EA02025

TEXAS INSTRUMENTS, INC.'S

09/10/03 LETTER TO ODI

REQUEST 9

BOX 12

PART A – O

PART I

Charlie

Charlie Douglas
(508) 236-3687 (P)
(508) 236-1598 (F)
c-douglas2@ti.com

From: Sharpe, Robert
Sent: Monday, February 22, 1999 8:17 AM
To: Douglas, Charles
Cc: McGuirk, Andy; Rahman, Aziz
Subject: Brake Pressure Switch History

HI Charlie,

During last Friday's "Executive Level" review at Ford regarding the Town Car issue, interest was expressed towards the change on our switch between snap disc and quiet disc. My understanding is that this change occurred sometime in CY95 (to quiet disc), based on your 12/8/98 E-Mail. In addition, we also thought that the "F2AC" was a quiet disc application, however, we have a few field returns of the "F2AC" that have CY92 date codes. Please confirm timing of the quiet disc changeover as well as history of the "F2AC".

As discussed with Andy on Friday afternoon, Ford expressed much interest with the change (focused on timing) to "quiet disc" applications. They were very pleased that our DOE addresses both quiet and snap disc applications.

Best Regards,

Rob Sharpe
Texas Instruments
Phone (248) 305-5729
Fax (248) 305-5734
rsharpe@ti.com

Dague, Bryan

From: Rahman, Aziz
Sent: Monday, February 22, 1999 10:34 AM
To: Dague, Bryan; McGuirk, Andy; Baumann, Russ; Beringhause, Steven; Sharpe, Robert
Subject: FW: TI Durability Samples

There seems to be a difference between the 728k sample kaptons and the rest. Any theories?
Bryan can you check if this switch was mounted on the dead-head end of the test manifold (opposite the inlet), where localized degradation of the brake fluid is higher? Or are the manifolds totally exhausted of brake fluid, at all test positions, for every pressure cycle? I don't remember the set-up.

Regards
Aziz.

From: Rahman, Aziz
Sent: Monday, February 22, 1999 10:26 AM
To: 'Steve LaRouche (Ford)'; 'Steve Reimers (Ford)'; 'Norm LaPointe (Ford)'; 'Fred Porter (Ford)'
Cc: Sharpe, Robert
Subject: TI Durability Samples

I have the following disassembled samples with me and I will forward them to Steve L. today pm.

200k Cycles	2 samples
400k Cycles	2 samples
600k Cycles	2 samples
726k Cycles	1 sample (observed leakage)
800k Cycles	2 samples

This will be part of the library to establish lab tests vs field data.

Regards
Aziz.

Dague, Bryan

From: Sharpe, Robert
Sent: Monday, February 22, 1999 7:55 AM
To: McGuirk, Andy; Terino, Gerard; Dague, Bryan
Cc: Beringhause, Steven; Rahman, Aziz
Subject: FW: AirBorne Express

Please find below shipping information for the 10 pcs of clutches received from Ford (Steve Reimers). These units were shipped to Gerry Friday afternoon. I believe these devices will be used for clutch loads on switch cycling in Attleboro.

I also went to a Ford Dealership and got an illustration of the 1999 Lincoln Town Car "Brake pedal and booster installation" which shows the brake pedal switch (plunger type) now used for speed control deactivation on Lincoln Town Car applications(fixed to C.Douglas). 2 samples of this switch (@ $4.60/pc service cost) will be available on Monday and forwarded to Attleboro.

Best Regards,

Rob Sharpe
Texas Instruments
Phone (248) 305-5729
Fax (248) 305-5734
rsharpe@ti.com

—Original Message—
From: Ardnage, Rosalie
Sent: Friday, February 19, 1999 3:31 PM
To: Sharpe, Robert
Subject: AirBorne Express

Rob, the shipment that went out Friday to Gerry Terino is #6988703750.

Regards,

Rose
TI Novi Sales Office
(248) 305-6721

Dague, Bryan

From: McGuirk, Andy
Sent: Friday, February 19, 1999 5:21 PM
To: Sullivan, Martha; Baumann, Russ; Beringhause, Steven; Baker, Gary
Cc: Rowland, Thomas; Dague, Bryan; Pechonik, John; Rahman, Aziz; Douglas, Charles; Watt, Jim; Sharpe, Robert
Subject: FORD CONF CALL OF 2/19

ATTORNEY CLIENT PRIVILEGED COMMUNICATION

STEVE BERINGHAUSE AND I HELD A CONFERENCE CALL WITH STEVE REIMERS OF FORD TO PROVIDE DETAILED BRIEFING TO HIM FOR HIS 4PM EXECUTIVE LEVEL MEETING (HE'S FILLING IN FOR FRED PORTER)

SUMMARY:
STEVE REIMERS WAS PREPPED FOR THE FORD EXEC MEETING WITH OUR TEST MATRIX AND UPDATE...HE WAS LEANING TOWARDS KAPTON WEAR OUT AS A KEY CONTRIBUTOR...AND WE HELPED HIM BALANCE WITH LACK OF IGNITION IN THE AGREED UPON TESTS TO DATE POINTING OUT WE THOUGHT SOME ELECTRICAL ANOMALY HAD TO BE HAPPENING TO DRIVE IGNITION.

WE COVERED A NUMBER OF POINTS IN SOME 50 MINUTES OF TELECON:

THE TEST NUMBER 7 RUN WOULD BE DONE MONDAY....THIS WAS SET UP AS A TEST TO LEAK POINT OF SOME 30 UNITS. 1ST ONE LEAKED AT 725,000 CYCLES VS 500,000 SPEC. (THERE WILL BE INTEREST IN A WEIBULL STATISTIC STATEMENT FROM THIS TESTING (JIM)

TESTING TO CHARACTERIZE WEAR OUT 'STAGES' OF KAPTON TO CONTINUE....PROVIDE FORD PHYSICAL SAMPLES VIA AZIZ MONDAY.

THERE WERE QUESTIONS ABOUT THE '93 ECONOLINE HARNESS....SWITCH LOCATION AND ORIENTATION

WE WILL ESTABLISH A D.O.E. STARTING MONDAY TO USE QUIET AND SNAP SWITCHES WITH CLEAN AND H20 CONTAMINATED BRAKE FLUID RUNNING SOME 10 UNITS ON AUTO CRUISE SERVO-MOTOR LOADS TO DETERMINE SIGNIFICANT EFFECTS AND WEAR OUT 'ACCELERATORS' TEST SHOULD RUN FOR 10 DAYS. THIS STARTS TO FORM THE BASIS FOR LONGER CYCLE LIFE SWITCH

DISCUSSED ABS AND TRACTION CONTROL VEHICLE OPTION PACKAGES AND WILL BE GETTING FORD INFO ABOUT THIS 'SOON'

AS WE DISCUSSED H20 CONTAMINATED BRAKE FLUID I ASKED IF IT IS A MATTER OF SERVICE RECORD THAT CAR BRAKE SYSTEMS 'ATTAIN' SUFFICIENT WATER CONTENT TO FREEZE.....UNKNOWN AND NOT COMMITTED RESPONSE FROM FORD

STEVE B EXPLAINED OUR UNDERSTANDING OF CAUSES OF KAPTON WEAR-OUT ACCELERATION....H2O, STRESS FROM HIGH PRESSURES, STRESS FROM 'VACUUM' OR HYDRAULIC SHOCK, WEAR-OUT FROM EXCESSIVE CYCLES...THIS LED TO 'DISMISSED' DISCUSSION OF TOWNCAR HYDRAULIC SYSTEM PRESSURES IN THE TRACTION CONTROL EVENTS WHICH WE POINTED OUT AS A POSSIBLE EXAMPLE OF A SIGNIFICANT STRESS RISER IN THE SYSTEM

STEVE B EXPLAINED WE WERE NOT SEEING THE POSSIBILITY OF IGNITION OF A SWITCH WITH CLEAN FLUID...LEADING TOWARD OUR BELIEF THAT SOME CONFOUNDING CREATED BY H2O CORROSION OF THE SWITCH AND/OR INTERNAL ARM MIGHT BE PATH TO CREATE HIGH RESISTANCE BUT THAT THE SYSTEM WOULD HAVE TO DRIVE SIGNIFICANT POWER BACK INTO THE SWITCH TOO.... STEVE REIMERS WAS NOT 'LISTENING' TO US VERY MUCH AT THIS TIME...

INTERNAL TI TO-DOS FOR ME TO DRIVE:
ASIDE FROM ABOVE ACTIONS...

STEVE B AND I AGREED WE WILL NEED TO CREATE THE SITUATION IN LAST PARAGRAPH AND DOCUMENT TO FORD EARLY NEXT WEEK SO WE COULD FOCUS DOWN TO LIKELY AREAS.

TI WILL NEED TO EXPAND THE TEST MATRIX TO COVER MANY OF THE ITEMS WE ARE DOING AND GAIN THE CREDIT THAT WE ARE WORKING IN MANY AREAS

TI NEEDS TO DOCUMENT THE APPROACH TO INCREASED SWITCH LIFE WITH A PLAN WHICH WOULD INCLUDE OUR POSITION AGAINST POWER ON AT ALL TIMES

I WILL RE-ENGAGE WITH FRED PORTER BY TUESDAY MORNING UPON HIS RETURN FROM VACATION

A

AUTOMOTIVE SENSORS AND CONTROLS QRA MANAGER
34 FOREST ST M/S 23-05
ATTLEBORO, MA 02703
TEL : (508) 236-3088
FAX : (508) 236-3745
PAGER: (800) 447-3700 PIN 604-2044

From: McGuirk, Andy
Sent: Friday, February 19, 1999 10:27 AM
To: Sullivan, Martha; Baumann, Russ; Beringhause, Steven; Baker, Gary
Cc: Rowland, Thomas; Dague, Bryan; Pechonis, John; Rahman, Aziz; Douglas, Charles; Watt, Jim
Subject: FORD PRESSURE IN SYSTEM....CYCLES C/O (U)Pressure Tests

ATTORNEY CLIENT PRIVILEGED COMMUNICATION

I HAVE BRIEFLY REVIEWED AND **BOLD NOTED** SEVERAL AREAS (AS WELL AS ADDED BLUE NOTES FOR CLARITY) FOR OUR FIRST CONSIDERATION. SEEMS THE TRACTION 'CONTROL' OR, AS IT WAS CALLED THE 'AUGMENTATION', MECHANISMS ARE FINALLY BEING REVIEWED AS CYCLE CONTRIBUTOR IN THE SYSTEM AND THIS FORD NOTE SHOULD MAKE IT A KEY FOCAL POINT BY LATER TODAY...

ONE CAN SEE THERE ARE A LARGE NUMBER OF PRESSURE AND CYCLE COMBINATIONS IN THIS SYSTEM INCLUDING SHOCK WAVES AS WELL AS CONTROL WAVES....MIGHT BE THESE SYSTEMS THAT 'LIMIT' THE WEAR OUT ISSUE TO THIS PLATFORM AND YEARS.

BRIEFLY STATED FOR YOUR REFERENCE BELOW; OUR SWITCH WAS SPEC'D BY FORD TO 'OPERATE' 500,000 CYCLES TO 1450 PSI, AND 'PROOF' (IE, RUN UP TO PRESSURE AND 'STILL' FUNCTION AFTER EXPOSURE) TO 3000 PSI, AND 'BURST' (IE, NOT RUPTURE DURING 30 SECONDS EXPOSURE) OF 7000 PSI.

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From: Rahman, Aziz
Sent: Friday, February 19, 1999 8:57 AM
To: McGuirk, Andy; Beringhause, Steven; Dague, Bryan; Baumann, Russ; Sharpe, Robert; Baker, Gary; Douglas, Charles
Subject: FW: (U)Pressure Tests

GOOD INFO.

From: Steve Reimers[SMTP:sreimers@ford.com]
Sent: Friday, February 19, 1999 8:13 AM
To: Aziz Rahman, Texas
Subject: (U)Pressure Tests

fyi... I gave him a copy of your test plan and asked what pressure range and fr
equency we should instrument for.

Steve Reimers — building 5 3C043
AVT Chassis E/E System Applications — mail drop 5011
39-03286 SREIMERS sreimers@ford.com — fax 39-03286 ;>
*** Forwarding note from JJOYCE1 --DRBN007 02/18/99 19:40 ***
To: SREIMERS--DRBN007
cc: FPORTER --DRBN007

FROM: John Joyce USABT(UTC -05:00)
Subject: (U)Pressure Tests

Steve,

I got your note and will be on vacation tomorrow through Wednesday. Here's the info.

The more I think about this, the more I think TRACTION CONTROL activation may be the
mechanism (? CYCLES AND LINE PRESSURES).

I am not sure of the order of the things connected and that can influence the low frequency amplitude of the signals. (WE HAVE INDICATED THE P/S LOCATION COULD BE KEY IN THIS ISSUE... MASTER CYLINDER VS PROP VALVE MOUNTING BEING ONE POINT I HAVE TRIED TO MAKE CLEAR) But the short answer is to instrument for 0-250 Bar and sample at 1 kHz or more.

Since I'm not sure of where the pressure switch is hydraulically connected I'll give you pressures at nodes and states I do know. **worst case for the switch would be to be connected between the HCU and the prop valve , which is where I think it is.**

This is the low frequency component of the signal, I'll talk about the high-frequency component further down.

MC - HCU NODE
Maximum Pressure - ~175 Bar (1 BAR IS 14.5 PSI, 2537 PSI)
Achieved by getting maximum vacuum (high revving engine and suddenly close throttle) then standing on the pedal as hard as you can. I don't remember this number very well it might be as low as ~130 or as high as 220 (3190 PSI). It also
depends on your leg strength. This type of pressure is VERY RARE at this node. For this car, the driver will typically apply <20 bar and vary rarely exceed 50 bar.

HCU - PROP VALVE NODE
Standing Still - Same as MC pressure - see above.

ABS Maximum - ~110 Bar (1595 PSI)
This is achieved by loading to GVW and performing an ABS stop, you may find that you are pedal effort limited, not limited by ABS control. It's pretty rare to get this high of pressure in this mode.

TCS Maximum - ~180 Bar(2610 PSI)
This is a good candidate. On this vehicle because the HCU had to pump through the prop valve to do the brakes-only traction control, the pressures coming out of the HCU got very high. The pressure relief valve on the pump VERY OFTEN dictated the peak pressure which could be developed - not the control - put another way, because the pressure at the rear brake had to restrain the entire powertrain (no engine intervention) and push through a prop valve, it was often possible to drive through the TC - the engine could overpower the brakes, even though very high pressures were being generated at the HCU. The noise during TC activation in these applications was very dependent upon the pressure relief valve opening point. So the pressure relief valve value got changed a few times over the years as performance was sacrificed for NOISE VIBRATION HARSHNESS. Also the tolerance on the pressure
relief valves was fairly large - a total of 40 bar, at that time I believe. The pressure relief valve pressure might be anywhere from 90 to 180 bar

depending on part-to-part variation and the design generation that was agreed upon.

You can achieve this easiest by getting the rear wheels off the ground and putting the car in drive. Get into the throttle hard, but not so hard that you drive out of first gear or faster than ~15 mph. If you maintain this for a while, the thermal model to protect the rear linings will disable the Traction Control. You will then need to wait for them to cool, before the function will be reenabled. You can dramatically accelerate the cooling time by cruising (without braking) at about 40 mph.

Typical drivers can regularly get high pressures (2610 PSI) in this mode.

PROP VALVE - REAR BRAKE MODE
ABS Maximum Pressure ~70 Bar
Load to GROSS VEHICLE WEIGHT and perform an ABS stop at maximum pedal effort.

TCS Maximum Pressure ~100 Bar
This pressure level is strongly dependent upon the pressure relief valve level - see above.

Standing Still
Same as ABS Maximum Pressure

High Frequency Content

The high frequency content has two parts. If you are not in ABS or Traction Control there is practically no high frequency content - the pressure is modulated at <10 Hz. This is basically limited by Booster response times and hydraulic dampening in the ABS orifices.

High Frequency Content Due To Control
During ABS/TC events the pressure is changed in quick steps(CYCLES?). Typically
it will increase by ~10 Bar in a few milliseconds, and this type of change occurs about every 100ms. The pressure will decrease by about 20 Bar every 300 ms. There can be quite a bit of variation in these numbers, but those are pretty typical. (Actually the numbers I assigned were for ABS, swap "increase" and "decrease" for TRACTION CONTROL activation.)

High Frequency Content Due to Shock Waves
This is a secondary effect from the control. Generally it is worst right at the outlet of the HCU. It is dampened and dissipated the further you get from the HCU. The shock wave is generated from the cyclical pulsing of the pump as well as the sudden changes in pressure when a solenoid valve is snapped open or shut.

The amplitude of this (shock waves) can be really big - I haven't looked at it in this generation unit for a few years, but I think it's about 50 Bar peak-peak (725 PSI)
right at the HCU. It will fall off as you move further away from the HCU.

The frequency is pretty high and I think some components are above the 1 kHz level, but you can get a very good idea of the disturbances by sampling at ~1kHz.

Regards,
John Joyce

Dague, Bryan

From: Rahman, Aziz
Sent: Friday, February 19, 1999 12:33 PM
To: 'Steve Reimers (Ford)'
Cc: McGuirk, Andy; Dague, Bryan; Sharpe, Robert; Beringhause, Steven; Baumann, Russ
Subject: Test Plan Update

Steve,

This is the updated test plan for your meeting this afternoon. Please add the details of the 50Amp test we did at AVT last week.

Andy McGuirk will be calling you today afternoon between 1 and 1.30 to go over the test results and any other information you may need for your meeting.

The spark tests (clutch loads) have not been included as of yet in this matrix. We will work them in once we get the clutch loads through you.

See you Monday AM.


Test Log.xls

Regards
Aziz.

Dague, Bryan

From: McGuirk, Andy
Sent: Friday, February 19, 1999 10:44 AM
To: Dague, Bryan; Watt, Jim; Beringhause, Steven
Cc: Rahman, Aziz; Baumann, Russ; Pechonis, John
Subject: MATERIAL FOR AZIZ
Importance: High

AZIZ WILL COME INTO THE PLANT SATURDAY TO PICK UP FOLLOWING ITEMS:

SAMPLES OF P/S FROM THE KAPTON CHARACTERIZATION TESTING WE HAVE DONE HERE (PROVIDES FORD THE 'SAME' SAMPLES WE HAVE COLLECTED FROM THE 'EVERY 200,000K' CYCLE TEST TO CHARATERIZE WEAR STATES.
.....BRYAN AND STEVE, PLS COORDINATE THESE INTO AZIZ OFFICE FOR HIS PICK UP

OFFSET KEYWAY CONNECTOR TO FIT THE PRESSURE SWITCHES WE ARE ALL TALKING ABOUT....PRESSURE TESTER HAS WRONG (?) CONNECTOR AND NEEDS RIGHT CONNECTOR HARNESS
.....BRYAN AND STEVE, PLS COORDINATE INTO AZIZ OFFICE FOR HIS PICK UP

'CORRECT' PRESSURE FITTING TO CONNECT INTO PRESSURE STATION AND INTO SWITCH QUICK CONNECT.
.....BRYAN AND STEVE AND JIM WATT, PLS COORDINATE INTO AZIZ'S OFFICE FOR SAT PICKUP

IF THERE ARE ANY QUESTIONS, PAGE AZIZ BEFORE NOON TODAY.....JIM WATT, PLS 'HOVER' OVER THIS TO ASSURE IT HAPPENS

A
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Steve Reimers building 5 3C043
AVT Chassis E/E System Applications mail drop 5011
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*** Forwarding note from JJOYCE1 --DRBN007 02/18/99 19:40 ***
To: SREIMERS--DRBN007
cc: FPORTER --DRBN007

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Subject: FW: (U)Pressure Tests

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FROM: John Joyce USAET(UTC -05:00)
Subject: (U)Pressure Tests

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You can achieve this easiest by getting the rear wheels off the ground and putting the car in drive. Get into the throttle hard, but not so hard that you drive out of first gear or faster than ~15 mph. If you maintain this for a while, the thermal model to protect the rear linings will disable the Traction Control. You will then need to wait for them to cool, before the function will be reenabled. You can dramatically accelerate the cooling time by cruising (without braking) at about 40 mph.

Typical drivers can regularly get high pressures in this mode.

PROP VALVE - REAR BRAKE MODE
ABS Maximum Pressure ~70 Bar
Load to GVW and perform an ABS stop at maximum pedal effort.

TCS Maximum Pressure ~100 Bar
This pressure level is strongly dependent upon the pressure relief valve level - see above.

Standing Still
Same as ABS Maximum Pressure

High Frequency Content
The high frequency content has two parts. If you are not in ABS or Traction Control there is practically no high frequency content - the pressure is modulated at <10 Hz. This is basically limited by Booster response times and hydraulic dampening in the ABS orifices.

High Frequency Content Due To Control
During ABS/TC events the pressure is changed in quick steps. Typically it will increase by ~10 Bar in a few milliseconds, and this type of change occurs about every 100ms. The pressure will decrease by about 20 Bar every 300 ms. There can be quite a bit of variation in these numbers, but those are pretty typical. (Actually the numbers I assigned were for ABS, swap "increase" and "decrease" for TC activation.)

High Frequency Content Due to Shock Waves
This is a secondary effect from the control. Generally it is worst right at the outlet of the HCU. It is dampened and dissipated the further you get from the HCU. The shock wave is generated from the cyclical pulsing of the pump as well as the sudden changes in pressure when a solenoid valve is snapped open or shut.

The amplitude of this can be really big - I haven't looked at it in this generation unit for a few years, but I think it's about 50 Bar peak-peak right at the HCU. It will fall off as you move further away from the HCU.

The frequency is pretty high and I think some components are above the 1 kHz level, but you can get a very good idea of the disturbances by sampling at ~1kHz.

Regards,

John Joyce

Dague, Bryan

From: Beringhause, Steven
Sent: Friday, February 19, 1999 7:00 AM
To: Dague, Bryan
Subject: FW: Brake Pressure Switch Test Log.xls

This is it.

From: Rahman, Aziz
Sent: Tuesday, February 16, 1999 5:08 PM
To: 'Fred Porter (Ford)'; 'Norm LaPointe (Ford)'; 'Steve LaRouche (Ford)'; 'Steve Reimen (Ford)'
Cc: Beringhause, Steven; Dague, Bryan; McGuirk, Andy; Baumann, Russ; Sharpe, Robert
Subject: Brake Pressure Switch Test Log.xls

Brake Pressure Switch Test Log.xls

Team,

This is a first pass at the test log we can use to track our tests and to update the core team on Wednesday meetings. Please review/add/edit/comment.

Thanks
Aziz.

Dague, Bryan

From: Beringhause, Steven
Sent: Friday, February 19, 1999 6:48 AM
To: Dague, Bryan
Subject: FW: Ford overview.... 2/18 telecon Update

From: McGuirk, Andy
Sent: Thursday, February 18, 1999 6:46 PM
To: Sullivan, Martha; Rowland, Thomas; Baumann, Russ; Baker, Gary
Cc: Beringhause, Steven; Pechonis, John; Rahman, Aziz; Bartosh, Bob; Sharpe, Robert; Douglas, Charles; Hopkins, AL

Subject: Ford overview.... 2/18 telecon Update

attorney client privileged communication

BELOW ARE MINUTES FROM MY TELECON WITH STEVE REIMERS OF FORD AND AZIZ RAHMAN FROM 2/18

REVIEWED FORD'S ANALYSIS SPREADSHEET AND SWITCH BACKLOG:

SUGGESTED PRIORITY OF SWITCHES FOR ANALYSIS PER OUR INTERNAL MEETING.... DISCOVERED SEVERAL OF THE '?' DATE CODES ARE IN SOME STAGE OF DISASSEMBLY (NOT CORRODED CRIMP RINGS AS WE THOUGHT) AND FORM WILL BE UPDATED TO SHOW STATE....AGREED THAT PRIORITY SHOULD BE HIGH MILE TOWNCARS FOLLOWED BY HIGH MILE CROWN-VIC/GRAND MARQ WITH SOME LOW MILE BASELINES. ALSO AGREED TO REVIEW 'CORROSION' UNITS FIRST IF EXTERNAL CORROSION WAS VISIBLE. MADE POINT TO TRACK ABS AND TRACTION CONTROL

WE AGREED THAT THE FORD EVALUATION PROCESS WAS OKAY TO USE

REVIEWED 'SCIENCE FAIR' EXPERIMENTS RESULTS

FORD REQUESTED UPDATE TO TEST LOG FIRST THING FRIDAY FOR TI TESTS NUMBER 1,2,6,7,8,10 TO INCLUDE FINAL OBSERVATIONS WITH DETAIL LIKE 'WAS THERE INTERNAL BLACK CORROSION' AFTER CYCLE TESTS AT TEMP ETC. THIS WILL BE USED TO SHOW EXECS THAT WE ARE MOVING FORWARD. WHILE IN THE CONTEXT OF VARIOUS ELECTRICAL OVERPOWER TESTS STEVE STATED "THE SWITCH BY ITSELF IS NOT ENOUGH TO 'LIGHT' UP" AND EXPANDED "IT SEEMS TO NEED A SPARK" WHICH THEN LED TO DIALOGUE ABOUT 'SPARK' BASED TESTS.

FORD REQUESTED WE ADD TESTS 12,13,14 TO BE "ES" TYPE (107 DEG C AMBIENT, 135 DEG C FLUID, PRESSURE CYCLING) INDUCTIVE TESTS OF SWITCHES WITH 'HIGH' CURRENT (AS MUCH AS WE CAN GET THRU THE INDUCTORS WITHOUT SATURATION) WITH 12 'CLEAN AND EMPTY', 13 'CLEAN BRAKE FLUID FILLED', AND 14 'CONTAMINATED BRAKE FLUID FILLED'. SEEMS LIKE THEY ARE TELLING US THAT THERE IS A 'SNEAK' CIRCUIT IN HERE SOMEPLACE THAT CAN AFFECT SWITCH ELECTRICALLY (FORD WILL SUPPLY SEVERAL SERVO MOTORS TO ACT AS LOADS).

FORD ALSO REQUESTED 'TO THE EXTENT POSSIBLE' THAT WE USE THE FORD EVALUATION CRITERIA TO CHARACTERIZE SWITCHES AFTER TESTING....PROVIDING A BASELINE OF DATA FROM SWITCH 'CADAVERS' FOR USE IN COMPARING TO FIELD RETURNS.

STEVE BERINGHAUSE AND I WILL REVIEW THESE FORD REQUESTS FOR RESOLUTION

UNDERSTAND FORD'S DATA ABOUT ABS (C/O TEVES) AND PROP VALVE PRESSURE TRACES

CONTINUED TO PUSH FOR THIS.... I THINK OUR PRIVATE PLAN TO GO UNDERSTAND PRESSURE IN DIFFERENT FORD SYSTEM LOCATIONS (MASTER CYLINDER UPSTREAM OF ABS AND TRACTION CONTROL IMPLICATIONS) WILL PROVE TO BE OF VALUE IN DIRECTING PLACEMENT OF SWITCH IN FUTURE AS WELL AS APPOINTING CAUSE NOW

DATA FROM DOW C/O FORD ABOUT BRAKE FLUID AS IT RELATES TO FIRES

DOW VISITING FORD MONDAY AND SHOULD HAVE DATA TO FORD WEDS NEXT WEEK (SLOW !)

KAPTON (FROM FORD)

FORD THINKS WE HAVE COMMITTED TO CONTACTING DUPONT HERE.....HAVE WE ??

UNDERSTAND BRAKE SWITCH AND KAPTON WEAROUT WITH ANOTHER FORD PLATFORM:

FORD STAYS FOCUSED ON THE TOWNCAR AND CROWN-VIC/GRAND-MARQ PLATFORM...NO PLANS HERE. OUR PRIVATE PLANE TO COLLECT SAME IS VALUABLE FOR ULTIMATE USE IN THE FORD GRANDER ISSUE OF OTHER PLATFORMS

DISCUSSED THE POTENTIAL BRAKE PEDAL POSITION AND OTHER 'SOLUTIONS' :

FORD STATED THAT THIS SOLUTION WAS A 'TEMPORARY' 'CONTAINMENT' AND ACKNOWLEDGED THIS SOLUTION WOULD BE POWERED AT ALL TIMES AND THAT IF EVENTS ARE NOT UNDERSTOOD A TOTAL SOLUTION WAS NOT CLEAR. THIS IS FORD'S PRIMARY PATH FOR APRIL 14TH 'SOLUTION'.

FORD ALSO STATED THEY STILL WANT US TO INVENT A HIGH CYCLE SWITCH PACKAGE FOR THIS APPLICATION AS THE LONGER TERM SOLUTION. WE WILL NEED TO GO ON THE RECORD OF OUR NO-POWER-ALL-TIMES CRITERIA AS WELL AS REALIZE THE FORD ORGANIZATION DOES NOT YET UNDERSTAND CYCLE OR CHEMICAL RESISTANCE GOALS. I WILL REVIEW THIS WITH STEVE BERINGHAUSE AND TOM ROWLAND.

a

ATTLEBORO, MA 02703
TEL : (508) 236-3080
FAX : (508) 236-3745
PAGER: (800) 487-3700 PIN 804-2044

From: McGuirk, Andy
Sent: Thursday, February 18, 1999 9:52 AM
To: Sullivan, Martha; Rowland, Thomas; Baumann, Russ; Baker, Gary
Cc: Beringhause, Steven; Pechonis, John; Rahman, Aziz; Bartosh, Bob
Subject: Ford overview.... 2/18 'status' Update

attorney client privileged communication

Ford has seen switch 'wear out' in several samples where brake fluid is believed to have leaked into the switch cavity (total of 7 switches 'analyzed' to 'complete scientific conclusions' from 1 P/S thermal event, 3 underhood thermal events, 2 cruise inops and 1 reference). there are 24 switches awaiting analysis at Ford, and in fact a faster paced analysis scheme is under review at Ford in order to work thru this backlog. **(Steve, do we recommend this approach?...late respond ASAP)**

Ford has concluded the Town Car underhood fire and thermal event and thermal anomaly history (my 92? and my 93?) is comprised of:
149 total events...broken down by Ford as follows

127 unknown causes
17 potential other causes
8 pressure switch causes.....or said a different way, **Ford might say that P/S is the number one known cause**

another cut at this.....broken down by Ford

105 events status unknown
39 events with engine off
9 events with engine on..... or said a different way, Ford might say engine on/off has little effect.....

Ford's executive team has established a plan to achieve root cause phase by March 3rd.

We believe Ford has obtained a two month 'window' from NHTSA.... **April 14th 'public disclosure'** plan

Ford's executive team seems to be frustrated by the inability to get to root cause....to turn on/off by the 'science fair' type testing being done at both TI and Ford to create the issue

We have presented the concept of de-power of the P/S as a containment mechanism....the Ford 1st line people do not seem to be moving toward this....more Friday

We have also presented the concept of the possible application of the APT as a containment mechanism...little movement here too.

Ford's current thought seems to be that the preferred containment solution might be to replace the P/S with a Brake Pedal position sensor as is on-board the '99 Town Car. Looks like first line folks are focused here.....seems like Ford 1st line guys do not want to 'tap' into brake lines in the future?

Ford continues to move slowly.... no Dow or Dupont or Texas involvement 'results' yet....seems like they're still fixing to get ready

Ford's Fred Porter (my primary contact) is on vacation and I am making plans to connect with his 'actes' either late today (he's out ?) or first tomorrow to discuss and direct some of these points. I will publish a 'plan' memo early afternoon today.

a

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AUTOMOTIVE SENSORS AND CONTROLS QRA MANAGER
14 FORMERLY AT M/S 23-05
ATTLEBORO, MA 02703
TEL : (508) 236-3520
FAX : (508) 236-3748
PAGER: (800) 687-3700 PIN 604-2046

From: Rahman, Aziz
Sent: Wednesday, February 17, 1999 6:16 PM
To: Beringhouse, Steven; Dague, Bryan; McGuirk, Andy; Baumann, Russ; Sharpe, Robert
Subject: 2/17 Update

Main event: 2PM core team meeting. Highlights:

- Manager Len Brown agitated that Dow has not shown up yet. Will probably get them on board tomorrow or Friday.
- Exec. meeting at 4.pm Friday. TI not invited. Will present test plan (copy with Steve B.).
- Ford team in DC today at NHTSA, asking 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 warranty data more closely for trending, and special causes.
- Increasing speculation that pure heat is not sufficient to ignite. Need spark.
- Will present brake pedal position sensor to execs as possible containment.

Two tests conducted today at AVT labs:

- Passed about 54 Amps at about 1V, through switch terminals, no fluid. Temp in connector area increased to about 162 F before system went open circuit. Dissection revealed spring arm deformed and twisted away from stationary. Will have pictures tomorrow.

- Passed about 50 Amps at about 1V through switch terminals, with switch based filled with approx 50% Brake Fluid, 50% salt water. Temp in connector area increased to about 270 F and stayed there. No smoke or ignition. Dissection revealed spring arm deformed. Pictures tomorrow.

-Will set up calibration station in Central Lab tomorrow.

- Will be returning to MA Friday 2pm flight.Later flights not available because of vacation week. Per Steve B.'s input, will plan to return next week

Regards
Aziz.

Dague, Bryan

From: Rahman, Aziz
Sent: Thursday, February 18, 1999 12:45 PM
To: 'Fred Porter (Ford)'; 'Norm LaPointe (Ford)'; 'Steve LaRouche (Ford)'; 'Steve Reimers (Ford)'
Cc: Beringhause, Steven; Dague, Bryan; Baumann, Russ; McGuirk, Andy; Sharpe, Robert
Subject: Switch Log and Eval. Procedure

Updated as of 2/18/99. There were some switches from the initial 24 switch survey that were opened up at AVT and the tag and switch parts were not kept together. I have noted this in the log.

Since the tag numbers for every incoming shipment start from 1, I suggest we use VIN numbers to track the database. This will uniquely identify the switch.

I suggest that the switch analysis priority be as follows:

- Switches from underhood fires, which have not been severely damaged
- Switches from Town Cars, starting by highest mileage and descending
- Switches from CV and GM, starting by highest mileage and descending
- Severely damaged switches from underhood fires
- Disassembled switches, with suspect paperwork trail


SwitchLog.xls

Evaluation Procedure updated as of 2/18/99. Note identification of harness wires by color.


EVALPROC.xls

I think we are closing in on finalizing the log format and the evaluation procedures. I believe that these are good enough for us to start using them for data entry.

In order to reduce confusion, I will plan on updating the log once a week. Please delete the earlier versions, so that you have only one latest copy.

Please comment.

Thanks
Aziz

Dague, Bryan

From: Beringhause, Steven
Sent: Thursday, February 18, 1999 7:21 AM
To: Hopkins, AL
Cc: Douglas, Charles; Rahman, Aziz; Baker, Gary; Baumann, Russ; Dague, Bryan; McGuirk, Andy
Subject: RE: Corrosivity of Brake Fluid/Water Mixtures on Brass

Attorney-client privileged communication

Al,
We were hoping to get that info from Aziz through Ford. Ford seems slow to connect with Dow. We will pursue the info from our end.

Steve

From: Hopkins, AL
Sent: Wednesday, February 17, 1999 6:08 PM
To: Beringhause, Steven
Cc: Douglas, Charles; Rahman, Aziz; Baker, Gary; Baumann, Russ; Dague, Bryan; McGuirk, Andy
Subject: Corrosivity of Brake Fluid/Water Mixtures on Brass

Attorney-client privileged communication

Has anybody talked to Dow from our end on the corrosivity 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

Dague, Bryan

From: Rahman, Aziz
Sent: Wednesday, February 17, 1999 6:16 PM
To: Beringhause, Steven; Dague, Bryan; McGuirk, Andy; Baumann, Russ; Sharpe, Robert
Subject: 2/17 Update

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-Will set up calibration station in Central Lab tomorrow.

- Will be returning to MA Friday 2pm flight.Later flights not available because of vacation week. Per Steve B.'s input, will plan to return next week (sigh...).

Regards
Aziz.

Dague, Bryan

From: Hopkins, AL
Sent: Wednesday, February 17, 1999 6:08 PM
To: Beringhause, Steven
Cc: Douglas, Charles; Rahman, Aziz; Baker, Gary; Baumann, Russ; Dague, Bryan; McGuirk, Andy
Subject: Corrosivity of Brake Fluid/Water Mixtures on Brass

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Al

Dague, Bryan

From: Rahman, Aziz
Sent: Wednesday, February 17, 1999 11:59 AM
To: Beringhause, Steven; Dague, Bryan; McGuirk, Andy; Baumann, Russ; Sharpe, Robert; Baker,

Gary; Sullivan, Martha; Douglas, Charles
Subject: FW: 77PS Ford Central Lab Findings

From: LaRoucha, Steve (S.)(SMTPslarouch@ford.com)
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.

<<Findings.doc>>

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

Dague, Bryan

REDACTED

Dague, Bryan

Aziz,

The only issue I am aware of is tied to the Econoline (mating connector issue from CY92) for which we have provided new copies of the 8D for the Ford team. I think you will recall since you were also involved directly with the 77PS back in this timeframe that x-rays showed the terminal arm had completely corroded and in some cases was nothing more than powder and in other cases there was a loose metal part within the switch cavity. However, the only vehicle issue this caused was a cruise control inop code.

Beyond the Econoline, there is a gap in my history on CCPS as I was not directly involved with this program between CY94 - CY97 so it is possible there is another issue I am not aware of. I would suggest that we have Andy follow up with his organization to see if there are any 8D's generated during this timeframe that may be tied to a loose metal part.

Regards,

Charlie

Charlie Douglas
(508) 236-3857 (P)
(508) 236-1596 (F)
c-douglas2@ti.com

From: Rahman, Aziz
Sent: Tuesday, February 16, 1999 8:56 PM
To: Beringhause, Steven; Dague, Bryan; Baumann, Russ; McGuirk, Andy; Baker, Gary; Sharpe, Robert; Douglas, Charles
Subject: 77PS Loose Metal Part?
Importance: High

Please review attached messages. Jack Paskus is Luxury VC Chief Engineer. Do any of you know what the previous history with a "Loose Metal Part" is all about? Could he be talking about the spring arm potentially separating due to corrosion, mechanical fatigue thermal effects etc and causing shorts? Please advise on effects of an assumed loose metal part in the switch cavity.
Do we know which switch terminal is hot and which is grounded through the module? Is the stationary terminal hot or the movable?

Thanks
Aziz.

From: Steve Reimers(SMTP:sreimers@ford.com)
Sent: Tuesday, February 16, 1999 6:13 PM
To: jnerne@ford.com; nkapoint@ford.com; nevi@ford.com; skrouch@ford.com; Aziz Rahman, Texas
Subject: (U)

Can you help me get smart regarding the "LOOSE METAL PART" mentioned above?

Steve Reimers building 5 3C043
AVT Chassis E/E System Applications mail drop 5011
39-03286 SREIMERS sreimers@ford.com fax 39-03286 ;>
*** Forwarding note from SCOLE1 --DRBN005 02/16/99 18:04 ***
To: SREIMERS--DRBN007
cc: DGOEL --DRBN005

From: Sam L. Cole USAET(UTC -05:00)
Subject: (U)
THE PREVIOUS CONCERN OF THE "LOOSE METAL PART" WAS MENTIONED IN THE LAST MEETING WITH JACK. HE WILL WANT A FOLLOW UP ON THIS AT THIS FRIDAY'S

MEETING. PLEASE GET UP TO SPEED ON THE HISTORY OF THIS CONCERN. IF IT TURNS OUT THAT THIS MAY BE A CAUSE, THEN WE WILL NEED TO KNOW WHEN THE ISSUE WAS IN THE FIELD, WHEN IT WAS FIXED AND HOW MANY ARE OUT THERE TO BE CONCERNED ABOUT. THANKS.

Thank You,
Sam
Ext. 21959
BLDG. 2, 22J31 - MD# 1220_- SCOLE1@FORD.COM
*** Forwarding note from SREIMERS--DRBN007 02/16/99 16:52 ***
To: SCOLE1 --DRBN005 DGOEL --DRBN005

FROM: Steve Reimers USAST(UTC -05:00)
Subject: (U)
I have the part to show and a take-apart version too. I am not familiar with t
he previous problem but a loose metal part in the switch cavity is definitely a
potential cause of this concern.

Steve Reimers building 5 3C043
AVT Chassis E/E System Applications mail drop 5011
39-03286 SREIMERS sreimers@ford.com fax 39-03286 />
*** Forwarding note from DB7AWAYR--DRBN007 02/16/99 13:41 ***
Subject: AWAY Facility/VM messages
This note was generated by the AWAY Facility/VM 5799-FLP (c)IBM Corp.
DO NOT REPLY TO THIS NOTE

AWA110I This mail item is being routed to you from SCOLE1 at DRBN005
on behalf of FPORTER at DRBN007.

To: FPORTER --DRBN007
cc: TMASTERS--DRBN005 TDONOVAN--DRBN005
DGOEL --DRBN005

From: Sam L. Cole USAST(UTC -05:00)
Subject: (U)
I UNDERSTAND THAT THERE WILL BE A FOLLOW UP MEETING WITH JACK PASKUS
THIS FRIDAY ON THE TOWN CAR INVESTIGATION. I MET WITH JACK TODAY FOR A 1
ON 1, AND HE REQUESTED SOME SPECIFIC INFO. AT FRIDAYS MEETING, PLEASE
BRING A SAMPLE SWITCH TO SHOW JACK.

ALSO, HE IS INTERESTED IN KNOWING OUR PROGRESS AND INVESTIGATING IF THE
PREVIOUS PROBLEM WITH THE INTERNAL COMPONENTS BREAKING LOOSE IS A
POTENTIAL CAUSE OF THIS CONCERN. PLEASE BE PREPARED TO DISCUSS THIS ON
FRIDAY. THANKS.

Thank You,
Sam
Ext. 21959
BLDG. 2, 22J31 - MD# 1220_- SCOLE1@FORD.COM

Dague, Bryan

From: Beringhause, Steven
Sent: Wednesday, February 17, 1999 11:08 AM

To: Dague, Bryan; McGuirk, Andy; Baumann, Russ; Sharpe, Robert; Rahman, Aziz
Subject: RE: Switch 7

Attorney client Privileged Information

Aziz,
I spoke with Al Hopkins and he and I both agree that brake fluid alone will not cause the corrosion of the contact arm. Water and contaminants in the water that drive conductivity will be needed to drive the corrosion. Although it is possible that the "dirty" water could come in to the switch with the brake fluid, it is more likely that the corrosion was caused by water and contaminants through the connector.

Regards,
Steve

From: Rahman, Aziz
Sent: Wednesday, February 17, 1999 10:21 AM
To: Beringhause, Steven; Dague, Bryan; McGuirk, Andy; Baumann, Russ; Sharpe, Robert
Subject: FW: Switch 7

Steve, I think it will be a good idea to respond quickly with what may have caused the spring arm to corrode. I believe that salt water intrusion will caused more accelerated corrosion than brake fluid.

From: Steve Reimers(SMTP:sreimers@ford.com)
Sent: Wednesday, February 17, 1999 9:41 AM
To: nlapoint@ford.com; Aziz Rahman, Texas
Subject: RE: (U)

```
Steve Reimers                                  building 5  3C043
AVT Chassis E/E System Applications            mail drop  5011
39-03286 SREIMERS   sreimers@ford.com          fax 39-03286      ;>
*** Forwarding note from SLAROUCH--FORDNA1  02/17/99 08:18 ***
To: SREIMERS--FORDMAIL Reimers, Steve (S.

From: LaRouche, Steve (S.)
Subject: RE: (U)

Steve:  The switch in question is switch F.  The copper-berylium arm of the
movable contact separated from the brass base.  Now that we have had a
chance to look at it in closer detail, it appears that the arm separated due
to a loss of material thickness from corrosion.  We have also found evidence
of stress corrosion cracking in the stationary contact.  We did not see any
evidence of heat or arc damage in this switch.  It looked like the arm
separated, fell away, and stuck to the wall of the switch cavity.

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


-----Original Message-----
From: Steve Reimers [mailto:sreimers@gw.ford.com]
Sent: Tuesday, February 16, 1999 6:13 PM
To: jnemo@gw.ford.com; nlapoint@gw.ford.com; rnevi@gw.ford.com;
slarouch@mail.ford.com; Aziz Rahman, Texas
```

Subject: (U)

Can you help me get smart regarding the "LOOSE METAL PART" mentioned above?

Steve Reimers building 5 3C043
AVT Chassis E/E System Applications mail drop 5011
39-03286 SREIMERS sreimers@ford.com fax 39-03286 ;>
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cc: DGOEL --DRBN005

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Subject: (U)
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To: FPORTER --DRBN007
cc: TMASTERS--DRBN005 TDONOVAN--DRBN005
DGOEL --DRBN005

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FRIDAY. THANKS.

Thank You,
Sam
Ext. 21959
BLDG. 2, 22J31 - MD# 1220_- SCOLE16FORD.COM

Dague, Bryan

From: Rahman, Aziz
Sent: Wednesday, February 17, 1999 11:01 AM
To: Dague, Bryan
Subject: Econoline 8D

Can you e-mail me a copy of that 8-D, or you can fax me a hard copy at 313-390-4145. Thx

---

From: Dague, Bryan
Sent: Wednesday, February 17, 1999 10:54 AM
To: Beringhause, Steven; McGuirk, Andy; Baumann, Russ; Sharpe, Robert; Rahman, Aziz
Subject: RE: Switch 7

Aziz,

I have not been able to close with JP yet, but I believe the only time we had an arm problem in the field was with the econo van circa 1992. You are very familiar with that issue.

I think somebody got this issue confused.

Regards,
Bry

From: Rahman, Aziz
Sent: Wednesday, February 17, 1999 10:21 AM
To: Beringhause, Steven; Dague, Bryan; McGuirk, Andy; Baumann, Russ; Sharpe, Robert
Subject: FW: Switch 7

Steve, I think it will be a good idea to respond quickly with what may have caused the spring arm to corrode. I believe that salt water intrusion will caused more accelerated corrosion than brake fluid.

From: Steve Reimers(SMTP:sreimers@ford.com)
Sent: Wednesday, February 17, 1999 9:41 AM
To: nlapoint@ford.com; Aziz Rahman, Texas
Subject: RE: (U)

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

*** Forwarding note from SLAROUCH--FORDMAI 02/17/99 08:18 ***
To: SREIMERS--FORDMAIL Reimers, Steve (S.

From: LaRouche, Steve (S.)
Subject: RE: (U)

Steve: The switch in question is switch F. The copper-berylium arm of the movable contact separated from the brass base. Now that we have had a chance to look at it in closer detail, it appears that the arm separated due to a loss of material thickness from corrosion. We have also found evidence of stress corrosion cracking in the stationary contact. We did not see any evidence of heat or arc damage in this switch. It looked like the arm separated, fell away, and stuck to the wall of the switch cavity.

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

-----Original Message-----
From: Steve Reimers [mailto:sreimers@gw.ford.com]
Sent: Tuesday, February 16, 1999 6:13 PM
To: jneme@gw.ford.com; nlapoint@gw.ford.com; rnevi@gw.ford.com; slarouch@mail.ford.com; Aziz Rahman, Texas
Subject: (U)

Can you help me get smart regarding the 'LOOSE METAL PART' mentioned above?

Steve Reimers building 5 3C043
AVT Chassis E/E System Applications mail drop 5011
39-03286 SREIMERS sreimers@ford.com fax 39-03286 />
*** Forwarding note from SCOLE1 --DRBN005 02/16/99 18:04 ***
To: SREIMERS--DRBN007
cc: DGOEL --DRBN005

From: Sam L. Cole USART(UTC -05:00)
Subject: (U)
THE PREVIOUS CONCERN OF THE 'LOOSE METAL PART' WAS MENTIONED IN THE LAST MEETING WITH JACK. HE WILL WANT A FOLLOW UP ON THIS AT THIS FRIDAY'S MEETING. PLEASE GET UP TO SPEED ON THE HISTORY OF THIS CONCERN. IF IT TURNS OUT THAT THIS MAY BE A CAUSE, THEN WE WILL NEED TO KNOW WHEN THE ISSUE WAS IN THE FIELD, WHEN IT WAS FIXED AND HOW MANY ARE OUT THERE TO BE CONCERNED ABOUT. THANKS.

Thank You,
Sam
Ext. 21959
BLDG. 2, 22J31 - MD# 1220_- SCOLE1@FORD.COM
*** Forwarding note from SREIMERS--DRBN007 02/16/99 16:52 ***
To: SCOLE1 --DRBN005 DGOEL --DRBN005

FROM: Steve Reimers USART(UTC -05:00)
Subject: (U)
I have the part to show and a take-apart version too. I am not familiar with t
he previous problem but a loose metal part in the switch cavity is definitely a
potential cause of this concern.

Steve Reimers building 5 3C043

AVT Chassis E/E System Applications mail drop 5011
39-03286 SREIMERS sreimers@ford.com fax 39-03286 ;>
*** Forwarding note from DB7ANAYR--DRBN007 02/16/99 13:41 ***
Subject: AMAY Facility/VM messages
This note was generated by the AMAY Facility/VM 5799-FLP (c)IBM Corp.
DO NOT REPLY TO THIS NOTE

ANAL10I This mail item is being routed to you from SCOLE1 at DRBN005
on behalf of FPORTER at DRBN007.

To: FPORTER --DRBN007
cc: TMASTERS--DRBN005 TDONOVAN--DRBN005
DGOEL --DRBN005

From: Sam L. Cole USAET(UTC -05:00)
Subject: (U)
I UNDERSTAND THAT THERE WILL BE A FOLLOW UP MEETING WITH JACK PASKUS THIS FRIDAY ON THE TOWN CAR INVESTIGATION. I MET WITH JACK TODAY FOR A 1 ON 1, AND HE REQUESTED SOME SPECIFIC INFO. AT FRIDAYS MEETING, PLEASE BRING A SAMPLE SWITCH TO SHOW JACK.

ALSO, HE IS INTERESTED IN KNOWING OUR PROGRESS AND INVESTIGATING IF THE PREVIOUS PROBLEM WITH THE INTERNAL COMPONENTS BREAKING LOOSE IS A POTENTIAL CAUSE OF THIS CONCERN. PLEASE BE PREPARED TO DISCUSS THIS ON FRIDAY. THANKS.

Thank You,
Sam
Ext. 21959
BLDG. 2, 22J31 - MD# 1220_- SCOLE1@FORD.COM

Dague, Bryan

From: Rahman, Aziz
Sent: Wednesday, February 17, 1999 10:21 AM
To: Beringhause, Steven; Dague, Bryan; McGuirk, Andy; Baumann, Russ; Sharpe, Robert
Subject: FW: Switch 7

Steve, I think it will be a good idea to respond quickly with what may have caused the spring arm to corrode. I believe that salt water intrusion will caused more accelerated corrosion than brake fluid.

From: Steve Reimers(SMTP:sreimers@ford.com)
Sent: Wednesday, February 17, 1999 9:41 AM
To: nlapoint@ford.com; Aziz Rahman, Texas
Subject: RE: (U)

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

*** Forwarding note from SLAROUCH--FORDNA1 02/17/99 08:18 ***
To: SREIMERS--FORDMAIL Reimers, Steve (S.

From: LaRouche, Steve (S.)
Subject: RE: (U)

Steve: The switch in question is switch F. The copper-berylium arm of the movable contact separated from the brass base. Now that we have had a chance to look at it in closer detail, it appears that the arm separated due to a loss of material thickness from corrosion. We have also found evidence of stress corrosion cracking in the stationary contact. We did not see any evidence of heat or arc damage in this switch. It looked like the arm separated, fell away, and stuck to the wall of the switch cavity.

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

-----Original Message-----
From: Steve Reimers [mailto:sreimers@gw.ford.com]
Sent: Tuesday, February 16, 1999 6:13 PM
To: jname@gw.ford.com; nlapoint@gw.ford.com; rnavi@gw.ford.com; slarouch@mail.ford.com; Aziz Rahman, Texas
Subject: (U)

Can you help me get smart regarding the "LOOSE METAL PART" mentioned above?

Steve Reimers building 5 3C043
AVT Chassis E/E System Applications mail drop 5011
39-03286 SREIMERS sreimers@ford.com fax 39-03286 ;>
*** Forwarding note from SCOLE1 --DREN005 02/16/99 18:04 ***
To: SREIMERS--DREN007
cc: DGOEL --DREN005

From: Sam L. Cole USAST(UTC -05:00)
Subject: (U)
THE PREVIOUS CONCERN OF THE "LOOSE METAL PART" WAS MENTIONED IN THE LAST MEETING WITH JACK. HE WILL WANT A FOLLOW UP ON THIS AT THIS FRIDAY'S MEETING. PLEASE GET UP TO SPEED ON THE HISTORY OF THIS CONCERN. IF IT TURNS OUT THAT THIS MAY BE A CAUSE, THEN WE WILL NEED TO KNOW WHEN THE ISSUE WAS IN THE FIELD, WHEN IT WAS FIXED AND HOW MANY ARE OUT THERE TO BE CONCERNED ABOUT. THANKS.

Thank You,
Sam
Ext. 21959
BLDG. 2, 22J31 - MD# 1220_- SCOLE1@FORD.COM
*** Forwarding note from SREIMERS--DREN007 02/16/99 16:52 ***
To: SCOLE1 --DREN005 DGOEL --DREN005

FROM: Steve Reimers USAST(UTC -05:00)
Subject: (U)
I have the part to show and a take-apart version too. I am not familiar with t
he previous problem but a loose metal part in the switch cavity is definitely a
 potential cause of this concern.

Steve Reimers building 5 3C043

AVT Chassis E/E System Applications mail drop 5011
39-03286 SREIMERS sreimers@ford.com fax 39-03286 ;>
*** Forwarding note from DB7AWAYR--DRBN007 02/16/99 13:41 ***
Subject: AWAY Facility/VM messages
This note was generated by the AWAY Facility/VM 5799-FLP (c)IBM Corp.
DO NOT REPLY TO THIS NOTE

AWA110I This mail item is being routed to you from SCOLE1 at DRBN005
on behalf of FPORTER at DRBN007.

To: FPORTER --DRBN007
cc: TMASTERS--DRBN005 TDONOVAN--DRBN005
DGOEL --DRBN005

From: Sam L. Cole USAET(UTC -05:00)
Subject: (U)
I UNDERSTAND THAT THERE WILL BE A FOLLOW UP MEETING WITH JACK PASKUS THIS FRIDAY ON THE TOWN CAR INVESTIGATION. I MET WITH JACK TODAY FOR A 1 ON 1, AND HE REQUESTED SOME SPECIFIC INFO. AT FRIDAYS MEETING, PLEASE BRING A SAMPLE SWITCH TO SHOW JACK.

ALSO, HE IS INTERESTED IN KNOWING OUR PROGRESS AND INVESTIGATING IF THE PREVIOUS PROBLEM WITH THE INTERNAL COMPONENTS BREAKING LOOSE IS A POTENTIAL CAUSE OF THIS CONCERN. PLEASE BE PREPARED TO DISCUSS THIS ON FRIDAY. THANKS.

Thank You,
Sam
Ext. 21959
BLDG. 2, 22J31 - MD# 1220_- SCOLE1@FORD.COM

Dague, Bryan

From: Rahman, Aziz
Sent: Tuesday, February 16, 1999 10:47 PM
To: Beringhause, Steven; McGuirk, Andy; Dague, Bryan; Baumann, Russ; Sharpe, Robert
Subject: FW: Brake Pressure Switch Evaluation Plan.xls

fyi.

Bryan/Steve, please forward Al Hopkins' protocol for dissecting switches. Thanks.

From: Rahman, Aziz
Sent: Tuesday, February 16, 1999 10:44 PM
To: 'Fred Porter (Ford)'; 'Norm LaPointe (Ford)'; 'Steve LaRouche (Ford)'; 'Steve Reimers (Ford)'
Subject: Brake Pressure Switch Evaluation Plan.xls

Brake Pressure Switch Evaluation Plan.xls

Team, please review evaluation plan. I will add the switch dissection section tomorrow. The pressure calibration station from TI is expected to arrive on Thursday and will probably reside at Central Labs due to availability of high pressure air.

Steve R, will Allan be available to perform the electrical characterizations data collection? I can definitely help with data analysis and maintenance of the database.

Please review the attachment and let's discuss tomorrow.

Thanks
Aziz.

Dague, Bryan

From: Rahman, Aziz
Sent: Tuesday, February 16, 1999 8:56 PM
To: Beringhause, Steven; Dague, Bryan; Baumann, Russ; McGuirk, Andy; Baker, Gary; Sharpe, Robert; Douglas, Charles
Subject: 77PS Loose Metal Part?
Importance: High

Please review attached messages. Jack Paskus is Luxury VC Chief Engineer. Do any of you know what the previous history with a "Loose Metal Part" is all about? Could he be talking about the spring arm potentially separating due to corrosion, mechanical fatigue thermal effects etc and causing shorts? Please advise on effects of an assumed loose metal part in the switch cavity.
Do we know which switch terminal is hot and which is grounded through the module? Is the stationary terminal hot or the movable?

Thanks
Aziz.

From: Steve Reimers(SMTP:sreimers@ford.com)
Sent: Tuesday, February 16, 1999 6:13 PM
To: jhanes@ford.com; nicpoint@ford.com; mevi@ford.com; slarouch@ford.com; Aziz Rahman, Texas
Subject: (U)

Can you help me get smart regarding the "LOOSE METAL PART" mentioned above?

Steve Reimers — building 5 3C043
AVT Chassis E/E System Applications — mail drop 5011
39-03286 SREIMERS sreimers@ford.com — fax 39-03286 ;>
*** Forwarding note from SCOLE1 --DREN005 02/16/99 18:04 ***
To: SREIMERS--DREN007
cc: DGOEL --DREN005

From: Sam L. Cole USAET(UTC -05:00)
Subject: (U)
THE PREVIOUS CONCERN OF THE "LOOSE METAL PART" WAS MENTIONED IN THE LAST MEETING WITH JACK. HE WILL WANT A FOLLOW UP ON THIS AT THIS FRIDAY'S MEETING. PLEASE GET UP TO SPEED ON THE HISTORY OF THIS CONCERN. IF IT TURNS OUT THAT THIS MAY BE A CAUSE, THEN WE WILL NEED TO KNOW WHEN THE ISSUE WAS IN THE FIELD, WHEN IT WAS FIXED AND HOW MANY ARE OUT THERE TO

BE CONCERNED ABOUT. THANKS.

Thank You,
Sam
Ext. 21959
BLDG. 2, 22J31 - MD# 1220_- SCOLE1@FORD.COM
*** Forwarding note from SREIMERS--DREN007 02/16/99 16:52 ***
To: SCOLE1 --DREN005 DGOEL --DREN005

FROM: Steve Reimers USAET(UTC -05:00)
Subject: (U)
I have the part to show and a take-apart version too. I am not familiar with t
he previous problem but a loose metal part in the switch cavity is definitely a
potential cause of this concern.

Steve Reimers building 5 3C043
AVT Chassis E/E System Applications mail drop 5011
39-03286 SREIMERS sreimers@ford.com fax 39-03286 ;>
*** Forwarding note from DB7ANAYR--DREN007 02/16/99 13:41 ***
Subject: AWAY Facility/VM messages
This note was generated by the AWAY Facility/VM 5799-FLP (c)IBM Corp.
DO NOT REPLY TO THIS NOTE

ANA110I This mail item is being routed to you from SCOLE1 at DREN005
on behalf of FPORTER at DREN007.

To: FPORTER --DREN007
cc: TMASTERS--DREN005 TDONOVAN--DREN005
DGOEL --DREN005

From: Sam L. Cole USAET(UTC -05:00)
Subject: (U)
I UNDERSTAND THAT THERE WILL BE A FOLLOW UP MEETING WITH JACK PASKUS
THIS FRIDAY ON THE TOWN CAR INVESTIGATION. I MET WITH JACK TODAY FOR A 1
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PREVIOUS PROBLEM WITH THE INTERNAL COMPONENTS BREAKING LOOSE IS A
POTENTIAL CAUSE OF THIS CONCERN. PLEASE BE PREPARED TO DISCUSS THIS ON
FRIDAY. THANKS.

Thank You,
Sam
Ext. 21959
BLDG. 2, 22J31 - MD# 1220_- SCOLE1@FORD.COM

Dague, Bryan

From: Rahman, Aziz
Sent: Tuesday, February 16, 1999 5:08 PM
To: 'Fred Porter (Ford)'; 'Norm LaPointe (Ford)'; 'Steve LaRouche (Ford)'; 'Steve Reimers (Ford)'
Cc: Beringhause, Steven; Dague, Bryan; McGuirk, Andy; Baumann, Russ; Sharpe, Robert
Subject: Brake Pressure Switch Test Log.xls

Brake Pressure Switch
Test Log.xls

Team,

This is a first pass at the test log we can use to track our tests and to update the core team on Wednesday meetings. Please review/add/edit/comment.

Thanks
Aziz.

Dague, Bryan

From: Rahman, Aziz
Sent: Tuesday, February 16, 1999 1:03 PM
To: Beringhause, Steven; Dague, Bryan; McGuirk, Andy; Baumann, Russ; Sharpe, Robert
Subject: Analysis workplan

File
RTRN_SM.XLS_PC

File
RTRN_SM.DOC_PC

Proposed flow chart for return device analysis, published by S. Reimers, Ford.

Dague, Bryan

From: Koos Bosch (SMTP:k-bosch@ti.com)
Sent: Tuesday, February 16, 1999 11:05 AM
To: Charles Douglas
Cc: Bryan Dague; H Nijenhuis; John Pechonis; Kazu Nakanishi; Sang-Hak Suh; Stan Homal; Stephen Prola; Steve Major
Subject: PMPS (LMPS) market outlook for Europe.

Charlie,
as discussed herewith my inputs.
I have added the total PSPS (PMPS and LMPS) volume to it

because, as said before, line mount applications is still a huge and growing market, however after 2002 the risk of system discontinuities fan-out is there.

If you have any questions pls do not hesitate to contact me

I am looking forward to the outcome of this brainstorm session. If we will be able to reach the DTC targets as discussed we will gain a much better position than we ever had in the past 2 - 3 years.

Thanks and regards,
Koos

Dague, Bryan

From: Rahman, Aziz
Sent: Monday, February 15, 1999 8:30 PM
To: Dague, Bryan; Beringhause, Steven; McGuirk, Andy; Sharpe, Robert; Baker, Gary; 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 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 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
Sent: Monday, February 15, 1999 8:22 PM
To: 'Fred Porter (Ford)'; 'Norm LaPointe (Ford)'; 'Steve LaRouche (Ford)'; 'Steve Reimers (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 Molnarney.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 any data.

Brake Pressure Switch Log.xls

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.

Regards

Aziz,

Dague, Bryan

From: Rahman, Aziz
Sent: Monday, February 15, 1999 3:33 PM
To: Dague, Bryan
Subject: FW: F2VC Materials List.xls

From: Rahman, Aziz
Sent: Monday, February 15, 1999 3:13 PM
To: 'Steve Reimers (Ford)'
Subject: F2VC Materials List.xls

F2VC Materials List.xls

Please let me know if you cannot open the file.

Regards
Aziz,

Dague, Bryan

From: McGuirk, Andy
Sent: Friday, February 12, 1999 5:26 PM
To: Baumann, Russ; Beringhouse, Steven; Dague, Bryan; Sullivan, Martha; Baker, Gary
Cc: Pechonis, John; Watt, Jim; Rowland, Thomas; Rahman, Aziz; Douglas, Charles; Sharpe, Robert
Subject: Ford conference call minutes of 2/12

attorney - client privileged communication

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

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

draft of key points:

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

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

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

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

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

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

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

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

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

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

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

a

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

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

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

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

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

a

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

below is Aziz day three feedback

attorney - client privileged communication

From: Rahman, Aziz
Sent: Friday, February 12, 1999 11:26 AM
To: McGuirk, Andy; Beringhause, Steven; Dague, Bryan; Baumann, Russ; Sharpe, Robert; Douglas, Charles; Baker, Gary; Rowland, Thomas
Subject: 77P8, 2/11/99

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

Key participants were:

Jack Pasques	Chief Engineer, Luxury VC
Chuck Peske	Program Engineer, Town Car
Ann O'Neill	Quality Directory, Luxury VC
Sam Cole	Manager Large Vehicles Electrical Systems

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

- There is a need to have the ability to implement, whatever solution is decided, in two months max.
- Next meeting with NHTSA is next week, as part of their regular quaterly meetings. Town Car underhood fires will be high on the discussion list, and the expectation (hope?) is that Ford will be able to get 2 months time to implement a solution.
- There is a very urgent need to re-create ignition in the lab. They kept coming back to this again and again.

Subject: Ford STA visit

John,

Ford STA John Rentis is scheduled to visit Attleboro next week (17th, 18th) primarily to review/understand the 77PS process and design. As such, Mr.Rentis would also like to use this visit to review our supplier rating management for the A9H2E, K9L1A, and K9L1E business units on Friday, the 18th. He has provided the attached file as a format for the 6/18 review and has asked that this chart be updated with our latest (mature) data (available in SIM). In addition, John R. will be expecting a QOS overview (Andy/Jim) as well.

I am assuming that you would lead our discussions on Friday (6/18) regarding our supplier rating management. I will be in Phoenix (w/Verizon) thru Thursday, back in the office on Friday and would like to work with you regarding an agenda for the 18th.

Best Regards,

Rob Sharpe
Texas Instruments
Phone (248) 305-5729
Fax (248) 305-5734
rsharpe@ti.com

Dague, Bryan

From: Haynes, John
Sent: Tuesday, June 08, 1999 10:14 AM
To: Dague, Bryan; Prola, Stephen
Cc: Pombo, Julie; rgildea@ti.com; MuNoz, Marco; Karina Lucio; Hernandez, Gabriel; Jimenez, Juan; Ruiz, Javier
Subject: RE: L-Springs

Bryan,
Please help Julie and the TI Mexico folks to identify the correct resources to help resolve this issue.
Thanks,
John

From: Javier Ruiz Malcom@SMTP:malk@ti.com)
Sent: Tuesday, June 08, 1999 9:35 AM
To: Antonio Jimenez
Cc: Pombo, Julie; rgildea@ti.com; MuNoz, Marco; Haynes, John; Karina Lucio; Gabriel Hernandez
Subject: Re: L-Springs

Dague, Bryan

From: Hopkins, AL
Sent: Thursday, February 11, 1999 1:58 PM
To: Dague, Bryan
Cc: Baumann, Russell
Subject: FW: TSL # 160709, Fluid identification

This is the work that Beth had done to show that the fluid from the switch from the Lincoln Town car fire was almost certainly brake fluid.

Regards,

Al

From: Kill, Beth
Sent: Friday, January 08, 1999 3:15 PM
To: Dague, Bryan
Cc: Hopkins, Al
Subject: TSL # 160709, Fluid identification

Objective:
Isolate and identify the fluid samples found in customer returned device.

Results:
First, I rinsed the cap, excluding the transfer pin hole, with chloroform. I filtered the mixture to remove the solids, and then evaporated the solvent. The remaining residue was identified as brake fluid by FT-IR spectroscopy. The match factor was 89% compared to a reference sample of Nissan brake fluid in my database. Visual comparison of the Nissan fluid to the sample suggests the fluid from the sample contains less water. This may be due to slightly different formulations produced by different manufacturers.

Next, I scanned the samples of fluid, provided by Al, from the transfer pin hole and the converter of this device. The two samples from the transfer pin hole are identical to the fluid rinsed from the cap with chloroform. The fluid from the converter also appears to be brake fluid, but appears to contain slightly more water than the other samples.

I will forward the spectral data to you by internal mail. Please let me know if I can discard the remaining fluid samples, or if you would like me to forward these to you also.

Regards,

Beth

Ext. 3069 MS 10-16 Fax 1670

Dague, Bryan

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

Day 2, 2/10/99 Highlights

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

TI is not invited to the Tech Rev. (whew?!)
Tech Rev will be a high level, broad overview of Town Car Underhood Fires
Numbers Joe has thus far:
149 Underhood Fires, Thermal Anomalies, Thermal Events
39 with engine off, 9 with engine on, no information on the rest
5 possible related to the Brake Pressure Switch (BPS), 17 potential other root causes, no information on the rest
Other root causes from above line : 42 way connector, EEC wire harness, Relay pack.
At this point NHTSA response required on BPS, F2VC part only. Others may follow
Lengthy discussion on approach for the review. General consensus that presentation from technical side should be broad based, since sufficient info is not available for any deep dive.
General consensus that we need a lot more parts back from the field that were involved in these events.Oasis message discussed.
Someone inquired about TI answers to questions from last meeting. I responded that I had provided the information to Fred and Steve Reimers, and they acknowledged. Two other questions for TI:
Does TI sell the switch directly to aftermarket, like auto part stores. I replied that most probably not. We would go through Ford Service Parts for service parts. Is that accurate Charlie?
Does TI have fire experts on site who can determine origin of fires, as in experts who work on structural fires. I replied in the negative, but said I would follow up. Any inputs? Intent was to answer repeatedly asked question: Do we know where the fire originated. Outside - in, Inside - out, what burned first, brake fluid, or plastic base??

Joe's meeting was followed by a vigorous brainstorming session with Fred, Tom, Norm, Steve & Len. This was all technical and I actively participated.
I reviewed TI report PS/98/14 on weibull life of quiet switch showing first leaker at 900k+ cycles. Gave copy to Norm. Bryan, need weibull data quickly on pass-car snap switch.
I reviewed our finding that the 92 through 97 Town Car, Grand Marquis, Crown Vic platforms had prop valve mounted switches and that in vehicles with ABS option, the prop valve is located downstream of the ABS module.
There was considerable discussion on pressure profile at such a location with Len saying that the switch probably sees full pressure reversals. We agreed that I would contact Teves for more info.
We discussed formation of electrolytic cell with Brake Fluid in the base cavity, and how a low resistance path to ground could be formed. Discussed the wattage available with a 15A fuse and 14Vdc system. Is that sufficient to generate enough heat through the ground path.
Discussed CRL analysis of Memphis part, and gave copy of Al's report to Norm. Bryan, per Norm, Al retained "spoonfuls" of the corrosion residue. Do you know if Al has done any compositional analysis (IR) as opposed to elemental only?
Kept getting back to source of fire. Ford has not yet been able to create a fire in a switch. Team decided that pulling in Dow Chemical was key to understand if we can create a fire with given constraints.
I will start exposing the resistivity test here to temperature 2/11.

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

More tomorrow.

Regards
Aziz.

Dague, Bryan

From: Rahman, Aziz
Sent: Thursday, February 11, 1999 11:02 AM
To: Baumann, Russ; Beringhouse, Steven; McGuirk, Andy; Dague, Bryan
Subject: RE: 77PS Overview

Team,

Thanks for the info below. I have reviewed last 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: Dague, Bryan
Sent: Thursday, February 11, 1999 8:48 AM
To: Baumann, Russell; Beringhouse, Steven; Rahman, Aziz; McGuirk, Andrew
Subject: 77PS Overview

Guys,

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

Please advise if I need to fax it to someone.

I am having copies of the appendix made today.

Regards,
Bry

****

Proprietary Information

77PS Overview
2/10/99

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

77PS Overview Appendix

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

Dague, Bryan

From: Watt, Jim
Sent: Thursday, February 11, 1999 10:10 AM
To: Baumann, Russ RUSB; Dague, Bryan; McGuirk, Andy; Beringhause, Steven; Watt, Jim
Subject: RE: 77PS Diaphragm Wear Out Cause & Effect Diagram - Resend
Sensitivity: Confidential

Ford 77PW.ppt

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

From: Watt, Jim
Sent: Thursday, February 11, 1999 9:55 AM
To: Baumann, Russ RUSB; Dague, Bryan; McGuirk, Andy; Beringhause, Steven
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Importance: High

Sensitivity: Confidential

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<<File: Ford 77PS1.ppt>>

Jim Watt, QRA, mqid: jw02; mail station 12-33; page (508)236-1010, no. (0696)
ph (508) 236-1719;
fax (508)236-3169

From: McGuirk, Andy
Sent: Wednesday, February 10, 1999 3:05 PM
To: Baumann, Russ RUSS; Dague, Bryan
Cc: Beringhause, Steven; 'Rahman, 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 'zillions' of 'se' test results we must have? we should also speak to the thunderbird applications ? maybe refer to the econoline issue of '93 with connector issues ?

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FAX : (508) 236-3745
PAGE: (800) 457-3780 PIN 604-2044

From: Dague, Bryan
Sent: Wednesday, February 10, 1999 1:24 PM
To: Baumann, Russ RUSS
Cc: Beringhause, Steven; Rahman, Aziz ZIZ; McGuirk, Andy
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Folks,

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,
Bryan

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Brake Fluid Intrusion
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 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 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 leak past an impaired gasket seal, or leak through a damaged or 'worn out' Kapton diaphragm.

The Gasket:

In order to create a fluid tight elastomeric seal, there must be proper compression of the elastomer, sufficient backing of the seal material to prevent movement when pressure is applied, and finally the elastomer must be compatible 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 material in 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 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 crimp together.

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also, there are IP-2 tests of 6/95, 10/95, 1/96 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: hair nets, protective smocks, and cleaning procedures for the equipment. As a result of the process and product controls, TI's customer returns rates including line fallout rates and end of line acceptance tests indicate gasket-manufacturing anomalies are below measurable limits (one leak return in 5 years from master cylinder leak testing or 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 but in our expert opinion not in late life without early leak signs.

Kapton Diaphragms:
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 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 polyimide film laminated on both sides with a 0.001-inch thick FEP Teflon film. The polyimide film has the ability to stretch without breaking (strains on the order of 70% before rupture), and the Teflon film is compatible with a wide range of chemicals. As a result of this layered construction, Kapton was selected for its mechanical and chemical properties. Moreover, TI has been using this material in 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 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 which is well above the 500,000 cycles specified in the Ford (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.

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 in our history of simulated and accelerated life testing. When Kapton rupture does occur, there are visual signs of de-lamination, cracking, and embrittlement. The Kapton diaphragms break down first in the areas of highest stress and or strain. In our expert opinion, the first region to show break down is the circumferential area surrounding the converter button. See Endurance Test (report # PS/98/53). Again, diaphragm life depends on stress levels (pressure magnitude applied), temperature, and chemical exposure.

The above mentioned tests were conducted in TI's Life Test lab with relatively controlled conditions. Water will accelerate the aging of the base polyimide. Chemical attack can come from two directions:
1) By entering the contact cavity via the electrical connector,
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End of Document.

Dague, Bryan

From: Watt, Jim
Sent: Thursday, February 11, 1999 9:55 AM
To: Baumann, Russ RUSB; Dague, Bryan; McGuirk, Andy; Beringhause, Steven
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Importance: High
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Ford 77PS1.ppt

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2/10/99

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End of Document.

Dague, Bryan

From: McGuirk, Andy
Sent: Thursday, February 11, 1999 7:52 AM
To: Baumann, Russ; Dague, Bryan
Cc: Beringhause, Steven; Rowland, Thomas
Subject: RE: 77PS Overview

just some minor points and drop out tenn line

a

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34 FORREST ST M/S 33-05
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Cc: Beringhause, Steven; McGuirk, Andrew
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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 and transmit pressure and movement to the sensing portion of the switch over the life as defined in Ford ES -F2VC-9F924-AA.

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

Two known ways that brake fluid may enter the contact cavity of TI's brake switches from the pressure cavity are 1. brake fluid could potentially leak past an impaired gasket seal, or 2. leak through a damaged or 'worn out' Kapton™ diaphragm.

The Gasket:
In order to create a fluid tight elastomeric seal, there must be proper compression of the elastomer, sufficient backing of the 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. 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 for brake applications is common practice throughout the industry, for seal gasket materials, and TI has been using this material in 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 24%was selected. The depth of the hexport gland shown on attachment #2 controls this attribute. This gland dimension is cut into the hexport at the time of manufacturing. As a result, this dimension in combination with the gasket dimensions determines the final gasket compression when the assembly is crimped together.

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

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

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

Gasket-manufacturing anomalies can be produced from out of spec gaskets, contamination of the gasket, or

GASKET sealing surfaces, and as a result, may cause leaks early in life. In order to protect TI's customer supply chain from gasket-manufacturing issues there are several preventative actions in place. These actions include: hair nets, protective smocks, and cleaning procedures for the equipment. 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 ™ Diaphragms:
A pressure switch diaphragm must seal the pressure cavity, transmit pressure forces to the converter, and follow the converter motion without significantly affecting the switch calibration points. In addition, the diaphragm material must

BE resistant TO chemical attack **BY** the brake fluid.

Basically, a single piece of Kapton ™ in this design consists of a 0.003-inch thick polyimide film laminated on both sides with a 0.001-inch thick FEP Teflon film. The 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. In this application three stacked Kapton ™ layers were used as the diaphragm seal.

To confirm the correct material was selected for this application we refer to the DFMEA. Specifically, this document identifies burst testing, impulse testing, and thermal cycle testing. These tests confirmed the Kapton's™ ability to meet the specified requirements (PV reports listed above). Since temperature, chemical exposure, and stress levels all affect the life expectancy of the Kapton ™ diaphragms, additional testing is commonly done. A typical impulse test would include pressure cycles to 1450 psi, constant temperature of 135 C, and a cycle rate of 120 cycles/minute. Depending on the factors listed above, the life expectancy of a TI brake pressure switch 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.

Manufacturing & PV anomalies such as pinched Kapton ™ can affect the Kapton ™ diaphragm seal performance (see PFMEA Document # 503831). ***Results of the analyses of the pressure switch from Tennessee showed curved marks on the diaphragm that may have been caused by a pinched Kapton ™.***
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-P2VC-9F924-AA) has shown acceptable performance.

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

The above mentioned tests were conducted in TI's Life Test lab with relatively controlled conditions. Water has been shown to accelerate the aging of the base polymide. Water can be introduced in two known ways:

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

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

Authored by Bryan Dague. Call Andy McGuirk (508) 236-3080 or Bryan Dague (508) 236-3234 with questions.

Brake Fluid Intrusion Appendix

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

Dague, Bryan

From: McGuirk, Andy
Sent: Wednesday, February 10, 1999 3:05 PM
To: Baumann, Russ RUSB; Dague, Bryan
Cc: Beringhause, Steven; 'Rahman, 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 'zillions' of 'ee' 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
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PAGER: (800) 467-3760 PIN 604-2044

From: Dague, Bryan
Sent: Wednesday, February 10, 1999 1:24 PM
To: Baumann, Russ RUSB
Cc: Beringhause, Steven; Rahman, Aziz ZIZ; McGuirk, Andy
Subject: 77PS Design explanation

Folks,

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,
Bryan

****

Attorney Client Privileged Information

Brake Fluid Intrusion
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 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 eletrical switching reaction used in the automobile system as a redundant safety related cruise control shutoff switch..

Background:
The pressure cavity is composed of the bexport, 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 bexport 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 leak past an impaired gasket seal, or leak through a damaged or 'worn out' Kapton diaphragm.

The Gasket:
In order to create a fluid tight elastomeric seal, there must be proper compression of the elastomer, sufficient backing of the seal material to prevent movement when pressure is applied, and finally the elastomer must be compatible 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 material in 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 24% was selected. The depth of the hexport gland shown on attachment #2 controls this attributs. 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 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 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. PS/91/48	77PSL2-3	1991
2. PS/91/49	77PSL2-1	1991
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4. PS/92/80	77PSL5-2	1992
5. PS/92/82	77PSL3-1	1992
6. PS/93/11	77PSL6-1	1993
7. PS/93/44	77PSL4-1	1993

also, there are IP-2 tests of 6/95, 10/95, 1/96 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: hair nets, protective smocks, and cleaning procedures for the equipment
As a result of the process and product controls, TI's customer return rates including line fallout rates and end of line acceptance tests indicate gasket-manufacturing anomalies are below measurable 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 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 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 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 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 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 which is well above the 500,000 cycles specified in the Ford (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.

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 in our history of simulated and accelerated life testing. When Kapton rupture does occur, there are visual signs of de-lamination, cracking, and embrittlement. The Kapton diaphragms break down first in the areas of highest stress and or strain. In our expert opinion, the first region to show break down is the circumferential area surrounding the converter button. See Endurance Test (report # PS/98/53). Again, diaphragm life depends on stress levels (pressure magnitude applied), temperature, and chemical exposure.

The above mentioned tests were conducted in TI's Life Test lab with relatively controlled conditions. Water will accelerate the aging of the base polymide. Chemical attach can come from two directions:
1) By entering the contact cavity via the electrical connector,
2) By being in solution in the brake fluid and entering the switch via the pressure port.

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

End of Document.

Dague, Bryan

From: Ha, Di
Sent: Wednesday, February 10, 1999 10:16 AM

To: Dague, Bryan
Subject: Toray Weibull.xls

It's called toray weibull, but the only parts that have failed so far are the kapton. This data is for ALL Kapton parts. The test was suspended and the parts will be taken off test. John Brennan to analyze.

Regards,
DI

Dague, Bryan

From: Rahman, Aziz
Sent: Tuesday, February 09, 1999 10:57 PM
To: McGuirk, Andy; Douglas, Charles; Beringhause, Steven; Dague, Bryan; Baker, Gary; Baumann, Russ; Sullivan, Martha; Sharpe, Robert; Rowland, Thomas
Subject: 77PS - 2/9/99 Summary

Had a fairly productive Day 1 at Ford today. Major highlights:

- Technical Review meeting set for Thursday, 2/11/99, TI participation undecided.
  - Audience: Luxury Car Chief Engineers, Luxury Car Chief Buyer
  - Agenda: Lincoln Town Car Underhood Fires
  - Expect further clarity on Total # of fires, Locationally what quadrant, what subset is switch, connector, harness & relay pack.
  - Key expected outcome : Management will provide advice on near term direction.
  - Fred is planning to present switch case in an 8D format.

- Core Team meeting set for Wednesday 2/10/99, TI will participate
  - Prepare groundwork for 2/11 8D
  - Update team on Ford/TI actions to date

- Central Research Lab Visit
  - Switches under investigation:
    - Memphis Switch - From vehicle with fire event
    - Switch A - From vehicle with fire event,
    - Switch B - From vehicle with fire event - switch not available due to pending legal issues
    - Switch C - From vehicle with fire event
    - Switch D - From 97 Crown Vic Police Car, leaker, cruise inop
    - Switch E - vehicle n/a, non leaker, non issue switch, for reference
    - Switch F - vehicle n/a, leaker, cruise intermittent
  - Steve LaRouche has completed his assessment of the "Memphis" switch, which was initially jointly analyzed by Ford/TI at TI. His analysis points out the tears in the kapton diaphragm. Additionally, kapton appears to be quite

brittle. This brittleness will be discussed later below. I will fax a copy of his report on the Memphis switch to Bryan tomorrow.

- Switches A & C were severely damaged, to the point of starting to melt the crimp ring. Very little analysis possible. Fred opined that it was possible that these switches were not the source of the fire. Per Fred, to date, 2 switches are known sources. The Memphis switch and another ?
- Switches D & F are primarily being looked at to assess kapton status. Possible tears evident in optical photos. SEM will be available tomorrow.

- Building 5 Lab Visit
  - Allan Janotick is Fred's technician and is running the 24V resistivity test. The connector cavity is filled with non-aged Brake Fluid. System is powered up through one of the terminals and grounded via the crimp ring (I would have preferred the hexport).
  - Current draw being checked with an ammeter in series. Ranging between 4.45 mA and 8.74 mA.
  - Plan is to expose switch to hot temps in a chamber.

- General Discussions:
  - Possible actions:
    - Remove power to switch by removal of connector. High customer impact as cruise control function will be disabled. Could possibly satisfy NHTSA as an immediate action.
    - Reviewed relay concept, with favorable reception. Need to find CC feed in vicinity.
    - Reviewed power on IGN only. Shared history on ITT approach. Will meet with speed control people tomorrow.
  - Kapton Wear
    - This is gaining momentum as an explanation of tear patterns observed in switches. Fred would like to understand if the wear on the Memphis switch is at "6 sigma limit". We will analyze other non-fire parts tomorrow to see what the wear distribution looks like. We need to compare a significant number of switches from vehicles, lab tests, production impulse tests etc.
    - We need a solid method to quantify kapton wear. We are looking at ways to map the topology of a kapton surface. We also need a method to quantify "brittleness" of worn kapton. Any ideas? It will not be possible to do any destructive tests.
    - Whatever resolution is arrived at for the situation at hand, Fred is heading towards "improving switch robustness". He wants Dupont brought in the loop to understand aging of kapton, specially in aged brake fluid with water. Is there a "magic diaphragm material?".
    - Switch D 97 Crown Vic Police Car, had P2AC, quiet switch. Fred is leaning to dismiss snap vs quiet theory for increased kapton wear.

- Actions from 2/9/99

1. Provide Steve L with 2 switches from 92/93 Town Cars with varying mileage for Kapton wear study - Aziz
2. Complete subjective "Brittleness" evaluation for above two parts + Memphis part + parts D & F - Steve L
3. Complete Kapton Topography study with Cadeyes on all parts above except Memphis part. - Steve L
4. Obtain update on 2 resistivity tests in progress at TI - Bryan/Aziz
5. Document data to date from Allan Janotik test - Aziz
6. Follow up with Dupont on change in Kapton properties with time/temp in aged Brake Fluid - Bryan/Aziz
7. Assess revising present Allan J. test to expose switch to high temp. - Aziz
8. Review history of other diaphragm materials as backup. Bryan, we had done some evaluation with elastomeric, stainless steel and PEEK diaphragms way back. Please see if you can resurrect any data.

Bryan, I will call you tomorrow for an update on our resistivity tests. Additionally please dig up any data we may have relative to kapton aging in brake fluid. Dave Czarn and John Brennan did extensive for Nissan, but probably used power-strg fluid.

I do not have a phone # yet, but am sitting across the desk from Fred. You may contact me via Rob.

More tomorrow.

Dague, Bryan

From: Ha, DI
Sent: Tuesday, February 09, 1999 3:10 PM
To: Dague, Bryan
Subject: itt report


itt test.doc

ps/98/53: I think this is the most recent.

Dague, Bryan

From: Beringhouse, Steven
Sent: Tuesday, February 09, 1999 12:38 PM
To: Dague, Bryan
Subject: FW: 77 p/s 'durability' baseline information
Importance: High
Sensitivity: Confidential

From: McGuirk, Andy
Sent: Tuesday, February 09, 1999 11:35 AM
To: Rahman, Aziz; Beringhouse, Steven
Subject: FW: 77 p/s 'durability' baseline information
Importance: High
Sensitivity: Confidential

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PAGE: (800) 467-3700 PIN 684-2044

From: Watt, Jim
Sent: Monday, February 08, 1999 4:31 PM
To: McGuirk, Andy; Douglas, Charles
Subject: RE: 77 p/s 'durability' baseline information
Importance: High
Sensitivity: Confidential

Andy,

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, Berea, KY, and caused by a misplaced gasket on a sensor assembly:

car98_30.doc

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

From: McGuirk, Andy
Sent: Saturday, February 06, 1999 10:54 AM
To: Baumann, Russ; Rose, Elaine; Watt, Jim
Cc: Beringhause, Steven; Dague, Bryan; Pechonik, John; Rowland, Thomas; Sullivan, Martha; Baker, Gary; Rahman, Aziz; Sharpe, Robert
Subject: 77 p/s 'durability' baseline information

attorney - client privileged communication

Jim and Elaine, 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' 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 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 hydraulic fluid leakers 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 seen in our factory floor and/or customer feedback. Jim, please take the lead on getting this done ASAP. we should consider customer AIQ spreadsheets and RMR data coupled with 8D's of the time to build a case for the low PPM leak rates of the sensor assembly further protected by downstream supply chain testing 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. there will be a building need to deliver data and evidence by Tuesday via Aziz and we should consider an alternate path of anecdotal 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 specs....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. Elaine please coordinate the data collection here. (We will likely turn to reliability experienced quality engineers Paul spaceman 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 sort 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 Aziz during his upcoming dialogues 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 assembling both relevant IP testing and PPAP 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 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, pls see John or me for help in getting people assigned or priority provided.

thank you for your continued support here,

a

AUTOMOTIVE SENSORS AND CONTROLS QRA MANAGER
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From: Douglas, Charles
Sent: Friday, February 05, 1999 8:43 AM
To: McGuirk, Andy; Rose, Elaine
Subject: 77P5 Matrix

Andy / Elaine,

Per our discussion:

<<File: Lincoln.doc>>
Regards,

Charlie

Charlie Douglas
(508) 236-3557 (P)
(508) 236-1566 (F)
c-douglas2@ti.com

Epstein, Sally

From: Dague, Bryan [bdague@email.mcil.com]
Sent: Monday, February 22, 1999 10:15 AM
To: Rahman, Aziz
Subject: TI Durability Samples

Aziz,

Yes, we noticed that as well. It all sc leaked way before any of the other switches. We are just now starting to get leakers (at about million cycles).

I think this particular switch is a "flyer". The discoloration is due to dust from the internal components wearing. I believe there is something different about this switch that generated more wear particles then the other, and we will confirm this once more switches are analyzed. I don't know if this switch was assembled with more particles in it to start with, or if it was assemble off-center causing more wear of the internal components, but one thing is clear. It was pretty dirty in the switch. Furthermore, I believe you will see this data point stick out from all the rest once they are plotted.

That is really all I can offer at this time.

Regards,
Bry

From: Rahman, Aziz
Sent: Monday, February 22, 1999 10:34 AM
To: Dague, Bryan; McGuirk, Andy; Baumann, Russ; Baringhause, Steven; Sharpe, Robert
Subject: FW: TI Durability Samples

There seems to be a difference between the 726k sample kaptons and the rest. Any theories?
Bryan can you check if this switch was mounted on the dead-head end of the test manifold (opposite the inlet), where localized degradation of the brake fluid is higher? Or are the manifolds totally exhausted of brake fluid, at all test positions, for every pressure cycle? I don't remember the set-up.

Regards
Aziz.

From: Rahman, Aziz
Sent: Monday, February 22, 1999 10:26 AM
To: 'Steve LaRouche (Ford)'; 'Steve Reimers (Ford)'; 'Norm LaPointe (Ford)'; 'Fred Porter (Ford)'
Cc: Sharpe, Robert
Subject: TI Durability Samples

I have the following disassembled samples with me and I will forward them to Steve L. today pm.

200k Cycles 2 samples
400k Cycles 2 samples
600k Cycles 2 samples
728k Cycles 1 sample (observed leakage)
800k Cycles 2 samples

This will be part of the library to establish lab tests vs field data.

Regards

Aziz.

Brandin, Sally

From:	Rahman, Aziz (arahman@email.mc.ti.com)
Sent:	Monday, February 22, 1999 10:18 AM
To:	Sharpe, Robert; Dague, Bryan; Douglas, Charles
Cc:	McGuirk, Andy; Sharpe, Robert
Subject:	RE: Brake Pressure Switch History

We could not have made any changes without Ford approval of a TI submittal. Can we go through our PPAP and SREA submittal records for both part numbers, F2VC and F2AC, with all suffixes (AA, AB , BA etc as applicable)? I would assume that TI information will be most reliable when a specific part number was qualified/approved. As to when and on what platform a specific part number is used, the Ford system will be most accurate.
In general, we don't validate a part for a specific platform. We validate conformance to a drawing/part number and specification. Part usage/fanout is determined by the end user. I am sure Ford has a, sort of a "Bill of Materials", which they can dig up? Bracketing end usage for a specific platform based on shipping quantities will not be very accurate.
Comments?

Regards
Aziz.

From: Douglas, Charles
Sent: Monday, February 22, 1999 11:05 AM
To: Sharpe, Robert; Dague, Bryan
Cc: McGuirk, Andy; Rahman, Aziz; Sharpe, Robert
Subject: RE: Brake Pressure Switch History

Rob,

I may have provided mis-information in my email of 12/8/98. One of the issues we face in trying to pull up this information is that historical information tells us the volume we are shipping of a specific part but it does not tie to specific platforms. We did stop shipping the snap switch that the Town Car used in CY95, however, this switch was used on a number of platforms and the Town Car may well have individually changed to the quiet switch much earlier.

The best (maybe only) way to determine exactly when we made this change is if we have any records remaining in engineering ---> Bryan, is there any documentation which exists which can help us pinpoint this timing.

Rob, if no specific information exists in engineering, I can questimate that the change occurred in late 1Q92 to mid 2Q92. This questimate is based on us shipping 40ku - 50ku of the snap switch during January and February of CY92 and ramping down to 10ku to 15ku per month by June of CY92. Also, old fcst records would indicate that we made our first shipments of the silent switch occurred in April of CY92. Assuming the Town Car was the lead platform for the silent switch, this would indicate that conversion timing occurred early 2Q92.

I know that we did make a running change so 2Q92 makes sense. I also know there was significant engineering activity around this change so if we are lucky, there will be some documentation in engineering which pinpoints the change.

Regards,

Charlie

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

From: Sharpe, Robert
Sent: Monday, February 22, 1999 8:17 AM
To: Douglas, Charles
Cc: McGuirk, Andy; Rahman, Aziz
Subject: ' Brake Pressure Switch History

Hi Charlie,

During last Friday's "Executive Level" review at Ford regarding the Town Car issue, interest was expressed towards the change on our switch between snap disc and quiet disc. My understanding is that this change occurred sometime in CY95 (to quiet disc), based on your 12/8/98 E-Mail. In addition, we also thought that the "F2AC" was a quiet disc application, however, we have a few field returns of the "F2AC" that have CY92 date codes. Please confirm timing of the quiet disc changeover as well as history of the "F2AC".

As discussed with Andy on Friday afternoon, Ford expressed much interest with the change (focused on timing) to "quiet disc" applications. They were very pleased that our DOE addresses both quiet and snap disc applications.

Best Regards,

Rob Sharpe
Texas Instruments
Phone (248) 305-5729
Fax (248) 305-5734
rsharpe@ti.com

McGuirk, Andy

From: Rahman, Aziz
Sent: Monday, February 22, 1999 5:01 PM
To: McGuirk, Andy; Dague, Bryan
Subject: Musings

Thinking out loud here, so please bear with me

Is there a way to identify the presence of two failure modes by looking at a Weibull chart?

The question is: We have circumferential cracks seen on parts from the lab durability test. Some field parts show the circumferential cracks, whereas other field parts show a radial crack.

The Weibull data I saw in Di Ha's report almost looked like it had a slope change halfway through. Can this be used as a predictor that a new failure mode has started?

Any Weibull gurus out there?

What happens if you have a circumferential crack and still continue to cycle, as will happen in the field? Will we see propagation of the same crack, or will a new one develop in a different direction, because the first one disturbed the stress field?

John Brennan and Ray Mandeville probably did a bunch of FE analyses. Anything in there?

Ford is looking for, and will turn the heat on quickly, Dupont response on chemistry of change of properties of Kapton in Brake Fluid.
Andy, can you please use your good offices to get expedient Dupont involvement? Ideally, a preliminary response will be good before the Wednesday meeting.

Thanks for your help folks.

Almost forgot....email snippet from Fred:

The 95th percentile driver applies the brakes about 16 times per mile. City stop & go traffic. Probably not sufficient pressure to actuate switch. But....16/mile is a lot of cycles, you will complete 500,000 cycles in only 30k miles. I do not know what the pressure profile will look like, will try to find out.

Aziz.

Baldwin, Sally

From: Rahman, Aziz [arahman@smail.mc.ti.com]
Sent: Wednesday, February 24, 1999 11:56 AM
To: 'Fred Porter (Ford)'; 'Norm LaPointe (Ford)'; 'Steve LaRouche (Ford)'; 'Steve Reimers (Ford)'
Cc: McGuirk, Andy; Dague, Bryan; Douglas, Charles; Sharpe, Robert; Baumann, Russ; Berringhause, Steven
Subject: Test Log.xls

Test Log.xls

<<Test Log.xls>>
Updated for today's meeting.

Regards
Aziz.

[illegible] Test Log

Updated [illegible]

Category	Test	Location	Test Parameters	Results Update
[illegible]	1	TI	[illegible]	[illegible]
	2	TI	[illegible]	[illegible]
	3	AVT	[illegible]	[illegible]
	4	AVT	[illegible]	[illegible]
	5	AVT	[illegible]	[illegible]
	5a	AVT	[illegible]	[illegible]
	6	TI	[illegible]	[illegible]
	6a	TI	[illegible]	[illegible]
[illegible]	7	TI	[illegible]	[illegible]
[illegible]	8	TI	[illegible]	[illegible]
[illegible]	9	Central Labs	[illegible]	[illegible]
[illegible]	10	TI	[illegible] DOE [illegible]	[illegible]
[illegible]	11	AVT	[illegible]	[illegible]
[illegible]	12	Central Labs	[illegible]	[illegible]
[illegible]	13	Central Labs	[illegible]	[illegible]

TT-NHTSA 016690

Epstein, Sally

From: Kitt, Michael (MS) (mkitt@dow.com)
Sent: Thursday, February 25, 1999 8:04 AM
To: Rahman, Aziz
Subject: SAE paper discuss at Ford meeting

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

Epstein, Sally

From: Steve Reimers [sreimers@ford.com]
Sent: Thursday, February 25, 1999 8:23 AM
To: Rahman, Aziz
Subject: Brake fluid switch ignition

Please look into the feasibility of David's suggestion and let me know what you think.

Steve Reimers building 5 3C043
AVT Chassis E/E System Applications mail drop 5011
39-03296 SREIMERS sreimers@ford.com fax 39-03296 ;>
*** Forwarding note from DBAUER3 --DRBN005 02/25/99 09:39 ***
To: SREIMERS--DRBN007

FROM: DAVID BAUER USAET(UTC -05:00)
Subject: Brake fluid switch ignition
Thinking about the switch ignition problem, it occurs to me that if the problem is a short between the contact spring and ground, one possible fix would be to coat the cup with an insulating epoxy coating. This should prevent any bridging of corrosion products from spring or rivet that would lead to high current draws and melting of the plastic. Leaking of fluid might still result in a switch failure, but there would not likely be a possibility of fire. Just a thought. Regards,
Dave Bauer (dbauer3) x41756

Regards,
DAVID BAUER

Epstein, Sally

From: Steve Reimers [sreimers@ford.com]
Sent: Friday, February 26, 1999 11:46 AM
To: Rahman, Aziz
Subject: Brake Pressure Profiles

fyi

Steve Reimers building 5 3C043
AVT Chassis E/E System Applications mail drop 5011
39-03286 SREIMERS sreimers@ford.com fax 39-03286 ;>
*** Forwarding note from FPORTER --DRBN007 02/26/99 08:46 ***
To: SREIMERS--DRBN007

FROM: F. J. Porter USAET(UTC -05:00)
Subject: Brake Pressure Profiles

Please forward to Aziz.

Regards,
Fred Porter OV - fporter fporter@ford.com
Chassis E/E Systems Applications (313)845-3722
Bldg 5 - Mail Drop 5030 - Cubicle 3E004 fax: 390-4145
*** Forwarding note from PBZVAJKN--EXTERNAL 02/25/99 19:08 ***
To: FPORTER --FORDMAIL

From: PBZVAJKN--EXTERNAL
Subject: Brake Pressure Profiles

From: James_Reebsh@contitevs.com

Fred,

I asked our hydraulics test department about the pressure distribution on the life tests I supplied here is what I found out:

The high pressure cycles are about 110bar at the master cylinder and 50 to 80 bar at the wheel ends.

The low pressure cycles are about 55 bar at the master cylinder and 24 to 40 bar at the wheel ends.

Hope this helps.

Jim

Currey, Pat

From: Rahman, Aziz [arahman@email.mc.ti.com]
Sent: Sunday, February 28, 1999 10:58 AM
To: McGuirk, Andy; Dague, Bryan; Douglas, Charles; 'Fred Porter (Ford)'; 'Norm LaPointe (Ford)'; Sharpe, Robert; Baumann, Russ; 'Steve LaRouche (Ford)'; 'Steve Reimers (Ford)'; Beringhause, Steven
Subject: Back Online

I apologize for being off the air for the past few days. I've been bitten by a particularly severe version of the flu bug. (FYI, this strain is characterized by cyclical high fevers and uncontrollable coughing spasms.) Under some TLC at home, I am about 30% operational now. Hope to kick in the remaining 80% next week, after I meet with my doc tomorrow.

Andy & Co at TI: I will try and come into the office tomorrow.

Fred & Steve R. at Ford: If I can't make it to the Wednesday meeting, would it be okay to update you via e-mail and conf. call?

Hope to be back in action soon. Thanks for your understanding.

Regards
Aziz.