thought of the pressure of 1450 psi at a fluid temp. of 185 C. Quetured disphragms result in brake-fluid Imakage, so the disphragm is the fundamental design element (along with the gasket) which contains and separated the brake fluid from the pressurersensing the seconds. The rupture occurs in the area which experiences maximum ratio. The type and Incetion of the rupture we are seeing is vary real for disphragms cycled to the end of their life. The problem why he viewed as disphragms which have a characteristic life which falls short of Ford's conservative specification.

2) Specificall, how meny cycles to failure ?

process. Eight of 12 virgin devices originally undergoing SB pasting falled due to leakage at the following points: one at 200K; at 200K; at 200K, at 200K, four at 388K, and four surviving removed from test at 388K. The other 12 devices, which appreciatly returned from the Fluid Resistance test, were placed under quarantine, where they remain.

(Trying to Keep Things in Perseptive: Weibull failure analysis of this data shows that Ford's specified reliability and probability (PFO+.90, see EB, page 3) gives a minimum value of 2:4K cycles, which seems logical in light of the first failure occuring at 270K. 2:4K is only 43% of the spec, and is meaningless to Ford regardless because it is based on failure testing, whereas the opec agrices success testing throughout: "For PV... all samples tested wick pass" (ES, page 12, section IV. A.) It is, nonetheless, two octronely hard brake applications per site for 100,000-plus miles."

5' Why is this taggering ?

TI-NHTSA 018695

summer We are still inventigating a rumber of hypotheses, and at this point none has clearly emerged as most probable. These includes group porsonators (prescuredities relationship in air eviloders) possible geometrical differences in criss diag. slight risable definesation of internal comparato due to crisp which is undetectable on disappeabled devices, had not of Kapton, Tempe to Montan or its Testion layer on the outcost; equipment, step to page

present with high priority.

51 White Japanian Estable communities actions?

Admint: Divid pressure-sensing subsectablies with minual trine. This is the configuration we incular tested aucomassibly inthit the t Fluid Resistance) for them 198.

5) What one our long-torm corrective estions and place?

Antwarr We must first complete the analysis of the rause of the smolles; and convince ourselves that we have a thorough underetarding by damonstrating that we can turn the problem on and off. At this point, whatever process controls, SPC checks, atc. that are needed to ensure permanency will be determined and applicabilities. Then we will be ready to rebuild parts on the sufficiation equipment which will undergo the fluid Resistance text and the Impulse text per the specification, and submit these results as an addendum to the ES test report. The timetable for these actions to unfortunately open-ended, because of the ensure of time required to "complete" (cycle to death) any given text int and we've still got a few to go.

31 Missellaneous additional thoughts:

no ordered to boild up to the stated 90 days.

b Mack Schollor has told us that Brucz Prose must write an "elect" will be good for a 90-day extension; we must re-ISR that automated crimp within 90 days. Idos, this info comes from your #88 1053402.) Ford cannot dictate our production process. It is our prerogative to choose our process and ISR it as such. At this paint we have done exactly that - we've chosen the manual sonsor has, and submitted the ISR for it (with the slight deviation parding Fluid Resistance). Of course, from a profit etandpoint it is to our own best interests to get the automatic sensor assumption on-line and ISR/ed ABAP, but as far as I can tell they have

Samuel Control of the

 3C cycles a sampling of devices from every lot, to the full 500%, which ensures that once we get our corrective actions in place that we'll be able to hold the gains.

Regarde. Stave D

TLNHTSA 018698

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Dave Czarn	ZAŔN	CC: Tom Burke	MFPC
Jeff DiDomenico	ELB	Tom Charbone	eau TC
Charlie Douglas	CPPC ·	Mike DeMatt:	a PCGA
Stan Hompl	5H2	Dick Bariep;	y MFPC
8eb Robichaud	RHRO	John Kourte:	sta MDES
Matt Sellers	PCME	Bill Sweet	PCME
		. Han Walth	9004

FR: Stave Offiler \$801

SU: Early Kapton Failures on AMI#2 Sensors

As most of you are aware, Production Validation of the 7798L2-1 has been significantly impacted by failure during the Impulse test. This test runs 500K pressure cycles from 0 to 1450 pei at 2 Hz. in 121 deg. C ambient. The failure mode was leakage, caused by ruptured Kapton, beginning at roughly 270K cycles. Sensors for this test were built on AMI#2 on 91-07-19.

We have placed the highest priority on solving this problem. Several test lots have been created to test a number of possible causes. These test lots, typically 5 devices per lot, have been cycled to failure and Weibull techniques employed. Results are presented as follows:

Sprted by: Thata

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Sorted by: Beta

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1 910828	: 3.5	1469	97.73	27713	IAMI In	is ! 1300 i

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y \$...

In Nejbuil terminology, Beta is the slope of the curve plotting cumulative percentage of failures versus # cycles, and Theta is the characteristic life, the number of cycles at which 63.2% of the devices have failed. A large Beta number means all failures occurring a relatively short tingspen, which is good because relatively accurate life or of the securate life or of the securate life or of the securate life.

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the percentage of failures at any given number of cycles is possible.

Scrutinizing the data above, sorted by Theta, shows devices built for Validation (both 77PSL2-1 and 77PSL2-3) on 91-07-19 are at the very bottom of the list. However, the attempt to reproduce the ray worst lot on 91-08-28 produced drastically different results aird best). It has come to our attention that certain upgrades to AMI#2 to increase speed were underway in the July timeframe. While more details are needed, it is possible that something related to these modifications may be the root cause of the observed failures from 91-07-19.

Results sorted by Beta are also presented above. The only interesting point to be made here is that the larger Seta's seem to correlate rather well with the presence of AMI pre-crise.

Other tools and techniques are also being seployed to help solve this problem, including: cross-sectioning of devices to expose any issues related to internal geometries; pressure-sentitive film which helps show location of peak forces applied during crimp, stc. Planes contact se for more details.

Regards, Steve 'Q.

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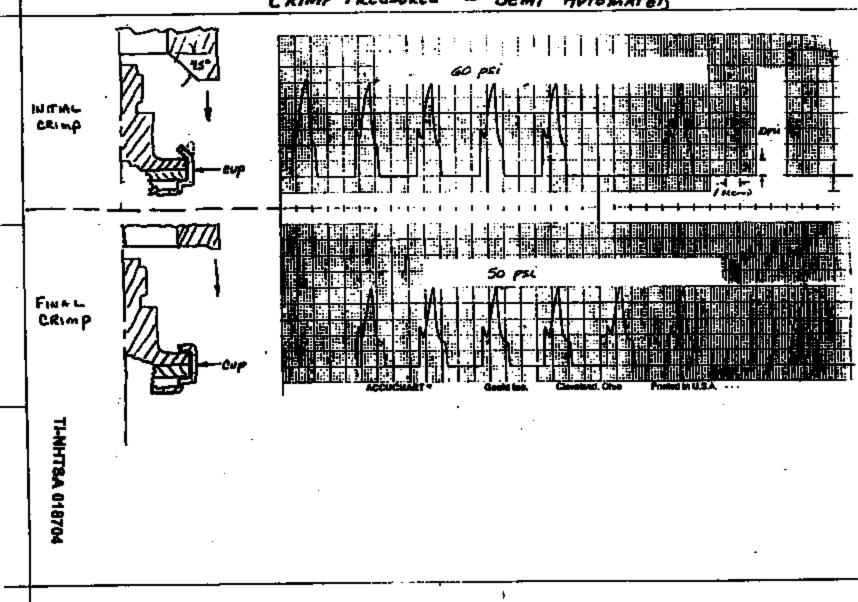
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Epatein, Sally

From:

Sullivan, Mertha (m-sullivan@email.mo.ti.com)

2 one:

Thursday, February 11, 1999 11:11 AM

Te: Ce: Buringheuse, Bleven McGuirk, Andy; Rahman, Aziz; Baumann, Russ

Subject:

Deterine Bhow

Attorney-client privileged communication

NEW YORK (Reuters) - Internal Ford documents show the automaker has known for years about potential wiring problems in its cruise control systems that one methanic believed may have caused some of its cars to accelerate suddanly, NBC News said on Tuesday. But the automaker said no compaction between cruise control and sudden acceleration has ever been proved, and blasted NBC.

Andy has the video of this ever here of this show. Points to shorts in the cruise control module. I wonder if this could cause current to pees through our switch after key of (?

Epatein, Sally

From: Sent: To: ČC:

McQuirk, Andy [s-maguirk@emsH.mc.ti.com] Thursday, February 11, 1998 12:05 PM Beringhause, Sleven; Bullivan, Martia Rahman, Aziz; 'Baumann, Ruas'

Subject

RE: Detailne Show

Attorney-client privileged communication

very good point.

if I understood the article, the demonstrations showed that the cruise system was always 'hot' even with cruise control switch off....and that a short between either of two different specific wires of the harness of the cruise control electrical 'module' wire board to electrical ground could cause the cruise system to engage to wide-open-throttle position.

so, assume we see these speak circuits and what might happen in our switch application ?

AUTOMOTIVE SENSORS AND CONTROLS ORA MANGER 34 FOREST ST N/S 23-05

ATTLEBORG, MA 02703 TEL : (508) 236-3080 FAX : (508) 236-3745

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

Front Sulliven, Marcha

Sent: Thursday, February 11, 1999 12:11 PM

Toı Beringhause, Steven

McGuirk, Andys Rahman, Azis; Beumann, Russ et: Dateline Show Cer

Subject:

Attorney-client privileged communication

NEW YORK (Rauters) - Internal Ford documents show the automaker has known for years about potential wiring problems in its cruise control systems that one machanic believed may have caused some of its cars to accelerate suddenly, NBC News said on Tuesday. But the automaker said no connection between cruise control and sudden acceleration has ever been proved, and blested WBC.

Andy has the video of this over here of this show. Points to shorts in the cruise control module. I wonder if this could cause current to pass through our switch after key off?

Graveline, Dora

Fram:

McGuirk, Andy

Sent

Thursday, February 11, 1999 1:08 PM

To:

Rahman, Aziz; Baumann, Russ RE: 77PS Overview

Subject

Attorney-client privileged communication

same.... we want to go on record again that we have given further consideration and still believe that the use of a nominally open relay upstream would be a good way to receive the concern. We want to see us taken out of the always powered circuit as we think that would be a good basic design practice

AUTOMOTIVE COMPANIE AND CONTROLS OF A PRINCES

)4 FOREST 67 M/S 33-08 ATTLEMEND, MA 62763 THE : (808) 234-3680 FAR : (838) 834-3746

PAGE: (808) 467-2185 FIN 684-2044

From:

Rehmen, Aziz

Cont:

Thursday, February 11, 1989 12:51 PM

Tec

MoQuink, Andy

RE: 77PS Overview

If you are talking about the normally open raisy upstream of the switch, I streetly reviewed that with Fred on Day 1. Is the de-electric circuit you are talking about the same ruley approach, or something new?

From:

McGoirt, Andy Thursday, Policiany 11, 1888 11:09 AM Rahmon, Adiz

at RE: 77PS Overview

lots talk ASAP about delivery of a new letter about the switch de-electric circuit proposal we sent earlier autovaters agreed also carregis que sent earlier agreement of 194 33-49 and 134-99 are 1940 a

Rehmen, Astz

Thursday, February 11, 1998 11:02 AM in, Russ: Saringhouse, Sleves; McGuirk, Andy; Cogus, Bryss RE: 77PS Overview

وبعنصو

Teatl

Thanks for the info below. I have reviewed test report 86/14 with them and will review this into at the next apportune time. I will let you know if I need a hard copy.

Promi

Cague, Bryst

Page 1

Sent

Thursday, February 11, 1999 8:44 AM

Seattern, Remail: Stringhouse, Steven: Asternat, Asia: McGuirk, Anderso

77F8 Overness

Quya,

Here is the flatial draft. Ariz to deliver to the customer??

Please advise if I need to fax it to someon.

I am having copies of the oppendix made today.

Regarda,

Bry

Proprietary Information

7775 Overview 2/16/99

The 77PS revicts (builty has been specifically designed to openies in an automotive braining system. The pressure cavity of the switch has been designed to each leaks fixed pressure and transmit pressure and, disverses to the sensing portion of the switch over the life as defined in Ford ES -F2VC-67924-AA.

Background:

The presence servicy is composed of the hexport, gasket, sad three Kapton Te disphasems (called out as "seal". on attachment 1.). The purpose of the gradest is so provide a fluid tight send between the import and the disphrages. The purpose of the Kapons ¹² disphragers is in provide a flexible fluid tight send between the presents cavity and the internal components of the switch. Furthermore, the displangue are intended to magnity presents to the converser, and follow the movement of the convenier as presents in the positive envity (brake line prospers) is varied.

Two known ways that broke fluid may enter the contact cavity of TTs beaks revisible from the posspare cavity. are i. brake fluid epold leak past an impaired gasket seak, or il. brake fluid could leak through a demaged or 'worn out' Kapton ^{tol} disphragen.

The Gudut:

In order to counts a finial tight electromeric seel, there caust be ptoput compression of the electromer, sufficient backing of the electromer to prevent movement when pressure is applied, and finally the electromer must be compatible with the working finisi.

Fluid compatibility is typically established by the use of published tables. These cather his fluid groups and general contacts 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 gestest supplier. Eduyions Propylers is used in the 77PS and is standard throughout the industry for east gestest meetals. Ti has been using this custorial in lambs applications since 1988.

The global compression target was obtained from published industry standards (see Parker O-ring Handbook). In this particular design a notation qualest compression of 24%was selected. The dayth of the happert gland shows on attachment #2 controls this attribute. This gland dissension is cut into the happert at the time of measufacturing. As a result, this dissipping in combination with the pariest dimensions describes the first gastest compensation when the expendity is crimped together.

Leafly, the movement/position of the gashet when presence is applied asset be controlled and retrained. This

Page 2

design accomplishes this by selecting the outer diameter of the gusket to be slightly smaller than the inner diameter of the gusket gland of the steel plated hexport. Therefore, the hexport gland prevents the gusket from moving outwards when high pressure is applied to the switch.

The DFMEA outlines the types of rests 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 raping, and thermal cycle tests were performed to confirm that the gasten performed as immeded. The specific details of these tests and the repulse can be seen in the PV tag report numbers limed below: (copies can be provided on request).

Ιœ	t Bettit 2	TI Switch Part number	Year Tested
L	PS/91/41	77PSL2-3	1991
2.	PS/91/49	77PSL2-1	1991
3.	P3/92/49	77 PSL 3-L	1992
4,	PS/92/80	77PSL5-2	L992
5.	PS/92/82	77 PSL3 -1	1992
6.	PS/93/11	77PSL6-1	1993
7.	PS/93/44	77 PSL 4-1	1991

Gushri-manufacturing anomalies can be produced from out of space pashets, contamination of the gustet or scaling serfaces, and as a result, may cause leaks early in life. In order to protect IT's customer supply chain from pasket-manufacturing issues there are several preventive actions at place. These actions include: hair nets, protective smooth, and cleaning procedures for the equipment. TT's customer return rates indicated by past return and analysis records are less than 1 ppm (one leaket return in 5 years from master cylinder leak seeting).

Kaptes [™] Dispkrague:

A practice dwitch displaying must send the presture exvity, telement practice firetat to the converter, and follow the converter motion without significantly affecting the switch californion points. In addition, the displaying material mast be resistant to chemical attack by the brake fluid.

Bacterily, a single piece of Kapten [™] in this design consists of a 0.003-lack thick polyimide film laminated on both sides with a 0.003-lack thick PRP Telion film. The polyimide film has the shifty to extend without breaking (strates on the order of 70% before reptace), and the Telion film is computable with a wide range of chamicals. As a result of this layered construction, Kapten [™] was selected for its suscincial and chamical properties. Moreover, I'l has been using this material in practices switch applications since 1981. In this application stress marked Kapten [™] layers were used as the dispirages seel.

To conficul the excreet material was salected for this application we refer to the DFMEA. Specifically, this document identifies burst making, impulse testing, and thermal cycle testing. These tests confirmed the Kapton's ¹⁶ obliby to meet the specified requirements (PV reports hinted above). Since temperature, chemical supposes, and these hereit all affect the life expectatory of the Kapton. ^{CM} displayages, additional testing is requirement, and a special impulse test would include pressure cycles to 1430 psi, constant temperature of 135 C, and a cycle rate of 120 cycles/minute. Depending on the finance listed above, the life expectancy of a 11 brake pressure switch case vary, but typically is around 1 million cycles which in well above the 500,000 cycles specifical in the fixed specification (ES-P2VC-9P924-AA). (See Life Testing to Failure (PS/9V/14))

In addition, continued conformance testing has been capping for every years at TL. The purpose of this testing is to confirm that the components, materials, and processes have remained stable over time and that the design instant is continuedly being achieved. See standed IP reports which confirm 100% successful pusting of all tests defined in the specification.

Meanfacturing & PV association such as pincined Kapton [™] can affect the Kapton [™] displaying seal Peop 3

TLNHTSA 018712

performance (see PFMEA Document # 503831). Masuris/chemical compatibility and stress/strain, concentrations can also cause the Kapton ¹²⁸ disphragms to fatigue. See DFMEA Document number 503796. In order to verify the correct design parameters were extreted, the switch was subjected to a number of tests designed to annulate accelerated life testing of the application. See PS reports called our above. Life testing per the customer specification (ES-F2VC-9F924-AA) has shown acceptable performance.

Typically, Kapton ^{1M} farigue occurs well over 0.5 million fall-scale pressure cycles in our history of signalated and accelerated life testing. When Kapton ^{1M} farigue does occur, there are visual signs of de-lamination, cracking, and embrimenest. The Kapton ^{1M} disphragms break down first in the acess of highest stress and or strain. Typically, the first region to show break down is the curaminential area surrounding the conventure button. See Endarance Test (report * PS-98/53). Again, disphragm life depends on stress levels (pressure magnitude applied), samparance, and chemical exposure. The above mentioned tests were conducted in Ti's Life Test lab with relatively controlled conditions.

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

() By entering the connect cavity via the electrical connector

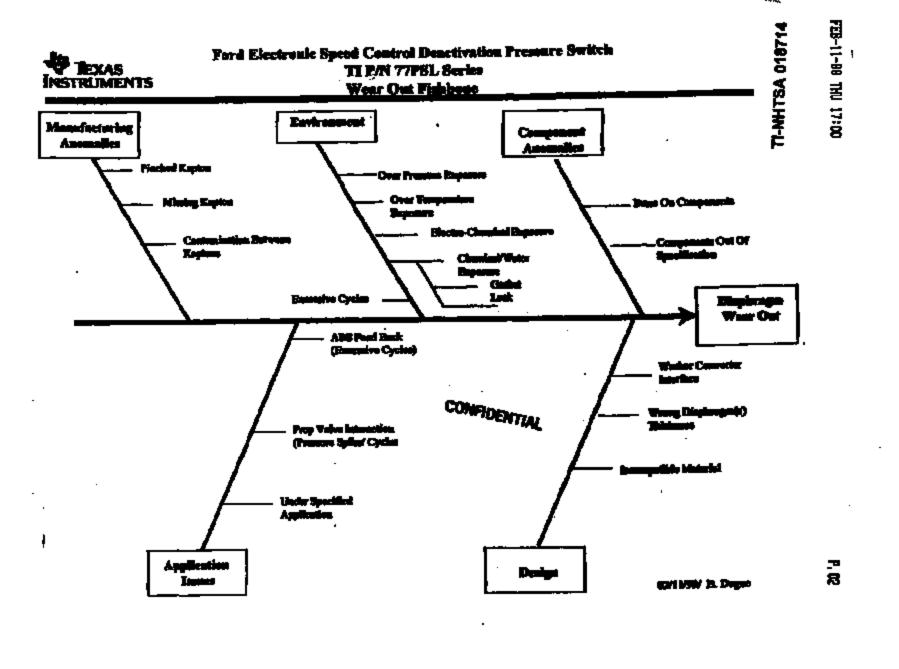
2) By being in solution in the brake fluid and entering the switch via the pressure port.

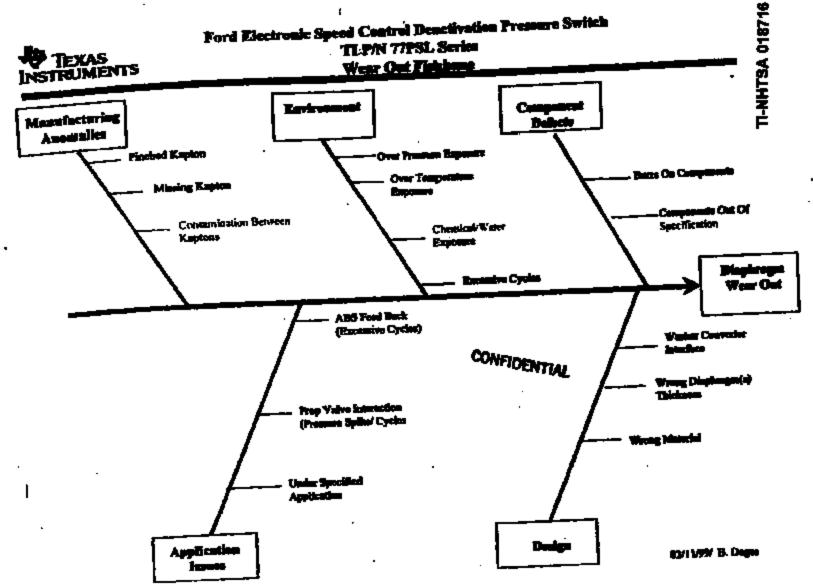
When wears enters the connector it will "age" the Kapton TM displangers and make them appear to though they have reached the end of life. This condition leaves visual class. Classic signs of chemical strack of the Kapton TM include de-larainestion of the Toflan from the base polymide base, ambrittlement, and crecking of the base polyment. See Endurance Test (report PS/9E/53).

Authored by Bryan Degree. Call Andy Meguirk or Beyon Degree with questions.

77PS Overview Appendix

- 1. Pressure Switch Cross Section
- 2. Hexport Print (T1 # 36996)
- 3. Gacket Print (TE# 74353)
- 4. DFMRA for Gusket and Kapson Seal
- 5. Life Test to Fellure Test Report (Welbull Analysis)
- 6. Customer Specification (ES-F2VC-9F924_AA)
- 7. PFMEA
- 1. IP Test Reports
- 9. Endurance Test Report





From: Sont: Ta: Bublect McGuirk, Andy (e-mcguirk@email.mc.tl.com) Thursday, February 11, 1999 12:08 PM talaman, Aziz; Baumann, Rusa

RE: 77PS Overview

Attorney-client privileged compunication

same.... We want to go on record again that we have given further consideration and still believe that the use of a pormally open relay upstream would be a good way to resolve the concern. We want to see us taken out of the always powered circuit as we think that would be a good basic design practice

AUTOMOTIVE SENSORS AND CONTROLS GRA 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

From: Rehman, Aziz

Thursday, February 11, 1999 12:51 PM Sent:

To: McQuiek, Andy

Aubject: RE: 77PS Overview

If you are talking about the normally open relay upstraum of the switch, I already seviewed that with Fred on Day 1. Is the de-electric circuit you are talking about the wame relay approach, or something new?

> From: McGuirk, Andy

Sent: Thursday, February 11, 1999 11:09 AM

To: Rahman, Aris

RE: 7799 Overview . Subject:

Importance: High

lets talk ASS about delivery of a new letter about the switch de-electric chronic proposal we don't earlier
AUTOMOTIVE SMEARS AND CONTROLS GRA MANGER
34 FOREST \$130/5 23-05
ATTLEBOOD, NA 02703

TEL : (508) 236-3000

FRE : (501) 236-3745

PAGE: (800) 467-3700 PIN 664-2044

from Rahman, Aziz

Sent: Thursday, February 11, 1999 11:02 AM

Tot Baumann, Russ; Beringhause, Steven; McGuick, Andy; Dague, Bryan

Subject: RE: 77PS Overview

Tour.

Thanks for the info below. I have reviewed test report 98/14 with them and

will review this info at the next opportune time. I will let you know if I need a hard сору.

> From: Dague, Bryan Thursday, Tabruary 11, 1999 0:46 AM To: Maumann, Russell; Beringhause, Steven; Rahman, Aziz; McGuirk, Andrew aubje**t**ti 7775 Overview

GUYE,

Here is the finial draft. Aziz to deliver to the customer??

Please advise if I need to fax it to somers.

I am having copies of the appendix made today.

Regards, Bzy

Proprietery Information

7709 Overview 2/10/99

TI's 77FS switch family has been specifically designed to operate in an autometive 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 hempost, gasket, and three Kapton TM disphragms (called out se "seal" on attachment 1.). The purpose of the gasket is to provide a fluid tight seal between the hemport and the disphragms. The purpose of the Kapton TM 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 seal, or ii. brake fuid could leak through a demaged or 'worm out' Kapton TM disphragm.

The General The Grante a fluid tight electroneric seek, there must be proper in steel to create a fluid tight electroneric seek, there must be proper compression of the electomer, sufficient backing of the electomer 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 natural 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 gastet supplier. Ethylene Propylene is used in the 77PS and is standard throughout the industry for seal quaket materials. TI has been using this material in brake applications since 1988.

The gasket compression target was obtained from published industry standards (see Ferker C-ring Rendbook). In this particular design a nominal gasket compression of 248was selected. The depth of the hemport 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 orimped together.

Lastly, the povement/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 lemment. Therefore, the hexport gland prevents the gasket from moving outwards when high plassure 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 ER-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. 28/91/48	779812-3	1991	
2. 98/91/49	77PSL2-1	1991	
3. P9/92/49	7795L3-1	1992	
4. PS/92/90	77PSL5-2	1992	
5. 99/92/82	772513-1	1992	•
d. PS/93/11	77 23 16-1	1993	
7. 28/93/44	777854-1	1993	

Gasket-manufacturing anomalies can be produced from out of spec gaskets, 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 lesues there are several preventative actions in place. These actions include: hair nets, protective emocks, and cleaning procedures for the equipment. TI's customer return rates indicated by past return and enalysis records are less than 1 ppm (one leaker return in 5 years from master cylinder leak testing).

Kapton TM Diaphragma:

A pressure switch disphrage must seel the pressure cavity, transmit pressure forces to the converter, and follow the converter motion without significantly affecting the switch calibration points. In addition, the disphrage material must be resistant to chamical attack by the brake fluid.

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

To confirm the correct material was selected for this application we refer to the DTMA. Specifically, this document identifies burst testing, impulse testing, and thermal cycle testing. These tests confirmed the Kapton's TM ability to meet the specified requirements (FV reports listed above). Since temperature, chemical exposure, and stress levels all affect the life expectancy of the Kapton TM disphragms, additional testing is commonly done. A typical impulse test would include pressure cycles to 1450 psi, donstant 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 Form apacification (ES-FZVC-9FS24-AA). (See Life Testing to Failure (PS/98/14))

In addition, continued conformance testing has been ongoing for many years at II. The purpose of this testing is to confirm that the domponents, 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 TM can effect the Kapton TM disphrage that performance (see PFMEA Document # 503831). Material/chemical compatibility and attess/strain concentrations can also cause the Kapton TM disphrages to farious. See DEMEA 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-97924-AA) has shown acceptable performance.

Typically, Kapton TM fatigum occurs well over 0.5 million full-scale pressure cycles in our history of simulated and accelerated life testing. When Mapton TM fatigue does occur, there ere visual signs of de-lamination, cracking, and embrittement. The Kapton TM diaphragms break down first in the areas of highest stress and or strain. Typically, the first region to show break down is the discumferential area surrounding the converter button. See Endurance Test (report # FS/98/53). Again, disphrage 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 addalarate 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 breke fluid and entering the switch tie the pressure port.

When water enters the connector it will "age" the Kapton TM disphragms and make them appear as though they have reached the and of life. This condition leaves visual clues. Classic signs of chemical attack of the Kapton TM 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 Moguirk or Bryan Dague with questions.

7775 Overview Appendix

- ressure Switch Cross Section export Print (TI # 36900)
- 2.
- asket Print (278 74353)
- THEA for Gasket and Espton Seal
- 5. Life Test to Failure Test Report (Weibull Analysis)
- Customer Specification (ES-F2VC-9F924 AA)
- 7. PPHEA
- 0. IP Test Reports
- 9. Endurance Test Report

5

Gravelina, Dora

From:

McQuirk, Andy

Sent:

Thursday, February 11, 1999 2:04 PM

Tes

Boumann, Russ; Murphy, Rich

Subject

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

atterney-client privileged communication

Flich, we have deployed a regular status Tier to Ford to essist in their work... Aziz Rahman.

this is his report from day?

AUTOMOTEVE MEMORIA AND COMPRISE DE 10 200000 DT N/O E1-02 ATTAMORIO, NA 01-02 ATTAMORIO, 130-1200 POL (800) 230-1748 PORM: (800) 467-1788 238 884-2044 O COMPRISE DEL PONTO

Reference, Asta

Thursday, February 11, 1999 11:08 AM

McGuirl, Andy, Seringhause, Steven; Saumenn, Ruse; Dague, Bryan; Dougles, Charles; Shaspe, Robert; Sullivan, Marina; Routens, Thomas; Batter, Cary 77PS Day 2, 2/10/98 Summery

Day 2, 2/10/98 Highlights

Main event of the day was a team meeting to prop for the Executive Technical Review on 2/11. Joe Nami of Large Verticle Balety Group led the meeting. There were a lot of participants, including Fred Porter, Tost Masters from Engineering, Norm LaPointe AVT Design Analysis, Steve LaRouche from CRL, Ford legal folios, wring, connector etc. TI was the only subplier represented.

Ti is not invited to the Test Rev. (where?)
Test Rev will be a high level, broad overview of Town Car Underhood Fires
Numbers Joe has thus far:

146 Underhead Fires, Thermal Anomalics, Thermal Events 39 with angine off, il with angine on, no information on the rest 5 possible related to the Brake Pressure Switch (BPS), 17 poisontel other root causes, no information on the

Other root causes from above the : 42 way our needer, ERC wire hymnes, Relay peck.

At this point MHTSA response required on SPS, FZVC part only. Others may follow

Langilly 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. Casis

птиненда фартизана.

Someone inquired about TI enemers 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:

Cose TI sell the switch directly to attenmental, like suito part stores. I replied that most probably not. We would go through Ford Service Parts for service parts. Is that securate Charle?

Pece 1

Does Tittave fire expects on site who can determine origin of fires, as in expects who work on abuctural fires. I replied in the negative, but said I would follow up. Any inputs? Intent was to enterer reportedly asked question: Do we know where the fire originated. Outside - in, inside - out, what burned first, traite fluid, or plastic base??

Joe's meeting was followed by a vigorous besimmorming session with Frad, Tong, Norm, Stove & Len. This was all moduled and I actively participated.

I reviewed TI report PS/98/14 on, weibull life of quint switch thatwing first tacker at 900k+ cycles. Gave copy to Norm. Bryan, need welfoull date quickly on pass-car stup 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 deventment of the ABS module.

There was considerable discussion on pressure profile at such a location with Len arying 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 resultance path to ground. could be formed. Discussed the waterpe evallable with a 15A few and 14Vdc system. (a that sufficient to generate enough keet through the ground path.

Discussed CRL analysis of Mamphis part, and gave copy of Al's report to Norse, Bryan, per Norse, Al retained "spoosfuls" of the currentee, randon, Do you know if Al has done my compositional analysis (III.) at apposed to elemental only?
Kept puting book to source of fire. Ford has not yet been able to create a fire in a switch. Tous decided that publing in Dow Chamical was key to understand if we can exect 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 full

More temorrow.

Regards Aziz.

THNHTSA 018723

Page 2

Epetein, Selty

From:

Perikh, Tusher (tparkh@emaii.mc.tj.com)

Sent:

Friday, February 12, 1999 10:12 AM

To: Cc:

Watt, Jim McQuirk, Andy

Subject:

FW: Impulse Test: Reliability Demonstration

Jim.

We just collected the Impulse Test Data since January of 1999 for 77F5.

Number of Pieces 180 Number of Cycles 500,000

This sample is much larger than what we need to demonstrate the mean life of the lot. As per my note below, I just need 41% samples 8 4500 cycles without any failure to demonstrate that the lot is exceptable and would have minimum mean life of 500,000 cycles. Hence we can make the statement that "the lot would have minimum mean life of 500,000 cycles." Producer's risk is still same at 5% level.

Any question, please give me a call.

Thanks.

Tusher Parikh

From: Paril

Perikh, Tusher

Sent: Thursday, February 11, 1999 8:41 AM '

To: Watt, Jim

Co: McGuisk, Andy

Subject: 1

Impulse Test: Reliability Demonstration

Jim,

After talking to you and Andy yesterday, I have done my literature research last night. The following is my findings:

This test fells into reliability demonstration category as reliability life tests terminated at prearranged time.

Brief Description of the test:

It is based on BCD Handbook H108. This kind of life test is stopped upon reaching a computed termination time (number of operation, cycles , etc) T provided the specified number of failures (in this case 1) did not occur before. The test is also stopped if the specified number of failures is reached before time T. This procedure is applicable to testing with or without replacement of failed parts.

The acceptability of a lot is determined by the time required for a predetermined number of failures, of (in this case 1), to occur in a sample size n (in this case 6), and a comparison of this time with the test termination time T multiplied by a constant k. The value of constant k with .05 % producer's risk, for a sample size of 6 is .009. A lot is accepted if the predetermined number of failures of (One) has not yet occurred before termination time T is reached.

T- K * mean life specified as acceptable

Mean life (specified Ford) - 500,000

T= .009 * 500,000=4500 Cycles

From the data provided to me yesterday, if the product does not fail before 4500 cycles during impulse Test, then we can make the statement that " the lot is acceptable and would have minimum mean life of 500,000 cycles." In our case, we need six samples that would have gone through at least 4500 Cycles without any failure. The number Andy gave me has six samples about twenty five times and fifty cycles. That is about 1250 cycles so far, for six samples, far short of 4500 cycles. If we have ninety times of fifty cycle test with six number of samples without any failure, then our statement would be valid.

I will talk to Rick to find out whether we could find all the data to support our calculation.

Let me know if this makes any sense to you.

Thenks.

Best Regards.

Tushag Parikh

Morris, Irene

From:

McGuirk, Andy

Sent:

Friday, February 12, 1999 10:38 AM

To:

Dague, Bryan, Beringhause, Steven; Baumann, Russ

Subject:

FW: 77PS Diaphragm Wear Out Cause & Effect Diagram - Updated a/o 5:00pm

Importance:

Hight

Sensitivity: Confidential

attorney - client privileged communication

lets agree to wording ASAP so Aziz can deliver

2 ACTIONOTIVE SEMECKE AND CONTROLE QUA MARGINE 14 FORSET ST N/S 23-05 ATTLEBORD, MA 02703 TEL : (508) 236-1080 PAR : (506) 236-3745 PAGE: (800) 467-3700 PIE E04-2044

From:

Watt, Jim

Sent

Thursday, February 11, 1999 4:55 PM

To:

'Saumann, Russ RUSS'; Degus, Bryan; McGuirk, Andy; Beringhause, Staven RE: 77PS Disphragm Wear Out Cause & Effect Diagram - Updated s/o 5:00pm

Subject: Sentitivity:

Confidential

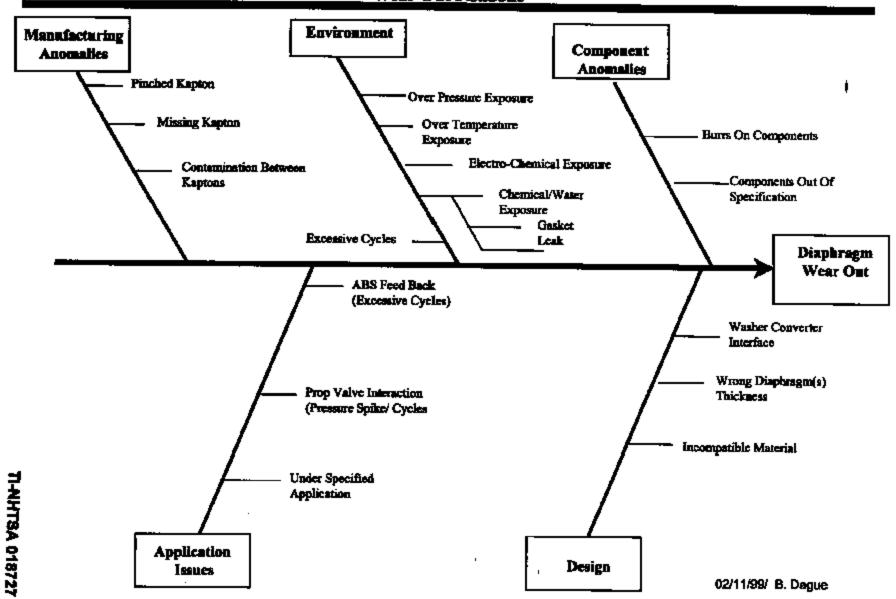


Jim Watt, QRA, magid: Jw02; mail station 12-33; page (508)238-1010, no. (0895) ph (506) 236-1719; fax (508)236-3153



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

Wear Out Fishbone



Epsteri, Sally

from; Sant: Behitr, Geriy (gbeler@ernel.evs.i.com) Friday, Pebruary 12, 1988 12:28 Ps4 Rehtren, Asig

CC:

McGuiri, Andy, Beringhauta, Steven; Digue, Bryan; Baumann, Ruse; Sharpe, Rebert: Douglas, Charles; Rowland, Thomas RE: 7798, 2/11/00

ubject: RE: 771

Aziz.

Thanks for the update.

On the point that "Maving 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: Rehman, Aziz

Friday, February 12, 1999 11:28 AM

To: McGuirk, Andy: Bezingheuse, Steven; Dague, Bryan; Baumann, Ruse; Sharpe, Robert; Douglas, Charles; Baker, Gary; Rowland, Thomas Subject: 77PS, 2/11/99

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

Key participants were: Jack Pasques Chief Engineer, Luxury VC

Chuck Pesks Program Engineer, Town Car

Ann O'Neill Quality Directory, Luxury VC

Sam Cole Manager Large Vehicles Electrical Systems

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

- There is a need to have the ability to implement, whatever solution is decided, in two months may.
- Next meeting with MATEA 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 meed 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 Jos Mani has been tasked to get a clearer picture of the events breakdown.
- There were strong feelings of "got to do more".
 Free's statement that "TI Engineering is resident here" eligited a "Good" response.
 - I met with Fred 2/12 morning to capture his thoughts on follow up actions:
- Need a "reft" of experiments to accolerate kapton wear. Need to design and execute a DOE with temperature, moisture, disc energy, conteminents (scap, detergent), # of kapton layers etc as fectors. I will close with Eryan 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 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 Stave Raimers 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 Stave to close these out.

I have a meeting with Central Labs folks at 1.30 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 leb tests. Bryan, can we do this with the switches we pulled from the field with known milesge. Can we swap parts in used cars, say at Tasca? Today PM, we will meet with Gred Stevens, materials guy at AVT who has been tasked with gesting 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 and of next week.

FYI, I have a phone & pager now. Thanks Andy. I felt like "Fer From the Meddening Crowd " (Thomas Hardy) without the comm-link! Phone: \$08-208-6119

Pager: 1800-946-4646, pin 604-2042

Regards Aziz.

Costain, Aally

Frank Serii: Tec

Rafetten, Azz (wahman@amal.mo.ii.com)

Monday, February 15, 1969 7:31 PM Degue, Bryon; Benngkause, Steven; McGurk, Andy; Sharpe, Robert; Baker, Gary; Beumann, Ruse FM: Braton Pressure Switch Log



Received second wave of parts from Toxos junkyards. All F2VC parts. Most : them with connector attached. Some of them with prop valves & serves. 2 from underhood fires. Analysis will start temorrow FM. Please let me know if there are any specifics to look at, before we disassemble these. I was thinking of doing some quick voltage drops, insulation resistance checks. Obviously loss of pictures. Any quick way to test these parts for leaks, prior to disassembly?

By the way, Steve R. did mention that the Electrical System folks were looking into us; a Brake Fedal Position Sensor as a replacement for the Brake Fressure Switch as a corrective /containment action. Have we determined what they use in the 99 Town Car?

Front: Rahman, Aziz

Segc:

Monday, February 15, 1999 8:22 PM
'Fred Porter (Ford)': 'Norm Lafointe (Ford)': 'Steve LaRouche (Ford)': 'Steve Toi

Reimers (Ford)'

Subjects Brake Pressure Switch Log

Attached is a log file with information on the devices under review. It also contains switches received today from John McInerney. In addition to Steve L's analysis summary file, I will be using this log to track incoming parts. Please advise if I have missed . data.

<<Brake Pressure Switch Log>>

Please let me know if you mannot open the file. Steve/Morm, can you please e-mail me th last update on your analysis summary file? Thanks.

Regards AR1E,

Log Updated 2/15/1968

344	Sw Date Code	Vahicie	VIN	Event	Misege	Lealar?
Memphe		Toen Cer		Sw. Fire		
A		Town Car		Underhood Fire		
В		Town Car		Underhapet Fire		
C		Town Car		Linderhood Fire		
В		Crawn Via Palice Car		Cruips Impg		
E		Town Car		Reference		
F		Town Car		Cruise (neg		
1	2006	Toren Car	NX702556	References	79164	ı
3	3019	Town Car	PY724043	Reference	71337	•
4	2348	Town Car	FY628170	Paris and	96087	,
5		TOWN CM		Réference	96348	1
6		Town Car		Reference	47325	i
7	2058	Town Car	NX725430	Reference	55022	!
	3025	Town Ger	PX180223	Reference	99514)
9	2250	Town Car	PXCCTTCC	Reference	77	
10	2261	Town Car	FY999375	Réference	E2224	•
11	3026	Town Car	PYTORUG	M eference	91386	•
From TX to	p of 2110 to 2113	!				
1	2025	Town Car	PYESMOO)	Reference		
2	3063	Crown Vio Police Car	PX190000	Paletters	100000)
3	3266	Grand Marquia	FX641586	Flatform on	77	
4	3026	Crewn Viz	PX103312	Reference	40044	1
5	2063	Your Car	PY810364	Reference	73115	•
	77	Town Car	NY72 410 6	Underhand Fire	27	
7	3061	Town Cip	PY780172	Calarates	27	
•	2046	Town Car	NY733191	Underhood Pre	100410	
9	3000	Town Cit	PY 738158	Reference	77	
10	2272	Crown Via	PX161146	Reference	72014	
11	2115	Town Car	NY75/408	Reference	77	
12	3086	Town Gar	FY742000	Reference	77	
13	3060	Town Car	PY7433413	Reference	100040	l

Kapton #1	Kapton #2	Kapton #3	Term-Heaps*26 Resistance	Mark Location of Sw.	Present Status	Соппину
Teer	Teer	Tear	Ca	minal Lab		
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			N/A	A .	Sw. not available	
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			ÄV			With Connector and sarvo
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			ÄV			With Connector
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			ÄV			With Connector
			AV			With Servo, Prop Valve
			AV	•		With Connector, Prop Valve, Servo
			AV			With Connector, Prop Valve, Servo
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			AV			With Connector
			ÂV			With Connector and Servo
			n•	•		ATTENDED AND ADDRESS OF THE PERSON AND ADDRESS OF THE PERSON AND ADDRESS OF THE PERSON A

Control . Bally

Sent:

٠

McGuirk, Analy (a-maguiridhema), ma.il.com) Tuesday, Pobrusry 18, 1888 7:18 AM Rowland, Thomas

Če:

Shirpe, Robert, Dodd, Bob, Pychanie, John: Salor, Gary; Beringheuse, Steven; Sertoch, Bob

Subject:

PW: Brake Procure Switch Log

importance:

High

tom, by copy of this note we will look to gazy baker and bob dodd and steve beringhause for information about the '99 town car today which reportedly was launched without a p/s in the brake system for cruise system.

we will also determine our analysis protocols for these taxes return units before noon today, tuesday.

a

AUTOMOTIVE SESSORS AND CONTROLS QRA MANGER

34 FOREST ST N/S 23-05 ATTLEBORO, MA 02703 TEL : [508] 236-3080 EAX : (508) 236-3745

PAGE: (800) 467-3700 9IN 504-2044

FEOMI Rahman, Aziz

Monday, February 15, 1999 6:30 PM Sept:

Dague, Bryan; Beringhause, Steven; McGuirk, Andy; Sharpe, Robert; Baker, Gary; TO1

Baumenn, Russ

Mil Brake Pressure Switch Log Subject:

Received second wave of parts from Taxas junkyards. All F2VC parts. Most of them with connector attached. Some of them with prop valves 4 serves. 2 from underhood fires. Analysis will start tomorrow \$16. Flease lat me know if there are any specifics to look at before we disassemble these. I was thinking of doing some quick voltage drops, insulation resistance checks. Obviously lots of pictuzes. Any quick way to test these parts for leaks, prior to disassembly?

By the way, Steve R. did mention that the Electrical System folks were looking into using a Brake Fedal Position Sensor as a replacement for the Brake Pressure Switch as a corrective /containment action. Have we determined what they use in the 99 Town Car?

Rebman, Aziz Front

Monday, February 15, 1999 1:22 PM
'Fred Porter (Ford)'; 'More LaPointe (Ford)'; 'Steve LaRouche (Ford)'; 'Steve Tot

Reimpre (Ford)'

Brake Gressure Switch Log Subject:

Attached is a log file with information on the devices under review. It also contains switches received today from John McInerney. In addition to Steve L's enelysis summery file, I will be using this log to track incoming parts. Please advise if I have missed at data.

i disabled file to conserve space and e-mail time.....

TI-NHTSA 018733

Please let me know if you cannot open the file. Stave/Norm, can you please e-mail me the last update on your analysis summary file? Thanks.

Regards — Aziz,

Epatein, Sally

From: Sent:

McGuirk, Andy [s-mcguirk@email.mc.tl.com]

. Tuesday, February 18, 1999 7:41 AM

To:

Watt, Jim; Parikh, Tushar

Subject:

RE: Impulse Yest: Reliability Demonstration

սունու<u>ի և և ունըն դ</u>ա

no. the thing 'wears out' at about 1 million cycles

AUTOMOTIVE SENSORS AND CONTROLS ORA MANGER 34 FOREST ST W/S 23-05 ATTLEBORO, NA 02703

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

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

Parikh, Tushar Tron:

Tuesday, February 16, 1999 8:24 AM Sept:

To: McGulrk, Andy; Watt, Jim

RE: Impulse Test: Reliability Demonstration

Thanks for clearing it up. with the new information, I have come up with the following answer.

Number of Units * Cycles the product went through impulse testing =1250*500,000**=625,000,0**00

In order to use DCD H100 tables, I will normalize the data for a sample of twenty pieces.

Mormalized Data without any failure=31,250,000 Cycles

With Producer's Risk at 50% (very high i.e. we are not taking practically any chance for sending any lot that would not meet the requirements of mean life of 500,000), estimated mean life would be-

31,250,000/ .035=892,657,000 i.e. about 1785 times the required minimum life of 500,000.

Please let me know whather this makes sense.

Thanks.

Tuekez Fazikh

r zami

McGuirk, Andy Monday, February 15, 1999 4:19 PM Sent:

Parikh, Tushar

RE: Impulse Test: Reliability Demonstration

you misunderstood.

1 had 30 sheets of data with 25 lines each sheet and each line was 6 pieces tested to 500,000 cycles with zero leak failure.

the number then is 1250 pieces tested to 500,000 cycles with sero failure. What we all wanted to 'claim' was some 'astronomical

TI-NHTSA 018735

AUTOMOTIVE SENSORS AND CONTROLS GRA MANGER

34 FOREST ST M/S 23-05 ATTLEBORG, MA 02703 TEL: (508) 236-3080

TEL : (504) 236-3080 FAX : (508) 236-3745

PAGE: (800) 467-3700 PIN 504-2044

From: Parikh, Tushar

Sent: Thursday, February 11, 1999 8:41 AM

To: Watt, Jim Co: McGuirk, Andy

Subject: Impulse Test: Reliability

Demonstration

Jim.

After telking to you end Andy yesterday, I have done my literature research last night. The following is my findings:

This test falls into reliability demonstration category as reliability life tests terminated at prescrenged time.

Brief Description of the test:

It is based on DOD Handbook HiGB. This kind of life test is stopped upon reaching a computed termination time (number of operation, cycles , etc) T provided the specified number of failures (in this case 1) did not occur before. The test is also stopped if the specified number of failures is reached before time T. This procedure is applicable to testing with or without replacement of failed parts.

The acceptability of a lot is determined by the time required for a predetermined number of failures, of (in this case 1), to occur in a sample size n (in this case 6), and a comparison of this time with the test termination time T multiplied by a constant k. The value of constant k with .03 b producer's risk, for a sample size of 6 is .009. A lot is accepted if the predetermined number of failures of (One) has not yet occurred before termination time T is reached.

To K * mean life specified as succeptable

Mean life (specified Ford) = 500,000

T= .009 * 500,000=4500 Cycles

From the data provided to me yesterday, if the product does not fail before 4500 cycles during impulse Test, then we can make the statement that "the lot is acceptable and would have minimum mean life of 500,050 cycles." In our case, we need six samples that would have gone through at least 4500 cycles without any failure. The number Andy gave me has six samples about twenty five times and fifty cycles. That is about 1250 cycles so far, for six samples, far short of 4500 cycles. If we have ninety times of fifty cycle test with six number of samples without any failure, than our statement would be valid.

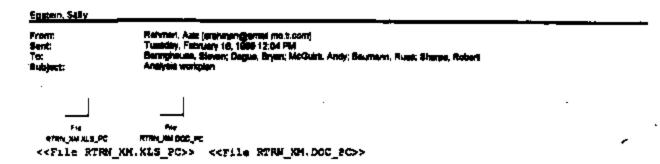
I will talk to Rick to find out whether we could find all the data to support our calculation.

Lat me know if this makes any sense to you.

Thanks.

Best Rebayds,

Tusher Parikh



Proposed flow chart for return device enalysis, published by A. Reimare, ford.

Dague, Bryan

From:

Degue, Bryan

Sant:

Tuesday, February 18, 1999 8:03 AM

To:

Rahman, Aziz

Subject:

RE: Brake Pressure Switch Log

Aziz.

I did get your phone MSG (est night, and it sounds like you are on the right track. Although ! don't know what kind of environment you are working in, you might try to get some of the following measurements:

- 1) Calibration (actuation and release)? Not save if you have the equipment there. At the same time you will see if there is a gross leaker.
- 2) Leak down test. Go up pretty high in pressure 200 to 3000 psi. If the kapton is crecked and there is a leak path -illied with brake fluid, the brake fluid will seel the leak path at low pressures (5 to 10 pai).
- Resistance from each terminal to the hexport. If the contact cavity is filled with brake fluid you will probably not get a stable reading. The voltage and ourrent supplied by the meter is enough to start moving ions around in the solution. The electrodes start charging and the resistance reading starts changing. The right way to do measure impedance. This is done with a fancy meter, and with an AC voltage and current. This is why we were unable to get good readings on our brake fluid resistance experiment.
- 4) The real information will come when you disaget the switches. Paying close attention to the following: a) wear on the bumps (arm, converter, and cup)

 - b) wear between the converter and washer.
 - c) Kapton degradation
 - d) wear between the pin and the cup.

That is gretty much all I can think of.

Good luck and let me know what you find.

Regards. Bry

From:

Rahman, Aziz

Sent

Montley, February 15, 1899 8:30 PM

To:

Degue, Gyert Seringhauss, Steven; McQuirk, Andr. Skurpe, Robert: Baker, Carv. Beumann, Russ.

PAY: Graida Protesture Shalligh Log

Received second wave of parts from Texas junkyards. All F2VC parts. Most of them with connector attached. Some of them with prop valves & servos. 2 from underhood fires. Analysis will start tomorrow PM. Please let me know if there are any specifics to look at, before we disassemble these. I was thinking of doing some quick voltage drope, insulation registance checks. Obviously lots of pictures. Any quick way to test these parts for leaks, prior to disassembly?

By the way, Steve R. did mention that the Electrical System folks were looking into using a Brake Pedal Position Sensor as a replacement for the Brake Pressure Switch as a corrective /containment action. Have we determined what they use in the 99 Town Car?

Rehmen, Aziz

Manday, Fabruary 15, 1896 5:22 PM

First Porter (Part Y; "Norm LaPeints (Part Y; "Stove La Rouche (Part Y; "Stove Reimers (Part Y

Epstein, Sally

From:

Beringhause, Steven (sberinghause@email.mc.ti.com) Tuesday, February 16, 1999 2:15 PM Rahman, Aziz

Sent

To:

Asts,

One comment on the switch testing, the plan looks good for junk yard parts. I would not run as aggressive a test plan on parts that were in a vehicle fire because we do not know what shape the smal is in from the fire and lookage might disrupt clues. My quees is that this matches the plan.

Steve

Morris, Irene

From:

Sharpe, Robert

Bent:

Tuesday, February 16, 1999 10:13 AM

To: Cc: McGuirk, Andy: Rowland, Thomas Dodd, Bob; Pechonis, John; Baker, Gery; Bertrighause, Steven; Bartoch, Bob; Douglas, Charles

Subject:

RE: Brake Pressure Switch Log

Last spring I reported to Marketing that the TI brake switch application on the Town Car had been converted to a "plunger type" switch (normally closed) application, mounted on the brake pedal, sometime in MY98. This is why you do not see the Town Car, Crwn Vic, and Gran Marg in Charle's application listing for MY98, sent to Frad Porter. In fact, my predecessor (Norm Freds) also indicated this in his forecasts from June 97.

I have a call into Ford, Mr. Date Stotztimer (ap?) for further confirmation, however, his voice mail is full. Date is the Core/AVT Engineer for switches within the Ford Chasis Group.

Aziz, let's try to confirm/quality Ford's potential containment action. Would this be across the board as a reptacement. for all TI brake switch applications, or only for the Town Car. Also, I would like to confirm if Ford is looking at using the same "plunger" type switch or are they looking at a different "position" sensor in regards to their potential containment action. Any feedback regarding our proposal to rewire (remove battery feed) the switch for containment action ?? I will see you later this afternoon.

Best Records.

Rob Sharpe

Texas Instruments Phone (248) 305-5729 Fax (248) 305-5734 reharps@ti.com

-Original Mar

From:

McGuirk, Andy

Sent:

Tuesday, February 18, 1999 8:18 AM

Te:

Flowland, Thomas

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Sharpe, Robert, Dodd, Bob; Pechania, John; Seker, Gery; Beringhause, Slaven; Bertoch, Bob

Euchlect:

PW: Brake Pressure Switch Log

Importance:

High

tom, by copy of this note we will look to gary baker and bob dodd and steve beringhause for information about the '99 town cer today which reportedly was launched without a p/s in the brake system for cruise system.

we will also determine our analysis protocols for these taxes return units before moon today, tuesday.

AUTOROTIVE BERGORS AND CONTROLS ORA HARDER 34 PORRET RT N/8 23-05 ATTLEMORO, NA 02701

THE : (RDS) 234-3980 PAK : (504) 236-3745 PAGE: (600) 467-1700 PZW 404-2044

From:

Rahman, Aziz

Sent

Monday, February 15, 1999 8:30 PM

To:

Dague, Bryan; Beringhause, Steven; McGulrk, Andy; Sharpe, Robert; Baker, Gery; Baumann, Russ

Subject:

FW: Brake Pressure Switch Log

Received second wave of parts from Texas junkyards. All F2VC parts, Most of them with connector attached, Some of them with prop valves & servos. 2 from underhood fires. Analysis will start tomorrow PM. Please list me know if there are any specifics to look at, before we disassemble these. I was thinking of doing some guick voltage drops. Insulation resistance checks. Obviously lots of pictures. Any quick way to test these parts for leaks, prior to disassembly?

By the way, Steve R. did mention that the Electrical System folks were looking into using a Brake Pedal Position Sensor as a replacement for the Brake Pressure Switch as a corrective /containment action. Have we determined what they use in the 99 Town Car?

From:

Rahman, Aziz

Šemb

Monday, February 15, 1999 8:22 PM

'Fred Porter (Ford)'; 'Norm LaPointe (Ford)'; 'Stave LaRouche (Ford)'; 'Stave Reimere (Ford)

Subject

Brake Pressure Switch Log

Attached is a log file with information on the devices under review, it also contains switches received today from John Moinemey in addition to Steve L'e enalysis summary file, I will be using this log to track incoming parts. Please edvise if I have missed any data.

I disabled file to conserve space and a-mail time.....

Please let me know if you cannot open the file. Steve/Norm, can you please e-mail me the last update on your analysis summary file? Thanks.

Recards Aziz.

Epetein, Sally

From:

Beringhause, Steven (speringhause@email.mc.ti.com)

Sent:

Wednesday, February 17, 1999 5:48 AM

To:

Rehmen, Aziz

Subject:

PW: 99-003: PROPOSED PROTOCOL FOR DISABSEMBLY AND ANALYSIS OF SWI TCH

PROM 77PS FROM LINCOLN TOWN CAR

A217,

Here was Al's first pass proposal. I am not sure if the final process changed. I will find out today, but I do not think it did. Bryan is not in yet, my quees is he is still sick. I will follow up with Al or Bryan at home.

Steve

Proposed Protocol for disassembly and analysis of switch from 7788 FROM LINCOLN TOWN CAR

Review Ford's Analysis data that they are bringing in.

Examine threads and determine if it is OR to just chase the threads to get a good seal or should we remove material for analysis.

Pressure Leak Test the device (15 minute static-hold, sir-pressurized test).

Decide if we should remove any material or try any other enalysis before we start disassembling the device.

Do a practice decap using the below procedure on a deliberately fractured part (to Mimic the condition that the returned device will be in) before performing it on the real sample. Bryan, you and I could do this now.

Procedure to remove aluminum crimp ring

- Use aluminum foil (or pleatic if ford prefers) to mask the analysis surface.
- Also create a paper/tape shield to further raduce chance of contamination during cutting of Grime ging.

Place a piece of tape over the area to be cut.

Cut crimp ring using jewelprs saw or Bramel cutoff wheel in one of the two areas indicated on optical photo.

Cut corners of ring at 180 degree orientation

Unfold origo ring

- Optically examine revealed surfaces. Take optical photographs (Digital camera with macro lans plus instant microphotography) and document observations where appropriate. Exemine the following areas
 - Inside surface of orimp ring.
 - Seal area and underside of base

' Top of sap

- Start SEM-ELK (Scanning Electron Microscope with Energy Dispersive Analysis of Xrays) analysis on the inside of the ring and on various surfaces of the plastic base.
- Reprotect the top surface and remove the cap. Bryan had originally suggested just using an end mill to remove the cap. I wouldn't, however, go all the way through with the and mill. I would leave some meterial behind as a shield. I would suggest then bending the cap off.

Optically document all revealed surfaces starting with cap.

Meamshile, start SEM-EDN analysis on top side of cap. Particularly focus in on the adges of the ceremic pin quide and on the indented ring that lines up with interior well of the switch cavity. Particularly look for evidence of correcion or aroing.

Decide if we should try to flake off any of the overlaying debris to try to examine the underlying metal surface.

- Proceed to perform SEM-EDK analysis on other component surfaces revealed by removal of cap.
- Won-destructively probe inside of the grownet to determine its resilience which will give us an indication of the temperature that it saw. Another indication hight be the depth of the indentations left by the growner seal rings in the wire.

Decide if it makes sense to further examine the mating connector or grownet seal.

Regards,

A1

TI-NHTSA 018744

Currey, Pat

From: Sent:

Rahman, Aziz [arahman@email.mc.ti.com]

Wednesday, February 17, 1999 11:00 AM

To:

Beringhause, Steven; Dague, Bryan; McGuirk, Andy; Baumann, Russ; Sharpe,

Robert; Baker, Gary, Sullivan, Martha; Douglas, Charles

Sabject:

FW: 77PS Ford Central Lab Findings



LaRouche, Stave (S.) [SMTP:slarouch@ford.com] From:

Sent:

Wednesday, February 17, 1999 11:54 AM

To: 'A. Rahman'

<<Findings.doc>>

Aziz: Here is a copy of the spread sheet summarizing our findings to date. Sorry I didn't get it to you sooner, but I wanted Norm to review it first.

<<fi>indings.doc>>

(SLAROUCH) Steve Lakouche Metallurgy Section, Central Laboratory, Room N410 (313) 845-4876 (313) 322-1614 FAX

DRAWINGS AVAILABLE UPON REQUEST

rGuirk, Andy in-maguiti@armil.comj educatin, Pulmany 17, 1887:244 PM fitr, Gury: Baumines, Ruse; Beringtmure, Stever; Degus, Bryon; Hapifes, Ai Lights, Charles; Rainrum, Asir; Revoland, Thuman; Sverpe, Rubert; Sulbate, Marija

When: Thursday, February 18, 1999, 2:00 PM - 3:00 PM, (GMT-05:00) Eastern Time (US & Canada) Mhere: 23A

~-*-*-*-*-*-*

I WANT TO REVIEW FORD'S AMALYSIS SPREADSHEET (ALL, LEG BY STEVE WITH THEORIES), OUR UPDATED CAUSE AND EFFECT DIAGRAM (BRYAM), OUR 'SCIENCE FAIR' EXPERIMENTS RESULTS (STEVE AND REVIEW A PROPOSAL FOR OUR RESPONSE TO FORD'S POSSIBLE OUESTION POSED AND BRYAN), FROM ASIS ABOUT TI POSITION (AMDY).

ALSO, I MANT TO UNDERSTAND FORD'S DATA ABOUT AND (C/O ASIS FROK TEVES) AND PROF VALVE PRESSURE TRACES, AS WELL AS DATA FROM DOS C/O FORD ABOUT STATE FLUID AS IT RELATES TO FIRES AS WELL AS RAPTON (C/O ALIL FROM FORD).

FINALLY, WE SHOULD UNDERSTAND BRAKE SWITCH AND KAPTON WEAROUT WITH AMOTEUR FORD PLATFORM...STEVE DID WE COLLECT ANY SAMPLES FROM SIMILAR AGE VEHICLES?

WE SHOULD ALSO DISCUSS THE SOTEWIIAL SMAKE PROAL POSITION 'SOLUTION' (CHARLIS AND ROS. . BRIEF GARY SO HE CAN DELIVER) AND SE PREPARED TO HELF FORD UNDERSTAND THEIR RISES IN TRAT PATE.

Epatein, Sally

From: Hopkins, AL [shopkins@small.mc.ti.com] Sent: Wednesday, February 17, 1999 5:09 PM

To: Beringhauss, Steven

Co: Dougles, Charles; Rehman, Aziz; Baker, Gary; Baumann, Ruse; Dague, Bryan; McGuirk,

Andy

Subject: Corrosivity of Brake Fluid/Water Mixtures on Brees

Attorney-client privileged communication

Has anybody talked to Dow from our end on the corresivity of Brake Fluid/Water Mixtures on Brass both in the stressed and unstressed condition? Also, has anybody from our side talked to them about flammability? In particular, you had raised a good issue about the flammability/evaporation interaction. They might be able to suggest the best temperature to do your tests at.

AL

AUTOMOTIVE SENSORS AND CONTROLS COA MANGES. 34 HOURSE ST M/S 23-05 ATTUENCEC, NR. 03703 TEL. (800) 236-3080 THE : (500) 236-3745 PMGE: (800) 467-3700 Park 404-2014

From:

Referent, Aziz

Sont:

Wednesday, February 17, 1999 6:16 PM

Tee

Beringheuse, Steven; Daguer, Bryan; McGuirk, Andy; Salumenn, Russ; Sharpe, Robert

Subject: 2/17 Update

Main event: 2PM core feem meeting, Highlights:

- Manager Len Brown agituted that Dow has not shown up yet. Will probably get them on board fornorow or Friday.
- Supp. meeting at 4.pm Friday. Til not invited. Will present test plan (copy with Stove B.).

- Ford tears in DC today at NHTSA, anking for two months for public action.

People surprised that on-vehicle characterization has not yet occurred. Leads provided on expediting this.

- Increasing tempo on getting more parts back for analysis.
 Re-emphasized need to study warmenly data more closely for trending, and special causes.
- Increasing speculation that pure heat is not exflicient to ignite. Need sperk.
 Will present brains posts position consect to excee se possible containment.

Two tests conducted today at AVT lake:

- Priced about 54 Amps at about 1V, through switch terminals, no fluid. Temp in connector area increased to about 182 F before system went open circuit. Dissection revealed spring arm deformed and twisted away from stationary. Will have pictures tomorrow.
- Passagd shout 50 Amps at about 1V through switch terminals, with switch based filled with approx 50% Brake Fluid, 50% sait water. Temp in connector area increased to about 270 F and stayed there. No amoke or ignition. Dissection revealed spring arm deformed. Plotures tomorrow.
- -Well set up calibration station in Central Lub tomorrow.
- Will be returning to MA Friday 2pm flight. Later flights not available because of vacation week. Per Stove B.'s input, will plan to return heat week

Recerds AZĒ.