

EA02025

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

REQUEST 9

BOX 12

PART A - O

PART H

Epstein, Sally

From: Steve Reimers [sreimers@ford.com]
Sent: Thursday, February 18, 1999 4:36 PM
To: Rahman, Aziz
Subject: PC File(s) sent to you...

only added footer.

Steve Reimers	building 5	30043
AVT Chassis E/E System Applications	mail drop	5011
39-03286 SREIMERS sreimers@ford.com	fax 39-03286	,>

Smith, Bob

From: McGuirk, Amy [a-magu@ford.com]
Sent: Thursday, February 16, 2006 2:47 PM
To: Sullivan, Martin; Reister, Thomas; Burnham, Russ; Baker, Gary
CC: Beringhaus, Steve; Pecharis, John; Korman, Aziz; Satooh, Bob; Shupe, Robert; Douglas, Charles; Hopkins, Al
Subject: Ford service... 216 telecon Update

attorney client privileged communication

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

REVIEWED FORD'S ANALYSIS SPREADSHEET AND SWITCH BACKLOG:

SUGGESTED PRIORITY OF SWITCHES FOR ANALYSIS PER OUR INTERNAL MEETING.... DISCOVERED SEVERAL OF THE '7' DATE CODES ARE IN SOME STAGE OF DISASSEMBLY (NOT CORRODED CRIMP RINGS AS WE THOUGHT) AND FORD WILL BE UPDATED TO SHOW STATE....AGREED THAT PRIORITY SHOULD BE HIGH MILE TOWNCARS FOLLOWED BY HIGH MILE CROWN-VIC/GRAND MARQ WITH SOME LOW MILE BASELINES. ALSO AGREED TO REVIEW 'CORROSION' UNITS FIRST IF EXTERNAL CORROSION WAS VISIBLE. MADE POINT TO TRACK ABS AND TRACTION CONTROL

WE AGREED THAT THE FORD EVALUATION PROCESS WAS OKAY TO USE

REVIEWED 'SCIENCE FAIR' EXPERIMENTS RESULTS:

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

FORD REQUESTED WE ADD TESTS 12,13,14 TO BE "ES" TYPE (107 DEG C AMBIENT, 139 DEG C FLUID, PRESSURE CYCLING) INDUCTIVE TESTS OF SWITCHES WITH 'HIGH' CURRENT (AS MUCH AS WE CAN GET THRU THE INDUCTORS WITHOUT SATURATION) WITH 12 'CLEAN AND EMPTY', 13 'CLEAN BRAKE FLUID FILLED', AND 14 'CONTAMINATED BRAKE FLUID FILLED'. SEEMS LIKE THEY ARE TELLING US THAT THERE IS A 'SNEAK' CIRCUIT IN HERE SOMEPLACE THAT CAN AFFECT SWITCH ELECTRICALLY (FORD WILL SUPPLY SEVERAL SERVO MOTORS TO ACT AS LOADS).

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

STEVE BEARINGHAUSE AND I WILL REVIEW THESE FORD REQUESTS FOR RESOLUTION

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

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

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

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

KAPTON (FROM FORD)

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

UNDERSTAND BRAKE SWITCH AND KAPTON WEAROUT WITH ANOTHER FORD PLATFORM:

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

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

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

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

AUTOMOTIVE SENSORS AND CONTROLS QRA MANGER
34 FOREST ST W/S 23-05
ATTLEBORO, MA 02703
TEL : (508) 236-3080
FAX : (508) 236-3745
PAGE: (800) 487-3700 PIN 804-2044

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

TI-NHTSA 016669

attorney client privileged communication

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

Ford has concluded the Town Car underhood fire and thermal event and thermal anomaly history (my 92? and my 93?) is comprised of:

148 total events...broken down by Ford as follows

127 unknown causes

17 potential other causes

5 pressure switch causes.....or said a different way, Ford might say that P/S is the number one known cause

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

105 events status unknown

38 events with engine off

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

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

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

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

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

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

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

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

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

TI-NHTSA 016570

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

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

Robert

Subject: 2/17 Update

Main event: 2PM core team meeting. Highlights:

- Manager Len Brown agitated that Dew has not shown up yet. Will probably get them on board tomorrow or Friday.
- Exec. meeting at 4 pm Friday. TI not invited. Will present test plan (copy with Steve B.).
- Ford team in DC today at NHTSA, asking for two months for public action.
- People surprised that on-vehicle characterization has not yet occurred. Leads provided on expediting this.
- Increasing tempo on getting more parts back for analysis.
- Re-emphasized need to study warranty data more closely for trending, and special causes.
- Increasing speculation that pure heat is not sufficient to ignite. Need spark.
- Will present brake pedal position sensor to execs as possible containment.

Two tests conducted today at AVT labs:

- Passed about 54 Amps at about 1V, through switch terminals, no fluid. Temp in connector area increased to about 182 F before system went open circuit. Dissection revealed spring arm deformed and twisted away from stationary. Will have pictures tomorrow.

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

- Will set up calibration station in Central Lab tomorrow.

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

Regards
Aziz.

TI-NHTSA 016571

Summary of 130 '92MY Town Car CQIS Verbatims and Electrical Next Steps**SUMMARY**

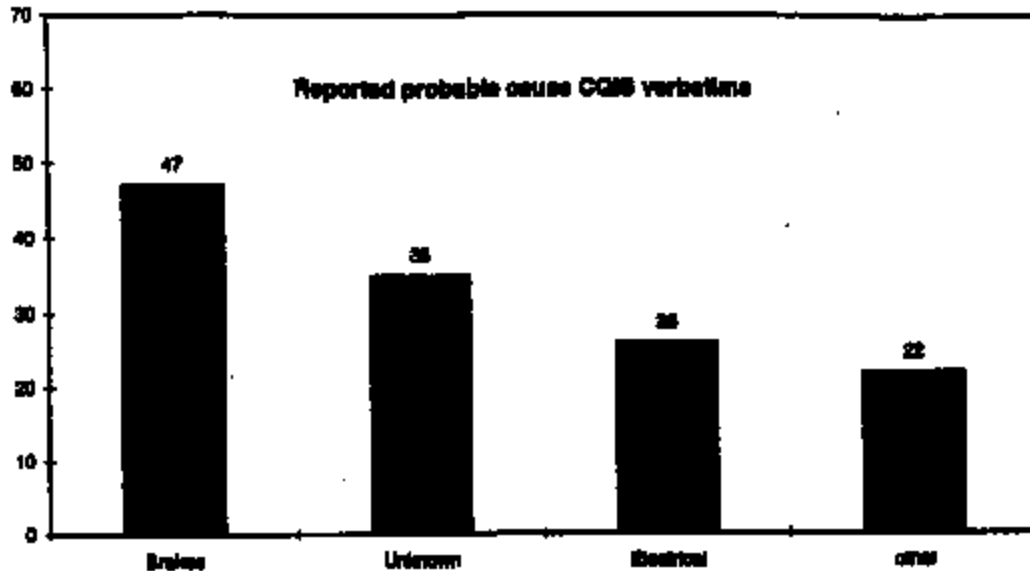
- 1.0 There are 4 main categories that the 130 CQIS verbatims can be binned to:
- (A). 38% or 47 out of 130 are reportedly brake related.
 - (B). 27% or 35 out of 130 are reportedly unknown.
 - (C). 20% or 26 out of 130 are reportedly electrical related.
 - (D). 17% or 22 out of 130 have reported probable causes relating to systems other than brakes or electrical.
- 2.0 There are 4 main categories of the 130 CQIS verbatims for vehicle locations of the reported fire.
- (A). 51% or 66 out of 130 are reported to be underhood.
 - (B). 35% or 46 out of 130 are reported to be unknown.
 - (C). 10% or 13 out of 130 are reported to be under the car.
 - (D). 4% or 5 out of 130 are reported not to be underhood.
- 3.0 There are 4 main categories of engine status for these 130 CQIS verbatims:
- (A). 35% or 50 out of 130 are reportedly engine unknown - not known whether engine was running or not.
 - (B). 35% or 46 out of 130 are reportedly engine running.
 - (C). 25% or 32 out of 130 are reportedly engine off.
 - (D). 2% or 2 out of 130 are reportedly with engine idling.

NEXT STEPS:

- 1.0 Review CV/GM CQIS verbatims for reported fire - target complete date is 2/26/1999.
- 2.0 Request FCSD to pull feature codes for the 130 related CQIS VIN's.
- 3.0 Request 12 previously burned vehicles be investigated per the electrical questions forwarded to JNeme.

1LNLM81W1PY641162	1LNLM82W7NY673408
1LNLM82W6NY790666	1LNLM81W6NY664182
1LNLM83W1NY729850	1LNLM83W7NY609557
1LNLM82W6NY748817	1LNLM82W6NY655868
1LNLM82W5NY629758	1LNLM81W6NY700851
1LNLM81W6NY723956	1LNLM82W2NY699217

92MY Town Car CQIS Pareto Analysis



Notes:

(1) Brakes account for 47 out of 130 92MY Town Car CQIS verbatims.

* Categories include these types of comments: Brake pressure switch, Brakes lock-up, brake booster hang-up, brake lines, frozen calipers, power brake unit, plastic piston caliper nails, brakes caught fire, undercut rotors, after market parts.

(2) Unknowns account for 35 out of 130 92MY Town Car CQIS verbatims.

* No probable root cause identified.

(3) Electrical accounts for 28 out of 130 92MY Town Car CQIS verbatims.

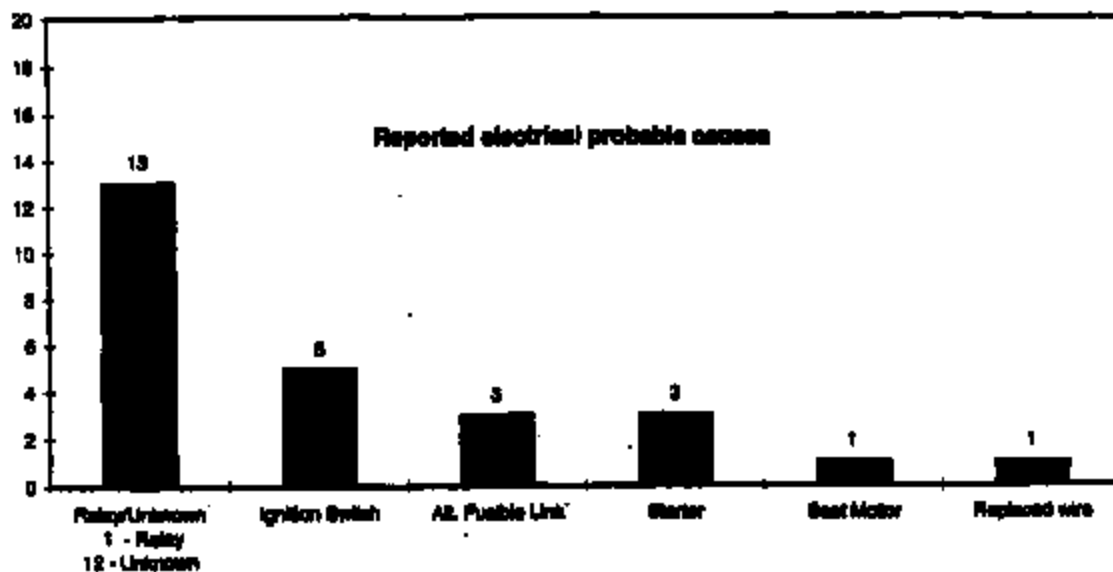
* Categories include these types of comments: 12 are reportedly an electrical issue with comments such as car shorted, possible electrical wire malfunction, electrical problem, electrical short, fire department stated electrical issue. others include suspension relay, replaced a wire, ignition switch, starter, alternator fusible link, Seat motor.

(4) Other accounts for 22 out of 130 92MY Town Car CQIS verbatims.

* Categories included are battery on top of car hood, left front of vehicle, right rear side, gas lines, engine low or no coolant, catalytic converter, dashboard, spark plug wires, A/C compressor (overheated), liquid fuel equipment.

A:chart1, by Juelati x05389, created 2/18/1999, revisions, page 1 of 1

92MY Town Car CQIS Parato Analysis



Note:

(1) Of the 13 probable electrical issues on the first bar, 12 are stated as an electrical issue without any other conclusion.

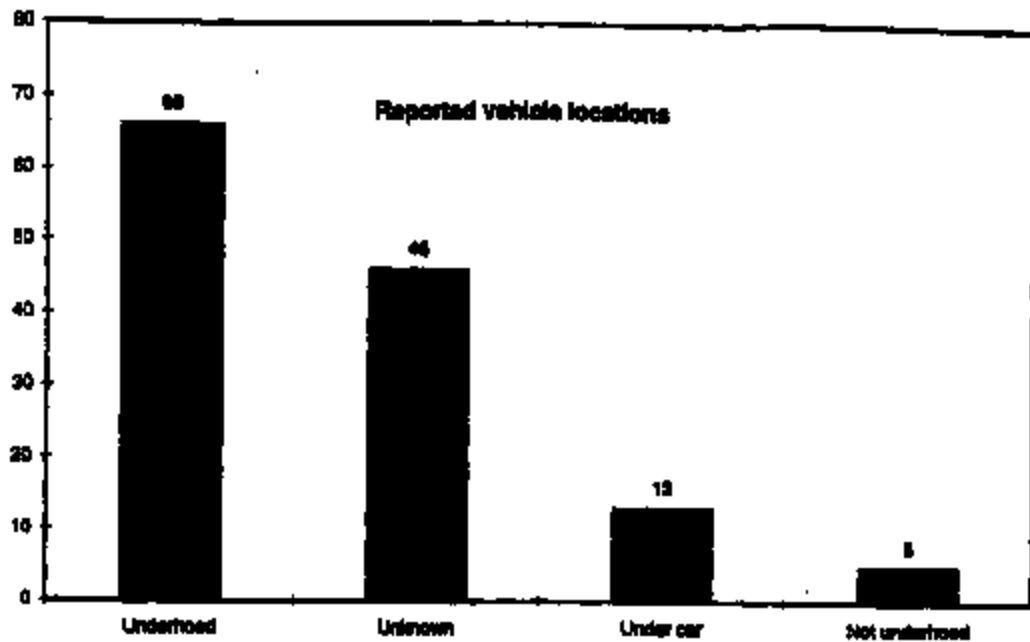
Relay/Unknown

- * 1 - Relay
- * 12 - Unknown

(2) Ignition Switch

- * 2 of the 5 Ignition switches were previous recall issues that customers did not bring in for service.
- * 3 are identified as possible Ignition switch.

92MY Town Car QGIS Parato Analysis



Notes:

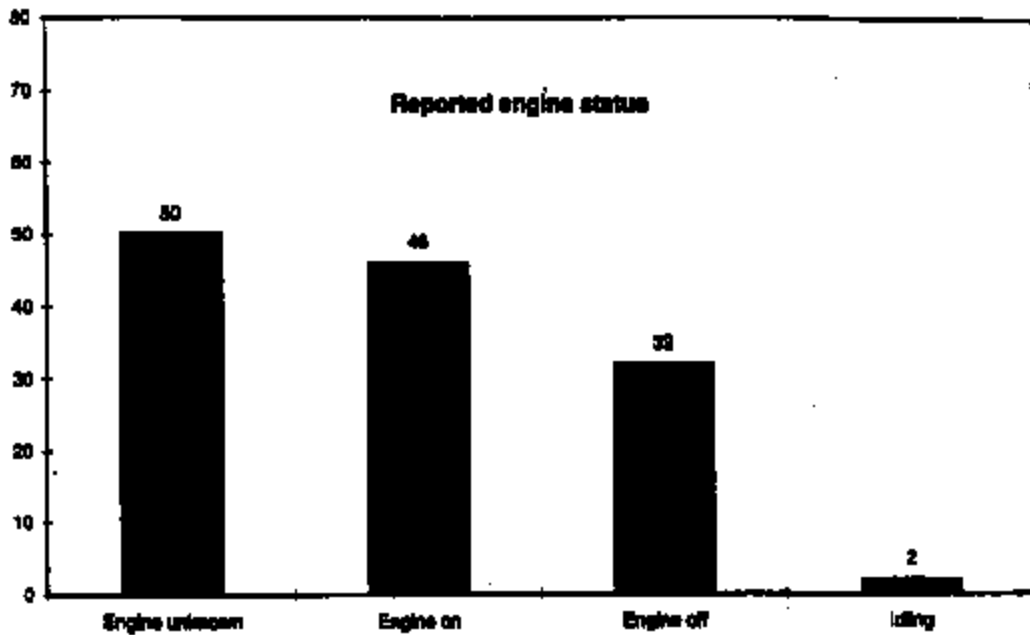
* Underhood location is broken down into the following categories as probable causes:

(1) Underhood unknown	18	Out of a total of 35
(2) Brakes related	15	Out of a total of 47
(3) Electrical related	13	Out of a total of 28
(4) Left front of vehicle	7	
(5) Engine tow/no coolant	3	
(6) Gas line	1	
(7) Battery on top of hood	1	
(8) Catalytic converter	1	
(9) A/C comp. (overheat)	1	
(10) Spark plug wires	1	
(11) Flight rear side	1	

A:\chart3, by Jkalati x05309, created 2/18/1999, revisions, page 1 of 1

TI-NHTSA 016576

82MY Town Car CQIS Pareto Analysis



Note:

* Of the reported probable causes with the engine off:

* Unknown (category 5)	12
* Electrical (category 6,7,8,9,17,21)	8
* Left Front of vehicle (category 11)	4
* Brakes (category 14,15,16)	2
* Gas lines (category 13)	2
* Right rear side (category 12)	1
* Dashboard (category 20)	1
* Spark plug wires (category 22)	1
* Liquid equipment (category 24)	1

A:\char4, by J:\afid x05386, created 2/19/1999, revisions, page 1 of 1

SECRET

Summary of 130 '88NY Town Car CCIS Verbatims and Electrical Next Steps

SUMMARY

- 1.0 There are 4 main categories that the 130 CCIS verbatims can be billed to:
 - (A). 36% or 47 out of 130 are reportedly brake related.
 - (B). 27% or 35 out of 130 are reportedly unknown.
 - (C). 20% or 26 out of 130 are reportedly electrical related.
 - (D). 17% or 22 out of 130 have reported probable causes relating to systems other than brakes or electrical.
- 2.0 There are 4 main categories of the 130 CCIS verbatims for vehicle locations of the reported tires.
 - (A). 61% or 80 out of 130 are reported to be underhood.
 - (B). 35% or 46 out of 130 are reported to be unknown.
 - (C). 10% or 13 out of 130 are reported to be under the car.
 - (D). 4% or 5 out of 130 are reported not to be underhood.
- 3.0 There are 4 main categories of engine status for these 130 CCIS verbatims:
 - (A). 38% or 50 out of 130 are reportedly engine unknown - not known whether engine was running or not.
 - (B). 35% or 46 out of 130 are reportedly engine running.
 - (C). 25% or 32 out of 130 are reportedly engine off.
 - (D). 2% or 2 out of 130 are reportedly with engine idling.

NEXT STEPS:

- 1.0 Review CVRGM CCIS verbatims for reported tires - target complete date is 2/26/1999.
- 2.0 Request FGSD to pull feature codes for the 130 related CCIS VIN's.
- 3.0 Request 12 previously burned vehicles be investigated per the electrical questions forwarded to JName.

1LNLM81W1PY641182	1LNLM82W7NY673406
1LNLM82W8NY760598	1LNLM81W8NY684182
1LNLM83W1NY720060	1LNLM83W7NY600557
1LNLM82W8NY748817	1LNLM82W8NY686088
1LNLM82W8NY620758	1LNLM81W8NY700851
1LNLM821W8NY729668	1LNLM82W2NY660217

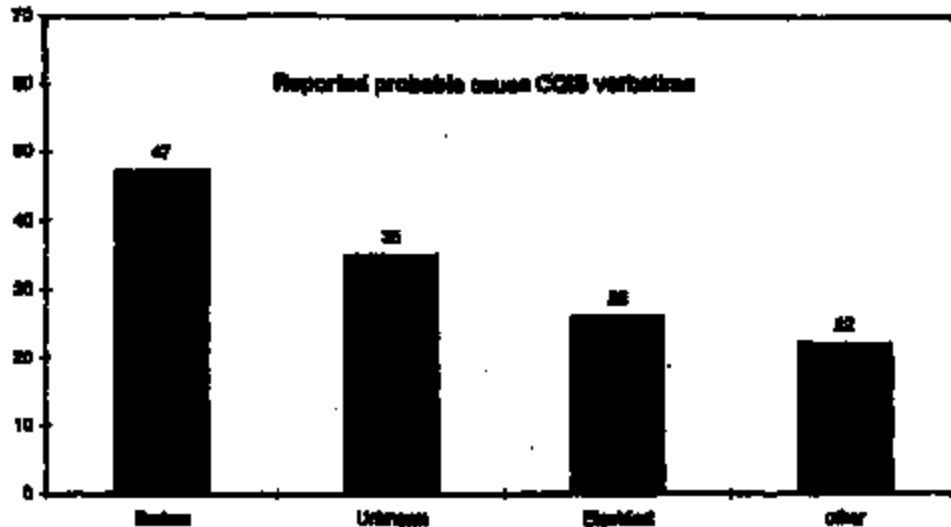
A:summary by J:afzal, 308886, created 2/19/1999, revisions, page 1 of 1.

NAVY System Cost Estimation Worksheet

Item	Quantity	Unit	Price	Total
1. Personnel				
1.1. Personnel	1	Person	10000	10000
1.2. Personnel	2	Person	20000	40000
1.3. Personnel	3	Person	30000	90000
1.4. Personnel	4	Person	40000	160000
1.5. Personnel	5	Person	50000	250000
1.6. Personnel	6	Person	60000	360000
1.7. Personnel	7	Person	70000	490000
1.8. Personnel	8	Person	80000	640000
1.9. Personnel	9	Person	90000	810000
1.10. Personnel	10	Person	100000	1000000
2. Materials				
2.1. Materials	1	Unit	1000	1000
2.2. Materials	2	Unit	2000	4000
2.3. Materials	3	Unit	3000	9000
2.4. Materials	4	Unit	4000	16000
2.5. Materials	5	Unit	5000	25000
2.6. Materials	6	Unit	6000	36000
2.7. Materials	7	Unit	7000	49000
2.8. Materials	8	Unit	8000	64000
2.9. Materials	9	Unit	9000	81000
2.10. Materials	10	Unit	10000	100000
3. Equipment				
3.1. Equipment	1	Unit	10000	10000
3.2. Equipment	2	Unit	20000	40000
3.3. Equipment	3	Unit	30000	90000
3.4. Equipment	4	Unit	40000	160000
3.5. Equipment	5	Unit	50000	250000
3.6. Equipment	6	Unit	60000	360000
3.7. Equipment	7	Unit	70000	490000
3.8. Equipment	8	Unit	80000	640000
3.9. Equipment	9	Unit	90000	810000
3.10. Equipment	10	Unit	100000	1000000
4. Software				
4.1. Software	1	Unit	10000	10000
4.2. Software	2	Unit	20000	40000
4.3. Software	3	Unit	30000	90000
4.4. Software	4	Unit	40000	160000
4.5. Software	5	Unit	50000	250000
4.6. Software	6	Unit	60000	360000
4.7. Software	7	Unit	70000	490000
4.8. Software	8	Unit	80000	640000
4.9. Software	9	Unit	90000	810000
4.10. Software	10	Unit	100000	1000000

FORM NO. 10-67 (REV. 12-15-77) USE PREVIOUS EDITIONS UNLESS SPECIFICALLY NOTED OTHERWISE

92MY Town Car QGIS Pareto Analysis



Notes:

(1) Brakes account for 47 out of 130 92MY Town Car QGIS verbatims.

* Categories include these types of comments: Brake pressure switch, Brakes lock-up, brake booster hang-up, brake lines, frozen calipers, power brake unit, plastic piston caliper melts, brakes caught fire, undersized rotors, after market parts.

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* No probable root cause identified.

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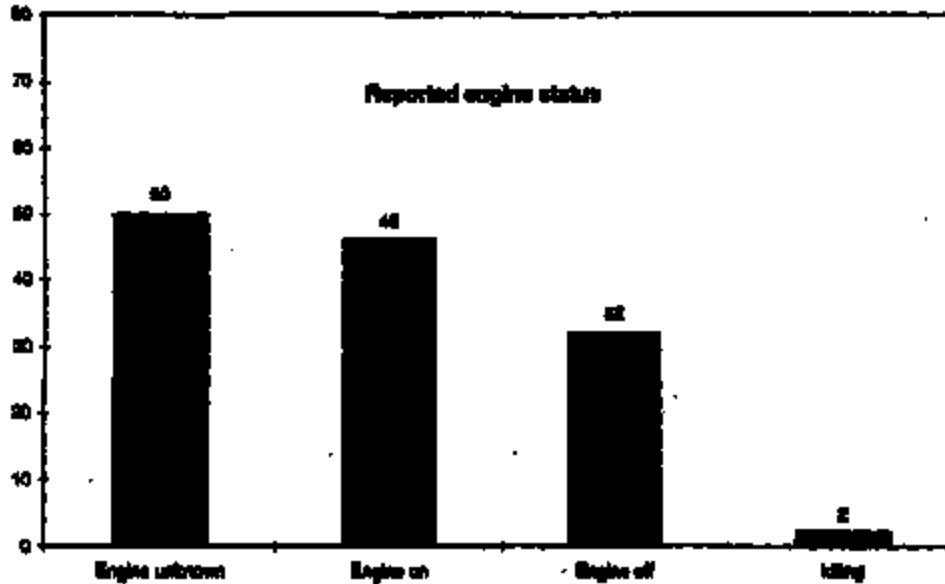
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A:\chart1, by J:\rdi 405888, created 2/13/1998, revisions, page 1 of 1

92MY Town Car CQIS Parato Analysis



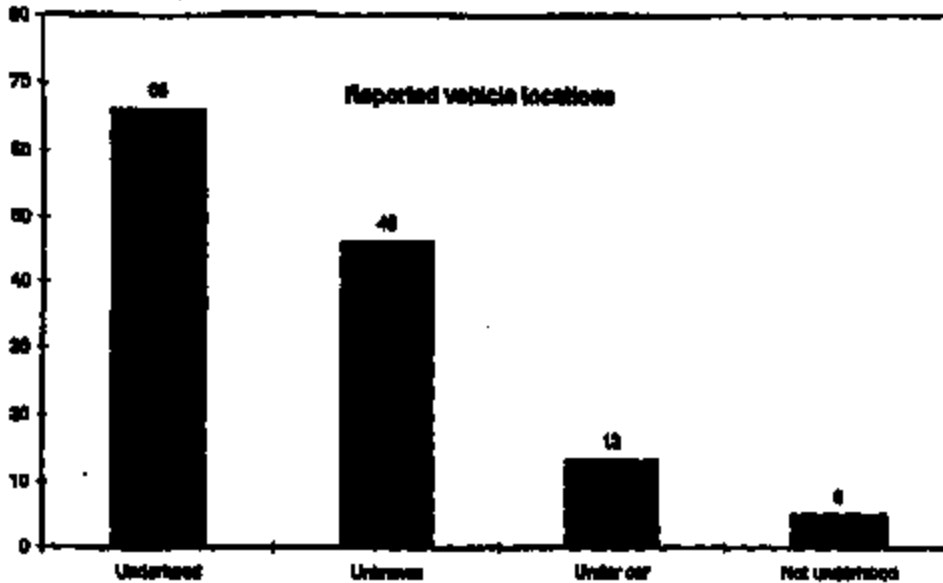
Note:

* Of the reported probable causes with the engine off:

* Unknown (category 5)	12
* Electrical (category 5,7,8,9,17,21)	8
* Left Front of vehicle (category 11)	4
* Brake (category 14,15,16)	2
* Gas lines (category 13)	2
* Right rear side (category 12)	1
* Dashboard (category 20)	1
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* Liquid equipment (category 24)	1

A:\chrt14, by J:\del\00588, created 2/15/1999, revisions, page 1 of 1

92MY Town Car CQIS Pareto Analysis



Note:

* Underhood location is broken down into the following categories as probable causes:

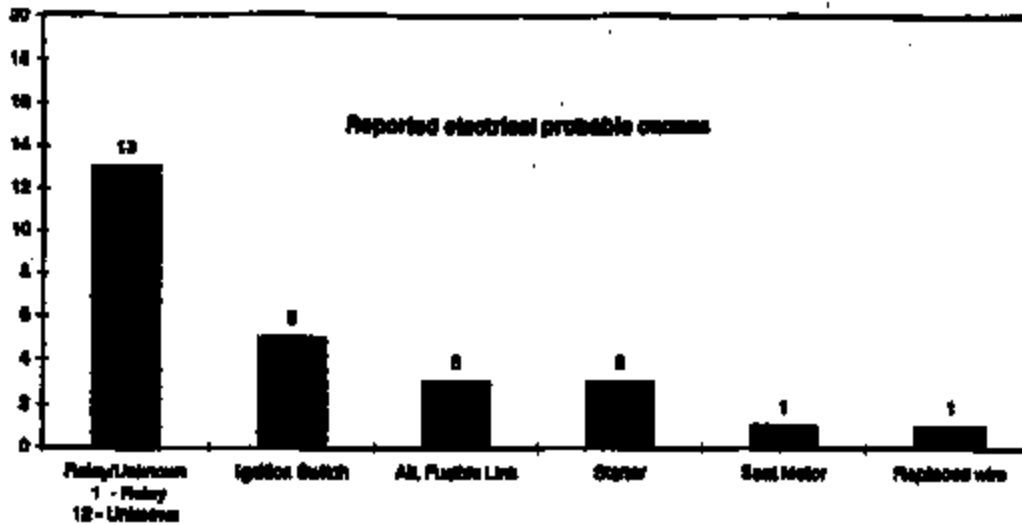
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(10) Spark plug wires	1	
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A:chart3, by J:afab x05389, created 2/18/1999, relations, page 1 of 1

FEB 22 1999 16:26 FR CHRIS B ELECTRONICS 313 398 4145 TO 91988235745 P.02/07

TI-NHTSA 016581

92MY Town Car CQIS Pareto Analysis



Note:

(1) Of the 13 probable electrical issues on the first bar, 12 are stated as an electrical issue without any other conclusion.

Relay/Unknown

- * 1 - Relay
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(2) Ignition Switch

- * 2 of the 5 ignition switches were previous recall issues that customers did not bring in for service.
- * 3 are identified as possible ignition switch.

A:chart2, by J:statal x02308, created 2/18/1998, revisions, page 1 of 1

FEB 22 '99 15:26 FR CHASSIS ELECTRONICS 313 390 4145 TO 91582235745 P. 03/87

TI-NHTSA 016582

Morris, Irene

From: McGuirk, Andy
Sent: Thursday, February 18, 1999 7:46 PM
To: Sullivan, Martha; Rowland, Thomas; Baumann, Russ; Baker, Gary
Cc: Beringhaus, Steven; Pechonis, John; Rahman, Aziz; Bartosh, Bob; Sharpe, Robert; Douglas, Charles; Hopkins, AL
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CONTINUED TO PUSH FOR THIS.... I THINK OUR PRIVATE PLAN TO GO UNDERSTAND PRESSURE IN DIFFERENT FORD SYSTEM LOCATIONS (MASTER CYLINDER UPSTREAM OF ABS AND TRACTION CONTROL IMPLICATIONS) WILL PROVE TO BE OF VALUE IN DIRECTING PLACEMENT OF SWITCH IN FUTURE AS WELL AS APPOINTING CAUSE NOW

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

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

KAPTON (FROM FORD)

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

UNDERSTAND BRAKE SWITCH AND KAPTON WEAROUT WITH ANOTHER FORD PLATFORM:

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

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

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

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

■

AUTOMOTIVE SENSORS AND CONTROLS O&A NUMBER
34 FOREST ST N/R 22-08
ATTLEBORO, MA 02703
TEL : (508) 236-1000
FAX : (508) 236-1745
PAGE: (500) 447-3700 PIN 604-2044

From: McGuirk, Andy
Sent: Thursday, February 18, 1999 8:52 AM
To: Sullivan, Martha; Rowland, Thomas; Baumann, Russ; Baker, Gary
Cc: Beringhaus, Steven; Pechonis, John; Rahman, Aziz; Bartosh, Bob
Subject: Ford overview.... 2/18 'status' Update

attorney client privileged communication

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

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

127 unknown causes

17 potential other causes

5 pressure switch causes.....or said a different way, Ford might say that P/S is the number one known cause

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

106 events status unknown

39 events with engine off

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

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

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

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

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

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

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

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

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

a

B
AUTOMOTIVE SENSORS AND CONTROLS (RA NUMBER)
34 FOREST ST N/S 23-03
ATTLEBORO, MA 02703
TEL : (508) 234-3000
FAX : (508) 234-3745
PAGE: (800) 467-3760 FIM 504-2044

From: Rahman, Aziz
Sent: Wednesday, February 17, 1999 8:16 PM
To: Beringhaus, Steven; Dague, Bryan; McGuirk, Andy; Baumann, Russ; Sharpe, Robert
Subject: 2/17 Update

Main event: 2PM core team meeting. Highlights:

- Manager Len Brown agitated that Dow has not shown up yet. Will probably get them on board tomorrow or Friday.
- Exec. meeting at 4pm Friday. TI not invited. Will present test plan (copy with Steve B.).
- Ford team in DC today at NHTSA, asking for two months for public action.
- People surprised that on-vehicle characterization has not yet occurred. Leads provided on expediting this.
- Increasing tempo on getting more parts back for analysis.
- Re-emphasized need to study warranty data more closely for trending, and special causes.
- Increasing speculation that pure heat is not sufficient to ignite. Need spark.
- Will present brake pedal position sensor to execs as possible containment.

Two tests conducted today at AVT labs:

- Passed about 54 Amps at about 1V, through switch terminals, no fluid. Temp in connector area increased to about 182 F before system went open circuit. Dissection revealed spring arm deformed and twisted away from stationary. Will have pictures tomorrow.

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

-Will set up calibration station in Central Lab tomorrow.

- Will be returning to MA Friday 2pm flight.Later flights not available because of vacation week. Per Steve

B.'s input, will plan to return next week

Regards
Aziz.

Epstein, Sally

From: McGuirk, Andy [a-mcguirk@email.mc.ti.com]
Sent: Friday, February 19, 1999 8:27 AM
To: Sullivan, Martha; Baumann, Russ; Beringhouse, Steven; Baker, Gary
Cc: Rowland, Thomas; Dague, Bryan; Pechonis, John; Rahman, Aziz; Douglas, Charles; Watt, Jim
Subject: FORD PRESSURE IN SYSTEM...CYCLES C/O (U)Pressure Tests

ATTORNEY CLIENT PRIVILEGED COMMUNICATION

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

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

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

A

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

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

GOOD INFO.

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

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

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

FROM: John Joyce
Subject: (U) Pressure Tests

USAET(UTC -05:00)

Steve,

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

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

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

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

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

MC - HCU NODE

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

HCU - PROP VALVE NODE

Standing Still - Same as MC pressure - see above.

ABS Maximum - ~110 Bar (1595 PSI)

This is achieved by loading to GVM and performing an ABS stop, you may find that you are pedal effort limited, not limited by ABS control. It's pretty rare to get this high of pressure in this mode.

TCS Maximum - ~180 Bar(2610 PSI)

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

You can achieve this easiest by getting the rear wheels off the ground

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

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

PROP VALVE - REAR BRAKE NODE

ABS Maximum Pressure -70 Bar

Load to GROSS VEHICLEWEIGHT and perform an ABS stop at maximum pedal effort.

TCS Maximum Pressure ~100 Bar

This pressure level is strongly dependent upon the pressure relief valve level - see above.

Standing Still

Same as ABS Maximum Pressure

High Frequency Content

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

High Frequency Content Due To Control

During ABS/TC events the pressure is changed in quick steps(CYCLES?).

Typically

it will increase by ~10 Bar in a few milliseconds, and this type of change occurs about every 100ms. The pressure will decrease by about 20 Bar every 300 ms. There can be quite a bit of variation in these numbers, but those are pretty typical. (Actually the numbers I assigned were for ABS, swap "increase" and "decrease" for TRACTION CONTROL activation.)

High Frequency Content Due to Shock Waves

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

The amplitude of this (Shock Waves) can be really big - I haven't looked at it in this generation unit for a few years, but I think it's about 50 Bar peak-peak (725 PSI)

right at the HCU. It will fall off as you move further away from the HCU.

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

Regards,
John Joyce

Engeln, Sally

From: Rahman, Aziz [arrahman@gmail.com, M.com]
Sent: Friday, February 19, 1999 11:34 AM
To: 'Steve Reinners (Ford)'
Cc: McGuirk, Andy; Deque, Bryan; Sharpe, Robert; Benninghaus, Steven; Baumann, Russ
Subject: Test Plan Update



Steve,

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

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

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

See you Monday AM.

<<Test Log>>

Regards
Aziz.

TI-NHTSA 018592

Brake Pressure Switch Test Log
Updated 2/18/99

Category	Test	Location	Test Parameters	Results Update
Lab Simulation	1	TI	Various Levels of Brake Fluid, Water, Deaerated 14Mk in eye involved, inport grounded	150+ hours, 5mA draw has reduced to 0.5mA. Fluid has discolored
of Potential Issues in Switch	2	TI	Various Levels of Brake Fluid, Water, Deaerated 1 Amp through switch terminals	150+ hours. Constant temperature No significant temperature rise with time
	3	AVT	Brake Fluid in Switch, 24 VDC to one terminal Inport Grounded	> 200 hours into test, resp current 7mA No significant change with time
	4	AVT	Brake Fluid in Switch, 24 VDC to one terminal Inport Grounded, Ambient at 100 C	15 hours into test resp current 5mA No significant temperature rise with time
	5	AVT	Brake Fluid in Switch, 16 Amps Through switch terminals	Temperature rise of 20 C above room temp Delta T reached steady state at 20 C
	6	TI	Steel Insulator element into Switch. No Fluid Heat of failure	2 failed. Struck observed, no ignition. A sparking device will be added as testing continues.
Life Cycle Reliability of Pressure Switch	7	TI	0-1400 psi pressure pulses at 150C ambient per EB	First leak observed at 720,000 cycles. Cycle count at 800,000. Corrosion to failure.
Changeover Motor	8	TI	0-1400 psi pressure pulses of 150C ambient	Parts withdrawn every 200k cycles, characterized for wear
Field vs Lab Correlation	9	Central Lab	Various Fluid mixtures, from driver jets, Juddparts	Parts in Central Lab, being processed
Analysis of Experimental Corrosion Products	10	TI	Various Levels of Brake Fluid, Water, Under EB conditions, to failure	Equipment sensitive underway. Blast expanded 204
Changeover Motor				
On Vehicle Characterization of Pressure & Temperature	11	AVT	Monitor Pressure and Temperature at Switch Location for ABS and non-ABS testing month.	Analysis being worked out.

1.5 Ohm Nichrome Wire

Epstein, Sally

From: Steve Reimers [sreimers@ford.com]
Sent: Friday, February 19, 1999 11:38 AM
To: jname@ford.com; sjarouch@ford.com; Frederick J. Porte; ranglis1@ford.com; sseiler@ford.com; nlapointe@ford.com; tmeesters@ford.com; kafar@ford.com; Steve Reimers; techrody@visteon.com; Fred Kohl; tbezz@ford.com; jmcinerm@ford.com; dbudzyna@visteon.com; petokse@visteon.com; dgoel@ford.com; lbrown@ford.com; scolet@ford.com; hwelfer3@ford.com; geteven1@ford.com; wabramcz@ford.com; mraese@ford.com; Rahman, Aziz; Sharpa, Robert
Subject: DOW Rep Meeting

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

Requester: Steve Reimers
Date to be scheduled: 02/23/99
Starting time: 09:00 AM
Ending time: 11:00 AM

Location: bldg 5 3A017

Purpose: Discuss with DOW the brake pressure switch.
Attend Only if interested in materials questions?

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

System, Sally

From: Rahman, Aziz [azrahman@msd.ford.com]
Sent: Friday, February 19, 1999 7:58 AM
To: McQuirk, Andy; Barnghaven, Steven; DeGus, Bryant; Baumann, Russ; Sharpe, Robert; Baker, Gary; Douglas, Charles
Subject: FW: (U)Pressure Tests

GOOD INFO.

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

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

Steve Reimers building 5 3C043
AVT Chassis E/E System Applications mail drop 5011
39-03286 SREIMERS sreimers@ford.com fax 39-03286 ;>
*** Forwarding note from JJJOYCE1 --DRB007 02/18/99 19:40 ***
To: SREIMERS--DRB007
cc: FPORTER --DRB007

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

Steve,

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

The more I think about this, the more I think TC activation may be the
mechanism.

I am not sure of the order of the things connected and that can influence
the low frequency amplitude of the signals. But the short answer is to
instrument for 0-250 Bar and sample at 1 kHz or more.

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

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

MC - HCU NODE

Maximum Pressure - -175 Bar

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

HCU - PROP VALVE NODE

Standing Still - Same as MC pressure - see above.

ABS Maximum - -110 Bar

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

TI-NHTSA 016585

TCS Maximum - 180 Bar

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

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

Typical drivers can regularly get high pressures in this mode.

PROP VALVE - REAR BRAKE NODE

ABS Maximum Pressure ~70 Bar

Load to GVW and perform an ABS stop at maximum pedal effort.

TCS Maximum Pressure ~100 Bar

This pressure level is strongly dependent upon the pressure relief valve level - see above.

Standing Still

Same as ABS Maximum Pressure

High Frequency Content

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

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

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

Regards,
John Joyce

Epstein, Sally

From: Steve Reimers [sreimers@ford.com]
Sent: Friday, February 18, 1999 7:13 AM
To: Rahman, Aziz
Subject: (U)Pressure Tests

Eyi... I gave him a copy of your test plan and asked what pressure range and frequency we should instrument for.

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

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

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MC - HCU NODE

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

HCU - PROP VALVE NODE

Standing Still - Same as MC pressure - see above.

ABS Maximum - ~110 Bar

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

TCS Maximum - ~180 Bar

This is a good candidate. On this vehicle because the HCU had to pump through the prop valve to do the brakes-only traction control, the pressures coming out of the HCU got very high. The pressure relief valve on the pump

VERY OFTEN dictated the peak pressure which could be developed - not the control - put another way, because the pressure at the rear brake had to restrain the entire powertrain (no engine intervention) and push through a prop valve, it was often possible to drive through the TC - the engine could overpower the brakes, even though very high pressures were being generated at the HCU. The noise during TC activation in these applications was very dependent upon the pressure relief valve opening point. So the pressure relief valve value got changed a few times over the years as performance was sacrificed for NVH. Also the tolerance on the pressure relief valves was fairly large - a total of 40 bar, at that time I believe. The pressure relief valve pressure might be anywhere from 90 to 130 bar depending on part-to-part variation and the design generation that was agreed upon.

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Typical drivers can regularly get high pressures in this mode.

PROP VALVE - REAR BRAKE NODE

ABS Maximum Pressure ~70 Bar

Load to GVW and perform an ABS stop at maximum pedal effort.

TCS Maximum Pressure ~100 Bar

This pressure level is strongly dependent upon the pressure relief valve level - see above.

Standing Still

Same as ABS Maximum Pressure

High Frequency Content

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

High Frequency Content Due To Control

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

High Frequency Content Due to Shock Waves

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

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Regards,
John Joyce

Epstein, Sally

From: McGuirk, Andy [a-mcguirk@email.mc.ti.com]
Sent: Friday, February 19, 1999 4:21 PM
To: Sullivan, Martha; Baumann, Russ; Beringhaus, Steven; Baker, Gary
Cc: Rowland, Thomas; Dague, Bryan; Pechonis, John; Rahman, Aziz; Douglas, Charles; Watt, Jim; Sharpe, Robert
Subject: FORD CONF CALL OF 2/19

ATTORNEY CLIENT PRIVILEGED COMMUNICATION

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

SUMMARY:

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

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

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

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

ATTORNEY CLIENT PRIVILEGED COMMUNICATION

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

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A

1

TI-NHTSA 018602

AUTOMOTIVE SENSORS AND CONTROLS QRA MANGER
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TEL : (508) 236-3080
FAX : (508) 236-3743
PAGE: (800) 467-3700 PIN 604-2044

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

GOOD INFO.

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

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equency we should instrument for.

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

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

Steve,

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

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activation may be the
mechanism (? CYCLES AND LINE PRESSURES).

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

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

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

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

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

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

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

You can achieve this easiest by getting the rear wheels off the
ground and putting the car in drive. Get into the throttle hard, but not
so hard that you drive out of first gear or faster than ~15 mph. If you
maintain this for a while, the thermal model to protect the rear linings will

disable the Traction Control. You will then need to wait for them to cool, before the function will be reenabled. You can dramatically accelerate the cooling time by cruising (without braking) at about 40 mph.

Typical drivers can regularly get high pressures (2510 PSI) in this mode.

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

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

Standing Still
Same as ABS Maximum Pressure

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

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

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

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

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

at ~1kHz.

Regards,
John Joyce

TI-NHTSA 016606

Morris, Irene

From: McGuirk, Andy
Sent: Friday, February 19, 1999 8:21 PM
To: Sullivan, Martha; Baumann, Russ; Beringhouse, Steven; Baker, Gary
Cc: Rowland, Thomas; Dague, Bryan; Pechonis, John; Rahman, Aziz; Douglas, Charles; Watt, Jim; Sharpe, Robert
Subject: FORD CONF CALL OF 2/19

ATTORNEY CLIENT PRIVILEGED COMMUNICATION

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

SUMMARY:

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

WE COVERED A NUMBER OF POINTS IN SOME 60 MINUTES OF TELECON:

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AUTOMOTIVE SENSORS AND CONTROLS OEA MARKER
34 FOREST ST N/S 23-05
ATTLEBORO, MA 02703
TEL : (508) 226-3080
FAX : (508) 226-3748
PAGE: (800) 487-3700 P2M 804-2044

From: McGuirk, Andy
Sent: Friday, February 19, 1998 10:27 AM
To: Sullivan, Martha; Baumann, Russ; Springhouse, Steven; Baker, Gary
Cc: Rowland, Thomas; Dagus, Bryan; Pechonis, John; Rahman, Aziz; Douglas, Charles; Watt, Jim
Subject: FORD PRESSURE IN SYSTEM....CYCLES C/O (U)Pressure Tests

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14 PORTER ST N/E 23-45
ATLASSBORO, MA 02703
TEL : (508) 234-2080
FAX : (508) 234-3748
PAGE: (800) 457-3700 PIN 604-2044

From: Rahman, Aziz
Sent: Friday, February 18, 1999 8:57 AM
To: McGuirk, Andy; Beringhouse, Steven; Dague, Bryan; Baumann, Russ; Sherpe, Robert; Bakar, Gary; Douglas, Charles
Subject: FW: (U)Pressure Tests

GOOD INFO.

From: Steve Reimers(SMTP:sreimers@ford.com)
Sent: Friday, February 18, 1999 8:13 AM
To: Aziz Rahman, Texas
Subject: (U)Pressure Tests

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

Steve Reimers building 5 3C043
AVT Chassis E/Z System Applications mail drop 5011
39-03286 SREIMERS sreimers@ford.com fax 39-03286 ;>
*** Forwarding note from JJOYCE1 --DREN007 02/18/99 19:40 ***
To: SREIMERS--DREN007
cc: FPORTER --DREN007

FROM: John Joyce
Subject: (U)Pressure Tests

USART(UTC -05:00)

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

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

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

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

MC - HCU MODE
Maximum Pressure - -175 Bar (1 BAR IS 14.5 PSI, 2537 PSI)

Page 3

TI-NHTSA 018609

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

ECU - PROP VALVE NODE

Standing Still - Same as MC pressure - see above.

ABS Maximum - -110 Bar (1595 PSI)

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

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

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Morris, Irene

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Cc: Rowland, Thomas; Dague, Bryan; Pechonis, John; Rahman, Aziz; Douglas, Charles; Watt, Jim
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34 FOREST ST N/S 23-05
ATTLEBORO, MA 01703
TEL : (508) 236-3080
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in this mode.

PROP VALVE - REAR BRAKE NODE

ABS Maximum Pressure ~70 Bar

Load to GROSS VEHICLEWEIGHT and perform an ABS stop at maximum pedal effort.

TCS Maximum Pressure ~100 Bar

This pressure level is strongly dependent upon the pressure relief valve level - see above.

standing Still

Same as ABS Maximum Pressure

High Frequency Content

The high frequency content has two parts. If you are **DOT** in ABS or Traction Control there is practically no high frequency content - the pressure is modulated at <10 Hz. This is basically limited by Booster response times and hydraulic dampening in the ABS orifices.

High Frequency Content Due To Control

During ABS/TC events the pressure is changed in quick steps(CYCLES?).

Typically

it will increase by ~10 Bar in a few milliseconds, and this type of change occurs about every 100ms. The pressure will decrease by about 20 Bar every 300 ms. There can be quite a bit of variation in these numbers, but those are pretty typical. (Actually the numbers I assigned were for ABS, swap "increase" and "decrease" for TRACTION CONTROL activation.)

High Frequency Content Due to Shock Waves

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

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

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

Regards,

John Joyce

2/19/99

w/ Steve Reimers

* Ask about F2VC, F2AC
CY92 Date Codes

ship clutches to Gerry Terino

Excellent choice

like the fact DOC includes both snap and quiet

Very interested in when we ^{start} using the quiet
impact looking/concerned in the field

Flashed Matrix (reviewed major tests)

All good tests (next Thursday / Friday)

few mentions on Crown Vic / Grand Marq (Focus on
Town Car

+
Pressure Switch others not looked out

Steve / Charlie

Russ
Charlie

Attorney opinions
to Russ Client Privileged

3/17/99

Team Review @ Ford

switch Test Log Rev. (1-11)

Brake Fluid Flash point 312°F (spark) = 150°C
auto ignition 606°F

Any '92, '93 vehicles checked for actual pressure levels @ switch?
(Planning co evaluate - Ford)

Several master cylinder (considerable) failures on '92, '93 caused
brake lock/fires. Justify looking @ '92-'93 vehicle evaluation

• Do not assume 15 Amp fuse protection as "best" (best "S").
This best will be increased with power.
Joe Nemi → look at "spark" input

May want to look for any "transient" load dump (similar to
capacitive discharge)

Used to determine if this is a "durability" event vs a "single"
event (Tom Masters collecting all data). June, next year → "EOL"
reports

Brake/speed control system changed in '96

Any '92-'95 Town Car, Crown Vic, Grand Marq will be looked at (Sun Fire
incident)

Pressure trace (if not from Texas) ask John Joyce

Told NHTSA today that we will (Ford) take field action within 2 months

Common to see reliability issues begin in specific region (hot,
cold, salt area).

Tom Boril → Marby Reese 7-7142 mrese@ford.com

Friday mtg. (have profile - pressure from '92, containment, Dow interface,
possibilities)

2/10/99
4^{PM}-5:15^{PM} Brainstorm w/Car

- Get Dow on TEAM

~~ASK~~ ASK THEM HOW FIRE STARTS
WITHIN CONSTRAINTS [14V, Black Substance,
15 AMP MAX CURRENT, VEH. TEMPERATURES.]

- Char's REAL VEH Brake Pressure.

- " " " " " " IN ABS/TC
EVENT.

- Thermo-couple Brk Pr switch after
veh. Driven & turned off.

- Take Rate of ABS

" " " " ABS w/TC

- Are Leaks/Fires common to ~~traction~~ traction assist.

- Black Substance: Copper, Zinc, Silver, Sulfur,
Brake Fluid.

- Understand TC/ABS Pressure Pulse/

HISTORY OF ELECTROLYSIS IN Brake Fluid.

Epstein, Sally

From: Sharpe, Robert [rsharpe@gmail.mc.f.com]
Sent: Monday, February 22, 1999 7:18 AM
To: Douglas, Charles
Cc: McGuirk, Andy; Rahman, Aziz
Subject: Brake Pressure Switch History

Hi Charlie,

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

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

Best Regards,

Rob Sharpe
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