EA02-025

TEXAS INSTRUMENTS, INC.'S

9/10/03

REQUEST NO. 7

BOX 9

PART A – R

PART D

Epstein, Sally

From: Proia, Stephen [s-proia@email.mc.ti.com]
Sent: Thursday, May 20, 1999 1:49 PM
To: Beringhause, Steven; Dague, Bryan; McGuirk, Andy
Cc: Pachonis, John
Subject: FW: L2-1 Yields

77PSL2-1 Yields_1992.xls

Steve,

Here is the '92 yield data you requested. Please review and get back to me with any questions. I have a meeting at 3:00 PM and should be back around 4:00.

Thanks.

STeve

From: Balthazar, Claire
Sent: Thursday, May 20, 1999 2:16 PM
To: Proia, Stephen
Subject: L2-1 Yields

Steve,

Here are the numbers for 1992. I saw no evidence of any major leak problems. If you look at the lot reports, you will see some failures in the leak category. If this number is divisible by 4 (if 1 leaks the tester aborts the test and calls them all bad) it usually means that a set of nests went through empty or there was a bad seal between the device and the machine. The devices would then be rerun separately one by one with other devices to identify the leaker if there was one. Kind of a process of elimination. The leak quantity on the lot report should be manually adjusted by the operator.

That is what should be happening but I can't guarantee it and it is probably not written anywhere on the specs.

<<77PSL2-1 Yields_1992.xls>>

Summary sheet is at the beginning.

Claire

77PSL2-1 Yields for 1992

Date	Tested	Good	%
January-92	14341	14209	99.1%
February-92	10569	10467	99.0%
March-92	28771	27990	97.3%
April-92	15827	15478	97.8%
May-92	12016	11136	92.7%
June-92	23443	23133	98.7%
July-92	11836	11673	98.6%
August-92	18536	18253	98.5%
September-92	11683	11562	99.0%
October-92	3836	3827	99.7%
November-92	0	0	0.0%
December-92	15939	15481	97.1%
Total	163479	149810	97.7%

Date	Tested	Good	%	Failure Modes		
January-92						
1/8	808	799	98.9%			
1/13	1208	1206	99.8%			
1/14	50	50	100.0%			
1/18	1746	1741	99.6%			
1/19	786	734	93.4%	cont 10	accr 20	rlcr 22
1/25	52	52	100.0%			
1/19	31	31	100.0%			
1/14	44	44	100.0%			
1/18	49	49	100.0%			
1/14	48	48	100.0%			
1/8	52	51	98.1%			
1/8	52	48	92.3%			
1/14	52	51	98.1%			
1/14	52	52	100.0%			
1/25	60	60	100.0%			
1/14	64	64	100.0%			
1/14	212	209	98.6%			
1/25	236	234	99.2%			
1/14	264	264	100.0%			
1/8	304	299	98.4%			
1/13	376	375	99.7%			
1/14	396	396	100.0%			
1/13	501	499	99.6%			
1/25	716	711	99.3%			
1/25	664	664	100.0%			
1/25	958	955	99.7%			
1/14	1096	1092	99.6%			
1/8	1308	1278	97.7%			
1/15	1916	1914	99.9%			
Total	14341	14209	99.1%			

Date	Tested	Good	%	Failure Modes				
February-02								
2/1	52	52	100.0%					
2/1	671	668	99.6%					
2/1	248	248	100.0%					
2/1	466	464	99.6%					
2/1	444	442	99.5%					
2/1	316	316	100.0%					
2/1	184	183	99.5%					
2/1	48	48	100.0%					
2/1	1364	1362	99.9%					
2/4	1248	1199	96.1%	cont 6	accr 3	achi 35	rlhl 1	rlcr 3
2/4	156	151	96.8%					
2/4	906	905	99.9%					
2/4	516	515	99.8%					
2/23	1429	1429	100.0%					
2/17	219	219	100.0%					
2/25	630	625	99.4%					
2/25	160	155	96.9%					
2/25	1088	1066	98.0%					
2/25	212	206	97.2%					
Total	10659	10487	98.4%					

Date	Tested	Good	%	Failure Modes				
March-92								
3/1	49	48	98.0%					
3/2	420	413	98.3%					
3/3	328	325	99.1%					
3/8	916	905	98.8%					
3/10	384	324	84.4%	schl 58	rlo 1			
3/10	872	748	85.8%	schl 145	dfhl 3			
3/11	292	291						
3/11	692	691						
3/11	256	255						
3/11	198	196						
3/11	426	425						
3/16	716	715	99.9%					
3/16	286	282	98.6%					
3/22	48	48						
3/22	148	147						
3/22	200	199						
3/22	616	612						
3/22	1400	1393						
3/23	576	573	99.5%					
3/23	140	139	99.3%					
3/23	1564	1556	99.5%					
3/23	220	218	99.1%					
3/23	759	745	98.2%					
3/23	292	286	97.9%					
3/24	304	303	99.7%					
3/24	532	523	98.3%					
3/26	1220	1213						
3/29	50	50	100.0%					
3/29	392	390	99.5%					
3/29	1376	1364	99.1%					
3/29	564	559	99.1%					
3/11	1911	1879	98.3%					
3/8	408	407	99.8%					
3/16	1380	1366	99.0%					
3/16	412	410	99.5%					
3/18	280	277	98.9%					
3/18	1724	1720	99.8%					
3/19	360	360	100.0%					
3/19	1032	1026	99.6%					
3/19	244	205	84.0%	schl 37	rfhl 1	rlcr 1		
3/19	338	333	99.1%					
3/31	486	485	99.8%					
3/31	1975	1952	98.8%					
3/31	331	276	83.4%	schl 55				
3/31	1351	1129	83.6%	schl 220	cont 1	rlcr 1		
3/31	60	25	41.7%	cont 4	schl 7	rlo 1	rlcr 7	dfhl 11
3/31	276	223	80.8%	cont 8	schl 45			
Total	28771	27880	97.3%					

TI-NHTSA 013637

Date	Tested	Good	%	Failure Modes		
April-02						
4/29	116	116	100.0%			
4/1	1440	1433	99.5%			
4/1	466	466	100.0%			
4/20	419	366	87.6%			
4/20	368	333	90.5%	achl 35		
4/12	1275	1267	99.3%			
4/13	788	784	99.5%			
4/13	124	124	100.0%			
4/13	352	346	98.3%			
4/14	1000	884	88.4%	achl 114	ecor 1	rlcr 1
4/21	396	393	99.2%			
4/21	212	211	99.5%			
4/21	548	547	99.8%			
4/21	28	26	92.9%			
4/21	1296	1287	99.3%			
4/21	360	355	98.6%			
4/21	212	207	97.6%			
4/21	400	400	100.0%			
4/21	548	543	99.1%			
4/27	496	493	99.4%			
4/27	212	212	100.0%			
4/27	1432	1397	97.6%			
4/27	212	211	99.5%			
4/27	388	382	98.5%			
4/27	664	654	98.5%			
4/27	360	358	99.4%			
4/29	296	293	99.0%			
4/29	792	775	97.9%			
4/29	384	376	97.9%			
Total	18827	18476	97.8%			

Date	Tested	Good	%	Failure Modes				
May-92								
5/5	419	381	90.9%	cont 3	scor 1	schl 1	rlcr 29	
5/6	1426	1260	88.4%	cont 3	scor 1	scic 1	schl 14	rlcr 147
5/11	1128	1016	90.1%	scor 5	schl 2	rlcr 105		
5/11	200	183	91.5%	schl 1	rlcr 16			
5/11	247	211	85.4%	schl 4	rlcr 21			
5/11	61	51	83.6%	schl 1	rlcr 7			
5/11	185	159	85.9%	schl 3	rlcr 21	cont 2		
5/11	50	48	96.0%					
5/12	486	416	85.6%	schl 53	rlcr 17			
5/12	136	126	92.6%					
5/14	564	552	97.9%					
5/14	348	320	92.0%					
5/25	1299	1239	95.4%					
5/25	336	271	80.7%	schl 17	rlcr 48			
5/25	1836	1618	88.1%	cont 1	scor 1	schl 18	rlcr 198	
5/26	132	132	100.0%					
5/26	162	162	100.0%					
5/26	1119	1117	99.8%					
5/26	702	700	99.7%					
5/26	904	901	99.7%					
5/26	104	102	98.1%					
5/26	60	60	100.0%					
5/26	124	123	99.2%					
Total	12028	11148	92.7%					

Date	Tested	Good	%	Failure Modes
June-02				
6/1	369	360	97.6%	
6/1	406	404	99.5%	
6/1	271	255	94.1%	
6/1	1394	1391	99.8%	
6/2	1028	1024	99.6%	
6/2	960	959	99.9%	
6/2	1563	1563	100.0%	
6/2	196	195	99.5%	
6/2	200	197	98.5%	
6/6	946	944	99.8%	
6/11	379	378	99.7%	
6/11	391	390	99.7%	
6/11	196	195	99.5%	
6/11	976	763	78.2%	
6/11	1278	1273	99.6%	
6/11	408	407	99.8%	
6/11	979	974	99.5%	
6/11	580	578	99.7%	
6/12	170	170	100.0%	
6/12	1044	1043	99.9%	
6/12	183	183	100.0%	
6/12	134	134	100.0%	
6/12	783	781	99.7%	
6/12	183	182	99.5%	
6/12	1262	1266	100.3%	
6/12	240	238	99.2%	
6/12	336	336	100.0%	
6/12	313	313	100.0%	
6/12	317	317	100.0%	
6/12	240	238	99.2%	
6/12	192	186	97.0%	
6/14	1436	1433	99.8%	
6/23	174	174	100.0%	
6/23	662	658	99.4%	
6/23	501	497	99.2%	
6/29	1198	1188	99.2%	
6/29	1128	1116	98.9%	
6/29	144	142	98.6%	
6/29	299	297	99.3%	
Total	23443	23138	98.7%	

TI-NHTSA 013640

Date	Tested	Good	%	Failure Modes
July-02				
7/26	640	631	98.6%	
	196	194	99.0%	
	1132	1119	98.9%	
7/8	815	779	95.6%	
7/15	367	365	99.4%	
7/14	698	685	98.4%	
	424	421	99.3%	
	692	686	99.0%	
	399	382	95.7%	
7/26	1360	1338	98.4%	
7/26	592	585	98.8%	
7/20	799	791	99.0%	
7/30	367	363	98.9%	
7/21	178	178	100.0%	
	204	204	100.0%	
	396	393	99.2%	
7/19	636	632	99.4%	
7/12	750	748	99.7%	
	1204	1192	99.0%	
Total	11838	11673	98.6%	

TI-NHTSA 013841

Date	Tested	Good	%	Failure Modes
August-92				
8/9	1976	1934	97.9%	
8/9	948	944	99.6%	
8/9	520	518	99.6%	
8/9	620	616	99.5%	
8/9	388	388	100.0%	
8/10	1976	1972	99.8%	
8/12	1327	1300	98.0%	
8/13	508	505	99.4%	
8/15	560	555	99.1%	
8/16	208	208	100.0%	
8/16	152	152	100.0%	
8/19	304	300	98.7%	
8/19	60	59	98.3%	
8/19	967	954	98.7%	
8/19	610	588	96.4%	
8/19	52	51	98.1%	
8/24	976	873	89.4%	
8/24	56	56	100.0%	
8/24	982	961	97.9%	
8/24	62	62	100.0%	
8/24	265	261	98.5%	
8/25	960	944	98.3%	
8/25	1782	1768	99.6%	
8/31	2066	2063	99.9%	
Total	[illegible]	[illegible]	[illegible]	

Date	Tested	Good	%	Failure Modes			
Sep-92							
9/2	1144	1143	99.9%				
9/2	220	219	99.5%				
9/2	576	569	98.8%				
9/3	636	635	99.9%				
9/3	1081	1076	99.5%				
9/7	2069	2061	99.6%				
9/8	1629	1615	99.2%				
9/8	1092	1023	93.7%	achl 68	cont 1	ecor 1	edc 1
9/8	48	47					
9/8	216	203		achl 13			
9/15	960	960	100.0%				
9/15	208	208	100.0%				
9/15	620	619	99.9%				
9/15	84	84	100.0%				
9/15	306	306	100.0%				
9/15	192	192	100.0%				
Total	11683	11582	99.0%				

Date	Tested	Good	%	Failure Modes
Oct-92				
10/1	1408	1403	99.6%	
10/19	232	231	99.6%	
	236	236	100.0%	
	266	266	100.0%	
	1252	1250	99.8%	
10/2	266	265	99.6%	
	179	179	100.0%	
Total	3838	3827	99.7%	

Date	Tested	Good	%	Failure Modes
Nov-02				
No reports				
Total	0	0		

Date	Tested	Good	%	Failure Modes	
Dec-92					
12/10	19	19	100.0%		
	220	211	95.9%		
	1665	1491	89.5%	cont 6	schf 168
	50	46	92.0%		
12/16	1044	1042	99.8%		
	708	707	99.9%		
	1084	1082	99.8%		
	1028	1027	99.9%		
12/10	409	371	90.7%	cont 1	schf 37
	50	50	100.0%		
	1376	1256	91.3%	cont 7	schl 113
12/15	540	540	100.0%		
	424	423	99.8%		
	524	522	99.6%		
	60	60	100.0%		
	932	930	99.8%		
	476	476	100.0%		
	228	228	100.0%		
	72	72	100.0%		
	50	50	100.0%		
	252	251	99.6%		
	632	632	100.0%		
	640	640	100.0%		
12/16	1500	1499	99.9%		
	260	260	100.0%		
	436	436	100.0%		
	179	179	100.0%		
12/3	50	44	88.0%	rlcr 6	
	719	645	89.7%	cont 2	rlcr 72
Total	18939	18451	97.1%		

Prola, Stephen

From: Balthazar, Claire
Sent: Thursday, May 20, 1999 2:16 PM
To: Prola, Stephen
Subject: L2-1 Yields

Steve,

Here are the numbers for 1992. I saw no evidence of any major leak problems. If you look at the lot reports, you will see some failures in the leak category. If this number is divisible by 4 (if 1 leaks the tester aborts the test and calls them all bad) it usually means that a set of nests went through empty or there was a bad seal between the device and the machine. The devices would then be rerun seperately one by one with other devices to identify the leaker if there was one. Kind of a process of elimination. The leak quantity on the lot report should be manually adjusted by the operator.

That is what should be happening but I can't guarantee it and it is probably not written anywhere on the specs.

77PSL2-1 Yields_1992.xls

Summary sheet is at the beginning.

Claire

* YIELD DATA IS BASED ON (2) BOXES OF LOT REPORTS FROM '91-92 PERIOD. COPIES HAVE NOT BEEN MADE FROM THESE BOXES UNTIL REQUESTED TO DO SO,

TI-NHTSA 013647

TEXAS INSTRUMENTS

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

Function Test Pareto Categories

Test Acronym	Definition	Cause	Disposition
ACHI	Actuation High	Device tests out of spec on the high side. Disc / Component selection.	Scrap
ACLO	Actuation Low	Device tests out of spec on the low side. Disc / Component selection.	Scrap
ACCR	Actuation Creep	Device fails creep test (< 200 ms). Creep is calculated from the time a switch changes electrical continuity to the time in which the system microphone detects an audible snap.	Scrap
RLHI	Release High	Device tests out of spec on the high side. Disc / Component selection.	Scrap
RLLO	Release Low	Device tests out os spec on the low side. Disc / Component selection.	Scrap
RLCR	Release Creep	Device fails creep test (< 200 ms). Creep is calculated from the time a switch changes electrical continuity to the time in which the system microphone detects an audible snap.	Scrap
CONT	Continuity	System fails to detect continuity between terminals. Typically caused by bad tester pogo pins.	Scrap
DFHI	Differential High	Device tests out os spec on the low side. Disc / Component selection.	Scrap
DFLO	Differential Low	Device tests out os spec on the low side. Disc / Component selection.	Scrap
LEAK	Leak	All nests must be full on the tester in order to complete a test sequence. If (1) device leaks the tester aborts the test and calls all (4) devices bad.	Retest to determine defective device, Scrap & Adjust lot report

77PSL2-1 Yields for 1992

Date	Tested	Good	%
January-92	14341	14209	99.1%
February-92	10589	10487	99.0%
March-92	28771	27990	97.3%
April-92	15827	15476	97.8%
May-92	12016	11136	92.7%
June-92	23443	23133	98.7%
July-92	11835	11673	98.6%
August-92	15536	15253	98.5%
September-92	11693	11582	99.0%
October-92	3636	3627	99.7%
November-92	0	0	0.0%
December-92	15939	15481	97.1%
Total	152475	149010	97.7%

Date	Tested	Good	%	Failure Modes		
January-92						
1/8	808	799	98.9%			
1/13	1206	1206	99.8%			
1/14	90	50	100.0%			
1/18	1748	1741	99.6%			
1/19	786	734	93.4%	cont 10	accr 20	rlor 22
1/25	52	52	100.0%			
1/19	31	31	100.0%			
1/14	44	44	100.0%			
1/16	46	46	100.0%			
1/14	48	46	100.0%			
1/8	52	51	98.1%			
1/8	52	48	92.3%			
1/14	52	51	98.1%			
1/14	52	52	100.0%			
1/25	80	80	100.0%			
1/14	84	84	100.0%			
1/14	212	209	98.6%			
1/25	236	234	99.2%			
1/14	284	284	100.0%			
1/8	304	299	98.4%			
1/13	376	375	99.7%			
1/14	396	396	100.0%			
1/13	501	499	99.6%			
1/25	716	711	99.3%			
1/25	884	884	100.0%			
1/25	958	955	99.7%			
1/14	1095	1092	99.7%			
1/8	1308	1278	97.7%			
1/18	1916	1914	99.9%			
Total	14341	14209	99.1%			

Date	Tested	Good	%	Failure Modes				
February-92								
2/1	52	52	100.0%					
2/1	671	668	99.6%					
2/1	248	248	100.0%					
2/1	468	466	99.6%					
2/1	444	442	99.5%					
2/1	316	316	100.0%					
2/1	184	183	99.5%					
2/1	48	48	100.0%					
2/1	1364	1362	99.9%					
2/4	1248	1199	96.1%	cont 6	eccr 3	achi 36	rihi 1	rlcr 3
2/4	156	151	96.8%					
2/4	908	906	99.8%					
2/4	516	515	99.8%					
2/23	1429	1429	100.0%					
2/17	219	219	100.0%					
2/25	830	825	99.4%					
2/25	188	186	98.9%					
2/25	1088	1066	98.0%					
2/25	212	206	97.2%					
Total	10589	10487	99.0%					

TI-NHTSA 013651

Date	Tested	Good	%	Failure Modes				
March-92								
3/1	48	46	95.8%					
3/2	420	413	98.3%					
3/5	328	325	99.1%					
3/8	916	905	98.8%					
3/10	384	324	84.4%	echl 59	rlo 1			
3/10	872	748	85.8%	echl 146	dfhl 3			
3/11	292	291						
3/11	692	691						
3/11	256	256						
3/11	196	196						
3/11	428	425						
3/16	716	715	99.9%					
3/16	286	282	98.6%					
3/22	48	48						
3/22	148	147						
3/22	200	199						
3/22	616	613						
3/22	1400	1393						
3/23	576	573	99.5%					
3/23	140	139	99.3%					
3/23	1584	1566	98.8%					
3/23	220	218	99.1%					
3/23	759	745	98.2%					
3/23	292	286	97.9%					
3/24	304	303	99.7%					
3/24	532	523	98.3%					
3/26	1220	1213						
3/29	60	60	100.0%					
3/29	392	390	99.5%					
3/29	1376	1364	99.1%					
3/29	564	559	99.1%					
3/11	1911	1879	98.3%					
3/9	408	407	99.8%					
3/18	1380	1366	99.0%					
3/16	412	410	99.5%					
3/18	280	277	98.9%					
3/18	1724	1720	99.8%					
3/19	380	380	100.0%					
3/19	1032	1028	99.6%					
3/19	244	206	84.0%	echl 37	rlhl 1	rlcr 1		
3/19	336	333	99.1%					
3/31	466	465	99.8%					
3/31	1975	1962	99.6%					
3/31	331	276	83.4%	echl 55				
3/31	1351	1129	83.6%	echl 220	cont 1	rlcr 1		
3/31	60	25	41.7%	cont 4	echl 7	rlo 1	rlcr 7	dfhl 11
3/31	276	223	80.8%	cont 6	echl 46			
Total	28771	27990	97.3%					

Date	Tested	Good	%	Failure Modes		
April-98						
4/29	116	116	100.0%			
4/1	1440	1433	99.5%			
4/1	488	488	100.0%			
4/20	419	368	87.8%			
4/20	366	333	90.8%	echl 35		
4/12	1276	1267	99.3%			
4/13	788	784	99.5%			
4/13	124	124	100.0%			
4/13	352	346	98.3%			
4/14	1000	884	88.4%	achi 114	socr 1	rlcr 1
4/21	396	393	99.2%			
4/21	212	211	99.5%			
4/21	548	547	99.8%			
4/21	28	26	92.9%			
4/21	1296	1287	99.3%			
4/21	380	368	96.8%			
4/21	212	207	97.6%			
4/21	400	400	100.0%			
4/21	548	543	99.1%			
4/27	496	493	99.4%			
4/27	212	212	100.0%			
4/27	1432	1397	97.6%			
4/27	212	211	99.5%			
4/27	388	382	98.5%			
4/27	864	854	98.8%			
4/27	360	358	99.4%			
4/29	296	293	99.0%			
4/29	792	776	97.9%			
4/29	384	376	97.9%			
Total	15837	15476	97.8%			

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Date	Tested	Good	%	Failure Modes				
May-92								
5/5	419	381	90.9%	cont 3	scor 1	schl 1	rlcr 29	
5/6	1426	1260	88.4%	cont 3	scor 1	solo 1	schl 14	rlcr 147
5/11	1128	1016	90.1%	scor 5	schl 2	rlcr 105		
5/11	200	183	91.5%	schl 1	rlcr 16			
5/11	247	211	85.4%	schl 4	rlcr 21			
5/11	61	51	83.6%	schl 1	rlcr 7			
5/11	185	159	85.9%	schl 3	rlcr 21	cont 2		
5/11	50	48	96.0%					
5/12	486	416	85.6%	schl 53	rlcr 17			
5/12	136	126	92.6%					
5/14	564	552	97.9%					
5/14	348	320	92.0%					
5/25	1289	1239	96.4%					
5/25	336	271	80.7%	schl 17	rlcr 48			
5/25	1836	1618	88.1%	cont 1	scor 1	schl 16	rlcr 198	
5/25	132	132	100.0%					
5/26	152	152	100.0%					
5/26	1119	1117	99.8%					
5/26	702	700	99.7%					
5/25	904	901	99.7%					
5/26	104	102	98.1%					
5/25	60	60	100.0%					
5/25	124	123	99.2%					
Total	12018	11139	92.7%					

Date	Tested	Good	%	Failure Modes
June-92				
6/1	369	360	97.6%	
6/1	406	404	99.5%	
6/1	271	255	94.1%	
6/1	1394	1391	99.8%	
6/2	1026	1024	99.8%	
6/2	960	959	99.9%	
6/2	1663	1663	100.0%	
6/2	196	195	99.5%	
6/2	200	197	98.5%	
6/5	948	944	99.6%	
6/11	376	375	99.7%	
6/11	391	390	99.7%	
6/11	196	195	99.5%	
6/11	976	763	78.2%	
6/11	1276	1273	99.8%	
6/11	408	407	99.8%	
6/11	976	974	99.8%	
6/11	580	578	99.7%	
6/12	170	170	100.0%	
6/12	1044	1043	99.9%	
6/12	163	163	100.0%	
6/12	134	134	100.0%	
6/12	783	781	99.7%	
6/12	163	162	99.6%	
6/12	1282	1286	100.3%	
6/12	240	238	99.2%	
6/12	338	338	100.0%	
6/12	313	313	100.0%	
6/12	317	317	100.0%	
6/12	240	238	99.2%	
6/12	192	188	97.9%	
6/14	1438	1435	99.8%	
6/23	174	174	100.0%	
6/23	662	658	99.4%	
6/23	501	497	99.2%	
6/29	1198	1188	99.2%	
6/29	1128	1118	99.6%	
6/29	144	142	98.6%	
6/29	299	297	99.3%	
Total	23443	23133	98.7%	

Date	Tested	Good	%	Failure Modes
July-92				
7/28	640	631	98.6%	
	196	194	99.0%	
	1132	1119	98.9%	
7/8	815	779	95.6%	
7/16	357	355	99.4%	
7/14	696	685	98.4%	
	424	421	99.3%	
	692	685	99.0%	
	399	382	95.7%	
7/28	1350	1338	98.4%	
7/26	592	585	98.8%	
7/20	799	791	99.0%	
7/30	367	363	98.9%	
7/21	176	176	100.0%	
	204	204	100.0%	
	396	393	99.2%	
7/19	636	632	99.4%	
7/12	750	748	99.7%	
	1204	1192	99.0%	
Total	11836	11673	98.6%	

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Date	Tested	Good	%	Failure Modes
August-92				
8/9	1976	1934	97.9%	
8/9	946	944	99.8%	
8/9	520	519	99.8%	
8/9	820	816	99.5%	
8/9	388	388	100.0%	
8/10	1976	1972	99.8%	
8/12	1327	1300	98.0%	
8/18	808	808	99.4%	
8/18	560	555	99.1%	
8/18	208	208	100.0%	
8/18	162	162	100.0%	
8/19	304	300	98.7%	
8/19	60	59	98.3%	
8/19	967	964	98.7%	
8/19	610	688	96.4%	
8/19	52	51	98.1%	
8/24	976	673	69.4%	
8/24	56	56	100.0%	
8/24	362	961	97.8%	
8/24	52	62	100.0%	
8/24	285	281	98.6%	
8/25	960	944	98.3%	
8/25	1792	1789	99.8%	
8/31	2068	2063	99.9%	
Total	[illegible]	[illegible]	[illegible]	

Date	Tested	Good	%	Failure Modes			
Sep-02							
9/2	1144	1143	99.9%				
9/2	220	219	99.5%				
9/2	576	569	98.8%				
9/3	636	635	99.9%				
9/3	1081	1076	99.5%				
9/7	2069	2061	99.6%				
9/8	1829	1815	99.2%				
9/8	1092	1023	93.7%	schl 66	cont 1	scor 1	solo 1
9/8	48	47					
9/8	216	203		schl 13			
9/15	960	960	100.0%				
9/15	208	208	100.0%				
9/15	820	819	99.9%				
9/15	64	64	100.0%				
9/15	309	309	100.0%				
9/15	192	192	100.0%				
Total	11883	11842	99.6%				

Date	Tested	Good	%	Failure Modes...
Oct-02				
10/1	'1408	1403	99.6%	
10/19	232	231	99.6%	
	236	236	100.0%	
	266	266	100.0%	
	1252	1250	99.8%	
10/2	266	265	99.6%	
	176	176	100.0%	
Total	3836	3827	99.7%	

Date	Tested	Good	%	Failure Modes
Nov-92				
No reports				
Total	0	0		

Date	Tested	Good	%	Failure Modes	
Dec-92					
12/19	19	19	100.0%		
	220	211	95.9%		
	1685	1491	88.5%	cont 6	schl 188
	50	46	92.0%		
12/16	1044	1042	99.8%		
	708	707	99.9%		
	1064	1062	99.8%		
	1028	1027	99.9%		
12/19	409	371	90.7%	cont 1	schl 37
	50	50	100.0%		
	1378	1258	91.3%	cont 7	schl 113
12/15	540	540	100.0%		
	424	423	99.8%		
	524	522	99.6%		
	50	50	100.0%		
	932	930	99.8%		
	476	476	100.0%		
	228	228	100.0%		
	72	72	100.0%		
	50	50	100.0%		
	252	251	99.6%		
	632	632	100.0%		
	640	640	100.0%		
12/15	1500	1499	99.9%		
	260	260	100.0%		
	436	436	100.0%		
	179	179	100.0%		
12/3	50	44	88.0%	rlcr 6	
	719	645	89.7%	cont 2	rlcr 72
Total	15839	15461	97.1%		

TI-NHTSA 013661

TI 77PS Test Synopsis Draft 5/20/99

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 <u>Brake Pressure Switch Test Log</u>.

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 % H_20.
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% H_20 in brake fluid.
(2) with 6% H_20 in brake fluid.
(2) with 10% H_20 in brake fluid.
(2) with 75% H_20 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.

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- 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 cannot 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 fumes in the contact cavity of the switch and engulfed the base material of the switch.
Dry device: 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.

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 H_2O 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 H_2O 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_2O 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

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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. It is unknown if this corrosion, under continuous power conditions, can eventually lead to sufficient current draw to drive an ignition.

- 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. There has been no increase in hexport current. These results are consistent with results previously found in Test 15a.

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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_2O 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 H_2O 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 H_2O.
(1) tap water
(1) rain water
(1) used brake fluid
(1) used brake fluid with 5 wt. % H_2O
(1) new brake fluid
(1) new brake fluid with 5 wt. % H_2O
The switch filled with 5 wt. % NaCl in H_2O 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. Because of its' significantly higher conductivity, an ionic rich fluid such as NaCl in H_20 is necessary to cause an ignition.

- 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 1out 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.

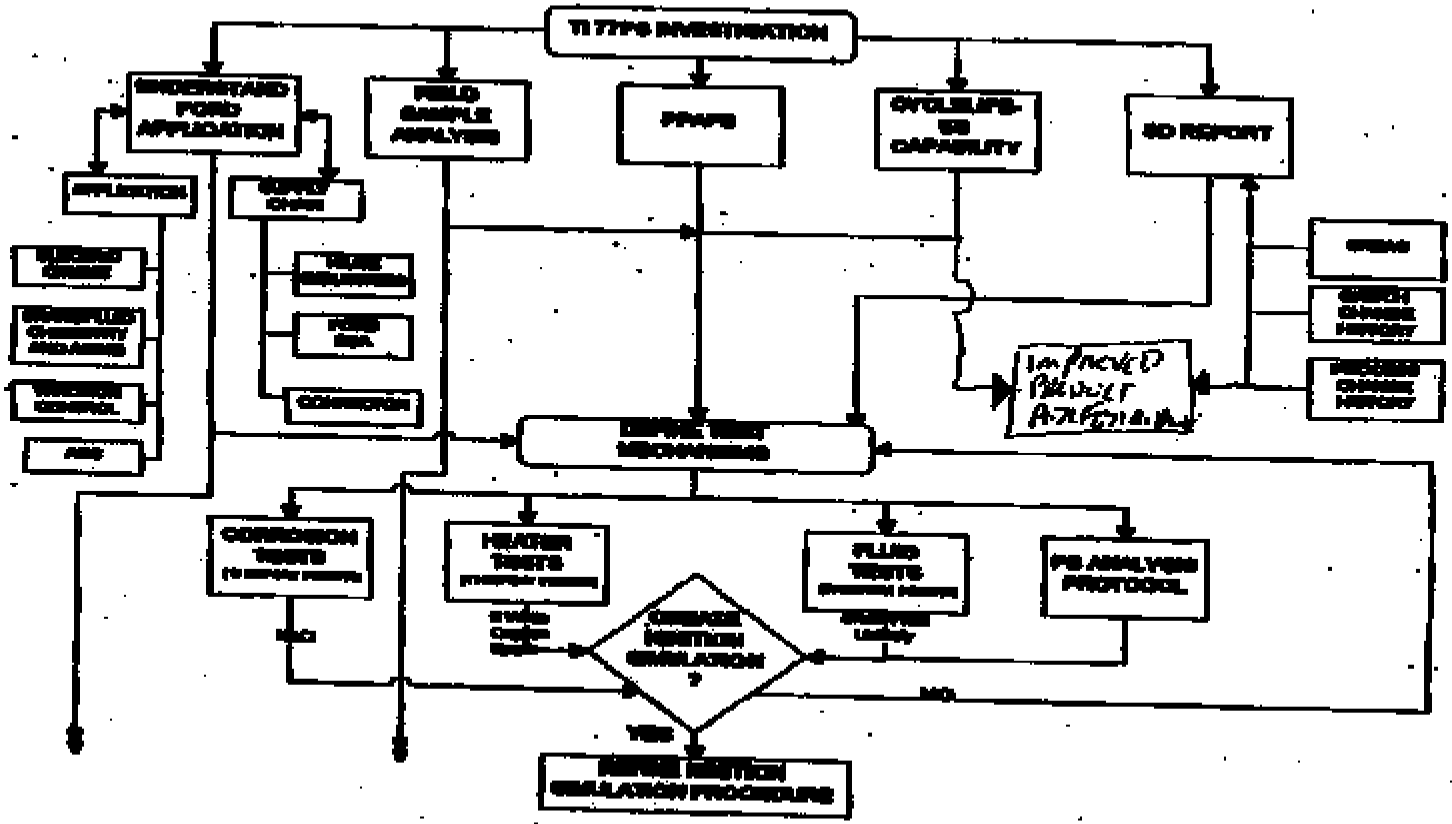
Results: (1) switch was injected with a solution of 5 wt. % Nacl in H_20 and placed in the proposed current limiting circuit for (48) hours. The current draw remained constant at 180 mAmps throughout the test. There was no activity observed and the contact arm remained mostly intact.
(1) switch was brought to an impending burn condition using the established burn method. An impending burn is a condition where a 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. There is not enough power in the proposed circuit to create ignition.

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99

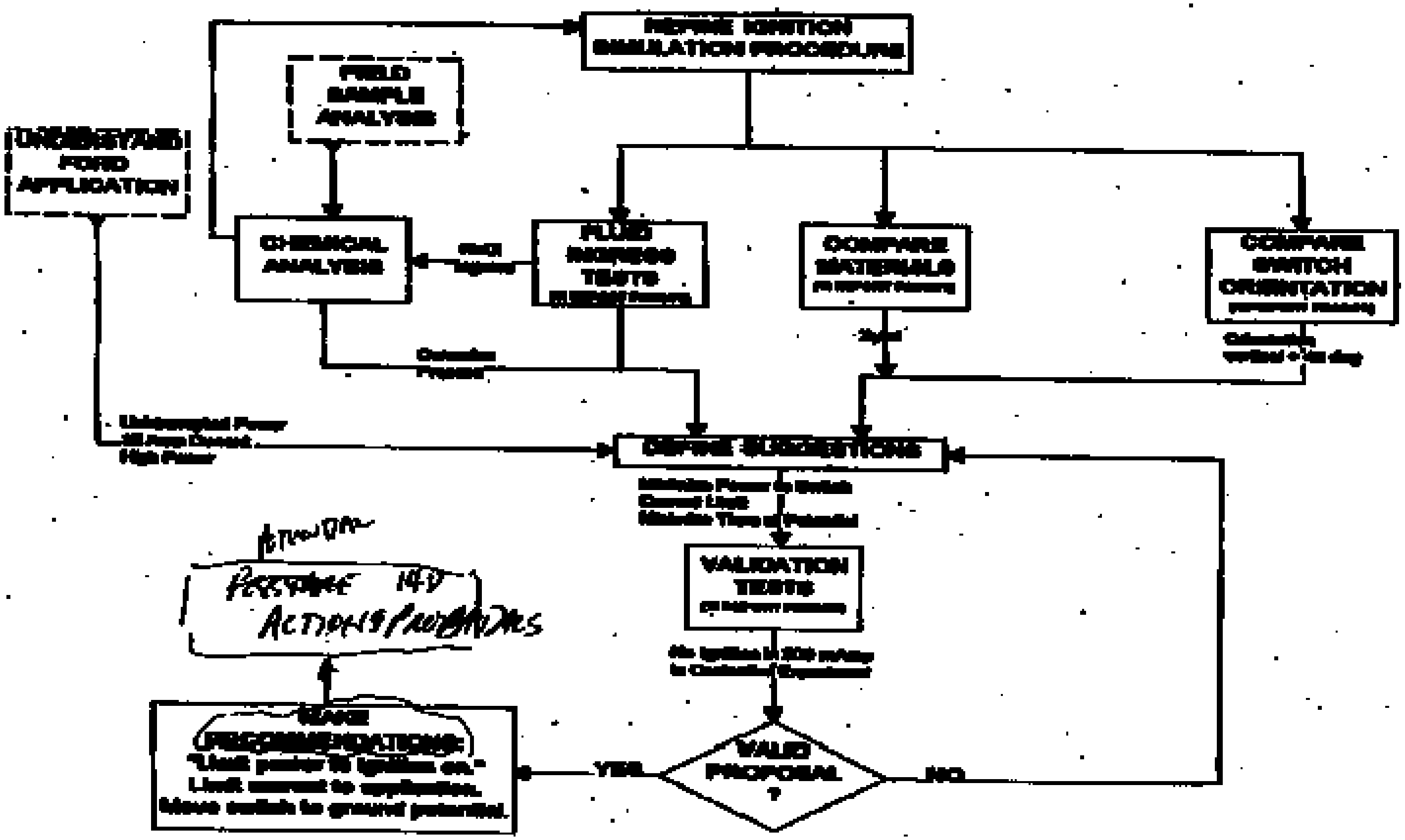


Attachment

TI-NHTSA 013669

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99



Attachment

TI-NHTSA 013670

Epstein, Sally

From: Gildea, Robert [rgildea@email.mo.ti.com]
Sent: Thursday, May 20, 1999 4:36 PM
To: Proia, Stephen; Pechonis, John; Martin, Scott; Dague, Bryan; Mulligan, Sean; Basiliere, Robert; Watt, Jim
Subject: Gaps in sensor building process

Team,

After reviewing the sensor building process for gaps that could cause leaks the following is a list of what I came up with. I also reviewed this with Bob Basilere who went through the program in depth to insure that the machine was programmed the way we assumed it was. I also had the AMI operator duplicate the failures to insure the program was working properly.

1) Gasket check station. This station is not fail safe. It is designed to check for a gasket and its position using four reflective sensors. There are several problems with this design. First, the operator can not tell if the sensors are working while the machine is running. They can only determine this while doing SPC checks which are performed roughly every four hours. Therefore there is the potential to produce approximately 4k to 5k sensors without all the sensors working. Secondly, the is no detection to see if the station actually stroked down and checked the nest for a gasket. If the station gets jammed up it will call every nest good.

2) Kapton Check Stations. These stations also are not fail safe. These stations are designed to work using a continuity probe to insure the proper number of kaptons are in the nest, and that they are in the proper orientation. The first check station checks that there is two pieces of kapton. Four pogo pins come down and check for the corners of the kapton and as long as the pins do not go to ground they call the nest good. Once again the problem is that the station could be stuck up and there is no way for the machine to know it. Also, the pogo pins could be bent, broken, or missing and the system wouldn't know it. The only back check that we have is that all the pogo pins are wired in series and if one of the wires is broken it will break the series and send a fault signal to the panel. The check for the third station works in the exact same way, but it also has one feature that makes it even less reliable. Because we make devices with two kaptons we fixture the check station for the third kapton so the station can be stored up out of the way while we are running the two kapton devices. If the operator does not put the station down and perform the SPC they could conceivably run for hours without the third check station engaged. Also, as with the gasket station, we do not check to see if the check stations actually stroke down and check the nest.

3) The crimp table. We call out exact pressures with tolerances on our process specifications for the 45 degree crimp , 90 degree crimp , and overpressure, but the gauges we are using are not calibrated. Also, we do not have a PM procedure in place for the crimp dies, we leave it up to the operators and the tool room. What we depend on are our SPC checks, which are very capable. We use a poka-yoke to check the diameter of the sensor and a dial indicator to check the height. The CpK for the sensor height is 2.6.

Regards,

Bob Gildea
Phone: (508) 236-2023
Fax: (508)236-3586
email: rgildea@ti.com

TI-NHTSA 013671

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99

NA Hydraulic Switch History

Time Period:	'83	'87	'90	'91	'98	'99
Application:	Power Steering	Power Steering Suspension	Power Steering Suspension Transmission	Power Steering Suspension Transmission Cruise	Power Steering Suspension Transmission Cruise Clutch	Power Steering Suspension Transmission Cruise Clutch
Fluid:	Power Steering Fluid →	→	→	→	→	→
		Brake Fluid →	→	→	→	→
CONFIDENTIAL			Transmission Fluid →	→	→	→

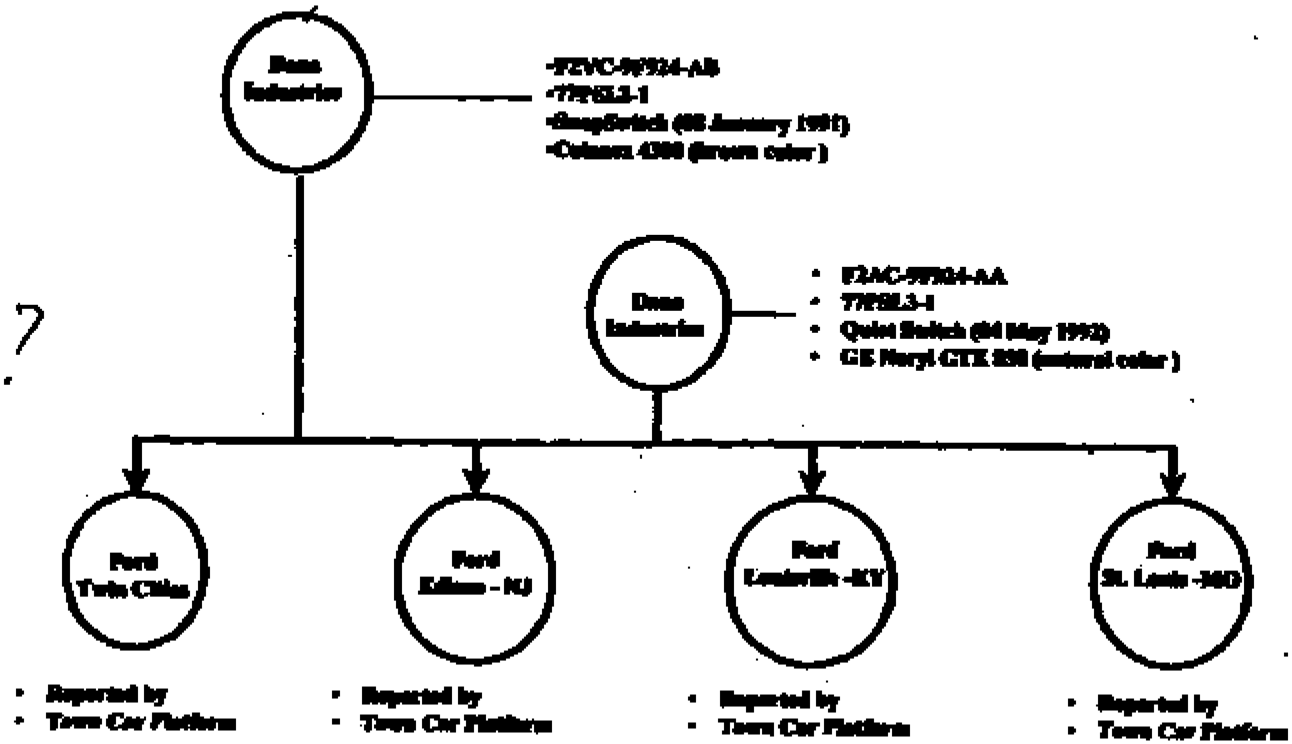
- TI has some 16 years and 130 million units accumulated experience in hydraulic applications using multiple fluids
- TI has some 12 years of brake system application experience working with brake fluids

TI-NHTSA 013572

TEXAS INSTRUMENTS

Town Car - Cruise Control PS
Ford P/N: F2VC-9F924-AB , F2AC-9F924-AA
TI P/N 77PSL2-1, 77PSL3-1

TOWN CAR SWITCH SEQUENCE ...



Pitts?
Hicites?

TI-NHTSA 013873

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99

NA Hydraulic Switch History

Time Period:	'83	'87	'90	'91	'98	'99
Application:	Power Steering	Power Steering Suspension	Power Steering Suspension Transmission	Power Steering Suspension Transmission Cruise	Power Steering Suspension Transmission Cruise Clutch	Power Steering Suspension Transmission Cruise Clutch
Fluid:	Power Steering Fluid →					
		Brake Fluid →				
			Transmission Fluid →			

- TI has some 16 years and 130 million units accumulated experience in hydraulic applications using multiple fluids
- TI has some 12 years of brake system application experience working with brake fluids

TI-NHT8A 013674

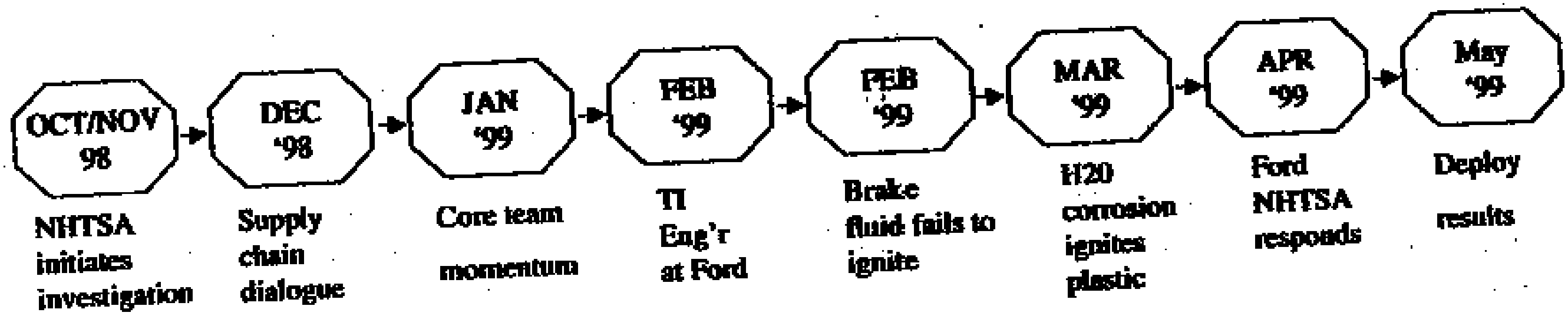
C:/McGask/[illegible]/Ford

Attachment

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99

OVERVIEW OF CONCERN TIME LINE

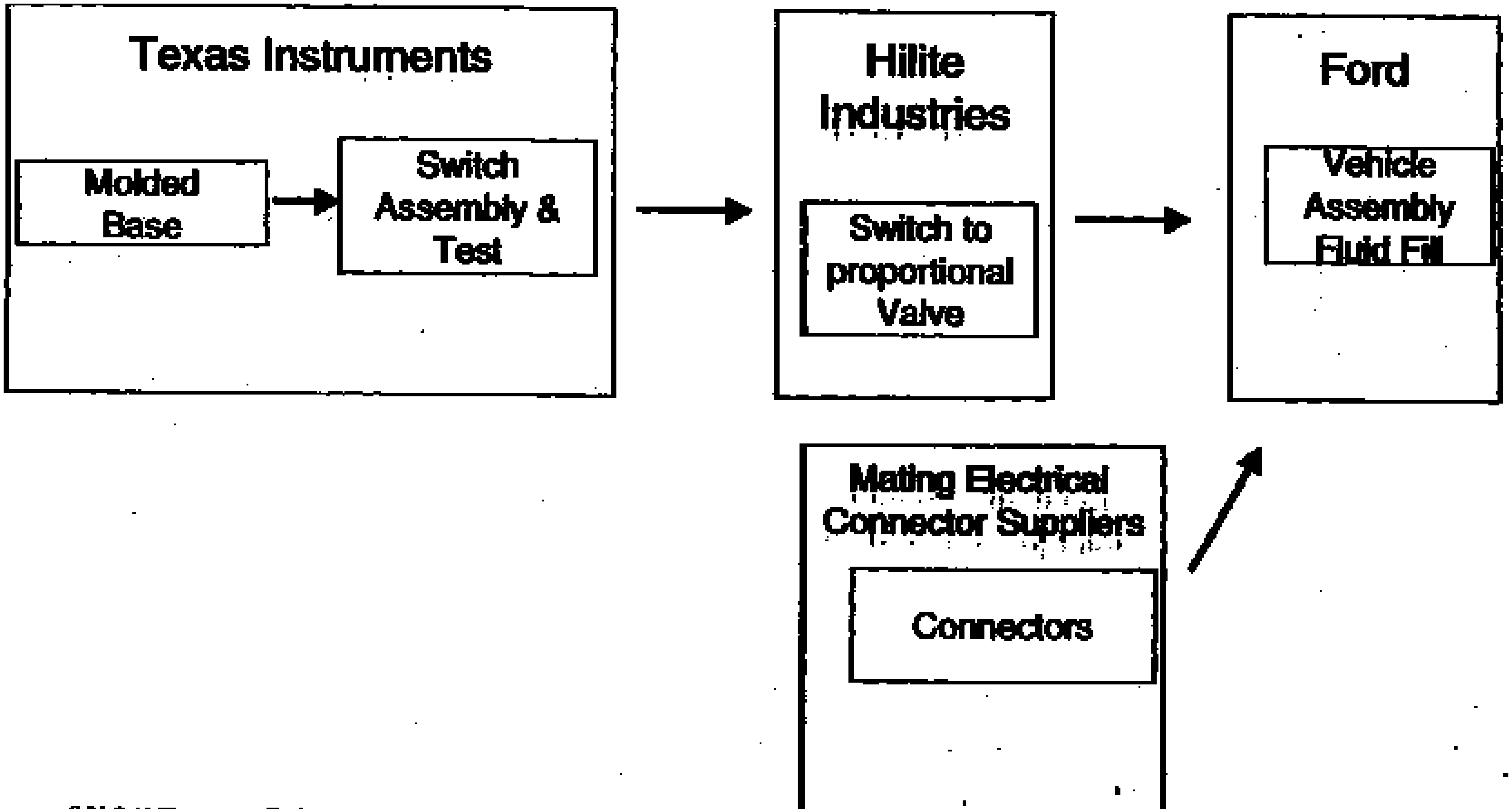


Attachment

Brake Switch Overview

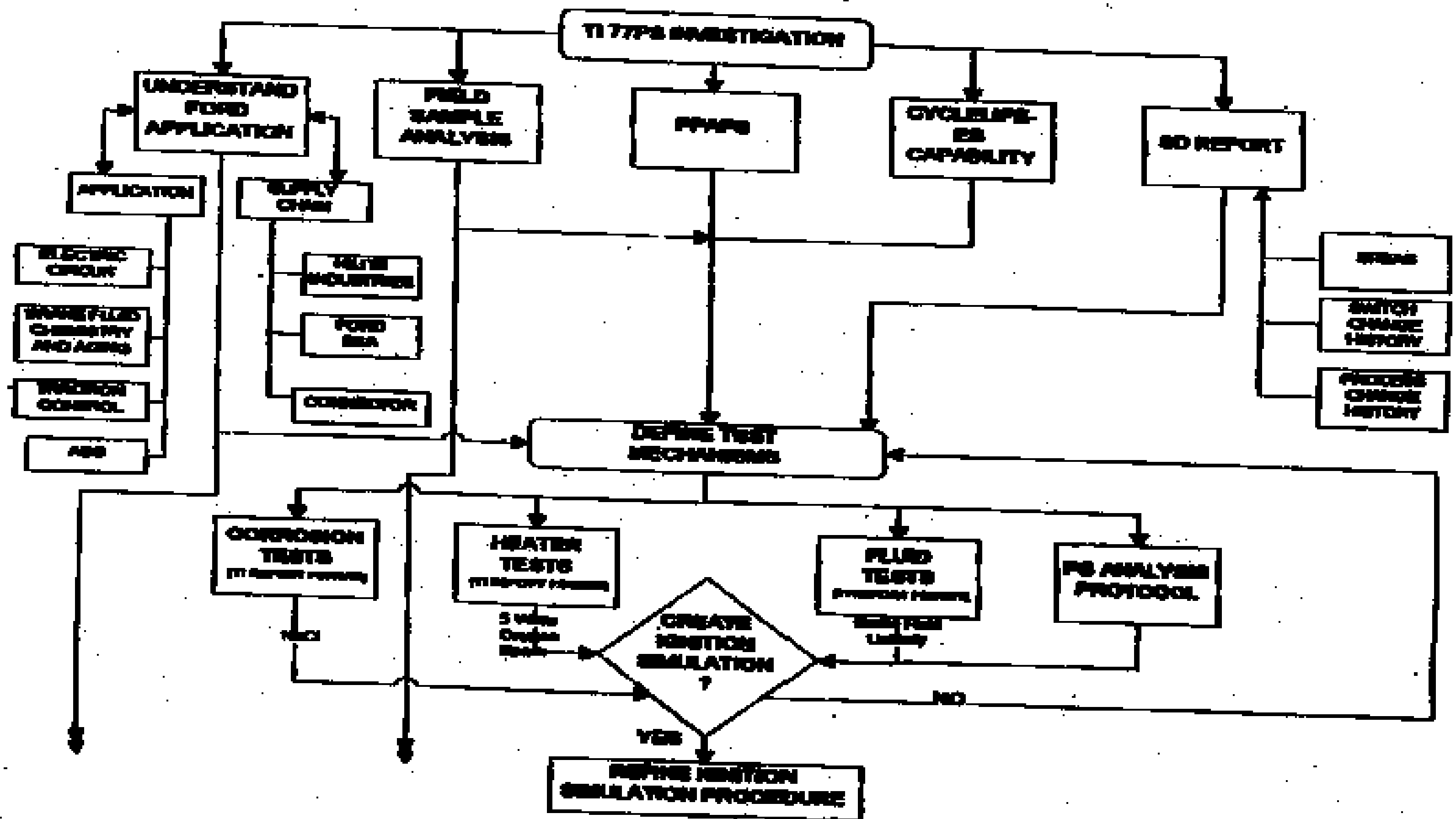
- Mounted under hood…14 inches under master cylinder
- Mounted on proportional valve at frame of vehicle
- Switch oriented approximately 25 degrees off vertical (connector up)
- Switch controls speed control…normally closed, opens at 130 psi
- Continuously powered by battery 15 amp connection

PRESSURE SWITCH "FLOW DIAGRAM" ('92, '93, TOWN CAR)



TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99



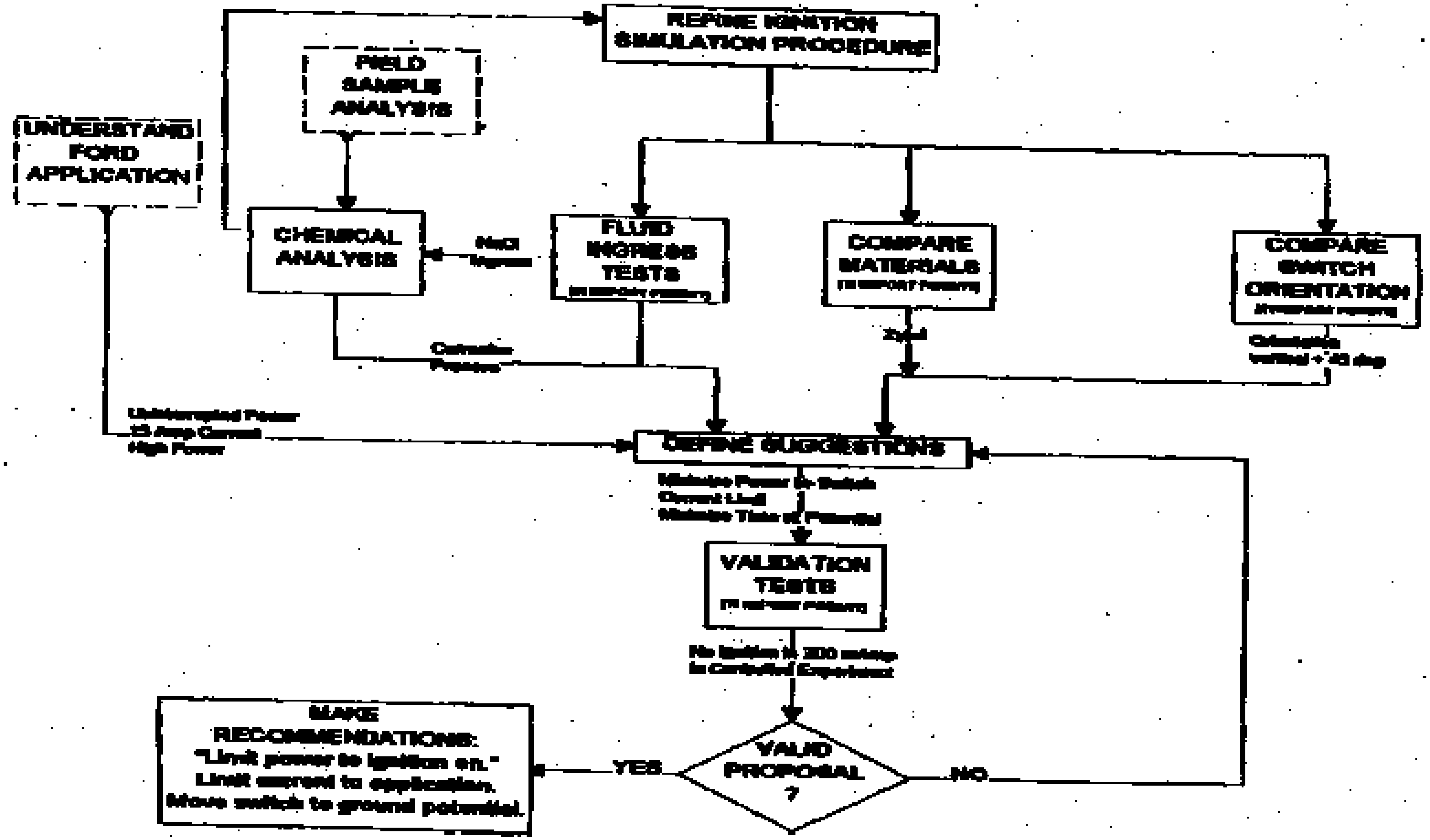
TI-NHTSA 013678

C:/McCaleb/...

Attachment

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99



TI-NHTSA 019679

C:/McGuire/Presentation/Ford

Attachment

Ford recalls 279,000 cars because of risk of cruise-control fires

05/19/1999
Associated Press Newswires

DEARBORN, Mich. (AP) - Ford Motor Co. has recalled 279,000 full-size cars because of a cruise-control switch that could short-circuit and cause a fire.

The recall affects the 1992 and '93 Lincoln Town Car, Mercury Grand Marquis and Ford Crown Victoria. About 10,900 of the recalled cars are in Canada.

There have been 147 reports of fires and two injuries attributed to the defect, Ford spokeswoman Karen Shaughnessy said Tuesday.

The automaker said it is still obtaining replacement switches. Until the switch can be fixed, customers should take their cars to their dealer and have the cruise control disabled, Ford said.

NA Hydraulic Switch History

Time Period:	'83	'87	'90	'91	'98	'99
Application:	Power Steering	Power Steering	Power Steering	Power Steering	Power Steering	Power Steering
		Suspension	Suspension	Suspension	Suspension	Suspension
			Transmission	Transmission	Transmission	Transmission
				Cruise	Cruise	Cruise
					Clutch	Clutch
Fluid:	Power Steering Fluid					
		Brake Fluid				
			Transmission Fluid			

- TI has some 16 years and 130 million units accumulated experience in hydraulic applications using multiple fluids
- TI has some 12 years of brake system application experience working with brake fluids

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99

NA Hydraulic Switch History

Time Period:	'83	'87	'90	'91	'98	'99
Application:	Power Steering	Power Steering Suspension	Power Steering Suspension Transmission	Power Steering Suspension Transmission Cruise	Power Steering Suspension Transmission Cruise Clutch	Power Steering Suspension Transmission Cruise Clutch
Fluid:	Power Steering Fluid →					
		Brake Fluid →				
			Transmission Fluid →			

- TI has some 16 years and 130 million units accumulated experience in hydraulic applications using multiple fluids
- TI has some 12 years of brake system application experience working with brake fluids

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TI-NHTSA 013982

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99

NA Hydraulic Switch History

Time Period:	'83	'87	'90	'91	'98	'99
Application:	Power Steering	Power Steering Suspension	Power Steering Suspension Transmission	Power Steering Suspension Transmission Cruise	Power Steering Suspension Transmission Cruise Clutch	Power Steering Suspension Transmission Cruise Clutch

Fluid:
- Power Steering Fluid ('83 →)
- Brake Fluid ('87 →)
- Transmission Fluid ('90 →)

- TI has some 16 years and 130 million units accumulated experience in hydraulic applications using multiple fluids
- TI has some 12 years of brake system application experience working with brake fluids

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TI-NHTSA 013683

[redacted]

NA Hydraulic Switch History

Time Period:	'83	'87	'90	'91	'98	'99
Application:	Power Steering	Power Steering Suspension	Power Steering Suspension Transmission	Power Steering Suspension Transmission Cruise	Power Steering Suspension Transmission Cruise Clutch	Power Steering Suspension Transmission Cruise Clutch
Fluid:	Power Steering Fluid →					
		Brake Fluid →				
			Transmission Fluid →			

- TI has some 16 years and 130 million units accumulated experience in hydraulic applications using multiple fluids
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TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99

Today's Date: UPDATED 04/21/99

Scope or Effect Description

1. Operational Definition (Problem Statement): TOWN CAR UNDERHOOD FIRES			
2. Description	IS	IS NOT	Get Information
WHAT	Town Car MY '92, '93, '94	Crown Victoria? Grand Marquis? T8 Super Coupe? MY '91, '95, 96? '92, '93 [illegible]	COMPARE PLATFORMS
	FIRES... • Electrical pressure switch • Connector • Servo system • Electrical Distribution	Not only pressure switches	COLLECT/TEST OTHER SYSTEM COMPONENTS FOR "SYNERGY" COMPARE VEHICLE OPTIONS FOR SYNERGY
	SYSTEM ISSUES... • Cruise inoperative • Locked in park • Horn inoperative • Brake lights inoperative • Discharged battery • Door locks? • [illegible]	Other circuits	COMPARE WARRANTY
WHERE	Driver side hood Medium height in engine compart.	Passenger side hood Dash – pass. compartment Not high in engine comp.	EVALUATE HEAT SOURCES
		Not low in engine comp.	
WHEN	1-24 hours after parking ignition off After 4-6 years After XXX miles	Not while driving Not while ignition on Not before 3 years? Not before YYY miles	EVALUATE POWER AND HEAT AND WIND SOURCES REVIEW MILES
	After AAA switch cycles	Not before BBB cycles	
HOW BIG	140 cars / 22k units "smaller size" fires	Not all cars? Not "explosion"	COMPARE PLATFORMS READ FIRE RPTS
	Several pressure switches	Not all underhood fires Not all pressure switches	PARETO UNDERHOOD

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TEXAS INSTRUMENTS

Brake Pressure Switch

Potential Thermal Event Theory Profile 5/20/99

Texas Instruments
Automotive Sensors & Controls
8D Report

Concern Title	77 PS Thermal Events	Open Date	2/99
T.I. CAR Report Number	CAR [illegible]	Updated: 4/[illegible]/99	
Status Date	Vehicle: Lincoln Model: Town Car Plant: Various	Part Name	[illegible] Speed Control Deactivation Pressure Switch
		Part No.	77PS [illegible]

1. Team: [illegible] [illegible] Dugan — A. [illegible] A. McGuirk — C. Douglas G. [illegible] — T. Rowland	2. Problem Description Under hood car fires

3. Containment Action(s):	% Effectiveness	Implementation Date
Under review, considering disabling speed control system		

4. Root Cause (see attachment 1, [illegible] - [illegible] Table)	% Contribution
(Theories of 3/[illegible]/99) • Water enters pressure switch thru connector • Continuous power drives corrosion • Corrosion causes high resistance • Resistance creates local heating • Several exposures over time (?) • Local heating ignites pressure switch and connector plastic • Operator protocol not [illegible]	Unknown

5. Chosen Permanent Corrective Actions (see attachment 2,3,4)	Verification	% Effectiveness
Under Review: • Relay harness • Contact [illegible] • Create ground fault protector • Improve connector seal • Eliminate constant power • Change PS orientation • [illegible] power [illegible] power reduction • Modify plastic [illegible] • Optimize polarity • Move to ground potential	TBD by lab experiments	Unknown

6. Implemented Permanent Corrective Actions	Implementation

7. Action(s) to Prevent Recurrence	Implementation
Eliminate constant power, reduce power to function need, [illegible] "illegal" electrical function	

8. Congratulate Team	Close Date		
		Reported By:	A. McGuirk
		Dept. Name:	QRA Manager
		Telephone No.:	[illegible]

Attachment

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Confidential Business Information [illegible]

TEXAS INSTRUMENTS

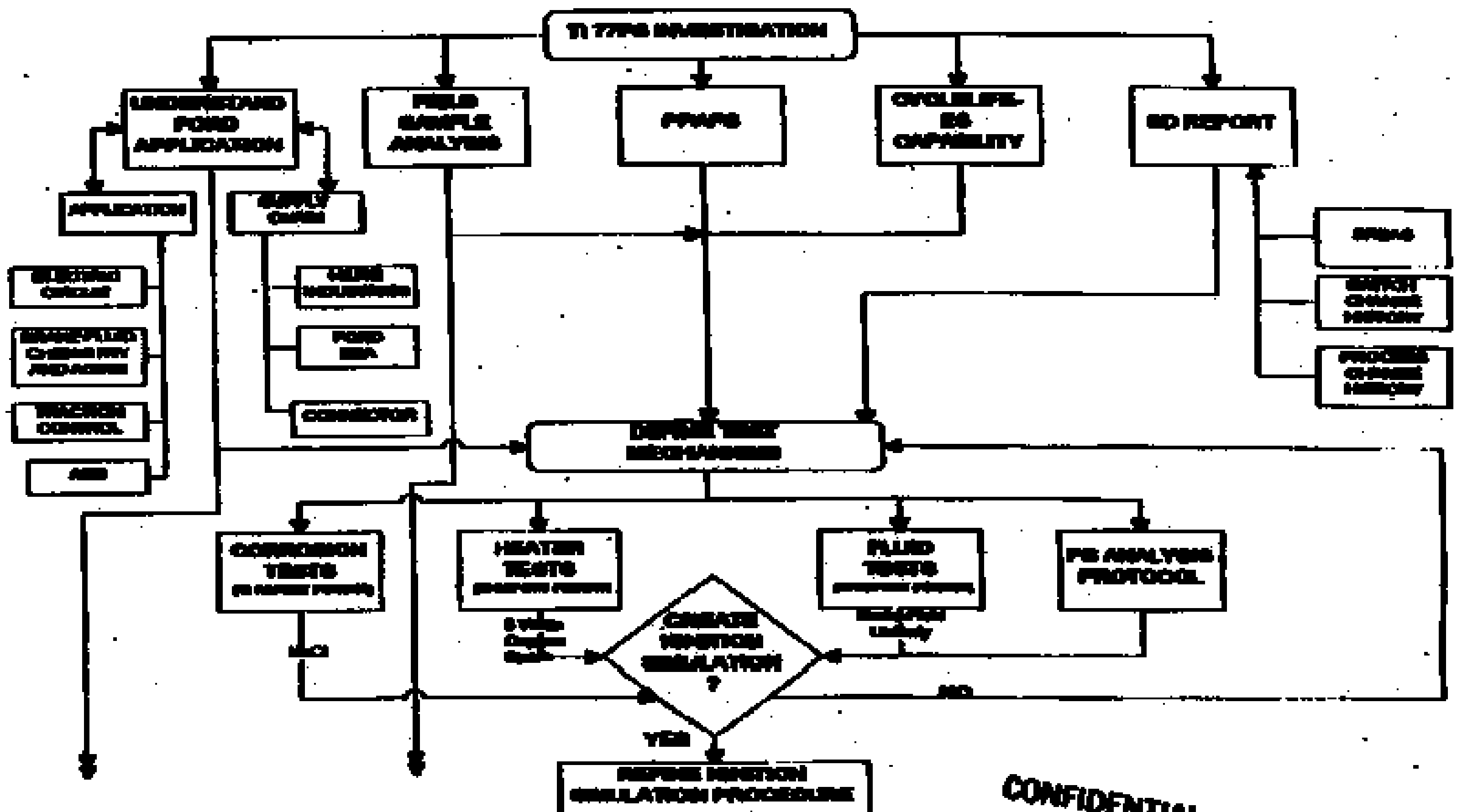
Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99

77psi2-1		GROSS QTY		COMPLETE	COMPLETE	BERM	IMPACT	COMMENTS/CONCERNS
COMPONE	DESCRIPTI	REQUIRED	SUPPLIER	14K	28K	PARTIAL	TO TI	
27406-1	CONVERTER	2,040,000	KF BASSLE	10 WKS	18 WKS	2 WKS	NONE	ADD OVERTIME/MATERIAL AVAILABILITY
27639-1	WASHER/ A	2,040,000	DEMASTER	10 WKS	18 WKS	2 WKS	NONE	MATERIAL AVAILABILITY
27713-1	CUP 77PS	2,040,000	VALENTINE	6 WKS	10 WKS	1 WK	NONE	RAW MATERIAL AVAILABILITY
38658-27	57PS	2,040,000	DISC DEPT	12+ WKS	24 WKS	3 WKS	TOOL $?	POSSIBLE CAPACITY ISSUE
38080-1	HEXPORT 77	2,040,000	ELCO	10 WKS	25 WKS	3 WKS	NONE	RAW MATERIAL AVAILABILITY
74224-1	KAPTON	204	ENDUPONT	2 WKS	2 WKS	2 WKS	NONE	
27225-1	KAPTON SI	1,102	ENDUPONT	3 WKS	3 WKS	2 WKS	NONE	
74353-1	GASKET	2,040,000	JBL PARKER	8 WKS	16 WKS	3 WKS	NONE	ELIMINATE CORES WILL INCREASE DEL. BY 10%
38086-1	STATIONAR	2,040,000	KF BASSLE	10 WKS	18 WKS	2 WKS	NONE	ADD OVERTIME/MATERIAL AVAILABILITY/ REELS
28744-1	CONTACT-S	2,040,000	DERINGER	4 WKS	8 WKS	1 WK	NONE	MATERIAL AVAILABILITY
38087-1	MOVABLE	2,040,000	KF BASSLE	10 WKS	18 WKS	2 WKS	NONE	ADD OVERTIME/MATERIAL AVAILABILITY/REELS
27718-1	BECU ISSU	440	BRUSHWELL	1 WK	2 WKS	1 WK	NONE	NONE
74916-1	RIVET	2,040,000	JOHN HASS	8 WKS	11 WKS	4 WKS	NONE	RAW MATERIAL AVAILABILITY
48515-2	PRESSURE S	2,040,000	MEMCLON	16 WKS	32 WKS	4 WKS	NONE	RAW MATERIAL CHANGEOVER/PRESS CAPACITY
74878-143	CERAMIN P	2,040,000	PARATECH	7 WKS	15 WKS	2 WKS	NONE	
74947-4	BLUE O'RING	2,040,000	JBL PARKER	8 WKS	10 WKS	2 WKS	NONE	ELIMINATE CORES WILL INCREASE DEL. BY 10%
74787-1	CRIMP RING	2,040,000	VALENTINE	6 WKS	10 WKS	1 WK	NONE	RAW MATERIAL AVAILABILITY
74889-1	RED THREA	2,040,000	MARK IV CA	3 WKS	8 WKS	1 WK	NONE	
77PS	SWITCH		TI	7/15,8/1,8/15	250K/MONTH			7 day weeks, thru summer vacations, 'aid' plastic mold

TI-NHTSA 013887

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99



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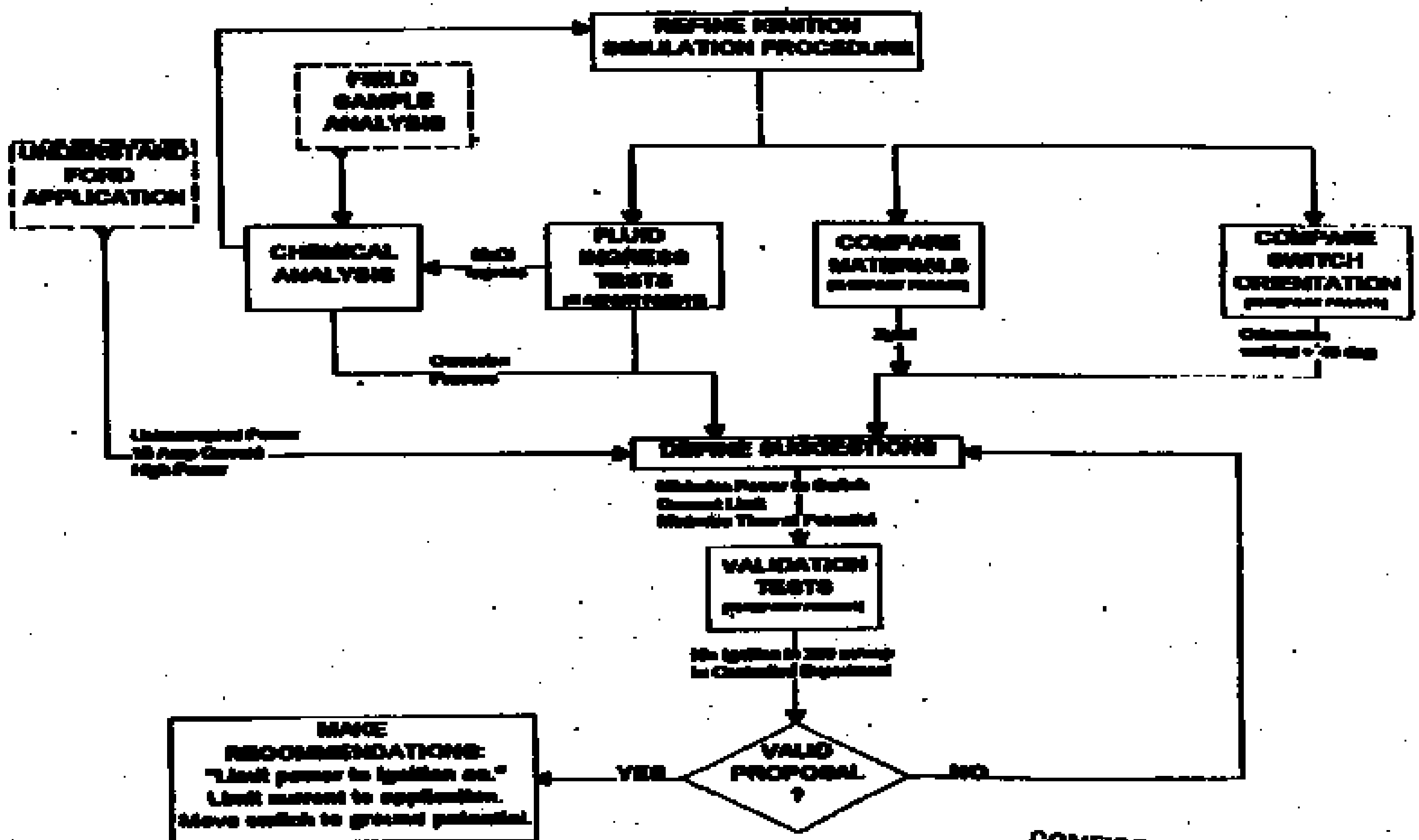
TI-NHTSA 019868

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99

[redacted]



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Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99

TEXAS INSTRUMENTS

Category	Test	Location	Test Parameters	Results Update
Lab Simulation	1	TI	Vary water concentrations in "new" Brake Fluid	250+ hours. Current draw in the 0.5mA to 5mA range
of Potential Ignition			14Vdc to one terminal, hexport grounded	Fluid was discolored.
in Switch			Water Conc: 4%, 6%, 10%, 70%	No Significant Temperature Rise. Test Suspended.
				Internal Analysis suspended.
	2	TI	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 Suspended.
	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 ongoing
	4	AVT	"new" Brake Fluid in Switch, 24 VDC to one	16 hours into test max current 5mA
			terminal. Hexport Grounded, Ambient at 150 C	No significant temperature rise with time. Test suspended.
	5	AVT	"new" Brake Fluid in Switch, 16 Amps	Temperature rise of 30 C above room temp
			Through switch terminals	Delta T reached steady state at 30 C. Test suspended.
	5a	AVT	"new" Brake Fluid in Switch approx. 60 Amps	Temperature rose to approx. 270 F. No smoke. No ignition
			through Switch Terminals	Test suspended.
	6	TI	Mold heater elements into the switch.	2 tested. Smoke observed, ignition observed on pad w/heater
			Heat til failure, include sparking.	See attachment
			With Fluid & Dry	Test complete
				Brake fluid in cavity slows down heat build-up
				Smoke observed at 675 F, flame exits and falls off at 800 F
	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 either very low resistance or [illegible]
			and hexport	It took about 140 hours to reach the 5 ohm stage.
				The 5 ohm device ignited under conditions similar to test 6.
	6b	TI	Re-run ignition test to understand	Switch ignition with repeated 5% water solution into switch
			repeatability and current path.	Current path is through hexport
				See plots and video.
				Additional test include tap water, old BF, new BF and other.

Brake Pressure Switch

TEXAS INSTRUMENTS Potential Thermal Event Theory Profile 5/20/99

	6a	TI	[illegible] "new" brake fluid with metal [illegible]	Metal [illegible] do not [illegible] significantly to brake fluid
				[illegible]
Life Cycle Reliability	7	TI	0-1400 psig pressure pulses at 135C	[illegible] observed at [illegible] cycles.
of Pressure Switch			per [illegible]	Test Completed. See attached Weibull Chart.
Diaphragm Wear	8	TI	0-1400 psig pressure pulses at 135C	[illegible] cycles, [illegible]
Field vs Lab Correlation	9	Central Lake	[illegible] returns, [illegible]	Parts to Central Lake, see [illegible]
Design Of Experiments (1)	10	TI	Vary [illegible] concentrations in "new" Brake Fluid	Test [illegible]
Evaluating Factors			12 crimp + 12 [illegible] w/ [illegible] % water in BF	[illegible] at 1.2 million cycles with no leaks observed.
Affecting Diaphragm Wear			12 crimp + 12 [illegible] w/ 5 % water in BF	[illegible] at 1.2 million cycles with 2 leaks
Injection test				[illegible] 1,200 [illegible] at [illegible] cycles to
				[illegible]
On-Vehicle Characterization	11	AVT	Monitor Pressure and Temperature	Test at AVT.....[illegible]
of Pressure & Temperature			at [illegible] Location for ABS and non-ABS	
Profile in Town Car			[illegible]	
[illegible]				
Brake fluid analysis	11a	TI	Analysis used Brake fluid at the master cylinder	[illegible]
Used fluid at master cylinder.			(UMC), used brake fluid at the caliper (UCA)	UMC: Cu = 418 [illegible], Fe = [illegible], Cr = [illegible], 1.1 %[illegible]
			and new brake fluid ([illegible]) for metal and water	UCA: Cu = [illegible], Fe = [illegible], Cr = 1.0 [illegible], 1.1 %[illegible]
			content.	[illegible]: Cu = [illegible], Fe = [illegible], Cr = [illegible], 0.3 %[illegible]
Spark/Arc Study	12	Central Lake	[illegible]	[illegible] set-up in progress at Central Lake.
			[illegible]	TI [illegible] with no "significant" sparks observed
			[illegible]	
			[illegible]	
Characterization of	13	Central Lake	Characterize electrical, mechanical	[illegible] set up complete.
[illegible]			and chemical aspects of [illegible]	Analysis of [illegible] in progress.
[illegible] & other [illegible]				
[illegible] Tests	14a	TI	[illegible]	[illegible]
			[illegible]	[illegible]
			5% NaCl in tap water	[illegible] less than 3 [illegible]. No [illegible]
			[illegible] water	[illegible]
			[illegible]	[illegible]
			tap water	[illegible]
			used brake fluid	Chemical analysis in process.
			used brake fluid w/ 5% H_2O	
			new brake fluid	
			new brake fluid w/ 5% H_2O	

C:/[illegible]

Attachment

TI-NHTSA 013861

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99

Compatibility of Kapton with Oxalic Acid	14	Dupont	Characterize change in properties of Kapton with various % oxalic acid in brake fluid.
Evaluation of Plastic Materials with Improved Parameters	15	TI	Assess properties and suitability of different grades of plastic resin with additives to improve plastic part performance.
Long duration brake fluid Immersion test.	12a	TI	(1) samples with new brake fluid (2) samples with used brake fluid
Evaluation of Switch Orientation	12b	TI	Assess ignition sensitivity to switch orientation. Test vertical versus 45 degree. Test rotational sensitivity in 45 deg. orientation.
Relay Circuit Test	16	TI	Repeat test 12a in Ford relay circuit for (48) hrs. Bring switch to impending ignition in (15) Amp circuit then place in relay circuit for (18) hrs. Input max. circuit pwr or into heater on switch.

Compatibility of Kapton with Oxalic Acid	14	Dupont	Characterize change in properties of Kapton with various % oxalic acid in brake fluid.
Evaluation of Plastic Materials with Improved Parameters	15	TI	Assess properties and suitability of different grades of plastic resin with additives to improve plastic part performance.
Long duration brake fluid Immersion test.	12a	TI	(1) samples with new brake fluid (2) samples with used brake fluid
Evaluation of Switch Orientation	12b	TI	Assess ignition sensitivity to switch orientation. Test vertical versus 45 degree. Test rotational sensitivity in 45 deg. orientation.
Relay Circuit Test	16	TI	Repeat test 12a in Ford relay circuit for (48) hrs. Bring switch to impending ignition in (15) Amp circuit then place in relay circuit for (18) hrs. Input max. circuit pwr or into heater on switch.

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99

[redacted]

NA Hydraulic Switch History

Time Period:	'83	'87	'90	'91	'98	'99
Application:	Power Steering	Power Steering Suspension	Power Steering Suspension Transmission	Power Steering Suspension Transmission Cruise	Power Steering Suspension Transmission Cruise Clutch	Power Steering Suspension Transmission Cruise Clutch
Fluid:	Power Steering Fluid →					
		Brake Fluid →				
			Transmission Fluid →			

- TI has some 16 years and 130 million units accumulated experience in hydraulic applications using multiple fluids
- TI has some 12 years of brake system application experience working with brake fluids

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TI-NHTSA 013893

Attachment

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99

[redacted]

OVERVIEW OF CONCERN TIME LINE

OCT/NOV 98	DEC '98	JAN '99	FEB '99	FEB '99	MAR '99	APR '99	May '99
NHTSA initiates investigation	Supply chain dialogue	Core team momentum	TI Eng'r at Ford	Brake fluid fails to ignite	H20 corrosion ignites plastic	Ford NHTSA responds	Deploy results

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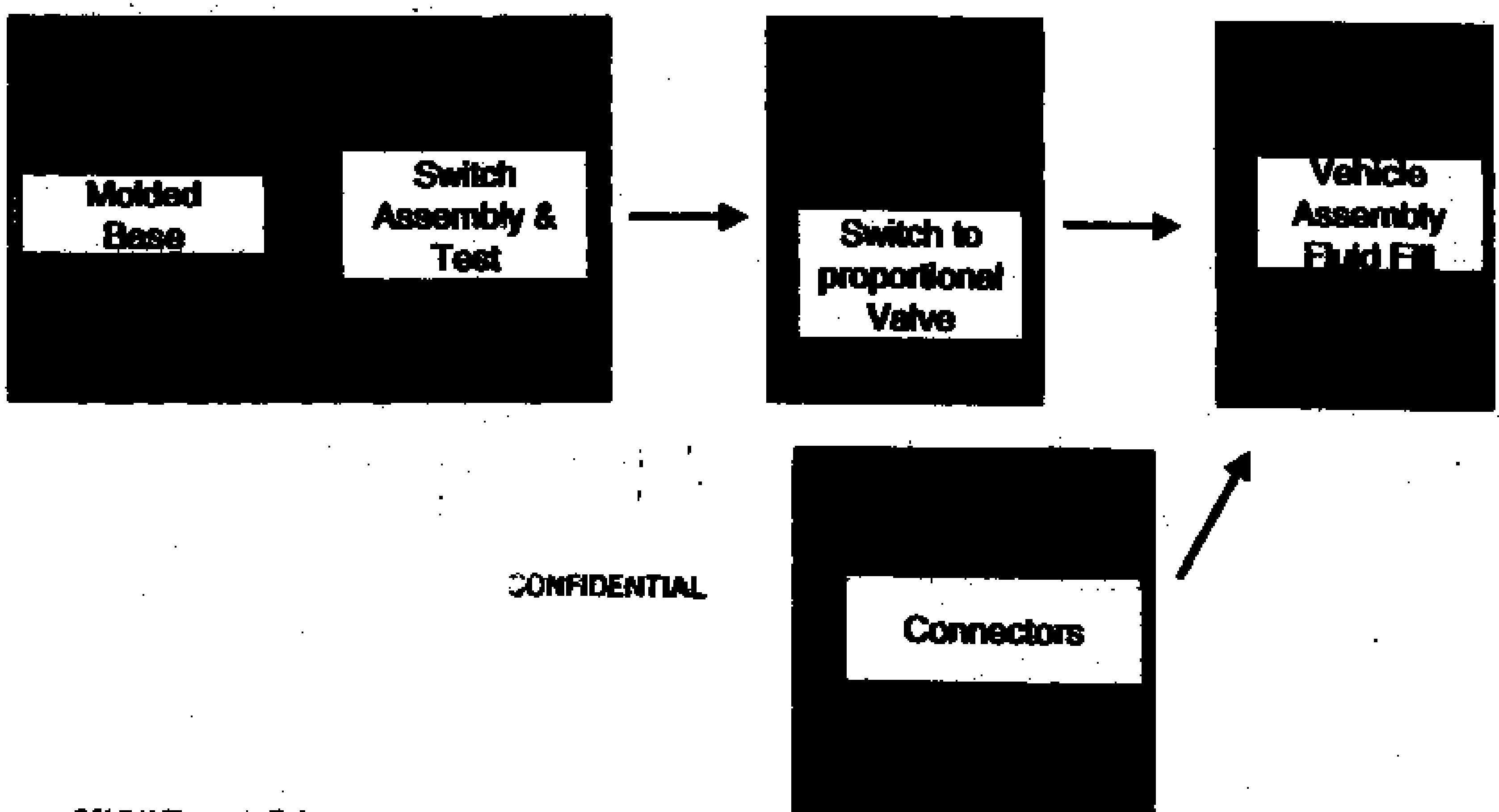
TI-NHTSA 013894

Attachment

Brake Switch Overview

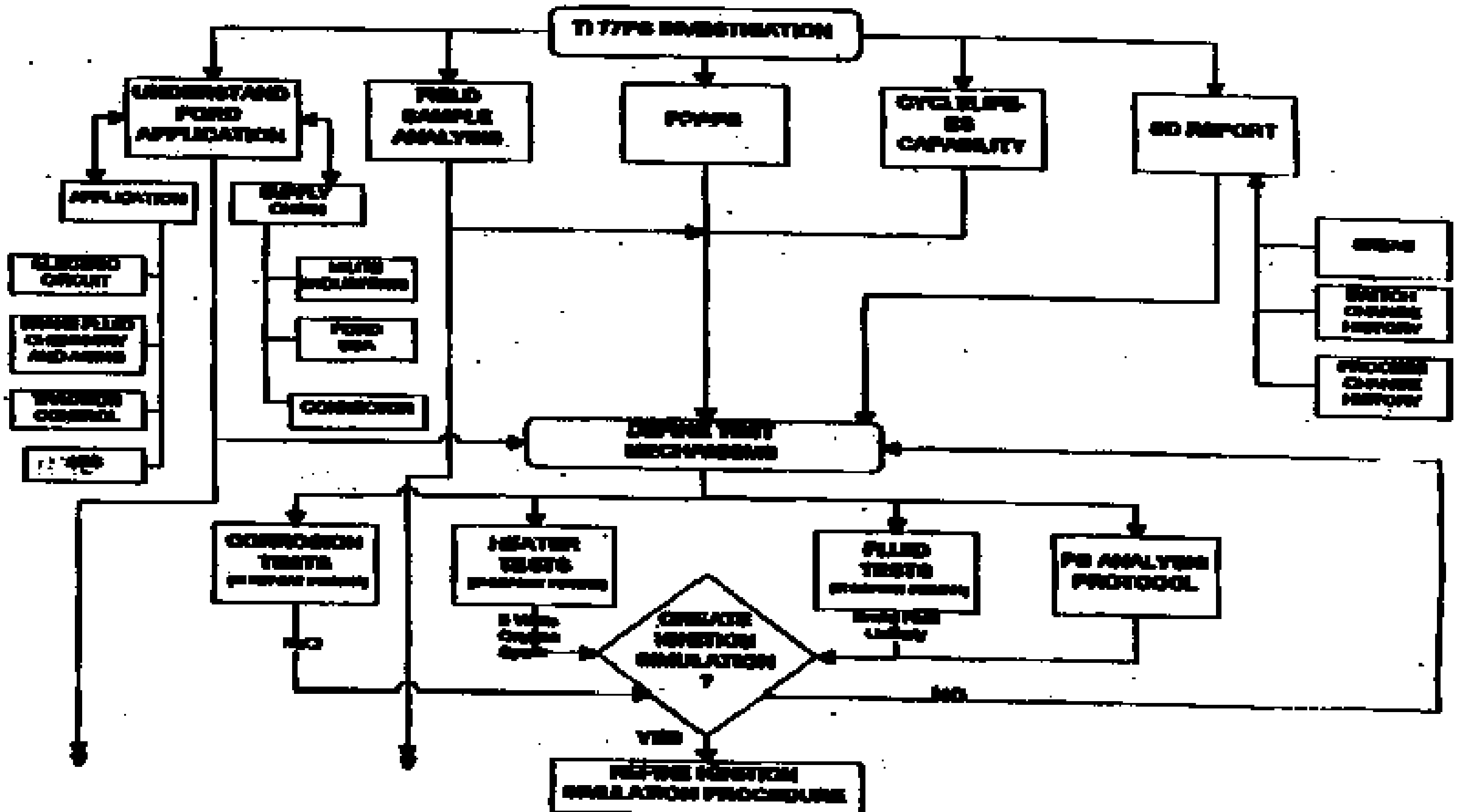
- Mounted under hood…14 inches under master cylinder
- Mounted on proportional valve at frame of vehicle
- Switch oriented approximately 25 degrees off vertical (connector up)
- Switch controls speed control…normally closed, opens at 130 psi
- Continuously powered by battery 15 amp connection

PRESSURE SWITCH "FLOW DIAGRAM" ('92, '93, TOWN CAR)



TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99



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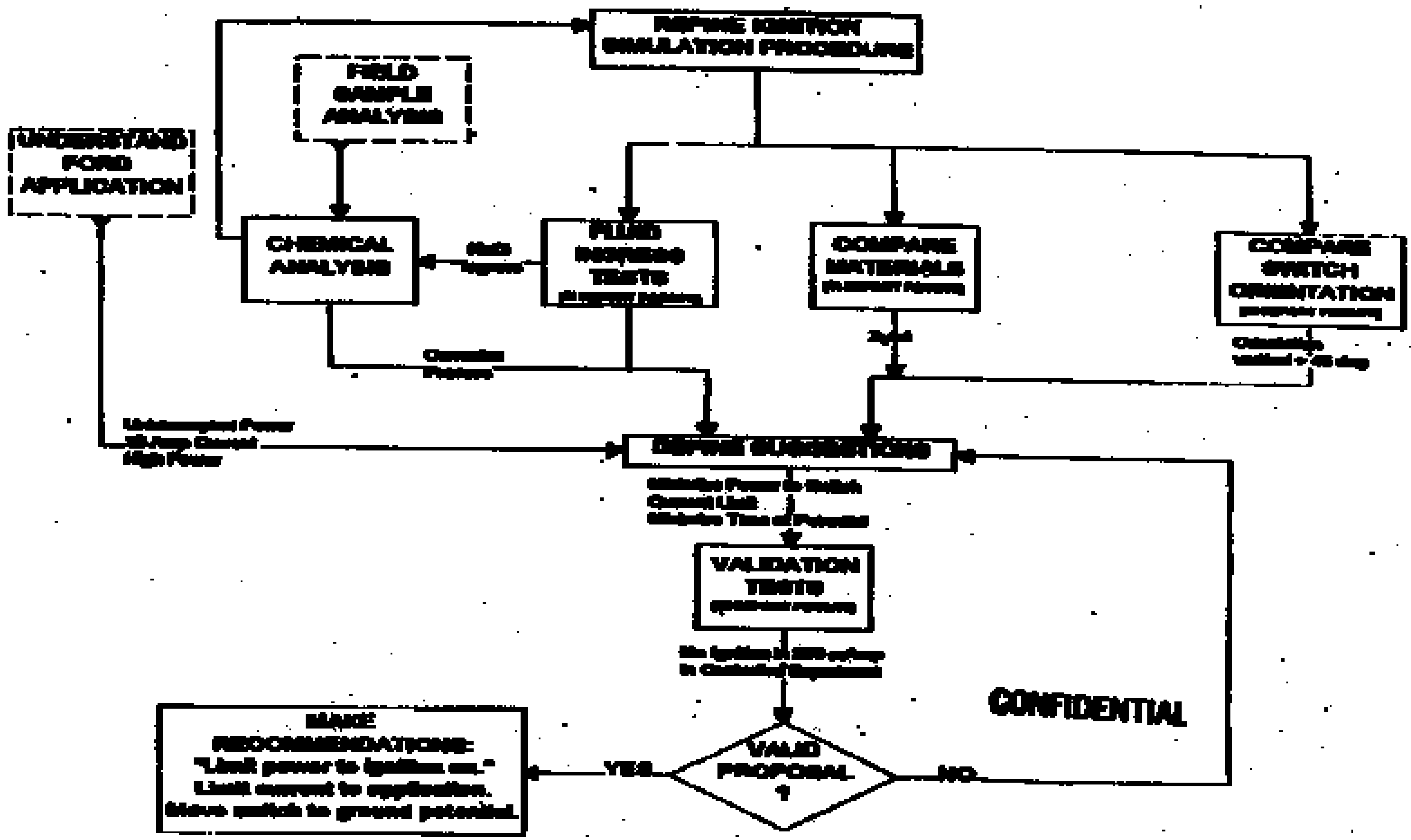
TI-NHTSA 013897

Attachment

Brake Pressure Switch
Potential Thermal Event Theory Profile 5/20/99

TEXAS INSTRUMENTS

[redacted]



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TINHTSA 013698

Attachment

Ford recalls 279,000 cars because of risk of cruise-control fires

05/19/1999
Associated Press Newswires

DEARBORN, Mich. (AP) - Ford Motor Co. has recalled 279,000 full-size cars because of a cruise-control switch that could short-circuit and cause a fire.

The recall affects the 1992 and '93 Lincoln Town Car, Mercury Grand Marquis and Ford Crown Victoria. About 10,900 of the recalled cars are in Canada.

There have been 147 reports of fires and two injuries attributed to the defect, Ford spokeswoman Karen Shaughnessy said Tuesday.

The automaker said it is still obtaining replacement switches. Until the switch can be fixed, customers should take their cars to their dealer and have the cruise control disabled, Ford said.

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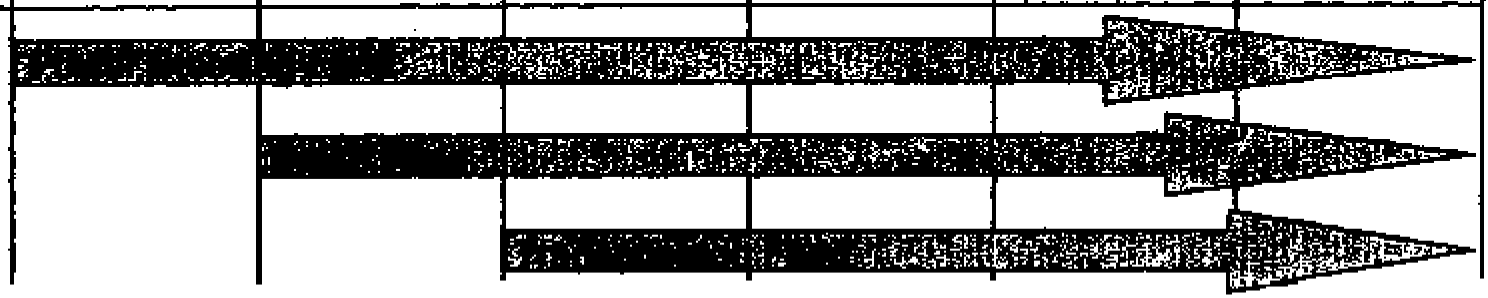
Brake Pressure Switch

Potential Thermal Event Theory Profile 5/20/99

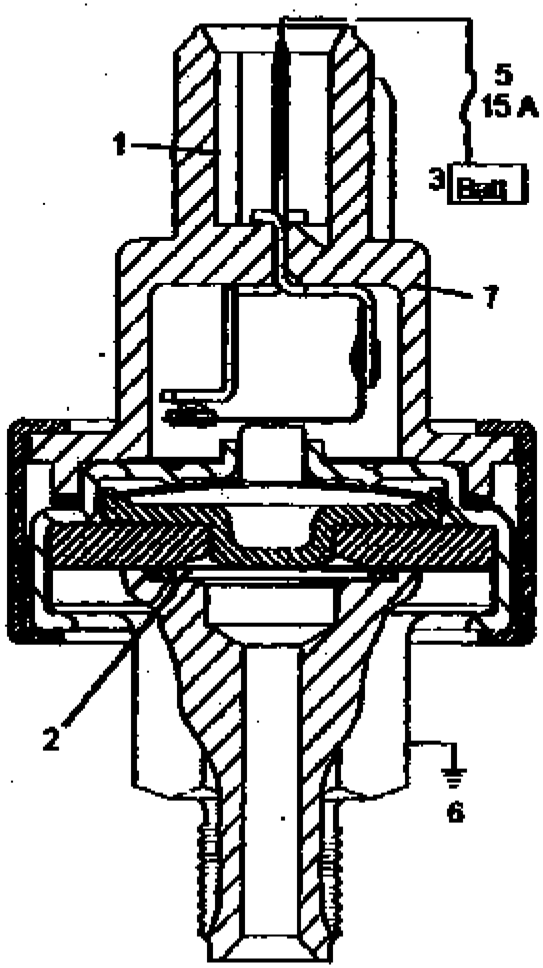
NA Hydraulic Switch History

Time Period:	'83	'87	'90	'91	'98	'99
Application:	Power Steering	Power Steering	Power Steering	Power Steering	Power Steering	Power Steering
		Suspension	Suspension	Suspension	Suspension	Suspension
			Transmission	Transmission	Transmission	Transmission
				Cruise	Cruise	Cruise
					Clutch	Clutch
Fluid:						



- TI has some 16 years and 130 million units accumulated experience in hydraulic applications using multiple fluids
- TI has some 12 years of brake system application experience working with brake fluids

Contributing Factors



1. Connector Seal
2. Kapton Life
3. Continuous Power
4. Switch Orientation
5. Current Capability
6. Grounded Hex-Port
7. Plastic Parameters

AGENDA

- CONTRIBUTING FACTORS AND ROBUST DESIGN DIALOGUE
- OVERVIEW TIME LINE
- SYSTEM OVERVIEW
  - SWITCH AND CONNECTOR
- IS / IS NOT TABLE
- CAUSE AND EFFECT DIAGRAMS
- THEORIES
  - BRAKE FLUID IGNITION
  - PLASTIC IGNITION
- TEST RESULTS
- CONTRIBUTING FACTORS AND ROBUST DESIGN DIALOGUE
- ROBUST DESIGN ALTERNATIVES

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

1. Connector Seal to P/S

2. Power continuously available
   A. Operator notifications

3. Switch orientation/location

4. Current limit / fuse

5. Hexport isolation

6. Plastic ignition robustness
   A. Nearby fuels

7. Kapton seal of P/S

8. Environmental seal of P/S

Attachment 1

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

OVERVIEW OF CONCERN TIME LINE

- **OCT/NOV 98** → NHTSA initiates investigation
- **DEC '98** → Supply chain dialogue
- **JAN '99** → Core team momentum
- **FEB '99** → TI Eng'r at Ford
- **FEB '99** → Brake fluid fails to ignite
- **MAR '99** → 1120 corrosion ignites plastic
- **APR '99** → Ford NHTSA responds
- **May '99** → Deploy results

Attachment

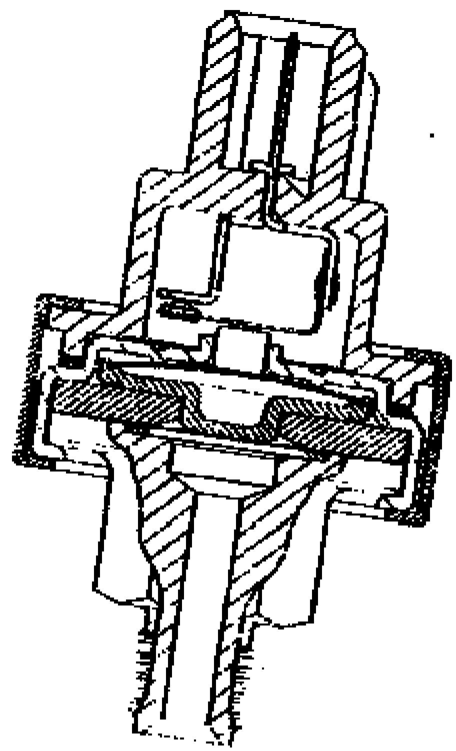
TI-NHTSA 013

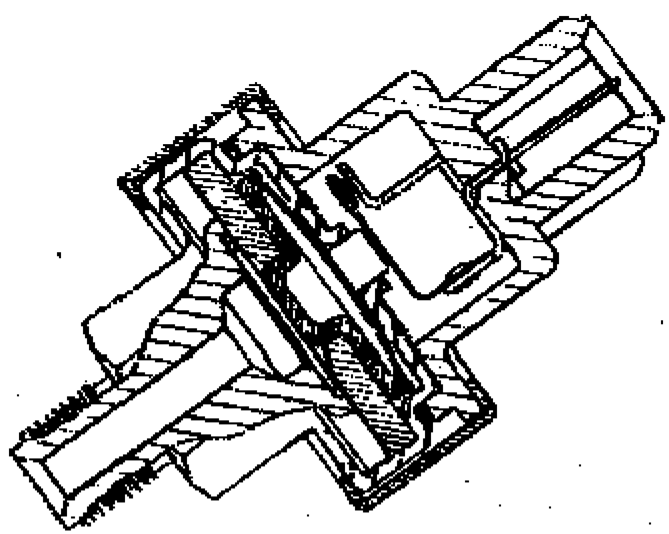
Brake Switch Overview

- Mounted under hood…14 inches under master cylinder
- Mounted on proportional valve at frame of vehicle
- Switch oriented approximately 25 degrees off vertical (connector up)
- Switch controls speed control…normally closed, opens at 130 psi
- Continuously powered by battery 15 amp connection

TEXAS INSTRUMENTS

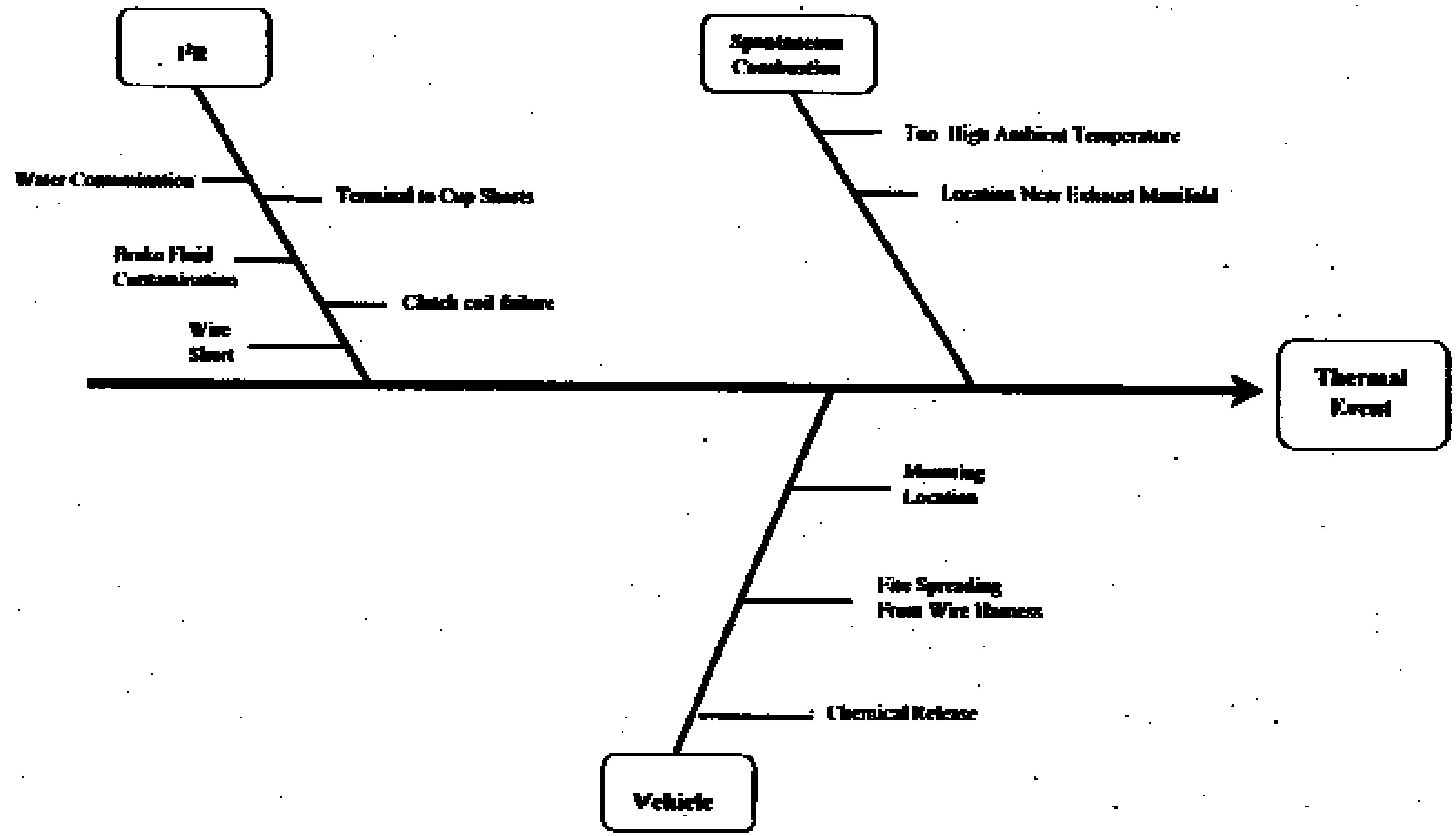
Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99





TEXAS INSTRUMENTS

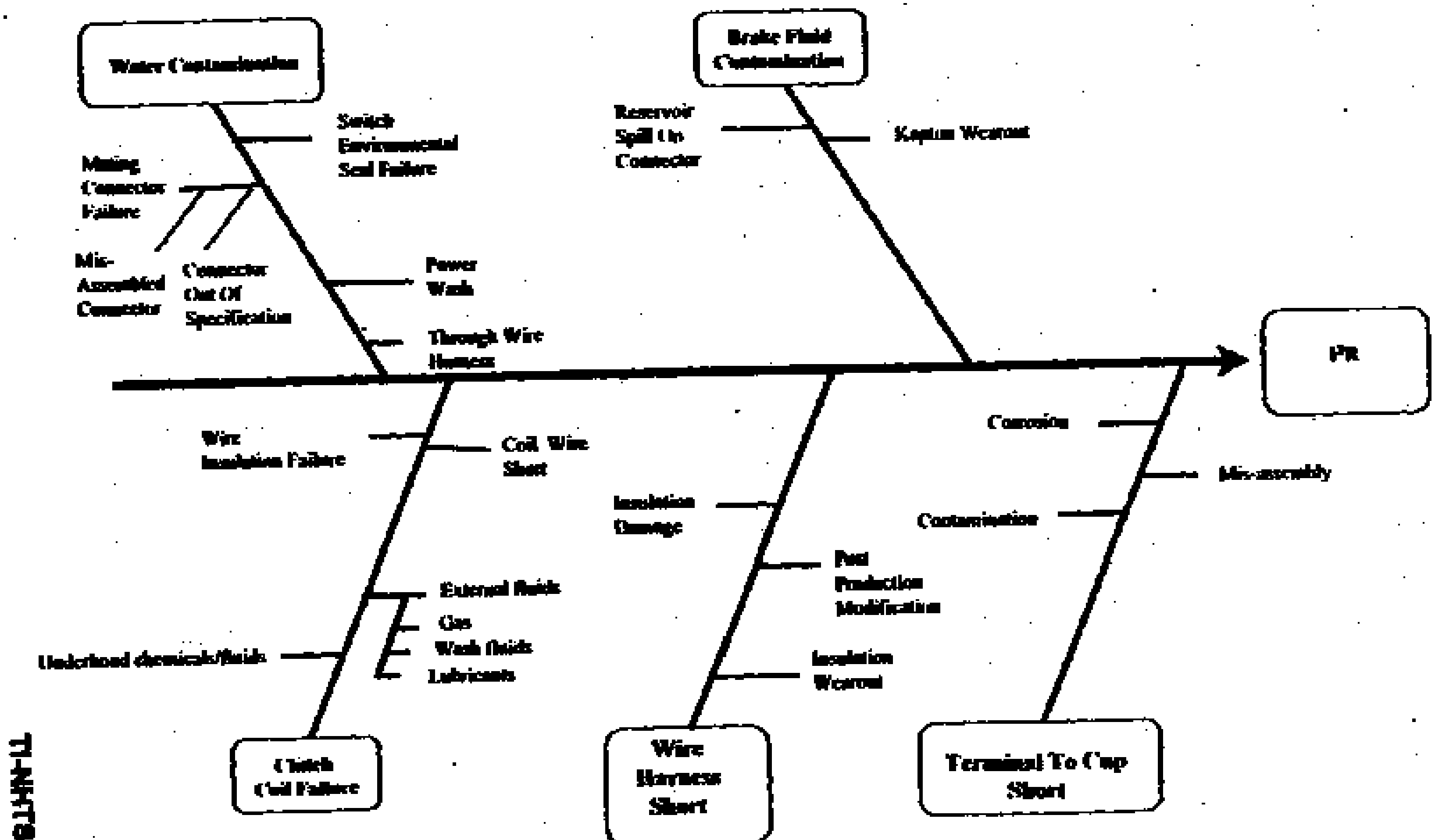
Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99



TI-NHTSA 013708

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

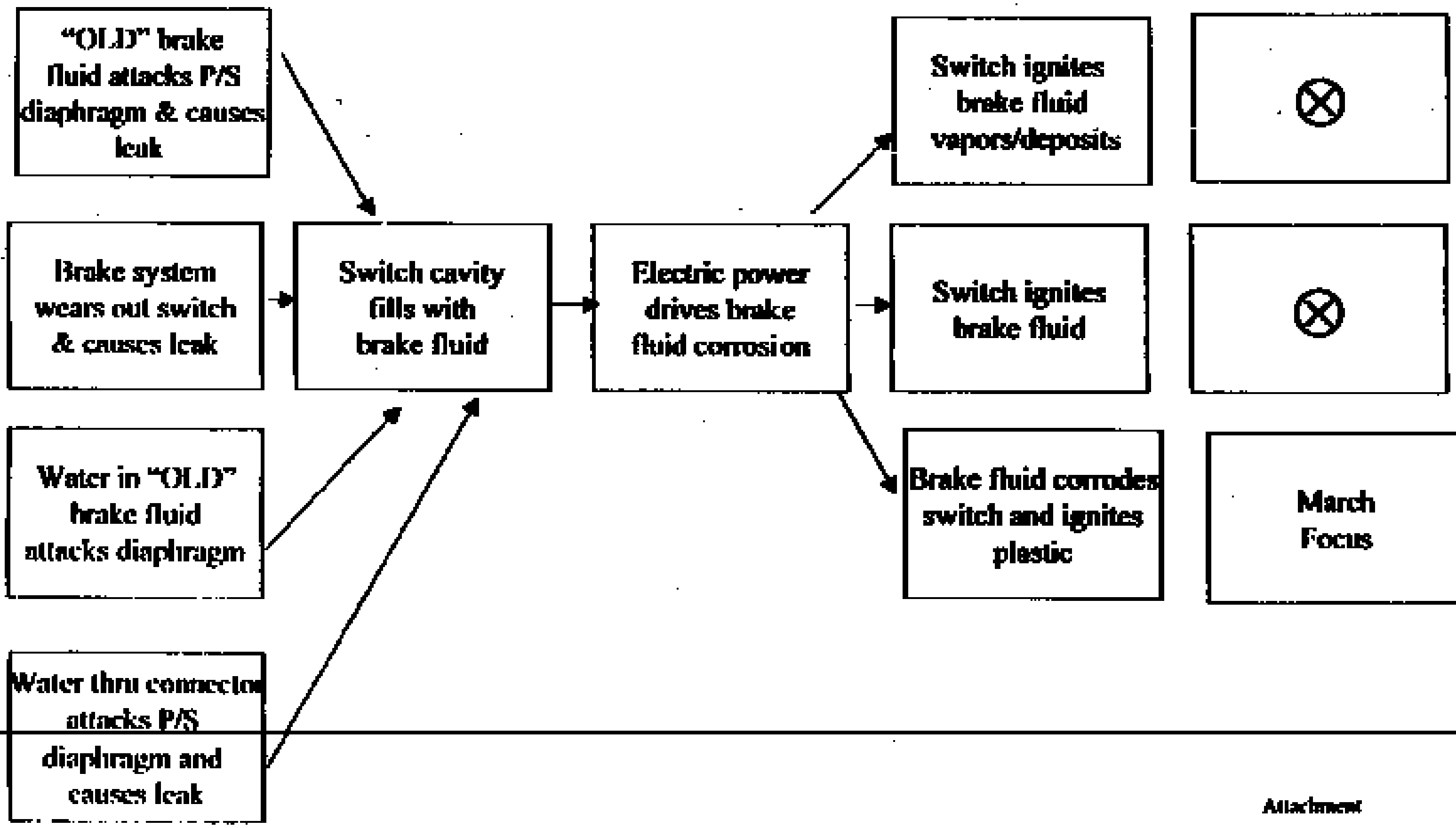


SEE EXCEL SPREADSHEET

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

REFINED BRAKE FLUID IGNITION THEORY
POSSIBLE CAUSE THEORIES
"FEB '99 FOCUS"



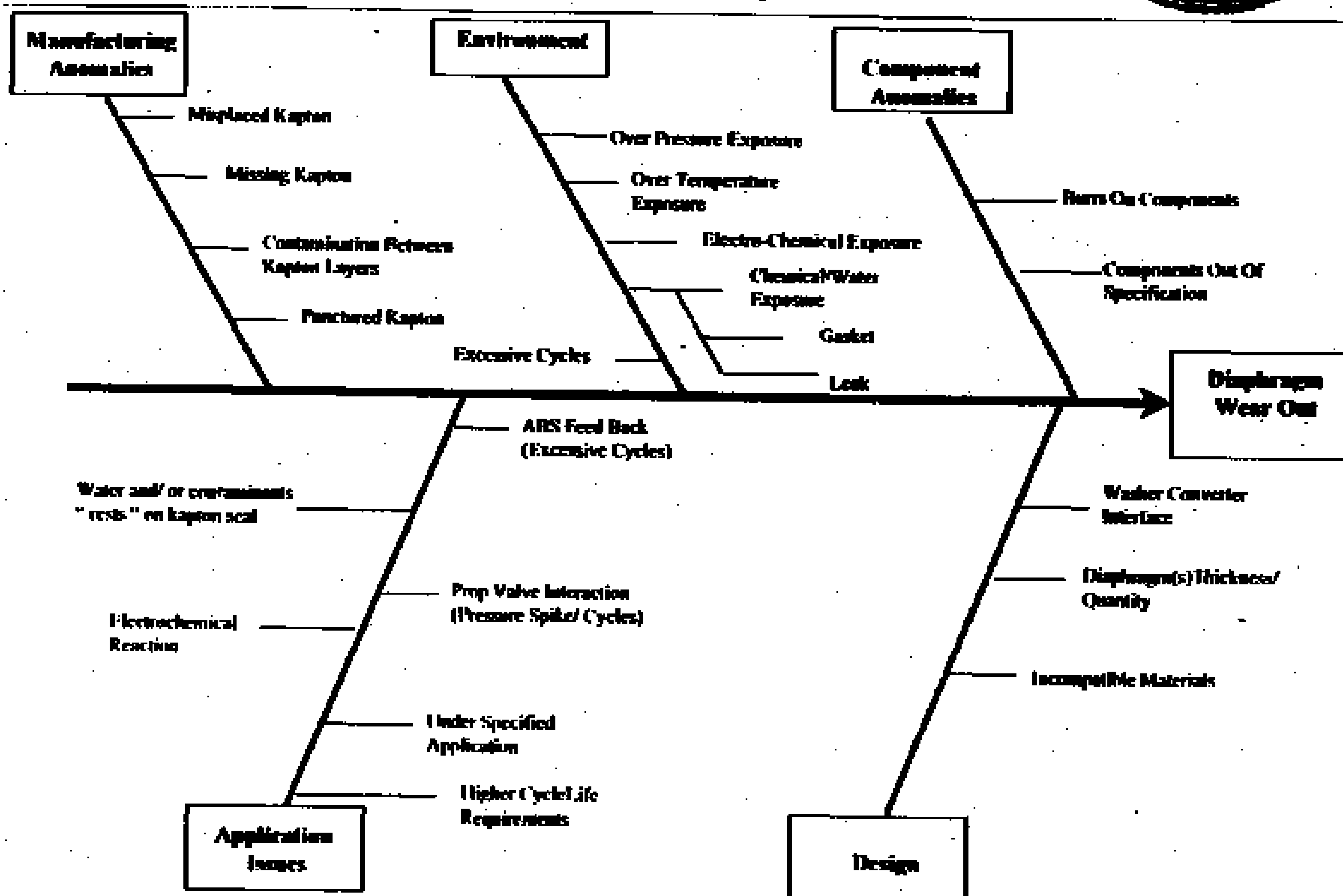
Attachment

TI-NHTSA 013711

- TI and Ford not successful in creating ignition with "new" brake fluids

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99



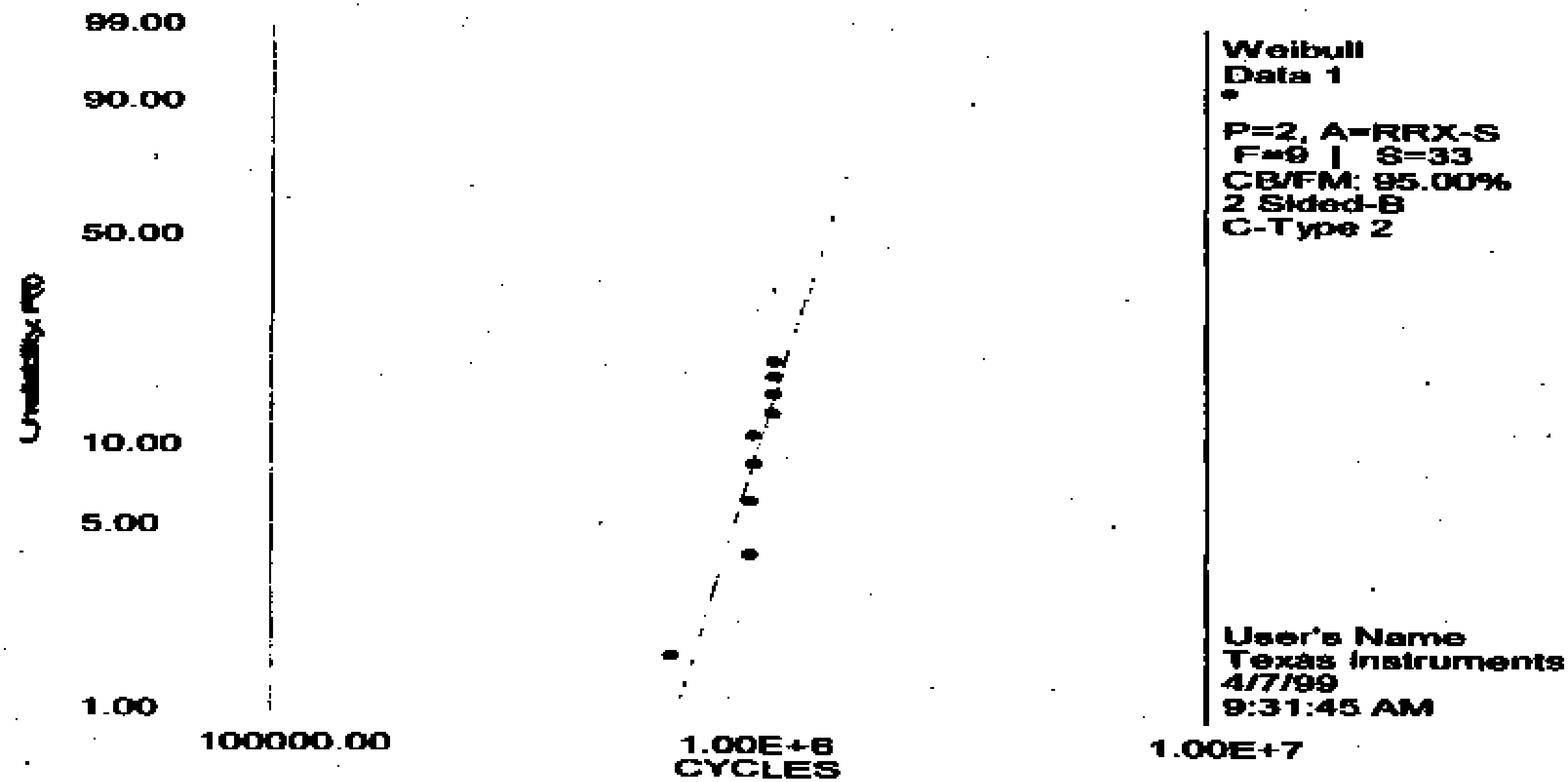
TI-NHTSA 013713

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

Generated by: ReliaSoft's Weibull++ 5.0 - www.Weibull.com - 888-886-0410

77PSL2-1 COMBINED DATA



$\beta = 5.83$, $\eta = 1.64E+6$, $\rho = 0.91$

TI-NHTSA 013714

TEXAS INSTRUMENTS

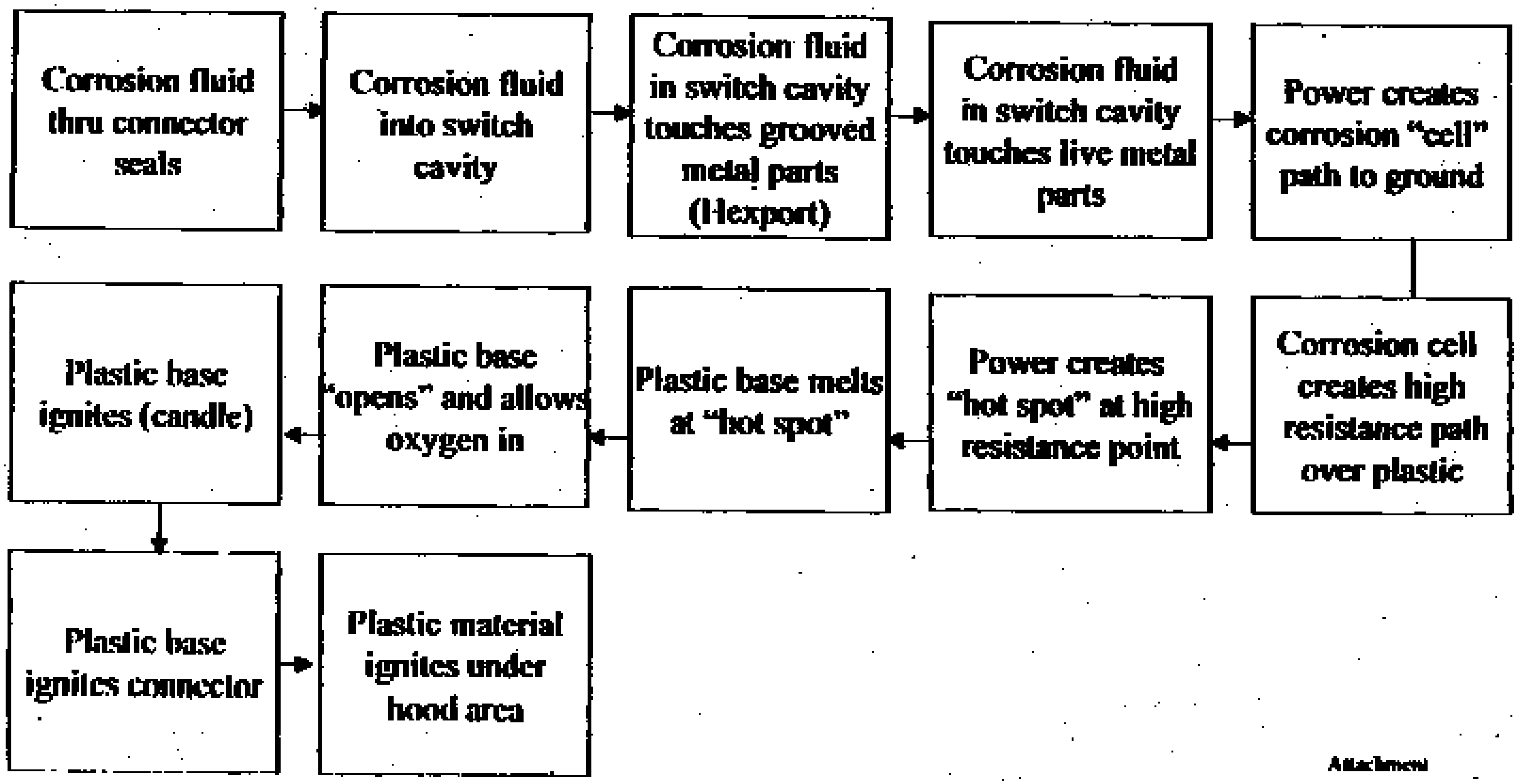
Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

- "Town Car" switch meets accelerated/simulated life cycle specification shown by "success" and "end-of-life" testing

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

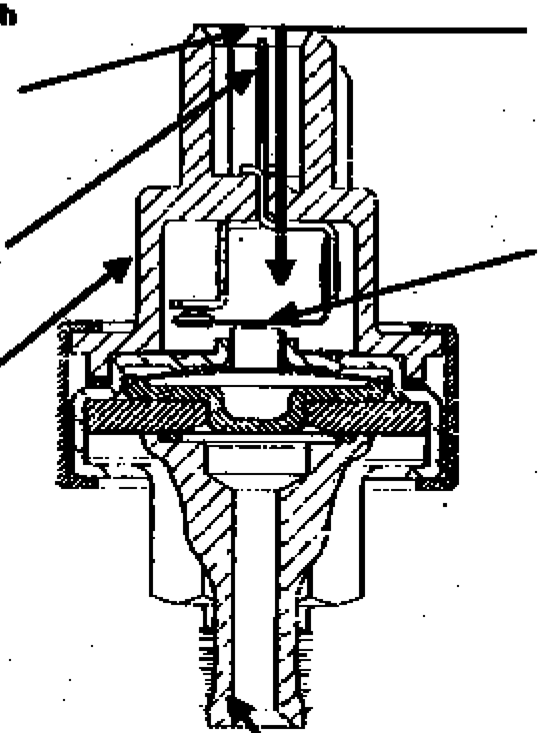
PROCESS FLOW DIAGRAM
"CORROSION" POTENTIAL CAUSE FLOW ANALYSIS



Attachment

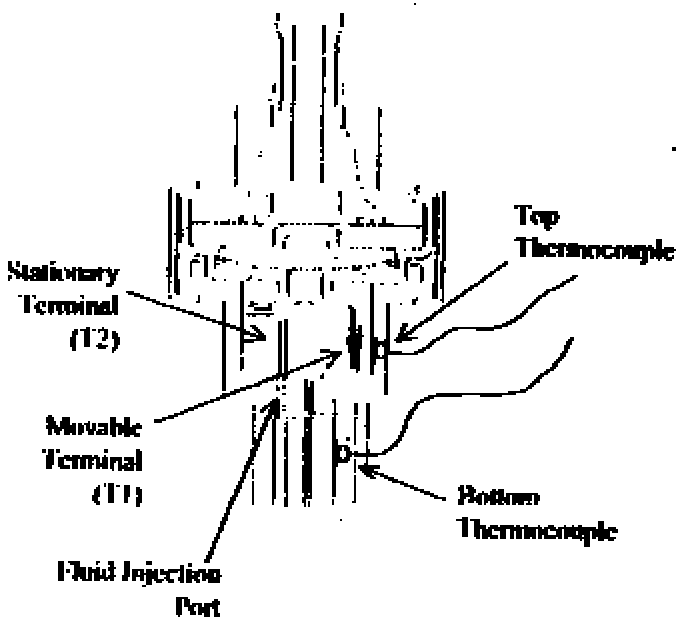
TEXAS INSTRUMENTS

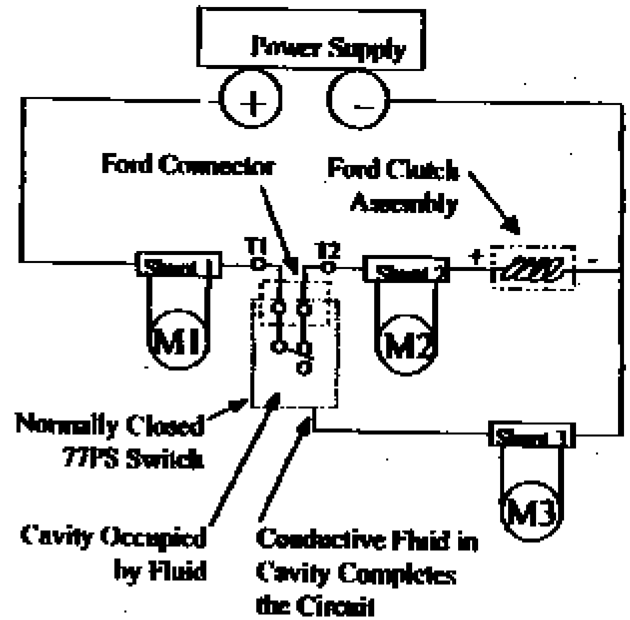
Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99



Attachment 2

5% Salt Water Ingress Experiment
Test 1





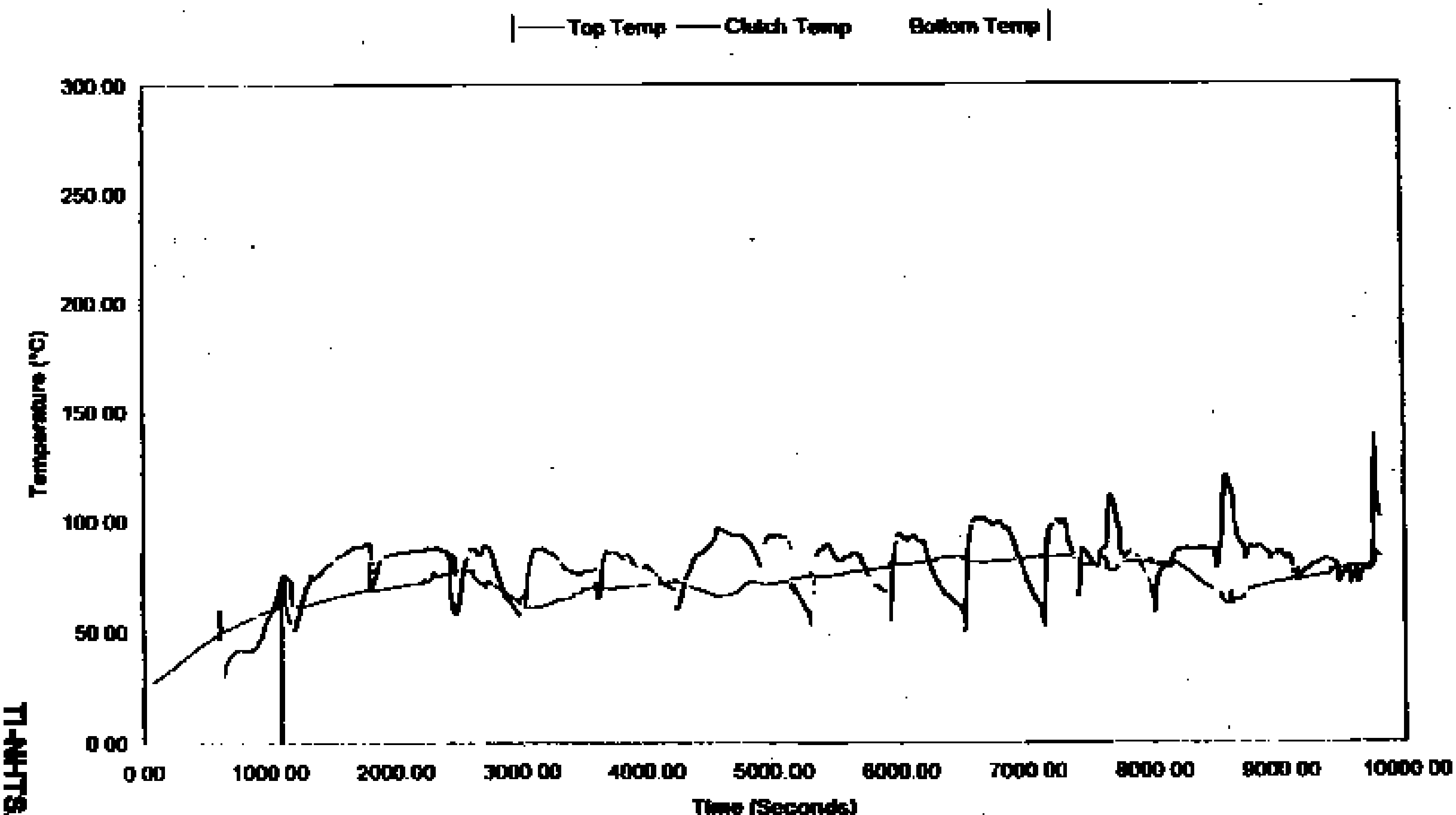
TI Report PS/99/12
03/15/99

Test 1: Figure 1 and Figure 2.

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

5% Salt Water Ingress Experiment
Temperature vs. Time

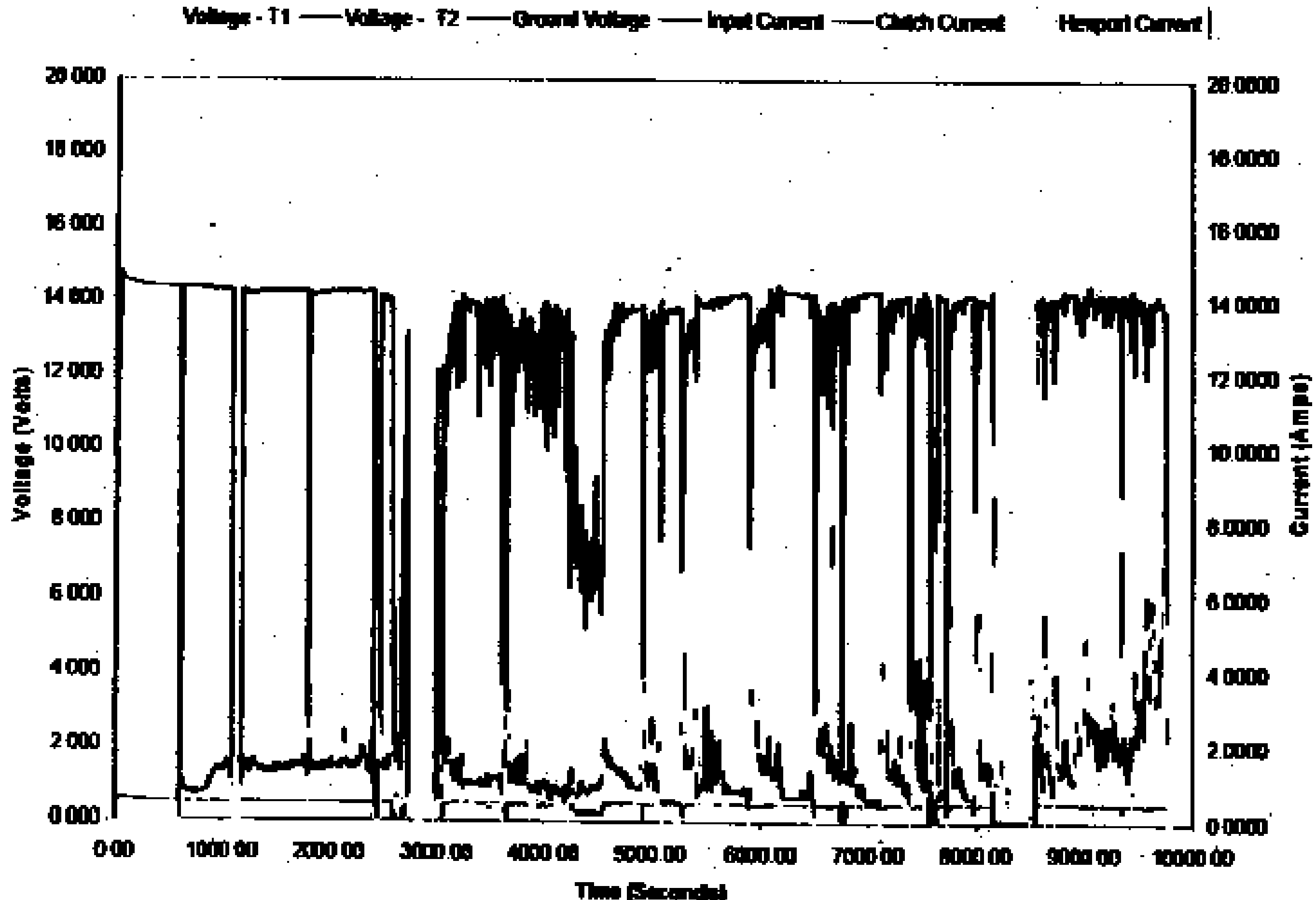


TI-NHTSA 013719

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

6% Salt Water Ingress Experiment



TI-NHTSA 013720

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

77PS
45° Orientation in 15 Amp Circuit
5% Salt Water Ingress

Cellanex 4300 Base

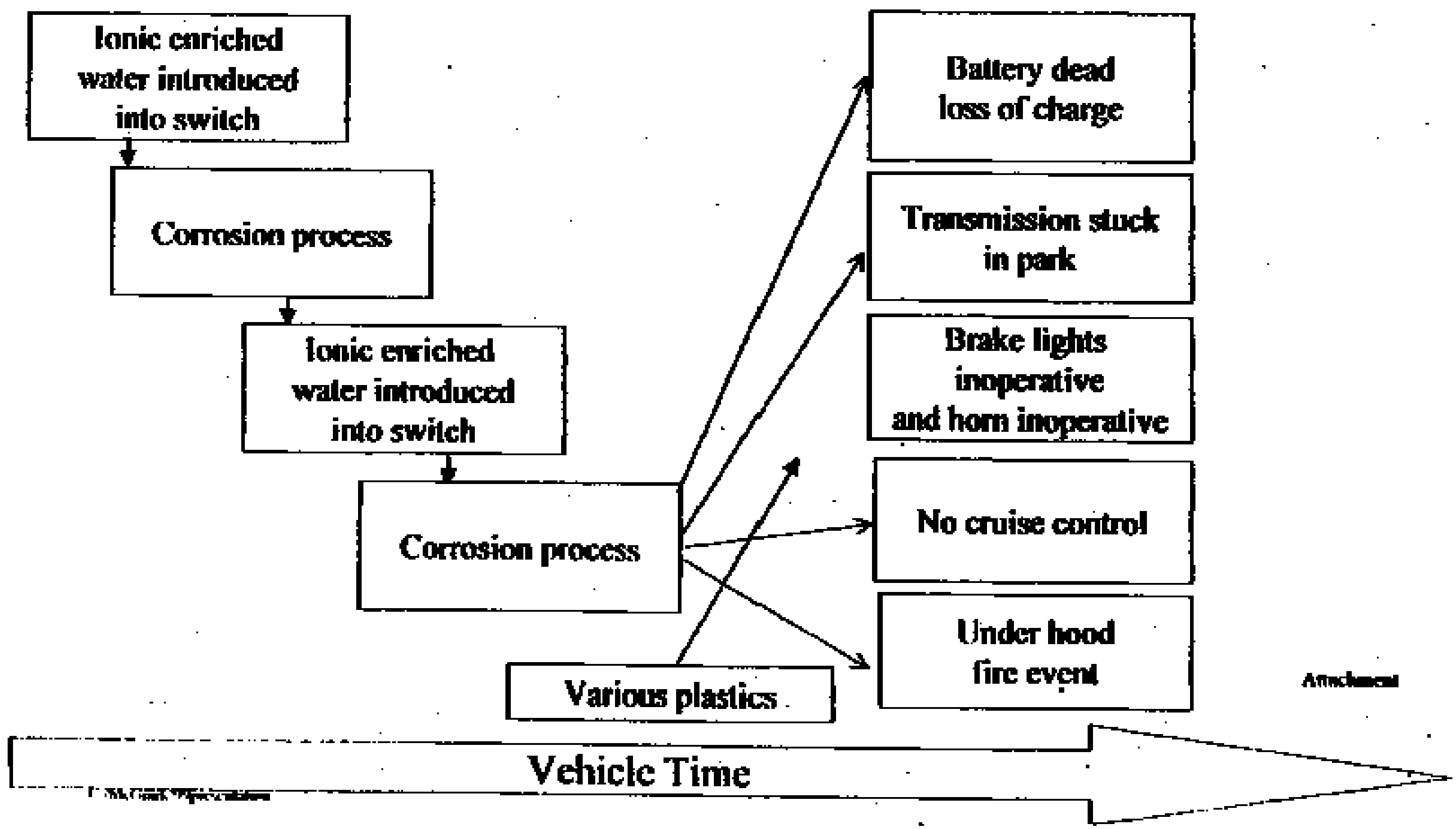
Cellanex 3316 Base

1 [illegible]

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

"Corrosion" potential cause time line
Theory Time Line

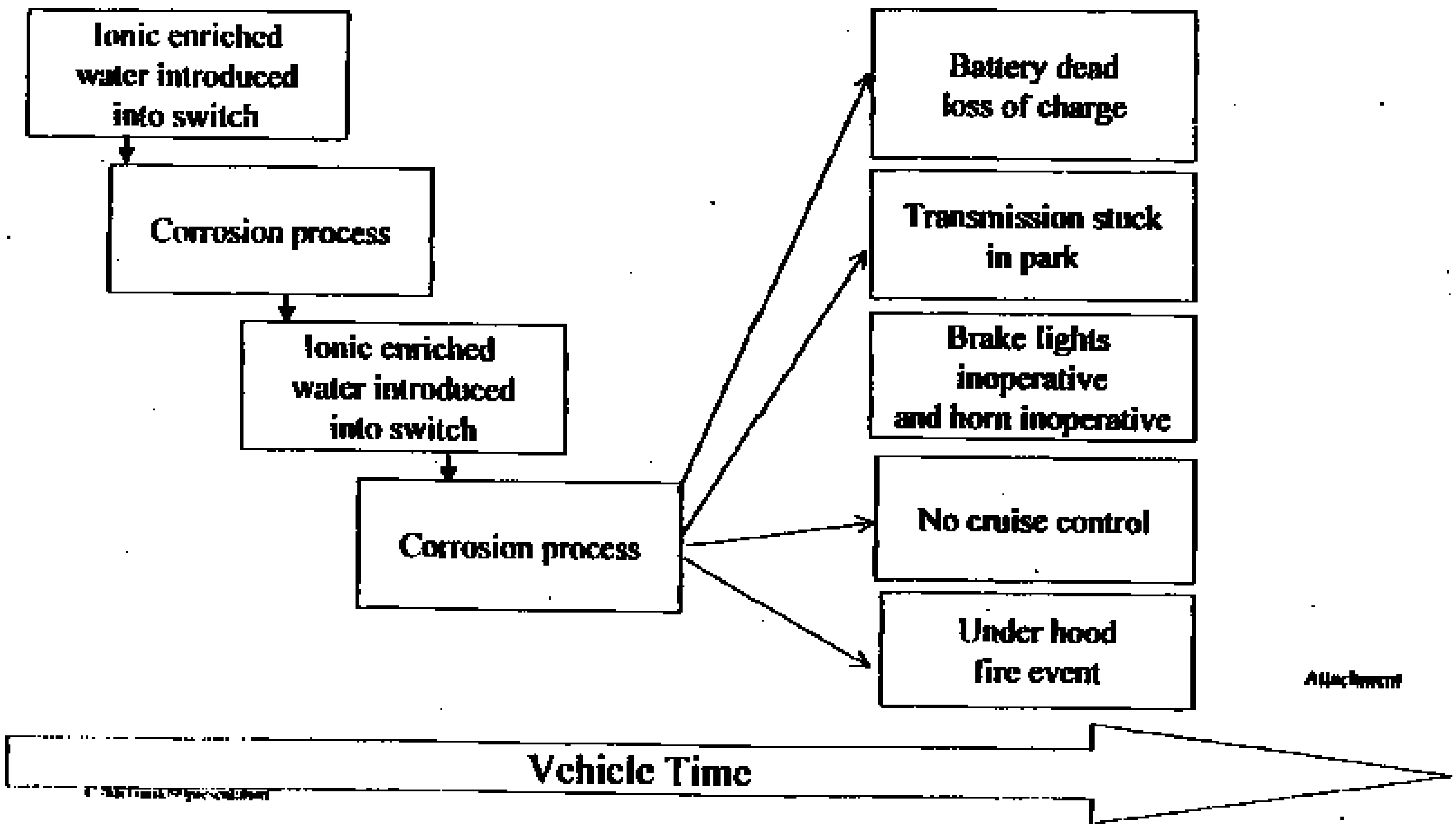


Attachment

Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

"Corrosion" potential cause time line
Theory Time Line



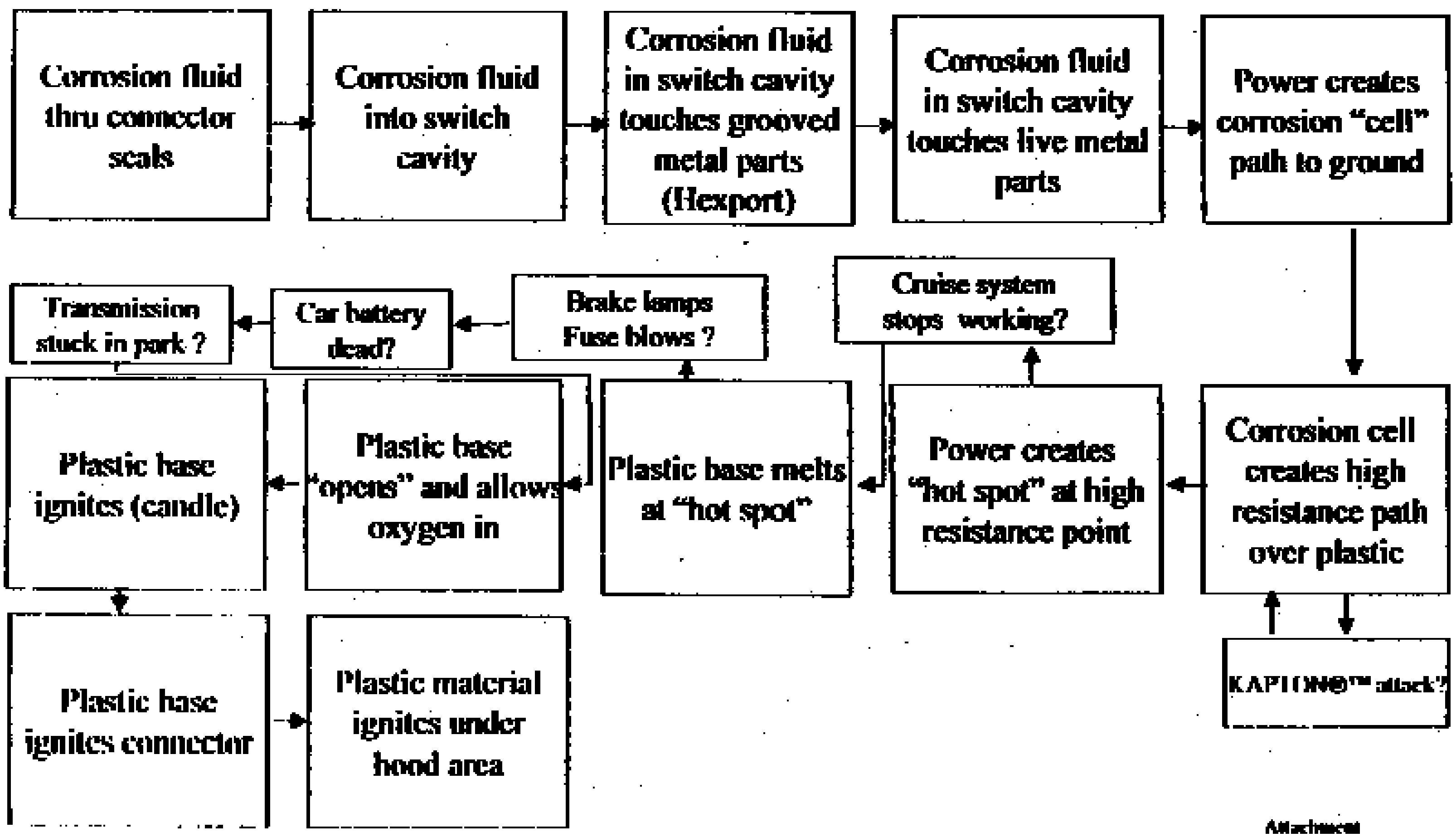
Attachment

TI-NHTSA 013723

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

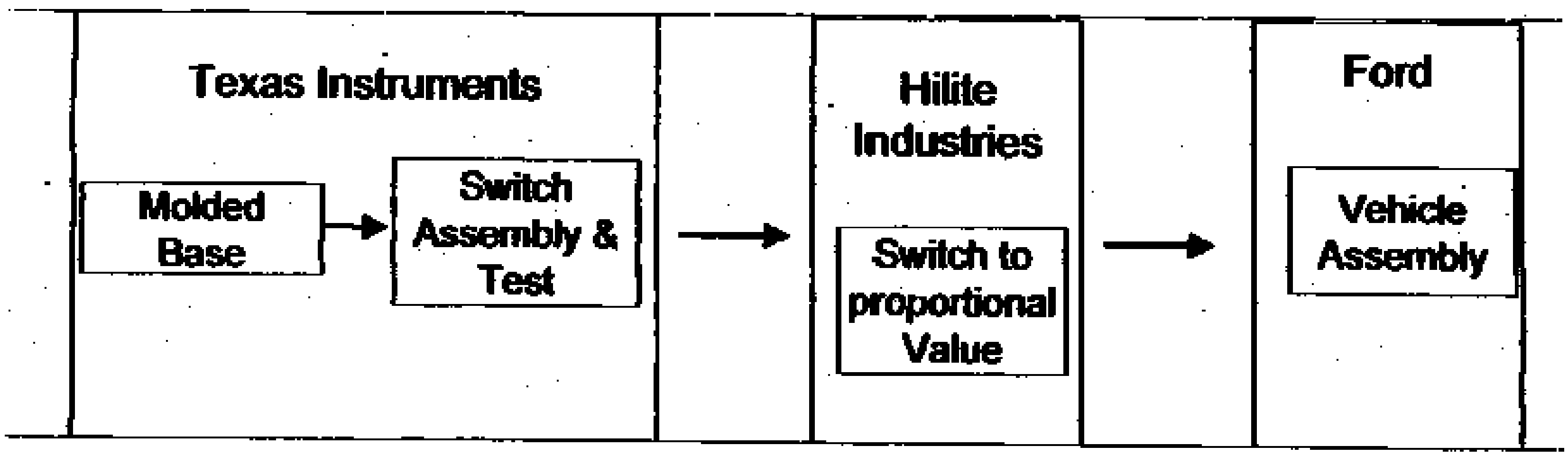
PROCESS FLOW DIAGRAM
"CORROSION" POTENTIAL CAUSE FLOW ANALYSIS



Attachment

TI-NHTSA 013724

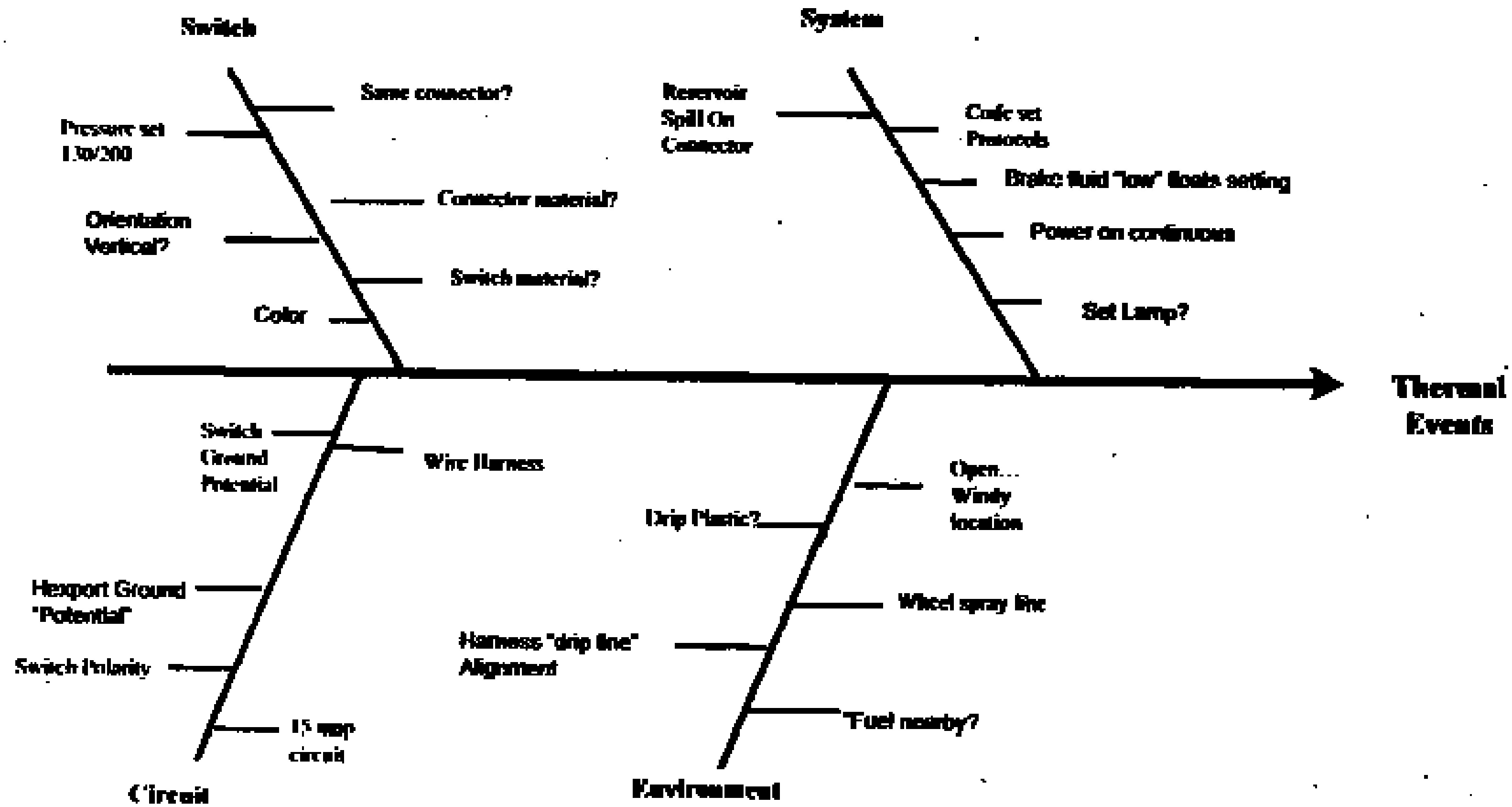
PRESSURE SWITCH "FLOW DIAGRAM"
('92, '93, '94 TOWN CAR)



Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

ECONOLINE VS. TOWN CAR P/S



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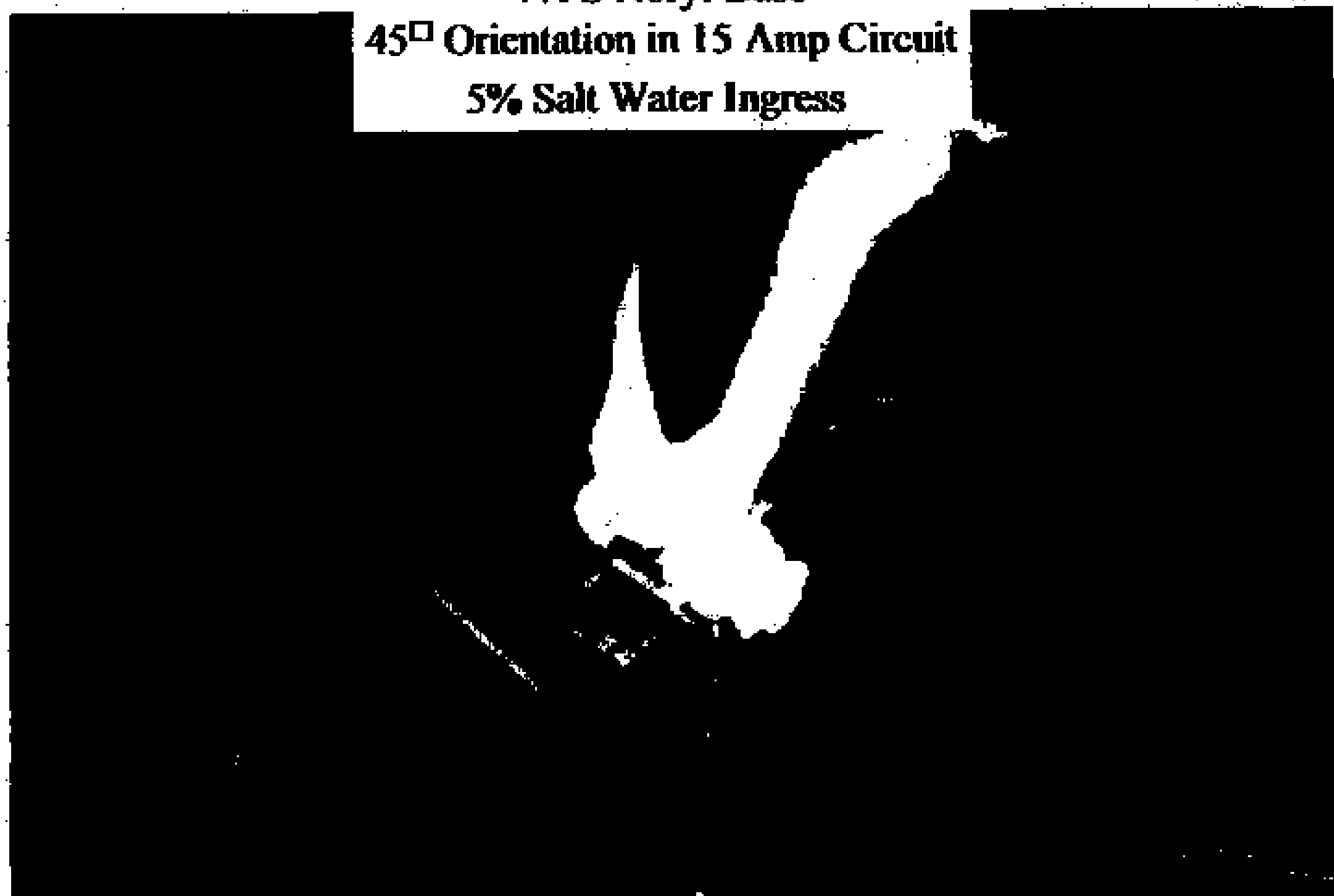
Texas Instruments

Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

77PS Noryl Base

45° Orientation in 15 Amp Circuit

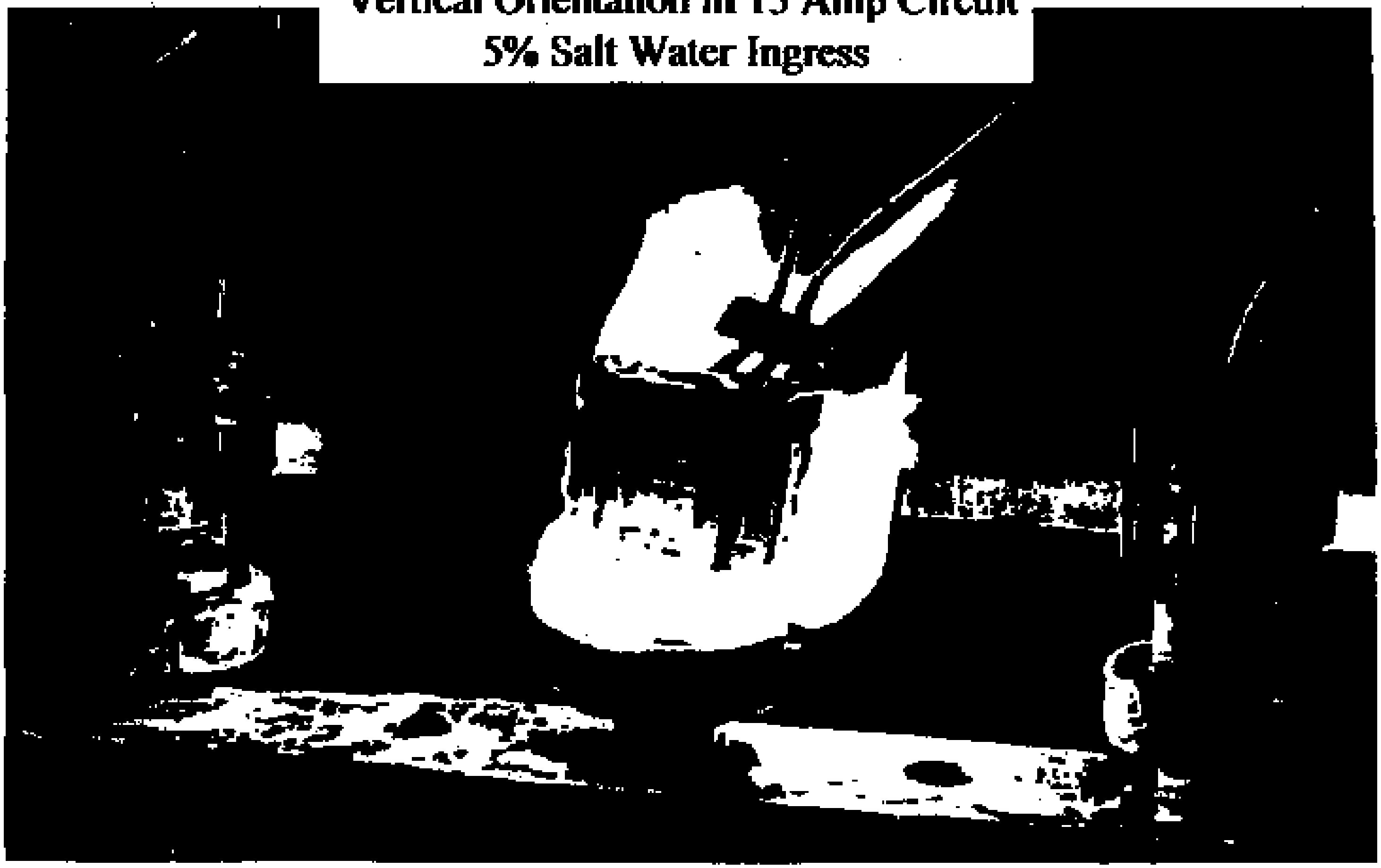
5% Salt Water Ingress



TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

77PS Cellanex 4300 Base
Vertical Orientation in 15 Amp Circuit
5% Salt Water Ingress

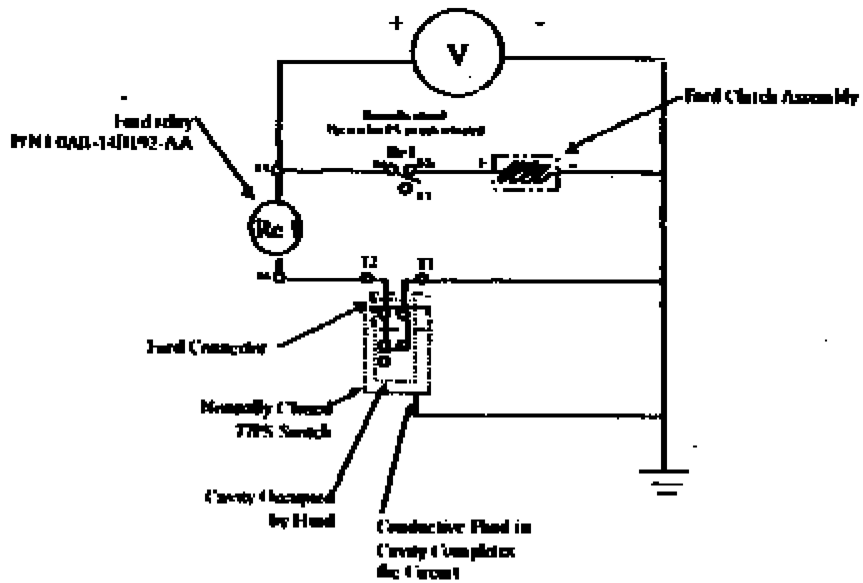


Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

TEXAS INSTRUMENTS

TTPS Proposed Wiring Schematic

14 Volts DC



Brake Pressure Switch
Potential Thermal Event Theory Profile 4/14/99

1. Connector Seal to P/S

2. Power continuously available
   A. Operator notifications

3. Switch orientation/location

4. Current limit / fuse

5. Hexport isolation

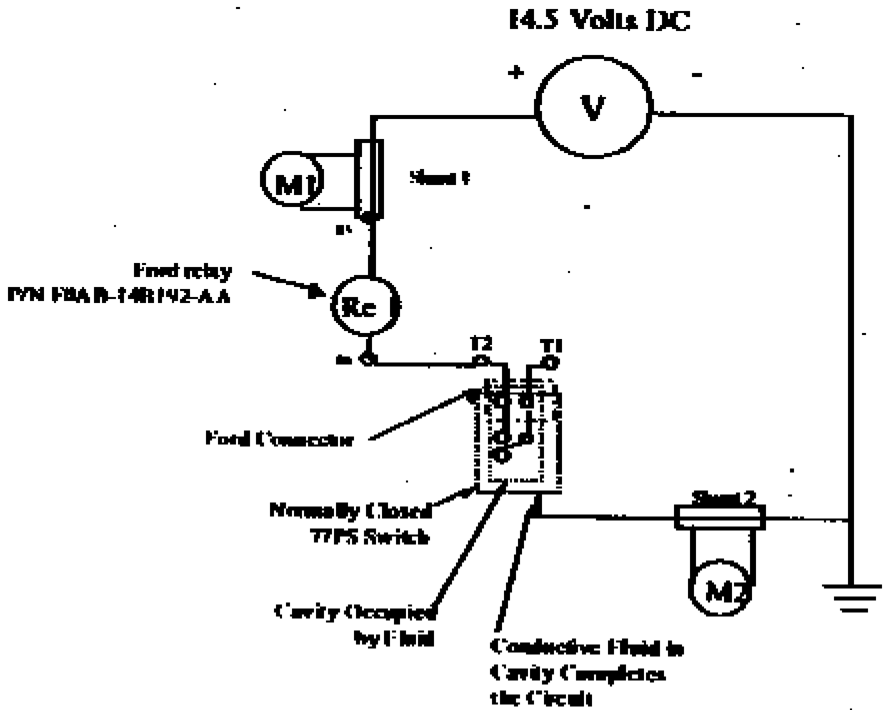
6. Plastic ignition robustness
   A. Nearby fuels

7. Kapton seal of P/S

8. Environmental seal of P/S

Attachment 1

200 mAmp Current Limit Circuit
Test Setup



Worst case scenario is when the switch is actuated, which puts T2 at full voltage.
To facilitate testing, TI is floating which keeps TI and T2 at full voltage but limits current draw to .2 Amps (This test is harsher than worst case scenario).

77ps2-1		GROSS QTY		COMPLETE	COMPLETE	BEGIN	IMPACT	COMMENTS/CONCERNS
COMPONENT	DESCRIPTION	REQUIRED	SUPPLIER	1WK	2WK	PARTIAL	TO TI	
27406-1	CONVERTER	2,040,000	KF BASSLER	10 WKS	18 WKS	2 WKS	NONE	ADD OVERTIME/MATERIAL AVAILABILITY
27639-1	WASHER / ARA	2,040,000	DIEMASTER	10 WKS	18 WKS	2 WKS	NONE	MATERIAL AVAILABILITY
27713-1	CUP 77PS	2,040,000	VALENTINE	6 WKS	10 WKS	1 WK	NONE	RAW MATERIAL AVAILABILITY
36656-27	57PS	2,040,000	DISC DEPT	12+ WKS	24 WKS	3 WKS	TOOL $?	POSSIBLE CAPACITY ISSUE
36900-1	HEXPORT 77PS	2,040,000	ELCO	10 WKS	25 WKS	3 WKS	NONE	RAW MATERIAL AVAILABILITY
74224-1	KAPTON	204	EI DUPONT	2 WKS	2 WKS	2 WKS	NONE	
27225-1	KAPTON STRIP	1,102	EI DUPONT	3 WKS	3 WKS	2 WKS	NONE	
74353-1	GASKET	2,040,000	JHL PARKER	8 WKS	18 WKS	3 WKS	NONE	ELIMINATE CORES WILL INCREASE DEL. BY 10%
36888-1	STATIONARY T	2,040,000	KF BASSLER	10 WKS	18 WKS	2 WKS	NONE	ADD OVERTIME/MATERIAL AVAILABILITY/ REELS
28744-1	CONTACT-SILV	2,040,000	DERRINGER	4 WKS	8 WKS	1 WK	NONE	MATERIAL AVAILABILITY
36887-1	MOVABLE TERM	2,040,000	KF BASSLER	10 WKS	18 WKS	2 WKS	NONE	ADD OVERTIME/MATERIAL AVAILABILITY/REELS
27736-1	BE/CU ISSUE	449	BRUSH WELLMAN	1 WK	2 WKS	1 WK	NONE	NONE
74916-1	RIVET	2,040,000	JOHN HASSAL	8 WKS	11 WKS	4 WKS	NONE	RAW MATERIAL AVAILABILITY
46515-2	PRESSURE SWI	2,040,000	MAT/MOLDING	16 WKS	32 WKS	4 WKS	NONE	RAW MATERIAL CHANGEOVER/PRESS CAPACITY
74078-143	CERAMIN PINS	2,040,000	PARATECH	7 WKS	15 WKS	2 WKS	NONE	
74247-4	BLUE O'RINGS	2,040,000	JHL PARKER	6 WKS	10 WKS	2 WKS	NONE	ELIMINATE CORES WILL INCREASE DEL. BY 10%
74797-1	CRIMP RING	2,040,000	VALENTINE	6 WKS	10 WKS	1 WK	NONE	RAW MATERIAL AVAILABILITY
74888-1	RED THREAD C	2,040,000	MARK IV CAPLUG	3 WKS	6 WKS	1 WK	NONE	

77PS SWITCH TI 7/15,8/1,8/1 250K/MONTH 7 day weeks, thru summer vacations, 'std' plastic mold

TI-NHT9A 013733

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 3/24/99

AGENDA

- CONTRIBUTING FACTORS AND ROBUST DESIGN DIALOGUE
- OVERVIEW TIME LINE
- SYSTEM OVERVIEW
  - SWITCH AND CONNECTOR
- IS / IS NOT TABLE
- CAUSE AND EFFECT DIAGRAMS
- THEORIES
  - BRAKE FLUID IGNITION
  - PLASTIC IGNITION
- TEST RESULTS
- CONTRIBUTING FACTORS AND ROBUST DESIGN DIALOGUE
- ROBUST DESIGN ALTERNATIVES

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 3/24/99

1. Connector Seal to P/S

2. Power continuously available

3. Switch orientation

4. Current limit / fuse

5. Hexport isolation

6. Plastic ignition robustness

7. Kapton seal of P/S

8. Environmental seal of P/S

Attachment 1

TEXAS INSTRUMENTS

Brake Pressure Switch
Potential Thermal Event Theory Profile 3/24/99

OVERVIEW OF CONCERN TIME LINE

OCT/NOV 98	DEC '98	JAN '99	FEB '99	FEB '99	MAR '99	APR '99	May '99
NHTSA initiates investigation	Supply chain dialogue	Core team momentum	TI Eng'r at Ford	Brake fluid fails to ignite	H20 corrosion ignites plastic	Ford NHTSA responds	Deploy results

Attachment

Brake Switch Overview

- Mounted under hood…14 inches under master cylinder
- Mounted on proportional valve at frame of vehicle
- Switch oriented approximately 25 degrees off vertical (connector up)
- Switch controls speed control…normally closed, opens at 130 psi
- Continuously powered by battery 15 amp connection