COMMUNICATIONS

Name / Project: MARK McAlees for Dan Fairley
Company / Department: DuPont
Address: OHIO FRED PORTER
Phones: 740-470-0725

What is Delamination Temp?	Melt pt 268°C [illegible] (514°F)
How can I induce brittleness (in KAPTON) [illegible]?	Two [illegible] "Change in/Temperature" 240°C (464°F) [illegible] years dr 5% 350°C 6 days 1% 450° 2 hours 1% KAPTON layer
Corona Treatment Started?	25 years
Processing changes?	Nothing. Definitely not in the 1990's
Has there been any changes to materials composition or manufacturing process since 1990?	1983-4 INORGANIC [illegible] ADDITIVE. ODA & PMDA 1983 release no changes
500HN FN131L for Auto?	ADDITIONAL INSPECTION Yes 15/20 years
Is it suitable for use with DOT3 Brake Fluid?	ethylene glycol on FEP @ 400°F no degradation
Is there test results for Brake Fluid compat?	"
	MARK TO CALL BACK WITH CHANGE HISTORY etc. 4/28

DUPONT

CIRCLEVILLE PLANT
P.O. Box 89
Circleville, OH 43113
HPF - SP Resin

Date 2/23/99

FACSIMILE TRANSMISSION COVER SHEET

ADDRESSEE(S):

NAME	COMPANY/BUSINESS/GROUP	FAX NUMBER
BRIAN DIGG	T.I	508-236-3586

SENDER:	BUSINESS SECTOR	LOCATION
MARK McALEES		

Total Number of Pages (Including Cover Sheet) 2

DuPont, Circleville HPF - SP Resin Fax No. - 614-474-0680 , Verification No. 614-474-6445

SPECIAL INSTRUCTIONS/INFORMATION TO RECIPIENT:

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[illegible]

DuPont Circleville
P.O. Box 89
Circleville, OH 43113

DuPont Circleville

Brian Digg
34 Forest Street
Attleboro MA, 02703
Fax 508-236-3586

February 23, 1999

Dear Brian

I have checked our records and have not found any test data on Kapton® FN type film and break fluid exposure in our files.

I have also spoken to several colleagues and we are unaware of any issues with the Kapton® FN that has been used in automotive diaphragms.

Sorry we can not be of more help. If you have any questions please call.

Regards,

Mark McAlees
Sr. Tech Service Rep. Kapton®
740-474-0725

[illegible] 2/23/99

COMMUNICATIONS

Name / Project PAUL KANE [illegible]
Company / Department DUPONT
Address
248-583-8107
Phones

DATE TIME	SEQ.	MY PLAN / I SAID NEEDS EXPRESSED / FEEDBACK SOUGHT	THEY SAID / FOLLOW-UP NEEDS EXPRESSED / FEEDBACK GIVEN	WHEN DATE
10:15				
4/1/97		Telecon : Greg Stevens	V0 PRODUCTS	
			WILL CONTINUE	
			TO BURN WHILE HEAT	
			SOURCE IS PRESENT.	
			SELF EXTINGUISHES.	
			- Zenite 6140L	
			40 Glass LCP	
			FORD APPROVED ON WASHER SYST	
			IS V0 ~600+F Melt Point	
			- Zytel HTN 52G 35 FR	
			Not Ford	
			is V0, ~540 F Melt Pt	
			PAUL Sending data	
			sheets	

I CALLED TI and asked them
to look into Zenite 6140L

Zytel sample tried at TI.

Subject: Marterials Recommendations for Flammability Issue
Date: Thu, 1 Apr 1999 09:44:08 -0500
From: "Paul J Kane" <Paul.J.Kane@USA.dupont.com>
To: GSTEVEN1@ford.com, SREIMERS@ford.com
CC: "Michael J Bauhof" <Michael.J.Bauhof@USA.dupont.com>

Greg, I recommend the Zenite 6140L (used at Ford in a wiper motor to solve similiar concern where high amperage going through when motor was in stall torque condition). The DuPont Zenite LCP is a liquid crystal polymer that is V-0 (flame retardant) down to .031 inch thickness and has a melt point of 635F. The Celanex PBT grades have a melt point of 431F and the Noryl GTX 830 which is just a nylon alloy has a melt point of 497 F.

My experience is that in these situations, going to higher melt point is the only hope for solving it from a polymer standpoint.

The other material I recommended is Zytel HTN FR52G30BL which has a melt point of 590 F and is flame retardant. This would be lower cost resin.

I have fax'd data sheet to you and we can rush samples to TI for molding if you want, Paul Kane....,248-583-8107

Product Information

Zenite™ LCP

liquid crystal polymer resin

PRELIMINARY DATA

Zenite™ 6140L BK010

A Lubricated 40% Glass Reinforced Liquid Crystal Polymer Resin

Zenite™ 6140L BK010 is a lubricated 40% glass reinforced black LCP resin with excellent toughness and a heat deflection temperature of 282 C. It is well suited for use in the automotive, electrical/electronic, telecommunications, and aerospace industries.

Property	Test Method	Units	Value
Mechanical			
Tensile Strength	ASTM D 638	MPa (kpsi)	137 (19.9)
Elongation at Break	ASTM D 638	%	3
Flexural Modulus	ASTM D 790	MPa (kpsi)	16500 (2400)
Flexural Strength	ASTM D 790	MPa (kpsi)	194 (28.1)
Izod Impact	ASTM D 256	J/m (ft-lb/in)	104 (1.9)
Thermal			
Heat Deflection Temperature	ASTM D 648	°C (°F)	
1.8MPa (264psi)			282 (540)
Melting Point	ASTM D 3418	°C (°F)	335 (635)
Flammability			
UL94 Rating at Min. Thickness	UL94		V-0
UL94 Min. Thickness Tested	UL94	mm (in)	0.79 (0.031)
Other			
Specific Gravity	ASTM D 792		1.71
Processing			
Melt Temperature Range		°C (°F)	330-360 (626-680)
Mold Temperature Range		°C (°F)	30-93 (86-200)
Processing Moisture Content		%	<0.01

Mechanical properties measured at 23°C (73°F)
Contact DuPont for MSDS, general guide and/or additional information about ventilation, venting, purging, drying, etc.

During molding, use protective equipment and clothing. Skin contact with molten Zenite™ resin can cause severe burns. Be particularly alert during purging.

The above data are preliminary and are subject to change as additional data are developed on subsequent lots.

960821

Dial DuPont First (800) 441-0575 • Automotive Inquiries (800) 533-1313

Product Information

Zytel® HTN

high temperature nylon resin

PRELIMINARY DATA

Zytel® HTNFR52G30BL NC010

A 30% Glass Reinforced, Flame Retardant High Temperature Nylon Resin

Zytel® HTNFR52G30BL is a 30% glass reinforced, lubricated, flame retardant high temperature nylon resin that has been developed for connector applications.

Property	Test Method	Units	Value
			DAM
Mechanical			
Tensile Strength	ASTM D 638	MPa (kpsi)	172 (25)
Elongation at Break	ASTM D 638	%	2.2
Flexural Modulus	ASTM D 790	MPa (kpsi)	11400 (1650)
Flexural Strength	ASTM D 790	MPa (kpsi)	240 (34.8)
Izod Impact	ASTM D 256	J/m (ft·lb/in)	115 (2.2)
Unnotched Impact	ASTM D 4812	J/m (ft·lb/in)	800 (15)
Thermal			
Heat Deflection Temperature	ASTM D 648	°C (°F)	
0.45MPa (66psi)			286 (547)
1.8MPa (264psi)			270 (518)
Flammability			
UL94 Rating at Min. Thickness	UL94		V0
UL94 Min. Thickness Tested	UL94	mm	0.85
Other			
Specific Gravity	ASTM D 792		1.61
Mold Shrinkage		%	
Flow, 1.6mm (0.062in)			0.3
Transverse, 1.6mm (0.062in)			0.5

Contact DuPont for MSDS, general guidance and/or additional information about ventilation, handling, purging, drying, etc.
Mechanical properties measured at 23°C (73°F) unless otherwise stated.

During molding, use proper protective equipment and adequate ventilation. Avoid exposure to fumes and limit the hold up time and temperature of the resin in the machine. Purge degraded resin carefully with HDPE.

The above data are preliminary and are subject to change as additional data are developed on subsequent lots.

H69430UC90

Dial DuPont First (800) 441-0575 • Automotive Inquiries (800) 533-1313

Zytel® HTNFR52G30BL NC010

Property	Test Method	Units	Value
			DAM
Processing			
Melt Temperature Range		°C (°F)	325-340 (615-644)
Mold Temperature Range		°C (°F)	60-130 (140-265)
Drying Time, Dehumidified Dryer		h	6-8
Drying Temperature		°C (°F)	100 (210)
Air Dew Point		°C (°F)	<-20 (-4)
Processing Moisture Content		%	<0.1

Contact DuPont for MSDS, general guides and/or additional information about ventilation, handling, purging, drying, etc.
Mechanical properties measured at 23°C (73°F) unless otherwise noted.

The above data are preliminary and are subject to change as additional data are developed on subsequent lots.

[illegible]

The data listed here fall within the normal range of product properties but they should not be used to establish specification limits nor used alone as the basis of design. The DuPont Company assumes no obligation or liability for any advice furnished by it or for results obtained with respect to this information. All such advice is given and accepted at the buyer's risk. The disclosure of information herein is not a license to operate under, or a recommendation to infringe, any patent of DuPont or others. DuPont warrants that the use or sale of any material which is described herein and is offered for sale by DuPont does not infringe any patent covering the material itself, but does not warrant against infringement by reason of the use thereof in combination with other materials or in the operation of any process.
CAUTION: Do not use in medical applications involving permanent implantation in the human body.
For other medical applications, see "DuPont Medical Caution Statement", H-50102.

Dial DuPont First (800) 441-0575 • Automotive Inquiries (800) [illegible]

```
****************************************************************************
*          Note printed by GSTEVEN1 on 12 Apr 1999 at 07:27:04            *
****************************************************************************

From: SREIMERS--DRBN007                        Date and time    04/10/99 13:10:02
To: GSTEVEN1--DRBN005                        FPORTER --DRBN007  Porter, F.J.

FROM: Steve Reimers                                USAET(UTC -04:00)
Subject: Re: Zytel Sample to TI
fyi

Steve Reimers                              building 5  3B004
RVT Chassis E/E System Applications        mail drop  5011
39-03286 SREIMERS   sreimers@ford.com      fax 39-04145        ;>
*** Forwarding note from PARCHERU--EXTERNAL 04/09/99 13:23 ***
To: SREIMERS--FORDMAIL Steve Reimers

From: Paul J Kane
Subject: Re: Zytel Sample to TI

From: "Paul J Kane"<Paul.J.Kane@usa.dupont.com>
cc: A-mcguirk@ti.com,
    swalters@ti.com

The V-0(flame retardant) high temperature Zytel HTN FR52030BL NC010
(natural color) will arrive at TI on Monday April 12. I talked with Andy
McGuirk and Steve Walters (molding responsibility) about this product and
have fax'd the processing guidelines to Steve. This product will have a
140F higher  melt point over the Celanex 4300 and a 100F higher melt point
over the Noryl GTX 830 (a nylon alloy). It will also have much better flow
and dimensional stability over the Noryl GTX 830. Paul 248-583-8107
```

DAVID CLARK TI ATTLEBORO
- DESIGN ENG. SUPERVISOR

STEVE OFFILER - DESIGN ENGINEERING

BILL SWEET - MANUFACTURING ENGINEERING SUPERVISOR

AGNES CORDOZO - COMMODITY BUYER (KAPTON®)

LIFE OF DIAPHRAM - ISSUE IN HYDRAULIC PRESSURE

BRAKE FLUID

POWER STEERING FLUID

SOME APPLICATIONS USE 2 → 3 LAYERS OF 131

(1500 PSI IN USE)
PROOF - 5000 PSI
BURST - 7000

1500 PSI - 1/2 MILLION CYCLES

FLUID TEMP - 135°C AMBIENT - 107°C

* NEED HIGHER FLEX LIFE OF KAPTON® IN CONSTRUCTION DUE TO FAILURE IN THE 1/2 MILLION CYCLE TESTING

KAPTON® VS TEFLON® - BRAKE FLUID - DOT 3
135° C

ACTION:

1) MAIL 8 1/2 X 11 SAMPLES OF NEW 131 (STEVE OFFILER
NEW 300 HIGH ®
2) PLASTIC CORES ??

TEXAS
INSTRUMENTS

Materials & Controls Group

August 6, 1992

Mr. Harry Gumm
E. I. Du Pont
Rte. 23 South
Du Pont Rd.
Circleville, OH 43113

Dear Mr. Gumm,

As agreed during our July 31 conversation, I am sending you the Kapton films from four typical brake fluid pressure switch failures. These 500 FN 131 films rupture during cycle testing at 135 C. The brake fluid tested is an after-market DOT 3 fluid, Gunk Heavy Duty Brake Fluid (Radiator Specialty Co.). Unfortunately, I am unable to supply films from the 170 C testing in which the polyimide is attacked severely.

We use three Kapton films stacked together as the switch diaphragm. I've labeled the side that contacts the brake fluid directly. The three films are rotated with respect to one another. I taped the layers together to retain the stacking and orientation.

We hope that you will help us understand what causes the rupture of these films during our cycle testing. I look forward to hearing from you. Thank you for your assistance.

Sincerely,

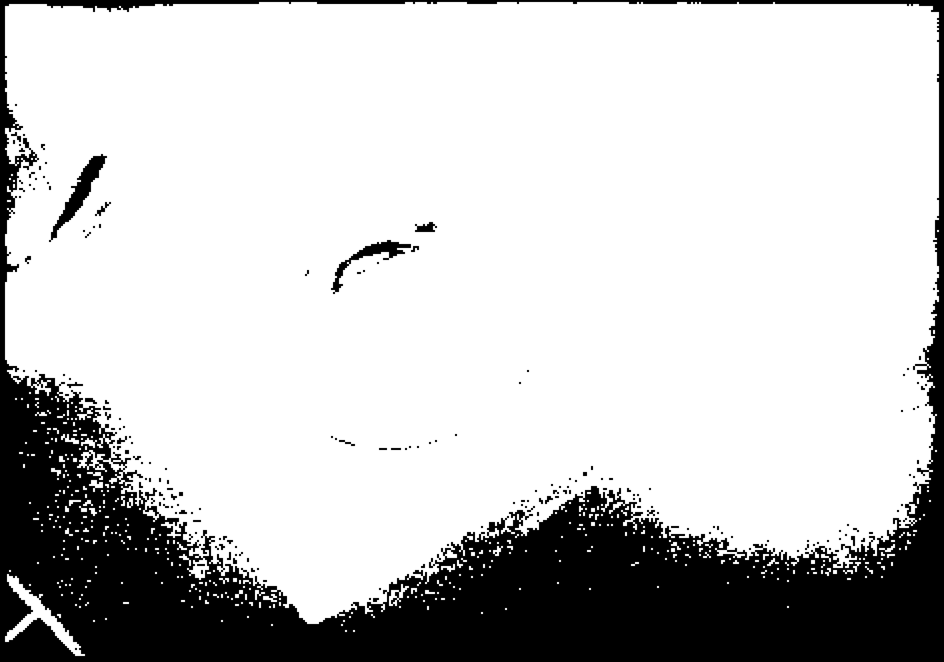
John E. Brennan

cc: Dave Czarn
Steve Offiler

TEXAS INSTRUMENTS INCORPORATED • 34 FOREST STREET • ATTLEBORO, MA 02703
508-[illegible]-3800 • TELEX [illegible] • CABLE TEXINS

SWITCHES AND KAPTON EXAMINED

3/21/2000	Invetech. Kapton from switches, originally supplied to Harry Gumm from TI. Photographed. (9358)



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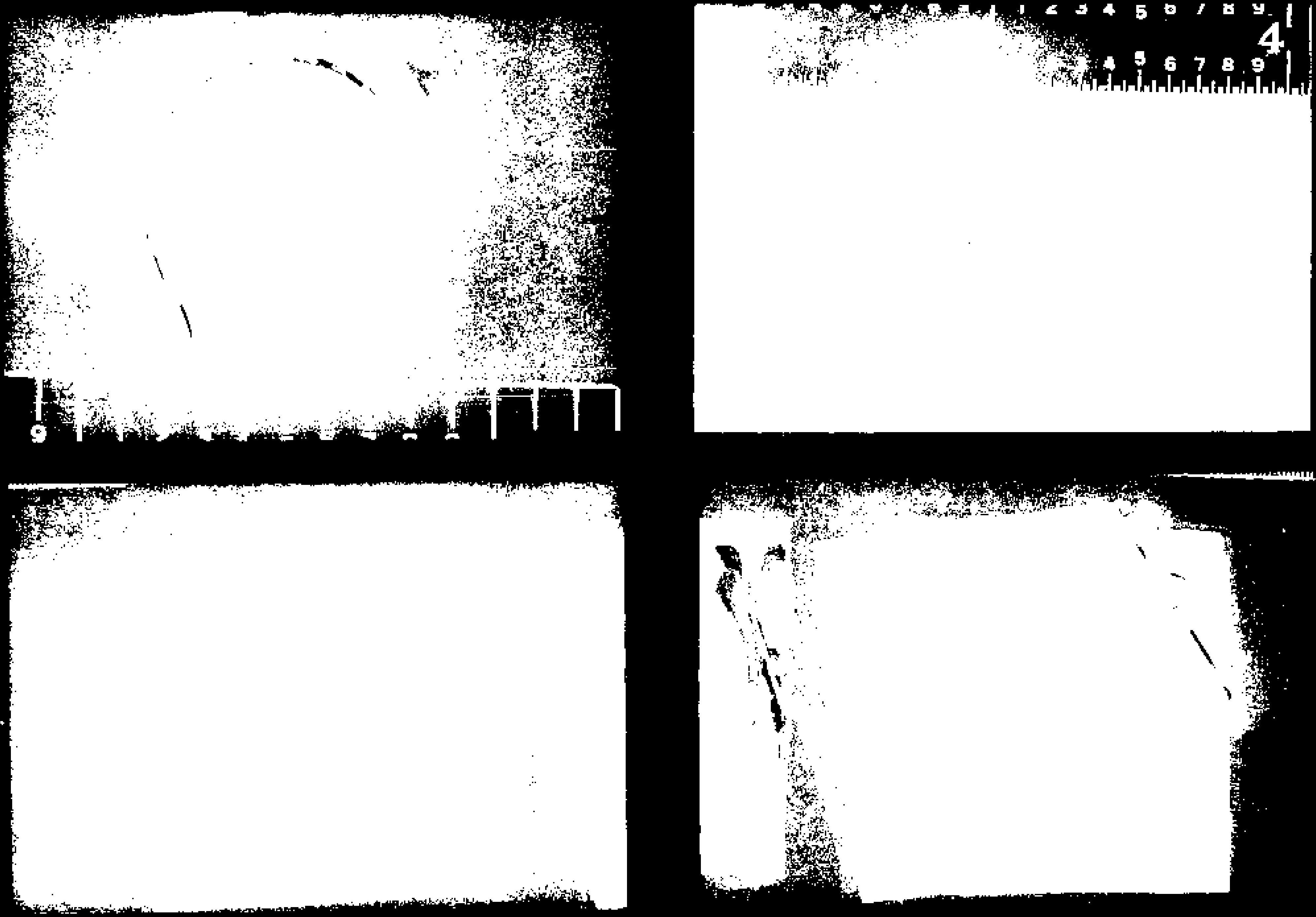

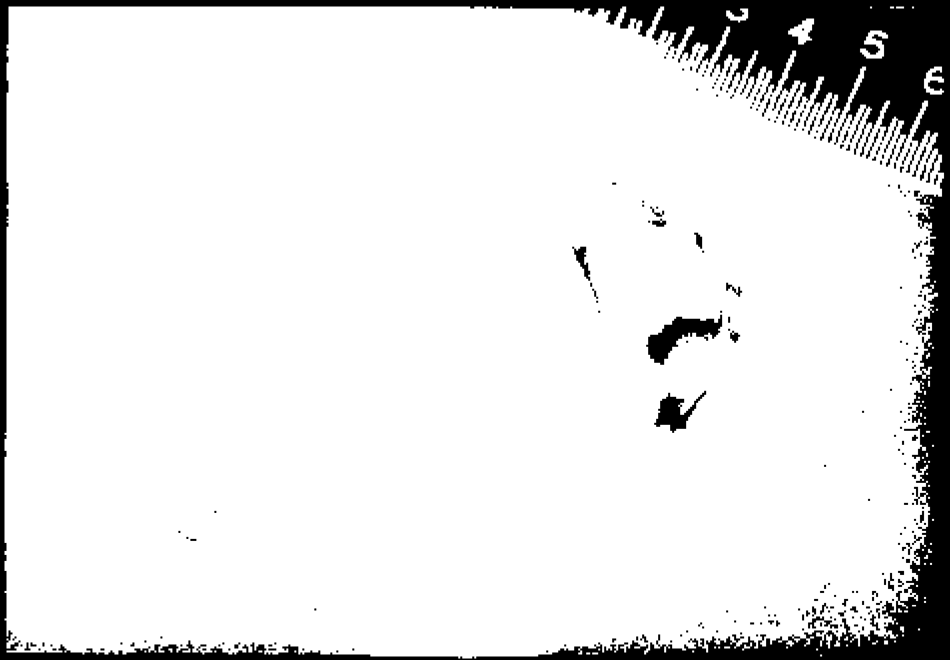
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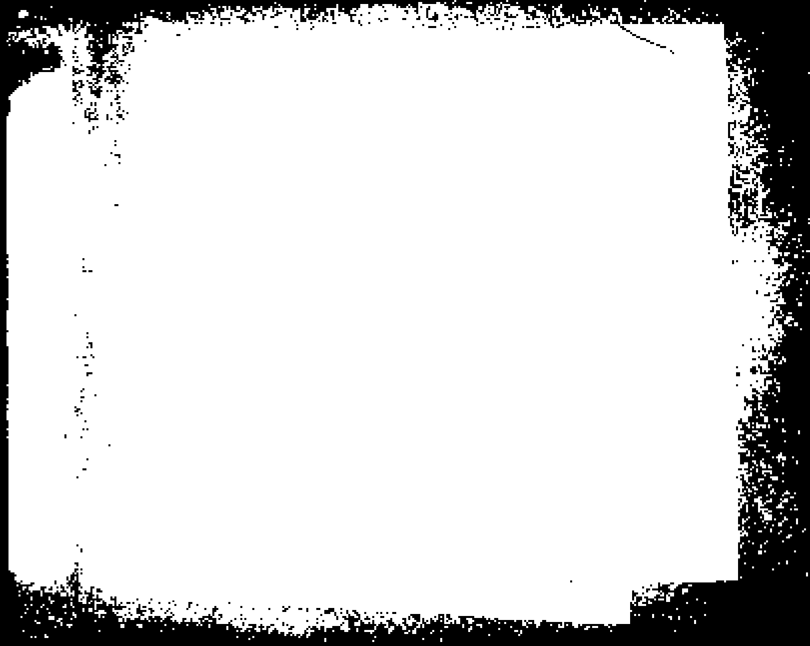

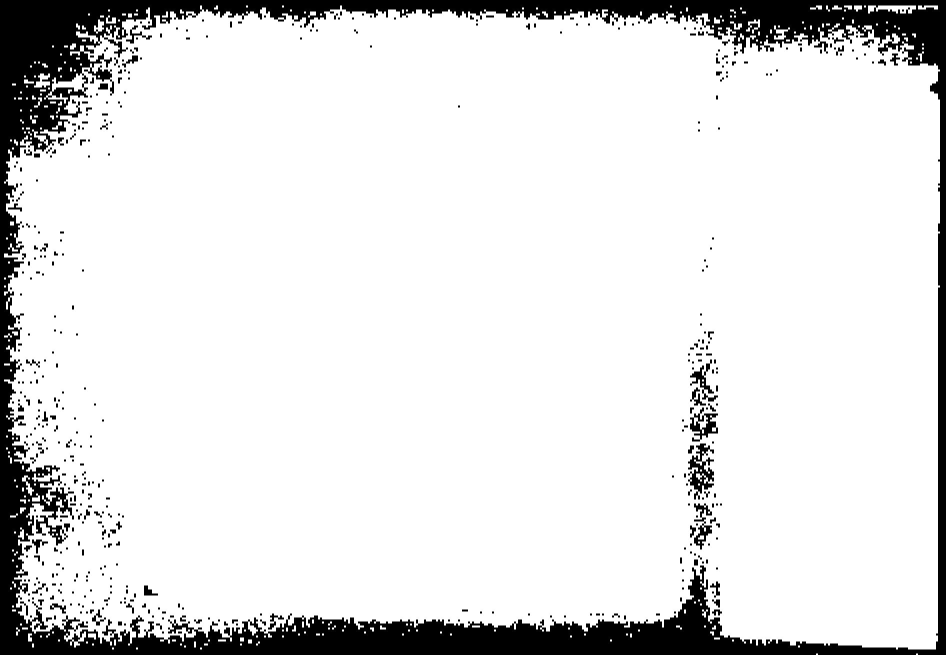


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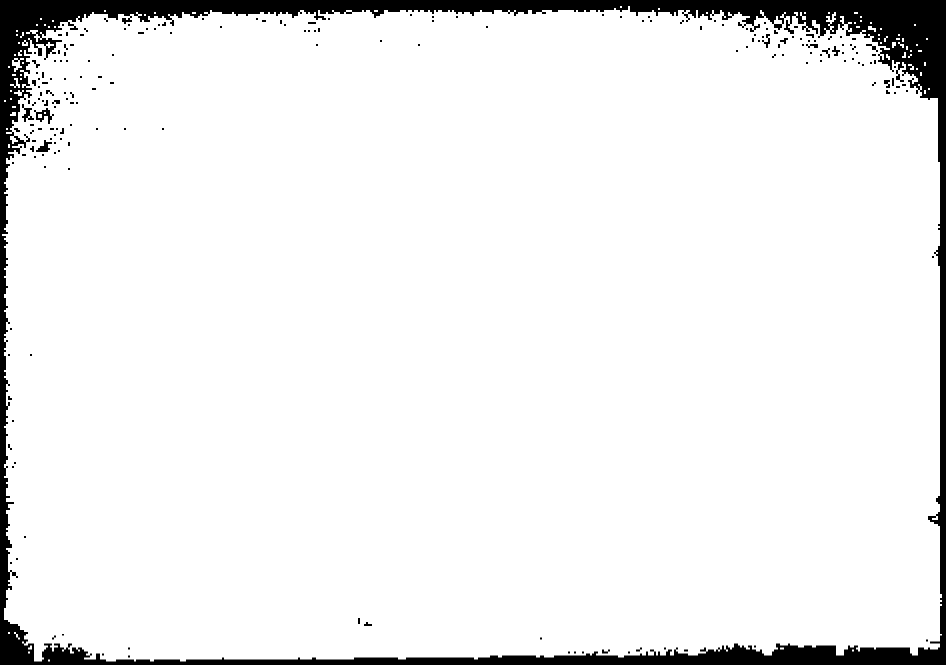

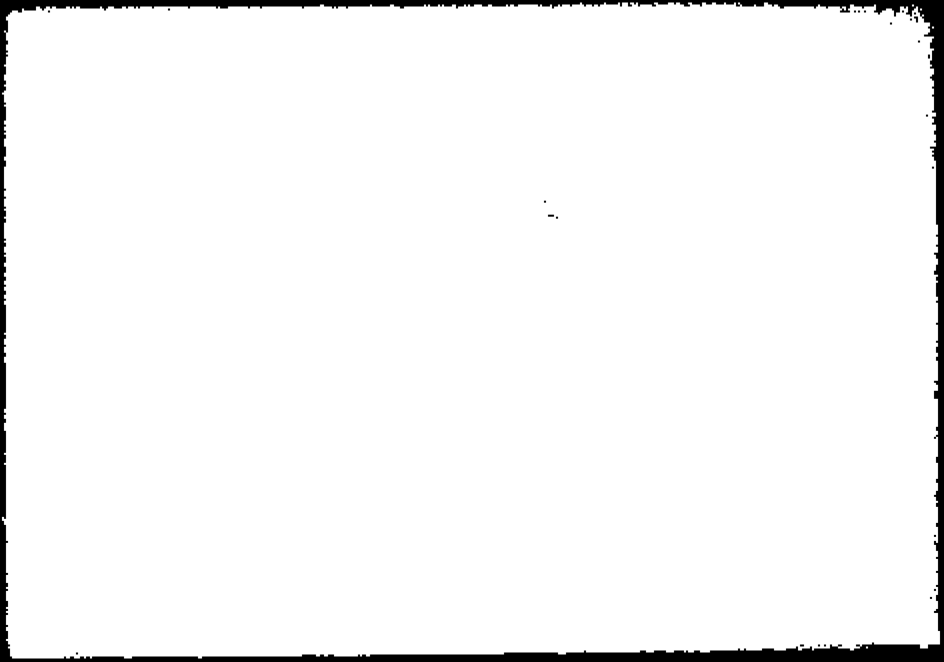

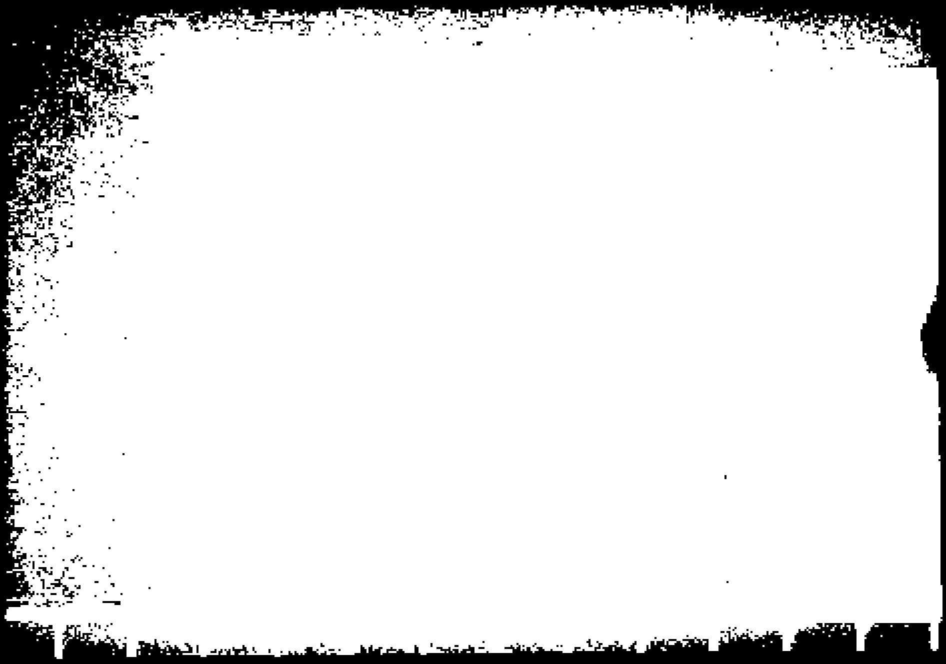

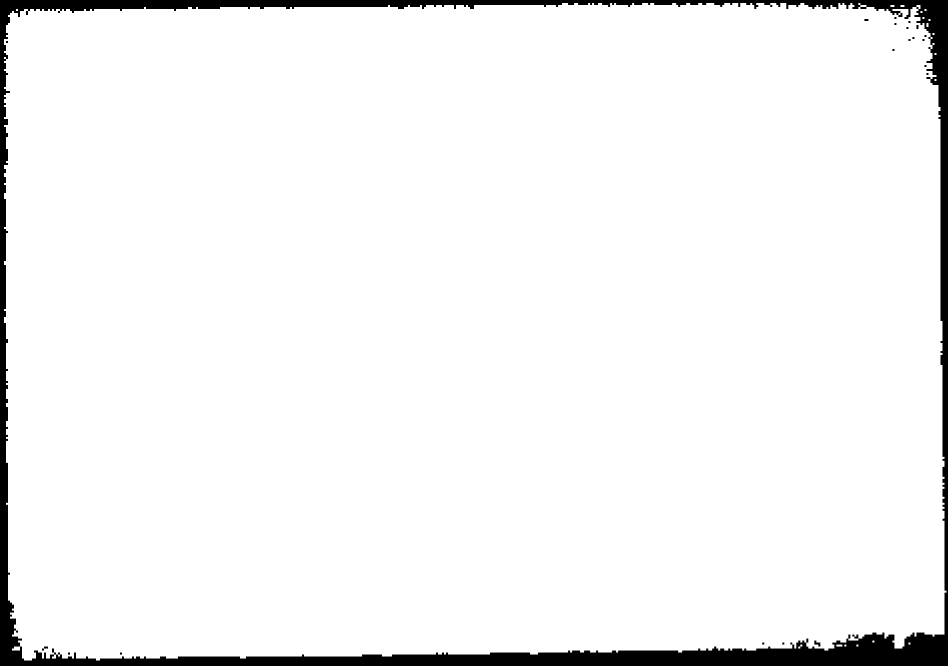

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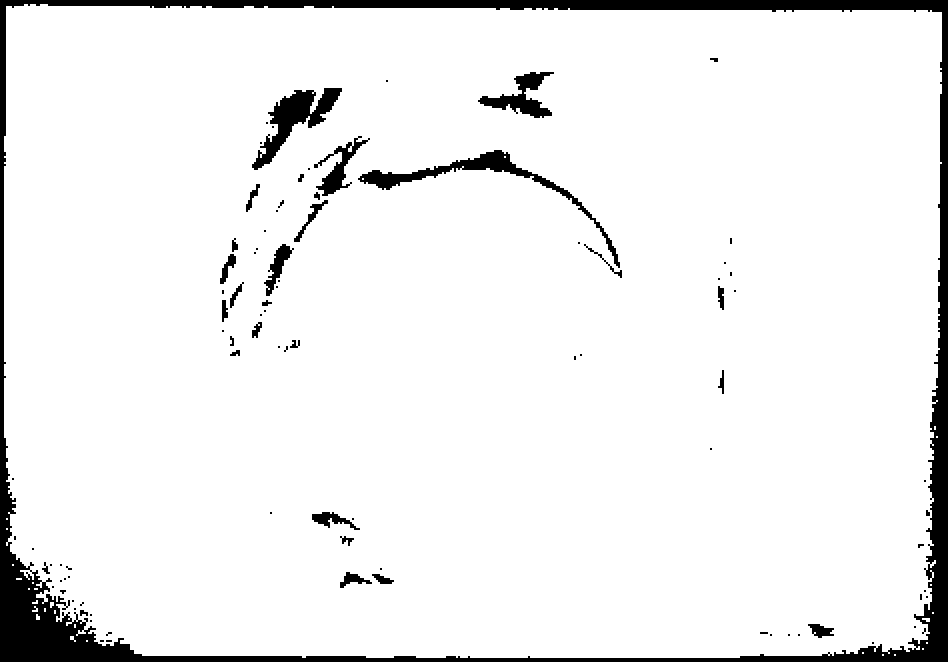

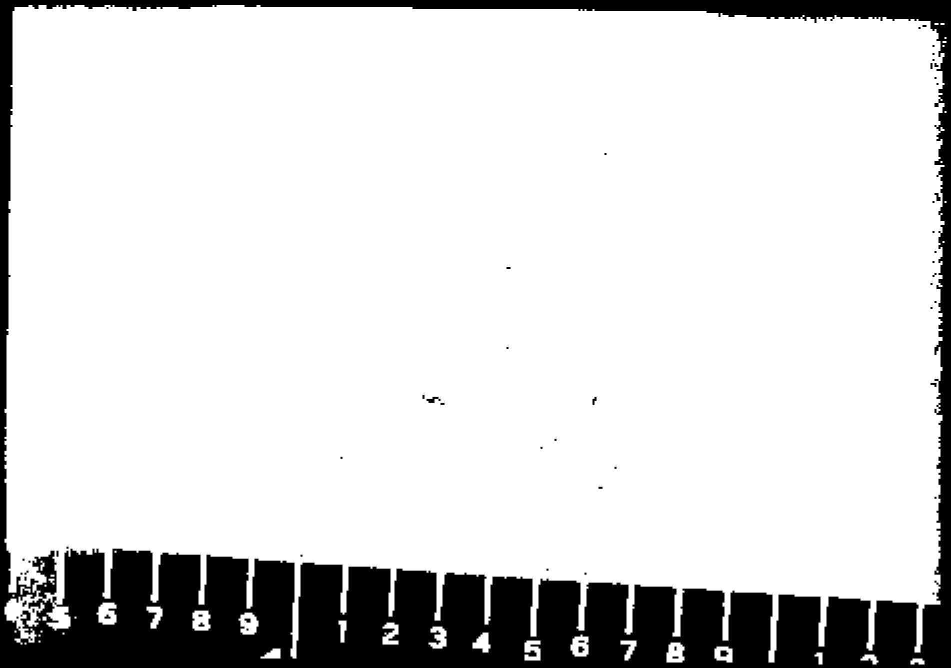
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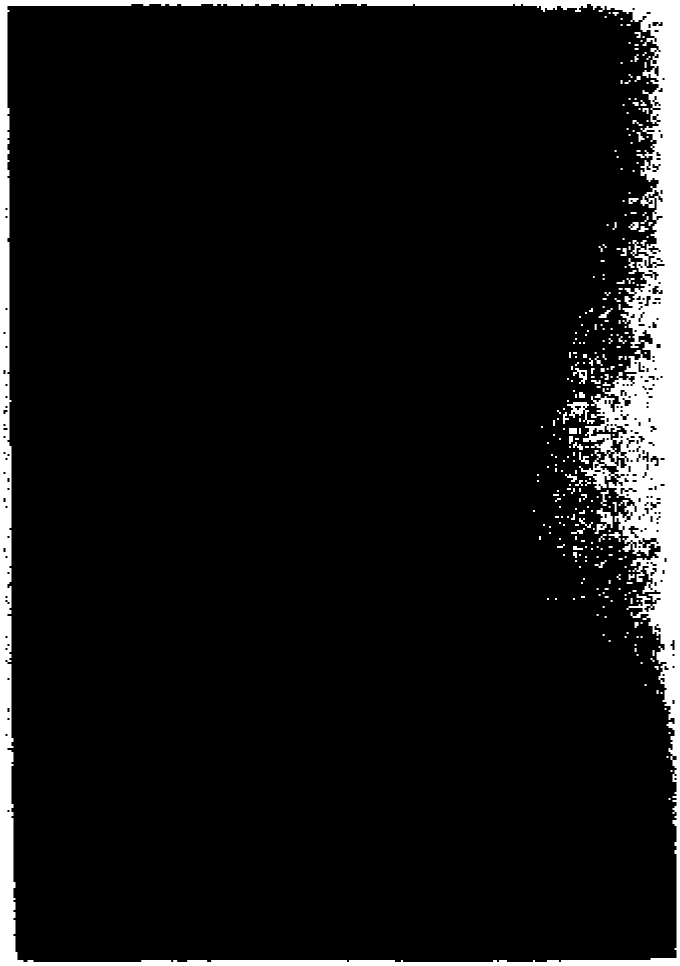


INVETECH
Engineering & Materials Consultants

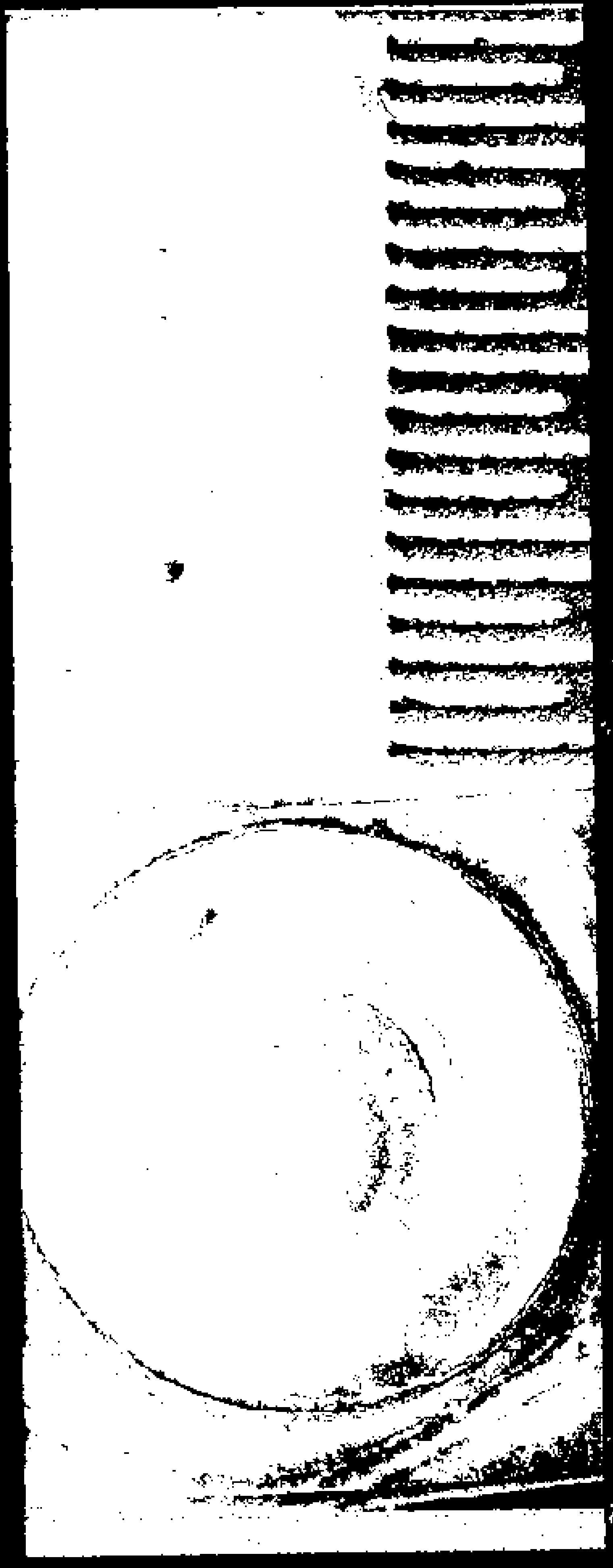
JOB # 9358

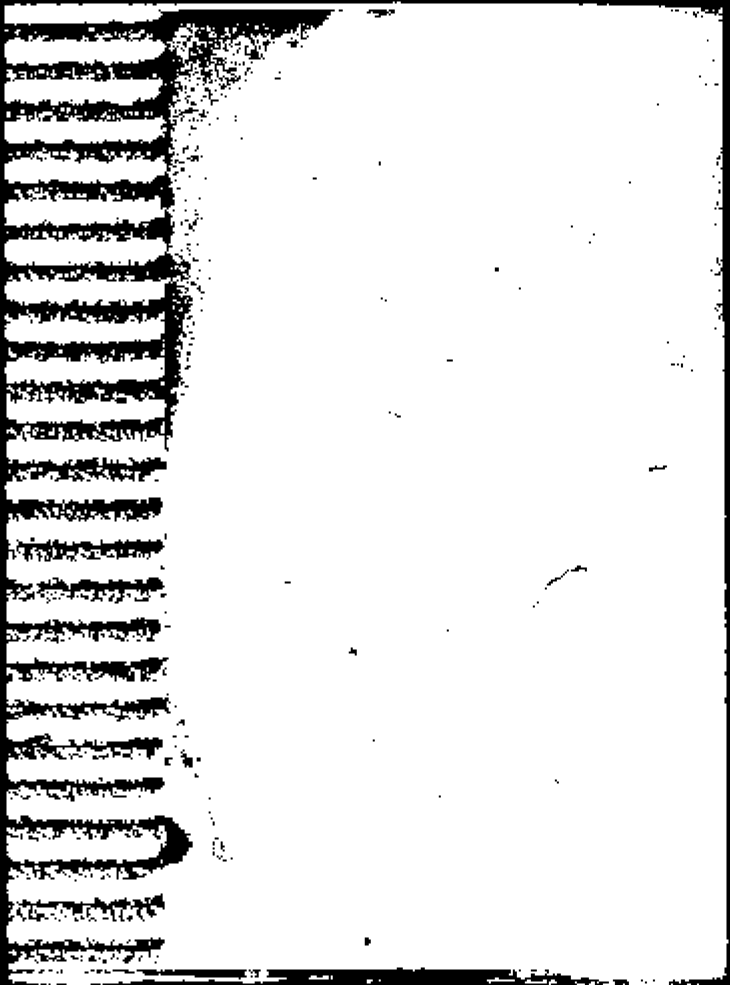
MP-2518
9358
8x

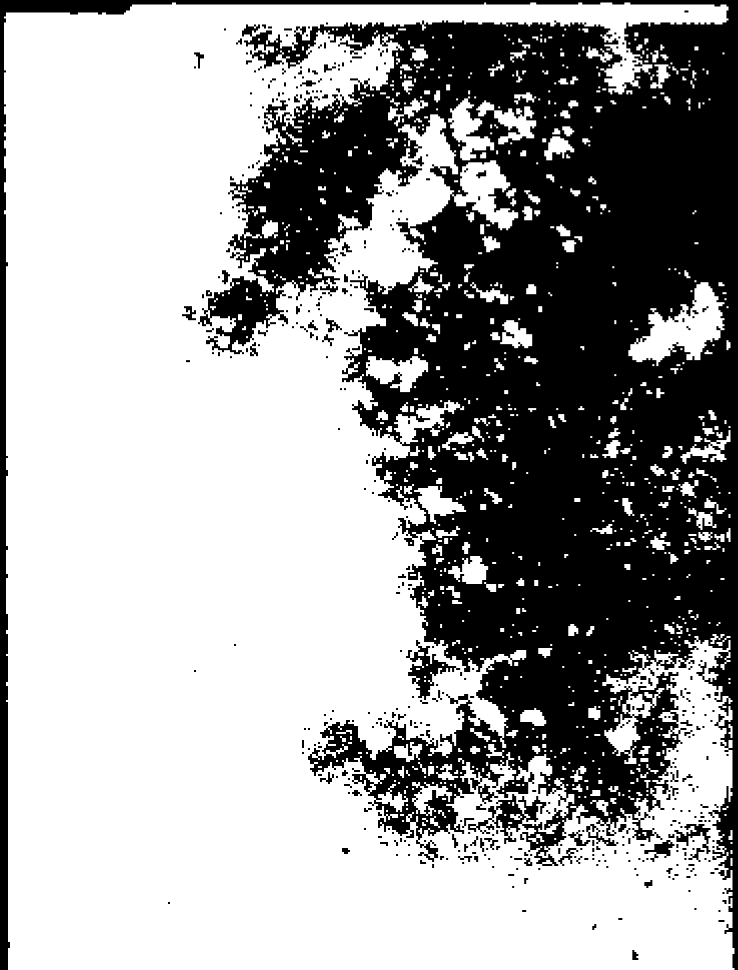
DATE
03/21/00
PICTURE NO.
MP-2518
MAG/ETCH
8x
DESCRIPTION
Representative
Kapton Film
From Known
Brake P.S. Failure

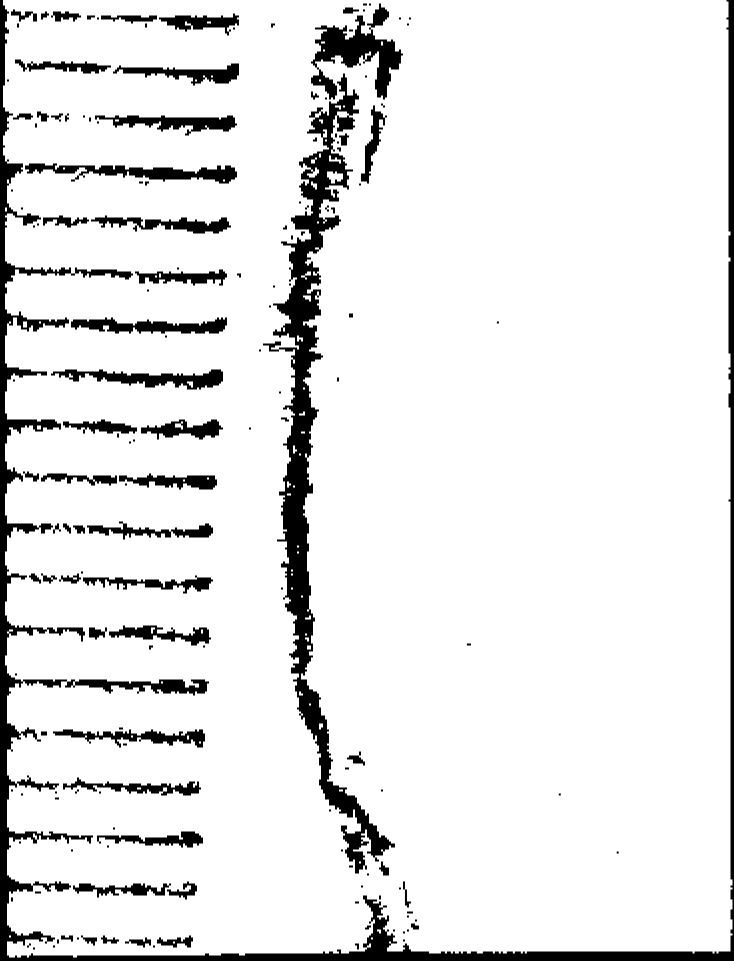
MP-2519
9358
11.5x

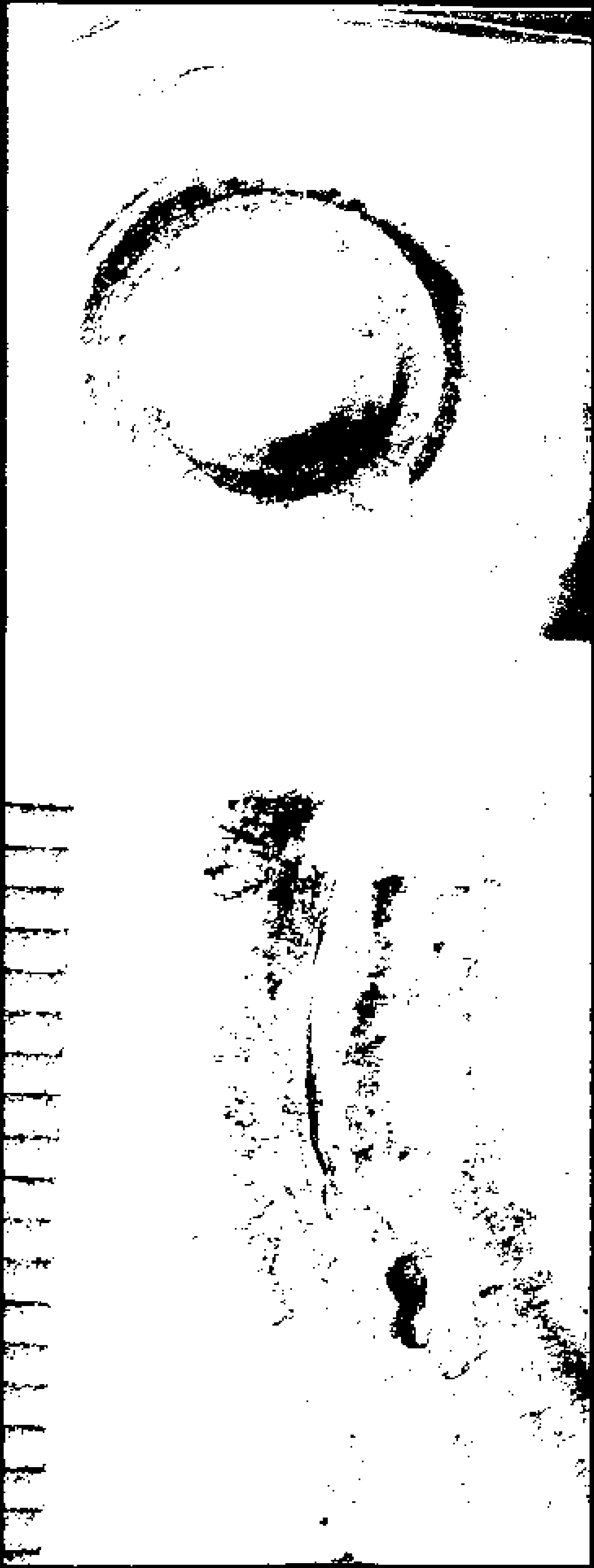
DATE
PICTURE NO.
MP-2519
MAG/ETCH
11.5x
DESCRIPTION











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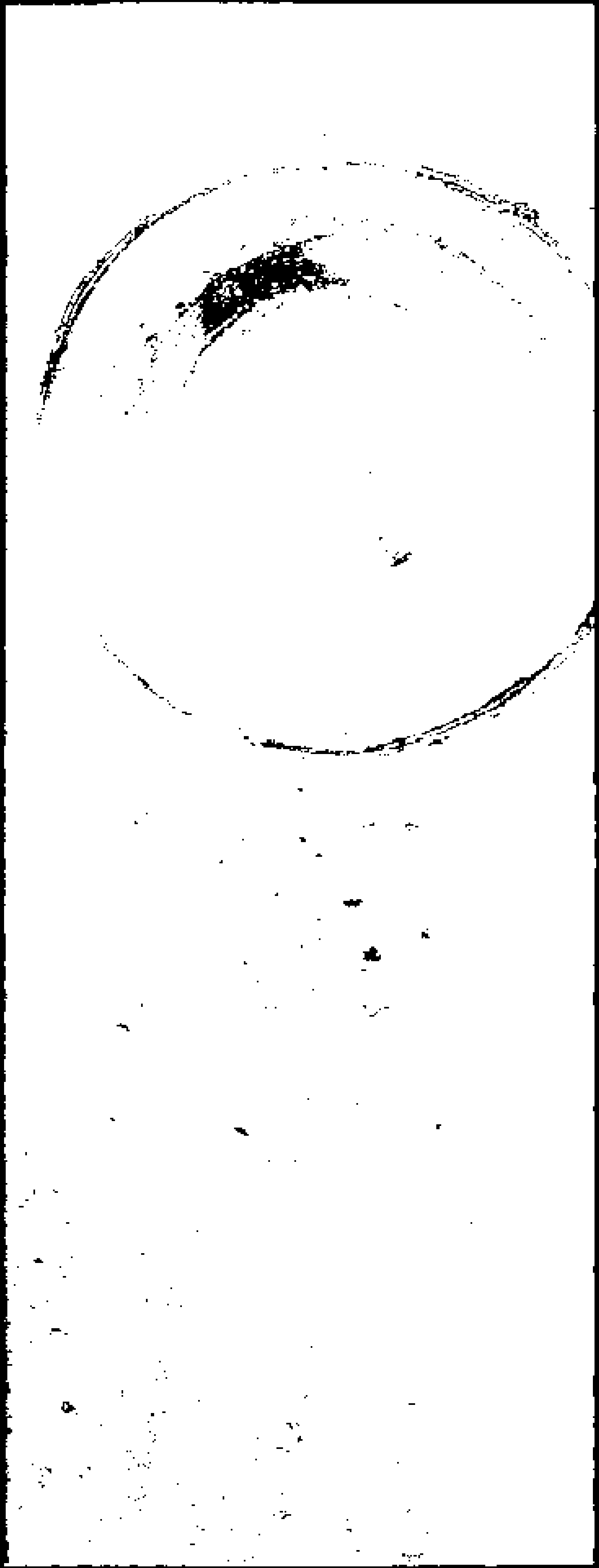
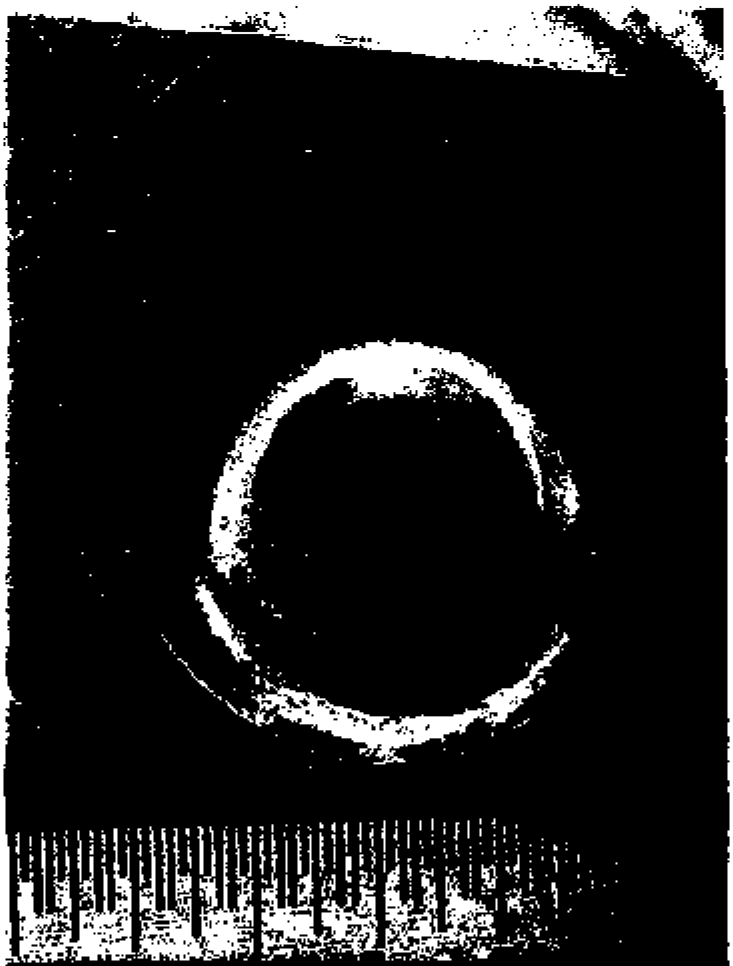
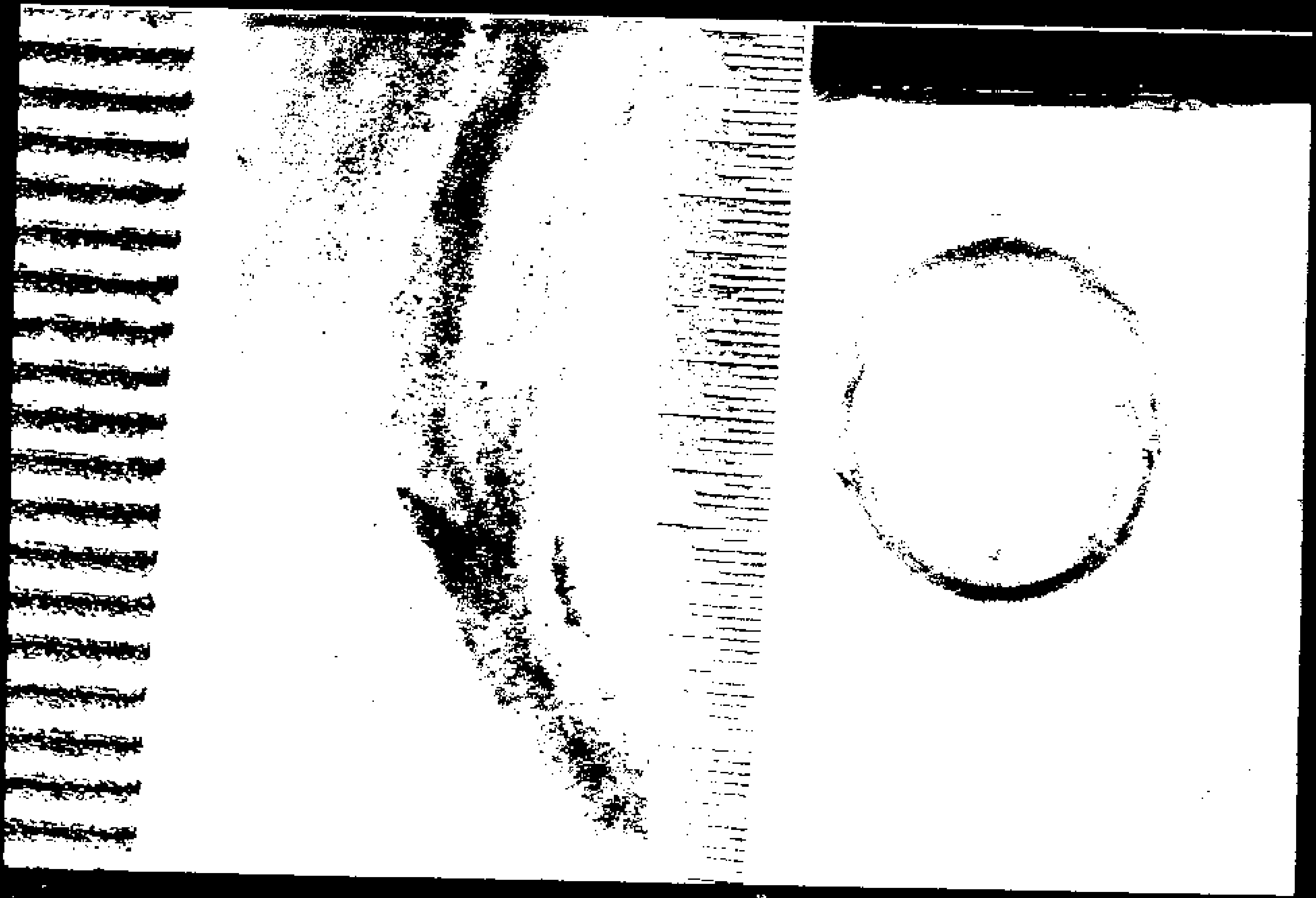
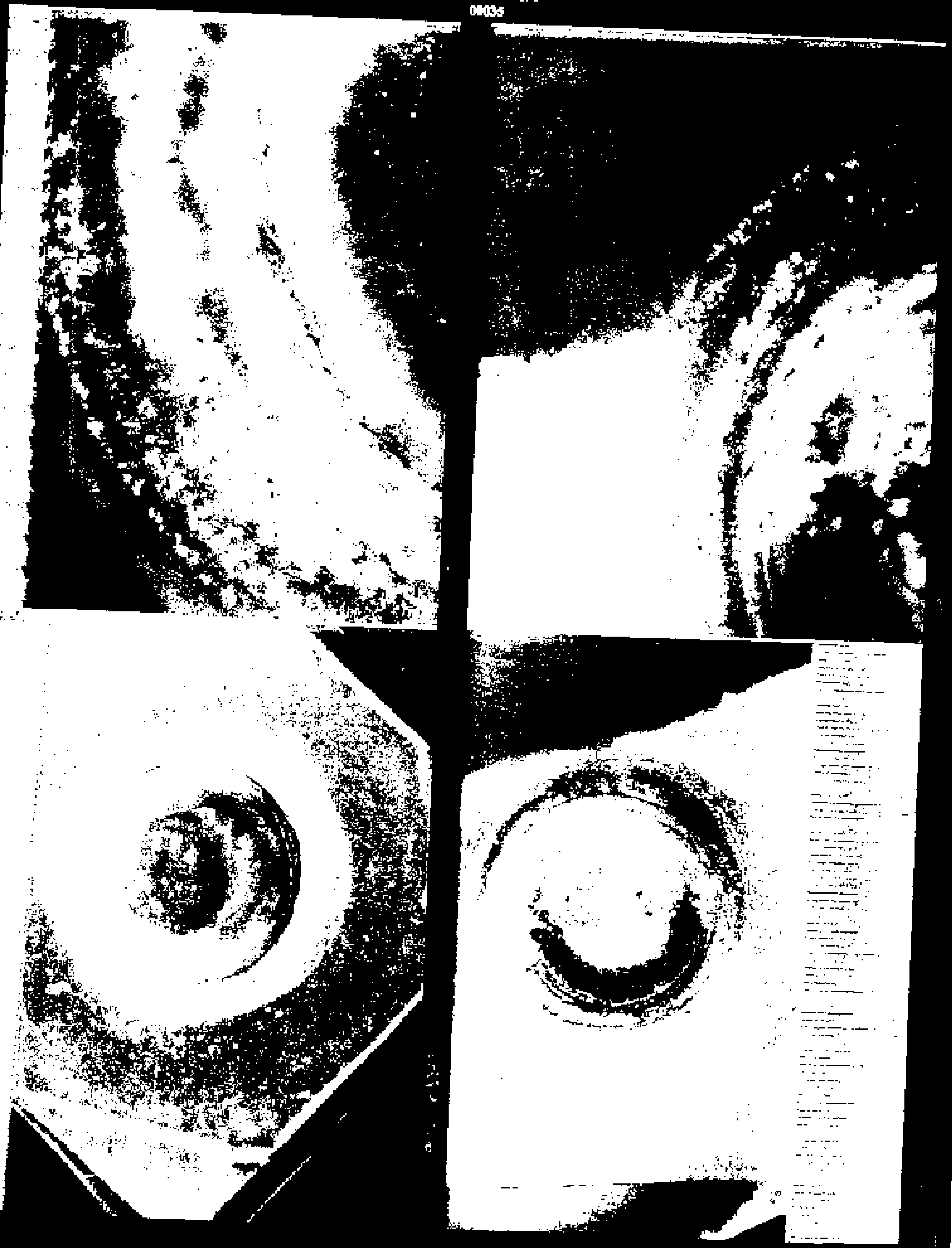
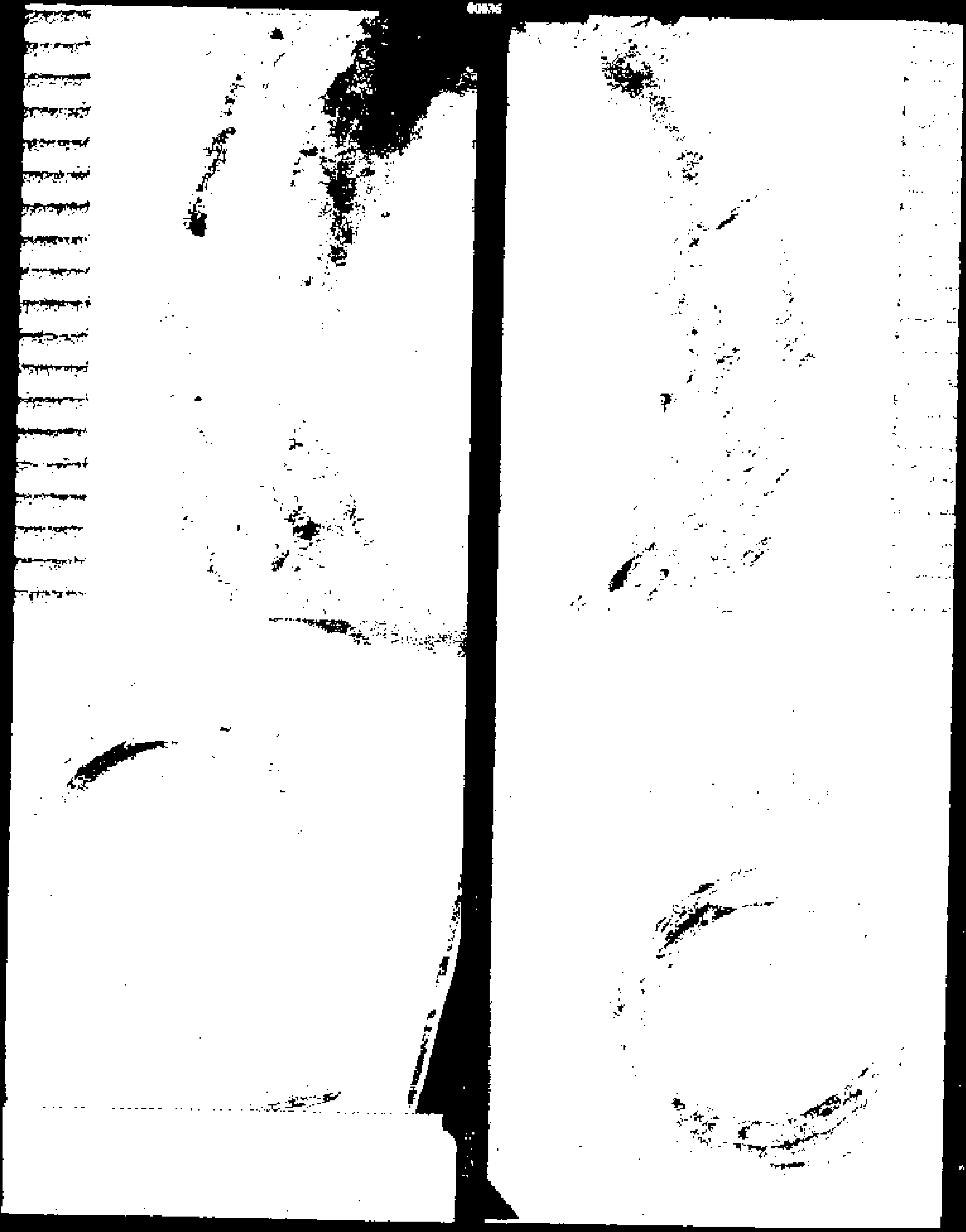










DEVNETRA No. 1
00037

FACSIMILE TRANSMITTAL

NOTE TO SENDER: Before sending any material via a facsimile machine, call the recipient to:

- Advise you will be transmitting material to them,
- Total number of pages being sent,
- Determine type of equipment to be used so adjustments can be made if necessary,
- verify correct telephone number so the recipient will know where to pick up the material.

DATE: OCTOBER 9, 1992

TO: .... NAME: [redacted]
LOCATION: DuPont Circleville
MAIL STATION: —
PHONE NUMBER:
FACSIMILE PHONE NUMBER: 614-474-0680

FROM: .... NAME: JOHN BRENNAN
LOCATION: TI - ATTLEBORO
MAIL STATION: 10-13
PHONE NUMBER: 508-699-1347
FACSIMILE PHONE NUMBER: 508-699-3476

TOTAL NO. OF PAGES (INCLUDING HEADER PAGE): 2

ADDITIONAL INFORMATION:

DD/NHTSA No. 1
[illegible]

KAPTON FILM TESTING OUTLINE

General

DuPont will prepare samples and deliver to TI.
TI will age samples in test fluids and deliver aged samples to DuPont.
DuPont will test aged and control samples and communicate results to TI.

Test Description

Materials
Kapton 500FN131
Kapton H (?) film that is base layer for 500FN131
Test Fluids
Power Steering Fluid as-received
Power Steering Fluid with water added
Brake Fluid as-received
Brake Fluid with water added
Test Temperature
150 C
Exposure Times
250 & 500 hrs
1000 hrs (optional--we would begin aging these samples, but testing would be contingent on the results of the 500 hr exposures.)
Control Lots
Unexposed Kapton 500FN131
Unexposed Kapton H (?) film that is base layer for 500FN131
Measures
Control Lots
Ultimate Tensile Strength
% Elongation at Break
Modulus
Tear Strength-initial
Exposed Samples
(for each test fluid at 250 & 500 hrs of exposure; posibly 1000 hrs also)
Ultimate Tensile Strength
% Elongation at Break
Modulus
Tear Strength-initial

Timing

10/23--receipt of test samples at TI
10/30--aging tests started at TI
11/12--250 hrs exposure complete, samples delivered to DuPont
11/20--500 hrs exposure complete, samples delivered to DuPont
12/10--results of control, 250 hr, 500 hr samples communicated to TI
decision on proceeding with 1000 hr samples
12/11--1000 hrs exposure complete, samples delivered to DuPont (OPTIONAL)
12/18--results of 1000 hr samples communicated to TI (OPTIONAL)

KAPTON FILM TESTING OUTLINE

NISSAN/HONDA
JAPAN MARKETS

General

DuPont will prepare samples and deliver to TI.
TI will age samples in test fluids and deliver aged samples to DuPont.
DuPont will test aged and control samples and communicate results to TI.

Test Description

Materials
- Kapton 500FN131
- Kapton H (?) film that is base layer for 500FN131

Test Fluids
- 300H Power Steering Fluid as-received 500FN131
- Power Steering Fluid with water added
- Brake Fluid as-received
- Brake Fluid with water added

Test Temperature
- 150 C

Exposure Times
- 250 & 500 hrs
- 1000 hrs (optional—we would begin aging these samples, but testing would be contingent on the results of the 500 hr exposures.)

4 FLUIDS
3 TIMES
12 + 2 CONTROL

Controls
- Unexposed Kapton 500FN131
- Unexposed Kapton H (?) film that is base layer for 500FN131

Measures

	300H	500FN131	
Control Lots			
Ultimate Tensile Strength	½" x 6"	½" x 6"	5 PULLS
% Elongation at Break			
Modulus			
Tear Strength-Initial	2½ x 4"	2½ x 4"	5 PULLS

Exposed Samples
(for each test fluid at 250 & 500 hr exposure; possibly 1000 hrs also)
- Ultimate Tensile Strength
- % Elongation at Break
- Modulus
- Tear Strength-Initial

LOT SIZE OF SAMPLES
(3) SETS OF SAMPLES. FOR TI
(1) SET FOR CONTROL
(1) SET OF ARCHIVES

Timing

10/2 eipt of test samples at TI
10/ ing tests started at TI
11/ 250 hr exposure complete, samples delivered to DuPont
11/20—500 hr exposure complete, samples delivered to DuPont
12/10—results of control, 250 hr, 500 hr samples munlcated to TI
decision o eding with 1000 hr samples
12/11—1000 hrs exposure complete, samples delivered to DuPont (OPTIONAL)
12/18—results of 1000 hr samples communicated to TI (OPTIONAL)

12 - ONE DIRECTION + CONTROLS (2)

24 - BOTH DIRECTIONS MD & TD + CONTROLS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 1

REQUESTED BY H. Human APP. BY ______ CHARGE CODE 303639 DATE SUB. ______ DATE NEED ______

GAGE 300 TYPE HN ROLL NO. 2112991 MATERIAL KAPTON® DATE PRODUCED 7/27/92

REASON FOR REQUEST CONTROL SAMPLES FOR TEXAS INSTRUMENTS FLUID TESTING PROGRAM (START)

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD ✓ TD ✓
[✓ 2. Elongation] MD ✓ TD ✓
[✓ 3. Tear] MD ✓ TD ✓
4. Thickness MD ______ TD ______
5. Gage % MD ______ TD ______
[✓ 6. Tensile] MD ✓ TD ✓
7. 400°C D.S. MD ______ TD ______
8. 275°C D.S. MD ______ TD ______
9. 200°C D.S. MD ______ TD ______
10. Heat Seals C Side ______
11. Heat Seals C20 Side ______
12. Laminate Seals ______
13. Acrylic Seals ______
14. Unit Weight ______
15. Melt Index ______
16. Wettability ______
17. Appearance ______

18. Color ______
19. Visuals ______
20. Pyralux Adhesion ______
21.
22.

ELECTRICAL

1. Dielectric Str. ______
2. Dissipation Factor ______
3. Dielectric Const. ______
4. ______
5. ______
6. ______

CHEMICAL

1. Residual DMAC ______
2. Thermal Dura MD ______ TD ______
3. Hydrolytic Stab. ______

4. DMAC PPM ______
5. POP TP ______
6. DMDA TP ______
7. Acetone PPM ______
8. B-Pic PPM ______
9. Ac20 Spec Grav. ______
10. ANHYDRIDE PPM ______
11.
12.
13.

OTHER

1. ______
2. ______
3. ______
4. ______

Checked and Released

By ______ Date ______

SPECIAL INSTRUCTIONS: 300 HN - CONTROL SAMPLES

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 2

REQUESTED BY H. Ham APP. BY ______ CHARGE CODE 303629 DATE SUB ______ DATE NEED ______

GAGE 300 TYPE HN ROLL NO 2112997 MATERIAL KAPTON® DATE PRODUCED 7/27/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus]	MD	✓	TD	✓
[✓ 2. Elongation]	MD	✓	TD	✓
[✓ 3. Tear]	MD	✓	TD	✓
4. Thickness	MD		TD	
5. Gage %	MD		TD	
[✓ 6. Tensile]	MD	✓	TD	✓
7. 400°C D.S.	MD		TD	
8. 275°C D.S.	MD		TD	
9. 200°C D.S.	MD		TD	

10. Heat Seals C Side ______
11. Heat Seals C20 Side ______
12. Laminate Seals ______
13. Acrylic Seals ______
14. Unit Weight ______
15. Melt Index ______
16. Wettability ______
17. Appearance ______

18. Color ______
19. Visuals ______
20. Pyralux Adhesion ______
21.
22.

ELECTRICAL

1. Dielectric Str. ______
2. Dissipation Factor ______
3. Dielectric Const. ______
4. ______
5. ______
6. ______

CHEMICAL

1. Residual DMAC ______
2. Thermal Dura MD ______ TD ______
3. Hydrolytic Stab. ______

4. DMAC PPM ______
5. POP TP ______
6. DMDA TP ______
7. Acetone PPM ______
8. B-Pic PPM ______
9. Ac20 Spec Grav. ______
10. ANHYDRIDE PPM ______
11.
12.
13.

OTHER

1. ______
2. ______
3. ______
4. ______

Checked and Released

By ______ Date ______

SPECIAL INSTRUCTIONS: 300HN - POWER STEERING FLUID AS RECEIVED -
150°C - 250 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 3

REQUESTED BY H. [illegible] APP. BY ____ CHARGE CODE 303639 DATE SUB. ____ DATE NEED ____

CAGE 300 TYPE HN ROLL NO. 2112991 MATERIAL KAPTON® DATE PRODUCED 7/27/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus]	MD ✓	TD ✓
[✓ 2. Elongation]	MD ✓	TD ✓
[✓ 3. Tears]	MD ✓	TD ✓
4. Thickness	MD	TD
5. Cage %	MD	TD
[✓ 6. Tensiles]	MD ✓	TD ✓
7. 400°C D.S.	MD	TD
8. 275°C D.S.	MD	TD
9. 200°C D.S.	MD	TD

10. Heat Seals C Side ____
11. Heat Seals C20 Side ____
12. Laminate Seals ____
13. Acrylic Seals ____
14. Unit Weight ____
15. Melt Index ____
16. Wettability ____
17. Appearance ____
18. Color ____
19. Visuals ____
20. Pyralux Adhesion ____
21.
22.

ELECTRICAL

1. Dielectric Str. ____
2. Dissipation Factor ____
3. Dielectric Const. ____
4. ____
5. ____
6. ____

CHEMICAL

1. Residual DMAC ____
2. Thermal Dura. MD ____ TD ____
3. Hydrolytic Stab. ____

4. DMAC PPM ____
5. POP TP ____
6. DMDA TP ____
7. Acetone PPM ____
8. B-Pic PPM ____
9. Ac20 Spec Grav. ____
10. ANHYDRIDE PPM ____
11.
12.
13.

OTHER

1. ____
2. ____
3. ____
4. ____

Checked and Released

By ____ Date ____

SPECIAL INSTRUCTIONS: 300 HN – POWER STEERING FLUID AS RECEIVED
150°C – 500 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 4

REQUESTED BY H. [illegible] APP. BY ______ CHARGE CODE 393 635 DATE SUB. ______ DATE NEED ______

GAGE 300 TYPE HN ROLL NO. 2/12991 MATERIAL KAPTON® DATE PRODUCED 7/27/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD ✓ TD ✓
[✓ 2. Elongation] MD ✓ TD ✓
[✓ 3. Tear] MD ✓ TD ✓
4. Thickness MD ______ TD ______
5. Gage % MD ______ TD ______
[✓ 6. Tensile] MD ✓ TD ✓
7. 400°C D.S. MD ______ TD ______
8. 275°C D.S. MD ______ TD ______
9. 200°C D.S. MD ______ TD ______
10. Heat Seals C Side ______
11. Heat Seals C20 Side ______
12. Laminate Seals ______
13. Acrylic Seals ______
14. Unit Weight ______
15. Melt Index ______
16. Wettability ______
17. Appearance ______

18. Color ______
19. Visuals ______
20. Pyralux Adhesion ______
21.
23.

ELECTRICAL

1. Dielectric Str. ______
2. Dissipation Factor ______
3. Dielectric Const. ______
4. ______
5. ______
6. ______

CHEMICAL

1. Residual DMAC ______
2. Thermal Dura MD ______ TD ______
3. Hydrolytic Stab. ______

4. DMAC PPM ______
5. POP TP ______
6. DMDA TP ______
7. Acetone PPM ______
8. B-Pic PPM ______
9. Ac20 Spec Com. ______
10. ANHYDRIDE PPM ______
11.
12.
13.

OTHER

1. ______
2. ______
3. ______
4. ______

Checked and Released

By ______ Date ______

SPECIAL INSTRUCTIONS: 300 HN - POWER STEERING FLUID AS RECEIVED
150°C - 1000 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 5

REQUESTED BY R. [illegible] APP. BY ______ CHARGE CODE 323689 DATE SUB. ______ DATE NEED ______

GAGE 300 TYPE HN ROLL NO. 2112991 MATERIAL KAPTON® DATE PRODUCED 7/31/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus]	MD ✓	TD ✓
[✓ 2. Elongation]	MD ✓	TD ✓
[✓ 3. Tears]	MD ✓	TD ✓
4. Thickness	MD	TD
5. Gage %	MD	TD
[✓ 6. Tensiles]	MD ✓	TD ✓
7. 400°C D.S.	MD	TD
8. 275°C D.S.	MD	TD
9. 200°C D.S.	MD	TD

10. Heat Seals C Side ______
11. Heat Seals C20 Side ______
12. Laminate Seals ______
13. Acrylic Seals ______
14. Unit Weight ______
15. Melt Index ______
16. Wettability ______
17. Appearance ______

18. Color ______
19. Visuals ______
20. Pyralux Adhesion ______
21.
23.

ELECTRICAL

1. Dielectric Str. ______
2. Dissipation Factor ______
3. Dielectric Const. ______
4. ______
5. ______
6. ______

CHEMICAL

1. Residual DMAC ______
2. Thermal Dura MD ______ TD ______
3. Hydrolytic Stab. ______

4. DMAC PPM ______
5. POP TP ______
6. DMDA TP ______
7. Acetone PPM ______
8. B-Pic PPM ______
9. Ac20 Spec Grav. ______
10. ANHYDRIDE PPM ______
11.
12.
13.

OTHER

1. ______
2. ______
3. ______
4. ______

Checked and Released

By ______ Date ______

SPECIAL INSTRUCTIONS: 300HN - POWER STEERING FLUID WITH WATER ADDED

150°C - 250 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 6

REQUESTED BY ______ APP. BY ______ CHARGE CODE 302629 DATE SUB. ______ DATE NEED ______

GAGE 300 TYPE HN ROLL NO. 2/12991 MATERIAL KAPTON® DATE PRODUCED 7/27/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD ✓ TD ✓
[✓ 2. Elongation] MD ✓ TD ✓
[✓ 3. Tear] MD ✓ TD ✓
4. Thickness MD ______ TD ______
5. Gage % MD ______ TD ______
[✓ 6. Tensile] MD ✓ TD ✓
7. 400°C D.S. MD ______ TD ______
8. 275°C D.S. MD ______ TD ______
9. 200°C D.S. MD ______ TD ______
10. Heat Seam C Side ______
11. Heat Seals C20 Side ______
12. Laminate Seals ______
13. Acrylic Seals ______
14. Unit Weight ______
15. Melt Index ______
16. Wettability ______
17. Appearance ______

18. Color ______
19. Visuals ______
20. Pyralux Adhesion ______
21.
23.

ELECTRICAL

1. Dielectric Str. ______
2. Dissipation Factor ______
3. Dielectric Const. ______
4. ______
5. ______
6. ______

CHEMICAL

1. Residual DMAC ______
2. Thermal Dura. MD ______ TD ______
3. Hydrolytic Stab. ______

4. DMAC PPM ______
5. PDP TP ______
6. DMDA TP ______
7. Acetone PPM ______
8. B-Pic PPM ______
9. Ac20 Spec Grav. ______
10. ANHYDRIDE PPM ______
11.
12.
13.

OTHER

1. ______
2. ______
3. ______
4. ______

Checked and Released

By ______ Date ______

SPECIAL INSTRUCTIONS: 300HN - POWER STEERING FLUID WITH WATER ADDED

150°C - 500 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 7

REQUESTED BY B. [illegible] APP. BY ____ CHARGE CODE 303629 DATE SUB ____ DATE NEED ____

GAGE 300 TYPE HN ROLL NO. 2112991 MATERIAL Kapton® DATE PRODUCED 7/27/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

	MD	TD
[✓ 1. Modulus]	✓	✓
[✓ 2. Elongation]	✓	✓
[✓ 3. Tabs]	✓	✓
4. Thickness		
5. Gage %		
[✓ 6. Tensiles]	✓	✓
7. 400°C D.S.		
8. 275°C D.S.		
9. 200°C D.S.		

10. Heat Seals C Side ____
11. Heat Seals C20 Side ____
12. Laminate Seals ____
13. Acrylic Seals ____
14. Unit Weight ____
15. Melt Index ____
16. Wettability ____
17. Appearance ____
18. Color ____
19. Visuals ____
20. Pyralux Adhesion ____
21.
22.

ELECTRICAL

1. Dielectric Str. ____
2. Dissipation Factor ____
3. Dielectric Const. ____
4. ____
5. ____
6. ____

CHEMICAL

1. Residual DMAC ____
2. Thermal Data MD ____ TD ____
3. Hydrolytic Stab. ____
4. DMAC PPM ____
5. POP TP ____
6. DMDA TP ____
7. Acetone PPM ____
8. B-Pic PPM ____
9. Ac20 Spec Grav. ____
10. ANHYDRIDE PPM ____
11.
12.
13.

OTHER

1. ____
2. ____
3. ____
4. ____

Checked and Released

By ____ Date ____

SPECIAL INSTRUCTIONS: 300 HN - POWER STEERING FLUID WITH WATER ADDED

150°C - 1000 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # B

REQUESTED BY K. Hamm APP. BY ____ CHARGE CODE 303629 DATE SUB. ____ DATE NEED ____

GAGE 300 TYPE HN ROLL NO. 3112991 MATERIAL Kapton® DATE PRODUCED 7/27/93

REASON FOR REQUEST Texas Instruments Fluid Testing Program

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD ✓ TD ✓
[✓ 2. Elongation] MD ✓ TD ✓
[✓ 3. Tear] MD ✓ TD ✓
4. Thickness MD ____ TD ____
5. Gage % MD ____ TD ____
[✓ 6. Tensile] MD ✓ TD ✓
7. 400°C D.S. MD ____ TD ____
8. 275°C D.S. MD ____ TD ____
9. 200°C D.S. MD ____ TD ____
10. Heat Seals C Side ____
11. Heat Seals C20 Side ____
12. Laminate Seals ____
13. Acrylic Seals ____
14. Unit Weight ____
15. Melt Index ____
16. Wettability ____
17. Appearance ____

18. Color ____
19. Visuals ____
20. Pyralux Adhesion ____
21.
22.

ELECTRICAL

1. Dielectric Str. ____
2. Dissipation Factor ____
3. Dielectric Const. ____
4.
5.
6.

CHEMICAL

1. Residual DMAC ____
2. Thermal Dura MD ____ TD ____
3. Hydrolytic Stab. ____

4. DMAC PPM ____
5. POP TP ____
6. DMDA TP ____
7. Acetone PPM ____
8. B-Pic PPM ____
9. Ac20 Spec Grav. ____
10. ANHYDRIDE PPM ____
11.
12.
13.

OTHER

1.
2.
3.
4.

Checked and Released

By ____ Date ____

SPECIAL INSTRUCTIONS: 300 HN - Brake Fluid as Received

150°C - 250 Hours

K & T LABORATORY ANALYSIS REQUEST

Sample # 9

REQUESTED BY K. [illegible] APP. BY ______ CHARGE CODE 303638 DATE SUB. ______ DATE NEED ______

GAGE 300 TYPE HN ______ ROLL NO. 212991 MATERIAL Kapton® DATE PRODUCED 2/27/92

REASON FOR REQUEST Texas Instruments Fluid Testing Program

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD ✓ TD ✓
[✓ 2. Elongation] MD ✓ TD ✓
[✓ 3. Tear] MD ✓ TD ✓
4. Thickness MD ______ TD ______
5. Gage % MD ______ TD ______
[✓ 6. Tensiles] MD ✓ TD ✓
7. 400°C D.S. MD ______ TD ______
8. 275°C D.S. MD ______ TD ______
9. 200°C D.S. MD ______ TD ______
10. Heat Seals C Side ______
11. Heat Seals C20 Side ______
12. Laminate Seals ______
13. Acrylic Seals ______
14. Unit Weight ______
15. Melt Index ______
16. Wettability ______
17. Appearance ______

18. Color ______
19. Visuals ______
20. Pyralux Adhesion ______
21.
22.

ELECTRICAL

1. Dielectric Str. ______
2. Dissipation Factor ______
3. Dielectric Const. ______
4. ______
5. ______
6. ______

CHEMICAL

1. Residual DMAC ______
2. Thermal Dura. MD ______ TD ______
3. Hydrolytic Stab. ______

4. DMAC PPM ______
5. POP TP ______
6. DMDA TP ______
7. Acetone PPM ______
8. B-Pic PPM ______
9. Ac20 Spec Grav. ______
10. ANHYDRIDE PPM ______
11.
12.
13.

OTHER

1. ______
2. ______
3. ______
4. ______

Checked and Released

By ______ Date ______

SPECIAL INSTRUCTIONS: 300 HN - Brake Fluid as Received

150°C - 500 Hours

DENNETTSA No. 1
[illegible]

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 10

REQUESTED BY H. G APP. BY ________ CHARGE CODE 303689 DATE SUB. ________ DATE NEED ________

GAGE 300 TYPE HN ROLL NO. 311391 MATERIAL KAPTON® DATE PRODUCED 7/22/82

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD ✓ TD ✓
[✓ 2. Elongation] MD ✓ TD ✓
[✓ 3. Tears] MD ✓ TD ✓
4. Thickness MD ____ TD ____
5. Gage % MD ____ TD ____
[✓ 6. Tensiles] MD ✓ TD ✓
7. 400°C D.S. MD ____ TD ____
8. 275°C D.S. MD ____ TD ____
9. 200°C D.S. MD ____ TD ____
10. Heat Seals C Side ____
11. Heat Seals C20 Side ____
12. Laminate Seals ____
13. Acrylic Seals ____
14. Unit Weight ____
15. Melt Index ____
16. Wettability ____
17. Appearance ____

18. Color ____
19. Visuals ____
20. Pyralux Adhesion ____
21.
22.

ELECTRICAL

1. Dielectric Str. ____
2. Dissipation Factor ____
3. Dielectric Const. ____
4. ____
5. ____
6. ____

CHEMICAL

1. Residual DMAC ____
2. Thermal Dass. MD ____ TD ____
3. Hydrolytic Stab. ____

4. DMAC PPM ____
5. PO? TP ____
6. DMDA TP ____
7. Acetone PPM ____
8. B-Pic PPM ____
9. Ac20 Spec Gran. ____
10. ANHYDRIDE PPM ____
11.
12.
13.

OTHER

1. ____
2. ____
3. ____
4. ____

Checked and Released

By ________ Date ________

SPECIAL INSTRUCTIONS: 300 HN – BRAKE FLUID AS RECEIVED
150°C – 1000 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 11

REQUESTED BY ______ APP. BY ______ CHARGE CODE 363629 DATE SUB. ______ DATE NEED ______

GAGE 300 TYPE HN ROLL NO. 2112991 MATERIAL KAPTON® DATE PRODUCED 7/27/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD ✓ TD ✓
[✓ 2. Elongation] MD ✓ TD ✓
[✓ 3. Tears] MD ✓ TD ✓
4. Thickness MD ______ TD ______
5. Gage % MD ______ TD ______
[✓ 6. Tensiles] MD ✓ TD ✓
7. 400°C D.S. MD ______ TD ______
8. 275°C D.S. MD ______ TD ______
9. 200°C D.S. MD ______ TD ______
10. Heat Seals C Side ______
11. Heat Seals C20 Side ______
12. Laminate Seals ______
13. Acrylic Seals ______
14. Unit Weight ______
15. Melt Index ______
16. Wettability ______
17. Appearance ______

18. Color ______
19. Visuals ______
20. Pyralux Adhesion ______
21.
22.

ELECTRICAL

1. Dielectric Str. ______
2. Dissipation Factor ______
3. Dielectric Const. ______
4. ______
5. ______
6. ______

CHEMICAL

1. Residual DMAC ______
2. Thermal Dura MD ______ TD ______
3. Hydrolytic Stab. ______

4. DMAC PPM ______
5. POP TP ______
6. DMDA TP ______
7. Acetone PPM ______
8. B-Pic PPM ______
9. Ac20 Spec Grav. ______
10. ANHYDRIDE PPM ______
11.
12.
13.

OTHER

1. ______
2. ______
3. ______
4. ______

Checked and Released

By ______ Date ______

SPECIAL INSTRUCTIONS: 300 HN - BRAKE FLUID WITH WATER ADDED
150°C - 250 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 12

REQUESTED BY H. [illegible] APP. BY ______ CHARGE CODE ______ DATE SUB. ______ DATE NEED ______

GAGE 300 TYPE HN ROLL NO. 2118991 MATERIAL KAPTON® DATE PRODUCED 2/22/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD ✓ TD ✓
[✓ 2. Elongation] MD ✓ TD ✓
[✓ 3. Tears] MD ✓ TD ✓
4. Thickness MD ______ TD ______
5. Gage % MD ______ TD ______
[✓ 6. Tensiles] MD ✓ TD ✓
7. 400°C D.S. MD ______ TD ______
8. 275°C D.S. MD ______ TD ______
9. 200°C D.S. MD ______ TD ______
10. Heat Seals C Side ______
11. Heat Seals C20 Side ______
12. Laminate Seals ______
13. Acrylic Seals ______
14. Unit Weight ______
15. Melt Index ______
16. Wettability ______
17. Appearance ______

18. Color ______
19. Visuals ______
20. Pyralux Adhesion ______
21.
22.

ELECTRICAL

1. Dielectric Str. ______
2. Dissipation Factor ______
3. Dielectric Const. ______
4. ______
5. ______
6. ______

CHEMICAL

1. Residual DMAC ______
2. Thermal Dur. MD ______ TD ______
3. Hydrolytic Stab. ______

4. DMAC PPM ______
5. POP TP ______
6. DMDA TP ______
7. Acetone PPM ______
8. B-Pic PPM ______
9. Ac20 Spec Gran. ______
10. ANHYDRIDE PPM ______
11.
12.
13.

OTHER

1. ______
2. ______
3. ______
4. ______

Checked and Released

By ______ Date ______

SPECIAL INSTRUCTIONS: 300 HN - BRAKE FLUID WITH WATER ADDED
150°C - 500 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 13

REQUESTED BY H. [illegible] APP. BY ______ CHARGE CODE 303629 DATE SUB. ______ DATE NEED ______

GAGE 300 TYPE HN ROLL NO. 2113991 MATERIAL KAPTON® DATE PRODUCED 7/27/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus]	MD	✓	TD	✓
[✓ 2. Elongation]	MD	✓	TD	✓
[✓ 3. Tear]	MD	✓	TD	✓
4. Thickness	MD		TD	
5. Gage %	MD		TD	
[✓ 6. Tensile]	MD	✓	TD	✓
7. 400°C D.S.	MD		TD	
8. 275°C D.S.	MD		TD	
9. 200°C D.S.	MD		TD	

10. Heat Seals C Side ______
11. Heat Seals C20 Side ______
12. Laminate Seals ______
13. Acrylic Seals ______
14. Unit Weight ______
15. Melt Index ______
16. Wettability ______
17. Appearance ______

18. Color ______
19. Visuals ______
20. Pyralux Adhesion ______
21.
22.

ELECTRICAL

1. Dielectric Str. ______
2. Dissipation Factor ______
3. Dielectric Const. ______
4. ______
5. ______
6. ______

CHEMICAL

1. Residual DMAC ______
2. Thermal Dura MD ______ TD ______
3. Hydrolytic Stab. ______

4. DMAC PPM ______
5. POP TP ______
6. DMDA TP ______
7. Acetone PPM ______
8. B-Pic PPM ______
9. Ac20 Spec Con. ______
10. ANHYDRIDE PPM ______
11.
12.
13.

OTHER

1. ______
2. ______
3. ______
4. ______

Checked and Released

By ______ Date ______

SPECIAL INSTRUCTIONS: 300HN – BRAKE FLUID WITH WATER ADDED

150°C - 1000 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 14

REQUESTED BY ______ APP. BY ______ CHARGE CODE 303629 DATE SUB. ______ DATE NEED ______

GAGE 300 TYPE HN ROLL NO. 212991 MATERIAL Kapton® DATE PRODUCED 7/22/98

REASON FOR REQUEST ARCHIVES – TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

1. Modulus MD ______ TD ______
2. Elongation MD ______ TD ______
3. Tears MD ______ TD ______
4. Thickness MD ______ TD ______
5. Gage % MD ______ TD ______
6. Tensiles MD ______ TD ______
7. 400°C D.S. MD ______ TD ______
8. 275°C D.S. MD ______ TD ______
9. 200°C D.S. MD ______ TD ______
10. Heat Seals C Side ______
11. Heat Seals C20 Side ______
12. Laminate Seals ______
13. Acrylic Seals ______
14. Unit Weight ______
15. Melt Index ______
16. Wettability ______
17. Appearance ______
18. Color ______
19. Visuals ______
20. Pyralux Adhesion ______
21.
23.

ELECTRICAL

1. Dielectric Str. ______
2. Dissipation Factor ______
3. Dielectric Const. ______
4. ______
5. ______
6. ______

CHEMICAL

1. Residual DMAC ______
2. Thermal Dura MD ______ TD ______
3. Hydrolytic Stab. ______
4. DMAC PPM ______
5. POP TP ______
6. DMDA TP ______
7. Acetone PPM ______
8. B-Pic PPM ______
9. Ac20 Spec Grav. ______
10. ANHYDRIDE PPM ______
11.
12.
13.

OTHER

1. ARCHIVES ONLY
2.
3.
4.

Checked and Released

By ______ Date ______

SPECIAL INSTRUCTIONS: 300 HN – ARCHIVES FOR TEXAS INSTRUMENTS FLUID TESTING PROGRAM

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 15

REQUESTED BY H. [illegible] APP. BY ____ CHARGE CODE 343629 DATE SUB. ____ DATE NEED ____

GAGE 500 TYPE EN131 ROLL NO. 4117831 MATERIAL K/T LAMINATE DATE PRODUCED 7/27/92

REASON FOR REQUEST CONTROL SAMPLES FOR TEXAS INSTRUMENTS ELLIO TESTING PROGRAM (START)

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD ✓ TD ✓
[✓ 2. Elongation] MD ✓ TD ✓
[✓ 3. Tear] MD ✓ TD ✓
4. Thickness MD ____ TD ____
5. Gage % MD ____ TD ____
[✓ 6. Tensile] MD ✓ TD ✓
7. 400°C D.S. MD ____ TD ____
8. 275°C D.S. MD ____ TD ____
9. 200°C D.S. MD ____ TD ____
10. Heat Seals C Side ____
11. Heat Seals C20 Side ____
12. Laminate Seals ____
13. Acrylic Seals ____
14. Unit Weight ____
15. Melt Index ____
16. Wettability ____
17. Appearance ____

18. Color ____
19. Visuals ____
20. Pyralux Adhesion ____
21.
22.

ELECTRICAL

1. Dielectric Str. ____
2. Dissipation Factor ____
3. Dielectric Const. ____
4. ____
5. ____
6. ____

CHEMICAL

1. Residual DMAC ____
2. Thermal Dura MD ____ TD ____
3. Hydrolytic Stab. ____

4. DMAC PPM ____
5. PCF TP ____
6. DMDA TP ____
7. Acetone PPM ____
8. B-Pic PPM ____
9. Ac20 Spec Grav. ____
10. ANHYDRIDE PPM ____
11.
12.
13.

OTHER

1. ____
2. ____
3. ____
4. ____

Checked and Released

By ____ Date ____

SPECIAL INSTRUCTIONS: 500 EN131 - CONTROL SAMPLES

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 16

REQUESTED BY H. H[illegible] APP. BY ______ CHARGE CODE 503639 DATE SUB. ______ DATE NEED. ______

GAGE 500 TYPE EN131 ROLL NO. 4117831 MATERIAL K/T LAMINATE DATE PRODUCED 7/27/77

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD ✓ TD ✓
[✓ 2. Elongation] MD ✓ TD ✓
[✓ 3. Tear] MD ✓ TD ✓
4. Thickness MD ______ TD ______
5. Gage % MD ______ TD ______
[✓ 6. Tensile] MD ✓ TD ✓
7. 400°C D.S. MD ______ TD ______
8. 275°C D.S. MD ______ TD ______
9. 200°C D.S. MD ______ TD ______
10. Heat Seals C Side ______
11. Heat Seals C20 Side ______
12. Laminate Seals ______
13. Acrylic Seals ______
14. Unit Weight ______
15. Melt Index ______
16. Wettability ______
17. Appearance ______

18. Color ______
19. Visuals ______
20. Pyralux Adhesion ______
21.
23.

ELECTRICAL

1. Dielectric Str. ______
2. Dissipation Factor ______
3. Dielectric Const. ______
4. ______
5. ______
6. ______

CHEMICAL

1. Residual DMAC ______
2. Thermal Dura. MD ______ TD ______
3. Hydrolytic Stab. ______

4. DMAC PPM ______
5. POF TP ______
6. DMDA TP ______
7. Acetone PPM ______
8. B-Pic PPM ______
9. Ac20 Spec Gran. ______
10. ANHYDRIDE PPM ______
11.
12.
13.

OTHER

1. ______
2. ______
3. ______
4. ______

Checked and Released

By ______ Date ______

SPECIAL INSTRUCTIONS: 500EN131 - POWER STEERING FLUID AS RECEIVED
150°C - 230 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE #17

REQUESTED BY H. [illegible] APP. BY ____ CHARGE CODE 303629 DATE SUB. ____ DATE NEED ____

GAGE 500 TYPE EAL131 ROLL NO. 9478.31 MATERIAL Off Granulate DATE PRODUCED 7/22/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD. ✓ TD. ✓
[✓ 2. Elongation] MD. ✓ TD. ✓
[✓ 3. Tears] MD. ✓ TD. ✓
4. Thickness MD. ____ TD. ____
5. Gage % MD. ____ TD. ____
[✓ 6. Tensile] MD. ✓ TD. ✓
7. 400°C D.S. MD. ____ TD. ____
8. 275°C D.S. MD. ____ TD. ____
9. 200°C D.S. MD. ____ TD. ____
10. Heat Seals C Side ____
11. Heat Seals C20 Side ____
12. Laminate Seals ____
13. Acrylic Seals ____
14. Unit Weight ____
15. Melt Index ____
16. Wettability ____
17. Appearance ____

18. Color ____
19. Visuals ____
20. Pyralux Adhesion ____
21.
22.

ELECTRICAL

1. Dielectric Str. ____
2. Dissipation Factor ____
3. Dielectric Const. ____
4. ____
5. ____
6. ____

CHEMICAL

1. Residual DMAC ____
2. Thermal Dura. MD. ____ TD. ____
3. Hydrolytic Stab. ____

4. DMAC PPM ____
5. POP TP ____
6. DMDA TP ____
7. Acetone PPM ____
8. B-Pic PPM ____
9. Ac20 Spec Grav. ____
10. ANHYDRIDE PPM ____
11.
12.
13.

OTHER

1. ____
2. ____
3. ____
4. ____

Checked and Released

By ____ Date ____

SPECIAL INSTRUCTIONS: 500EAL131 - POWER STEERING FLUID AS RECEIVED
150°C - 500 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE #1B

REQUESTED BY H. Glumm APP. BY ______ CHARGE CODE 303629 DATE SUB. ______ DATE NEED ______

GAGE 500 TYPE FN131 ROLL NO. 4U7831 MATERIAL K/F LAMINATE DATE PRODUCED 7/27/93

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

	MD	TD
[✓ 1. Modulus]	✓	✓
[✓ 2. Elongation]	✓	✓
[✓ 3. Tears]	✓	✓
4. Thickness		
5. Gage %		
[✓ 6. Tensiles]	✓	✓
7. 400°C D.S.		
8. 275°C D.S.		
9. 200°C D.S.		

10. Heat Seals C Side ______
11. Heat Seals C20 Side ______
12. Laminate Seals ______
13. Acrylic Seals ______
14. Unit Weight ______
15. Melt Index ______
16. Wettability ______
17. Appearance ______

18. Color ______
19. Visuals ______
20. Pyralux Adhesion ______
21.
22.

ELECTRICAL

1. Dielectric Str. ______
2. Dissipation Factor ______
3. Dielectric Const. ______
4. ______
5. ______
6. ______

CHEMICAL

1. Residual DMAC ______
2. Thermal Dura MD ______ TD ______
3. Hydrolytic Stab. ______

4. DMAC PPM ______
5. POP TP ______
6. DMDA TP ______
7. Acetone PPM ______
8. B-Pic PPM ______
9. Ac20 Spec Grav. ______
10. ANHYDRIDE PPM ______
11.
12.
13.

OTHER

1. ______
2. ______
3. ______
4. ______

Checked and Released

By ______ Date ______

SPECIAL INSTRUCTIONS: 500FN131 - POWER STEERING FLUID AS RECEIVED.
150°C - 1000 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 19

REQUESTED BY H. Glu[illegible] APP. BY ____ CHARGE CODE 303639 DATE SUB. ____ DATE NEED ____

GAGE 500 TYPE FN 131 ROLL NO. 4LL7831 MATERIAL K/C LAMINATE DATE PRODUCED 7/27/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD ✓ TD ✓
[✓ 2. Elongation] MD ✓ TD ✓
[✓ 3. Tear] MD ✓ TD ✓
4. Thickness MD ____ TD ____
5. Gage % MD ____ TD ____
[✓ 6. Tensile] MD ✓ TD ✓
7. 400°C D.S. MD ____ TD ____
8. 275°C D.S. MD ____ TD ____
9. 200°C D.S. MD ____ TD ____
10. Heat Seals C Side ____
11. Heat Seals C20 Side ____
12. Laminate Seals ____
13. Acrylic Seals ____
14. Unit Weight ____
15. Melt Index ____
16. Wettability ____
17. Appearance ____
18. Color ____
19. Visuals ____
20. Pyralux Adhesion ____
21.
23.

ELECTRICAL

1. Dielectric Str. ____
2. Dissipation Factor ____
3. Dielectric Const. ____
4. ____
5. ____
6. ____

CHEMICAL

1. Residual DMAC ____
2. Thermal Dura MD ____ TD ____
3. Hydrolytic Stab. ____
4. DMAC PPM ____
5. POP TP ____
6. DMDA TP ____
7. Acetone PPM ____
8. B-Pic PPM ____
9. Ac20 Spec Conc. ____
10. ANHYDRIDE PPM ____
11.
12.
13.

OTHER

1. ____
2. ____
3. ____
4. ____

Checked and Released

By ____ Date ____

SPECIAL INSTRUCTIONS: 500 FN 131 — POWER STEERING FLUID WITH WATER ADDED
150°C — 250 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 20

REQUESTED BY H. Glassman APP. BY ________ CHARGE CODE 563629 DATE SUB. ________ DATE NEED. ________

GAGE 500 TYPE FN 131 ROLL NO. 4478.31 MATERIAL E/T LAMINATE DATE PRODUCED 7/27/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD ✓ TD ✓
[✓ 2. Elongation] MD ✓ TD ✓
[✓ 3. Tear] MD ✓ TD ✓
4. Thickness MD ____ TD ____
5. Gage % MD ____ TD ____
[✓ 6. Tensiles] MD ✓ TD ✓
7. 400°C D.S. MD ____ TD ____
8. 275°C D.S. MD ____ TD ____
9. 200°C D.S. MD ____ TD ____
10. Heat Seals C Side ____
11. Heat Seals C20 Side ____
12. Laminate Seals ____
13. Acrylic Seals ____
14. Unit Weight ____
15. Melt Index ____
16. Wettability ____
17. Appearance ____

18. Color ____
19. Visuals ____
20. Pyralux Adhesion ____
21.
22.

ELECTRICAL

1. Dielectric Str. ____
2. Dissipation Factor ____
3. Dielectric Const. ____
4. ____
5. ____
6. ____

CHEMICAL

1. Residual DMAC ____
2. Thermal Dura. MD ____ TD ____
3. Hydrolytic Stab. ____

4. DMAC PPM ____
5. PDP TF ____
6. DMDA TF ____
7. Acetone PPM ____
8. B-Pic PPM ____
9. Ac20 Spec Grav. ____
10. ANHYDRIDE PPM ____
11.
12.
13.

OTHER

1. ____
2. ____
3. ____
4. ____

Checked and Released

By ____ Date ____

SPECIAL INSTRUCTIONS: 500FN131 - POWER STEERING FLUID WITH WATER ADDED

150°C - 500 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 21

REQUESTED BY H. Hemm APP. BY ____ CHARGE CODE 303629 DATE SUB. ____ DATE NEED ____

GAGE 500 TYPE EN 131 ROLL NO. 4117831 MATERIAL E/T LAMINATE DATE PRODUCED 7/27/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

	MD	TD
[✓ 1. Modulus]	✓	✓
[✓ 2. Elongation]	✓	✓
[✓ 3. Tear]	✓	✓
4. Thickness		
5. Gage %		
[✓ 6. Tensile]	✓	✓
7. 400°C D.S.		
8. 275°C D.S.		
9. 200°C D.S.		

10. Heat Seals C Side ____
11. Heat Seals C20 Side ____
12. Laminate Seals ____
13. Acrylic Seals ____
14. Unit Weight ____
15. Melt Index ____
16. Wettability ____
17. Appearance ____

18. Color ____
19. Visuals ____
20. Pyralux Adhesion ____
21.
23.

ELECTRICAL

1. Dielectric Str. ____
2. Dissipation Factor ____
3. Dielectric Const. ____
4. ____
5. ____
6. ____

CHEMICAL

1. Residual DMAC ____
2. Thermal Dura. MD ____ TD ____
3. Hydrolytic Stab. ____
4. DMAC PPM ____
5. POP TP ____
6. DMDA TP ____
7. Acetone PPM ____
8. B-Pic PPM ____
9. Ac20 Spec Grav. ____
10. ANHYDRIDE PPM ____
11.
12.
13.

OTHER

1. ____
2. ____
3. ____
4. ____

Checked and Released

By ____ Date ____

SPECIAL INSTRUCTIONS 500 EN131 - POWER STEERING FLUID WITH WATER ADDED
150°C - 1000 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 22

REQUESTED BY H. [illegible] APP. BY ____ CHARGE CODE 303627 DATE SUB. ____ DATE NEED ____

GAGE 500 TYPE FN 131 ROLL NO. 9117831 MATERIAL K/T LAMINATE DATE PRODUCED 7/27/93

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. [illegible]] MD ✓ TD ✓
[✓ 2. Elongation] MD ✓ TD ✓
[✓ 3. Tear] MD ✓ TD ✓
4. Thickness MD ____ TD ____
5. Gage % MD ____ TD ____
[✓ 6. Tensile] MD ✓ TD ✓
7. 400°C D.S. MD ____ TD ____
8. 275°C D.S. MD ____ TD ____
9. 200°C D.S. MD ____ TD ____
10. Heat Seals C Side ____
11. Heat Seals C20 Side ____
12. Laminate Seals ____
13. Acrylic Seals ____
14. Unit Weight ____
15. Melt Index ____
16. Wettability ____
17. Appearance ____

18. Color ____
19. Visuals ____
20. Pyralux Adhesion ____
21.
23.

ELECTRICAL

1. Dielectric Str. ____
2. Dissipation Factor ____
3. Dielectric Const. ____
4. ____
5. ____
6. ____

CHEMICAL

1. Residual DMAC ____
2. Thermal Dura MD ____ TD ____
3. Hydrolytic Stab. ____

4. DMAC PPM ____
5. POP TP ____
6. DMDA TP ____
7. Acetone PPM ____
8. B-Pic PPM ____
9. Ac20 Spec Grav. ____
10. ANHYDRIDE PPM ____
11.
12.
13.

OTHER

1. ____
2. ____
3. ____
4. ____

Checked and Released

By ____ Date ____

SPECIAL INSTRUCTIONS: 500 FN 131 – BRAKE FLUID AS RECEIVED
150°C – 250 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 23

REQUESTED BY H. [illegible] APP. BY ______ CHARGE CODE 303629 DATE SUB. ______ DATE NEED ______

GAGE 500 TYPE FN131 ROLL NO. 911/2831 MATERIAL K/T LAMINATE DATE PRODUCED 7/27/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD ✓ TD ✓
[✓ 2. Elongation] MD ✓ TD ✓
[✓ 3. [illegible]] MD ✓ TD ✓
4. Thickness MD ______ TD ______
5. Gage % MD ______ TD ______
[✓ 6. Tensile] MD ✓ TD ✓
7. 400°C D.S. MD ______ TD ______
8. 275°C D.S. MD ______ TD ______
9. 200°C D.S. MD ______ TD ______
10. Heat Seals C Side ______
11. Heat Seals C20 Side ______
12. Laminate Seals ______
13. Acrylic Seals ______
14. Unit Weight ______
15. Melt Index ______
16. Wettability ______
17. Appearance ______

18. Color ______
19. Visuals ______
20. Pyralux Adhesion ______
21.
23.

ELECTRICAL

1. Dielectric Str. ______
2. Dissipation Factor ______
3. Dielectric Const. ______
4. ______
5. ______
6. ______

CHEMICAL

1. Residual DMAC ______
2. Thermal Dura. MD ______ TD ______
3. Hydrolytic Stab. ______

4. DMAC PPM ______
5. POP TF ______
6. DMDA TF ______
7. Acetone PPM ______
8. B-Pic PPM ______
9. Ac20 Spec Grav. ______
10. ANHYDRIDE PPM ______
11.
12.
13.

OTHER

1. ______
2. ______
3. ______
4. ______

Checked and Released

By ______ Date ______

SPECIAL INSTRUCTIONS: 500FN131 - BRAKE FLUID AS RECEIVED
150°C - 500 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 24

REQUESTED BY H. APP. BY CHARGE CODE 303629 DATE SUB. DATE NEED

GAGE 500 TYPE FN131 ROLL NO. 4117831 MATERIAL K/T LAMINATE DATE PRODUCED 7/27/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD ✓ TD ✓
[✓ 2. Elongation] MD ✓ TD ✓
[✓ 3. Tear] MD ✓ TD ✓
4. Thickness MD TD
5. Gage % MD TD
[✓ 6. Tensile] MD ✓ TD ✓
7. 400°C D.S. MD TD
8. 275°C D.S. MD TD
9. 200°C D.S. MD TD
10. Heat Seals C Side
11. Heat Seals C20 Side
12. Laminate Seals
13. Acrylic Seals
14. Unit Weight
15. Melt Index
16. Wettability
17. Appearance
18. Color
19. Visuals
20. Pyralux Adhesion
21.
23.

ELECTRICAL

1. Dielectric Str.
2. Dissipation Factor
3. Dielectric Const.
4.
5.
6.

CHEMICAL

1. Residual DMAC
2. Thermal Dura. MD TD
3. Hydrolytic Stab.
4. DMAC PPM
5. POF TP
6. DMDA TP
7. Acetone PPM
8. B-Pic PPM
9. Ac20 Spec Grav.
10. ANHYDRIDE PPM
11.
12.
13.

OTHER

1.
2.
3.
4.

Checked and Released

By Date

SPECIAL INSTRUCTIONS: 500 FN 131 - BRAKE FLUID AS RECEIVED
150°C - 1000 HOURS

DUNLITHA No. 1
96869

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 25

REQUESTED BY H. Glemann APP. BY ______ CHARGE CODE 303 629 DATE SUB. ______ DATE NEED ______

GAGE 500 TYPE FN131 ROLL NO. 4117831 MATERIAL E/T LAMINATE DATE PRODUCED 7/27/93

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD ✓ TD ✓
[✓ 2. Elongation] MD ✓ TD ✓
[✓ 3. Tear] MD ✓ TD ✓
4. Thickness MD ______ TD ______
5. Gage % MD ______ TD ______
[✓ 6. Tensile] MD ✓ TD ✓
7. 400°C D.S. MD ______ TD ______
8. 275°C D.S. MD ______ TD ______
9. 200°C D.S. MD ______ TD ______
10. Heat Seals C Side ______
11. Heat Seals C20 Side ______
12. Laminate Seals ______
13. Acrylic Seals ______
14. Unit Weight ______
15. Melt Index ______
16. Wettability ______
17. Appearance ______

18. Color ______
19. Visuals ______
20. Pyralux Adhesion ______
21.
22.

ELECTRICAL

1. Dielectric Str. ______
2. Dissipation Factor ______
3. Dielectric Const. ______
4. ______
5. ______
6. ______

CHEMICAL

1. Residual DMAC ______
2. Thermal Dura MD ______ TD ______
3. Hydrolytic Stab. ______

4. DMAC PPM ______
5. POP TP ______
6. DMDA TP ______
7. Acetone PPM ______
8. B-Pic PPM ______
9. Ac20 Spec Cran. ______
10. ANHYDRIDE PPM ______
11.
12.
13.

OTHER

1. ______
2. ______
3. ______
4. ______

Checked and Released

By ______ Date ______

SPECIAL INSTRUCTIONS: 500 FN 131 – BRAKE FLUID WITH WATER ADDED
150°C – 250 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 26

REQUESTED BY H. Gleason APP. BY ______ CHARGE CODE 303629 DATE SUB. ______ DATE NEED ______

GAGE 500 TYPE FN 131 ROLL NO. 4127831 MATERIAL K/T LAMINATE DATE PRODUCED 7/22/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus]	MD ✓	TD ✓
[✓ 2. Elongation]	MD ✓	TD ✓
[✓ 3. Tear]	MD ✓	TD ✓
4. Thickness	MD	TD
5. Gage %	MD	TD
[✓ 6. Tensile]	MD ✓	TD ✓
7. 400°C D.S.	MD	TD
8. 275°C D.S.	MD	TD
9. 200°C D.S.	MD	TD

10. Heat Seals C Side ______
11. Heat Seals C20 Side ______
12. Laminate Seals ______
13. Acrylic Seals ______
14. Unit Weight ______
15. Melt Index ______
16. Wettability ______
17. Appearance ______
18. Color ______
19. Visuals ______
20. Pyralux Adhesion ______
21.
22.

ELECTRICAL

1. Dielectric Str. ______
2. Dissipation Factor ______
3. Dielectric Const. ______
4. ______
5. ______
6. ______

CHEMICAL

1. Residual DMAC ______
2. Thermal Dura MD ______ TD ______
3. Hydrolytic Stab. ______
4. DMAC PPM ______
5. POP TP ______
6. DMDA TP ______
7. Acetone PPM ______
8. B-Pic PPM ______
9. Ac2O Spec Cren. ______
10. ANHYDRIDE PPM ______
11.
12.
13.

OTHER

1. ______
2. ______
3. ______
4. ______

Checked and Released

By ______ Date ______

SPECIAL INSTRUCTIONS: 500 FN 131 - BRAKE FLUID WITH WATER ADDED

150°C - 500 HOURS

DUNETTSA No. 1
9/4/03

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 27

REQUESTED BY ________ APP. BY ________ CHARGE CODE 303629 DATE SUB. ________ DATE NEED ________

GAGE 500 TYPE FN 131 ROLL NO. #112831 MATERIAL K/T LAMINATE DATE PRODUCED 7/27/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD ✓ TD ✓

[✓ 2. Elongation] MD ✓ TD ✓

[✓ 3. Yield] MD ✓ TD ✓

4. Thickness MD ____ TD ____

5. Gage % MD ____ TD ____

[✓ 6. Tensile] MD ✓ TD ✓

7. 400°C D.S. MD ____ TD ____

8. 275°C D.S. MD ____ TD ____

9. 300°C D.S. MD ____ TD ____

10. Heat Seals C Side ____

11. Heat Seals C20 Side ____

12. Laminate Seals ____

13. Acrylic Seals ____

14. Unit Weight ____

15. Melt Index ____

16. Wettability ____

17. Appearance ____

18. Color ____

19. Visuals ____

20. Pyralux Adhesion ____

21.

22.

ELECTRICAL

1. Dielectric Str. ____

2. Dissipation Factor ____

3. Dielectric Const. ____

4. ____

5. ____

6. ____

CHEMICAL

1. Residual DMAC ____

2. Thermal Dura MD ____ TD ____

3. Hydrolytic Stab. ____

4. DMAC PPM ____

5. POP TP ____

6. DMDA TP ____

7. Acetone PPM ____

8. B-Pic PPM ____

9. Ac20 Spec Grav. ____

10. ANHYDRIDE PPM ____

11.

12.

13.

OTHER

1. ____

2. ____

3. ____

4. ____

Checked and Released

By ____ Date ____

SPECIAL INSTRUCTIONS: 500FN131 – BRAKE FLUID WITH WATER ADDED

150°C – 1000 HOURS

K & T LABORATORY ANALYSIS REQUEST

SAMPLE # 28

REQUESTED BY K. Harmon APP. BY ____ CHARGE CODE 323629 DATE SUB. ____ DATE NEED ____

GAGE 500 TYPE FN131 ROLL NO. 4119831 MATERIAL K/C LAMINATE DATE PRODUCED 7/22/92

REASON FOR REQUEST TEXAS INSTRUMENTS FLUID TESTING PROGRAM

CIRCLE TESTS DESIRED

PHYSICALS

[✓ 1. Modulus] MD ✓ TD ✓
[✓ 2. Elongation] MD ✓ TD ✓
[✓ 3. Tear] MD ✓ TD ✓
4. Thickness MD ____ TD ____
5. Gage % MD ____ TD ____
[✓ 6. Tensile] MD ✓ TD ✓
7. 400°C D.S. MD ____ TD ____
8. 275°C D.S. MD ____ TD ____
9. 200°C D.S. MD ____ TD ____
10. Heat Seals C Side ____
11. Heat Seals C20 Side ____
12. Laminate Seals ____
13. Acrylic Seals ____
14. Unit Weight ____
15. Melt Index ____
16. Wettability ____
17. Appearance ____

18. Color ____
19. Visuals ____
20. Pyralux Adhesion ____
21.
23.

ELECTRICAL

1. Dielectric Str. ____
2. Dissipation Factor ____
3. Dielectric Const. ____
4. ____
5. ____
6. ____

CHEMICAL

1. Residual DMAC ____
2. Thermal Dura. MD ____ TD ____
3. Hydrolytic Stab. ____

4. DMAC PPM ____
5. POP TP ____
6. DMDA TP ____
7. Acetone PPM ____
8. B-Pic PPM ____
9. Ac20 Spec Gran. ____
10. ANHYDRIDE PPM ____
11.
12.
13.

OTHER

1. [✓ ARCHIVES ONLY]
2. ____
3. ____
4. ____

Checked and Released

By ____ Date ____

SPECIAL INSTRUCTIONS: 500 FN131 - ARCHIVES FOR TEXAS INSTRUMENTS FLUID TESTING PROGRAM

TEXAS
INSTRUMENTS

April 8, 1993

Harrison V. Gumm
E. I. Du Pont de Nemours & Company
Box 89
Circleville, OH 43113

Harry,

We agreed at the beginning of our study (some time ago that was) that Texas Instruments would share our results with you. Enclosed with this letter are tables and charts presenting our results on Kapton films aged in power steering fluids blended with 1% water. The results are very encouraging. Kapton appears to be mechanically stable in the power steering fluid environment.

Results of the brake fluid aging experiments should be coming to you shortly.

Thank you very much for all the support you provided during this effort. We could not have conducted this testing for our customer without your assistance.

Please contact me if you have any questions.

Take Care,

John E. Brennan, Ph. D.
Member, Technical Staff
Texas Instruments, Inc.

TEXAS INSTRUMENTS INCORPORATED • 34 FOREST STREET • ATTLEBORO, MA 02703
508-[illegible]-3800 • TELEX 210301 • CABLE TEXINS

Table 1
KAPTON TEST MATRIX

FLUID	% WATER	KAPTON	DIRECTION	TIME (hr)	# SAMPLES
Nissan PSF	1	300H	MD	223	5
Nissan PSF	1	300H	TD	223	5
Nissan PSF	1	500FN131	MD	223	5
Nissan PSF	1	500FN131	TD	223	5
Nissan PSF	1	300H	MD	502.5	5
Nissan PSF	1	300H	TD	502.5	5
Nissan PSF	1	500FN131	MD	502.5	5
Nissan PSF	1	500FN131	TD	502.5	5
Honda PSF	1	300H	MD	232	5
Honda PSF	1	300H	TD	232	5
Honda PSF	1	500FN131	MD	232	5
Honda PSF	1	500FN131	TD	232	5
Honda PSF	1	300H	MD	500	5
Honda PSF	1	300H	TD	500	5
Honda PSF	1	500FN131	MD	500	5
Honda PSF	1	500FN131	TD	500	5

all aging at 125°C

Table 2
HONDA PSF AGING

TIME (hr)	ULTIMATE TENSILE STRENGTH (kpsi)			
	KAPTON 300H		KAPTON 500FN131	
	MD	TD	MD	TD
0	23 20-25	23 21-27	18 17-20	16 14-17
232	26 23-29	26 20-31	18 15-22	19 17-23
500	28 21-31	20 17-25	20 20-20	14 12-17

strength values format:

average value
lower value-upper value

HONDA POWER STEERING FLUID AGING

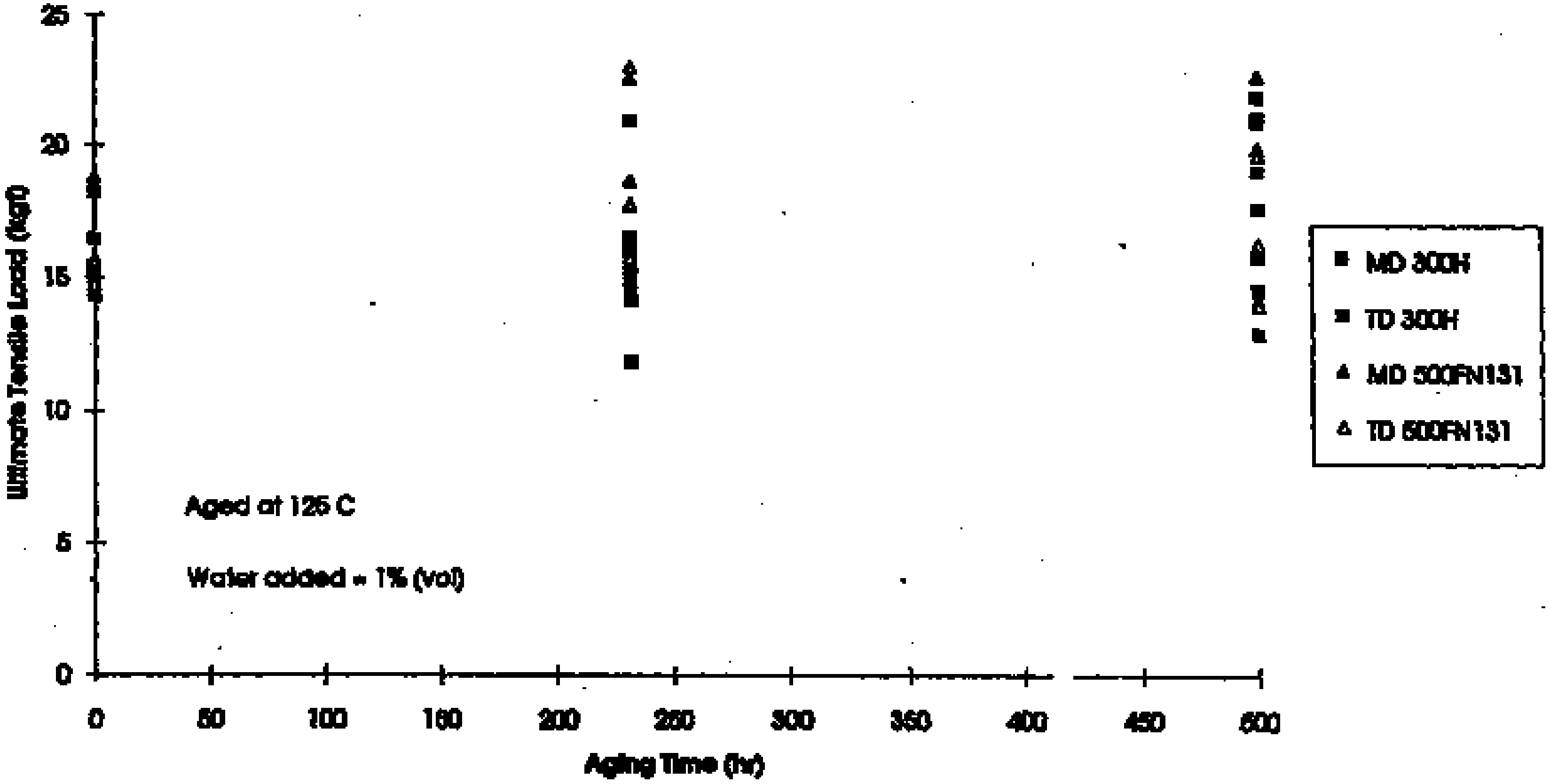
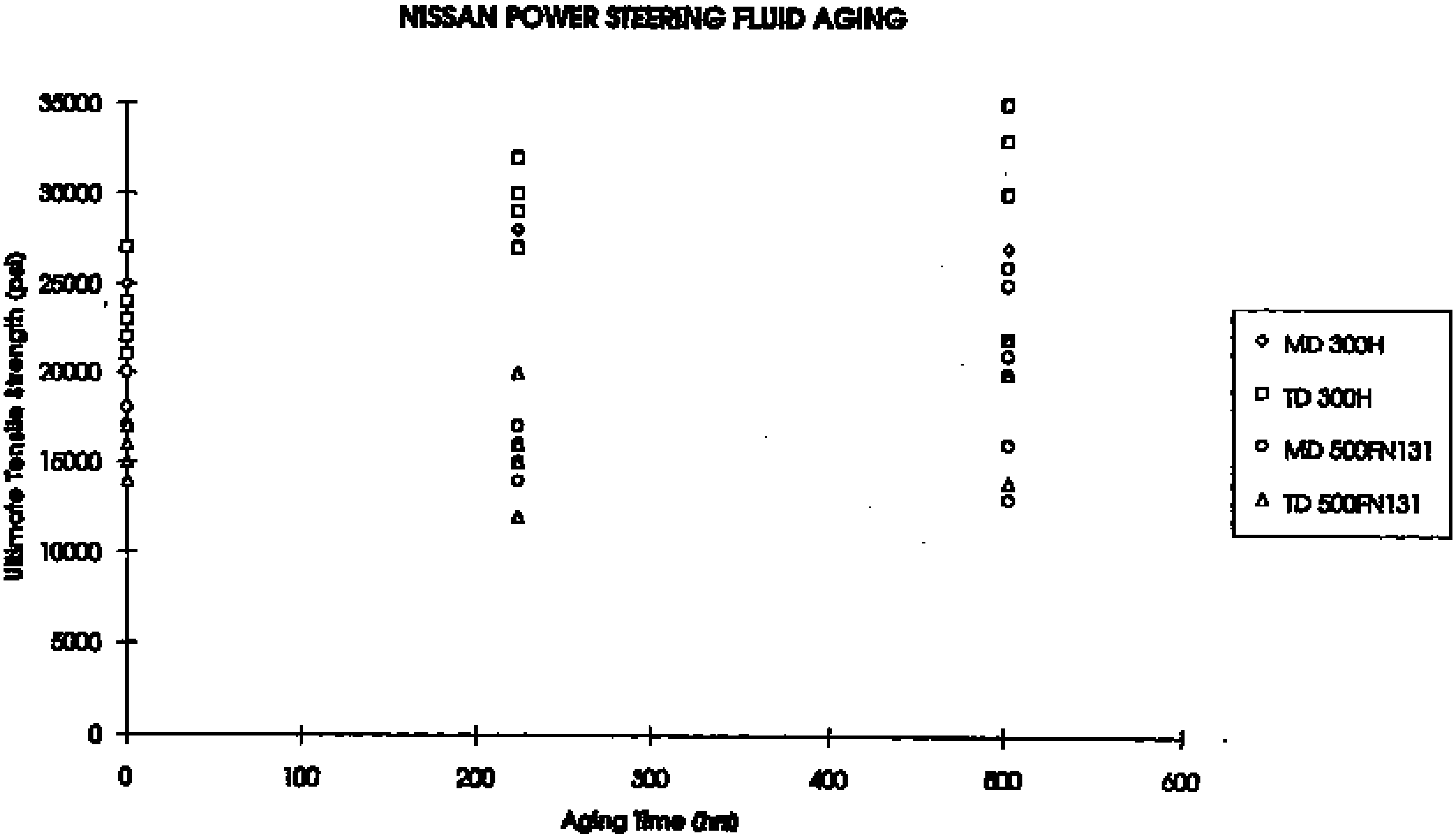


Table 3
NISSAN PSF AGING

TIME (hr)	ULTIMATE TENSILE STRENGTH (kpsi)			
	KAPTON 300H		KAPTON 500FN131	
	MD	TD	MD	TD
0	23 20-25	23 21-27	18 17-20	16 14-17
223	29 27-32	29 27-32	16 14-17	16 12-20
502.5	24 21-27	30 22-38	20 13-26	18 14-22

strength values format:

average value
lower value-upper value



NISSAN POWER STEERING FLUID AGING

DUPONT

CIRCLEVILLE PLANT
P.O. Box 89
Circleville, OH 43113
HPF - SP Resin

Date 3/25/99

FACSIMILE TRANSMISSION COVER SHEET

ADDRESSEE(S):

NAME	***COMPANY/BUSINESS/GROUP***	***FAX NUMBER***
JOHN HYNES	TI	508-236-~~3470~~ 3131

SENDER:	***BUSINESS SECTOR***	***LOCATION***
MARK MCALEES	KAPTON	

Total Number of Pages (Including Cover Sheet) 4

DuPont, Circleville HPF - SP Resin Fax No. - 614-474-0680 , Verification No. 614-474-0445

SPECIAL INSTRUCTIONS/INFORMATION TO RECIPIENT:

**** CONFIDENTIALITY NOTE ****

([illegible])

CHEMICAL EXPOSURE DATA ON KAPTON

CHEMICAL EXPOSURE DATA ON 100HN AND 200 HN

CHEMICAL		TIME	TEMP.	% PROP. RETAINED		
				TENSILE	ELONG.	MODULUS
ACETONE		1 YR.	RT.	67	72	110
ACETONE		56 DAYS	56 C	100	100	100
ANILINE		30 DAYS	115 C	89	42	103
AMMON/HYDROX.		5 DAYS	RT		DISSOLVES	
ASKAREL	(4).	1 YR	150 C	100	83	142
BENZENE		1 YR	RT	100	83	100
BENZENE		56 DAYS	80 C	100	100	104
CHLOROBENZ		36 DAYS	132 C	100	85	103
CHLORONAPHTHALENE		1 YR	RT	88	82	106
CHLORONAPHTHALENE		56 DAYS	130 C	100	100	95
CHLOROFORM		1 YR	RT	93	74	86
CHLOROFORM		56 DAYS	60 C	100	104	100
DIMETHYL ANILINE		2 DAYS	190 C	41	33	103
DMF		1 YR	RT	81	48	85
DMF		1 ** DAY	153 C	0	0	0
DOW SILICONE- VARNISH 1402		48 HRS	250 C		VARNISH DECOMPOSED	
DOW SILICONE- VARNISH [illegible]		96 HRS	250 C	100	84	114
[illegible]+ PHENOL		1 YR	RT	83	33	130
[illegible]+ PHENOL		7 DAYS	150 C	83	16	134
FERRIC CHLORIDE	(3).	30 DAYS	80 C	48	24	90
GLACIAL ACETIC		36 DAYS	118 C	85	45	103
HEXANE		1 YR	RT	97	89	100
HEXANE		56 DAYS	65 C	100	106	114
JP-4 JET FUEL	(2)	181 DAYS	RT	96	80	84
JP-4 JET FUEL		28 DAYS	150 C	94	76	113
METHANOL		1 YR	RT	100	73	140
METHANOL		56 DAYS	64 C	100	100	105
M-CRESOL		22 DAYS	200 C	100	77	102
SOD. HYDROX. 10%		5 DAYS	RT		DISSOLVES	
SKYDROL	(1).	181 DAYS	RT	80	80	86
SKYDROL		14 DAYS	200 C	76	83	71
[illegible]- [illegible]		3 DAYS	215 C	31	10	83
SULFURIC ACID 10%		181 DAYS	RT	73	71	83
TOLUENE		1 YR	RT	94	68	97
TOLUENE		28 DAYS	110 C	82	33	99
TRANSIL OIL	(5).	6 MOS	150 C	100	100	108
WATER		24 DAYS	135 C	100	88	102
WATER PH-1		144 HRS	100 C		31	
WATER PH-10		100 HRS	100 C		45	

** IF AIR AND IN THE PRESENCE OF WATER
IF WATER AND AIR ARE REMOVED, LIFE IS EXTENDED CONSIDERABLY
(TO 3 WEEKS @ 153 C)

(1) HYDRAULIC FLUID (PHOSPHATE)

(2) GOVERNMENT SPEC. JET FUEL

(3) AQUEOUS SOLUTION OF FeCl3 + 0.3% COPPER POWDER

(4) CHLORINATED DIPHENYL (TRANSFORMER OIL)

(5) HYDROCARBON TRANSFORMER OIL

TEFLON FEP

Chemical Properties

DuPont FEP fluorocarbon film is chemically inert and solvent resistant to virtually all chemicals except molten alkali metals, fluorine at elevated temperatures, and certain complex halogenated compounds such as chlorine trifluoride at elevated temperatures and pressures.

In circumstances where end-use temperatures are close to the upper service limit 205°C (400°F), 80% sodium hydroxide, metal hydrides, aluminum chloride, ammonia, and certain amines ($R\text{-}NH_2$) may attack the film in a manner similar to molten alkali metals. Special testing is required when such extreme reducing or oxidizing conditions are evident.

With these exceptions noted, DuPont FEP fluorocarbon films exhibit a very broad range of chemical and thermal serviceability.

Due to the many complex aspects of performance in severe environments, final selection should be based on functional evaluations or experience under actual end-use conditions.

The chemical substances listed in Table 5 are representative of those with which DuPont FEP film has been found to be nonreactive.

Table 5
Typical Chemicals with Which DuPont FEP Film is Nonreactive*

- Abietic acid
- Acetic acid
- Acetic anhydride
- Acetone
- Acetophenone
- Acrylic anhydride
- Allyl acetate
- Allyl methacrylate
- Aluminum chloride
- Ammonia, liquid
- Ammonium chloride
- Aniline
- Benzonitrile
- Benzoyl chloride
- Benzyl alcohol
- Borax
- Boric acid
- Bromine
- n-Butyl amine
- Butyl acetate
- Butyl methacrylate
- Calcium chloride
- Carbon disulfide
- Cetane
- Chlorine
- Chloroform
- Chlorosulfonic acid
- Chromic acid
- Cyclohexane
- Cyclohexanone
- Dibutyl phthalate
- Dibutyl sebacate
- Diethyl carbonate
- Diethyl ether
- Dimethyl formamide
- Di-isobutyl adipate
- Dimethylformamide
- Dimethylhydrazine, unsymmetrical
- Dioxane
- Ethyl acetate
- Ethyl alcohol
- Ethyl ether
- Ethyl hexoate
- Ethylene bromide
- Ethylene glycol
- Ferric chloride
- Ferric phosphate
- Fluoronaphthalene
- Fluoronitrobenzene
- Formaldehyde
- Formic acid
- Furane
- Gasoline
- Hexachlorethane
- Hexane
- Hydrazine
- Hydrochloric acid
- Hydrofluoric acid
- Hydrogen peroxide
- Lead
- Magnesium chloride
- Mercury
- Methyl ethyl ketone
- Methacrylic acid
- Methanol
- Methyl methacrylate
- Naphthalene
- Naphthols
- Nitric acid
- Nitrobenzene
- 2-Nitro-butanol
- Nitromethane
- Nitrogen tetroxide
- 2-Nitro-2-methyl propanol
- n-Octadecyl alcohol
- Oils, animal and vegetable
- Ozone
- Perchlorethylene
- Pentachloro-benzamide
- Perfluoroxylene
- Phenol
- Phosphoric acid
- Phosphorus pentachloride
- Phthalic acid
- Pinene
- Piperidene
- Polyacrylonitrile
- Potassium acetate
- Potassium hydroxide
- Potassium permanganate
- Pyridine
- Soap and detergents
- Sodium hydroxide
- Sodium hypochlorite
- Sodium peroxide
- Solvents, aliphatic and aromatic**
- Stannous chloride
- Sulfur
- Sulfuric acid
- Tetrabromoethane
- Tetrachlorethylene
- Trichloracetic acid
- Trichlorethylene
- Tricresyl phosphate
- Triethanolamine
- Vinyl methacrylate
- Water
- Xylene
- Zinc chloride

---

*Based on experiments conducted up to the boiling points of the liquids listed. FEP resins have normal service temperatures up to 205°C (400°F). Absence of a specific chemical does not mean that it is reactive with FEP film.

**Some halogenated solvents may cause moderate swelling.

TEFLON FEP.

Physical Properties

Absorption

Almost all plastics absorb small quantities of certain materials with which they come in contact. Submicroscopic voids between polymer molecules provide space for the material absorbed without chemical reaction. This phenomenon is usually marked by a slight weight increase and sometimes by discoloration.

DuPont FEP fluorocarbon films have unusually low absorption compared with other thermoplastics. They absorb practically no common acids or bases at temperatures as high as 200°C (392°F) and exposures of up to one year. Even the absorption of solvents is extremely small. Weight increases are generally less than 1% when exposed at elevated temperatures for long periods. In general, aqueous solutions are absorbed very little by DuPont FEP film. *Moisture absorption is typically less than 0.01% at ambient temperature and pressure.*

Permeability

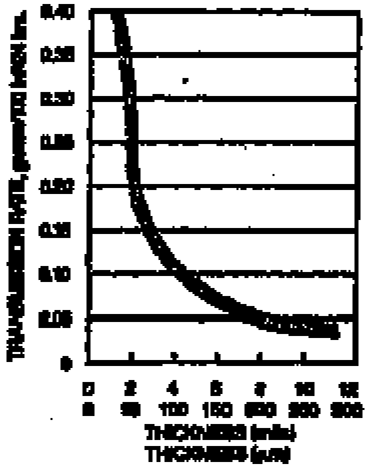
Many gases and vapors permeate FEP films at a much lower rate than for other thermoplastics (see Figure 13). In general, permeation increases with temperature, pressure, and surface contact area and decreases with increased film thickness. Table 6 lists rates at which various gases are transmitted through DuPont FEP fluorocarbon film, while Table 7 lists rates of vapor permeability for some representative substances. Note that the pressure for each material is its vapor pressure at the indicated temperature.

Table 6
Typical Gas Permeability Rates of DuPont FEP Fluorocarbon Film, 25 µm (1 mil) Thickness
(Test Method: ASTM D-1434 at 25°C [77°F])

Gas	Permeability Rate* cm³/(m²·24 h·atm)
Carbon Dioxide	25.9 x 10³
Hydrogen	34.1 x 10³
Nitrogen	5.0 x 10³
Oxygen	11.6 x 10³

*To convert to cm³/(100 in²·24 h·atm), multiply by 0.0645.

Figure 13. Water Vapor Transmission Rate of DuPont FEP Film at 40°C (104°F) per ASTM E-96 (Modified)



Notes: Values are averages only and not for specification purposes. To convert the permeation values for 100 in² to those for 1 m², multiply by 15.5.

Table 7
Typical Vapors Transmission Rates of DuPont FEP Fluorocarbon Film, 25 µm (1 mil) Thickness
(Test Method: Modified ASTM E-96)

Vapor	Temperature °C	°F	Vapor Transmission Rate SI Units (g/m²·d)	English Units (g/100 in²·d)
Acetic Acid	35	95	6.3	0.41
Acetone	35	95	14.7	0.95
Benzene	35	95	9.9	0.64
Carbon Tetrachloride	35	95	4.8	0.31
Ethyl Acetate	35	95	11.7	0.76
Ethyl Alcohol	35	95	10.7	0.69
Freon® F-12	23	73	372.0	24.0
Hexane	35	95	8.7	0.56
Hydrochloric Acid	25	77	<0.2	<0.01
Nitric Acid (Red Fuming)	25	77	160.0	10.5
Sodium Hydroxide, 50%	25	77	<0.2	<0.01
Sulfuric Acid, 98%	25	77	2×10^{-4}	1×10^{-5}
Water	39.5	103	7.0	0.40

Summary of Chemical Properties
3/2/99

The following pages were supplied by Dupont and show chemical and physical properties for Teflon and Kapton. In summary, water will degrade the mechanical properties of Kapton, but Teflon is unaffected by water. This is the reason why the Teflon-Kapton-Teflon system was selected for Texas Instruments switch diaphragm (3 mil thick Kapton layer coated with 1 mil Teflon on both sides). Page 1 (marked with "A") indicates that the Teflon is non-reactive with water. While page 2 shows Teflon has a relatively low vapor transmission rate (marked with "B"). Page 3 shows how the mechanical properties of Kapton degrade with water and temperature exposure (marked with "C").

End of document.

TEFLON

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Benzoyl chloride
Benzyl alcohol
Borax
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Bromine
n-Butyl amine
Butyl acetate
Butyl methacrylate
Calcium chloride
Carbon disulfide
Cetane
Chlorine
Chloroform
Chlorosulfonic acid
Chromic acid
Cyclohexane
Cyclohexanone
Dibutyl phthalate
Dibutyl sebacate
Diethyl carbonate
Diethyl ether
Dimethyl formamide
Di-isobutyl adipate
Dimethylformamide
Dimethylhydrazine, unsymmetrical
Dioxane
Ethyl acetate
Ethyl alcohol
Ethyl ether
Ethyl hexoate
Ethylene bromide
Ethylene glycol
Ferric chloride
Ferric phosphate
Fluoronaphthalene
Fluoronitrobenzene
Formaldehyde
Formic acid
Furane
Gasoline
Hexachloroethane
Hexane
Hydrazine
Hydrochloric acid
Hydrofluoric acid
Hydrogen peroxide
Lead
Magnesium chloride
Mercury
Methyl ethyl ketone
Methacrylic acid
Methanol
Methyl methacrylate
Naphthalene
Naphthols
Nitric acid
Nitrobenzene
2-Nitro-butanol
Nitromethane
Nitrogen tetroxide
2-Nitro-2-methyl propanol
n-Octadecyl alcohol
Oils, animal and vegetable
Ozone
Perchloroethylene
Pentachloro-benzamide
Perfluoroxylene
Phenol
Phosphoric acid
Phosphorus pentachloride
Phthalic acid
Pinene
Piperidene
Polyacrylonitrile
Potassium acetate
Potassium hydroxide
Potassium permanganate
Pyridine
Soap and detergents
Sodium hydroxide
Sodium hypochlorite
Sodium peroxide
Solvents, aliphatic and aromatic**
Stannous chloride
Sulfur
Sulfuric acid
Tetrabromoethane
Tetrachloroethylene
Trichloroacetic acid
Trichloroethylene
Tricresyl phosphate
Triethanolamine
Vinyl methacrylate
Water
Xylene
Zinc chloride

#

---

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Page 1

TEFLON FEP.

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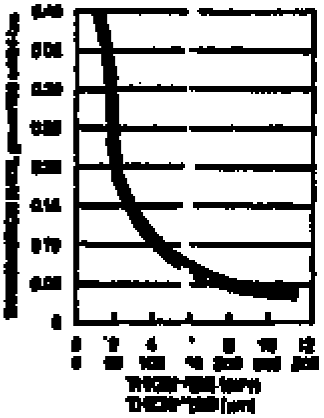
Figure 23. Water Vapor Transmission Rate of DuPont FEP Film at 40°C (104°F) by ASTM E-96 (Modified)



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Hexane	35	95	5.7	0.56
Hydrochloric Acid	25	77	<0.2	<0.01
Nitric Acid (Red Fuming)	25	77	160.0	10.5
Sodium Hydroxide, 50%	25	77	<0.2	<0.01
Sulfuric Acid, 98%	25	77	2×10^{-3}	1×10^{-4}
Water	38.5	100	7.0	0.40

3

TI-001468

Page 2

Summary of Chemical Properties
3/2/99

The following pages were supplied by Dupont and show chemical and physical properties for Teflon and Kapton. In summary, water will degrade the mechanical properties of Kapton, but Teflon is unaffected by water. This is the reason why the Teflon-Kapton-Teflon system was selected for Texas Instruments switch diaphragm (3 mil thick Kapton layer coated with 1 mil Teflon on both sides). Page 1 (marked with "A") indicates that the Teflon is non-reactive with water. While page 2 shows Teflon has a relatively low vapor transmission rate (marked with "B"). Page 3 shows how the mechanical properties of Kapton degrade with water and temperature exposure (marked with "C").

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TEFLON FEP

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Aniline
Benzonitrile
Benzoyl chloride
Benzyl alcohol
Borax
Boric acid
Bromine
n-Butyl amine
Butyl acetate
Butyl methacrylate
Calcium chloride
Carbon disulfide
Cetane
Chlorine
Chloroform
Chlorosulfonic acid
Chromic acid
Cyclohexane
Cyclohexanone
Dibutyl phthalate
Dibutyl sebacate
Diethyl carbonate
Diethyl ether
Dimethyl formamide
Di-isobutyl adipate
Dimethylformamide
Dimethylhydrazine, unsymmetrical
Dioxane
Ethyl acetate
Ethyl alcohol
Ethyl ether
Ethyl hexoate
Ethylene bromide
Ethylene glycol
Ferric chloride
Ferric phosphate
Fluoronaphthalene
Fluoronitrobenzene
Formaldehyde
Formic acid
Furane
Gasoline
Hexachloroethane
Hexane
Hydrazine
Hydrochloric acid
Hydrofluoric acid
Hydrogen peroxide
Lead
Magnesium chloride
Mercury
Methyl ethyl ketone
Methacrylic acid
Methanol
Methyl methacrylate
Naphthalene
Naphthols
Nitric acid
Nitrobenzene
2-Nitro-butanol
Nitromethane
Nitrogen tetroxide
2-Nitro-2-methyl propanol
n-Octadecyl alcohol
Oils, animal and vegetable
Ozone
Perchloroethylene
Pentachloro-benzamide
Perfluoroxylene
Phenol
Phosphoric acid
Phosphorus pentachloride
Phthalic acid
Pinene
Piperidine
Polyacrylonitrile
Potassium acetate
Potassium hydroxide
Potassium permanganate
Pyridine
Soaps and detergents
Sodium hydroxide
Sodium hypochlorite
Sodium peroxide
Solvents, aliphatic and aromatic**
Stannous chloride
Sulfur
Sulfuric acid
Tetrabromoethane
Tetrachloroethylene
Trichloroacetic acid
Trichloroethylene
Tricresyl phosphate
Triethanol amine
Vinyl methacrylate
Water
Xylene
Zinc chloride

---

*Based on experimental exposure up to the boiling points of the liquids listed, FEP resists [illegible] normal service temperature [illegible] to 200°C (400°F). Absence of a specific chemical does not mean that it is reactive with FEP film.

**Some halogenated solvents may cause moderate swelling.

TEFLON FEP

Physical Properties

Absorption

Almost all plastics absorb small quantities of certain materials with which they come in contact. Submicroscopic voids between polymer molecules provide space for the material absorbed without chemical reaction. This phenomenon is usually marked by a slight weight increase and sometimes by discoloration.

DuPont FEP fluorocarbon films have unusually low absorption compared with other thermoplastics. They absorb practically no common acids or bases at temperatures as high as 200°C (392°F) and exposures of up to one year. Even the absorption of solvents is extremely small. Weight increases are generally less than 1% when exposed at elevated temperatures for long periods. In general, aqueous solutions are absorbed very little by DuPont FEP film. *Moisture absorption is typically less than 0.01% at ambient temperature and pressure.*

Permeability

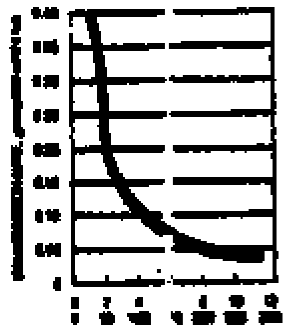
Many gases and vapors permeate FEP films at a much lower rate than for other thermoplastics (see Figure 13). In general, permeation increases with temperature, pressure, and surface contact area and decreases with increased film thickness. Table 6 lists rates at which various gases are transmitted through DuPont FEP fluorocarbon film, while Table 7 lists rates of vapor permeability for some representative substances. Note that the pressure for each material is its vapor pressure at the indicated temperature.

Table 6
Typical Gas Permeability Rates of DuPont FEP Fluorocarbon Film, 25 µm (1 mil) Thickness (Test Method: ASTM D-1434 at 25°C [77°F])

Gas	Permeability Rate* cm³/(m²·d·MPa)
Carbon Dioxide	25.9 × 10³
Hydrogen	34.1 × 10³
Nitrogen	5.0 × 10³
Oxygen	11.6 × 10³

*To convert to cm³/100 in²·d·atm), multiply by [illegible].

Figure 13. Water Vapor Transmission Rate of DuPont FEP Film at 40°C (104°F) by ASTM E-96 (Modified)



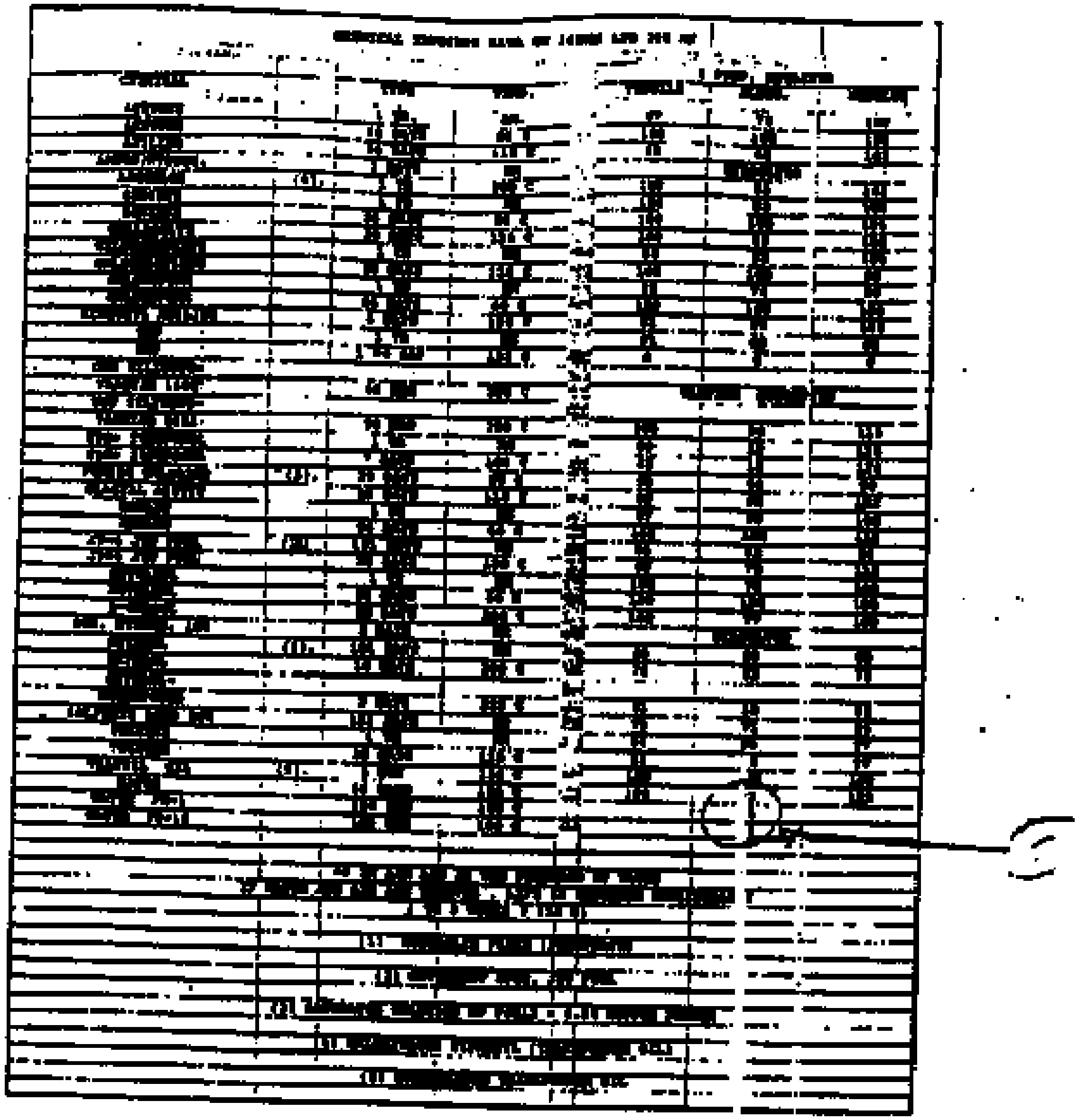
Notes: Values are averages only and not for specification purposes. To convert the permeation values for 100 in² to those for 1 m², multiply by 15.5.

Table 7
Typical Vapor Transmission Rates of DuPont FEP Fluorocarbon Film, 25 µm (1 mil) Thickness (Test Method: Modified ASTM E-96)

	Temperature		Vapor Transmission Rate	
Vapor	°C	°F	SI Units g/(m²·d)	English Units g/(100 in²·d)
Acetic Acid	35	95	6.3	0.41
Acetone	35	95	14.7	0.95
Benzene	35	95	9.9	0.64
Carbon Tetrachloride	35	95	4.8	0.31
Ethyl Acetate	35	95	11.7	0.75
Ethyl Alcohol	35	95	10.7	0.69
Freon® F-12	23	73	372.0	24.0
Hexane	35	95	8.7	0.56
Hydrochloric Acid	25	77	<0.2	<0.01
Nitric Acid (Red Fuming)	25	77	155.0	10.0
Sodium Hydroxide, 50%	25	77	<0.2	<0.01
Sulfuric Acid, 98%	25	77	2 × 10⁻⁵	1 × 10⁻⁶
→ Water	39.5	103	7.0	0.45

Page 2

[illegible] on KAPTON



Page 3

OXALIC ACID TEST AVGS.

500FN131

	MODULUS	TENSL	ELONG.									
CONTROL	317.8	26.2	112.9									
	ROOM TEMPERATURE						[illegible] C					
	0.5% SOLUTION			5.0% SOLUTION			0.5% SOLUTION			5.0% SOLUTION		
	MODULUS	TENSL	ELONG.	MODULUS	TENSL	ELONG.	MODULUS	TENSL	ELONG.	MODULUS	TENSL	ELONG.
100 HRS.	300.9	25.18	115	304.1	25.67	119.8	309.1	18.88	59.78	314.4	17.1	40.71
500 HRS.	327.4	25.78	111.7	330.1	25.3	107.5	341.2	14.83	18.5	345	13.83	13
2372 HRS.	321.7	23.46	99.38	323.6	21.76	82.07	345.6	9.841	4.365	353.1	10.07	4.134
3212 HRS.	314.9	22.17	89.41	314.8	21.61	81.99	350.3	9.577	4.049	341.9	9.073	3.274
6555 HRS.	221.3	18.81	100.1	228.9	19.35	83.49	282.0	0	8.7	284.8	8.633	4.336
8524 HRS	317.3	22.45	89.57	322.9	18.72	84.05	378.5	9.389	2.898	Failed	Failed	Failed

jaw

05/11/99

OXALIC ACID TEST AVGS.

300FN929

	MODULUS	TENSIL.	ELONG.
CONTROL	347.7	29.86	93.55

	ROOM TEMPERATURE						90 DEGREES C					
	0.5% SOLUTION			5.0% SOLUTION			0.5% SOLUTION			5.0% SOLUTION		
	MODULUS	TENSIL.	ELONG.	MODULUS	TENSIL.	ELONG.	MODULUS	TENSIL.	ELONG.	MODULUS	TENSIL.	ELONG.
100 HRS.	353.7	31.21	94.35	382.3	31.05	88.97	352	24.18	57.28	358	21.42	41.43
500 HRS.	382.8	30.08	85.59	386.2	31.31	81.79	421.1	19.14	21.89	408.1	16.78	13.88
2373 HRS.	382.6	27.77	78.82	382.2	28.76	74.65	421.1	12.93	6.311	422.8	12.95	5
3212 HRS.	408.4	29.89	78.55	374.4	25.29	64.21	409.4	13.38	6.555	415.9	10.36	3.103
6039 hrs	301.6	25.74	80.5	311.9	24.89	58.88	317.8	13.2	6.827	327	0	4.749
6624 HRS	389.7	28.84	70.41	379.9	22.87	44.47	451.8	13.96	3.988	0	0.209	0.0656

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09119

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08/11/98

OXALIC ACID TEST AVGS.

300HN

	MODULUS	TENSIL	ELONG.
CONTROL	451.2	38.29	84.91

	ROOM TEMPERATURE						80 DEGREES C					
	0.5% SOLUTION			5.0% SOLUTION			0.5% SOLUTION			5.0% SOLUTION		
	MODULUS	TENSIL	ELONG.	MODULUS	TENSIL	ELONG.	MODULUS	TENSIL	ELONG.	MODULUS	TENSIL	ELONG.
100 HRS.	431.6	35.59	105.4	436.7	34.34	97.57	499.2	28.95	60.11	433.1	24.09	38.15
500 HRS.	464.5	32.21	89.07	476.7	31.26	80.53	516.6	21.26	17.69	518.3	17.91	9.504
2872 HRS.	470.8	31.4	86.89	471	28.59	76.02	509.9	15.33	5.146	516.3	14.16	3.638
3212 HRS.	469.04	29.59	76.63	-471	28.64	69.61	466.6	14.3	4.19	472.7	9.639	2.845
5036 hrs	331	27.53	89.71	518.2	28.45	74.05	379.9	12.56	4.675	387.5	8.012	4.151
6524 HRS	465.6	28.62	66.28	494.1	25.5	49.37	506.3	14.8	4.176	466.2	7.482	1.709

DDVNETRA No. 1
06129

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05/11/99

EA02-025

CROWELL
MORING

09/03/03

ATTACHMENT
2

Proprietary Information

77PS Overview
2/10/99

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

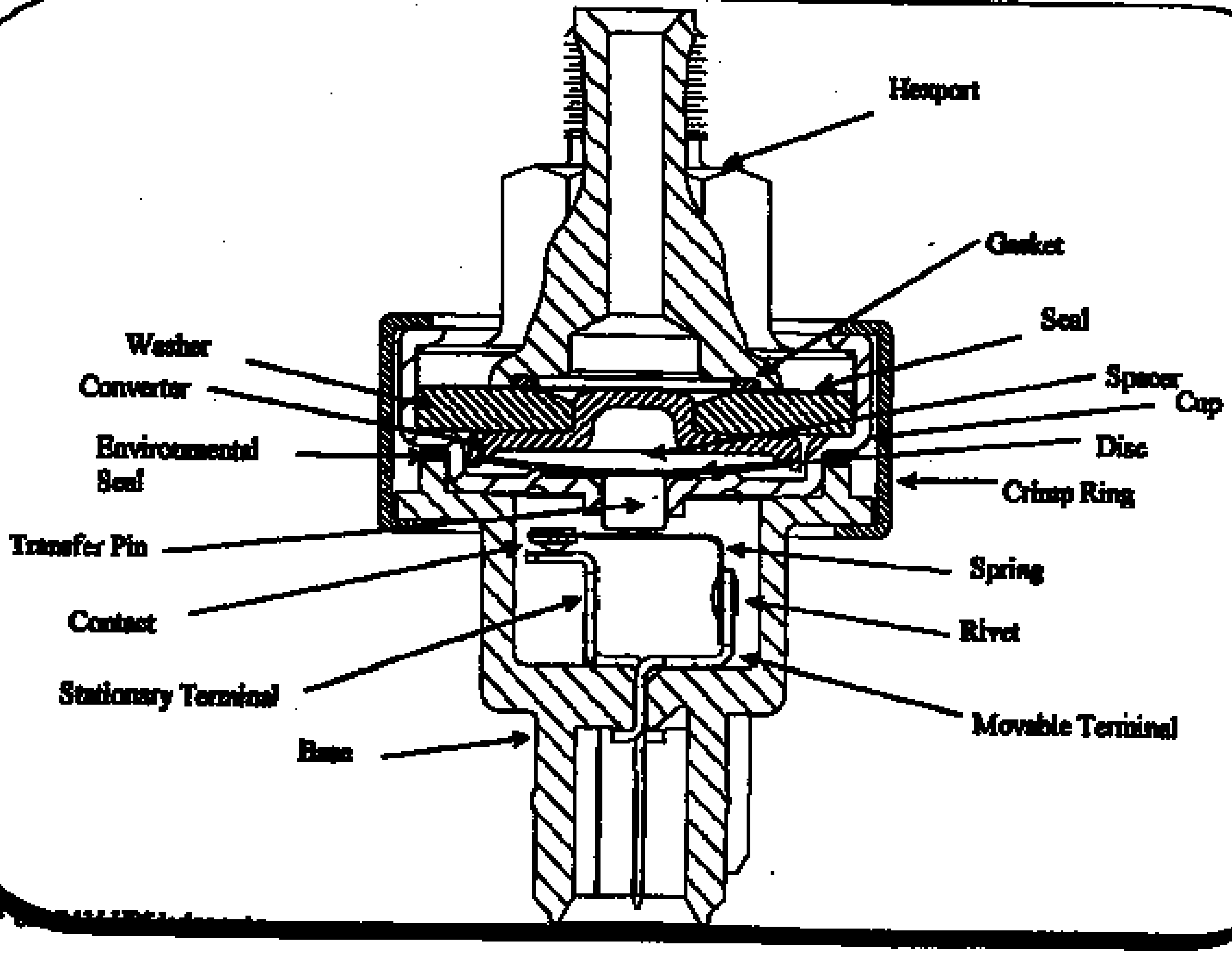
When water enters the connector it will "age" the Kapton ™ diaphragms and make them appear as though they have reached the end of life. This condition leaves visual clues. Classic signs of chemical attack of the Kapton ™ include de-lamination of the Teflon from the base polyimide base, embrittlement,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

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

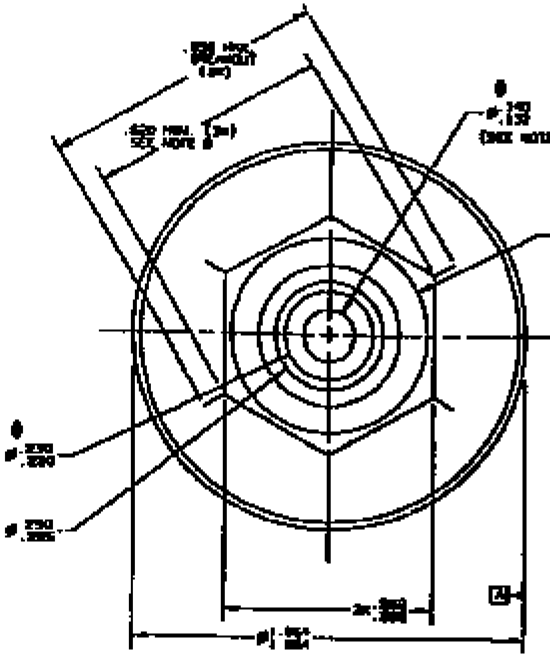
77PS Overview Appendix

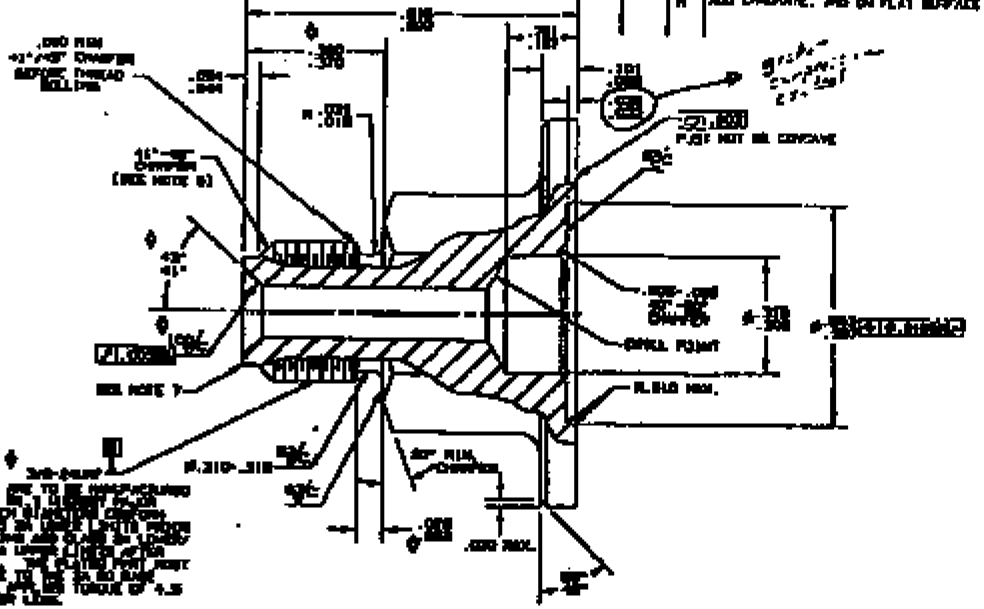
1. **Pressure Switch Cross Section**
2. **Hexport Print (TI # 36900)**
3. **Gasket Print (TI# 74353)**
4. **DFMEA for Gasket and Kapton Seal**
5. **Life Test to Failure Test Report (Weibull Analysis)**
6. **Customer Specification (ES-F2VC-9F924_AA)**
7. **PFMEA**
8. **IP Test Reports**
9. **Endurance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

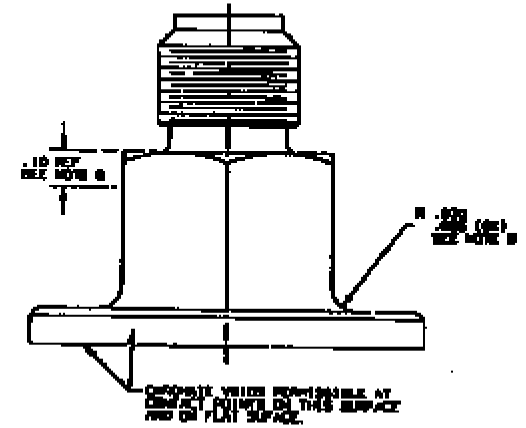
Pressure Switch Cross Section



N	ADD CHROMATE, AND ON FLAT SURFACE [illegible]			







CHROMATE VOIDS PERMISSIBLE AT CONTACT POINTS ON THIS SURFACE AND ON FLAT SURFACE.

NOTE:

1 DIMENSIONS APPLY AFTER PLATING.

2 . " TO BE SHIPPED, [illegible] AND STORED IN SEALED PLASTIC BAG.

3 FINISHED PART FLANGE HARDNESS TO BE ROCKWELL B-73 MINIMUM.

4. THREAD MUST CONFORM TO FORD SPEC. [illegible] (4.5 IN-LBS MIN. TORQUE ON RING GAGE).

5. .015" MAX. MISMATCH ALLOWABLE ON Ø.130 - .140 THROUGH HOLE WHEN DRILLED FROM BOTH ENDS OF PART.

6. 43°-47° CHAMFER ANGLE APPLIED IN AREAS WITHOUT THREAD.

7. BREAK EDGE WITH RADIUS OR 45° REF. CHAMFER .015" MAX.

8. .020 MIN. TO BE MEASURED WITHIN AREA SHOWN. .017 MIN. ALLOWED AT CORNER OF UNDERCUT [illegible]

9. MEASURE AT THE CENTER OF HEX FLAT. TRANSITION RADIUS ALLOWED AT HEX CORNER.

NOTE: THIS DRAWING CONTAINS A CUSTOMER CRITICAL CHARACTERISTIC [illegible]

THIS DRAWING SUPERSEDES [illegible] REV. [illegible] DATED [illegible]

36900-1	[illegible] STEEL	ZINC PLATING .0003 MIN. THICK WITH YELLOW CHROMATE
PART NO.	MATERIAL	FINISH

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

TOLERANCE ON
FRACTIONS DECIMALS ANGLES

MATERIAL

DRAWN	J.D. HAYALL	[illegible]
CHECKED	C.D. WAGNER	[illegible]
APPROVED	H.J. SELLERS	[illegible]

SIGNATURES ON FILE. REFER TO ELECTRONIC CHANGE NOTICE.

TEXAS INSTRUMENTS

TITLE
MODIFIED SAE J512
HEX PORT

SIZE	CODE IDENT NO.	DWG NO.
C	82647	36900

74353

REV.	DESCRIPTION	
A	[illegible] 3-5-85	
B	ADDED -2 & NOTE 6 CR 95890 [illegible] 85	
C	ADDED -3 CR95663 [illegible]	
D	ADDED -4 CR96519 [illegible]	
E	SEE C.A.I. [illegible]	
F	[illegible]	
G	CHG. NOTE 6 CR [illegible]	
H	CHG. NOTE 4 SEE DOC [illegible]	

TITLE GASKET

REV. H 74353

FOR REFERENCE ONLY
CHECK LATEST REVISION
BEFORE USE
Parts Made To This Print Must Conform To
ENG. STD. E9898 REV. E
Date JAN 1 9 1999

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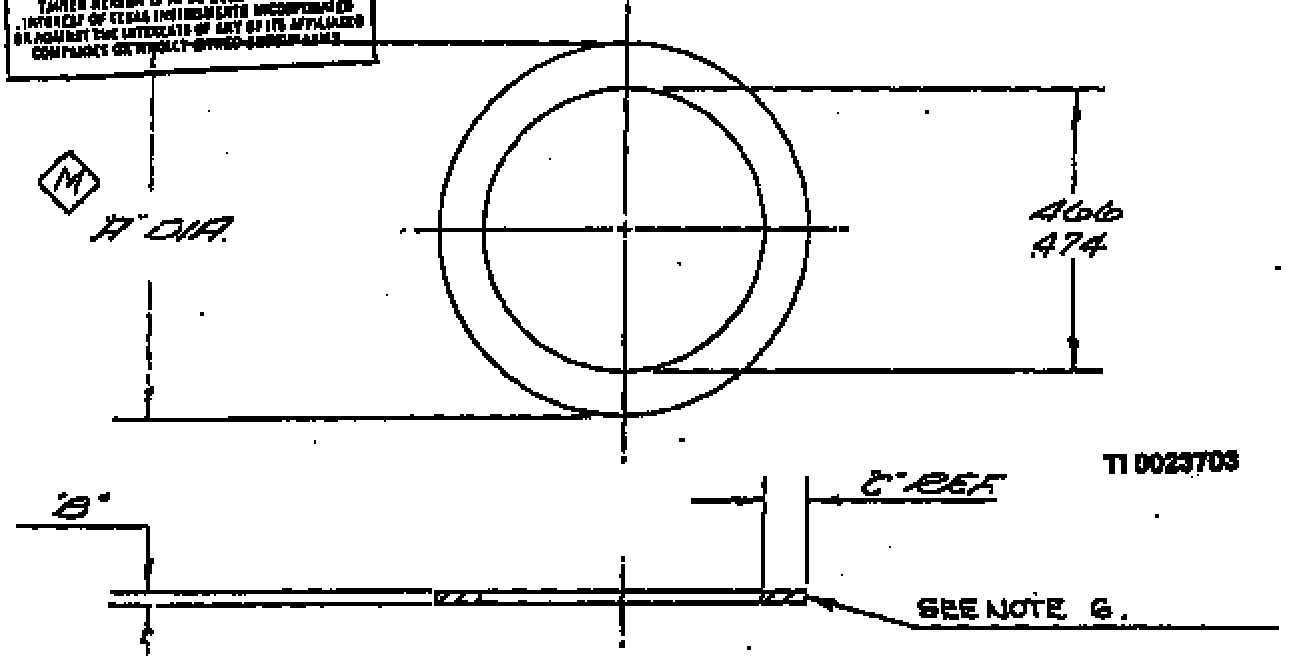


TI 0023703

NOTES:

1. PARTS MUST BE PURCHASED FROM T.I. ENGINEERING APPROVED VENDORS, LISTED BELOW.
2. MATERIAL CERTIFICATION REQUIRED WITH EACH SHIPMENT.
3. MATERIAL TO BE COMPATIBLE WITH FREON-12 & REFRIGERANT OIL.
4. PARTS TO BE SHIPPED, ISSUED, AND STORED ON 4 FOOT +/- 6 INCH MANDRELS, SEALED IN PLASTIC BAGS AND SHIPPED IN CARDBOARD TUBES.
5. ALL CONTAINERS OF PARTS MUST BE MARKED TO REFLECT ANY MATERIAL LOT, TOOL OR PROCESS CHANGE.
6. DASH 1 (-1) AND DASH 4 (-4) GASKET MUST HAVE FOUR (4) WHITE STRIPING INK MARKS, EQUALLY SPACED AROUND THE CIRCUMFERENCE, AND NOT LESS THAN 1/8 INCH WIDE. NO INK IS ALLOWED ON ANY OTHER SURFACE. M

PART NO.	MATERIAL	DUROMETER	COLOR	A. M	B M	C
74353-4	ETYLENE PROPYLENE JBL COMPOUND E-7104-70 JBL PART NO. 6197E	70	BLACK	.670-.662	.030-.036	.063
74353-3	ETHYLENE PROPYLENE JBL COMPOUND E-7054	70	WHITE	.670-.662	.030-.036	.06
74353-2	ETHYLENE PROPYLENE JBL COMPOUND E-7054	70	WHITE	.599-.591	.030-.036	.06
74353-1	ETHYLENE PROPYLENE JBL COMPOUND E-7104-70 JBL PART NO. 6197E	70	BLACK	.599-.591	.030-.036	.06

REV. J5? QB-1 Q-1? MH T5? P37-7 P35-1 [illegible]

BY T. Dail 3-18-85
CH. [illegible] 3-[illegible]
ENG. [illegible] 3-[illegible]

TEXAS INSTRUMENTS
INCORPORATED
ATTLEBORO, MASS., U.S.A.

KLIXON
CONTROL PRODUCTS DIVISION

DWG. SIZE A

PARTS LIST 74353

DD/NHTSA No. 2
00007

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Page 1

___ System
___ Subsystem
_X_ Component Pressure Switch

Model Year(s)/Vehicle(s) Various

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Design Responsibility Pressure Switch Group

Key Date 1996

Document Number 503799
Revision Level 0
Revision Date 4-Nov-96

Original (initial) Date 29-Dec-95

Prepared By C. Wagner

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s)/ Mechanism(s) of Failure	Occur	Current Design Controls	Detec	R.P.N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results: Actions Taken	Sev	Occ	Det	R.P.N.
DIAPHRAGM (OR SEAL) [BR] (74176) Forms flexible element of fluid containment cavity.	Fails to contain fluid.	Fluid leakage.	9		Gradual rupture over life due to improper design of supporting elements. Gradual rupture over life due to excessive flexure/displacement. Gradual rupture over life due to stress concentrations caused by asymmetric strain distributions. Chemical attack due to incorrect material specified. Incorrect thickness (or # of layers) of diaphragm material. Insufficient location/clamping of diaphragm.	1	Burst, impulse, and thermal cycle tests. Material mfg. recommendation. Comparison of design with similar products.	1	9							
Transfers pressure from fluid to pressure-sensing elements.	Change in area of pressure transfer over life.	Shift in setpoint over life.	8		Diaphragm too stiff. Incorrect material specified.	1	Life testing w/ characteristics at intermediate points.	1	8							

DUNHITRA No. 2
06049

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

Page 2

___ System
___ Subsystem
_X_ Component Pressure Switch

Model Year(s)/Vehicle(s) Various

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Design Responsibility Pressure Switch Group

Key Date 1995

Document Number [illegible]
Revision Level D
Revision Date 4-Nov-95

Original (initial) Date 20-Dec-93

Prepared By C. Wagner

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s) / Mechanism(s) of Failure	Occur	Current Design Controls	Detec	R. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results: Actions Taken	Sev	Occ	Det	R. P. N.
DIAPHRAGM (OR SEAL) [BR] (74178)	Excessive change of pressure transfer area versus pressure.	Excessively high pressures needed to adequately form pressure transfer area; wide sigma on setpoints due to unpredictability at lower pressures.	5		Diaphragm too stiff.	1	Force and pressure versus deflection testing to calculate effective areas.	1	5							
					Incorrect material specified.											

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(DESIGN FMEA)

___ System
___ Subsystem
_X_ Component Pressure Switch

Model Year(s)/Vehicle(s) Various

Core Team Design Engineering, Manufacturing Engineering, Manufacturing, Quality

Design Responsibility Pressure Switch Group

Key Date 1993

Document Number 303704
Revision Level 0
Revision Date 4-Nov-96

Original (Initial) Date 20-Dec-93

Prepared By C. Wagner

Item / Function	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s)/ Mechanism(s) of Failure	Occur	Current Design Controls	Detec	R.P.N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results: Actions Taken	Sev	Occ	Det	R.P.N.
GASKET (74863) Provides fluid seal between baseplate and diaphragm.	Fails to provide adequate fluid seal.	Brake fluid leakage.	9		Insufficient compression specified. Very excessive compression specified, leading to displacement from gland. Incorrect ID and/or OD leading to displacement from gland. Incorrect cross-section shape specified. Incorrect material specified, fluid incompatibility. Incorrect design of sealing mechanism.	1	Review of general seal design principles. Manufacturer's recommendations. Burst, impulse, and thermal cycle tests. Comparison with design of similar products.	1	9							

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

Author: Di Ha, Design Engineering
Date: April 8, 1998
Report No.: PS/98/14

Purpose

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

Sample Description

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

Actuation Pressure: 200-300 psig
Release Pressure: 40 psig min.

Procedure

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

Endurance testing was run to the following specification:

Temperature: 135C
Frequency: 2Hz
Total Cycles: 500,000
Electrical Load:
    0-475,000 cycles: 13V +/- 1V, trace current
    475,001-500,000 cycles: 13 +/- 1V, 750 +/- 50 mA
Operating Pressures:
    Pressure (Low): 0-40psig
    Pressure (High): 1400-1500 psig

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

Results

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

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

Conclusion

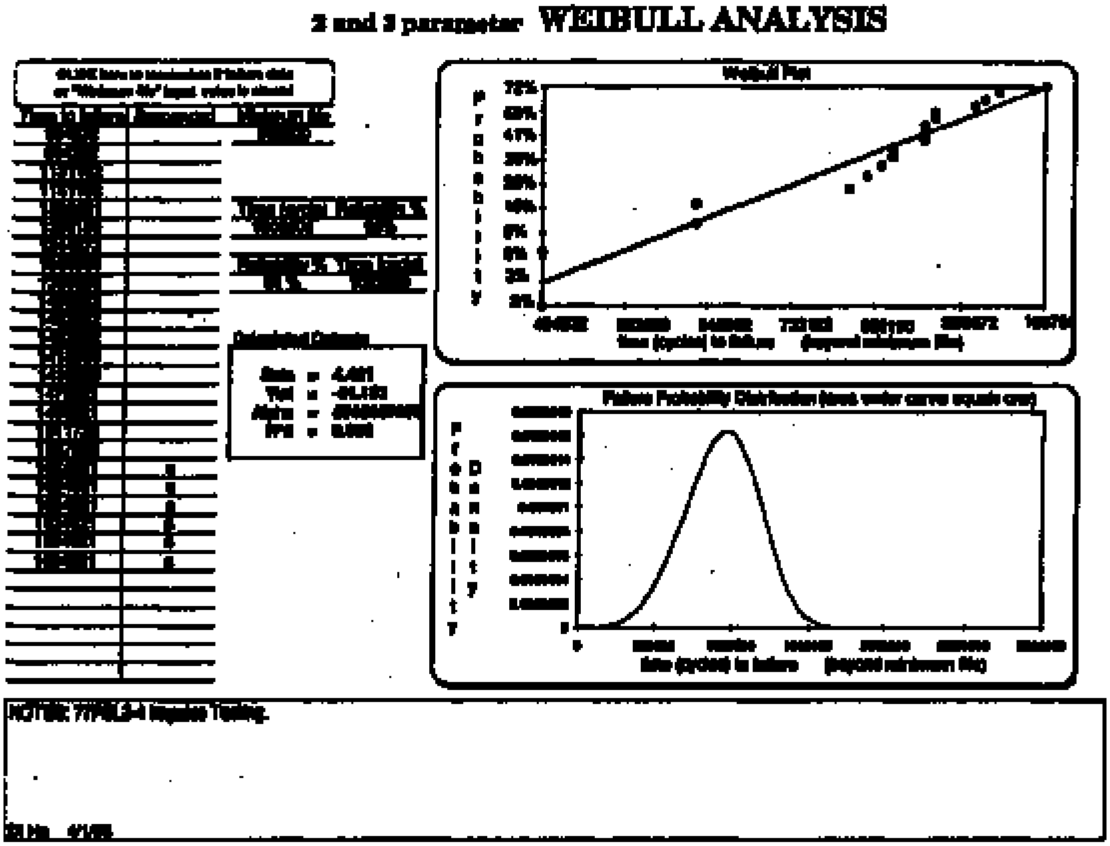
Reliability of the switches to 500K cycles is 100 percent. However, we cannot guarantee a life cycle requirement of 1 million cycles, as there were leakage failures prior to the completion of 1 million cycles.

Raw Data

	Pre-Test Data			Post 500K					
Device	Actuation (psig)	Release (psig)	Diff (psig)	Actuation (psig)	Release (psig)	Diff (psig)	mvD (LifeTest)	Act % Drift	# Cycles to Failure
1	255.6	186.8	68.8	245.8	182.0	63.8	0.18	-3.8	**
2	253.6	184.1	69.5	243.5	178.5	65.0	0.15	-4.0	1,587,659
3	248.3	187.3	61.0	243.5	183.6	59.9	0.13	-1.9	**
4	249.5	182.0	67.5	240.2	177.6	62.6	0.16	-3.7	**
5	241.1	175.4	65.7	232.7	172.4	60.3	0.12	-3.5	1,403,522
6	248.8	183.1	65.7	244.0	186.0	58.0	0.09	-1.9	1,302,691
7	255.8	187.9	67.9	238.4	179.3	59.1	0.12	-6.8	1,344,673
8	247.5	185.9	61.6	246.5	184.9	61.6	0.13	-0.4	1,403,522
9	245.7	178.1	67.6	233.0	178.8	54.2	0.1	-5.2	1,408,522
10	249.9	184.1	65.8	240.4	179.3	61.1	0.13	-3.8	1,131,102
11	264.1	197.2	66.9	252.8	193.7	59.1	0.1	-4.3	994,232
12	255.1	187.5	67.6	247.9	183.3	64.6	0.32	-2.8	**
13	248.2	186.2	62.0	239.0	176.2	62.8	0.3	-3.7	1,481,221
14	261.4	189.6	71.8	250.3	191.5	58.8	0.07	-4.2	994,232
15	250.4	188.0	62.4	240.1	181.2	58.9	0.09	-4.1	1,131,102
16	255.1	183.4	71.7	240.7	176.7	64.0	0.31	-5.6	1,359,639
17	244.2	176.2	68.0	234.7	176.2	58.5	0.11	-3.9	1,418,250
18	251.5	187.8	63.7	240.1	183.1	57.0	2.37	-4.5	1,472,621
19	254.0	192.2	61.8	247.1	182.1	65.0	3.46	-2.7	1,511,726
20	256.8	190.7	66.1	252.2	189.6	62.6	0.3	-1.8	1,418,250
21	251.7	182.3	69.4	241.6	182.4	59.2	0.08	-4.0	1,321,190
22	250.1	183.6	66.5	239.7	182.9	56.8	0.12	-4.2	1,359,639
23	249.1	180.4	68.7	246.6	182.4	64.2	0.22	-1.0	**
24	257.4	184.1	73.3	246.6	183.4	63.2	0.24	-4.2	**
Average	251.9	185.2	66.7	242.8	182.0	60.8	0.4	-3.6	**
Sigma	5.3	4.9	3.4	5.4	4.9	3.0	0.8	1.4	

** indicates that these devices were impulse tested to 1,634,921 cycles without failures.
The test was stopped with 1,634,921 cycles on 4/1/98.

Weibull Analysis



2 and 3 parameter **WEIBULL ANALYSIS**

Calculated Outputs

Beta = 4.401

NOTES: 77PSL3-4 Impulse Testing.

Engineering Specification

PART NAME
[redacted]

PART NUMBER
[redacted]

LET																			
FR																			
LET																			
FR																			

DATE	LET	FR	REVISIONS	DR	CH
			ADDED DATA TO COMPLETE		
			SPEC. & RATIFIED		
901130			NC006100797751002		

REFERENCE

PREPARED/APPROVED BY

CHECKED BY

DETAILED BY

CONCURRENCE/APPROVAL SIGNATURES

DESIGN ENGINEERING SUPERVISOR

DESIGN ENGINEERING MGR.

MANUFACTURING ENGRG.

QUALITY CONTROL

PURCHASING

SUPPLIER QUALITY ASSISTANCE

ELECTRONICS DIVISION

▽CONTROL ITEM — THE ▽ SYMBOL ALSO IDENTIFIES PRODUCT ENGINEERING DESIGNATED CRITICAL CHARACTERISTICS. THESE AND ADDITIONAL CRITICAL CHARACTERISTICS IDENTIFIED BY PROCESS REVIEWS, MUST APPEAR ON SHED-O-MATIC/CONTROL PLANS WHICH REQUIRE PRODUCT ENGINEERING APPROVAL.

FRAME 1 OF 18

REV

▽ ES-F2VC-9F924-AA

MAY 1986 PD 3947-a1 (Previous editions may NOT be used)

SWITCH ASSEMBLY - SPEED CONTROL DEACTIVATE

I. General

This specification covers the test requirements for the speed control deactivate switch -9F924- [illegible]. Design changes on the switch assembly or its components shall not be made without compliance to Section V of this specification and written approval from the releasing Production Engineering Office.

This engineering specification is a supplement to the released drawing on the above part, and all requirements herein must be met in addition to all other requirements of the part drawing. Minimum measures necessary for demonstrating compliance to these requirements are given in each section.

The engineering tests, sample sizes, and test frequencies contained within this engineering specification reflect the minimum requirements established to provide a regular evaluation of conformance to design intent. The engineering test program is intended as a supplement to normal material inspections, dimensional checking and in-process controls, and should in no way adversely influence other inspection operations.

Q1 suppliers may implement different test sample sizes and frequencies providing these changes have been included in an alternate Control Plan approved by the design responsible Product Engineering Office and concurred in by SQA.

II. PRODUCTION VALIDATION AND IN-PROCESS TESTS

- Production Validation (PV) Tests must be completed satisfactorily with parts from production tooling (and processes where possible) before ISIR approval and authorization for shipment of production parts can be effected. Parts must be revalidated completely, or per Section V whenever any change is made which could possibly affect part function or performance.

- In-Process Test Phase 1 (IP-1) - IP-1 tests are used to demonstrate process capability and must be completed using initial production parts from production tooling and processes prior to first production shipment approval. IP-1 tests are to continue in effect until process capability is demonstrated.

- In-Process Tests Phase 2 (IP-2) - IP-2 test program may be implemented only after process capability has been established. Tests must be completed with production parts on a continuing basis. Samples for these tests must be selected on a random basis to represent the entire production population as much as possible. In the event that any of the requirements in these tests is not met, the reaction plan specified in Ford Q101 Sect. 3.5, "Engineering Specification (ES) Test Performance Requirements" shall be invoked.

Engineering Specification

SECTION III. TABLE OF TESTS

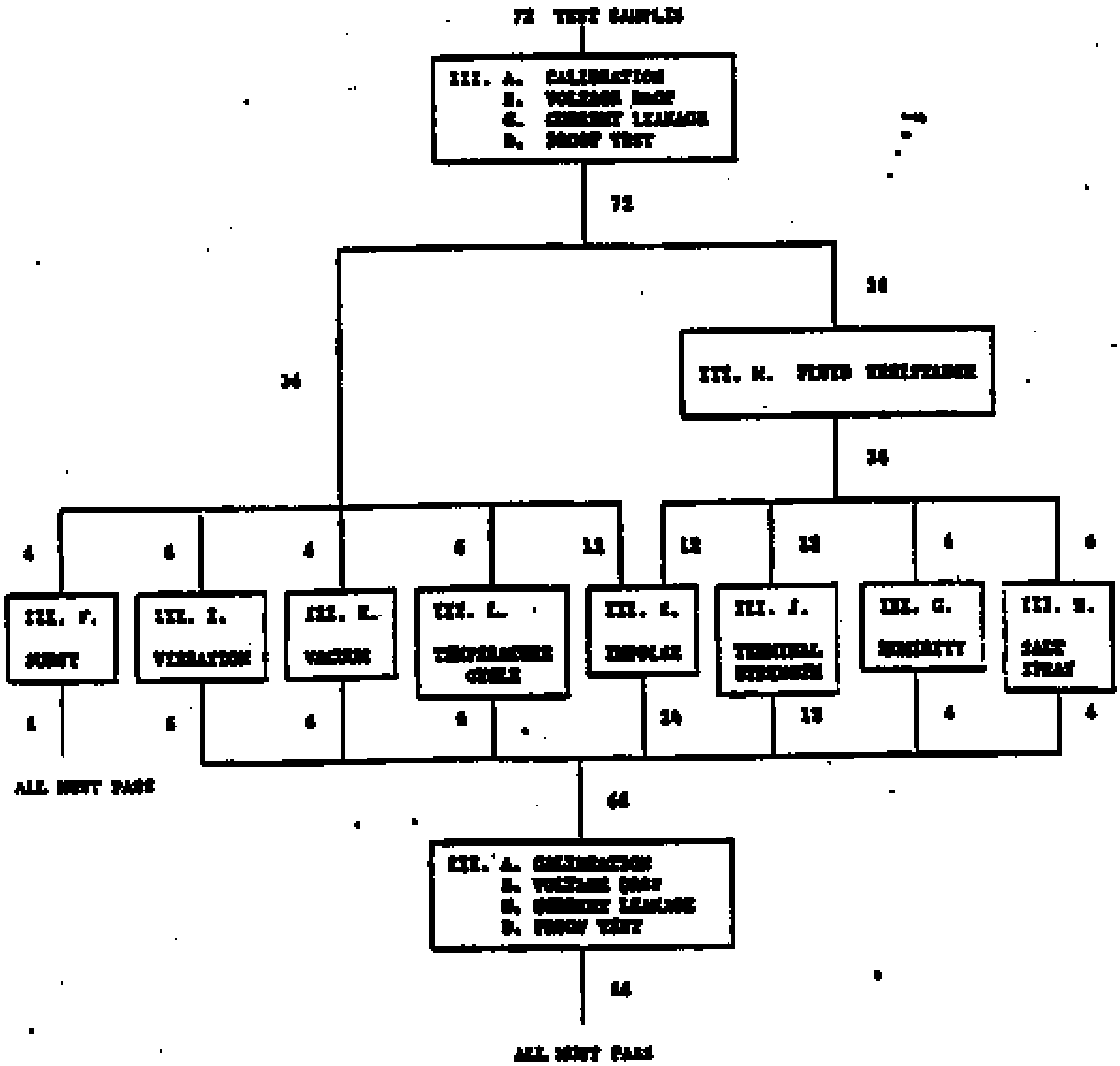
		PRODUCTION VALIDATION		IN-PROCESS IP-1		IN-PROCESS IP-2	
Item	Test Name Functional Tests	Minimum Sample Size	Statistical Test Acceptance Criteria	Minimum Sample Size	Statistical Test Acceptance Criteria	Minimum Sample Size	Statistical Test Acceptance Criteria
III.							
▽ A	Calibration	72	P90-.96	100%	All Must Pass	100%	All Must Pass
B	Voltage Drop	72	P90-.96	12/Mo.	P90-.84	4/Lot	" " "
C	Current Leakage	72	P90-.96	3/Mo.	P90-.56	4/Lot	" " "
D	Proof Test	72	P90-.96	12/Mo.	P90-.84	4/Lot	" " "
F	Burst	6	P90-.72	3/Mo.	P90-.56	4/Lot	" " "
I	Vibration	6	P90-.72	3/Mo.	P90-.56	6/6 Mo.	P90-.72
J	Terminal Strength	12	P90-.84	6/Mo.	P90-.72	4/Lot	All Must Pass
K	Vacuum	6	P90-.72	3/Mo.	P90-.56	6/6 Mo.	P90-.72
L	Temperature Cycle	6	P90-.72	3/Mo.	P90-.56	6/6 Mo.	P90-.72
M	Fluid Resistance	36	P90-.94	36/12Mo	P90-.94	36/12Mo.	P90-.94

Durability Tests

Item	Test	Minimum Sample Size	Statistical Test Acceptance Criteria	Minimum Sample Size	Statistical Test Acceptance Criteria	Minimum Sample Size	Statistical Test Acceptance Criteria
III.							
E	Impulse	24	P90-.90	12/Mo.	P90-.84	3/3 Mo.	P90-.56
G	Humidity	6	P90-.72	3/Mo.	P90-.56	6/6 Mo.	P90-.72
H	Salt Spray	6	P90-.72	3/Mo.	P90-.56	6/6 Mo.	P90-.72

FRAME 3 OF 8	REVISED		NUMBER ▽ ES-F2TC-9F924-AA

PRODUCTION VALIDATION FLOW CHART



4 OF 18 FRAME	REVISED		F23-Y2Y0-9F924-AA NUMBER

III. TEST PROCEDURES AND REQUIREMENTS

▽ A. Calibration

1. Test Requirements

   a. Switch calibration is to be checked at room temperature (16°C-35°C) using ambient air or equivalent.

   b. Calibration settings shall be specified on the part drawing with the settings checked after 2 or more pressure cycles with ambient air, or equivalent. Pressure cycle range is to be determined by the manufacturer to insure switch calibration stability. The cut-in and differential set points are to be measured while conducting 750 ± 50 milliamperes while 13.0 ± 1.0 volts D.C. is applied. The cut-in point is to be checked with increasing pressure.

   c. The cut-out point is to be checked with decreasing pressure, and the differential set point is to be calculated using the cut-in pressure minus the cut-out pressure.

2. Acceptance Requirements

   a. Nonconformance is defined as any switch point which falls outside the tolerance band specified on the part drawing.

B. Voltage Drop

1. Test Requirements

   a. Voltage drop is to be measured after 2 or more cycles with ambient air or equivalent from 0 to 10,000 ± 172 KPa (1450 ± 25 PSI) while conducting 750 ± 50 milliamps and 13.0 ± 1.0 volts D.C. is applied to the switch. Under these conditions with the switch closed the voltage drop is to be measured. Millivolt connection interface to terminals to be less than 10 millivolts.

2. Acceptance Requirements

   a. Nonconformance is defined as a voltage drop in excess of 200 millivolts.

III. TEST PROCEDURES AND REQUIREMENTS (cont'd)

C. Current Leakage

1. Test Requirements

   a. Current leakage is to be checked with 500 volts, 60 Hz alternating current.

   b. Current leakage is to be checked:

      (1) Between the switch leads with the contacts open.
      (2) Between the lead and the switch housing with contacts closed.
      (3) Between either lead and switch housing with the contacts open.

2. Acceptance Requirements

   a. Nonconformance is defined as any leakage current in excess of one hundred (100) microampere.

D. Proof Test

1. Test Requirements

   a. Subject sample switches to Section A to establish their initial switching pressures.

   b. Proof test is to be conducted using brake fluid or equivalent as the pressure medium. Test pressure shall be as specified on the part drawing. Test pressure shall be isolated from pressure source and hold for not less than 30 seconds.

   c. Recheck the switches to Section A.

2. Acceptance Requirements

   a. No evidence of fluid leakage, seepage, or drop in test pressure greater than 430 KPa. (62 PSI) is permitted.

   b. A change in cut-in and cut-out pressures greater than ± 5% from the initial value is not permitted.

   c. The test samples must be destroyed after testing.

— 3000 psig
4000 psig

Pass Car
Truck

III. TEST PROCEDURES AND REQUIREMENTS (cont'd)

E. Impulse

1. Test Requirements

   a. Test the switch for a total of 500,000 cycles. Cycle pressure between (low) 0-276 KPa (0-40 psi) and (high) 10,000 ± 345 KPa (1450 ± 50 psi).

      1) 0 - 475,00 cycles: 13 ± 1 volts, trace current to monitor function.

      2) 475,001 - 500,000 cycles: 13 ± 1 volts D.C., 750 ± 50 ma., per figure 4.

   b. Brake fluid temperature to be 135 ± 14°C and ambient temperature to be 107°C min.

   c. Cycle rate is to be 110-130 cycles per minute.

   d. Switch must open and close each cycle.

2. Acceptance Requirements

   a. After impulse test check to sections A, B, C, & D using the procedure established in each section.

   b. Nonconformance is defined as any switch not meeting the criteria in sections A, B, C, & D.

   c. Samples used for this test must be destroyed after all testing is completed.

F. Burst

1. Test Requirement

   a. Burst strength is to be checked using brake fluid or equivalent as the pressure medium.

   b. Pressurize the switch to 48.3 MPa (7000 PSI) minimum and hold for 30 seconds minimum.

2. Acceptance Requirements

   a. Nonconformance is defined as any evidence of fluid leakage or seepage from the switch or threads. Samples used for this test must be destroyed after testing is completed.

G. Humidity

1. Test Requirements

a. Mount the switch in the test port in a humidity chamber. Currently released mating electrical connector must be installed before start of test.

b. Subject the switch to ten (10) continuous humidity cycles as follows:

(1) Raise temperature to 65 +10/-2 °C over 2.5 hours; at 90-98% relative humidity.

(2) Hold 3 hours at 65 +10/-2 °C at 90-98% relative humidity.

(3) Lower temperature to 25 +10/-2 °C over 2.5 hours; at 80-98% relative humidity.

2. Acceptance Requirements

a. Within 15 minutes after completion of the tenth humidity cycle check the switch to sections A, B, C, D, using the procedure established in each section.

b. Nonconformance is defined as any switch not meeting the criteria in sections A, B, C, or D.

H. Salt Spray

1. Test Requirements

a. Mount the switch in the test port in a salt spray chamber. The currently released mating electrical connector and wiring must be installed prior to start of test.

b. Expose the switch assembly to 72 hours of salt spray per ASTM B-117.

2. Acceptance Requirements

a. After exposure, check the switch to sections A, B, C, D, using the procedure established in each section.

b. Nonconformance is defined as any switch not meeting the criteria in sections A, B, C, or D. Samples used for this test must be destroyed after all testing is completed.

III. TEST PROCEDURES AND REQUIREMENTS (cont'd)

I. Vibration

1. Test Requirements

a. Mount the switch in the test port and attach the currently released mating electrical connector before start of test.

b. Switches are to be vibrated in all 3 planes with electrical continuity being monitored during the entire test. See Figure 1 for switch orientation in the 3 planes. Vibration tests are to be conducted at room temperature using brake fluid, ambient air, or equivalent as the pressure medium.

c. Internal pressure shall be maintained at 0 kPa G. when the switch is in the closed position and 1.1 times max actuation pressure shown on print when the switch is in the open position.

d. Vibrate the switch at 1.5 mm displacement (peak-to-peak) while varying the frequency uniformly from 5 to 50 to 5 Hz over a 5 minute period.

e. Vibrate the switch in alternate one-hour periods in the open and closed positions for a total of 8 hours in each plane. (Total test time is 24 hours).

2. Acceptance Requirements

a. After the entire vibration sequence check the switches to sections A, B, C, or D using the procedure established in each section.

b. Nonconformance is defined as any evidence of leakage or any change in electrical continuity/discontinuity during the vibration cycles, or any switch not meeting the criteria in sections A, B, C, or D. Samples used for this test must be destroyed after all testing is completed.

J. Terminal Strength

1. Test Requirements

   a. Mount the switch in the test port.

      (1) Apply a 89 ± 9 N axial force to each terminal.

      (2) With a pendulum apply a 45 ± 5 N impact force to the switch housing at the connector and, perpendicular to the centerline axis of the switch. See Figure 2 for force application point and direction.

2. Acceptance Requirements

   a. Check the switch to sections A, B, C, and D using the procedures established in each section.

   b. Nonconformance is defined as any terminal or housing fracture, or any switch not meeting the criteria in sections A, B, C, or D.

K. Vacuum

1. Test Requirements

   a. Mount the switch in the test port. Vacuum tests are to be conducted at room temperature using ambient air as the pressure medium.

   b. Subject the switch to 5 cycles of vacuum from atmospheric pressure (760 mm Hg) to an absolute pressure of 3-4 mm Hg. Maintain the vacuum for a minimum of 60 seconds.

2. Acceptance Requirements

   a. Check the switch to sections A, B, C, and D using the procedure established in each section.

   b. Nonconformance is defined as any switch not meeting the criteria in sections A, B, C, and D.

III. TEST PROCEDURES AND REQUIREMENTS (cont'd)

L. Temperature Cycle

1. Test Requirements

a. Mount switches in test ports; test to be run using currently released brake fluid.

b. Repeat the following procedure 25 times.

(1) Lower the switch and fluid temperature to at least -40°C.

(2) Cycle the switches ten times at 10 seconds/cycles. One cycle consists of a pressure variation from 0 - 276 KPa.G (0-40 psi) to 10,000 ± 345 KPa.G (1450 ± 50 PSI).
Note: Switch must open and close each cycle.

(3) Raise switch and fluid temperature to 38°C minimum. 120°F

(4) Repeat Step 2.

c. At completion of Step b, check switches per sections A, B, C, and D.

2. Acceptance Requirements

a. Nonconformance is defined as any evidence of switch fluid leakage, seepage, or not meeting the criteria of sections A, B, C, and D.

M. Fluid Resistance

1. Test Requirements

a. Mount the switch in the test port and orient as installed in the vehicle.

b. Install the currently released mating electrical connector (with wire leads) to the switch.

c. Sequentially, immerse the switch into each of the specified fluids, at a temperature of 23 ± 2 °C, for 5 ± 1 second. Remove the switch and drain and store the switch for the specified time at room temperature, prior to immersing into the next fluid.

III. TEST PROCEDURES AND REQUIREMENTS (cont'd)

Fluid	Drain Time	Storage Time
Reference Fuel C ASTM D471	60 ± 5 min.	none
10W40 Engine Oil	24 ± 1 hour	14 days
Ethylene Glycol/ Water 50/50 by Volume	24 ± 1 hour	24 ± 1 hour
Brake Fluid DOT 3	24 ± 1 hour	48 ± 1 hour
Automatic Transmission/ Power Steering Fluid (same) ESP-M2C138-CJ	24 ± 1 hour	14 days
Isopropyl Alcohol/ Water 50/50 by Volume	24 ± 1 hour	none
Reference Fuel C, ASTM D471 with Methyl Alcohol 85/15 by Volume	24 ± 1 hour	none

d. For the Flow Chart, subject the prescribed number of immersed switch's to the post immersion tests specified below:

III. E. Impulse
III. G. Humidity
III. H. Salt Spray
III. J. Terminal Strength

Acceptance Requirements

a. Switches must fully meet the requirements of the specified post,immersion test.

b. Nonconformance is defined as any switch not meeting the criteria in sections A, B, C, or D. Samples used for this test must be destroyed after all testing is completed.

IV. STATISTICAL ANALYSIS METHODS

A. For PV, IP-1 and IP-2 tests, all samples tested must pass. [redacted] R-C is interpreted as minimum reliability equal to R, at a confidence C; thus R90-C90 means a minimum reliability of 90% at 90% confidence.

B. All samples must pass in the statistical test acceptance criteria stated for tests with 100% frequency; or samples from lots, which could have a variable size.

V. REVALIDATION REQUIREMENTS

A. No change in design, material, process or component supplier shall be made without prior approval from the releasing Product Engineering Office. As part of approving a change, the releasing Product Engineering Office will establish the portion of the Product Validation tests required to be run to revalidate the switch. The following table is to be used as a guide in determining the type of tests required for revalidation requirements.

RUNNING CHANGE REVALIDATION

Component	Process or Material Change or New Supplier
1. Terminals, Contacts, or Connector	III, B, C, E, G, H, I, J, L, M.
2. Case or Housing	All Tests
3. Disc or Diaphragm	III, A, D, E, F, I, K, L.
4. Fitting or Fluid Connection	III, D, E, F, H, I, M.

B. Annual revalidation is not required on carryover switches.

VI. LOT DEFINITION

A lot is defined as no more than eight (8) hours of production up to 4,000 pieces. If shifts extend beyond eight (8) hours, or more than 4,000 pieces are produced in a shift, the product must be separated into at least two lots.

VII. RECORD RETENTION

A. Recording and record retention shall conform with Ford Q-101.

B. Production Validation test results and analysis are to be forwarded to the releasing Product Engineering Office before approval for shipment of production parts can be granted.

C. In-Process test results shall be available at the supplier's manufacturing facility for the releasing Product Engineering Office and Ford SQA or its representatives to review on request.

VIII. INSTRUCTIONS AND NOTES

All switches are to be identified with the Ford part number, supplier identification, and a date code indicating final assembly.

All test equipment and test procedures for testing to this specification must be approved by the releasing Product Engineering Office and no change in equipment or procedure may be made without their written concurrence.

Test part configuration is shown in Figure 3.

O-rings, if used in the design, shall be free from cuts, nicks, abrasions or any other damage which would result in a fluid leak.

All switches must have a shipping cap installed over the port threads to prevent contamination. All shipping caps must be approved by the releasing Product Engineering Office prior to production incorporation.

All switches that do not pass the calibration test are to either be readjusted and rechecked, or scrapped. (Salvage of component parts permitted with 100% reinspection).

If product nonconformance occurs for test Sections III. B, C, D, E, F, and J, production shall be stopped and the problems corrected. All production lots shall be sorted 100% prior to shipment. Suspected nonconformance of any shipped parts shall be reported immediately to the releasing Product Engineering Office.

If nonconformance of the statistical acceptance criteria occurs for test Sections III. G, H, I, K, L and M, a cause to recall the subject weeks production and to stop production may result.

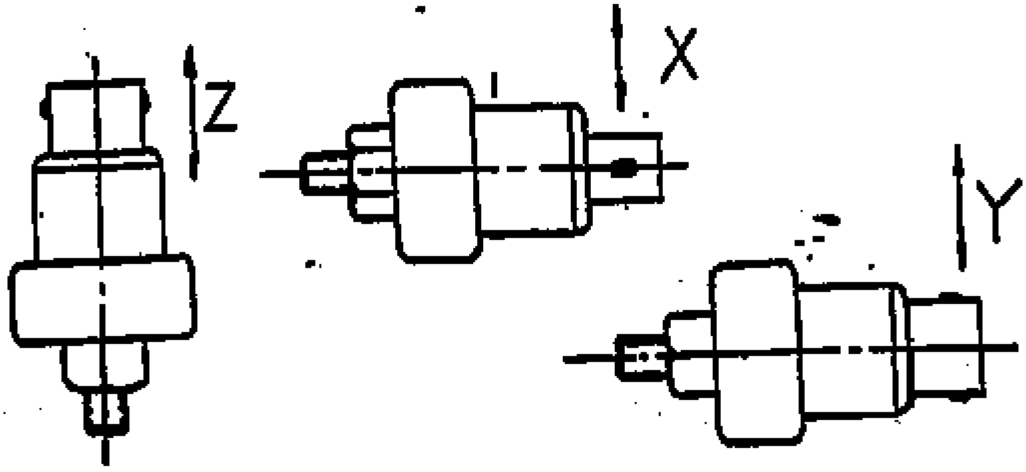
IX. COMPILATION OF REFERENCE DOCUMENTS

ASTM B-117. Salt Spray Testing

Ford Q-101. Quality System Standard - 1990 Edition

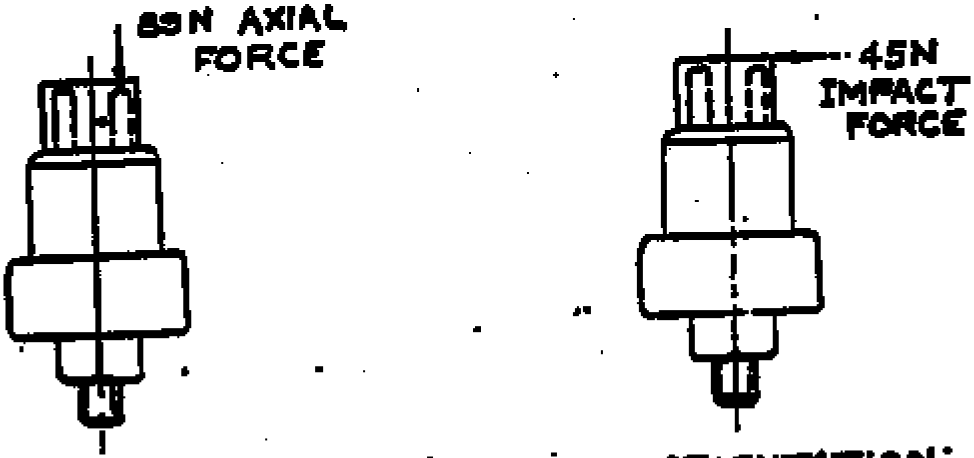
ES-F0XE-14A464-AA. Specification - SLV Assy - Wire Connector

ES-F2VF-9C735-AA. Specification - Servo Assembly Speed Control



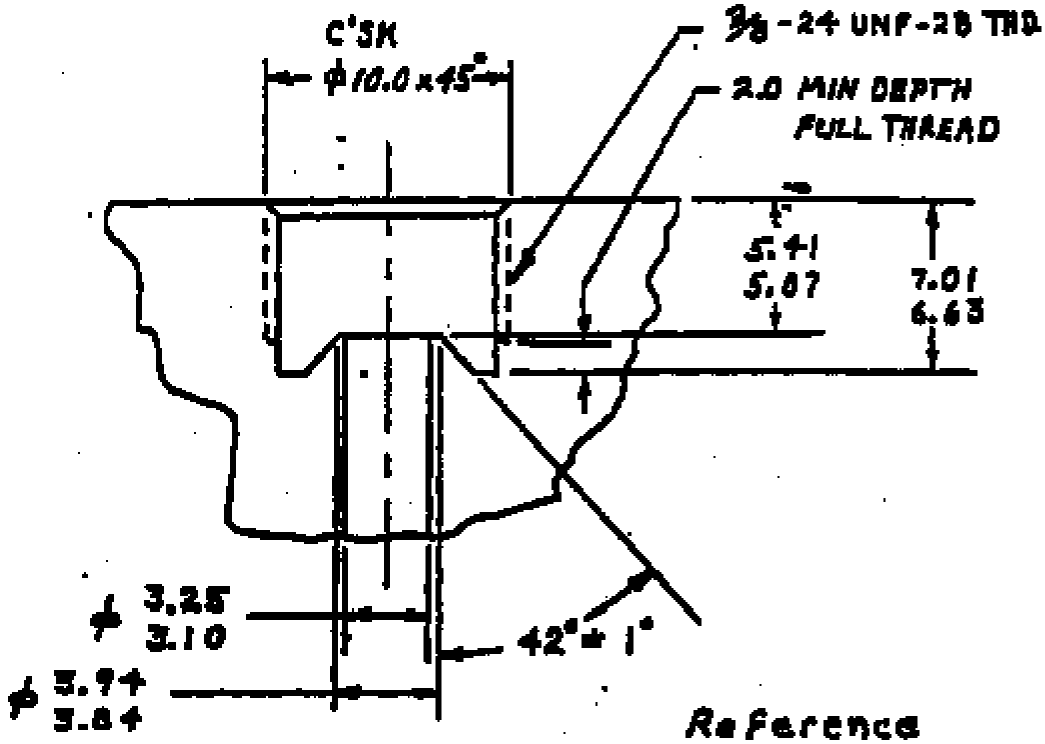
VIBRATION TEST - SWITCH ORIENTATION

FIGURE 1.



TERMINAL STRENGTH - LOAD ORIENTATION

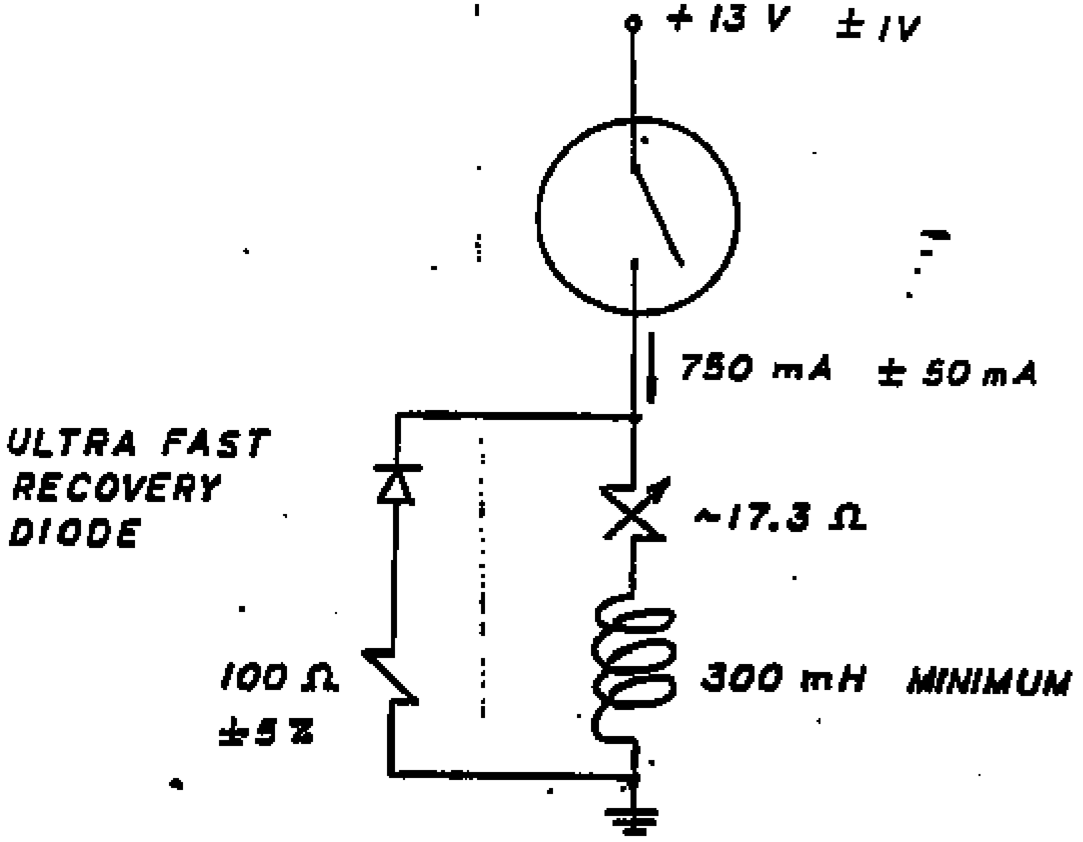
FIGURE 2.



Reference
SAE J512 OCT 80
figure 5A

TEST FIXTURE PORT CONFIGURATION

FIGURE 3



DEACTIVATE SWITCH TEST SET UP

FIGURE 4

16 FRAME	16 OF	REVISED		▽ [illegible] NUMBER

Document #: 503691

POTENTIAL
FAILURE MODE AND EFFECTS ANALYSIS
(PROCESS FMEA)

PROCESS: AUTOMATED SENSOR ASSEMBLY

MODEL YEAR(S)/VEHICLE(S): [illegible]

PROCESS RESPONSIBILITY: MATT SELLERS/ANN REA

DESIGN/QUAL/MFG RESPONSIBILITY: KEITH ROSIELLO / JIM WATT / PEGGY ALLEN

PREPARED BY: MATT SELLERS

FMEA DATE (ORIG.) [illegible]
FMEA REVISION: B

Item	Process Function/ Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s)/ Mechanism(s) of Failure	Occur	Current Process Controls	Detec	R. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
													Actions Taken	Sev	Occ	Det	R. P. N.
1	FEED AND ASSEMBLE HEXPORT TO NEST.	DOES NOT FEED	NO SUBSEQUENT ASSEMBLY PERMISSIBLE YIELD LOSS	5		MACHINE ERROR	1	PREVENTATIVE MAINT. 100% PRESENCE CHECK VERIFY OPERATION OF CHECK PROBE	1	5							
		DOES NOT NEST PROPERLY	NO SUBSEQUENT ASSEMBLY PERMISSIBLE	5		DEBRIS IN NEST; MACHINE ERROR	1	PREVENTATIVE MAINT. 100% PRESENCE CHECK	1	5							
		LOADS MULTIPLE HEXPORT	NO SUBSEQUENT ASSEMBLY PERMISSIBLE	5		MACHINE ERROR	1	PREVENTATIVE MAINT. 100% PRESENCE CHECK	1	5							
2	CONFIRM HEXPORT PRESENCE AND STYLE.	FAILS TO IDENTIFY OUT OF RANGE HEXPORT	MIXED HEXPORT	5		SET-UP ERROR	1	SET-UP MASTERS	1	5							
3	FEED AND ASSEMBLE GASKET TO HEXPORT GLAND.	MISPLACED GASKET	LEAK BURST RESISTANCE DEGRADATION	8		MACHINE ERROR OPERATOR INTERVENTION	1	100% FUNCTION TEST CONTINUITY PROBE CYCLING AUDITS	1	8							
		NO GASKET	LEAK BURST RESISTANCE DEGRADATION	8		MACHINE ERROR OPERATOR INTERVENTION	1	100% FUNCTION TEST CONTINUITY PROBE CYCLING AUDITS	1	8							
		MULTIPLE GASKET	LEAK BURST RESISTANCE DEGRADATION YIELD LOSS	8		OPERATOR INTERVENTION	1	100% FUNCTION TEST	1	8							
4	CONFIRM GASKET PRESENCE	FAILS TO IDENTIFY MISSING OR OUT OF PLACE GASKET	LEAK	8		MACHINE ERROR	1	SET-UP MASTERS	1	8							
5	BLANK AND ASSEMBLE (2) SEALS	ONLY (1) SEAL LOADED	REDUCED DIAPHRAGM LIFE	5		OPERATOR DOES NOT TURN ON 2ND STATION	1	PROCESS SPECS MACHINE SET-UP MATERIAL KITTING	1	5							

PROCESS: AUTOMATED SENSOR ASSEMBLY

PROCESS RESPONSIBILITY: MATT SELLERMANN REA

MODEL YEAR(S)/VEHICLE(S): [illegible]

DSGN/QUAL/MFG RESPONSIBILITY: KEITH ROSIELLO / JIM WATT / PEGGY ALLEN

FMEA DATE (ORIG.) 4/29/96
FMEA REVISION: B

Item	Process Function/ Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s)/ Mechanism(s) of Failure	Occur	Current Process Controls	Detec	R.P.N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
													Actions Taken	Sev	Occ	Det	R.P.N.
		NO SEAL LOADED	LEAK	[illegible]		MACHINE ERROR	1	100% FUNCTION TEST CONTINUITY PROBE	1	[illegible]							
		IMPROPERLY CUT SEAL	LEAK DIAPHRAGM LIFE FAILURE YIELD LOSS	[illegible]		MACHINE ERROR	1	100% FUNCTION TEST CONTINUITY PROBE CYCLING AUDITS PREVENTIVE MAINT.	1	[illegible]							
		MISPLACED SEAL	LEAK REDUCED DIAPHRAGM LIFE	[illegible]		MACHINE ERROR OR STATIC	1	100% FUNCTION TEST CONTINUITY PROBE ANTI-STATIC STATION PREVENTIVE MAINT. CYCLING AUDITS	1	[illegible]							
		MORE THAN (2) SEALS LOADED	SHIFT IN SET POINTS	[illegible]		STATIC BUILD UP	1	ANTI-STATIC STATION	1	[illegible]							
4	CONFIRM (2) SEALS PRESENCE.	FAILS TO IDENTIFY MISSING OR OUT OF PLACE SEAL(S).	LEAK	[illegible]		MACHINE ERROR,	1	SET-UP MASTERS	1	[illegible]							
7	WHERE APPLICABLE, BLANK AND ASSEMBLE (2ND) SEAL FOR BRAKE APPLICATION	NO SEAL LOADED	LEAK	[illegible]		MACHINE ERROR,	1	100% FUNCTION TEST	1	[illegible]							
		IMPROPERLY CUT SEAL	LEAK DIAPHRAGM LIFE FAILURE PREVENTS SUBSEQUENT ASSEMBLY YIELD LOSS	[illegible]		MACHINE ERROR	1	CONTINUITY PROBE 100% FUNCTION TEST CONTINUITY PROBE CYCLING AUDITS PREVENTIVE MAINT.	1	[illegible]							
		MISPLACED SEAL	LEAK REDUCED DIAPHRAGM LIFE	[illegible]		MACHINE ERROR OR STATIC	1	100% FUNCTION TEST CONTINUITY PROBE ANTI-STATIC STATION PREVENTIVE MAINT. CYCLING AUDITS	1	[illegible]							
		MORE THAN (1) SEAL LOADED	SHIFT IN SET POINTS	[illegible]		STATIC BUILD UP	1	ANTI-STATIC STATION	1	[illegible]							

PROCESS: AUTOMATED SENSOR ASSEMBLY

MODEL YEAR(S)/VEHICLE(S): [illegible]

PROCESS RESPONSIBILITY: MATT SELLERS/ANN REA

DSGN/QUAL/MFG RESPONSIBILITY: KEITH ROSIELLO / JIM WATT / PEGGY ALLEN

FMEA DATE (ORIG.) 4/29/96
FMEA REVISION: B

Item	Process Function/ Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s)/ Mechanism(s) of Failure	Occur	Current Process Controls	Detec	R.P.N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results: Actions Taken	Sev	Occ	Det	R.P.N.
8	INSURE APPLICABLE- CONFIRM (SPEC) SEAL PRESENCE	FAILS TO IDENTIFY MISSING OR OUT OF PLACE SEAL	LEAK	9		MACHINE ERROR	1	SET-UP MASTERS	1	9							
9	FEED AND ASSEMBLE CONVERTER TO WASHER	MISSED CONVERTER	INOPERATIVE SWITCH	9		MACHINE MISFEED	2	100% PRESENCE CHECK 100% FUNCTION TEST	1	18							
		MISSED WASHER	INOPERATIVE DEVICE	9		MACHINE MISFEED	3	100% PRESENCE CHECK 100% FUNCTION TEST	1	27							
		UPSIDE DOWN WASHER	LEAK SHIFT IN DEVICE SET POINTS REDUCED KAPTON LIFE	9		MACHINE MISFEED OPERATOR ERROR	1	POKE YOKE LBL TRACK 100% FUNCTION TEST CYCLING AUDITS	1	9							
10	FEED AND ASSEMBLE WASHER/CONVERTER ASSEMBLY	DISLODGEMENT OF CONVERTER	INOPERATIVE DEVICE	6		AIR PICK AND PLACE ERROR	1	OPERATOR SET-UP 100% FUNCTION TEST 100% PRESENCE CHECK PREVENTIVE MAINT. CYCLING AUDITS	1	6							
		NON-CONCENTRIC PLACEMENT	MISPLACED KAPTON REDUCED KAPTON LIFE MISPLACED (DISC) INOPERATIVE DEVICE	9		AIR PICK AND PLACE ALIGNMENT ERROR	1	OPERATOR SET-UP 100% FUNCTION TEST 100% PRESENCE CHECK PREVENTIVE MAINT. CYCLING AUDITS	1	9							
		FAILS TO LOAD ASSEMBLY	NO SUBSEQUENT ASSEMBLY PERMISSIBLE YIELD LOSS	4		MACHINE ERROR	1	PREVENTIVE MAINT. 100% PRESENCE CHECK VERIFY OPERATION OF CHECK PROBE	1	4							
		LOADS MULTIPLE ASSEMBLIES	NO SUBSEQUENT ASSEMBLY PERMISSIBLE	4		MACHINE ERROR	1	PREVENTIVE MAINT 100% PRESENCE CHECK	1	4							
11	CONFIRM WASHER CONVERTER ASSEMBLY PRESENCE	FAILS TO IDENTIFY MISSING OR OUT OF PLACE WASHER CONVERTER ASSEMBLY	INOPERATIVE DEVICE	8		MACHINE ERROR	1	YIELD MONITORING	1	8							
12	BLANK AND ASSEMBLE SPACER	MISPLACED SPACER	REDUCED DISC LIFE	7		MACHINE ERROR	1	100% FUNCTION TEST	1	7							

DEMETRA No. 1
[illegible]

PROCESS: AUTOMATED SENSOR ASSEMBLY

PROCESS RESPONSIBILITY: MATT SELLERS/ANN REA

MODEL YEAR(S)/VEHICLE(S): 52/57/77/80/97PS

DSGN/QUAL/MFG RESPONSIBILITY: KEITH ROSIELLO / JIM WATT / PEGGY ALLEN

FMEA DATE (ORIG.) 4/29/98
FMEA REVISION: B

Item	Process Function/ Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s)/ Mechanism(s) of Failure	Occur	Current Process Controls	Detec	R. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
													Actions Taken	Sev	Occ	Det	R. P. N.
			CONTINUITY FAILURE LOSS OF CALIBRATION DRIFT OVER LIFE					CONTINUITY PROBE CYCLING AUDITS TRAPPED DISC PROBE									
		NO SPACER	REDUCED DISC LIFE LOSS OF CALIBRATION DRIFT OVER LIFE	7		MACHINE ERROR TOOL DULL, BROKEN, OR OTHERWISE MALF.	1	100% FUNCTION TEST CONTINUITY PROBE CYCLING AUDITS PREVENTIVE MAINT.	1	7							
		IMPROPERLY CUT SPACER; TOO LARGE	REDUCED DISC LIFE LOSS OF CALIBRATION DRIFT OVER LIFE CONTINUITY FAILURE	7		MACHINE ERROR TOOL DULL, BROKEN, OR OTHERWISE MALF.	1	100% FUNCTION TEST CONTINUITY PROBE CYCLING AUDITS PREVENTIVE MAINT.	1	7							
		IMPROPERLY CUT SPACER; TOO SMALL	REDUCED DISC LIFE LOSS OF CALIBRATION DRIFT OVER LIFE	7		MACHINE ERROR TOOL DULL, BROKEN, OR OTHERWISE MALF.	1		1	7							
		2 OR MORE SPACERS LOADED	CONTINUITY FAILURE LOSS OF CALIBRATION DRIFT OVER LIFE	7		STATIC BUILDUP	1	ANTI-STATIC STATION	1	7							
13	CONFIRM SPACER PRESENCE	FAILS TO IDENTIFY MISSING OR OUT OF PLACE SPACER	REDUCED DISC LIFE	7		MACHINE ERROR	1	SET-UP MASTERS	1	7							
14	FEED AND ASSEMBLE DISC	MISPLACED DISC (TRAPPED)	CONTINUITY FAILURE	5		MACHINE ERROR	3	PRESSURE PROBE TRAPPED DISC PROBE 100% FUNCTION TEST	1	15							
		UPSIDE DOWN DISC	CONTINUITY FAILURE	5		MACHINE ERROR	3	100% DISC PROBE TRAPPED DISC PROBE 100% FUNCTION TEST	1	15							
		MULTIPLE DISC	CONTINUITY FAILURE ACTUATION FAILURE	5		MACHINE ERROR	3	100% DISC PROBE TRAPPED DISC PROBE	1	15							
		WRONG DISC	LOSS OF CALIBRATION AUDIBLE SNAP ON QUIET	8		MIXED	1	100% FUNCTION TEST DISC SLIPS ROUTE SLIPS	1	8							

EXHIBITS \ No. 2
00036

PROCESS: AUTOMATED SENSOR ASSEMBLY

PROCESS RESPONSIBILITY: MATT SELLERSMANN REA

MODEL YEAR(S)/VEHICLE(S): [illegible]

DSSN/QUAL/MFG RESPONSIBILITY: KEITH ROSSELLO / JIM WATT / PEGGY ALLEN

FMEA DATE (ORIG.) 4/29/98
FMEA REVISION: B

Item	Process Function/ Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s)/ Mechanism(s) of Failure	Occur	Current Process Controls	Detec	R. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results: Actions Taken	Sev	Occ	Det	R. P. N.
			APPLICATION(S)														
		MISSING DISC	CONTINUITY FAILURE	6		MACHINE ERROR	1	100% EMO PROBE 100% FUNCTION TEST	1	6							
15	CONFIRM DISC PRESENCE	FAILS TO IDENTIFY MISSING OR OUT OF PLACE DISC	INOPERATIVE DEVICE	7		MACHINE ERROR	1	YIELD MONITORING	1	7							
16	FEED AND ASSEMBLE CUP	MISSING CUP	NO DEVICE OPERATION	[illegible]		MACHINE WORK ERROR	1	100% PRESENCE CHECK 100% FUNCTION CHECK	1	[illegible]							
		DISLODGMENT OF INTERNAL COMPONENTS	INOPERATIVE DEVICE LEAK	[illegible]		MISALIGNED AIR PICK AND PLACE	1	TRAPPED DISC PICKING 100% FUNCTION TEST CYCLING AUDITS	1	[illegible]							
		MULTIPLE CUPS LOADED	NO SUBSEQUENT ASSEMBLY PERMISSIBLE	[illegible]		MACHINE ERROR INCORRECT OPERATOR INTERVENTION	1	100% PRESENCE CHECK	1	[illegible]							
		LOW RATIO CUP LOADED IN PLACE OF HIGH RATIO CUP	SHIFT IN DEVICE SET POINTS	[illegible]		MIXING ERROR	1	100% FUNCTION CHECK	1	[illegible]							
			EXCESSIVE SPRING PRE-LOAD CREEP CONTINUITY FAILURE			OPERATOR ERROR		KAN BAN LOT CONTROL									
		HIGH RATIO CUP LOADED IN PLACE OF LOW RATIO CUP	SHIFT IN DEVICE SET POINTS	[illegible]		MIXING ERROR	1	100% FUNCTION CHECK	1	[illegible]							
			INSUFFICIENT SPRING PRE-LOAD CREEP CONTINUITY FAILURE			OPERATOR ERROR		KAN BAN LOT CONTROL									
17	CONFIRM CUP PRESENCE	FAILS TO IDENTIFY MISSING OR OUT OF PLACE CUP	INOPERATIVE DEVICE	7		MACHINE ERROR	1	YIELD MONITORING	1	7							

[illegible] No. 2
00437

PROCESS: AUTOMATED SENSOR ASSEMBLY

PROCESS RESPONSIBILITY: MATT SELLERMANN REA

MODEL YEAR(S)/VEHICLE(S): [illegible]

[illegible]/QUAL/MFG RESPONSIBILITY: KEITH ROSELLO / JIM WATT / PEGGY ALLEN

FMEA DATE (ORIG.) 4/[illegible]
FMEA REVISION: B

Item	Process Function/ Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s)/ Mechanism(s) of Failure	Occur	Current Process Controls	Detec	R.P.N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results: Actions Taken	Sev	Occ	Det	R.P.N.
10	PRE-CRIMP SENSOR ASSEMBLY	UNDER CRIMP	DISLODGMENT OF INTERNAL COMPONENTS DURING TRANSFER TO [illegible]	5		BROKEN OR WORN TOOLS	3	OPERATOR SET-UP	1	15							
						PRESSURE TOO LOW		100% FUNCTION TEST PREVENTIVE MAINT.									
		OVER CRIMP	DIFFICULT FINAL CRIMP DUE TO SIDE WALL STIFFENING	5		EXCESS PRESSURE	3	PREVENTIVE MAINT.	1	15							
						SET-UP ERROR		SET-UP INSPECTION									
15	PROBE FOR TRAPPED DISC.	FAILS TO IDENTIFY MISSING OR TRAPPED DISC.	INOPERATIVE DEVICE. CONTINUITY FAILURE.	7		MACHINE ERROR	1	YIELD MONITORING	1	7							
20	TRANSFER PRE-CRIMPED SENSOR ASSEMBLY TO SENSOR CRIMPER	DISLODGED INTERNAL COMPONENTS	LEAK	[illegible]		INSUFFICIENT PRE-CRIMP	1	PREVENTIVE MAINT.	1	[illegible]							
			CONTINUITY FAILURE					100% FUNCTION TEST SET-UP INSPECTION									
		FAILS TO TRANSFER	EMPTY PUCK. NO EFFECT ON SUBSEQUENT OPERATIONS	[illegible]		MACHINE ERROR	1	PREVENTIVE MAINT.	1	[illegible]							
		TRANSFERS MULTIPLE SENSOR ASSEMBLIES	SENSOR DAMAGE	[illegible]		INCORRECT OPERATOR INTERVENTION	1	OPERATOR AWARENESS TRAINING	1	[illegible]							
21	UNLOAD BAD PARTS SENSOR ASSEMBLIES	FAILS TO UNLOAD	HEMPORT LOADED ONTO OCCUPIED NEST.	[illegible]		UNLOAD FAILURE	1	EMPTY NEST PROBE	1	[illegible]							
22	CHECK EMPTY NEST	FAILS TO IDENTIFY OCCUPIED NEST.	HEMPORT LOADED ONTO OCCUPIED NEST.	[illegible]		UNLOAD FAILURE	1	YIELD MONITORING	1	[illegible]							
[illegible]	WHERE APPLICABLE- PLACE EXTERNAL O-RING ON HEMPORT	FAILS TO PLACE O-RING ON PART	IF UNDETECTED IN SUBSEQUENT OPERATION COULD CAUSE LEAK IN APPLICATION	8		PICK & PLACE MIS-HANDLES O-RING	[illegible]	100% O-RING CHECK ON CRIMP TABLE	3	[illegible]	ADD O-RING CHECK TO FINAL FUNCTION TEST AS A REDUNDANT CHK.	MFG. ENGINEERING	COMPLETE [illegible]	[illegible]	[illegible]	1	[illegible]
						NO O-RING PRESENT AT TRACK DUE TO EMPTY BOWL FEED, CONTAMINATION IN TRACK, MISALIGNED TRACK	[illegible]	O-RING DETECTION P.M. ROUTE SLP AND VISUAL AIDS FOR O-RING REQUIREMENTS									

PROCESS: AUTOMATED SENSOR ASSEMBLY

PROCESS RESPONSIBILITY: MATT SELLERS/ANN REA

MODEL YEAR(S)/VEHICLE(S): 98/97/77/80/87PS

DSGN/QUAL/MFG RESPONSIBILITY: KEITH ROSIELLO / JIM WATT / PEGGY ALLEN

FMEA DATE (ORIG.) 4/29/96
FMEA REVISION: 6

Item	Process Function/ Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s)/ Mechanism(s) of Failure	Occur	Current Process Controls	Detec	R. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results: Actions Taken	Sev	Occ	Det	R. P. N.
						O-RING STATION NOT ACTIVATED		100% VISUAL INSPECTION AT PRESSURE TEST AND PACKING									
						PICK & PLACE WORN, MISALIGNED OR NOT DESIGNED PROPERLY											
						PUCK NOT LOCATED PROPERLY DUE TO MISALIGNED STOP OR CONTAMINATION BELT											
						STRIPPER PIN FAILS TO REMOVE O-RING											
		PLACES TWO O-RINGS ON ONE PART	HIGH ASSEMBLY TORQUE	4		PUCK STOP FAILS TO RELEASE PUCK AT END OF CYCLE	3	100% MULTIPLE O-RING CHECK ON CRIMP TABLE	2	24	ADD O-RING CHECK TO FINAL FUNCTION TEST	MFG. ENG.	COMPLETE 12/96	4	2	1	8
			POTENTIAL INABILITY TO FULLY ASSEMBLE IN APPLICATION	5			3	100% VISUAL INSPECTION AT PRESSURE TEST AND PACKING P.M. FOR O-RING STATION	3	45	TEST			5	2	1	10
		O-RING DAMAGED BY FEED SYSTEM OR PICK & PLACE	POSSIBLE LEAK IN APPLICATION	6		PICK & PLACE AND FEED SYSTEM WORN OR NOT DESIGNED PROPERLY	1	P.M. FOR PICK & PLACE AND FEED SYSTEM DESIGN VERIFICATION THROUGH DEBUG AND PROCESS HISTORY Q.C. AUDIT FROM EACH LOT SUBJECTED TO FLUID LEAK CHECK	2	12							
		THREADS DAMAGED BY PICK & PLACE	MAY RESULT IN HIGH INSTALLATION TORQUE	4		PICK & PLACE AND FEED SYSTEM WORN, MISALIGNED OR NOT DESIGNED PROPERLY	2	P.M. FOR PICK & PLACE AND FEED SYSTEM	2	16							
			FINISHED DEVICE WILL NOT ASSEMBLE AT CUSTOMER	5		PUCK NOT LOCATED PROPERLY	1	DESIGN VERIFICATION THROUGH DEBUG AND PROCESS HISTORY Q.C. AUDIT FROM EACH LOT SUBJECTED TO THREAD QUALITY CHECK	2	10							

PROCESS: AUTOMATED SENSOR ASSEMBLY

PROCESS RESPONSIBILITY: MATT SELLERS/ANN REA

MODEL YEAR(S)/VEHICLE(S): 59/57/77/80/87/P6

DSGN/QUAL/MFG RESPONSIBILITY: KEITH ROSIELLO / JIM WATT / PEGGY ALLEN

FMEA DATE (ORIG.) 4/29/95
FMEA REVISION: B

Item	Process Function/ Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s)/ Mechanism(s) of Failure	Occur	Current Process Controls	Detec	R.P.N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results: Actions Taken	Sev	Occ	Det	R.P.N.
		O-RING NOT LOCATED PROPERLY ON THE ASSY	MAY RESULT IN HIGH INSTALLATION TORQUE	4		PICK & PLACE AND FEED SYSTEM WORN, MISALIGNED OR NOT DESIGNED PROPERLY	2	P.M. FOR PICK & PLACE AND FEED SYSTEM	2	16							
			POTENTIAL O-RING DAMAGE DURING ASSEMBLY RESULTING IN A FAIL	5		PUCK NOT LOCATED PROPERLY	1	OPERATION VERIFICATION THROUGH DEBUG AND PROCESS HISTORY Q.C. AUDIT FROM EACH LOT SUBJECTED TO THREAD QUALITY CHECK. 100% VISUAL CHECK AT PREMLIFE TEST AND PACK	3	15							
24	TRANSFER SENSOR ASSEMBLY TO ROTARY CRIMP NEST	FAILS TO TRANSFER.	PRE-CRIMPED SENSOR ASSEMBLY LOADED ONTO OCCUPIED NEST.	5		UNLOAD FAILURE	1	YIELD MONITORING	1	5							
25	45 DEGREE CRIMP SENSOR ASSEMBLY	UNDER CRIMP	LOSS OF SPC CONTROL OF DIAMETER OR HEIGHT POTENTIAL DIAPHRAGM LIFE PROBLEM	8		PRESSURE TOO LOW TOOL WEAR/BREAKAGE	1	SPC DIA. AND HEIGHT PROCESS SPEC SET-UP PREVENTIVE MAINT. 100% FUNCTION TEST CYCLING AUDITS	1	8							
		OVER CRIMP	CRIMP DIAMETER TOO LARGE CAUSING DIFFICULT FINAL ASSY COMPONENT DAMAGE POTENTIAL DIAPHRAGM LIFE PROBLEM	8		PRESSURE TOO HIGH	1	SPC DIA. AND HEIGHT PROCESS SPEC SET-UP PREVENTIVE MAINT. 100% FUNCTION TEST CYCLING AUDITS	1	8							
		IMPROPER CRIMP	COMPONENT DAMAGE CRIMP DIAMETER AND HEIGHT OUT OF SPEC.	5		OPERATOR SET-UP 90 DEG. TOOL IN 45 DEG. STATION WRONG DIE GEOMETRY	3	SPC DIA. AND HEIGHT PROCESS SPEC SET-UP PREVENTIVE MAINT. 100% FUNCTION TEST CYCLING AUDITS	1	15							
		FAILS TO CRIMP	COMPONENT DAMAGE AT 90 DEGREE CRIMP CRIMP DIAMETER AND HEIGHT OUT OF SPEC.	5		MACHINE MALFUNCTION SET-UP ERROR	1	PREVENTIVE MAINT. SET-UP SPECS	1	5							

PROCESS: AUTOMATED SENSOR ASSEMBLY **PROCESS RESPONSIBILITY: MATT SELLERS/ANN REA**

MODEL YEAR(S)/VEHICLE(S): 63/67/77/80/87PS **DESIGN/QUAL/MFG RESPONSIBILITY: KEITH ROSIELLO / JIM WATT / PEGGY ALLEN**

FMEA DATE (ORIG.) 4/29/98
FMEA REVISION: B

Item	Process Function/ Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s)/ Mechanism(s) of Failure	Occur	Current Process Controls	Detec	R.P.N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
													Actions Taken	Sev	Occ	Det	R.P.N.
		IMPROPER TOOL REGISTRATION	MINOR REGISTRATION ERROR: SENSOR DIAMETER OUT OF ROUND SENSOR HEIGHT UNEVEN MAJOR REGISTRATION ERROR: - COMPONENT DAMAGE	5		MACHINE ERROR, MAINTENANCE SET-UP ERROR	1	SPC. DIA. AND HEIGHT PREVENTIVE MAINT.	1	5							
26	VERIFY O-RING PRESENT ON SENSOR	FAILS TO DETECT MISSING O-RING	PART WILL BE UNLOADED INTO GOOD BIN AND COULD CAUSE LEAK IN APPLICATION IF UNDETECTED IN SUBSEQUENT OPERATIONS	4		PROBE MISALIGNED, WORN OR IMPROPERLY DESIGNED	3	MASTER DEVICES REDUNDANT O-RING CHK ON FINAL FUNCTION CK	1	12							
						PROBE CONTAMINATION PROBE STATION NOT ACTIVATED		ALIGNMENT TOOL VISUAL INSPECTION PROBE P.M.'S									
		FAILS TO DETECT O-RING PRESENT	PART WILL BE UNLOADED INTO BAD BIN RESULTING IN YIELD LOSS	2		PROBE MISALIGNED, WORN OR IMPROPERLY DESIGNED	2	MASTER DEVICES ALIGNMENT TOOL	1	4							
						PROBE CONTAMINATION PART ALIGNMENT IN NEST		PROBE DESIGN PROVEN THROUGH DEBUG & PROCESS HISTORY PROBE P.M.'S									
		FAILS TO DETECT TWO O-RINGS PRESENT	PART WILL BE UNLOADED INTO GOOD BIN POSSIBLY RESULTING IN HIGH INSTALLATION TORQUE AT CUSTOMER	4		PROBE MISALIGNED, WORN OR IMPROPERLY DESIGNED	2	MASTER DEVICES ALIGNMENT TOOL	2	16							
						PROBE CONTAMINATION PROBE STATION NOT ACTIVATED		PROBE P.M.'S ROUTE SLIPS VISUAL INSPECTION									
		O-RING DAMAGED BY PROBE TIP	LEAK IN APPLICATION	9		PROBE MISALIGNED, WORN OR IMPROPERLY DESIGNED	1	PROBE DESIGNED TO MINIMIZE THREAD CONTACT	2	18							
								PROBE P.M.'S PROBE DESIGN PROVEN THROUGH RE-DEBUG AND PROCESS HISTORY									
27	90 DEGREE CRIMP SENSOR ASSEMBLY	UNDER CRIMP	INPUT RESISTANCE DEGRADED	9		PRESSURE TOO LOW	1	SPC. DIA. AND HEIGHT	1	9							

DD-NEITNA No. 2
60941

PROCESS: AUTOMATED SENSOR ASSEMBLY

PROCESS RESPONSIBILITY: MATT SELLERS/JANN REA

MODEL YEAR(S)/VEHICLE(S): [illegible]

DSGN/QUAL/MFG RESPONSIBILITY: KEITH ROSIELLO / JIM WATT / PEGGY ALLEN

FMEA DATE (ORIG.) 4/28/98
FMEA REVISION: B

Item	Process Function/ Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s)/ Mechanism(s) of Failure	Occur	Current Process Controls	Detec	R.P.N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
													Actions Taken	Sev	Occ	Det	R.P.N.
			LEAK CRIMP HEIGHT OUT OF SPEC. DIFFICULT FINAL ASSEMBLY CRIMPING			TOOL WEAR/BREAKAGE 40 DEG. TOOL IN 60 DEG. STATION		PROCESS SPEC SET-UP P.M./Q.C. AUDITS 100% FUNCTION TEST CYCLING AUDITS									
		OVER CRIMP	CRIMP DIAMETER TOO LARGE CAUSING DIFFICULT FINAL ASSY	[illegible]		PRESSURE TOO HIGH	1	SPC. DIA. AND HEIGHT PROCESS SPEC SET-UP PREVENTIVE MAINT. 100% FUNCTION TEST CYCLING AUDITS	1	[illegible]							
28	OVER-PRESSURE SENSOR ASSEMBLY	INSUFFICIENT O/P	DRIFT OVER LIFE OR CALIBRATION CHANGE LEADING TO YIELD LOSS	[illegible]		IMPROPER DESIGN OF OP HEAD INCORRECT OP SETTINGS INADEQUATE SEAL [illegible]	1	100% FUNCTION TEST, MIN. PRESSURE LEVEL GAGE.	1	[illegible]							
29	UNLOAD GOOD SENSOR ASSEMBLIES	FAILS TO UNLOAD GOOD SENSOR	TABLE WON'T INDEX PAST NEXT CYCLE (EMPTY NEST FAILURE)	2		LOOSE/ MISADJUSTED OR IMPROPERLY DESIGNED PICK-UP JAWS	2	EMPTY NEST PROBE (NEST/GRIPPER PART)	1	4							
			YIELD/UPTIME LOSS	2			1	JAW DESIGN PROVEN THROUGH DE-BUG & PROCESS HISTORY	1	2							
		THREAD DAMAGE	POSSIBLY RESULTING IN HIGH INSTALLATION TORQUE	4		JAWS WORN, MISALIGNED OR IMPROPERLY DESIGNED	2	JAW P.M.'S JAWS DESIGNED TO MINIMIZE THREAD CONTACT DESIGN PROVEN THROUGH DEBUG & PROCESS HISTORY	2	16							
30	PICK & UNLOAD ASSEMBLY W/O O-RINGS	FAILS TO UNLOAD BAD SENSOR	TABLE WON'T INDEX PAST NEXT CYCLE (EMPTY NEST FAILURE)	2		LOOSE/ MISADJUSTED OR IMPROPERLY DESIGNED PICK UP JAWS	2	EMPTY NEST PROBE (NEST/GRIPPER PART) JAW DESIGN PROVEN THROUGH DEBUG & PROCESS HISTORY	1	4							
			UPTIME LOSS	2			1		1	2							
		THREAD DAMAGE	POSSIBLY RESULTING IN HIGH INSTALLATION TORQUE AT CUSTOMER.	4		JAWS WORN, MISALIGNED OR IMPROPERLY DESIGNED	2	JAW P.M.'S JAWS DESIGNED TO MINIMIZE THREAD CONTACT DESIGN PROVEN THROUGH DEBUG & PROCESS HISTORY	2	16							

F2VC-9F924-AB

MATERIAL ANALYSIS

PARTS LIST

	PART NAME	PART #	CERTIFIED
1	BASE	46515-2	YES
2	STA.TERM.	36888-1	YES
3	MOVE.CONTACT	74408-1	YES
4	RIVET	74171-1	YES
5	MOVE.TERM.	36887-1	YES
6	SPRING ARM	36889-1	YES
7	J512 HEXPORT	36900-1	YES
8	GASKET	74353-1	YES
9	CUP	27713-1	YES
10	SEAL	74176-1	YES
11	KAPTON STRIP	27225-1	YES
12	WASHER	27639-1	YES
13	CONVERTER	27406-1	YES
14	KAPTON TAPE	74224-1	YES
15	SPACER	73958-2/-3	YES
16	CRIMP RING	74797-1	YES
17	TRANSFER PIN	74078-SEL	YES
18	ENVIO.SEAL	74247-~~2~~	YES
19	THREAD CAP	~~74179-2~~ 748854	YES

submitted -4 CERT.
JAN. '92

KAPTON* SALES TO TEXAS INSTRUMENTS (POUNDS)						
Customer/Loc	Product	1999	1998	1997	1996	1995
TEXAS INSTRUMENTS H ALMELO (HOLLAND)	300FN 929	0	0	67.1	2.6	0
TEXAS INSTRUMENTS I ATTLEBORO MA	200HN	370.6	598.5	641.1	594.3	662.6
TEXAS INSTRUMENTS I ATTLEBORO MA	300FN 929	358.5	112	202	47.3	20.9
TEXAS INSTRUMENTS I ATTLEBORO MA	300HN	2571.5	1822.6	1684.7	1234.7	1154.2
TEXAS INSTRUMENTS I ATTLEBORO MA	500FN 131	7694.9	6896.7	6795.6	5651	5910.6
TEXAS INSTRUMENTS I ATTLEBORO MA	500FN 131M	0	0	0	221.7	0
TEXAS INSTRUMENTS I ATTLEBORO MA	500HN	395.9	261	359.3	52.1	156.1
TEXAS INSTRUMENTS I COPPELL TX	500FN 131	111	0	0	0	0
TEXAS INSTRUMENTS I DALLAS TX	50HN	0	0	0	0	19.8
TEXAS INSTRUMENTS I DALLAS TX	500FPC	0	0	0	0	118
TEXAS INSTRUMENTS I SHERMAN TX	500HN	0	0	0	0	75.8
TEXAS INSTRUMENTS I VERSAILLES KY	500HN	0	1066	873.7	295.7	180.7

DD/NHTSA No. 2
04/145

C

LaRouche, Steve (S.)

From: Frederick J. Porter [fporter@pw ford com]
Sent: Tuesday, January 26, 1999 5 28 PM
To: nlapoint@pw ford.com; slarouch@mas ford com
Subject: (U) Brake Pressure Switch Material

The following is from TI drawings

Part	Material	Comments
Modified SAE J512 Hexport	C10L10 Steel	Zinc Plating .0003 min thk w/yellow dichromate
Converter	1008 or 1010 C.R. Steel	Zinc Plating .0002-.0004 thk may have rust inhibitor
Washer	1050 CRS	Zinc Plate .0002-.0006 thk Heat treat austemper Rockwell 40-50
Cup	1010 or 1008 C.R.S.	Zinc Plating w/yellow chromate .0002-.0004 thk
Spring	Beryllium copper C17200	Mill hardened (Brush Wellman alloy 190 hm)
Kapton	Dupont 500 FN1313L	1 mil Teflon FEP 3 mil Kapton Type H 1 mil teflon FEP
Moveable Contact	Copper	Finish: DMC-133 OFHC Silver DMC-10 fine silver
Environmental Seal	Silicon JBL 57519	
Transfer Pin	L-3 Grade Steatite (DC-16E5) or L-3 Grade Steatite (DC-144E)	
Switch Rivet	CDA 260 Brass	
Gasket	Ethylene Propylene JBL Compound E-7104-70 JBL Part No. 6197E	
Spacer	Dupont Kapton 200H	.0017-.0023 thk
Crimp Ring	Aluminum 5052	
Thread Cap	LDPE	

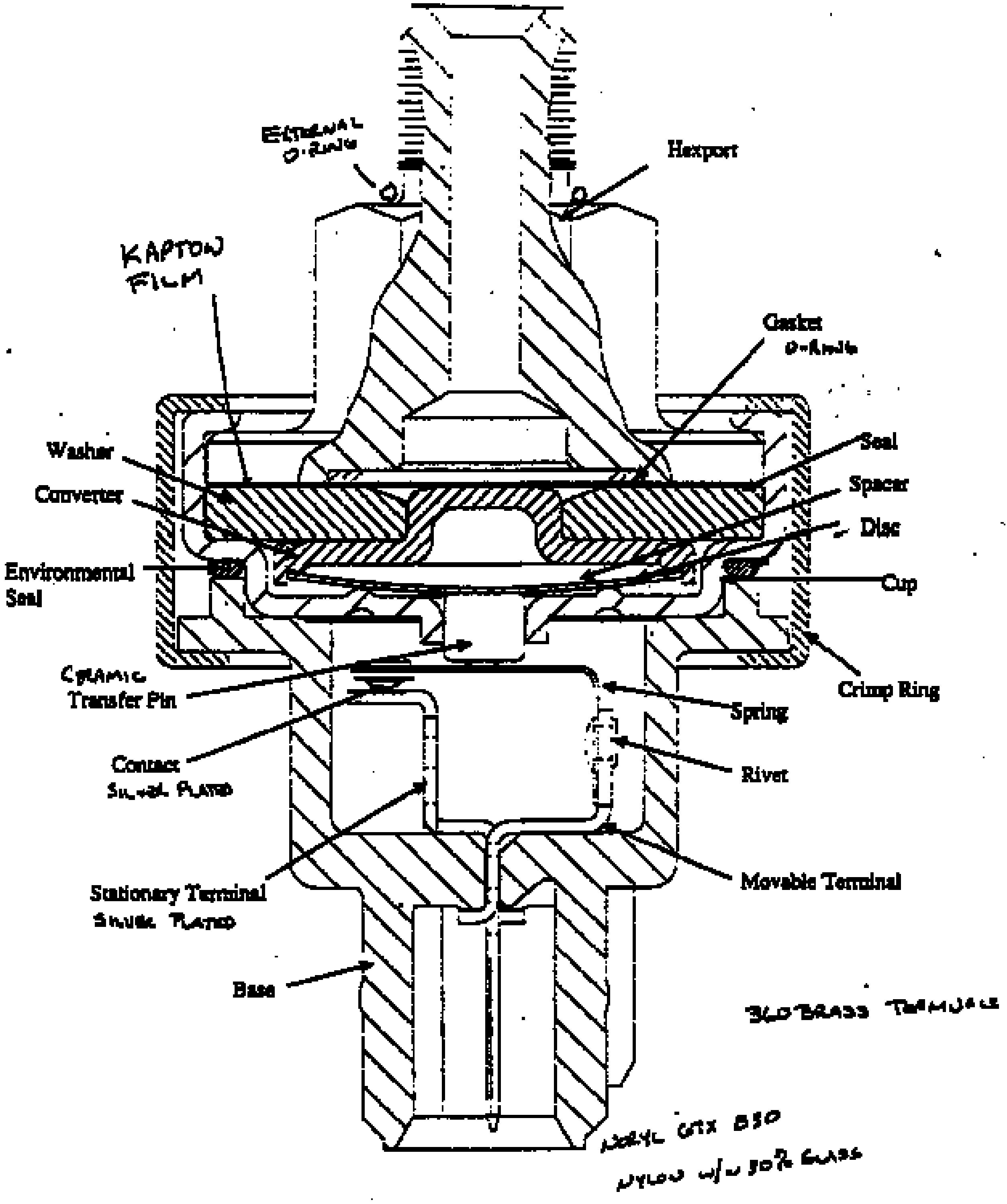
Regards,
Fred Porter   OV - fporter   fporter@ford.com
Chassis E/E Systems Applications   (313)845-3722
Bldg 5 - Mail Drop 5030 - Cubicle 3E004   fax: 390-4146

Brake Pressure Switch
F2VC-9F924-AB
Material List for MY 92/93

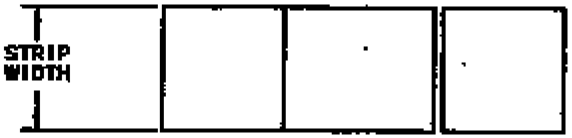
Component Name	Material	Comment
Gasket	Elastomer Ethylene Propylene	JBL Compound # E-7104-70
Diaphragm	Kapton, Polyimide	Dupont 500 FN131L, 3 Diaphragms per switch
Base	PBT, Plastic	Grade Celanex 4300
Crimp Ring	Aluminum	Grade # 5052
Spacer	Kapton, Polyimide	Dupont #200H,Friction Reducer on Disc
Rivet	Brass	CDA 260
Transfer Pin	Ceramic	Steatite , L-3 Grade
Environmental Seal	Silicone	JBL Compound # S7519
Converter	Cold Rolled Steel	Grade # 1008
Washer	Cold Rolled Steel, Zinc Plated	Grade # 1050
Cup	Cold Rolled Steel	Grade 1010
Spring Arm	Beryllium Copper	Grade # C17200
Movable Contact	Silver Plated Copper	Oxygen Free Cu, Fine Silver
Stationary Terminal	Brass + Silver Inlay	CDA 260
Movable Terminal	Brass	CDA 260
Disc	Stainless Steel	Grade 302
Hexport	Cold Rolled Steel, Zinc Plated	C10L10
Thread Cap	LDPE, Plastic	

C

Hydraulic Pressure Switch Cross Section



REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B	ADDED "CORE MATERIAL" COLUMN. 27225-1 & -2 ROLL OUT OF I.D. WAS "3" CR.104035. CF	8-6-90	CJ



NOTES:

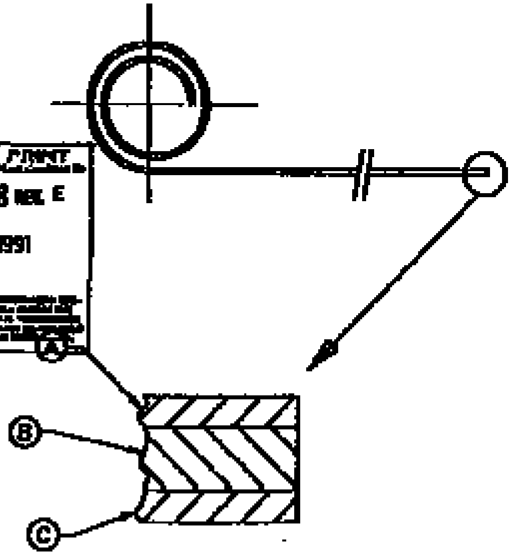
1. STRIP TO BE INSPECTED FOR TEFLON COATING, THICKNESS, DEFORMITIES, BUBBLES, AND LAMINATE SEPARATION.
2. EACH KAPTON STRIP ROLL MUST BE LABELED WITH T.I. PART NO. ON INSIDE OF CORE.
3. NO MORE THAN 2 SPLICES PER COIL PERMITTED. SPLICES TO BE CLEARLY MARKED WITH YELLOW MYLAR.
4. MATERIAL CERTIFICATION REQUIRED WITH EACH SHIPMENT.
5. ROLLS SLITTED FROM END OF MASTER COIL NOT ACCEPTABLE.
6. BUCKLING OF THE CORE ALLOWED UP TO 1/4" MEASURED RADIALLY AWAY FROM THE CORE.
7. DENT RIP OR JAGGED EDGES ON MATERIAL NOT ALLOWED.
8. ROLLS ARE TO BE SHIPPED WITH PROTECTIVE INSERT CORES IN THE PACKING BOX.

THIS DWG. SUPERSEDES 27225 REV."N" DATED 12-13-88

CERTIFIED PRINT

ENG. SUB. E3698 REV E

Date JUL 1 1991



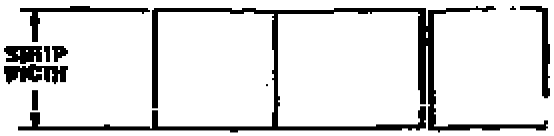
PART NO.	MATERIAL	THICKNESS(MILS) ◇	TEFLON FEP Ⓐ	KAPTON TYPE Ⓑ	TEFLON FEP Ⓒ	STRIP WIDTH ◇ (In.)	[illegible] (I.D.)(O.D.) (IN.)	CORE MATERIAL
			CONSTRUCTION (MILS)(SEE NOTE 2)					
27225-3	DUPONT 300 FN929	3 ±.4 MILS	0.5	2	0.5	.530-.534	3 x 8 1/2	PLASTIC (WHITE)
27225-2	DUPONT 500 FN131	5 ±.5 MILS	1	3	1	.532-.534	6 x 9 1/2	CARDBOARD
27225-1	DUPONT 500 FN131	5 ±.5 MILS	1	3	1	.734-.738	6 x 8 1/2	CARDBOARD

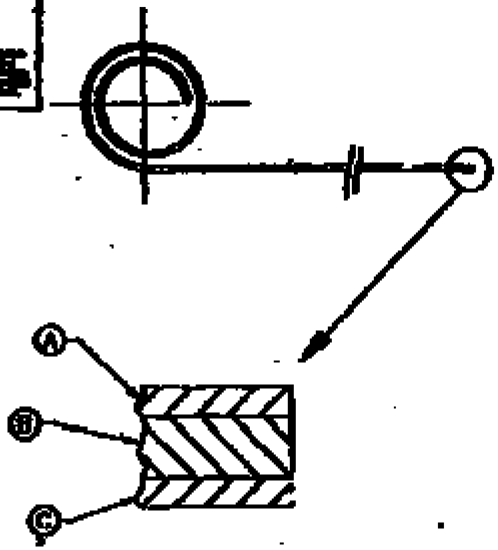
P37-4

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES	DR TOM WATL.	DATE 11-1-88	TEXAS INSTRUMENTS [illegible]
TOLERANCE ON FRACTIONS DECIMALS ANGLES	CHK		KLIXON ® CONTROL PRODUCTS DIVISION
MATERIAL	ENG	5-11-90	TITLE KAPTON STRIP SPECIFICATION
	APPROVED		SIZE B · CODE IDENT NO. 82647 · 27225
			SCALE · SHEET

CERTIFIED PRINT

OCT 0 1 1982





ZONE	LTR	DESCRIPTION	DATE	APPROVED
	F	[illegible] -1, -2, -4, [illegible] MATERIAL WAS [illegible]	[illegible]	[illegible]

NOTES:

1. STRIP TO BE INSPECTED FOR TEFLON COATING, THICKNESS, DEFORMITIES, BUBBLES, AND LAMINATE SEPARATION.
2. EACH KAPTON STRIP ROLL MUST BE LABELED WITH T.I. PART NO. ON INSIDE OF CORE.
3. NO MORE THAN 2 SPLICES PER COIL PERMITTED. SPLICES TO BE CLEARLY MARKED WITH YELLOW MYLAR.
4. MATERIAL CERTIFICATION REQUIRED WITH EACH SHIPMENT.
5. ROLLS SLITTED FROM END OF MASTER COIL NOT ACCEPTABLE.
6. [illegible] OF THE CORE ALLOWED UP TO 1/4" MEASURED RADIALLY AWAY FROM THE CORE.
7. BENT KAP OR JAGGED EDGES ON MATERIAL NOT ALLOWED.
8. ROLLS ARE TO BE SHIPPED WITH PROTECTIVE INSERT CORES IN THE PACKING BOX.

PART NO.	MATERIAL	THICKNESS (MILS)	CONSTRUCTION (THICKNESS IN MILS) A	B	C	STRIP WIDTH (IN.)	I.D. X O.D. (IN.)	CORE MATERIAL
27225-1	[illegible] (KAPTON)	3 ±0.3 MILS	0.5	2	0.5	[illegible]	3 x 9 1/2	PLASTIC (WHITE)
27225-2	KAPTON 300 [illegible]	[illegible] MILS	0.5	2	0.5	[illegible]	3 x 9 1/2	PLASTIC (WHITE)
27225-3	KAPTON [illegible]	[illegible] MILS	1	3	1	[illegible]	3 x 9 1/2	PLASTIC (WHITE)
27225-4	KAPTON [illegible]	[illegible] MILS	1	3	1	[illegible]	3 x 9 1/2	PLASTIC (WHITE)

TEXAS INSTRUMENTS

DRAWN: 11-1-80

Shamel 8-26-[illegible]

TITLE: KAPTON STRIP SPECIFICATION

SIZE: B

CODE IDENT NO. 82647

27225

[illegible] REFERENCE 27225 REV. "F" DATED 7-6-82

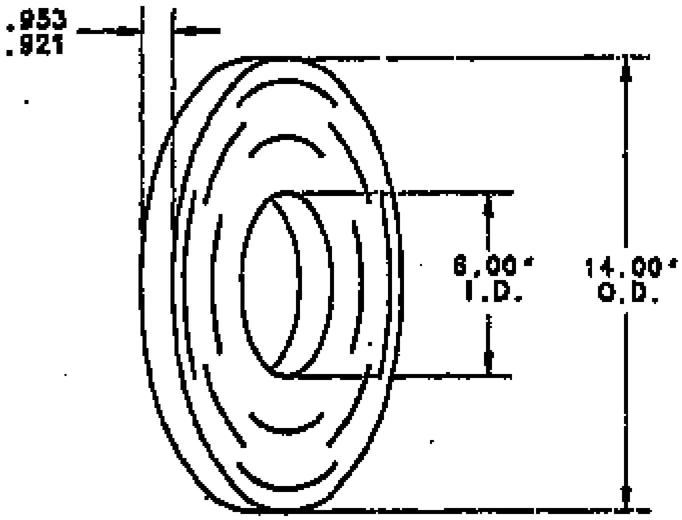
KAPTON TAPE

F

74224

NOTES:

1. ROLLS SLITTED FROM ENDS OF MASTER COIL NOT ACCEPTABLE.
2. BUCKLING OF THE CORE ALLOWED UP TO 1/4" MEASURED RADIALLY AWAY FROM THE CORE.
3. DENTS, RIPS, OR JAGGED EDGES ON MATERIAL NOT ALLOWED.
4. ROLLS ARE TO BE SHIPPED WITH PROTECTIVE INSERT CORES IN THE PACKING BOX.



CERTIFIED PRINT
Parts Made To This Print Must Conform To
ENG. STD. E9898 REV. E
Date NOV 2 2 1991
[illegible]

TI 0020420

74224-1	DUPONTS, KAPTON 200H	.0017/.0023	
PART NUMBER	MATERIAL	THICKNESS	

THIS DWG. SUPERSEDES 74224 REV."E" DATED 10-14-88

AH

ADDED MATERIAL SIZE
CR.155371,10-15-90 GF

REV [illegible]

BY TOM DAIL 10-14-88	TEXAS INSTRUMENTS ATTLEBORO, MASSACHUSETTS 02703	KLIXON CONTROL PRODUCTS DIVISION	DWG. SIZE A	DWG. NO. 74224
CK.				
ENG. Stan Howard 10-16-90				

MAKEPEACE

DD/NHTSA No. 2
00051

CODE IDENT NO.

PROCESS: AUTOMATED SENSOR ASSEMBLY

PROCESS RESPONSIBILITY: MATT SELLERS/ANN REA

MODEL YEAR(S)/VEHICLE(S): 52/57/77/80/87PS

DSGN/QUAL/MFG RESPONSIBILITY: KEITH ROSIELLO / JIM WATT / PEGGY ALLEN

FMEA DATE (ORIG.) 4/29/96
FMEA REVISION: B

Item	Process Function/ Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Sev	Class	Potential Cause(s)/ Mechanism(s) of Failure	Occur	Current Process Controls	Detec	R. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	Action Results				
													Actions Taken	Sev	Occ	Det	R. P. N.
31	CHECK EMPTY NEST.	FAIL TO IDENTIFY OCCUPIED NEST	SENSOR ASSEMBLY LOADED ONTO OCCUPIED NEST.	5		UNLOAD FAILURE	1	YIELD MONITORING	1	5							