EA02025

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

REQUEST 9

BOX 12
PART A – O
PART M

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From: McGuirk, Andy Sent: Friday, May 28, 1999 3:22 PM

To: 'Frederick J. Porter'

Cc: Beringhause, Steven; Sharpe, Robert

Subject: Ford Core team update

Fred, per our discussions and Rob Sharpe's visit enclosed is our updates...

<<synopsil.doc>> <<TESTLOG9.xls>> <<FredPortCore.doc>> <<77PSL2_1.xla>>

AUTOMOTIVE SENSORS AND CONTROLS QRA MANAGER 34 FOREST ST M/S 23-05 ATTLEBORO, MA 02703 TEL : (508) 236-3080 FAX : (508) 236-3745

MOBILE: (508) 208-6119

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

May 26, 1999

Mr. Frederick J. Porter, Supervisor E/E Systems Engineering Building 5, Mail Drop 5011 20000 Rotunda Drive, Rm 3E004 Dearborn Mi 48121-2053

Dear Fred:

I want to review our recent support of the Ford core team to assure we do not have any misunderstandings regarding our pressure switch performance, our continued contribution to the 'core' team, and our commitment to a quick conclusion.

For six months the Texas Instruments Automotive Sensors & Controls Team has been supporting the Ford Core Diagnostic Team with technical facts, data, and analysis regarding our brake pressure switch product applied in the Ford cruise control deactivation circuit.

A senior TI pressure switch engineer was in residence at Ford for three weeks to assist with switch related issues in the system diagnostic process. Senior TI leadership participation has also been involved in virtually every Ford Core Team meeting delivering facts, data, and technical support year-to-date '99.

We also investigated switch capability, and using agreed upon accelerated simulation life testing techniques, demonstrated the ability of the model year '92 & '93. Town Car speed control deactivation switches to consistently exceed "cycle life specification" of 500,000 pressure cycles. Ti Weibuli reports of pressure switches tested in 1999 conservatively demonstrate 95% reliability to 1 million cycles (with confidence intervals greater than 50%).

Additionally "success testing records" of some 665 ES units that were tested during the 1991 - 1992 (11/91 - 12/92) showed zero leakage at 500,000 cycles.

Conclusion to date: 1992 period switches met specification. 1999 switch meets or exceeds specification

We have developed and delivered a laboratory model of accelerated plastic base ignition of the switch resulting from fluid in the switch cavity coupled with application of constant power as designed in the speed control circuit. Theories from the model suggest that fluids in the switch cavity in the presence of uninterrupted power could lead to a corresion product formation which might create a plastic base ignition path.

Mr. Fred Porter May 26, 1999 Page 2

Conclusion to date: Constant speed control power allows long term corrosion.

in light of this laboratory model and the need for cruise system power only during vehicle operation, we suggest the system architecture of "key-on/off" based power be considered.

We have been open and forthright in our communications and delivery of information and we believe we have been instrumental in helping Ford address the underhood fire concern issue.

In this regard, we think it is appropriate at this point that our active participation in the diagnostic journey of the vintage 1992 product move towards a timely conclusion. Toward this end, we will continue to support the "core" team review of 1992 product history with targeted completion in July 1999.

We are preparing to fulfill your request for hosting a site visit, supporting campaign field return device analysis, and participating in robust system brainstorming sessions moving toward conclusion in July, as well as reviewing the optimization of our product line process controls.

Our prime focus at this time is in rapidly supplying Ford with 225,000 units in support of the field actions.

Regards,

Andrew C. McGuirk QRA Manager Texas Instruments

attachments: 1992 Testing History

TI 77PS Test synopsis

TI 77PS investigation Flow Diagram

TI 77PS Test Synopsis

This document is a synopsis of tests conducted by Texas Instruments during the 77PS investigation. The intent of this document is to highlight test findings which drove the investigation to its current state. Throughout the investigation, several tests were conducted with the same objective. When each objective was met, efforts were refocused to obtain a new level of understanding and to establish a new set of objectives. As such, tests have been categorized into (5) levels, representing the level of knowledge obtained from the group of tests conducted. Each level is listed below with a short description of the objective:

- Level 1: Create a laboratory switch ignition without any restrictions on methods.
- Level 2: Creats a laboratory switch ignition using only conditions found in the switch operating environment.
- Level 3: Understand the laboratory ignition mechanism.
- Level 4: Compare factors contributing to laboratory ignition.
- Level 5: Evaluate recommendations.

Refer to Brake Pressure Switch Test Log.

Level 1 Objective: Determine if a switch ignition can be created in the laboratory.

Text 1

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Switch contact cavity flooded with brake fluid mixed with varying amounts of % H_2 0.

14 volts applied to one terminal, second terminal electrically floating. (No electrical load across switch terminals).

Switch hexport electrically grounded.

Results:

- (8) samples were tested total:
- (2) with 4% H₂0 in brake fluid.
- (2) with 6% H₂0 in brake fluid.
- (2) with 10% H₂0 in brake fluid.
- (2) with 75% H₂0 in brake fluid.

No ignition occurred. No significant temperature rise observed in all samples. Current draw ranged from 0.5 mAmps to 5 mAmps over a period greater than (250) hours.

Test 2

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Switch contact flooded with brake fluid. 14 volts applied to one terminal, second terminal connected to a 14 Ω resistor which is tied to ground. (1 Amp load across switch terminals). Switch hexport electrically grounded.

Results: (2) samples were tested. No ignition occurred. No significant temperature rise observed for a period over (250) hours.

Conclusion: A(1) Amp load through switch terminals did not ignite brake fluid in the contact cavity of switches.

Test 6

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Heater element installed in contact cavity of the switch.

Power applied to the heater element until plastic base melts.

Spark generated in contact cavity of switch.

Brake fluid present in the contact cavity (wet device) and absent in the contact cavity (dry device).

Results: (2) dry devices were tested and (1) wet device was tested. Ignition occurred in all devices.

<u>Wet device</u>: The internal temperature of a wet device reached 660°F. A hole burned through the base of the switch (close to the heating element). The applied spark ignited the fumes in the contact cavity of the switch and engulfed the base material of the switch.

<u>Dry device</u>: The internal temperature of a dry switch reached over 1000°F. The switch base flopped over. The applied spark ignited the fumes in the contact cavity of the switch and engulfed the base material of the switch.

Conclusion: A switch ignition can occur under the following laboratory conditions:

Heater element installed in the switch contact cavity.

5 watts of power dissipated in heating element.

Spark generated in the contact cavity of the switch.

Brake fluid did not contribute to the ignition process.

TI-NHTSA 017026

Level 2: Objective: Determine if a laboratory ignition can occur using only switch components and elements found in the switch environment.

Test 6a.

Objective: Determine if corrosive degradation of switch electrical components can cause an increase in electrical resistance (and thus a source of heat) in the switch, which may lead to an ignition.

Results: (1) out of (15) samples tested increased resistance to 5 Ω s. A solution of 5 wt. % NaCl in H₂0 can corrode the electrical components of the switch and cause an increase in electrical resistance. Repeated injections of the solution of 5 wt. % NaCl in H₂0 into the contact cavity of a switch, with the switch continuously powered at 14 Volts, can cause an ignition.

Conclusion: A switch ignition can occur under the following laboratory conditions:

A solution of 5% NaCl in H_20 is injected into contact cavity of a switch. Continuous 14 Volt power applied to the switch. Hexport is grounded. Current is limited at 15 Amps.

Test 6c

Objective: Determine if brake fluid with metal shavings is conductive enough to create an ignition.

Results: (3) devices with various size metal particles were tested. No significant current increase detected.

Conclusion: Metal shavings did not significantly increase conductivity brake fluid. Current levels measured were well below levels necessary to create an ignition.

Test 7

Objective: Determine if switch meets cycle life specification.

Results: Tests conducted during the first quarter of 1999 show that switches exceed cycle life specification.

In the first quarter of 1999, a total of (42) 77PSL2-1 snap switches were impulse tested to over 1,000,000 cycles with only (1) leak below 1,000,000 cycles, which

occurred at 728,000 cycles. A Weibull analysis showed 99.9% reliability at 500,000 cycles at 95% confidence level.

Conclusions: Switches meet cycle life specification. First quarter, 1999 tests confirm impulse test findings made during the period between 1991 and 1992. During that period, (6) impulse tests on 144 devices of 57PS and 77PS construction, had no leaks when tested to 500,000 cycles. A Weibull analysis of first quarter, 1999 tests, showed 99.9% reliability at 500,000 cycles at 95% confidence level.

Test 15a.

Objective: Determine the long term corrosive effects of brake fluid on the electrical components of switches which are continuously powered at 14 Volts.

Results: Test was suspended after 550 hours of testing. (6) samples were tested with continuous 14 Voits power. The contact cavity of (4) switches contained new brake fluid and (2) switches contained old brake fluid. Switches with old brake fluid drew very little hexport current and showed a decrease in hexport current over time to less than 1/10 mAmp. Samples with new brake fluid showed an increase in hexport current to over 20 mAmps toward the end of the 550 hours of testing. Analyses of (1) sample with new brake fluid and (1) sample with old brake fluid revealed electrolytic corrosion of the contact arm of both switches. There was a much lower level of corrosion in the sample with used brake fluid than the sample with new brake fluid.

Conclusion: Brake fluid in the contact cavity of switches, which are at 14 Volts continuous power for over 500 hours, can cause electrolytic corrosion of the switch contact arm and an increase in hexport current.

Test 17

Objective: Quantify the long term corrosive effects of new brake fluid on the electrical components of switches under the following laboratory conditions:

Contact cavity of switch flooded with new brake fluid. Switches at continuous 14 Volts power. Switches subjected to vibration for (1) hour per day. Switches subjected to 100°C for (1) hour per day.

Results: Test suspended after (312) hours. (50) samples tested. The average hexport current draw after (312) hours is 1.9 mAmps with a standard deviation of 1.8 mAmps. These results are consistent with results previously found in Test 15a at the 300 hour point.

TI-NHTSA 017027

Conclusion: New brake fluid in the contact cavity of switches, has not caused an increase in hexport current after (312) hours at continuous 14 Volts power.

Level 3: Objective: Understand the laboratory ignition process, determine the current path and establish a repeatable ignition method.

Test 6b

Objective: Understand the ignition process, determine the current path and establish a repeatable ignition method.

Results: Multiple attempts at laboratory ignition, via injection of a solution of 5 wt. % NaCl in H_20 into the contact cavity of switches, has resulted in a repeatability rate of approximately 50%. Plots of hexport current verses time show an increase in current until the point of ignition.

Conclusion: A repeatable laboratory method for switch ignition was established. Based on hexport current measurements, the current path is from switch terminals to hexport body.

When a solution of 5 wt. % NaCl in H₂0 is repeatedly injected into the contact cavity of powered switches, electrolytic corrosion of the switch terminal results in an increase in terminal resistance. When sufficient power is drawn through the corrosive resistance, switch elements heat up and begin to glow red hot. A hole burns through the switch base and ignition occurs. There is arcing visible throughout the corrosion process which may provide the spark necessary for ignition.

Level 4: Objective: Compare and contrast variables influencing ignition using the established laboratory ignition method.

Test 13a.

Objective: Compare various fluids in the established ignition method.

Results: The following fluids were tested.

- (1) NaCl in H₂0.
- (1) tap water
- rain water
- used brake fluid
- used brake fluid with 5 wt. % H₂0
- (1) new brake fluid
- (1) new brake fluid with 5 wt. % H₂0

The switch filled with 5 wt. % NaCl in H₂0 resulted in an ignition when average hexport current exceeded 2.5 Amps. Switches that were filled with tap water and rain water drew less than 10 mAmps over a (3) hour test and showed little signs of

corrosion. Switches filled with a matrix of new and used brake fluids, with water and without water, all drew less than 3 mAmps hexport current draw and showed no signs of corrosion over the (24) hour test.

Conclusion: Brake fluid is not conductive enough to cause the electrolytic corrosion and necessary current draw to create an ignition within a 3 hour lab test. Because of its' significantly higher conductivity, an ionic rich fluid such as NaCl in H₂0 can cause an ignition in a 3 hour lab test exposure..

Test 15

Objective: Compare the ignition characteristics of various plastics as switch base material.

Results: When 5 wt. % NaCl in H_20 was injected into switches with different base materials, the following results were obtained: Cellanex 4300 ignited 3 out of 5 attempts. Noryl ignited 2 out of 5 attempts. Zytel ignited 1 out of 5 attempts.

Conclusions: All plastics tested can ignite using the established laboratory ignition method.

Test 15b

Objective: Determine if switch ignition can occur in the vertical position and 45° orientation. Determine if switch ignition can occur and at different rotational angles in the 45° orientation.

Results: Switch ignitions can occur in both the vertical and 45° orientation using the established laboratory ignition method.

Conclusion: Switch ignition does not appear to be sensitive to vertical orientation verses 45° orientation nor to rotational angle in the 45° orientation.

Level 5 Objective:

Test 16

Objective: Test proposed relay circuit.

Results: (1) switch was injected with a solution of 5 wt. % Nacl in H₂0 and placed in the proposed current limiting circuit for (48) hours. The current draw remained constant at 180 mAmps throughout the test. There was no activity observed and the contact arm remained mostly intact.

(1) switch was brought to an impending burn condition using the established burn method. An impending burn is a condition where a corresive resistance has built

up in the switch and an ignition is imminent. The switch was then placed in the proposed relay circuit for (18) hours where it drew 160 mAmps, showed no visible activity and did not result in an ignition.

Because the proposed relay circuit acts as a resistor which limits current to the switch, the maximum power to the switch is limited to .75 Watts. A resistive wire was wrapped around the base of (1) switch and 0.75 Watts of power was dissipated in the wire. The wire became warm to the touch but had no effect on the switch.

Conclusion: 0.75 Watts, the maximum power in the proposed circuit design, is insufficient to cause substantial electrolytic corrosion or significant switch terminal heating, which is necessary to create an ignition. In previous tests, using a resistor as the heating element (see Test 6), approximately 5 Watts of power was necessary to create an ignition.

Brake Pressure Switch Test Log, Updated 7/12/99

Calegory	Tost	Location	Test Parameters	Results Update
sio Signulation	11	Ti -	Vary writer concentrations in 'new' Brake Fluid	2504 hours, Current draw in the 0.5mA to 5mA range
Potential Ignifica	_11		14Vdc to one terminal, heaport grounded	Fluid true discolored.
Bwitch	1 1		Water Conc. 4%, 6%, 10%, 75%	No Significant Temperature Rise. Test Suspended.
				Internal Analysis suspended.
	2	π	New Brake Fluid	250+ hours. Constant temperature.
			1 Amp through switch terminals	No significant temperature rise with time
		· ·	14Vdc to one terminal, hexport grounded	Test Guspended.
	3	AVT	new Brake Fluid in Switch, 24 VDC to one	> 300 hours into test, max current 7mA
			terminal. Hexport Grounded	No significant change with time. Test suspended
	- , 	4)45	The Paris Land State of Land	16 hours into test max current 6mA
	- 1 	AVT	new Breke Fluid in Switch, 24 VDC to one terminal. Hexport Grounded, Ambient at 100 C	No algorithms transportation rise with time. Test suspended.
	- 1 - 1		Billians. Heaport Growning, Albuque at 100 C	nto segregates transportation (see well trible. I day suspension.
	- 	ĀVT	new Brake Fluid in Switch, 16 Amps	Temperature rise of 20 C above from temp
	╌┼╌		Through switch terminals	Delta T reached steady state at 20 C. Test suspended.
	┷		THE COLUMN TO TH	
	- Sa	AVT	new Brake Fluid in Switch approx. 50 Ampe	Temperature rose to suprox, 270 F. No smoke. No ignition
	- + 		through Switch Terminals	Test suspended.
			<u> </u>	
	8	71	Build heater eignerile into Setich.	3 tested. Smoke observed, ignillon observed on part wingster
			Heat till feiture, include sperking.	See attachment
	\neg	•	(1) w/ solution of Brake Fluid and 8 wt. % H ₂ 0	Test complete
	_			Brake fluid in cavity alone down heat build-up
				Smoke observed at 876 F, Base malts and falls off at 800 F
	- Ba	п п	Create heater by corroding spring arm	One out of 15 devices increased resistance to 6 otypes.
	- °° -		Satt water solution, 14V between spring	Othern either very low resistance or magachinis
	- 	 _	and hesport	It took about 100 hours to reach the 6 chm stage.
			I I I I I I I I I I I I I I I I I I I	The 5 ohm device ignited under conditions similar to test 6.
			· · · · · · · · · · · · · · · · · · ·	THE S WAS COURSE OF THE CAMERA CAMERA IN COST OF
	- 1 5b	77	Re-run Ignition test to understand	Switch ignition with repeated 5% water solution into switch
- ţ	- 		repeatability and current path.	Current path is through hesport.
- 🛨 💳				See plots and video.
- <u>-</u>			 	Additional teal include top water, old BF, new BF and other.
- š 	Bc	77	Pure 'new' brake fluid with motal shavings	Metal shavings do not contribute significantly to brake fluid

Brake Pressure Switch Test Log, Updated 7/12/99

		<u> </u>		enductivity
ife Cycle Reliability	7		0-1400 pelg pressure pulses at 135C	First leak observed at 729,000 cycles.
of Pressure Switch			poer E8	Test Completed, See attached Weibuil Chart.
Diaphragm Wear	8	Π	0-1400 paig pressure pulses et 135C.	Parts withdrawn every 200k cycles, characterized for wear
Field verLab Correlation	8	Control Labo	Fleid returne, from denier lots, junkyards	Parts in Central Labe, see Ford spreadsheet
Design Of Experiments (1)	10	΄ Π_	Vary water concentrations in 'new' Brake Fluid	Test Report being written investigation continues.
Evaluating Factors			12 map + 12 quiet avritches w/ 0 % water in BF	Suspended at 1.3 million cycles with no leaks observed.
Effecting Displyagm Wear		- "	12 snap + 12 quiel switches w/ 5 % water in BF	Snop samples suspended at 1.3 million cycles with 2 leaks
Impulse test	_			observed at 1.3M. Quiet samples suspended at 500k cycles to
				assess fiduring anomalies.
On-Vehicle Characterization	11	TVA	Monitor Preseure and Temperature	Teet at AVTage Ford charts>500k in car?
of Pressure & Temperature	<u> </u>		at Suitch Location for ABS and non-ABS	
Profile in Town Car			braking events.	·
Prako Suid analysis	11m	<u> </u>	Analyza used brake fluid at the master cylinder	Teel complete.
Used floid at master cylinder.	\vdash		(UNAC), used broke fluid at the caliper (UCA)	UNIC: Cu = 415 (ug/ml), Fe = 5.5 (ug/ml), Cr = 0.05 (ug/ml), 1.1 %/120.
	. 		and new brake fluid (NEW) for metal and water	UCA: Cu = 592 (ug/m), Fe = 5.5 (ug/m), Cr = 1.9 (ug/m), 1.1 %H20.
	1		content	NEW: Cu = <0.01 (ug/m), Fe = 0.02 (ug/m), Cr = <.01 (ug/m), D.3 %H20.
Sperk /Arc Study	12	Central Labo	Delemine if erclepark forms in switch	Equipment est-up in progress at Central Labs.
	_		using clutch loads and high apout video.	TI Experimented with no 'eignificant' sperks observed.
	$\overline{}$		Use dry switches as well as muliches with	
	 	· · · · · · · · · · · · · · · · · · ·	various braise field water rabus.	
Characterization of	13	Central Labo	Characterize electrical, mechanical	Date log and analysis procedure set up complete.
autiches retrieved from field	1 -		and chardcal aspects of returned switches	Analysis of switches in progress.
unioperds & other sources	 	 		
THE PERSON NAMED IN COLUMN TWO				
Fluid Ingrees Tests	134	π	Repeat ignition signalation with different fluids.	Test complain.
. mrs oppose . com-	+	 :	(3) hour tests:	6% NaCl eample resulted in an Ignifica.
 :	1 -	 	5% NeCl in top water	All brake fluid samples drew less than 3 mAmps. No corrosion
-	1		main writer	visible on brake fluid samples.
TI-MHIN-LI	╀━-	 	(24) hour tests:	Rain water and tap water samples drew <10 mArrays and showed
┝╼╴┋╶ ─	┿		tep water	some aignes of corresion.
├ ─ 쿪	+		used brake fluid	Chemicel aniyale in process.
¥ - 		L		

Brake Pressure Switch Test Log, Updated 7/12/99

	ŢŢ		used brake fluid w/ 5% H ₂ 0	
	 		new brake fluid	
<u> </u>	1		new brake fluid w/ 5% H ₂ 0	
Design Of Experiments (2)	13b	П	Very water concentrations in 'new' Brake Fluid	Test suspended. Analysis in process to assess test fiduring.
Repeat of test 10	 '	<u> </u>	10 srup + 20 quiet switches w/ 0 % water in BF	
Neppen or cont 19	┪╼╁		10 anap + 20 quiet awitches w/ 5 % vester in BF	<u> </u>
	┤╾┥			
				and the second of the second o
Compatibility of Kapton	14	Dupont	Characterize change in properties of Kapton	Test in progress (100) hours completed. Ossiic eckl shows
with Ozelic Add	╅╌╸	- LANGE	with various % could edd in broke fluid.	similar effects that water has on Kapton proeffes.
	1		Mariament to pursue plant is actual ange.	
Evaluation of Plantic	15	π	Assess properties and moldability of different	Test suspended.
Materials with Improved	} " 	<u> </u>	grades of playic rasin with additives	Celenese and Noryl Ignited 3/5 and 2/5 tripls
Parameters	 -	 	to improve plactic part parformance	ZYTEL samples tested 1/5 ignitions
- ACALIDERS				
Long duration brake fluid	158	π	(4) samples with new brake fluid	Test suspended (550) hours completed.
ingrees toot.	 		(2) samples with used brake fluid	Used brake fuld current dropped off to <u10 mamp.<="" td=""></u10>
	 			New DF hexport current can increases w/ time under cont. power.
Evaluation of Switch	15b	Π	Assess ignition sensitivity to evilich orientation.	Test complete. Ignition is independent of switch orientation.
Orientation			Test vertical verses 45 degree.	elmulated exilich ignition can occur in vertical or 45 degree angle.
		-	Test rotational constituty in 45 deg. orientation.	ignilion appears not setuitive to switch rotational alignment.
Relay Circuit	18	Π	Repeat test 13a in Ford relay circuit for (46) hrs.	Test complete. No ignition. Corresion rate drastically reduced.
Test	\vdash		Bring switch to impending ignition in (15) Amp	Insufficient power in circuit to create or move toward ignition in lab
	—		circuit then place in raley circuit for (16) fee.	Heater element was wern to the touch.
			input max, afouit power into heater an switch.	
Long duration brake fluid	17	. П	(50) samples filled with new brades fluid	Test suspended. (312) hours completed.
ingress last number 2.			(1) hour of vibration per day	Average hexport current is 1.9 mAmp (stdeviation = 1.8 mAmps)
			(1) hour sock at 100 deg C per day	

preliminary draft summary of TI record search findings of May 14-17 1999

summary by Steve Beringhams & Andy McGuhk May 19th 1999

TI P/N:

77PSL2-1

Ford P/N;

F2VC-9F924-AB

Tested at 'room temp' per manufacturing ES requirements

		Qty	
	Lot	Impoles	Qty
Date	Sine	Tested	Leek
26-Nov-91	4,000	10	-
26-Nov-91	4,000	10	•
5-Dec-91	4,000	10	•
5-Dec-91	4,000	10 10	•
9-Dec-91 9-Dec-91	4,000 2,000	5	-
11-Dec-91	4,000	10	-
11-Dec-91	4,000	10	_
13-Dec-91	4,000	10	_
14-Dec-91	4,000	10	_
16-Dec-91	4,000	10	· <u>-</u>
16-Dec-91	4,000	10	-
2-Jan-92	4,000	10	-
6-Jan-92	4,000	10	-
7-Jan-92	2,000	5	-
- 8-J an-92	4,000	10	-
8-Jan-92	4,000	10	-
1 4- J an-92	4,000	10	-
14-Jan-92	4,000	10	-
15-Jan-92	4,000	10	-
28-J an-92	2,000	5	•
31-J -92	4,000	10	-
2-Feb-92	1,650	5 10	-
4-Feb-92 5-Feb-92	4,000 4,000	10	•
6-Peb-92	4,000	10	_
10-Feb-92	4,000	10	_
11-Feb-92	4,000	10	_
12-Feb-92	4,000	10	_
12-Peb-92	4,000	10	-
14-Feb-92	4,000	10	_
14-Peb-92	4,000	10	-
14-Feb-92	4,000	10	-
15-Peb-92	4,000	10	-
24-Feb-92	4,000	10	-
26-Feb-92	4,000	10	-
26-Peb-92	4,000	10	-
28-Peb-92	4,000	10	•
28-Peb-92	4,000	10	•
28-Peb-92	4,000	10	•
6-Mar-92	4,000	10	•
10-Mar-92 11-Mar-92	4,000 4,000	10 10	-
11-Mar-92 12-Mar-92	4,000	10	-
14-5115-74	4,000	LU	-

77PSL2-1: impulse Data Results 11/91 - 12/92

23-Apr-92 2,000 5 - 2-May-92 2,000 5 - 5-May-92 2,000 5 - 6-May-92 2,000 5 - 14-Sep-92 2,000 10 - 30-Sep-92 4,000 10 - 7-Oct-92 4,000 10 - 7-Oct-92 4,000 10 - 16-Oct-92 4,000 10 - 21-Oct-92 4,000 10 - 29-Oct-92 4,000 10 - 29-Oct-92 4,000 10 - 29-Oct-92 4,000 10 - 29-Oct-92 4,000 10 - 10-Nov-92 4,000 10 - 10-Nov-92 4,000 10 - 10-Nov-92 4,000 10 - 11-Nev-92 4,000 10 - 11-Dec-92 4,000 10 - 16-Dec-92 4,000 10 -	18-Mar-92	4,000	10	
5-May-92 2,000 5 - 6-May-92 2,000 5 - 14-Sep-92 2,000 5 - 22-Sep-92 4,000 10 - 30-Sep-92 4,000 10 - 7-Oct-92 4,000 10 - 16-Oct-92 4,000 10 - 21-Oct-92 4,000 10 - 21-Oct-92 4,000 10 - 29-Oct-92 4,000 10 - 29-Oct-92 4,000 10 - 29-Oct-92 4,000 10 - 30-Oct-92 4,000 10 - 10-Nov-92 4,000 10 - 10-Nov-92 4,000 10 - 11-Nev-92 4,000 10 - 11-Dec-92 2,000 5 - 9-Dec-92 2,000 5 - 14-Dec-92 2,000 5 - 16-Dec-92 4,000 10 -	23-Apr-92	2,000	5	
5-May-92 2,000 5 - 6-May-92 2,000 5 - 14-Sep-92 2,000 5 - 22-Sep-92 4,000 10 - 30-Sep-92 4,000 10 - 7-Oct-92 4,000 10 - 7-Oct-92 4,000 10 - 16-Oct-92 4,000 10 - 21-Oct-92 4,000 10 - 21-Oct-92 4,000 10 - 29-Oct-92 4,000 10 - 29-Oct-92 4,000 10 - 30-Oct-92 4,000 10 - 30-Oct-92 4,000 10 - 10-Nov-92 4,000 10 - 10-Nov-92 4,000 10 - 11-Nev-92 4,000 10 - 11-Dec-92 4,000 10 - 16-Dec-92 4,000 10 - 11-Dec-92 4,000 10 - 11-Dec-92 4,000 10 - 11-Dec-92 4,000 10 -	2-May-92	2,000	5	•
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14-Sep-92	6-May-92	2,000	5	-
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Totals units	244 486	
	784 644	_
		_

Currey, Pat

From:

fporter@ford.com

Senti

Friday, May 28, 1999 2:26 PM

To:

McGuirk, Andy

Subject

X.400 Inter-Personal Notification

Your message to: fporter@gw.ford.com was received at: 28 May 1999 15:26:28 -0400

This notification was generated automatically The following extra information was given: Ford Core team update

Carrey, Pat

From:

Haumann, Russ [rbaumann@email.mc.ti.com]

Sent

Friday, May 28, 1999 6:35 AM

Te:

McGuirk, Andy; Beringhause, Steven

Subject:

FW: GM recall - fires when car is turned off

FYI

RUSS

From:

Reynolds, Steven[SMTP:s-reynoldsl@ti.com]

Sent:

Thursday, May 27, 1999 6:23 PM

To:

Baumann, Rusa

Subject

GM recall - fires when car is turned off

GM recalls 35,000 Cadillacs

Automaker says '98 and '99 Cadillac Sevilles have an electrical short

May 27, 1999: 5:42 p.m. ET

DETROIT (Reuters) - General Motors Corp. said Thursday it is recalling about 35,000 1998 and 1999 Cadillac Sevilles because of an electrical short that could cause an engine compartment fire.

A fire could occur with the engine off and the car key removed, GH said. The automaker has confirmed seven reports of fires as a result. None have caused injuries.

"We want our customers to know that we consider this a serious condition," John Smith, Cadillac general manager, said in a statement. "We have started the process of contacting customers so that they can have their vehicles serviced as soon as possible at their Cadillac dealer. We also want them to know that Cadillac is taking extra measures to minimize any inconvenience, including providing courtesy cars until the repair can be made."

Most of the cars being recalled are model year 1999 Sevilles, with only 139 cars, made in the last month of model year 1998, affected by the problem, GM said. The 1998 cars carry vehicle identification numbers greater than WU934376.

Because fire can spread, GM strongly recommended that the Sevilles not be parked in an enclosed area such as a garage until they are brought into the dealership.

Pechenis, John

From: Sent:

To:

McGuirk, Andy Tuesday, June 01, 1999 10:39 AM Penhanis, John; Dague, Bryan; Prois, Stephen; Watt, Jim Beumann, Russ FW: Ford Core team update

Ċc:

Subject

for your background info as we host Steve reliners weds

AUTOMOTIVE STUMBORS AND CONTROLS (SA MARKER 34 FUNDS? BY 379 22-05 ACTUARCES, NA 62703 25C.; (500) 236-3705 EAZ: (500) 236-3745 MCBILE: (500) 206-6119 256E: (600) 467-3700 PIK 604-2044

Front

Sent: Te:

McGuirk, Andy Fridey, May 26, 1900 3:22 PM 'Frederick J. Porter' Befinghtuse, Steven, Sherpe, Robert Ford Core team update

Fred, per our discussions and Rob Sharpe's visit enclosed is our updates...

TÄRTLÖGG. de

APPONENT PERSONA AND CONTROLS CRA NORMARK 34 MCREST ST M/S 23-05 ATTARAGNO, NA 04703 TEL : (804) 234-3000 TEL : (504) 246-3745 NORMARK: (508) 201-611 PAGE: (800) 467-3700 FIN 804-2014

Attorney Client Privileged

May 25, 1999

Mr. Frederick J. Porter, Supervisor E/E Systems Engineering Suliding 5, Meil Drop 5011 20000 Rotunda Drive, Rm 35004 Dearborn MI 48121-2053

Deer Fred:

I want to review our recent support of the Ford core team to assure we do not have any misunderstandings regarding our pressure switch performance, our contribution to the 'core' team, and our commitment to a quick conclusion.

For six morths the Texas instruments Automotive Sensors & Controls Team has been supporting the Ford Core Diagnostic Team with technical facts, data, and analysis regarding our brake pressure switch product applied in the Ford cruise control deactivation circuit.

A senior TI pressure switch engineer was in residence at Ford for three weeks to assist with switch related issues in the system diagnostic process. Senior TI leadership participation has also been involved in virtually every Ford Core Team meeting delivering facts, data, and technical support year-to-date 199.

We also investigated switch capability, and using agreed upon accelerated simulation life testing techniques, demonstrated the ability of the model year '92 & '93. Town Car speed control descrivation switches to consistently exceed "cycle life specification" of 500,000 pressure cycles. TI Welbull reports of pressure switches tested in '1999 conservatively demonstrate 95% religibility to 1 million cycles (with confidence intervals greater than 50%).

Additionally "success testing records" of some 665 68 units that were tested during the 1991 - 1992 (11/91 - 12/92) showed zero leakage at 500,000 cycles.

Conclusion to date: 1992 period switches met specification. 1999 switch meets or exceeds specification

We have developed and delivered a taboratory model of accelerated plastic base ignition of the switch resulting from fluid in the switch cavity coupled with application of constant power as designed in the speed control circuit. Theories from the model suggest that fluids in the switch cavity in the presence of uninterrupted power could lead to a corresion product formation which might create a plastic base ignition path.

Mr. Fred Porter May 26, 1999 Page 2

Conclusion to date: Constant speed control power allows long term corresion

Per Fred And problem to this point

_=

In light of this laboratory model and the need for cruise system power only during vehicle operation, we suggest the system architecture of "key-on/off based power be considered.

We have been open and forthright in our communications and delivery of information and we believe we have been instrumental in helping Ford address the underhood fire concern issue.

In this regard, we think it is appropriate at this point that our active participation in the diagnostic journey of the vintage 1992 product move towards a timely conclusion.

Under the trail of

We are preparing to fulfill your request for hosting a site visit, supporting campaign field return device analysis, and participating in robust system brainstonning sessions moving toward conclusion in July, as well as reviewing the optimization of our product line process controls.

Our prime focus at this time is in rapidly supplying Ford with 225,000 units in support of the field actions.

Regards.

Andrew C. McGuirk QRA Manager Texas Instruments

attechments: 1992 Testing History

Ti 77PS Test synopsis

TI 77PS Investigation Flow Diagram

* Find has issue with the left 3 paragraphs in regards to clearing or defining a conclusion to the diagnostic journey. This comes from the fact Uthet we still do not have a root cause.

* Initial field service to rewise switch circuit (w/relay) was rejected due to durability concerns with relay (would) be not want to inwoduce another potential problem.

P4 20+2

How Lang Will It Take? The time needed for either of the repairs is less than one-half day. However, due to service scheduling issues, your dealer may need your values for a longer period of time. Floure call your dealer for a service date.

Call your dealer without delay. Ask for a service date and whether parts are in stock for Safety Recall 99815.

If your dealer does not have the parts in small, they can be ordered before scheduling your service data. If available, parts would be expected to arrive within a week after ordering. If parts are not available, your dealer can perform the interim Repair free of charge. When parts are available, your dealer will perform the Permanent Repair free of charge.

When you bring your vehicle in, show the dealer this letter. If you misplace this letter, your dealer will still do the work, free of charge.

Refunda

If you paid to have this service done before the date of this letter, Ford is offering a full refund. For the refund, please give your paid original receipt to your Ford or Lincoln Mercury dealer. To avoid delays, do not send receipts to Ford Motor Company.

Changed Address Or Sold The Vahlele? Flows fill out the enclosed propeld postered and mail it to us if you have changed your address or sold the validie.

If the dealer doesn't make the repair promptly sed without charge, you may contact the Ford Customer Assistance Center, P.O. Box 6248, Desriewn, Michigan 42121. You also may send a complaint to the Administrator, National Highway Traffic Enfety Administration, 400 Seventh Street, R.W., Weshington, D.C. 20500 or call the toll-free Auto Sufety Hotline 1-800-424-9393 (Washington, D.C. some residents may call 366-0123).

We regret the inconvenience this service may cause you, but we want you to have the work done for your safety and estimation with your Pord or Lincoln built valids.

Sincerely,

L R ONell

Director

Vahiole Service and Programs

Safety Recall

MRY 27 '99 09:49

5882363745

PAGE: 982

This notice is sent to you in accordance with the requirements of the National Traffic and Motor Vehicle Safety Act.

Pord Motor Company has decided that a defect which relates to motor vehicle safety exists in certain 1992 and 1993 Crown Viotoria, Grand Marquis, and Lincoln Town Cars with Speed Control.

Befoty Defects Some Speed Control Descrivation Switches on the affected vehicles may develop a recistive short in the electrical circuit that may potentially result in an underhand fire. A fire is possible both when the vehicle is rushing and when the vehicle engine is off. Also, the short may disable the speed outstrol system or came the brake light fuse to open.

Repaires

Repair parts may not be available until mid-June, 1999. If your dealer is not able to obtain the parts needed for this retail, an Interim Repair can be performed at no charge to you. However a second visit to your dealer will be required at a later date to have the permanent repair performed. We regret this inconvenience, but your safety is our primary concern.

Interim Repairs If parts are not evaliable, the Interim Repair should be performed immediately. This repair involves disconnecting the electrical connector from the Speed Control Descrivation Switch and protecting the connector and from contamination. The Speed Control system will be inoperative until the Permanent Repair is performed; normal valuable operation without Speed Control is not affected.

Personnent Repairs Parts for this requir are expected to become available the middle of June, 1999. This requir will involve the replacement of the Speed Control Descrivation Ewitch with a new switch. In addition, the switch hard-shall commetter will be replaced to diminate the possibility of undetected heat durings to the connector.

P4 2042

How Long Will It Take? The time needed for either of the repetre is less than one-half day. However, due to service scheduling issues, your dealer may need your vehicle for a longer period of time. Please call your dealer for a service date.

Call your dealer without delay. Ask for a service data and whether parts are in stock for Befety Recall 99215.

If your dealer does not have the parts in smoot, they can be ordered before scheduling your service date. If evaluable, parts would be expected to arrive within a week after ordering. If parts are not available, your dealer can perform the laterine Repair free of charge. When parts are available, your dealer will perform the Fermanent Repair free of charge.

When you bring your relaids in, show the dealer this latter. If you misplace this latter, your dealer will still do the work, free of charge.

Refunde

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Changed Address Or Sald The Vehicle? Please fill out the englosed properly postered and mail it to us if you have changed your address or sold the vehicle.

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We regret the inconvenience this service may came you, but we want you to have the work done for your safety and existention with your Ford or Lincoln tailt values.

Sincerely.

A. R. O'Rell

Director

Vehicle Service and Programs

Safety Recall 98615

5882363745

PRGE . 882

Currey, Pat

From:

McGuirk, Andy [a-mcguirk@emsil.mc.ti.com] Friday, May 28, 1999 12:50 PM

1

Sent:

To:

Warner, Pam

Subject

Core team update testing



May 25, 1989

Mr. Frederick J. Porter, Supervisor E/E Systems Engineering Building 5, Mail Drop 5011 20000 Rotunda Drive, Rm 3E004 Dearborn Mi 48121-2053

Dear Fred:

I want to review our recent support of the Ford core team to assure we do not have any misunderstandings regarding our pressure switch performance, our continued contribution to the 'core' team, and our commitment to a quick conclusion.

For six months the Texas instruments Automotive Sensors & Controls Team has been supporting the Ford Core Diagnostic Team with technical facts, data, and analysis regarding our brake pressure switch product applied in the Ford cruise control deactivation circuit.

A senior TI pressure switch engineer was in residence at Ford for three weeks to assist with switch related issues in the system diagnostic process. Senior Titleadership participation has also been involved in virtually every Ford Core Team meeting delivering facts, data, and technical support year-to-date '89.

We also investigated switch capability, and using agreed upon accelerated simulation life testing techniques, demonstrated the ability of the model year '92. & '93. Town Car speed control descrivation switches to consistently exceed "cycle life specification" of 500,000 pressure cycles. Ti Weibuil reports of pressure switches tested in '1999 conservatively demonstrate 95% reliability to 1 million cycles (with confidence intervals greater than 50%).

Additionally "success testing records" of some 665 ES units that were tested during the 1991 - 1992 (11/91 - 12/92) showed zero leakage at 500,000 cycles.

Conclusion to date: 1992 period switches met specification. 1999 switch meets or exceeds specification.

We have developed and delivered a laboratory model of accelerated plastic base ignition of the switch resulting from fluid in the switch cavity coupled with application of constant power as designed in the speed control circuit. Theories from the model suggest that fluids in the switch cavity in the presence of uninterrupted power could lead to a corrosion product formation which might create a plastic base ignition path.

Mr. Fred Porter May 25, 1999 Page 2

Conclusion to date: Constant speed control power allows long term corrosion

In light of this laboratory model and the need for cruise system power only during vehicle operation, we suggest the system architecture of "key-on/off" based power be considered.

We have been open and forthright in our communications and delivery of information and we believe we have been instrumental in helping Ford address the underhood fire concern issue.

in this regard, we think it is appropriate at this point that our active participation in the diagnostic journey of the vintage 1992 product move towards a timely conclusion. Toward this end, we will continue to support the "core" team review of 1992 product history with targeted completion in July 1999.

We are preparing to fulfill your request for hosting a site visit, supporting campaign field return device analysis, and participating in robust system brainstorming sessions moving toward conclusion in July, as well as reviewing the optimization of our product line process controls.

Our prime focus at this time is in rapidly supplying Ford with 225,000 units in support of the field actions.

Regards,

Andrew C. McGuirk QRA Manager Texas Instruments

attachmente: 1992 Testing History

177PS Test synopsis

TI 77PS Investigation Flow Diagram

Currey, Pat

From:

McGuirk, Andy [a-meguirk@email.mc.tl.com]

Sent:

Friday, May 28, 1999 1:35 PM

To:

Warner, Pam

Subject:

FW: my second draft 77PSL2 1.xls



AUTOMOTIVE SENSORS AND CONTROLS QRA MANAGER 34 FOREST ST M/S 23-05

ATTLEBORG, MA 02703 TEL: (508) 236-3080 FAX: (508) 236-3745 MOBILE: (508) 208-6119

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

from:

McGuirk, Andy

Sent:

Mednesday, May 19, 1999 12:54 PM

To: Sharpe, Robert Beringhause, Steven

Subject: FW: my second draft 77PSL2_1.xls

AUTOMOTIVE SENSORS AND CONTROLS QRA MANAGER

34 FOREST ST M/S 23-05 ATTLEBORO, MA 02703 TEL : (508) 236-3080 FAX : (508) 236-3745 MOBILE: (508) 208-6119

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

Fram: McGuirk, Andy

Wednesday, May 19, 1999 12:45 PM Sent:

Sharpe, Robert To: Baumann, Rusa

my first draft 77PSL2_1.xls Subject:

AUTOMOTIVE SENSORS AND CONTROLS ORA MANAGER

34 FOREST ST M/S 23-05 ATTLEBORO, MA 02703 TEL: (508) 236-3080 FAX : (508) 236-3745 MOBILE: (508) 208-6119

PAGE: (800) 457-3700 PIN 604-2044

<<77PSL2_1.mlm>>

Regards,

andy

May 26, 1999

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Mr. Fred Porter May 26, 1999 Page 2

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Andrew C. McGuirk QRA Manager Texas Instruments

attachments: 1992 Testing History

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TI 77PS Investigation Flow Diagram

Epstein, Sally

From:

McGuirk, Andy (a-mcguirk@email.mc.tl.com)

Sent:

Friday, May 28, 1999 2:22 PM

To:

"Frederick J. Porter"

Cc:

Beringhause, Staven; Sharpe, Robert

Subject:

Ford Core team update

THE PROPERTY AND IN

77Pfs.3 1.es

Fred, per our discussions and Rob Sharpe's visit enclosed is our updates...

<<FredPortCore.doc>>

<<synopsil.doc>>

<<TESTLOG9.xls>>

<<77PSL2_1.xls>>

AUTOMOTIVE SENSORS AND CONTROLS ORA MANAGER 34 FOREST ST M/S 23-05

ATTLEBORO, MA 02703 TEL : (508) 236-3080 FAX : (508) 236-3745 MOSILE: (508) 208-6119

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

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Additionally "success testing records" of some 555 ES units that were tested during the 1991 - 1992 (11/91 - 12/92) showed zero leakage at 500,000 cycles.

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We have developed and delivered a laboratory model of accelerated plastic base ignition of the switch resulting from fluid in the switch cavity coupled with application of constant power as designed in the speed control circuit. Theories from the model suggest that fluids in the switch cavity in the presence of uninterrupted power could lead to a corresion product formation which might create a plastic base ignition path.

Mr. Fred Porter May 25, 1999 Page 2

Conclusion to date: Constant speed control power allows long term corrosion

In light of this laboratory model and the need for cruise system power only during vehicle operation, we suggest the system architecture of "key-on/off" based power be considered.

We have been open and forthright in our communications and delivery of information and we believe we have been instrumental in helping Ford address the underhood fire concern issue.

In this regard, we think it is appropriate at this point that our active participation in the diagnostic journey of the vintage 1992 product move towards a timely conclusion. Toward this end, we will continue to support the "core" team review of 1992 product history with targeted completion in July 1999.

We are preparing to fulfill your request for hosting a site visit, supporting campaign field return device analysis, and participating in robust system brainstorming sessions moving toward conclusion in July, as well as reviewing the optimization of our product line process controls.

Our prime focus at this time is in rapidly supplying Ford with 225,000 units in support of the field actions.

Regards.

Andrew C. McGuirk QRA Manager Texas instruments

attachments: 1992 Testing History

TI 77PS Test synopsis

TI 77PS (rivestigation Flow Diagram

TI 77PS Test Synopsis

This document is a synopsis of tests conducted by Texas Instruments during the 77PS investigation. The intent of this document is to highlight test findings which drove the investigation to its current state. Throughout the investigation, several tests were conducted with the same objective. When each objective was met, efforts were refocused to obtain a new level of understanding and to establish a new set of objectives. As such, tests have been categorized into (5) levels, representing the level of knowledge obtained from the group of tests conducted. Each level is listed below with a short description of the objective:

- Level 1: Create a laboratory switch ignition without any restrictions on methods.
- Level 2: Create a laboratory switch ignition using only conditions found in the switch operating environment.
- Level 3: Understand the laboratory ignition mechanism.
- Level 4: Compare factors contributing to laboratory ignition.
- Level 5: Evaluate recommendations.

Refer to Brake Pressure Switch Test Log.

Level 1 Objective: Determine if a switch ignition can be created in the laboratory.

Test 1

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Switch contact cavity flooded with brake fluid mixed with varying amounts of % H₂0.

14 volts applied to one terminal, second terminal electrically floating. (No electrical load across switch terminals). Switch hexport electrically grounded.

Results:

- (8) samples were tested total:
- (2) with 4% H₂0 in brake fluid.
- (2) with 6% H₂0 in brake fluid.
- (2) with 10% H₂0 in brake fluid.
- (2) with 75% H₂0 in brake fluid.

No ignition occurred. No significant temperature rise observed in all samples. Current draw ranged from 0.5 mAmps to 5 mAmps over a period greater than (250) hours.

TI-NHT8A 017054

Test 2

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Switch contact flooded with brake fluid. 14 volts applied to one terminal, second terminal connected to a 14 Ω resistor which is tied to ground. (1 Amp load across switch terminals). Switch hexport electrically grounded.

Results: (2) samples were tested. No ignition occurred. No significant temperature rise observed for a period over (250) hours.

Conclusion: A (1) Amp load through switch terminals did not ignite brake fluid in the contact cavity of switches.

Test 6

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Heater element installed in contact cavity of the switch.

Power applied to the heater element until plastic base melts.

Spark generated in contact cavity of switch.

Brake fluid present in the contact cavity (wet device) and absent in the contact cavity (dry device).

Results: (2) dry devices were tested and (1) wet device was tested. Ignition occurred in all devices.

<u>Wet device</u>: The internal temperature of a wet device reached 660°F. A hole burned through the base of the switch (close to the heating element). The applied spark ignited the fumes in the contact cavity of the switch and engulfed the base material of the switch.

<u>Dry device:</u> The internal temperature of a dry switch reached over 1000°F. The switch base flopped over. The applied spark ignited the fumes in the contact cavity of the switch and engulfed the base material of the switch.

Conclusion: A switch ignition can occur under the following laboratory conditions:

Heater element installed in the switch contact cavity.

5 watts of power dissipated in heating element.

Spark generated in the contact cavity of the switch.

Brake fluid did not contribute to the ignition process.

TI-NHTSA 017055

Level 2: Objective: Determine if a laboratory ignition can occur using only switch components and elements found in the switch environment.

Test 6a

Objective: Determine if corrosive degradation of switch electrical components can cause an increase in electrical resistance (and thus a source of heat) in the switch, which may lead to an ignition.

Results: (1) out of (15) samples tested increased resistance to 5 Ωs. A solution of 5 wt. % NaCl in H₂0 can corrode the electrical components of the switch and cause an increase in electrical resistance. Repeated injections of the solution of 5 wt. % NaCl in H₂0 into the contact cavity of a switch, with the switch continuously powered at 14 Volts, can cause an ignition.

Conclusion: A switch ignition can occur under the following laboratory conditions:

A solution of 5% NaCl in H₂0 is injected into contact cavity of a switch. Continuous 14 Volt power applied to the switch. Hexport is grounded.

Current is limited at 15 Amps.

Test 6c

Objective: Determine if brake fluid with metal shavings is conductive enough to create an ignition.

Results: (3) devices with various size metal particles were tested. No significant current increase detected.

Conclusion: Metal shavings did not significantly increase conductivity brake fluid. Current levels measured were well below levels necessary to create an ignition.

Test 7

Objective: Determine if switch meets cycle life specification.

Results: Tests conducted during the first quarter of 1999 show that switches exceed cycle life specification.

In the first quarter of 1999, a total of (42) 77PSL2-1 snap switches were impulse tested to over 1,000,000 cycles with only (1) leak below 1,000,000 cycles, which

occurred at 728,000 cycles. A Weibull analysis showed 99.9% reliability at 500,000 cycles at 95% confidence level.

Conclusions: Switches meet cycle life specification. First quarter, 1999 tests confirm impulse test findings made during the period between 1991 and 1992. During that period, (6) impulse tests on 144 devices of 57PS and 77PS construction, had no leaks when tested to 500,000 cycles. A Weibuil analysis of first quarter, 1999 tests, showed 99.9% reliability at 500,000 cycles at 95% confidence level.

Test 15a

Objective: Determine the long term corrosive effects of brake fluid on the electrical components of switches which are continuously powered at 14 Volts.

Results: Test was suspended after 550 hours of testing. (6) samples were tested with continuous 14 Volts power. The contact cavity of (4) switches contained new brake fluid and (2) switches contained old brake fluid. Switches with old brake fluid drew very little hexport current and showed a decrease in bexport current over time to less than 1/10 mAmp. Samples with new brake fluid showed an increase in hexport current to over 20 mAmps toward the end of the 550 hours of testing. Analyses of (1) sample with new brake fluid and (1) sample with old brake fluid revealed electrolytic corrosion of the contact arm of both switches. There was a much lower level of corrosion in the sample with used brake fluid than the sample with new brake fluid.

Conclusion: Brake fluid in the contact cavity of switches, which are at 14 Volts continuous power for over 500 hours, can cause electrolytic corrosion of the switch contact arm and an increase in hexport current.

Test 17

Objective: Quantify the long term corrosive effects of new brake fluid on the electrical components of switches under the following laboratory conditions:

Contact cavity of switch flooded with new brake fluid. Switches at continuous 14 Volts power. Switches subjected to vibration for (1) hour per day. Switches subjected to 100°C for (1) hour per day.

Results: Test suspended after (312) hours. (50) samples tested. The average hexport current draw after (312) hours is 1.9 mAmps with a standard deviation of 1.8 mAmps. These results are consistent with results previously found in Test 15a at the 300 hour point.

Conclusion: New brake fluid in the contact cavity of switches, has not caused an increase in hexport current after (312) hours at continuous 14 Volts power.

Level 3: Objective: Understand the laboratory ignition process, determine the current path and establish a repeatable ignition method.

Test 6b

Objective: Understand the ignition process, determine the current path and establish a repeatable ignition method.

Results: Multiple attempts at laboratory ignition, via injection of a solution of 5 wt. % NaCl in H₂0 into the contact cavity of switches, has resulted in a repeatability rate of approximately 50%. Plots of bexport current verses time show an increase in current until the point of ignition.

Conclusion: A repeatable laboratory method for switch ignition was established. Based on hexport current measurements, the current path is from switch terminals to hexport body.

When a solution of 5 wt. % NaCl in H₂0 is repeatedly injected into the contact cavity of powered switches, electrolytic corrosion of the switch terminal results in an increase in terminal resistance. When sufficient power is drawn through the corrosive resistance, switch elements heat up and begin to glow red hot. A hole burns through the switch base and ignition occurs. There is aroing visible throughout the corrosion process which may provide the spark necessary for ignition.

Level 4: Objective: Compare and contrast variables influencing ignition using the established laboratory ignition method.

e Test 13a

Objective: Compare various fluids in the established ignition method.

Results: The following fluids were tested.

- NaCl in H₂0.
- (1) tep water
- (1) rain water
- (1) used brake fluid
- (1) used brake fluid with 5 wt. % H₂0
- (i) new brake fluid
- (1) new brake fluid with 5 wt. % H₂O

The switch filled with 5 wt. % NaCl in H₂0 resulted in an ignition when average hexport current exceeded 2.5 Amps. Switches that were filled with tap water and rain water draw less than 10 mAmps over a (3) hour test and showed little signs of

corrosion. Switches filled with a matrix of new and used brake fluids, with water and without water, all drew less than 3 mAmps hexport current draw and showed no signs of corrosion over the (24) hour test.

Conclusion: Brake fluid is not conductive enough to cause the electrolytic corrosion and necessary current draw to create an ignition within a 3 hour lab test. Because of its' significantly higher conductivity, an ionic rich fluid such as NaCl in H₂O can cause an ignition in a 3 hour lab test exposure.

Test 15

Objective: Compare the ignition characteristics of various plastics as switch base material.

Results: When 5 wt. % NaCl in H_2O was injected into switches with different base materials, the following results were obtained: Cellanex 4300 ignited 3 out of 5 attempts. Noryl ignited 2 out of 5 attempts. Zytel ignited 1 out of 5 attempts.

Conclusions: All plastics tested can ignite using the established laboratory ignition method.

Test I5b

Objective: Determine if switch ignition can occur in the vertical position and 45° orientation. Determine if switch ignition can occur and at different rotational angles in the 45° orientation.

Results: Switch ignitions can occur in both the vertical and 45° orientation using the established laboratory ignition method.

Conclusion: Switch ignition does not appear to be sensitive to vertical orientation verses 45° orientation nor to rotational angle in the 45° orientation.

Level 5 Objective:

Test 16

Objective: Test proposed relay circuit.

Results: (1) switch was injected with a solution of 5 wt. % Necl in H₂0 and placed in the proposed current limiting circuit for (48) hours. The current draw remained constant at 180 mAmps throughout the test. There was no activity observed and the contact arm remained mostly intact.

 switch was brought to an impending burn condition using the established burn method. An impending burn is a condition where a corrosive resistance has built up in the switch and an ignition is imminent. The switch was then placed in the proposed relay circuit for (18) hours where it drew 160 mAmps, showed no visible activity and did not result in an ignition.

Because the proposed relay circuit acts as a resistor which limits current to the switch, the maximum power to the switch is limited to .75 Watts. A resistive wire was wrapped around the base of (1) switch and 0.75 Watts of power was dissipated in the wire. The wire became warm to the touch but had no effect on the switch.

Conclusion: 0.75 Watts, the maximum power in the proposed circuit design, is insufficient to cause substantial electrolytic corrosion or significant switch terminal heating, which is necessary to create an ignition. In previous tests, using a resistor as the heating element (see Test 6), approximately 5 Watts of power was necessary to create an ignition.

Brake Pressure Switch Test Log, Updated 5/30/99

Category	Teat	Location	Test Parameters	Results Update
b Simulation	. 1	TI _• .	Vary water concentrations in 'new' Brake Fluid	250+ hours, Current draw in the 0.5mA to 5mA range
Potential Ignition			14Vde to one terminal, hexport grounded	Fluid has discotored
Switch,			Water Conc. 4%, 6%, 10%, 75%	No Significant Temperature Rise, Test Suspended
				internal Analysis suspended.
	3	Ţı	New Brake Fluid	250+ hours. Constant temperature.
			1 Amp through switch terminels	No significant temperature rise with time
			14Vde to see terreiner, hexport grounded	Test Suspended
	3	AVT	new Braite Fluid in Switch, 24 VDC to one	> 300 hours into test, max current 7mA
			terminal. Herport Grounded	No significant change with time. Test suspended
		TVA	new Brake Fluid in Switch, 24 VDC to one	16 hours into test max current 5mA
			terminal. Harport Grounded, Ambient at 100 C	No significant temperature rise with time. Test suspended.
	Б.	AVT	new Brake Fluid in Switch, 16 Amps	Temperature rise of 20 C above room temp
			Through switch terminals	Delta T reached steady state at 20 C. Test suspended.
	5a	AVT	nen' Brake Fluid in Switch approx. 60 Amps.	Temperature rose to approx. 270 F. No smoke. No ignition
			through Switch Terminals	Total suspended
				<u> </u>
	6	TI	Build heater elements into Switch.	3 tested. Smoke observed, ignition observed on part withouter
	_		Heat till fature, include sperideg.	See attachment
			(1) we solution of Brate Fluid and 5 wt. % H ₂ O	Tast complete
		L		Brake fluid in cavity slows down heat build-up
				Smoke observed at 675 F, Base melts and fails off at 800 F
			<u> </u>	
	Ba	π	Create heater by corroding spring arm	One out of 15 devices increased resistance to 5 chms.
			Salt water edution, 14V between spring	Others either very low resistance or megachins
			and harport	It took about 100 hours to reach the 5 ahm stage.
				The 5 ohm device ignited under conditions similar to test 6.
<u> </u>	- 6b	TI	Re-run ignition test to understand	Switch ignition with repeated 5% water solution into switch
<u> </u>		<u> </u>	repostability and current path.	Current path is through heapart.
Ī			<u> </u>	See plots and video.
THE THE				Additional test include tap water, old BF, new BF and other.
E	6c	π	Pure 'new brake fluid with metal shavings	fidual shavings do not contribute significantly to brake Ruid

Brake Pressure Switch Test Log, Updated 8/30/99

				coductivity
ifa Cycle Reliability	7	TI	0-1400 paig pressure pulses et 135C	First leak observed at 728,000 cycles.
Pressure Switch			per ES	Test Completed. See attached Weibuil Charl
g (8748) 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		d - d	Assert Control of the	A CONTRACTOR OF THE CONTRACTOR
iaphragm Wear	-8		0-1400 paig pressure pulses at 135C.	Parts withdrawn every 200k cycles, characterized for weer
	10.00	2 -	NAMES OF THE PARTY	
ield vs Lab Corretation	•		Field returns, from dealer lots, junicyards	Parts in Central Labs, see Ford apreadsheet
1770 . 化原本材料作品多价的。	3.73		CACAC CARREST AND A CACACAC	
esign Of Experiments (1)	10	T	Very water concentrations in 'new' Brake Fluid	Test Report being written investigation continues
volunting Factors			12 enep + 12 quiet switches w/ 0 % water in BF	Suspended at 1.3 million cycles with no leaks observed.
Secting Disphragm Weer	_		12 enap + 12 quiet switches w/ 5 % water in BF	Snap samples suspended at 1.3 million cycles with 2 leaks
mpulse test	-			observed at 1.3M. Quiet samples suspended at 500k cycles to
<u></u>		 		assess ficturing anomalies.
Market Commence of the Commenc	(5%)	12 15 00 18		
Do-Vehicle Characterization	11	AVT	Monitor Pressure and Temperature	Total at AVTsee Ford charts>500s in car?
Pressure & Tomperature	 		at Switch Location for ABS and non-ABS	
rolle in Town Car		-	braking events.	
and a supplied the supplied of the supplied of the supplied to the supplied of the supplied o	. <u>.</u>	7. 44 Tan	THE STREET STREET, STR	
Brake Ruid printysis	114		Analyza used brake fluid at the master cylinder	Test complete.
lead fluid at marter cylinder.	┝ᢡ	 '`- 	(UNIC), used broke (bid at the college (UCA)	UNIC: Cu = 415 (up/mb, Fe = 5.5 (up/mb), Cr = 0.05 (up/mb, 1.1 *4420.
	₩	╆╌┈	and new brake Build (NEW) for metal and water	UCA: Cu = 502 (uplint), Fa = 5.5 (uplint), Cr = 1.9 (uplint), 1.1 %H20.
	-	 - 	content	NEW: Cu = <0.01 (up/m), Fe = 0.82 (up/m), Cr = <.01 (up/m), 0.3 %/(20.
TO THE PARTY OF TH	3400	Woodship Date	English and the state of the st	
Spark IArc Study	12	Control abs	Columnico II are/spark forms in switch	Equipment set-up in progress at Central Labs.
open rac oney	} '		using clutch loads and high speed video.	Ti Experimented with no 'significant' sparks observed
	╁━	 	Use dry switches as well as switches with	
	⊢	 	various brake fluid water mices.	<u> </u>
March Andrews States and the States of The Prince of The P	354.84	Internation of Press (2)		
A SALES OF THE PROPERTY OF THE PARTY OF THE	13	Control Labor	Characterize electrical, mechanical	Data log and analysis procedure set up complete.
Characterization of	13	CHEST LES	and chamical espects of returned switches	Analysis of switches in progress.
switches retrieved from field	₩	 -	Many Continent subgress or Larra Land Assistance	ультуры от виналет в грофека.
unkyards & other sources	-	S MODERATE F.A.D. 1980		
	W _{inj} i		Conset in the security of the different fixed	Test complete.
Fluid Ingrees Tests	130	 	Repeat ignition simulation with different fluids.	5% NaCl sample resulted in an ignition.
	₩	 -	(3) hour tests.	All brain field samples draw less than 3 mAmps. No correction
. d	₩	 ~-	5% NeCl in tep water	
Z	┺	 	rain water	visible on brake fluid samples
. T	┺	1	(24) hour tests	Rain water sand tap water samples drew <10 mArtips and showed
; a		·	tap water	some signer of corresion.

TI-NHTSA 017062

Brake Pressure Switch Test Log, Updated 6/30/99

			used brake fluid	Chamical aniyeis in process.
		-	used brake fluid w/ 5% H ₂ 0	
			new brake fluid	
				
			new brake fluid w/ 5% H ₂ 0	
Marketon : Parton				
Design Of Experiments (2)	13b	_π		Test suspended. Analysis in process to assess test federing.
Repeat of test 10			10 map + 20 quiet matches w/ 0 % water in BF	
			10 snap + 20 quiet puliches w/ 5 % water in EF	
Carra Adam Andrew	323.10		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
Compatibility of Kapton	14	Dupant	Cherechelze change in properties of Kapton	Test in progress (100) hours completed. Chalic acid shows.
with Charle Add	 ~		with various % coeffic acid in farable fluid.	aimiter effects that water has do Kapton procritics.
F7.00 WARREN CO.	r 3	State .	No real base	the same of the sa
Evaluation of Plastic	16	TI	Amuses proposition and moldability of different	Test suspended
Materiale with Improved	-		grades of plastic resin with additions	Colonges and Horyl ignited 3/5 and 2/5 tripls
Parameters.			to improve plactic part partirmance	ZYTEL samples leaded 1/5 ignitions
			10 miles	
Long duration brake fluid	15e	TI	(4) vertples with new broke fleid	Tetal suspended (560) hours completed.
iogresa feet.	<u> </u>		(2) samples with used broke fluid	Ligad brake fluid current dropped off to <1/10 mAmp.
				New BF hexport current can increases w/ time under cont. power.
AL PROPERTY OF THE PARTY OF THE	2	The second of	An	
Evaluation of Statech	150	} π	Assess lythion sessionly to switch extentation.	Test camplete. Ignition is independent of switch orientation.
Orientation	1		Test verifical verses 45 degree	simulated writch ignition can occur in vertical or 45 degree angle.
	Ţ		Test rotational sensitivity in 45 dag. orientation.	ignition appears not sensitive to switch extational alignment.
PART OF THE PROPERTY OF THE PART OF THE PA	,	1.00		The state of the s
Raley Circuit	10	TI	Report test 13s in Ford relay circuit for (48) hrs.	Test complete. No ignition. Corresion rate drastically reduced.
<u> </u>	<u>.</u>	<u> </u>	Eiring wellch to Impending ignition in (15) Amp	Impulficated power in circuit to create or move toward ignition in lab
		}	icional than place in relay circuit for (18) less.	if leater element was warm to the touch.
			input max, obcuit power into heater on exiton	<u></u>
Company of the Compan	125	Prince .		the control of the co
Long duration brake fixed	17	ַ דו	(50) samples filted with new brake fluid	Test suspended. (312) hours completed.
ingress lest number 2			(1) hour of vibration per day	Assurage hosport current is 1.9 mAsse (stdeviation = 1.6 mAsses)
	<u>{</u>	1	(1) hour week at 100 dag C per day	1

proliminary draft sugmentry of TI record search findings of May 14-17 1999

summary by Steve Beringhouse & Andy McGuirk May 19th 1999

TI P/N:

77P\$L2-1

Ford P/N: F2VC-9F924-AB

Tested at 'room temp' per manufacturing ES requirements

		Qty	-
	Lox	Impulse	Qt7
Date	Şizze	Tested	<u>Leak</u>
26-Nov-91	4,000	10	-
26-Nov-91	4,000	10	-
5-Dec-91	4,000	10	-
5-Dec-91	4,000	10	-
9-Dec-91	4,000	16	-
9-Dec-91	2,000		-
11-Dec-91	1,000	10	. •
11-Dec-91	1,000	10	•
13-Dec-91	4,000	10	•
14-Dec-91	4,000	10	-
16-Dec-91	4,000	10	
16-Dec-91	4,000 4,000	10 10	-
2-Jan-92	4,000	10	_
6-Jan-92 7-Jan-92	2,000	5	_
7-1411-72 8-Jan-92	4,000	10	_
8-Jan-92	4,000	10	
14-Jan-92	4,000	10	
14-Jan-92	4,000	10	
15-Jan-92	4,000	10	
28-Jan-92	2,000	5	
3!-Jan-92	4,000	10	
2-Feb-92	L,650		
4-Feb-92	1,000	ŧō.	
5-Feb-92	4,000	io	
6-Peb-92	4,000	10	•
(0-Feb-92	4,000	10	-
11-Peb-92	4,000	to	-
12-Feb-92	4,000	10	_
12-Feb-92	4,000	10	-
14-Feb-92	4,000	10	-
14-Pab-92	4,000	10	•
14-Feb-92	4,000	ιq	•
15-Pub-92	4,000	10	•
24-Fab-92	4,000	10	•
26-Peb-92	4,000	. 10	•
26-Feb-92	4,000	10	-
28-Feb-92	4,000	10	-
28-Feb-92	4,000	10	•
28-Feb-92	4,000	10	•
6-Mar-92	4,000	10	•
10 -Mar-92	4,000	Ó1	•
11-Mar-92	4,000	10	•
12 -Mar-9 2	4,000	10	•

TI-NHTSA 017084

77P6L2-1: Impuise Data Results 11/91 - 12/92

18-Mar-92	4,000	LO	•
23-Apr-92	2,000	5	-
2-84ay-92	2,000	5	-
5-May-92	2,000	5	-
6-May-92	2,000	5	-
14-Sep-92	2,000	5	-
22-Sep-92	4,000	ιO	•
30-Sep-92	4,000	10	-
7-Oct-92	4,000	10	-
7-Oct-92	4,000	10	-
16-Oct-92	4,000	10	•
Zi-Oct-92	2,000	5	-
20-Oct-92	4,000	10	-
29-Oct-92	4,000	10	•
29-Oct-92	4,000	LO	-
30-Oct-92	4,000	10	-
4-Nov-92	4,000	10	•
10-Nov-92	4,000	10	•
10-Nov-92	4,000	10	•
11-Nov-92	4,000	10	•
17-Nov-92	2,000	5	-
20-Nov-92	4,000	LO	-
4-Dec-92	2,000	5	-
9-Dec-92	2,000	5	-
14-Dec-92	2,000	5	-
16-Dec-92	4,000	10	-
16-Dec-92	4,000	10	-
16-Dec-92	4,000	10	-
21-Dec-92	2,000	5	4
21-Dec-92	4,000	10	•

Currey, Pat

From: Sent:

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

Friday, May 28, 1999 3:15 PM

To:

Baumann, Russ

Subject:

FW: Ford Core tram update









AUTOMOTIVE SENSORS AND CONTROLS GRA MANAGER

34 FOREST ST M/S 23-05 ATTLEBORO, MA 02703 TEL : (508) 236-3080 FAX : (508) 236-3745

MOBILE: (508) 208-6119 PAGE: (800) 467-3700 PIN 604-2044

Fromi

McGuirk, Andy Friday, May 28, 1999 3:22 FM 'Frederick J. Porter' Sent:

To:

Beringhause, Steven; Sharpe, Robert CGI

Subject: Ford Core team update

Fred, per our discussions and Rob Sharpe's visit enclosed is our updates...

<<fredPortCore.dod>> <<synopsil.doc>> <<TESTLOG9.xla>> <<77PSL2_1.xls>>

AUTOMOTIVE SENSORS AND CONTROLS QRA MANAGER 34 FOREST ST M/S 23-05 ATTLEBORG, MA 02703 TEL : (508) 236-3080 FAX : (508) 236-3745 MOBILE: (508) 208-6119

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

TI 77PS Test Synopsis

This document is a synopsis of tests conducted by Texas Instruments during the 77PS investigation. The intent of this document is to highlight test findings which drove the investigation to its current state. Throughout the investigation, several tests were conducted with the same objective. When each objective was met, efforts were refocused to obtain a new level of understanding and to establish a new set of objectives. As such, tests have been categorized into (5) levels, representing the level of knowledge obtained from the group of tests conducted. Each level is listed below with a short description of the objective:

Level 1: Create a laboratory switch ignition without any restrictions on methods.

Level 2: Create a laboratory switch ignition using only conditions found in the switch operating environment.

Level 3: Understand the laboratory ignition mechanism.

Level 4: Compare factors contributing to laboratory ignition.

Level 5: Evaluate recommendations.

Refer to Brake Pressure Switch Test Log.

Level 1 Objective: Determine if a switch ignition can be created in the laboratory.

- Test i

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Switch contact cavity flooded with brake fluid mixed with varying amounts of % H_20 .

14 volts applied to one terminal, second terminal electrically floating. (No electrical load across switch terminals).
Switch herport electrically grounded.

Regulta:

- (8) samples were tested total:
- (2) with 4% H₂0 in brake fluid.
- (2) with 6% H₁0 in brake fluid.
- (2) with 10% H₂0 in brake fluid.
- (2) with 75% H₂0 in brake fluid.

No ignition occurred. No significant temperature rise observed in all samples. Current draw ranged from 0.5 mAmps to 5 mAmps over a period greater than (250) hours.

TI 7776 Test Sympole 27/12/99

Test 2

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Switch connect flooded with brake fluid. 14 volts applied to one terminal, second terminal connected to a 14 Ω resistor which is tied to ground. (1 Amp load across switch terminals). Switch hexport electrically grounded.

Results: (2) samples were tested. No ignition occurred. No significant temperature rise observed for a period over (250) hours.

Conclusion: A (1) Amp load through switch terminals did not ignite brake fluid in the contact cavity of switches.

Test 6

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Heater element installed in contact cavity of the switch.

Power applied to the heater element until plantic base melts.

Spark generated in contact cavity of switch.

Brake fluid present in the contact cavity (wet device) and absent in the contact cavity (dry device).

Results: (2) dry devices were tested and (1) wet device was tested. Ignition occurred in all devices.

Wet daying. The internal temperature of a wet device reached 660°F. A hole burned through the base of the switch (close to the heating element). The applied spark ignited the furnes in the contact cavity of the switch and engulfed the base material of the switch.

<u>Dry device:</u> The internal temperature of a dry switch reached over 1000°F. The switch base flopped over. The applied spark ignited the fluxes in the contact cavity of the switch and engulfed the base material of the switch.

Conclusion: A switch ignition can occur under the following laboratory conditions:

Henter element installed in the switch contact cavity, 5 wants of power dissipated in heating element.

Spack generated in the contact cavity of the switch.

Brake fluid did not contribute to the ignition process.

Lavel 2: Objective: Determine if a laboratory ignition can occur using only switch components and elements found in the switch environment.

Test 6a

Objective: Determine if corrosive degradation of switch electrical components can cause an increase in electrical resistance (and thus a source of heat) in the switch, which may lead to an ignition.

Results: (1) out of (15) samples tested increased resistance to 5 Ωs. A solution of 5 wt. % NaCl in H₂0 can corrode the electrical components of the switch and cause an increase in electrical resistance. Repeated injections of the solution of 5 wt. % NaCl in H₂0 into the contact cavity of a switch, with the switch continuously powered at 14 Volts, can cause an ignition.

Conclusion: A switch ignition can occur under the following laboratory conditions:

A solution of 5% NaCl in H₂0 is injected into contact cavity of a switch.

Continuous 14 Volt power applied to the switch.

Hexpor grounded.

Current is limited at 15 Amps.

Text fc

Objective: Determine if brake fluid with metal shavings is conductive enough to create an ignition.

Results: (3) devices with various size metal particles were tested. No significant current increase detected.

Conclusion: Metal shavings did not significantly increase conductivity brake fluid. Current levels measured were well below levels necessary to create an ignition.

Test 7

Objective: Determine if switch meets cycle life specification.

Results: Tests conducted during the first quarter of 1999 show that switches exceed cycle life specification.

In the first quarter of 1999, a total of (42) 77PSL2-1 snep switches were impulse tested to over 1,000,000 cycles with only (1) leak below 1,000,000 cycles, which

occurred at 728,000 cycles. A Weibull analysis showed 99,9% reliability at 500,000 cycles at 95% confidence level.

Conclusions: Switches meet cycle life specification. First quarter, 1999 tests confirm impulse test findings made during the period between 1991 and 1992. During that period. (6) impulse tests on 144 devices of 57PS and 77PS construction, had no leaks when tested to 500,000 cycles. A Welbuli analysis of first quarter, 1999 tests, showed 99.9% reliability at 500,000 cycles at 95% confidence level.

Test 15a

Objective: Determine the long term corrosive effects of brake fluid on the electrical components of switches which are continuously powered at 14 Volts.

Results: Test was suspended after 550 hours of testing. (6) samples were tested with continuous 14 Volts power. The contact cavity of (4) switches contained new brake fluid and (2) switches contained old brake fluid. Switches with old brake fluid draw very little hexport current and showed a decrease in hexport current over time to less than 1/10 mAmp. Samples with new brake fluid showed an increase in hexport current to over 20 mAmps toward the end of the 550 hours of testing. Analyses of (1) sample with new brake fluid and (1) sample with old brake fluid revealed electrolytic corresion of the contact arm of both switches. These was a much lower level of corresion in the sample with used brake fluid than the sample with new brake fluid.

Conclusion: Brake fluid in the contact cavity of switches, which are at 14 Volta continuous power for over 500 hours, can cause electrolytic corresion of the switch contact arm and an increase in hexport current.

Test 17

Objective: Quantify the long term corrective effects of new brake fluid on the electrical components of switches under the following laboratory conditions:

Contact cavity of switch flooded with new brake fluid. Switches at continuous 14 Volts power.

Switches subjected to vibration for (i) hour per day.

Switches subjected to 100°C for (i) hour per day.

Results: Test suspended after (312) hours. (50) samples tested. The average hexport current draw after (312) hours is 1.9 mAmps with a standard deviation of 1.8 mAmps. These results are consistent with results previously found in Test 15a at the 300 hour point.

Ti 77PS Yes Synopsis 07(1)/99

Conclusion: New brake fluid in the contact cavity of switches, has not caused an increase in hosport current after (312) bours at continuous 14 Volts power.

Level 3: Objective: Understand the laboratory ignition process, determine the current path and establish a repeatable ignition method.

Test 6b

Objective: Understand the ignition process, determine the current path and establish a repeatable ignition method.

Results: Multiple attempts at laboratory ignition, via injection of a solution of 5 wt. % NaCl in H₂0 into the contact cavity of switches, has regulated in a repeatability rate of approximately 50%. Plots of hexport current verses time show an increase in current until the point of ignition.

Conclusion: A repeatable laboratory method for switch ignition was established. Based on hexport current measurements, the current path is from switch terminals to hexport body.

When a solution of 5 wt. % NaCl in H₂0 is repeatedly injected into the contact cavity of powered switches, electrolytic corrollon of the switch terminal results in an increase in terminal resistance. When sufficient power is drawn through the corrosive resistance, switch elements heat up and begin to glow red bot. A bole burns through the switch base and ignition occurs. There is areing visible throughout the corrosion process which may provide the spark necessary for ignition.

Level 4: Objective: Compare and contrast variables influencing ignition using the ostablished laboratory ignition method.

Test 13a.

Objective: Compare various fittids in the established ignition method.

Results: The following fluids were tested.

- (1) NeCl in H₂0.
- (1) top water
- (I) rain water
- (1) used brake fluid
- (1) used brake fluid with 5 wt. % H20
- (1) new brake fluid
- (1) new brake fluid with 5 wt. % H₂0

The switch filled with 5 wt. % NaCl in H₂0 resulted in an ignition when average beopport current exceeded 2.5 Amps. Switches that were filled with top water and rain water drew less than 10 mAmps over a (3) hour test and showed little signs of

corrosion. Switches filled with a matrix of new and used brake fluids, with water and without water, all drew less than 3 mAmps hexport current draw and showed no signs of corrosion over the (24) hour test.

Conclusion: Brake fluid is not conductive enough to cause the electrolytic corrosion and necessary current draw to create an ignition within a 3 hour lab test. Because of its' significantly higher conductivity, an ionic rich fluid such as NaCi in H₂0 can cause an ignition in a 3 hour lab test exposure...

Test 15

Objective: Compare the ignition characteristics of various plastics as switch base material.

Results: When 5 wt. % NaCl in H₂0 was injected into switches with different base materials, the following results were obtained: Cellanex 4300 ignited 3 out of 5 attempts. Noryl ignited 2 out of 5 attempts. Zytel ignited 1 out of 5 attempts.

Conclusions: All plastics tested can ignite using the established laboratory ignition method.

Test 15b

Objective: Determine if switch ignition can occur in the vertical position and 45° orientation. Determine if switch ignition can occur and at different rotational angles in the 45° orientation.

Results: Switch ignitions can occur in both the vertical and 45° orientation using the established laboratory ignition method.

Conclusion: Switch ignition does not appear to be sensitive to vertical orientation verses 45° orientation not to rotational angle in the 45° orientation.

Lovel 5 Objective:

Test 16

Objective: Test proposed relay circuit.

Results: (1) switch was injected with a solution of 5 wt. % Nacl in H₂0 and placed in the proposed current limiting eigenit for (48) hours. The current draw remained constant at 180 m.Amps throughout the test. There was no activity observed and the contact arm remained mostly intact.

 switch was brought to an impending burn condition using the established burn method. An impending burn is a condition where a correlive resistance has built

T1 77PS Test Symmets 07/11/90

up in the switch and an ignition is insulnent. The switch was then placed in the proposed relay circuit for (18) boars where it drew 160 mAmps, showed no visible activity and did not result in an ignition.

Because the proposed relay circuit acts as a resistor which limits current to the switch, the maximum power to the switch is limited to .75 Watts. A resistive wire was wrapped around the base of (1) switch and 0.75 Watts of power was dissipated in the wire. The wire became warm to the touch but had no effect on the switch.

Conclusion: 0.75 Watts, the maximum power in the proposed circuit design, is insufficient to cause substantial electrolytic corresion or significant switch terminal heating, which is necessary to create an ignition. In previous tests, using a resistor as the heating element (see Test 6), approximately 5 Watts of power was necessary to create an ignition.

Broke Pressure Switch Test Log, Updated 7/12/99

Category	Test	Legation	Test Parameters	Results Update
ab Samulation	- 17 	П	Very nation concentrations in reter Brake Fluid	250+ hours, Custant draw in the 0.5mA to 5mA range
Polaniki Ignilian	- 		14Vdc to one terminal, heaport grounded	Fluid her discalared
Selich	- - 		Minter Conc. 4%, 6%, 10%, 75%	No Significant Temperature Rise, Test Suspended.
944.2				Internal Analysis suspended.
	· - 			<u> </u>
	- 1 - 2	Ti-	Ham Brake Fluid	(250+ hours. Constant impossiture.
_ 	╍╅╼╴	·· ···	1 Amp through switch tearmen	No significant improvidure the with time
			144do to cate terminal, heaport grounded	Test Suspended.
	- 1 3	AVT	new Series Fluid in Guilton, 24 VDC to one	> 300 hours into test, make current 7mA
	. 1 * 		Jerminal, Hasport Grounded	No significant change with time. Test suspended
				<u> </u>
	14	AVT	new Breice Fluid in Switch, 24 VIDC to one	15 hours into test max current SmA
		- '`	terminal. Hasport Groundest, Antibiost at 100 C	No significant impossion rice with time. Test suspended.
	-+-	 -		
	- 6	AVT	nge/ Brake Fuld in Switch, 18 Araps	Temperature ries of 20 C shows room temp
	 	 	Procupit satisch terminals	Dulle T reached shooty state at 20 C. Test suspended
	-}-			
	1 54	AVE	ment Broke Field in Sellich apparet. 50 Amps.	Temperature rose to express. 270 F. No smoke. No ignition
	- 	} ~~	Quough Suitch Terminals	Test suspended.
 	- -	 -		
	- 1 6	 - ~-	Culti havely elecated into Sultah.	3 tested. Bancka observed, ignition observed on part withouter
	╍┿╩	 -	Pipel till lallers, inchele spielding.	See allectronic
		 	(1) of solution of Electra Fluid and 6 of. % H ₂ O	Tent contplete
				Broke State in cavify stone closes heat build-up
		 	+	Smolin channel at 675 F, Date melts and falls off at 600 F
		 		
	 -	1 11	Create heater by conceing spring arm	One out of 15 devices increased resistance to 5 obtres.
	- 6-		Selt water solution, 14V behinsen spring	Others within very low regulance or prognotions
	_		and housest	It took about 100 hours in each the 5 characture.
<u> </u>		┴ ───		The 5 also device ignited upder conditions statiler to test 6.
			- Caldan Sandardand	Builtch ignition with respected \$15, water atthirm into watch
	- 0		Re-rus ignition test to understand	Custod path is through httsport.
		<u></u>	repealedailty and current path.	See plots and video.
<u> </u>				Additional had include top water, old RF, new RF and other.
		L		higher phonings do not contribute agrainantly to brake field
	- 6c		Pure 'now' brake fluid with pretail shawings	: brien Saint on an examina afterward or man ain

Brake Pressure Switch Test Log, Updated 7/12/99

		 ~_T		coductivity
				First leak observed at 728,000 cycles
le Cycle Reliability	7		0-1400 paig protesse pulses at 135C	Yout Completed, See situated Weited Chart.
Pressure Sealch			per ES	Jest Combasor: 200 mercen secret Cumi
		1 T 1 T 1	K · į	and the standard by standard
aphragas Week	8	π	0-1400 peig pressure pulses at 135C.	Parts withdrawn every 200k cycles, characterized for wear
	•		d8.	
ekt va Lab Comstation	-	Control Labe	Fluid returns, Sort deeler lole, junityerds	Parts in Curical Labs, see Ford spreadshed
	_		ay "	<u>''</u>
migr. Of Experiments (1)	10	4	Vary water concentrations in 'sear' Brake Fluid	Test Report being written investigation continues.
niumbe Factors			12 mars + 12 quiet multities w/ 0 % water in BF _	Suspended at 1.3 million cycles with no leaks observed.
ecine Displayer West	 		12 supp + 12 quiet politiches w/ 8 % water in EF	Spep samples suspended at 1.3 militar cycles with 2 lanks
	┝			chearward at 1.364. Quiet exceptes suspended at 600k cycles to
<u> </u>	┪━			nanges fichaling anomalies
	├ ─	· · ·		<u> </u>
	15	AVI	Maries Pressure and Temperature	Test at AVTsee Ford charle>SOOs in car?
w Vehicle Characterisation			at Switch Location for ABS and non-ABS	
Processo & Temperature	┢─		broking events	
relie in Town Cor		 -		
	\ 	 	Analysis used brake fluid at the meater cylinder	Test complain.
rain field trailytic	118	<u> </u>	(LBAC), used brate this at the calput (UCA)	MBAC: Co = 415 basino. Fo = 5.6 (agint), Cr = 0.08 (agint), 1.1 50420.
legd fluid at meater cylinder.	╀—		and their basin field (NEW) for mainl and white	* NCA: Ca = 502 busine. Fo = 5.5 (sphie), Cr = 1.9 (sphie), 1.1 %*(20).
	↓	 -	content.	PEW: Co = <0.61 (upins), Fe = 0.50 (upins), Cr = <.01 (upins), 0.3 NA120
	┺	 		
	1	 	The second second is sufficient	Equipment set-up in program at Central Labo.
park Mc Study	12	Control Labo	Delegation if archipeats forms in switch	Ti Experimented with no 'algeblasm' specks observed
			using cheich loads and high speed vitims.	
		<u></u>	Use dry sullches as well so matches with	
	<u> </u>	\	verlous brains fluid matter referen	.
				Outs log and enalysis procedure set up complete.
Terrecontration of	15	Constant Larbo	Characterize electrical, machanical	
milches retirered term field	1	T	and chardest supects of returned avaiches	Analysis of muliches in program.
unkyerin & other sources.	Ί	T	l	_
 	1 -			
Lid Ingross Tests	130	1	Repeat Ignition simulation with different fluids.	Test complete.
	1	 	(3) hour leafe:	5% NaCl sample resulted in unignition
	┿	-	5% NaCl in top water	All brake fluid complet drew loss than 3 mAraps. No correction
	┿	 	rain water	visible on testa fluid samples.
	┿		(24) hour tests:	Rain water and top water camples dress <10 mArrors and showed
	4—	 	lap water	e some signer of corresion.
		_		Climatosi antysis in process.

Brake Pressure Switch Test Log, Updated 7/12/99

				`
_			used brake fluid w/ 5% H ₂ O	<u> </u>
	T		new toroka fluid	I
	 " 		new brake fluid w/ 5% H ₂ 0	
Xeeign Of Experiments (2)	130	_ n _	Vary water concentrations in 'nam' Brake Fluid	Test suspended. Analysis in process to assess test listuring.
Aupani of test 10			16 armo + 20 qualet suitches w/ 0 % under in BF	
·	T 		10 easy + 20 quiet quickes of 5 % venter in EF	
	╁┈╂		*****	
ampathilly of Kapton	14	Dugost	Characterise change in properties of Kepton	Test in programs (100) hours completed. Osatic acid shows
atth Ciralic Acid	7		with various % senits acid in braits fluid	similar effects that water has on Kapton promises
	 		14.31	
animation of Plants	16	Ti	Assess properties and moldability of different	Test suspended
legeneral dill lapraved	1 -		gradus of plantic reals with adultives	Culoasea and Noryi Igrillad 36 and 25 trials
windten			to improve plantic part partournance	ZYTEL samples techni 1/5 igniticat
one duration brake fluid	166	TI	(4) samples with our brain field	Test suspended (050) hours completed.
ngrasa fest	—		(2) martyles with used broke fluid	Used bridge State current dropped off to <1/10 mAnsp.
				Place BF tresport current can incremen vel finte under cord. power.
Evaluation of Switch	150	<u> 71 </u>	Assess ignition considery to switch extended on.	Text complete. Ignition is independent of switch misstation.
rientation	 - 		Test vertical verses 45 degree.	ulmulated police ignition can occur in vertical or 45 degree angle.
		·	Test retellared surrailwity in 45 deg. orientation.	ignition appears not assettles to switch rotational alignment.
Nating Classic	1 18	<u> 1</u>	Regnal last 13e in Ford raley clearlt for (48) fire.	Test complete. No ignition. Costation rate drastically reduced.
	 		Briss suitch to impending location in (15) Amp	insufficient passer in circuit to events or move toward lightion in lab
	1		circuit then pince in ruley circuit for (18) has.	Hoose element was warm to the lough.
			legat max, circuit power into heater on wellch.	
				Total supported (2000 hours applied)
أتنبأ جنبها مطبهيك وبخا	17	F	(50) complex filled with new braice fluid	Test suspected. (\$12) hours completed.
ngrees lest number 2.	1		(1) hour of vibration per day	Assemble heroport current is 1.9 mArtip (etdeviation = 1.8 mArmps)
		_	(1) four seek of 100 day C per day	<u> </u>

profinitionly draft summary of "IS record search fludings of May 14-17 1999

summary by Stove Beringtome & Andy McCleick May 19th 1999 TI P/N: 77PSL2-1

Ford P/N: P2VC-9P924-AB

Tested at 'room temp' per manufacturing ES requirements

		Qty	
	Let	[mpulm	Qty
Dete	Size	Testad	Lesk
26-Nov-91	4,000	IO.	•
26-Nov-91	4,000	10	•
5-Dec-91	4,000	10	-
1-Dec-91	4,000	10 10	•
9-Dec-91 9-Dec-91	4,000 2,000	1Q 5	•
11-Dec-91	4,000	10	•
11-Dec-91	4.000	10	-
13-Dec-91	4,000	10	
14-Dec-91	4.000	· ič	
16-Dec-91	4,000	Ю	
16-Dec-91	4,000	10	•
2-Jan-92	4,000	10	
6-Jap-92	4,000	LO	-
7-J an-92	1,000	5	•
8-5 ap-9 2	4.000	10	-
6-Jan-92	4,000	10	•
14-Jan-92	4,000	10	-
14-Jan-92 15-Jan-92	4,000	10	•
	4,000	10	•
28-j as-92 31-jas-92	1,000 4,000	5 10	-
2-Fab-92	1,650	5	:
4-Feb-92	4,000	10	
5-Feb-92	4,000	io	
6-Feb-91	4,000	10	
10-Feb-92	4,000	10	
11-Fab-92	4,000	10	
12-Peb-92	4,000	10	•
12-Fab-92	4,000	LQ.	-
14-Feb-92	4,000	LO	•
14-7-6-92	4,000	10	•
14-Pag-92	4,000	10	•
15-Feb-92	4,000	10	•
24-Pub-92 26-Pub-92	4,900	10 10	•
20-Feb-92	4,000 4,000	10	•
25-F-6-92	4,000	10	
28-Poh-42	4,000	10	•
28-Pos-92	4,000	ID	
6-Mar-92	4,000	io	•
10-May-92	4,000	10	
11-Mar-92	4,000	10	
12-Mar-92	4,000	IO	

6000

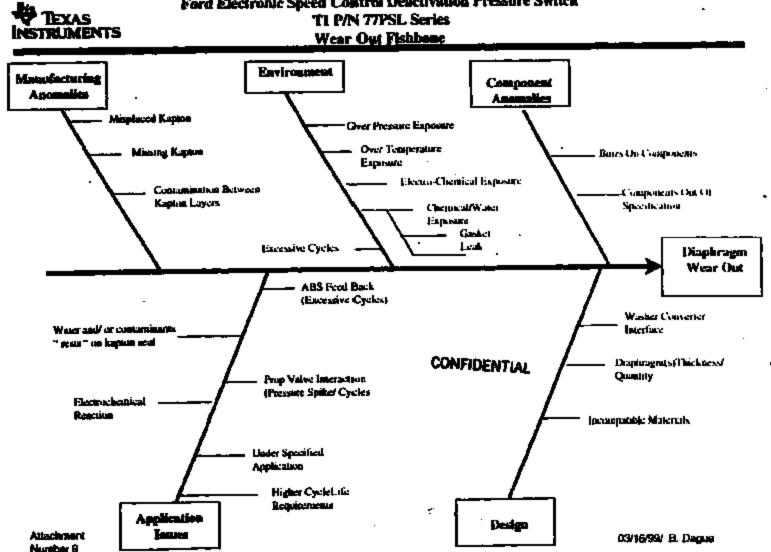
77PSL2_1.xfs

77PBL2-1: Impulse Date Results 11/91 - t2/92

18-Mar-92	4,000	10	•
23-Apr-92	2,000	5	-
2-May-92	2,000	5	-
5-May-92	2,000	5	•
6-May-92	2,000	5	
14-Sep-92	2,000	5	•
22-Sep-92	4,000	LO	-
30-Sep-92	4,000	10	-
7-Oct-92	4,000	10	-
7-Oct-92	4,000	1 Q	-
16-Oct-92	4,000	10	-
21-Oct-92	2,000	5	-
20-Oct-92	4,000	£O.	-
29-Oct-92	4,000	10	•
29-Oct-92	4,000	10	•
30-0:2-92	4,000	Ю	-
4-Nov-92	4,000	10	-
10-Nov-92	4,000	10	-
10-Nov-92	4,000	10	•
11-Nov-92	4,000	10	٠.
17-Nov-92	2,000	5	•
20-Nov-92	4,000	10	•
4-Dec-92	2,000	3	•
9-Dec-92	2.000	5	•
14-Dec-92	2,000	5	. •
t6-Dec-92	4,000	10	•
16-Dec-92	4,000	10	•
t6-Dec-92	4,000	10	•
21-Dec-93	2,000	•	-
21-Dec-92	4,000	10	•

Tatah mila 261,639 668 ·

Ford Electronic Speed Control Deactivation Pressure Switch T1 P/N 77PSL Series Wear Out Fishbone

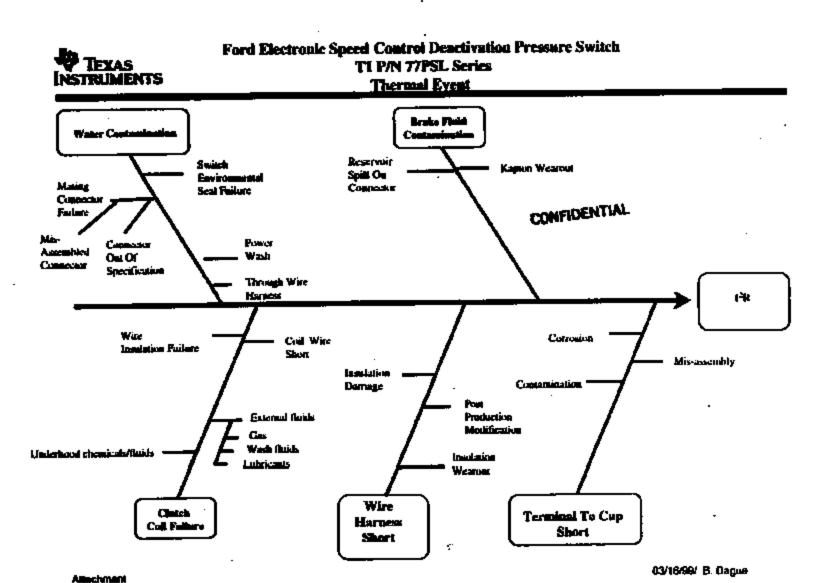


Ford Electronic Speed Control Deactivation Pressure Switch TI P/N 77PSL Series

Thermal Event

Assechment Number 10

Number 11



Morris, irone

From:

McGuirk, Andy

Sent:

Friday, May 28, 1999 4:15 PM

To:

Baumann, Russ

Subject:

FW: Ford Care team update

ACTOROTIVE SINEORS AND CONTROLS QUA MARAGER ATTLEBORO, MA 08703
TEL / [BOH] 234-3040
FAR: [BOH] 234-3040
FAR: [BOH] 234-3148
MORILE: [500] 106-6118
PAGE: [600] 467-3700 PIM 404-2044

From:

McGuirk, Andy

Sent:

Friday, May 28, 1999 3:22 PM Frederick J. Porter

To:

Ço:

Beringhause, Steven; Sharpe, Robert

Subject:

Ford Core team update

Fred, per our discussions and Rob Sharpe's visit anclosed is our updates...









FredPortCore.dog

synopsi1.doc

ТЕВТДОСИЛНО

7774L2_1.xts

ALTOHOTIVE BEHNORE AND CONTROLS ORA MAMAGES.
14 NOREST BY N/S 23-05
ATTLEMENO, MA 02703
TEL: (508) 216-1080
PAK: (508) 216-1080
PAK: (508) 206-6119
PAGE: (600) 467-1700 PIN 604-2844

May 26, 1999

Mr. Frederick J. Porter, Supervisor E/E Systems Engineering Building 5, Mail Drop 5011 20000 Rotunda Drive, Rm 3E004 Dearborn MI 48121-2053

Dear Fred:

I want to review our recent support of the Ford core team to assure we do not have any misunderstandings regarding our pressure switch performance, our continued contribution to the 'core' team, and our commitment to a quick conclusion.

For six months the Texas Instruments Automotive Sensors & Controls Team has been supporting the Ford Core Diagnostic Team with technical facts, data, and analysis regarding our brake pressure switch product applied in the Ford cruise control deactivation circuit.

A senior TI pressure switch engineer was in residence at Ford for three weeks to assist with switch related issues in the system diagnostic process. Senior TI leadership participation has also been involved in virtually every Ford Core Team meeting delivering facts, data, and technical support year-to-date '99.

We also investigated switch capability, and using agreed upon accelerated simulation life testing techniques, demonstrated the ability of the model year '92 & '93. Town Car speed control deactivation switches to consistently exceed "cycle life specification" of 500,000 pressure cycles. Ti Weibuil reports of pressure switches tested in 1999 conservatively demonstrate 95% reliability to 1 million cycles (with confidence intervals greater than 50%).

Additionally "success testing records" of some 665 ES units that were tested during the 1991 - 1992 (11/91 - 12/92) showed zero leakage at 500,000 cycles.

Conclusion to date: 1992 period switches met specification. 1999 switch meets or exceeds specification

We have developed and delivered a laboratory model of accelerated plastic base ignition of the switch resulting from fluid in the switch cavity coupled with application of constant power as designed in the speed control circuit. Theories from the model suggest that fluids in the switch cavity in the presence of uninterrupted power could tead to a corrosion product formation which might create a plastic base ignition path.

Mr. Fred Porter May 26, 1999 Page 2

Conclusion to data: Constant speed control gower allows long term corresion

In light of this laboratory model and the need for cruise system power only during vehicle operation, we suggest the system architecture of "key-on/off" based power be considered.

We have been open and forthright in our communications and delivery of information and we believe we have been instrumental in helping Ford address the underhood fire concern issue.

In this regard, we think it is appropriate at this point that our active participation in the diagnostic journey of the vintage 1992 product move towards a timely conclusion. Toward this end, we will continue to support the "core" team review of 1992 product history with targeted completion in July 1999.

We are preparing to fulfill your request for hosting a site visit, supporting campaign field return device analysis, and participating in robust system brainstorming sessions moving toward conclusion in July, as well as reviewing the optimization of our product line process controls.

Our prime focus at this time is in rapidly supplying Ford with 225,000 units in support of the field actions.

Recerds.

Andrew C. McGuirk QRA Manager Texas Instruments

attachments: 1992 Testing History

TI 77PS Test synopsis

TI 77PS Investigation Flow Diagram

TI 77PS Test Synopsis

This document is a synopsis of tests conducted by Texas Instruments during the 77PS investigation. The intent of this document is to highlight test findings which drove the investigation to its current state. Throughout the investigation, several tests were conducted with the same objective. When each objective was met, efforts were refocused to obtain a new level of understanding and to establish a new set of objectives. As such, tests have been categorized into (5) levels, representing the level of knowledge obtained from the group of tests conducted. Each level is listed below with a short description of the objective:

- Level 1: Create a laboratory switch ignition without any restrictions on methods.
- Level 2: Create a laboratory switch ignition using only conditions found in the switch operating environment.
- Level 3: Understand the laboratory ignition mechanism.
- Level 4: Compare factors contributing to laboratory ignition.
- Level 5: Evaluate recommendations.

Refer to Brake Pressure Switch Test Log.

Level 1 Objective: Determine if a switch ignition can be created in the laboratory.

Test 1

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Switch contact cavity flooded with brake fluid mixed with varying amounts of % H₂0.

14 voits applied to one terminal, second terminal electrically floating. (No electrical load across switch terminals).

Switch hexport electrically grounded.

Results:

- (8) samples were tested total:
- (2) with 4% H₂0 in brake fluid.
- (2) with 6% H₂0 in brake fluid.
- (2) with 10% H₂0 in brake fluid.
- (2) with 75% H₂0 in brake fluid.

No ignition occurred. No significant temperature rise observed in all samples. Current draw ranged from 0.5 mAmps to 5 mAmps over a period greater than (250) hours.

TI-NHTSA 017085

Test 2

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Switch contact flooded with brake fluid. 14 volts applied to one terminal, second terminal connected to a 14 Ω resistor which is tied to ground. (I Amp load across switch terminals). Switch hexport electrically grounded.

Results: (2) samples were tested. No ignition occurred. No significant temperature rise observed for a period over (250) hours.

Conclusion: A (1) Amp load through switch terminals did not ignite brake fluid in the contact cavity of switches.

Test 6

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Heater element installed in contact cavity of the switch.

Power applied to the heater element until plastic base melts.

Spark generated in contact cavity of switch.

Brake fluid present in the contact cavity (wet device) and absent in the contact cavity (dry device).

Results: (2) dry devices were tested and (1) wet device was tested. Ignition occurred in all devices.

Wet device: The internal temperature of a wet device reached 660°F. A hole burned through the base of the switch (close to the heating element). The applied spark ignited the fames in the contact cavity of the switch and engul fed the base material of the switch.

<u>Dry device</u>. The internal temperature of a dry switch reached over 1000°F. The switch base flopped over. The applied spark ignited the furnes in the contact cavity of the switch and engulfed the base material of the switch.

Conclusion: A switch ignition can occur under the following laboratory conditions:

Heater element installed in the switch contact cavity. 5 watts of power dissipated in heating element.

Spark generated in the contact cavity of the switch.

Brake fluid did not contribute to the ignition process.

TI-NHTSA 017086

Level 2: Objective: Determine if a laboratory ignition can occur using only switch components and elements found in the switch environment.

Test 6a

Objective: Determine if corrosive degradation of switch electrical components can cause an increase in electrical resistance (and thus a source of heat) in the switch, which may lead to an ignition.

Results: (1) out of (15) samples tested increased resistance to 5 Ωs. A solution of 5 wt. % NaCl in H₂0 can corrode the electrical components of the switch and cause an increase in electrical resistance. Repeated injections of the solution of 5 wt. % NaCl in H₂0 into the contact cavity of a switch, with the switch continuously powered at 14 Volts, can cause an ignition.

Conclusion: A switch ignition can occur under the following laboratory conditions:

A solution of 5% NaCl in H₂0 is injected into contact cavity of a switch. Continuous 14 Volt power applied to the switch. Hexport is grounded.

Current is limited at 15 Amps.

Test 6c

Objective: Determine if brake fluid with metal shavings is conductive enough to create an ignition.

Results: (3) devices with various size metal particles were tested. No significant current increase detected.

Conclusion: Metal shavings did not significantly increase conductivity brake fluid. Current levels measured were well below levels necessary to create an ignition.

Test 7

Objective: Determine if switch meets cycle life specification.

Results: Tests conducted during the first quarter of 1999 show that switches exceed cycle life specification.

In the first quarter of 1999, a total of (42) 77PSL2-1 snap switches were impulse tested to over 1,000,000 cycles with only (1) leak below 1,000,000 cycles, which

occurred at 728,000 cycles. A Weibull analysis showed 99.9% reliability at 500,000 cycles at 95% confidence level.

Conclusions: Switches meet cycle life specification. First quarter, 1999 tests confirm impulse test findings made during the period between 1991 and 1992. During that period, (6) impulse tests on 144 devices of 57PS and 77PS construction, had no leaks when tested to 500,000 cycles. A Weibull analysis of first quarter, 1999 tests, showed 99.9% reliability at 500,000 cycles at 95% confidence level.

Test 15a

Objective: Determine the long term corrosive effects of brake fluid on the electrical components of switches which are continuously powered at 14 Volts.

Results: Test was suspended after 550 hours of testing. (6) samples were tested with continuous 14 Volts power. The contact cavity of (4) switches contained new brake fluid and (2) switches contained old brake fluid. Switches with old brake fluid drew very little hexport current and showed a decrease in hexport current over time to less than 1/10 mAmp. Samples with new brake fluid showed an increase in hexport current to over 20 mAmps toward the end of the 550 hours of testing. Analyses of (1) sample with new brake fluid and (1) sample with old brake fluid revealed electrolytic corrosion of the contact arm of both switches. There was a much lower level of corrosion in the sample with used brake fluid than the sample with new brake fluid.

Conclusion: Brake fluid in the contact cavity of switches, which are at 14 Volts continuous power for over 500 hours, can cause electrolytic corrosion of the switch contact arm and an increase in hexport current.

Test 17

Objective: Quantify the long term corresive effects of new brake fluid on the electrical components of switches under the following laboratory conditions:

Contact eavity of switch flooded with new brake fluid. Switches at continuous 14 Volts power.

Switches subjected to vibration for (1) hour per day.

Switches subjected to 100°C for (1) hour per day.

Results: Test suspended after (312) hours. (50) samples tested. The average hexport current draw after (312) hours is 1.9 mAmps with a standard deviation of 1.8 mAmps. These results are consistent with results previously found in Test 15a at the 300 hour point.

TI-NHTSA 017088

Conclusion: New brake fluid in the contact cavity of switches, has not caused an increase in hexport current after (312) hours at continuous 14 Volts power.

Level 3: Objective: Understand the laboratory ignition process, determine the current path and establish a repeatable ignition method.

Test 6b

Objective: Understand the ignition process, determine the current path and establish a repeatable ignition method.

Results: Multiple attempts at laboratory ignition, via injection of a solution of 5 wt. % NeCl in H_20 into the contact cavity of switches, has resulted in a repeatability rate of approximately 50%. Plots of hexport current verses time show an increase in current until the point of ignition.

Conclusion: A repeatable laboratory method for switch ignition was established. Based on hexport current measurements, the current path is from switch terminals to hexport body.

When a solution of 5 wi. % NaCl in H₂0 is repeatedly injected into the contact cavity of powered switches, electrolytic corrosion of the switch terminal results in an increase in terminal resistance. When sufficient power is drawn through the corrosive resistance, switch elements heat up and begin to glow red hot. A hole burns through the switch base and ignition occurs. There is areing visible throughout the corrosion process which may provide the spark necessary for ignition.

Level 4: Objective: Compare and contrast variables influencing ignition using the established laboratory ignition method.

Test 13a

Objective: Compare various fluids in the established ignition method.

Results: The following fluids were tested.

- NaCl in H₂0.
- (1) tap water
- (1) rain weter
- (1) used brake fluid
- (1) used brake fluid with 5 wt. % H₂O
- (1) new brake fluid
- (1) new brake fluid with 5 wt. % H20

The switch filled with 5 wt. % NaCl in H₂0 resulted in an ignition when average hexport current exceeded 2.5 Amps. Switches that were filled with tap water and rain water drew less than 10 mAmps over a (3) hour test and showed little signs of

corresion. Switches filled with a matrix of new and used brake fluids, with water and without water, all drew less than 3 mAmps hexport current draw and showed no signs of corresion over the (24) hour test.

Conclusion: Brake fluid is not conductive enough to cause the electrolytic corresion and necessary current draw to create an ignition within a 3 hour lab test. Because of its' significantly higher conductivity, an ionic rich fluid such as NaCl in H₂O can cause an ignition in a 3 hour lab test exposure...

Test 15

Objective: Compare the ignition characteristics of various plastics as switch bear material.

Results: When 5 wt. % NaCl in H₂0 was injected into switches with different base materials, the following results were obtained: Cellanex 4300 ignited 3 out of 5 attempts. Noryl ignited 2 out of 5 attempts. Zytel ignited 1 out of 5 attempts.

Conclusions: All plastics tested can ignite using the established laboratory ignition method.

Test 15b

Objective: Determine if switch ignition can occur in the vertical position and 45° orientation. Determine if switch ignition can occur and at different rotational angles in the 45° orientation.

Results: Switch ignitions can occur in both the vertical and 45° orientation using the established laboratory ignition method.

Conclusion: Switch ignition does not appear to be sensitive to vertical orientation verses 45° orientation nor to rotational angle in the 45° orientation.

Level 5 Objective:

Test 16

Objective: Test proposed relay circuit.

Results: (1) switch was injected with a solution of 5 wt. % Nacl in H_10 and placed in the proposed current limiting circuit for (48) hours. The current draw remained constant at 180 mAmps throughout the test. There was no activity observed and the contact arm remained mostly intact.

 switch was brought to an impending burn condition using the established burn method. An impending burn is a condition where a corresive resistance has built up in the switch and an ignition is imminent. The switch was then placed in the proposed relay circuit for(18) hours where it drew 160 mAmps, showed no visible activity and did not result in an ignition.

Because the proposed relay circuit acts as a resistor which limits current to the switch, the maximum power to the switch is limited to .75 Watts. A resistive wire was wrapped around the base of (1) switch and 0.75 Watts of power was dissipated in the wire. The wire became warm to the touch but had no effect on the switch.

Conclusion: 0.75 Watts, the maximum power in the proposed circuit design, is insufficient to cause substantial electrolytic corrosion or significant switch terminal heating, which is necessary to create an ignition. In previous tests, using a resistor as the heating element (see Test 6), approximately 5 Watts of power was necessary to create an ignition.

Brake Pressure Switch Test Log, Updated 06/24/1999

Category ab Simulation	Test	Location	Test Parameters	Results Update
	 -4	TI	Vary water concentrations in 'new Broke Fluid	250+ hours, Current draw in the 0.5mA to 5mA range
Potential Ignition	<u> </u>		14Vdc to one terminal, hexport grounded	Fluid has discolored.
Switch	-		Water Conc. 4%, 6%, 10%, 75%	No Significant Temperature Rise. Test Suspended.
				Internal Analysis suspended.
			<u> </u>	
 	2	T)	New Brake Fluid	250+ hours. Constant temperature.
<u> </u>			1 Amp through switch terminals	No algorithm temperature rise with time
	T		14Vdc to one terminal, hexport grounded	Test Sespended.
	1 1			100 Gedjanog.
	3	AVT	new Brake Fluid in Switch, 24 VDC to one	200 leves lets to the second s
			Intelnal. Hesport Grounded	> 300 hours into test, max current 7mA
	1			No significant change with time. Test suspended
7	141	AVT	new Brake Fluid in Switch, 24 VDC to one	
	+++		terminal. Heigart Grounded, Ambient at 100 C	16 hours into teet max current 5mA
	- 		Company Company Company Tolling Company	No significant temperature rise with time. Test suspended.
	16	AVT	new Brake Fluid in Switch, 18 Armos	
	┿	- CTI	Through switch forminate	Temperatuse rise of 20 C above room temp
	- - 		(HOUGH SHELL) TO(KENES)	Delta T resched sizedy state at 20 C. Test suspended.
	- 5a	ÁVT		
	 22	741	nates' Braice Fluid in Switch approx. 50 Auros	Temperature rose to approx. 270 F. No smoke. No ignition
			Bytugh Selich Terminals	Test avepended.
	╌╂╼╤╼╂╴			-
<u> </u>	6		Build heater elements into Switch.	3 tested. Smalle observed, ignifica observed on part witnester
			Heal III failute, include sparking.	See attachment
			(1) w/ extulion of Brake Fluid and 8 wt. % H ₂ 0	Test complate
				Brake fluid in cavily places down heat build-up
				Smoke observed at 875 F, Base make and talts off at 800 F
				THE RESIDENCE OF SECURITION OF
	6a	TI	Create heater by corroding spring arm	One out of 15 devices increased resistance to 5 ohms.
			Salt water solution, 14V between spring	Others officer and the second second to 5 of the second se
	1 1	·	and hepport	Chars either very low resistance or megachase
*	1			It took about 190 hours to reach the 5 ohm stage.
一 至 ———	+ +			The 5 ohm device ignited under conditions similar to test 6.
- -	66		Re-run ignition test to understand	
_ NT			CONTRACTOR MAN IN CONTRACTOR	Switch ignition with repeated 5% water solution into switch
— <u>-</u>	╼╂╼╼╾┼╌		repostability and current path.	Current path is through hexport.
- 947002 - 002	╅		<u> </u>	See piote and video.
— × ———	86		B. and J. L. S.	Additional test include top water, old EF, new BF and other.
— ≊ ———] ac	П	Puto 'new' brake fluid with mutul skewings	Metal shavings do not contribute significantly to brake fluid

Brake Pressure Switch Test Log. Updated 06/24/1998

	_	┺		
Life Cycle Regability	—∱-	ӻ╂╌┈		Coductivity
of Pressure Switch		<u> </u>	0-1400 paip pressure pulses at 1350	
			per ES	First leak observed at 728,000 cycles.
Displacion West	- 			Test Completed, See attached Welbuil Chert.
and the state of t	8	<u> </u>	0-1400 poly r	was one mached weekel Chert.
Flett (" b. c			0-1400 pelg pressure pulses at 135C	Prote selectores
Field ve Lab Correlation	9	Control I at		Ports admirate every 200k cycles, characterized for waar
<u>-</u>		- 	re Fleit) returns, from dealer lots, junkyands	Double to Double
Design Of Experiments (1)	10	<u> 77 </u>		Partis in Control Laby, and Ford specialished
Eviluating Factors	┿╌	' +	Vary water concentrations in 'new Brake Fleet	
Meding Disphrages Wear	- -		_ ''	Test Report being written investigation continues.
moutee lest	╼┼┉╌		12 arrain + 12 quiet switches w/ 5 % water in BF	
	┵-	 -	THE PERSON NO. IN COURSE BY REP.	Snap samples supported at 1.2
			T	Snap samples suspended at 1.3 million cycles with 2 leaks observed at 1.3M. Quiet samples suspended at 500k cycles to essess facturing anomalies.
- 17-1-1				Reseas Schuring anomalies.
in-Valuate Characterization	117	AVT	March C	
/ Pressure & Темрическия	1		Monitor Prospure and Temperature	Tarl of 61/7
volle in Town Car		 -	A SMILE LOCATION for ARC and any ACC	Test at AVTsee Ford cheris>500k in car?
	+	!	braking events.	
rake fluid enelysis	+:	╂━╼	<u> </u>	<u></u>
eed fluid at meeter cylinder.	110	<u> </u>	Analyze used brain fluid at the stander cylinder	
CHICAL	+-			Test complete
		<u> </u>	and new brake fluid (NEW) for motel and under	UNIC: Cu = 415 (unbol) - E C C
			Content.	UCA: Cu = 982 Agains), Fo = 5.5 (Agains), Cr = 0.08 (Agains), 1.1 Notes). NEW: Cu = <0.01 (Agains), Fo = 0.02 (Agains), 1.1 Notes).
				AEDY: Com at 0.4 August 1.1 % Light Com 1.8 (up mt), 1.1 % Light
onk /Arc Study	12	Control (al-		NEW: Co = <0.51 (agent), Fo = 0.82 (agent), Cr = <.01 (agent), 0.3 %(co).
	7		Determine if anylogisk forms in switch	Gruden at a second and a second at a secon
	╄		Particular Company of the same	T) Experiment set-up in progress at Control Labs.
	╅╼╌┪		1000 tr y 2000/100 00 trail no ambabas	Ti Experimented with no injurious apprint observed
	╀╼╌┤	- <u>-</u>	Warlous brains fluid water robus.	
enciarization of	 			
iches retrieved from field	13	Central Labo	Characteriza electrical, mechanical	
formation from Both	$ldsymbol{\sqcup}$		and chemical aspects of mismed switches	Data log and snatynic procedure ast up complete.
loyards & other courses	L I		Parce of Landschild	Artifysie of sudicines in progress.
	r —			The same of property.
id ingress Tests	13a	77		
	— 		Repeat ignition elmulation with different fluids.	h
	┍╾╃			Test complete.
	├──		O'A Nat 1 in two wasters	5% NaC7 sample resulted in an ignition.
z				The course with the course of
NHT/SA		}	(24) hour louts:	vielble on brake fuld eamples.
 ;; ↓	щ.			COST William And the water appropriate description
———— % !			med brake Suid	some algress of corresion.
017				Chemical aniyels in process.

Brake Pressure Switch Test Log. Updated 06/24/1999

	_ii		used brake fluid w/ 5% H ₂ O	
	$oldsymbol{oldsymbol{oldsymbol{oldsymbol{\Box}}}$		new breke fluid	
	 		new brake fluid w/ 5%, H _e 0	<u> </u>
Design Of Experiments (2)	136	77)	Vary unter concessivations to 'ages' State Fauld	Total and the latest t
Repeat of lest 10			10 strap + 20 quiel switches of 0 % water in AF	Test suspended. Armiyals in process to means test fixturing.
<u>-</u>			10 map + 20 quiet switches of \$ % water in EF	
'amanth Vis d W				
Compatibility of Kapton with Oxalic Acid	14	Duport	Characterize change in propurities of Kingdon	Test in prograse (100) hours completed. Oxalic acid shows
MI VANC ACE	╌╊╌╌╁		with various % could acid in brake fluid.	similar effects that water has on Xapton proorties.
valuation of Plastic	15	77	Assess properties and moldshifty of different	Test suspended.
Asterials with Improved			grades of piselic tests with additives	
, manuscripte			to improve plantic part performance	Colonese and Maryl Ignited 3/5 and 2/5 trials. ZYTEL samples tested 1/5 ignitions.
ong duration brake field	150	n	(4) samples with new trade fluid	Tree! purposeded (SSO) lesses completed.
agrees teet	\perp		(2) complex with used brake fluid	Used brake fluid current dropped off to <1/10 mAmp.
· ·	╌╂╾╼╂			How EF heapont current can increases of firm under cont. power.
valuation of Switch	150	71	Associa ignificar semalibility to switch outerhalism.	<u> </u>
Prientalion			Test vertical verses 45 degree.	Test complete. Ignition is independent of switch orientation.
			Test rotational assettivity in 45 day, orientation.	stanulated switch ignition can occur in vertical or 45 degree angle. Ignition appears not sensitive to switch rotational alignment.
				Service of seasons to street together segment.
tetay Circuit	18	<u>TI</u>	Propert fact 13a in Ford relay circuit for (48) has.	Test complete. No ignition. Corrector rate draptically reduced.
cet	┴── ┞		(Bring switch to kepanding ignition in (15) Apply	insufficient power in circuit to create or move toward ignition is lab
	+		circuit then place in makey circuit for (18) has.	House element was warm to the touch.
	+++		input mix. circuit power into heater on switch.	
ong duration basks fluid	17	Ti	(60) symples filled with new brake field	Test suspended. (312) hours completed.
gress tost number 2.	1		(1) how of vibration per day	Average hexport current is 1.9 mAmp (sidertation = 1.5 mAmps)
	\perp		(1) hour sout at 100 day C per day	1'0 usoubri

TI-NHTSA 017094

preliminary draft summary of TI record search flushings of May 14-17 1999

summary by Steve Beringhause & Andy McGuirk May 19th 1999

TI P/N: 77PSL2-1 Ford P/N: F2VC-9F924-AB

Tested at 'room temp' per manufacturing ES requirements

	indo Sea men	Qty	•
	Lot	(mpulse	Qty
Date	Size	Tested	Leek
25-Nov-91	4,000	10	•
25-Nov-91	4,000	10	•
05-Dec-91	4,000	10	•
05-Dec-91	4,000	1Ú 10	•
09-Dec-91 09-Dec-91	4,000 2,000	5	-
11-Dec-91	4,000	10	
11-Dec-91	4,000	10	
13-Dec-91	4,000	10	-
14-Dec-91	4,000	10	-
16-Dec-91	4,000	10	-
16-Dec-91	4,000	10	•
02-Jan-92	4,000	10	-
06-Jan-92	4,000	10	•
07-Jan-92	2,000	5	-
08-Jan-92	4,000	10	
08-Jan-92	4,000	10 10	•
14-Jan-92 14-Jan-92	4,000 4,000	10	•
15-Jan-92	4,000	10	•
28-Jan-92	2,000	5	
31-Jan-92	4,000	ιō	•
02-Feb-92	1,650	5	-
04-Feb-92	4,000	10	-
05-Feb-92	4,000	ΙΦ	-
06-Feb-92	4,000	LO	•
10-Feb-92	4,000	ΙÓ	-
11-Feb-92	4,000	IO	•
12-Feb-92	4,000	10 10	•
12-Feb-92 14-Feb-92	4,000 4,000	01	•
14-Feb-92	4,000	10	
14-Feb-92	4,000	10	-
15-Feb-92	4,000	10	-
24-Feb-92	4,000	10	-
26-Feb-92	4,000	10	-
26-Feb-92	4,000	10	-
28-Feb-92	4,000	10	-
28-Feb-92	4,000	IQ.	-
28-Feb-92	4,000	ΙQ	•
06-Mar-92	4,000	IO	•
10-Mar-92	4,000 4,000	10 10	•
11-Mar-92 12-Mar-92	4,000	10	-
12- ME-92	4,444	10	-

77PSL2-1: Impulse Data Results 11/91 - 12/92

PATRIX COMPA	403,634	665	
Totals units	265,450	648	
21-Dec-92	4,000	ſ0	-
21-Dec-92	2,000	5	-
16-Dec-92	-14	01	-
16-Dec-92		10	-
16-Dec-92	•	10	•
14-Dec-92	-,	5	-
	_,		•
04-Dec-92 09-Dec-92		5 5	•
			•
17-Nov-92 20-Nov-92		5 10	-
			•
10-Nov-92 11-Nov-92	-1	10	•
10-Nov-92		10	-
10-Nov-92		10	-
04-Nov-92		10	•
30-Oct-92		10	-
29-0 01-9 2 29-0 01-9 2	•	10	-
29-On-92		10	-
20-Oct-92	•	10	•
21-Oct-92		30	-
16-Oct-92	•	10	-
07-Oct-92	.,	10	•
07-Oct-92		10	-
30-Sep-92		10	
22-Sep-92		10	•
14-Sep-92		5	
06-May-92		3	
05-May-92		ร์	
02-May-92		5	
23-Apr-92		5	- :
18-Mar-92	4,000	10	_

Epstein, Sally

From:

McGuirk, Andy [a-moguirk@email.mc.tl.com]

Sent:

Tuesday, June 01, 1999 9:39 AM

To:

Pachonia, John; Dague, Bryan; Proia, Stephen; Watt, Jim

Ç¢:

Baumann, Russ

Subject:

FW: Ford Core learn update

for your background info as we host Steve reimers weds

AUTOMOTIVE SENSORS AND CONTROLS ORA MANAGER

34 FOREST ST M/S 23-05 ATTLEBORO, MA 02703 TEL : (508) 236-3080 FAX : (508) 236-3745 MOBILE: (500) 206-6119

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

From: McGuirk, Andy

Friday, May 28, 1999 3:22 PM 'Frederick J. Forter' Sent:

To:

Beringhause, Steven; Sharpe, Robert

Subject: Ford Core team update

Fred, per our discussions and Rob Sharpe's visit enclosed is our updates...

<<fredPortCore.doc>>

<<synopsil.doc>> <<TESTLOG9.xls>>

<<7795L2_1.x1e>>

AUTOMOTIVE SENSORS AND CONTROLS OR MANAGER

34 FOREST ST M/S 23-05 ATTLEBORO, MA. 02703 TEL : (508) 236-3060 FAX : (508) 236-3745 MOBILE: (508) 208-6119

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

May 26, 1999

Mr. Frederick J. Porter, Supervisor E/E Systems Engineering Building 5, Mail Drop 5011 20000 Rotunds Drive, Rm 3E004 Dearborn, MI 48121-2053

Dear Fred:

I want to review our recent support of the Ford core team to assure we do not have any misunderstandings regarding our pressure switch performance, our continued contribution to the 'core' team, and our commitment to a quick conclusion.

For six months the Texas Instruments Automotive Sensors & Controls Team has been supporting the Ford Core Diagnostic Team with technical facts, data, and analysis regarding our brake pressure switch product applied in the Ford cruise control deactivation circuit.

A senior TI pressure switch engineer was in residence at Ford for three weeks to assist with switch related issues in the system diagnostic process. Senior TI leadership participation has also been involved in virtually every Ford Core Team meeting delivering facts, data, and technical support year-to-date '99.

We also investigated switch capability, and using agreed upon accelerated simulation life testing techniques, demonstrated the ability of the model year '92 & '93. Town Car speed control descrivation switches to consistently exceed "cycle life specification" of 500,000 pressure cycles. TI Weibuil reports of pressure switches tested in 1996 conservatively demonstrate 95% reliability to 1 million cycles (with confidence intervals greater than 50%).

Additionally "success testing records" of some 555 ES units that were tested during the 1991 - 1992 (11/91 - 12/92) showed zero leakage at 500,000 cycles.

Conclusion to date: 1992 period switches met specification. 1999 switch meets or exceeds specification.

We have developed and delivered a laboratory model of accelerated plastic base ignition of the switch resulting from fluid in the switch cavity coupled with application of constant power as designed in the speed control circuit. Theories from the model suggest that fluids in the switch cavity in the presence of uninterrupted power could lead to a corrosion product formation which might create a plastic base ignition path.

Mr: Fred Porter May 26, 1999 Page 2

Conclusion to date: Constant speed control power allows long term corresion.

In light of this laboratory model and the need for cruise system power only during vehicle operation, we suggest the system architecture of "key-on/off" based power be considered.

We have been open and forthright in our communications and delivery of information and we believe we have been instrumental in helping. Ford address the underhood fire concern issue.

In this regard, we think it is appropriate at this point that our active participation in the diagnostic journey of the vintage 1992 product move towards a timely conclusion. Toward this end, we will continue to support the "core" team review of 1992 product history with targeted completion in July 1999.

We are preparing to fulfill your request for hosting a site visit, supporting campaign field return device analysis, and participating in robust system brainstorming sessions moving toward conclusion in July, as well as reviewing the optimization of our product line process controls.

Our prime focus at this time is in rapidly supplying Ford with 225,000 units in support of the field actions.

Regarde.

Andrew C. McGuirk QRA Manager Texas Instruments

attachments: 1992 Teeting History

TI 77PS Test synopsis

TI 77PS Investigation Flow Diagram

TI 77PS Test Synopsis

This document is a synopsis of tests conducted by Texas Instruments during the 77PS investigation. The intent of this document is to highlight test findings which drove the investigation to its current state. Throughout the investigation, several tests were conducted with the same objective. When each objective was met, efforts were refocused to obtain a new level of understanding and to establish a new set of objectives. As such, tests have been categorized into (5) levels, representing the level of knowledge obtained from the group of tests conducted. Each level is listed below with a short description of the objective:

- Level 1: Create a laboratory switch ignition without any restrictions on methods.
- Level 2: Create a laboratory switch ignition using only conditions found in the switch operating environment.
- Level 3: Understand the laboratory ignition mechanism.
- Level 4: Compare factors contributing to laboratory ignition.
- Level 5: Evaluate recommendations.

Refer to Brake Pressure Switch Test Log-

Level 1 Objective: Determine if a switch ignition can be created in the laboratory.

• Test 1

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Switch contact cavity flooded with brake fluid mixed with varying amounts of % Hs0.

14 volts applied to one terminal, second terminal electrically floating. (No electrical load across switch terminals).

Switch besport electrically grounded.

Results:

- (8) samples were tested total:
- (2) with 4% H₂0 in brake fluid.
- (2) with 6% H₂0 in brake fluid.
- (2) with 10% H₂0 in brake fluid.
- (2) with 75% H₂0 in brake fluid.

No ignition occurred. No significant temperature rise observed in all samples. Current draw ranged from 0.5 mAmps to 5 mAmps over a period greater than (250) hours.

TI-NHTSA 017100

• Test 2

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Switch contact flooded with brake fluid.

14 volts applied to one terminal, second terminal connected to a 14 Ω resistor which is tied to ground. (1 Amp load across switch terminals). Switch hexport electrically grounded.

Results: (2) samples were tested. No ignition occurred. No significant temperature rise observed for a period over (250) hours.

Conclusion: A (I) Amp load through switch terminals did not ignite brake fluid in the contact cavity of switches.

Test 6

Objective: Determine if switch ignition can occur under the following laboratory conditions:

Heater element installed in contact cavity of the switch.

Power applied to the heater element until plastic base melts.

Spark generated in contact cavity of switch.

Brake fluid present in the contact cavity (wet device) and absent in the contact cavity (dry device).

Results: (2) dry devices were tested and (1) wet device was tested. Ignition occurred in all devices.

<u>Wet device:</u> The internal temperature of a wet device reached 660°F. A hole burned through the base of the switch (close to the heating element). The applied spark ignited the fumes in the contact devity of the switch and engulfed the base material of the switch.

<u>Dry device</u>: The internal temperature of a dry switch reached over 1000°F. The switch base flopped over. The applied spark ignited the flumes in the contact cavity of the switch and enguised the base material of the switch.

Conclusion: A switch ignition can occur under the following laboratory conditions:

Heater element installed in the switch contact cavity.

5 watts of power dissipated in heating element.

Spark generated in the contact cavity of the switch.

Brake fluid did not contribute to the ignition process.

TI-NHTSA 917191

Level 2: Objective: Determine if a laboratory ignition can occur using only switch components and elements found in the switch environment.

Test 6a.

Objective: Determine if corrosive degradation of switch electrical components can cause an increase in electrical resistance (and thus a source of heat) in the switch, which may lead to an ignition.

Results: (1) out of (15) samples tested increased resistance to 5 Ωs. A solution of 5 wt. % NaCl in H₂0 can corrode the electrical components of the switch and cause an increase in electrical resistance. Repeated injections of the solution of 5 wt. % NaCl in H₂0 into the contact cavity of a switch, with the switch continuously powered at 14 Volts, can cause an ignition.

Conclusion: A switch ignition can occur under the following laboratory conditions:

A solution of 5% NaCl in H₂0 is injected into contact cavity of a switch. Continuous 14 Volt power applied to the switch. Hexport is grounded.

Current is limited at 15 Amps.

Test 6c

Objective: Determine if brake fluid with metal shavings is conductive enough to create an ignition.

Results: (3) devices with various size metal particles were tested. No significant current increase detected.

Conclusion: Metal shavings did not significantly increase conductivity brake fluid. Current levels measured were well below levels necessary to create an ignition.

Test 7

Objective: Determine if switch meets cycle life specification.

Results: Tests conducted during the first quarter of 1999 show that switches exceed cycle life specification.

In the first quarter of 1999, a total of (42) 77PSL2-1 snap switches were impulse tested to over 1,000,000 cycles with only (1) leak below 1,000,000 cycles, which

occurred at 728,000 cycles. A Weibull analysis showed 99.9% reliability at 500,000 cycles at 95% confidence level.

Conclusions: Switches meet cycle life specification. First quarter, 1999 tests confirm impulse test findings made during the period between 1991 and 1992, During that period, (6) impulse tests on 144 devices of 57PS and 77PS construction, had no leaks when tested to 500,000 cycles. A Weibull analysis of first quarter, 1999 tests, showed 99.9% reliability at 500,000 cycles at 95% confidence level.

Test 15a

Objective: Determine the long term corrosive effects of brake fluid on the electrical components of switches which are continuously powered at 14 Volts.

Results: Test was suspended after 550 hours of testing. (6) samples were tested with continuous 14 Volts power. The contact cavity of (4) switches contained new brake fluid and (2) switches contained old brake fluid. Switches with old brake fluid drew very little hexport current and showed a decrease in hexport current over time to less than 1/10 mAmp. Samples with new brake fluid showed an increase in hexport current to over 20 mAmps toward the end of the 550 hours of testing. Analyses of (1) sample with new brake fluid and (1) sample with old brake fluid revealed electrolytic corrosion of the contact arm of both switches. There was a much lower level of corrosion in the sample with used brake fluid than the sample with new brake fluid.

Conclusion: Brake fluid in the contact cavity of switches, which are at 14 Volts continuous power for over 500 hours, can cause electrolytic corresion of the switch contact arm and an increase in hexport current.

Test 17

Objective: Quantify the long term corrosive effects of new brake fluid on the electrical components of switches under the following laboratory conditions:

Contact cavity of switch flooded with new brake fluid. Switches at continuous 14 Volts power. Switches subjected to vibration for (1) hour per day. Switches subjected to 100°C for (1) hour per day.

Results: Test suspended after (312) hours. (50) samples tested. The average hexport current draw after (312) hours is 1.9 mAmps with a standard deviation of 1.8 mAmps. These results are consistent with results previously found in Test 15a at the 300 hour point.

Conclusion: New brake fluid in the contact cavity of switches, has not caused an increase in hexport current after (312) hours at continuous 14 Volta power.

Level 3: Objective: Understand the laboratory ignition process, determine the current path and establish a repeatable ignition method.

Test 6b

Objective: Understand the ignition process, determine the current path and establish a repeatable ignition method.

Results: Multiple attempts at laboratory ignition, via injection of a solution of 5 wt. % NaCl in H₂0 into the contact cavity of switches, has resulted in a repeatability rate of approximately 50%. Plots of hexport current verses time show an increase in current until the point of ignition.

Conclusion: A repeatable laboratory method for switch ignition was established. Based on hexport current measurements, the current path is from switch terminals to hexport body.

When a solution of 5 wt. % NaCl in H₂0 is repeatedly injected into the contact cavity of powered switches, electrolytic corrosion of the switch terminal results in an increase in terminal resistance. When sufficient power is drawn through the corrosive resistance, switch elements heat up and begin to glow red hot. A hole burns through the switch base and ignition occurs. There is arcing visible throughout the corrosion process which may provide the spark necessary for ignition.

Level 4: Objective: Compare and contrast variables influencing ignition using the established laboratory ignition method.

• Test 13a

Objective: Compare various fluids in the established ignition method.

Results: The following fluids were tested.

- (1) NaCl in Ha0.
- (1) tan water
- (1) raid water
- (1) used brake fluid
- (1) used brake fluid with 5 wt. % H₂0
- (1) new brake fluid
- (1) new brake fluid with 5 wt. % H₂0

The switch filled with 5 wt. % NaCl in H₂0 resulted in an ignition when average hexport current exceeded 2.5 Amps. Switches that were filled with tap water and rain water drew less than 10 mAmps over a (3) hour test and showed little signs of

corrosion. Switches filled with a matrix of new and used brake fluids, with water and without water, all drew less than 3 mAmps hexport current draw and showed no signs of corrosion over the (24) hour test.

Conclusion: Brake fluid is not conductive enough to cause the electrolytic corrosion and necessary current draw to create an ignition within a 3 hour lab test. Because of its' significantly higher conductivity, an ionic rich fluid such as NaCl in H₂O can cause an ignition in a 3 hour lab test exposure.

Test 15

Objective: Compare the ignition characteristics of various plastics as switch base material.

Results: When 5 wt. % NaCl in H₂0 was injected into switches with different base materials, the following results were obtained: Cellanex 4300 ignited 3 out of 5 attempts. Notyl ignited 2 out of 5 attempts. Zytel ignited 1 out of 5 attempts.

Conclusions: All plastics tested can ignite using the established laboratory ignition method.

Test 15b

Objective: Determine if switch ignition can occur in the vertical position and 45° orientation. Determine if switch ignition can occur and at different rotational angles in the 45° orientation.

Results: Switch ignitions can occur in both the vertical and 45° orientation using the established laboratory ignition method.

Conclusion: Switch ignition does not appear to be sensitive to vertical orientation verses 45° orientation nor to rotational angle in the 45° orientation.

Level 5 Objective:

Test 16

Objective: Test proposed relay circuit.

Results: (1) switch was injected with a solution of 5 wt. % Nacl in H₂0 and placed in the proposed current limiting circuit for (48) hours. The current draw remained constant at 180 mAmps throughout the test. There was no activity observed and the contact arm remained mostly intact.

 switch was brought to an impending burn condition using the established burn method. An impending burn is a condition where a corrowive resistance has built up in the switch and an ignition is imminent. The switch was then placed in the proposed relay circuit for (18) hours where it drew 160 mAmps, showed no visible activity and did not result in an ignition.

Because the proposed relay circuit acts as a resistor which limits current to the switch, the maximum power to the switch is limited to .75 Watts. A resistive wire was wrapped around the base of (1) switch and 0.75 Watts of power was dissipated in the wire. The wire became warm to the touch but had no effect on the switch.

Conclusion: 0.75 Watts, the maximum power in the proposed circuit design, is insufficient to cause substantial electrolytic corrosion or significant switch terminal heating, which is necessary to create an ignition. In previous tests, using a resistor as the heating element (see Test 6), approximately 5 Watts of power was necessary to create an ignition.

Brake Pressure Switch Test Log, Updated 6/22/99

Category	Test	Location	Tool Parameters	Results Update
Lab Simulation	1	<u>. \$1</u>	Very water concentrations in 'new' Brake Fluid	250+ hours, Current draw in the 0.5mA to 5mA range
of Potential Ignition			14Vdc to one terminal, herport grounded	Fluid has discolored.
in Switch	7	_	Minter Conc: 4%, 6%, 10%, 75%	No Significant Temperature Rise. Test Suspended.
	7-			Interest Anglysis suspended.
	7	_		
	2	11	Herr Brake Fluid	250+ hours. Constant temperature.
	\top		(Amp Brough maltch terminals	No significant lateparature rise with time
	T		14Vdc to one terminal, heaport grounded	Text Suspended.
	3	AVT_	new Breite Fluid in Switch, 24 VDC to one	> 300 hours into test, must current 7/mA
	7		terminal. Hesport Grounded	No significant change with time. Yest suspended
<u> </u>	4	AYT	nea' Brake Fald in Selich, 24 VDC to one	18 hours into test max current SmA
			fernánci. Herpart Grounded, Ambient et 100 C	No significant temperature rise with time. Test suspendent.
	- 5	AVT	mes' Brains Fluid in Switch, 16 Amps	Temperature rise of 20 C shave more temp
	Т.		Through switch terrainals	Data T meched steedy state at 20 C. Test suspended.
	54	AVT	new Brake Fluid in Switch approx. 50 Amps	Temperature rose to approx. 270 F. No smoke. No ignition
	\Box		Security Switch Terminals	Test suspended
	\top			
	6	Π	Build hunter elements into Switch.	3 tested. Smoke ebserved, ignition observed on part withester
	\Box	<u> </u>	Heat III failure, include sperling.	Bee affectations
	\Box	Γ	(1) we solution of Brake Fluid and 6 wt. % H ₂ 0	Test complete
<u> </u>				Brake fluid in cavity slows down heat build-up
				Graphic chaerway at 675 F, Base melts and falls off at 800 F
	7=	TI.	Create heater by corroding spring arm	One out of 15 devices incressed resistance to 5 ohms.
	7		Set water solution, 14V between spring	Others either very low resistence or magazitims
			and haspett	It look about 100 hours to reach the 5 plun stage.
	1			The 5 ohin device ignited under conditions similar to test 6.
	 			<u></u>
	66	Ŧ	Re-new ignition test to understand	Switch ignition with repeated 5% webs solution into switch
Ž	1		repealability and current path.	Current path is through hexpost.
3				Bee picks and vides.
<u> </u>	1		T	Additional test include top water, old GF, new BF and other
> 	80	Ti Ti	Pure 'ngw' tooks fluid with matel chavings	Mintel shavings do not contribute significantly to brake fluid

Brake Pressure Switch Test Log, Updated 6/22/99

				coductivity
TO THE REPORT OF THE PROPERTY OF	360.23	1 1 2 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	TO THE PROPERTY OF THE PARTY OF	to the Alice Control of the Control
He Cycle Rollability	7	য়	0-1400 paig pressure pulses et 135C	First leak observed at 729,000 cycles.
of Pressure Switch	┪		per ES	Test Completed, See attached Weibull Chart.
	636		*	THE REPORT OF THE PROPERTY OF
Disphragm Weer		Ti	0-1400 paig proposes pulses at 136C.	Parts willindrawn gowy 200k cycles, characterized for waar
2000 Aug 36 37 83		- 11		TANK TO THE PERSON NAMED IN
Field vs Lab Correlation		Control Labor	Field returns, from dealer lots, puricyards	Parts in Central Labs, see Ford spreadsheet
WEST AND COMMENT		V		
Design Of Experiments (1)	10	'n	Very water concentrations in 'near' Brake Fluid	Test Report being written investigation continues
	 ''- '		12 samp + 12 quiet entitches w/ 0 % water in BF	Suspended at 1.3 million cycles with no leaks observed
Evaluating Factors	┢┈┈		12 seep + 12 guiet switches w/ 5 % wader in BF	Snep camping suspended at 1.3 million cycles with 2 leaks
Effecting Displangm West	┨┈╾╢			observed at 1.3M. Culot samples suspended at 500k cycles to
repulse test	╌		<u> </u>	access Eduring encrimões.
				Committee of the second
	11	TVA	Monitor Pressure and Temperature	Test at AVTsee Ford digets>500k in car?
On-Vehicle Characterization	╃╩		at Switch Lecation for ABS and non-ABS	
of Pressure & Temperature	1-		besiding evitats.	<u>" " </u>
Profile in Town Car			amp d is size	1 340 miles () 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
	110	Ϋ́I	Analyze used brain Suid at the master cylinder	Test cumplate
Brake fluid analysis	 110	 "	(UMC), used brain fluid at the onliner (UCA)	UMC: Cu = 415 (uglad), Fe = 5.6 (uglad), Cr = 0.08 (uglad), 1.1 96420.
Lised fluid at mester dylinder	╂━┈	 	and new brake fluid (NEW) for metal and water	UCA: Cu = 502 (ugled). Fe = 6.5 (ugled). Cr = 1.9 (ugled). 1.1 9.H20.
	╄	 	content.	MEM: Cu = <0.01 (uplot), Fa = 0.62 (uplot), Cr = <.01 (uplot), 0.3 5M20.
	1			
MON.	1 48		Determine if exclopack forms in switch	Equipment set up in progress at Central Labs.
Spark (Arc Study	12		using clutch toads and high speed victor.	Ti Experimented with no 'significant' sparks observed
	↓- -		Use dry exitches as well as maliches with	
	₩	\ 	various brake third under more.	
			Maitrice and and Agent	
Bas de la	- 15		District of the second of the	Data log und analysis procedure set up complete.
Characterization of	1 13	Catalian mass	Characterize electrical, mechanical	Analysis of pulphes in progress.
switches retrieved from field	┸	 _	and charactal aspects of returned prefiction	Principles of American is broduced.
junkyards & other sources		<u> </u>		
Bosto Million				Tark complete
Fluid Ingrees Tests	13e	π	Report ignition structures with different fluids.	Test complete. 6% NeCl sample resulted in an ignition.
			(3) hour tests:	All brake fluid samples them less than 3 mArrips. No corrosion
_ 		<u></u>	5% NeCl in top water	visible on brake field semples.
TI-NHTS			rain verter	Rain water and tap water samples thew <10 mAraps and showed
		<u> </u>	(24) hour tests:	Com desired that cab after seminor man - in manks with separate
r , -	$\overline{}$		top water	some signes of correction

Brake Pressure Switch Test Log, Updated 6/22/99

				
			used brake fluid	Chamical aniyais in process
	1 7		used brake fluid w/ 5% H ₂ 0	1
	1 1		now trake fluid	
<u> </u>	┲┈╅		now brake fluid w/ 5% H ₂ D	
n ere de la composition della	S : 15 ()			* * * * * * * * * * * * * * * * * * *
Design Of Experiments (2)	136	Al	Very water concentrations to 'next Brake Fluid	Test suppended. Analysis in process to assess test toturing.
Repeat of test 10	 		10 enep + 20 quiet sylliches w/ 0 % water in BF	The second second is a second to a second to s
			10 map + 20 quiet meliches w/ 5 % water in GF	
Distriction ()	144			
Conspectibility of Kapton	14.	Dupont	Characterize change in properties of Kepton	Test in progress (100) hours completed. Oxelic acid shows
etti Oralic Acid			with regions % contic sold in broke Buid.	similar affects that water has an Kapton proorties.
valuation of Plants	45			
valuation of Pleasic	15	Π	Access properties and moldability of different	Yest suspended.
interials with Improved	┸╼┵		grades of pincile resin with additives	Colonne and Noryl ignited 3/5 and 2/5 trials
Pararoetara	\perp		to improve plantic part partermence	ZYTEL samples trained 1/5 ignitions
Í · _ · _ ·				
ong duration brake field	156	Tì	(4) semples with new brains fluid	Test suspended (550) hours completed.
ograms test.	$oldsymbol{oldsymbol{\sqcup}}$		(2) बस्प्यूनेक प्रति प्रकार क्रियोग वैपरि	Used brake fluid current dropped off to <1/10 mAmp.
				New RF hasport current can increases w/ time under cost. power.
N 1				
evaluation of Switch	164	TI	Assess ignition constituty to switch orientation.	Test complete. Ignition is independent of switch orientation.
Orientation			Test vertical verses 45 degree.	nimulated exitich ignition can expur in vertical or 45 degree angle.
	\mathbf{L}_{-}		Test rotational sensitivity in 46 deg. orientation.	Ignition appears and secolities to switch rotational alignment.
telay Circuit	16	71	Repeat feet 13m in Ferd rainy circuit for (42) has	Test complete. No ignition. Corrosion rate drastically reduced.
aut	Γ		String switch to impending lightion in (16) Amp	installicient power in circuit to create or move toward ignition in tab
	1		circuit than place in rately circuit for (18) tyre.	Heater element was warm to the touch.
	1		input max, circuit power into heater on matten.	
47.				
ong daration beake fluid	177		(50) paraphy filled with new broke field	Test suspended. (312) hours completed.
agrees test number 2	1. 1		(1) hour of vibration per day	Average hexport current is 1.9 mAmp (sideviation = 1.5 mAmps)

preliminary deaft summary of TT record search fluidings of May 14-17 1999

menutomy by Stove Beringhause & Andy McGulck May 19th 1999

TI P/N: 77PSL2-1 Ford P/N: F2VC-9F924-AB

Tened at 'room temp' per manufacturing ES requirements

		Qty	-
	Lot	Litegral so	Qty
Date	<u> Size</u>	Tested	<u>Leek</u>
26-Nov-91	4,000	10	•
26-Nov-91	4,000	10	•
5-Dec-91	4,000	10	-
5-Dec-91	4,000	10	•
9-Dec-91	4,000	10	•
9-Dec-91	2,000	5	•
11-Dec-91	4,000	10	•
11-Dec-91	4,000	10	•
13-Dec-91	4,000	10	•
14-Dec-91	4,000	10	•
16-Dec-91	4,000	10	•
16-Dec-91	4,000	10	•
2-Jan-92	4,000	10	-
6-Jan-92	4,000	10	•
7-Jen-92	2,000	5	•
6-Jan-92	4,000	10	•
B-Jan-92	4,000	10	•
14-Jan-92	4,000	10	• .
14-Jan-92	4,000	10	•
13-J an-9 2	4,000	10	•
26-Jan-92	2,000		•
31-Jan-92	4,000	IQ.	•
2-Feb-92	1,650	5	•
4-Feb-92	4,000	10	•
5-Feb-92	4,000	10	•
6-Peb-92	4,000	10	•
10-Peb-93	4,000	10	•
11-Feb-93	4,000	10 10	•
13-Peb-92	4,000	10	•
12-7-0-92	4,000 4,000	10	•
14-F-6-92	•	ro ro	-
14-7-6-92	4,000	10	•
14-Feb-92	4,000	10	-
15-Feb-92	4,000	10	•
24-Feb-92	4,000	10	•
26-Feb-92 26-Feb-92	4,000 4,000	10	
	4,000	10	_
28-Feb-92 28-Feb-92	4,000	10	· -
28-Feb-92	4,000	10	·
6-Mar-92	4,000	10	i.
10-Mar-92	4,000	10	i.
11-Mar-92	4,000	10	:
12-Mar-92	4,000	10	-
(4 -440) -74	7,000		_

TI-NHTSA 017110

77PSL2-1: Impulso Day Results 11/91 - 12/92

Totals units	145,650	64	
21-Dec-92	4,000	10	
21-Dec-92	2,000	5	•
16-Dec-92	4,000	10	-
16-Dec-92	4,000	10	•
16-Dec-92	4,000	10	•
14-Dec-92	2,000	5	
9-Dec-92	2,000	•	
4-Dec-92	2,000	5	-
20-Nov-92	4,000	10	-
17-Nov-92	2,000	3	-
11-Nov-92	4.000	10	-
10-Nov-92	4,000	10	
10-Nov-92	4,000	10	
4-Nov-92	4.000	ίο	
30-Oct-92	4,900	10	
29-Oct-92	4,000	10	-
29-Oct-92	4,000	10	_
20-Oct-92	4,000	10	
21-Oct-92	2,000		-
16-Oct-92	4.000	10	
7-Oct-92	4,000	10	-
7-Oct-92	4,000	10	-
30-Sep-92	4,000	10	-
22-Sep-92	4,000	10	•
14-Sep-92	2,000	5	•
6-May-92	2,000	5	•
5-May-92	2,000	5	•
23-Apr-92 2 -May-9 2	2,000 2,000	5 5	•
18-Mar-92	4,000	10	•
10 14 04		10	

TI-NHTSA 017111

<u>Carrey, Pat</u>

From:

Andres, Amy [asadres@email.me.ti.com]

Sent:

Tuesday, June 01, 1999 12:56 PM

To:

Siuzdak, Allan; Chura, Stephen; Griffin, Hank; Hopkins, AL; Kill, Beth; Su, Rose

Cc:

McGuirk, Andy

Subject:

FW: line audit by ford

I am forwarding this for your information. It appears that Ford will be visiting tomorrow and the agenda follows. I do not see a time for a lab tour, but please be prepared.

Thank you! Best Regards, Amy Andres aandres@ti.com #3616 pgx0662

McGuirk, Andy From:

Tuesday, June 01, 1999 1:28 PM Sent:

To: Pechonis, John: Proia, Stephen: Ameral, Paul; Matt. Jim: Beringhause, Steven; Dague, Bryan; Sharpe, Robert Co: Baumann, Russ; Rowland, Thomas; Haynes, John: Andres, Amy; Douglas,

Charles

Subject:

RE: line audit by ford

to complete final preparations for our ford audit, pls join me in bldg 12-15 at 7 am weds to review our preps and make any last minute adjustments

below was the agends i sent to fred for final resolution....... AUTOMOTIVE SENSORS AND CONTROLS ORA MANAGER

34 FOREST ST M/9 23-05 ATTLEBORO, MA 02703 TEL : (5DB) 236-3080 FAX : (508) 236-3745 MOBILE: (508) 208-6119

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

From: McGuirk, Andy

Tuesday, June 01, 1999 12:41 PM 'Frederick J. Porter'; 'Steve Reimers' To:

Sharpe, Robert: Beringhause, Steven: Prois, Stephen Ford visit draft agenda for June 2nd visit Subject:

visit by Steve:

The flight should place Steve into our conference room care of Rob 3: between 3:15 and 3:30... with a "formal" start at 3:30... I see us accomplishing the transition of core team focus from product to process, having an update on corrosion status, and reviewing process controls from '92 with discussion about differences and changes to '99. Lets review this "DRAFT" and talk about finalizing same this afternoon...

ARRIVE TI BLDG 12-1A CONF ROOM AND INTRODUCTIONS/COFFEE 9:15 - 9:30

FINALIZE OBJECTIVES OF THE DAY 9:30 - 9:40

ANDY M

....

STEVE R AND ANDY M

FORD ISSUE OVERVIEW AND CIALOGUE 9:40 - 9:50

TI BRAKE SWITCH/CORROSION REVIEW - UPDATE

STEVE B

9:50 - 10:15

BRAKE SWITCH ASSEMBLY PROCESS OVERVIEW

STEVE P

10:15-10:45

TIME-LINE DISCOSSION....MANUAL VS AUTO CRIMP

STÉVE P

10:45 -11:15

CRIMP PROCESS CONTROLS...CLE, CONTROLS

STEVE P

11:15-11:30

LINE TOUR - LINE DISCUSSIONS

STEVE P

11:30- 12:30

WORKING LUNCH

ALL

12:30 -1:00

DISCUSSIONS, MORE LINE TOUR, NEXT STEPS

ALL

1:00 - 2:00

FORD CORE TEAM CONFERENCE CALL.... NRAP-UP

ALL

2:00 - 2:30

DEPART FOR AIRPORT

ROB S

2:30

STEVE R &

From: McGuirk, Andy

Sent: Friday, May 29, 1999 9:58 AM
To: Pechonis, John; Proia, Stephen; Amaral, Paul; Watt, Jim; Beringhause, Steven; Dague, Sryan; Sharpe, Robert; McGuirk, Andy Co: Baumann, Russ; Rowland, Thomas; Kaynes, John; Andres, Amy;

Douglas, Charles

Subject: RE: line audit by ford

Importance: Kigh

we have agreed to host a visit by steve relmers on weds june 2nd for a 930-200 visit to the operations. rob sharps will attend.

ford understands our issues trying to accommodate the visit with our current conflict of launches and vacations etc.

(we will also continue to plan on a larger visit 17-18 june.)

we will start weds with the extended team, intro and days objectives....andy

quick ford lasue overview and dialogue by stev randy

maybe look at brake fluid corresion status samples...photos....the corrosion story....steve b

line overview and key process parameters.......stave p

let stave r tall us the story of ford concerns/causes....show the 14 d ?? (1'11 try).........steve r

we should plan on the time line discussion(sp/bg/bd) and the crimp controls (bg/sp) as well as yield data.

show photos of 'manual' vs auto crimpers and discuss differences..........steve p

show crimper controls.....tools geometry controls 7......steve p

design lab tour to see the testing process and the support systems.....bryan d

discussions of what the likely parameters are of interest....cause and effect diagram.... steve p

prepare to go into pfmme and d fmee and control plan.....jim w & paul a and bryan d and bob q TI-NHTSA 017114

wrap up and make plans for the 17th visit participate in ford 2pm core team meeting depart to airport at 230 pm

pls review and comment via phone to me

i suggest we include a line overview and have counseled several key techs and lead operators for possible dialogue with steve during the eventual line tour (lets hold a session with them tuesday !)

AUTOMOTIVE SENSORS AND CONTROLS ORA MANAGER 34 FOREST ST M/S 23-05 ATTLEBORD, MA 02703 TEL: (508) 236-3080 FAX: (508) 236-3745 HOBILE: (508) 208-6119 PAGE: (800) 467-3700 PIN 604-2044

Epstein, Sally

From:

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

Sent:

Tuesday, June 01, 1999 12:29 PM

To:

Pechanis, John; Prois, Stephen; Amarel, Paul; Wett, Jim; Beringhause, Steven; Dague,

Bryan; Sharps, Robert

C¢:

Bournann, Russ; Rowland, Thomas; Haynes, John; Andres, Arry; Douglas, Charles

Subject: RE: line sudit by ford

to complete final preparations for our ford sudit, pla join me in bldg 12-15 at 7 am wads to review our preparations and make any last minute adjustments

á

From: McGuirk, Andy

Sent: Tuesday, June 01, 1999 12:41 PM

To: 'Frederick J. Porter'; 'Steve Reimers'

Co: Sharpe, Robert; Beringhause, Steven; Prois, Stephen Subject: Ford visit draft agenda for June 2nd visit

Fred and Steve, I'd like to propose the following agenda for tomorrow's visit by Steve:

The flight should place Steve into our conference room (care of Rob S) between 9:15 and 9:30... with a "formal" start at 9:30. I see us accomplishing the transition of core team focus from product to process, having an update on corrosion status, and reviewing process controls from '92 with discussion about differences and changes to '99. lets review this "DRAFT" and talk about finalizing same this afternoon...

ARRIVE TI BLDG 12-1A CONF ROOM AND INTRODUCTIONS/COFFEE 9:30

9:15 -

FINALIZE OBJECTIVES OF THE DAY 9:30 - 9:40 ANDY K

FORD 198US OVERVIEW AND DIALOGUE 9:50

STEVE R AND ANDY M

9:40 -

TI BRAKE SWITCH/CORROSION REVIEW - UPDATE 9:50 - 10:15

STEVE B

STEVE P

BRAKE SWITCH ASSEMBLY PROCESS OVERVIEW 10:45

10:15-

TIME-LINE DISCUSSION....MANUAL VS AUTO CRIMP

10:45 -11:15

CRIMP PROCESS CONTROLS ... CEE, CONTROLS

11:15-11:30

STEVE P

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LINE TOUR - LINE DISCUSSIONS

11:30- 12:30

STEVE P

WORKING LUNCH

12:30 -1:00

ALL

DISCUSSIONS, MORE LINE TOUR, WEXT STEPS

1:00 - 2:00

ALL

FORD CORE TEAM CONFERENCE CALL.... WRAP-UP ALL

2:00 - 2:30

DEPART FOR AIRPORT

2:30

STEVE R A ROS S

From: McGuirk, Andy
Sent: Friday, May 28, 1999 9:38 AM
To: Pechonis, John; Proia, Stephen; Amaral, Paul; Watt, Jim; Beringhause, Steven;

Daque, Bryan; Sharpe, Robert; McGuirk, Andy Co: Baumann, Russ; Rowland, Thomas; Raynes, John; Andres, Amy; Douglas, Charles Subject: RE: line audit by ford

Importance Algh we have agreed to host a visit by stave reiners on weds june 2nd for a 930-200 visit to the operations. The sharps will attend.

ford understands our issues trying to accommodate the visit with our current conflict of launches and vacations etc.

(we will also continue to plan on a larger visit 17-18 june.)

we will start weds with the extended team, intro and days objectives....andy quick ford issue overview and dialogue by stev randy

maybe look at brake fluid corrosion status samples...photos....the corrosion story....steve b

line overview and key process parameters.........steve p

let steve z tell us the story of ford concerns/causes....show the 14 d ?? (i'll try).....steve z

we should plan on the time line discussion(sp/hg/hd) and the crimp controls (bg/sp) as well as yield data.

show photos of 'manual' vs auto crimpers and discuss differences.....stove p

show crimper controls.....tools geometry controls 7.....steve p

discussions of what the likely parameters are of interest.....cause and effect diagram.... steve ${\bf p}$

prepare to go into pimes and d imes and control plan.....jim w 4 paul a and bryan d and bob g

wrap up and make plans for the 17th visit participate in ford 2pm core team meeting depart to sirport at 230 pm

pls review and comment vie phone to ma

i suggest we include a line overview and have counseled several key techs and lead operators for possible dialogue with steve during the eventuall line tour (lets hold a session with them tuesday !)

AUTOMOTIVE SENSORS AND CONTROLS ORA MANAGER AUTOMOTIVE SENSORS AND CONTROLS OF 34 FOREST ST M/S 23-05 ATTLEBORD, MA 02703 TEL: (508) 236-3060 FAX: (508) 236-3745 MOBILE: (508) 208-6119 PAGE: (800) 467-3700 PIN 604-2044

Currey, Pat

From:

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

Sent: To: Tuesday, June 01, 1999 2:45 PM 'Steve Reimers'; 'Frederick J. Porter'

Subject:

FW: Ford visit draft agenda for June 2nd visit

Importance:

High

From: McGuirk, Andy

Sent: Tuesday, June 01, 1999 12:41 PM To: 'Frederick J. Porter', 'Steve Reimers'

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WORKING LUNCH

ALL

12:30 -1:00

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ALL

1:00 - 2:00

FORD CORE TEAM CONFERENCE CALL...WRAP-UP 2:00 - 2:30 ALL

1

2:30

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AUTOMOTIVE SENSORS AND CONTROLS QRA MANAGER 34 FOREST ST M/S 23-05 ATTLEBORO, MA 02703

TEL: (508) 236-3080 FAX: (508) 236-3745 MOBILE: (508) 208-6119 PAGE: (800) 467-3700 PIN 604-2044

Currey, Pat

From:

McGuirk, Andy (a-meguirk@email.mc.ti.com)

Sent:

Tuesday, June 01, 1999 11:41 AM

Tes

'Frederick J. Porter'; 'Steve Reimers'

Ce:

Sharpe, Robert: Beringhause, Steven; Prois, Stephen

Subject:

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2:30

STEVE R 4

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Currey, Pat

From:

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

Sent: To: Tuesday, June 01, 1999 3:16 PM Proia, Stephen; Pechonis, John

Ce;

Baumann, Russ; Martin, Scott; Beringhause, Steven; Sharpe, Robert

Subject:

final: Ford visit agenda for June 2nd visit

Importance:

High

fred and I discussed and he agreed to this................... more disloque at line where operations take place as his expectation.

(his e-mail was down)

a

AUTOMOTIVE SENSORS AND CONTROLS ORA MANAGER 34 FOREST ST M/S 23-05 ATTLEBORO, MA 02703 TEL : (508) 236-3080 FAX : (508) 236-3745

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Sent: Tuesday, June 01, 1999 3:45 PM To: 'Steve Reimers': 'Frederick J. Porter'

Subject: FW: Ford visit draft agenda for June 2nd visit

Importance: High

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TI-NHTSA 017124

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STEVE R &

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

Currey, Pat

From:

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

Sent:

Tuesday, June 01, 1999 3:18 PM

To:

Warner, Pam

Subject:

FW: final: Ford visit agenda for June 2nd visit

Importance:

Hìgh

pls make foil and copy for ford for 7 am tomorrow morning (in std TI agenda format, not my fouled up mess)

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9:40 - 9:50

(14 D overview)

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Steve Reimers - see process, understand what Andy has verbally provided. Octobs started, Steve R started 2/1/99 Bruce Pend?) 192 Ford Rolleare Engineer

ABS, Ride Control, Air Suspension a Steve's Group Responsion and Charles Control where honging out

Sill no rook course for recall

Rate of Fires as fime change

line up with manual crimp to Auto crimp. To

Don't

Hilita Industries (Prop Valve)

Struct A. would like (emin) copy of FMEA

Steve B. CONTINUA RAU-Update Fullule of Fighbane
Focused in an IR (bower) heating

water Ceonosian Fluid) into switch cavity. Bridges terminals to Herport. Carrosian cell eventus high resustant path w/ conductive Slurry

Tosted with Mory! , Callenge Bose Material , = 50% duplinding

Solt water = extensive corrosion Copper Carbon, Oxygen

Brake Fluid = carrosian (200 ms) injected one time

to oxygen and expect some flushing

(\$50 m and)

Struct, asked if we looked beyond the cup corrosion to see effect on tapton (No)

Finitellies between sale water collection and Monphis Rtn

Stove R. expects = 50K field returns from recell
timing? Aland to setup Analysis Protocall
recent Failure (lock Thereby) antions in damage to come's above

ZIOK Sarvice Suitches completed

a. Any more beating ? ? ?

All testing completed . corresion - ignition

(understand) corresion - From Sult Water

- Brake Cluid

چه جودنی

32107"

Steve P.

Manufacturing / Process Row - How do we know kepton is cut connectly? 4 too long, will not fit in Nest too short, probe will make detect

Found on 90° esimp process (booked@ outsel die) rang rate for "overpressule" (Kapton web birg) izoopii (no contia), open unive) test

How many lots/dry (zohro = 20K, 8-10 lots)

Under til same date ende, no =0 for each late

Soling Copper Torming S once hex hear or bese Asay detreted " No Good" no additional companents are added and unit is eventually discorded

checks between 10-19 - mounting have is promote

Tour Walk

45" + 40"

9/91 Falled impalse Test (500K) Time Line rest course to Auto occuper (stewy rheat) "Tral to Appeared for Auto climpe!

state R - - How do we know & stimp gressure too high or too ering height Compression, to high Chigh pressure, back compressed y to bed Duly

mount tring shift word today (in honice)

manuel = hand loading , Austo = pick ; place same abotions (stylinder) see steve's comparison beble

store R throught manual us fautomotic 32/pe par min Ly need to write think close to 44% ering velocity!

scene R william's heapont to specific every position or Auto Process for pick : place change ? (put up by

Stewn ? - What do we do for PM (waterstand characterist explored relieble, mobile ble for review 1

AB US BB SHFF.X

TI-NHTSA 017131

Э

when spc finds a problem, how does Steve R. operator document. so field for input in the SPC file/chart the to add input before see is cleared the after door crimp of happen? - what drives changes to the crip die and what is the process to correct. K Any crimp ring lage problems this year Bub clear to Feb 99. need to go back farther I poky woke, if bulging wont fit into cripping & piak & place wildale crimp to a stop us pressure menta downstroke renser Awall bine ? Doro it battom mut understand downstake Sanger Cal, etc. some to my know reject of onell fine La Aigen helicus none ; used to know where --- they changes to process? awill, etc Afternoon Bose Asmy Line work Stamp. Chart Car all Process Controls (Extracted 17, 18th show all Process Checks Cen It) AB Antonotic what changed? look @ drawings for crimp Die 45/40" - Feb 42 "clearance" change Both Dies why? Both Dies why? bepth names SREA? No -> clemente i no planto " 16" Flance 140421-2-1404 140422-2 🛥 45 Conf. Call Crimp Process Directly (Process Carbols) mor party no issues needing resolution them about further back i what kinds of pioness controls in place that need changing if controls "out of whack" Book to lower /

Things might be subtle

200

Roots 174 184

bate on Isal, Implementation first then updated print Need to understand mechanical history 1.38 20 MF 1 1.25

A Rusesian punct thepe 10/25/40 3/8/14 45 C . 800 WAS ,750

Need to summerite Crimo by a Process Tool (Unultion etc) Explain tool differences between / Auto : Manual

Voy close & steve know!

RIVION PFMCA

electicisted horstage of Black i webster Cluby were erim dass originally different)

Product Design -> YTP Paky Yake i SPC Can to Process Design issue's

> -> Fred P- Any chought to how we would create a winkled Kapton -> Davide Know how

TI / Fono 1/5 morona 6/2/99 ROB SHAMPS - HOLD SANT ENG BOB GILAM - PROWES EDG STOVE PADIA - PADIESS ELA SESPENISON JOHN PERHENIS - BUSINESS MAKE STONE BORINGHOUSE - DESIGNED AMBOR BETTEN ENE SUPER-USON BRYAN DAZIN BUTTEN ENG Som Much GAN SRA MINGR ANDY METHICA WRA ERG Jun WAT TECH SUC LAD MUGR Any Anones

- 1) Flack points 2 base materials Calanex, North (1,14)
 Aziz has material Specis Kaptan and Taflon
 Gookse seel (getting)
- 2) 1'5 in material paye FRAC Lounched at "G" masses + 779563-1 Base material bigger
- 4) Terminal passition = SPC measure housing (Spect chart) hought tominal puch and Espes x-r separation (Spec = 2 his x-r)
 Alignment (Spec = 2he que)
- s) IP Testing no problems

4

- 7) Internally Teating.

 O conductivity of Brake Cluid with NAF unter levels

 Inpropers U
 - 1 Understand conductivity of switch to ground with contaminated fluid.
 - Drake fluid moroce in switch willow saw fathers on leaf arm
- 8) On tolde Ford

 Lord Rever (within 185) hat only on ignition charlis volume

 5785 Anti Dive rear banks, nount

 lyeor

TI-NHTSA 017136

\$1200 ORT 191-TE TO SERVE SER